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August 9, 2024

Keegan MacDonna
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794

Re: Dynegy Midwest Generation, LLC - Hennepin Power Plant
Log No. 2021-100019
Bureau ID: W1550100002
Initial Review Letter - Part 845 Construction/Operating Permit Application(s)

Mr. MacDonna:

Dynegy Midwest Generation, LLC ("Dynegy") received the Hennepin Power Plant CCR Surface Impoundment Operating and Construction Permit Application Review Letter dated October 11, 2023. At this time, we submit the below responses to Illinois Environmental Protection Agency's (IEPA's) initial comments.

As discussed more specifically below, Dynegy will produce data and information requested by IEPA in two productions, starting concurrently with this letter by producing data and information that is reasonably and readily available and producing the remaining information, as indicated in the below responses, when it is available. All documents and responses will be provided in hard copy, as requested by IEPA, as well as through a courtesy email and temporary file-sharing service. As noted below, IPGC will also be producing electronic data deliverables ("EDDs"), which can only be shared electronically and will be provided via the temporary file-sharing service.

Within the below responses, IPGC requests additional information and clarification regarding several comments. To further discuss those requests, IPGC will schedule meetings with IEPA to ensure IPGC is providing complete responses.

Initial Operating Permit Application

History of Construction [35 Ill. Adm. Code 845.230(d)(3)(A)]

Comment 1: *To comply with the application requirements of 35 Ill. Adm. Code 845.230(d)(3)(A), the applicant must provide a written history of construction containing the information specified in 35 Ill. Adm. Code 845.220(a)(1). The* *history of construction information submitted in the operating permit applications for the Old West Ash Pond (OWAP), the Old West Polishing Pond (OWPP) and Ash Pond No. 2 is outdated. The history of construction information submitted with the operating permit application for the East Ash Pond, dated October 11, 2021, is more recent and should be added to the operating permit applications for the other ponds.*

Response: Dynegy has included with this letter, as Attachment A, the October 11, 2021, History of Construction included with the operating permit application for the East Ash Pond and incorporates the same, by reference, into its operating permit applications for the Old West Ash Pond (OWAP), the Old West Polishing Pond (OWPP) and Ash Pond No. 2.

Comment 2: *No history of construction was provided for Ash Pond No. 4 in the initial operating permit application. The history of construction submitted with the construction permit application for the East Ash Pond also does not include Ash Pond No. 4. A written history of construction for Ash Pond No. 4 needs to be submitted to the Agency in accordance with the requirements of 35 Ill. Adm. Code 845.220(a)(1).*

Response: In preparing its Operating Permit application, Dynegy reviewed all available files and identified and interviewed all employees that could potentially have relevant information. Additionally, Dynegy conducted no less than 3 plant visits. Despite its efforts and due to the age of Ash Pond No. 4, Dynegy was unable to find information related to the topics within the History of Construction that it previously identified as “not reasonably and readily available.”

Comment 3: *Pursuant to 35 Ill. Adm. Code 845.220(a)(1)(D-E), the applicant must provide a description of the physical and engineering properties of the foundation and abutment materials of the CCRSI, and a statement detailing physical and engineering properties of the materials used in construction each zone or stage of the CCRSI.*

Response: As submitted, Dynegy’s history of construction provides an adequate description of the physical and engineering properties of the foundation and abutment materials of the OWAP, the OWPP, Ash Pond No. 2, and the East Ash Pond and a statement detailing physical and engineering properties of the materials used in constructing each zone or stage of the ponds. Specifically, all of the information requirements in Adm. Code 845.220(a)(1)(D-E) is included in Tables 1 through 4 of the History of Construction document within the operating permit applications based on previous geotechnical explorations and laboratory testing, including:

a. Summary of Material Engineering Properties (Table 1 of HoC)

b. Summary of Foundation and Abutment Material Engineering Properties (Table 2 of HoC)

c. Summary of Construction Material Engineering Properties for Embankments (Table 3 and 4 of HoC)

d. Approximate dates of construction of each successive stage of construction (Table 5 of HoC)

e. Listing of drawings containing items pertaining to the information requested (Table 6, Appendix B and Appendix C of HoC)

The attached full certification report (Attachment B) also includes all of the borings, lab testing, and analyses of the geotechnical aspects for East Ash Pond.

In preparing its Operating Permit application, Dynegy reviewed all available files and identified and interviewed all employees that could potentially have relevant information. Additionally, Dynegy conducted no less than 3 plant visits. Despite its efforts and due to the age of Ash Pond No. 4, Dynegy was unable to find information related to the topics within the History of Construction that it previously identified as "not reasonably and readily available."

Comment 4: *To support the information provided to meet these requirements, the application should be revised to include geotechnical exploration data and laboratory testing data for the foundation, abutment, and zone/stage construction materials for each impoundment.*

Response: The attached full certification report (Attachment B) includes all of the borings, lab testing, and analyses of the geotechnical aspects of the East Ash Pond. Part 845 does not require the requested information. Section 845.230(d)(3)(A) (incorporating Section 845.220(a)(1)(D-E)) requires a "description of the physical and engineering properties of the foundation and abutment materials of the CCRSI," 845.220(a)(1)(D), and "a statement detailing physical and engineering properties of the materials used in construction each zone or stage of the CCRSI." 35 Ill. Admin. Code 845.220(a)(1)(E). Section 845.220(a)(1)(D-E) does not require specific testing be performed. In addition, Dynegy's History of Construction (Attachment A) includes a description, based on previous geotechnical explorations and laboratory testing, of the physical and engineering properties of the soils, clays, and silts that make up the foundation and abutments of the OWAP, the OWPP, Ash Pond No. 2, and the East Ash Pond. *See, e.g.*, Hennepin's East Ash Pond Operating Permit Application, Attachment B at 3–6.

Emergency Action Plan [35 Ill. Adm. Code 845.230(d)(3)(D)]

Comment 5: *To comply with the application requirements of 35 Ill. Adm. Code 845.230(d)(3)(D), the applicant must provide a written Emergency Action Plan containing the information specified in 35 Ill. Adm. Code 845.520. Written Emergency Action Plans were not provided for the OWAP, OWPP, Ash Pond No. 2, or Ash Pond No. 4. Written Emergency Action Plans for these ponds need to be submitted to the Agency in accordance with the requirements of 35 Ill. Adm. Code 845.520(a-c) and (e).*

Response: Dynegy is reviewing and preparing additional Emergency Action Plans in response to IEPA's comment 5, which it will submit in its second, responsive production.

Location Restrictions [35 Ill. Adm. Code 845.230(d)(2)(D)]

Comment 6: *To comply with the application requirements of 35 Ill. Adm. Code 845.230(d)(2)(D), the applicant must provide written demonstrations that an existing CCR surface impoundment complies with, or an explanation of how it does not comply with, the location restriction requirements specified in 35 Ill. Adm. Code 845.300-340. With the exception of a demonstration of compliance for floodplain location restrictions under 35 Ill. Adm. Code 845.340(c), written demonstrations were not submitted in the initial operating permit application for the East Ash Pond. Only memorandums certifying the demonstrations were submitted for the other location restrictions. Written demonstrations of compliance with the location restrictions for the East Ash Pond need to be submitted to the Agency in accordance with 35 Ill. Adm. Code 845.300-340.*

Additionally, the submitted application contains two memorandums regarding certification of the location restriction demonstration for placement above the uppermost aquifer. One memo from Haley & Aldrich, Inc., dated October 16, 2018, states that the East Ash Pond does not meet the requirements of 40 CFR 257.60(a). which contains the same requirements as 35 Ill. Adm. Code 845.300(a), nearly verbatim. However, another memo from Burns McDonnell, dated October 25, 2021, states that the demonstration was previously certified that the East Ash Pond meets the requirements of 40 CFR 257.60. Along with the demonstration for placement above the uppermost aquifer for the East Ash Pond, a new certification statement needs to be signed and stamped by an Illinois Registered Professional Engineer and submitted to the Agency.

Response: Dynegy is reviewing and preparing additional demonstrations in response to IEPA's Comment 6, which it will submit in its second, responsive production.

Preliminary Written Closure Plan [35 Ill. Adm. Code 845.230(d)(2)(J)]

Comment 7: *To comply with the application requirements of 35 Ill. Adm. Code 845.230(d)(2)(J), the applicant must provide a preliminary written closure plan containing the information specified in 35 Ill. Adm. Code 845.720(a). The closure plan for the East Ash Pond, dated October 17, 2016, is referenced on Page 6 of the October 11, 2021 history of construction that was included in the application. However, the closure plan itself is not included in the application. The written closure plan for the East Ash Pond needs to be submitted to the Agency in accordance with 35 Ill. Adm. Code 845.720(a).*

Response: The East Ash Pond is required to close under 35 Ill. Admin. Code § 845.700. Therefore, a preliminary closure plan is not required for the unit. Section 845.720(a)(1) requires a preliminary written closure plan only for those units "***not required to close under Section 845.700***." 35 Ill. Admin. Code § 845.720(a)(1) (emphasis added).

Certification of CCR Surface Impoundment Liner [35 Ill. Adm. Code 845.230(d)(2)(L)]

Comment 8: *To comply with the application requirements of 35 Ill. Adm. Code 845.230(d)(2)(L), the applicant must provide a certification that an existing CCR surface impoundment has a liner that meets the requirements of 35 Ill. Adm. Code 845.400(a), or a statement that it does not have a liner meeting those requirements. No certification of the liner for the East Ash Pond was included in the initial operating permit application, nor did it contain a statement that the liner does not meet the aforementioned requirements. A certification that the liner meets the requirements of 35 Ill. Adm. Code 845.400(a) signed and stamped by a Registered Illinois Professional Engineer, or a statement otherwise, must be submitted to the Agency in accordance with 35 Ill. Adm. Code 845.230(d)(2)(L).*

Response: As required by Section 845.230(d)(2)(L), Dynegy states that the East Ash Pond does not have a liner that meets the requirements of Section 845.400(b) or (c).

Hydrogeologic Site Characterization [35 Ill. Adm. Code 845.230(d)(2)(I)(i) and 35 Ill. Adm. Code 845.230(d)(3)(E)(i)]

Comment 9: *To comply with the application requirements of 35 Ill. Adm. Code 845.230(d)(2)(I)(i) and 35 Ill. Adm. Code 845.230(d)(3)(E)(i), the applicant must provide a hydrogeologic site characterization meeting the requirements of 35 Ill. Adm. Code 845.620 for each CCR surface impoundment. The OWAP and OWPP are both located in an area of minimal flood hazard. For these ponds, the application should include an evaluation of the potential for flooding by using seasonal groundwater patterns and climatic aspects. The floodplain plan included in the initial operating permit application for the East Ash Pond would cover the OWAP and OWPP sufficiently and should be added to the operating permit applications for them accordingly.*

Response: Dynegy has included with this letter, as Attachment H, the October 20, 2021, Hennepin Power Plant Floodplain Compliance Certification included with the operating permit application for the East Ash Pond and incorporates the same, by reference, into its operating permit applications for the Old West Ash Pond (OWAP), the Old West Polishing Pond (OWPP) and Ash Pond No. 2.

As submitted, Dynegy's operating permit application for the East Ash Pond included a copy of a Letter of Map Revision of Hennepin Power Plant completed by the Federal Emergency Management Agency (Attachment C) showing that the OWAP is no longer located in an area of flood hazard. The OWPP was closed by removal with certification of closure activities completed dated December 17, 2020.

Comment 10: *The OWAP and OWPP are located in areas of freshwater ponds and freshwater wetland areas. The hydrogeologic site characterizations for these ponds must include an evaluation of the potentials for impact on nearby wetlands pursuant to the requirements of 35 Ill. Adm. Code 845.310.*

Response: Dynegy will provide a technical memorandum that summarizes nearby freshwater ponds and wetland areas in addition to the requested information in Comment 11 in its second, responsive production.

Comment 11: *The hydrogeologic site characterizations for the OWAP, OWPP, Ash Pond No. 2, and Ash Pond No. 4 must be amended to include identification of nearby dedicated nature preserves and identification of potential migration pathways, pursuant to the requirements of 35 Ill. Adm. Code 845.620(b)(5) and 845.620(b)(11), respectively. The characterizations for these surface impoundments must also be amended to include climatic aspects of the site, including seasonal and temporal fluctuations in groundwater flow, pursuant to the requirements of 35 Ill. Adm. Code 845.620(b)(2).*

Response: Dynegy will provide a technical memorandum identifying nearby dedicated nature preserves and potential migration pathways as well as amending the characterization of OWAP, OWPP, Ash Pond No. 2, and Ash Pond No. 4 to include climatic aspects of the site, including seasonal and temporal fluctuations in groundwater flow in its second, responsive production.

Comment 12: *The hydrogeologic site characterization for the East Ash Pond must be amended to include a map of the potentiometric surface, pursuant to the requirements of 35 Ill. Adm. Code 845.620(b)(16)(E).*

Response: A map of the potentiometric surface of the East Ash Pond was included in the initial operating permit application. *See* Hennepin's East Ash Pond Operating Permit Application at Attachment H, Figures 3-3–3-5.

Groundwater Monitoring Program [35 Ill. Adm. Code 845.230(d)(2)(I)(iii-iv) and 35 Ill. Adm. Code 845.230(d)(3)(E)(iii-iv)]

Comment 13: *To comply with the application requirements of 35 Ill. Adm. Code 845.230(d)(2)(I)(iii-iv) and 35 Ill. Adm. Code 845.230(d)(3)(E)(iii-iv), the applicant must provide details of proposed groundwater sampling, analysis, and monitoring programs meeting the requirements of 35 Ill. Adm. Code 845.640 and 650 for each CCR surface impoundment. For all CCR surface impoundments at the site, the applicant must provide laboratory reports, field stabilization records, and purge documentation to sufficiently address the requirements of 35 Ill. Adm. Code 845.640(a). Additionally, the applicant must identify the certified laboratory used for groundwater sample analysis of samples collected at each CCR surface impoundment pursuant to the requirements of 35 Ill. Adm. Code 845.640(j).*

Response: On December 19, 2023, Dynegy technical staff and IEPA met to discuss IEPA's Initial Review Letter. Pursuant to that discussion, Dynegy is producing the electronic data deliverable ("EDD") responsive to the above request concurrently with this response. Given the nature of the data to be shared, Dynegy will provide IEPA with a link to a temporary file-sharing service containing the EDD.

Comment 14: *The Statistical Analysis Plan provided in the application for the OWAP and OWPP states that the full statistical summary of downgradient well exceedances is attached to the Plan, but this summary was not included.*

Response: The full statistical summary of downgradient well exceedances that was referenced in a previous Statistical Analysis Plan (SAP) dated 2018 was not produced. Subsequently, a revised SAP was prepared and included in the Operating Permit Application submitted in 2021. The full statistical summary of downgradient well exceedances for OWAP and OWPP was included in the History of Potential Exceedances included in Attachment M of the Operating Permit._

Comment 15: *The data provided in Attachment I, Table 3-1 for Pond No. 2, Pond No. 4, and the East Ash Pond does not include appropriate minimum detection limits for each constituent in order to evaluate the constituent statistically for comparison with the numerical groundwater protection standards pursuant to 35 Ill. Adm. Code 845.600(a)(1).*

Response: IPGC has received and reviewed IEPA's December 28, 2023 letter regarding additional comments on statistical methods proposed in the initial operating permit applications. IPGC and IEPA met on May 2, 2024 to discuss the comments in this initial review letter and in the December 28, 2023 letter. Responses to the initial review letter are provided here, and IPGC will provide separate written responses to the December 28, 2023 letter.

Typical laboratory detection and reporting limits are summarized in the Groundwater Monitoring Plan/Attachment I, Table 4-2. All detection and reporting limits are equal to or less than the groundwater protection standards (GWPS) in 35 IAC § 845.600(a)(1). The electronic data deliverables (EDDs) submitted to IEPA contain the actual laboratory detection and reporting limits associated with each sample result. Only sample results above the reporting limits are considered detected values for statistical background determinations to avoid introduction of additional uncertainty or error associated with sample results below reporting limits. Sample results below reporting limits are considered non-detects for statistical calculations and handled as specified in the Statistical Analysis Plan included in the Groundwater Monitoring Plan as Appendix A. In very rare cases, the reporting limits for individual sample results may exceed the GWPS in 35 IAC § 845.600(a)(1) due to matrix effects requiring dilution of the sample before analysis. These results are specifically examined to make sure they do not disproportionately affect the statistical background determination, and are excluded for conservatism if they do. No samples included in the Hennepin background determinations had non-detect results with reporting limits exceeding the GWPS in 35 IAC § 845.600(a); therefore, background values calculated for chloride, cobalt, and total dissolved solids at East Ash Pond and chloride, cobalt, and total dissolved solid at Ash Pond 2 and Ash Pond 4 were not affected by detection limits above the GWPS.

The background concentrations were determined using a tolerance interval established from the distribution of the background data, pursuant to 35 IAC §845.640(f)(1)(c) and as discussed with IEPA in the May 2 meeting. This method of determining a background level is consistent with methods in the USEPA guidance document Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance (2009).

Comment 16: *Additionally for these impoundments, the calculated protection/background values for chloride, cobalt, and total dissolved solids do not exhibit the correct use of the statistics pursuant to 35 Ill. Adm. Code 845.600(a)(2).*

Response: See comment 15.

History of Known Exceedances of the Groundwater Protection Standards [35 Ill. Adm. Code 845.230(d)(2)(M)]

Comment 17: *To comply with the application requirements of 35 Ill. Adm. Code 845.230(d)(2)(M), the applicant must provide a history of known exceedances of the groundwater protection standards in Section 845.600, and any corrective action taken to remediate the groundwater. The history of known exceedances provided for the East Ash Pond does not contain raw sample data, only the results of a statistical analysis. Raw data that is consistent with the data quality information required by 35 Ill. Adm. Code 845.640(a) must be provided to the Agency for all impoundments at the site. Additionally, the provided data should include calculated protection values for all parameters that are consistent with the requirements of 35 Ill. Adm. Code 845.600(a)(2).*

Response: On December 19, 2023, Dynegy technical staff and IEPA met to discuss IEPA's Initial Review Letter. Pursuant to that discussion, Dynegy is producing the EDD responsive to the above request concurrently with this response. Given the nature of the data to be shared, Dynegy will provide IEPA with a link to a temporary file-sharing service containing the EDD.

Waste Characterization/CCR Characterization [35 Ill. Adm. Code 845.150(a)(1), 35 Ill. Adm. Code 845.230(d)(2)(B-C), 35 Ill. Adm. Code 845.600, 35 Ill. Adm. Code 845.640(a)]

Comment 18: *To comply with the application requirements of 35 Ill. Adm. Code 845.230(d)(2)(B-C), the applicant must provide an analysis of the chemical constituents found within the CCR located in or to be placed in a CCR surface impoundment (waste characterization) and an analysis of the chemical constituents of all waste streams, chemical additives and sorbent materials entering or contained in the CCR surface impoundment. CCR waste characterization must include all waste streams as defined by SW846, incorporated by reference, which includes appropriate number of samples to characterize each waste type and identification of all waste types which includes solids, semi-solids, liquids, and air born parts that come from the CCR. The applicant must provide date and time sampled, number of samples* *collected, constituents analyzed for each sample, statistics or data reduction technical explanations, and laboratory reports for the analytical data for the following waste streams at the East Ash Pond: CCR solids and semi-solids; leachate water, if any; surface water, if any; and any other waste stream as defined by SW846 Compendium.*

Response: The existing characterization is consistent with Part 845. While it is true that SW846 is incorporated by reference into Part 845 by Section 845.150, inclusion in the general "incorporations by reference" section of Part 845 does not create an affirmative obligation to use SW846 in all circumstances. The Board has explained that where Illinois rules incorporate analytical methods by reference via a "centralized listing of incorporations by reference" such as Section 845.150, "Illinois rules further indicate where each method is used *in the body of the substantive provisions*." *See In the Matter of: SDWA Update, USEPA Amendments (January 1, 2013 through June 30, 2013)*, R 2014-008, Opinion of the Board at 24–25 (Jan. 23, 2014) (emphasis added).

Further, Chapter 2 of SW846 states that the methods in that document are not "mandatory" unless specifically specified as such by regulation. United States Environmental Protection Agency ("USEPA"), *SW-846 Update V* at 1 (July 2014).[1] USEPA guidance also makes clear that SW846 is only legally required where "explicitly specified" in a regulation. USEPA, *Disclaimer for Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846)* at 1 (July 2014).[2] The only substantive provision of Part 845 specifically requiring analysis using SW846 is Section 845.640(e), which applies to analyzing groundwater monitoring samples under a groundwater monitoring program and is not at issue here. 35 Ill. Admin. Code § 845.640(e). There is no requirement to use SW846 under Section 845.230(d)(2). The plain language of Part 845 does not require the utilization of SW846 for purposes of waste and CCR characterization.

Dynegy followed best practices in the industry in conducting its "analysis of the chemical constituents found within the CCR to be placed in the CCR surface impoundment" and "analysis of the chemical constituents of all waste streams, chemical additives and sorbent materials entering or contained in the CCR surface impoundment." Dynegy collected porewater, which is the most representative of the chemical constituents from the leachate of the impoundment. Testing of the actual porewater from a CCR surface impoundment is more appropriate than SW846's use of leach test results to estimate a total potential for chemical leaching from CCR into groundwater. In promulgation of the Federal 257 CCR Rule (40 CFR 257), USEPA states that "[t]he use of porewater data is still considered the most appropriate approach to estimate constituent fluxes to groundwater for CCR surface impoundments" (USEPA, 2015, Preamble p. 21441) because porewater is water "collected from the interstitial water between waste particles in surface impoundments as it occurs in the field" and represents

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[1] Available at https://www.epa.gov/sites/default/files/2015-10/documents/chap2_1.pdf.

[2] Available at https://www.epa.gov/sites/default/files/2015-10/documents/disclaim.pdf.

the material potentially leached from impoundments. The CCR materials are the primary source of constituents loading to the CCR porewater. Over an extended period (e.g., months or years), the CCR porewater (i.e., water) reaches equilibrium with the CCR materials. The concentrations within the porewater are "the most representative data available for impoundments because these data are field-measured concentrations of leachate" (USEPA, 2014, Risk Assessment). The porewater analysis used is the best and most accurate scientifically available information for source characterization. *See, e.g.,* US EPA, Industrial Environmental Research Laboratory, Chemical and Biological Characterization of Leachates from Coal Solid Wastes, EPA-600/7-80-039, March 1980; US EPA & TVA, Effects of Coal-ash Leachate on Ground Water Quality, EPA-600/7-80-066, March 1980; US EPA, Office of Research and Development, Characterization of Coal Combustion Residues from Electric Utilities – Leaching and Characterization Data, EPA-600/R-09/151, December 2009; *see also* X.Wang, *et al., Leaching and Geochemical Evaluation of Oxyanion Partitioning Within an Active Coal Ash Management Unit,* Chemical Engineering Journal, Vol. 454, Part 4, at 140406 (Feb. 15, 2023).

Prior to performing hydrogeologic investigations in 2021 as needed to support the operating permit applications, Ramboll completed a review of existing data to determine whether sufficient information existed to meet the requirements of 35 I.A.C. § 845. Based on the review, Ramboll developed an approach to fully characterize the CCR material as part of the 2021 investigation. Three locations for porewater wells and CCR solids sample collection were selected by evaluating the extent of ash through time on aerial photographs (Figure 1 in Attachment D), identifying visible differences (color) in surficial materials, and capturing a representative spatial distribution (both vertically and horizontally). A total of three porewater wells were installed in 2021. Analytical results of solid samples are provided in tables from the Hydrogeologic Characterization Reports which have also been included in Attachment D.

Hazard Potential Classification and Certification [35 Ill. Adm. Code 845.230(d)(2)(O) and 35 Ill. Adm. Code 845.440]

Comment 19: *To comply with the application requirements of 35 Ill. Adm. Code 845.230(d)(2)(O), the applicant must provide a hazard potential classification assessment and accompanying certification pursuant to the requirements of 35 Ill. Adm. Code 845.440(a)(2). The applicant must provide this assessment and accompanying certification for the East Ash Pond.*

Response: A Hazard Potential Classification and Certification for the East Ash Pond was included in the initial operating permit application. *See* Hennepin's East Ash Pond Operating Permit Application at Attachment O.

Inflow Design Flood Control System Plan and Certification [35 Ill. Adm. Code 845.230(d)(2)(R) and 35 Ill. Adm. Code 845.510(a)(3) and (c)]

Comment 20: *To comply with the application requirements of 35 Ill. Adm. Code 845.230(d)(2)(R), the applicant must provide an Inflow Design Flood Control System Plan and accompanying certification pursuant to the requirements of 35 Ill. Adm. Code 845.510. The applicant must provide a certified Inflow Design Flood Control System Plan that corresponds with the assessed hazard potential classification for the East Ash Pond.*

Response: An Inflow Design Flood Control System Plan and Certification for the East Ash Pond was included in the initial operating permit application. *See* Hennepin's East Ash Pond Operating Permit Application at Attachment R.

Safety and Health Plan [35 Ill. Adm. Code 845.230(d)(2)(S) and Ill. Adm. Code 845.530]

Comment 21: *To comply with the application requirements of 35 Ill. Adm. Code 845.230(d)(2)(S), the applicant must provide a Safety and Health Plan pursuant to the requirements of 35 Ill. Adm. Code 845.530. The applicant must provide a revised Safety and Health Plan for the East Ash Pond that includes procedures for using, inspecting, repairing, and replacing facility emergency and monitoring equipment pursuant to the requirements of 35 Ill. Adm. Code 845.530(c)(2)(A).*

Response: Dynegy has provided as Attachment F to this letter a revised Safety and Health Plan dated December 2023 that addresses these requirements in Section 3.4 "Emergency and Monitoring Equipment Training" as requested by IEPA.

Initial Construction Permit Application - East Ash Pond

Groundwater Monitoring Program and Hydrogeologic Site Characterization [35 Ill. Adm. Code 845.220(a)(7) and 35 Ill. Adm. Code 845 Subpart F]

Comment 22: *To comply with the application requirements of 35 Ill. Adm. Code 845.220(a)(7), the applicant must provide documentation of a new or updated groundwater monitoring program that includes: a hydrogeologic site investigation meeting the requirements of 35 Ill. Adm. Code 845.620, design and construction plans of a groundwater monitoring system meeting the requirements of 35 Ill. Adm. Code 845.630, and a proposed groundwater sampling and analysis program including selection of the statistical procedures used for evaluating groundwater monitoring data pursuant to the requirements of 35 Ill. Adm. Code 845.640-650. The Groundwater Information provided as Attachment B of the application must be revised to meet these requirements, including the addition of laboratory documents to validate the groundwater and surface water summary tables.*

Response: The requested groundwater information was inadvertently omitted from the permit application. The information is contained in the Groundwater Monitoring Plan and Hydrogeologic Site Characterization Report originally submitted as part of the operating permit application. Copies of those documents are included as Attachment E.

Further, on December 19, 2023, IPRG technical staff and IEPA met to discuss IEPA's Initial Review Letter. Pursuant to that discussion, IPRG is producing the EDD responsive to the above request concurrently with this response. Given the nature of the data to be shared, IPRG will provide IEPA with a link to a temporary file-sharing service containing the EDD.

Comment 23: *Table 1 only includes the observed concentrations of boron and model calibrations. The history of potential exceedances must be provided to verify the data in Table 1. Section 2.1 of Attachment B only lists groundwater modeling results for boron. This section should be revised to include groundwater modeling results for all constituents listed in 35 Ill. Adm. Code 845.600 that have been found to be present in the East Ash Pond. Boron will be the first constituent to complete leaching from the pond and does not represent the flow rate and leachability of all constituents.*

Response: Part 845 does not require that groundwater models developed in support of the closure alternative analysis evaluate all constituents listed in Section 845.600 that have been found to be present in the CCR surface impoundment. Part 845 requires that groundwater modeling evaluate only "how the closure alternative will achieve compliance with the applicable groundwater protection standards" 35 Ill. Admin. Code § 845.710(d)(2). 221-9587There is no language in Part 845 requiring that the groundwater model must evaluate all constituents that have been detected in a surface impoundment. Further, as discussed in Attachment G, modeling selected constituents is a common industry approach for evaluation of environmental systems and is sufficient to achieve the modeling objectives in support of the closure alternatives analysis. Attachment G at 4. Dynegy selected, as a surrogate, boron as the constituent at the site that will likely require the longest time to achieve the groundwater protection standards. Id. This surrogate constituent is appropriate to determine when the closure of each unit will achieve the groundwater protection standards as required by Section 845.710(d)(2). Id. at 5, 9–11.

In addition, Dynegy will be providing hydrogeologic and geochemical conceptual site models as components of the nature and extent report required by 35 Ill. Admin. Code § 845.650(d)(1). The nature and extent report was submitted concurrent with the corrective measures assessment report on May 8, 2024. Further, Dynegy will be conducting fate and transport modeling for evaluation of potential corrective measures in the corrective action alternatives analysis (CAAA) report (due no later than June 2025 for all units) using boron as a surrogate constituent. A geochemical evaluation report will also be submitted concurrently with the CAAA that discusses the expected transport and fate of all 845.600 constituents that have been detected above the GWPS and are attributable to a CCR unit. These activities will address the concerns posed by IEPA in its Initial Review Letter.

History of Construction [35 Ill. Adm. Code 845.220(a)]

Comment 24: *To comply with the application requirements of 35 Ill. Adm. Code 845.220(a)(1)(D-E), the applicant must provide a description of the physical and engineering properties of the foundation and abutment materials of the CCRSI, and a statement detailing physical and engineering properties of the materials used in construction each zone or stage of the CCRSI.*

Response: See response to comment 3.

Comment 25: *To support the information provided to meet these requirements for the East Ash Pond, the application should be revised to include geotechnical exploration data and laboratory testing data for the foundation, abutment, and zone/stage construction materials.*

Response: See response to comment 4.

Waste Characterization/CCR Characterization [35 Ill. Adm. Code 845.150(a)(1), 35 Ill. Adm. Code 845.220(a)(2)(A), 35 Ill. Adm. Code 845.600, 35 Ill. Adm. Code 845.640(a)]

Comment 26: *To comply with the application requirements of 35 Ill. Adm. Code 845.220(a)(2)(A), the applicant must provide an analysis of the chemical constituents found within the CCR located in or to be placed in a CCR surface impoundment (waste characterization). CCR waste characterization must include all waste streams as defined by SW846, incorporated by reference, which includes appropriate number of samples to characterize each waste type and identification of all waste types which includes solids, semi-solids, liquids, and airborne parts that come from the CCR. The applicant must provide date and time sampled, number of samples collected, constituents analyzed for each sample, statistics or data reduction technical explanations, and laboratory reports for the analytical data for the following waste streams at the East Ash Pond: CCR solids and semi-solids; leachate water, if any; surface water, if any; and any other waste stream as defined by SW846 Compendium.*

Response: See comment 18.

Final Closure Plan and Alternatives Analysis [35 Ill. Adm. Code 845.220(d), 35 Ill. Adm. Code 845.210, 35 Ill. Adm. Code 845.720(b), and 35 Ill. Adm. Code 845.750]

Comment 27: *To comply with the application requirements of 35 Ill. Adm. Code 845.220(d)(2), the applicant must provide a final closure plan pursuant to the requirements of 35 Ill. Adm. Code 845.720(b), including a closure alternatives analysis pursuant to the requirements of 35 Ill. Adm. Code 845.210. The final closure plan for closure-in-place of the East Ash Pond in accordance with 35 Ill. Adm. Code 845.750 should include plans for surveying the final extents of the pond at each of the following points in the construction schedule: prior to commencement of construction activities, after compaction and dewatering of the CCR, after completion of* *placement of the low permeability layer, and after completion of final grading and seeding.*

The final closure plan must include documented consideration of the seasonal variations that may occur with the fate and transport of contaminants with the closure alternative over time, pursuant to the requirements of 35 Ill. Adm. Code 845.710(d)(3).

Response: Dynegy will conduct a survey of the final extents of the CCR surface impoundments prior to commencement of construction activities and after closure has been completed and will include this information in the closure report required to be submitted to the Agency pursuant to Section 845.760(e).

Comment 28: *The final closure plan should also include steps to verify that the proposed cover system soils come from an uncontaminated borrow source, including lab testing for SVOCs, VOCs, and PCBs listed in 35 Ill. Adm. Code 620 and metals listed in 35 Ill. Adm. Code 845.600. Alternatively, the borrow source material must be certified "uncontaminated soil" to ensure that the borrow source material does not pose a risk to human health and the environment.*

Response: Part 845 does not require Dynegy to verify that the proposed cover system soils come from an uncontaminated borrow source or, alternatively, to certify the borrow source as "uncontaminated soil." Further, to the extent IEPA is relying on 35 Ill. Admin. Code Part 1100 to require certified "uncontaminated soil" to be used as fill material at the site, it does not. Part 1100's application is limited to uncontaminated soil fill operations and clean construction demolition debris (CCDD) fill operations. The East Ash Pond is neither. None the less, Dynegy is committed to using borrow sourced from a location that has no known surface soil contamination of such a level to pose a significant risk to human health or the environment.

Comment 29: *The final closure plan should include laboratory documents to validate the groundwater and surface water summary tables in Attachment G, Appendix A, specifically for Table 2.1, Table 2.2, and Table 2.3.*

Response: On December 19, 2023, IPRG technical staff and IEPA met to discuss IEPA's Initial Review Letter. Pursuant to that discussion and follow up emails exchanged on December 20, 2023, IPRG is producing the EDD responsive to the above request concurrently with this response. Given the nature of the data to be shared, IPRG will provide IEPA with a link to a temporary file-sharing service containing the EDD. Note that the EDD will only contain groundwater data, and that the surface water data is included in the previously submitted nature and extent report, submitted on May 8, 2024.

Comment 30: *Table 2.2 does not include concentrations for the following parameters pursuant to the requirements of 35 Ill. Adm. Code 845.600: chloride, fluoride, sulfate, pH, and total dissolved solids.*

Response: The parameters were inadvertently left out of the summary in Table 2.2, however, they were included in the Constituents of Interest for both Human Health and Ecological Risk evaluations. Groundwater data for these parameters from 2015-2021 is summarized as follows:

Chloride – Concentrations range from 33 to 366 milligrams per liter (mg/L), the GWPS is 435 mg/L.

Fluoride – Concentrations range from 0.1 to 0.41 mg/L, the GWPS is 4 mg/L.

Sulfate – Concentrations range from 22 to 278 mg/L, the GWPS is 400 mg/L.

pH – Concentrations range from 6.3 to 7.9 standard units (SU), the lower limit GWPS is 6.5 SU and the upper limit GWPS is 9.0 SU.

Total dissolved solids - Concentrations range from 294 to 1,520 mg/L, the GWPS is 1,620 mg/L.

Note there are no exceedances of the GWPS for these constituents.

Comment 31: *Section 3.1 of Appendix A of the final closure plan does not indicate sampling and analysis of sediments in the Illinois River. This document must be revised to establish a background value for the aforementioned parameters. The revision must include verification that the model is correct or revision of the exhibit for the contribution of the identified parameters to the sediments.*

Response: Part 845 does not require sediment samples in nearby waters of the state. While Section 845.710(d)(3) requires that the closure alternatives analysis "assess impacts to waters in the state," Section 845.710 does not require sampling and analysis of surface water sediments. The closure alternatives analysis submitted with the Construction Permit Application includes an analysis of impacts to the Illinois River: "[M]odeled and measured surface water concentrations in the Illinois River are all below relevant human health and ecological screening benchmarks" and further indicates "[s]urface water concentrations of CCR associated constituents are expected to decline over time under both closure scenarios. Thus, no future exceedances of any human health or ecological screening benchmarks are anticipated under either closure scenario." East Ash Pond Closure Permit Application, Attachment G (Final Closure Plan and Proposed Closure Schedule) at Attachment A (Closure Alternatives Analysis). p. 23. Therefore, Dynegy's closure plan satisfies the requirements of Section 845.710(d)(3) by assessing and determining no impacts to the Illinois River.

Comment 32: *Section 4 and Attachment 3 of the final closure plan does not discuss the manner in which the final cover addresses groundwater flow through the East Ash Pond from the shallow aquifer. The document should be revised to address this groundwater flow.*

Response: Dynegy is reviewing and preparing additional information in response to IEPA's Comment 32, which it will submit in its second, responsive production.

Should you have any questions or comments regarding the above responses, please contact Rhys Fuller at rhys.fuller@vistracorp.com or (618) 975-1799.

Sincerely,

Phil Morris, P.E.
Sr. Director, Environmental

Fuller, Rhys

From: Fuller, Rhys
Sent: Monday, August 12, 2024 11:05 AM
To: MacDonna, Keegan
Cc: LeCrone, Darin; Hunt, Lauren; EPA.CCR.Part845.Coordinator; Morris, Phil
Subject: Hennepin Response to Comments (Log No. 2021-100019)

Keegan,

Please find at the link provided below a copy of our initial response to the review letter provided by IEPA concerning our Part 845 operating and closure construction permit applications for the Hennepin Power Plant's CCR Surface Impoundments. A hard copy of the submittal was delivered to IEPA's Springfield Office earlier today. We will also place a copy on our public website. Also linked below is a folder containing the electronic data deliverables which can only be shared electronically.

PDF Hennepin 845 Permit Application Response to Comments.pdf

Hennepin EDD Files

Please let us know if you have any additional questions or if you have difficulty accessing the files via the links above. Note that you may have also received a separate email providing a link to response and EDD files.

Thanks,

Rhys Fuller
618-975-1799

Attachment A

October 2016

Dynegy Midwest Generation, LLC
13498 E 800th St.
Hennepin, IL 61327

RE: History of Construction
USEPA Final CCR Rule, 40 CFR § 257.73(c)
Hennepin Power Station
Hennepin, Illinois

On behalf of Dynegy Midwest Generation, LLC, AECOM has prepared the following history of construction for the Old West Polishing Pond, Old West Ash Pond, Ash Pond No. 2, and East Ash Pond at the Hennepin Power Station in accordance with 40 CFR § 257.73(c).

BACKGROUND

40 CFR § 257.73(c)(1) requires the owner or operator of an existing coal combustion residual (CCR) surface impoundment that either (1) has a height of five feet or more and a storage volume of 20 acre-feet or more, or (2) has a height of 20 feet or more to compile a history of construction by October 17, 2016 that contains, to the extent feasible, the information specified in 40 CFR § 257.73(c)(1)(i)–(xii).

The history of construction presented herein was compiled based on existing documentation, to the extent that it is reasonably and readily available (see 80 Fed. Reg. 21302, 21380 [April 17, 2015]), and AECOM's site experience. AECOM's document review included construction drawings, geotechnical investigations, operation and maintenance information, etc. for Old West Polishing Pond, Old West Ash Pond, Ash Pond No. 2, and East Ash Pond at the Hennepin Power Station.

HISTORY OF CONSTRUCTION

§ 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.

Owner:	Dynegy Midwest Generation, LLC
Address:	1500 Eastport Plaza Drive Collinsville, IL 62234
CCR Units:	Old West Polishing Pond Old West Ash Pond (Pond No. 1 and Pond No. 3) Ash Pond No. 2 East Ash Pond, IDNR Dam ID No. IL50363

The Old West Polishing Pond, Old West Ash Pond, and Ash Pond No. 2 do not have a state assigned identification number.

§ 257.73(c)(1)(ii): The location of the CCR unit identified on the most recent USGS $7^1/_2$ or 15 minute topographic quadrangle map or a topographic map of equivalent scale if a USGS map is not available.

The locations of the Old West Polishing Pond, Old West Ash Pond, Ash Pond No. 2, and East Ash Pond have been identified on an USGS 7-1/2 minute topographic quadrangle map in **Appendix A**.

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

The following captures the purpose of each CCR unit:

- The Old West Polishing Pond (inactive) was used to store and dispose fly ash and bottom ash and is currently being used to clarify stormwater runoff from the Old West Ash Pond prior to discharge in accordance with the station's NPDES permit.
- The Old West Ash Pond (inactive) was used to store and dispose fly ash and bottom ash.
- The Ash Pond No. 2 (inactive) was used to store and dispose fly ash, bottom ash, and other non-CCR waste streams including coal pile runoff.
- The East Ash Pond is being used to store and dispose bottom ash, fly ash, and other non-CCR waste and to clarify process water prior to discharge in accordance with the station's NPDES permit.

Notice of intent to close the Old West Polishing Pond, Old West Ash Pond, and Ash Pond No. 2 was provided in November 2015.[1]

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[1] This history of construction report was prepared on a facility-wide basis for CCR surface impoundments at the Hennepin Power Station. The inclusion of the Old West Polishing Pond, Old West Ash Pond, and Ash Pond No. 2 in this history of construction report does not concede and should not be construed to concede that the Old

§ 257.73(c)(1)(iv): The name and size in acres of the watershed where the CCR unit is located.

The Hennepin Power Station and the above-referenced CCR units are located at the western edge of the Depue Lake-Illinois River Watershed with a 12-digit Hydrologic Unit Code (HUC) of 071300010804 and a drainage area of 44,525 acres (USGS 2016).

§ 257.73(c)(1)(v): A description of the physical and engineering properties of the foundation and abutment materials on which the CCR unit is constructed.

Physical properties of the foundation materials for the Old West Polishing Pond and Old West Ash Pond are described as cohesive material underlain by granular material. The cohesive material consists of lean clay, gravelly clay, silt, clayey silt, and sandy silt. The consistency of the cohesive material varies from very soft to medium stiff. The granular material consists of silty sand and clayey gravel. The relative density of the granular materials varies from loose to very dense and generally increases with depth. An available summary of the engineering properties of the foundation materials for the Old West Polishing Pond and Old West Ash Pond is presented in **Table 1** below. The engineering properties are based on previous geotechnical explorations and laboratory testing.

Table 1. Summary of Material Engineering Properties for the Old West Polishing Pond and Old West Ash Pond

Layer	Unit Weight (pcf)	Total (undrained) Shear Strength Parameters		Effective (drained) Shear Strength Parameters	
		ϕ (deg)	***c (psf)***	***ϕ' (deg)***	***c' (psf)***
CL (soft)	120	0	500	28	0
CL (medium stiff gravely clay)	120	28	0	28	0
ML (soft to medium stiff)	125	28	0	28	0
CL-ML (very soft)	120	0	400	26	0
SM (very loose)	125	28	0	28	0
GC (dense)	130	34	0	34	0
GC (very dense)	130	36	0	36	0
Fill: GC (very dense)	130	34	50	34	0

West Polishing Pond, Old West Ash Pond, and Ash Pond No. 2 are subject to the Design Criteria or all Operating Criteria in the CCR Rule.

The Old West Polishing Pond and Old West Ash Pond are enclosed impoundments with dikes and do not have abutments.

Physical properties of the foundation and abutment materials for Ash Pond No. 2 and the East Ash Pond are described as gravel materials with varying amounts of silt and clay. The relative density of the gravel is medium dense to very dense. An available summary of the engineering properties of the foundation materials for Ash Pond No. 2 and the East Ash Pond is presented in **Table 2** below. The engineering properties are based on previous geotechnical explorations and laboratory testing.

Table 2. Summary of Foundation and Abutment Material Engineering Properties for the Ash Pond No. 2 and East Ash Pond

Material	Unit Weight (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters	
		c’ (psf)	Φ’ (°)	c (psf)	Φ (°)
Alluvial Foundation	135	0	38	0	38

§ 257.73(c)(1)(vi): A statement of the type, size, range, and physical and engineering properties of the materials used in constructing each zone or stage of the CCR unit; the method of site preparation and construction of each zone of the CCR unit; and the approximate dates of construction of each successive stage of construction of the CCR unit.

Physical properties of the embankment materials for the Old West Polishing Pond and Old West Ash Pond are described as gravel with occasional zones of clayey sand and lean clay. The gravel has a general relative density of very dense. An available summary of the engineering properties of the embankment materials for the Old West Polishing Pond and Old West Ash Pond is presented in **Table 1** above. The engineering properties are based on previous geotechnical explorations and laboratory testing.

The physical properties of Ash Pond No. 2 embankment construction materials are described in this paragraph. The original embankments are constructed of sand with varying amounts of coal pieces and gravel. The initial embankment raise is constructed of silty clay, clayey sand, sand, and gravel and the later embankment raise is constructed with layers of lean clay, silty clay, clayey silt, clayey, and gravel. An available summary of the engineering properties of the embankment materials for Ash Pond No. 2 is presented in **Table 3** below. The engineering properties are based on previous geotechnical explorations and laboratory testing.

Table 3. Summary of Construction Material Engineering Properties for Ash Pond No. 2

Material	Unit Weight (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters	
		c' (psf)	Φ' (°)	c (psf)	Φ (°)
Fill: GP-GM (medium dense)	125	0	32	0	32
Fill: CL (hard)	120	0	32	4000	0
Fill: ML (hard)	120	0	32	4500	0
Fill: SC (medium dense)	120	0	28	0	28

Physical properties of the embankment materials for the East Ash Pond are described as clayey silt and clay. The consistency of both the clayey silt and clay ranges from stiff to hard. The original pond surface is lined with a 4-foot thick compacted clay layer of 1.0 x 10^{-7} cm/s underlain by a 1-foot thick sand layer. The liner system of the embankment raise consists of a (from top to bottom) 45 mil reinforced polyethylene geomembrane, a 1-foot thick clay layer, and an 8 oz/sy polypropylene geotextile. A typical cross section profile of the liner system is shown on drawing C-56 presented in **Appendix B**. An available summary of the construction material engineering properties for the East Ash Pond is presented in **Table 4** below. The engineering properties are based on previous geotechnical explorations and laboratory testing.

Table 4. Summary of Construction Material Engineering Properties for the East Ash Pond

Material	Unit Weight (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters	
		c' (psf)	Φ' (°)	c (psf)	Φ (°)
Embankment Fill	105	30	32	2500	0
Liner System	120	60	30	2500	0

The method of site preparation and construction of the Old West Polishing Pond, Old West Ash Pond, Ash Pond No. 2, and the original East Ash Pond are not reasonably and readily available. Site preparation and construction of the 2003 East Ash Pond liner raise were completed in accordance with the applicable construction specification (see § 257.73(c)(1)(xi) below).

Reasonably and readily available approximate dates of construction of each successive stage of construction of the Old West Polishing Pond, Old West Ash Pond, Ash Pond No. 2, and East Ash Pond are provided in **Table 5** below.

Table 5. Approximate dates of construction of each successive stage of construction.

Date	Event
1951 to 1952	Construction of historical Ash Pond No. 1
1958	Construction of Ash Pond No. 2
Late 1960's	Construction of historical Ash Pond No. 3
1978	Embankment raise of Ash Pond No. 2
1985	Embankment raise of Ash Pond No. 2 to elevation 484 feet and Ash Pond No. 3 (Old West Ash Pond) to elevation 460 feet
1988 to 1989	Embankment raise of Old West Ash Pond to elevation 465 feet that merged historical Ash Pond No. 1 and Ash Pond No. 3 into one single pond and created the Old West Polishing Pond
1989	Embankment raise of Ash Pond No. 2 to elevation 494 feet
1995 to 1996	Construction of East Ash Pond
2003	Embankment liner raise of East Ash Pond
2009 to 2010	Eastern portion of Ash Pond No. 2 was removed to facilitate construction of the Leachate Pond
2011	Landfill Cell 1 was constructed over placed CCR in Ash Pond No. 2 adjacent to the Leachate Pond
2014	North Embankment tree removal, grading, and vegetation re-establishment of Ash Pond No. 2

§ 257.73(c)(1)(vii): At a scale that details engineering structures and appurtenances relevant to the design, construction, operation, and maintenance of the CCR unit, detailed dimensional drawings of the CCR unit, including a plan view and cross sections of the length and width of the CCR unit, showing all zones, foundation improvements, drainage provisions, spillways, diversion ditches, outlets, instrument locations, and slope protection, in addition to the normal operating pool surface elevation and the maximum pool surface elevation following peak discharge from the inflow design flood, the expected maximum depth of CCR within the CCR surface impoundment, and any identifiable natural or manmade features that could adversely affect operation of the CCR unit due to malfunction or mis-operation.

Drawings that contain items pertaining to the requested information for the Old West Polishing Pond, Old West Ash Pond, Ash Pond No. 2, and East Ash Pond are listed in **Table 6** below. Items marked as "Not Available" are items not found during a review of the reasonably and readily available record documentation.

Table 6. List of drawings containing items pertaining to the information requested in § 257.73(c)(1)(vii).

	Old West Polishing Pond	Old West Ash Pond	Ash Pond No. 2	East Ash Pond
Dimensional plan view (all zones)	HEN1-B460-2	HEN1-B460-1 to 2	HEN1-B461, HEN1-C117	HEN1-C55
Dimensional cross sections	HEN1-B452 to B457	HEN1-B452 to B457	HEN1-B458-1 to 7, Berm Modification Drawings 7 to 9	HEN1-C56 to C59
Foundation Improvements	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Drainage Provisions	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Spillways and Outlets	Not Available	Not Available	Not Applicable	HEN1-C8 to C9, HEN1-C109, HEN1-C113
Diversion Ditches	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Instrument Locations	Figure 2D	Figure 2C	Figure 2A	Figure 2B
Slope Protection	Not Available	Not Available	Berm Modification Drawings 3 to 9	HEN1-C56 to C59
Normal Operating Pool Elevation	Not Available	Not Available	Not Available	Not Available
Maximum Pool Elevation	Not Available	Not Available	Not Available	Not Available
Approximate Maximum Depth of CCR in 2016	11 feet	15 feet	46 feet	35 feet

All drawings referenced in **Table 6** above can be found in **Appendix B** and **Appendix C**.

Based on the review of the drawings listed above, no natural or manmade features that could adversely affect operation of these CCR units due to malfunction or mis-operation were identified.

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

Existing instrumentation consists of open-standpipe piezometers installed in 2015. The purpose of the piezometers is to measure the pore water pressures within the embankments of the Old West Polishing Pond, Old West Ash Pond, Ash Pond No. 2, and East Ash Pond. There are seven (7) existing piezometers within the Old West Polishing Pond, Old West Ash Pond, Ash Pond No. 2, and East Ash Pond. A location map of the existing instrumentation is presented in **Appendix C**.

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

Area-capacity curves for the Old West Polishing Pond, Old West Ash Pond, Ash Pond No. 2, and East Ash Pond are not reasonably and readily available.

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

The Old West Polishing Pond contains a 24-inch diameter corrugated metal pipe (CMP) outlet that discharges stormwater to the Illinois River in accordance with the station's NPDES permit. Current capacity and calculation information for the Old West Polishing Pond's discharge capability is not reasonably and readily available.

The Old West Ash Pond contains a 24-inch dia. pipe culvert. Stormwater collected within the CCR unit drains via surface flow and through the pipe culvert into the Old West Polishing Pond. Current capacity and calculation information for the Old West Ash Pond's discharge capability is not reasonably and readily available.

The Ash Pond No. 2 does not contain a spillway or diversion feature. Stormwater collected within the CCR unit drains via surface flow into the East Ash Pond. Current capacity and calculation information for the Ash Pond No. 2's discharge capability is not reasonably and readily available.

The East Ash Pond contains two outlet structures. The southeast outlet is a 5-foot wide stop-log structure that is connected to a 36-inch diameter reinforced concrete pipe (RCP). The 36-inch diameter RCP discharges into the East Polishing Pond. The northeast outlet, located on the northeast corner of the East Ash Pond, is a headwall structure connected to an 18-inch diameter RCP. The 18-inch diameter RCP discharges into the East Leachate Pond. In 2016, the discharge capacity of the East Ash Pond was evaluated using HydroCAD 10 software modeling a 1,000-year, 24-hour rainfall event. The model results indicate that the East Ash Pond has enough storage capacity and will not overtop the embankment during the 1,000-year, 24-hour storm event. The results of the HydroCAD 10 analysis are presented below in **Table 7**.

Table 7. Results of HydroCAD 10 analysis

	East Ash Pond
Approximate Minimum Berm Elevation[1] (ft)	493.0
Approximate Emergency Spillway Elevation[1] (ft)	Not Applicable
Starting Pool Elevation[1] (ft)	490.4
Peak Elevation[1] (ft)	492..2
Time to Peak (hr)	12.5
Surface Area (ac)	6.5
Storage[2] (ac-ft)	8.4

Note: 1. Elevations are based on NAVD88 datum
2. Storage given is from Starting Pool Elevation to Peak Elevation.

§ 257.73(c)(1)(xi): The construction specifications and provisions for surveillance, maintenance, and repair of the CCR unit.

The construction specifications for Old West Polishing Pond, Old West Ash Pond, Ash Pond No. 2, and the original East Ash Pond are not reasonably and readily available. The construction specification for the 2003 East Ash Pond liner raise is located in *Specification J-2616, Rev. A* (presented in **Appendix D**).

The provisions for surveillance, maintenance, and repair of the Old West Polishing Pond and Old West Ash Pond are located in *Hennepin Power Station; West Ash Disposal Pond Maintenance Plan* (2013) (presented in **Appendix E**). The provisions for surveillance, maintenance, and repair of Ash Pond No. 2 are located in *Hennepin Power Station; Old East Ash Disposal Pond Maintenance Plan* (2013) (presented in **Appendix F**). The provisions for surveillance, maintenance, and repair of the East Ash Pond are located in *Hennepin Power Station; East Ash Disposal Pond Maintenance Plan* (2014) (presented in **Appendix G**).

The operations and maintenance plans for the Old West Polishing Pond, Old West Ash Pond, Ash Pond No. 2, and East Ash Pond are currently being revised by Dynegy Midwest Generation, LLC.

§ 257.73(c)(1)(xii): Any record or knowledge of structural instability of the CCR unit.

There is no record or knowledge of structural instability of the Old West Polishing Pond, Old West Ash Pond, Ash Pond No. 2, and East Ash Pond at the Hennepin Power Station.

LIMITATIONS

The signature of AECOM's authorized representative on this document represents that to the best of AECOM’s knowledge, information and belief in the exercise of its professional judgment, it is AECOM’s professional opinion that the aforementioned information is accurate as of the date of such signature. Any recommendation, opinion or decisions by AECOM are made on the basis of AECOM's experience, qualifications and professional judgment and are not to be construed as warranties or guaranties. In addition, opinions relating to environmental, geologic, and geotechnical conditions or other estimates are based on available data and that actual conditions may vary from those encountered at the times and locations where data are obtained, despite the use of due care.

Sincerely,

Claudia Prado

Claudia Prado	Victor Modeer, P.E., D.GE
Project Manager	Senior Project Manager

REFERENCES

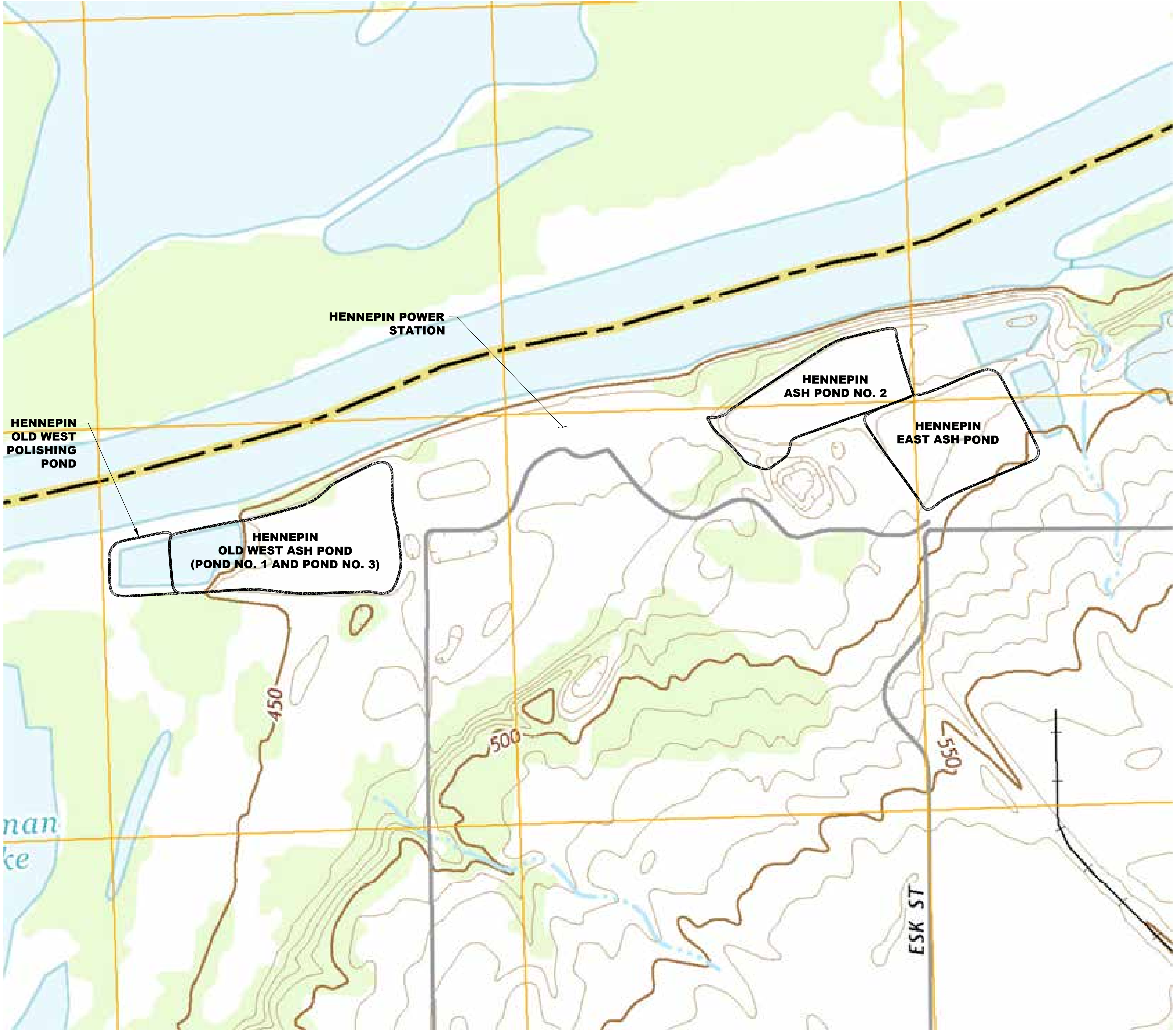
United States Environmental Protection Agency (USEPA). (2015). *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule.* 40 CFR Parts 257 and 261, 80 Fed. Reg. 21302, 21380 April 17, 2015.

United States Geological Survey (USGS). (2016). The National Map Viewer. http://viewer.nationalmap.gov/viewer/. USGS data first accessed in March of 2016.

APPENDICES

Appendix A: History of Construction Vicinity Map
Appendix B: Hennepin Power Station Drawings
Appendix C: Hennepin Power Station Piezometer Locations
Appendix D: Specification J-2616, Rev. A, Primary Ash Pond Modifications
Appendix E: Hennepin Power Station; West Ash Disposal Pond Maintenance Plan (2013)
Appendix F: Hennepin Power Station; Old East Ash Disposal Pond Maintenance Plan (2013)
Appendix G: Hennepin Power Station; East Ash Disposal Pond Maintenance Plan (2014)

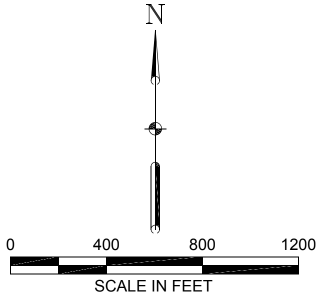
Appendix A: History of Construction Vicinity Map



LEGEND

▭ CCR UNITS

SOURCE:
MAP PROVIDED FROM ELECTRONIC USGS DIGITAL RASTER GRAPHIC 7.5 MINUTE TOPOGRAPHIC MAP OF DEPUE ILLINOIS, REVISED 2015.



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DYNEGY MIDWEST GENERATION, L.L.C.
13498 East 800th Street
Hennepin, IL 61327

HISTORY OF CONSTRUCTION

HENNEPIN POWER STATION
HENNEPIN, ILLINOIS

ISSUED FOR BIDDING ____ DATE BY

ISSUED FOR CONSTRUCTION ____ DATE BY

REVISIONS

NO.	DESCRIPTION	DATE
△		
△		
△		
△		
△		

AECOM PROJECT NO:	60489731
DRAWN BY:	DJD
DESIGNED BY:	DJD
CHECKED BY:	MN
DATE CREATED:	2016-04-13
PLOT DATE:	
SCALE:	1" = 400'
ACAD VER:	2014

SHEET TITLE

HISTORY OF CONSTRUCTION VICINITY MAP

01

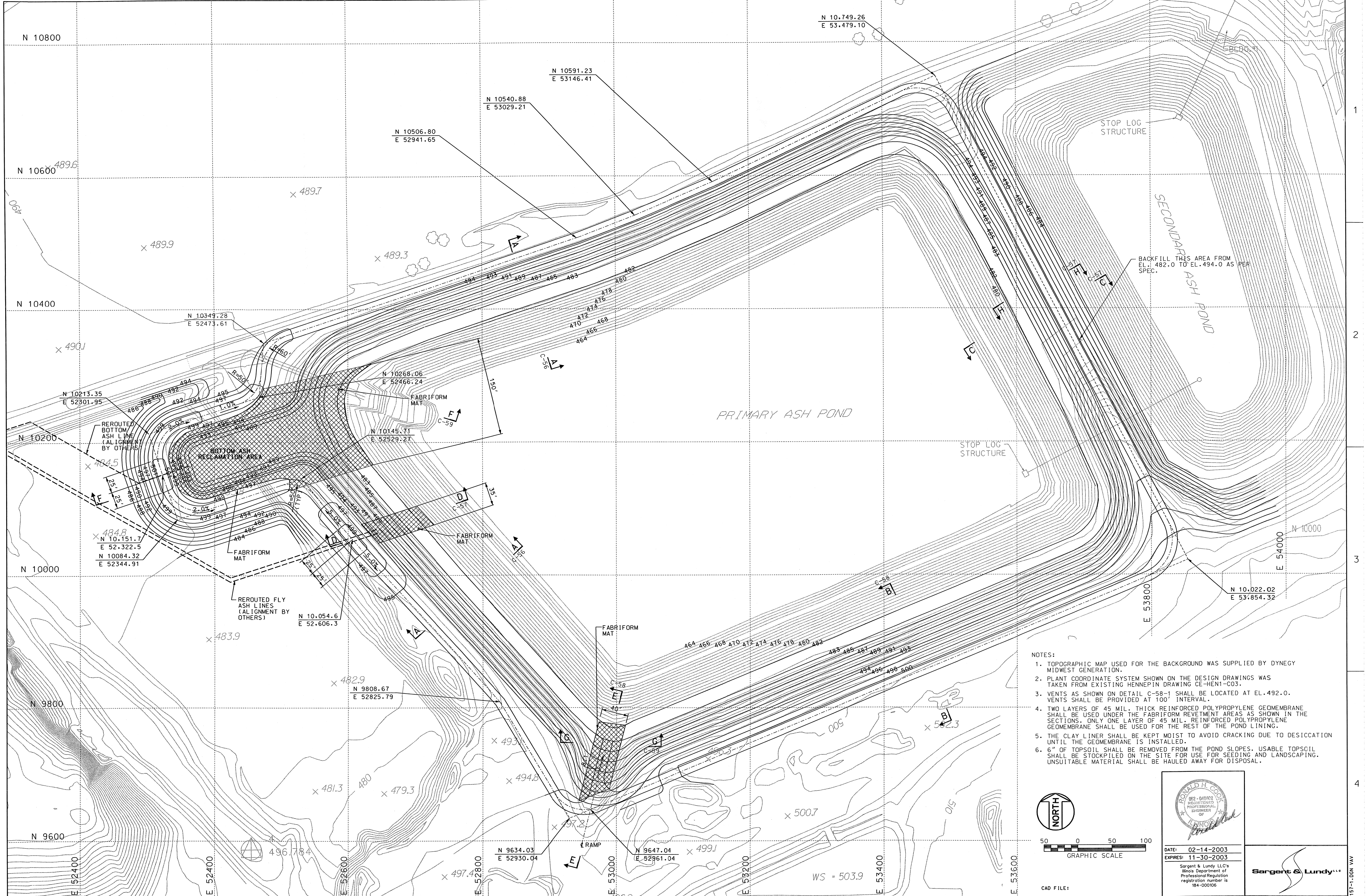
AECOM DRAWING PATH: P:\Projects\Geotech\60428794_DynegyCCR\13_Construction History\04 Technical Production\4_Hennepin\Reference Documents\Vicinity Location Map References\Figures\C-01 History of Construction Vicinity Map (Hennepin) - MJN.dwg NANAK, MATT, 9/28/2016 4:11 PM

Appendix B: Hennepin Power Station Drawings

1. “Plan of Primary Ash Pond, Modification to Primary Ash Pond”, Drawing No. C-55, Revision 0.1, 14 February, 2003, Sargent & Lundy, LLC.
2. “Sections and Details – Sheet 1, Modification to Primary Ash Pond”, Drawing No. C-56, Revision 0.1, 14 February, 2003, Sargent & Lundy, LLC.
3. “Sections and Details – Sheet 2, Modification to Primary Ash Pond”, Drawing No. C-57, Revision 0.1, 14 February, 2003, Sargent & Lundy, LLC.
4. “Sections and Details – Sheet 3, Modification to Primary Ash Pond”, Drawing No. C-58, Revision 0.1, 14 February, 2003, Sargent & Lundy, LLC.
5. “Sections and Details – Sheet 4, Modification to Primary Ash Pond”, Drawing No. C-59, Revision 0.1, 14 February, 2003, Sargent & Lundy, LLC.
6. “Cross Sections of Ash Pond Berm Extension, Sta 1+00, 5+00 & 9+50”, Drawing No. E-HEN1-B452, Revision 0, 4 November, 1997, Illinois Power Company.
7. “Cross Sections of Ash Pond Berm Extension, Sta 14+25, 20+80 & 26+00”, Drawing No. E-HEN1-B453, Revision 0, 4 November, 1997, Illinois Power Company.
8. “Cross Sections of Ash Pond Berm Extension, Sta 30+00, 35+00 & 39+00”, Drawing No. E-HEN1-B454, Revision 0, 4 November, 1997, Illinois Power Company.
9. “Cross Sections of Ash Pond Berm Extension, Sta 40+00, 42+00, 44+90”, Drawing No. E-HEN1-B455, Revision 0, 4 November, 1997, Illinois Power Company.
10. “Cross Sections of Ash Pond Berm Extension, Sta 47+00, 51+00 & 56+00”, Drawing No. E-HEN1-B456, Revision 0, 4 November, 1997, Illinois Power Company.
11. “Cross Sections of Ash Pond Berm Extension, Sta 61+50”, Drawing No. E-HEN1-B457, Revision 0, 4 November, 1997, Illinois Power Company.
12. “Cross Sections, East Ash Pond Extension”, Drawing No. E-HEN1-B458-1, Revision 0, 8 March, 1990, Illinois Power Company.
13. “Cross Sections, East Ash Pond Extension”, Drawing No. E-HEN1-B458-2, Revision 0, 8 March, 1990, Illinois Power Company.
14. “Cross Sections, East Ash Pond Extension”, Drawing No. E-HEN1-B458-3, Revision 0, 8 March, 1990, Illinois Power Company.
15. “Cross Sections, East Ash Pond Extension”, Drawing No. E-HEN1-B458-4, Revision 0, 8 March, 1990, Illinois Power Company.
16. “Cross Sections, East Ash Pond Extension”, Drawing No. E-HEN1-B458-5, Revision 0, 8 March, 1990, Illinois Power Company.
17. “Cross Sections, East Ash Pond Extension”, Drawing No. E-HEN1-B458-6, Revision 0, 8 March, 1990, Illinois Power Company.
18. “Cross Sections, East Ash Pond Extension”, Drawing No. E-HEN1-B458-7, Revision 0, 8 March, 1990, Illinois Power Company.
19. “Plan-Unit #1 Ash Pond Extension, Sheet #1”, Drawing No. E-HEN1-B460-1, 2 February, 1988, Illinois Power Company.
20. “Plan-Unit #1 Ash Pond Extension, Sheet #2”, Drawing No. E-HEN1-B460-2, 2 February, 1988, Illinois Power Company.

Appendix B: Hennepin Power Station Drawings (continued)

21. "Contour and Grading Plan, Unit #2 Ash Pond Extension", Drawing No. CE-HEN1-B461, Revision 0, 8 March, 1990, Illinois Power Company.
22. "Pond 2 East, Flexible Membrane Liner and Structures", Drawing No. HEN1-C109, Revision 0, 28 July, 2010, Civil & Environmental Consultants, Inc.
23. "Pond 2 East, Details", Drawing No. HEN1-C113, Revision 0, 28 July, 2010, Civil & Environmental Consultants, Inc.
24. "Landfill Phase 1 Construction, Existing Conditions", Drawing No. HEN1-C117, Revision 0, 28 November, 2010, Civil & Environmental Consultants, Inc.
25. "Layout-Pond Discharge Structures, 1995 Ash Facility", Drawing No. CE-HEN1-C8, Revision 0, 17 September, 1996, Illinois Power Company.
26. "Details: Pond Discharge Structure, 1995 Ash Facility", Drawing No. CE-HEN1-C9, Revision 0, 17 September, 1996, Illinois Power Company.
27. "East Berm Modification, Existing Site Conditions", Drawing No. 3, Revision 3, 4 February, 2015, Civil & Environmental Consultants, Inc.
28. "East Berm Modification, Proposed Site Plan", Drawing No. 4, Revision 3, 4 February, 2015, Civil & Environmental Consultants, Inc.
29. "East Berm Modification, Proposed Grading Plan 1 of 2", Drawing No. 5, Revision 3, 4 February, 2015, Civil & Environmental Consultants, Inc.
30. "East Berm Modification, Proposed Grading Plan 2 of 2", Drawing No. 6, Revision 3, 4 February, 2015, Civil & Environmental Consultants, Inc.
31. "East Berm Modification, Proposed Sections Sta 1+00 to 15+00", Drawing No. 7, Revision 3, 4 February, 2015, Civil & Environmental Consultants, Inc.
32. "East Berm Modification, Proposed Sections Sta 16+00 to 23+50", Drawing No. 8, Revision 3, 4 February, 2015, Civil & Environmental Consultants, Inc.
33. "East Berm Modification, Berm and Erosion Control Details", Drawing No. 9, Revision 3, 4 February, 2015, Civil & Environmental Consultants, Inc.



NOTES:

1. TOPOGRAPHIC MAP USED FOR THE BACKGROUND WAS SUPPLIED BY DYNEGY MIDWEST GENERATION.
2. PLANT COORDINATE SYSTEM SHOWN ON THE DESIGN DRAWINGS WAS TAKEN FROM EXISTING HENNEPIN DRAWING CE-HEN1-C03.
3. VENTS AS SHOWN ON DETAIL C-58-1 SHALL BE LOCATED AT EL.492.0. VENTS SHALL BE PROVIDED AT 100' INTERVAL.
4. TWO LAYERS OF 45 MIL. THICK REINFORCED POLYPROPYLENE GEOMEMBRANE SHALL BE USED UNDER THE FABRIFORM REVETMENT AREAS AS SHOWN IN THE SECTIONS. ONLY ONE LAYER OF 45 MIL. REINFORCED POLYPROPYLENE GEOMEMBRANE SHALL BE USED FOR THE REST OF THE POND LINING.
5. THE CLAY LINER SHALL BE KEPT MOIST TO AVOID CRACKING DUE TO DESICCATION UNTIL THE GEOMEMBRANE IS INSTALLED.
6. 6" OF TOPSOIL SHALL BE REMOVED FROM THE POND SLOPES. USABLE TOPSOIL SHALL BE STOCKPILED ON THE SITE FOR USE FOR SEEDING AND LANDSCAPING. UNSUITABLE MATERIAL SHALL BE HAULED AWAY FOR DISPOSAL.

RONALD H. COOK
062-048602
REGISTERED PROFESSIONAL ENGINEER OF ILLINOIS

Ronald H. Cook

DATE: 02-14-2003
EXPIRES: 11-30-2003

Sargent & Lundy LLC's Illinois Department of Professional Regulation registration number is 184-000106

Sargent & Lundy LLC

REFERENCE DRAWINGS

NO.	DATE	REVISION	PREP'D	REV'D	APPR'D	NO.	DATE	REVISION	PREP'D	REV'D	APPR'D
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SCALE: 1"=50'
DWN. M.DOWNS DATE 02-12-03
CHK. V.PATEL DATE 02-14-03
APPV. DATE

DYNEGY

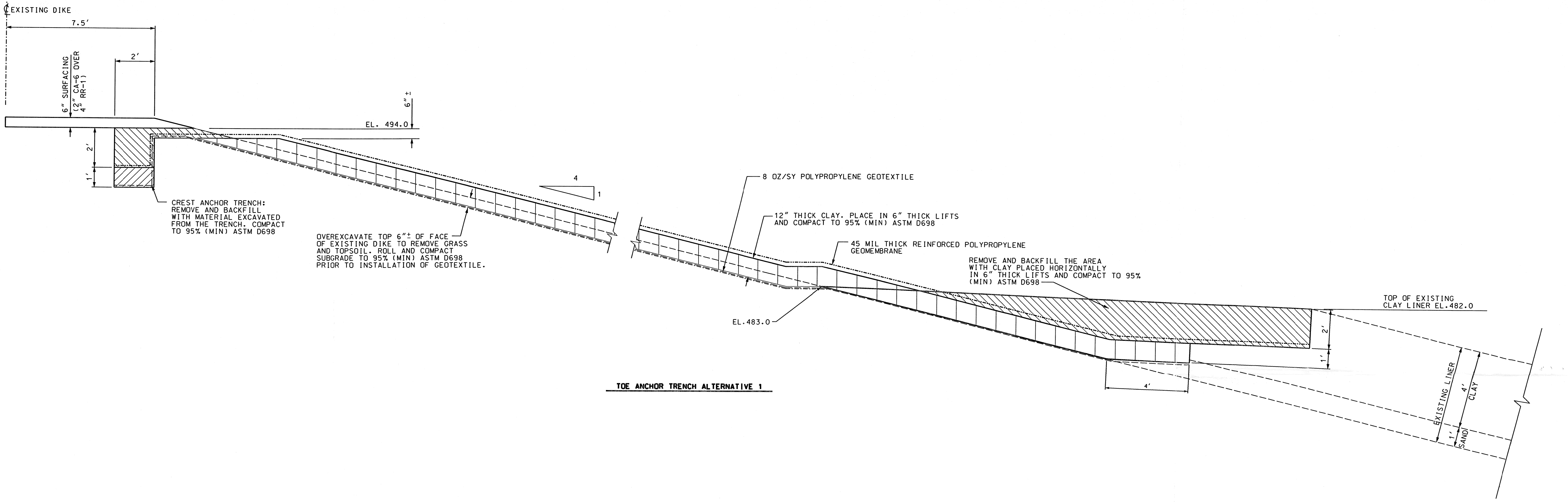
PLAN OF PRIMARY ASH POND

MODIFICATION TO PRIMARY ASH POND
HENNEPIN POWER STATION

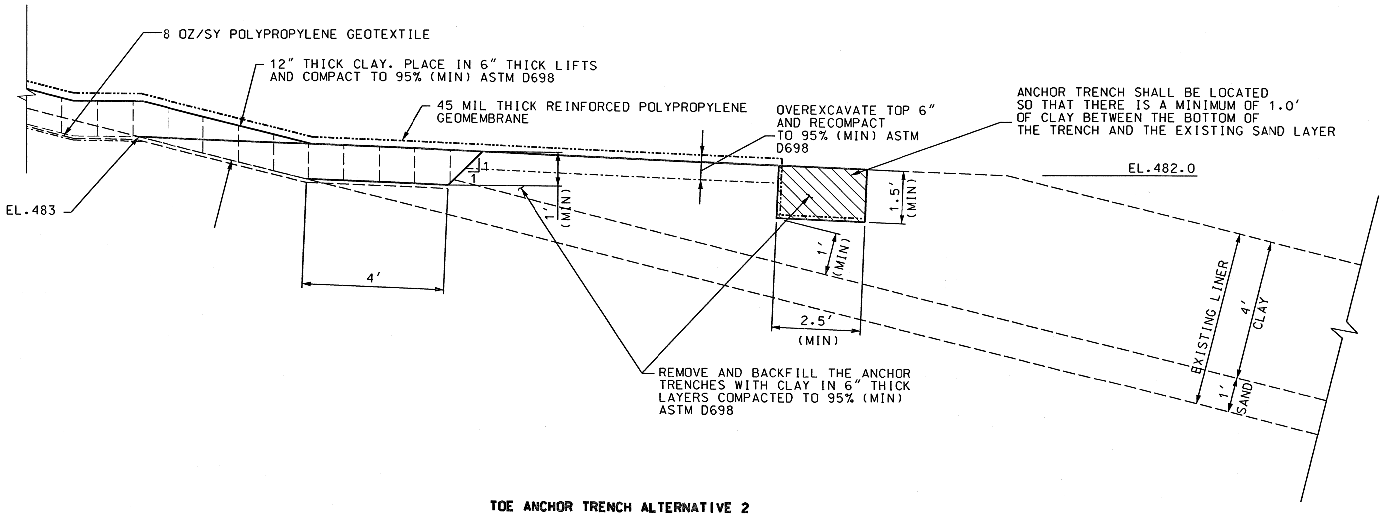
PROJECT NO.: 08820-331
CLIENT: DYNEGY MIDWEST GENERATION
DWG. NO.: C-55
REV. 0.1

E-WDR1-E157-1.DGN VAV
07-10-2001

02-13-03 ALS



TOE ANCHOR TRENCH ALTERNATIVE 1



TOE ANCHOR TRENCH ALTERNATIVE 2

SECTION A

SEE DWG C-55

NOTES:

1. CONTRACTOR SHALL BE RESPONSIBLE FOR CHECKING EXISTING ELEVATIONS AND DIMENSIONS PRIOR TO FABRICATION OF THE GEOMEMBRANE LINER.
2. CONTRACTOR MAY USE EITHER ALTENATIVE 1 OR ALTERNATIVE 2 AS APPROVED BY THE BUYER FOR ALL TOE ANCHOR TRENCH DETAILS.
3. DIMENSIONS WERE TAKEN FROM TYPICAL SECTION ON DRAWING CH-HEN1-C6.1 DATED 12-9-93.

062-048602
RONALD H. COOK
DATE: 02-14-2003
EXPIRES: 11-30-2003
Sargent & Lundy LLC's Illinois Department of Professional Regulation registration number is 184-000106

Sargent & Lundy LLC

CAD FILE:

REFERENCE DRAWINGS

NO.	DATE	REVISION	PREP'D	REV'D	APPR'D
0.1	02-14-2003	FOR PERMIT	MED	VP	——

SCALE:
DWN. M.DOWNS DATE 02-12-02
CHK. V.PATEL DATE 02-14-03
APPV. DATE

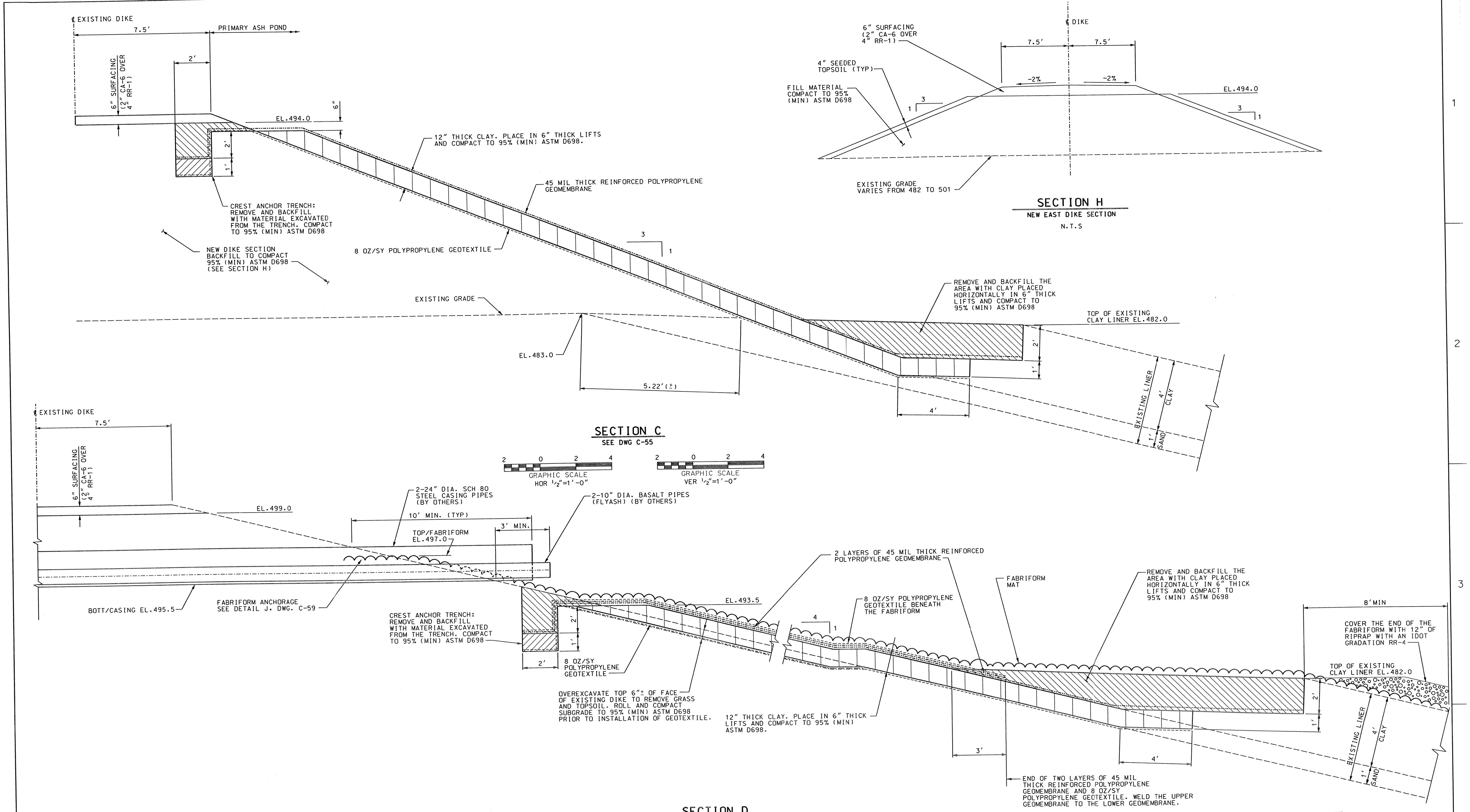
DYNEGY

SECTIONS AND DETAILS - SHEET 1

MODIFICATION TO PRIMARY ASH POND
HENNEPIN POWER STATION

PROJECT NO.: 08820-331
CLIENT: DYNEGY MIDWEST GENERATION
DWG. NO.: C-56
REV. 0.1

E-WDR1-E157-1.DGN VAV
07-10-2001
02-13-03 ALS



SECTION H

NEW EAST DIKE SECTION

N.T.S

SECTION C

SEE DWG C-55

2 0 2 4
GRAPHIC SCALE
HOR 1/2"=1'-0"

2 0 2 4
GRAPHIC SCALE
VER 1/2"=1'-0"

SECTION D

SEE DWG C-55

2 0 2 4
GRAPHIC SCALE
HOR 1/2"=1'-0"

2 0 2 4
GRAPHIC SCALE
VER 1/2"=1'-0"

RONALD H. COOK
062-048602
Ronald Cook

DATE: 02-14-2003
EXPIRES: 11-30-2003

Sargent & Lundy LLC's
Illinois Department of
Professional Regulation
registration number is
184-000106

Sargent & Lundy LLC

CAD FILE:

E-WDR1-E157-1.DGN VAV

REFERENCE DRAWINGS

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0.1	02-14-2003	FOR PERMIT	MED	VP	———						

SCALE: 1/2"=1'-0"
DWN. M.DOWNS DATE 02-12-02
CHK. V.PATEL DATE 02-14-03
APPV. DATE

DYNEGY

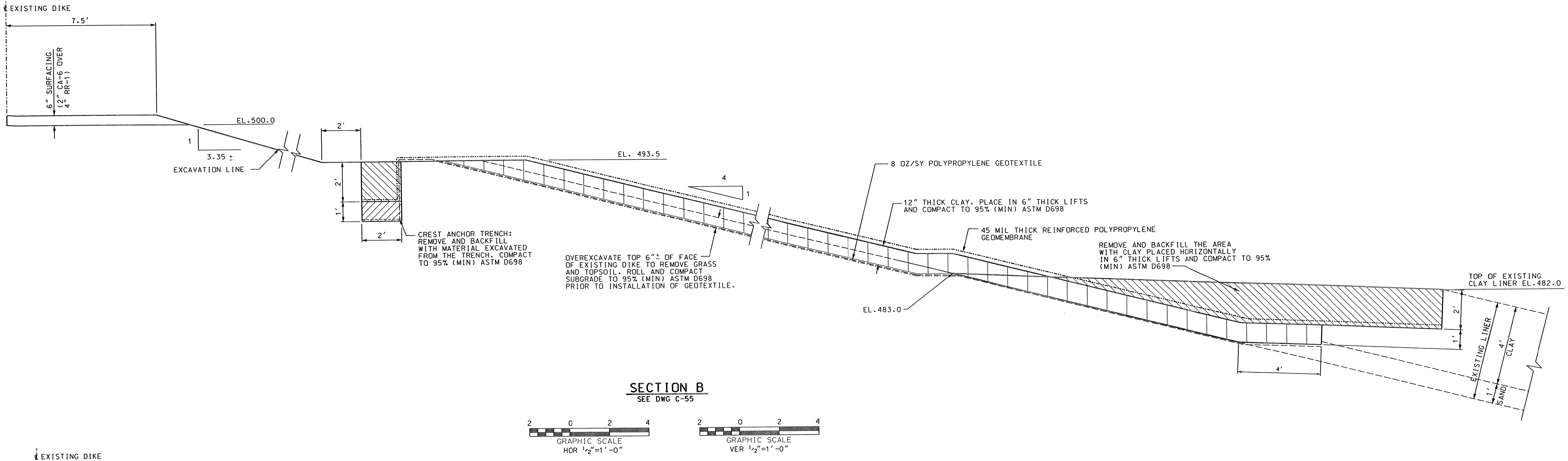
SECTIONS AND DETAILS - SHEET 2

MODIFICATION TO PRIMARY ASH POND
HENNEPIN POWER STATION

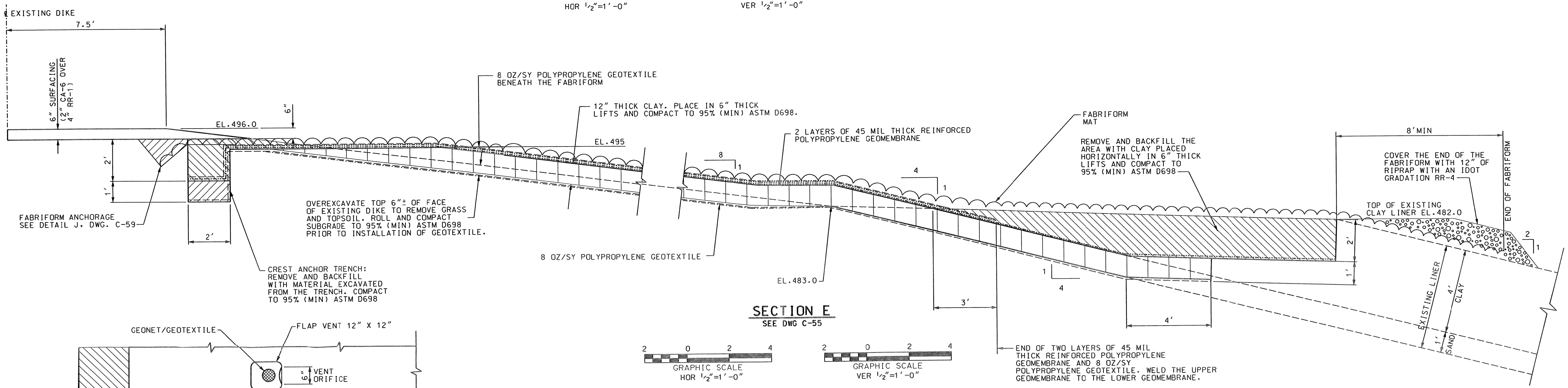
PROJECT NO.: 08820-331
CLIENT: DYNEGY MIDWEST GENERATION
DWG. NO.: C-57
REV. 0.1

07-10-2001

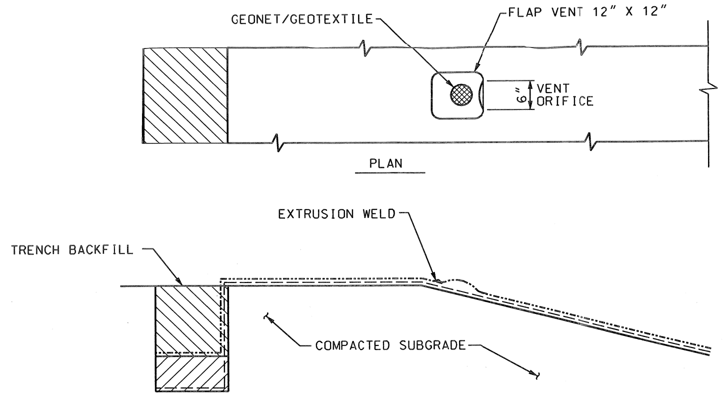
02-13-03 ALS



SECTION B
SEE DWG C-55



SECTION E
SEE DWG C-55



DETAIL C-58-1
MAXIMUM INTERVAL SHALL BE 100'

CAD FILE:

062-048602
REGISTERED PROFESSIONAL ENGINEER OF ILLINOIS
RONALD H. COOK
Ronald Cook

DATE: 02-14-2003
EXPIRES: 11-30-2003

Sargent & Lundy LLC's
Illinois Department of
Professional Regulation
registration number is
184-000106

Sargent & Lundy LLC

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SCALE: 1/2"=1'-0"
DWN. M.DOWNS DATE 02-14-03
CHK. V.PATEL DATE 02-14-03
APPV. DATE

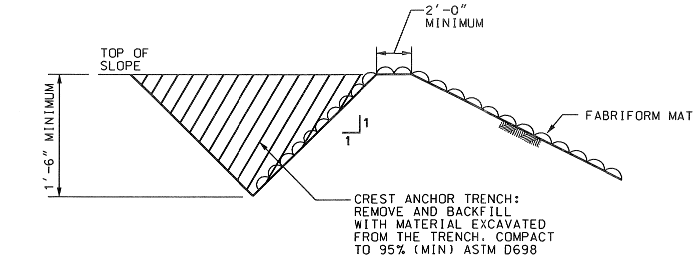
DYNEGY

SECTIONS AND DETAILS - SHEET 3

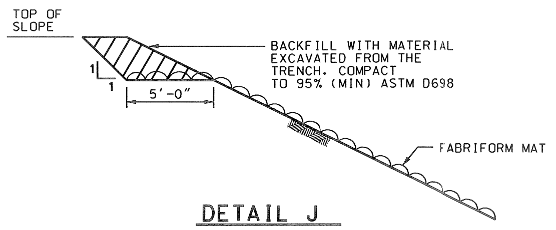
MODIFICATION TO PRIMARY ASH POND
HENNEPIN POWER STATION

PROJECT NO.: 08820-331
CLIENT: DYNEGY MIDWEST GENERATION
DWG. NO.: C-58
REV. 0.1

E-WDR1-E157-1.DGN VAV
07-10-2001
02-12-03 ALS

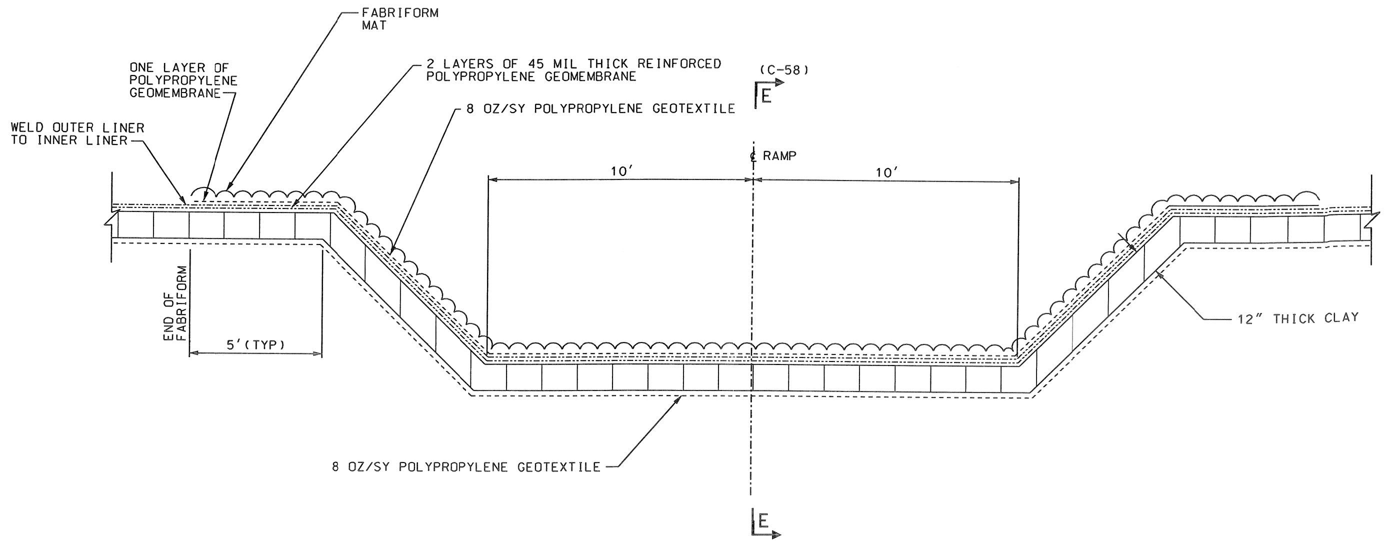


ANCHORAGE IF PROTECTION IS PROVIDED TO THE TOP OF THE SLOPE



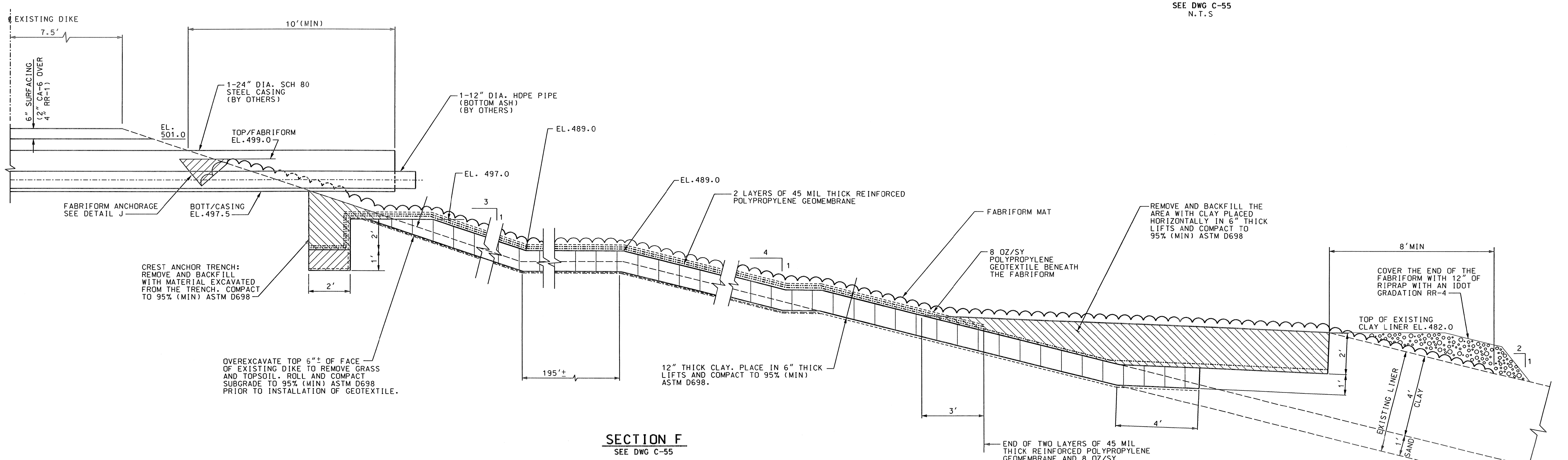
DETAIL J

ANCHORAGE FOR FABRIFORM MAT
N.T.S.



SECTION G

SEE DWG C-55
N.T.S



SECTION F

SEE DWG C-55

GRAPHIC SCALE
HOR $^1/_2$"=1'-0"

GRAPHIC SCALE
VER $^1/_2$"=1'-0"

CAD FILE:

RONALD H. COOK
062-048602
REGISTERED PROFESSIONAL ENGINEER OF ILLINOIS
Ronald Cook

DATE: 02-14-2003
EXPIRES: 11-30-2003

Sargent & Lundy LLC's
Illinois Department of
Professional Regulation
registration number is
184-000106

Sargent & Lundy LLC

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0.1	02-14-2003	FOR PERMIT	MED	VP	——						

SCALE: $^1/_4$"=1'-0"
DWN. M.DOWNS DATE 02-12-02
CHK. V.PATEL DATE 02-14-03
APPV. DATE

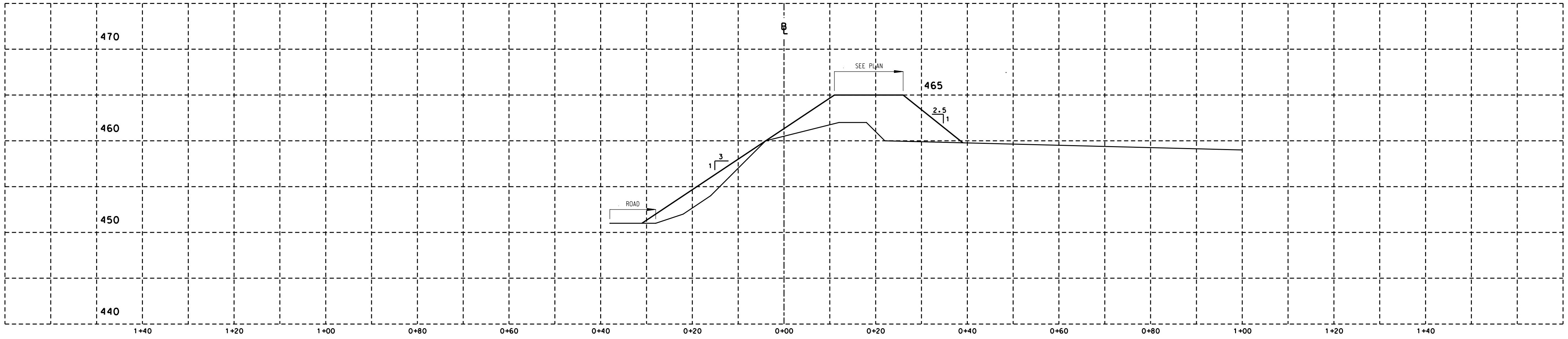
DYNEGY

SECTIONS AND DETAILS - SHEET 4

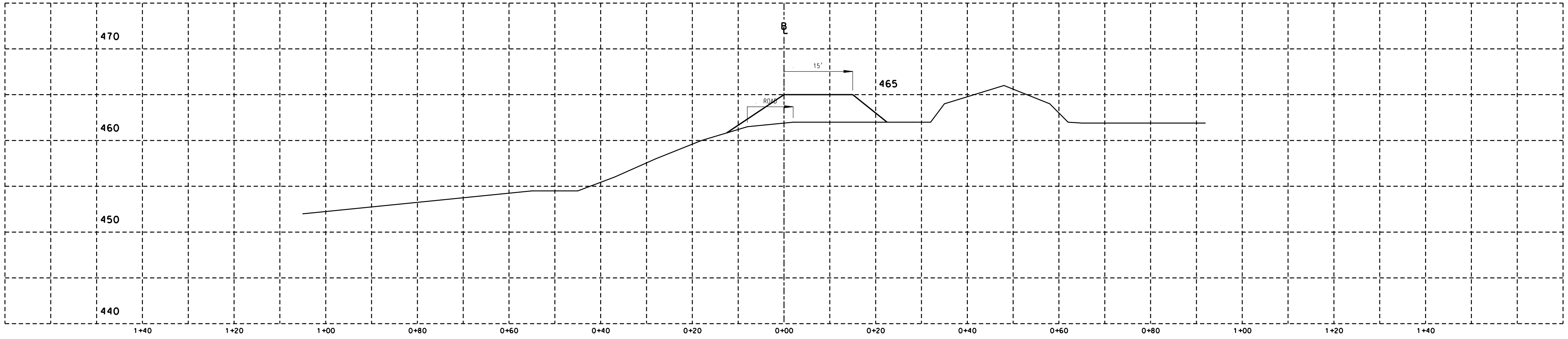
MODIFICATION TO PRIMARY ASH POND
HENNEPIN POWER STATION

PROJECT NO.: 08820-331
CLIENT: DYNEGY MIDWEST GENERATION
DWG. NO.: C-59
REV. 0.1

E-WDR1-E157-1.DGN VAV
07-10-2001
02-13-03 ALS



STATION 9+50



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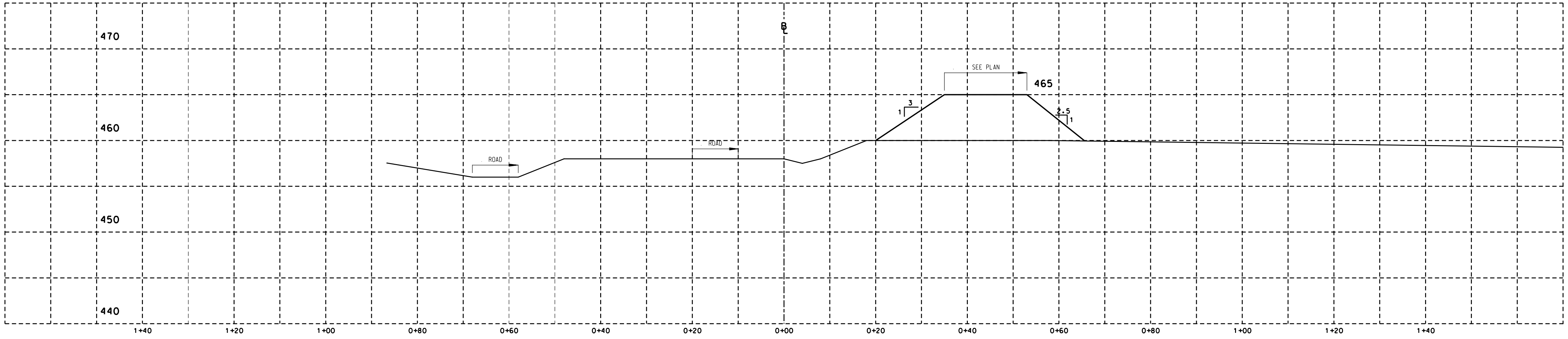


STATION 1+00

LEDGEND

℄	REFERENCE BASE LINE SHOWN ON PLAN
—	OLD BERM
—	NEW BERM
▽	WATER LINE
✳	ESTIMATED ELEVATION

E-HEN1-B452

NO	DATE	DRF	DESCRIPTION	E	C	A	NO	DATE	DRF	DESCRIPTION	E	C	A
⓪													

NOTES

REFERENCES

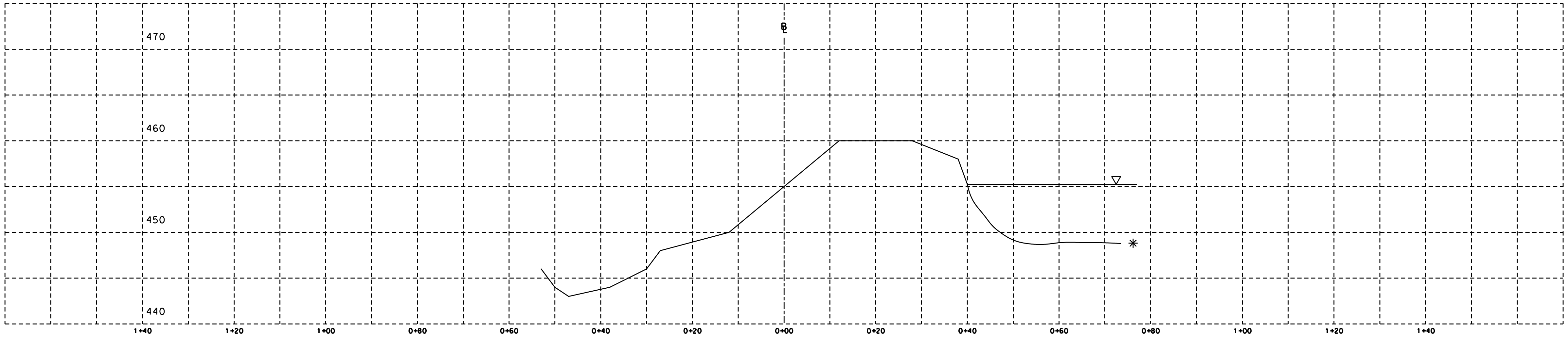
REVISION STATUS
□ -CONSTRUCTION
○ -RECORD
⓪

ILLINOIS POWER COMPANY
DECATUR

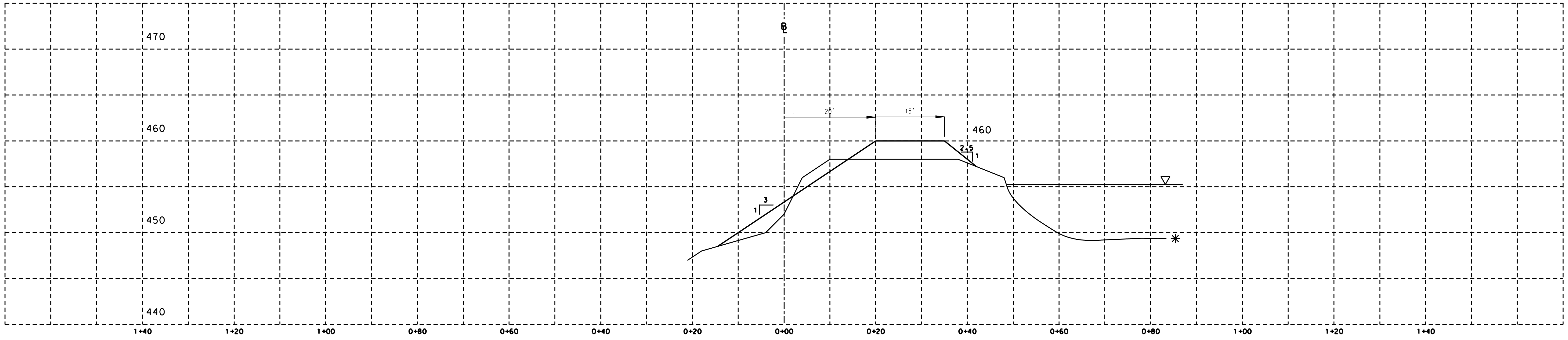
CROSS SECTIONS OF
ASH POND BERM EXTENSION
STA 1+00, 5+00 & 9+50
HENNEPIN POWER STATION

DR GRH	CAD EM	DATE 12-30-87
OK	CKD	SCALE 1"=10'H,1"=5'V
APP APP	PLOTTED 11-4-97	E-HEN1-B452

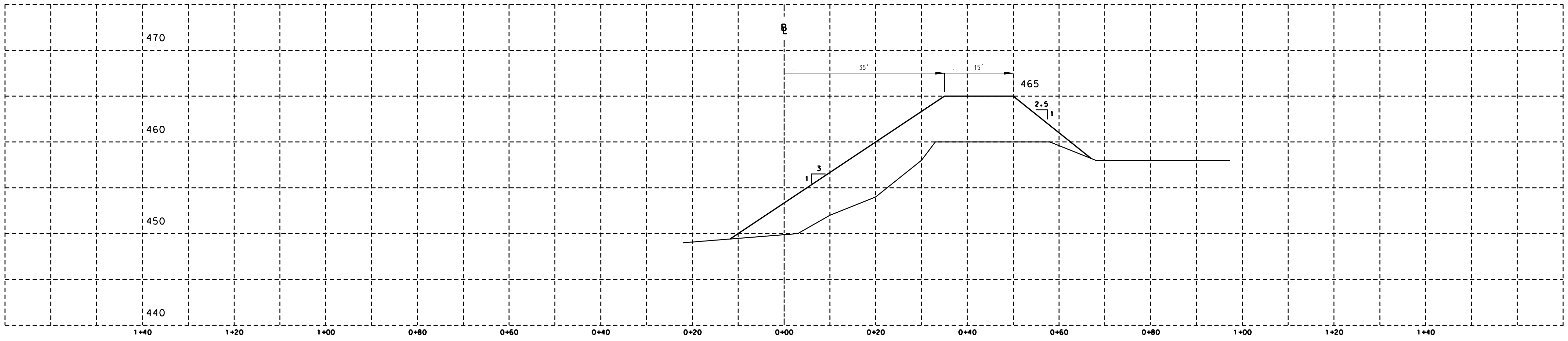
COMPUTER DWG. - DO NOT REVISE MANUALLY



STATION 26+00



STATION 20+80



STATION 14+25

LEDGEND

BL	REFERENCE BASE LINE SHOWN ON PLAN
—	OLD BERM
—	NEW BERM
▽	WATER LINE
✳	ESTIMATED ELEVATION

NO	DATE	DRF	DESCRIPTION	E	C	A	NO	DATE	DRF	DESCRIPTION	E	C	A
⓪													

NOTES

REFERENCES

REVISION STATUS
☐ -CONSTRUCTION
○ -RECORD
⓪

ILLINOIS POWER COMPANY
DECATUR

CROSS SECTIONS OF
ASH POND BERM EXTENSION
STA 14+25, 20+80 & 26+00
HENNEPIN POWER STATION

DR GRH	CAD EM	DATE 12-30-87
OK	CKD	SCALE 1"=10'H,1"=5'V
APP	PLOTTED 11-4-97	E-HEN1-B453
APP		

E-HEN1-B453

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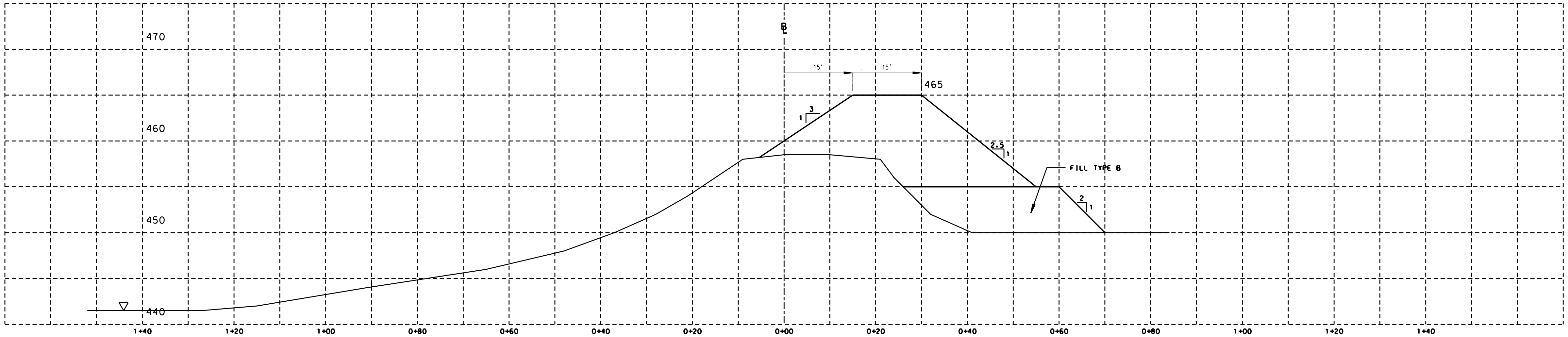

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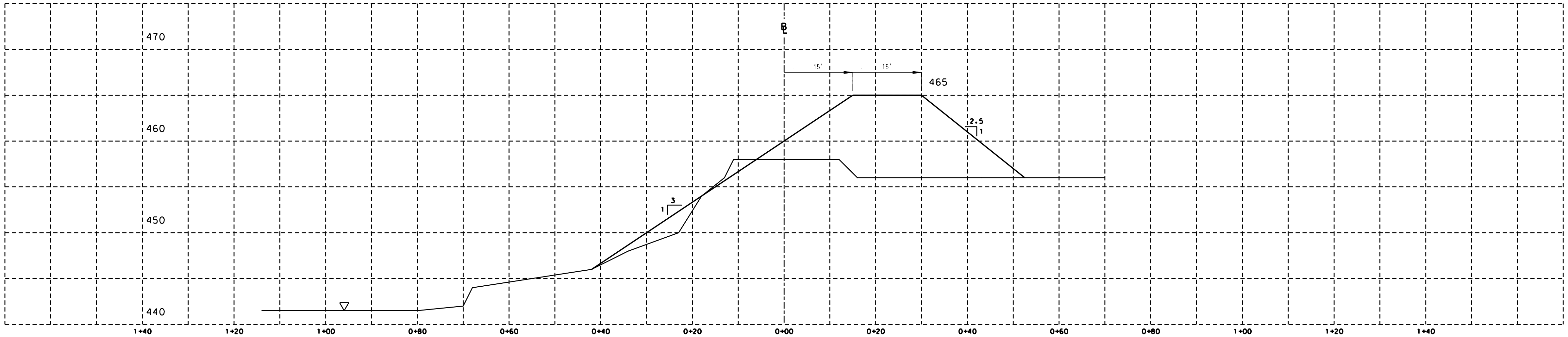

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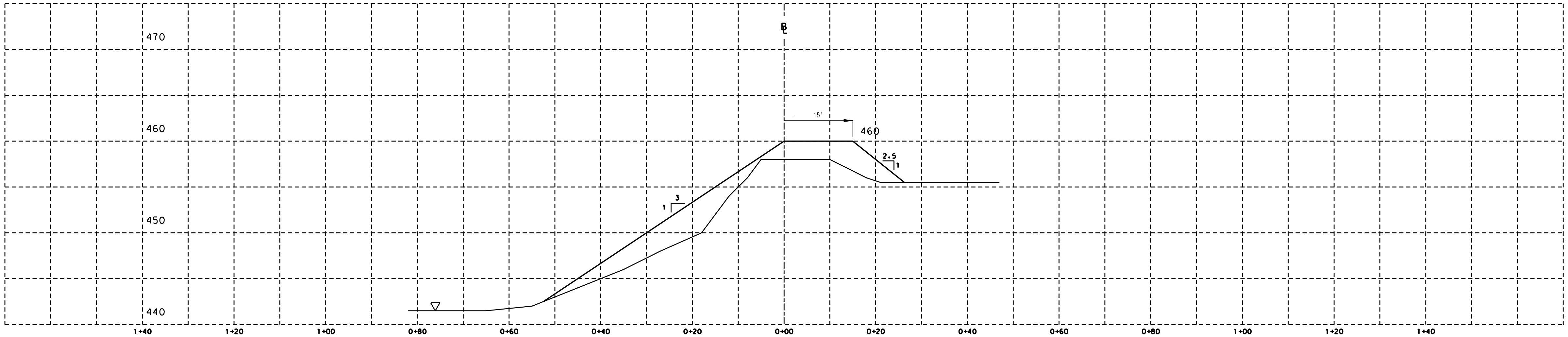

STATION 30+00

LEDGEND

℄ REFERENCE BASE LINE SHOWN ON PLAN
── OLD BERM
━━ NEW BERM
▽ WATER LINE
✳ ESTIMATED ELEVATION

E-HEN1-B454

NO	DATE	DRF	DESCRIPTION	E	C	A	NO	DATE	DRF	DESCRIPTION	E	C	A
⓪													

NOTES

REFERENCES

REVISION STATUS
□ -CONSTRUCTION
○ -RECORD
⓪

ILLINOIS POWER COMPANY
DECATUR

CROSS SECTIONS OF
ASH POND BERM EXTENSION
STA 30+00, 35+00 & 39+00
HENNEPIN POWER STATION

DR GRH	CAD EM	DATE 12-30-87
OK	CKD	SCALE 1"=10'H, 1"=5'V
APP APP	PLOTTED 11-4-97	E-HEN1-B454

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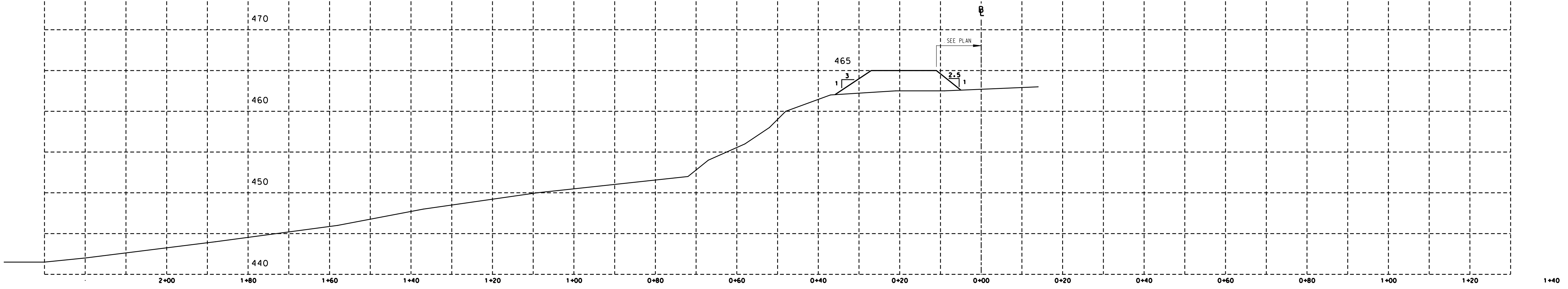

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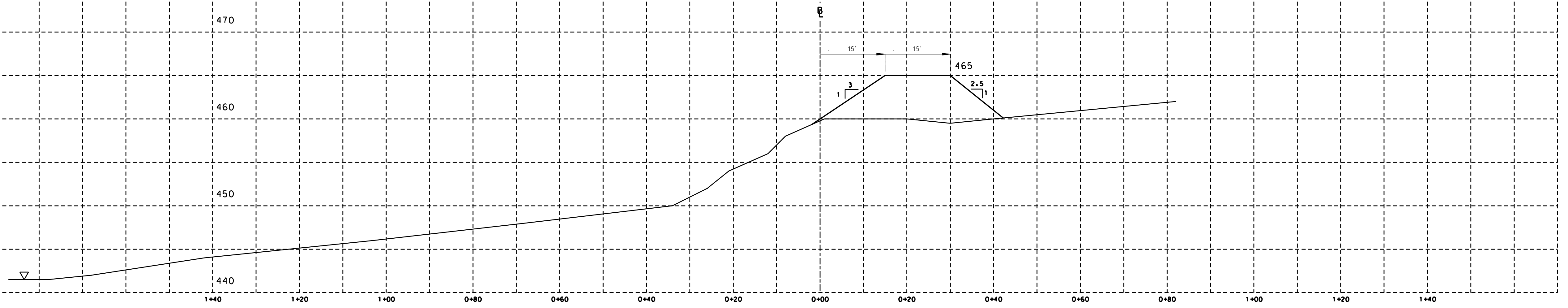

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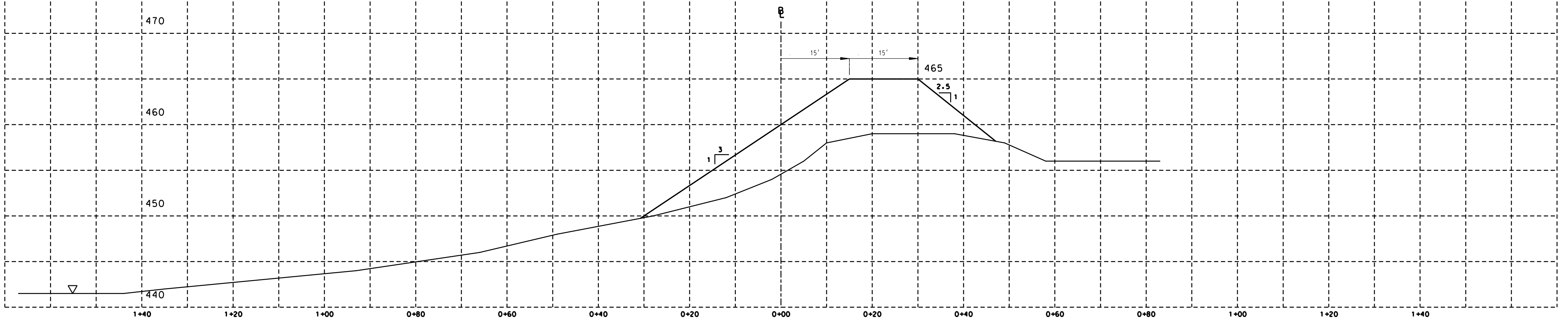


STATION 40+00

LEDGEND

BL REFERENCE BASE LINE SHOWN ON PLAN

OLD BERM

NEW BERM

▽ WATER LINE

✳ ESTIMATED ELEVATION

E-HEN1-B455

NO	DATE	DRF	DESCRIPTION	E	C	A	NO	DATE	DRF	DESCRIPTION	E	C	A
⓪													

NOTES

REFERENCES

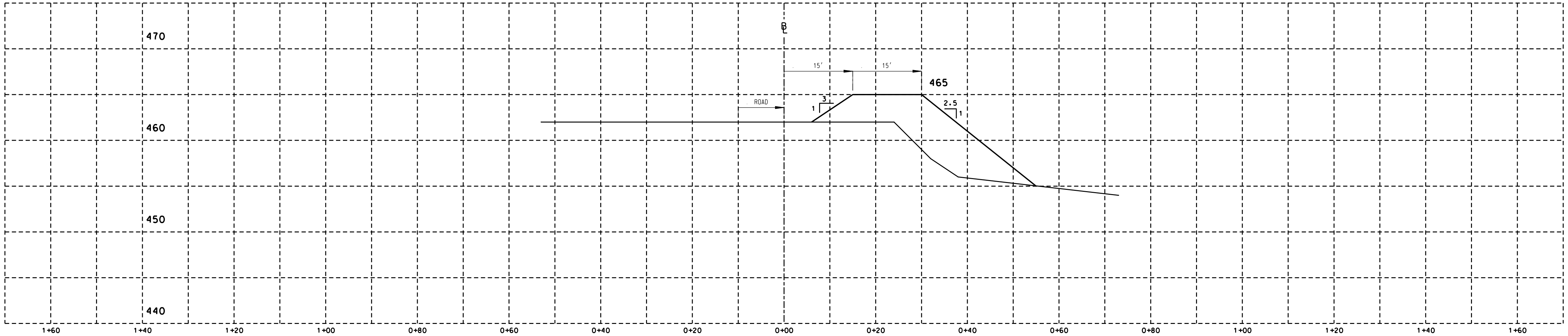
REVISION STATUS
☐ -CONSTRUCTION
○ -RECORD
⓪

ILLINOIS POWER COMPANY
DECATUR

CROSS SECTIONS OF
ASH POND BERM EXTENSION
STA 40+00, 42+00 & 44+90
HENNEPIN POWER STATION

DR GRH	CAD EM	DATE 12-30-87
OK	CKD	SCALE 1"=10'H,1"=5'V
APP	PLOTTED 11-4-97	E-HEN1-B455
APP		

COMPUTER DWG. - DO NOT REVISE MANUALLY



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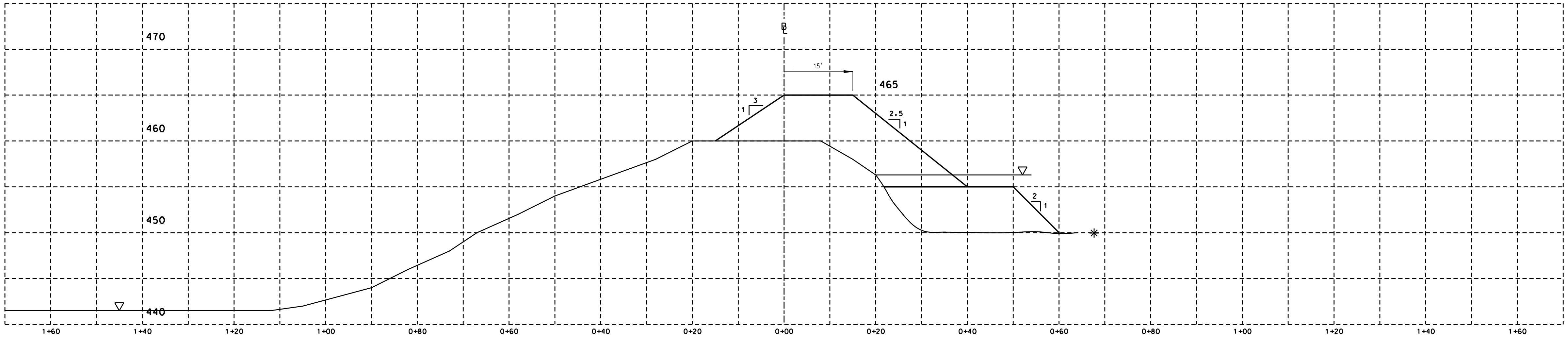

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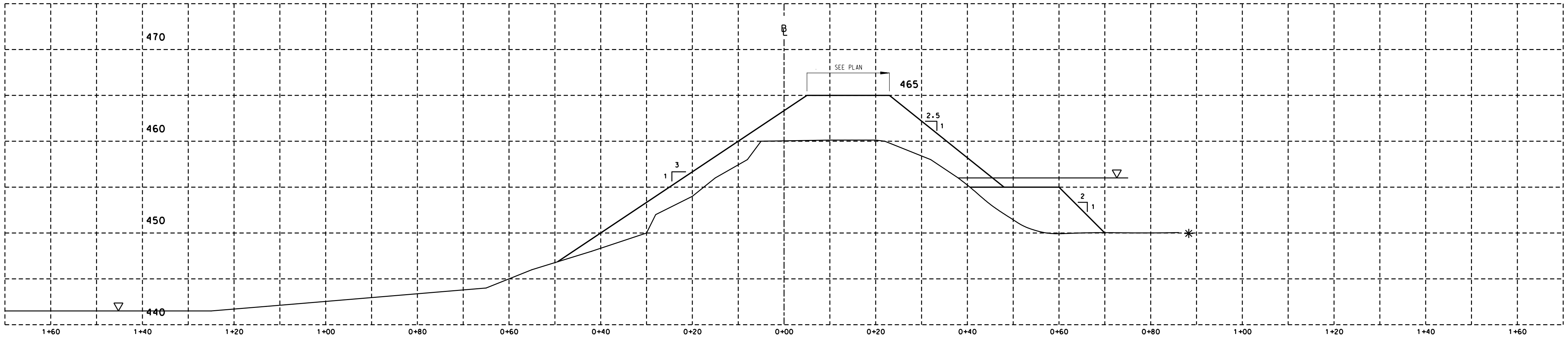


STATION 47+00

LEDGEND

℄ REFERENCE BASE LINE SHOWN ON PLAN
—— OLD BERM
—— NEW BERM
▽ WATER LINE
✳ ESTIMATED ELEVATION

E-HEN1-B456

NO	DATE	DRF	DESCRIPTION	E	C	A	NO	DATE	DRF	DESCRIPTION	E	C	A
⓪													

NOTES

REFERENCES

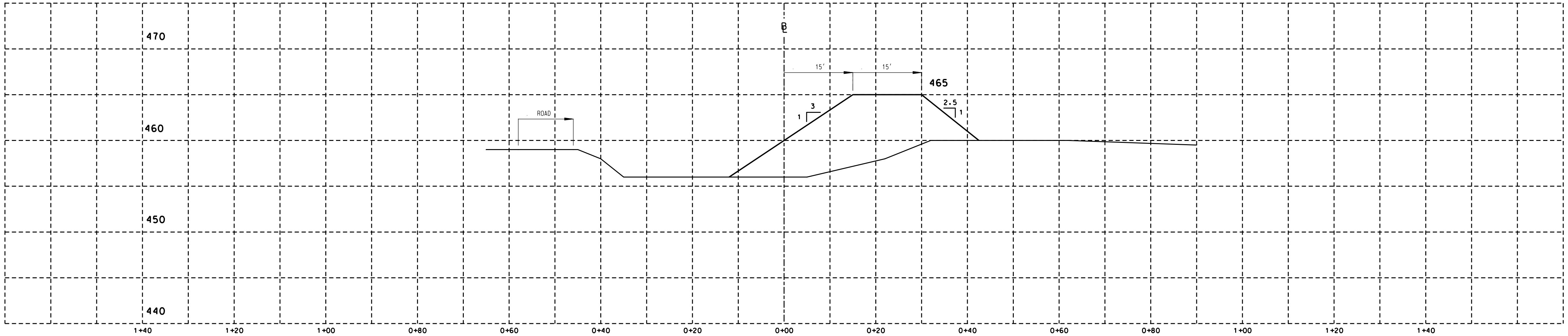
REVISION STATUS
□ -CONSTRUCTION
○ -RECORD
⓪

ILLINOIS POWER COMPANY
DECATUR

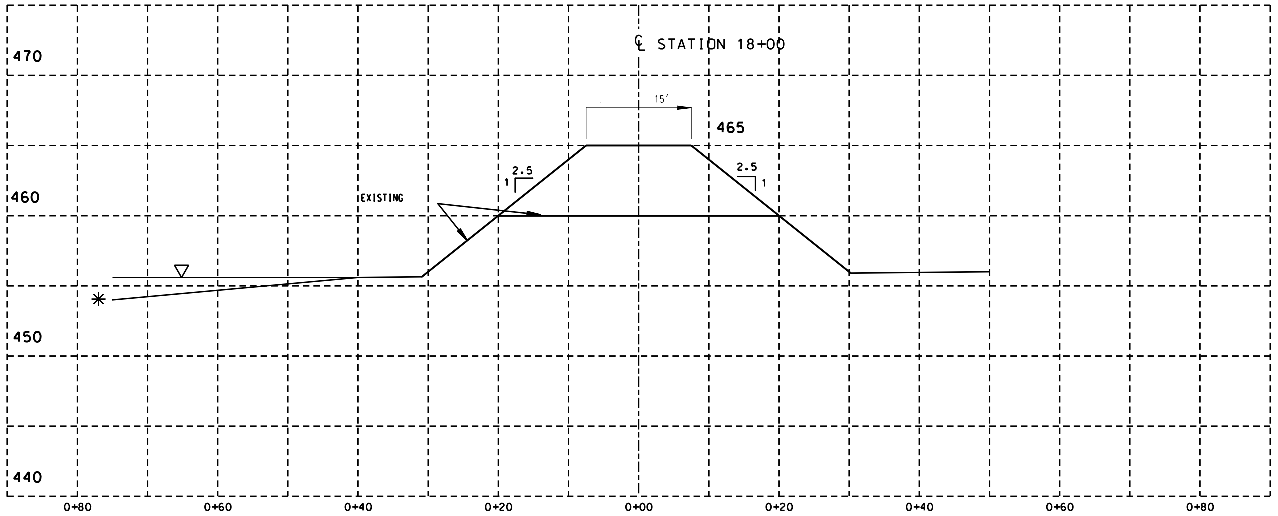
CROSS SECTIONS OF
ASH POND BERM EXTENSION
STA 47+00, 51+00 & 56+00
HENNEPIN POWER STATION

DR GRH	CAD EM	DATE 12-30-87
OK	CKD	SCALE 1"=10'H, 1"=5'V
APP APP	PLOTTED 11-4-97	E-HEN1-B456

COMPUTER DWG. - DO NOT REVISE MANUALLY



STATION 61+50



SECTION A-A

LEDGEND

BL REFERENCE BASE LINE SHOWN ON PLAN
—— OLD BERM
—— NEW BERM
▽ WATER LINE
✳ ESTIMATED ELEVATION

NO	DATE	DRF	DESCRIPTION	E	C	A	NO	DATE	DRF	DESCRIPTION	E	C	A
⓪													

NOTES

REFERENCES

REVISION STATUS
□ -CONSTRUCTION
○ -RECORD
⓪

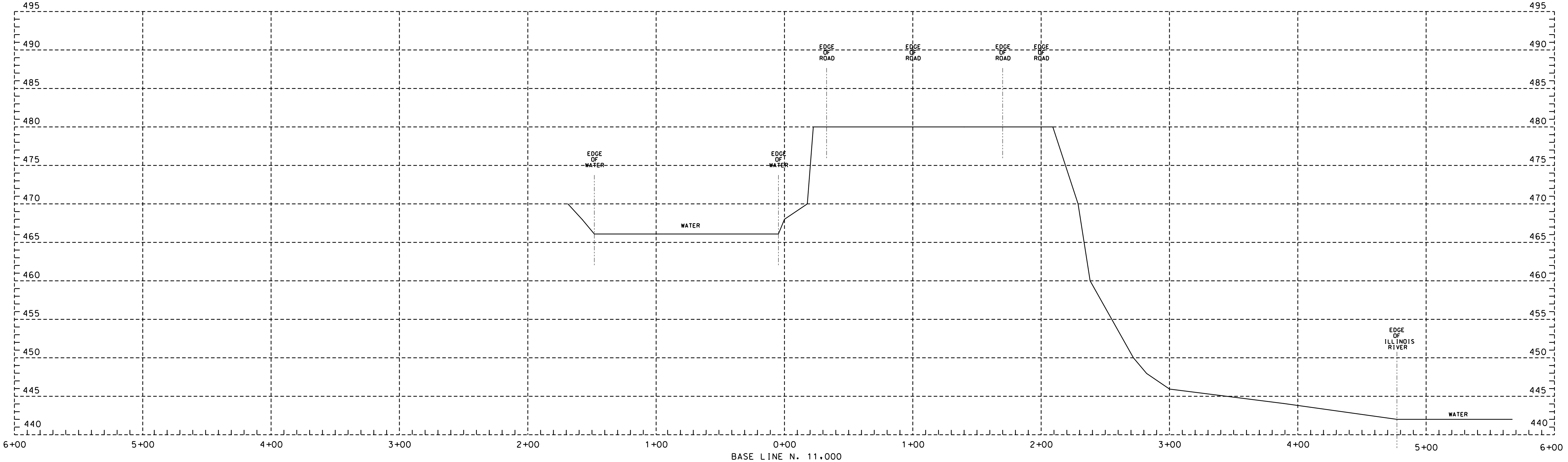
ILLINOIS POWER COMPANY
DECATUR

CROSS SECTIONS OF
ASH POND BERM EXTENSION
STA 61+50
HENNEPIN POWER STATION

DR GRH	CAD EM	DATE 12-30-87
OK	CKD	SCALE 1"=10'H,1"=5'V
APP APP	PLOTTED 11-4-97	E-HEN1-B457

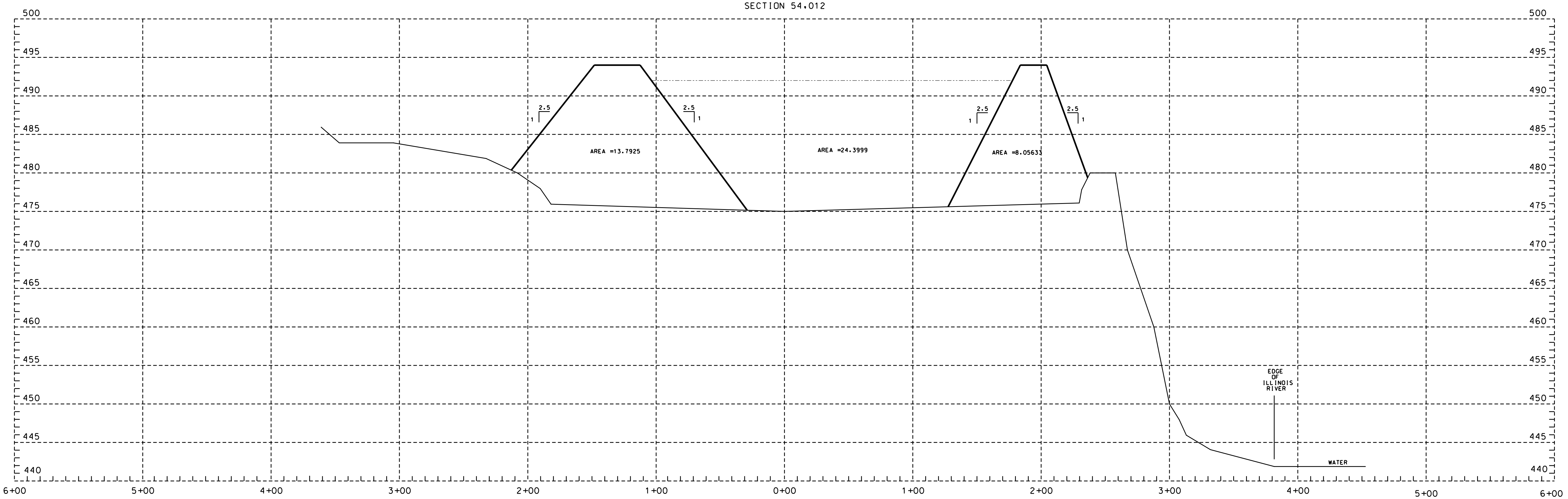
E-HEN1-B457

COMPUTER DWG. - DO NOT REVISE MANUALLY



BASE LINE N. 11,000

SECTION 54,012



BASE LINE N. 11,000

SECTION E. 53,812

NO	DATE	DRF	DESCRIPTION	E	C	A	NO	DATE	DRF	DESCRIPTION	E	C	A
0													

NOTES

1. DATA COLLECTED FROM TOPO ON DWG. CE-HEN1-B-450 DATED NOV. 4, 1987, REV. 0
2. COORDINATES WERE SUPPLIED BY G. DECKARD FIELD INFORMATION TIEING TO J.L. FISHER'S PANELS.

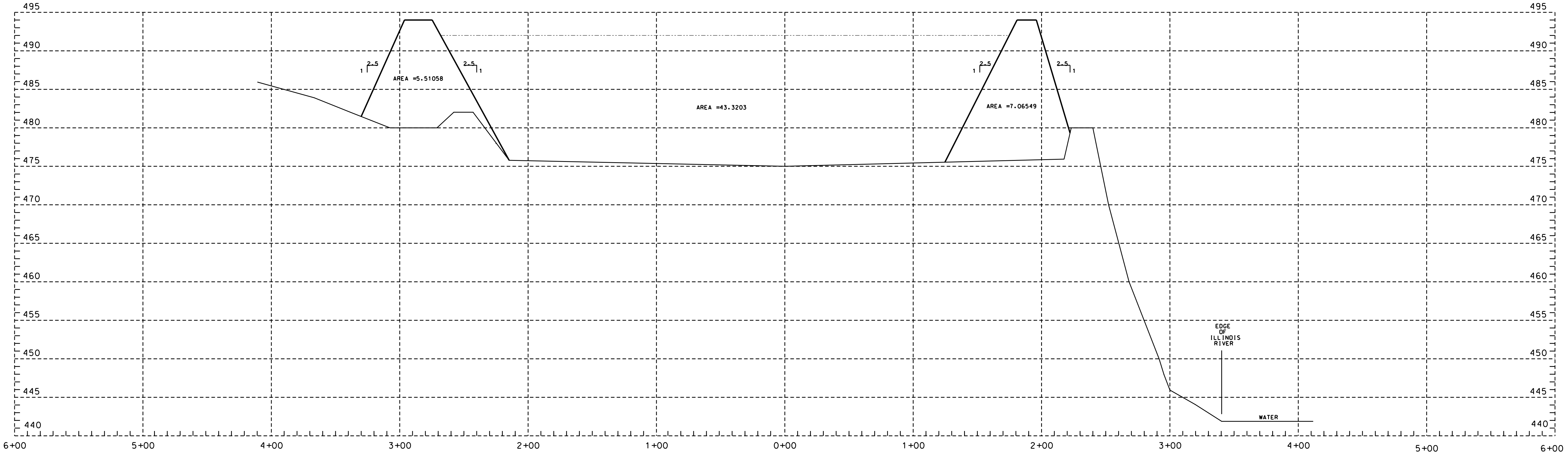
REFERENCES

REVISION STATUS
☐ -CONSTRUCTION
○ -RECORD
0

ILLINOIS POWER COMPANY
DECATUR

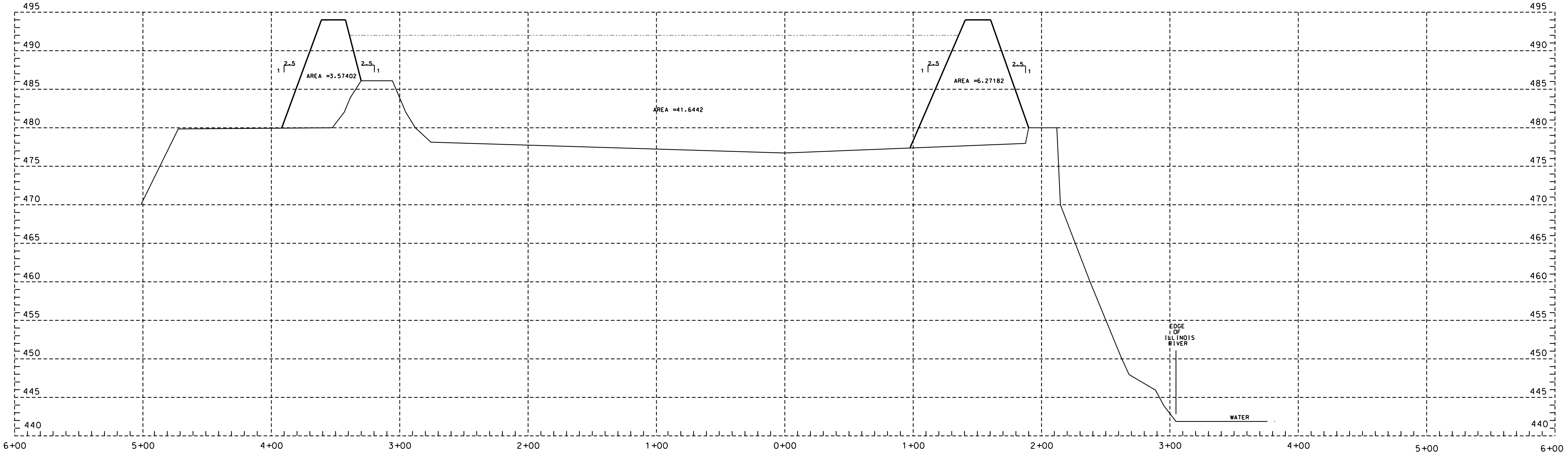
CROSS SECTIONS
EAST ASH POND EXTENSION
HENNEPIN POWER STATION

DR WJM	CAD WJM	DATE 1-11-89
OK	CKD	SCALE 1"=5' V. 1"=30' H.
APP	PLOTTED 03-08-90	CE-HEN1-B458-1
APP		



BASE LINE N. 11,000

SECTION E. 53.692



BASE LINE N. 11,000

SECTION E. 53.492

NO	DATE	DRF	DESCRIPTION	E	C	A	NO	DATE	DRF	DESCRIPTION	E	C	A
0													

NOTES

1. DATA COLLECTED FROM TOPO ON DWG. CE-HEN1-B-450 DATED NOV. 4, 1987, REV. 0
2. COORDINATES WERE SUPPLIED BY G. DECKARD FIELD INFORMATION TIEING TO J.L. FISHER'S PANELS.

REFERENCES

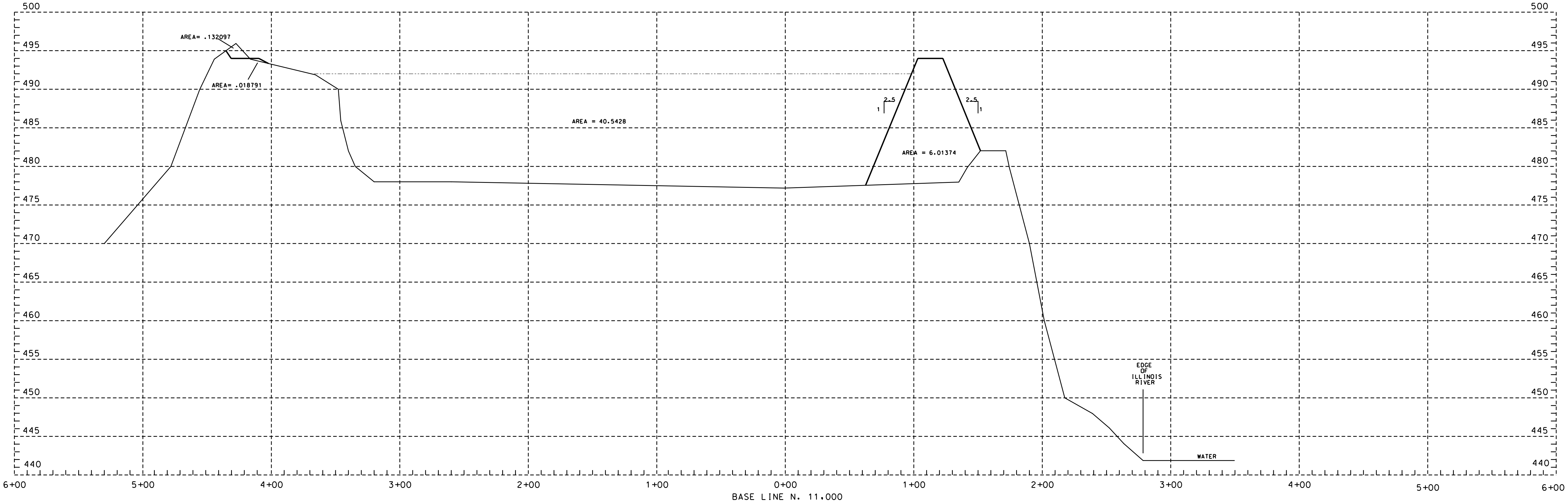
REVISION STATUS
□ -CONSTRUCTION
○ -RECORD
0

ILLINOIS POWER COMPANY

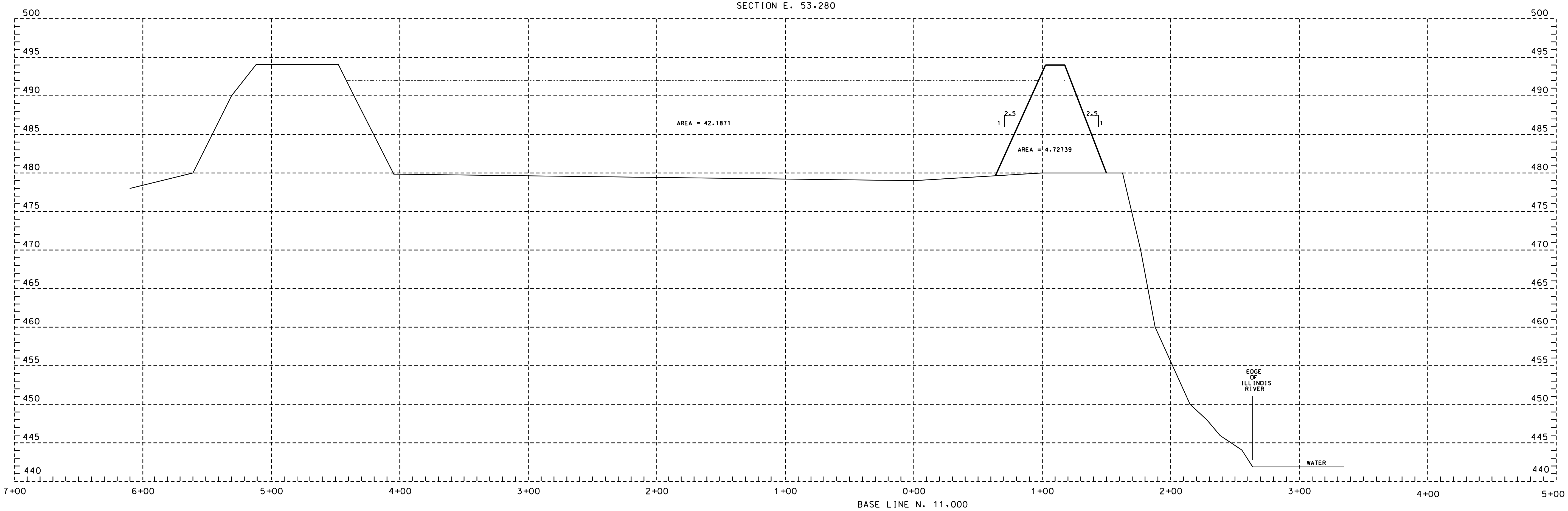
DECATUR

CROSS SECTIONS
EAST ASH POND EXTENSION
HENNEPIN POWER STATION

DR WJM	CAD WJM	DATE 1-12-89
DK	CKD	SCALE 1"=5' V. 1"=30' H.
APP	PLOTTED 03-08-90	CE-HEN1-B458-2
APP		



SECTION E. 53,280



SECTION E. 53,080

NO	DATE	DRF	DESCRIPTION	E	C	A	NO	DATE	DRF	DESCRIPTION	E	C	A
0													

NOTES

1. DATA COLLECTED FROM TOPO ON DWG. CE-HEN1-B-450 DATED NOV. 4, 1987, REV. 0
2. COORDINATES WERE SUPPLIED BY G. DECKARD FIELD INFORMATION TIEING TO J.L. FISHER'S PANELS.

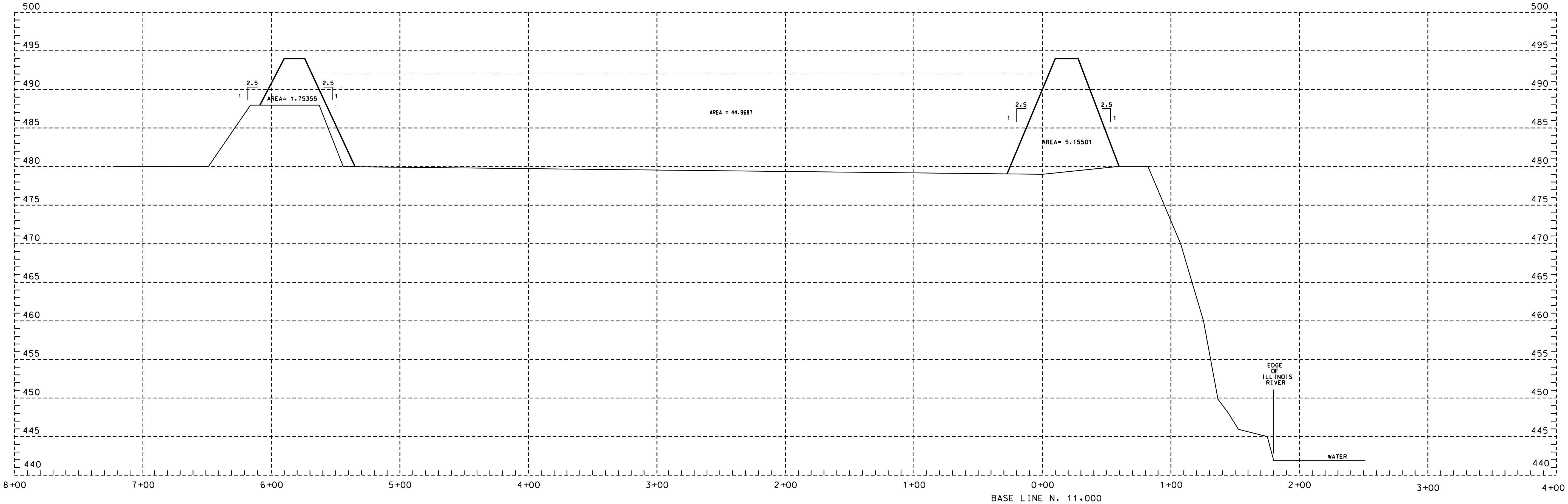
REFERENCES

REVISION STATUS
□ -CONSTRUCTION
○ -RECORD
0

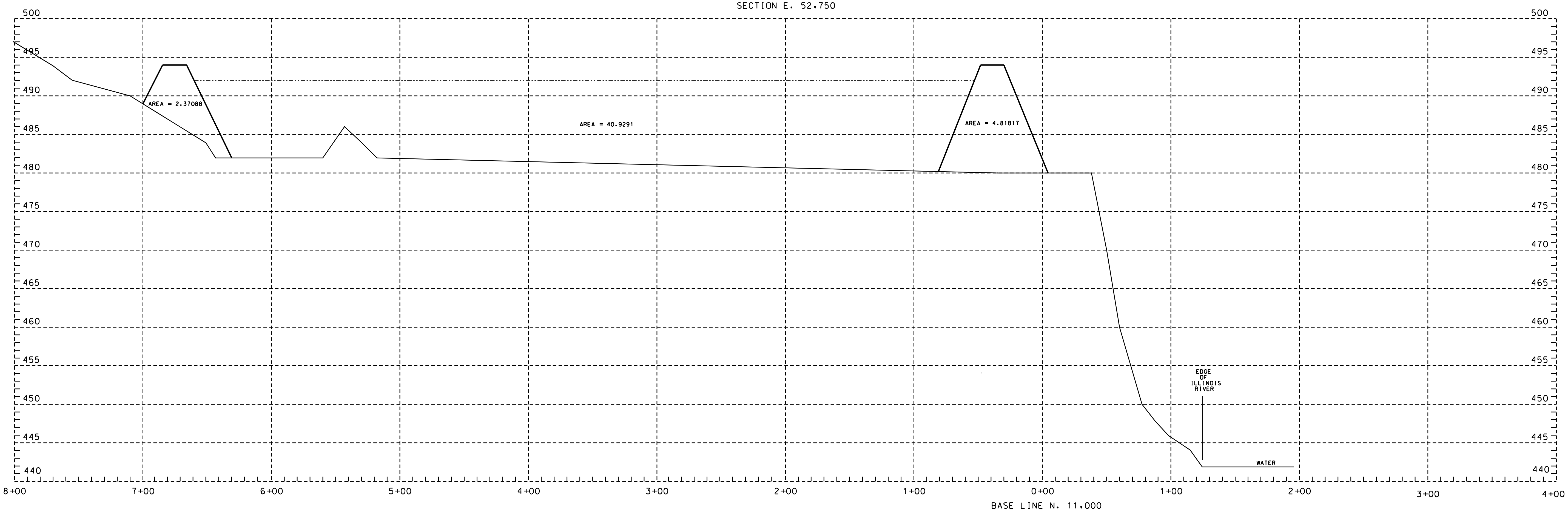
ILLINOIS POWER COMPANY
DECATUR

CROSS SECTIONS
EAST ASH POND EXTENSION
HENNEPIN POWER STATION

DR WJM	CAD WJM	DATE 1-12-89	
OK	CKD	SCALE 1"=5' V. 1"=30' H.	
APP	PLOTTED 03-08-90	CE-HEN1-B458-3	
APP			



SECTION E. 52.750



SECTION E. 52.448

NO	DATE	DRF	DESCRIPTION	E	C	A	NO	DATE	DRF	DESCRIPTION	E	C	A
0													

NOTES

1. DATA COLLECTED FROM TOPO ON DWG. CE-HEN1-B-450 DATED NOV. 4, 1987, REV. 0
2. COORDINATES WERE SUPPLIED BY G. DECKARD FIELD INFORMATION TIEING TO J.L. FISHER'S PANELS.

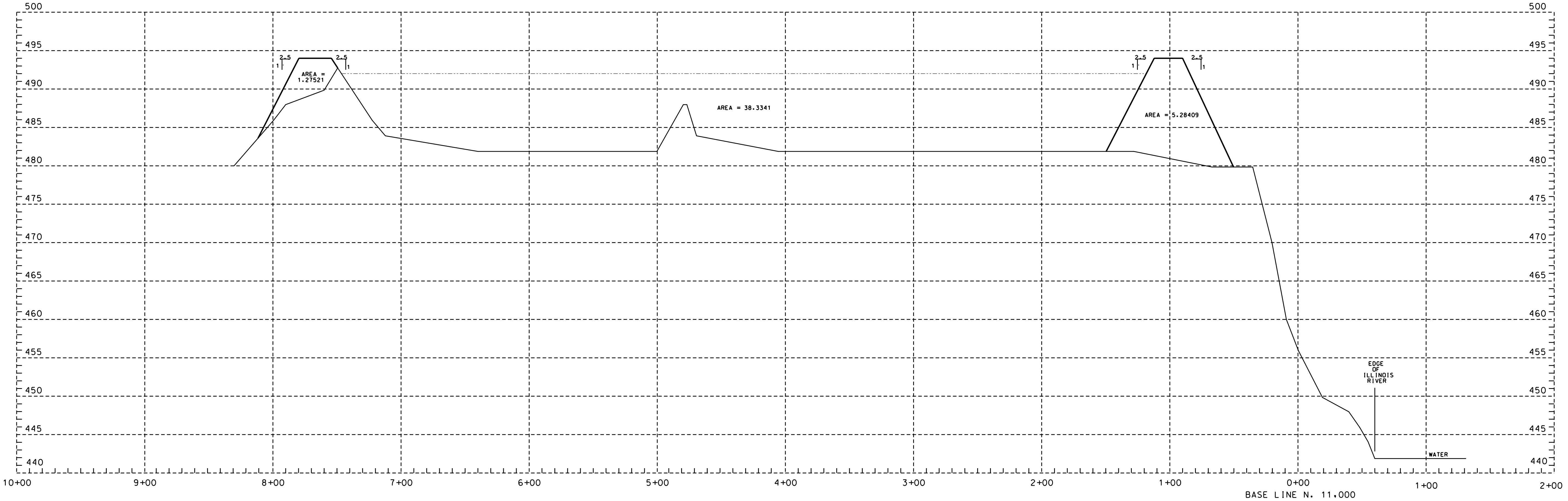
REFERENCES

REVISION STATUS
☐ -CONSTRUCTION
○ -RECORD
0

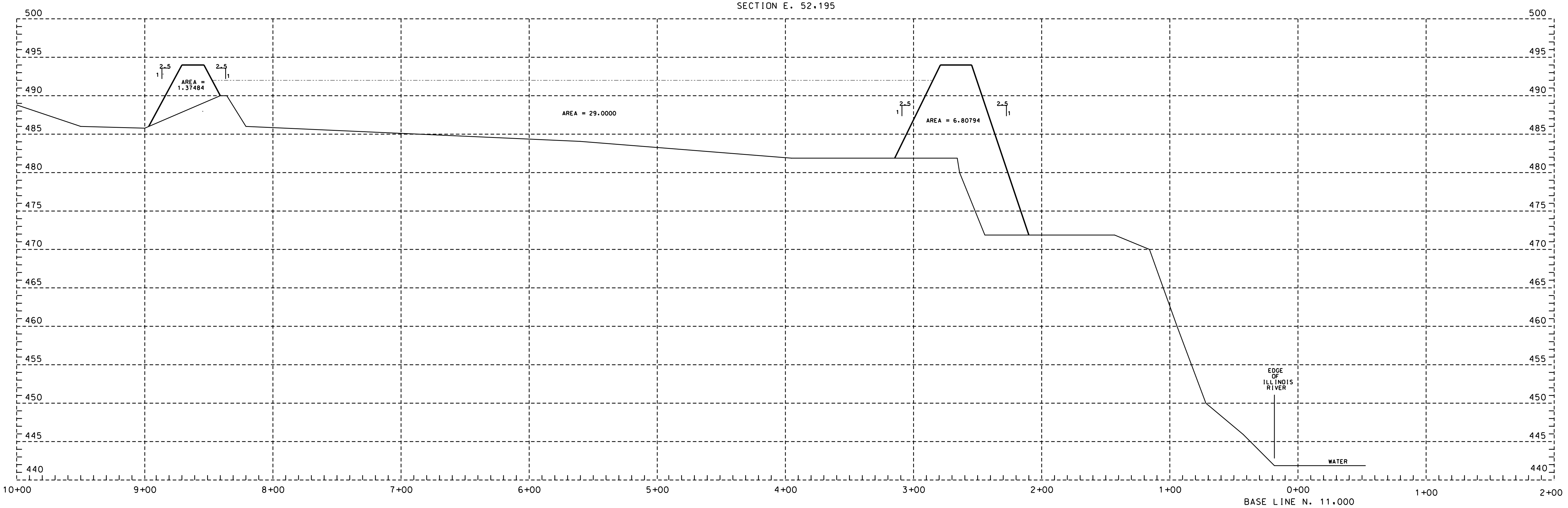
ILLINOIS POWER COMPANY
DECATUR

CROSS SECTIONS
EAST ASH POND EXTENSION
HENNEPIN POWER STATION

DR WJM
OK
APP
APP
CAD WJM
CKD
PLOTTED 03-08-90
DATE 1-12-89
SCALE 1"=5' V. 1"=30' H.
CE-HEN1-B458-4



SECTION E. 52,195



SECTION E. 51,920

NO	DATE	DRF	DESCRIPTION	E	C	A	NO	DATE	DRF	DESCRIPTION	E	C	A
0													

NOTES

1. DATA COLLECTED FROM TOPO ON DWG. CE-HEN1-B-450 DATED NOV. 4, 1987, REV. 0
2. COORDINATES WERE SUPPLIED BY G. DECKARD FIELD INFORMATION TIEING TO J.L. FISHER'S PANELS.

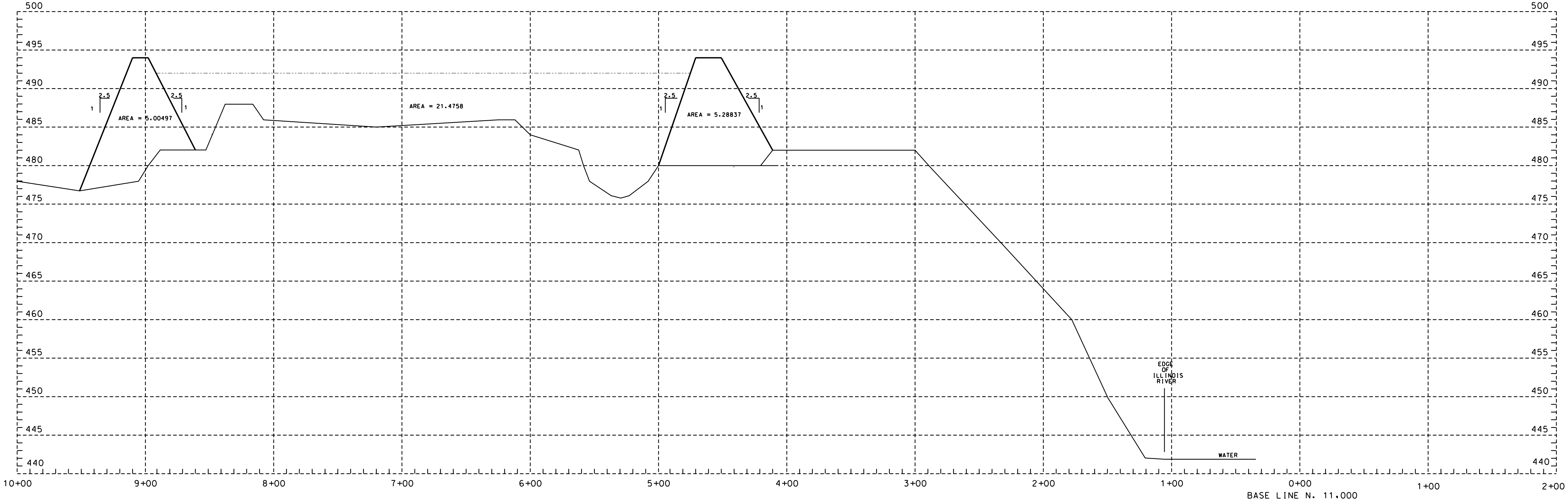
REFERENCES

REVISION STATUS
□ -CONSTRUCTION
○ -RECORD
0

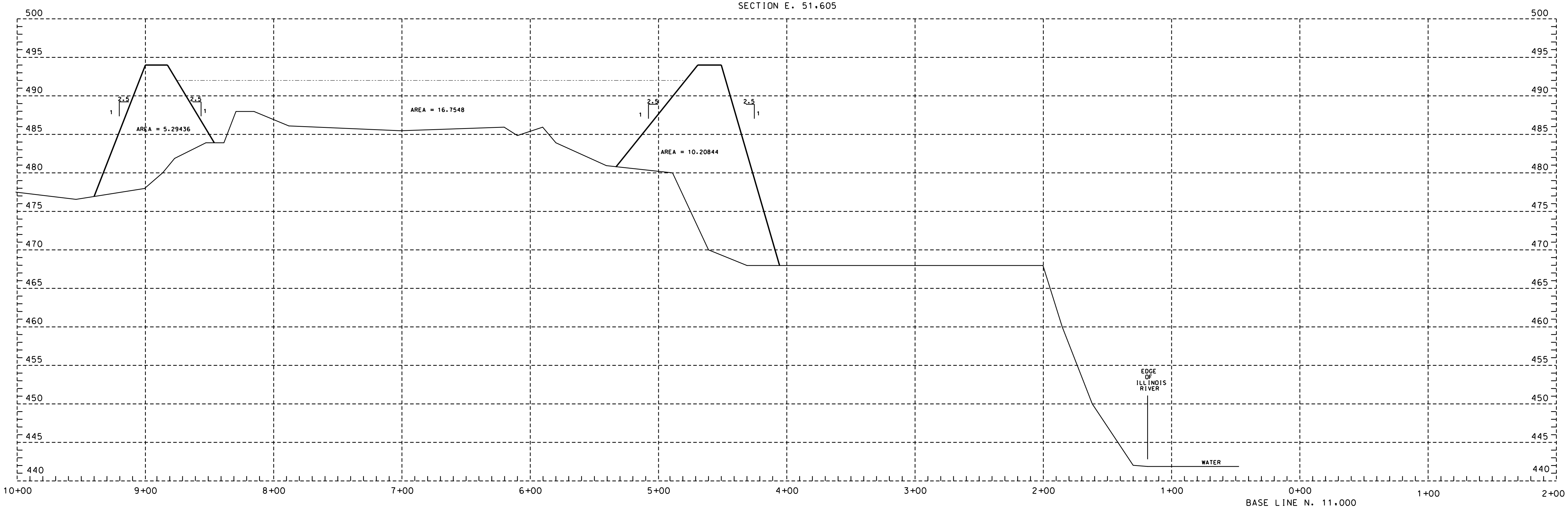
ILLINOIS POWER COMPANY
DECATUR

CROSS SECTIONS
EAST ASH POND EXTENSION
HENNEPIN POWER STATION

DR WJM
OK
APP
APP
CAD WJM
CKD
PLOTTED 03-08-90
DATE 1-12-89
SCALE 1"=5' V. 1"=30' H.
CE-HEN1-B458-5



SECTION E. 51.605



SECTION E. 51.552

NO	DATE	DRF	DESCRIPTION	E	C	A	NO	DATE	DRF	DESCRIPTION	E	C	A
0													

NOTES

1. DATA COLLECTED FROM TOPO ON DWG. CE-HEN1-B-450 DATED NOV. 4, 1987, REV. 0
2. COORDINATES WERE SUPPLIED BY G. DECKARD FIELD INFORMATION TIEING TO J.L. FISHER'S PANELS.

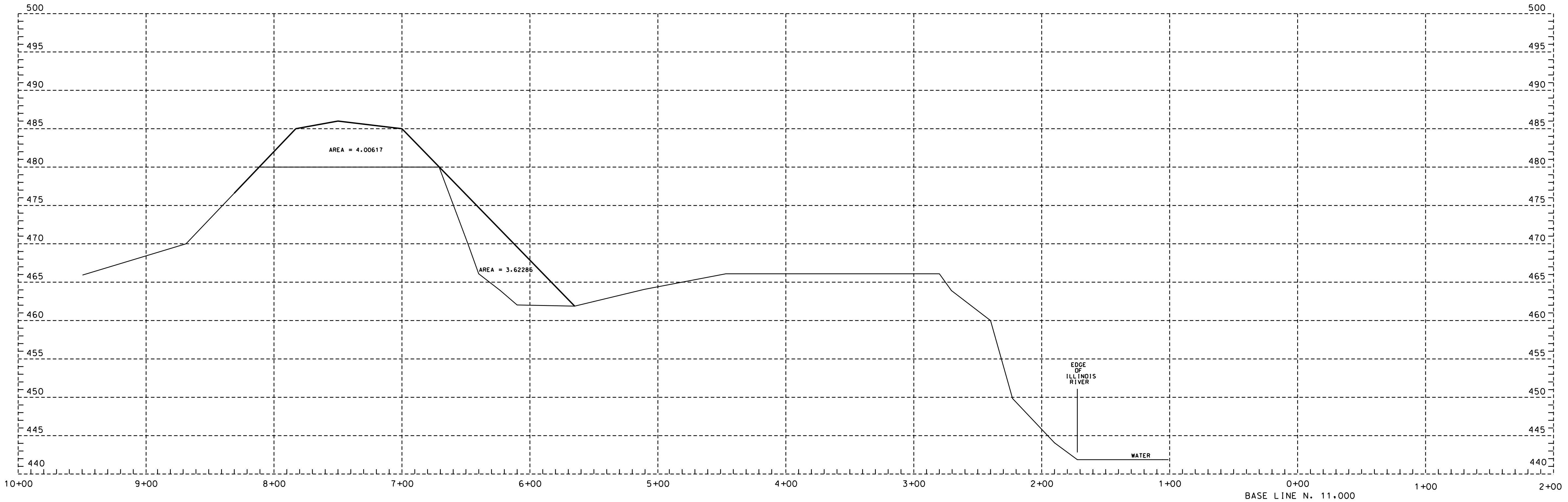
REFERENCES

REVISION STATUS
☐ -CONSTRUCTION
○ -RECORD
0

ILLINOIS POWER COMPANY
DECATUR

CROSS SECTIONS
EAST ASH POND EXTENSION
HENNEPIN POWER STATION

DR WJM	CAD WJM	DATE 1-12-89
OK	CKD	SCALE 1"=5' V. 1"=30' H.
APP	PLOTTED 03-08-90	CE-HEN1-B458-6
APP		



SECTION E. 51,285

NO	DATE	DRF	DESCRIPTION	E	C	A	NO	DATE	DRF	DESCRIPTION	E	C	A
0													

NOTES

1. DATA COLLECTED FROM TOPO ON DWG. CE-HEN1-B-450 DATED NOV. 4, 1987, REV. 0
2. COORDINATES WERE SUPPLIED BY G. DECKARD FIELD INFORMATION TIEING TO J.L. FISHER'S PANELS.

REFERENCES

REVISION STATUS
☐ -CONSTRUCTION
○ -RECORD
0

ILLINOIS POWER COMPANY
DECATUR

CROSS SECTIONS
EAST ASH POND EXTENSION
HENNEPIN POWER STATION

DR WJM	CAD WJM	DATE 1-12-89
OK	CKD	SCALE 1"=5' V. 1"=30' H.
APP	PLOTTED 03-08-90	CE-HEN1-B458-7
APP		

REVISIONS

REVISION STATUS
○ • CONSTRUCTION
○ • RECORD

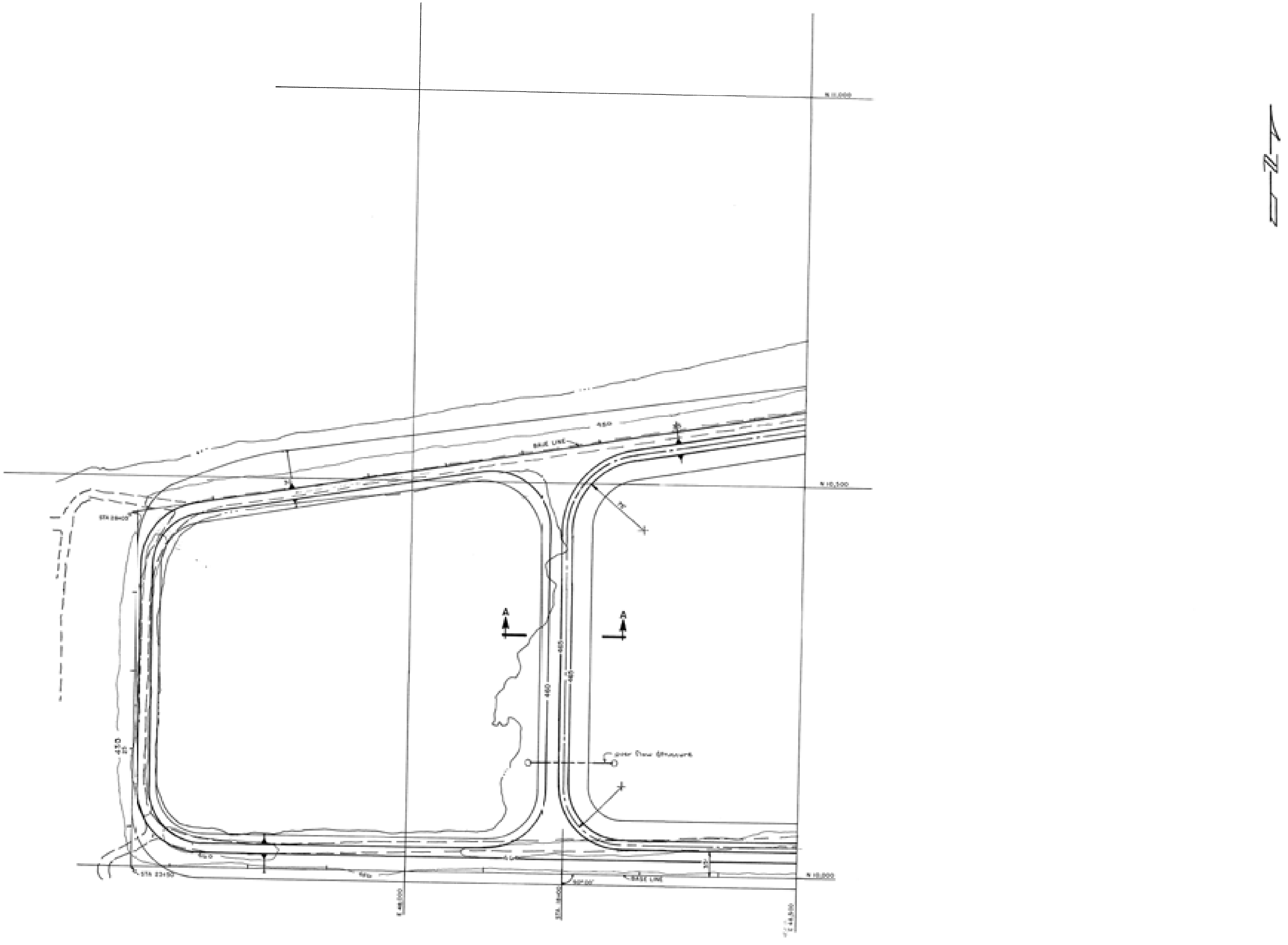
ILLINOIS POWER COMPANY
DECATUR

PLAN-UNIT#1 ASH POND EXTENSION
HENNEPIN POWER STATION
SHEET # 1

DR. C.R.H.
CK.
DATE 2-2-88
SCALE 1"=50'
APP.

E-HEN1-B460-1

PLATE NO. 1



REVISIONS

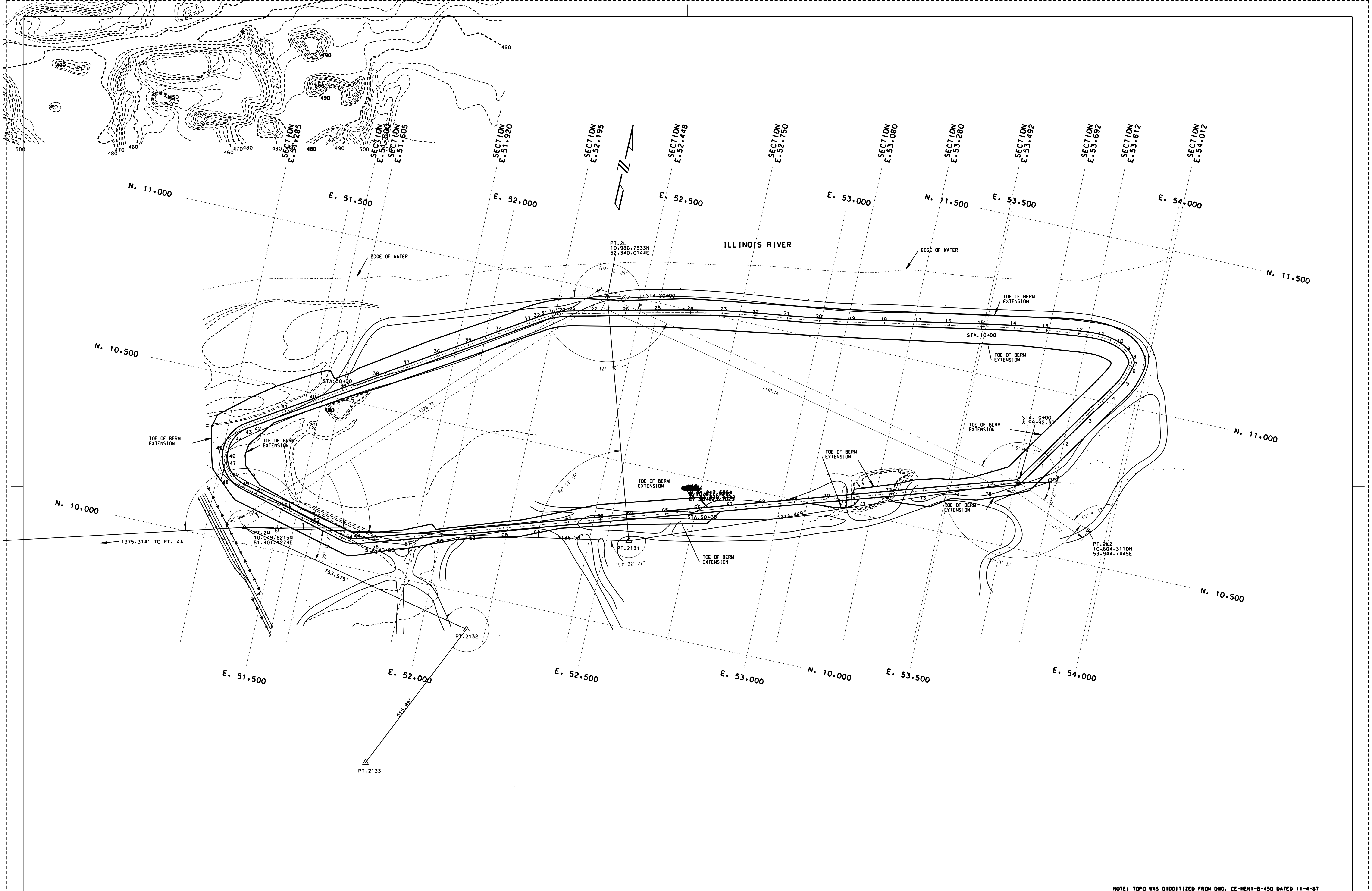
REVISION STATUS
O – CONSTRUCTION
O – RECORD

ILLINOIS POWER COMPANY
DECATUR

PLAN – UNIT#1 ASH POND EXTENSION
HENNEPIN POWER STATION
SHEET #2

DR. G.R.H.
CK. [illegible]
DATE 2-2-88
SCALE 1"=50'
E-HEN1-B460-2

PLATE NO. 1



NOTE: TOPO WAS DIDGITIZED FROM DWG. CE-HEN1-B-450 DATED 11-4-87

NO	DATE	DRF	DESCRIPTION	E	C	A	NO	DATE	DRF	DESCRIPTION	E	C	A
0													

NOTES

REFERENCES

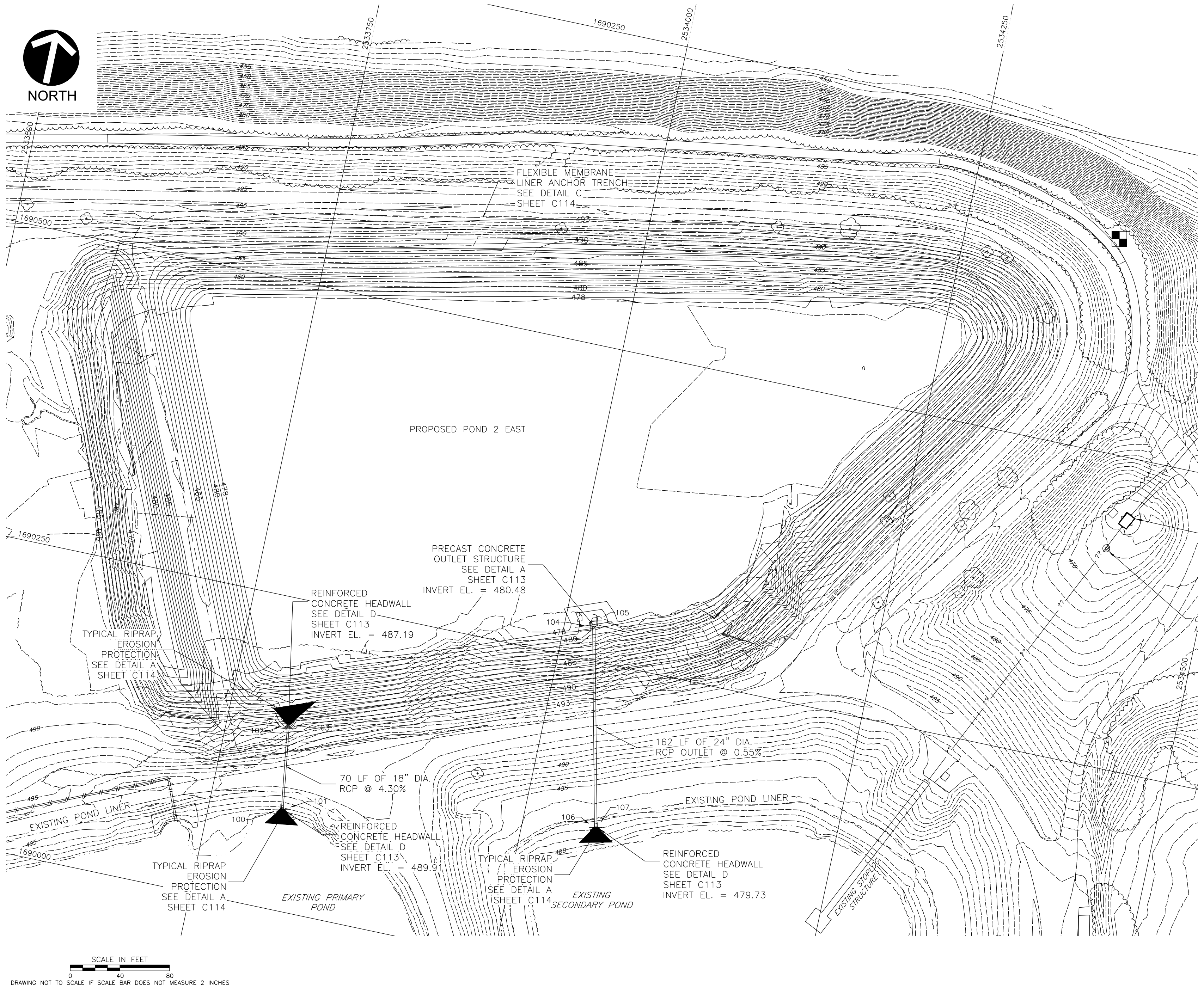
REVISION STATUS
□ -CONSTRUCTION
○ -RECORD
0

ILLINOIS POWER COMPANY
DECATUR

CONTOUR AND GRADING PLAN
UNIT #2 ASH POND EXTENSION
HENNEPIN POWER STATION

DR WJM	CAD WJM	DATE 1-11-89
OK	CKD	SCALE 1"=100"
APP	PLOTTED 03-08-90	CE-HEN1-B461
APP		

0V0.1.2.3.4.5



DRAWING NOT TO SCALE IF SCALE BAR DOES NOT MEASURE 2 INCHES

REFERENCE

1. TOPOGRAPHIC INFORMATION BASED UPON AERIAL SURVEY CONDUCTED BY SURDEX CORPORATION FLOWN ON OCTOBER 26, 2008.

STRUCTURE TABLE		
Point #	Northing	Easting
100	1690080.864	2533807.450
101	1690081.207	2533809.928
102	1690149.246	2533797.977
103	1690149.589	2533800.456
104	1690276.331	2534020.790
105	1690282.205	2534024.973
106	1690118.909	2534057.560
107	1690119.451	2534060.003

NOTE

THE LOCATION OF THE ABOVE AND BELOW GRADE STRUCTURES SHOWN ON THESE DRAWINGS ARE APPROXIMATE. PRIOR TO PERFORMING EXCAVATIONS, THE CONTRACTOR SHALL FIELD LOCATE STRUCTURES THAT MAY BE WITHIN THE LIMITS OF WORK AND PROTECT THEM ACCORDINGLY.

LEGEND

——495——	PROPOSED INDEX CONTOURS
——495——	PROPOSED INTERMEDIATE CONTOURS
— —495— —	EXISTING INDEX CONTOURS
- - -495- - -	EXISTING INTERMEDIATE CONTOURS
——??——	EXISTING STORM WATER DRAINS
— — — — —	EXISTING ACCESS ROAD

Civil & Environmental Consultants, Inc.
5910 Haper Road, Suite 106 - Solon, OH 44139
Ph: 330.310.6800 · 866.507.2324
www.cecinc.com

DYNEGY CONFIDENTIAL

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REFERENCE DRAWINGS

NO.	DATE	REVISION	BY	APPROVED	

NO.	DATE	REVISION	BY	APPROVED	
⓪	7/28/10	RECORD REVISION - 082-255	DFB	SFP	

SCALE: AS_NOTED

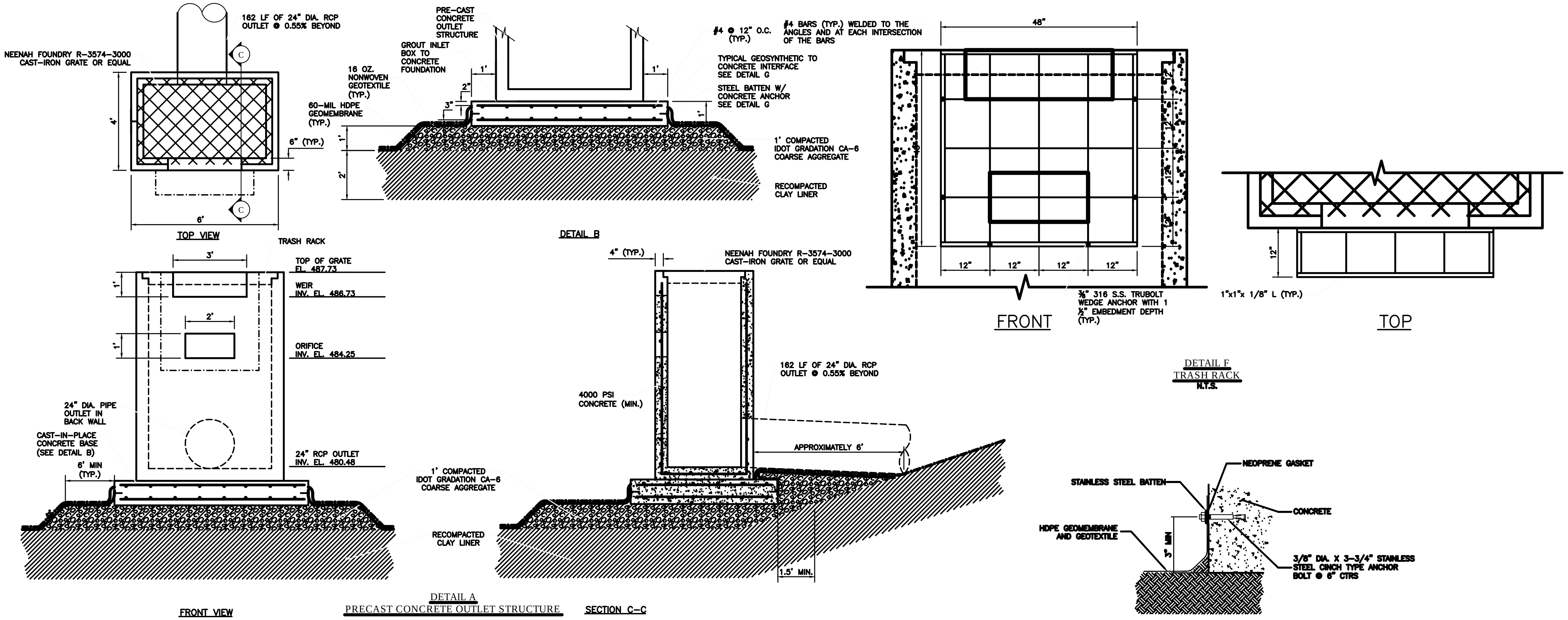
DWN. DFB	DATE 07/05/2010
CHK. RTM	DATE 07/12/2010
APPV. SFP	DATE 07/12/2010

DYNEGY

DYNEGY MIDWEST GENERATION, INC.
HENNEPIN POWER STATION
POND 2 EAST
FLEXIBLE MEMBRANE LINER AND STRUCTURES

PROJECT NO.: 082-255
CLIENT: DYNEGY
DWG. NO.: HEN1-C109
REV. ⓪

HENNEPIN HEN1-C109 DFB 07/05/2010



DETAIL A
PRECAST CONCRETE OUTLET STRUCTURE
N.T.S.

NOTES

1. REFER TO ILLINOIS DEPARTMENT OF TRANSPORTATION (IDOT) STANDARD FOR OUTLET REINFORING.

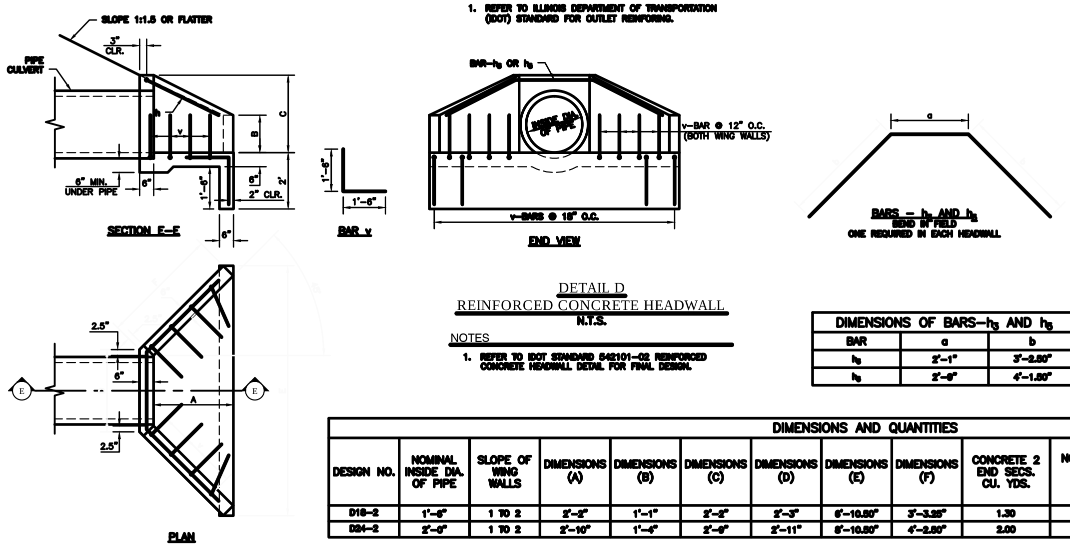
DETAIL F
TRASH RACK
N.T.S.

STEEL BATTEN W/ CONCRETE ANCHOR

DETAIL G
TYPICAL GEOSYNTHETIC TO CONCRETE INTERFACE
N.T.S.

NOTES

1. EARTH ADJACENT TO CONCRETE TO BE WELL CONPACTED TO PREVENT FUTURE DIFFERENTAL SETTLEMENT.
2. ALL CONCRETE COLLARS TO BE CHAMFERED A MINIMUM OF 1" (TYP.) @ ALL CORNERS IN CONTACT WITH LINER



DETAIL D
REINFORCED CONCRETE HEADWALL
N.T.S.

NOTES

1. REFER TO IDOT STANDARD 542101-02 REINFORCED CONCRETE HEADWALL DETAIL FOR FINAL DESIGN.

DIMENSIONS OF BARS-h_3 AND h_5		
BAR	a	b
h_3	2'-1"	3'-2.50"
h_5	2'-9"	4'-1.50"

DIMENSIONS AND QUANTITIES

DESIGN NO.	NOMINAL INSIDE DIA. OF PIPE	SLOPE OF WING WALLS	DIMENSIONS (A)	DIMENSIONS (B)	DIMENSIONS (C)	DIMENSIONS (D)	DIMENSIONS (E)	DIMENSIONS (F)	CONCRETE 2 END SECS. CU. YDS.	NO.4 REBAR h-BARS (BAR)	NO.4 REBAR h-BARS (LENGTH)	NO.4 REBAR v-BARS NO.	NO.4 REBAR TOTAL WT. 2 END SECS. LBS.
D18-2	1'-6"	1 TO 2	2'-2"	1'-1"	2'-2"	2'-3"	6'-10.50"	3'-3.25"	1.30	h_3	8'-6"	22	60
D24-2	2'-0"	1 TO 2	2'-10"	1'-4"	2'-9"	2'-11"	8'-10.50"	4'-2.50"	2.00	h_5	11'-0"	28	70

Civil & Environmental Consultants, Inc.
5910 Haper Road, Suite 106 - Solon, OH 44139
Ph: 330.310.6800 · 866.507.2324
www.cecinc.com

REFERENCE DRAWINGS

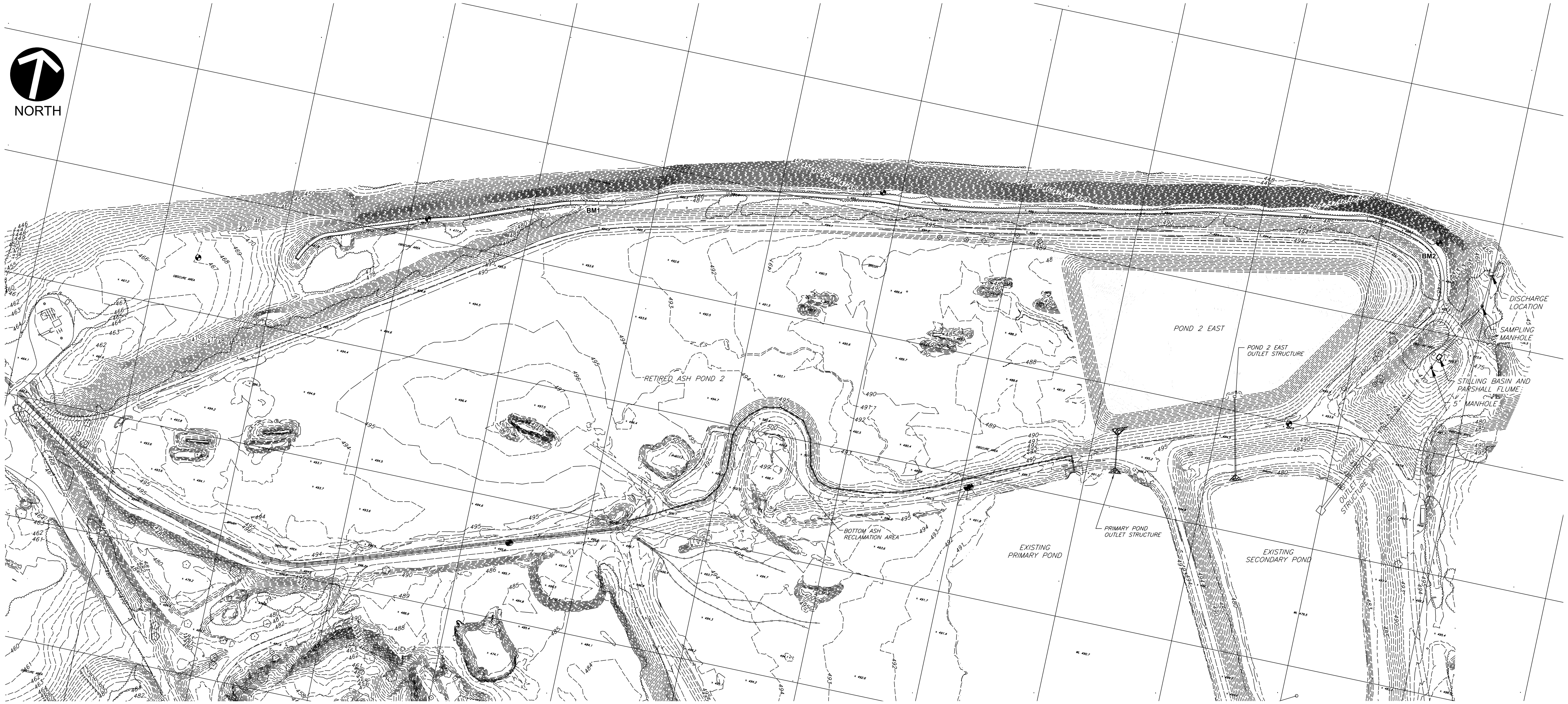
NO.	DATE	REVISION	BY	APPROVED	NO.	DATE	REVISION	BY	APPROVED
					⓪	7/28/10	RECORD REVISION - 082-255	DFB	SFP

SCALE: AS_NOTED
DWN. DFB DATE 07/05/2010
CHK. RTM DATE 07/12/2010
APPV. SFP DATE 07/12/2010

DYNEGY

DYNEGY MIDWEST GENERATION, INC.
HENNEPIN POWER STATION
POND 2 EAST
DETAILS

PROJECT NO.: 082-255
CLIENT: DYNEGY
DWG. NO.: HEN1-C113
REV. ⓪



BENCHMARK LOCATIONS			
NUMBER	NORTHING	EASTING	ELEVATION
1	1690395.43	2532618.60	482.19
2	1690670.86	2534372.87	484.00
3*	1689478.87	2534643.99	506.80
4*	1688458.82	2533256.76	499.45
5*	1688781.84	2531352.15	468.27
6*	1689875.08	2531310.12	463.75

* BENCHMARKS BEYOND DRAWING BOUNDARY.

SCALE IN FEET
0 100 200
DRAWING NOT TO SCALE IF SCALE BAR DOES NOT MEASURE 2 INCHES

REFERENCE:

1. TOPOGRAPHIC INFORMATION BASED UPON AERIAL SURVEY CONDUCTED BY SURDEX CORPORATION FLOWN ON SEPTEMBER 10, 2008.

   DUE TO CONSTRUCTION ACTIVITIES, ACTUAL FIELD TOPOGRAPHY MAY VARY.

2. POND 2 EAST CONTOURS FROM CONSTRUCTION DRAWINGS SUBMITTED AUGUST 2009.

LEGEND

——— ? ———	MISCELLANEOUS FLOW PIPING
——— ?? ———	EXISTING STORMWATER DRAINS
ỏỏỏỏỏỏỏỏỏ	EXISTING TREELINE
—‖—‖—‖—‖—	EXISTING PIPING
— — — — —	EXISTING ACCESS ROAD
—— · · · ——	EXISTING PONDS/STREAMS
——•——•——	EXISTING FENCE
▚	EXISTING BENCHMARK
—— -500- ——	EXISTING INDEX CONTOUR
– – – -499- – – –	EXISTING INTERMEDIATE CONTOUR
▨	EXISTING ROCK CHANNEL PROTECTION
◕	EXISTING MONITORING WELL

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REFERENCE DRAWINGS

NO.	DATE	REVISION	BY	APPROVED

NO.	DATE	REVISION	BY	APPROVED
⓪	11/28/10	RECORD REVISION - 082-255	DFB	SFP

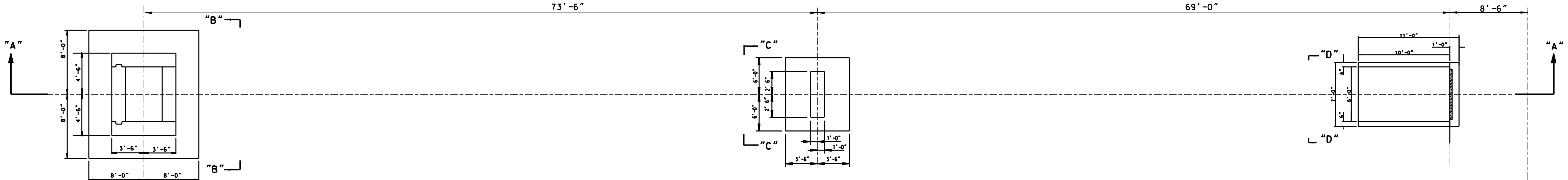
SCALE: AS_NOTED	
DWN. DFB	DATE 11/05/2010
CHK. RTM	DATE 11/12/2010
APPV. SFP	DATE 11/12/2010
EAPP_BY	EABD
FEAPP_BY	FEABD

DYNEGY

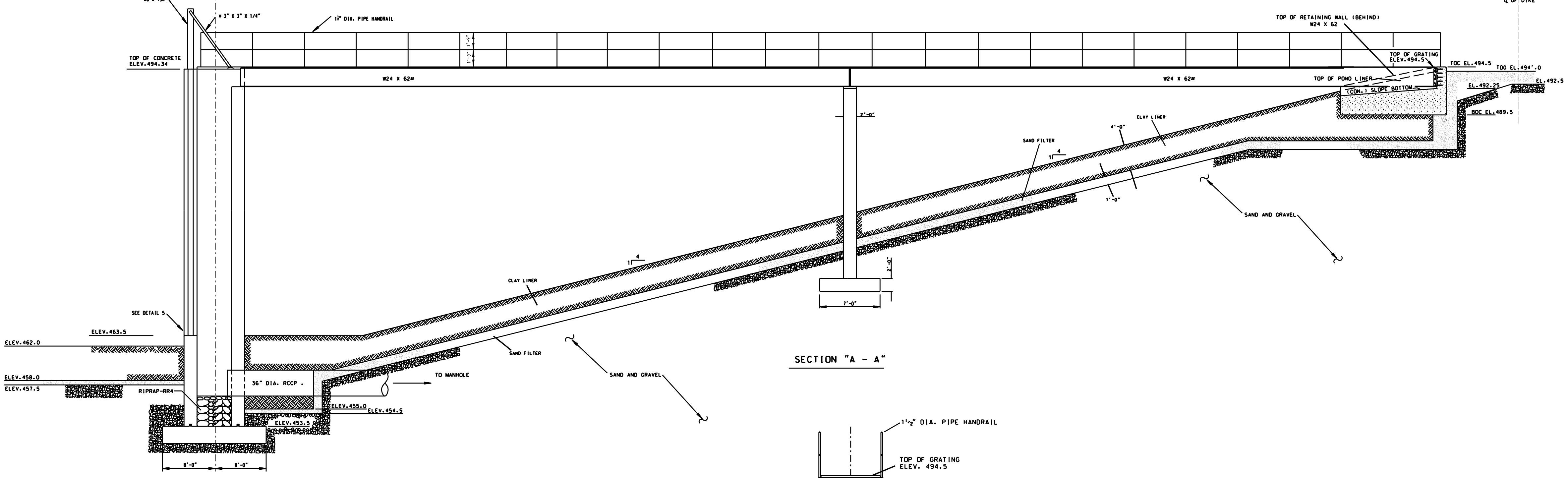
DYNEGY MIDWEST GENERATION, INC.
HENNEPIN POWER STATION
LANDFILL PHASE 1 CONSTRUCTION
EXISTING CONDITIONS

PROJECT NO.: 082-255
CLIENT: DYNEGY
DWG. NO.: HEN1-C117
REV. ⓪

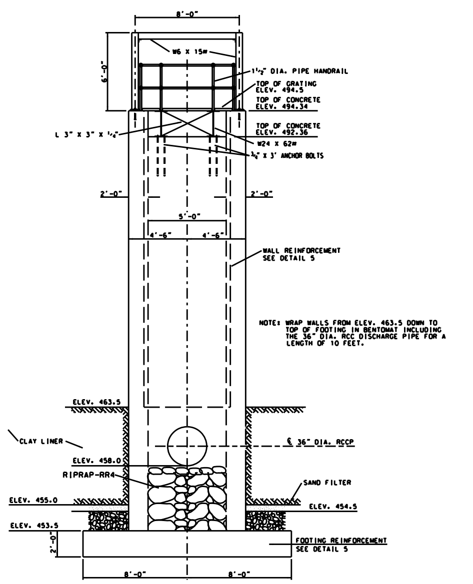
HENNEPIN
HEN1-C117
DFB
07/05/2010



FOUNDATION LAYOUT

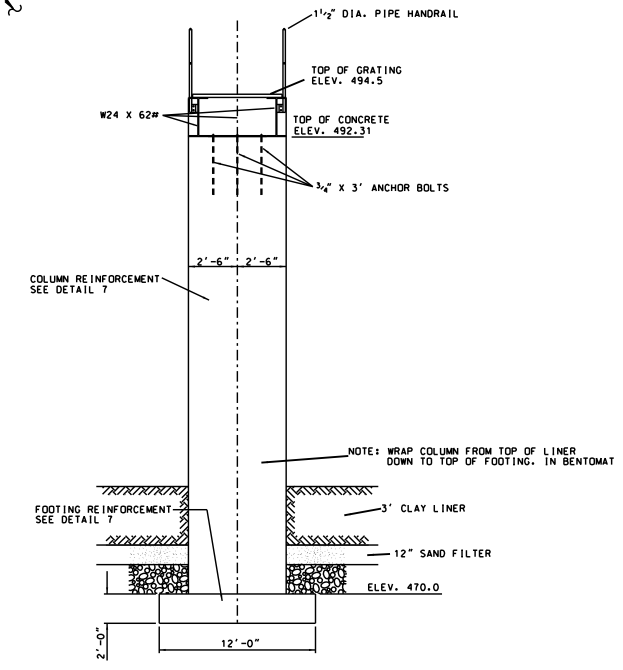


SECTION "A - A"



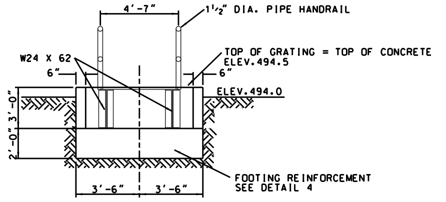
NOTE: WRAP WALLS FROM ELEV. 463.5 DOWN TO TOP OF FOOTING IN BENTOMAT INCLUDING THE 36" DIA. RCC DISCHARGE PIPE FOR A LENGTH OF 10 FEET.

SECTION "B"-"B"



NOTE: WRAP COLUMN FROM TOP OF LINER DOWN TO TOP OF FOOTING. IN BENTOMAT

SECTION "C"-"C"



SECTION "D"-"D"

NOTE: WRAP BOTTOM 2'-0" OF FOOTING IN BENTOMAT.

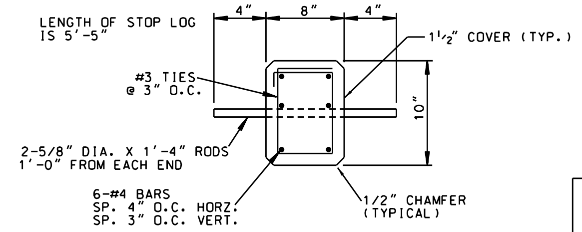
NO	DATE	DRF	DESCRIPTION	E	C	A	NO	DATE	DRF	DESCRIPTION	E	C	A
0													

REVISION STATUS
☐ -CONSTRUCTION
○ -RECORD
⓪
p0019275.dgn

ILLINOIS POWER COMPANY
DECATUR

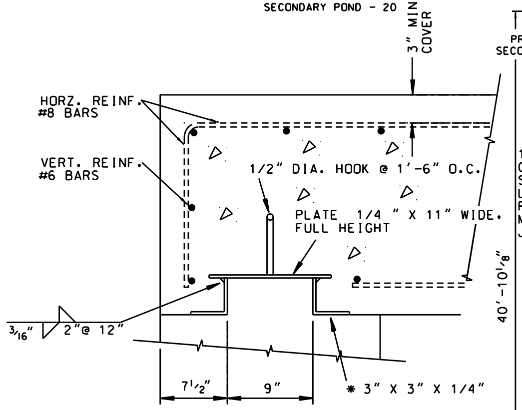
LAYOUT-POND DISCHARGE STRUCTURES
1995 ASH FACILITY
HENNEPIN POWER STATION

DR G.R.H.
CAD G.R.H.
DATE 1/5/94
OK
CKD
SCALE NO SCALE
APP
APP
PLOTTED 9/17/96
CE-HEN1-C8

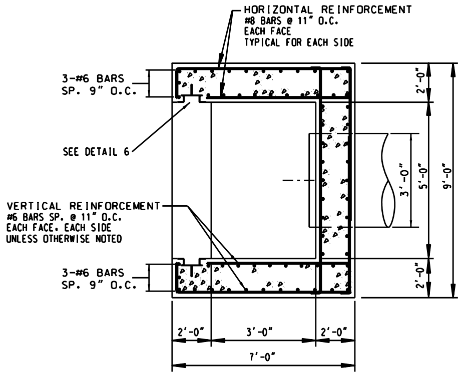


STOP LOG DETAIL

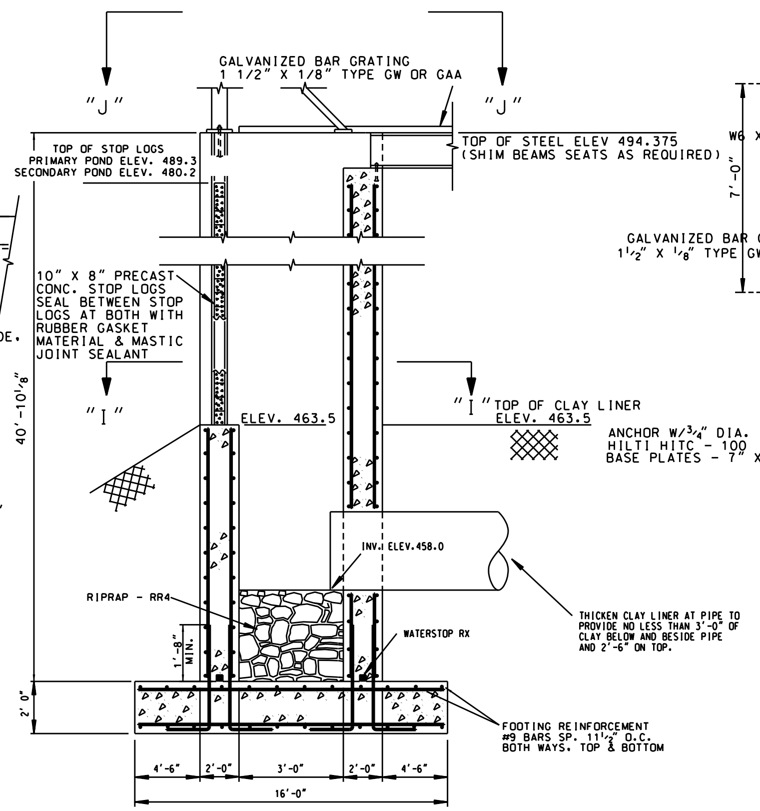
(51 REQUIRED INITIALLY, PROVIDE COMPANY WITH 10 EXTRA)
PRIMARY POND - 31
SECONDARY POND - 20



DETAIL 6



SECTION "I - I"



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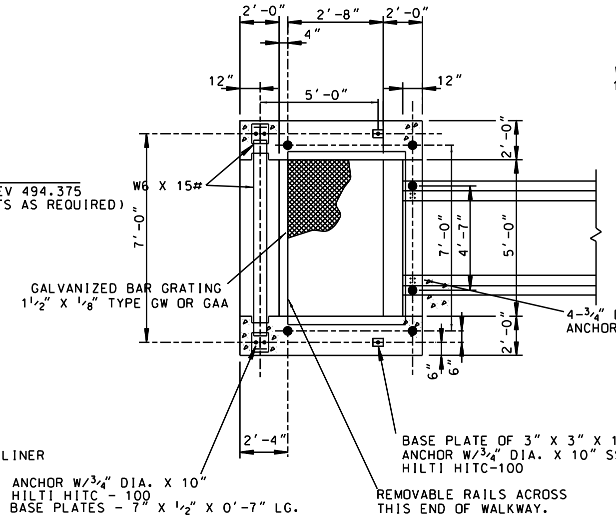
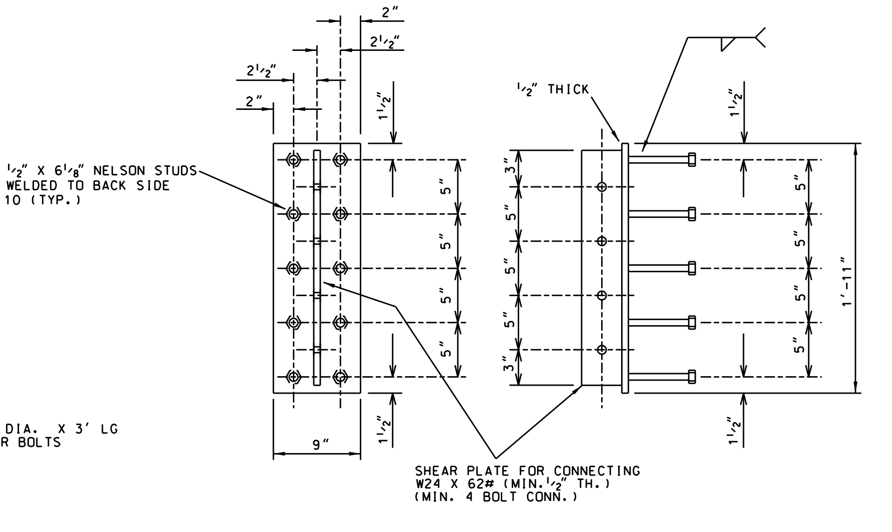
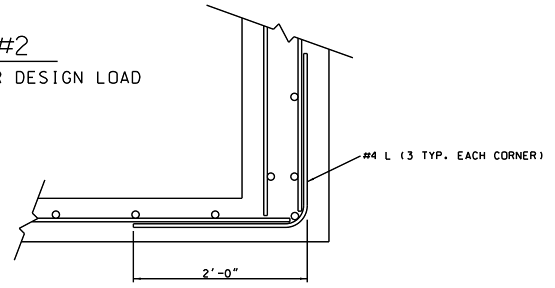


SECTION J-J



DETAIL #2

SEE CATWALK PLAN FOR DESIGN LOAD



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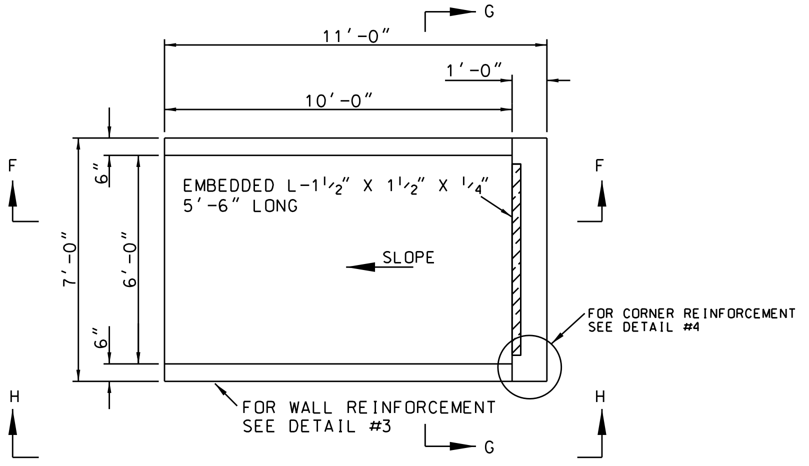
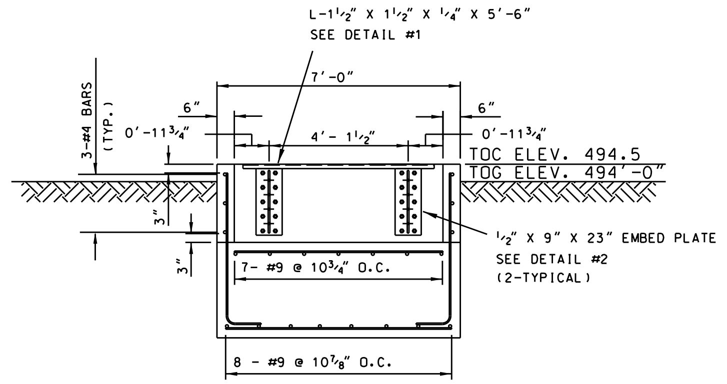


PLAN: CATWALK FOUNDATION



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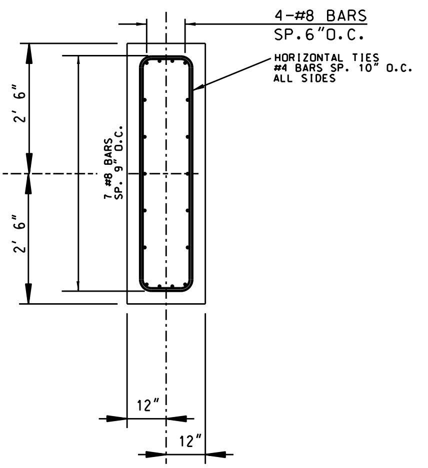

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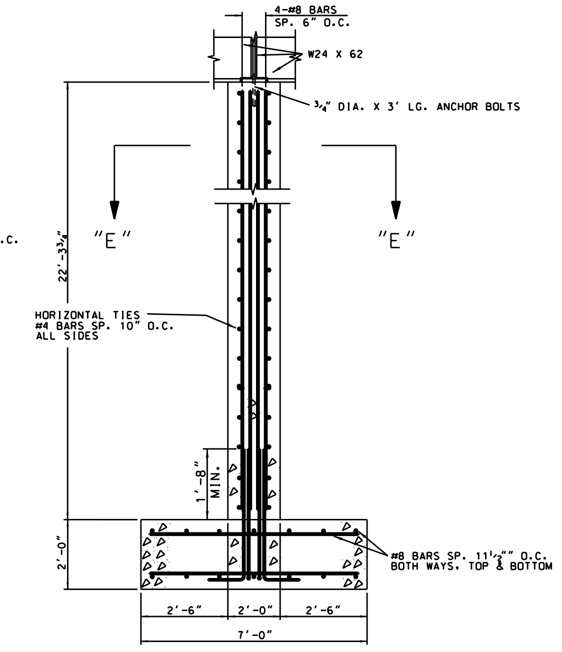
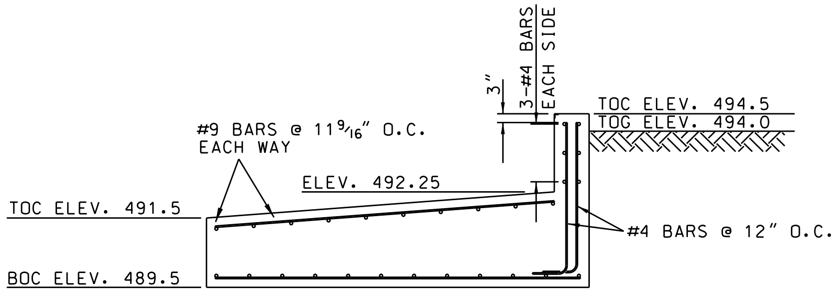


DETAIL 7



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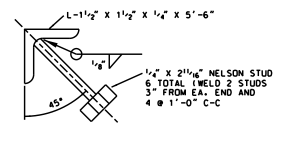
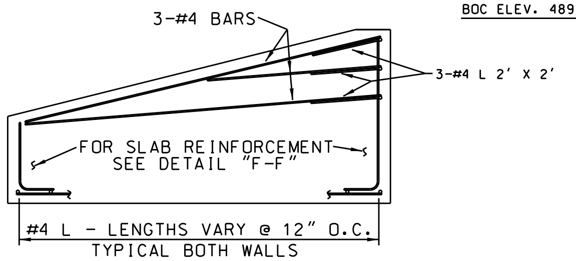
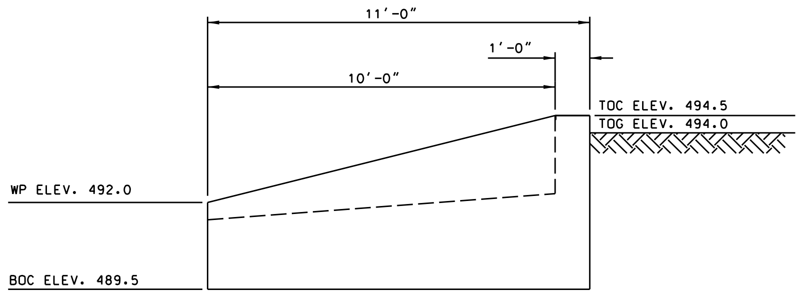


DETAIL #1



TYPICAL BOTH WALLS

DETAIL #3



SECTION "H-H"

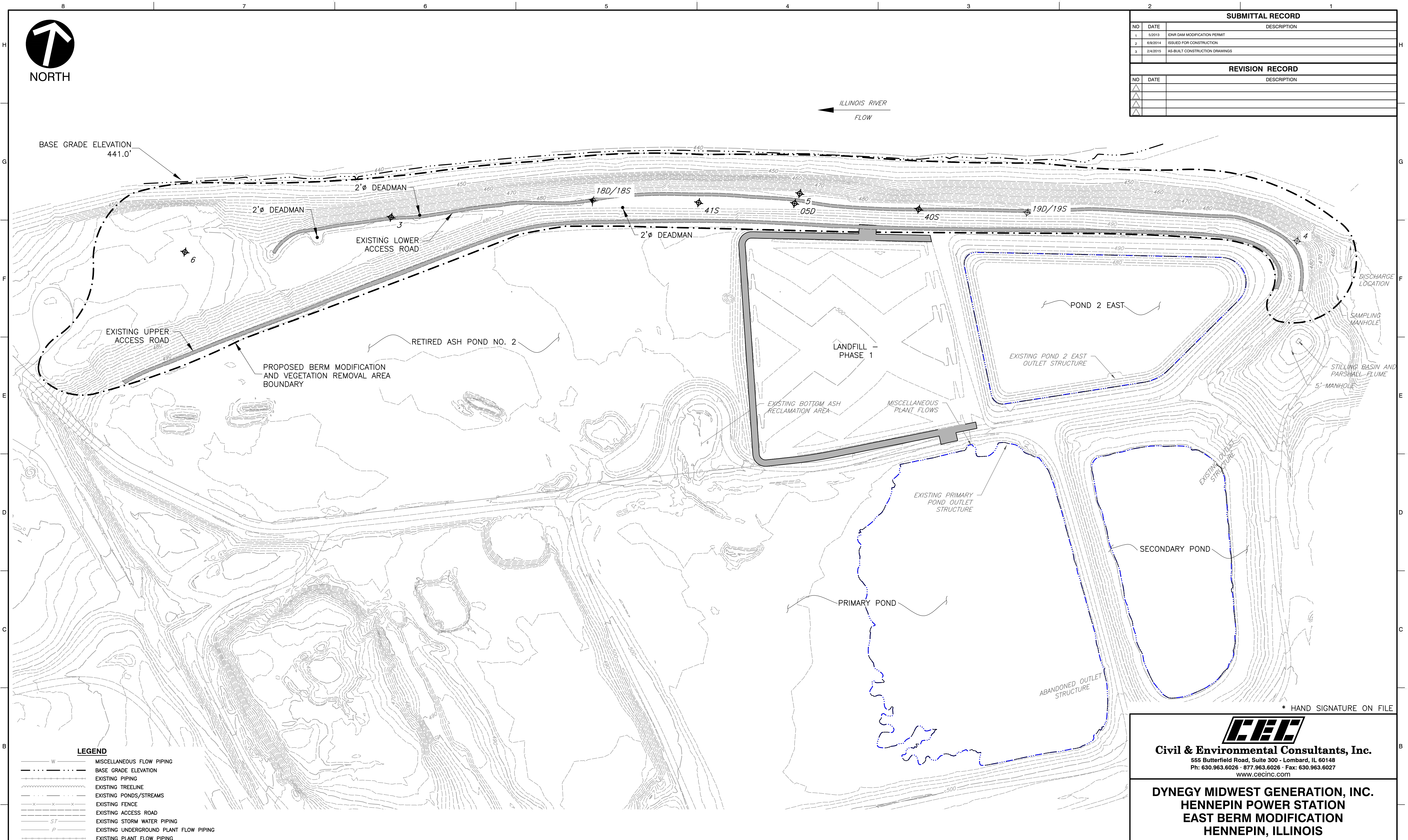
REVISION STATUS ☐ -CONSTRUCTION ○ -RECORD	ILLINOIS POWER COMPANY DECATUR	
⓪	DETAILS: POND DISCHARGE STRUCTURE 1995 ASH FACILITY HENNEPIN POWER STATION	
	DR G.R.H.	CAD G.R.H.	DATE 1/5/94
	OK	CKD	SCALE AS NOTED
p0019276.dgn	APP APP	PLOTTED 9/17/96	CE-HEN1-C9

SUBMITTAL RECORD

NO	DATE	DESCRIPTION
1	5/2013	IDNR DAM MODIFICATION PERMIT
2	6/9/2014	ISSUED FOR CONSTRUCTION
3	2/4/2015	AS-BUILT CONSTRUCTION DRAWINGS

REVISION RECORD

NO	DATE	DESCRIPTION
△		
△		
△		
△		



* HAND SIGNATURE ON FILE

LEGEND

——W——	MISCELLANEOUS FLOW PIPING
—·· —·· —	BASE GRADE ELEVATION
┼┼┼┼┼	EXISTING PIPING
︵︵︵︵	EXISTING TREELINE
— · · — · · —	EXISTING PONDS/STREAMS
—×—×—×—	EXISTING FENCE
– – – –	EXISTING ACCESS ROAD
——ST——	EXISTING STORM WATER PIPING
——P——	EXISTING UNDERGROUND PLANT FLOW PIPING
┼┼┼┼┼	EXISTING PLANT FLOW PIPING
— — 495 — —	EXISTING INDEX CONTOURS
- - - - - -	EXISTING INTERMEDIATE CONTOURS
⌖18D	EXISTING MONITORING WELL LOCATIONS
▨	EXISTING ACCESS ROAD
— · — · —	PROPOSED EAST BERM MODIFICATIONS AREA BOUNDARY

REFERENCE:

1. TOPOGRAPHIC INFORMATION BASED UPON AERIAL SURVEY CONDUCTED BY SURDEX CORPORATION FLOWN ON SEPTEMBER 10, 2008.
2. EMBANKMENT AREA SURVEY RECEIVED BY CEC FROM DLZ ON MARCH 4, 2013 AND JANUARY 10, 2014.
3. IL DNR PERMIT NO. DS2014017–DAM I.D. NO. 50663
4. AS–BUILT SURVEY RECEIVED BY CEC FROM DLZ, DECEMBER 12, 2014.

AS-BUILT CONSTRUCTION PLANS

SCALE IN FEET
0 100 200

Civil & Environmental Consultants, Inc.
555 Butterfield Road, Suite 300 - Lombard, IL 60148
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www.cecinc.com

DYNEGY MIDWEST GENERATION, INC.
HENNEPIN POWER STATION
EAST BERM MODIFICATION
HENNEPIN, ILLINOIS

DRAWN BY:	DFB	CHECKED BY:	MDJ	APPROVED BY:	*MDJ
DATE:	FEBRUARY 2015	DWG SCALE:	AS NOTED	PROJECT NO:	132-650

EXISTING SITE CONDITIONS PLAN

DRAWING NO.: **3**
SHEET 3 OF 9

p:\2013\132-650.0200\-CADD\Dwg\CV02\132650-CV02-C100-Existing Conditions.dwg{EXISTING SITE CONDITIONS PLAN} LS:(2/11/2015 - thootman) - LP: 2/17/2015 10:43 AM

SUBMITTAL RECORD

NO	DATE	DESCRIPTION
1	5/2013	IDNR DAM MODIFICATION PERMIT
2	2/2014	ISSUED FOR CONSTRUCTION
3	2/4/2015	AS-BUILT CONSTRUCTION DRAWINGS

REVISION RECORD

NO	DATE	DESCRIPTION
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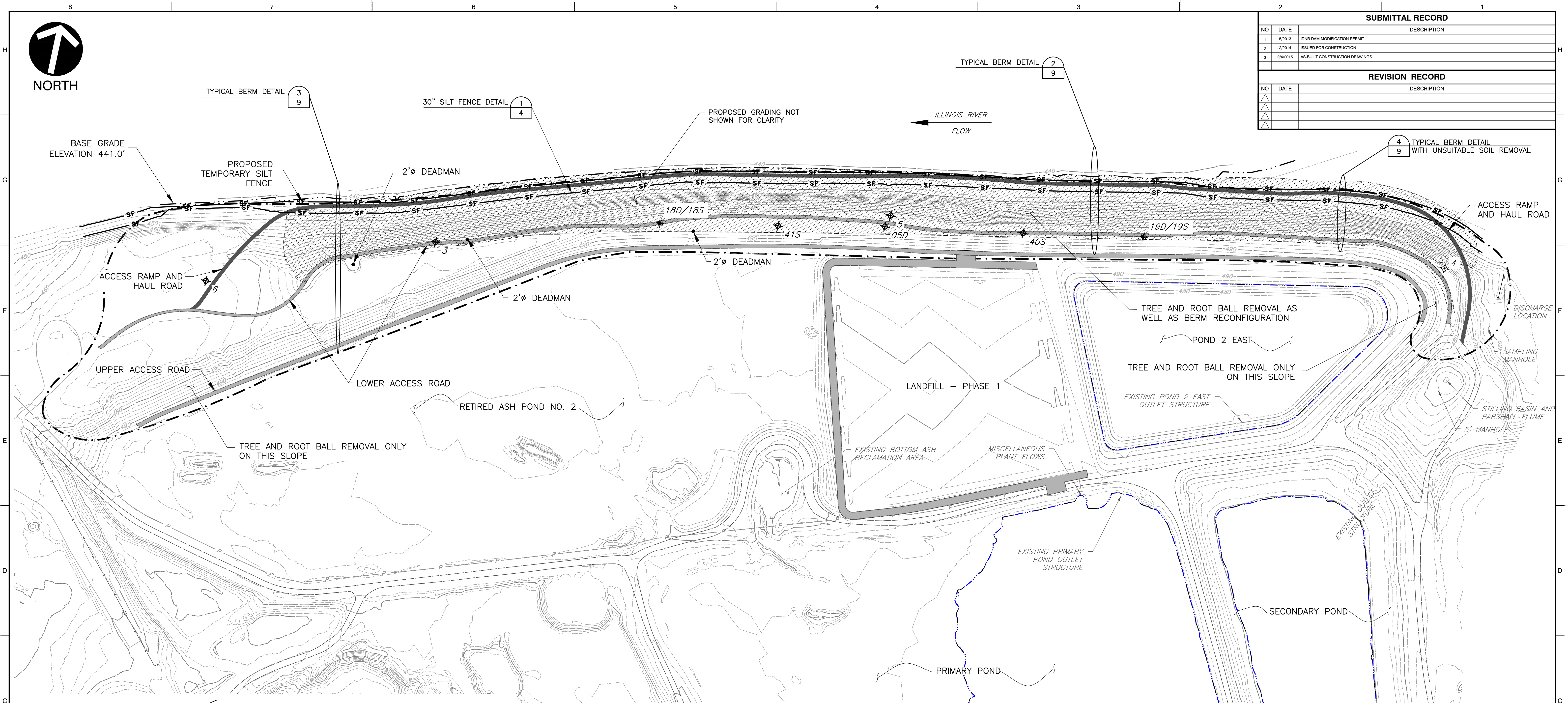
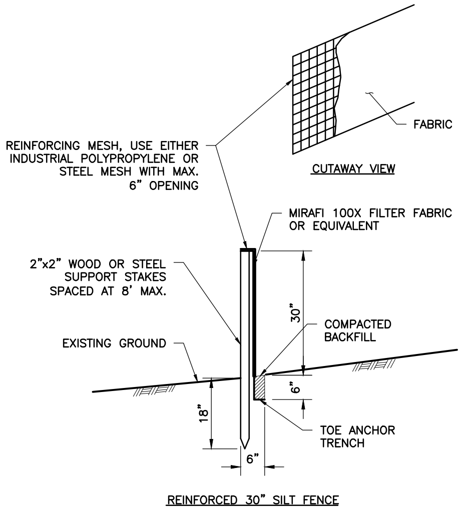


SITE PLAN
SCALE: 1" = 100'



DETAIL 1
30" SILT FENCE DETAIL
N.T.S.

SILT FENCE NOTES:

1. SILT FENCE SHALL BE PLACED ON LEVEL GRADE, WHERE POSSIBLE, AND BOTH ENDS OF THE SILT FENCE SHALL BE EXTENDED UP THE SLOPE.
2. SILT FENCE SHALL NOT BE PLACED IN ANY AREA OF CONCENTRATED FLOW NOR IN AREAS WHERE ROCK OR ROCKY SOILS PREVENT THE FULL AND UNIFORM ANCHORING OF THE FENCE TOE.
3. THE CONTRACTOR SHALL INSPECT THE SILT FENCE AFTER EVERY PRECIPITATION EVENT AND IMMEDIATELY REPAIR ANY DEFICIENCIES.
4. THE CONTRACTOR SHALL REMOVE ACCUMULATED SEDIMENTS AS REQUIRED TO KEEP THE FENCE FUNCTIONAL. IN ALL CASES, THE CONTRACTOR SHALL REMOVE DEPOSITS WHERE ACCUMULATIONS REACH ONE–HALF THE ABOVE GROUND HEIGHT OF THE FENCE.
5. THE CONTRACTOR SHALL IMMEDIATELY REPAIR ALL UNDERCUTTING OR EROSION OF THE ANCHOR TOE WITH A ROCK FILTER OUTLET.
6. THE CONTRACTOR SHALL CONFORM TO ANY RECOMMENDATIONS BY THE MANUFACTURER FOR REPLACING FILTER FABRIC FENCE DUE TO WEATHERING.

LEGEND

—— W ——	MISCELLANEOUS FLOW PIPING
— · · · — · · · —	BASE GRADE ELEVATION
	EXISTING PIPING
	EXISTING TREELINE
— · · · — · · · —	EXISTING PONDS/STREAMS
—×—×—×—	EXISTING FENCE
▨	EXISTING ACCESS ROAD
—— ST ——	EXISTING STORM WATER PIPING
—— P ——	EXISTING UNDERGROUND PLANT FLOW PIPING
	EXISTING PLANT FLOW PIPING
495	EXISTING INDEX CONTOURS
- - - - -	EXISTING INTERMEDIATE CONTOURS
⌖18D	EXISTING MONITORING WELL LOCATIONS
■	PROPOSED CONSTRUCTION ACCESS ROAD
— · — · —	PROPOSED EAST BERM MODIFICATIONS AREA BOUNDARY
—— SF ——	PROPOSED SILT FENCE
▨	PROPOSED GRADING LIMITS

AS-BUILT CONSTRUCTION PLANS

NOTE:
MONITORING WELLS EXIST WITHIN THE PROPOSED BERM MODIFICATION AREA. CONTRACTOR SHALL PROTECT EXISTING MONITORING WELLS WHILE PERFORMING BERM MODIFICATION ACTIVITIES.

REFERENCE:

1. TOPOGRAPHIC INFORMATION BASED UPON AERIAL SURVEY CONDUCTED BY SURDEX CORPORATION FLOWN ON SEPTEMBER 10, 2008.
2. EMBANKMENT AREA SURVEY RECEIVED BY CEC FROM DLZ ON MARCH 4, 2013 AND JANUARY 10, 2014.
3. IL DNR PERMIT NO. DS2014017–DAM I.D. NO. 50663
4. AS–BUILT SURVEY RECEIVED BY CEC FROM DLZ, DECEMBER 12, 2014.

SCALE IN FEET
0 100 200

* HAND SIGNATURE ON FILE

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Civil & Environmental Consultants, Inc.
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Ph: 630.963.6026 · 877.963.6026 · Fax: 630.963.6027
www.cecinc.com

DYNEGY MIDWEST GENERATION, INC.
HENNEPIN POWER STATION
EAST BERM MODIFICATION
HENNEPIN, ILLINOIS

DRAWN BY:	DFB	CHECKED BY:	MDJ	APPROVED BY:	*MDJ
DATE:	FEBRUARY 2015	DWG SCALE:	AS NOTED	PROJECT NO:	132-650

PROPOSED SITE PLAN

DRAWING NO.: **4**
SHEET 4 OF 9

p:\2013\132–650.0200\–CADD\Dwg\CV02\132650–CV02–C200–Construction Conditions.dwg{PROPOSED SITE PLAN} LS:(2/11/2015 – thootman) – LP: 2/17/2015 10:43 AM

NO	DATE	DESCRIPTION
SUBMITTAL RECORD		
1	5/2013	IDNR DAM MODIFICATION PERMIT
2	6/9/2014	ISSUED FOR CONSTRUCTION
3	2/4/2015	AS-BUILT CONSTRUCTION DRAWINGS

NO	DATE	DESCRIPTION
REVISION RECORD		
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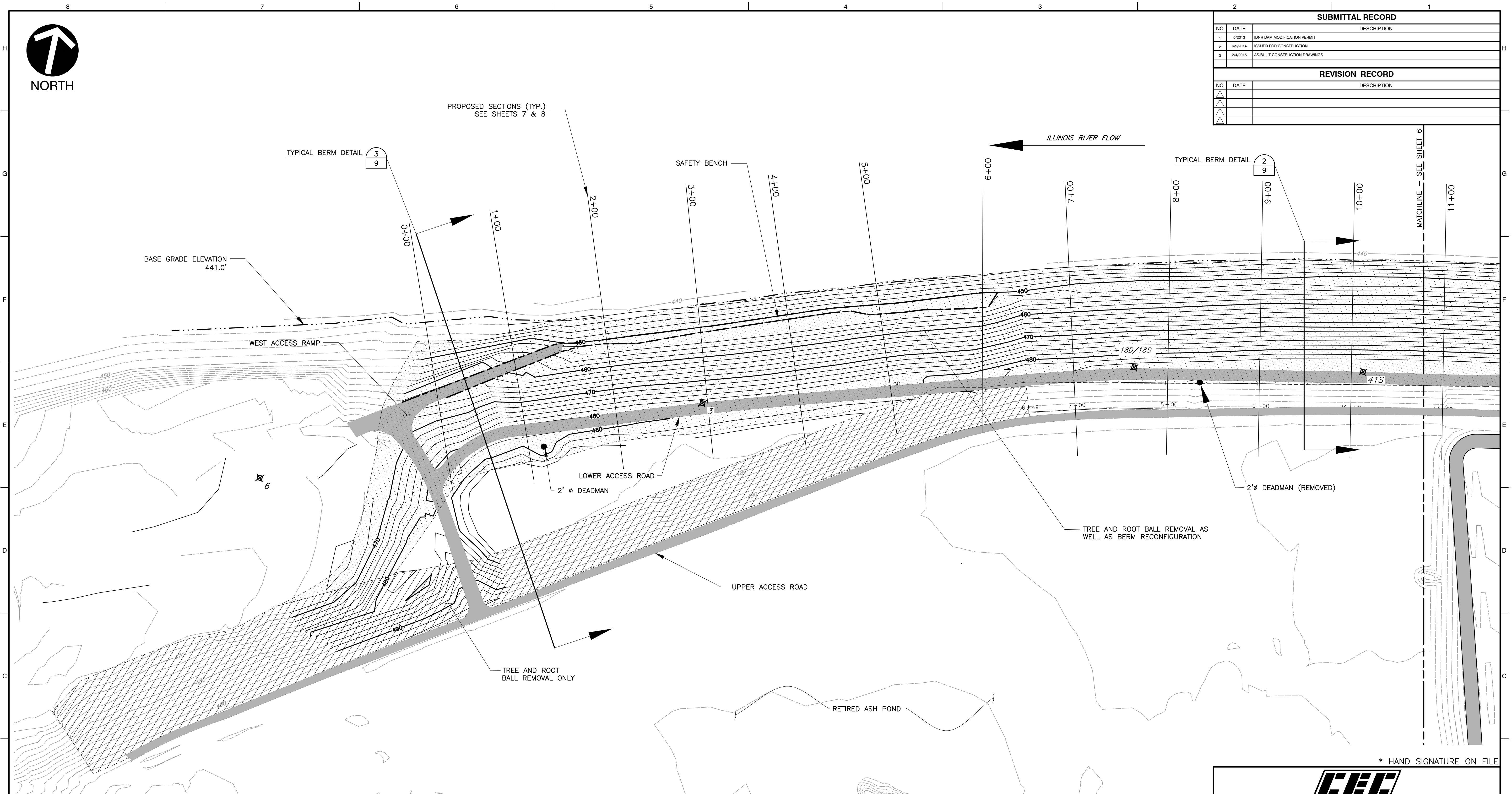
△		
△		
△		



* HAND SIGNATURE ON FILE

LEGEND

—— W ——	MISCELLANEOUS FLOW PIPING
—·—··	BASE GRADE ELEVATION
⌒⌒⌒	EXISTING TREELINE
— ··· —	EXISTING PONDS/STREAMS
—x—x—	EXISTING FENCE
— — —	EXISTING ACCESS ROAD
—— ST ——	EXISTING STORM WATER PIPING
—— P ——	EXISTING UNDERGROUND PLANT FLOW PIPING
┼┼┼┼	EXISTING PLANT FLOW PIPING
—— 495 ——	EXISTING INDEX CONTOURS
- - - -	EXISTING INTERMEDIATE CONTOURS
⌖ 18D	EXISTING MONITORING WELL LOCATIONS
▬	EXISTING ACCESS ROAD
—·—·—	PROPOSED EAST BERM MODIFICATIONS AREA BOUNDARY
——	PROPOSED INDEX CONTOUR
——	PROPOSED INTERMEDIATE CONTOUR
— — —	PROPOSED SAFETY BENCH
▨	TREE/ROOT BALL REMOVAL ONLY
⬚	TREE/ROOT BALL REMOVAL WITH BERM RECONFIGURATION

AS-BUILT CONSTRUCTION PLANS

REFERENCE:

1. TOPOGRAPHIC INFORMATION BASED UPON AERIAL SURVEY CONDUCTED BY SURDEX CORPORATION FLOWN ON SEPTEMBER 10, 2008.
2. EMBANKMENT AREA SURVEY RECEIVED BY CEC FROM DLZ ON MARCH 4, 2013 AND JANUARY 10, 2014.
3. IL DNR PERMIT NO. DS2014017–DAM I.D. NO. 50663
4. AS–BUILT SURVEY RECEIVED BY CEC FROM DLZ, DECEMBER 12, 2014.

SCALE IN FEET
0 50 100

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DYNEGY MIDWEST GENERATION, INC.
HENNEPIN POWER STATION
EAST BERM MODIFICATION
HENNEPIN, ILLINOIS

DRAWN BY:	DFB	CHECKED BY:	MDJ	APPROVED BY:	*MDJ
DATE:	FEBRUARY 2015	DWG SCALE:	AS NOTED	PROJECT NO:	132-650

PROPOSED GRADING PLAN
1 OF 2

DRAWING NO.: **5**
SHEET 5 OF 9

SUBMITTAL RECORD

NO	DATE	DESCRIPTION
1	5/2013	IDNR DAM MODIFICATION PERMIT
2	6/9/2014	ISSUED FOR CONSTRUCTION
3	2/4/2015	AS-BUILT CONSTRUCTION DRAWINGS

REVISION RECORD

NO	DATE	DESCRIPTION
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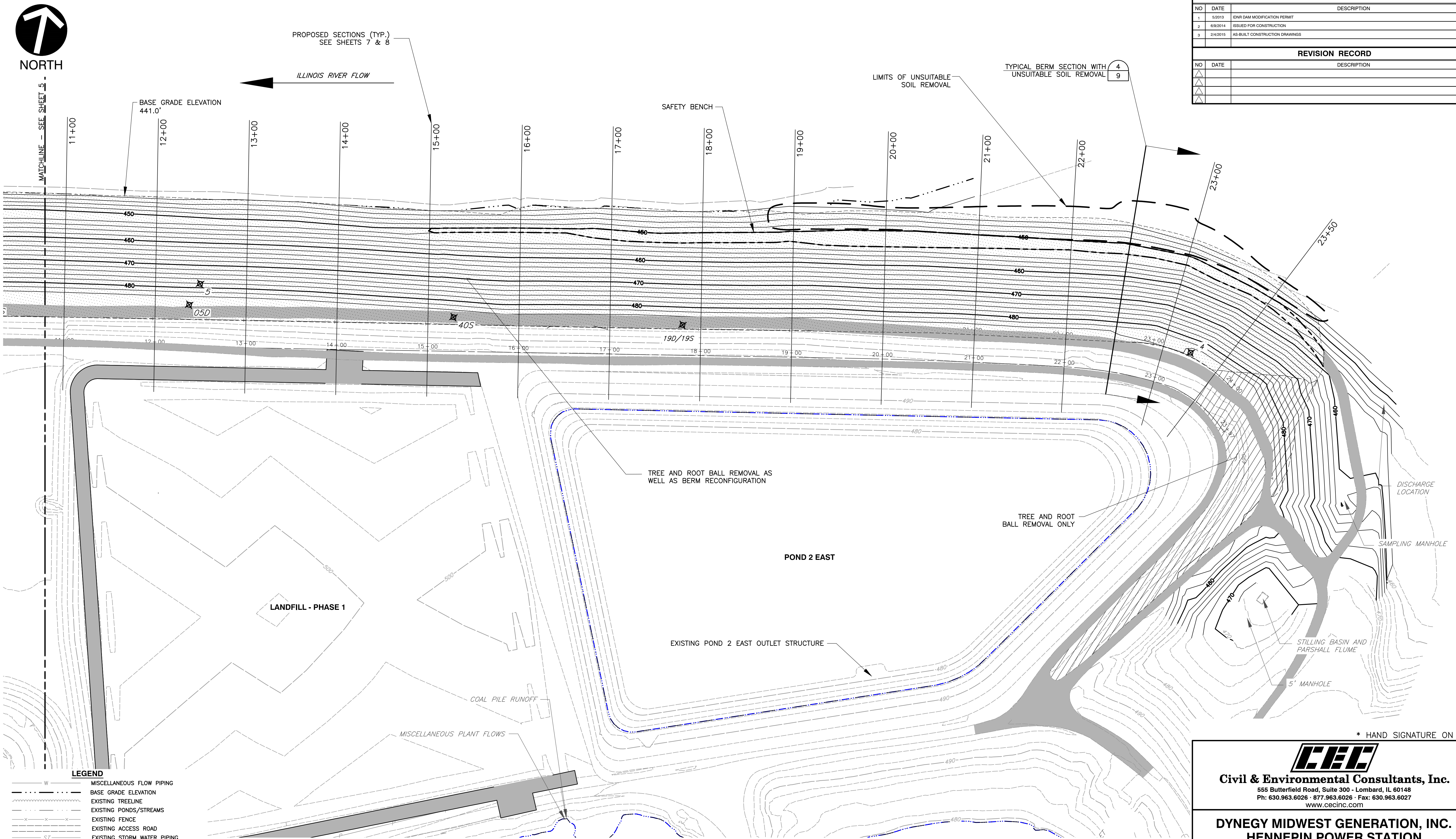

LEGEND

- MISCELLANEOUS FLOW PIPING
- BASE GRADE ELEVATION
- EXISTING TREELINE
- EXISTING PONDS/STREAMS
- EXISTING FENCE
- EXISTING ACCESS ROAD
- EXISTING STORM WATER PIPING
- EXISTING UNDERGROUND PLANT FLOW PIPING
- EXISTING PLANT FLOW PIPING
- EXISTING INDEX CONTOURS
- EXISTING INTERMEDIATE CONTOURS
- EXISTING MONITORING WELL LOCATIONS
- EXISTING ACCESS ROAD
- PROPOSED EAST BERM MODIFICATIONS AREA BOUNDARY
- PROPOSED INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- PROPOSED SAFETY BENCH

▨ TREE/ROOT BALL REMOVAL ONLY

⁙ TREE/ROOT BALL REMOVAL WITH BERM RECONFIGURATION

AS-BUILT CONSTRUCTION PLANS

REFERENCE:

1. TOPOGRAPHIC INFORMATION BASED UPON AERIAL SURVEY CONDUCTED BY SURDEX CORPORATION FLOWN ON SEPTEMBER 10, 2008.
2. EMBANKMENT AREA SURVEY RECEIVED BY CEC FROM DLZ ON MARCH 4, 2013 AND JANUARY 10, 2014.
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4. AS–BUILT SURVEY RECEIVED BY CEC FROM DLZ, DECEMBER 12, 2014.

SCALE IN FEET
0 50 100

* HAND SIGNATURE ON FILE

Civil & Environmental Consultants, Inc.
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Ph: 630.963.6026 · 877.963.6026 · Fax: 630.963.6027
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**DYNEGY MIDWEST GENERATION, INC.
HENNEPIN POWER STATION
EAST BERM MODIFICATION
HENNEPIN, ILLINOIS**

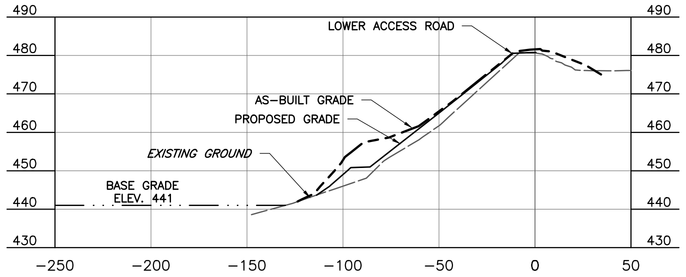
DRAWN BY:	DFB	CHECKED BY:	MDJ	APPROVED BY:	*MDJ
DATE:	FEBRUARY 2015	DWG SCALE:	AS NOTED	PROJECT NO:	132-650

**PROPOSED GRADING PLAN
2 OF 2**

DRAWING NO.: 6

SHEET 6 OF 9

p:\2013\132-650.0200\-CADD\Dwg\CV02\132650-CV02-C300-Proposed Grading Plan.dwg{PROPOSED GRADING PLAN – 2 OF 2} LS:(2/17/2015 – dbronchik) – LP: 2/17/2015 10:43 AM



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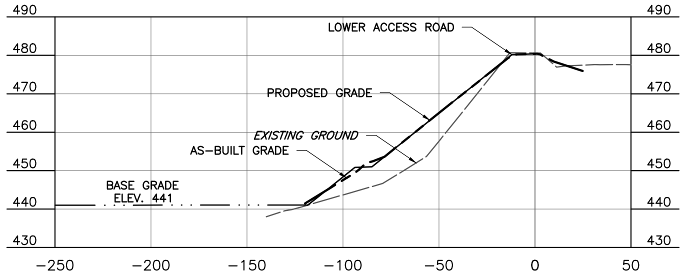

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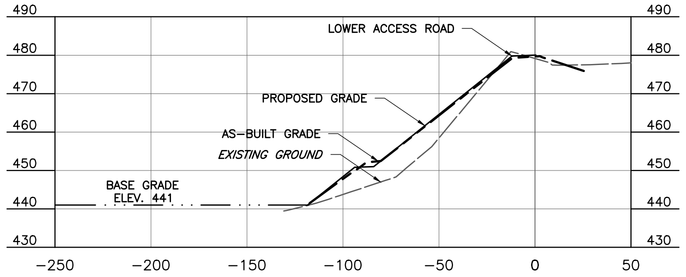

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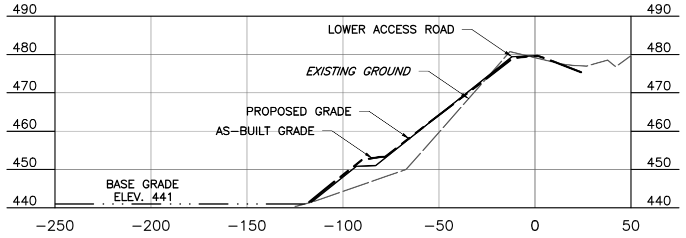

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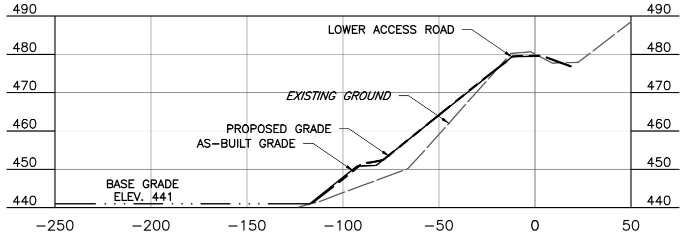
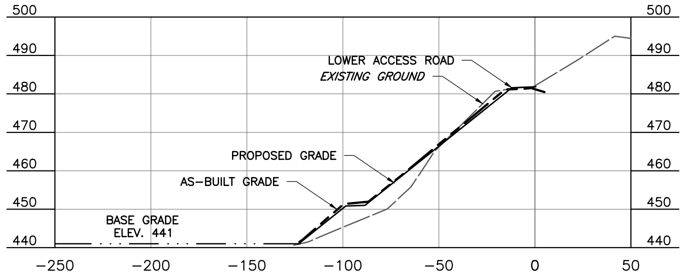


STA 5+00



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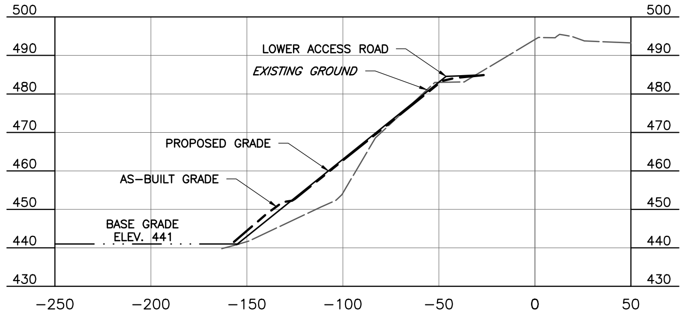

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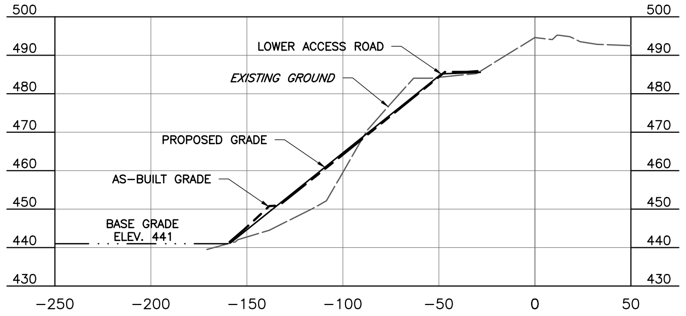

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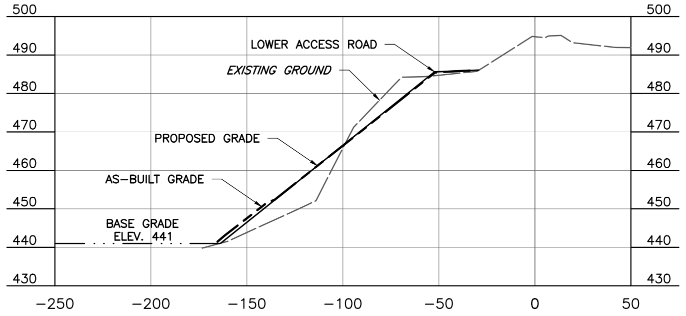

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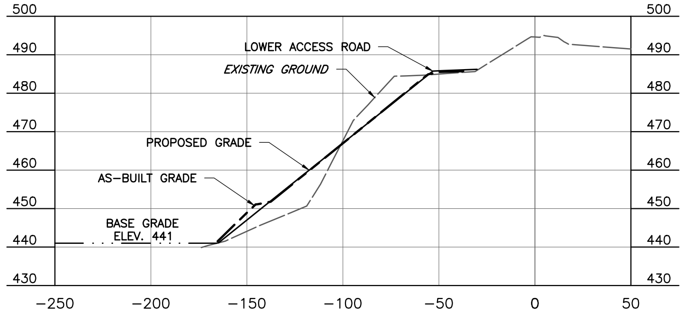

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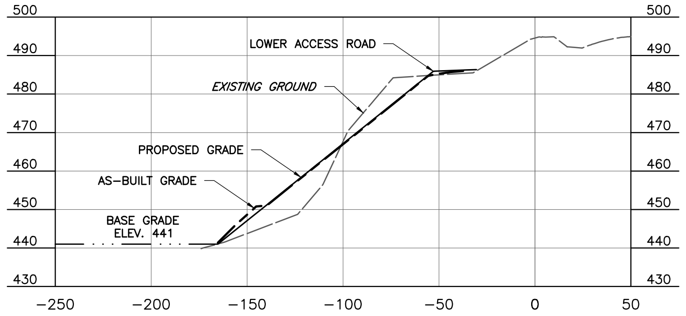

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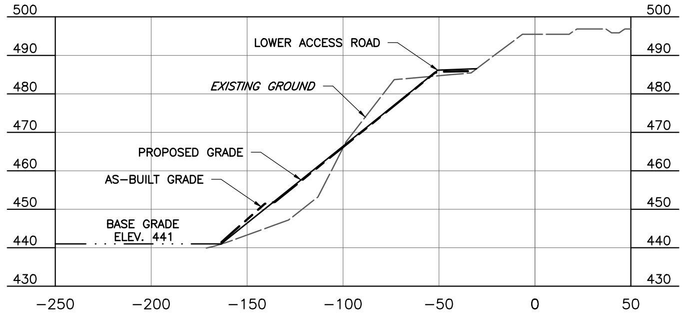

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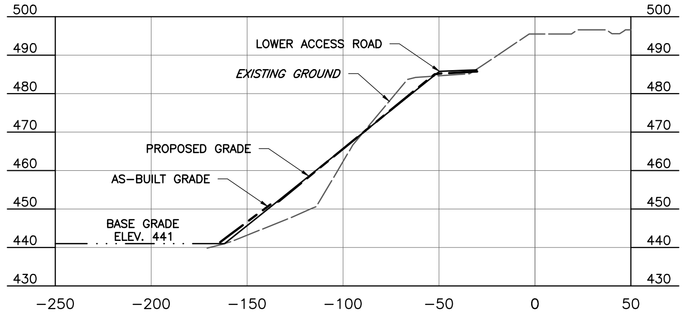

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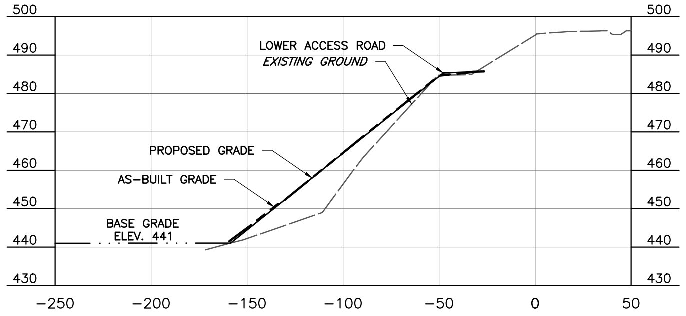

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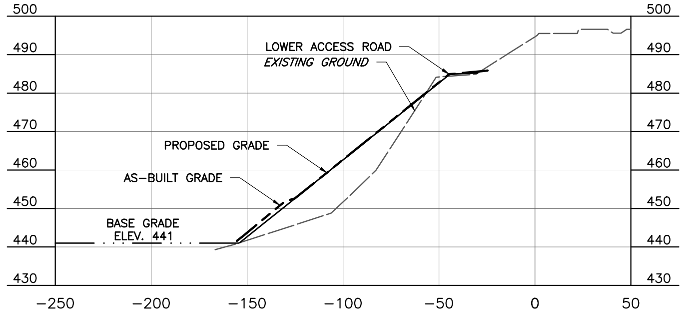


STA 15+00

SUBMITTAL RECORD

NO	DATE	DESCRIPTION
1	5/2013	IDNR DAM MODIFICATION PERMIT
2	6/9/2014	ISSUED FOR CONSTRUCTION
3	2/4/2015	AS-BUILT CONSTRUCTION DRAWINGS

REVISION RECORD

NO	DATE	DESCRIPTION
△		
△		
△		
△		

REFERENCE:

1. TOPOGRAPHIC INFORMATION BASED UPON AERIAL SURVEY CONDUCTED BY SURDEX CORPORATION FLOWN ON SEPTEMBER 10, 2008.
2. EMBANKMENT AREA SURVEY RECEIVED BY CEC FROM DLZ ON MARCH 4, 2013 AND JANUARY 10, 2014.
3. IL DNR PERMIT NO. DS2014017–DAM I.D. NO. 50663
4. AS–BUILT SURVEY RECEIVED BY CEC FROM DLZ, DECEMBER 12, 2014.

AS-BUILT CONSTRUCTION PLANS

HORIZONTAL
SCALE IN FEET
0 50 100

VERTICAL
SCALE IN FEET
0 25 50

* HAND SIGNATURE ON FILE

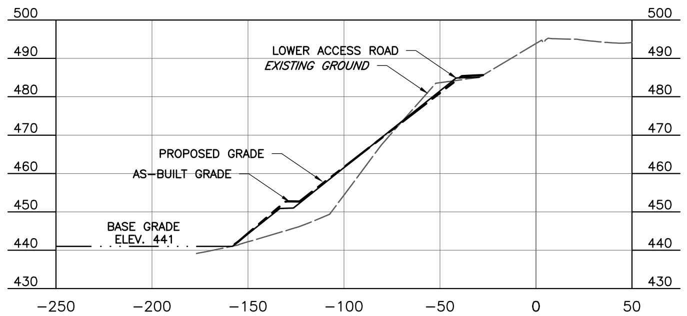
Civil & Environmental Consultants, Inc.
555 Butterfield Road, Suite 300 - Lombard, IL 60148
Ph: 630.963.6026 · 877.963.6026 · Fax: 630.963.6027
www.cecinc.com

DYNEGY MIDWEST GENERATION, INC.
HENNEPIN POWER STATION
EAST BERM MODIFICATION
HENNEPIN, ILLINOIS

DRAWN BY:	DFB	CHECKED BY:	MDJ	APPROVED BY:	*MDJ
DATE:	FEBRUARY 2015	DWG SCALE:	AS NOTED	PROJECT NO:	132-650

PROPOSED SECTIONS
STA 1+00 TO 15+00

DRAWING NO.: 7
SHEET 7 OF 9



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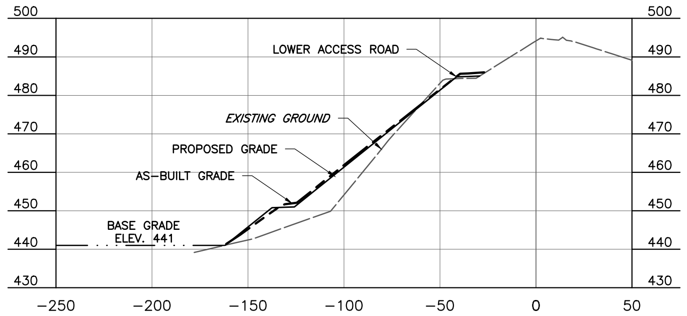

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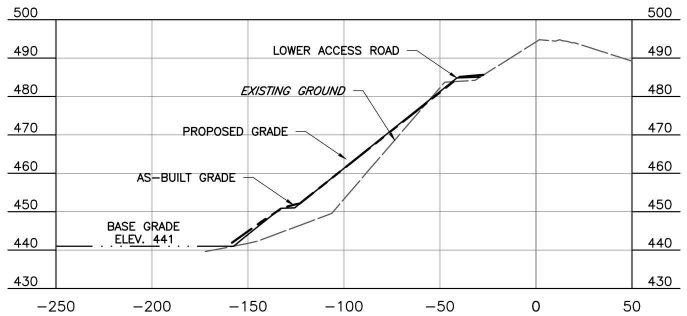

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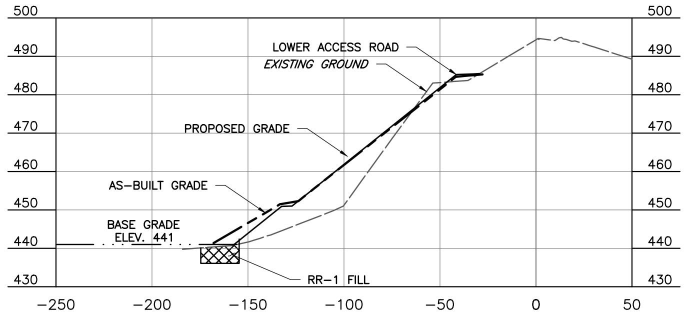

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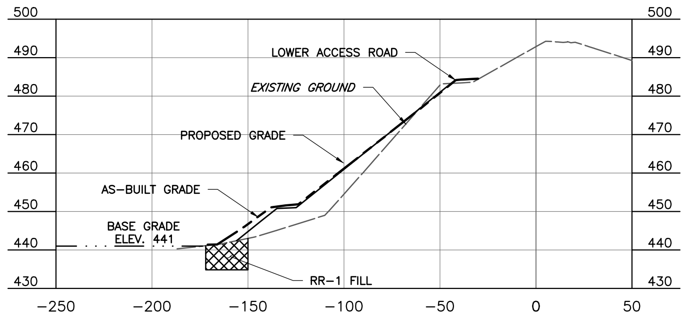

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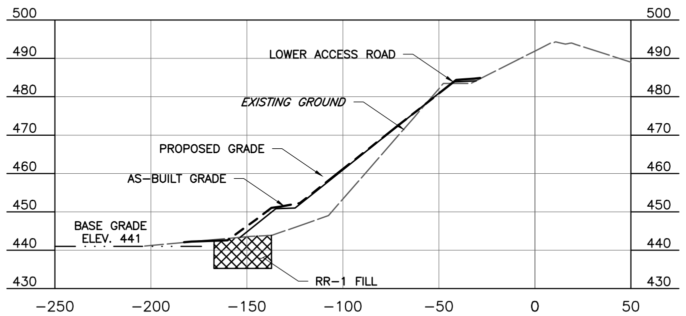

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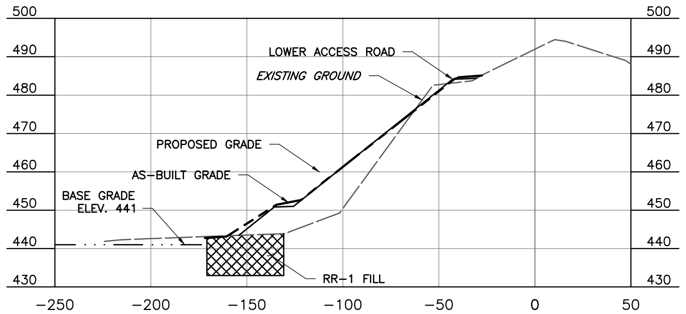

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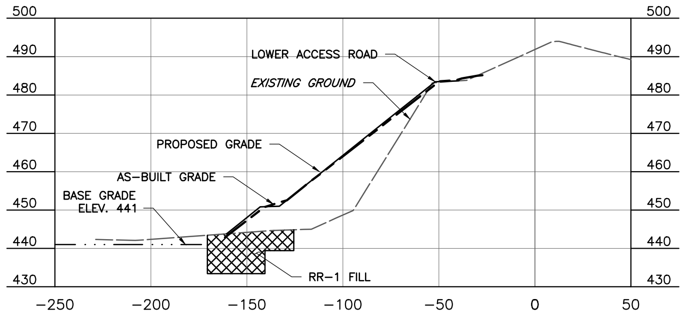

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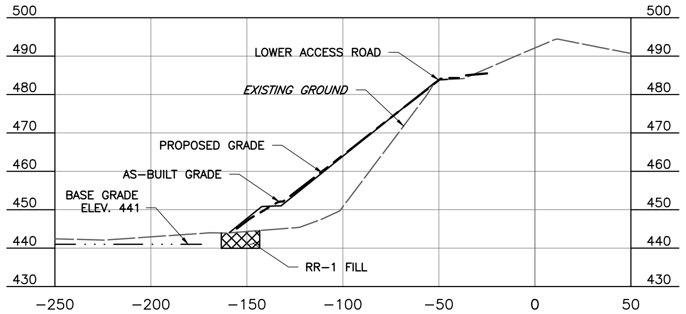

STA 23+50

SUBMITTAL RECORD

NO	DATE	DESCRIPTION
1	5/2013	IDNR DAM MODIFICATION PERMIT
2	6/9/2014	ISSUED FOR CONSTRUCTION
3	2/4/2015	AS-BUILT CONSTRUCTION DRAWINGS

REVISION RECORD

NO	DATE	DESCRIPTION
△		
△		
△		
△		

REFERENCE:

1. TOPOGRAPHIC INFORMATION BASED UPON AERIAL SURVEY CONDUCTED BY SURDEX CORPORATION FLOWN ON SEPTEMBER 10, 2008.
2. EMBANKMENT AREA SURVEY RECEIVED BY CEC FROM DLZ ON MARCH 4, 2013 AND JANUARY 10, 2014.
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AS-BUILT CONSTRUCTION PLANS

HORIZONTAL
SCALE IN FEET
0 50 100

VERTICAL
SCALE IN FEET
0 25 50

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HENNEPIN POWER STATION
EAST BERM MODIFICATION
HENNEPIN, ILLINOIS

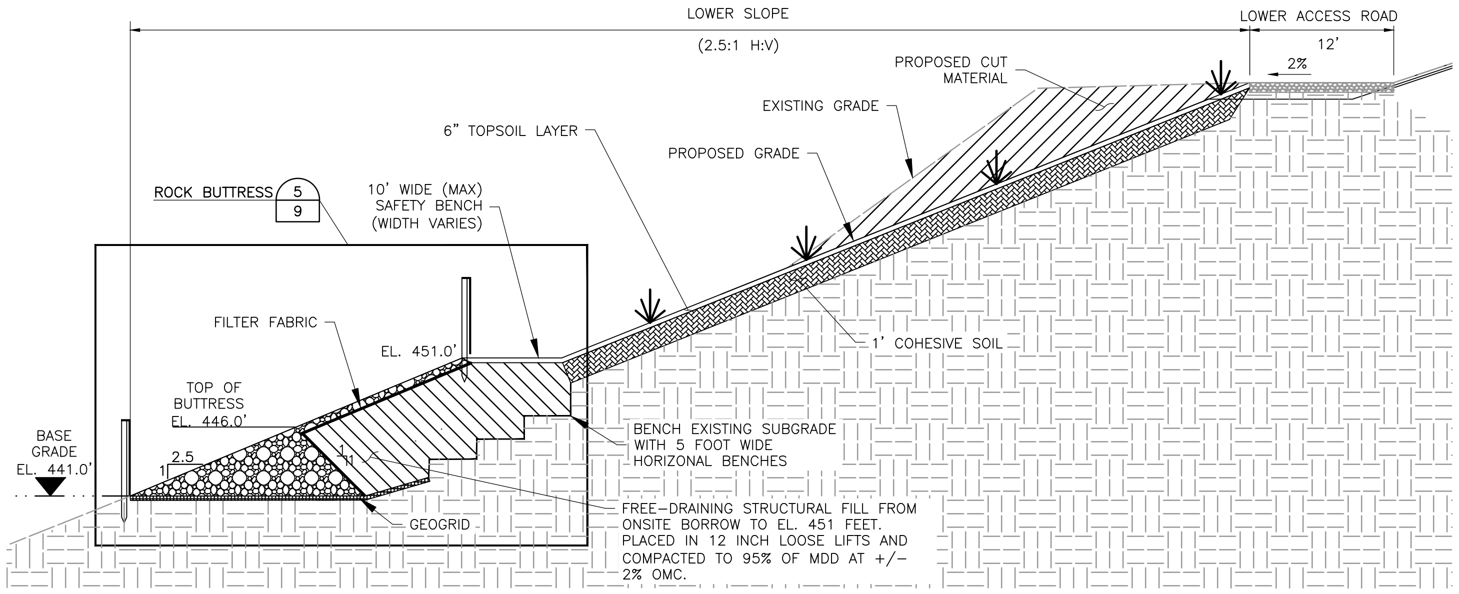
DRAWN BY: **DFB**	CHECKED BY: **MDJ**	APPROVED BY: ***MDJ**
DATE: **FEBRUARY 2015**	DWG SCALE: **AS NOTED**	PROJECT NO: **132-650**

PROPOSED SECTIONS
STA 16+00 TO 23+50

DRAWING NO.: **8**

SHEET **8** OF **9**

p:\2013\132-650.0200\-CADD\Dwg\CV02\132650-CV02-C300-Proposed Grading Plan.dwg{CROSS SECTIONS (2)} LS:(2/17/2015 - dbronchik) - LP: 2/17/2015 10:43 AM



DETAIL 2
TYPICAL BERM DETAIL
SCALE: NTS

LEGEND

▨	PROPOSED CUT MATERIAL
▧	PROPOSED STRUCTURAL FILL
▩	UNSUITABLES/RR1 FILL
○	RIPRAP
▨	DRAINAGE LAYER
——	PROPOSED GRADELINE
— —	EXISTING GRADELINE
— · · —	WATER SURFACE ELEVATION
↓	VEGETATION

SUBMITTAL RECORD

NO	DATE	DESCRIPTION
1	5/2013	IDNR DAM MODIFICATION PERMIT
2	6/9/2014	ISSUED FOR CONSTRUCTION
3	2/4/2015	AS-BUILT CONSTRUCTION DRAWINGS

REVISION RECORD

NO	DATE	DESCRIPTION
△		
△		
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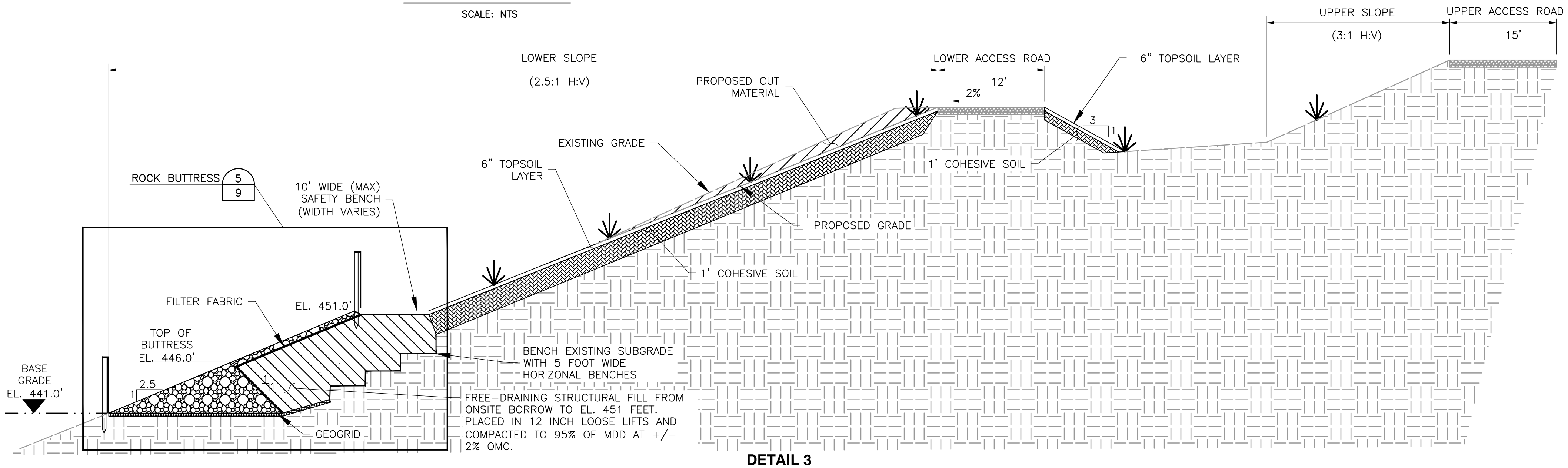
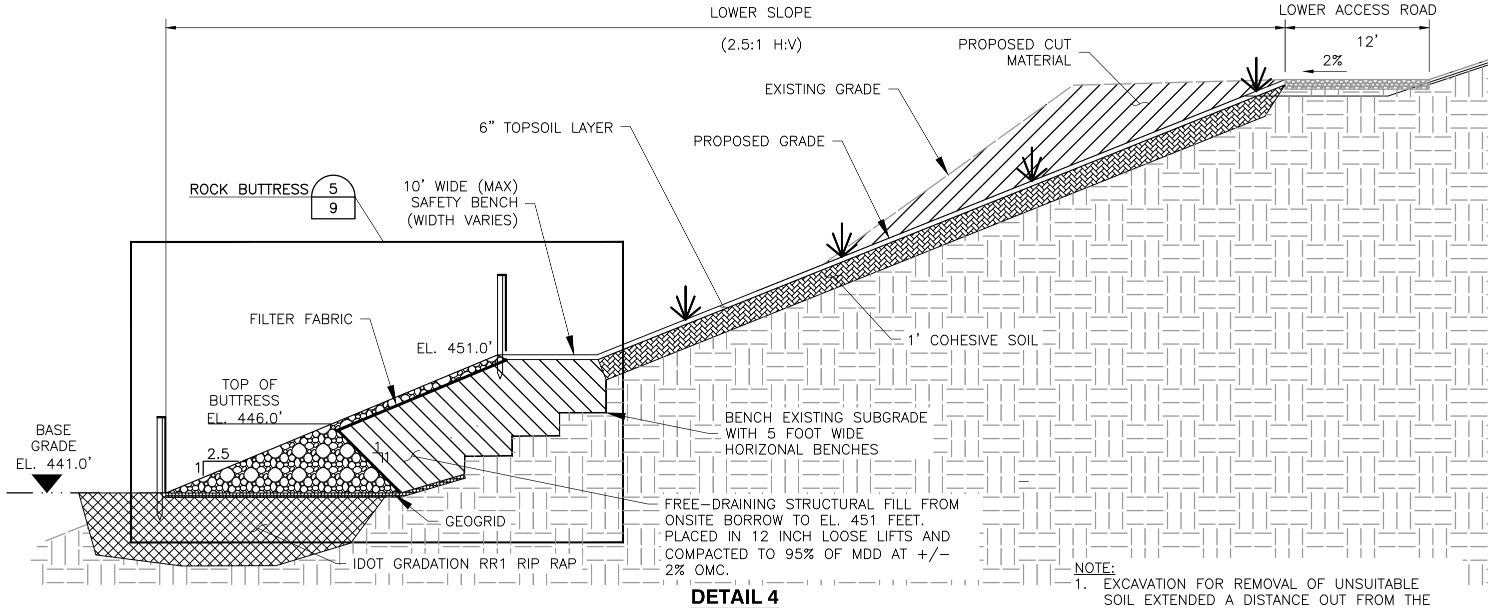


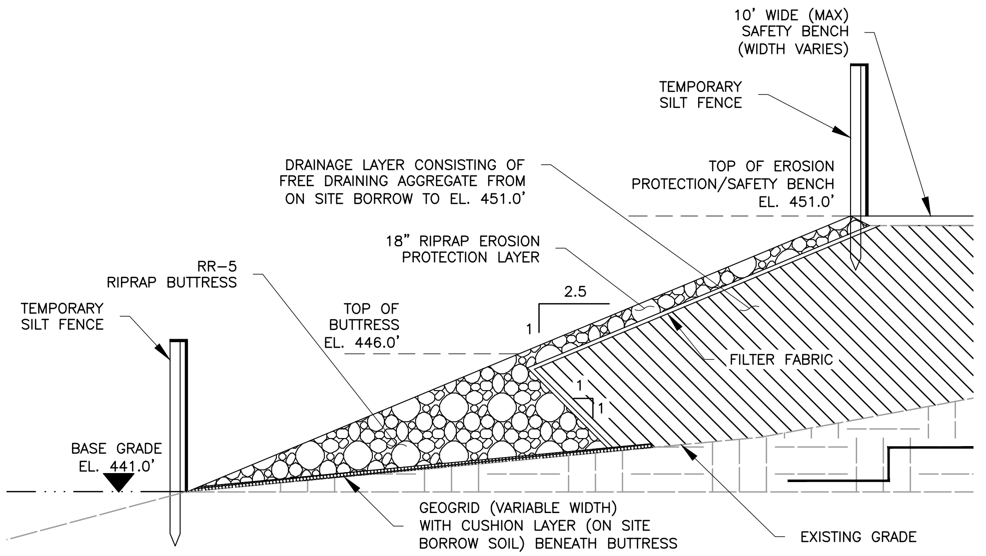
DETAIL 3
TYPICAL BERM DETAIL
SCALE: NTS

NOTE:
1. TEMPORARY SILT FENCE WAS INSTALLED PRIOR TO ROCK BUTTRESS INSTALLATION. UPON COMPLETION OF ROCK BUTTRESS. SILT FENCE WAS INSTALLED UP SLOPE OF ROCK BUTTRESS AND TEMPORARY SILT FENCE REMOVED.
2. AFTER PLACING TOPSOIL AND SEEDING, EROSION CONTROL BLANKETS WERE INSTALLED ON ALL SLOPES STEEPER THAN 3:1 FOR EROSION PROTECTION AND SEED ESTABLISHMENT. STRAW WATTLES WERE PLACED AT MID-HEIGHT OF BERM FOR ADDITIONAL EROSION PROTECTION.



DETAIL 4
TYPICAL BERM WITH UNSUTABLE SOIL REMOVAL DETAIL
SCALE: NTS

NOTE:
1. EXCAVATION FOR REMOVAL OF UNSUITABLE SOIL EXTENDED A DISTANCE OUT FROM THE TOE OF BERM EQUAL TO THE DEPTH OF EXCAVATION.



DETAIL 5
ROCK BUTRESS AND
EROSION PROTECTION LAYER DETAIL
SCALE: NTS

AS-BUILT CONSTRUCTION PLANS

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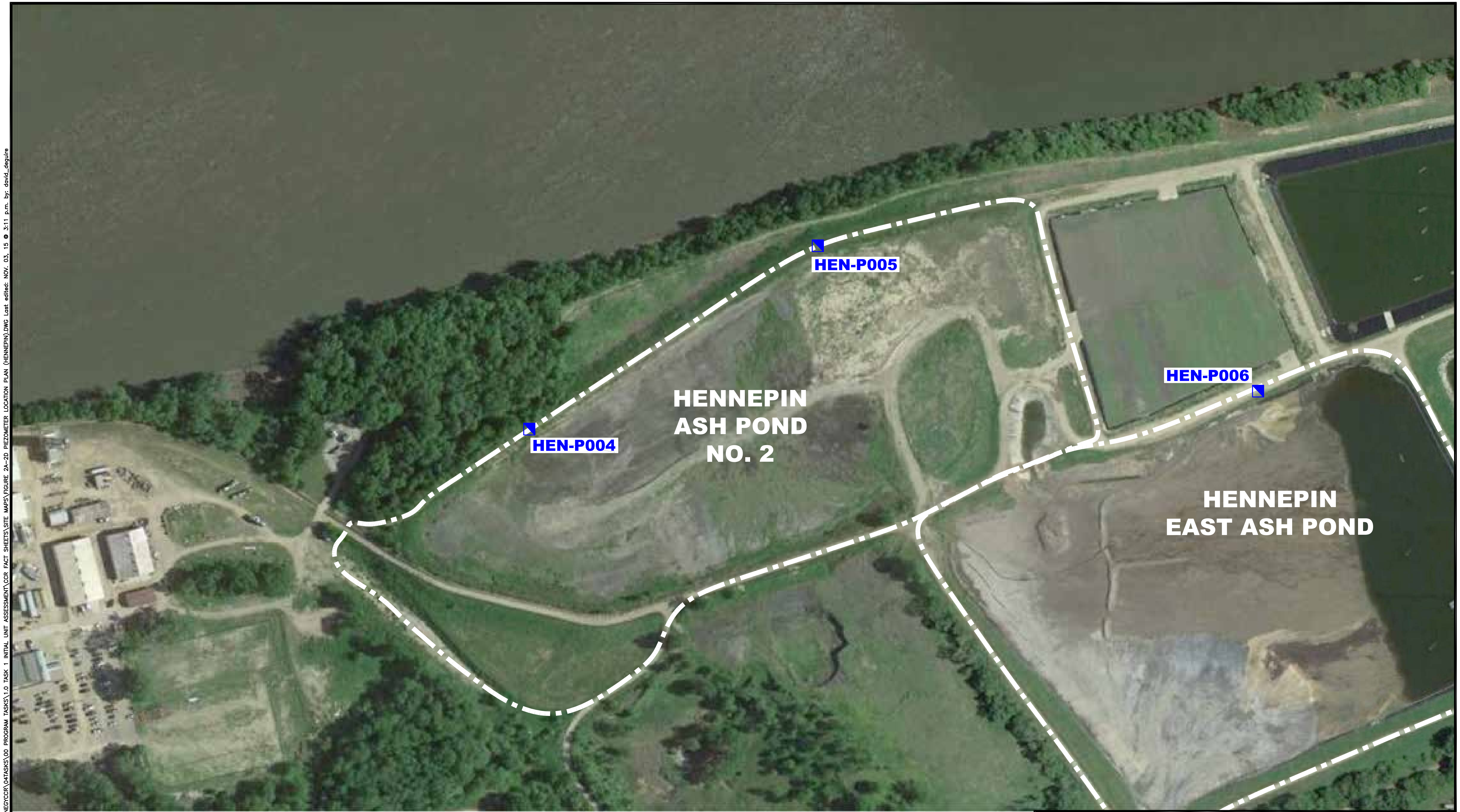
BERM AND EROSION CONTROL DETAILS

DRAWING NO.: 9
SHEET 9 OF 9

p:\2013\132-650.0200\-CADD\Dwg\CV02\132650-CV02-C900-Erosion Control Details.dwg{DETAILS 22X34} LS:(2/17/2015 - dbronchik) - LP: 2/17/2015 10:43 AM

Appendix C: Hennepin Power Station Piezometer Locations

File: P:\PROJECTS\GEOTECH\60428794_DYNEGYCCR\04TASKS\00 PROGRAM TASKS\1.0 TASK 1 INITIAL UNIT ASSESSMENT\CCR FACT SHEETS\SITE MAPS\FIGURE 2A-2D PIEZOMETER LOCATION PLAN (HENNEPIN).DWG Last edited: NOV. 03, 15 @ 3:11 p.m. by: david_deguire



◪ XXX-X###

EXPLORATION METHOD (B=BORING, C=CPT, P=PIEZOMETER)

ID NUMBER

STATION ABBREVIATION

SOURCE:
MAP PROVIDED BY GOOGLE EARTH PRO 2015

LEGEND

◪ PIEZOMETER LOCATION

▬ ▪ ▬ CCR UNIT BERM ALIGNMENT

0 200

APPROXIMATE SCALE FEET

DYNEGY MIDWEST GENERATION, LLC

PROJECT NO.
60439752

AECOM

DRN. BY: djd October 2015
DSGN. BY: eg
CHKD. BY: eg

Hennepin Ash Pond No. 2
Piezometer Locations

FIG. NO.
2A

File: P:\PROJECTS\GEOTECH\60428794_DYNEGYCCR\04TASKS\00 PROGRAM TASKS\1.0 TASK 1 INITIAL UNIT ASSESSMENT\CCR FACT SHEETS\SITE MAPS\FIGURE 2A-2D PIEZOMETER LOCATION PLAN (HENNEPIN).DWG Last edited: NOV. 03, 15 @ 3:11 p.m. by: david_deguire

▨ XXX-X###
EXPLORATION METHOD (B=BORING, C=CPT, P=PIEZOMETER)
ID NUMBER
STATION ABBREVIATION

SOURCE:
MAP PROVIDED BY GOOGLE EARTH PRO 2015

LEGEND

▨ PIEZOMETER LOCATION

▬ ▪ ▬ CCR UNIT BERM ALIGNMENT

0 200
APPROXIMATE SCALE FEET

DYNEGY MIDWEST GENERATION, LLC

PROJECT NO.
60439752

AECOM

DRN. BY: djd October 2015
DSGN. BY: eg
CHKD. BY: eg

Hennepin East Ash Pond
Piezometer Locations

FIG. NO.
2B

◪ XXX-X###

EXPLORATION METHOD (B=BORING, C=CPT, P=PIEZOMETER)

ID NUMBER

STATION ABBREVIATION

SOURCE:
MAP PROVIDED BY GOOGLE EARTH PRO 2015

LEGEND

◪ PIEZOMETER LOCATION

▬ ▪ ▬ CCR UNIT BERM ALIGNMENT

0 200
APPROXIMATE SCALE FEET

DYNEGY MIDWEST GENERATION, LLC

PROJECT NO.
60439752

AECOM

DRN. BY: djd October 2015
DSGN. BY: eg
CHKD. BY: eg

Hennepin Old West Ash Pond
(Pond No. 1 and Pond No. 3)
Piezometer Locations

FIG. NO.
2C

File: P:\PROJECTS\GEOTECH\60428794_DYNEGYCCR\04TASKS\00 PROGRAM TASKS\1.0 TASK 1 INITIAL UNIT ASSESSMENT\CCR FACT SHEETS\SITE MAPS\FIGURE 2A-2D PIEZOMETER LOCATION PLAN (HENNEPIN).DWG Last edited: NOV. 03, 15 @ 3:11 p.m. by: david_deguire

◪ XXX-X###

EXPLORATION METHOD (B=BORING, C=CPT, P=PIEZOMETER)

ID NUMBER

STATION ABBREVIATION

SOURCE:
MAP PROVIDED BY GOOGLE EARTH PRO 2015

LEGEND

◪ PIEZOMETER LOCATION

— · — CCR UNIT BERM ALIGNMENT

0 100

APPROXIMATE SCALE FEET

DYNEGY MIDWEST GENERATION, LLC

PROJECT NO.
60439752

AECOM

DRN. BY: djd October 2015
DSGN. BY: eg
CHKD. BY: eg

Hennepin Old West Polishing Pond Piezometer Locations

FIG. NO.
2D

File: P:\PROJECTS\GEOTECH\60428794_DYNEGYCCR\04TASKS\00 PROGRAM TASKS\1.0 TASK 1 INITIAL UNIT ASSESSMENT\CCR FACT SHEETS\SITE MAPS\FIGURE 2A-2D PIEZOMETER LOCATION PLAN (HENNEPIN).DWG Last edited: NOV. 03, 15 @ 3:11 p.m. by: david_deguire

Appendix D: Specification J-2616, Rev. A, Primary Ash Pond Modifications

3

Sargent & Lundy LLC

DYNEGY MIDWEST GENERATION
HENNEPIN POWER STATION

SPECIFICATION J-2616, REV. A
PERMIT APPLICATION

PRIMARY ASH POND MODIFICATIONS

Prepared By:
Sargent & Lundy, LLC
55 East Monroe Street
Chicago, Illinois 60603

PRIMARY ASH POND MODIFICATIONS

ISSUE SUMMARY

Rev.	Purpose of Issue	Date	Sections Affected
A	Spec No. J-2616 Released for Permit Application	02/14/03	All

CERTIFICATION OF SPECIFICATION

FOR

PRIMARY ASH POND MODIFICATION

I certify that this Specification was prepared by me or under my supervision and that I am a registered professional engineer under the laws of the State of Illinois.

Sargent & Lundy LLC's Illinois Department of Professional Regulation registration number is 184-000106.

Certified By: Ronald Cook

Date: Feb 14, 2003

RONALD H. COOK
062 - 048602

EXP. 11-30-03

Seal

Revision: ______ Certified By: ______________________ Date: __________

PRIMARY ASH POND MODIFICATIONS

TABLE OF CONTENTS

Notes:

(1) Where Division and/or Sections are not included, work under the unlisted headings is not part of the Work.

(2) This Table of Contents will indicate the date of issue for the latest complete issue or revision issue of each section and any subsequent revision issue thereto.

(3) The numbering and subsequent Revisions to the Specification are in sequence with the previously issued Revision mark number.

FABRIC FORMED CONCRETE MATS

ISSUE SUMMARY

Rev.	Purpose of Issue	Date	Sections Affected	Prepared By	Reviewed By	Approved By
A	Permit Application	02/14/03	ALL	Ronald Cook	Daniel C. Konik	Ronald Cook

FABRIC FORMED CONCRETE MATS

TABLE OF CONTENTS

Notes:

(1) This Table of Contents will indicate the date of issue for the latest complete issue or revision issue of each section and any subsequent revision issue thereto.

(2) The numbering and subsequent Revisions to the Specification are in sequence with the previously issued Revision mark number.

Page

Fabric Formed Concrete Mats - Technical Specification and Optional Features/Accessories

1.0
Scope of Work

The intent of this specification is to define the material and installation requirements for fabric formed concrete mats installed in accordance with the Design Drawings, technical data and as specified herein.

1.1
Work Included

The work shall include, but not be limited to, the following items as indicated:

A. Preparation and grading of surfaces to receive fabric mats.

B. Placing fabric mats and filling them with a pumpable sand/cement slurry to form a stable erosion protection system.

C. Offsite disposal of excess or unsuitable materials and debris.

2.0
Codes and Standards

A. Standards, specifications, manuals, codes and other publications of nationally recognized organizations and associations are referenced herein. Methods, equipment and materials specified herein shall comply with the specified and applicable portions of the referenced documents, in addition to federal, state or local codes having jurisdiction.

B. References to these documents are to the latest issue date of each document, unless otherwise indicated, together with the latest additions, addenda, amendments, supplements, etc., thereto, in effect as of the date of contract for the work.

C. Abbreviations listed indicate the form used to identify the reference documents in the specification text.

2.1
ASTM – American Society for Testing and Materials

A. ASTM C 31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.

B. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

C. ASTM C 143 – Standard Test Method for Slump of Hydraulic Cement Concrete.

D. ASTM C 172 – Standard Practice for Sampling Freshly Mixed Concrete.

E. ASTM C 173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

F. ASTM C 231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

G. ASTM C1064 – Standard Test Method for Temperature of Freshly Mixed Portland-Cement Concrete.

H. ASTM D 543 – Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.

I. ASTM D 751 – Standard Test Methods for Coated Fabrics.

J. ASTM D 792 – Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

K. ASTM D1777 – Standard Test Method for Thickness of Textile Materials.

L. ASTM D2101 – Standard Test Method for Tensile Properties of Single Man-Made Textile Fibers Taken From Yarns and Tows.

M. ASTM D3776 – Standard Test Methods for Mass Per Unit Area (Weight) of Fabric.

N. ASTM D3786 – Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics (Mullen Burst).

O. ASTM D3787 – Standard Test Method for Bursting Strength of Knitted Goods: Constant-Rate-of Traverse (CRT) Ball Burst Test.

P. ASTM D3885 – Standard Test Method for Abrasion Resistance of Textile Fabrics.

Q. ASTM D4355 – Standard Test Methods for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.

R. ASTM D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

S. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles.

T. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

U. ASTM D5034 – Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test).

V. ASTM D5035 – Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Strip Method).

3.0
Supplier's Drawings and Data Submittals

A. Supplier shall submit drawings and data as specified. Supplier's drawings and data shall be submitted via electronic medium in a format compatible for importing into the Buyer's information systems specified by the Buyer.

3.1
Submittals Prior to Installation

The Supplier shall submit the following items at least 30 days prior to scheduled delivery of materials:

A. Manufacturer's literature providing specifications on the fabric mats that will be supplied.

B. Manufacturer's certification that the fabric mats to be supplied comply with the requirements of this Technical Specification.

C. Manufacturer's Quality Control and Construction Quality Control Plans. The MQC Plan shall state the frequency that index tests are performed on the fabric mat during manufacturing.

D. If requested by the Buyer, four samples of each fabric mat suitable for testing.

E. Required concrete grout slurry mix design, including requirements for compressive strength, slump, air content and maximum temperature.

3.2
Submittals During and After Installation

The Supplier shall submit the following items on a daily basis during installation and a complete set of data within 30 days of the completion of the work:

A. Results of tests performed on the concrete grout fill.

4.0
Construction Quality Assurance

A. The Supplier shall examine the areas and conditions under which the work is to be installed and notify Buyer in writing of conditions detrimental to the proper and timely completion of the work that have changed from the time of the bidder's walkdown.

B. Material and installation procedures are subject to inspection and tests conducted by an Independent Testing Service employed by the Buyer. Such inspections and tests will not relieve the Supplier of responsibility for providing material and installation procedures in compliance with specified requirements. The Buyer reserves the right, at any time before final acceptance, to reject material not complying with the specified requirements.

C. The Supplier shall correct deficiencies in the work which inspections and laboratory test reports have indicated to be not in compliance with requirements. The Supplier shall perform additional tests, at his expense, as may be necessary to reconfirm any noncompliance of the original work, and as may be necessary to show compliance of corrected work.

D. The Supplier shall promptly correct errors or flaws in material or placement of the protection mats identified during construction. The Supplier shall make immediate substitution of non-complying component or make field changes to make the non-complying component acceptable. Whether the correction is made by substitution or field correction, it shall be performed without cost to the Buyer.

4.1
Testing

4.1.1
Independent Testing Service

An Independent Testing Service shall perform the following:

A. Test material for the concrete slurry fill and prepare initial test cylinders in accordance with the requirements specified herein.

B. Prepare test cylinders and determine the compressive strength of job concrete fill test cylinders.

4.1.2
Concrete Grout Testing

A. Obtaining and testing concrete grout shall be by the Independent Testing Service in accordance with the following specifications:

- Sampling freshly mixed grout shall be done in accordance with ASTM C172.
- Making and curing concrete test specimens shall be in accordance with ASTM C31.
- Slump test shall be in accordance with ASTM C143.
- Air Content tests shall be in accordance with ASTM C173 or ASTM C231.
- Tests for the temperature of the freshly mixed grout shall be in accordance with ASTM C1064.
- Compressive strength test shall be in accordance with ASTM C39.

B. The frequency of testing shall be as directed by Buyer as follows:

- At least one test shall be made for each day's placement of grout, but not less than once for each 100 cubic yards or part thereof placed.
- A test shall consist of a minimum of four cylinders taken from the same truck. One 7-day and two 28-day tests shall be performed by the laboratory with results submitted to the Buyer as soon as possible. One spare cylinder shall be made and used as directed by the Buyer.
- A slump test and air content test shall be performed on every 100 cubic yards of concrete grout.
- The temperature of each 100 cubic yards shall be recorded in the field prior to placement. If the concrete grout temperature is in excess of 100°F, the concrete shall be rejected.

5.0
Materials

5.1
Fabric Design

A. Fabric-forming material shall consist of double-layer, open-selvage fabric joined in a mat configuration. The fabric shall be woven of 100% continuous multi-filament nylon fiber of which 50% by weight shall be bulk textured fiber. The use of staple yarns will not be permitted.

B. The fabric shall be woven in such a manner as to provide interwoven points of attachment on spaced centers. These points of attachment shall serve to control the thickness of the finished product and to also act as a filter point to provide relief of hydrostatic uplift pressure beneath the completed revetment. The fabric shall be woven in a basket or other open pattern to provide permeability at the filter points and the main fabric field.

C. The spacing of the filter points is indicated on the Design Drawings. This spacing will result in an average revetment thickness that is consistent with the average thickness published by the manufacturer for the designated style specified.

5.2
Fiber and Fabric Material

A. The warp fiber shall be 1260 Denier Nylon, 18.5 ends/inch per single layer and the fill fiber shall be 1900 Denier Nylon, 14 picks/inch per single layer. The fiber and fabric material shall meet the minimum requirements listed in Table 1.

TABLE 1
MATERIAL PROPERTIES

PROPERTY	ASTM TEST METHOD	MINIMUM TEST VALUE
Fiber count	-	0.164 g/m
Trapezoidal tear breaking force on the warp fiber at 70% elongation	D 4533	80 lbs/in
Trapezoidal tear breaking force on the fill fiber at 70% elongation	D 4533	40 lbs/in
Density	D 792	1.00 g/cm^3
Fiber dry breaking strength at 48% elongation	D 2101	20 lbs
Fiber wet breaking strength at 53% elongation (soaked in water for 2 hours)	D 2101	19 lbs
Tensile strength in the warp direction after exposure to 300 hours of Ca (OH) at a pH of 10	D 543	180 lbs/in
Tensile strength in the warp direction after exposure to 300 hours of H_2SO_4	D 543	170 lbs/in
Tensile breaking strength in the warp direction on a strip of the fabric at 39% elongation (1)	D 5034, D 5035	160 lbs/in
Tensile breaking strength in the fill direction on a strip of the fabric at 34% elongation (1)	D 5034, D 5035	190 lbs/in
Mass/unit area for a single layer of fabric	D 3776	7.8 oz/sq yd
Thickness of a single layer of fabric	D 1777	31 mils
Falling head permittivity of two layers of fabric woven together	D 4491	0.28 s^{-1} 0.04 cm/s (3)
Falling head permittivity of a single layer of fabric	D 4491	1.3 s^{-1} 0.12 cm/s
Seam strength (2)	D 751	35 lbs/in
Abrasion resistance in the warp direction	D 3885	160 lbs/in
Grab strength in the warp direction at 31% elongation	D 4632	350 lbs
Grab strength in the fill direction at 41% elongation	D 4632	275 lbs
Breaking strength in the warp direction after exposure to 500 hours of UV light	D 4355	190 lbs/in
Mullen burst test	D 3786	750 psi
Puncture test	D 3787	80 lbs

Notes for Table 1:

(1) 3" x 8" sample gripped along full width of the specimen with 3" of separation between grips. Strip test to be performed on single layer of fabric at cross-head speed of 5 inches per minute.

(2) Seam centered between grips 3" apart and gripped the full width of the specimen.

(3) Applies to Filter Points only

5.3
Fabric Assembly

A. Adjacent fabric panels shall be connected by sewing or by means of zipper.

B. The two top layers of fabric and the two bottom layers of fabric shall be joined separately permitting full mat thickness between the two parallel seams. A single seam in which all four layers of the fabric are joined at one point will not be permitted.

C. If required, grout stops may be installed parallel to and in between individual mill widths at predetermined intervals to regulate the flow of the concrete fill. Grout stops shall be so designed as to produce full mat thickness along the full length of the grout stop.

5.4
Concrete Grout

A. The concrete grout shall consist of a mixture of Portland cement, fine aggregate and water so proportioned and mixed as to provide a readily pumpable slurry.

B. Admixtures and/or a pozzolan may be used with the approval of the Buyer. The use of superplasticizers and/or silica fume require special precautions and the approval of the Buyer.

C. The hardened concrete shall exhibit a minimum compressive strength of 2,500 psi at 28 days when specimens are made and tested in accordance with the provisions of ASTM C 31 and ASTM C 39.

5.5
Acceptable Materials

The following companies manufacture products that meet the requirements of the specification:

A. Fabriform Filter Point Fabric as manufactured by Construction Techniques, Inc., Cleveland, Ohio, 440-572-8300.

B. Other approved by Buyer.

6.0
Execution

6.1
Acceptance and Storage at the Project Site

6.1.1
Handling of Rolls

A. The method of off-loading the fabric at the project site shall not cause any damage to the fabric, its core, nor its protective covering.

B. Any protective covering that is accidentally damaged or stripped off of a pallet or roll shall be immediately repaired or the pallet or roll shall be moved to an enclosed facility until the repair can be made.

6.1.2
Storage at the Field Site

A. The Buyer shall provide on-site storage space in a location near where the fabric will be placed such that on-site transportation and handling are minimized. The Supplier shall be responsible for protecting the stored material from theft and vandalism.

B. Rolls or pallets of fabric shall be stored in such a manner that cores are not crushed, the fabric damaged, and as required to provide protection from exposure to ultraviolet light, inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious condition.

C. Outdoor storage of rolls or pallets shall not exceed the manufacturer's recommendations or longer than six months, whichever is less.

6.2
Inspection upon Delivery

A. Upon delivery of the materials to the site, the Supplier shall conduct a visual inspection of all rolls of fabric for damage or defects. This inspection shall be done without unrolling any rolls unless damage to the inside of a roll is found or suspected.

B. Any damage or defects shall be noted and immediately reported to the Buyer, the manufacturer and the carrier that transported the material. Any roll, or portion thereof, which, in the judgement of the Buyer, is seriously damaged, shall be removed from the project site and replaced with complying material at no additional cost to the Buyer.

6.3
Fabric Placement

A. Prior to concrete injection, the fabric shall be positioned over a geotextile on the grade as indicated on the Design Drawings making appropriate allowances for contraction of the fabric mats as a result of injecting the concrete grout.

B. Anchoring of fabric shall be as shown on the Design Drawings.

C. Fabric panels may be factory assembled in predetermined sizes and joined together side-by-side at the project site by field sewing or by means of zipper closures attached to the upper and lower layers of the fabric. In no case will simple unattached butt joints between panels be allowed. Overlapping shall be allowed only if approved by the Buyer.

6.4
Concrete Injection

A. Following placement of the fabric mats the specified concrete grout shall be injected between the top and bottom layers of the fabric through small slits cut in the upper layer of the fabric. The injection pipe shall be wrapped tightly at the point of injection with a strip of burlap, or similar material, during pumping to seal the joint between the injection pipe and the slit. After pumping, the burlap shall be pushed into the slit as the injection pipe is withdrawn in order to minimize spillage of the concrete slurry onto the surface of the revetment.

B. The sequence of concrete slurry injection shall be such as to insure complete filling of the revetment-forming fabric to average thickness indicated by the manufacturer for the designated style specified on the Design Drawings.

C. Foot traffic will not be permitted on the freshly pumped mat since such traffic will cause permanent indentations in the mat surface. Walk boards shall be used where necessary.

D. Excess concrete slurry which has been inadvertently spilled on the mat surface shall be cleaned up with a broom and shovel. The use of a water hose to remove spillage from the surface of a freshly pumped mat will not be permitted.

E. During concrete slurry injection, the mat thickness shall be measured by inserting a short piece of stiff wire through the crowns of the mats midway between the filter points at several locations from the crest to the toe of the slope. Any mat measurements less than 90% of the average of all thickness measurements shall be re-injected until the average thickness indicated for the style specified has been attained.

TEMPORARY AND PERMANENT SEEDING (ILLINOIS)

ISSUE SUMMARY

Rev.	Purpose of Issue	Date	Sections Affected	Prepared By	Reviewed By	Approved By
A	Permit Application	02/14/03	ALL	Ronald Cook	Daniel [illegible]	Ronald Cook

TEMPORARY AND PERMANENT SEEDING (ILLINOIS)

TABLE OF CONTENTS

Notes:

(1) This Table of Contents will indicate the date of issue for the latest complete issue or revision issue of each section and any subsequent revision issue thereto.

(2) The numbering and subsequent Revisions to the Specification are in sequence with the previously issued Revision mark number.

Page

Temporary and Permanent Seeding (Illinois) – Technical Specification and Optional Features/Accessories

1.0
Scope of Work

The intent of this specification is to define the minimum requirements for material and work for establishing a vegetative cover by planting grass seed.

1.1
Purpose and Use

A. All graded areas, slopes, and ditches which will not be paved or otherwise surfaced shall be provided with permanent seeding.

B. Graded areas subject to erosion shall not remain unprotected for longer than 30 days. Temporary seeding shall be provided by the Supplier to protect graded areas from erosion where permanent protection is not scheduled to be installed for 2 to 12 months after grading is completed.

1.2
Method of Seed and Mulch Application

Seed may be spread by a conventional method of application such as broadcasting, grass drill, or cultipacker followed by an application of mulch <u>or</u> by a hydro seeding procedure consisting of spraying a slurry mixture of water, seed, mulch, fertilizer, and tackifier onto the prepared seedbed.

1.3
Work Included

A. Furnish all materials.

B. Subgrade preparation.

C. Seedbed preparation, including placing topsoil and the addition of lime and fertilizer.

D. Seeding using broadcast, grass drill, or the cultipacker method and mulching, <u>or</u> hydro seeding with a mixture that contains seed, mulch and a tackifier.

E. Installation of matting where specified for erosion control.

F. Protection.

G. Maintenance.

H. Repairing and reseeding.

2.0
Codes and Standards

A. Standards, specifications, manuals, codes and other publications of nationally recognized organizations and associations are referenced herein. Methods, equipment and materials specified herein shall comply with the specified and applicable portions of the referenced documents, in addition to federal, state or local codes having jurisdiction.

B. References to these documents are to the latest issue date of each document, unless otherwise indicated, together with the latest additions, addenda, amendments, supplements, etc., thereto, in effect as of the date of Contract for the Work.

C. Abbreviations listed indicate the form used to identify the reference documents in the Specification text.

2.1
USDA - United States Department of Agriculture, Soil Conservation Service

A. USDA-SCS Soil Classification. Supplement to Soil Classification System (7th Approximation), SCS, USDA, Second Printing, March 1967.

2.2
ASTM - American Society for Testing and Materials

A. C602 - Specification for Agricultural Liming Materials.

B. D977 - Specification for Emulsified Asphalt.

C. D2026 - Specification for Cutback Asphalt (Slow-Curing Type).

D. D2027 - Specification for Cutback Asphalt (Medium-Curing Type).

E. D2028 - Specification for Cutback Asphalt (Rapid-Curing Type).

F. D2397 - Specification for Cationic Emulsified Asphalt.

G. D5268 - Specification for Topsoil Used for Landscaping Purposes.

3.0
Supplier's Drawings and Data Submittals

Supplier shall submit drawings and data not less than 30 days before material is to be delivered. Supplier's drawings and data shall be submitted via electronic medium in a format compatible for importing into the Buyer's information systems specified by the Buyer.

3.1
Topsoil

A. Topsoil Material:

- A copy of laboratory reports on two representative samples of topsoil. Laboratory tests shall be performed for:
- Percent deleterious material.
- Total organic content.

- Silt and clay contents.
- Sand content.
- pH.

B. If it is anticipated that topsoil stripped from either the present site or the borrow area will be used for permanent seeding, if requested by the Buyer, the Supplier shall provide two 50-pound samples to the Buyer's Testing Service for analyses.

3.2
Seed

A. A certified copy of a statement signed by the seed supplier that each lot of seed has been tested by a recognized seed-testing laboratory within six months before the date of delivery to the plant site.

B. A certified statement signed by the seed supplier that the maximum percentage of noxious weeds in the seed mixture complies with state law.

3.3
Data on Materials as Applied

As applied data on the following items:

A. Seed mixture and seed application rate.

B. Limestone application rate.

C. Fertilizer type, trademark name (if any), chemical composition, and application rate.

D. Mulch.

E. Tackifier.

3.4
Binder Spray

Data on the binder spray (tackifier) to be used on straw mulch or with hydro seeding. If a synthetic binder (tackifier) will be used, the Supplier shall provide a complete set of Manufacturer's specifications at least 30 days prior to anticipated use. Manufacturer's specifications shall contain a description of the binder material, the recommended method of application, and the recommended application rate.

3.5
Matting

Catalog data on the proposed erosion control matting and Manufacturer's literature on the recommended method of installation.

3.6
Samples

If requested by the Buyer, submit a sample of each material designated by the Buyer for laboratory testing.

4.0
Products

4.1
Topsoil

A. Topsoil shall consist of sandy clay loam, sandy loam, loam, clay loam, silty clay loam or silt loam as defined by the SCS Soil Classification System.

B. Topsoil shall be relatively free from large roots, sticks, weeds, brush or stones larger than 1 inch in diameter or other litter and waste products. It shall have at least 90 percent passing the No. 10 sieve.

C. The topsoil shall meet requirements of ASTM D5268 as follows:
  - It shall contain not less than 2 percent nor more than 20 percent total organic matter.
  - It shall contain not less than 35 percent nor more than 70 percent silt and clay.
  - It shall contain not less than 20 percent nor more than 60 percent sand.
  - The pH of the sample shall not be lower than 5.0 nor higher than 7.5.
  - The percent deleterious material (rock, gravel, slag, cinder, roots, sod) shall not exceed 5 percent.

4.2
Seed

4.2.1
General Requirements

A. Grasses, legumes, or cover crop seed of the type specified herein shall conform to the standards of the United States Department of Agriculture for seed certification.

B. Seed or seeding mixtures shall be furnished in sealed bags or containers in accordance with standard commercial practice.

C. Each bag or container shall be tagged or labeled in accordance with state law. As a minimum, the tag or label shall provide the following information:
  - Name and address of the supplier.
  - Common name of seed.
  - Lot number.
  - Net weight.
  - Guaranteed percentage of germination.
  - Percentage of weed seed and inert material content.

D. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be accepted.

E. All seed furnished shall be free of primary noxious weed seed such as Russian or Canadian Thistle, European Birdweed, Johnson Grass and Leafy Spurge. The maximum allowable percentage of noxious weed seed in the seed mixture shall comply with state law.

4.2.2

Seed Storage

If it is necessary to store seeds after their arrival on the site, they shall be stored in an approved weatherproof building in such a manner as to protect the seeds from deterioration and to permit easy access for inspection. The Buyer's approval for the storage building and the method of storage shall not relieve the Supplier of responsibility for the quality and fitness of the seeds at the time of their use.

4.2.3

Seed Mixture

A. Seed species, rate per acre, and other data relevant to permanent seeding are given in Table 1.

B. Seed species, rate per acre, and other data relevant to temporary seeding are given in Table 2.

TABLE 1
ACCEPTABLE MIXTURES FOR PERMANENT SEEDING

Mixture	Seed Species (1)	Seeding Rate, Pure Live Seed for Conventional Seed Application (2)		Suitable pH	Site Suitability			Acceptable Dates for Seeding
		Lbs. per acre	Lbs. per 1,000 sq. ft.		Sunny, Dry	Well Drained	Wet	
1	Smooth Bromegrass or Tall Fescue	30	0.75	6.0-7.5	X	X	X	4-1 to 6-1 8-1 to 9-1
	Alfalfa or Birdsfoot Trefoil	10	0.25					
2	Smooth Bromegrass or Tall Fescue	30	0.75	6.0-8.0	X	X		4-1 to 6-1 8-1 to 9-1
	Crown Vetch	20	0.50					
3	Tall Fescue	15	0.35	5.5-7.5		X	X	4-1 to 6-1 8-1 to 9-1
	Timothy or Redtop	3	0.07					
	Birdsfoot Trefoil	15	0.35					
4	Reed Canary Grass	15	0.35	5.5-7.5	X	X		4-1 to 6-1 8-1 to 9-1
	Smooth Bromegrass or Tall Fescue	15	0.35					
	Ladino (optional)	3	0.07					

Notes: (1) Mixtures as defined by SCS for Illinois.

(2) Triple the seeding rate shown in the table when hydro seeding.

TABLE 2
ACCEPTABLE MIXTURES FOR TEMPORARY SEEDING

MIXTURE	SEED SPECIES	MAXIMUM WEED SEED (percentage)	SEEDING RATE PER ACRE	SUITABLE pH	PLANTING DEPTH	ACCEPTABLE DATES FOR SEEDING
1	Wheat	0.50	150 lbs	5.5 to 7.0	1" to 1 ½"	3-1 to 5-15 7-1 to 10-15
2	Cereal Rye	0.50	150 lbs	5.5 to7.0	1" to 1 ½"	3-1 to 5-15 7-1 to 10-15
3	Spring Oats	0.50	100 lbs	5.5 to 7.0	1"	3-1 to 7-1
4	Perennial Ryegrass	0.50	40 lbs	5.0 to 7.5	1/4"	4-1 to 6-1 8-1 to 9-15

4.3
Lime (Agricultural Ground Limestone)

Agricultural lime shall be flour grade meeting the requirements of ASTM C602.

4.4
Fertilizer

A. Fertilizer shall be a standard brand commercial grade of inorganic fertilizer furnished in unopened containers. The material may be separate or in a mixture containing the percentage of total nitrogen, available phosphoric acid and water-soluble potash in the amounts specified. If materials are separate, the Buyer shall be present when the separate fertilizers are mixed in the field. The fertilizer shall be odor free.

B. Fertilizer shall be supplied in one of the following forms:

- A dry free-flowing granular fertilizer suitable for application by an agricultural fertilizer spreader.
- A soluble form that will permit complete suspension of insoluble particles in water, suitable for application by power sprayer.

C. The following information shall be shown on the fertilizer container or on a tag attached thereto:

- Name and address of manufacturer.
- Name, brand or trademark.
- Number of net pounds of ready-mixed material in the package.
- Chemical composition or analysis.
- Guarantee of analysis.

4.5
Mulch

4.5.1
Straw Mulch

A. Straw shall be stalks of small grain straw of wheat, rye, oats, barley or other approved grain. Straw shall be air dried and free of grain and noxious weed seed, other materials detrimental to plant life, and mold.

B. Straw shall be seasoned before bailing or loading. Straw mulch shall be suitable for spreading with mulch blower equipment.

C. Old dry straw which breaks up in the crimping process instead of bending, or straw in such advanced stages of decomposition that it will smother or retard the normal growth of grass, is not acceptable.

4.5.2
Wood Cellulose Fiber Mulch

A. Wood cellulose fiber shall be partly digested wood fibers.

B. The material shall be dyed green.

C. The material shall not contain growth or organism inhibiting agents.

D. The material shall be air-dried with a minimum of 30 percent of the fibers 3.7 mm (0.145 inch) or longer.

4.5.3
Binder Sprays

A. Cutback Asphalt shall be in accordance with ASTM D2026 (Slow-Curing Type), ASTM D2027 (Medium-Curing Type) or ASTM D2028 (Rapid-Curing Type).

B. Emulsified Asphalt shall be in accordance with D977 (Emulsified Asphalt) or D2397 (Cationic Emulsified Asphalt).

4.6
Tackifier (Synthetic Binder)

A. Tackifier material shall be an acrylic copolymer or a polyvinyl acetate emulsion in a liquid form. The material may contain additives to enhance its ability to penetrate the soil.

B. The material shall be non-toxic, non-flammable, and biodegradable.

C. Approved Materials:

- Soil Seal Concentrate manufactured by Soil Seal Corp., 1111 W. Sixth St., Los Angeles, California 90017, telephone number 213-481-7185.
- Reinco Mulch Binder and Terra Tac manufactured by Rienco Mulch Binder Corp., 520 North Avenue, Plainfield, New Jersey 07060, telephone number 1-800-526-7687.
- Aerospray 70 Binder manufactured by American Cyanamid Company, Mobile, Alabama 36601, telephone number 205-476-5800.

4.7
Inoculant

A. The inoculant for treating legume seeds shall be a pure culture of nitrogen fixing bacteria prepared specifically for the species and shall not be used later than the date indicated on the container. A mixing medium, as recommended by the manufacturer, shall be used to bond the inoculant to the seed.

B. All legumes not pre-inoculated shall be inoculated within 12 hours of seeding. If the seed was pre-inoculated more than 60 days prior to seeding then it must be reinoculated.

4.8
Matting for Erosion Control

A. Matting for erosion control may be one of the following unless a specific matting is specified on the Design Drawings.

- Jute mat shall be cloth of a uniform plain weave of undyed and unbleached single jute yarn, 48 inches in width, plus or minus 1 inch and weighing an average of 1.2 pounds per linear yard of cloth with a tolerance of plus or minus 5 percent, with approximately 78 warp ends per width of cloth and 41 weft ends per linear yard of cloth. The yarn shall be of a loosely twisted construction having an average twist of not less than 1.6 turns per inch and shall not vary in thickness by more than one-half its nominal diameter.

- Excelsior mat shall be wood excelsior, 48 inches in width plus or minus 1 inch and weighing 0.8 pounds per square yard plus or minus 10 percent. The excelsior material shall be covered with a netting to facilitate handling and to increase strength.
- Glass fiber matting of bonded textile glass fibers with an average fiber diameter of 8 to 12 microns, 2 to 4 inch strands of fiber bonded with phenol formaldehyde resin. Mat shall be roll type, water permeable, minimum thickness 1/4 inch, maximum thickness 1/2 inch, density not less than 3 pounds per cubic foot.

B. Staples for anchoring soil stabilizing materials shall be No. 11 gauge wire or heavier. Their length shall be 6 to 10 inches. Ten inch long staples shall be used on loose, unstable soils.

5.0
Execution

5.1
Site Preparation

A. Prior to seeding, install all erosion control facilities specified on the Design Drawings. These include: diversions, berms, sediment control traps, silt fences and straw bale dikes.

B. Grade areas as specified on the Design Drawings. Gullied and uneven areas shall be smoothed before starting seedbed preparation.

5.2
Limestone for pH Adjustment

A. The Supplier shall apply limestone as required to raise the pH of the subsoil. Apply a minimum of 4 tons of limestone per acre for clayey soils, 3 tons of limestone per acre for sandy loam, and 2 tons of limestone per acre for loamy sand or silty soils.

B. Thoroughly work the limestone into the subsoil to a depth of 2 to 3 inches with a harrow or disk. The limestone may be applied prior to or concurrently with the fertilizer described.

5.3
Fertilizer

A. The Supplier shall apply a 12-12-12 fertilizer to the subsoil at a rate of 300 pounds per acre.

B. Work the fertilizer into the soil to a depth of 2 to 3 inches with a harrow, disk, or rake. On slopes, operate the disk or rake across the slope.

C. If hydro seeding is used, the fertilizer may be added to the hydroseed mixture.

5.4
Tilling of Subsoil

Prior to placing the topsoil, scarify the subsoil to a depth of 3 inches immediately prior to spreading topsoil to ensure bonding of the topsoil and the subsoil. Repeat scarification in areas where equipment used for hauling and spreading topsoil has compacted the subsoil.

5.5

Placing Topsoil

Note: topsoil does not have to be placed for temporary seeding. Topsoil must be placed prior to permanent seeding.

A. Place topsoil during dry weather on a dry, unfrozen subgrade. Topsoil shall not be spread if it is frozen or muddy.

B. Remove large pieces of organic matter and foreign non-organic material from topsoil while spreading. There shall be no large roots, branches or trash of any kind in the topsoil.

C. Spread the topsoil to provide a compacted thickness of not less than 4 inches.

D. Compact the topsoil with a roller not exerting more than 100 pounds per square inch. The topsoil must be loose enough for water infiltration and root penetration. The soil surface on slopes shall be roughened to catch seeds if they are to be broadcast.

5.6

Seeding (Conventional Method)

A. Tables 1 and 2 list acceptable seed mixtures that may be used for seeding. The Supplier shall select a mixture from the appropriate table and plant within the dates shown in that table for that mixture.

B. Apply seed uniformly at the rate shown in the appropriate table with a rangeland grass drill or cultipacker type seeder, or broadcast seed uniformly. The seeding methods and equipment shall be submitted to the Buyer for approval prior to beginning work.

C. All seeders shall be calibrated and adjusted to sow seeds at the proper rate. Equipment shall be operated to ensure a complete and even coverage. Do not seed areas greater than that which can be mulched on the same day.

D. Do not sow immediately following a rain, where the ground is too dry, during windy periods, or otherwise when conditions are not proper for seeding.

E. No seeds shall be sown until the purity test has been completed for the seeds to be used and the tests show that the seed meets the noxious weed seed requirements.

F. Within 12 hours, all seeded areas shall be rolled at right angles to the runoff with a cultipacker or approved roller to compact the seedbed and place the seed in contact with the soil. The optimum depth for planting shall be 1/4 inch. Rolling is not required if the seeding equipment is equipped with a roller that achieves the desired compaction or a grass drill has been used. Note: For temporary seeding planted without topsoil, the optimum planting depth is shown in Table 2.

5.7

Mulching (Conventional Method)

5.7.1

Straw Mulching

A. All seeded areas shall be mulched with straw mulch within 24 hours after seeding. The mulch may be hand or machine applied. The mulch shall be uniformly applied in a loose enough condition to permit air to circulate, but compact enough to reduce erosion. About 25 percent of the solid surface should show through the mulch. If baled mulch material is used, care shall be taken that the material is in a loosened condition and contains no lumps or knots of compacted material.

B. Straw mulch shall be applied at the rate of 2 tons per acre, or 75 to 100 (two bales) pounds per 1,000 square feet.

C. Straw mulch shall be anchored immediately after placement to minimize loss by wind or water. Straw mulch shall be anchored using a mulch anchoring tool or by spraying with a liquid binder.

5.7.2
Anchoring Mulch Using a Mulch Anchoring Tool

A. The mulch anchoring tool shall be designed to punch and anchor the mulch into the top 2 to 3 inches of soil at 6 inch intervals. As an alternative, a smooth disk set in a straight position may be used.

B. On slopes flatter than 3 horizontal to 1 vertical, mulch anchoring shall cross the contour of the land (across slopes). On slopes steeper than 3 horizontal to 1 vertical, the mulch shall be anchored by tracking a bulldozer with 1-1/2 inch track cleats up and down slope making grooves running across the slope.

5.7.3
Anchoring Using a Sprayed Liquid Binder

A. A sprayed liquid binder may be used in lieu of crimping to anchor the mulch. The binder may be sprayed into the mulch as it leaves the blower pipe or it may be applied as an over spray. If over sprayed, the binder spray should be heavier at the edges where wind catches the mulch, in valleys and at crests of banks. Binder shall be applied uniformly over the remainder of the area. Caution shall be used when spraying binder near areas occupied by construction personnel.

B. Binder Spray shall be applied at the following rates:

- Cutback asphalt - Rapid curing (RC-70, RC-250, and RC-800) or medium curing (MC-250 or MC-800). Apply 5 gallons per 1,000 square feet or 218 gallons per acre.
- Emulsified asphalt - (SS-1, CSS-l, CMS-2, MS, RS-l, RS-2, CRS-l, and CRS-2). Apply 5 gallons per 1,000 square feet or 218 gallons per acre.
- Synthetic binders - Synthetic binders such as Acrylic Dir (Agri-Tac), DCA-70, Petroset or Terra Tack may be used at rates recommended by the manufacturer to anchor mulch material.

5.7.4
Repairing and Reseeding

A. Areas not mulched and anchored within 24 hours after seeding shall be reseeded and mulched.

B. Areas not properly mulched, or damaged due to construction activities, shall be repaired, reseeded, and remulched.

5.8
Hydro Seeding

A. Hydro seeding consists of spraying a slurry mixture of water, seed, fertilizer, mulch, and a tackifier on a prepared seed bed.

B. The slurry mixture shall be mixed and applied using a hydraulic seeder. Hydraulic seeding equipment shall include a pump rated and operated at not less than 100 gallons per minute and 100 psi pressure. The tank shall have a mechanical agitator powerful enough to keep the slurry mixture in a uniform suspension in water.

C. Hydrated lime **shall not** be added to the slurry mixture.

D. The slurry mixture shall contain a maximum of 55 percent solids (125 pounds of solids per 100 gallons of water).

E. The seed mixture shall be as specified in Table 1 or Table 2 except that the weight of seed in the slurry mixture shall be a minimum of three times the weight of pure live seed per acre specified in the appropriate table for conventional seed application.

F. The slurry mixture shall contain a minimum of 1500 pounds of wood cellulose fiber mulch per acre or 2000 pounds of straw mulch per acre.

G. The amount of tackifier provided per acre shall be in accordance with Manufacturer's recommendations.

H. The slurry-mixture shall contain a minimum of 1000 pounds of grade 12-12-12 fertilizer per acre or the equivalent weight of chemicals if another grade is used.

I. The soil surface shall be moist when the slurry mixture is applied.

5.9
Laying and Securing Matting

5.9.1
Laying and Securing Jute Matting

A. Prepare the seed bed as specified and lime, fertilize, and seed, except that when using jute matting, apply approximately one-half of the seed after laying the mat.

B. Most drainage channels will require multiple widths of jute matting. The total width shall be as specified on the Design Drawings. Unroll matting starting at the upper end of the channel allowing a 4 inch overlap of mattings along center of channel.

C. Bury the top ends of jute matting in a narrow trench. Backfill the trench and tamp firmly to conform to channel cross-section. Secure the matting with a row of staples about 4 inches down slope from the trench. Spacing between staples shall be a maximum of 6 inches.

D. Staple the 4 inch overlap in the center of the channel using an 18 inch spacing between staples. Before stapling the outer edges of the matting, make sure the matting is smooth and in firm contact with the soil. Staples shall be placed 2 feet apart along the outer edge of matting.

E. Where one roll of jute matting ends and another begins, the end of the top strip shall overlap the upper end of the lower strip by 4 inches, shiplap fashion.

F. Where matting crosses erosion stops, reinforce with a double row of staples placed six (6) inches apart in a staggered pattern on either side of erosion stop. Likewise, overlaps joining the length of matting together and the discharge end of the matting liner should be similarly secured with 2 double rows of staples.

5.9.2

Laying and Securing Excelsior Matting

A. Provide the same seedbed preparation as specified for jute matting with the exception that all seeding must be completed before laying excelsior matting.

B. Bury the top ends of excelsior matting in a trench as described for jute matting. As the blankets are unrolled down slope, the matting must be on top with the wood fibers in contact with the soils. Butt snugly at the ends and sides before stapling.

C. Using two (2) foot spacing between staples, excelsior matting shall be secured with four rows for each strip, with one row along each edge and alternating parallel rows down the center. The stapling over erosion stops, entrance and discharge ends of matting and butted end joints shall be the same as described for jute matting.

5.10

Construction Completed after Acceptable Seeding Dates

When construction is completed between October 15 and March 1 prepare the seedbed, fertilize and mulch as specified. Apply seed for permanent seed sometime between December 1 and March 1 increasing the seeding rates shown in Table 1 by 50 percent.

6.0

Protection

Planted areas shall be protected from damage and erosion. The Supplier shall provide and erect temporary barriers and signs as necessary to prevent vehicles, equipment and foot traffic from damaging seeded areas.

7.0

Maintenance

The Supplier shall perform the following maintenance tasks:

A. Keep seedbed continually moist with light, frequent sprinklings several times a day to prevent seedlings from drying out.

B. Inspect periodically after planting to see that vegetative stands are adequately established. Immediately reseed areas which show bare spots larger than 2 feet by 2 feet after germination.

C. Check for erosion damage after storm events and repair damage. Reseed and mulch, if necessary.

D. Fertilize newly permanent seeded areas one year after seeding with 300 pounds per acre of a complete (N-P-K) 10-10-10 or equivalent turf type slow release fertilizer.

- Application rate per acre shall be:

  Nitrogen (N) - 120 pounds of actual nitrogen.

Phosphorus (P) - 120 pounds of P_20_5.

Potassium (K) - 120 pounds of K_20.

Appendix E: Hennepin Power Station; West Ash Disposal Pond Maintenance Plan (2013)

DYNEGY MIDWEST GENERATION, LLC

Hennepin Power Station
Hennepin, Illinois

Putnam County

West Ash Disposal Pond

IDNR Permit No. (not permitted)

Dam ID No. (not permitted)

Maintenance Plan

September 2013

TABLE OF CONTENTS

1.0 GENERAL

The following operations and maintenance procedures are provided to maintain the structural integrity of the west ash storage surface impoundment at the Hennepin Power Station, which is unclassified and unpermitted, by the Illinois Department of Natural Resources, Office of Water Resources.

2.0 EMERGENCY OPERATIONS

2.1 Unusual Conditions

Any unusual condition discovered during major storm events or routine inspection, which may constitute an emergency, shall be handled as follows. Notice of any type of emergency involving the dikes or outfall shall be made to the Shift Leader on duty [(815) 339-9211]. The Shift Leader on duty shall notify the Station Manager, Ted Lindenbusch [home: (815) 875-2381], or, in his absence, the Environmental Coordinator, John P. Augspols [home: (815) 925-7488]. One of the above designated personnel shall notify the following city, county, state and federal regulatory authorities of the emergency condition.

- Division of Water Resources, Dam Safety Section, Dam Safety Engineers (217) 782-3862
- Illinois Emergency Management Agency, 24-hour service 1-(800) 782-7860
- Putnam County Sheriff/Hennepin Police Department (815) 925-7015
- Senior Director – Environmental Compliance, Dynegy Operating Company (618) 206-5912

2.2 Dewatering

The Station Manager or the Environmental Coordinator shall have the responsibility of determining how repairs shall be accomplished and whether dewatering of the disposal facility is necessary. Emergency dewatering shall be accomplished by portable pumps.

3.0 MAINTENANCE

3.1 Vegetation

Dikes shall be maintained to protect the structural integrity of the disposal facility. Damaged and barren areas shall be repaired as soon as appropriate after being discovered. Damaged areas shall be filled with topsoil. Limed, fertilized, and seeded with appropriate vegetation. Trees and shrubs observed during semiannual inspections shall be cut and removed from the dikes and discharge channel. This shall be done as frequently as is necessary to insure that no tree reaches a size where the root structure would require removal and filling. Woody vegetation, shrubs, and trees shall be removed during the early stages of growth before reaching a three-inch diameter.

Low growing vegetation, a prairie grass mixture that grows to a height of no more than six inches, shall be planted and maintained to facilitate inspections.

3.2 Discharge Structure

The discharge structure shall be inspected periodically for significant corrosion and deterioriation. Any defects discovered shall be promptly repaired.

3.3 Animal Damage and Repairs

Animal burrows discovered during inspections shall be promptly repaired by filling with grout.

3.4 Restriction of Unauthorized Vehicles

Facility approaches shall be posted with signs restricting unauthorized travel on the roadways and slopes.

3.5 Inspections/Remedial Measures

3.5.1 Weekly Inspections

Weekly inspections of the perimeter berms shall be conducted, looking for seepage and slumping, and unusual seepage at and/or blockage of the outfall structures in each cell. All findings shall be entered into the weekly inspection checklist, discussed in Section 4.0. Maintenance activities shall be initiated, if required. Refer to Section 4.0 for the recommended inspection checklist to be used for the weekly inspections.

3.5.2 Quarterly Inspections

Inspections shall be made quarterly by Station personnel to determine the general condition of the dam and embankments. During these inspections, embankment erosion, tree growth, and embankment seepage shall be monitored. Seepage shall be observed for change in quantity and coloration. Refer to Section 4.0, for the recommended inspection checklist to be used for documenting the quarterly inspections.

3.5.3 Annual Inspections

An annual inspection shall be made by a licensed professional engineer. This inspection shall follow the Illinois Department of natural Resources (IDNR) *Guidelines and Forms for Inspection of Illinois Dams*, and shall be followed by verbal and written reports by the consulting engineer. Based on the findings of the inspection, the Station Manager shall implement corrective action as required to promote dam safety. Procedures and methods for corrective action shall be performed in accordance with recommendations of the consulting engineer and as outlined above. Because the dam is not permitted by the IDNR, copies of the engineer’s report, along with corrective action taken, will not be reported to the IDNR.

4.0 INSPECTION CHECKLISTS

The following Inspection checklists should be used during the weekly and quarterly inspections.

WEEKLY DAM INSPECTION FORM

Dam Location: Hennepin Power Station – West Ash Pond

Owner: Dynegy Midwest Generation, LLC, Havana Power Station

Permit No.: Not permitted **Class of Dam: Not classified**

Type of Dam: Homogeneous earth dam

Type of Spillway: Drop structure

Date Inspected: ______________________

Weather Conditions: ____

Pool Elevation: ______________________

Inspection Personnel:

______________________________ ______________________

Name / Title **Signature**

Inspection Item	Conditions	Location of Problem and Recommended Remedial Measures and Implementation Schedule
Vertical and Horizontal Alignment of Crest		
Unusual Movement or Cracking at or Beyond Toe		
Seepage		
Vegetative Cover		
Embankment Erosion		
Structural Cracking		
Outfall Structures		
Other		

QUARTERLY DAM INSPECTION FORM

Dam Location: Hennepin Power Station – West Ash Pond

Owner: Dynegy Midwest Generation, LLC, Hennepin Power Station

Permit No.: Not permitted **Class of Dam: Not classified**

Type of Dam: Homogeneous earth dam

Type of Spillway: Drop structure

Date Inspected: ________________

Weather Conditions: ____

Pool Elevation: ________________________

Inspection Personnel:

____

Name / Title **Signature**

Inspection Item	Conditions	Location of Problem and Recommended Remedial Measures and Implementation Schedule
Vertical and Horizontal Alignment of Crest	Good condition, with no significant issues	
Downstream Fill Slopes	Good condition, with no significant issues	
Upstream Fill Slopes	Good condition, with no significant issues	
Unusual Movement or Cracking at or Beyond Toe	Good condition, with no significant issues	
Seepage (Condition/Color)	Good condition, with no significant issues	
Vegetative Cover (Tree growth)	Good condition, with no significant issues	
Animal Damage	Good condition, with no significant issues	
Embankment Erosion	Good condition, with no significant issues	
Water Passages	Good condition, with no significant issues	
Structural Cracking	Good condition, with no significant issues	
Outfall Structures	Good condition	
Other		

Appendix F: Hennepin Power Station; Old East Ash Disposal Pond Maintenance Plan (2013)

DYNEGY MIDWEST GENERATION, LLC

Hennepin Power Station
Hennepin, Illinois

Putnam County

Old East Ash Disposal Pond

IDNR Permit No. (not permitted)

Dam ID No. (not permitted)

Maintenance Plan

September 2013

TABLE OF CONTENTS

1.0 GENERAL

The following operations and maintenance procedures are provided to maintain the structural integrity of the old east ash storage surface impoundment at the Hennepin Power Station, which is unclassified and unpermitted, by the Illinois Department of Natural Resources, Office of Water Resources.

This is primarily the @ 0.5 mile significant berm system that extends along the Illinois River. The old east ash pond system consists of the inactive cells # 2 and # 4. As a result of the May 2011 USEPA dam assessment, a dam safety permit was submitted to IDNR in May 2013, to address major modifications to this significant berm. These major modifications include extensive tree removal and resloping. Resloping is required to improve slope stability and allow safe access to slope, for long-term mowing and maintenance.

2.0 EMERGENCY OPERATIONS

2.1 Unusual Conditions

Any unusual condition discovered during major storm events or routine inspection, which may constitute an emergency, shall be handled as follows. Notice of any type of emergency involving the dikes or outfall shall be made to the Shift Leader on duty [(815) 339-9211]. The Shift Leader on duty shall notify the Station Manager, Ted Lindenbusch [home: (815) 875-2381], or, in his absence, the Environmental Coordinator, John P. Augspols [home: (815) 925-7488]. One of the above designated personnel shall notify the following city, county, state and federal regulatory authorities of the emergency condition.

- Division of Water Resources, Dam Safety Section, Dam Safety Engineers (217) 782-3862
- Illinois Emergency Management Agency, 24-hour service 1-(800) 782-7860
- Putnam County Sheriff/Hennepin Police Department (815) 925-7015
- Senior Director – Environmental Compliance, Dynegy Operating Company (618) 206-5912

2.2 Dewatering

Not applicable.

3.0 MAINTENANCE

3.1 Vegetation

Dikes shall be maintained to protect the structural integrity of the disposal facility. Damaged and barren areas shall be repaired as soon as appropriate after being discovered. Damaged areas shall be filled with topsoil. Limed, fertilized, and seeded with appropriate vegetation. Trees and shrubs observed during semiannual inspections shall be cut and removed from the dikes and discharge channel. This shall be done as frequently as is necessary to insure that no tree reaches a size where the root structure would require removal and filling. Woody vegetation, shrubs, and trees shall be removed during the early stages of growth before reaching a three-inch diameter.

Low growing vegetation, a prairie grass mixture that grows to a height of no more than six inches, shall be planted and maintained to facilitate inspections.

3.2 Discharge Structure

Not applicable.

3.3 Animal Damage and Repairs

Animal burrows discovered during inspections shall be promptly repaired by filling with grout.

3.4 Restriction of Unauthorized Vehicles

Facility approaches shall be posted with signs restricting unauthorized travel on the roadways and slopes.

3.5 Inspections/Remedial Measures

3.5.1 Weekly Inspections

Weekly inspections of the perimeter berms shall be conducted, looking for seepage and slumping. All findings shall be entered into the weekly inspection checklist, discussed in Section 4.0. Maintenance activities shall be initiated, if required. Refer to Section 4.0 for the recommended inspection checklist to be used for the weekly inspections.

3.5.2 Quarterly Inspections

Inspections shall be made quarterly by Station personnel to determine the general condition of the dam and embankments. During these inspections, embankment erosion, tree growth, and embankment seepage shall be monitored. Seepage shall be observed for change in quantity and coloration. Refer to Section 4.0, for the recommended inspection checklist to be used for documenting the quarterly inspections.

3.5.3 Annual Inspections

An annual inspection shall be made by a licensed professional engineer. This inspection shall follow the Illinois Department of natural Resources (IDNR) *Guidelines and Forms for Inspection of Illinois Dams*, and shall be followed by verbal and written reports by the consulting engineer. Based on the findings of the inspection, the Station Manager shall implement corrective action as required to promote dam safety. Procedures and methods for corrective action shall be performed in accordance with recommendations of the consulting engineer and as outlined above. Because the dam is not permitted by the IDNR, copies of the engineer's report, along with corrective action taken, will not be reported to the IDNR.

4.0 INSPECTION CHECKLISTS

The following Inspection checklists should be used during the weekly and quarterly inspections.

WEEKLY DAM INSPECTION FORM

Dam Location: **Hennepin Power Station – Old East Ash Pond**

Owner: **Dynegy Midwest Generation, LLC, Havana Power Station**

Permit No.: **Not permitted** **Class of Dam: Not classified**

Type of Dam: **Homogeneous earth dam**

Type of Spillway: **N/A**

Date Inspected: ______________________

Weather Conditions: ____

Pool Elevation: ______________________

Inspection Personnel:

___________________________________ ________________________

Name / Title **Signature**

Inspection Item	Conditions	Location of Problem and Recommended Remedial Measures and Implementation Schedule
Vertical and Horizontal Alignment of Crest		
Unusual Movement or Cracking at or Beyond Toe		
Seepage		
Vegetative Cover		
Embankment Erosion		
Structural Cracking		
Outfall Structures		
Other		

QUARTERLY DAM INSPECTION FORM

Dam Location: Hennepin Power Station – Old East Ash Pond

Owner: Dynegy Midwest Generation, LLC, Hennepin Power Station

Permit No.: Not permitted **Class of Dam: Not classified**

Type of Dam: Homogeneous earth dam

Type of Spillway: Not applicable

Date Inspected: ________________

Weather Conditions: ____

Pool Elevation: ______________________

Inspection Personnel:

____

Name / Title **Signature**

Inspection Item	Conditions	Location of Problem and Recommended Remedial Measures and Implementation Schedule
Vertical and Horizontal Alignment of Crest	Good condition, with no significant issues	
Downstream Fill Slopes	Good condition, with no significant issues	
Upstream Fill Slopes	Good condition, with no significant issues	
Unusual Movement or Cracking at or Beyond Toe	Good condition, with no significant issues	
Seepage (Condition/Color)	Good condition, with no significant issues	
Vegetative Cover (Tree growth)	Good condition, with no significant issues	
Animal Damage	Good condition, with no significant issues	
Embankment Erosion	Good condition, with no significant issues	
Water Passages	Good condition, with no significant issues	
Structural Cracking	Good condition, with no significant issues	
Outfall Structures	Good condition	
Other		

Appendix G: Hennepin Power Station; East Ash Disposal Pond Maintenance Plan (2014)

DYNEGY MIDWEST GENERATION, LLC

Hennepin Power Station
Hennepin, Illinois

Putnam County

East Ash Disposal Pond

Small Class III Dam

IDNR Permit No. DS2011079

Dam ID No. IL50363

Maintenance Plan

Revised – August 2014

TABLE OF CONTENTS

1.0 GENERAL

The following operations and maintenance procedures are provided to maintain the structural integrity of the east ash storage surface impoundment at the Hennepin Power Station, which is classified as a small Class III dam by the Illinois Department of Natural Resources, Office of Water Resources. The primary pond's maximum normal poll elevation will be 489.5 msl with a dam crest at elevation 494.0 msl. The secondary pond's maximum normal pool elevation will be 480.5 with a dam crest at 494.0 msl.

2.0 EMERGENCY OPERATIONS

2.1 Unusual Conditions

Any unusual condition discovered during major storm events or routine inspection, which may constitute an emergency, shall be handled as follows. Notice of any type of emergency involving the dikes or outfall shall be made to the Shift Leader on duty [(815) 339-9211]. The Shift Leader on duty shall notify the Managing Director, Byron Veech [cell: (309) 543-8714], or, in his absence, the Environmental Coordinator, John P. Augspols [home: (815) 925-7488]. One of the above designated personnel shall notify the following city, county, state and federal regulatory authorities of the emergency condition.

- Division of Water Resources, Dam Safety Section, Dam Safety Engineers (217) 782-3862
- Illinois Emergency Management Agency, 24-hour service 1-(800) 782-7860
- Putnam County Sheriff/Hennepin Police Department (815) 925-7015
- Senior Director – Environmental Compliance, Dynegy Operating Company (618) 343-7761

2.2 Dewatering

The Station Manager or the Environmental Coordinator shall have the responsibility of determining how repairs shall be accomplished and whether dewatering of the disposal facility is necessary. Dewatering shall be accomplished by manually removing the concrete beams from the primary and/or secondary pond structures until the desired water level is reached.

3.0 MAINTENANCE

3.1 Vegetation

Dikes shall be maintained to protect the structural integrity of the disposal facility. Damaged and barren areas shall be repaired as soon as appropriate after being discovered. Damaged areas shall be filled with topsoil. Limed, fertilized, and seeded with appropriate vegetation. Trees and shrubs observed during periodic inspections shall be cut and removed from the dikes and discharge channel. This shall be done as frequently as is necessary to insure that no tree reaches a size where the root structure would require removal and filling. Woody vegetation, shrubs, and trees shall be removed during the early stages of growth before reaching a three-inch diameter.

Low growing vegetation shall be planted and maintained to facilitate inspections.

3.2 Discharge Structure

The discharge structure shall be inspected periodically for significant corrosion, spalling, and cracking. Any defects discovered shall be promptly repaired.

3.3 Animal Damage and Repairs

Animal burrows discovered during inspections shall be promptly repaired by filling with grout.

3.4 Restriction of Unauthorized Vehicles

Facility approaches shall be posted with signs restricting unauthorized travel on the roadways and slopes.

3.5 Inspections/Remedial Measures

3.5.1 Weekly Inspections

Weekly inspections of the perimeter berms shall be conducted, looking for seepage and slumping, and unusual seepage at and/or blockage of the outfall structures in each cell. All findings shall be entered into the weekly inspection checklist, discussed in Section 4.0. Maintenance activities shall be initiated, if required. Refer to Section 4.0 for the recommended inspection checklist to be used for the weekly inspections.

3.5.2 Quarterly Inspections

Inspections shall be made quarterly by Station personnel to determine the general condition of the dam and embankments. During these inspections, embankment erosion, tree growth, and embankment seepage shall be monitored. Seepage shall be observed for change in quantity and coloration. Refer to Section 4.0, for the recommended inspection checklist to be used for documenting the quarterly inspections.

3.5.3 Five-Year Inspections

Every five years, an inspection shall be made by a licensed professional engineer. This inspection shall follow the Illinois Department of natural Resources (IDNR) *Guidelines and Forms for Inspection of Illinois Dams*, and shall be followed by verbal and written reports by the consulting engineer. Based on the findings of the inspection, the Station Manager shall implement corrective action as required to promote dam safety. Procedures and methods for corrective action shall be performed in accordance with recommendations of the consulting engineer and as outlined above. Copies of the engineer's report, along with corrective actin taken, shall be reported to the IDNR.

3.6 Annual Statement

An annual statement on forms furnished by IDNR, certifying compliance with this maintenance plan, shall be submitted to IDNR.

4.0 INSPECTION CHECKLISTS

The following Inspection checklists should be used during the weekly and quarterly inspections.

WEEKLY DAM INSPECTION FORM

Dam Location: **Hennepin Power Station – East Ash Pond**
Owner: **Dynegy Midwest Generation, LLC, Havana Power Station**
Permit No.:DS2011079 **Class of Dam: III**
Type of Dam: **Homogeneous earth dam, with clay and geosynthetic / clay liner**
Type of Spillway: **Drop structure and stop logs**

Date Inspected: ________________________
Weather Conditions: ____
Pool Elevation: ________________________

Inspection Personnel:

______________________________________ ________________________
Name / Title **Signature**

Inspection Item	Conditions	Location of Problem and Recommended Remedial Measures and Implementation Schedule
Vertical and Horizontal Alignment of Crest		
Unusual Movement or Cracking at or Beyond Toe		
Seepage		
Vegetative Cover		
Embankment Erosion		
Structural Cracking		
Outfall Structures		
Other		

QUARTERLY DAM INSPECTION FORM

Dam Location: Hennepin Power Station – East Ash Pond

Owner: Dynegy Midwest Generation, LLC, Hennepin Power Station

Permit No.:DS2011079 **Class of Dam: III**

Type of Dam: Homogeneous earth dam, with clay and geosynthetic / clay liner

Type of Spillway: Drop structure and stop logs

Date Inspected: ____________________

Weather Conditions: ____

Pool Elevation: ____________________________

Inspection Personnel:

____

Name / Title **Signature**

Inspection Item	Conditions	Location of Problem and Recommended Remedial Measures and Implementation Schedule
Vertical and Horizontal Alignment of Crest	Good condition, with no significant issues	
Downstream Fill Slopes	Good condition, with no significant issues	
Upstream Fill Slopes	Good condition, with no significant issues	
Unusual Movement or Cracking at or Beyond Toe	Good condition, with no significant issues	
Seepage (Condition/Color)	Good condition, with no significant issues	
Vegetative Cover (Tree growth)	Good condition, with no significant issues	
Animal Damage	Good condition, with no significant issues	
Embankment Erosion	Good condition, with no significant issues	
Water Passages	Good condition, with no significant issues	
Structural Cracking	Good condition, with no significant issues	
Outfall Structures	Good condition	
Other		

Attachment B

AECOM

Submitted to
Dynegy Midwest Generation
LLC
1500 Eastport Plaza Drive
Collinsville, IL 62234

Submitted by
AECOM
1001 Highlands Plaza Drive West,
Suite 300
St. Louis, MO 63110

October 2016

CCR Certification Report: Initial Structural Stability Assessment, Initial Safety Factor Assessment, and Initial Inflow Design Flood Control System Plan

For

East Ash Pond

At Hennepin Power Station

Table of Contents

Tables

Figures

Appendices

Executive Summary

The initial structural stability assessment, initial safety factor assessment, and initial inflow design flood control system plan for the East Ash Pond at the Hennepin Power Station have been prepared in accordance with the United States Environmental Protection Agency (USEPA) Coal Combustion Residual (CCR) Rule 40 Code of Federal Regulations (CFR) §257.73(d), §257.73(e), and §257.82, respectively. These regulations require that the specified structural stability, safety factor, and hydrologic and hydraulic (supporting the inflow design flood control system plan) assessments for an existing CCR surface impoundment be completed by October 17, 2016.

The engineering investigations, analyses, and evaluations determined that the East Ash Pond meets all requirements for the safety factor assessment and hydrologic and hydraulic analysis, as summarized in **Table ES-1**. All requirements for structural stability are met, except for the structural integrity of hydraulic structures (§257.73(d)(1)(vi)). In accordance with §257.73(d)(2), AECOM recommends that a CCTV pipe inspection be performed on the secondary spillway hydraulic structure pipe as soon as feasible and that this assessment report be updated with documentation of that inspection.

Table ES-1 – Certification Summary

Report Section	CCR Rule Reference	Requirement Summary	Requirement Met?	Comments
Initial Structural Stability Assessment				
3.1	§257.73(d)(1)(i)	Stable foundations and abutments	Yes	Foundations and abutments were found to be stable.
3.2	§257.73(d)(1)(ii)	Adequate slope protection	Yes	Slope protection is adequate.
3.3	§257.73(d)(1)(iii)	Sufficiency of dike compaction	Yes	Dike compaction is sufficient for expected ranges in loading conditions.
3.4	§257.73(d)(1)(iv)	Presence and condition of slope vegetation	Yes	Vegetation is present on exterior slopes and is maintained. Interior slopes have alternate protection (geomembrane liner).
3.5	§257.73(d)(1)(v)(A) and (B)	Adequacy of spillway design and management	Yes	Spillways are adequately designed and constructed and adequately manage flow during 1,000-year flood.
3.6	§257.73(d)(1)(vi)	Structural integrity of hydraulic structures	No	Requirement cannot be certified at this time due to inability to complete a CCTV pipe inspection of the discharge pipe to the East Polishing Pond due to submerged outfall conditions needed for plant operations. AECOM recommends inspecting this pipe as soon as feasible to address this issue.
3.7	§257.73(d)(1)(vii)	Stability of downstream slopes inundated by water body	Not Applicable	Inundation of exterior slopes is not expected.
Initial Safety Factor Assessment				
4.1	§257.73(e)(1)(i)	Maximum storage pool safety factor must be at least 1.50	Yes	Safety factors were calculated to be 2.14 and higher.
4.2	§257.73(e)(1)(ii)	Maximum surcharge pool safety factor must be at least 1.40	Yes	Safety factors were calculated to be 2.14 and higher.
4.3	§257.73(e)(1)(iii)	Seismic safety factor must be at least 1.00	Yes	Safety factors were calculated to be 2.53 and higher.
4.4	§257.73(e)(1)(iv)	For dikes constructed of soils that have susceptibility to liquefaction safety factor must be at least 1.20	Not Applicable	Dike soils are not susceptible to liquefaction.
Initial Inflow Design Flood Control System Plan				
5.1	§257.82(a)(1), (2), (3)	Adequacy of inflow design flood control system	Yes	Flood control system adequately manages inflow and peak discharge during the 1,000–year, 24-hour, Inflow Design Flood.
5.2	§257.82(b)	Discharge from the CCR Unit	Yes	Discharges of pollutants in violation of the NPDES permit are not expected to occur during both normal and 1,000-year, 24-hour, Inflow Design Flood conditions.

1 Introduction

This report documents that the structural stability assessment, safety factor assessment, and inflow design flood control system plan meet the requirements specified in 40 CFR §257.73(d), §257.73(e), and §257.82, respectively, to support the certification required under each of those regulatory provisions for the Hennepin Power Station East Ash Pond, except as noted herein. The East Ash Pond is an existing CCR surface impoundment as defined by 40 CFR §257.53. The CCR Rule requires that the specified initial structural stability assessment, initial safety factor assessment, and initial inflow design flood control system plan (i.e., hydrologic and hydraulic analysis) for an existing CCR surface impoundment be completed by October 17, 2016.

The Hennepin Power Station has one existing CCR surface impoundment, the East Ash Pond. The East Ash Pond has been evaluated to determine whether the structural stability, safety factor, and inflow design flood control system plan requirements are met. The following sections describe the evaluations performed and the results from the analyses, as supported by the underlying data and analyses included in the appendices.

2 Facility Description and Location Map

2.1 Overview of Existing Surface Impoundments

The Hennepin Power Station is a coal-fired power plant located near Hennepin, Illinois in Putnam County. The Hennepin Power Station is located on the south bank of the Illinois River, and the East Ash Pond is located approximately 0.4 miles east of the station. A site location map showing the Hennepin Power Station is in **Figure 1. Figure 2** presents the Hennepin Power Station site plan.

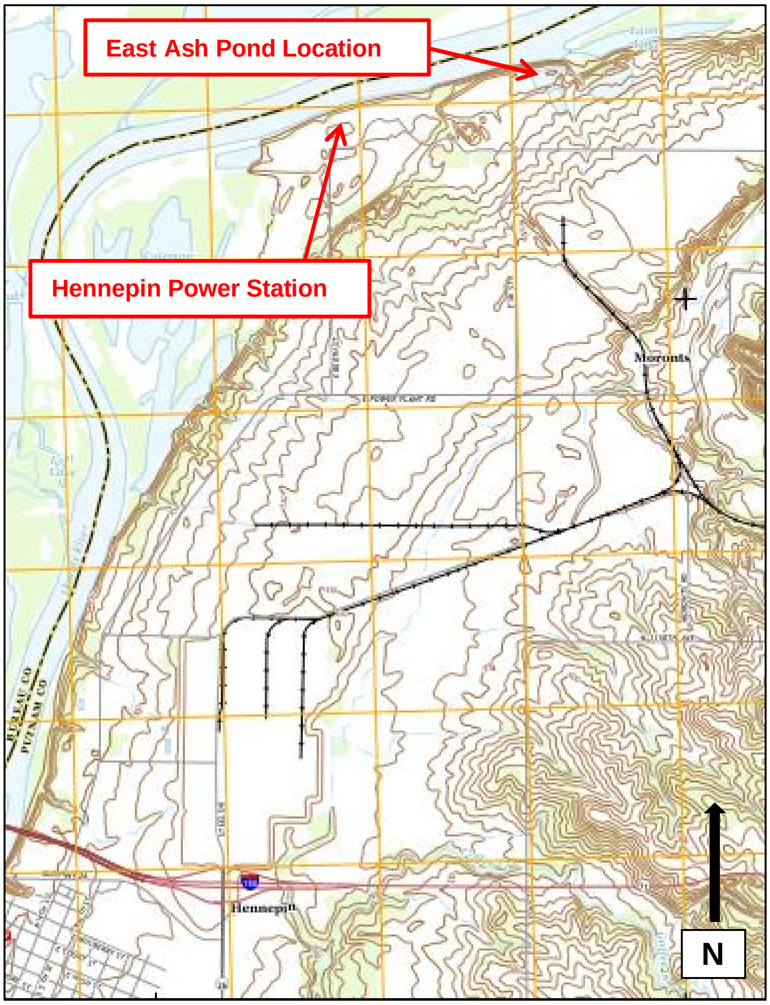


Figure 1 – Hennepin Power Station Location Map
(from United States Geological Survey Depue, IL 7.5' Topographic Maps, 2015)

One active CCR surface impoundment – the East Ash Pond – is utilized for managing CCRs generated by the Hennepin Power Station. The East Ash Pond has a significant hazard potential based on the initial hazard potential classification assessment performed by Stantec in 2016 in accordance with §257.73(a)(2).

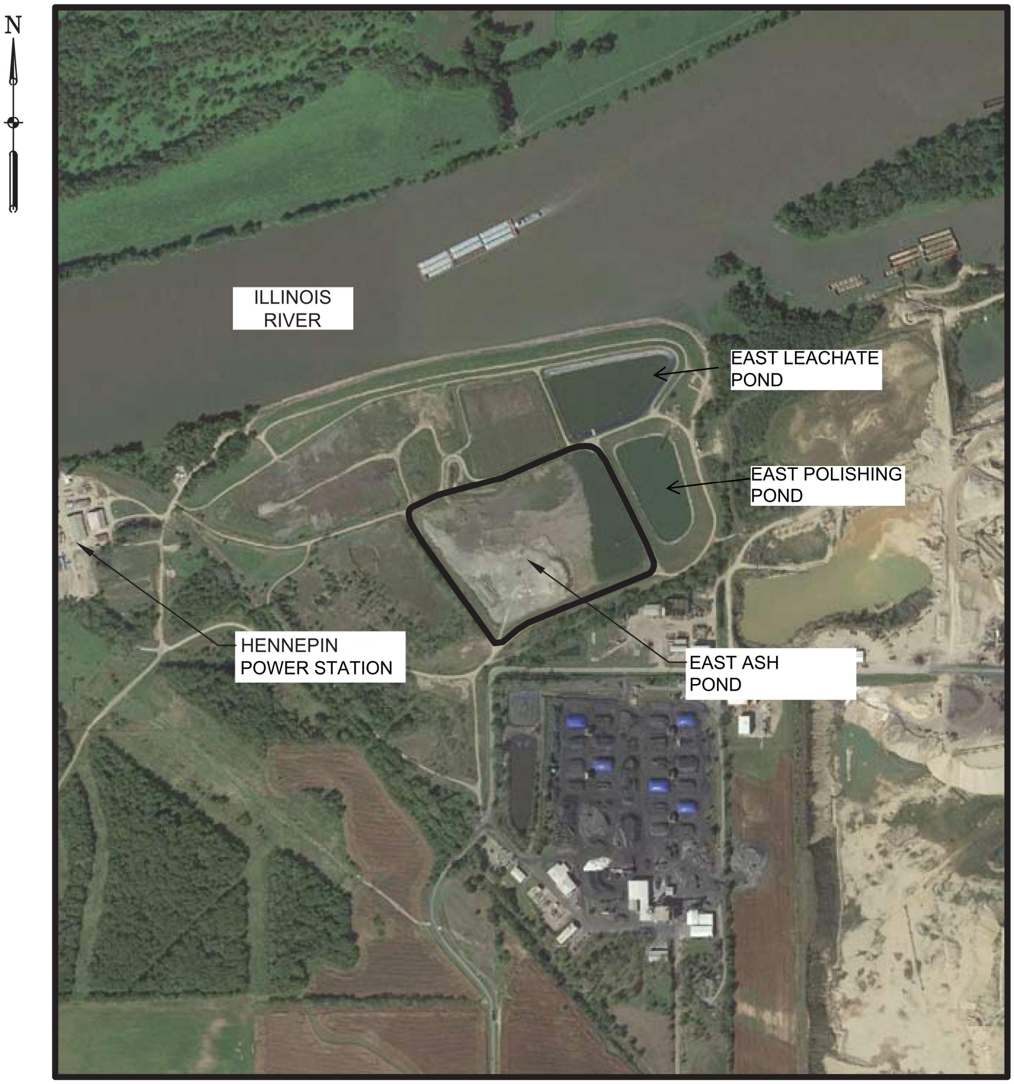


Figure 2 – Hennepin Power Station Site Plan
(Imagery from Google Earth Pro, 2016)

The East Ash Pond serves as the wet impoundment basin for CCR materials produced by the Hennepin Power Station. The East Ash Pond receives sluiced CCR materials and plant process waters from the power station via a single high density polyethylene (HDPE) sluice pipe that discharges into the northwest corner of the pond. Outflow from the East Ash Pond is discharged downstream to East Leachate Pond, an adjacent non-CCR surface impoundment, via a 18-inch diameter reinforced concrete pipe (RCP) culvert (invert elevation 489.9 feet) (all elevations in this report are in the NAVD88 datum, unless otherwise noted) that acts as the primary spillway. Additional outflow is discharged to East Polishing Pond, which is another adjacent non-CCR surface impoundment. Flow from the East Ash Pond to the East Polishing Pond is transmitted via a 7-ft. wide x 9-ft. wide concrete riser structure (invert elevation 490.6 feet) with a generally horizontal 36-inch RCP secondary spillway pipe. Flow from the East Leachate Pond is transmitted to the East Polishing Pond. Flow from the East Polishing Pond discharges into the Illinois River at a NPDES-permitted outfall.

The East Ash Pond is comprised of earthen embankments. Maximum embankment heights on the west and east sides are 16 and 36 feet, respectively, as referenced to the downstream toe. The downstream embankment slopes range from 3.5H:1V (horizontal to vertical) to 4H:1V and the interior slopes have an orientation of 3H:1V above El. 482 feet and 4H:1V below El. 482 feet. An embankment is not present on the south side of the East Ash Pond, where the impoundment is adjacent to natural high ground that slopes upward to the south. The dike on the north side of the East Ash Pond is adjacent to the former East Ash Pond No. 4, and CCRs within East Ash Pond No. 4 have been placed to approximately the crest elevation of the dike. On the south side of the north dike, CCRs within the East Ash Pond have also been placed to approximately the crest elevation of the dike. Therefore, the grade is essentially flat in this area, and a slope is not present. Embankment crest widths range from approximately 18 feet to 19 feet along the west and east sides of the East Ash Pond.

According to the “Modification to Primary Ash Pond” design drawings, the perimeter embankment was raised from an elevation of 483 feet to the current elevations of 493 to 500 feet in the early 2000’s. As part of this construction, a double layer of 45 mil reinforced polypropylene geomembrane liner was installed over a 12-inch thick clay layer on the slopes and keyed into the existing 4-foot thick clay liner system (design permeability of $1x10^{-7}$ centimeters per second) at an elevation of 480 feet. The clay liner then extends at a 4H:1V slope with the top of liner at an elevation of approximately 460.5 feet. A layer of 8-ounce polypropylene was placed under the 1 foot thick layer of clay and was terminated at the existing liner. Under the existing 4 foot thick clay liner is a 6-inch thick sand filter layer on the bottom of the pond and a 12-inch thick sand layer on the side slopes of the pond.

As currently operated, the normal pool of the East Ash Pond is El. 490.4 feet, based on the 2015 Weaver survey, as controlled by the primary spillway pipe invert. The East Ash Pond is approximately 21 acres in area. The total length of the embankments is approximately 3,800 feet. Additional details about the geometry and configuration of the pond are provided in the Geotechnical Report in **Appendix B**.

3 Initial Structural Stability Assessment

40 CFR §257.73(d)(1)
The owner or operator of the CCR unit must conduct initial and periodic structural stability assessments and document whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. The assessment must, at a minimum, document whether the CCR unit has been designed, constructed, operated, and maintained with [the standards in (d)(1)(i)-(vii)].

Analyses completed for the initial structural stability assessment of the Hennepin Power Station's East Ash Pond are described in this section. Data and analysis results in the following subsections were developed using recent and historical data provided by Dynegy Midwest Generation, LLC (DMG), including impoundment design information, spillway design information, survey data, historical data, analysis reports, and information about operational and maintenance procedures. These data were supplemented with subsurface investigation and laboratory data collected by AECOM in 2015.

DMG's operation of the East Ash Pond is consistent with the design and construction of the CCR unit. DMG follows an established maintenance program that quickly identifies and resolves issues of concern.

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

CCR unit designed, constructed, operated, and maintained with stable foundations and abutments.

Stability of the foundations of the East Ash Pond was evaluated by reviewing soil consistencies and phreatic data estimated from Standard Penetration Test (SPT) values, Cone Penetration testing (CPT), piezometer installation, and collected soil laboratory test data from the 2015 AECOM field investigation, which is discussed in more detail in **Section 4**. Based on these data, the East Ash Pond foundation materials generally consist of medium dense to very dense alluvial gravel with trace amounts of silt and clay. Borings were terminated in the alluvial gravel and were not extended to bedrock. The phreatic is located within the foundation of the East Ash Pond.

This information was used to perform slope stability analyses as required by §257.73(e)(1), which is discussed in more detail in **Section 4**. Safety factors for slip surfaces passing through the dike and foundation were found to meet or exceed the minimum requirements required by §257.73(e)(1), which indicates that the foundation of the East Ash Pond is stable. At the abutments, the soil conditions were found to be similar to the critical sections, although the embankment is shorter. Therefore, slope stability analyses were not performed specifically for the abutments as the factors of safety for the embankment analysis at the critical cross sections were judged to be higher than at the abutment, by inspection.

Based on this evaluation, the East Ash Pond meets the requirements presented in §257.73(d)(1)(i). A detailed presentation of the field and laboratory data collected for the foundations and the completed slope stability analyses can be found in **Appendix B**.

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

CCR unit designed, constructed, operated, and maintained with adequate slope protection to protect against surface erosion, wave action and adverse effects of sudden drawdown.

The adequacy of slope protection present at the East Ash Pond was evaluated by reviewing design drawings, operational and maintenance procedures, and conditions observed in the field during AECOM's June 8 and 9, 2015 site visit.

The exterior dike slopes have a 3.5H:1V to 4H:1V orientation and are covered with vegetation for slope protection. DMG regularly maintains the slopes, including repairing observed surface erosion and addressing areas of poor vegetation growth, as required.

Where the East Ash Pond shares its east dike with the East Leachate Pond, an exposed geomembrane liner is present on the exterior slopes of the East Ash Pond. DMG maintains the liner by repairing tears or rips if they occur. As the liner isolates the pool from the dike soils, it protects the dike against surface erosion and wave action. Sudden drawdown is not applicable to the exterior slopes of the East Ash Pond adjacent to the East Leachate Pond, as the liner serves to prevent saturation of the dike's soils below the normal pool.

Where the East Ash Pond shares its east dike with the East Polishing Pond, riprap slope protection is present on the lower portion of the exterior slope to protect from wave action and surface erosion. The pool level in the downstream East Polishing Pond is controlled by a concrete riser structure with stop logs. Although lowering the pool level in the downstream East Polishing Pond is not anticipated, DMG has instituted operational controls to limit the rate of pool lowering to 1 foot per week. This rate is expected to allow phreatic water from the embankments of the East Ash Pond to drain concurrently with the pool in the downstream East Polishing Pond, and reduce the potential for sudden drawdown conditions from developing in the East Ash Pond embankment. Therefore, sudden drawdown conditions in the embankment between the East Ash Pond and East Polishing Pond is not expected to occur due to operational controls, and slope protection to protect against the adverse effects of sudden drawdown is not required.

The interior dike slopes have a 3H:1V or shallower orientation and are covered with a 45-mil reinforced polypropylene geomembrane liner. DMG maintains the liner by repairing tears or rips as they occur. As the liner isolates the pool from the dike soils, it protects the dike against surface erosion and wave action. Sudden drawdown is not applicable to the interior slopes of the East Ash Pond, as the liner serves to prevent saturation of the dike's soils below the normal pool.

AECOM observed the slope protection described above to be adequately protecting against wave action and surface erosion for the interior and exterior slopes of the East Ash Pond. Based on this evaluation, the East Ash Pond meets the requirements in §257.73(d)(1)(ii).

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

CCR unit designed, constructed, operated, and maintained with dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit.

Compaction of the East Ash Pond dikes was evaluated using field data obtained from the 2015 AECOM geotechnical investigation and by reviewing design drawings and operational and maintenance procedures. Based on the 2015 AECOM data, both the original portion of the East Ash Pond dike and the raised portion of the dike are comprised of clay materials with some limited amounts of sand and gravel. SPT values indicate that the dike material is stiff to hard, which is indicative of mechanically compacted dikes. Slope stability analyses as required by §257.73(e)(1) found acceptable safety factors for each required loading condition, as presented in **Section 4**. Therefore, the dike compaction and density is sufficient for withstanding required ranges in loading conditions.

Based on this evaluation, the East Ash Pond meets the requirements in §257.73(d)(1)(iii). A detailed presentation of the field and laboratory data collected for the dikes and the completed slope stability analyses can be found in **Appendix B**.

3.4 Vegetated Slopes (§257.73(d)(1)(iv))[1]

CCR unit designed, constructed, operated, and maintained with vegetated slopes of dikes and surrounding areas, except for slopes which have an alternate form or forms of slope protection.

The adequacy of slope vegetation at the East Ash Pond was evaluated by reviewing conditions observed in the field during AECOM's June 8 and 9, 2015 site visit and by reviewing design drawings and operational and maintenance procedures. At the time of the site visit, the exterior slopes were vegetated or covered with riprap or an exposed geomembrane liner, which is an alternate form of slope protection. The interior slopes are covered with exposed geomembrane, which is an alternate form of slope protection. The vegetation on the exterior slopes is well-maintained. Regular maintenance manages the vegetation as described in this section.

Based on this evaluation, the East Ash Pond meets the requirements in §257.73(d)(1)(iv).

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[1] As modified by court order issued June 14, 2016, Utility Solid Waste Activities Group v. EPA, D.C. Cir. No. 15-1219 (order granting remand and vacatur of specific regulatory provisions).

3.5 Spillways (§257.73(d)(1)(v))

CCR unit designed, constructed, operated, and maintained with a single spillway or a combination of spillways configured as specified in [paragraph (A) and (B)]:

(A) All spillways must be either:

(1) of non-erodible construction and designed to carry sustained flows; or

(2) earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected.

(B) The combined capacity of all spillways must adequately manage flow during and following the peak discharge from a:

(1) Probable maximum flood (PMF) for a high hazard potential CCR surface impoundment; or

(2) 1000-year flood for a significant hazard potential CCR surface impoundment; or

(3) 100-year flood for a low hazard potential CCR surface impoundment.

The spillways at the East Ash Pond were evaluated using hydrologic and hydraulic analyses, conditions observed during AECOM's June 8 and 9, 2015 site visit, and historic design and construction information provided by DMG. The East Ash Pond has a significant hazard potential; therefore, the 1,000-year storm event is the design flood event for the East Ash Pond, per §257.73(d)(1)(v)(B).

The primary spillway system for the East Ash Pond includes an 18-inch diameter RCP culvert with an invert elevation of 489.9 feet that conveys flow to the East Leachate Pond. The secondary spillway for the East Ash Pond includes a vertical concrete riser structure with a 36-inch diameter RCP pipe used to convey flow to the East Polishing Pond. The reinforced concrete comprising both spillways is a non-erodible material designed to carry sustained flows. The capacity of the spillways was evaluated using hydrologic and hydraulic analyses. The analysis found that the spillways can adequately manage flow during peak discharge resulting from the 1,000-year storm event without overtopping of the embankments, as discussed in more detail in **Section 5**.

Based on these evaluations, the East Ash Pond meets the requirements in §257.73(d)(1)(v). A detailed presentation of the hydraulic and hydrologic analyses can be found in **Appendix C**.

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

CCR unit designed, constructed, operated, and maintained with hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure.

The structural stability and integrity of the East Ash Pond hydraulic structures were evaluated using design drawings, operational and maintenance procedures, conditions observed in the field, inspection data, and structural analyses collected and performed by AECOM. There are two hydraulic structures that pass through the dike of the East Ash Pond: the 18-inch RCP primary spillway and the 36-inch RCP secondary spillway. No other hydraulic structures are known to pass through the dike of or underlie the base of the East Ash Pond.

The 18-inch primary spillway pipe was inspected on July 21, 2016, using closed-circuit television (CCTV) inspection equipment. The inspection found that the primary spillway outlet structure is free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris accumulation that may negatively affect the hydraulic operation of the structure. A detailed presentation of the CCTV inspection of the 18-inch primary spillway pipe can be found in **Appendix A**. Based on the evaluation, the 18-inch primary spillway pipe meets the requirements of §257.73(d)(1)(vi).

An evaluation of the 36-inch secondary spillway pipe design drawings, operational and maintenance procedures and conditions observed in the field did not identify any issues. However, the 36-inch secondary spillway pipe has not yet been inspected using CCTV equipment because the outlet of the pipe is below the normal pool elevation in the downstream East Polishing Pond, causing the pipe to be completely full of water during normal conditions. The pool level in the East Polishing Pond must be maintained above the pipe elevation as part of station operations, and the condition precludes camera inspection. Because a thorough visual inspection of the 36-inch secondary spillway pipe has not yet been completed, AECOM cannot currently conclude that the §257.73(d)(1)(vi) requirements have been met for the secondary spillway pipe. As a corrective measure, AECOM recommends that the 36-inch secondary spillway pipe be inspected using CCTV equipment as soon as feasible and that this assessment be updated with documentation of the inspection at that time.

3.7 Downstream Slope Inundation/Stability (§257.73(d)(1)(vii))

CCR unit designed, constructed, operated, and maintained with, for CCR units with downstream slopes which can be inundated by the pool of an adjacent water body, such as a river, stream or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body or sudden drawdown of the adjacent water body.

The structural stability of the downstream slope of the East Ash Pond was evaluated by comparing the location of the East Ash Pond relative to published flood maps for the area. The East Ash Pond is outside the flood zone shown on the FEMA Federal Insurance Rate Map (FIRM) map for Putnam County, Illinois. The East Ash Pond is adjacent to the downstream East Polishing Pond and East Leachate Pond non-CCR units, however these are not rivers, streams, or lakes, and drawdown of these non-CCR units is discussed in **Section 3.2** of this report, pursuant to §257.73(d)(1)(ii). **Figure 3** shows the footprint of the East Ash Pond within the FIRM map (FEMA, 2011).

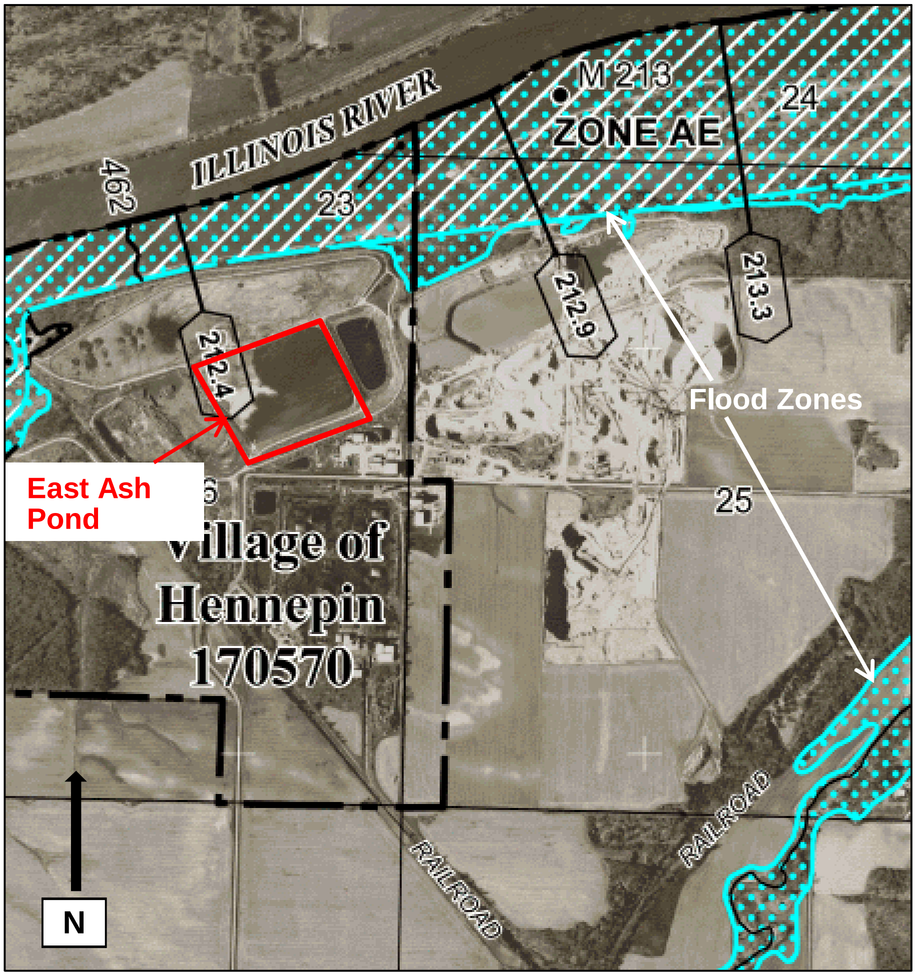


Figure 3. East Ash Pond Flood Zone Map
(from FEMA Flood Hazard Boundary Map, Putnam County, Illinois, 2011)

Based on this assessment, the requirements in §257.73(d)(1)(vii) are not applicable to the East Ash Pond, as inundation of the downstream slopes by a river, lake, or stream is not expected to occur.

4 Initial Safety Factor Assessment

40 CFR §257.73(e)(1)
The owner or operator must conduct initial and periodic safety factor assessments for each CCR unit and document whether the calculated factors of safety for each CCR unit achieve the minimum safety factors specified in (e)(1)(i) through (iv) of this section for the critical cross section of the embankment. The critical cross section is the cross section anticipated to be the most susceptible of all cross sections to structural failure based on appropriate engineering considerations, including loading conditions. The safety factor assessments must be supported by appropriate engineering calculations.

A geotechnical investigation program and stability analyses were performed by AECOM in 2015 to evaluate the design, performance, and condition of the earthen dikes of the East Ash Pond. The exploration consisted of 4 auger borings, installation of 2 piezometers to monitor phreatic conditions, 6 Cone Penetration Test (CPT) soundings with shear wave velocity measurements and pore pressure dissipation testing, and laboratory program including strength, consolidation, and index testing. Data collected from the 2015 AECOM investigation, available design drawings, construction records, inspection reports, previous engineering investigations, and other pertinent historic documents were utilized to perform the safety factor assessment and geotechnical analyses.

In general, the subsurface conditions at the East Ash Pond consist of a stiff to hard compacted clay embankment overlying medium dense to very dense alluvial gravel with trace amounts of silt and clay. Borings were terminated in the alluvial gravel and were not extended to bedrock. The phreatic surface is within the foundation of the East Ash Pond.

Two (2) cross sections (SL-10 and SL-12) were analyzed using GeoStudio SLOPE/W limit equilibrium slope stability analysis software to evaluate stability of the perimeter dike system and foundations. Slip surface search routines in SLOPE/W relied on circular slip surfaces using the entry and exit-based method to define the initial critical slip surface. The slip surface was then optimized to find a critical, non-circular slip surface, and factors of safety were calculated using the Spencer method. The cross section locations were based primarily on the critical subsurface conditions and slope geometry (embankment height and slopes) along east and west sides of the East Ash Pond. Cross-sections were not analyzed along the north side of the East Ash Pond, as the grade is essentially flat beyond the East Ash Pond dike, and therefore a slope is not present. Along the south side of the East Ash Pond, a dike is not present as the adjacent ground is sloping into the East Ash Pond; therefore, an analysis was not performed. The cross sections were evaluated for each of the loading conditions stipulated in §257.73(e)(1).

The results of the initial safety factor assessment are summarized in the following sub-sections. A detailed presentation of the analyses performed, including development of site stratigraphy, strength parameters, and stability analysis methodology, and figures showing the location of cross-sections and investigation locations be found in **Appendix B**.

4.1 Factor of Safety: Maximum Storage Pool Loading (§257.73(e)(1)(i))

The calculated static factor of safety under long-term, maximum storage pool loading condition must equal or exceed 1.50.

This calculation models the dike stability under static, long-term conditions, under the normal storage water level (El. 490.4 feet) within the impoundments, which corresponds to the water level measured during the September 2015 survey of the site performed by Weaver Consultants. Drained (effective stress) shear strength parameters were used for all materials, and phreatic conditions were estimated based on available piezometer and boring data. The calculated minimum factors of safety are identified in **Table 1.**

Table 1 – Summary of Factors of Safety – Maximum Storage Pool Loading Condition

Cross Section	Calculated Factor of Safety (§257.73(e)(1)(i) Minimum = 1.50)
SL-10	2.14*
SL-12	2.81

*Indicates critical cross section (i.e., lowest calculated factor of safety out of the 2 cross sections analyzed)

The calculated factors of safety exceed 1.50 for all cross sections analyzed, which meets the requirements in §257.73(e)(1)(i).

4.2 Factor of Safety: Maximum Surcharge Pool Loading (§257.73(e)(1)(ii))

The calculated static factor of safety under maximum surcharge pool loading condition must equal or exceed 1.40.

This calculation models the dike stability under short-term, surcharge pool conditions. The pool level for analysis (El. 492.2 feet) was taken from the hydrologic and hydraulic analysis performed for the 1,000-year Inflow Design Flood (see **Section 5**). Drained (effective stress) shear strength parameters were used for all materials, as the change in pool elevation is temporary and fairly small, and is unlikely to initiate total stress mechanisms of failure. Pore pressures within the embankment were assumed to be the same as the Maximum Storage Pool case, due to the presence of a liner. The calculated factors of safety are identified in **Table 2**.

Table 2 – Summary of Factors of Safety – Maximum Surcharge Pool Loading Condition

Cross Section	Calculated Factor of Safety (§257.73(e)(1)(ii) Minimum = 1.40)
SL-10	2.14*
SL-12	2.81

*Indicates critical cross section (i.e., lowest calculated factor of safety out of the 2 cross sections analyzed)

The calculated factors of safety exceed 1.40 for all cross sections analyzed, which meets the requirements in §257.73(e)(1)(ii).

4.3 Factor of Safety: Seismic (§257.73(e)(1)(iii))

The calculated seismic factor of safety must equal or exceed 1.00.

This calculation models the dike stability under short-term, seismic loading conditions during the design 2,500-year return period seismic event. Seismic loading is modeled as a horizontal force acting outward on the dike and foundation. This analysis is intended to model conditions during earthquake shaking, when seismically-induced material strength losses have not yet occurred. Therefore, peak undrained (total stress) shear strength parameters were used for all materials. The pool elevation and phreatic conditions were assumed to be the same as the Maximum Storage Pool case (**Section 4.1**), and correspond to normal operating conditions at the East Ash Pond. The calculated factors of safety are identified in **Table 3**.

Table 3 – Summary of Factors of Safety – Seismic Loading Condition

Cross Section	Calculated Factor of Safety (§257.73(e)(1)(iii) Minimum = 1.00)
SL-10	4.23
SL-12	2.53*

*Indicates critical cross section (i.e., lowest calculated factor of safety out of the 2 cross sections analyzed)

The calculated factors of safety exceed 1.00 for all cross sections analyzed, which meets the requirements in §257.73(e)(1)(iii).

4.4 Factor of Safety: Soils Susceptible to Liquefaction (§257.73(e)(1)(iv))

For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.

The 2015 AECOM field investigation did not identify any soil layers susceptible to liquefaction within either the embankments or the foundations at the East Ash Pond. Therefore, the §257.73(e)(1)(iv) requirements are not applicable to the East Ash Pond at the Hennepin Power Station, and a liquefaction factor of safety analysis was not performed.

5 Initial Inflow Design Flood Control System Plan

40 CFR §257.82
(a) The owner or operator of an existing … CCR surface impoundment … must design, construct, operate, and maintain an inflow design flood control system as specified in paragraphs (a)(1) and (2) of this section.
> *(1) The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood specified in paragraph (a)(3) of this section.*
> *(2) The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood specified in paragraph (a)(3) of this section.*
> *(3) The inflow design flood is:*
> > *(i) For a high hazard potential CCR surface impoundment, …, the probable maximum flood;*
> > *(ii) For a significant hazard potential CCR surface impoundment, …, the 1,000-year flood;*
> > *(iii) For a low hazard potential CCR surface impoundment, …, the 100-year flood; or*
> > *(iv) For an incised CCR surface impoundment, the 25-year flood.*

(b) Discharge from the CCR unit must be handled in accordance with the surface water requirements under §257.3-3.

Analyses completed for the initial inflow design flood control system plan of the East Ash Pond are described in the following subsections. Data and analysis results in the following subsections are based on spillway design information shown on design drawings, construction information, topographic surveys, information about operational and maintenance procedures provided by DMG and field measurements collected by AECOM. The analysis approach and results of the hydrologic and hydraulic analyses are presented in the following subsections. A detailed presentation of the analyses performed can be found in **Appendix C**.

The East Ash Pond has a significant hazard potential; therefore, the inflow design flood (IDF) is the 1,000-year flood.

5.1 Initial Inflow Design Flood Control Systems (§257.82(a))

An initial inflow design flood control system plan, supported by a hydraulic and hydrologic analysis, was developed for the East Ash Pond by evaluating the effects of a 24-hour duration design storm for the 1,000-year IDF using a hydraulic HydroCAD (Version 10) computer model and a starting water surface elevation (WSE) of 490.4 feet based on the pool level in the East Ash Pond surveyed by Weaver Consultants in 2015. The computer model evaluated the East Ash Pond's ability to collect and control the 1,000-year IDF under existing operational and maintenance procedures. Rainfall data for the 1,000-year IDF was obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14. The NOAA Atlas 14 rainfall depth is 9.70 inches.

The HydroCAD model results for the East Ash Pond indicate that the CCR unit has sufficient storage capacity and spillway structures to adequately manage (1) flow into the CCR unit during and following the peak discharge of the 1,000-year IDF and (2) flow from the CCR unit to collect and control the peak discharge resulting from the 1,000-year IDF. The peak water surface elevation is 492.2 feet during the IDF, and the minimum crest elevation of the East Ash Pond dike is 493.0 feet. Therefore, overtopping is not expected.

Based on this evaluation, the East Ash Pond meets the requirements in §257.82(a), and the hydrologic and hydraulic analysis is presented in **Appendix C**.

5.2 Discharge from the CCR Unit (§257.82(b))

40 CFR §257.82(b) provides that the discharge from the CCR unit must be handled in accordance with the surface water requirements under 40 CFR §257.3-3, which states the following:

> *(a) For purposes of section 4004(a) of the Act, a facility shall not cause a discharge of pollutants into waters of the United States that is in violation of the requirements of the National Pollutant Discharge Elimination System (NPDES) under section 402 of the Clean Water Act, as amended.*
>
> *(b) For purposes of section 4004(a) of the Act, a facility shall not cause a discharge of dredged material or fill material to waters of the United States that is in violation of the requirements under section 404 of the Clean Water Act, as amended.*
>
> *(c) A facility or practice shall not cause non-point source pollution of waters of the United States that violates applicable legal requirements implementing an areawide or Statewide water quality management plan that has been approved by the Administrator under section 208 of the Clean Water Act, as amended.*
>
> *(d) Definitions of the terms Discharge of dredged material, Point source, Pollutant, Waters of the United States, and Wetlands can be found in the Clean Water Act, as amended, 33 U.S.C. 1251 et seq., and implementing regulations, specifically 33 CFR part 323 (42 FR 37122, July 19, 1977).*

The handling of discharge was evaluated by reviewing design drawings, operational and maintenance procedures, conditions observed in the field by AECOM, and the inflow design flood control system plan developed per §257.82(a).

Based on this evaluation, outflow from the East Ash Pond is ultimately routed through a NPDES-permitted discharge into the Illinois River via the East Polishing Pond and East Leachate Pond non-CCR surface impoundments. Hydraulic and hydrologic analyses performed as part of the initial inflow design flood control system plan found that the East Ash Pond adequately manages outflow during the 1,000-year IDF, as overtopping of the East Ash Pond embankments is not expected.

Therefore, discharge of pollutants in violation of the NPDES permit is not expected as all discharge is routed and controlled through the existing spillway system and NPDES-permitted outfall during both normal and IDF conditions. Based on this evaluation, the East Ash Pond meets the requirements in §257.82(b).

6 Conclusions

The East Ash Pond at the Hennepin Power Station was evaluated relative to the USEPA CCR Rule requirements for initial structural stability assessments (§257.73(d)), initial safety factor assessments (§257.73(e)), and initial inflow design flood control system plan (§257.82). Based on the evaluations presented herein, the referenced requirements are satisfied for safety factor assessments and hydrologic and hydraulic analyses. The requirements for structural stability (§257.73(d)) are also satisfied, except for §257.73(d)(1)(vi).

At this time, the structural integrity of all of the hydraulic structures passing through the dike of the East Ash Pond (§257.73(d)(1)(vi)) cannot be certified because the secondary spillway pipe has not been fully visually inspected using CCTV equipment. In accordance with §257.73(d)(2), AECOM recommends performing a CCTV inspection of secondary spillway pipe as soon as feasible and updating this assessment once the inspection has been performed.

7 References

AECOM (2016). *Hydrologic and Hydraulic Summary Report- Hennepin Power Station, East Ash Pond.* Hennepin, Illinois.

AECOM (2016). *Geotechnical Report- Hennepin Power Station, East Ash Pond.* Hennepin, Illinois.

Federal Emergency Management Agency (FEMA). (2011). Flood Insurance Rate Map, Putnam County, Illinois, Unincorporated Area, Panel 25 of 175. Map Number 17155C0025E.

U.S. Environmental Protection Agency [USEPA]. (2015). *Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments.* 40 CFR Part 257, Subpart D. 80 Fed. Reg. 21468 April 17, 2015.

Weaver Consultants Group. (2015). *Topographic Ground Survey, Hennepin Ash Ponds*. Performed in September of 2015. Hennepin, Illinois.

8 Appendices

A. Pipe Inspection Report

B. Geotechnical Report

C. Hydrologic and Hydraulic Report

Appendix A. Pipe Inspection Report

Tel:
Fax:
E-mail:

Inspection Report

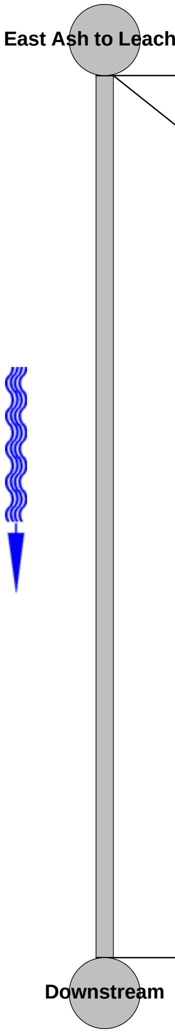
Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
7/21/2016		**Dry**	**Jake Mason - 182**		**1**
Certificate No.	Survey Customer	System Owner	Date Cleaned	Pre-Cleaning	Sewer Category
U-314-0602-0316				**No Pre-Cleaning**	

Street123	**13498 E 800th St**	Use of Sewer	**Stormwater**	Upstream MH	**East Ash to Leachate**
City	**Hennepin, IL**	Drainage Area		Dowstream MH	**Downstream**
Loc. details		Flow Control		Dir. of Survey	**Downstream**
Location Code		Length surveyed	**61.00 ft**	Section Length	**61.00 ft**

Purpose of Survey		Joint Length	
Year Laid		Dia./Height	**18 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.		Lining Method	

Add. Information :

1:150 **Position** **Observation**



Position	Observation
0.00	Water Level, 10 %of cross sectional area
0.00	End of Pipe
61.00	End of Pipe

0 FT

61 FT

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

Tel:
Fax:
E-mail:

Inspection photos

City :	Street :	Date :	Pipe Segment Reference :	Section No :
Hennepin, IL	**13498 E 800th St**			**1**

Photo: 1_1_1_A.JPG
0FT, End of Pipe

Photo: 1_1_4_A.JPG
61FT, End of Pipe

Appendix B. Geotechnical Report

AECOM
1001 Highlands Plaza Drive West
Suite 300
St. Louis, MO 63110-1337
www.aecom.com

314.429.0100 tel
314.429.0462 fax

October 7, 2016

Mr. Matt Ballance, PE
Senior Project Engineer
Dynegy Inc.
1500 Eastport Plaza Drive
Collinsville, Illinois 62234

RE: Geotechnical Report
Hennepin Power Station
East Ash Pond

Dear Mr. Ballance:

AECOM is pleased to provide this Geotechnical Report for the Dynegy Midwest Generation, LLC (DMG) East Ash Pond Coal Combustion Residuals (CCR) unit at the Hennepin Power Station located in Hennepin, Illinois. This Geotechnical Report has been prepared to document the analysis performed to check that the facility meets the geotechnical slope stability requirements including Factors of Safety required by 40 CFR § 257.73.

AECOM looks forward to providing continued support to DMG and working together on this important program. Please do not hesitate to call Ron Hager at 314-429-0100 (office) / 440-591-7868 (mobile), if you have any questions or comments on this Geotechnical Report.

Sincerely,

AECOM

Ronald H. Hager

Jeremy Thomas, PE
Site Manager
jeremy.thomas@aecom.com

Ronald Hager
Program Manager
ronald.hager@aecom.com

cc: Mark Rokoff, PE – AECOM

Attachments:

- **A.** Figures
- **B.** Boring Logs
- **C.** Piezometer Logs
- **D.** CPT Data Report
- **E.** Laboratory Test Data
- **F.** Material Characterization Calculations
- **G.** Slope Stability Analysis

1. INTRODUCTION

1.1. *Purpose of This Report*

This report presents the results of the geotechnical analyses prepared by AECOM for the Dynegy Midwest Generation, LLC (DMG[1]) East Ash Pond Coal Combustion Residuals (CCR) unit at the Hennepin Power Station in Hennepin, Illinois (see **Figure 1, Attachment A** for Location Map). The purpose of the geotechnical investigation and analyses performed is to evaluate the design, performance, and condition of the impoundment and associated structures using the data collected from surface and subsurface investigations, available design drawings, construction records, inspection reports, previous engineering investigations, and other pertinent historical documents provided to AECOM by DMG. This information was then used to evaluate the design and operation of the surface impoundment against the regulatory standards set in 40 CFR § 257.73.

The geotechnical field exploration was conducted between September 1 and October 21, 2015. The field program consisted of conventional hollow-stem auger and mud rotary borings, Standard Penetration Testing (SPT), Cone Penetration testing (CPT), and piezometer installation. Laboratory testing was conducted on the materials obtained through various sampling techniques to assist in characterization of the subsurface conditions, especially with respect to defining material parameters for use in stability analyses. Stability analyses were performed by AECOM to evaluate the potential for slope instabilities, in accordance with the Environmental Protection Agency (EPA) regulation 40 CFR § 257.73(d) and (e).

A summary or the geotechnical field program, laboratory testing program, and stability evaluations are presented herein. Detailed interpretations, calculations, and presentation of analysis results are provided in the Attachments to this report.

1.2. *Description of Impoundment*

The Hennepin Station has one active CCR surface impoundment, the East Ash Pond, which receives sluiced bottom ash, fly ash, boiler slag, and plant process water. The East Ash Pond is approximately 21 acres in size and is contained by an earthen perimeter embankment that forms the exterior of the CCR unit on all but the south side, where the East Ash Pond is bordered by high natural ground.

A site specific aerial and bathymetric survey of the East Ash Pond was completed by Weaver Consultants Group in September of 2015. The survey is spatially referenced to the Illinois NAD 1983 State Plane West, Zone 12020. Elevations are in feet and referenced to the North American Vertical Datum 1988 (NAVD88). Coordinates and elevations in this report are referenced to NAD83 and NAVD88, respectively, unless otherwise stated.

The north side of the East Ash Pond is bordered by the inactive Ash Pond No. 2 and the Hennepin Landfill. The crest of the Hennepin Landfill is at an elevation slightly higher than the East Ash Pond embankment. To the northeast and east of the East Ash Pond are the East Leachate Pond and the East Polishing Pond, respectively, both of which are non-CCR impoundments and are located at lower elevations than the East Ash Pond. The plant operations sluice bottom ash into the East Ash Pond for particle settling before being discharged downstream to the East Leachate Pond.

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[1] Although the Hennepin Power Station and the East Ash Pond are owned and operated by DMG, Dynegy Administrative Services Company (*Dynegy*) contracted AECOM to develop this geotechnical report on behalf of DMG. Therefore, “Dynegy” is referenced in materials attached to this geotechnical report.

The East Ash Pond also utilizes a secondary outflow to the East Polishing Pond. The south side of the East Ash Pond is bordered by natural high ground. The west side is bordered by the former East Ash Pond No. 4.

According to the "Modification to Primary Ash Pond" design drawings, the perimeter embankment was raised from an elevation of 483 feet to the current elevations from 494 to 500 feet in the early 2000's. The original East Ash Pond included an interior liner system consisting of a 4-foot thick compacted clay layer (design permeability of $1.0x10^{-7}$ centimeters per second) overlying a 1-foot thick sand drainage layer under the pond footprint. During the perimeter embankment raise, the liner system was extended from El. 480 feet (top of the original liner) to El. 494.0 feet using, from bottom to top, an 8-ounce polypropylene geotextile, 1-foot of compacted clay, and a double-layer of 45-mil polypropylene geomembrane. The raised East Ash Pond embankment is composed primarily of compacted clay fill materials with a gravel crest access road (described further in **Section 3.1**).

Embankment height on the west and east sides range from approximately 16 to 36 feet, as referenced to the downstream toe. The downstream embankment slope between the East Ash Pond and East Ash Pond No. 4 is approximately 3.5H:1V. The slope between the East Ash Pond and the East Polishing Pond is approximately 4H:1V. Embankment crest widths range from approximately 18 feet to 19 feet along the west and east sides of the East Ash Pond..

The site location and vicinity map are included in **Attachment A**.

2. SUMMARY OF FIELD INVESTIGATIONS

A subsurface exploration was performed at the Hennepin East Ash Pond, including 4 soil borings, installation of 2 piezometers, and 6 cone penetration test (CPT) soundings with shear wave velocity measurements and pore pressure dissipation (PPD) testing. Two of the CPT soundings were performed within the adjacent inactive East Ash Pond No. 2 to characterize behavior of the impounded CCR materials. The borings were drilled by AECOM's subcontractor Strata Earth Services, LLC of Palatine, IL, under the full-time supervision of AECOM geotechnical personnel. Strata Earth Services used a truck-mounted Mobile B-57 drill rig in conjunction with 3¼-inch inner diameter hollow stem augers with mud rotary methods as needed to drill the borings. CPT soundings were performed by AECOM's subcontractor ConeTec, Inc. of Charles City, Virginia, again with full-time oversight by AECOM personnel.

Borings extended to a predetermined depth of 41.5 feet, within alluvial sand and gravel present beneath the East Ash Pond and CPT depths varied based on refusal from approximately 11 to 29.5 feet below existing grades. Piezometers were installed in un-sampled boreholes, with drilling bottom-of-boring depths of 50 and 55 feet, in order to gather phreatic data in the alluvial sand and gravel layer. Approximate boring, piezometer, and CPT sounding locations are depicted on **Figure 2** in **Attachment A**. Logs of the borings are presented in **Attachment B**. Logs of the CPT soundings are presented in **Attachment D**, and piezometer logs are presented in **Attachment C**. Locations of borings and CPTs, as surveyed by Weaver Consultants in 2015, are summarized in **Table 1**.

Representative soil samples were collected from each of the borings for classification and/or testing. The soil samples were obtained by SPT with a split-spoon sampler, in accordance with ASTM D 1586. Undisturbed samples of fine-grained soils were obtained using 3-inch outside diameter steel (Shelby) tubes conventionally pushed in accordance with ASTM D 1587. Results of the laboratory testing are presented in **Attachment E**.

Table 1
Boring and CPT Exploration Location Data

Exploration ID	Easting (ft NAD83)	Northing (ft NAD83)	Elevation (ft NAVD88)
Auger Borings			
HEN-B029	2533022	1689436	499.7
HEN-B030	2533585	1690015	495.4
HEN-B032	2534055	1689837	494.3
HEN-B034	2533831	1689246	499.3
CPT Soundings			
HEN-C029	2533022	1689436	499.6
HEN-C030	2533582	1690014	495.3
HEN-C032	2534055	1689837	494.3
HEN-C032B[1]	2534056	1689838	494.0
HEN-C034	2533831	1689245	499.4

1. Location of HEN-CO32B was not surveyed as the CPT could not be located in the field. Locations are approximated based on handheld GPS measurements taken during investigation. The elevation for this boring is based on site topographic survey data from Weaver Consultants Group in September of 2015. The accuracy of this measurement is assumed to be approximately ±5 feet horizontal and ±1 foot vertical.

3. SUMMARY OF SITE-SPECIFIC SUBSURFACE CONDITIONS

3.1. Site Stratigraphy

Road Fill Materials: An access road surrounds the perimeter of the East Ash Pond. The material is primarily comprised of silty sand. The relative density of the road fill measured by the standard penetration test was very dense.

Embankment Fill: The perimeter embankment of the East Ash Pond was constructed in two stages, with an original embankment and a later raise constructed on top of the original. According to the “Modification to Primary Ash Pond” design drawings, this raise was completed in the early 2000s, raising the dike crest from an original elevation around 483 feet to the current elevations ranging from 494 to 500 feet. As indicated by the CPT logs, the new dike section was constructed primarily with clayey silt and clay, although some zones of sand and gravel were also noted, as well as limited amounts of CCRs. The consistency of the fill, as measured by uncorrected SPT N-values and pocket penetrometer tests, ranged from stiff to hard. Per construction drawings, the fill material was to be compacted to 95 percent (minimum) ASTM D698. Historical compaction records for the fill material were not available, but current field data were generally indicative of well-compacted materials.

Alluvial Foundation: Alluvial foundation materials, consisting primarily of sand and gravel with varying amounts of silt and clay were encountered in the borings drilled around the perimeter of the Hennepin East Ash Pond. The relative density of the alluvial foundation as measured by the standard penetration test ranged from medium dense to very dense.

Fly Ash (Impounded CCR Materials): Borings and CPTs were not performed within the footprint of the East Ash Pond to minimize any risk of compromising the existing liner system. Material properties for the CCRs in the East Ash Pond (assumed to be fly ash and bottom ash) were estimated based on data obtained from CPT soundings in CCR materials encountered in East Ash Pond No. 2. CPT correlations indicated soil behavior types corresponding to silt and sand with some gravel and clay.

Liner System: Per the “Modification to Primary Ash Pond” record drawings, the East Ash Pond has a 4-foot thick compacted clay liner on the bottom and side slopes of the pond. Under the clay liner is a 6-inch thick sand filter layer on the bottom of the pond and 12-inch thick sand layer on the side slopes of the pond. The liner was extended during the dike raise using, from top to bottom, a 8-ounce polypropylene geotextile, 1 foot of compacted clay, and a 45-mil polypropylene geomembrane. CPTs and borings were not performed within the lined area, to avoid puncturing the liner and construction documentation data was not available, therefore material properties for the liner system were estimated based on typical published values and AECOM’s experience.

Bedrock: Bedrock was not encountered in the soil borings. It was estimated that bedrock is greater than 100 feet below the ground surface based on AECOM borings completed within the vicinity in 2015.

Specific information used to assess and develop the design site stratigraphy can be found in **Attachment B** – Boring Logs, **Attachment D** – CPT Data Report, and **Attachment E** – Laboratory Test Data.

3.2. Phreatic Water Conditions

AECOM evaluated piezometer data from five measurement events (10/27/15, 11/24/15, 12/17/15, 1/14/16, and 2/10/16) and borehole phreatic water depths measured immediately after drilling. Piezometer readings were judged to be the most representative of in-situ, steady state phreatic conditions. Saturated conditions did not appear to be encountered during CPT soundings surrounding the Hennepin East Ash Pond or in any of the other soil borings, other than a saturated pocket in boring HEN-B030 at 33 feet.

A total of two standpipe piezometers were installed for the Hennepin East Ash Pond. The two piezometers were installed through the perimeter embankment with the screened elevations located within the alluvial foundation soils.

Refer to **Table 2** for the piezometer locations and phreatic data.

Table 2
Piezometer Location and Water Level Data

PZ No.	Embankment	Northing[1] (NAD83 feet)	Easting[1] (NAD83 feet)	Ground Surface Elevation[1] (NAVD88 feet)	Location	PZ Type[2]	Total Depth[3] (ft)	Phreatic Surface Elevation (NAVD88 feet)				
								10/27/ 2015	11/24/ 2015	12/17/ 2015	1/14/ 2016	2/10/ 2016
HEN-P006	North	1690015	2533585	495.4	Crest	OSP_{stick}	43.7	452.1	452.1	452.2	452.4	452.1
HEN-P007	East	1689837	2534055	494.3	Crest	OSP_{flush}	47.4	450.7	449.4	449.7	452.8	449.3

Notes:

1. Piezometer locations based on adjacent surveyed SPT boring locations. Actual piezometer locations were not surveyed. Accuracy is assumed to be +/- 5 feet horizontal and +/- 1 foot vertical.
2. OSP = open standpipe piezometer.
3. Total Depth = Approx. bottom of screen for standpipe piezometers.

4. SUMMARY OF LABORATORY TESTING

4.1. *Summary of Laboratory Testing Scope*

Soil samples collected from the subsurface exploration were sealed at the site and transported to AECOM's laboratory testing subcontractor, Terracon of Vernon Hills, Illinois, where an AECOM geotechnical engineer reviewed and selected samples for laboratory testing. The laboratory testing program performed for the East Ash Pond was intended to obtain information on index properties and shear strength parameters of the subsurface materials at the site. The laboratory testing program for characterization of the materials at the East Ash Pond is summarized in **Table 3**.

Table 3
Summary of Laboratory Testing Program for Hennepin East Ash Pond

ASTM Designation	Test Type	Number of Tests				
		Total	Road Fill	Embankment Fill	Alluvial Foundation	Other Materials
D2216	Moisture Content	45	5	16	22	2
D4318	Atterberg Limits	3	-	3	-	-
T311[1], D1140, D422	Gradation / Hydrometer	6	1	-	5	-
D854	Specific Gravity	3	-	2	1	-
D5084	Hydraulic Conductivity	0	-	-	-	-
D2435	Consolidation	1	-	1	-	-
D 2166	Unconfined Compression	1	-	1	-	-
D4767	Consolidated Undrained Triaxial (CIU)	1	-	1	-	-
D6528	Direct Shear (DS)	1	-	1	-	-

[1] American Association of State Highway and Transportation Officials (AASHTO) test designation

4.2. *Summary of Laboratory Testing Results*

A summary of laboratory test results for the identified material horizons with the exception of the impounded CCR materials at the Hennepin East Ash Pond are presented in **Tables 4, 5** and **6**, respectively. Laboratory test data is included in **Attachment E**. Graphical displays of the shear strength characterization for the stratigraphic materials are included in the Material Characterization Calculation Package in **Attachment F**.

Table 4
Summary of Laboratory Test Results – Road Fill

Boring Number	Sample Number	Depth (feet)	USCS[1]	WC%[2]	% Gravel	% Sand	% Silt	% Clay
HEN-B029	S-1	0.0-1.5		4.7				
HEN-B030	S-1A	0.0-1.5		7				
HEN-B030	S-2	2.5-4.0	SM	6.4	34	45.7	11	9.3
HEN-B032	S-1A	0.0-1.0		2.7				
HEN-B034	S-1A	0.0-0.5		4.2				

Table 5
Summary of Laboratory Test Results –Embankment Fill

Boring Number	Sample Number	Depth (feet)	USCS[1]	WC%[2]	LL[3]	PL[4]	PI[5]	Specific Gravity	Direct Shear	
									c' (psf)[6]	phi' (deg)[7]
HEN-B029	S-2	2.5-4.0		14.7						
HEN-B029	S-3	5.0-7.0	CL	10.8	22	15	7			
HEN-B029	S-4	7.0-8.5		14.8						
HEN-B029	S-5	10.0-12.0	CL	16.7	31	17	14		62.2	31.8
HEN-B029	S-6	15.0-16.5		21.7						
HEN-B030	S-3	5.0-6.5		11.5				2.746		
HEN-B030	S-4	7.5-9.0		17.1						
HEN-B030	S-5	10.0-11.0		18.1						
HEN-B030	S-7	21.5		23.9						
HEN-B032	S-1B	1.0-1.5		7.9						
HEN-B032	S-2	2.5-4.0		9.7						
HEN-B032	S-3	5.0-7.0	CL	14	35	18	17			
HEN-B032	S-4	7.5-9.0		16.7						
HEN-B032	S-5	10.0-11.5		16.2						
HEN-B032	S-9	30.0-31.5		10.6						
HEN-B034	S-1B	0.5-1.5		9.1						
HEN-B034	S-2	2.5-4.0		14.2				2.704		
HEN-B034	S-3A	5.0-5.5		15.9						

Table 6
Summary of Laboratory Test Results – Alluvial Foundation

Boring Number	Sample Number	Depth (feet)	USCS[1]	WC%[2]	% Gravel	% Sand	% Silt	% Clay	Specific Gravity
HEN-B029	S-7	20.0-21.5		11.5					
HEN-B029	S-8	25.0-26.5		8.8					
HEN-B029	S-9	30.0-30.9		12.7					
HEN-B029	S-10	35.0-36.5	GP-GC	13.8	61	26			
HEN-B029	S-11	40.0-41.5		4.6					
HEN-B030	S-6	15.0-16.5	GW	17.6	81.4	14.8			
HEN-B030	S-8	25.0-26.5		11.2					
HEN-B030	S-10	35.0-36.5		8.9					
HEN-B030	S-11	40.0-41.5		9					
HEN-B032	S-6	15.0-16.5		8.2					
HEN-B032	S-7	20.0-21.5	SM	11.1	30.5	43.6	13.4	12.5	
HEN-B032	S-8	25.0-26.5		9.1					
HEN-B032	S-10	35.0-36.5		5.5					
HEN-B032	S-11	40.0-41.3		10.9					
HEN-B034	S-3B	5.5-6.5		1.4					
HEN-B034	S-4	7.5-9.0		2.5					
HEN-B034	S-5	10.0-11.5	GP-GM	11.2	60.1	27	7.7	5.2	
HEN-B034	S-6	15.0-16.5		9.1					2.808
HEN-B034	S-7	20.0-21.5		12.5					
HEN-B034	S-9	30.0-31.5		13.6					
HEN-B034	S-10	35.0-36.5	GP-GM	10.9	82.8	11.3			
HEN-B034	S-11	40.0-41.5		1.5					

Notes:
[1] USCS = Unified Soil Classification System
[2] WC% = Water Content (percent)
[3] LL = Liquid Limit
[4] PL = Plastic Limit
[5] PI = Plasticity Index
[6] C’ = Cohesion
[7] Phi’ = Friction Angle

5. SLOPE STABILITY ANALYSES

Slope stability analyses were performed for varying loading conditions at selected cross-sections, as described in the following sub-sections. Analysis section development, soil material properties, and seismic analyses related to the slope stability analysis are also discussed in the following sub-sections.

5.1. *Cross-Sections for Analysis*

Two cross sections were identified as representative cross sections for the stability evaluation of the East Ash Pond perimeter embankments. As the geometry and the foundation conditions underneath the East Ash Pond embankments were fairly uniform, sections were selected based primarily on the critical subsurface conditions and slope geometry (embankment height and slopes) along east and west sides of the East Ash Pond. Cross-sections were not analyzed along the north side of the East Ash Pond, as the grade is essentially flat beyond the East Ash Pond Dike, and therefore a slope is not present. Along the south side of the East Ash Pond, a dike is not present as the adjacent ground is sloping into the East Ash Pond, and an analysis was not performed. The location of each analysis section is listed in **Table 7** and shown on **Figure 2 (Attachment A)**.

Table 7
Cross-section Locations for Slope Stability Analyses

Cross-Section	Boring/CPT Numbers
SL-10	HEN-B029, HEN-C029
SL-12	HEN-B032, HEN-C032, HEN-C032B

The section geometry for each analysis cross-section was determined based on the site topographic survey data from Weaver Consultants Group in September of 2015, shown on **Figure 2 (Attachment A)**, and subsurface information from the borings and CPT soundings. Additionally, design drawings from the “1995 Ash Facility Hennepin Power Station” by Illinois Power Company (1993) and “Modification to Primary Ash Pond Hennepin Power Station” by Sargent & Lundy (2003) were used to supplement the subsurface investigation in developing the subsurface embankment geometry. The piezometric surfaces for each analysis section were determined based on the normal pool elevation of approximately 490.4 feet within the East Ash Pond and phreatic water level readings from the piezometers. The development of the analysis sections is discussed further in **Attachment G**.

5.2. *Stability Analysis Conditions Considered*

Consistent with the criteria provided in the USEPA CRR Rule § 257.73(e), the stability of the ash pond embankments was evaluated for four load cases:

Static, Steady-State, Normal Pool Condition*:* This case models the embankment under static, long-term conditions, at normal water level within the impoundment of El. 490.4 feet based on AECOM’s *Hydrologic and Hydraulic Summary Report* for the Hennepin East Ash Pond (AECOM, 2016). Drained (effective stress) shear strength parameters were used for all materials, and phreatic conditions were estimated based on available piezometer data. ***Target Factor of Safety of 1.50.***

Static, Maximum Surcharge Pool Condition: This case models the conditions under short-term surcharge pool conditions, at a surcharge pool level within the impoundment of EL. 492.2 feet, based on AECOM’s *Hydrologic and Hydraulic Summary Report* for the Hennepin East Ash Pond

(AECOM, 2016). Drained (effective stress) shear strength parameters were used for all materials, as the change in pool elevation is temporary and fairly small, and is unlikely to initiate total stress mechanisms of failure. It was assumed that the temporary surcharge load did not alter the phreatic surface in the embankment or foundation, due to the presence of a liner system. Therefore, the phreatic surface was modeled equivalent to the steady state case. ***Target Factor of Safety of 1.40.***

Seismic Slope Stability Analysis: These analyses incorporate a horizontal seismic coefficient k_h selected to be representative of expected loading during the design earthquake event (i.e., a "pseudostatic" analysis). The analyses utilized peak undrained strengths for all materials. The pool elevation and phreatic conditions corresponding to the steady state pool from the static analyses were utilized for this analysis. ***Target Factor of Safety of 1.00***.

Post-Liquefaction Slope Stability Analyses: Soils susceptible to liquefaction were not identified in the embankment or foundation soils at the East Ash Pond. Therefore, post-liquefaction conditions were not evaluated.

5.3. *Material Properties*

Material properties for slope stability analyses were developed using laboratory testing data (index and strength testing) and strength correlations from CPT and SPT data. The material characterization and development of strength parameters is described further in **Attachment F**.

Unit weight for the embankment fill was evaluated using laboratory test results from relatively undisturbed samples. All other materials were conservatively assigned unit weights based on typical published values and previous experience with similar materials.

Effective (drained) shear strengths for the embankment fill layers were evaluated using results from the consolidated undrained triaxial (CIU) and direct shear (DS) tests, as well as correlations with SPT data. In general, when assigning lab tests, direct shear tests were assigned for deeper samples and CIU tests were assigned to shallower samples to match the assumed orientation of the slope stability slip surface.

Total (undrained) shear strengths were developed using CIU and unconfined compression (UC) tests for the embankment fill and fly ash, as well and published correlations for SPT data.

The material properties developed for use in the slope stability analyses are listed in **Table 8**.

Table 8
Material Properties for Slope Stability Analyses

Material	Unit Weight Above and Below WT (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters	
		c' (psf)	Φ' (°)	c (psf)	Φ (°)
Road Fill	130	0	38	0	38
Embankment Fill	105	30	32	2500	0
Alluvial Foundation	135	0	38	0	38
Fly Ash	105	100	27	600	0
Liner System	120	60	30	2500	0

5.4. Methodology of Analyses

Limit equilibrium stability analysis was completed using the two-dimensional SLOPE/W 2012 (v. 8.15.4.11512 by GeoStudio) computer program. Factors of safety were calculated using Spencer's method utilizing circular search routines with optimization to develop non-circular sliding planes through lower-strength layers which may represent a lower factor of safety. Pore pressures were assigned as hydrostatic pressure under the piezometric line.

A brief summary of the analyses is presented in the following sections. A more detailed discussion is provided in **Attachment G**.

5.4.1. Static Analysis Conditions

Static stability was evaluated for steady-state phreatic conditions using both the normal pool elevation and the maximum flood surcharge pool elevation. Phreatic surfaces for impounded CCR materials in the stability models were developed utilizing a normal pool elevation of 490.4 feet and a maximum flood surcharge pool elevation of 492.2 feet. Phreatic surfaces for all non-impounded fill and native materials were modeled at elevations of 450 feet in cross section SL-12 and 452 feet in cross section SL-10, based on data form piezometers installed by AECOM.

5.4.2. Earthquake Analysis Conditions

Earthquake ground motions at the site were developed using simplified procedures, as described in the following sub-sections.

5.4.3. Determination of Ground Motion Parameters

Seismic ground motions were estimated using the United States Geological Survey (USGS) 2008 Interactive Deaggregation tool (http:earthquake.usgs.gov/hazards/apps/). This application generates acceleration values, including peak ground acceleration (PGA) for top of rock, and mean and modal moment magnitudes based on user entered values of location, exceedance probability, and spectral period. Results are computed based on the 2008 National Seismic Hazard Mapping Project (NSHMP) Probabilistic Seismic Hazard Analysis (PSHA) Seismic Hazard Maps.

For the Hennepin Power Station, the calculated PGA for an event with a probability of exceedance of 2% in 50 years (approximately a 2,500 year event) was 0.073g for top of hard rock. To estimate the free-field, ground surface horizontal acceleration, the site was classified according to the site classes defined in the International Building Code (2003) and amplified using the site amplification factors found in NEHRP (2009). The site class was determined based on the weighted average of the shear wave velocities of the upper 100 feet of the stratigraphic profile and found to be Site Class D ($600 \leq V_s \leq 1,200$ ft/sec). This corresponds to a NEHRP amplification factor of 1.6, resulting in a ground surface acceleration of 0.119g. The Peak Transverse Acceleration at the dike crest was estimated using the ground surface acceleration and the procedure proposed by Idriss (2015), resulting in a peak crest acceleration of 0.35g. Details of the estimation of ground motion parameters are included in **Attachment G**.

5.4.4. Seismic Coefficient

The seismic coefficient was calculated for use in the pseudo-static slope stability analysis based on the simplified procedure developed by Makdisi and Seed (1978). For the estimated peak crest acceleration value of 0.34g and full-height slip surfaces that were identified in the stability analyses (presented in **Attachment G**), a seismic coefficient of 0.119g was estimated for the pseudo-static analyses.

5.4.5. Liquefaction Triggering Analysis

Liquefaction is used to describe the contraction of coarse-grained (i.e. cohesionless) sand and gravel soils under cyclic loading imposed by earthquake shaking. The result is a reduction in the effective confining stress within the soil and an associated loss of strength (Idriss and Boulanger 2008). Liquefaction only occurs in saturated soils. Liquefaction susceptibility also largely depends on compositional characteristics such as particle size, shape, and gradation; however, laboratory and field observations also indicate that plasticity characteristics influence liquefaction susceptibility (Kramer 1996). Idriss and Boulanger (2008) suggested that soils with a plasticity index (PI) greater than about 7 are not susceptible to liquefaction.

AECOM's field exploration did not encounter saturated cohesionless soils in the embankment or foundation of the East Ash Pond. All cohesive soils encountered by AECOM were also unsaturated, and had PI's equal to or greater than 7, which means that neither the cohesive or cohesionless soils encountered in AECOM's field exploration are susceptible to liquefaction. However, AECOM's piezometers did indicate that the alluvial sand and gravel is typically saturated below El. 450 to 452 feet beneath the embankments, while the deepest SPT data collected by AECOM was at El. 452.8 feet. SPT blowcounts collected by AECOM in the alluvial sand and gravel between El. 470 and 452.8 feet ranges from 17 to 85 blows per foot, with a mean value of 53 blows per foot. Based on correlations provided in Idriss and Boulanger (2008), these blow counts are generally well above any case history where liquefaction was identified, meaning that the risk of liquefaction is low given the relatively low seismicity at the Hennepin Power Station and high observed blowcounts. Two SPT blowcounts, of 17 and 21, represent the lower-bound data for the alluvial sand, while most of the data is above 30 blows per foot. Consequently, a formal liquefaction analysis was determined unnecessary as the embankment and foundation soils at the site are not susceptible to liquefaction based on their composition, consistency, index properties, and observed saturation.

Due to the typically stiff nature of the compacted clay embankment fill, and relatively low seismicity at the site, the materials are also not susceptible to cyclic softening.

6. RESULTS

6.1. Results of Static Stability Analyses

The results of the limit equilibrium slope stability analyses for the static load cases are summarized in **Table 9**. The SLOPE/W output figures showing the critical slip surfaces and details of the analyses are included in **Attachment G.1**.

Table 9
Summary of Minimum Slope Stability Factors of Safety for Static Load Cases

Load Case	Program Criteria	Cross-Section	
		SL-10	SL-12
Steady State (Normal Pool)	FS≥1.50	2.14	2.81
Surcharge Pool (Flood Pool)	FS≥1.40	2.14	2.81

6.2. Results of Earthquake Stability Analyses

6.2.1. Slope Stability Analysis

The results of the slope stability analyses for the seismic load cases are summarized in **Table 10**. The SLOPE/W output figures showing the critical slip surfaces and details of the analyses are included in **Attachment G.1**.

Table 10
Summary of Minimum Slope Stability Factors of Safety for Earthquake Load Cases

Load Case	Program Criteria	Cross Section	
		SL-10	SL-12
Seismic (Pseudostatic)	FS ≥ 1.00	4.23	2.53

7. CONCLUSIONS

The calculated factors of safety from the limit equilibrium slope stability analysis satisfy the USEPA CCR Rule § 257.73(e) requirements for each loading condition at all of the analysis sections that represent the embankments of East Ash Pond at the Hennepin Power Station. Load cases analyzed for this study included static (steady-state) normal pool, maximum flood surcharge pool and seismic (pseudo-static).

8. LIMITATIONS

Background information, design basis, and other data have been furnished to AECOM by DMG. AECOM has used this data in preparing this report. AECOM has relied on this information as furnished, and is not responsible for the accuracy of this information.

Borings have been spaced as closely as economically feasible, but variations in soil properties between borings, that may become evident at a later date, are possible. The conclusions developed in this report are based on the assumption that the subsurface soil, rock, and phreatic water conditions do not deviate appreciably from those encountered in the site-specific exploratory borings. If any variations or undesirable conditions are encountered in any future exploration, we should be notified so that additional analyses can be made, if necessary.

The conclusions presented in this report are intended only for the purpose, site location, and project indicated. The recommendations presented in this report should not be used for other projects or purposes. Conclusions or recommendations made from these data by others are their responsibility. The conclusions and recommendations are based on AECOM's understanding of current plant operations, maintenance, stormwater handling, and ash handling procedures at the station, as provided by DMG. Changes in any of these operations or procedures may invalidate the findings in this report until AECOM has had the opportunity to review the changes, and revise the report if necessary.

This geotechnical investigation was performed in accordance with the standard of care commonly used as state-of-practice in our profession. Specifically, our services have been performed in accordance with accepted principles and practices of the geological and geotechnical engineering profession. The conclusions presented in this report are professional opinions based on the indicated project criteria and data available at the time this report was prepared. Our services were provided in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation is intended.

9. REFERENCES

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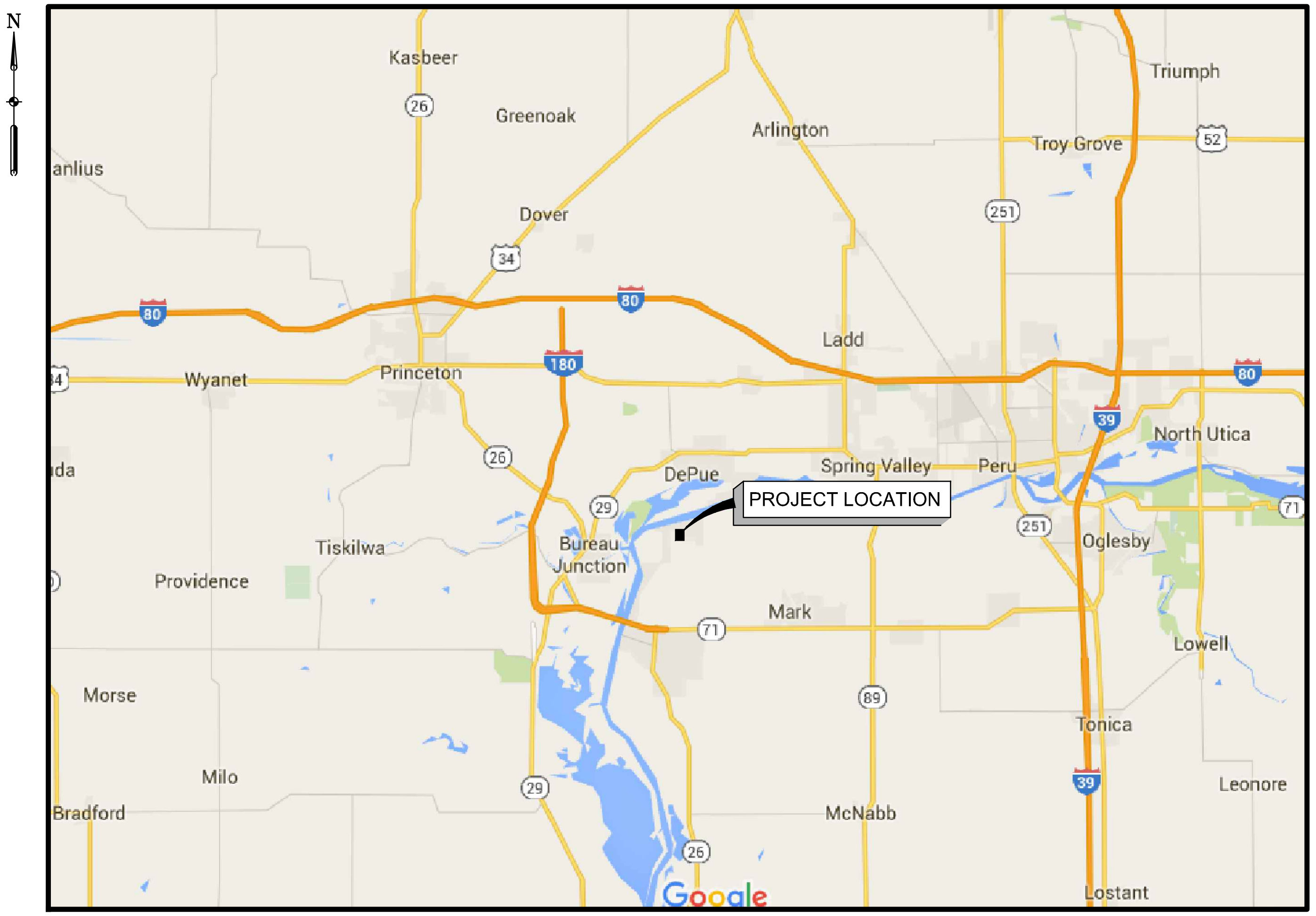
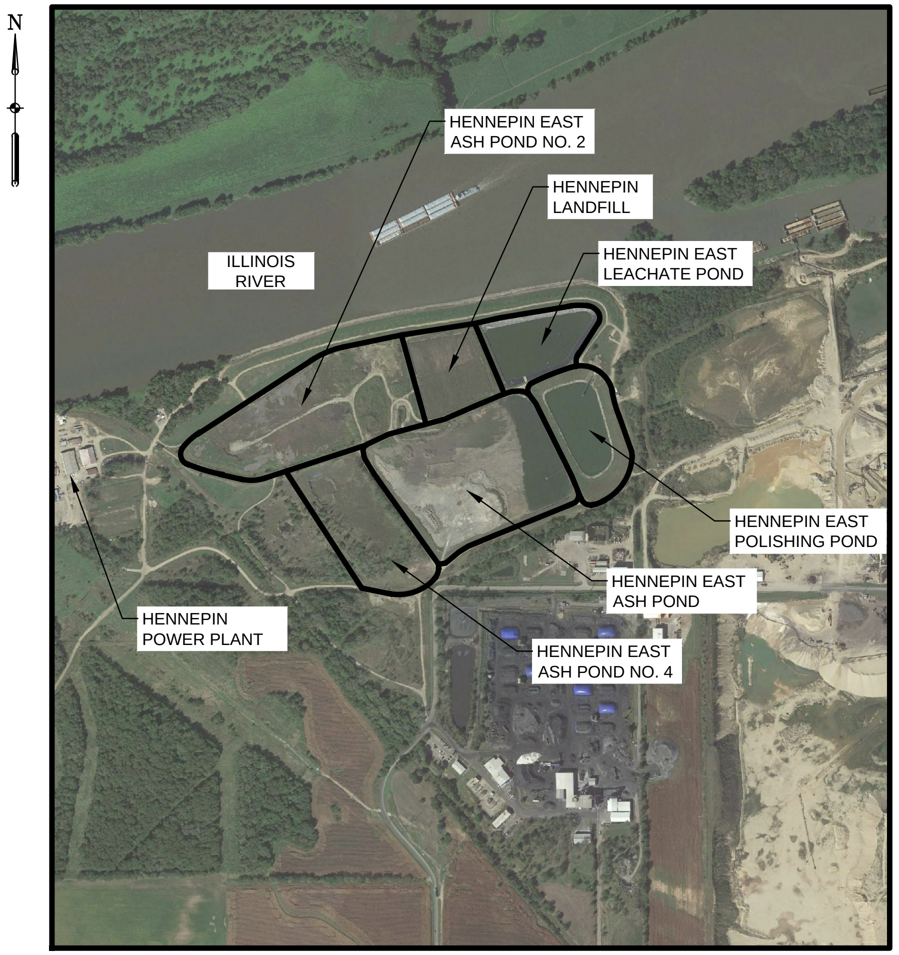
Attachment A. Figures

AECOM DRAWING PATH: K:\Projects\60427894-Dynegy\900-WORKING DOCS-CAD\902-SHEETS\30% Design Sheets_East\Draft Geotechnical Report for Dynegy Hennepin Ash Pond CCR Unit\HEN 1-1 LOCATION PLAN.dwg ALLEN, SHANNON (OSHKOSH), 3/2/2016 9:21 AM



LOCATION MAP
NOT TO SCALE



VICINITY MAP
NOT TO SCALE

AERIAL FROM GOOGLE EARTH PRO
MAP FROM GOOGLE

AECOM
558 N Main Street
Oshkosh, Wisconsin
920 235-0270 (phone)
920 235-0321 (fax)

DYNEGY
Dynegy Inc.
1500 East Port Plaza Drive
Collinsville, IL 62234

CCR RULE ASSESSMENT OF PLANTS

HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

GEOTECHNICAL REPORT
EAST ASH POND

ISSUED FOR BIDDING ______ DATE BY

ISSUED FOR CONSTRUCTION ______ DATE BY

REVISIONS

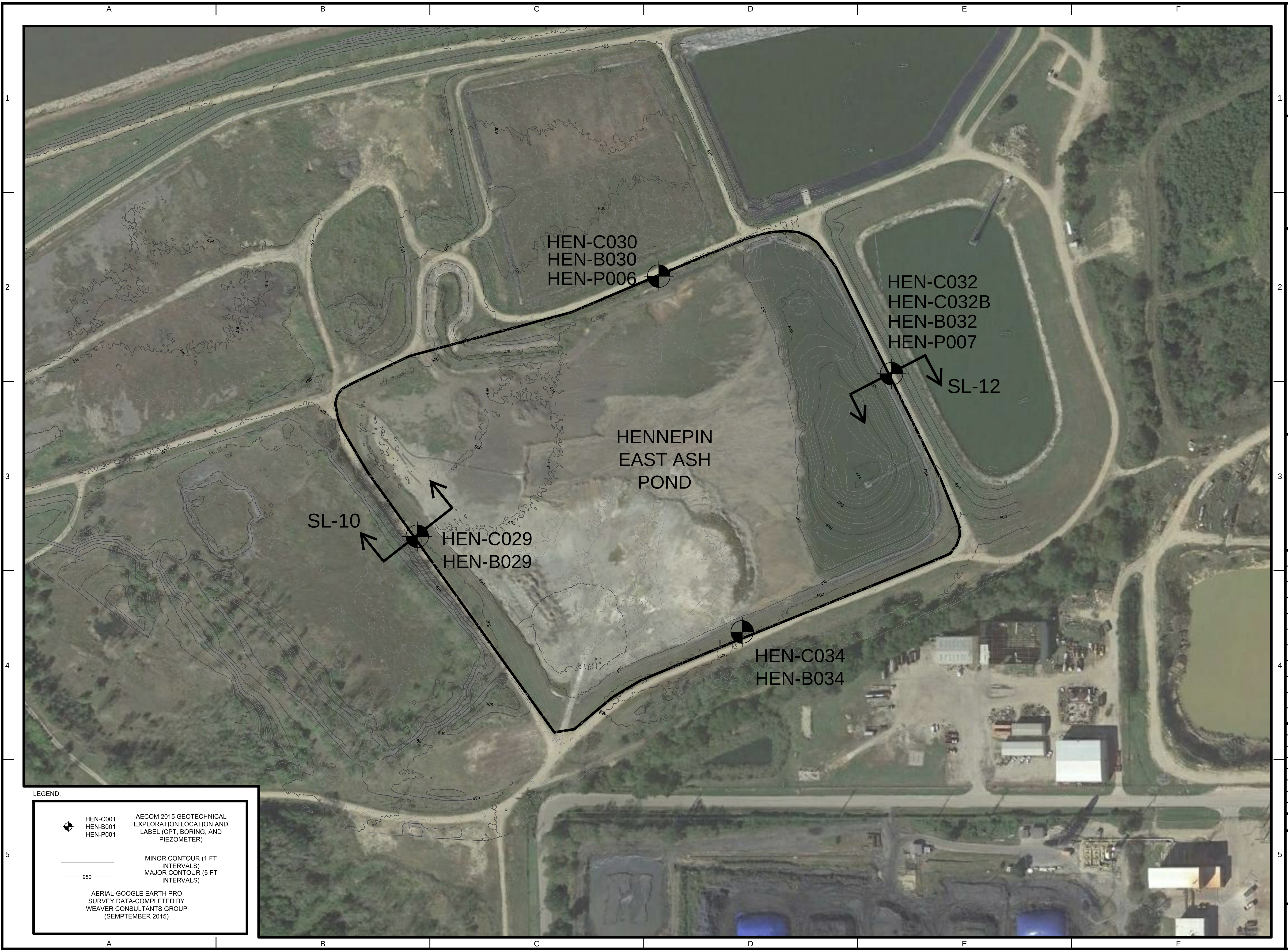
NO.	DESCRIPTION	DATE
△		
△		
△		
△		
△		

AECOM PROJECT NO:	60439752
DRAWN BY:	TPB
DESIGNED BY:	TPB
CHECKED BY:	SRA
DATE CREATED:	2/25/2016
PLOT DATE:	2/26/2016
SCALE:	AS SHOWN
ACAD VER:	2014

SHEET TITLE

LOCATION MAP AND SITE VICINITY MAP

FIGURE 1



LEGEND:

⯐	HEN-C001 HEN-B001 HEN-P001	AECOM 2015 GEOTECHNICAL EXPLORATION LOCATION AND LABEL (CPT, BORING, AND PIEZOMETER)
———		MINOR CONTOUR (1 FT INTERVALS)
—— 950 ——		MAJOR CONTOUR (5 FT INTERVALS)

AERIAL-GOOGLE EARTH PRO
SURVEY DATA-COMPLETED BY
WEAVER CONSULTANTS GROUP
(SEMPTEMBER 2015)

AECOM DRAWING PATH: K:\Projects\60427894-Dynegy\900-WORKING DOCS-CAD\902-SHEETS\30% Design Sheets_East\Draft Geotechnical Report for Dynegy Hennepin Ash Pond CCR Unit\HEN 2-1 OVERALL GEOTECHNICAL SITE PLAN.dwg

BRAND, TRAVIS, 2/26/2016 8:40 AM

AECOM
558 N Main Street
Oshkosh, Wisconsin
920 235-0270 (phone)
920 235-0321 (fax)

DYNEGY
Dynegy Inc.
1500 East Port Plaza Drive
Collinsville, IL 62234

HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

N

0 125 250

SCALE IN FEET

ISSUED FOR BIDDING ______ DATE BY

ISSUED FOR CONSTRUCTION ______ DATE BY

REVISIONS

NO.	DESCRIPTION	DATE
△		
△		
△		
△		
△		

AECOM PROJECT NO:	60439752
DRAWN BY:	TPB
DESIGNED BY:	TPB
CHECKED BY:	SRA
DATE CREATED:	2/25/2016
PLOT DATE:	2/26/2016
SCALE:	AS SHOWN
ACAD VER:	2014

SHEET TITLE

OVERALL
GEOTECHNICAL
SITE PLAN

FIGURE 2

Attachment B. Boring Logs

Project: HENNEPIN POWER STATION

Project Location: HENNEPIN, ILLINOIS

Project Number: 60439752

Key to Soil Boring Logs

Sheet 1 of 1

	Graphic Symbol	Description	USCS Classification
SAND AND GRAVEL	⠿	SAND poorly graded	SP
	▒	SAND well graded	SW
	▥	Silty SAND	SM
	▨	Clayey SAND	SC
	▚	GRAVEL poorly graded	GP
LOW PLASTIC SILTS AND CLAYS	▥	Inorganic low plastic SILT	ML
	▨	Inorganic low plastic CLAY	CL
	▥▨	Inorganic low plastic SILTY-CLAY	CL-ML
HIGH PLASTIC SILT AND CLAYS	▨	Inorganic high plastic CLAY	CH
	▨	Sandy Inorganic high plastic CLAY	CH
	▨	Inorganic elastic SILT	MH
SURFACE MATERIALS	■	Asphalt, Pavement	
	▤	Topsoil	
	▩	Gravel Limestone	
	⟆	Fly Ash	
	⟆	Bottom Ash	
	⟆	Fill	

TERMS DESCRIBING DENSITY OR CONSISTENCY

Coarse grained soils (major portion retained on No. 200 sieve) include gravels and sands. Density is based on the Standard Penetration Test (SPT).

Density	SPT blows per foot
Very loose	0 - 5
Loose	5 - 10
Medium dense	10 - 30
Dense	30 - 50
Very dense	Greater than 50

Fine grained soils (major portion passing No. 200 sieve) include clays and silts. Consistency is rated according to shearing strength, as indicated by uncorrected SPT blows per foot.

Descriptive Term	SPT blows per foot	Estimated undrained shear strength (ksf)	Hand Test
Very soft	0-2	< 0.25	Extrudes between fingers
Soft	2-4	0.25-0.5	Molded by slight pressure
Medium stiff	4-8	0.5-1.0	Molded by strong pressure
Stiff	8-15	1.0-2.0	Indented by thumb
Very stiff	15-30	2.0-4.0	Indented by thumbnail
Hard	> 30	> 4.0	Difficult to indent

LEGEND AND NOMENCLATURE

⧄	Standard penetration split spoon test sample
▥	Undisturbed shelby tube sample
PP qu	Pocket penetrometer unconfined compressive strength
NMC	Natural Moisture Content, %
LL	Liquid Limit
PL	Plastic Limit
PI	Plasticity Index
NP	Non-plastic
▽	Depth Groundwater enters at time of drilling.
▼	Groundwater Level at some specified time after drilling
Su	Undrained Shear Strength
TXUU	Triaxial Unconsolidated Undrained
DTW	Depth to water
N/A	Not Applicable

SAMPLING RESISTANCE

P	Sample pushed by hydraulic rig action.
3 6 9	Numbers indicate blows per 6 in. of sampler penetration. Standard penetration test sampler, (2-in O.D.) and oversize penetration sample (3-in O.D.) are driven by a 140 lb hammer falling freely 30-in
50/2	Number of blows (50) used to drive a penetration sampler a certain number of inches (2)
WOH	Weight of hammer
WOR	Weight of rods

ABBREVIATIONS USED UNDER "REMARKS"

HSA	Hollow Stem Auger	No.	Number
ATD	At Time of Drilling	CIU	Isotropically Consolidated Undrained
AD	After Drilling	ST	Shelby Tube
ID	Inside Diameter	SS	Split Spoon
OD	Outside Diameter		
RQD	Rock Quality Designation		
-#200	(% Pass #200 Sieve)		
Sa (%)	Sieve Analysis (% Passing #200)		

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AECOM

Project: Hennepin Power Station

Project Location: Hennepin, Illinois
Project Number: 60439752

Log of Boring HEN-B029

Sheet 1 of 2

Date(s) Drilled	12:00AM 10/01/2015 to 12:00AM 10/01/2015	Logged By	Robert Weseljak	Checked By	AJW
Drilling Method	Mud Rotary	Drilled By	S. Komen	Borehole Depth	41.5 '
Drill Rig Type	Mobile 57 Truck Mounted	Drilling Contractor	Strata Earth Services	Surface Elevation	499.7 ' (NAVD88)
Borehole Backfill	Portland Cement and Grout	Drill Bit Size/Type	3 7/8" Tricone Roller Bit	Hammer Data	Automatic, 140 lbs, 30" drop
Boring Location	N 1689435.679 E 2533022.216 (NAD83)	Sampling Method(s)	Split Spoon/3" Thin Walled Tube	Groundwater Level(s)	Not Encountered

Elevation (feet)	Depth (feet)	SAMPLES Type Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU, Su (ksf)	REMARKS
	0	SS-1	24 28 34	556		499.7 / 0.0 Very dense, dry, brown, silty GRAVEL (GM) [Road Fill].	4.7							
	2													
		SS-2	10 6 11	556	▨	497.2 / 2.5 Stiff to very stiff, dry, brown to very dark brown and gray, lean CLAY (CL) with sand and gravel [Embankment Fill].	14.7				4.5			
495	4				▨									
	6	ST-3		417	▨		10.8		22	7	4.5			*Pushed shelby tube from 5.0 to 7.0 feet*
	8	SS-4	12 14 17	556	▨		14.8				4.0			
490	10				▨									
		ST-5		417	▨		16.7		31	14	2.5			*Pushed shelby tube from 10.0 to 12.0 feet*
	12				▨									
	14				▨									
485														
	16	SS-6	4 6 8	461	▨	484.7 / 15.0 Stiff, dark brown with trace rust, lean CLAY (CL), trace fine to coarse gravel [Embankment Fill].	21.7				1.5			
	18				▨									
480	20													
		SS-7	6 12 20	433		479.5 / 20.2 Dense, dry, brown, clayey GRAVEL with sand (GP-GC).	11.5				1.5			
	22													
	24													
475														
	26	SS-8	17 17 43	311			8.8							
	28													
470	30													

Project: Hennepin Power Station

Project Location: Hennepin, Illinois
Project Number: 60439752

Log of Boring HEN-B029

Sheet 2 of 2

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION Elevation (feet)	Depth (feet)	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU, Su (ksf)	REMARKS
	30	▨	SS-9	29 50/5"	122				12.7							*Less fines in Sample 9*
	32															
	34															
465																
	36	▨	SS-10	20 25 28	339				13.8							
	38															
460																
	40	▨	SS-11	16 14 15	33				4.6							
							458.2	41.5								
	42						End of Boring at 41.5 '									*Boring backfilled with 94 pounds of Portland Cement and 25 pounds of bentonite*
	44															
455																
	46															
	48															
450																
	50															
	52															
	54															
445																
	56															
	58															
440																
	60															
	62															
	64															
435																

AECOM

Project: Hennepin Power Station

Project Location: Hennepin, Illinois
Project Number: 60439752

Log of Boring HEN-B030

Sheet 1 of 2

Date(s) Drilled	**12:00AM 09/29/2015 to 12:00AM 09/30/2015**	Logged By	**Norm Seiler**	Checked By	**AJW**
Drilling Method	**Hollow-Stem Auger**	Drilled By	**S. Komen**	Borehole Depth	**41.5 '**
Drill Rig Type	**Mobile 57 Truck Mounted**	Drilling Contractor	**Strata Earth Services**	Surface Elevation	**495.4 ' (NAVD88)**
Borehole Backfill	**Portland Cement and Grout**	Drill Bit Size/Type	**3 7/8" Tricone Roller Bit**	Hammer Data	**Automatic, 140 lbs, 30" drop**
Boring Location	**N 1690014.94 E 2533585.318 (NAD83)**	Sampling Method(s)	**Split Spoon/3" Thin Walled Tube**	Groundwater Level(s)	**33.0 ' at 12:00AM on 09/30/2016**

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION Elevation (feet) / Depth (feet)	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU, Su (ksf)	REMARKS
495	0	▨	SS-1	22 17 37	461		495.4 / 0.0 Very Dense, Brownish gray sand, gravel, and clay [Fill].	7.0							
	2	▨	SS-2	15 17 15	372		492.9 / 2.5 Dense, Brown and light brown, silty sand with gravel (SM) [Fill].	6.4							
	4						491.4 / 4.0 Very Dense, Dark gray silty SAND (SM) with trace gravel, sand, and clay, with ASH [Fill].								
490	6	▨	SS-3	18 20 30	461			11.5							
	8	▨	SS-4	4 5 6	556		Becomes medium dense	17.1							
															9.0 feet: Wet
485	10	▤	ST-5		275		485.4 / 10.0 Black ASH with gravel [Fill].	18.1							*Pushed shelby tube from 10.0 to 11.0 feet* *10.0 feet: Switch to mud rotary*
	12														
	14														
480	16	▨	SS-6	11 11 16	311		480.4 / 15.0 Medium dense, light brown and tan, well graded GRAVEL with sand (GW) [Embankment Fill].	17.6							
	18														
475	20	▨	SS-7	3 4 7	122		475.4 / 20.0 Soft, dark gray and rust CLAY (CL) with organics and wood.	23.9							
	22														
	24														
470	26	▨	SS-8	30 36 40	494		470.4 / 25.0 Dense to very dense, brown and some black, clayey fine to coarse GRAVEL (GC) with sand.	11.2							*25.0 feet - Drillers note - rock pieces in Sample 8*
	28														
	30														

AECOM

Project: Hennepin Power Station

Project Location: Hennepin, Illinois
Project Number: 60439752

Log of Boring HEN-B030

Sheet 2 of 2

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION Elevation (feet)		Depth (feet)	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU, Su (ksf)	REMARKS
465	30	▨	SS-9	56	42	▨											
	33					▨											*33.0 feet - Drillers note - water level at 33.0 feet and dropping*
460	36	▨	SS-10	7 8 25	211	▨				8.9							
455	40	▨	SS-11	20 46 27		▨				9.0							
	42						453.9	End of Boring at 41.5 '	41.5								*Boring backfilled with 2 batches Portland Cement and bentonite grout*

Elevation scale: 465, 460, 455, 450, 445, 440, 435

Depth scale: 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64

AECOM

Project: Hennepin Power Station

Project Location: Hennepin, Illinois
Project Number: 60439752

Log of Boring HEN-B032

Sheet 1 of 2

Date(s) Drilled	12:00AM 09/30/2015 to 12:00AM 09/30/2015	Logged By	Robert Weseljak	Checked By	AJW
Drilling Method	Mud Rotary	Drilled By	S. Komen	Borehole Depth	41.5 '
Drill Rig Type	Mobile 57 Truck Mounted	Drilling Contractor	Strata Earth Services	Surface Elevation	494.3 ' (NAVD88)
Borehole Backfill	Portland Cement and Grout	Drill Bit Size/Type	3 7/8" Tricone Roller Bit	Hammer Data	Automatic, 140 lbs, 30" drop
Boring Location	N 1689837.064 E 2534055.482 (NAD83)	Sampling Method(s)	Split Spoon/3" Thin Walled Tube	Groundwater Level(s)	Not Encountered

Elevation (feet)	Depth (feet)	Type Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	MATERIAL DESCRIPTION	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU, Su (ksf)	REMARKS
494.3	0.0	SS-1	32 29 20	372	Very dense, dry, brown, fine to coarse well graded GRAVEL with silt and sand [Fill].	2.7				4.5			
493.3	1.0				Hard, dry, dark brownish gray, Lean CLAY (CL)with sand and gravel [Embankment Fill]								
		SS-2	6 18 17	556		9.7				3.5			
		ST-3		329		14.0		35	17	4.5			*Pushed shelby tube from 5.0 to 7.0 feet*
		SS-4	8 12 16	556		16.7				3.5			
		SS-5	8 16 20	244		16.2				0.5			*10.0 feet: Coarse gravel*
479.3	15.0	SS-6	19 39 43	400	Very dense, moist, brown, Silty SAND (SM) with gravel.	8.2							
		SS-7	18 36 50/3"	339		11.1							
		SS-8	98 35 50/4"	433		9.1							*24.5: Drillers Note - boulder from 24.5 to 25.2 feet*
464.3	30.0												

AECOM

Project: Hennepin Power Station

Project Location: Hennepin, Illinois
Project Number: 60439752

Log of Boring HEN-B032

Sheet 2 of 2

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU, Su (ksf)	REMARKS
	30	▨	SS-9	18 11 30	556	▨	Hard, moist, brown, fine to coarse gravelly lean CLAY (CL).	10.6				3.0 4.5			
459.3	35.0	▨	SS-10	41 28 40	372	▒	Very dense, moist, brown and black, clayey fine to coarse Silty SAND (SM) with gravel.	5.5							
	40	▨	SS-11	12 18 50/4"	400	▒		10.9							
452.8	41.5						End of Boring at 41.5 '								*Boring backfilled with 94 pounds of Portland Cement and 25 pounds of bentonite*

Report: GEO_SOIL; File P:\PROJECTS\GEOTECH\60428794_DYNEGYCCR\21_REVISED_CERT_REPORTS\08_HEN\REV 1\GEOTECH\ATTACHMENT REVISIONS\ATT. A&B_FIGURES-GINT\60439752_HENNEPINDYNEGYBORINGLOGS_EAST ASH POND.GPJ; 9/22

Project: Hennepin Power Station

Project Location: Hennepin, Illinois
Project Number: 60439752

Log of Boring HEN-B034

Sheet 1 of 2

Date(s) Drilled	12:00AM 09/30/2015 to 12:00AM 10/01/2015	Logged By	Robert Weseljak	Checked By	AJW
Drilling Method	Mud Rotary	Drilled By	S. Komen	Borehole Depth	41.5 '
Drill Rig Type	Mobile 57 Truck Mounted	Drilling Contractor	Strata Earth Services	Surface Elevation	499.3 ' (NAVD88)
Borehole Backfill	Portland Cement and Grout	Drill Bit Size/Type	3 7/8" Tricone Roller Bit	Hammer Data	Automatic, 140 lbs, 30" drop
Boring Location	N 1689245.6 E 2533830.734 (NAD83)	Sampling Method(s)	Split Spoon/3" Thin Walled Tube	Groundwater Level(s)	Not Encountered

SAMPLES Type Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	Elevation (feet)	MATERIAL DESCRIPTION	Depth (feet)	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU, Su (ksf)	REMARKS
				499.3		0.0								
				498.8	Very dense, dry, brown, silty SAND (SM) [Fill].	0.5								
SS-1	25 19 21	556			Hard, dry, black, gravelly lean CLAY (CL) [Fill].		4.2				1.5 2.5			
SS-2	7 8 11	556					14.2				3.5 4.5			
				494.3		5.0								
				493.8	Dense, dry, brown, silty SAND (SM).	5.5								
SS-3	17 28 32	556			Very dense, moist, brown to gray, silty fine to coarse GRAVEL (GP-GM) with silt [Embankment Fill].		15.9							
SS-4	11 18 32	556					2.5							
SS-5	27 35 18	311					11.2							
SS-6	21 24 25	244					9.1							
				479.3		20.0								
SS-7	10 11 9	244			Medium dense, dry, silty fine to coarse GRAVEL (GM).		12.5							
SS-8	11 13 16	33												
				469.3		30.0								

AECOM

Project: Hennepin Power Station

Project Location: **Hennepin, Illinois**
Project Number: **60439752**

Log of Boring HEN-B034

Sheet 2 of 2

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION Elevation (feet) / Depth (feet)	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU, Su (ksf)	REMARKS
	30	▨	SS-9	14 14 12	122		Medium dense, moist to wet, light brown and tan, poorly graded GRAVEL (GP-GM) with sand and silt.	13.6							
	32														
	34														
465															
	36	▨	SS-10	9 11 10	372			10.9							
	38														
460															
	40	▨	SS-11	10 8 9	94		457.8 / 41.5	1.5							
	42						End of Boring at 41.5 '								*Boring backfilled with 94 pounds of Portland Cement and 25 pounds of bentonite*
	44														
455															
	46														
	48														
450															
	50														
	52														
	54														
445															
	56														
	58														
440															
	60														
	62														
	64														
435															

Attachment C. Piezometer Logs

Project: Dynegy

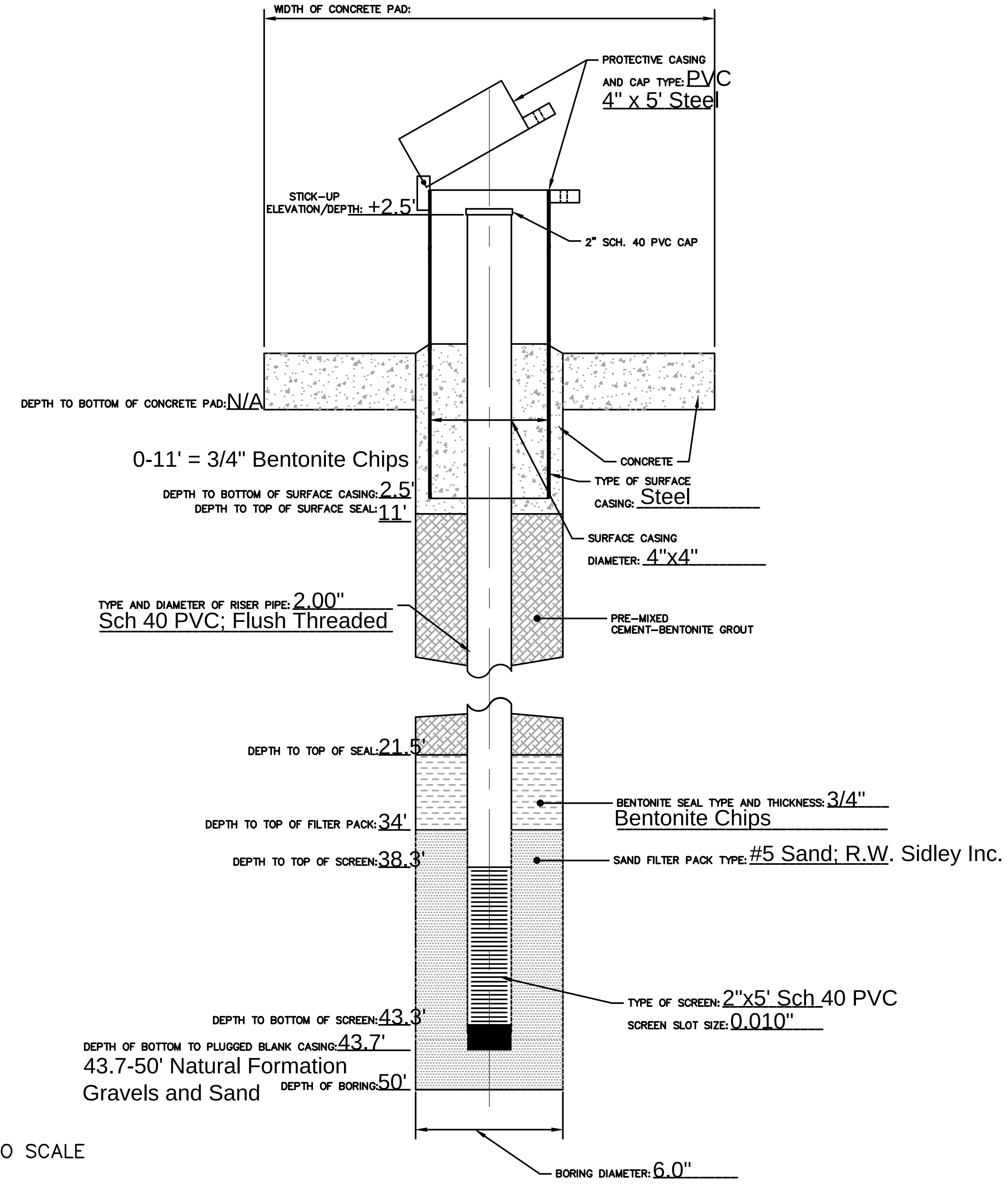
Project Location: Hennepin, IL

Project Number: 60439752

Log of Piezometer

Sheet 1 of 1

Piezometer Location	P006	Date Installed	10/20/15	Time	11:20 A.M.
Installed By	Scott Komen	Observed By	R. Weseljak	Total Depth	50'
Method of Installation	6" Tricone Mud Rotary	Drilling Contractor	Strata	Surface Elevation	495.4'
Screened Interval	38.3-43.3'	Completion Zone	Gravel		
Remarks		Groundwater Level(s)	45.74' T.O.C.		



WIDTH OF CONCRETE PAD:

PROTECTIVE CASING AND CAP TYPE: PVC 4" x 5' Steel

STICK-UP ELEVATION/DEPTH: +2.5'

DEPTH TO BOTTOM OF CONCRETE PAD: N/A

0-11' = 3/4" Bentonite Chips

DEPTH TO BOTTOM OF SURFACE CASING: 2.5'

DEPTH TO TOP OF SURFACE SEAL: 11'

TYPE OF SURFACE CASING: Steel

SURFACE CASING DIAMETER: 4"x4"

TYPE AND DIAMETER OF RISER PIPE: 2.00" Sch 40 PVC; Flush Threaded

DEPTH TO TOP OF SEAL: 21.5'

BENTONITE SEAL TYPE AND THICKNESS: 3/4" Bentonite Chips

DEPTH TO TOP OF FILTER PACK: 34'

DEPTH TO TOP OF SCREEN: 38.3'

SAND FILTER PACK TYPE: #5 Sand; R.W. Sidley Inc.

TYPE OF SCREEN: 2"x5' Sch 40 PVC

SCREEN SLOT SIZE: 0.010"

DEPTH TO BOTTOM OF SCREEN: 43.3'

DEPTH OF BOTTOM TO PLUGGED BLANK CASING: 43.7'

43.7-50' Natural Formation Gravels and Sand

DEPTH OF BORING: 50'

BORING DIAMETER: 6.0"

NOT TO SCALE

AECOM

Project: Dynegy

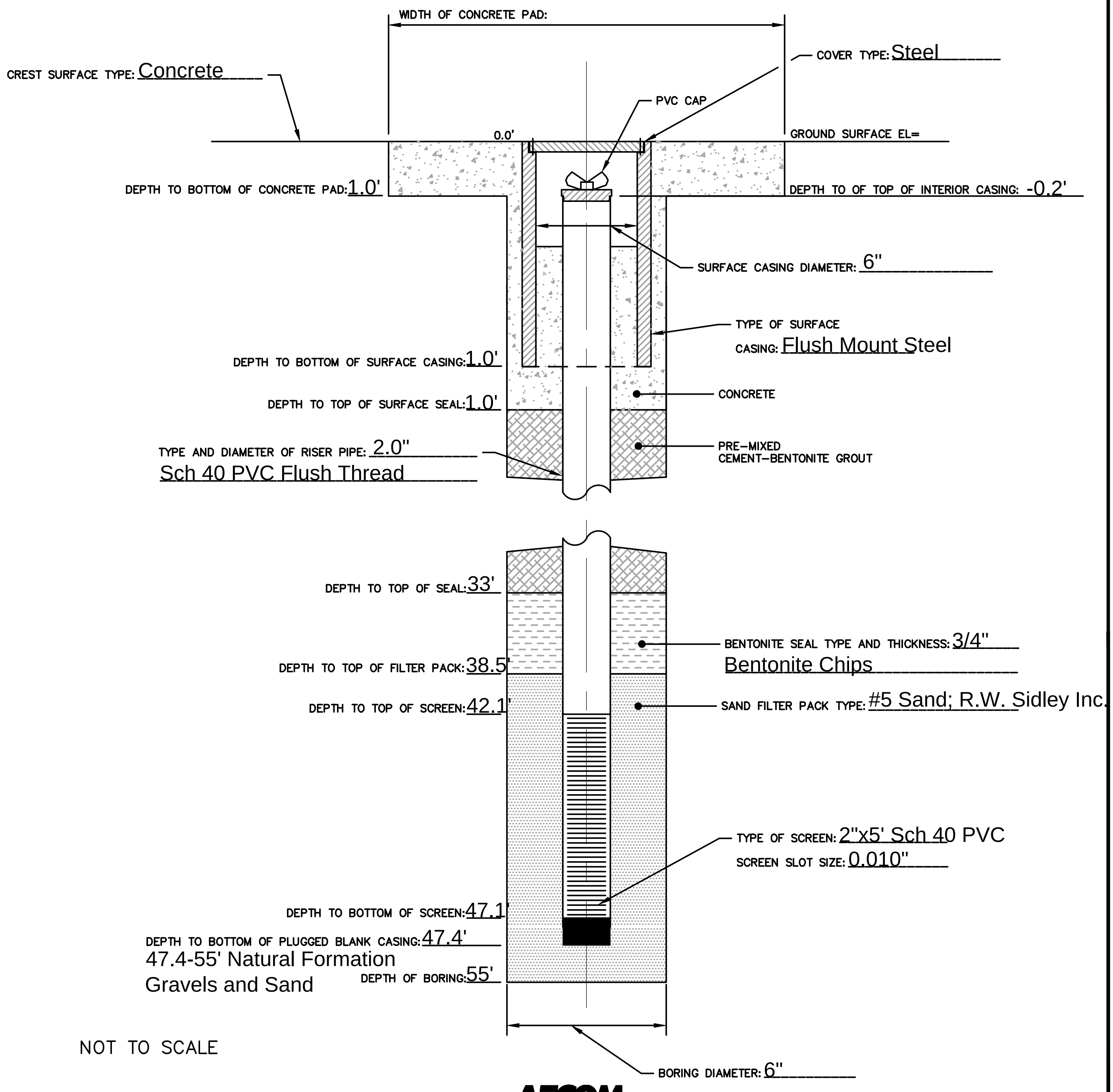
Project Location: Hennepin, IL

Project Number: 60439752

Log of Piezometer

Sheet 1 of 1

Piezometer Location P007	Date Installed 10/21/15	Time 5:00 P.M.
Installed By Scott Komen	Observed By R. Weseljak	Total Depth 55'
Method of Installation 6" Tricone Mud Rotary	Drilling Contractor Strata	Surface Elevation 494.3'
Screened Interval 42.1-47.1'	Completion Zone Gravels	
Remarks	Groundwater Level(s) 44.65' T.O.C.	



CREST SURFACE TYPE: Concrete

COVER TYPE: Steel

DEPTH TO BOTTOM OF CONCRETE PAD: 1.0'

DEPTH TO OF TOP OF INTERIOR CASING: -0.2'

SURFACE CASING DIAMETER: 6"

TYPE OF SURFACE CASING: Flush Mount Steel

DEPTH TO BOTTOM OF SURFACE CASING: 1.0'

DEPTH TO TOP OF SURFACE SEAL: 1.0'

TYPE AND DIAMETER OF RISER PIPE: 2.0" Sch 40 PVC Flush Thread

DEPTH TO TOP OF SEAL: 33'

BENTONITE SEAL TYPE AND THICKNESS: 3/4" Bentonite Chips

DEPTH TO TOP OF FILTER PACK: 38.5'

DEPTH TO TOP OF SCREEN: 42.1'

SAND FILTER PACK TYPE: #5 Sand; R.W. Sidley Inc.

TYPE OF SCREEN: 2"x5' Sch 40 PVC

SCREEN SLOT SIZE: 0.010"

DEPTH TO BOTTOM OF SCREEN: 47.1'

DEPTH TO BOTTOM OF PLUGGED BLANK CASING: 47.4'

47.4-55' Natural Formation Gravels and Sand

DEPTH OF BORING: 55'

BORING DIAMETER: 6"

AECOM

Attachment D. CPT Data Report

Cone Penetration Test Summary and

Standard Cone Penetration Test Plots

Job No:	15-53081
Client:	AECO
Project:	Hennepin Power Station, Hennepin, IL
Start Date:	01-Sep-2015
End Date:	11-Sep-2015

CONE PENETRATION TEST SUMMARY

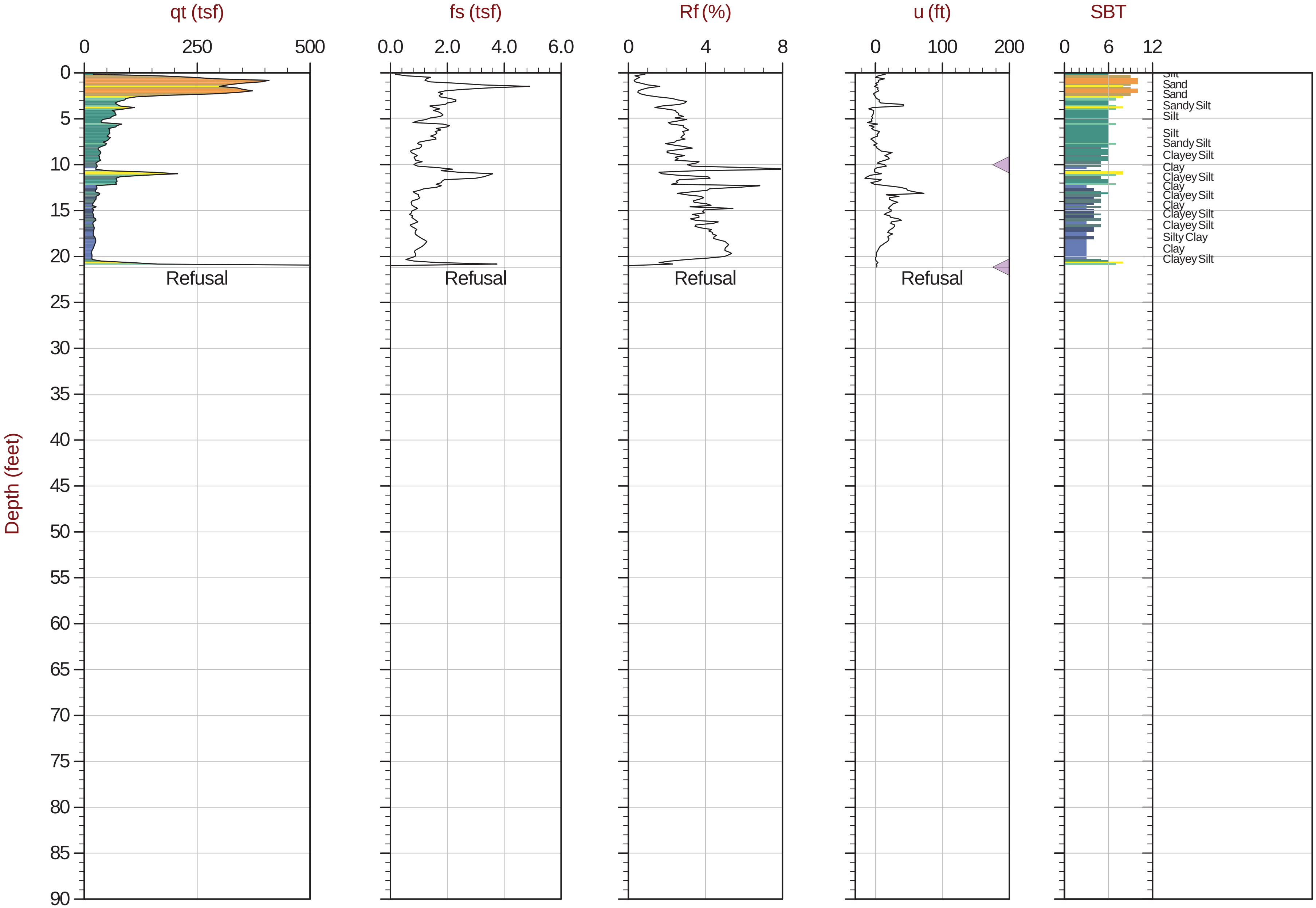
Sounding ID	File Name	Date	Cone	Assumed Phreatic Surface[1] (ft)	Final Depth (ft)	Shear Wave Velocity Tests	Northing[2] (m)	Easting (m)	Refer to Notation Number
HEN-C029	15-53081_CP29	01-Sep-2015	374:T1500F15U500		21.16		4574869	306935	4
HEN-C030	15-53081_SP30	02-Sep-2015	374:T1500F15U500		11.16	3	4575040	307109	4
HEN-C032	15-53081_CP32	02-Sep-2015	374:T1500F15U500		12.30		4574980	307252	4
HEN-C032B	15-53081_CP32B	02-Sep-2015	374:T1500F15U500		12.14		4574980	307253	4
HEN-C034	15-53081_SP34	02-Sep-2015	374:T1500F15U500		29.53	5	4574804	307178	4

1. Assumed phreatic surface depths were determined from the pore pressure data. Hydrostatic data were used for calculated parameters.
2. Coordinates are WGS 84 / UTM Zone 16 and were collected using a GlobalSat (MR-350) and a handheld GPS Receiver.
3. Assumed phreatic surface estimated from dynamic pore pressure response.
4. No phreatic surface detected

AECOM

Job No: 15-53081
Date: 09:01:15 15:44
Site: Hennepin Power Station, Hennepin, IL

Sounding: HEN-C029
Cone: 374:T1500F15U500



Max Depth: 6.450 m / 21.16 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 15-53081_CP29.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4574869m E: 306935m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◀ PPD, Ueq not achieved

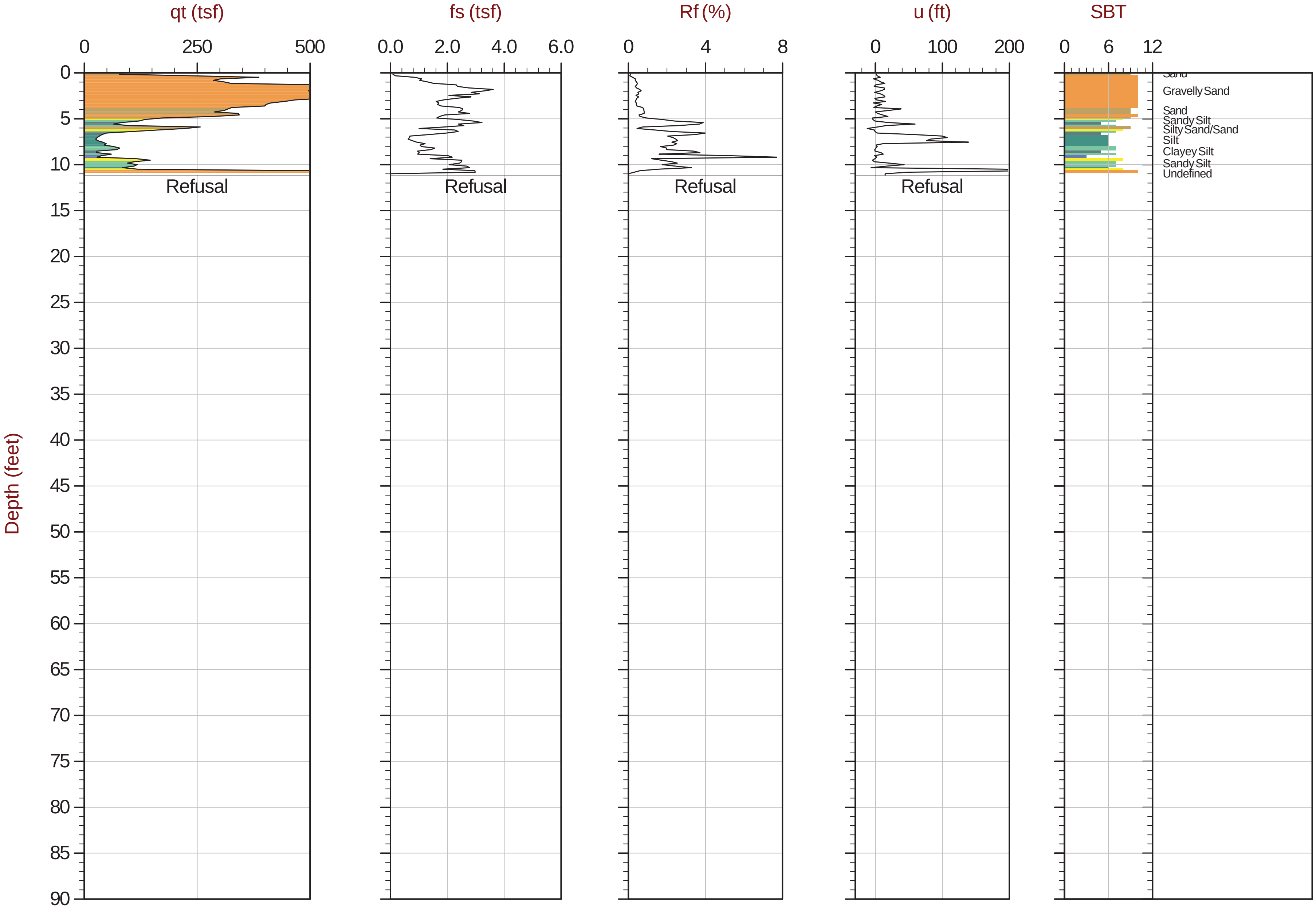
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

AECOM

Job No: 15-53081
Date: 09:02:15 14:24
Site: Hennepin Power Station, Hennepin, IL

Sounding: HEN-C030
Cone: 374:T1500F15U500



Max Depth: 3.400 m / 11.15 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 15-53081_SP30.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4575040m E: 307109m

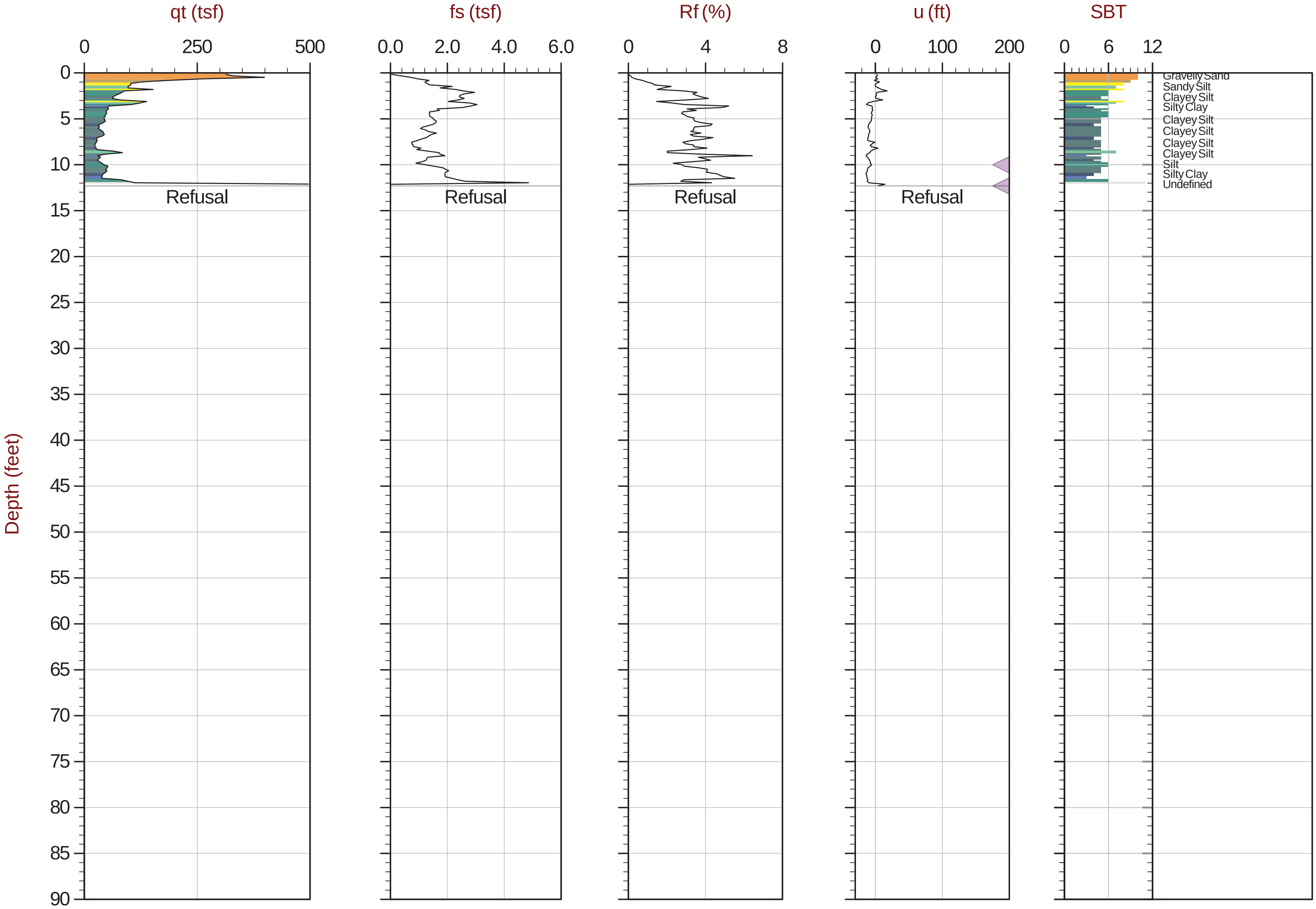
Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◀ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

ConeTec

AECOM

Job No: 15-53081
Date: 09:02:15 10:27
Site: Hennepin Power Station, Hennepin, IL
Sounding: HEN-C032
Cone: 374:T1500F15U500



Max Depth: 3.750 m / 12.30 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 15-53081_CP32.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4574980m E: 307252m

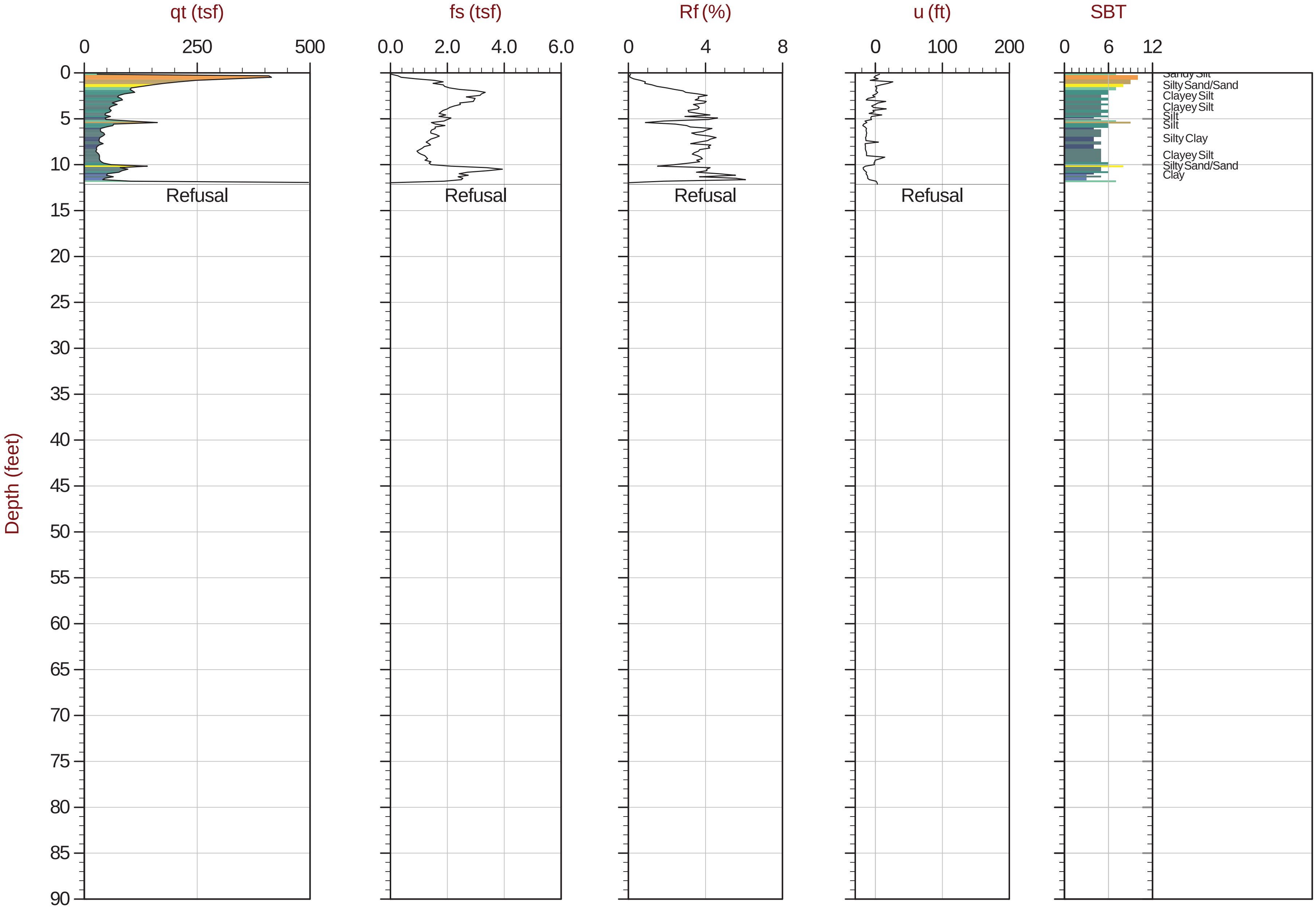
— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◀ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

AECOM

Job No: 15-53081
Date: 09:02:15 11:26
Site: Hennepin Power Station, Hennepin, IL

Sounding: HEN-C032B
Cone: 374:T1500F15U500



Max Depth: 3.700 m / 12.14 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 15-53081_CP32B.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4574980m E: 307253m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

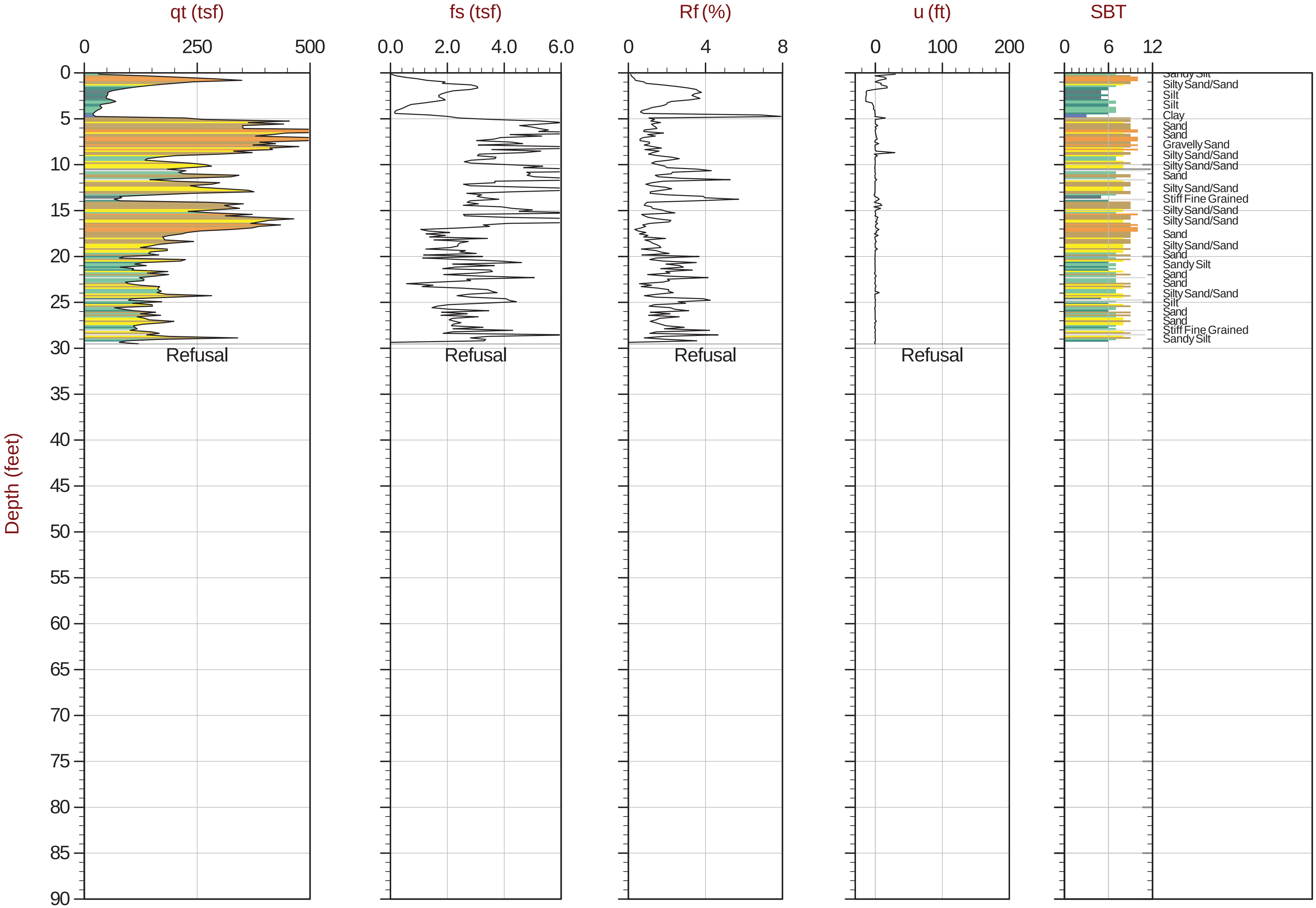
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

AECOM

Job No: 15-53081
Date: 09:02:15 08:46
Site: Hennepin Power Station, Hennepin, IL

Sounding: HEN-C034
Cone: 374:T1500F15U500



Max Depth: 9.000 m / 29.53 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 15-53081_SP34.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4574804m E: 307178m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◀ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

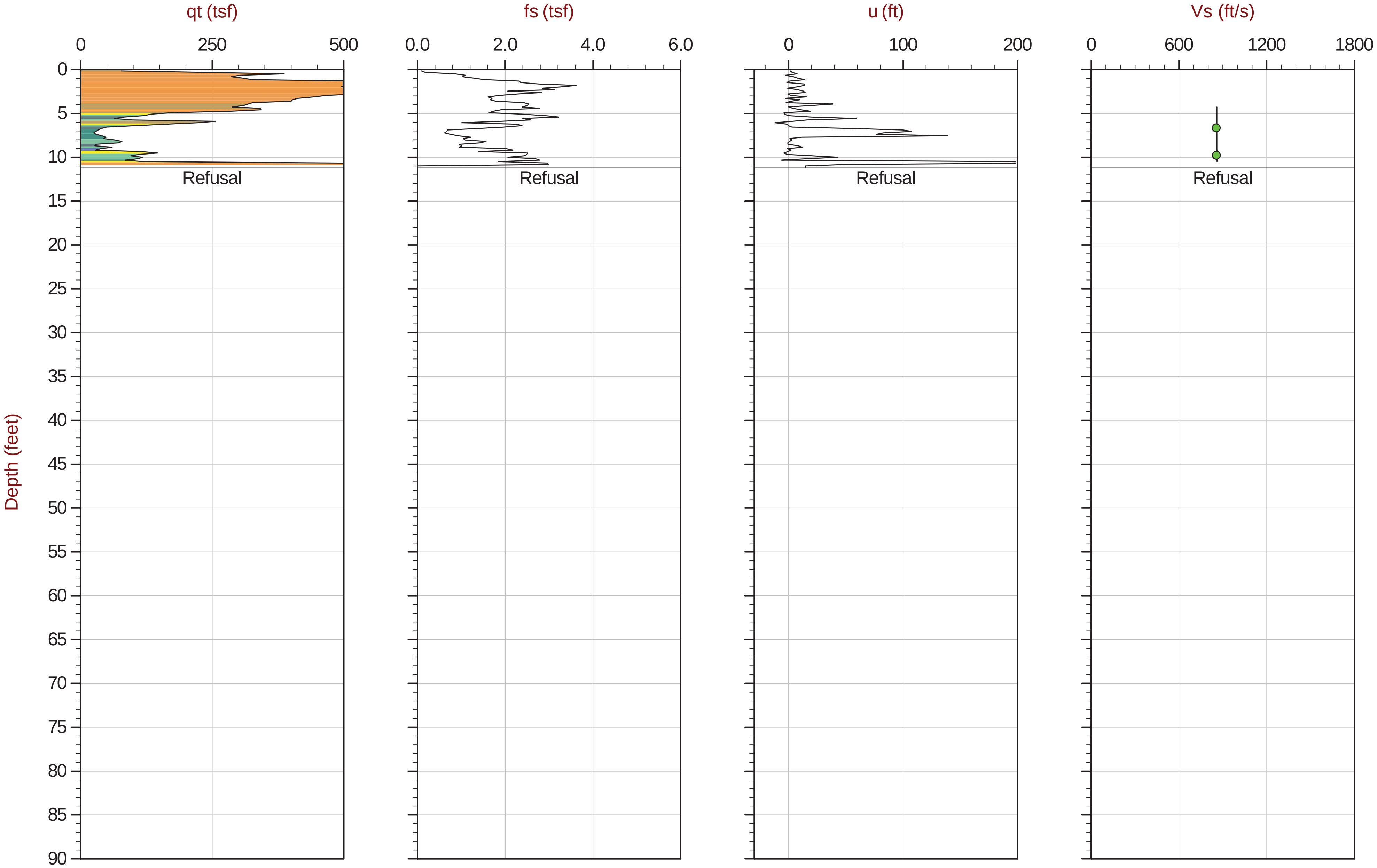
Seismic Cone Penetration Test Plots

CONETEC

AECOM

Job No: 15-53081
Date: 09:02:15 14:24
Site: Hennepin Power Station, Hennepin, IL

Sounding: HEN-C030
Cone: 374:T1500F15U500



Max Depth: 3.400 m / 11.15 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 15-53081_SP30.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4575040m E: 307109m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◀ PPD, Ueq not achieved

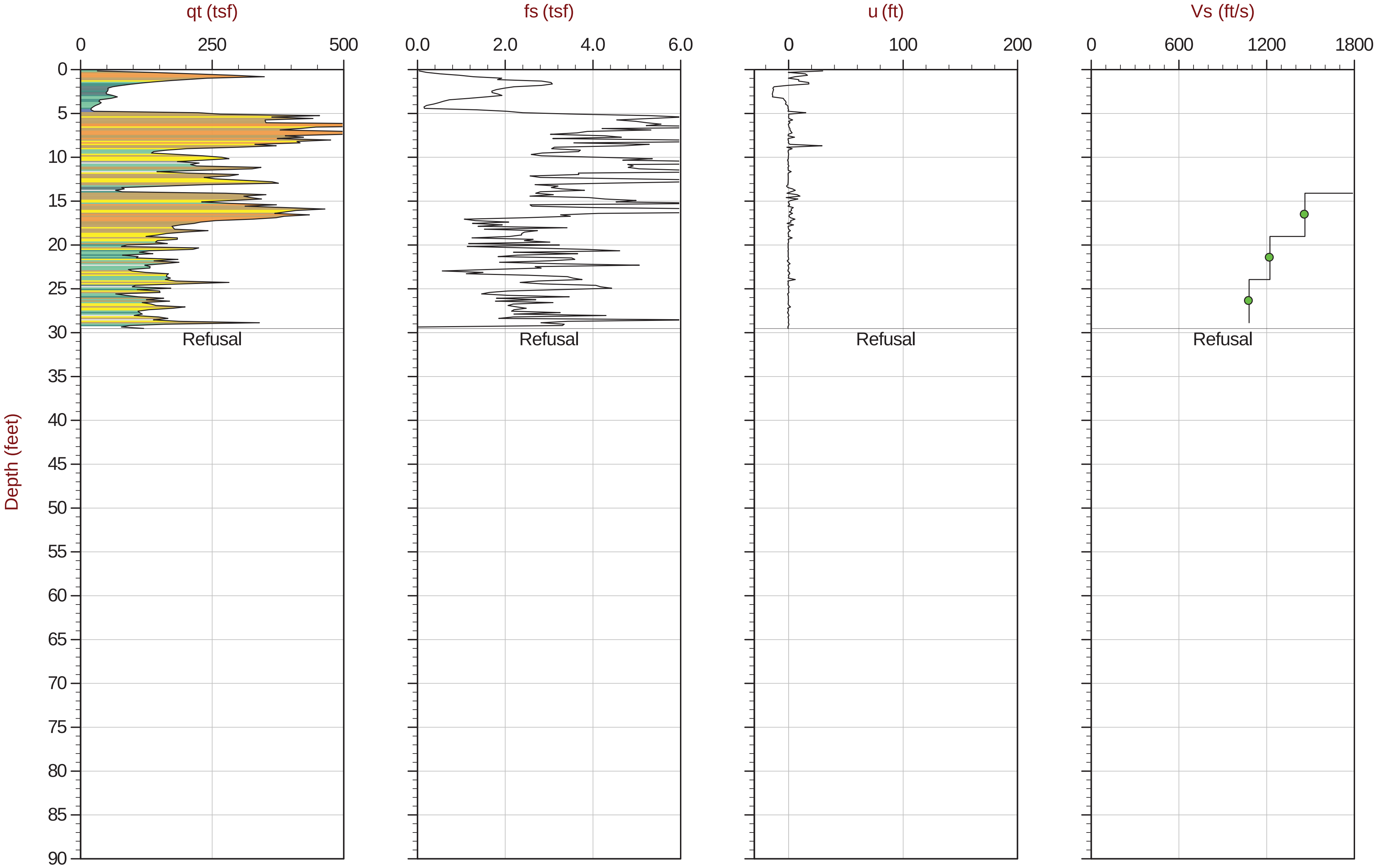
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

AECOM

Job No: 15-53081
Date: 09:02:15 08:46
Site: Hennepin Power Station, Hennepin, IL

Sounding: HEN-C034
Cone: 374:T1500F15U500



Max Depth: 9.000 m / 29.53 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: Every Point

File: 15-53081_SP34.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4574804m E: 307178m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◀ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Seismic Cone Penetration Test Tabular Results (Vs)

Job No: 15-53081
Client: AECOM
Project: Hennepin Power Plant
Sounding ID: HEN-C030
Date: 02-Sep-2015

Seismic Source: Beam
Source Offset (ft): 7.21
Source Depth (ft): 0.00
Geophone Offset (ft): 0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
4.92	4.27	8.38			
9.84	9.19	11.68	3.30	3.84	860
11.15	10.50	12.74	1.06	1.23	861

Job No: 15-53081
Client: AECOM
Project: Hennepin Power Plant
Sounding ID: HEN-C034
Date: 02-Sep-2015

Seismic Source: Beam
Source Offset (ft): 7.21
Source Depth (ft): 0.00
Geophone Offset (ft): 0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
9.84	9.19	11.68			
14.76	14.11	15.84	4.17	2.04	2038
19.69	19.03	20.35	4.51	3.08	1462
24.61	23.95	25.01	4.66	3.81	1223
29.53	28.87	29.76	4.75	4.39	1080

Pore Pressure Dissipation Summary and

Pore Pressure Dissipation Plots

Job No: 15-53081
Client: AECOM
Project: Hennepin Power Station, Hennepin, IL
Start Date: 01-Sep-2015
End Date: 11-Sep-2015

CPTu PORE PRESSURE DISSIPATION SUMMARY

Sounding ID	File Name	Cone Area (cm^2)	Duration (s)	Test Depth (ft)	Estimated Equilibrium Pore Pressure U_{eq} (ft)	Calculated Phreatic Surface (ft)	Estimated Phreatic Surface (ft)	t_{50} [a] (s)	Assumed Rigidity Index (I_r)	c_h [b] (cm^2/min)
HEN-C029	15-53081_CP29	15	900	10.01						
HEN-C029	15-53081_CP29	15	600	21.16						
HEN-C032	15-53081_CP32	15	1200	10.01	2.40					
HEN-C032	15-53081_CP32	15	300	12.30	4.57					

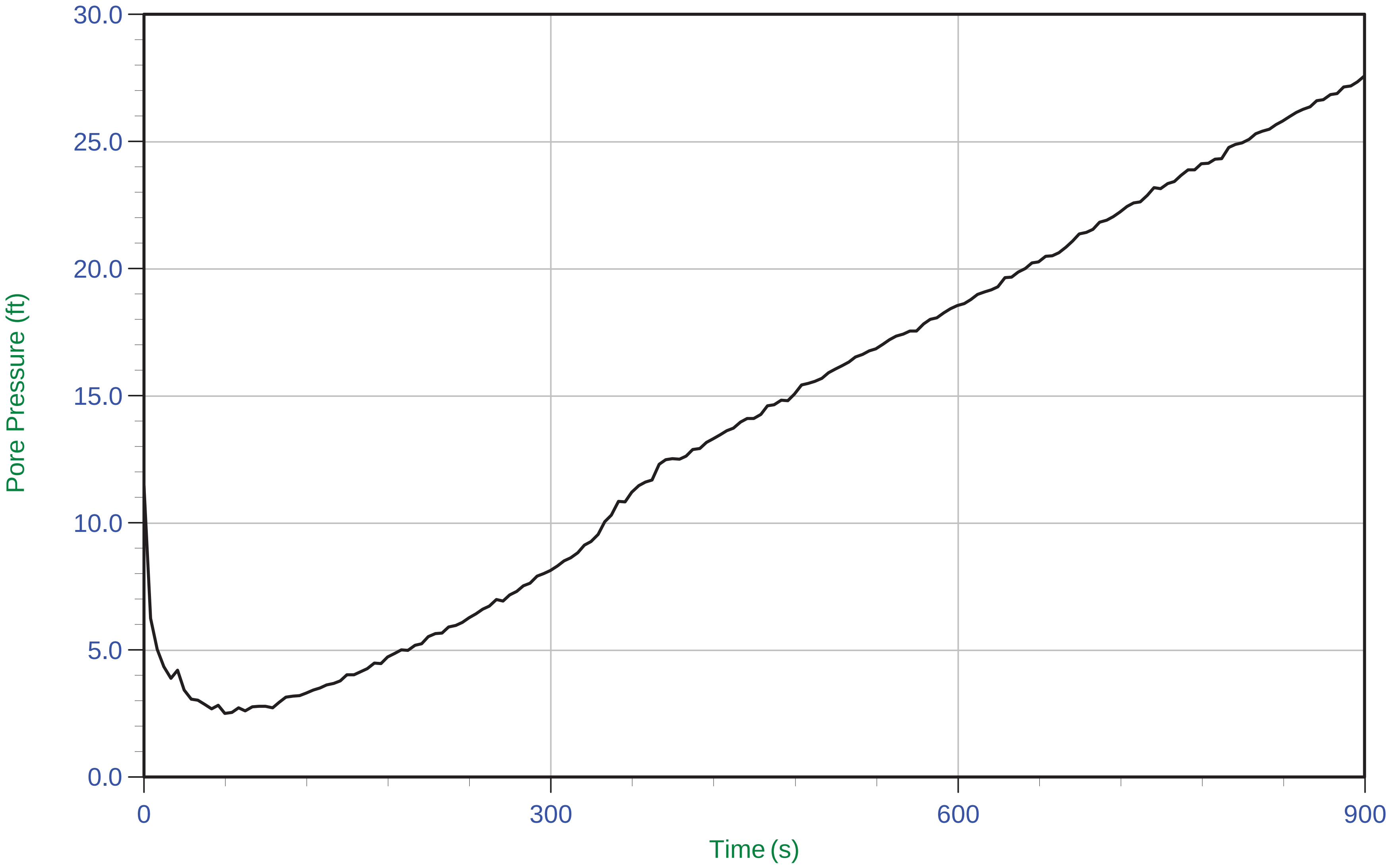
a. Time is relative to where umax occurred
b. Houlsby and Teh, 1991

CONETEC

AECOM

Job No: 15-53081
Date: 01-Sep-2015 15:44:33
Site: Hennepin Power Station, Hennepin, IL

Sounding: HEN-C029
Cone: 374
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53081_CP29.PPD
Depth: 3.050 m / 10.006 ft
Duration: 900.0 s

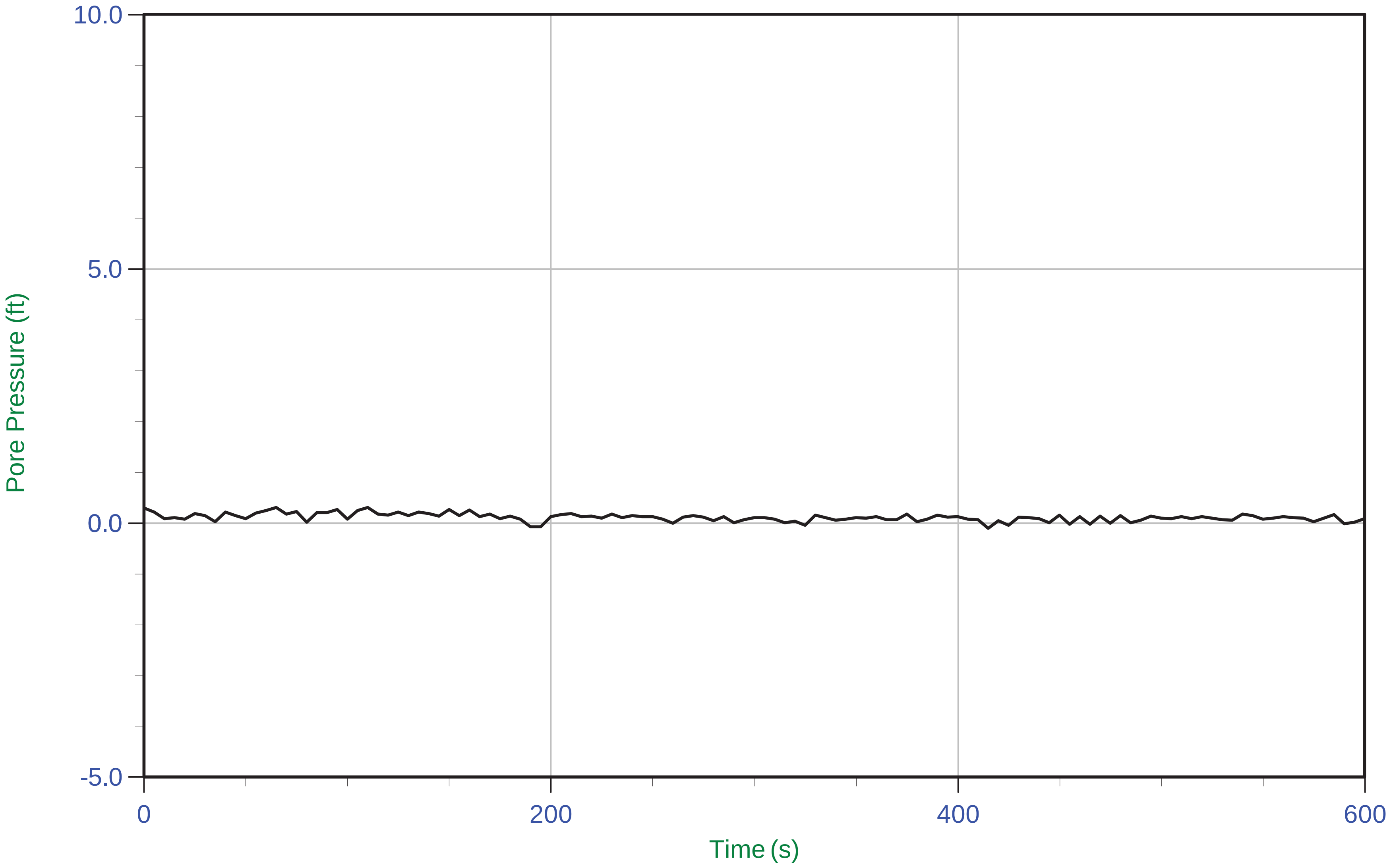
U Min: 2.5 ft
U Max: 27.6 ft

CONETEC

AECOM

Job No: 15-53081
Date: 01-Sep-2015 15:44:33
Site: Hennepin Power Station, Hennepin, IL

Sounding: HEN-C029
Cone: 374
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53081_CP29.PPD
Depth: 6.450 m / 21.161 ft
Duration: 600.0 s

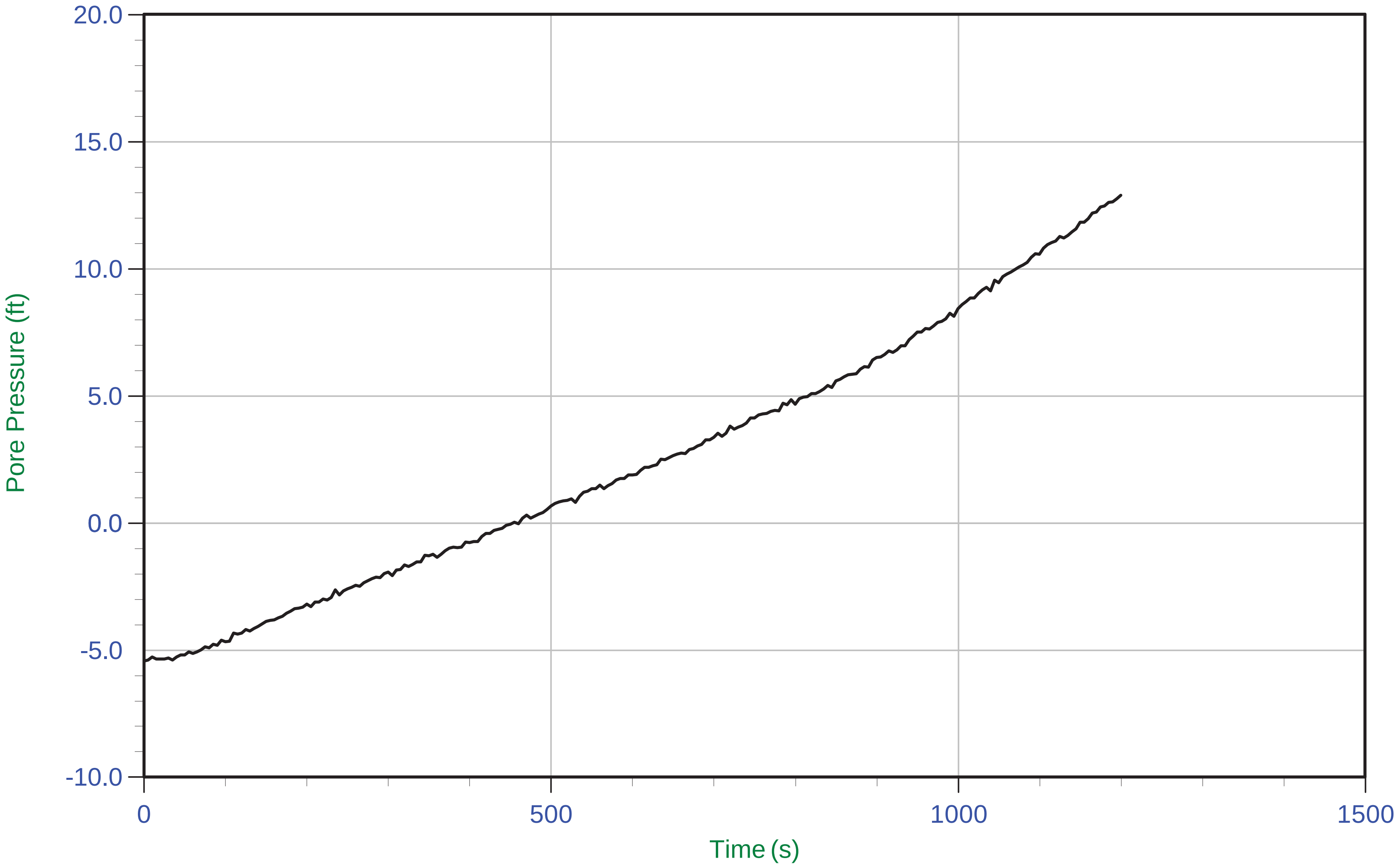
U Min: -0.1 ft
U Max: 0.3 ft

CONETEC

AECOM

Job No: 15-53081
Date: 02-Sep-2015 10:27:31
Site: Hennepin Power Station, Hennepin, IL

Sounding: HEN-C032
Cone: 374
Cone Area: 15 sq cm



Trace Summary:

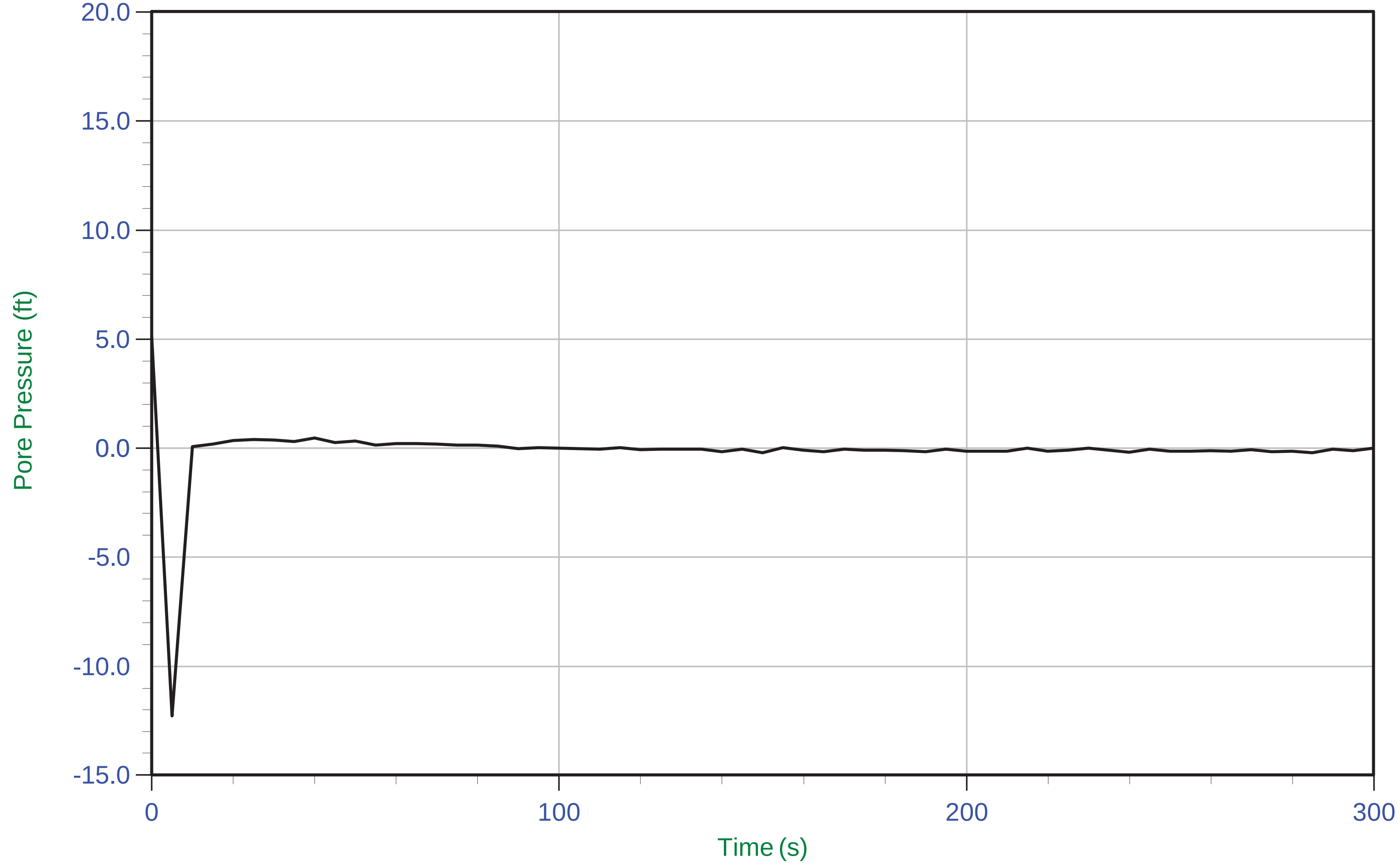
Filename: 15-53081_CP32.PPD
Depth: 3.050 m / 10.006 ft
Duration: 1200.0 s

U Min: -5.4 ft
U Max: 12.9 ft

AECOM

Job No: 15-53081
Date: 02-Sep-2015 10:27:31
Site: Hennepin Power Station, Hennepin, IL

Sounding: HEN-C032
Cone: 374
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53081_CP32.PPD
Depth: 3.750 m / 12.303 ft
Duration: 300.0 s

U Min: -12.3 ft
U Max: 5.1 ft

Attachment E. Laboratory Test Data

LABORATORY TESTING SUMMARY

PROJECT NAME: Dynegy - Hennepin Site **PROJECT NUMBER:** MR155233 **CLIENT:** AECOM

Boring Number	Sample Number	Depth	Description	USCS	WC %	Qp (tsf)	% Gravel	% Sand	% Silt	% Clay	% Fines	LL	PL	PI	Specific Gravity
HEN-B029	S-1	0.0'-1.5'	BROWN POORLY GRADED SAND		4.7										
HEN-B029	S-2	2.5'-4.0'	DARK BROWN SANDY LEAN CLAY		14.7										
HEN-B029	S-3	5.0'-7.0'	BROWN LEAN CLAY WITH SAND AND GRAVEL	CL	10.8							22	15	7	
HEN-B029	S-4	7.0'-8.5'	DARK BROWN LEAN CLAY		14.8										
HEN-B029	S-5	10.0'-12.0'	VERY DARK BROWN AND GRAY SLIGHTLY ORGANIC LEAN CLAY WITH SAND AND GRAVEL	CL	16.7							31	17	14	
HEN-B029	S-6	15.0'-16.5'	POSSIBLE FILL: BROWN TO DARK BROWN LEAN CLAY		21.7										
HEN-B029	S-7	20.0'-21.5'	BROWN TO GRAY SILTY LEAN CLAY		11.5										
HEN-B029	S-8	25.0'-26.5'	BROWN SILTY LEAN CLAY WITH SAND		8.8										
HEN-B029	S-9	30.0'-30.9'	BROWN SILTY LEAN CLAY WITH SAND		12.7										
HEN-B029	S-10	35.0'-36.5'	LIGHT BROWN POORLY GRADED GRAVEL WITH SAND AND CLAY	GP-GC	13.8		61.0	26.0			13.0				
HEN-B029	S-11	40.0'-41.5'	BROWN SILTY SAND WITH CLAY		4.6										

Terracon

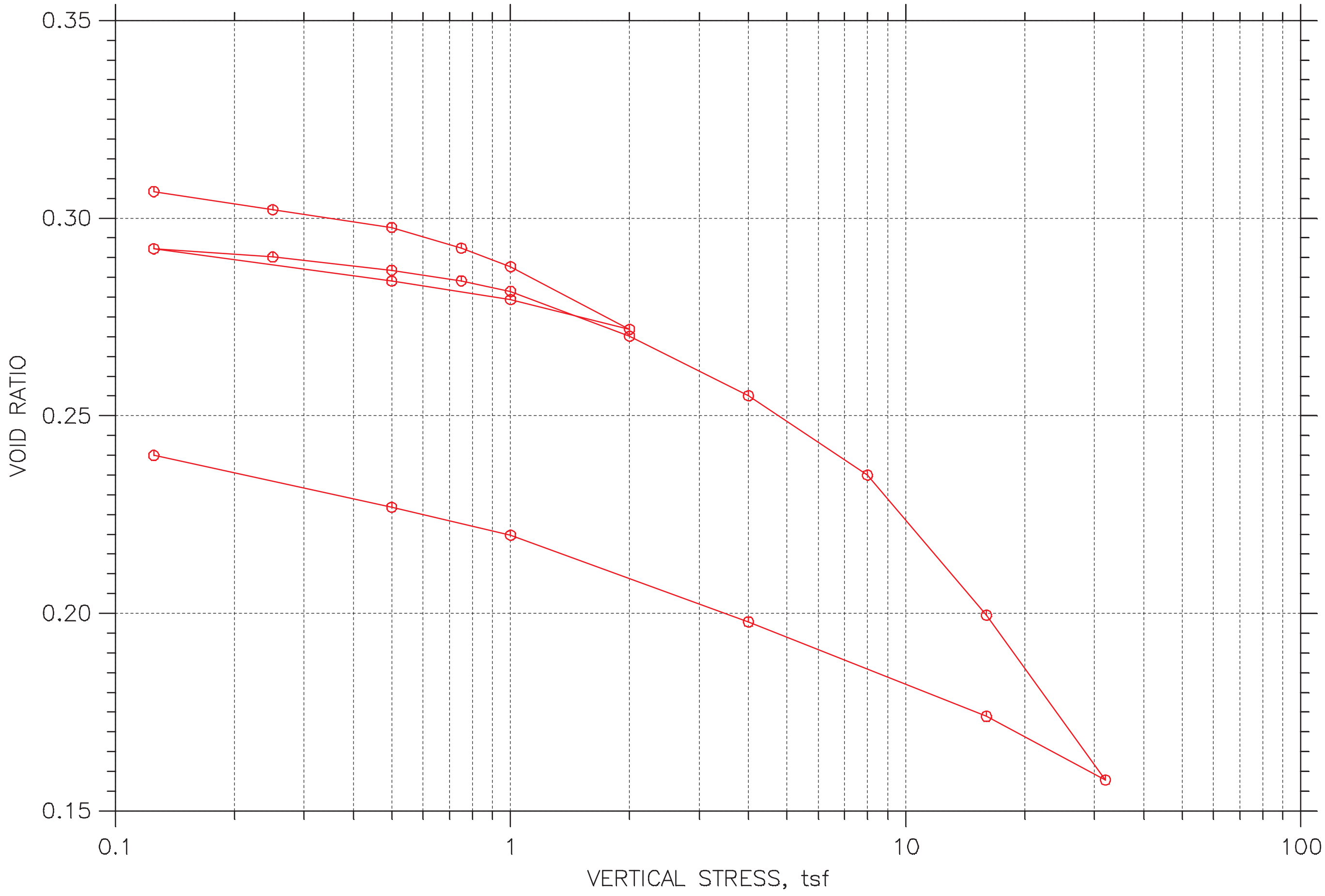
LABORATORY TESTING SUMMARY

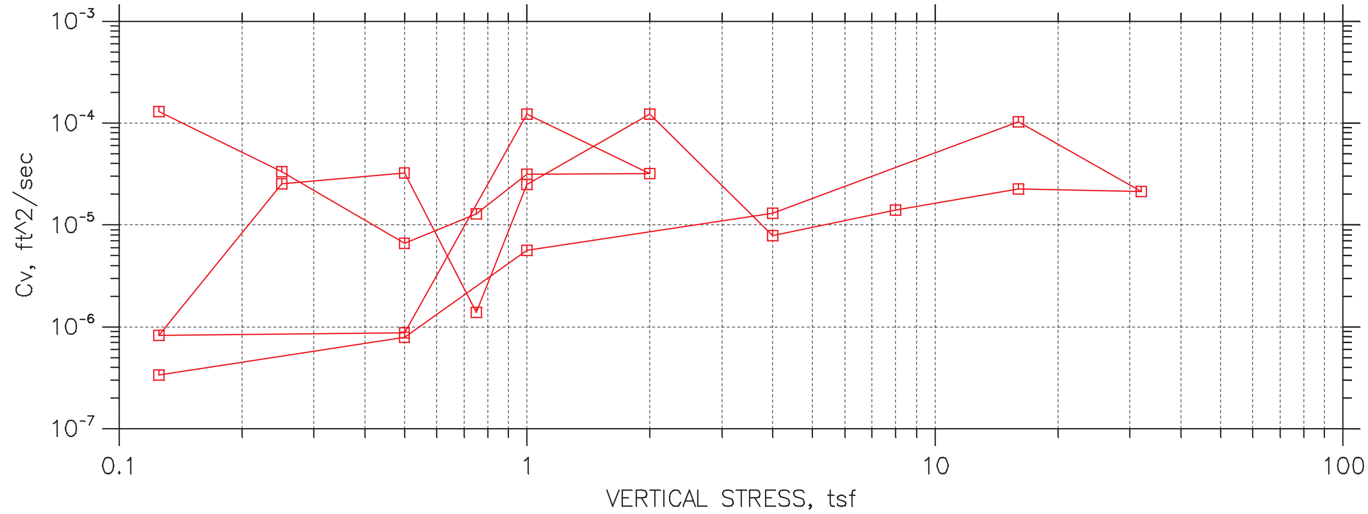
PROJECT NAME: Dynegy - Hennepin Site **PROJECT NUMBER:** MR155233 **CLIENT:** AECOM

Boring Number	Sample Number	Depth	Description	USCS	WC %	Qp (tsf)	% Gravel	% Sand	% Silt	% Clay	% Fines	LL	PL	PI	Specific Gravity
HEN-B030	S-1A	0.0'-1.5'	FILL: DARK BROWN AND BROWN SANDY LEAN CLAY WITH GRAVEL		7.0										
HEN-B030	S-2	2.5'-4.0'	BROWN AND LIGHT BROWN SILTY SAND WITH GRAVEL	SM	6.4		34.0	45.7	11.0	9.3	20.3				
HEN-B030	S-3	5.0'-6.5'	FILL: BROWN AND GRAY LEAN CLAY WITH SILT, SAND AND GRAVEL		11.5										2.746
HEN-B030	S-4	7.5'-9.0'	BROWN LEAN CLAY		17.1										
HEN-B030	S-5	10.0'-11.0'	DARK BROWNISH GRAY FLY ASH AND LEAN CLAY MIXTURE WITH SAND		18.1										
HEN-B030	S-6	15.0'-16.5'	LIGHT BROWN AND TAN WELL GRADED GRAVEL WITH SAND	GW	17.6		81.4	14.8			3.8				
HEN-B030	S-7	21.5'	DARK BROWN AND BLACK ORGANIC CLAY WITH GRAVEL - WOOD NOTED		23.9										
HEN-B030	S-8	25.0'-26.5'	BROWN SILTY SAND WITH GRAVEL		11.2										
HEN-B030	S-10	35.0'-36.5'	BROWN CLAYEY SAND WITH GRAVEL		8.9										
HEN-B030	S-11	40.0'-41.5'	BROWN CLAYEY SAND		9.0										
HEN-B032	S-1A	0.0'-1.0'	BROWN AND GRAYISH BROWN CLAYEY SAND		2.7										
HEN-B032	S-1B	1.0'-1.5'	FILL: BROWN SANDY LEAN CLAY		7.9										
HEN-B032	S-2	2.5'-4.0'	FILL: DARK BROWN SANDY LEAN CLAY		9.7										
HEN-B032	S-3	5.0'-7.0'	DARK BROWNISH GRAY LEAN CLAY WITH SAND AND GRAVEL	CL	14.0							35	18	17	
HEN-B032	S-4	7.5'-9.0'	DARK BROWN LEAN CLAY		16.7										
HEN-B032	S-5	10.0'-11.5'	DARK BROWN AND DARK GRAY LEAN CLAY WITH GRAVEL		16.2										
HEN-B032	S-6	15.0'-16.5'	BROWN AND GRAYISH BROWN SILTY SAND WITH GRAVEL		8.2										
HEN-B032	S-7	20.0'-21.5'	BROWN SILTY SAND WITH GRAVEL	SM	11.1		30.5	43.6	13.4	12.5	25.9				
HEN-B032	S-8	25.0'-26.5'	BROWN SILTY SAND WITH GRAVEL AND CLAY		9.1										
HEN-B032	S-9	30.0'-31.5'	BROWN LEAN CLAY WITH SAND AND GRAVEL		10.6										
HEN-B032	S-10	35.0'-36.5'	BROWN SILTY SAND WITH GRAVEL		5.5										
HEN-B032	S-11	40.0'-41.3'	BROWN AND GRAYISH BROWN SILTY LEAN CLAY WITH SAND AND GRAVEL		10.9										
HEN-B034	S-1A	0.0'-0.5'	BROWN SILTY SAND WITH GRAVEL		4.2										
HEN-B034	S-1B	0.5'-1.5	POSSIBLE FILL: DARK BROWN LEAN CLAY		9.1										
HEN-B034	S-2	2.5'-4.0'	DARK BROWN LEAN CLAY WITH SILT AND SAND		14.2										2.704
HEN-B034	S-3A	5.0'-5.5'	BROWN SILTY SAND		15.9										
HEN-B034	S-3B	5.5'-6.5'	BROWN GRAVELLY SAND		1.4										
HEN-B034	S-4	7.5'-9.0'	BROWN AND GRAYISH BROWN SILTY SAND WITH GRAVEL		2.5										
HEN-B034	S-5	10.0'-11.5'	BROWN AND LIGHT BROWN POORLY GRADED GRAVEL WITH SILT AND	GP-GM	11.2		60.1	27.0	7.7	5.2	12.9				
HEN-B034	S-6	15.0'-16.5'	BROWN AND LIGHT BROWN POORLY GRADED GRAVEL WITH CLAY AND		9.1										2.808
HEN-B034	S-7	20.0'-21.5'	LIGHT BROWN SILTY SAND WITH GRAVEL		12.5										
HEN-B034	S-9	30.0'-31.5'	BROWN, GRAY AND PINKISH BROWN POORLY GRADED GRAVEL		13.6										
HEN-B034	S-10	35.0'-36.5'	LIGHT BROWN AND TAN POORLY GRADED GRAVEL WITH SAND AND SILT	GP-GM	10.9		82.8	11.3			5.9				
HEN-B034	S-11	40.0'-41.5'	BROWN POORLY GRADED GRAVEL WITH SILT AND SAND		1.5										

One-Dimensional Consolidation Tests
ASTM D 2535

ONE DIMENSIONAL CONSOLIDATION TEST
ASTM D2435





Terracon Consulting Engineers & Scientists	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

Mon, 21-DEC-2015 16:47:42

CONSOLIDATION TEST DATA

Project: DYNEGY HENNEPIN
Location: HENNEPIN, IL
Project No.: MR155233
Boring No.: HEN-029 S-3
Tested By: HP
Checked By: BCM
Sample No.: S-3
Test Date: 12/14/15
Depth: 5.0'-7.0'
Test No.: HENB029S3
Sample Type: 3.0" ST
Elevation: -----

Soil Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL
Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435

Estimated Specific Gravity: 2.72
Liquid Limit: 22
Initial Height: 0.74 in
Initial Void Ratio: 0.31
Plastic Limit: 15
Specimen Diameter: 2.49 in
Final Void Ratio: 0.24
Plasticity Index: 7

	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
Container ID	X-7	RING	RING	118
Wt. Container + Wet Soil, gm	167.52	207.79	207.7	156.24
Wt. Container + Dry Soil, gm	155.54	196.84	196.84	145.48
Wt. Container, gm	44.63	74.87	74.87	24.64
Wt. Dry Soil, gm	110.91	121.97	121.97	120.84
Water Content, %	10.80	8.98	8.90	8.90
Void Ratio	---	0.31	0.24	---
Degree of Saturation, %	---	77.94	100.93	---
Dry Unit Weight, pcf	---	129.29	136.94	---

CONSOLIDATION TEST DATA

Terracon
Consulting Engineers & Scientists

Project: DYNEGY HENNEPIN
Location: HENNEPIN, IL
Project No.: MR155233
Boring No.: HEN-029 S-3
Tested By: HP
Checked By: BCM
Sample No.: S-3
Test Date: 12/14/15
Depth: 5.0'-7.0'
Test No.: HENB029S3
Sample Type: 3.0" ST
Elevation: -----

Soil Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL
Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435

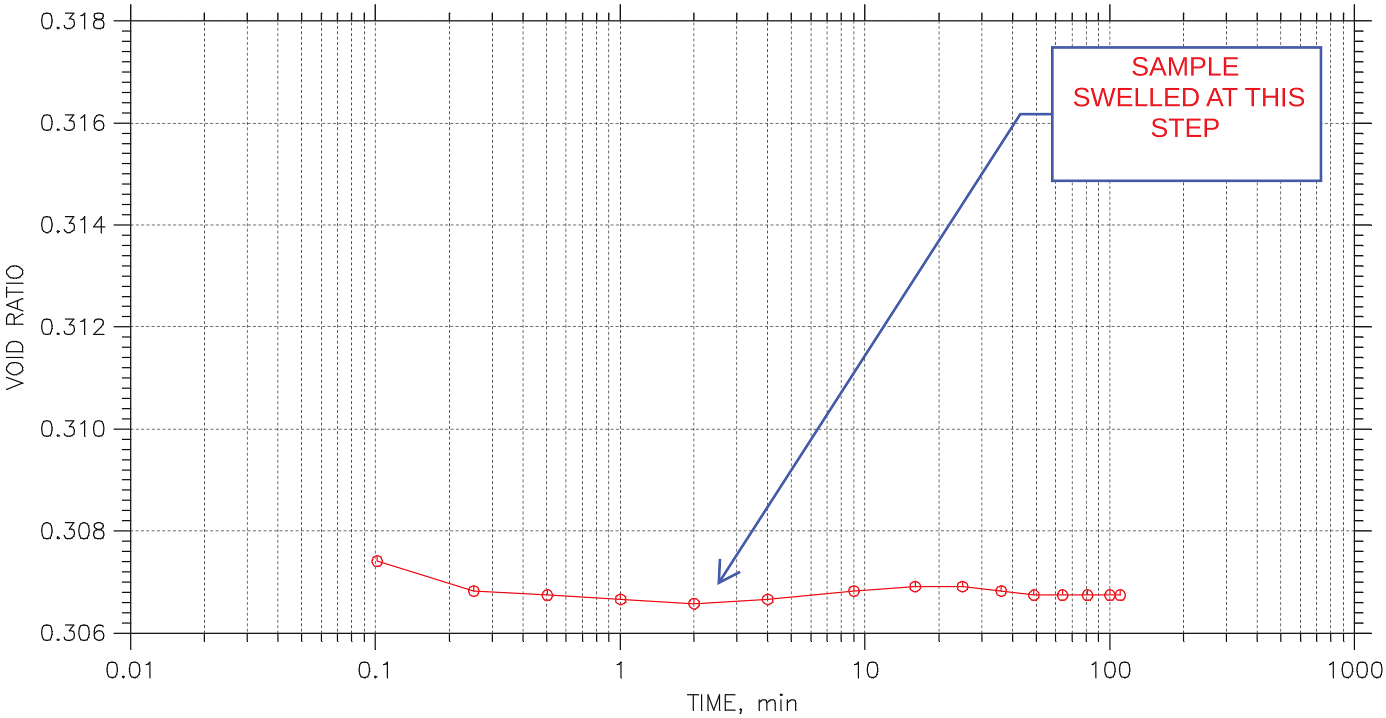
	Applied	Final	Void	Strain	T50 Fitting		Coefficient of Consolidation		
	Stress	Displacement	Ratio	at End	Sq.Rt.	Log	Sq.Rt.	Log	Ave.
	tsf	in		%	min	min	ft^2/sec	ft^2/sec	ft^2/sec
1	0.125	0.00369	0.307	0.50	0.0	0.0	1.30e-004	0.00e+000	1.30e-004
2	0.25	0.006259	0.302	0.85	0.1	0.0	3.32e-005	0.00e+000	3.32e-005
3	0.5	0.008782	0.298	1.19	0.5	0.0	6.59e-006	0.00e+000	6.59e-006
4	0.75	0.01172	0.292	1.59	0.2	0.0	1.28e-005	0.00e+000	1.28e-005
5	1	0.01434	0.288	1.95	0.1	0.0	3.13e-005	0.00e+000	3.13e-005
6	2	0.02322	0.272	3.16	0.1	0.0	3.18e-005	0.00e+000	3.18e-005
7	1	0.01901	0.279	2.58	0.0	0.0	1.23e-004	0.00e+000	1.23e-004
8	0.5	0.0164	0.284	2.23	3.4	0.0	8.69e-007	0.00e+000	8.69e-007
9	0.125	0.01182	0.292	1.61	3.6	0.0	8.29e-007	0.00e+000	8.29e-007
10	0.25	0.01299	0.290	1.76	0.1	0.0	2.54e-005	0.00e+000	2.54e-005
11	0.5	0.01485	0.287	2.02	0.1	0.0	3.22e-005	0.00e+000	3.22e-005
12	0.75	0.01635	0.284	2.22	2.1	0.0	1.38e-006	0.00e+000	1.38e-006
13	1	0.01784	0.281	2.43	0.1	0.0	2.51e-005	0.00e+000	2.51e-005
14	2	0.0242	0.270	3.29	0.0	0.0	1.23e-004	0.00e+000	1.23e-004
15	4	0.03265	0.255	4.44	0.4	0.0	7.87e-006	0.00e+000	7.87e-006
16	8	0.04391	0.235	5.97	0.2	0.0	1.39e-005	0.00e+000	1.39e-005
17	16	0.06376	0.200	8.67	0.1	0.0	2.26e-005	0.00e+000	2.26e-005
18	32	0.08712	0.158	11.84	0.1	0.0	2.12e-005	0.00e+000	2.12e-005
19	16	0.0781	0.174	10.61	0.0	0.0	1.03e-004	0.00e+000	1.03e-004
20	4	0.0647	0.198	8.79	0.2	0.0	1.30e-005	0.00e+000	1.30e-005
21	1	0.05241	0.220	7.12	0.5	0.0	5.63e-006	0.00e+000	5.63e-006
22	0.5	0.04844	0.227	6.58	3.4	0.0	7.92e-007	0.00e+000	7.92e-007
23	0.125	0.04111	0.240	5.59	8.1	0.0	3.37e-007	0.00e+000	3.37e-007

CONSOLIDATION TEST DATA

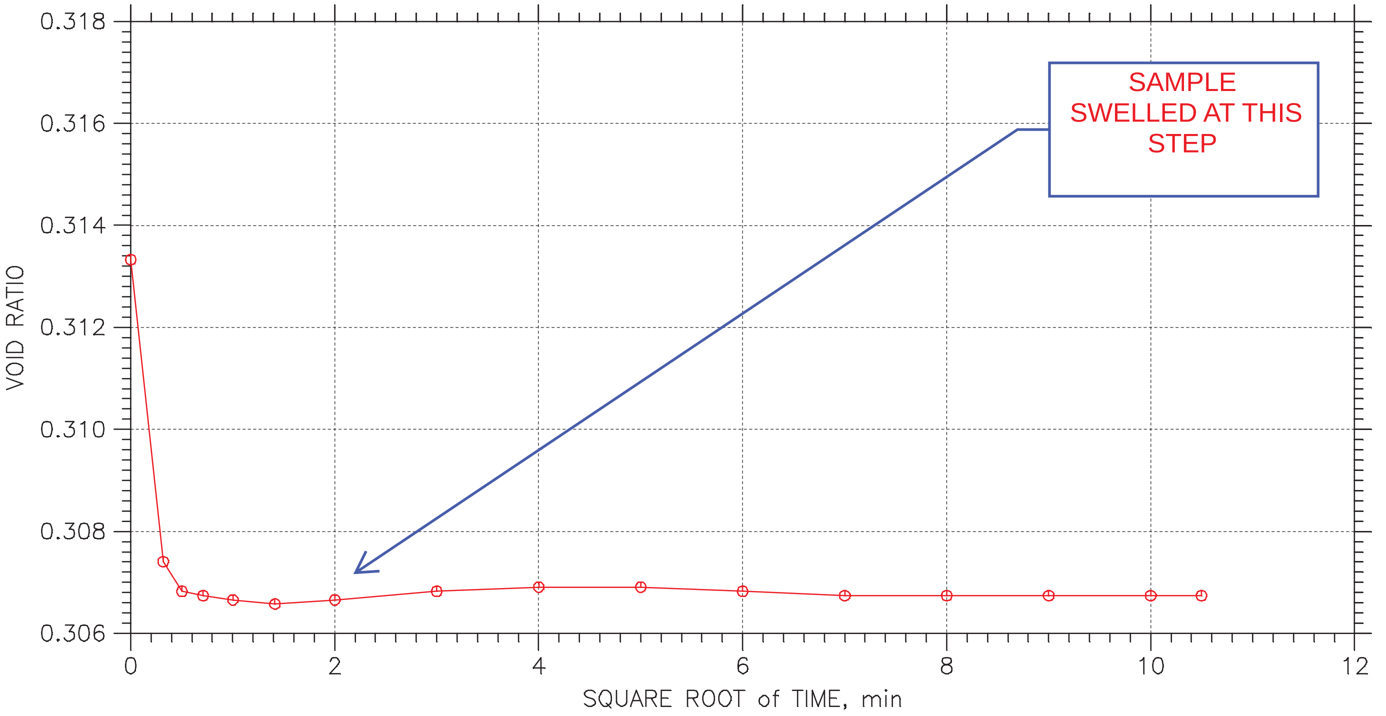
TIME CURVES

Constant Load Step: 1 of 23

Stress: 0.125 tsf



SAMPLE SWELLED AT THIS STEP



SAMPLE SWELLED AT THIS STEP

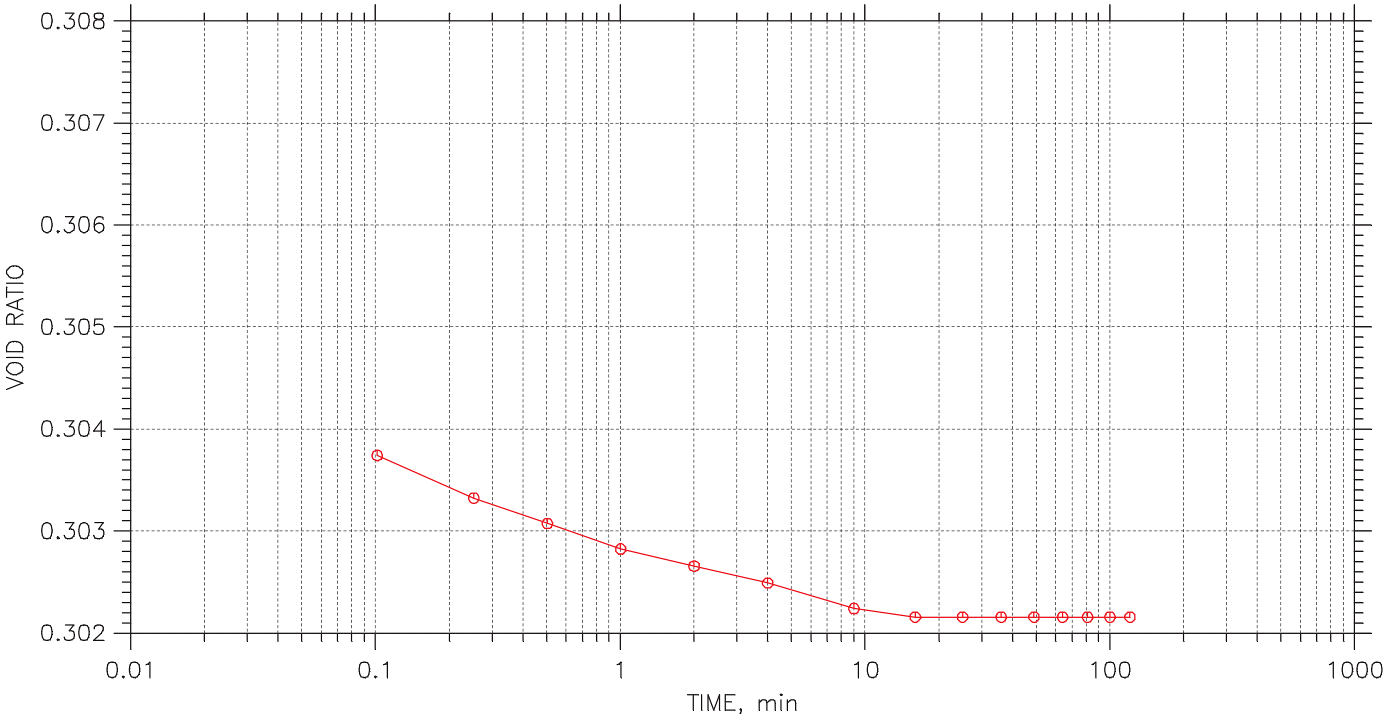
Terracon Consulting Engineers & Scientists	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

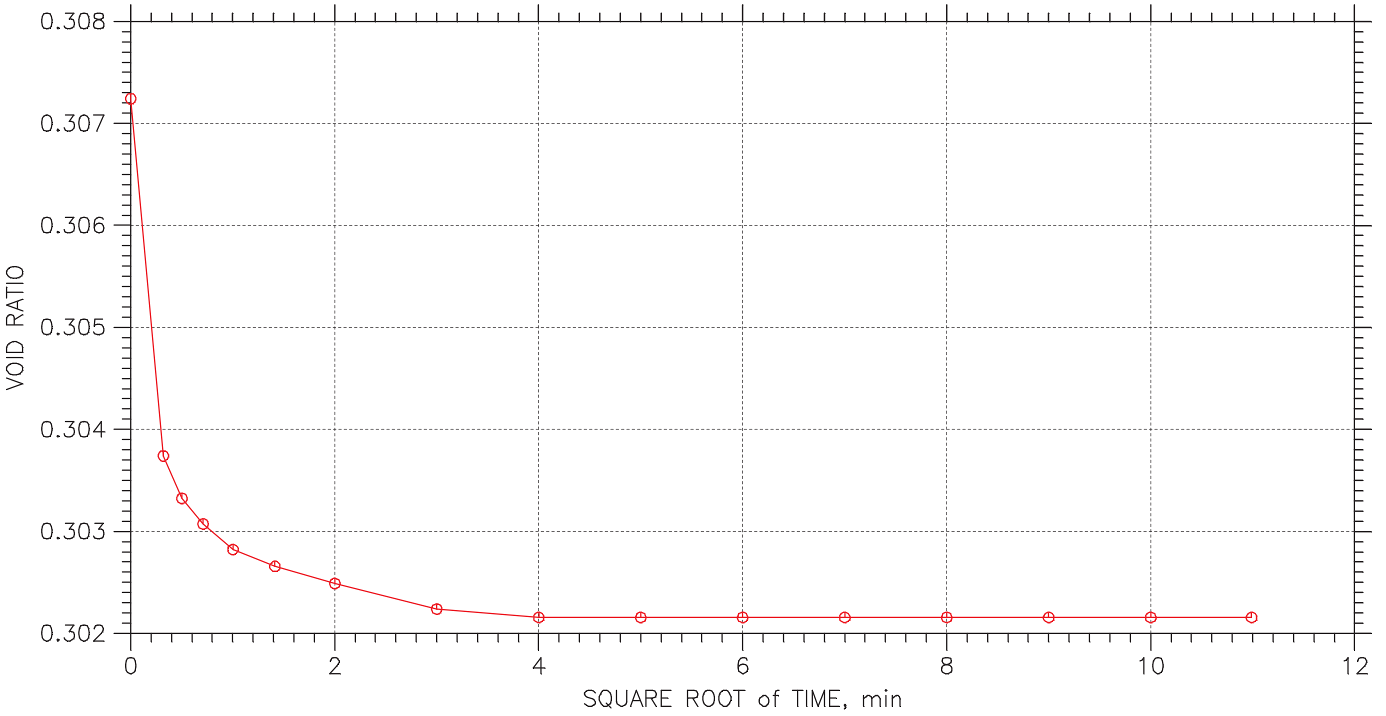
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 2 of 23

Stress: 0.25 tsf





Project: **DYNEGY HENNEPIN**	Location: HENNEPIN, IL	Project No.: MR155233
Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

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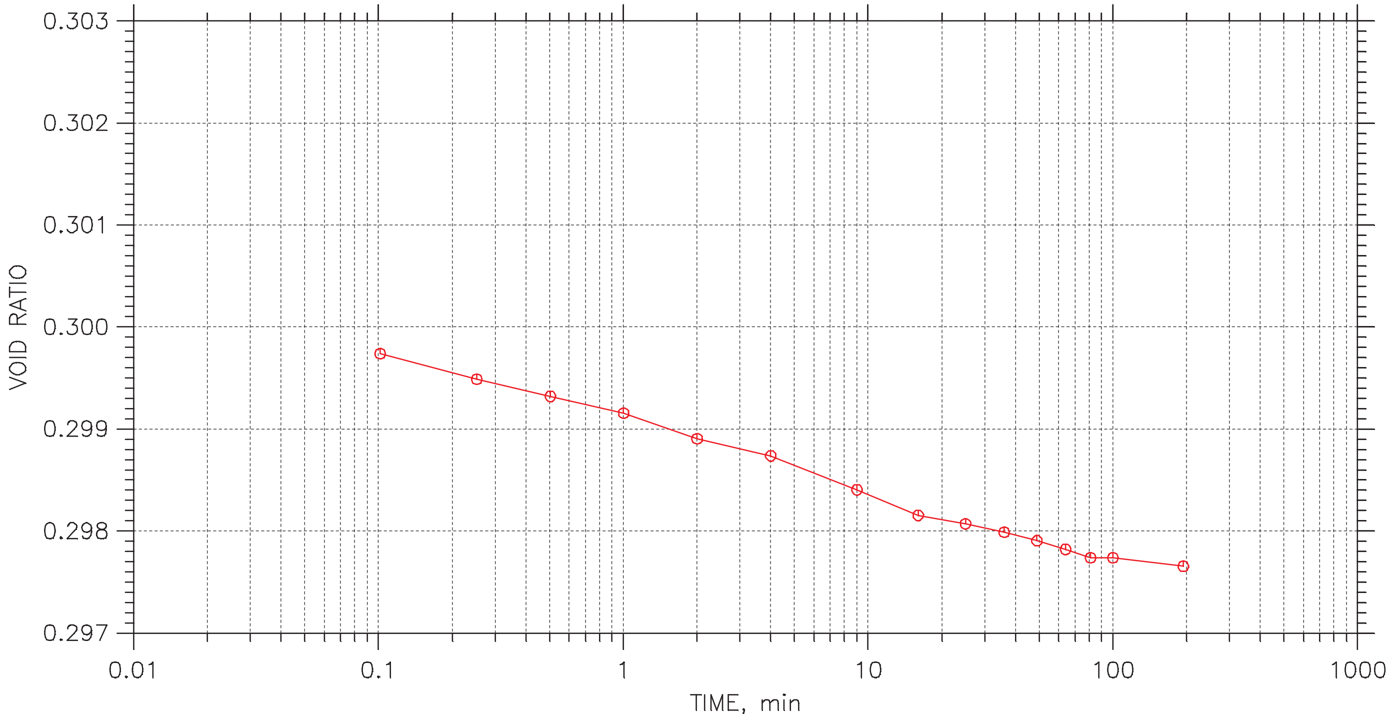
Mon, 21-DEC-2015 16:48:16

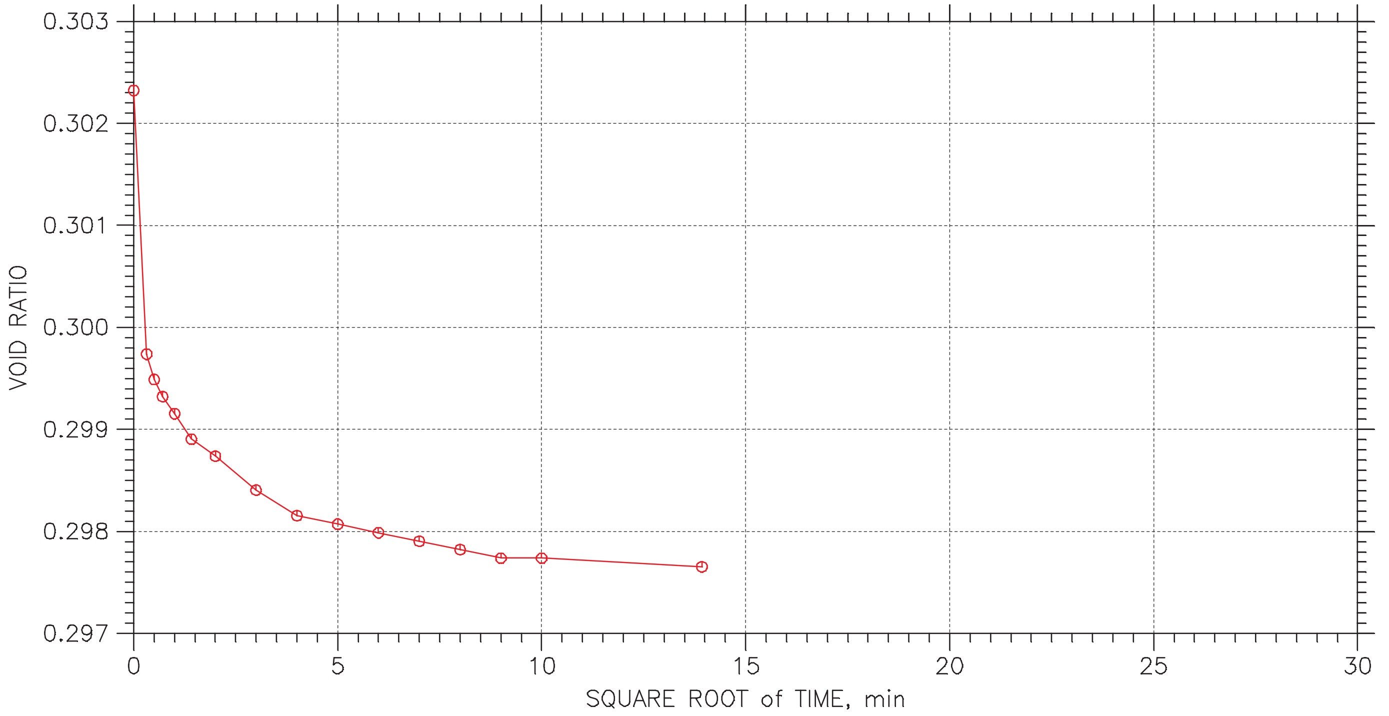
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 3 of 23

Stress: 0.5 tsf





Terracon Consulting Engineers & Scientists	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

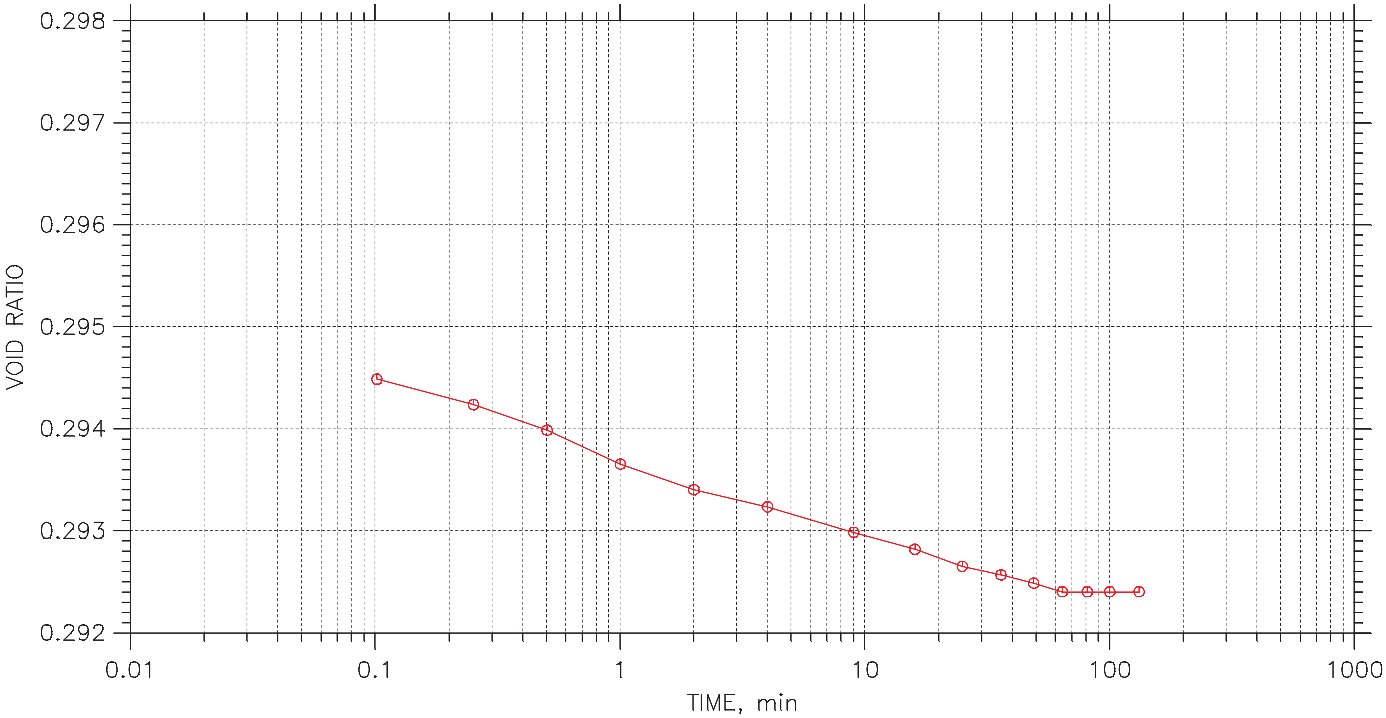
Mon, 21-DEC-2015 16:48:17

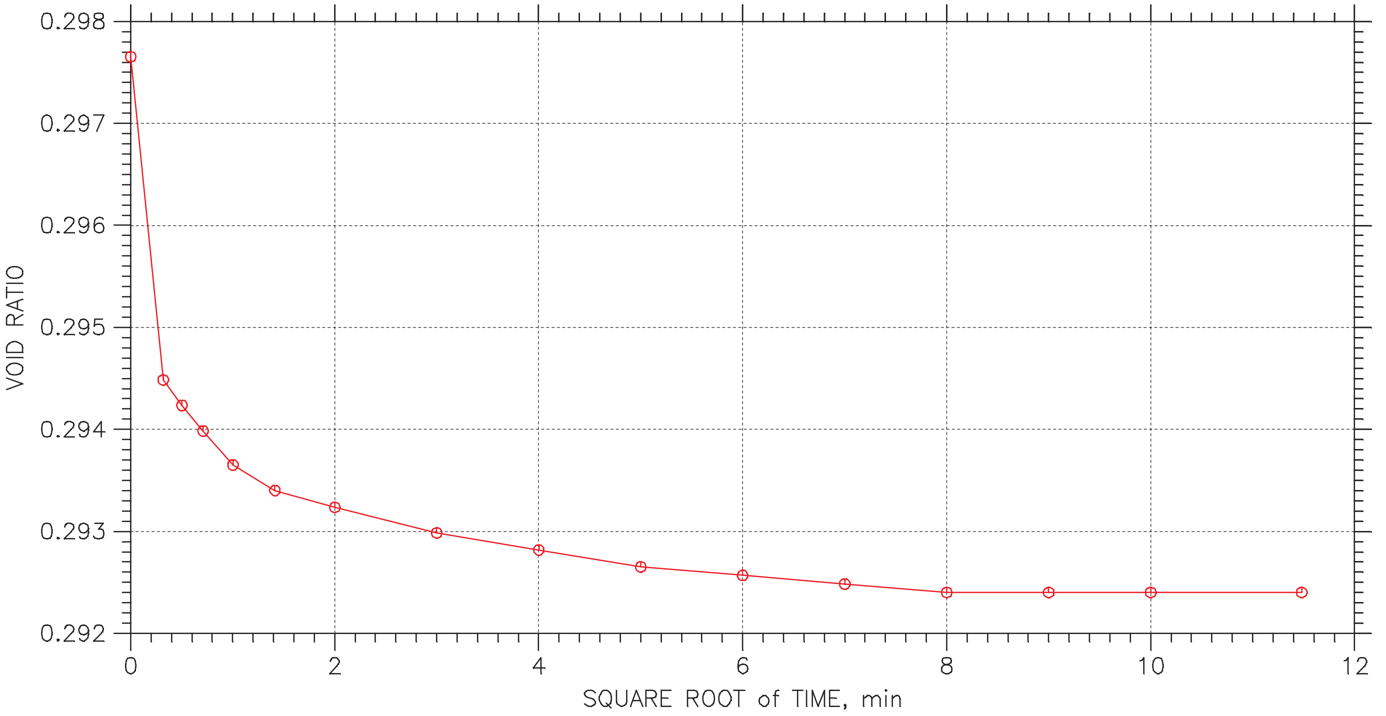
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 4 of 23

Stress: 0.75 tsf





Terracon Consulting Engineers & Scientists	Project: **DYNEGY HENNEPIN**	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

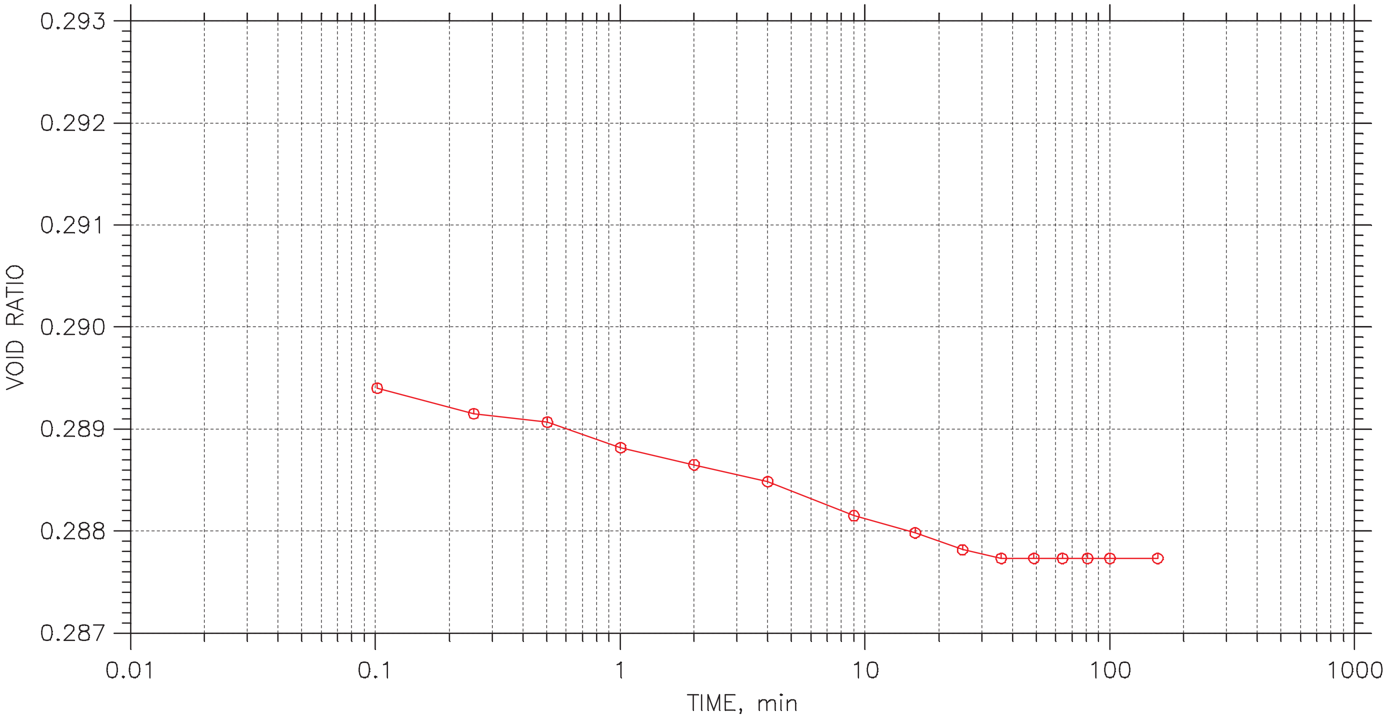
Mon, 21-DEC-2015 16:48:19

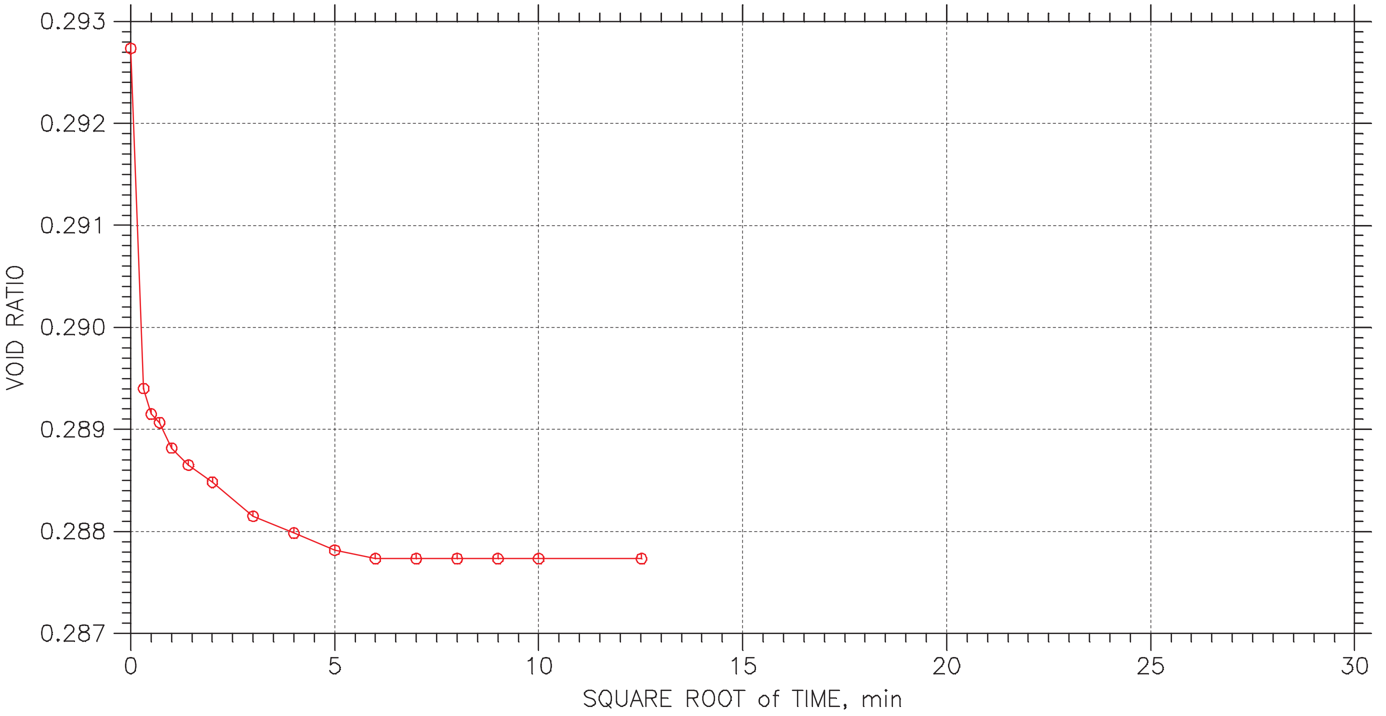
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 5 of 23

Stress: 1. tsf





Terracon Consulting Engineers & Scientists	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

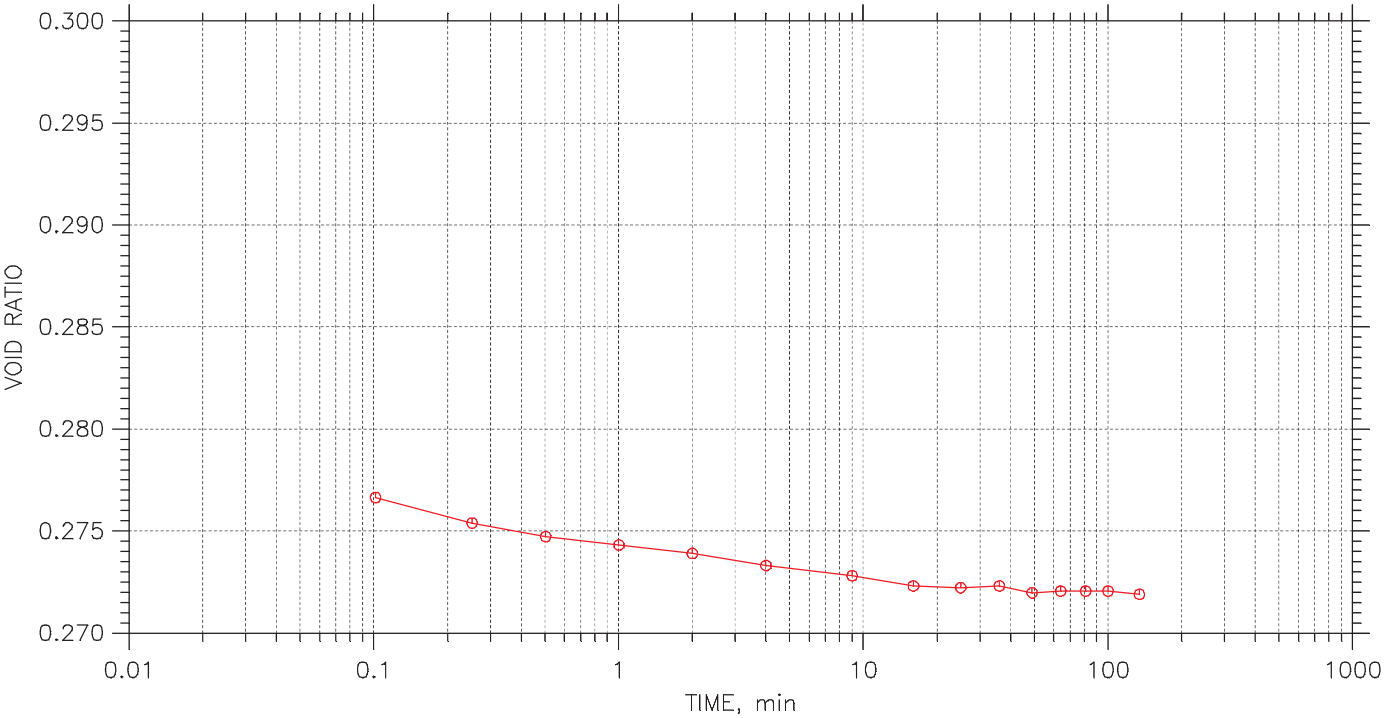
Mon, 21-DEC-2015 16:48:20

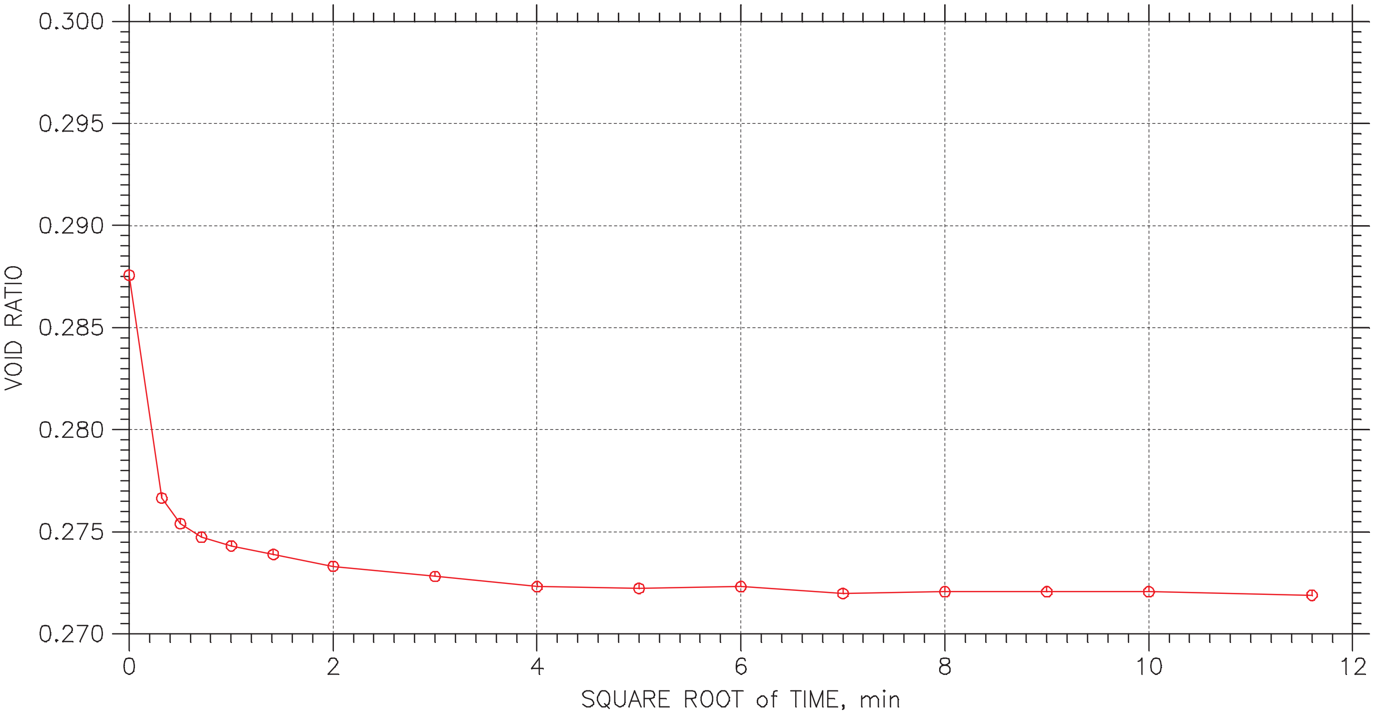
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 6 of 23

Stress: 2. tsf





Terracon Consulting Engineers & Scientists	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

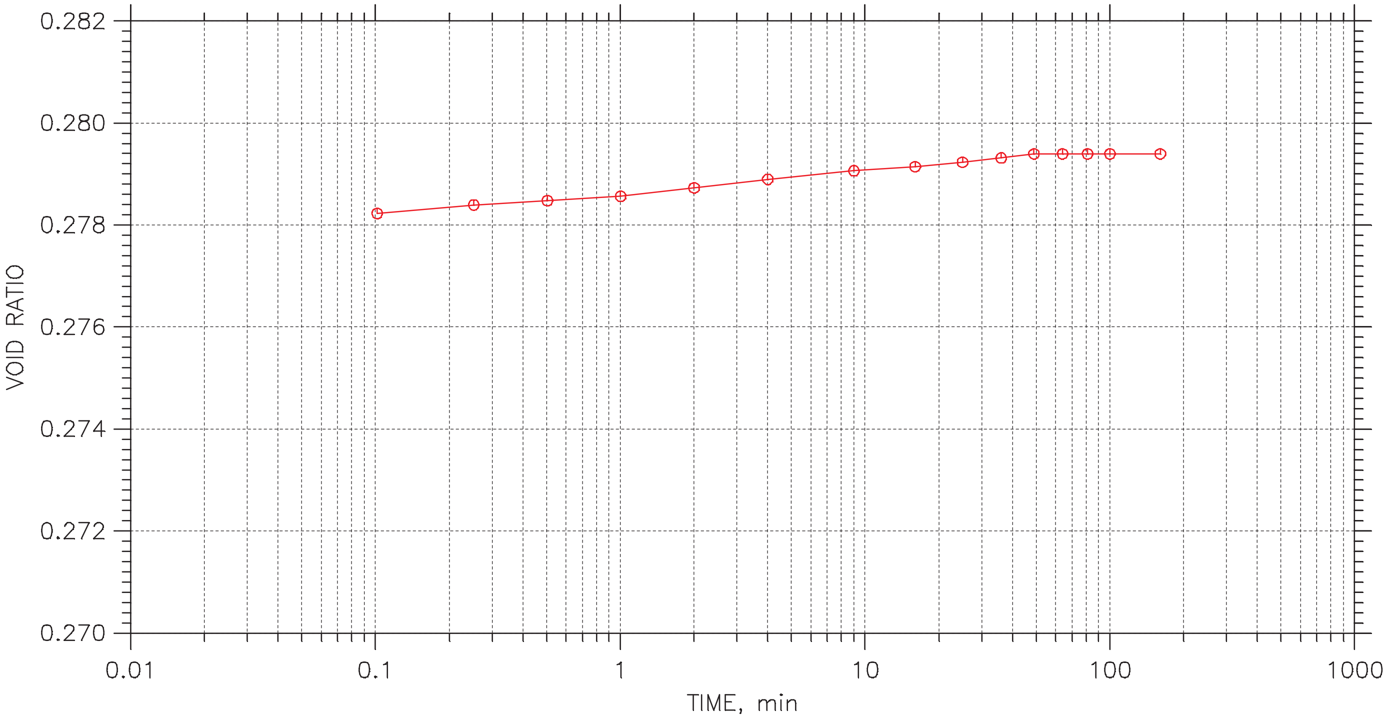
Mon, 21-DEC-2015 16:48:21

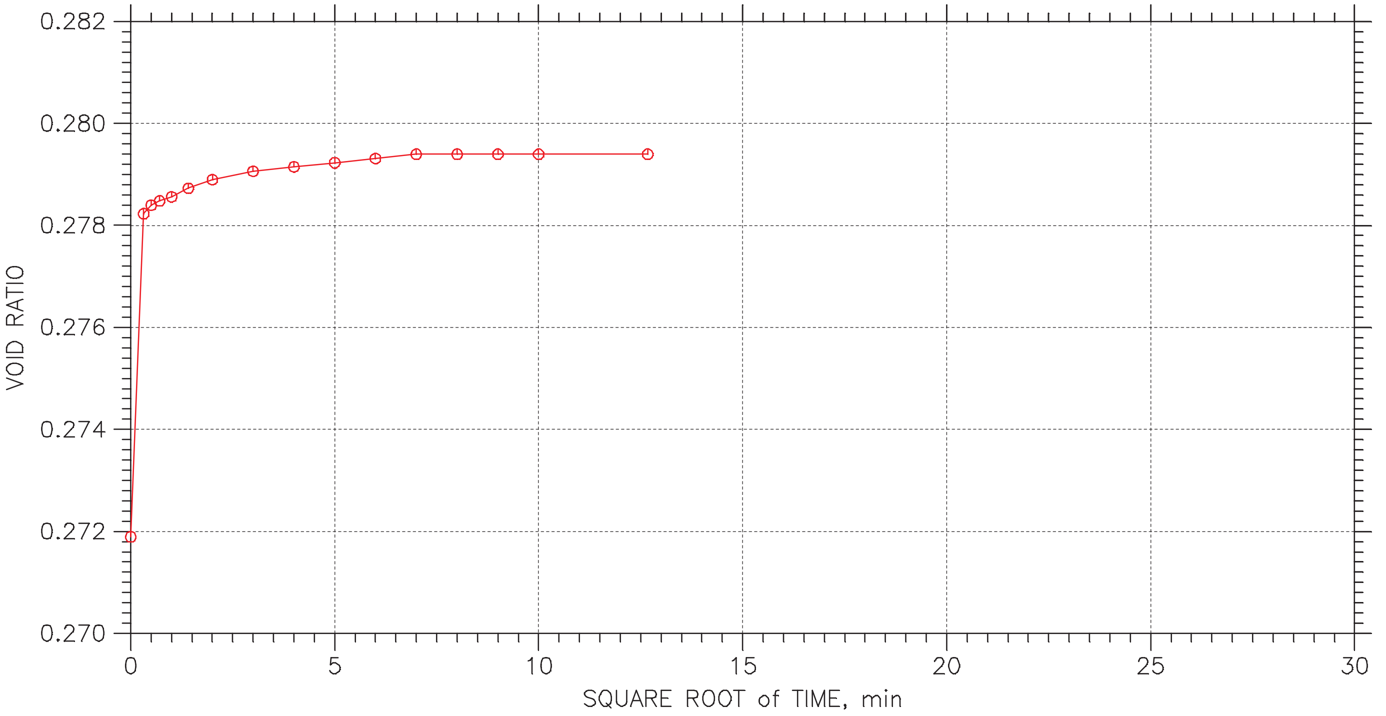
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 7 of 23

Stress: 1. tsf





Terracon Consulting Engineers & Scientists	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

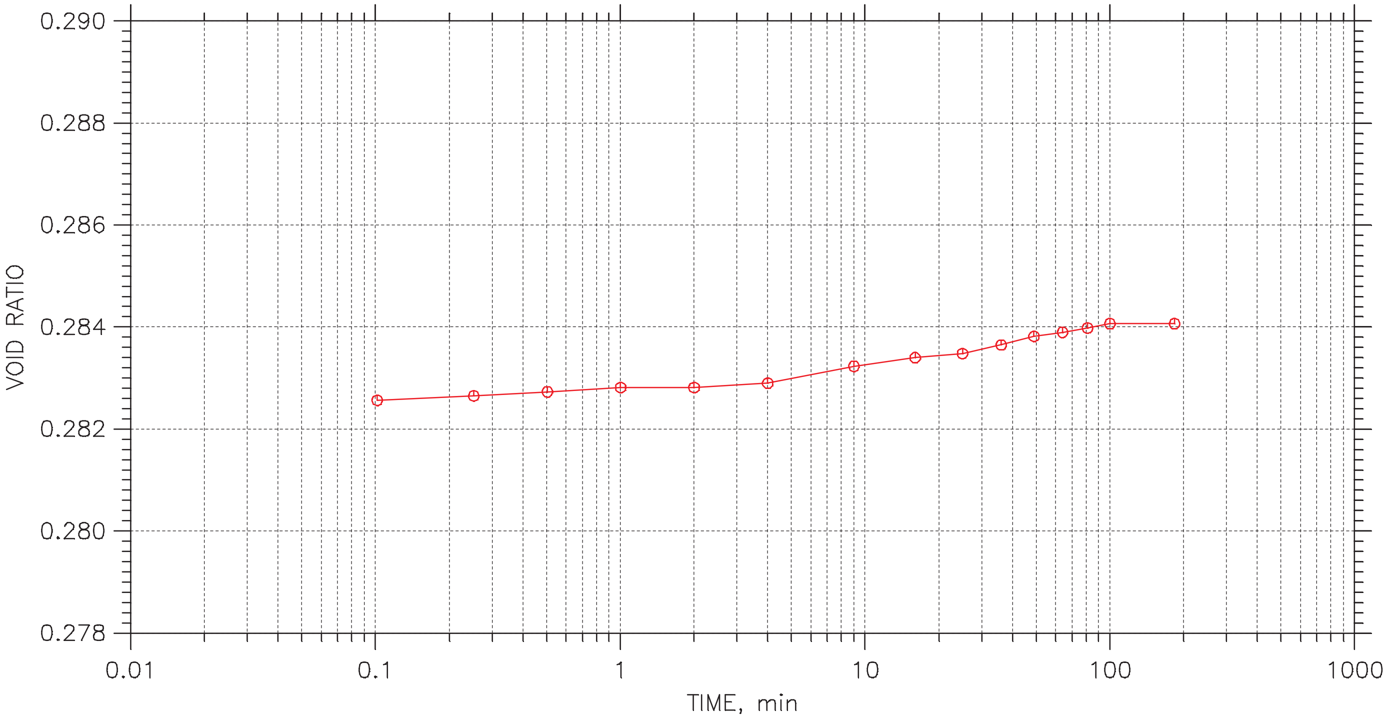
Mon, 21-DEC-2015 16:48:23

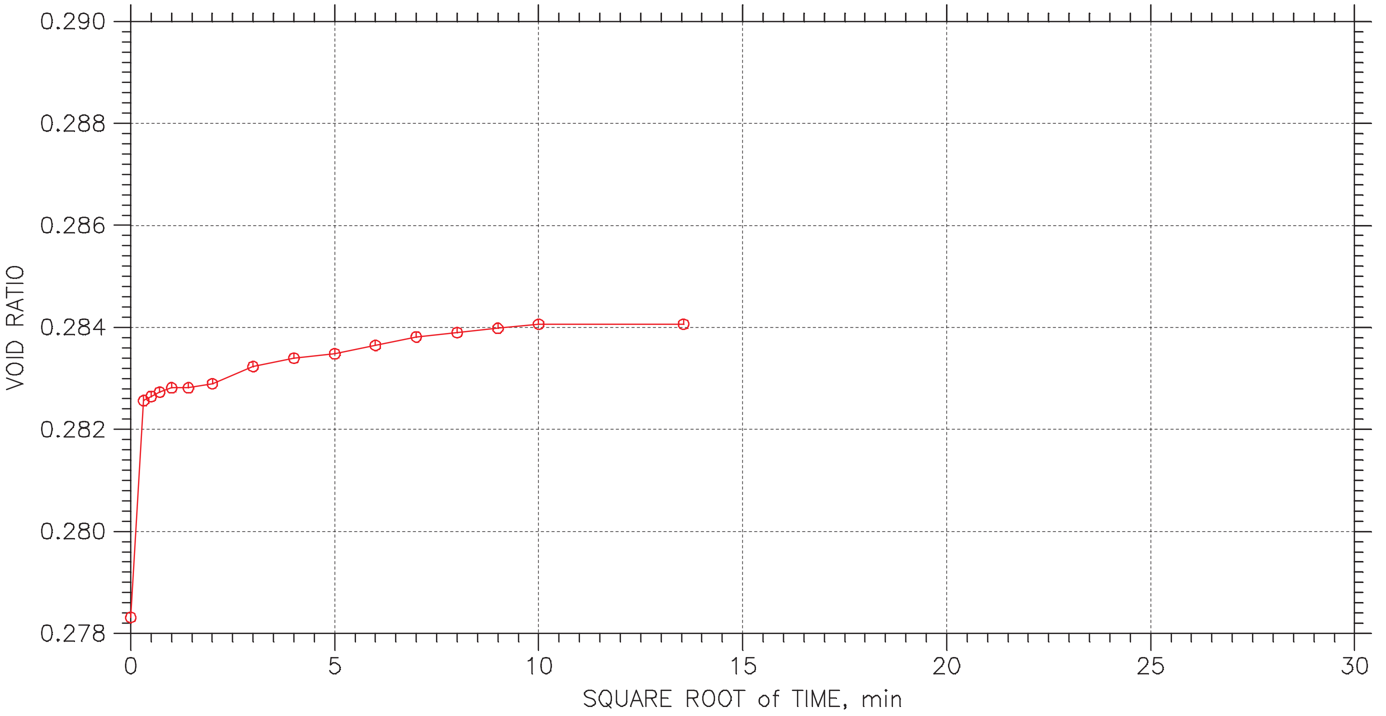
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 8 of 23

Stress: 0.5 tsf





Terracon Consulting Engineers & Scientists	Project: **DYNEGY HENNEPIN**	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

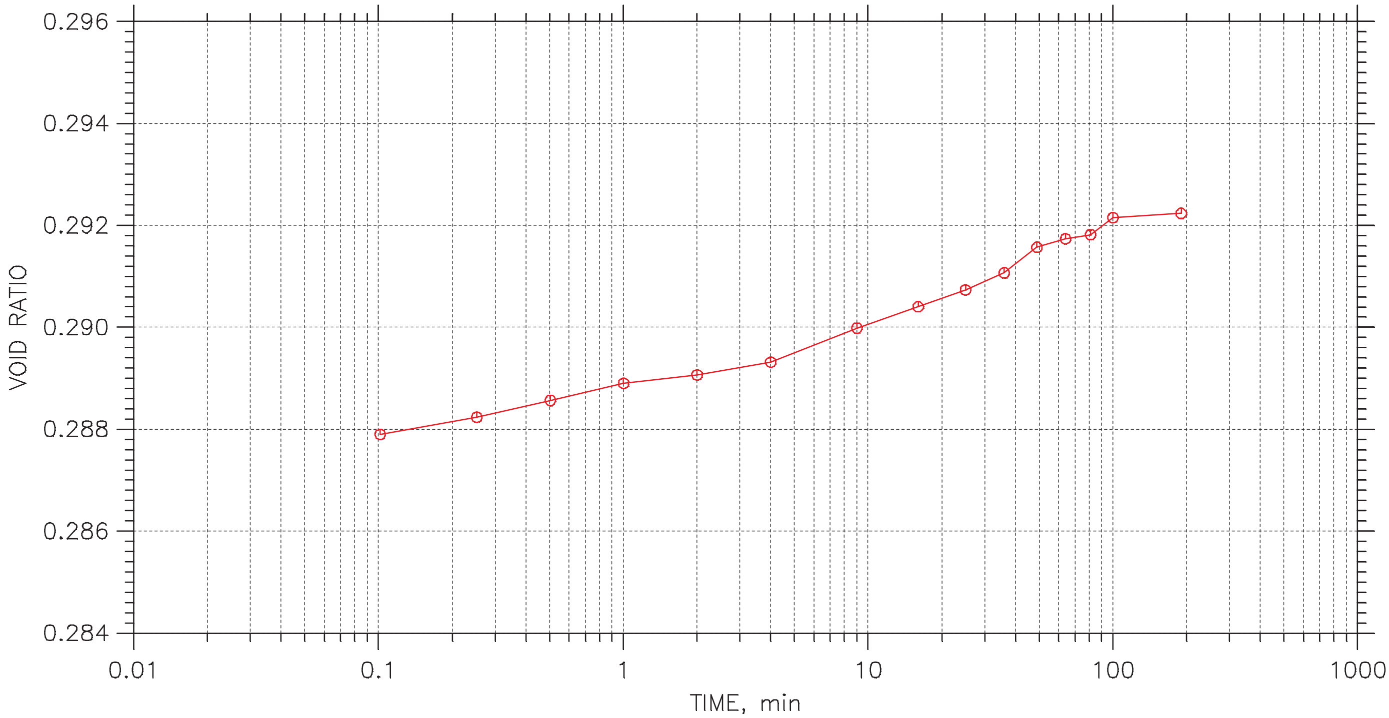
Mon, 21-DEC-2015 16:48:24

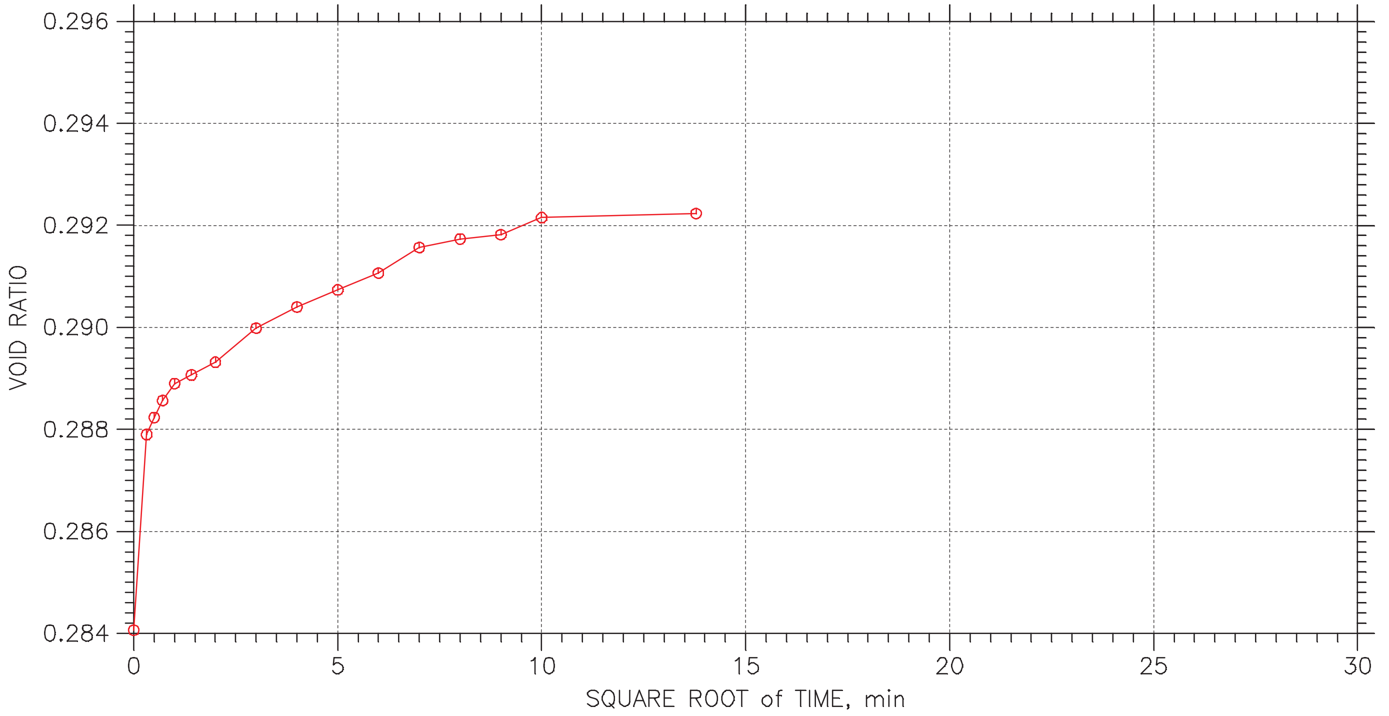
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 9 of 23

Stress: 0.125 tsf





Terracon Consulting Engineers & Scientists	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

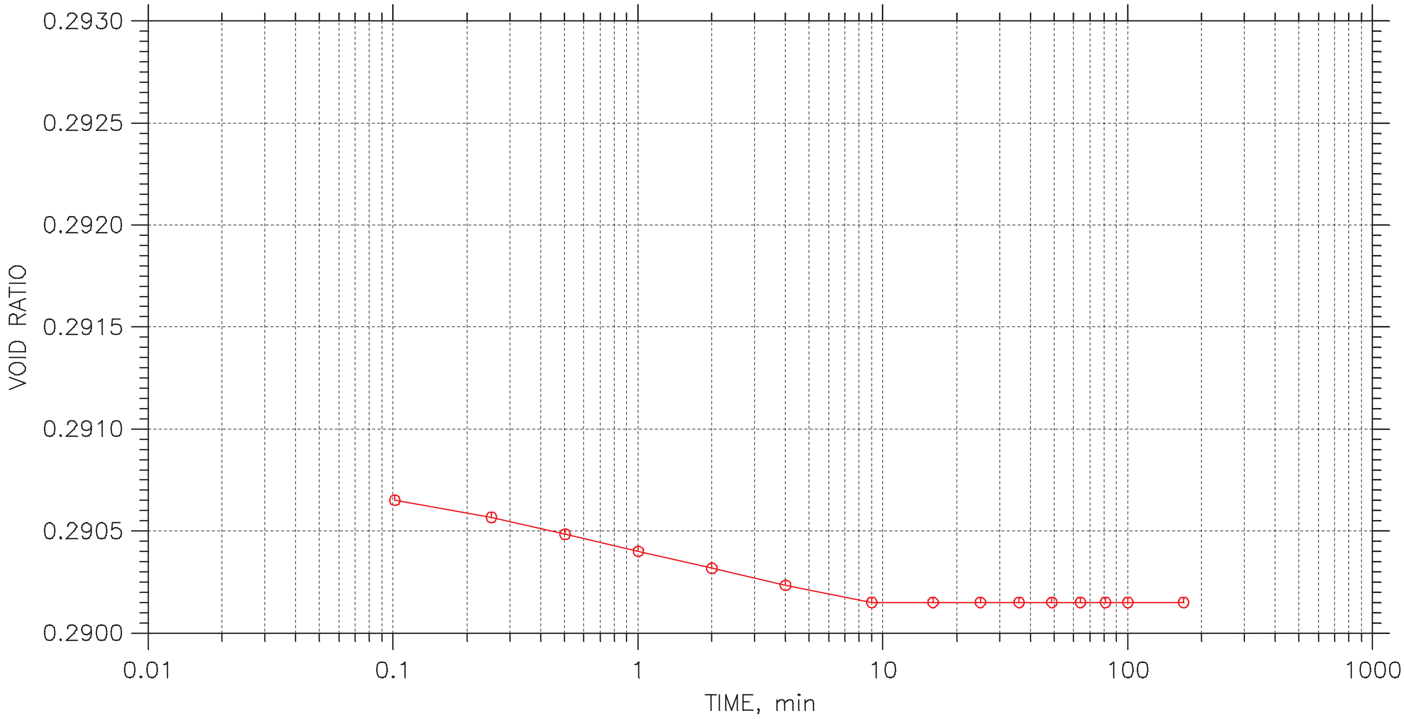
Mon, 21-DEC-2015 16:48:26

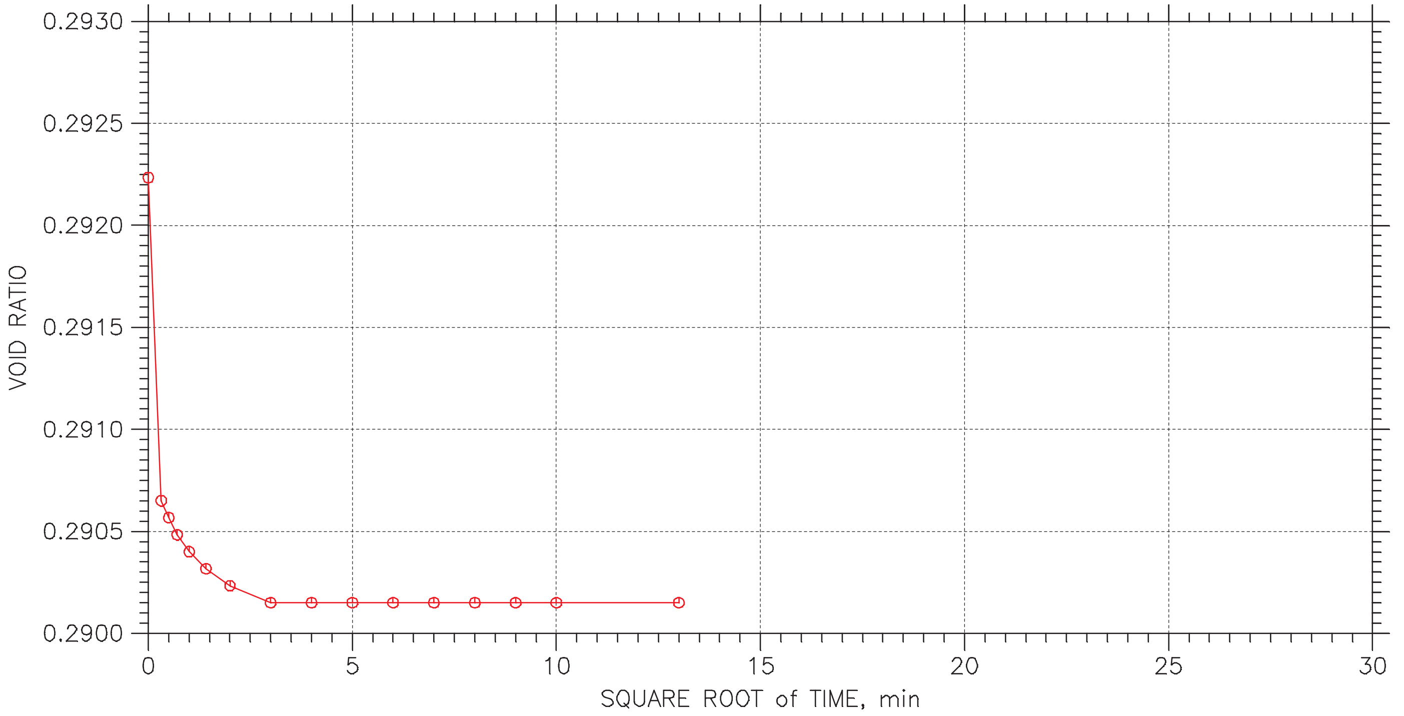
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 10 of 23

Stress: 0.25 tsf





Terracon Consulting Engineers & Scientists	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

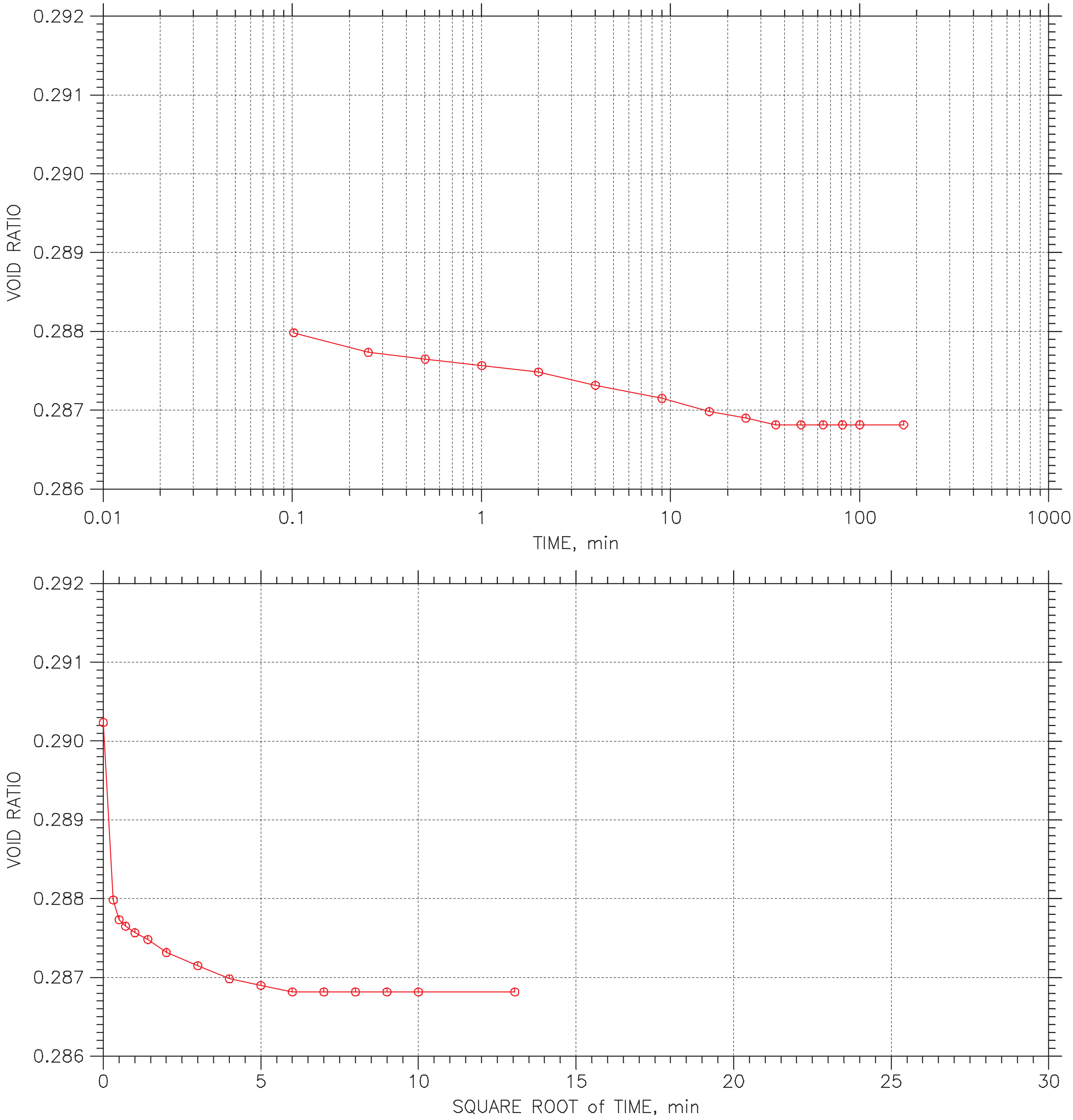
Mon, 21-DEC-2015 16:48:27

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 11 of 23

Stress: 0.5 tsf



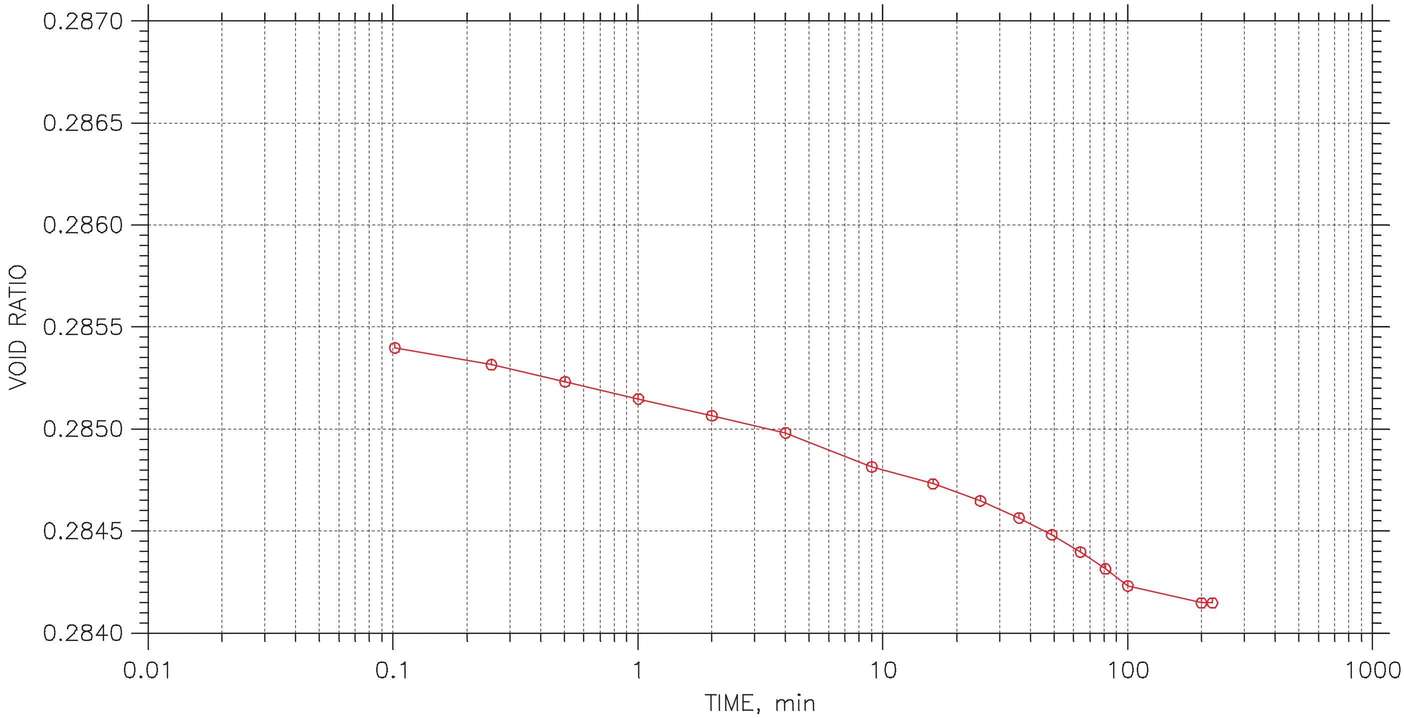
Terracon Consulting Engineers & Scientists	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

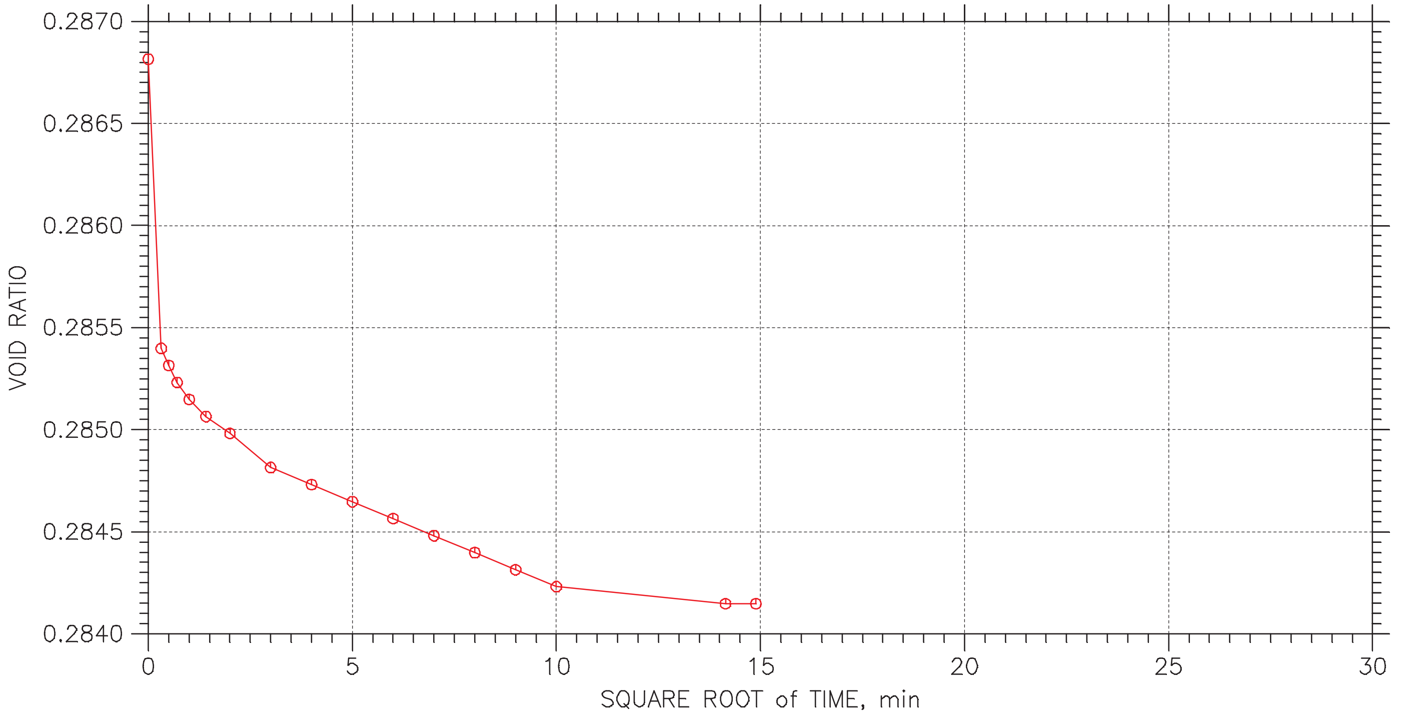
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 12 of 23

Stress: 0.75 tsf





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Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

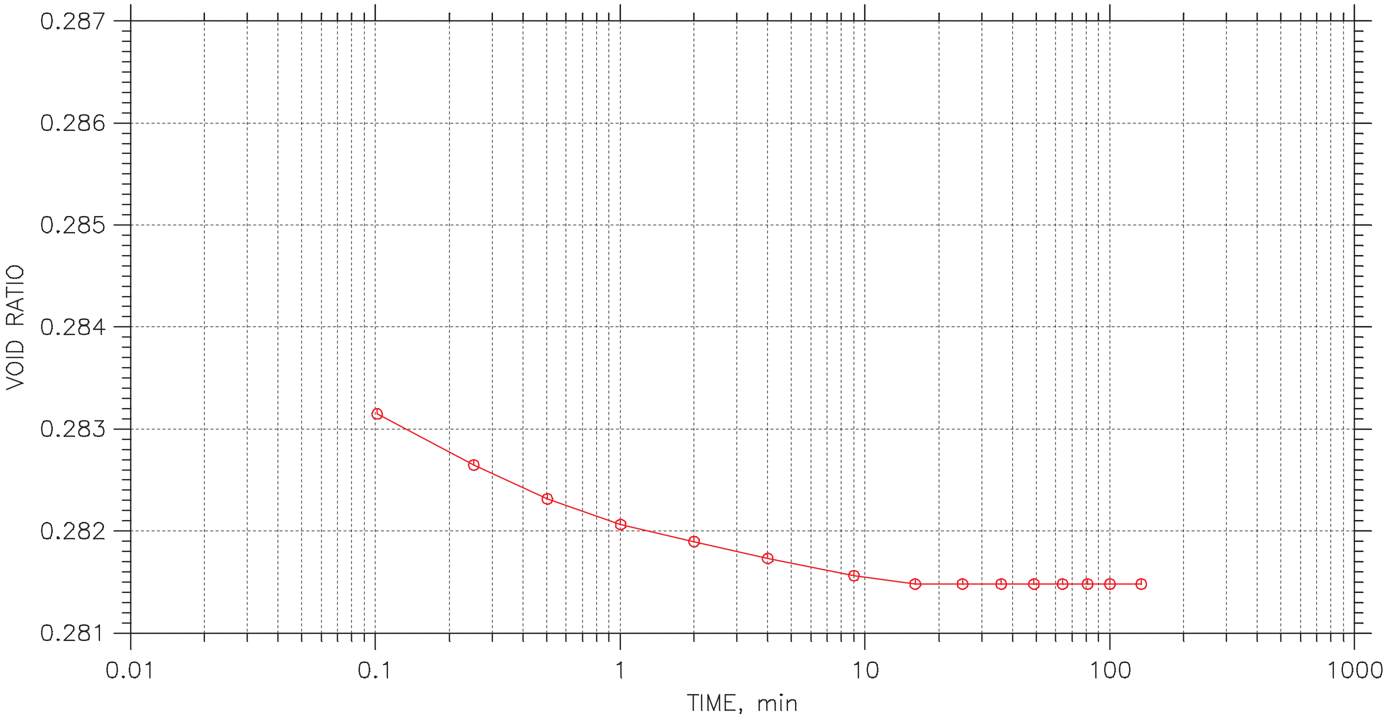
Mon, 21-DEC-2015 16:48:30

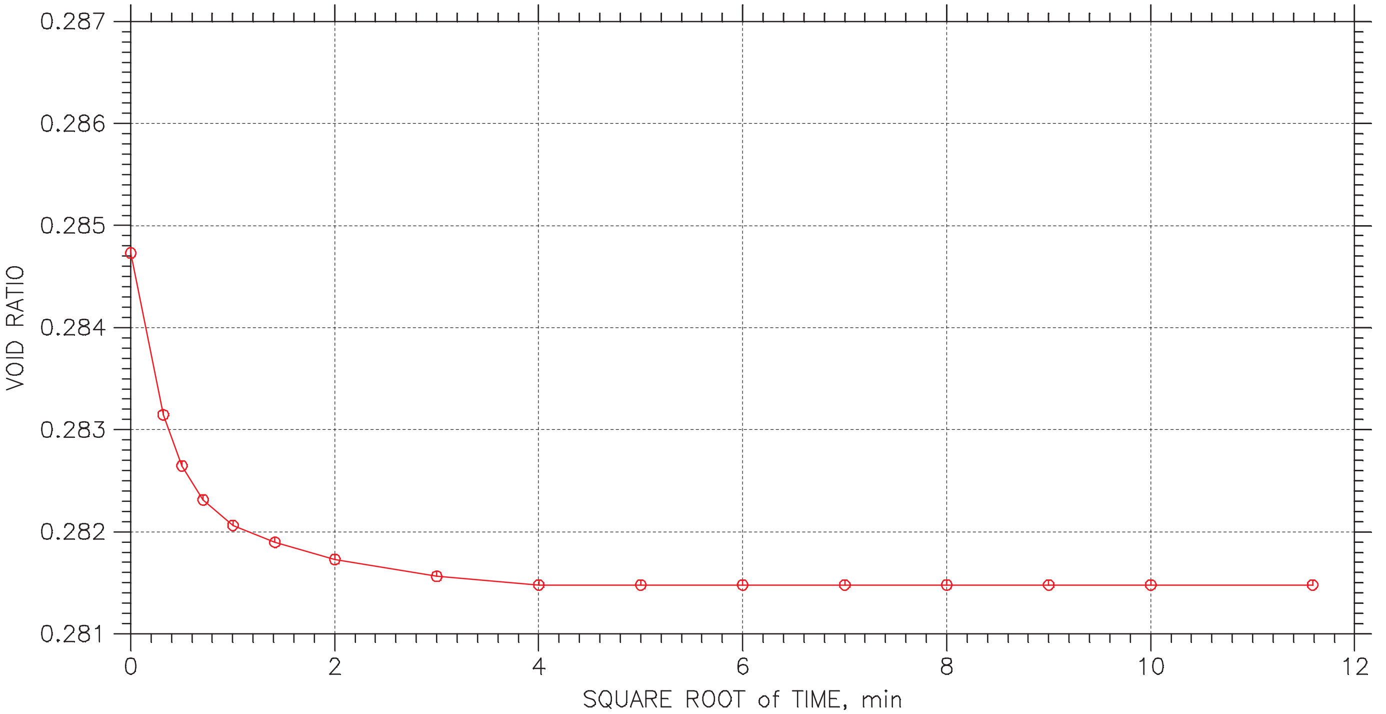
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 13 of 23

Stress: 1. tsf





Terracon Consulting Engineers & Scientists	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

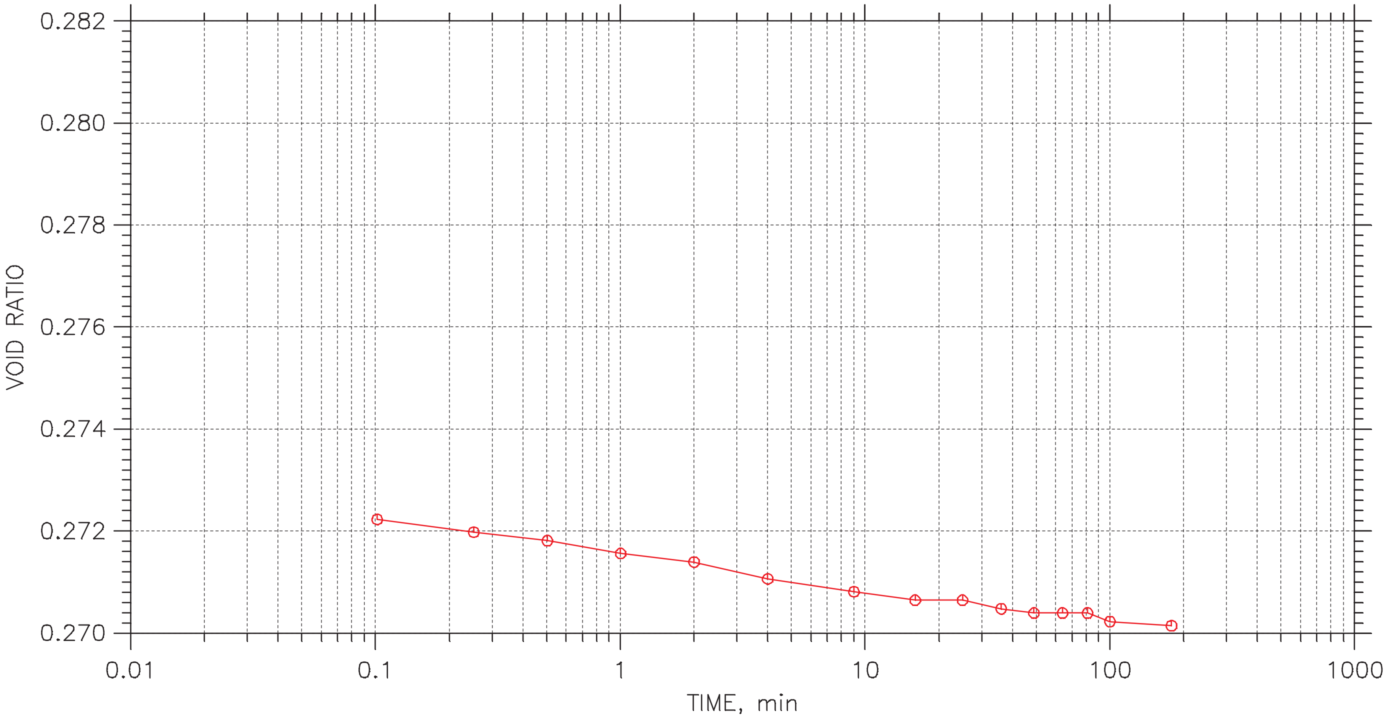
Mon, 21-DEC-2015 16:48:31

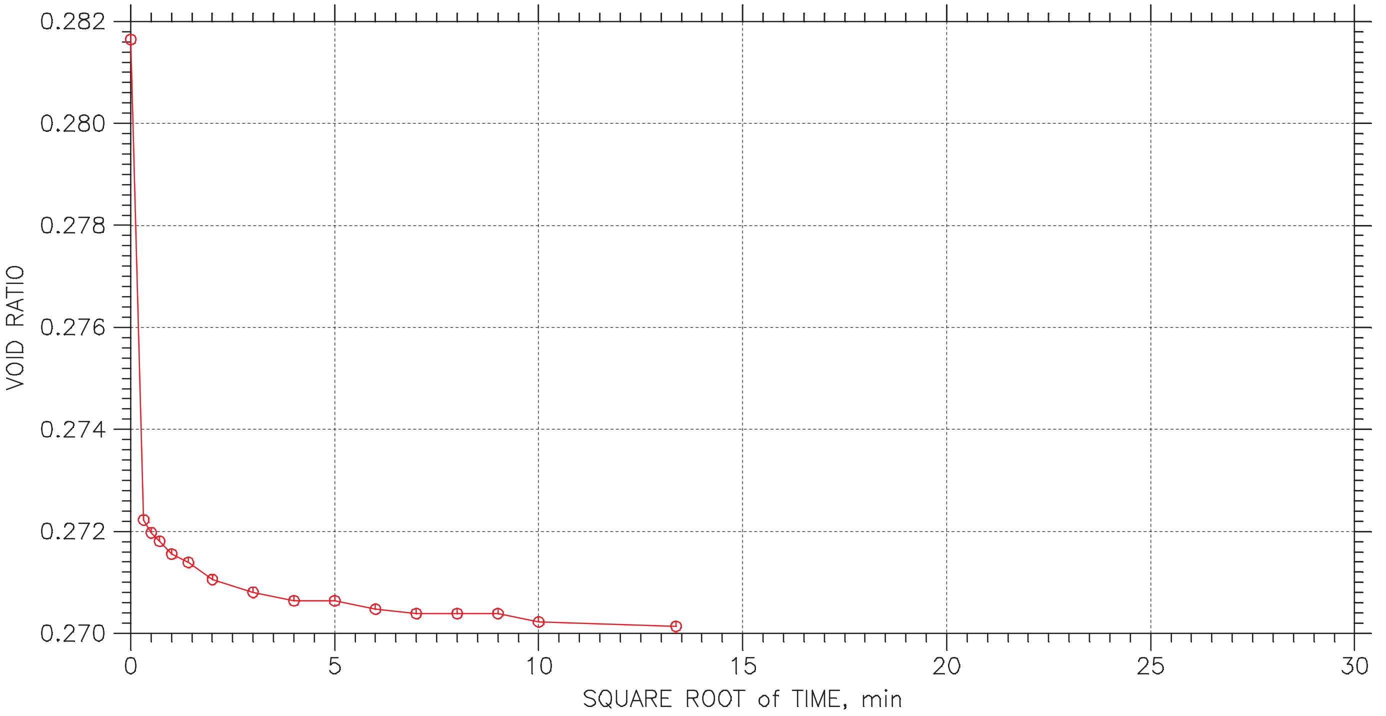
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 14 of 23

Stress: 2. tsf





Project: **DYNEGY HENNEPIN**	Location: HENNEPIN, IL	Project No.: MR155233
Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

Terracon
Consulting Engineers & Scientists

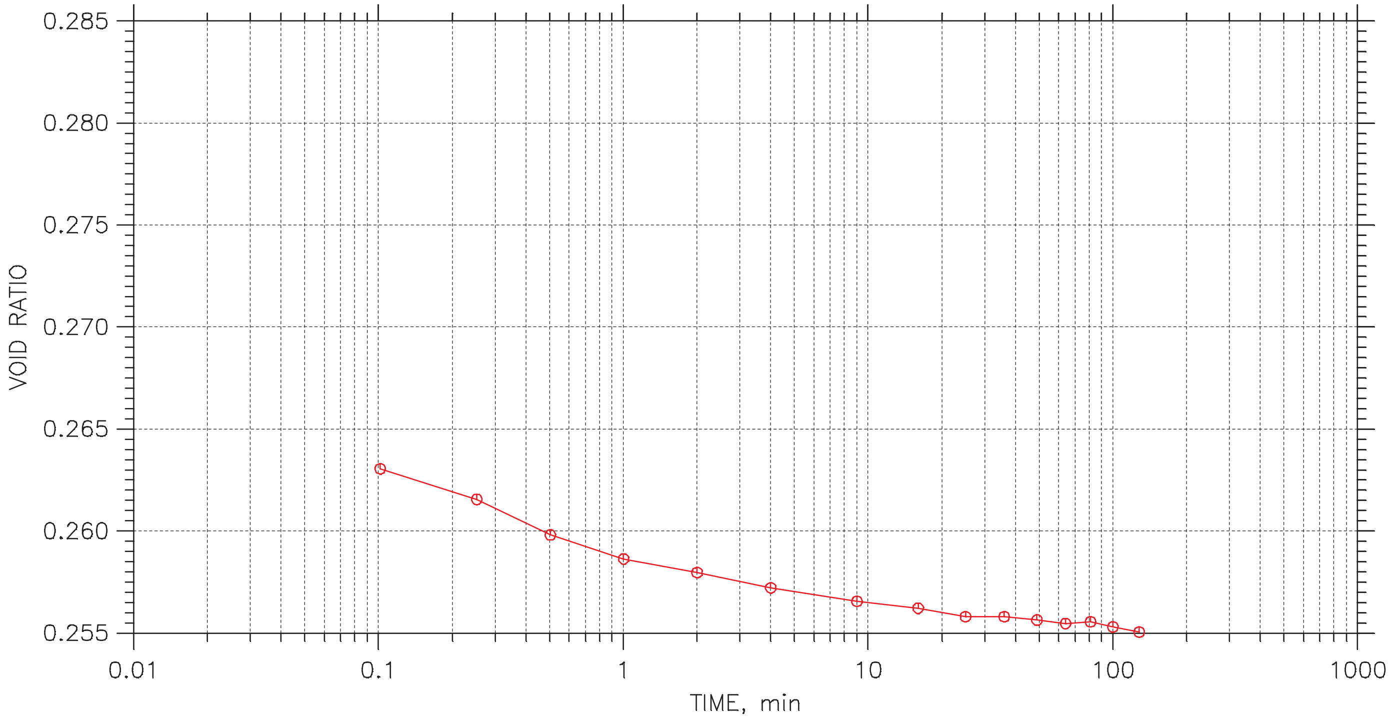
Mon, 21-DEC-2015 16:48:33

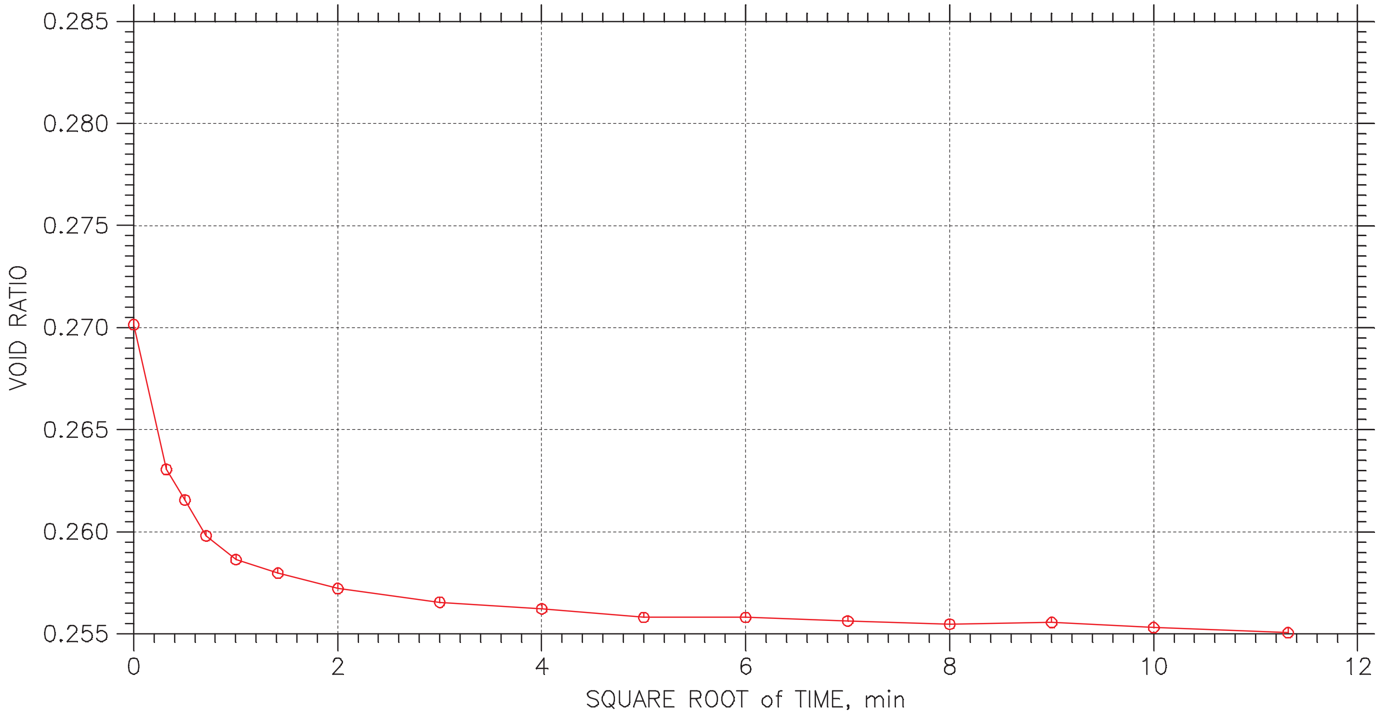
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 15 of 23

Stress: 4. tsf





Terracon Consulting Engineers & Scientists	Project: **DYNEGY HENNEPIN**	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

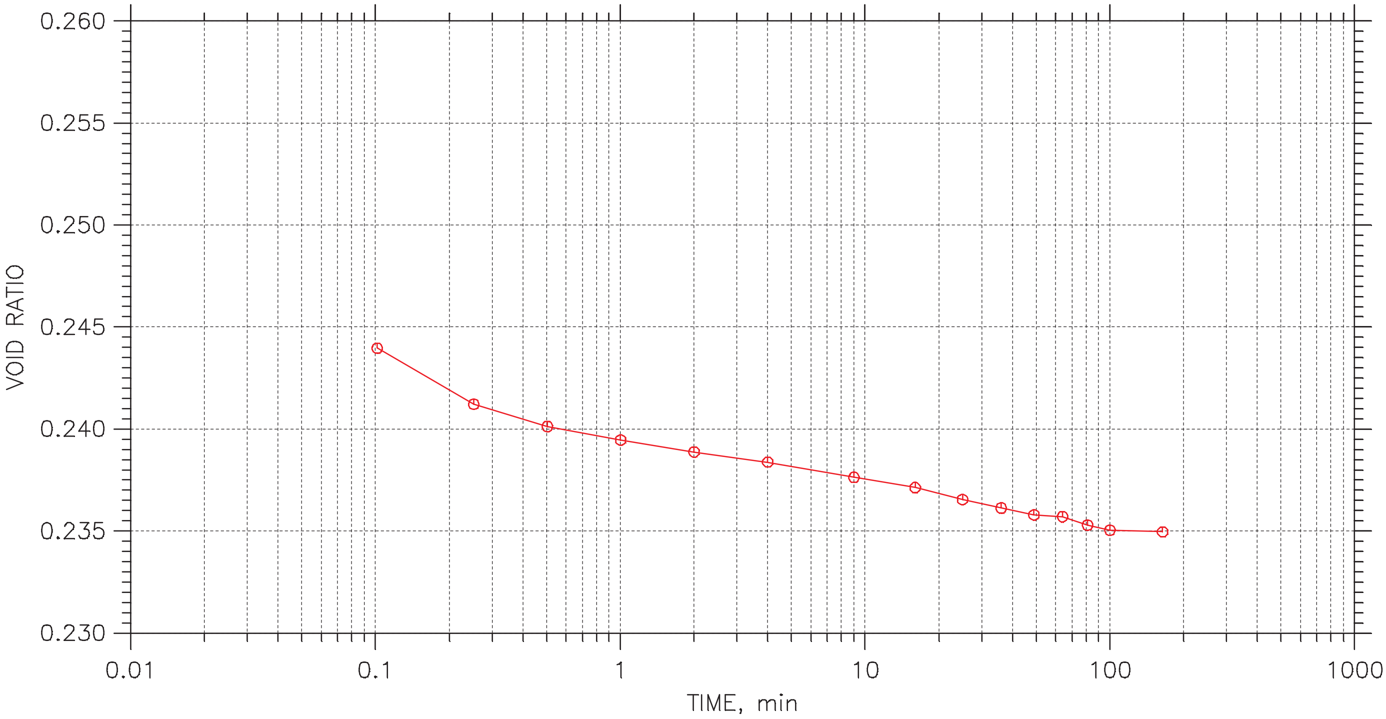
Mon, 21-DEC-2015 16:48:34

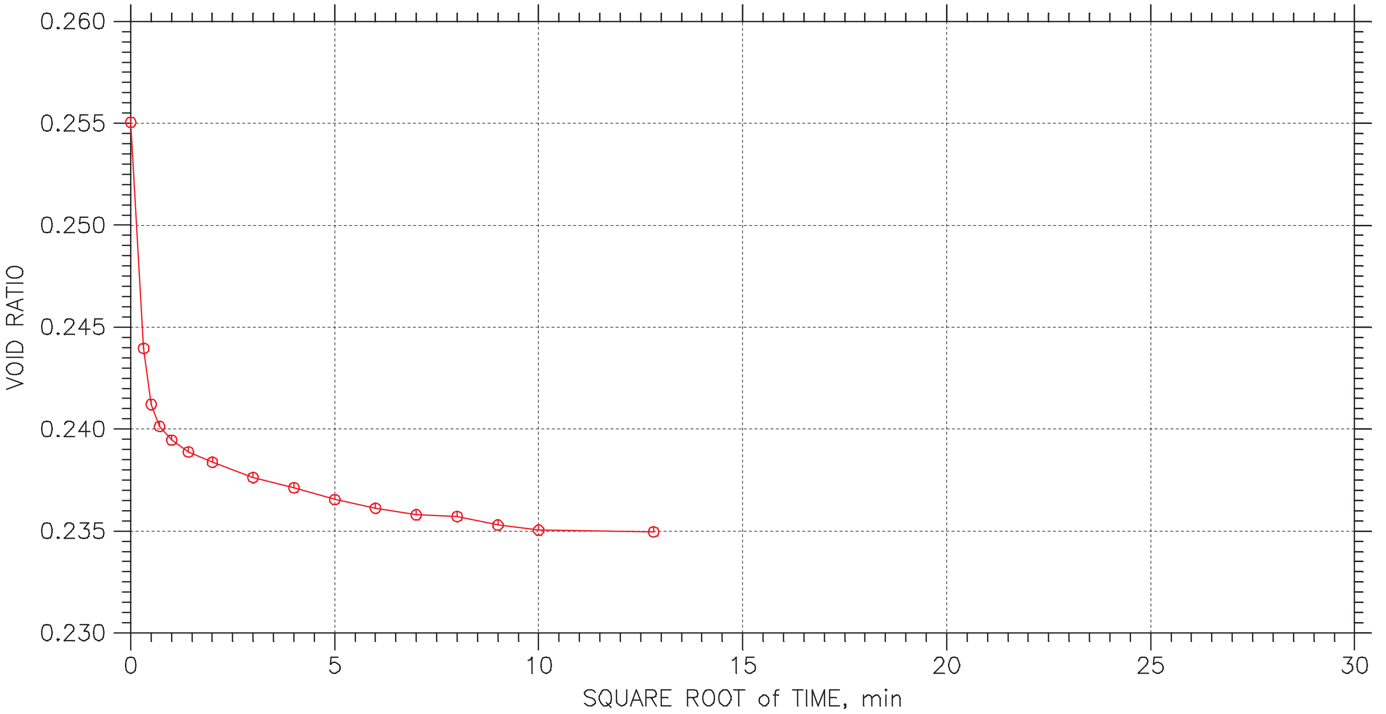
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 16 of 23

Stress: 8. tsf





Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

Terracon
Consulting Engineers & Scientists

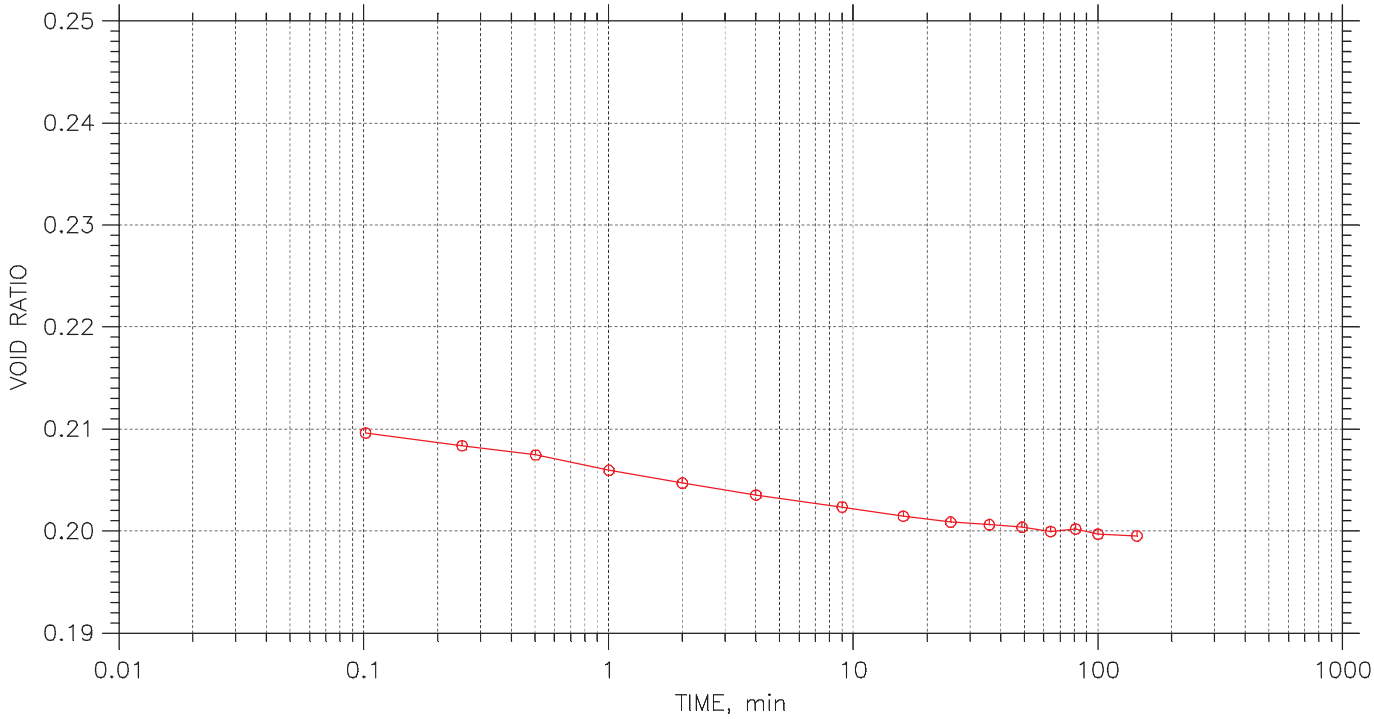
Mon, 21-DEC-2015 16:48:36

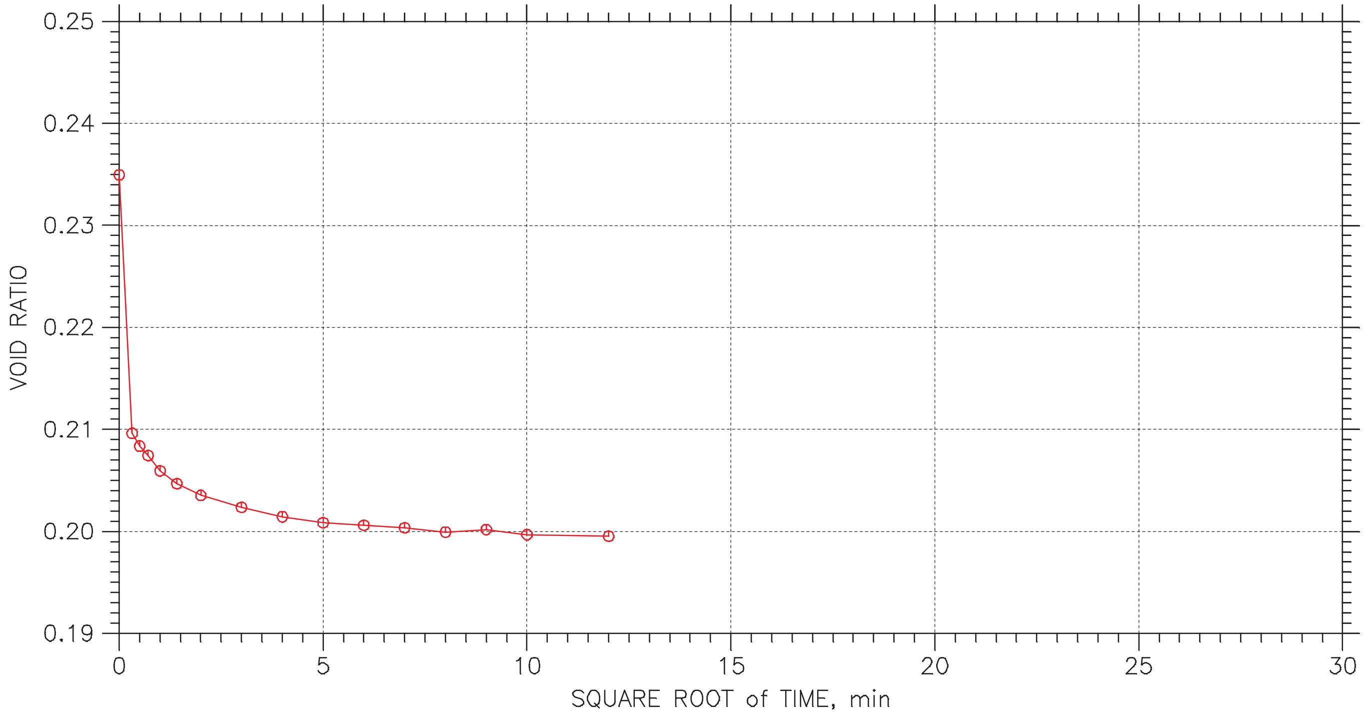
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 17 of 23

Stress: 16. tsf





Terracon Consulting Engineers & Scientists	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

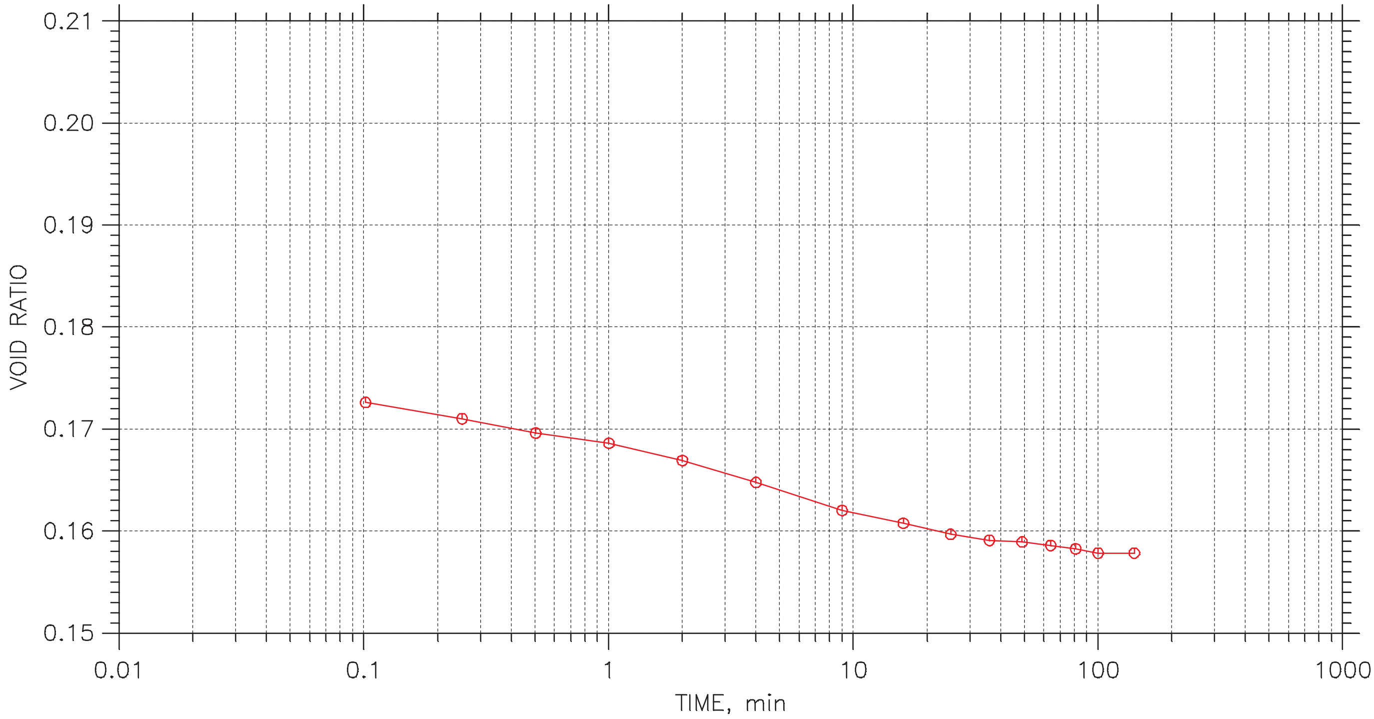
Mon, 21-DEC-2015 16:48:37

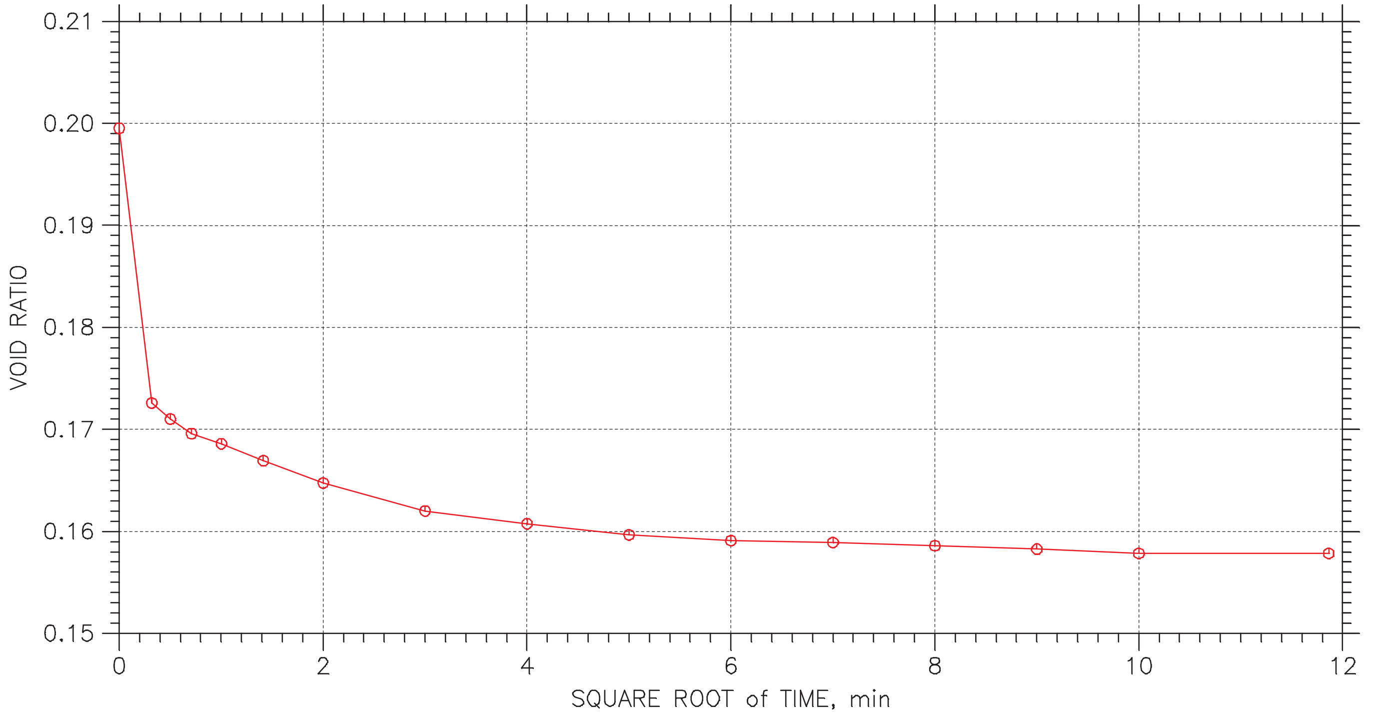
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 18 of 23

Stress: 32. tsf





Terracon Consulting Engineers & Scientists	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

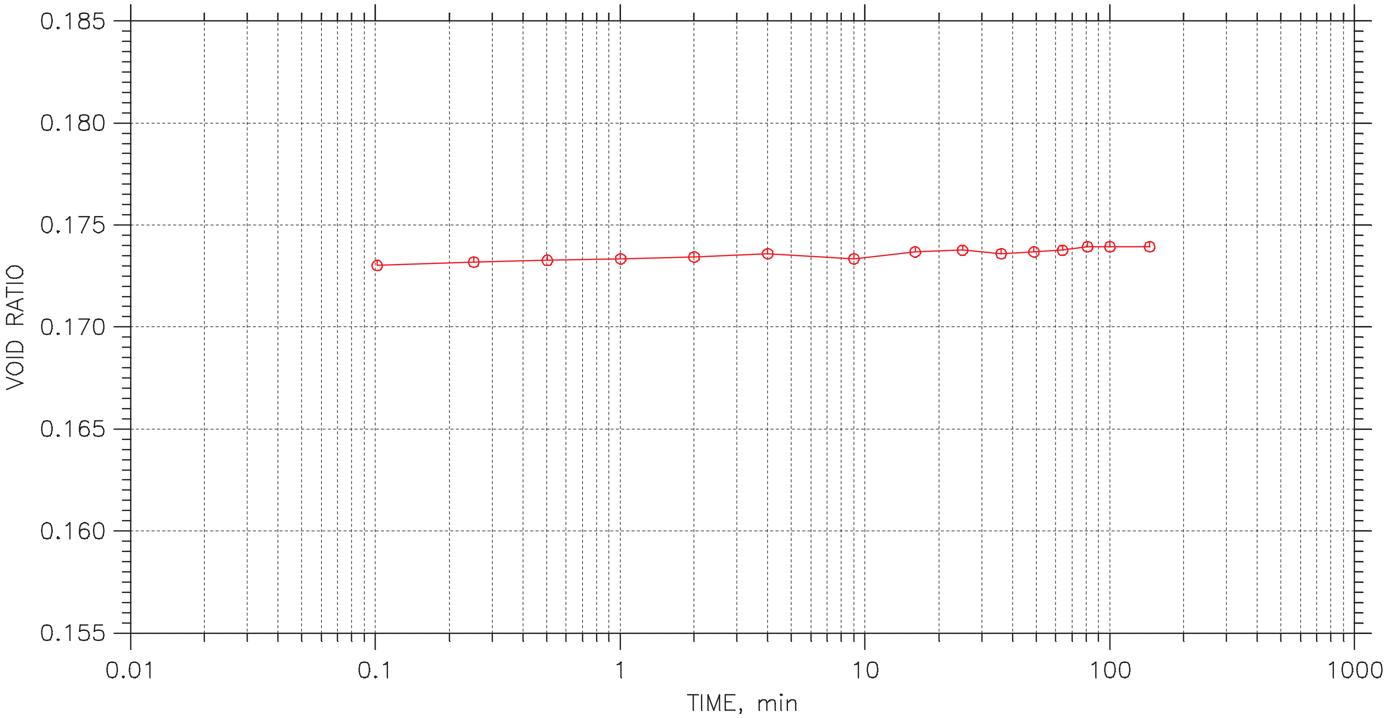
Mon, 21-DEC-2015 16:48:38

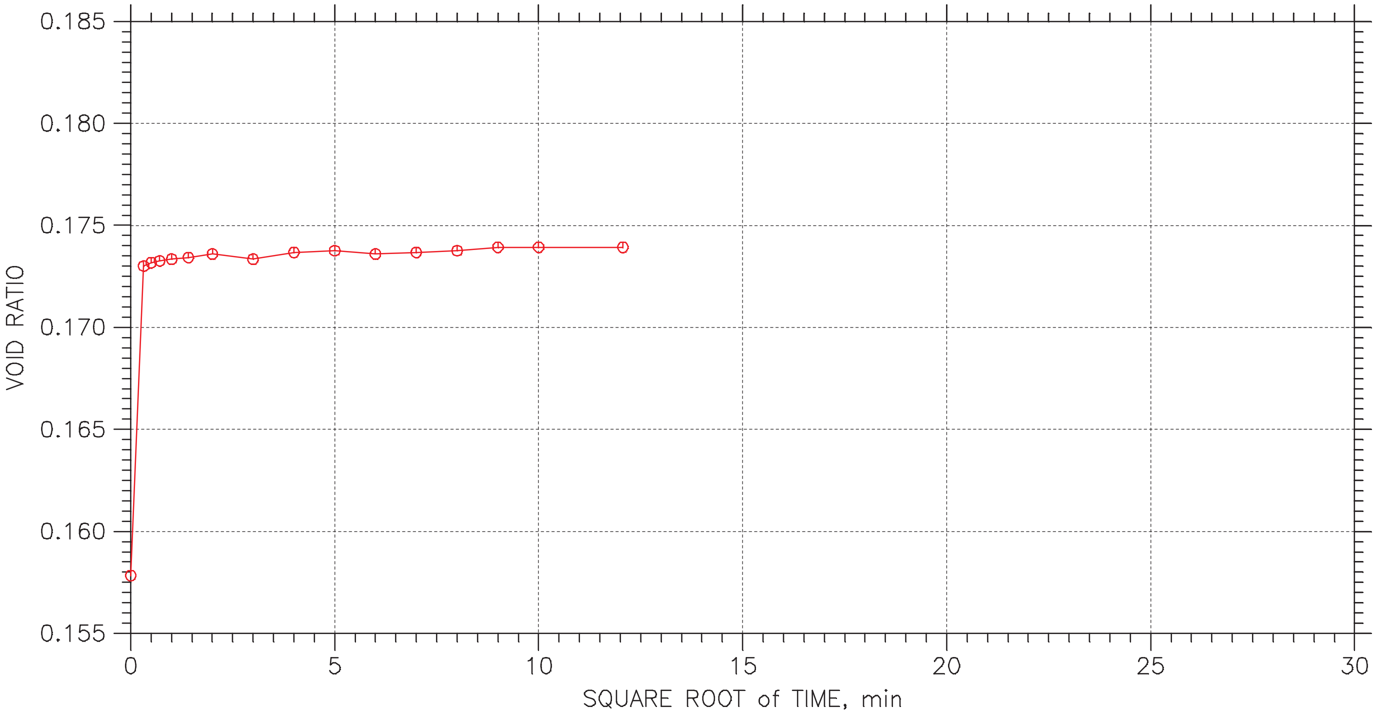
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 19 of 23

Stress: 16. tsf





	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
Terracon Consulting Engineers & Scientists	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

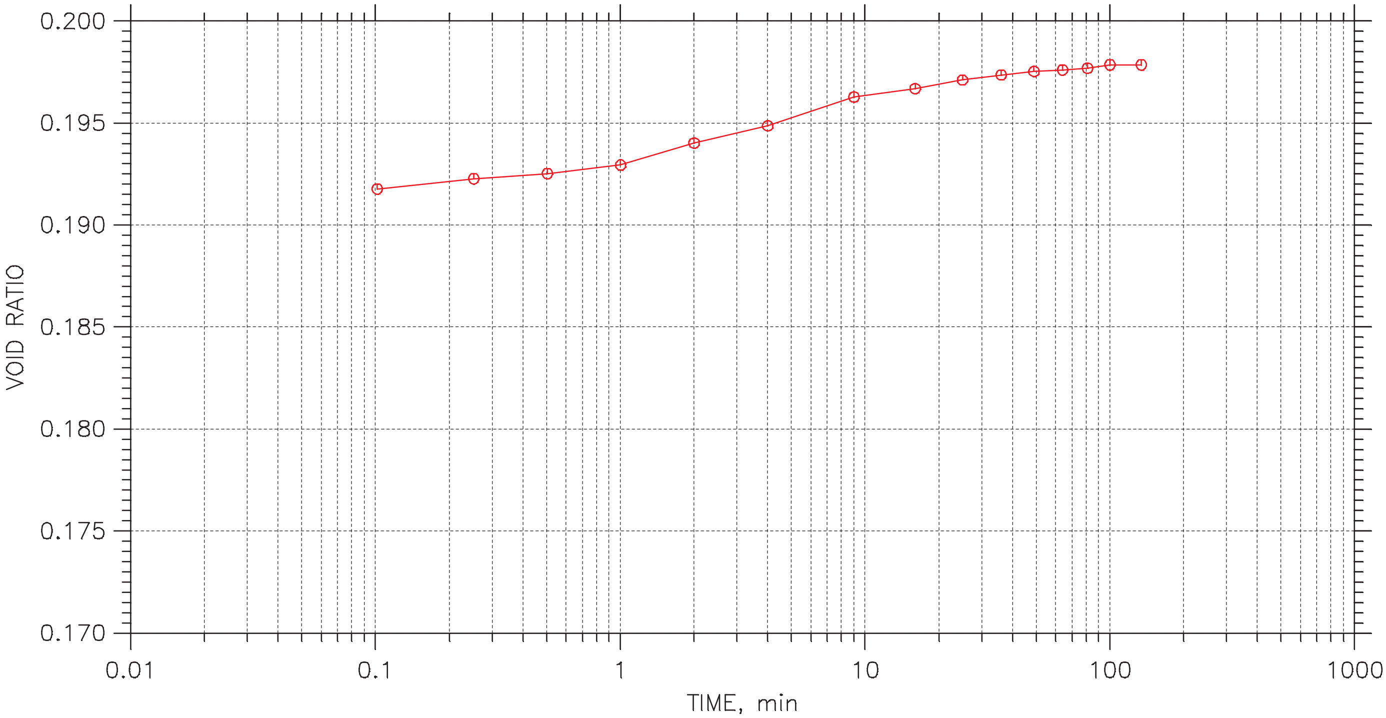
Mon, 21-DEC-2015 16:48:40

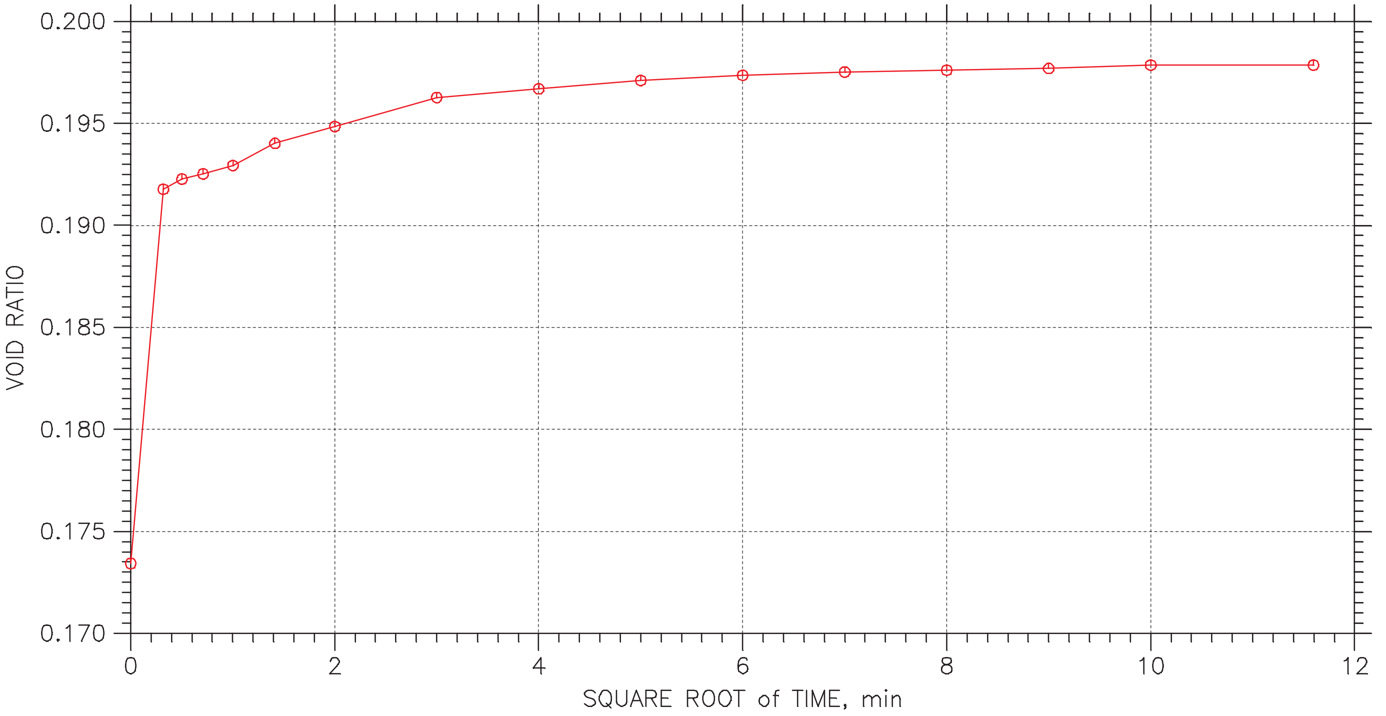
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 20 of 23

Stress: 4. tsf





Terracon Consulting Engineers & Scientists	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

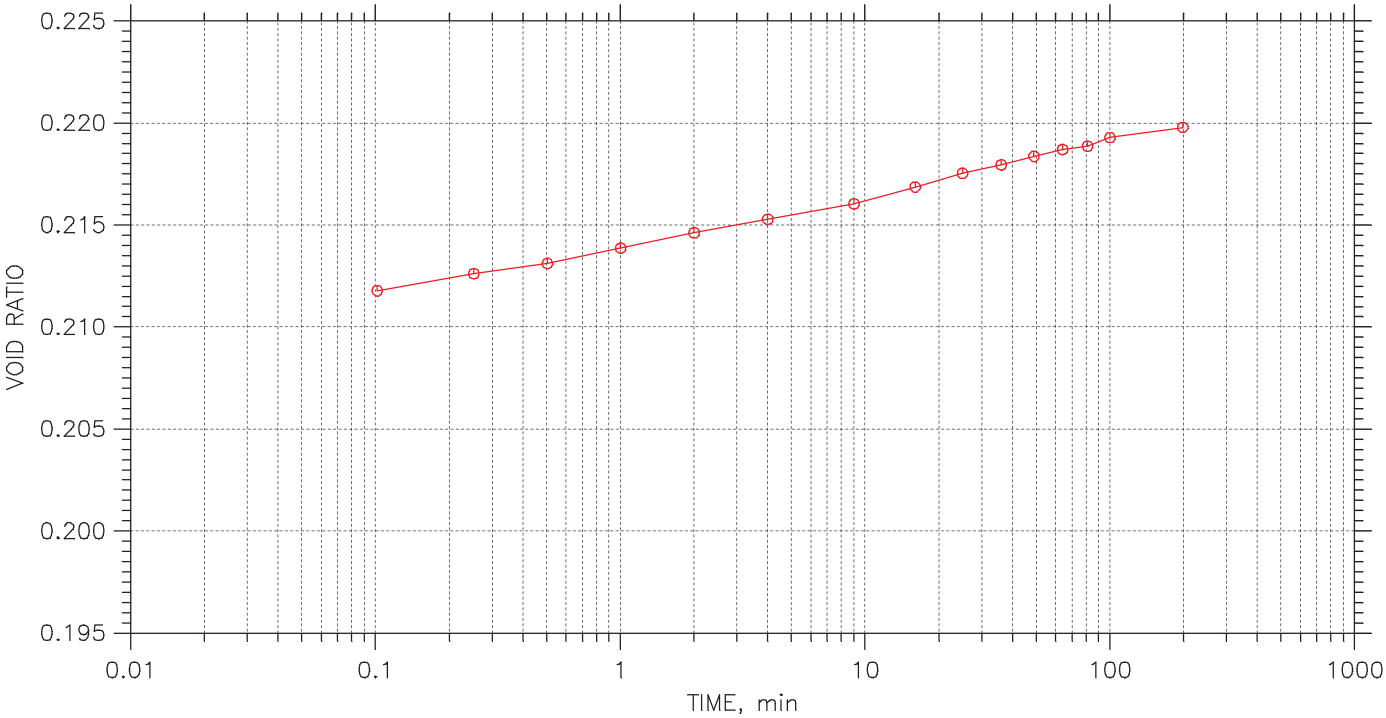
Mon, 21-DEC-2015 16:48:41

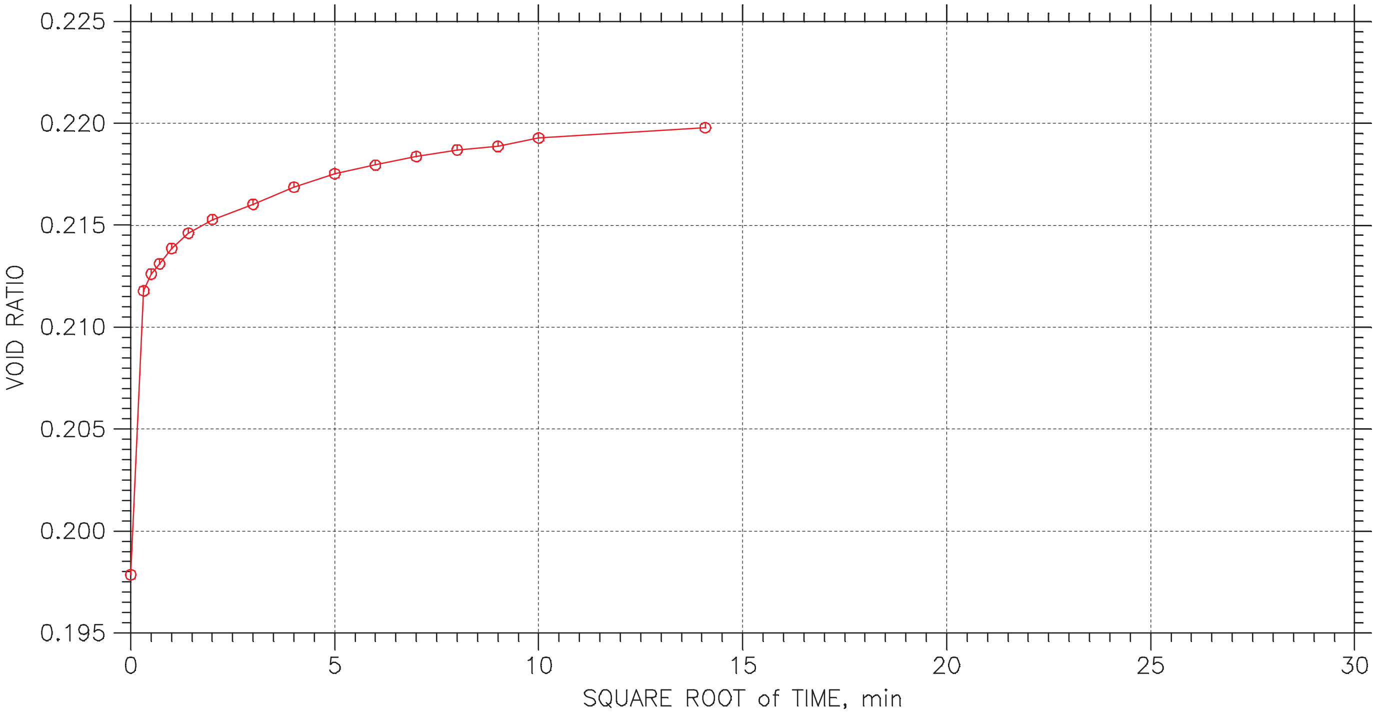
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 21 of 23

Stress: 1. tsf





Terracon Consulting Engineers & Scientists	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

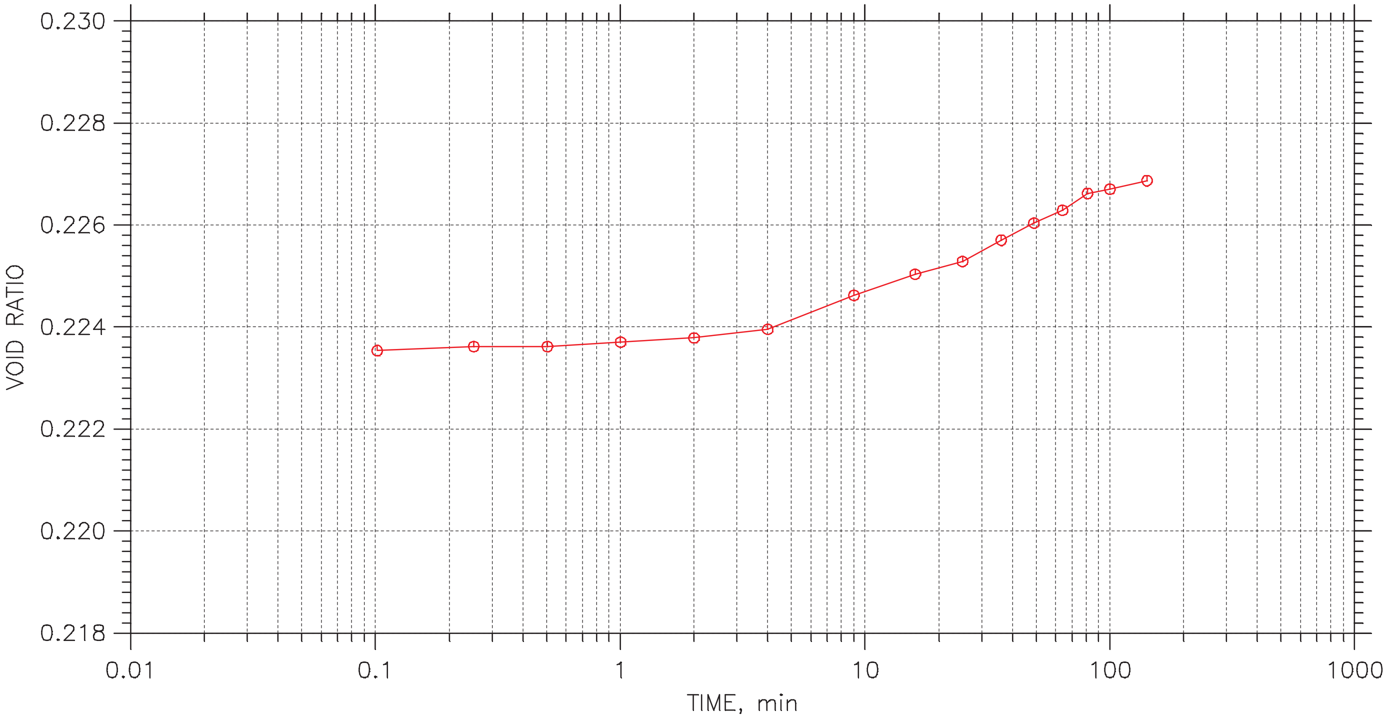
Mon, 21-DEC-2015 16:48:42

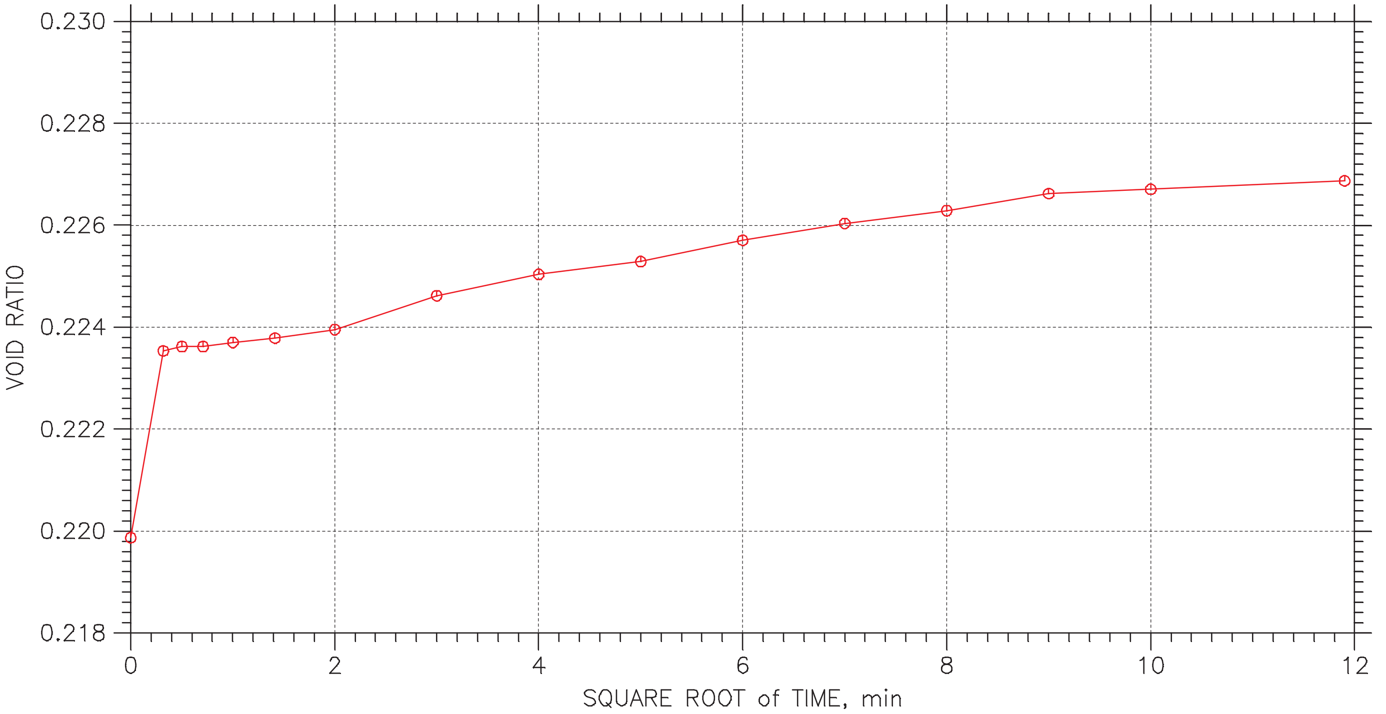
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 22 of 23

Stress: 0.5 tsf





Terracon Consulting Engineers & Scientists	Project: **DYNEGY HENNEPIN**	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

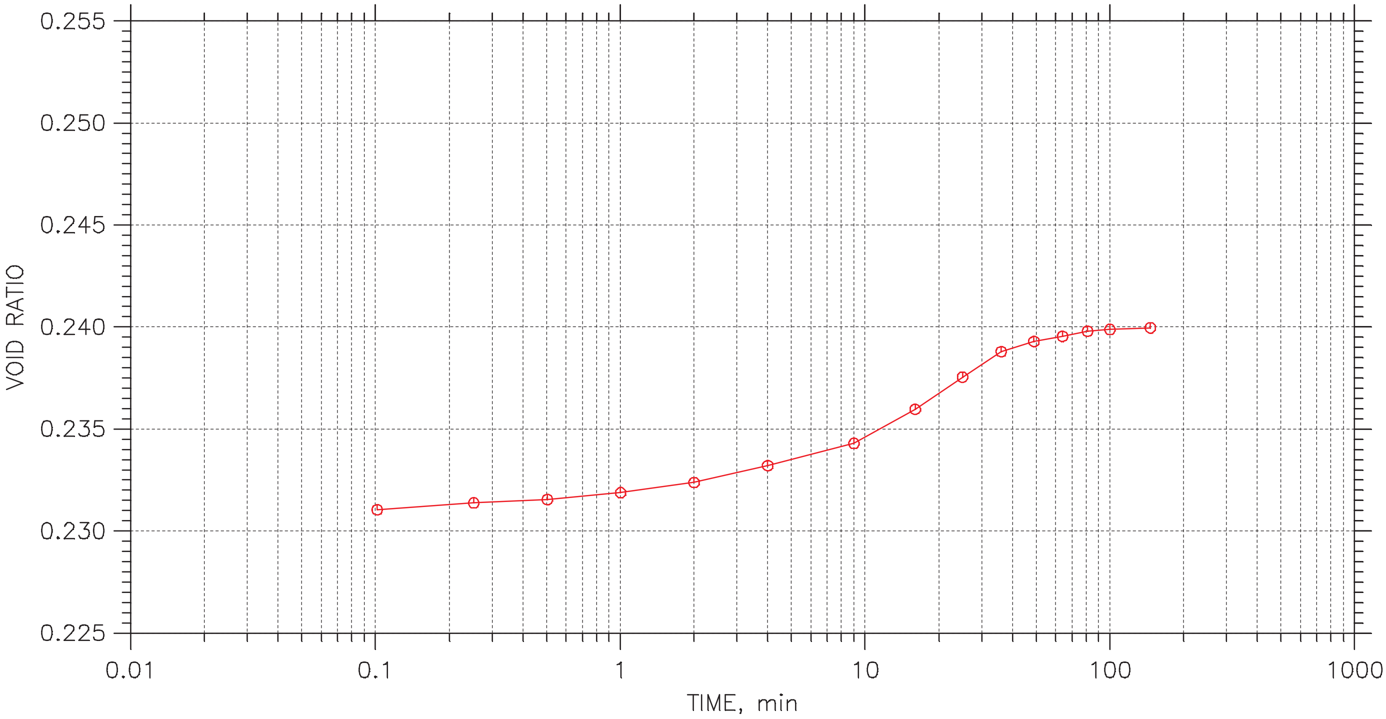
Mon, 21-DEC-2015 16:48:44

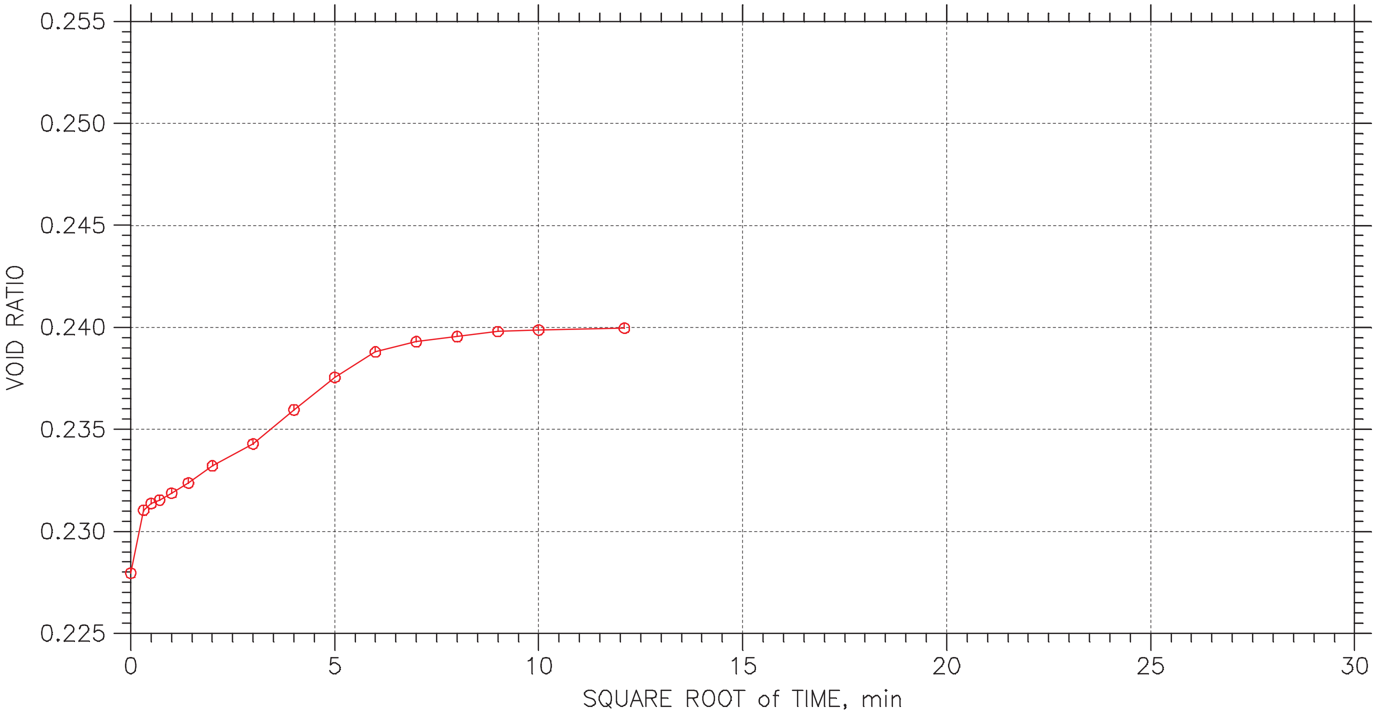
CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 23 of 23

Stress: 0.125 tsf



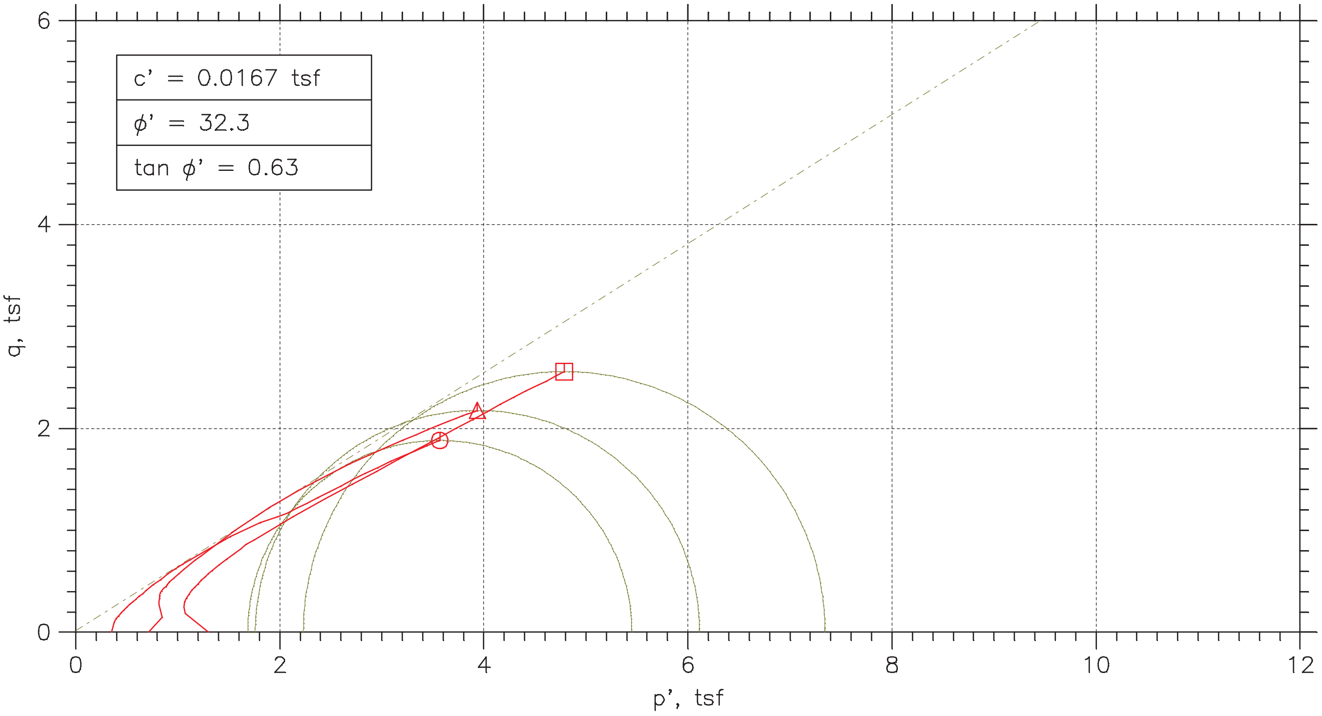


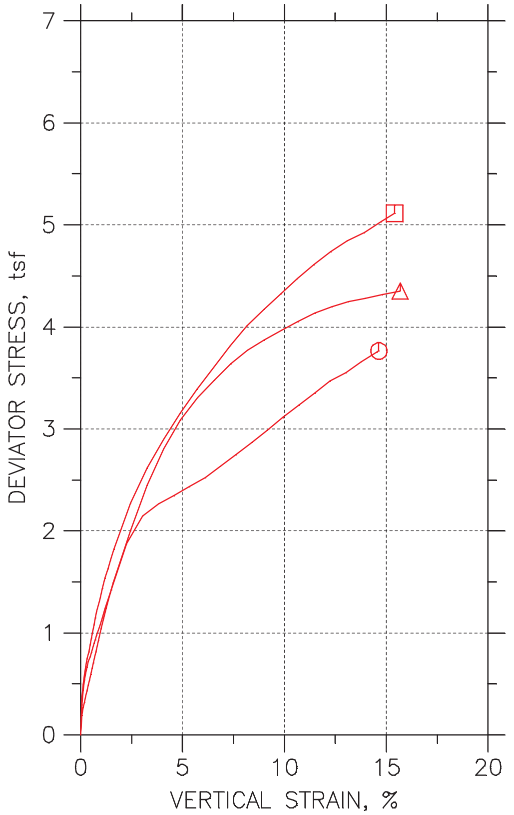
Terracon Consulting Engineers & Scientists	Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
	Boring No.: HEN-029 S-3	Tested By: HP	Checked By: BCM
	Sample No.: S-3	Test Date: 12/14/15	Depth: 5.0'-7.0'
	Test No.: HENB029S3	Sample Type: 3.0'' ST	Elevation: -----
	Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
	Remarks: Pc = 3.1 tsf Cc = 0.128 Ccr = 0.034 TEST PERFORMED AS PER ASTM D2435		

Mon, 21-DEC-2015 16:48:45

Consolidated Undrained Triaxial Compression Tests
ASTM D 4767

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST
ASTM D4767





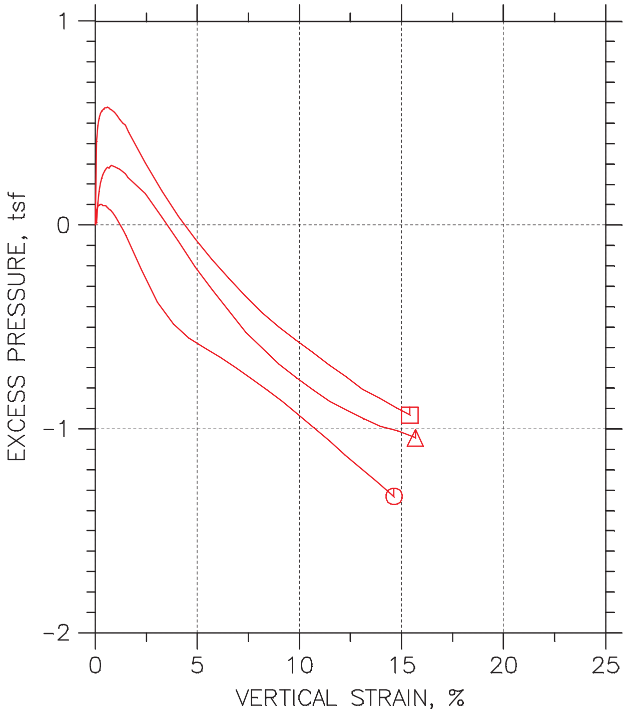
Symbol		○	△	□	
Test No.		5.0 PSI	10.0 PSI	20.0 PSI	
Initial	Diameter, in	2.813	2.7921	2.8256	
	Height, in	6.0902	5.9878	6.0303	
	Water Content, %	8.98	11.83	8.88	
	Dry Density, pcf	128.2	127.1	126.	
	Saturation, %	75.28	95.64	69.49	
	Void Ratio	0.32442	0.33638	0.34747	
Before Shear	Water Content, %	13.14	12.04	11.49	
	Dry Density, pcf	125.1	127.9	129.4	
	Saturation, %	100.00	100.00	100.00	
	Void Ratio	0.35748	0.32749	0.31248	
	Back Press., tsf	5.0458	5.0445	5.1811	
Minor Prin. Stress, tsf		0.35425	0.71546	1.2989	
Max. Dev. Stress, tsf		3.764	4.3529	5.114	
Time to Failure, min		1147.2	1143.8	1128.7	
Strain Rate, %/min		0.02	0.02	0.02	
B-Value		0.95	0.97	0.95	
Estimated Specific Gravity		2.72	2.72	2.72	
Liquid Limit		22	22	22	
Plastic Limit		15	15	15	
Plasticity Index		7	7	7	
Failure Sketch					

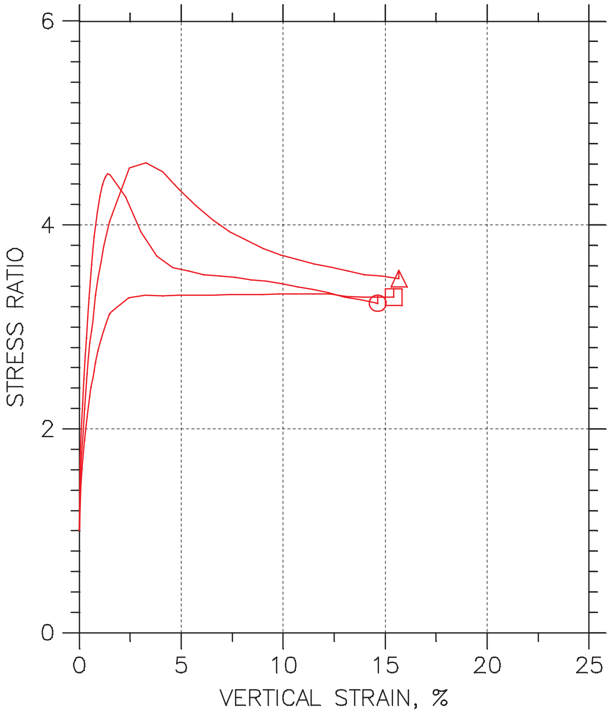
Project: DYNEGY HENNEPIN
Location: HENNEPIN, IL
Project No.: MR155233
Boring No.: HEN-029 S-3
Sample Type: 3.0'' ST

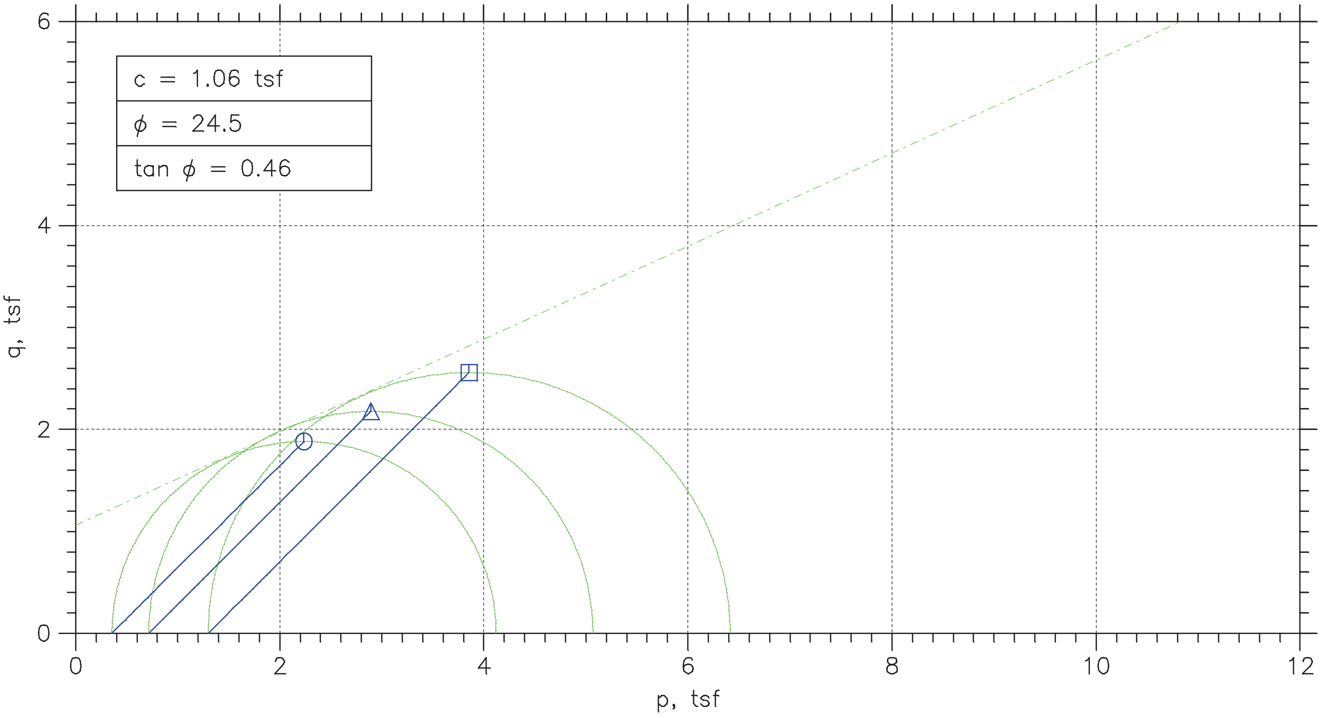
Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL

Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D4767.

CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST
ASTM D4767







Project: DYNEGY HENNEPIN	Location: HENNEPIN, IL	Project No.: MR155233
Boring No.: HEN-029 S-3	Tested By: BCM	Checked By: WPQ
Sample No.: S-3	Test Date: 12/17/15	Depth: 5.0'-7.0'
Test No.: HEN-029 S-3	Sample Type: 3.0" ST	Elevation: ----
Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL		
Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D4767.		

Tue, 22-DEC-2015 13:47:19

TRIAXIAL TEST

Project: DYNEGY HENNEPIN
Boring No.: HEN-029 S-3
Sample No.: S-3
Test No.: 5.0 PSI

Location: HENNEPIN, IL
Tested By: BCM
Test Date: 12/17/15
Sample Type: 3.0" ST

Project No.: MR155233
Checked By: WPQ
Depth: 5.0'-7.0'
Elevation: ----

Soil Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL
Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D4767.

Specimen Height: 6.09 in
Specimen Area: 6.21 in^2
Specimen Volume: 37.85 in^3

Piston Area: 0.00 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.00 lb

Filter Strip Correction: 0.00 tsf
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

Liquid Limit: 22

Plastic Limit: 15

Estimated Specific Gravity: 2.72

	Time min	Vertical Strain %	Corrected Area in^2	Deviator Load lb	Deviator Stress tsf	Pore Pressure tsf	Horizontal Stress tsf	Vertical Stress tsf
1	0	0	6.2148	0	0	5.0458	5.4	5.4
2	5.0035	0.055219	6.2182	17.005	0.1969	5.1201	5.4	5.5969
3	10.003	0.11893	6.2222	23.059	0.26683	5.1363	5.4	5.6668
4	15.003	0.17981	6.226	27.85	0.32207	5.1427	5.4	5.7221
5	20.003	0.24353	6.23	32.852	0.37967	5.1462	5.4	5.7797
6	25.003	0.30866	6.234	37.643	0.43475	5.1462	5.4	5.8348
7	30.003	0.37237	6.238	42.276	0.48795	5.1422	5.4	5.8879
8	35.003	0.43609	6.242	46.961	0.54168	5.1422	5.4	5.9417
9	40.003	0.49838	6.2459	51.752	0.59657	5.1392	5.4	5.9966
10	45.003	0.5621	6.2499	56.385	0.64956	5.1346	5.4	6.0496
11	50.003	0.6244	6.2538	61.386	0.70674	5.1294	5.4	6.1067
12	55.003	0.68811	6.2579	66.335	0.76322	5.123	5.4	6.1632
13	60.003	0.75041	6.2618	71.126	0.81783	5.1172	5.4	6.2178
14	70.003	0.87784	6.2698	80.918	0.92923	5.1027	5.4	6.3292
15	80.003	1.0067	6.278	90.553	1.0385	5.0835	5.4	6.4385
16	90.003	1.1341	6.2861	99.661	1.1415	5.0638	5.4	6.5415
17	100	1.2601	6.2941	108.72	1.2436	5.0411	5.4	6.6436
18	110	1.3904	6.3024	117.14	1.3382	5.0179	5.4	6.7382
19	120	1.5164	6.3105	124.88	1.4248	4.9917	5.4	6.8248
20	180	2.271	6.3592	165.63	1.8753	4.828	5.4	7.2753
21	240	3.037	6.4095	191.27	2.1486	4.6677	5.4	7.5486
22	300	3.8158	6.4613	203.48	2.2674	4.5591	5.4	7.6674
23	360	4.5789	6.513	212.11	2.3449	4.4923	5.4	7.7449
24	420	5.3421	6.5655	222.17	2.4364	4.4447	5.4	7.8364
25	480	6.1095	6.6192	231.96	2.5232	4.3959	5.4	7.9232
26	540	6.874	6.6735	244.18	2.6344	4.346	5.4	8.0344
27	600	7.6386	6.7288	257.13	2.7513	4.2926	5.4	8.1513
28	660	8.4116	6.7856	270.03	2.8652	4.2357	5.4	8.2652
29	720	9.1663	6.842	283.82	2.9867	4.1793	5.4	8.3867
30	780	9.9295	6.8999	298.25	3.1122	4.1172	5.4	8.5122
31	840	10.708	6.9601	312.3	3.2307	4.051	5.4	8.6307
32	900	11.471	7.0201	326.83	3.3521	3.986	5.4	8.7521
33	960	12.232	7.0809	340.94	3.4668	3.9169	5.4	8.8668
34	1020	13.009	7.1442	352.31	3.5507	3.8512	5.4	8.9507
35	1080	13.774	7.2075	366.11	3.6572	3.7891	5.4	9.0572
36	1140	14.538	7.272	379.11	3.7536	3.7217	5.4	9.1536
37	1147.2	14.632	7.28	380.59	3.764	3.7142	5.4	9.164

TRIAXIAL TEST

Project: DYNEGY HENNEPIN
Boring No.: HEN-029 S-3
Sample No.: S-3
Test No.: 5.0 PSI

Location: HENNEPIN, IL
Tested By: BCM
Test Date: 12/17/15
Sample Type: 3.0" ST

Project No.: MR155233
Checked By: WPQ
Depth: 5.0'-7.0'
Elevation: ----

Soil Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL
Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D4767.

Specimen Height: 6.09 in
Specimen Area: 6.21 in^2
Specimen Volume: 37.85 in^3

Piston Area: 0.00 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.00 lb

Filter Strip Correction: 0.00 tsf
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

Liquid Limit: 22

Plastic Limit: 15

Estimated Specific Gravity: 2.72

	Vertical Strain %	Total Vertical Stress tsf	Total Horizontal Stress tsf	Excess Pore Pressure tsf	A Parameter	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	Stress Ratio	Effective p tsf	q tsf
1	0.00	5.4	5.4	0	0.000	0.35425	0.35425	1.000	0.35425	0
2	0.06	5.5969	5.4	0.07433	0.378	0.47681	0.27992	1.703	0.37837	0.098449
3	0.12	5.6668	5.4	0.09059	0.340	0.53049	0.26366	2.012	0.39707	0.13342
4	0.18	5.7221	5.4	0.096978	0.301	0.57934	0.25727	2.252	0.4183	0.16104
5	0.24	5.7797	5.4	0.10046	0.265	0.63345	0.25378	2.496	0.44362	0.18983
6	0.31	5.8348	5.4	0.10046	0.231	0.68854	0.25378	2.713	0.47116	0.21738
7	0.37	5.8879	5.4	0.096397	0.198	0.7458	0.25785	2.892	0.50182	0.24397
8	0.44	5.9417	5.4	0.096397	0.178	0.79953	0.25785	3.101	0.52869	0.27084
9	0.50	5.9966	5.4	0.093494	0.157	0.85732	0.26075	3.288	0.55904	0.29829
10	0.56	6.0496	5.4	0.088848	0.137	0.91496	0.2654	3.447	0.59018	0.32478
11	0.62	6.1067	5.4	0.083622	0.118	0.97736	0.27062	3.611	0.62399	0.35337
12	0.69	6.1632	5.4	0.077234	0.101	1.0402	0.27701	3.755	0.65862	0.38161
13	0.75	6.2178	5.4	0.071427	0.087	1.1007	0.28282	3.892	0.69173	0.40892
14	0.88	6.3292	5.4	0.056909	0.061	1.2266	0.29734	4.125	0.76195	0.46462
15	1.01	6.4385	5.4	0.037746	0.036	1.355	0.3165	4.281	0.83576	0.51926
16	1.13	6.5415	5.4	0.018002	0.016	1.4777	0.33624	4.395	0.907	0.57075
17	1.26	6.6436	5.4	-0.0046456	-0.004	1.6025	0.35889	4.465	0.98071	0.62182
18	1.39	6.7382	5.4	-0.027874	-0.021	1.7203	0.38212	4.502	1.0512	0.66911
19	1.52	6.8248	5.4	-0.054006	-0.038	1.8331	0.40825	4.490	1.1207	0.71241
20	2.27	7.2753	5.4	-0.21776	-0.116	2.4473	0.57201	4.278	1.5096	0.93763
21	3.04	7.5486	5.4	-0.37804	-0.176	2.8809	0.73229	3.934	1.8066	1.0743
22	3.82	7.6674	5.4	-0.48663	-0.215	3.1083	0.84088	3.696	1.9746	1.1337
23	4.58	7.7449	5.4	-0.55341	-0.236	3.2525	0.90766	3.583	2.0801	1.1724
24	5.34	7.8364	5.4	-0.60103	-0.247	3.3917	0.95528	3.550	2.1735	1.2182
25	6.11	7.9232	5.4	-0.64981	-0.258	3.5272	1.0041	3.513	2.2656	1.2616
26	6.87	8.0344	5.4	-0.69975	-0.266	3.6884	1.054	3.499	2.3712	1.3172
27	7.64	8.1513	5.4	-0.75318	-0.274	3.8588	1.1074	3.484	2.4831	1.3757
28	8.41	8.2652	5.4	-0.81008	-0.283	4.0295	1.1643	3.461	2.5969	1.4326
29	9.17	8.3867	5.4	-0.86641	-0.290	4.2074	1.2207	3.447	2.714	1.4934
30	9.93	8.5122	5.4	-0.92855	-0.298	4.395	1.2828	3.426	2.8389	1.5561
31	10.71	8.6307	5.4	-0.99475	-0.308	4.5797	1.349	3.395	2.9643	1.6153
32	11.47	8.7521	5.4	-1.0598	-0.316	4.7661	1.414	3.371	3.0901	1.676
33	12.23	8.8668	5.4	-1.1289	-0.326	4.9499	1.4831	3.337	3.2165	1.7334
34	13.01	8.9507	5.4	-1.1945	-0.336	5.0994	1.5488	3.293	3.3241	1.7753
35	13.77	9.0572	5.4	-1.2566	-0.344	5.2681	1.6109	3.270	3.4395	1.8286
36	14.54	9.1536	5.4	-1.324	-0.353	5.4318	1.6783	3.237	3.555	1.8768
37	14.63	9.164	5.4	-1.3316	-0.354	5.4499	1.6858	3.233	3.5678	1.882

TRIAXIAL TEST

Project: DYNEGY HENNEPIN
Boring No.: HEN-029 S-3
Sample No.: S-3
Test No.: 10.0 PSI

Location: HENNEPIN, IL
Tested By: BCM
Test Date: 12/17/15
Sample Type: 3.0" ST

Project No.: MR155233
Checked By: WPQ
Depth: 5.0'-7.0'
Elevation: ----

Terracon
Consulting Engineers & Scientists

Soil Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL
Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D4767.

Specimen Height: 5.99 in
Specimen Area: 6.12 in^2
Specimen Volume: 36.66 in^3

Piston Area: 0.00 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.00 lb

Filter Strip Correction: 0.00 tsf
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

Liquid Limit: 22

Plastic Limit: 15

Estimated Specific Gravity: 2.72

	Time min	Vertical Strain %	Corrected Area in^2	Deviator Load lb	Deviator Stress tsf	Pore Pressure tsf	Horizontal Stress tsf	Vertical Stress tsf
1	0	0	6.1229	0	0	5.0445	5.76	5.76
2	5.0033	0.057527	6.1265	25.039	0.29426	5.058	5.76	6.0543
3	10.003	0.12145	6.1304	37.584	0.44142	5.1518	5.76	6.2014
4	15.003	0.19176	6.1347	45.895	0.53865	5.2102	5.76	6.2986
5	20.003	0.25727	6.1387	52.089	0.61094	5.2487	5.76	6.3709
6	25.003	0.32599	6.143	57.012	0.66822	5.2731	5.76	6.4282
7	30.003	0.3931	6.1471	61.458	0.71985	5.2947	5.76	6.4799
8	35.003	0.46021	6.1512	65.375	0.76522	5.3111	5.76	6.5252
9	40.003	0.52573	6.1553	69.134	0.80868	5.321	5.76	6.5687
10	45.003	0.59444	6.1596	72.945	0.85267	5.3262	5.76	6.6127
11	50.003	0.66316	6.1638	76.651	0.89536	5.3239	5.76	6.6554
12	55.003	0.72867	6.1679	80.356	0.93803	5.3315	5.76	6.698
13	60.003	0.79898	6.1723	84.009	0.97997	5.3355	5.76	6.74
14	70.003	0.93481	6.1807	91.314	1.0637	5.3309	5.76	6.8237
15	80.003	1.0674	6.189	98.884	1.1504	5.3251	5.76	6.9104
16	90.003	1.2049	6.1976	106.24	1.2343	5.3186	5.76	6.9943
17	110	1.4781	6.2148	121.28	1.405	5.2971	5.76	7.165
18	120	1.6155	6.2235	129.06	1.4931	5.2784	5.76	7.2531
19	180	2.4465	6.2765	174.42	2.0009	5.1979	5.76	7.7609
20	240	3.2615	6.3294	215.08	2.4466	5.0819	5.76	8.2066
21	300	4.0812	6.3835	248.9	2.8074	4.9623	5.76	8.5674
22	360	4.909	6.439	275.85	3.0845	4.8381	5.76	8.8445
23	420	5.7319	6.4952	298.08	3.3042	4.7238	5.76	9.0642
24	480	6.5549	6.5524	316.61	3.479	4.6206	5.76	9.239
25	540	7.3826	6.611	334.34	3.6413	4.5173	5.76	9.4013
26	600	8.1976	6.6697	349.06	3.7681	4.4392	5.76	9.5281
27	660	9.0189	6.7299	362.08	3.8737	4.3628	5.76	9.6337
28	720	9.8547	6.7923	374.04	3.9649	4.2946	5.76	9.7249
29	780	10.668	6.8541	386.11	4.056	4.2374	5.76	9.816
30	840	11.485	6.9174	397.49	4.1373	4.1808	5.76	9.8973
31	900	12.324	6.9836	407.45	4.2007	4.1354	5.76	9.9607
32	960	13.15	7.05	415.97	4.2482	4.0945	5.76	10.008
33	1020	13.976	7.1177	423.01	4.279	4.0578	5.76	10.039
34	1080	14.808	7.1873	430.74	4.315	4.0345	5.76	10.075
35	1140	15.625	7.2568	438.47	4.3503	4.003	5.76	10.11
36	1143.8	15.678	7.2613	438.99	4.3529	4.0001	5.76	10.113

TRIAXIAL TEST

Project: DYNEGY HENNEPIN
Boring No.: HEN-029 S-3
Sample No.: S-3
Test No.: 10.0 PSI

Location: HENNEPIN, IL
Tested By: BCM
Test Date: 12/17/15
Sample Type: 3.0" ST

Project No.: MR155233
Checked By: WPQ
Depth: 5.0'-7.0'
Elevation: ----

Soil Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL
Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D4767.

Specimen Height: 5.99 in
Specimen Area: 6.12 in^2
Specimen Volume: 36.66 in^3

Piston Area: 0.00 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.00 lb

Filter Strip Correction: 0.00 tsf
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

Liquid Limit: 22

Plastic Limit: 15

Estimated Specific Gravity: 2.72

	Vertical Strain %	Total Vertical Stress tsf	Total Horizontal Stress tsf	Excess Pore Pressure tsf	A Parameter	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	Stress Ratio	Effective p tsf	q tsf
1	0.00	5.76	5.76	0	0.000	0.71546	0.71546	1.000	0.71546	0
2	0.06	6.0543	5.76	0.013413	0.046	0.99631	0.70205	1.419	0.84918	0.14713
3	0.12	6.2014	5.76	0.10731	0.243	1.0496	0.60815	1.726	0.82886	0.22071
4	0.19	6.2986	5.76	0.16562	0.307	1.0885	0.54984	1.980	0.81916	0.26932
5	0.26	6.3709	5.76	0.20411	0.334	1.1223	0.51135	2.195	0.81681	0.30547
6	0.33	6.4282	5.76	0.22861	0.342	1.1551	0.48685	2.373	0.82096	0.33411
7	0.39	6.4799	5.76	0.25019	0.348	1.1851	0.46527	2.547	0.8252	0.35993
8	0.46	6.5252	5.76	0.26651	0.348	1.2142	0.44895	2.704	0.83155	0.38261
9	0.53	6.5687	5.76	0.27643	0.342	1.2477	0.43903	2.842	0.84337	0.40434
10	0.59	6.6127	5.76	0.28168	0.330	1.2865	0.43378	2.966	0.86012	0.42633
11	0.66	6.6554	5.76	0.27935	0.312	1.3315	0.43612	3.053	0.8838	0.44768
12	0.73	6.698	5.76	0.28693	0.306	1.3666	0.42853	3.189	0.89755	0.46901
13	0.80	6.74	5.76	0.29101	0.297	1.4044	0.42445	3.309	0.91444	0.48999
14	0.93	6.8237	5.76	0.28634	0.269	1.4928	0.42912	3.479	0.96098	0.53186
15	1.07	6.9104	5.76	0.28051	0.244	1.5853	0.43495	3.645	1.0101	0.57518
16	1.20	6.9943	5.76	0.2741	0.222	1.6756	0.44136	3.796	1.0585	0.61713
17	1.48	7.165	5.76	0.25252	0.180	1.8679	0.46294	4.035	1.1654	0.7025
18	1.62	7.2531	5.76	0.23386	0.157	1.9747	0.4816	4.100	1.2281	0.74654
19	2.45	7.7609	5.76	0.15338	0.077	2.563	0.56208	4.560	1.5625	1.0004
20	3.26	8.2066	5.76	0.037324	0.015	3.1248	0.67814	4.608	1.9014	1.2233
21	4.08	8.5674	5.76	-0.082229	-0.029	3.6051	0.79769	4.519	2.2014	1.4037
22	4.91	8.8445	5.76	-0.20645	-0.067	4.0064	0.92191	4.346	2.4641	1.5422
23	5.73	9.0642	5.76	-0.32075	-0.097	4.3404	1.0362	4.189	2.6883	1.6521
24	6.55	9.239	5.76	-0.42397	-0.122	4.6184	1.1394	4.053	2.8789	1.7395
25	7.38	9.4013	5.76	-0.5272	-0.145	4.8839	1.2427	3.930	3.0633	1.8206
26	8.20	9.5281	5.76	-0.60534	-0.161	5.0889	1.3208	3.853	3.2049	1.8841
27	9.02	9.6337	5.76	-0.68174	-0.176	5.2709	1.3972	3.772	3.3341	1.9369
28	9.85	9.7249	5.76	-0.74997	-0.189	5.4304	1.4654	3.706	3.4479	1.9825
29	10.67	9.816	5.76	-0.80713	-0.199	5.5785	1.5226	3.664	3.5506	2.028
30	11.48	9.8973	5.76	-0.8637	-0.209	5.7165	1.5792	3.620	3.6478	2.0687
31	12.32	9.9607	5.76	-0.90918	-0.216	5.8254	1.6246	3.586	3.725	2.1004
32	13.15	10.008	5.76	-0.95001	-0.224	5.9137	1.6655	3.551	3.7896	2.1241
33	13.98	10.039	5.76	-0.98675	-0.231	5.9812	1.7022	3.514	3.8417	2.1395
34	14.81	10.075	5.76	-1.0101	-0.234	6.0405	1.7255	3.501	3.883	2.1575
35	15.62	10.11	5.76	-1.0416	-0.239	6.1074	1.757	3.476	3.9322	2.1752
36	15.68	10.113	5.76	-1.0445	-0.240	6.1128	1.7599	3.473	3.9364	2.1764

TRIAXIAL TEST

Project: DYNEGY HENNEPIN
Boring No.: HEN-029 S-3
Sample No.: S-3
Test No.: 20.0 PSI

Location: HENNEPIN, IL
Tested By: BCM
Test Date: 12/17/15
Sample Type: 3.0" ST

Project No.: MR155233
Checked By: WPQ
Depth: 5.0'-7.0'
Elevation: ----

Soil Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL
Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D4767.

Specimen Height: 6.03 in
Specimen Area: 6.27 in^2
Specimen Volume: 37.81 in^3

Piston Area: 0.00 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.00 lb

Filter Strip Correction: 0.00 tsf
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

Liquid Limit: 22

Plastic Limit: 15

Estimated Specific Gravity: 2.72

	Time min	Vertical Strain %	Corrected Area in^2	Deviator Load lb	Deviator Stress tsf	Pore Pressure tsf	Horizontal Stress tsf	Vertical Stress tsf
1	0	0	6.2706	0	0	5.1811	6.48	6.48
2	5.0002	0.061721	6.2745	31.946	0.36658	5.5924	6.48	6.8466
3	10	0.12796	6.2786	43.274	0.49624	5.6668	6.48	6.9762
4	15	0.19419	6.2828	51.605	0.59138	5.7058	6.48	7.0714
5	20	0.26043	6.287	58.557	0.67061	5.7267	6.48	7.1506
6	25	0.32817	6.2912	65.03	0.74424	5.7413	6.48	7.2242
7	30	0.39441	6.2954	71.383	0.8164	5.7511	6.48	7.2964
8	35	0.45914	6.2995	77.257	0.88301	5.7558	6.48	7.363
9	40	0.52538	6.3037	83.31	0.95156	5.7575	6.48	7.4316
10	45	0.59312	6.308	89.244	1.0186	5.7587	6.48	7.4986
11	50	0.66086	6.3123	94.878	1.0822	5.7558	6.48	7.5622
12	55	0.72861	6.3166	100.57	1.1464	5.7511	6.48	7.6264
13	60	0.79635	6.3209	106.15	1.2091	5.7477	6.48	7.6891
14	70	0.93334	6.3297	116.22	1.3219	5.7337	6.48	7.8019
15	80.001	1.0688	6.3383	126.22	1.4338	5.718	6.48	7.9138
16	90.001	1.2043	6.347	135.51	1.5373	5.6994	6.48	8.0173
17	100	1.3428	6.3559	144.26	1.6342	5.6796	6.48	8.1142
18	110	1.4798	6.3648	152.18	1.7215	5.6726	6.48	8.2015
19	120	1.6183	6.3737	160.81	1.8165	5.6371	6.48	8.2965
20	180	2.4372	6.4272	202.52	2.2687	5.4865	6.48	8.7487
21	240	3.2501	6.4812	235.37	2.6147	5.3475	6.48	9.0947
22	300	4.0781	6.5372	263.42	2.9013	5.2224	6.48	9.3813
23	360	4.8865	6.5927	289.19	3.1583	5.1119	6.48	9.6383
24	420	5.7054	6.65	313.16	3.3906	5.0119	6.48	9.8706
25	480	6.5349	6.709	335.88	3.6046	4.92	6.48	10.085
26	540	7.3478	6.7679	358.41	3.813	4.8328	6.48	10.293
27	600	8.1637	6.828	379.99	4.0069	4.7525	6.48	10.487
28	660	8.9992	6.8907	399.41	4.1734	4.6792	6.48	10.653
29	720	9.8151	6.953	417.75	4.3259	4.6164	6.48	10.806
30	780	10.631	7.0165	435.67	4.4706	4.5565	6.48	10.951
31	840	11.459	7.0821	453.83	4.6139	4.4954	6.48	11.094
32	900	12.269	7.1475	470.55	4.7401	4.4396	6.48	11.22
33	960	13.094	7.2154	485.54	4.8451	4.3744	6.48	11.325
34	1020	13.928	7.2853	498.42	4.9259	4.3314	6.48	11.406
35	1080	14.742	7.3549	513.89	5.0307	4.2854	6.48	11.511
36	1128.7	15.412	7.4131	526.53	5.114	4.2494	6.48	11.594

TRIAXIAL TEST

Project: DYNEGY HENNEPIN
Boring No.: HEN-029 S-3
Sample No.: S-3
Test No.: 20.0 PSI

Location: HENNEPIN, IL
Tested By: BCM
Test Date: 12/17/15
Sample Type: 3.0" ST

Project No.: MR155233
Checked By: WPQ
Depth: 5.0'-7.0'
Elevation: ----

Terracon
Consulting Engineers & Scientists

Soil Description: BROWN LEAN CLAY WITH SAND AND GRAVEL CL
Remarks: FAILURE CRITERIA = MAXIMUM EFFECTIVE STRESS RATIO TEST PERFORMED AS PER ASTM D4767.

Specimen Height: 6.03 in
Specimen Area: 6.27 in^2
Specimen Volume: 37.81 in^3

Piston Area: 0.00 in^2
Piston Friction: 0.00 lb
Piston Weight: 0.00 lb

Filter Strip Correction: 0.00 tsf
Membrane Correction: 0.00 lb/in
Correction Type: Uniform

Liquid Limit: 22

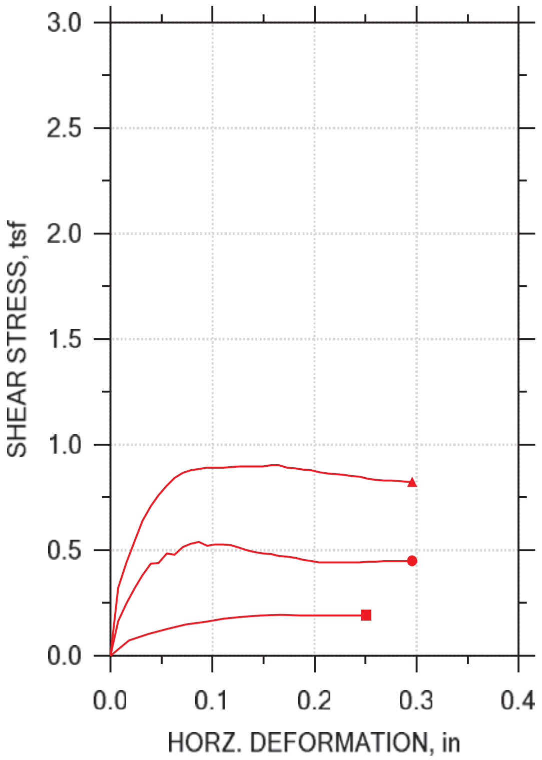
Plastic Limit: 15

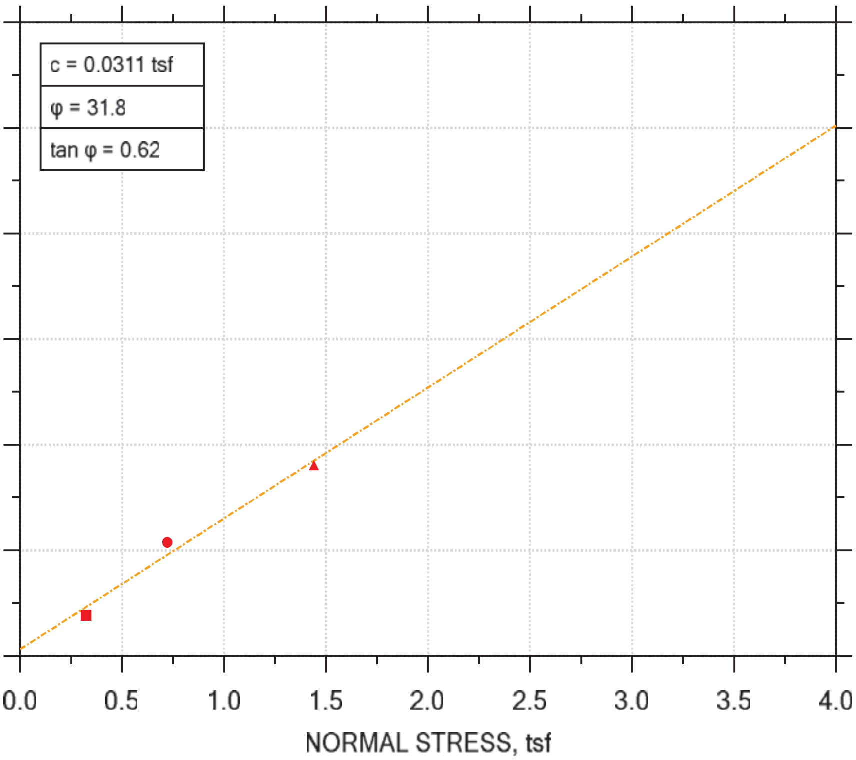
Estimated Specific Gravity: 2.72

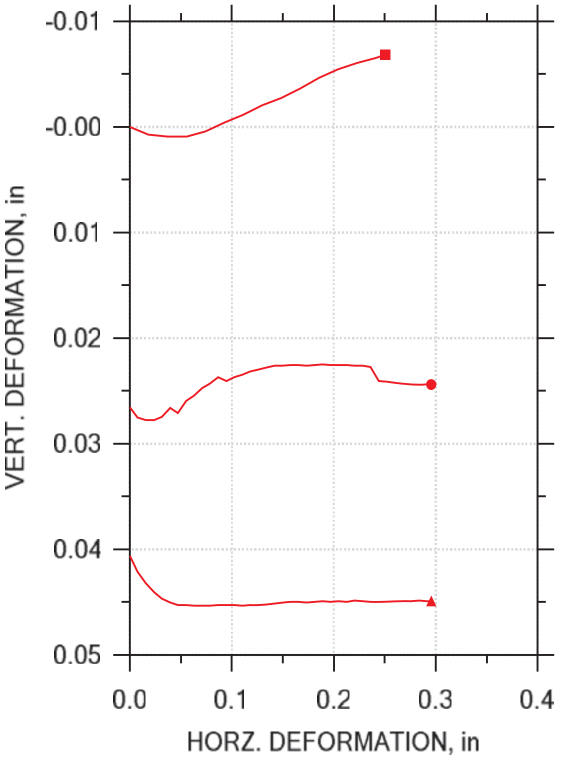
	Vertical Strain %	Total Vertical Stress tsf	Total Horizontal Stress tsf	Excess Pore Pressure tsf	A Parameter	Effective Vertical Stress tsf	Effective Horizontal Stress tsf	Stress Ratio	Effective p tsf	q tsf
1	0.00	6.48	6.48	0	0.000	1.2989	1.2989	1.000	1.2989	0
2	0.06	6.8466	6.48	0.41121	1.122	1.2542	0.88764	1.413	1.0709	0.18329
3	0.13	6.9762	6.48	0.48566	0.979	1.3094	0.81319	1.610	1.0613	0.24812
4	0.19	7.0714	6.48	0.52463	0.887	1.3656	0.77423	1.764	1.0699	0.29569
5	0.26	7.1506	6.48	0.54557	0.814	1.4239	0.75329	1.890	1.0886	0.33531
6	0.33	7.2242	6.48	0.56011	0.753	1.483	0.73875	2.007	1.1109	0.37212
7	0.39	7.2964	6.48	0.57	0.698	1.5453	0.72886	2.120	1.1371	0.4082
8	0.46	7.363	6.48	0.57465	0.651	1.6072	0.72421	2.219	1.1657	0.4415
9	0.53	7.4316	6.48	0.57639	0.606	1.674	0.72246	2.317	1.1982	0.47578
10	0.59	7.4986	6.48	0.57756	0.567	1.7399	0.7213	2.412	1.2306	0.50932
11	0.66	7.5622	6.48	0.57465	0.531	1.8064	0.72421	2.494	1.2653	0.5411
12	0.73	7.6264	6.48	0.57	0.497	1.8752	0.72886	2.573	1.302	0.57319
13	0.80	7.6891	6.48	0.56651	0.469	1.9414	0.73235	2.651	1.3369	0.60454
14	0.93	7.8019	6.48	0.55255	0.418	2.0683	0.74631	2.771	1.4073	0.66097
15	1.07	7.9138	6.48	0.53684	0.374	2.1959	0.76201	2.882	1.4789	0.71692
16	1.20	8.0173	6.48	0.51823	0.337	2.3179	0.78062	2.969	1.5493	0.76863
17	1.34	8.1142	6.48	0.49846	0.305	2.4346	0.8004	3.042	1.6175	0.81712
18	1.48	8.2015	6.48	0.49148	0.285	2.5288	0.80738	3.132	1.6681	0.86073
19	1.62	8.2965	6.48	0.456	0.251	2.6594	0.84286	3.155	1.7511	0.90827
20	2.44	8.7487	6.48	0.30535	0.135	3.2622	0.9935	3.284	2.1279	1.1344
21	3.25	9.0947	6.48	0.16635	0.064	3.7472	1.1325	3.309	2.4399	1.3073
22	4.08	9.3813	6.48	0.041296	0.014	4.1588	1.2576	3.307	2.7082	1.4506
23	4.89	9.6383	6.48	-0.069214	-0.022	4.5263	1.3681	3.309	2.9472	1.5791
24	5.71	9.8706	6.48	-0.16925	-0.050	4.8588	1.4681	3.310	3.1634	1.6953
25	6.53	10.085	6.48	-0.26115	-0.072	5.1646	1.56	3.311	3.3623	1.8023
26	7.35	10.293	6.48	-0.3484	-0.091	5.4602	1.6472	3.315	3.5537	1.9065
27	8.16	10.487	6.48	-0.42866	-0.107	5.7345	1.7275	3.319	3.731	2.0035
28	9.00	10.653	6.48	-0.50195	-0.120	5.9742	1.8008	3.318	3.8875	2.0867
29	9.82	10.806	6.48	-0.56476	-0.131	6.1895	1.8636	3.321	4.0266	2.1629
30	10.63	10.951	6.48	-0.62467	-0.140	6.3942	1.9235	3.324	4.1588	2.2353
31	11.46	11.094	6.48	-0.68574	-0.149	6.5985	1.9846	3.325	4.2915	2.3069
32	12.27	11.22	6.48	-0.74158	-0.156	6.7805	2.0404	3.323	4.4105	2.3701
33	13.09	11.325	6.48	-0.80672	-0.167	6.9506	2.1056	3.301	4.5281	2.4225
34	13.93	11.406	6.48	-0.84976	-0.173	7.0745	2.1486	3.293	4.6116	2.463
35	14.74	11.511	6.48	-0.89571	-0.178	7.2252	2.1946	3.292	4.7099	2.5153
36	15.41	11.594	6.48	-0.93177	-0.182	7.3446	2.2306	3.293	4.7876	2.557

Drained Direct Shear Tests
ASTM D 3080

DIRECT SHEAR TEST by ASTM D3080







	Symbol	■	●	▲	
	Test No.	5.0 PSI	10.0 PSI	20.0 PSI	
	Sample No.	S-5	S-5	S-5	
	Shape	Circular	Circular	Circular	
Initial	Dimension, in	2.4913	2.4941	2.4976	
	Area, in²	4.8748	4.8856	4.8995	
	Height, in	0.9878	0.99094	0.99252	
	Water Content, %	16.30	16.70	16.83	
	Dry Density, pcf	112.2	111.3	110.7	
	Saturation, %	86.28	86.36	85.72	
	Void Ratio	0.51397	0.52594	0.53408	
	Consol. Height, in	0.9878	0.9644	0.95193	
	Consol. Void Ratio	0.51397	0.48506	0.47134	
Final	Water Content, %	19.67	18.05	17.75	
	Dry Density, pcf	111.4	114.1	115.9	
	Saturation, %	102.01	100.52	103.90	
	Void Ratio	0.52446	0.48839	0.46469	
	Normal Stress, tsf	0.32343	0.72072	1.4396	
	Max. Shear Stress, tsf	0.19271	0.53843	0.90226	
	Ult. Shear Stress, tsf	0.19231	0.44946	0.82371	
	Time to Failure, min	39.855	23.081	41.061	
	Disp. Rate, in/min	0.047244	0.004	0.004	
	Estimated Specific Gravity	2.72	2.72	2.72	
	Liquid Limit	31	31	31	
	Plastic Limit	17	17	17	
	Plasticity Index	14	14	14	

Project: DYNEGY HENNEPIN

Location: HENNEPIN, IL

Project No.: MR155233

Boring No.: HEN-029 S-5

Sample Type: TRIMMED

Description: DARK BROWN AND GRAY SLIGHTLY ORGANIC CLAY CL SAND POCKETS NOTED

Remarks:

Project: DYNEGY HENNEPIN
Boring No.: HEN-029 S-5
Sample No.: S-5
Test No.: 5.0 PSI

Location: HENNEPIN, IL
Tested By: BCM
Test Date: 12/13/15
Sample Type: TRIMMED

Project No.: MR155233
Checked By: WPQ
Depth: 10.0'-12.0'
Elevation: ----

Soil Description: DARK BROWN AND GRAY SLIGHTLY ORGANIC CLAY CL SAND POCKETS NOTED
Remarks:

Step: 1 of 1

	Elapsed Time min	Vertical Stress tsf	Vertical Displacement in	Horizontal Stress tsf	Horizontal Displacement in	Cumulative Displacement in
1	0.00	0.323	0.0000	0.000202	0.0000	0.0000
2	5.49	0.322	0.0007383	0.0717	0.01854	0.01854
3	10.36	0.323	0.0009004	0.104	0.03709	0.03709
4	15.03	0.323	0.0009004	0.128	0.05563	0.05563
5	19.38	0.323	0.0004142	0.147	0.07418	0.07418
6	23.15	0.323	-0.0003962	0.161	0.09280	0.09280
7	27.26	0.323	-0.001135	0.175	0.1113	0.1113
8	31.47	0.323	-0.002053	0.186	0.1299	0.1299
9	35.85	0.324	-0.002755	0.191	0.1484	0.1484
10	39.85	0.323	-0.003638	0.193	0.1670	0.1670
11	44.32	0.323	-0.004646	0.192	0.1856	0.1856
12	48.69	0.323	-0.005475	0.192	0.2041	0.2041
13	53.17	0.323	-0.006051	0.192	0.2228	0.2228
14	57.05	0.323	-0.006537	0.192	0.2413	0.2413
15	60.08	0.322	-0.006843	0.192	0.2506	0.2506

Project: DYNEGY HENNEPIN
Boring No.: HEN-029 S-5
Sample No.: S-5
Test No.: 10.0 PSI

Location: HENNEPIN, IL
Tested By: BCM
Test Date: 12/13/15
Sample Type: TRIMMED

Project No.: MR155233
Checked By: WPQ
Depth: 10.0'-12.0'
Elevation: ----

Soil Description: DARK BROWN AND GRAY SLIGHTLY ORGANIC CLAY CL SAND POCKETS NOTED
Remarks:

Step: 1 of 1

	Elapsed Time min	Vertical Stress tsf	Vertical Displacement in	Horizontal Stress tsf	Horizontal Displacement in	Cumulative Displacement in
1	0.00	0.719	0.02654	0.000	0.0000	0.0000
2	2.71	0.719	0.02752	0.165	0.007902	0.007902
3	4.89	0.719	0.02777	0.248	0.01580	0.01580
4	7.16	0.720	0.02779	0.321	0.02364	0.02364
5	9.14	0.721	0.02746	0.382	0.03150	0.03150
6	11.21	0.721	0.02662	0.436	0.03940	0.03940
7	12.99	0.722	0.02710	0.441	0.04727	0.04727
8	14.76	0.722	0.02597	0.484	0.05517	0.05517
9	16.83	0.722	0.02543	0.479	0.06300	0.06300
10	18.94	0.722	0.02471	0.516	0.07087	0.07087
11	21.09	0.721	0.02433	0.529	0.07877	0.07877
12	23.08	0.721	0.02372	0.538	0.08664	0.08664
13	25.09	0.720	0.02404	0.521	0.09451	0.09451
14	26.95	0.721	0.02370	0.527	0.1024	0.1024
15	28.84	0.720	0.02343	0.528	0.1102	0.1102
16	30.60	0.720	0.02318	0.523	0.1182	0.1182
17	32.68	0.720	0.02294	0.512	0.1260	0.1260
18	34.69	0.720	0.02280	0.499	0.1339	0.1339
19	36.76	0.720	0.02262	0.491	0.1417	0.1417
20	38.80	0.720	0.02258	0.485	0.1496	0.1496
21	40.72	0.720	0.02256	0.482	0.1575	0.1575
22	42.71	0.720	0.02253	0.474	0.1654	0.1654
23	44.65	0.720	0.02258	0.468	0.1732	0.1732
24	46.29	0.720	0.02255	0.463	0.1811	0.1811
25	48.27	0.720	0.02249	0.455	0.1890	0.1890
26	50.29	0.720	0.02255	0.448	0.1969	0.1969
27	52.42	0.720	0.02253	0.444	0.2047	0.2047
28	54.59	0.720	0.02253	0.441	0.2126	0.2126
29	56.45	0.720	0.02260	0.441	0.2205	0.2205
30	58.41	0.720	0.02264	0.441	0.2283	0.2283
31	60.25	0.720	0.02271	0.443	0.2362	0.2362
32	62.14	0.719	0.02408	0.443	0.2441	0.2441
33	64.05	0.720	0.02410	0.444	0.2520	0.2520
34	66.14	0.720	0.02424	0.447	0.2598	0.2598
35	68.26	0.719	0.02431	0.448	0.2678	0.2678
36	70.36	0.719	0.02438	0.449	0.2756	0.2756
37	72.12	0.719	0.02442	0.449	0.2835	0.2835
38	74.01	0.719	0.02437	0.449	0.2914	0.2914
39	75.01	0.719	0.02438	0.449	0.2953	0.2953

Project: DYNEGY HENNEPIN
Boring No.: HEN-029 S-5
Sample No.: S-5
Test No.: 20.0 PSI

Location: HENNEPIN, IL
Tested By: BCM
Test Date: 12/13/15
Sample Type: TRIMMED

Project No.: MR155233
Checked By: WPQ
Depth: 10.0'-12.0'
Elevation: ----

Terracon
Consulting Engineers & Scientists

Soil Description: DARK BROWN AND GRAY SLIGHTLY ORGANIC CLAY CL SAND POCKETS NOTED
Remarks:

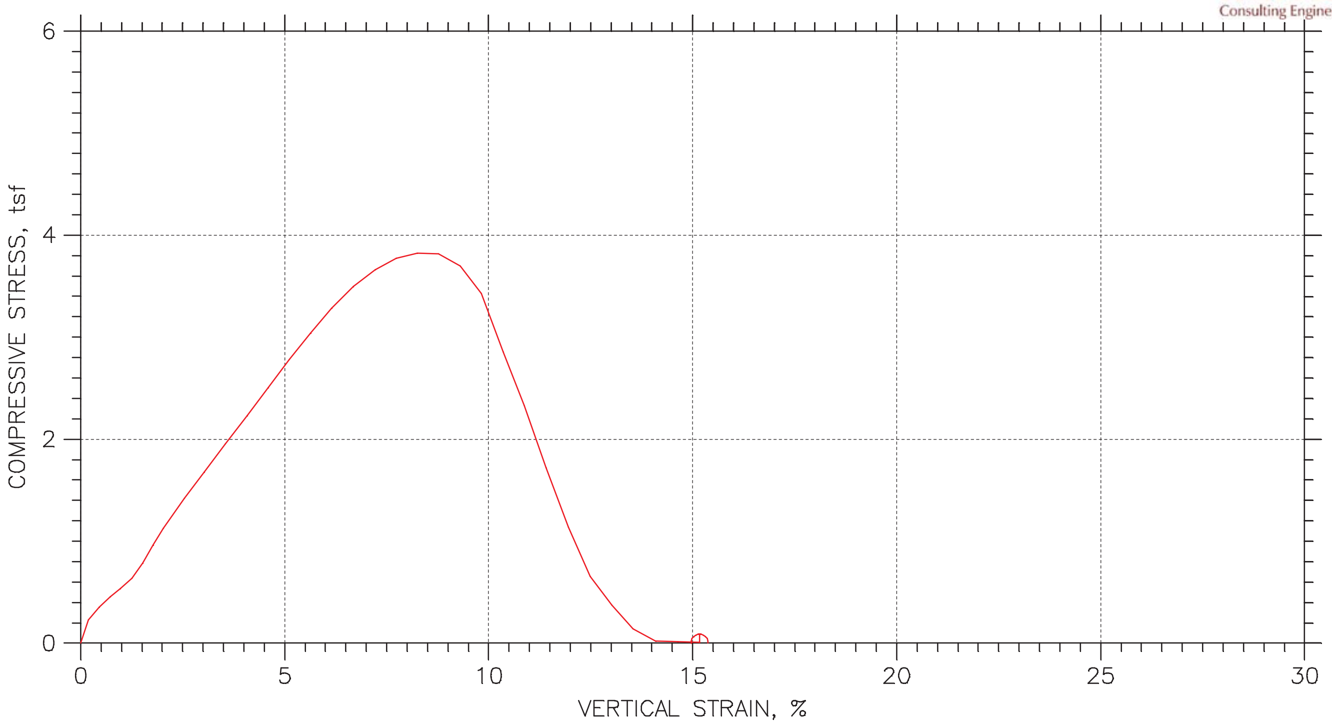
Step: 1 of 1

	Elapsed Time min	Vertical Stress tsf	Vertical Displacement in	Horizontal Stress tsf	Horizontal Displacement in	Cumulative Displacement in
1	0.00	1.44	0.04059	0.000	0.0000	0.0000
2	2.82	1.44	0.04214	0.321	0.007867	0.007867
3	4.83	1.44	0.04324	0.444	0.01573	0.01573
4	7.10	1.44	0.04405	0.546	0.02360	0.02360
5	9.38	1.44	0.04470	0.641	0.03147	0.03147
6	11.33	1.44	0.04504	0.710	0.03937	0.03937
7	13.35	1.44	0.04526	0.759	0.04724	0.04724
8	15.20	1.44	0.04529	0.807	0.05510	0.05510
9	17.03	1.44	0.04533	0.841	0.06297	0.06297
10	19.00	1.44	0.04531	0.865	0.07087	0.07087
11	21.09	1.44	0.04531	0.877	0.07877	0.07877
12	23.26	1.44	0.04527	0.883	0.08660	0.08660
13	25.19	1.44	0.04529	0.890	0.09447	0.09447
14	27.24	1.44	0.04527	0.891	0.1023	0.1023
15	29.09	1.44	0.04533	0.890	0.1102	0.1102
16	30.98	1.44	0.04529	0.893	0.1181	0.1181
17	32.82	1.44	0.04526	0.896	0.1260	0.1260
18	34.93	1.44	0.04524	0.896	0.1338	0.1338
19	36.84	1.44	0.04513	0.895	0.1417	0.1417
20	39.05	1.44	0.04500	0.896	0.1496	0.1496
21	41.06	1.44	0.04499	0.902	0.1575	0.1575
22	42.87	1.44	0.04495	0.902	0.1653	0.1653
23	44.87	1.44	0.04502	0.889	0.1732	0.1732
24	46.86	1.44	0.04497	0.888	0.1811	0.1811
25	48.59	1.44	0.04493	0.883	0.1889	0.1889
26	50.54	1.44	0.04499	0.877	0.1968	0.1968
27	52.49	1.44	0.04493	0.869	0.2047	0.2047
28	54.68	1.44	0.04497	0.865	0.2126	0.2126
29	56.76	1.44	0.04488	0.862	0.2204	0.2204
30	58.63	1.44	0.04493	0.858	0.2283	0.2283
31	60.64	1.44	0.04497	0.850	0.2362	0.2362
32	62.54	1.44	0.04497	0.847	0.2441	0.2441
33	64.42	1.44	0.04499	0.840	0.2519	0.2519
34	66.26	1.44	0.04493	0.834	0.2598	0.2598
35	68.32	1.44	0.04493	0.831	0.2677	0.2677
36	70.44	1.44	0.04493	0.830	0.2756	0.2756
37	72.48	1.44	0.04488	0.828	0.2834	0.2834
38	74.27	1.44	0.04490	0.825	0.2913	0.2913
39	75.29	1.44	0.04490	0.824	0.2955	0.2955

Unconfined Compression Tests
ASTM D 2166

UNCONFINED COMPRESSION TEST REPORT

Terracon
Consulting Engineers & Scientists



Symbol		⦶			
Test No.		HEN032S3			
Initial	Diameter, in	2.8303			
	Height, in	5.85			
	Water Content, %	14.10			
	Dry Density, pcf	115.8			
	Saturation, %	82.27			
	Void Ratio	0.46619			
Unconfined Compressive Strength, tsf		3.8231			
Undrained Shear Strength, tsf		1.9116			
Time to Failure, min		8.0041			
Strain Rate, %/min		1.14			
Estimated Specific Gravity		2.72			
Liquid Limit		35			
Plastic Limit		18			
Plasticity Index		17			
Failure Sketch					

Project: DYNEGY HENNEPIN

Location: HENNEPIN, IL

Project No.: MR155233

Boring No.: HEN032 S-3

Sample Type: 3.0'' ST

Description: DARK BROWNISH GRAY LEAN CLAY WITH SAND AND GRAVEL CL

Remarks: TEST PERFORMED AS PER ASTM D2166.

Tue, 22-DEC-2015 15:25:34

UNCONFINED COMPRESSION TEST

Terracon
Consulting Engineers & Scientists

Project: DYNERGY HENNEPIN
Boring No.: HEN032 S-3
Sample No.: ST-3
Test No.: HEN032S3

Location: HENNEPIN, IL
Tested By: BCM
Test Date: 12/15/15
Sample Type: 3.0" ST

Project No.: MR155233
Checked By: WPQ
Depth: 5.0'-7.0'
Elevation: ----

Soil Description: DARK BROWNISH GRAY LEAN CLAY WITH SAND AND GRAVEL CL
Remarks: TEST PERFORMED AS PER ASTM D2166.

Specimen Height: 5.85 in
Specimen Area: 6.29 in^2
Specimen Volume: 36.81 in^3

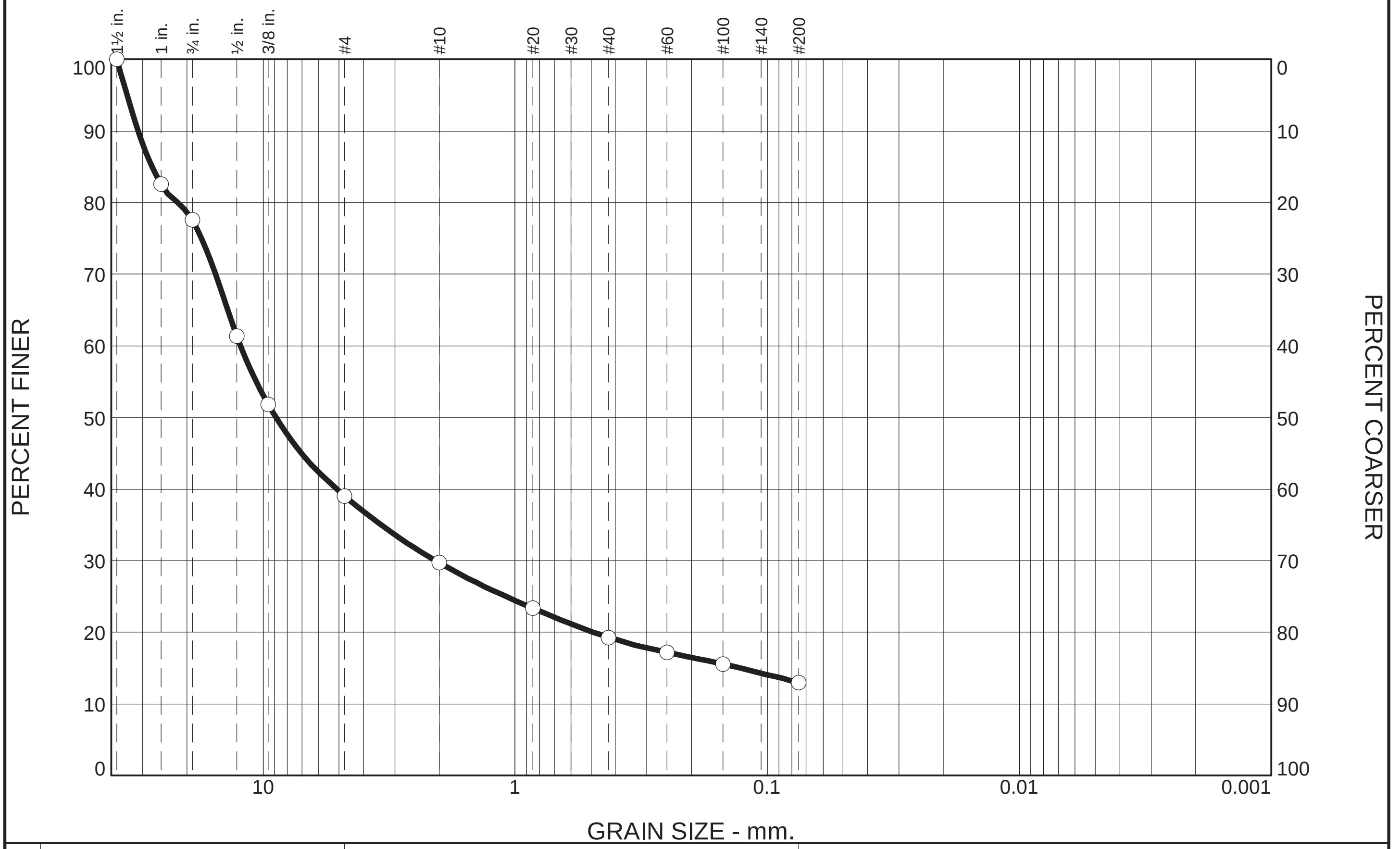
Liquid Limit: 35
Plastic Limit: 18
Estimated Specific Gravity: 2.72

Cap Mass: 0 gm

	Time min	Axial Displacement in	Axial Strain %	Load lb	Corrected Area in^2	Vertical Stress tsf	Shear Stress tsf
1	0	0	0	0	6.2916	0	0
2	0.25403	0.011115	0.18999	20.059	6.3036	0.22911	0.11456
3	0.50403	0.026602	0.45474	30.798	6.3203	0.35085	0.17543
4	0.75403	0.041999	0.71793	39.748	6.3371	0.45161	0.22581
5	1.004	0.057395	0.98111	47.382	6.3539	0.53692	0.26846
6	1.254	0.073065	1.249	56.543	6.3711	0.63899	0.31949
7	1.504	0.088735	1.5168	69.915	6.3885	0.78796	0.39398
8	1.7541	0.10358	1.7707	85.657	6.405	0.96289	0.48144
9	2.0041	0.11853	2.0261	100.35	6.4217	1.1251	0.56254
10	2.504	0.14841	2.5369	127.09	6.4553	1.4175	0.70875
11	3.004	0.17738	3.0321	151.41	6.4883	1.6802	0.8401
12	3.5041	0.20726	3.5429	176.95	6.5227	1.9532	0.97661
13	4.0041	0.23833	4.074	203.01	6.5588	2.2285	1.1143
14	4.5041	0.26903	4.5988	229.49	6.5949	2.5055	1.2527
15	5.0041	0.29937	5.1174	256.29	6.6309	2.7828	1.3914
16	5.5041	0.32943	5.6313	281.66	6.667	3.0418	1.5209
17	6.0041	0.36004	6.1545	305.56	6.7042	3.2816	1.6408
18	6.5041	0.39092	6.6825	327.41	6.7421	3.4965	1.7482
19	7.0041	0.42172	7.2089	344.52	6.7804	3.6584	1.8292
20	7.5041	0.45215	7.729	357.32	6.8186	3.773	1.8865
21	8.0041	0.48248	8.2476	364.11	6.8571	3.8231	1.9116
22	8.5041	0.51319	8.7724	365.79	6.8966	3.8189	1.9094
23	9.0041	0.54443	9.3066	356.58	6.9372	3.7009	1.8504
24	9.5041	0.57495	9.8283	332.2	6.9773	3.428	1.714
25	10.004	0.60556	10.352	278.29	7.0181	2.8551	1.4275
26	10.504	0.63636	10.878	228.38	7.0595	2.3293	1.1646
27	11.004	0.66724	11.406	169.79	7.1016	1.7214	0.8607
28	11.504	0.69895	11.948	113.14	7.1453	1.14	0.57002
29	12.004	0.73056	12.488	65.651	7.1894	0.65748	0.32874
30	12.504	0.76144	13.016	37.169	7.233	0.36999	0.185
31	13.004	0.79242	13.546	14.32	7.2773	0.14168	0.070839
32	13.504	0.82403	14.086	2.3165	7.3231	0.022775	0.011388
33	14.004	0.85619	14.636	1.5794	7.3703	0.015429	0.0077146
34	14.503	0.88735	15.168	0.7897	7.4165	0.0076665	0.0038332

Particle Size Analysis of Soils
ASTM D 422

PARTICLE SIZE ANALYSIS OF SOILS ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	22.4	38.6	9.3	10.4	6.3	13.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	82.5		
.75	77.6		
.5	61.4		
.375	51.8		
#4	39.0		
#10	29.7		
#20	23.4		
#40	19.3		
#60	17.2		
#100	15.6		
#200	13.0		

* (no specification provided)

LIGHT BROWN POORLY GRADED GRAVEL WITH SAND AND CLAY

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 31.2310 D_{85}= 27.6077 D_{60}= 12.2743
D_{50}= 8.8861 D_{30}= 2.0649 D_{15}= 0.1281
D_{10}= C_u= C_c=

Classification

USCS= GP-GC AASHTO=

Remarks

F.M.=5.20

Source of Sample: HEN-B029 **Depth:** 35.0'-36.5'
Sample Number: S-10

Date: 12-10-15

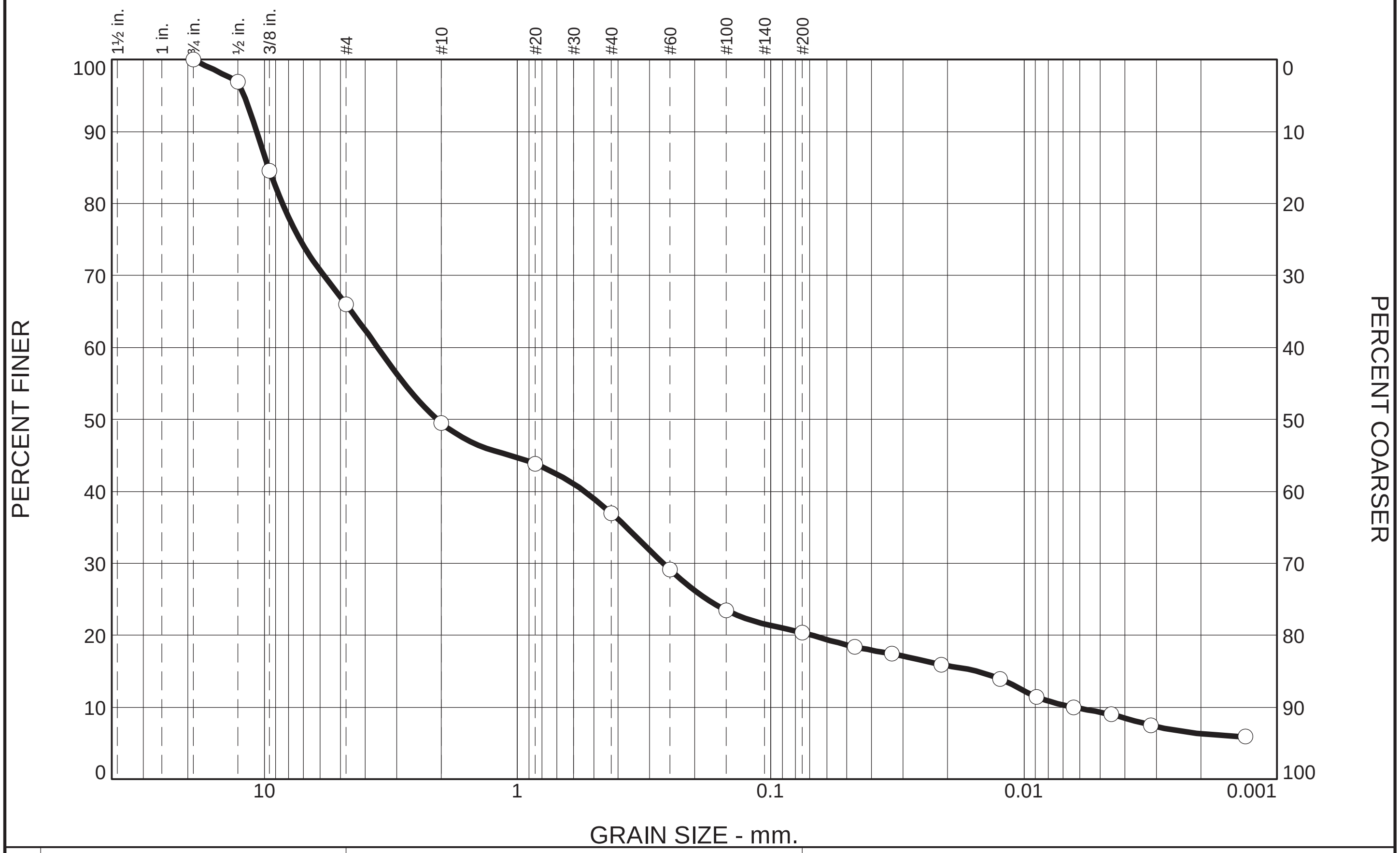
Terracon

Client: AECOM
Project: DYNERGY - HENNEPIN

Project No: MR155233 **Figure**

Tested By: SJH **Checked By:** WPQ

PARTICLE SIZE ANALYSIS OF SOILS ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	34.0	16.5	12.6	16.6	11.0	9.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	97.0		
.375	84.6		
#4	66.0		
#10	49.5		
#20	43.8		
#40	36.9		
#60	29.1		
#100	23.5		
#200	20.3		

* (no specification provided)

BROWN AND LIGHT BROWN SILTY SAND WITH GRAVEL

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 10.7082 D_{85}= 9.6174 D_{60}= 3.5682
D_{50}= 2.0785 D_{30}= 0.2659 D_{15}= 0.0154
D_{10}= 0.0064 C_u= 557.69 C_c= 3.10

Classification

USCS= SM AASHTO=

Remarks

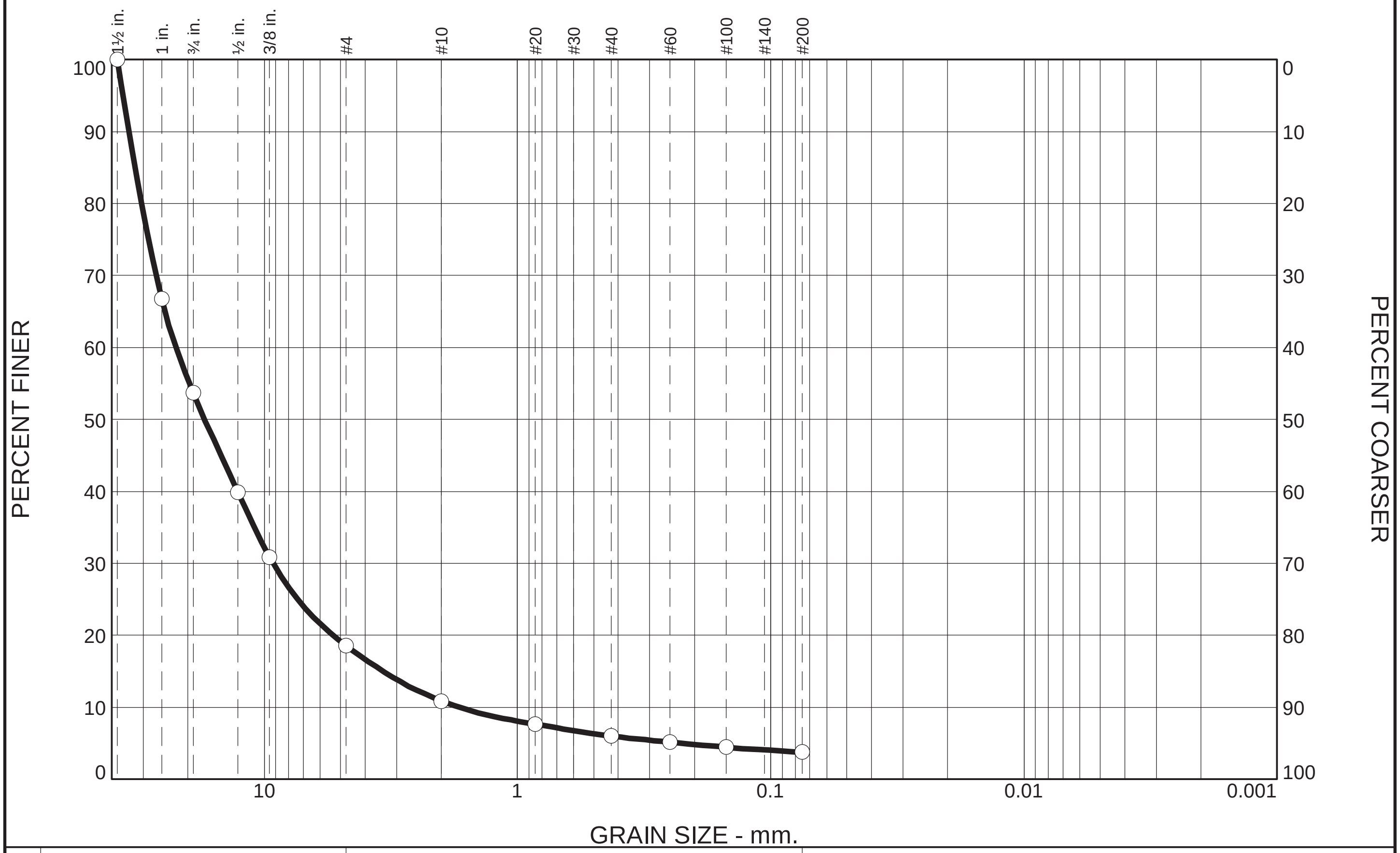
F.M.=3.56

Source of Sample: HEN-B030 **Depth:** 2.5'-4.0'
Sample Number: S-2 **Date:** 12-15-15

Client: AECOM
Project: DYNEGY - HENNEPIN
Project No: MR155233 **Figure**

Tested By: SJH **Checked By:** WPQ

PARTICLE SIZE ANALYSIS OF SOILS ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	46.3	35.1	7.7	4.9	2.2	3.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	66.8		
.75	53.7		
.5	39.9		
.375	30.9		
#4	18.6		
#10	10.9		
#20	7.6		
#40	6.0		
#60	5.1		
#100	4.4		
#200	3.8		

* (no specification provided)

LIGHT BROWN AND TAN WELL GRADED GRAVEL WITH SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 34.1590 D_{85}= 32.2869 D_{60}= 22.3306
D_{50}= 17.1780 D_{30}= 9.2189 D_{15}= 3.3953
D_{10}= 1.7025 C_u= 13.12 C_c= 2.24

Classification

USCS= GW AASHTO=

Remarks

F.M.=6.60

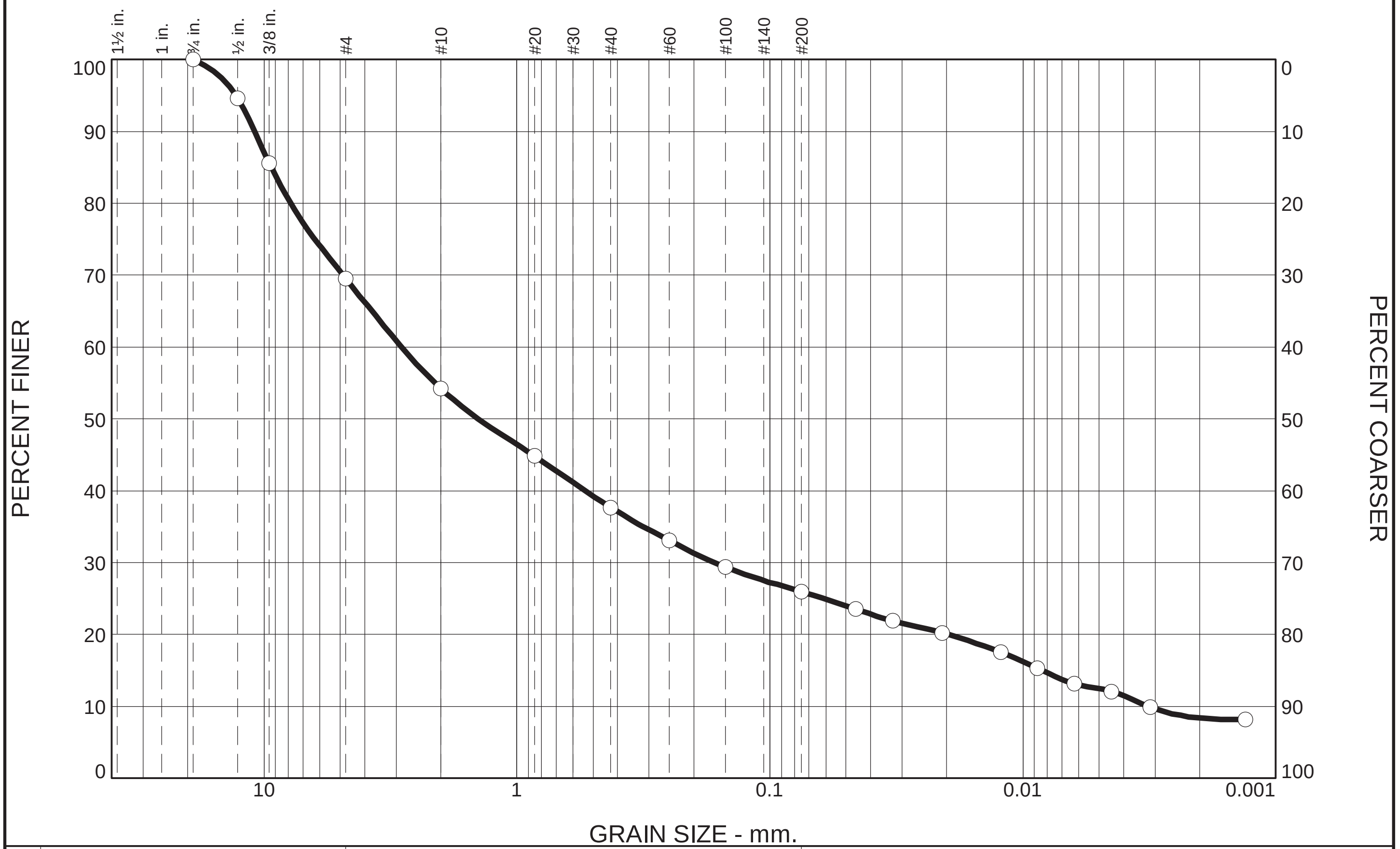
Source of Sample: HEN-B030 **Depth:** 15.0'-16.5'
Sample Number: S-6
Date: 12-10-15

Terracon

Client: AECOM
Project: DYNEGY - HENNEPIN
Project No: MR155233 **Figure**

Tested By: SJH **Checked By:** WPQ

PARTICLE SIZE ANALYSIS OF SOILS ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	30.5	15.3	16.5	11.8	13.4	12.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	94.6		
.375	85.6		
#4	69.5		
#10	54.2		
#20	44.8		
#40	37.7		
#60	33.1		
#100	29.4		
#200	25.9		

* (no specification provided)

BROWN SILTY SAND WITH GRAVEL

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 10.8888 D_{85}= 9.3568 D_{60}= 2.8565
D_{50}= 1.4206 D_{30}= 0.1654 D_{15}= 0.0084
D_{10}= 0.0032 C_u= 894.95 C_c= 3.00

Classification

USCS= SM AASHTO=

Remarks

F.M.=3.35

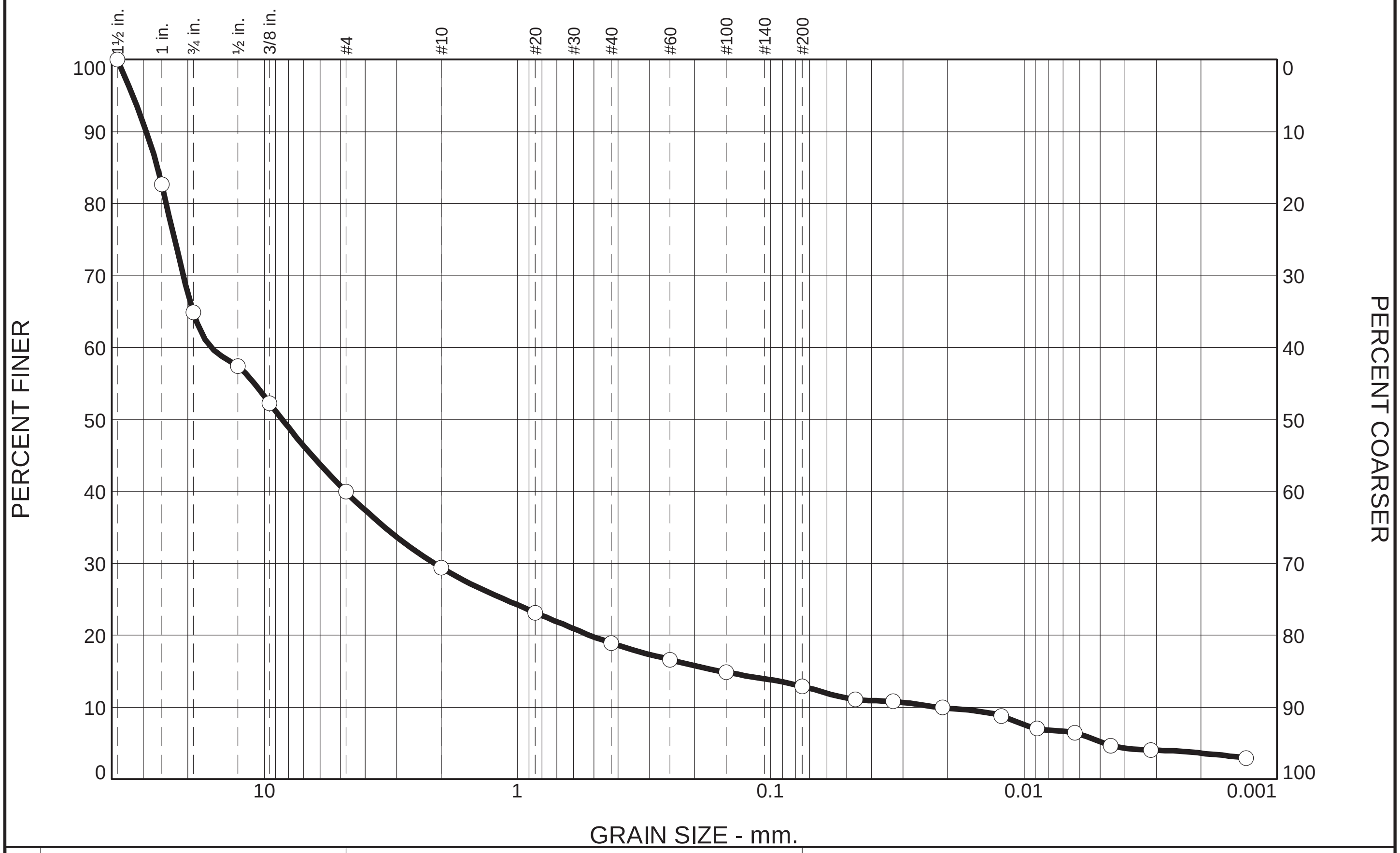
Source of Sample: HEN-B032 **Depth:** 20.0'-21.5'
Sample Number: S-7 **Date:** 12-15-15

Terracon

Client: AECOM
Project: DYNEGY - HENNEPIN
Project No: MR155233 **Figure**

Tested By: SJH **Checked By:** WPQ

PARTICLE SIZE ANALYSIS OF SOILS ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	35.1	25.0	10.5	10.5	6.0	7.7	5.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	82.7		
.75	64.9		
.5	57.4		
.375	52.3		
#4	39.9		
#10	29.4		
#20	23.2		
#40	18.9		
#60	16.6		
#100	14.8		
#200	12.9		

* (no specification provided)

BROWN AND LIGHT BROWN POORLY GRADED GRAVEL WITH SILT AND SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 29.2016 D_{85}= 26.4297 D_{60}= 16.1803
D_{50}= 8.4958 D_{30}= 2.1337 D_{15}= 0.1581
D_{10}= 0.0218 C_u= 742.74 C_c= 12.92

Classification

USCS= GP-GM AASHTO=

Remarks

F.M.=5.34

Source of Sample: HEN-B034 **Depth:** 10.0'-11.5'
Sample Number: S-5
Date: 12-17-15

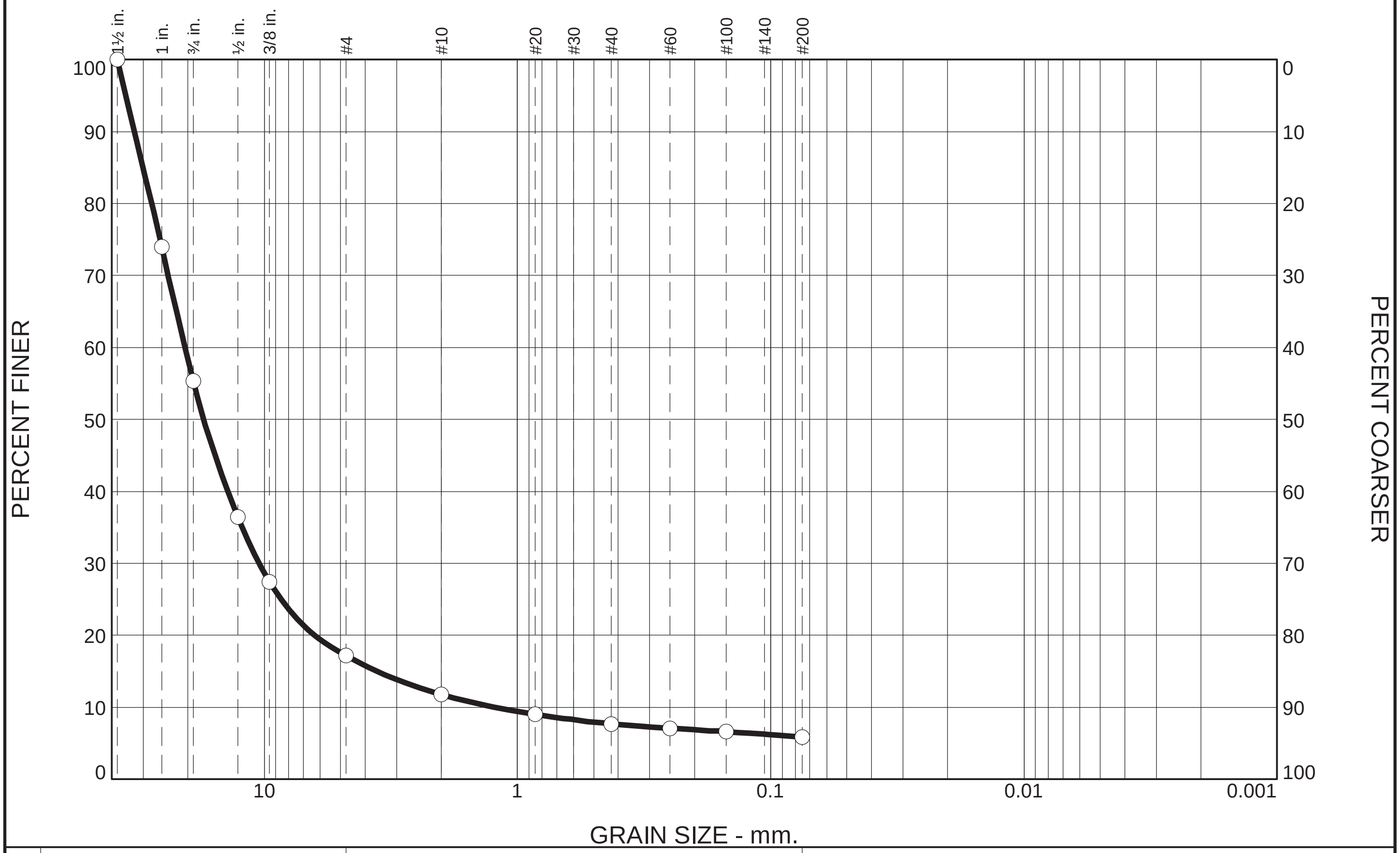
Terracon

Client: AECOM
Project: DYNEGY - HENNEPIN

Project No: MR155233 **Figure**

Tested By: SJH **Checked By:** WPQ

PARTICLE SIZE ANALYSIS OF SOILS ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	44.7	38.1	5.4	4.1	1.8	5.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	74.0		
.75	55.3		
.5	36.4		
.375	27.4		
#4	17.2		
#10	11.8		
#20	9.0		
#40	7.7		
#60	7.1		
#100	6.6		
#200	5.9		

* (no specification provided)

LIGHT BROWN AND TAN POORLY GRADED GRAVEL WITH SAND AND SILT

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 32.5083	D_{85}= 30.0560	D_{60}= 20.5658
D_{50}= 17.3171	D_{30}= 10.4646	D_{15}= 3.5815
D_{10}= 1.2300	C_u= 16.72	C_c= 4.33

Classification

USCS= GP-GM AASHTO=

Remarks

F.M.=6.56

Source of Sample: HEN-B034 **Depth:** 35.0'-36.5'
Sample Number: S-10 **Date:** 12-10-15

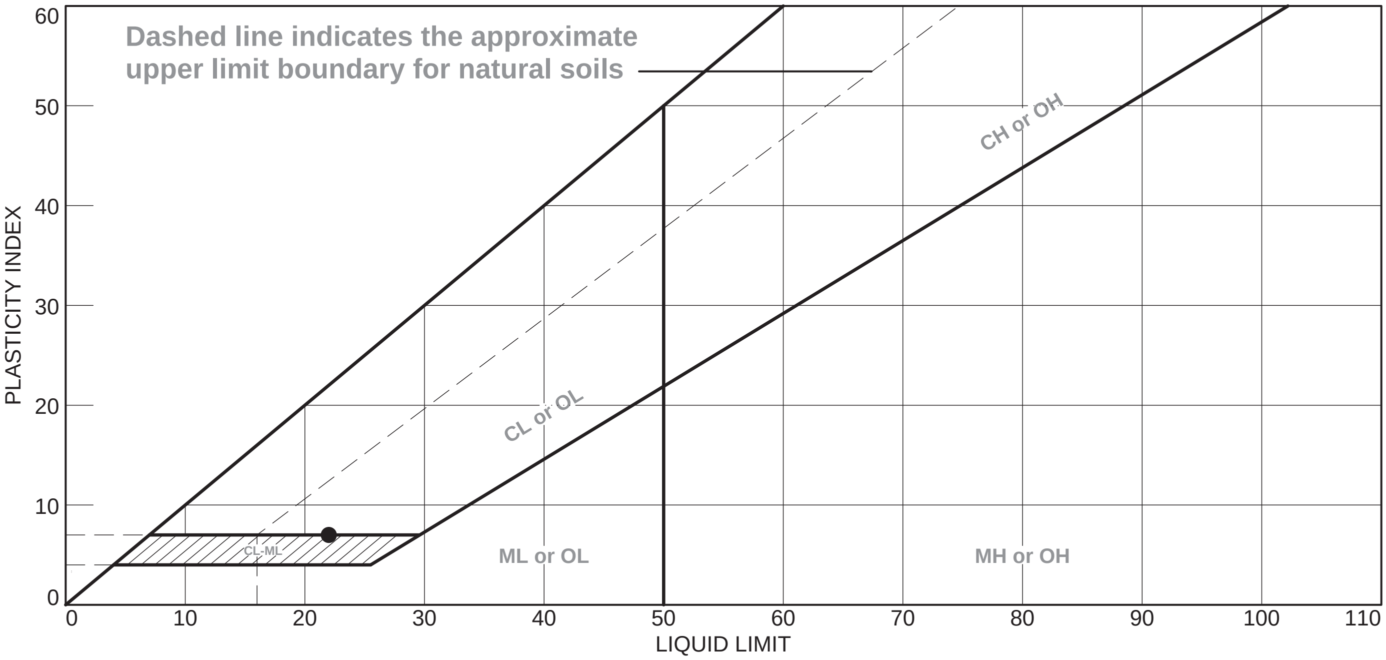
Terracon

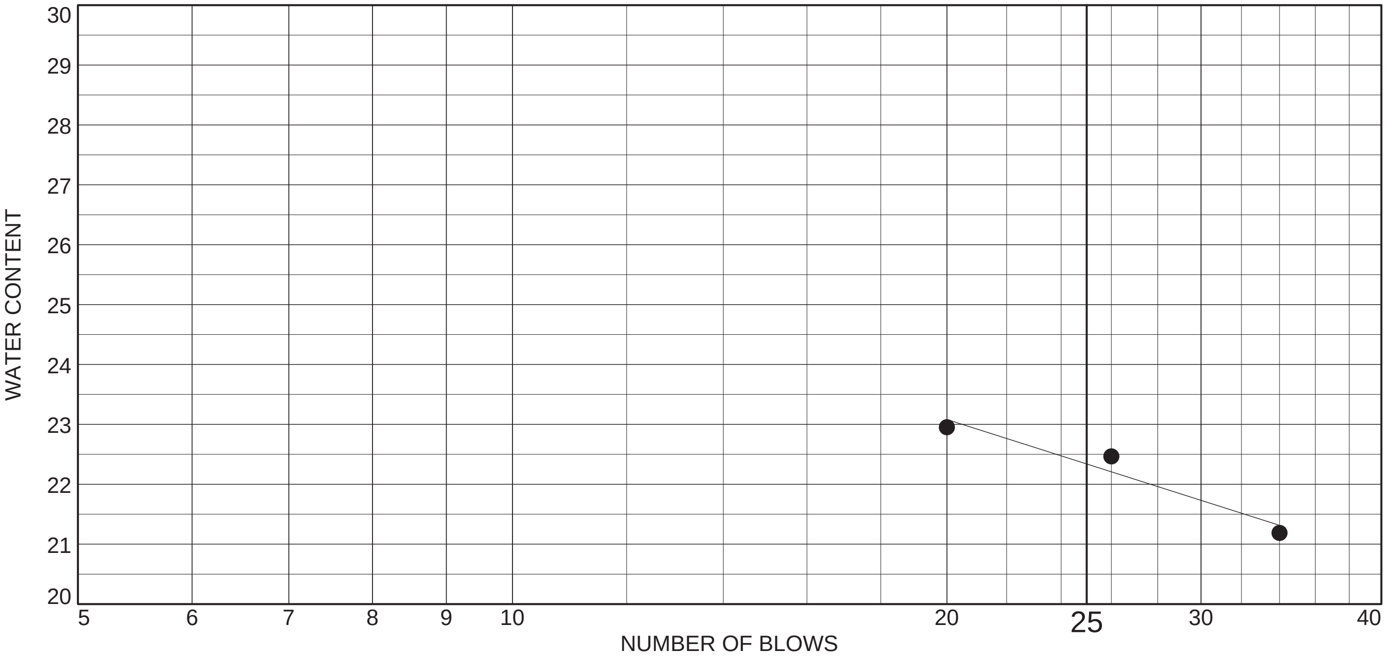
Client: AECOM
Project: DYNEGY - HENNEPIN
Project No: MR155233 **Figure**

Tested By: SJH **Checked By:** WPQ

Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D 4318

LIQUID AND PLASTIC LIMITS ASTM D4318





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	BROWN LEAN CLAY WITH SAND AND GRAVEL	22	15	7			CL

Project No. MR155233 **Client:** AECOM

Project: DYNEGY - HENNEPIN

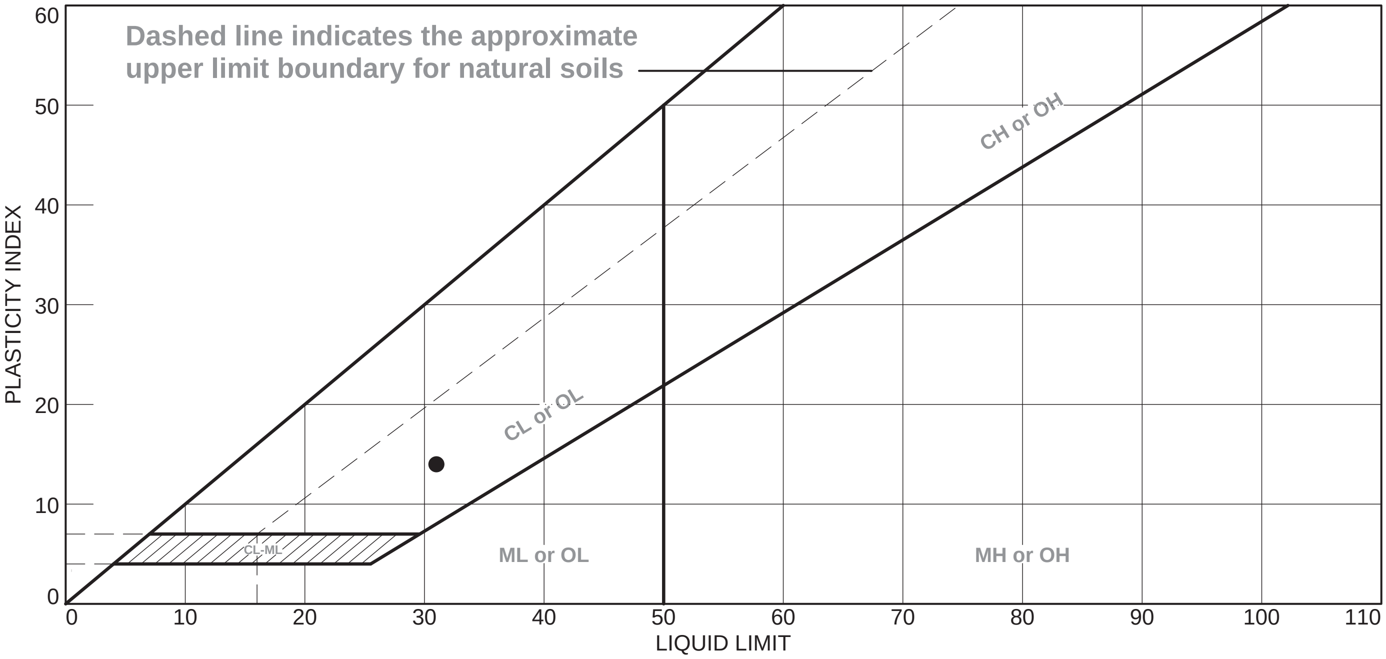
Source of Sample: HEN-B029 **Depth:** 5.0'-7.0'
Sample Number: S-3

Remarks:

Figure

Tested By: BCM **Checked By:** WPQ

LIQUID AND PLASTIC LIMITS ASTM D4318



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	VERY DARK BROWN AND GRAY SLIGHTLY ORGANIC LEAN CLAY WITH SAND AND GRAVEL	31	17	14			CL

Project No. MR155233 **Client:** AECOM

Project: DYNEGY - HENNEPIN

Source of Sample: HEN-B029 **Depth:** 10.0'-12.0'
Sample Number: S-5

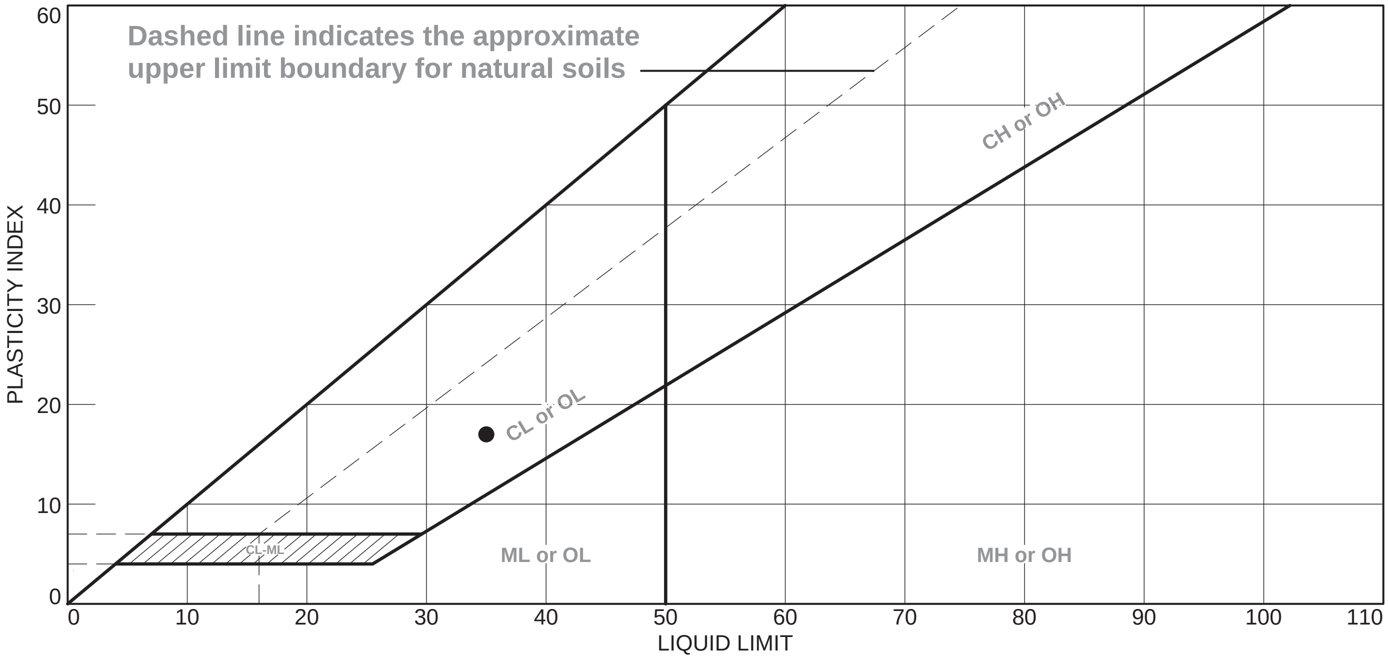
Terracon

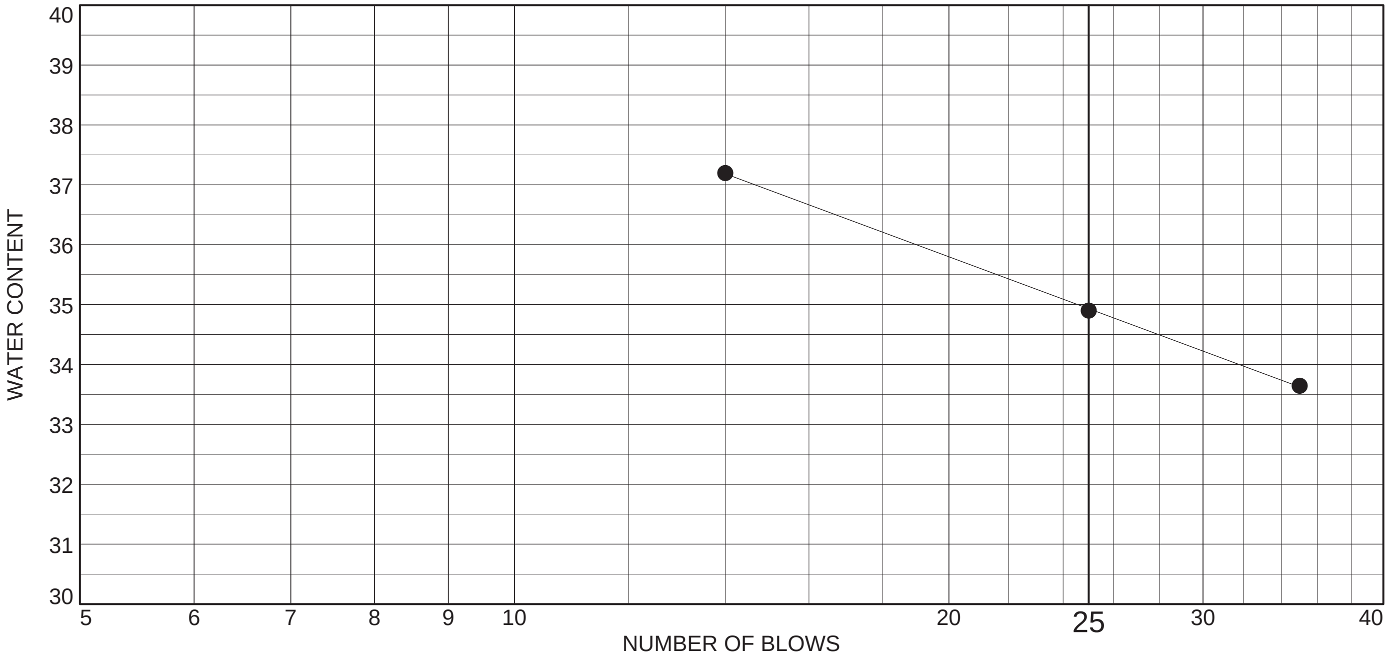
Remarks:

Figure

Tested By: BCM **Checked By:** WPQ

LIQUID AND PLASTIC LIMITS ASTM D4318





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	DARK BROWNISH GRAY LEAN CLAY WITH SAND AND GRAVEL	35	18	17			CL

Project No. MR155233 **Client:** AECOM

Project: DYNEGY - HENNEPIN

Source of Sample: HEN-B032 **Depth:** 5.0'-7.0'
Sample Number: S-3

Terracon

Remarks:

Figure

Tested By: HP **Checked By:** WPQ

Specific Gravity of Soils
ASTM D 854

Terracon
Consulting Engineers & Scientists

SPECIFIC GRAVITY OF SOIL SOLIDS
ASTM D-854

Project Number: MR155233
Project Name: Dynegy Hennepin
Test Date: 12/11/2015

Results Summary

Boring / Sample	Sample Description	USCS	Sample Number	Depth (ft)	Passing #4	Specific Gravity (Gs)
HEN-B030	FILL: BROWN AND GRAY LEAN CLAY WITH SILT, SAND AND GRAVEL	CL	S-3	5.0'-6.5'	100.00%	2.746
HEN-B034	DARK BROWN LEAN CLAY WITH SILT AND SAND	CL	S-2	2.5'-4.0'	100.00%	2.704
HEN-B034	BROWN AND LIGHT BROWN GRAVEL WITH CLAY AND SAND	GP-GC	S-6	15.0'-16.5'	100.00%	2.808

Attachment F. Material Characterization Calculations

1. Objective

This calculation package summarizes the material characteristics of the subsurface strata encountered during AECOM's geotechnical investigation of the Hennepin East Ash Pond at Dynegy's Hennepin Power Station in Hennepin, Illinois. Selection of material properties for slope stability analyses are also developed and summarized within this package.

2. Subsurface Conditions

A subsurface exploration was performed at the Hennepin East Ash Pond between September 1 and October 21, 2015. The subsurface exploration included the following; four soil borings, installation of two piezometers to monitor phreatic conditions, and a program of four cone penetrometer test (CPT) soundings. Pore pressure dissipation testing and seismic shear wave velocity measurements were conducted on a selection of the CPT soundings. A full set of AECOM's boring logs, including soil descriptions, types of sampling, and choice laboratory test results, is provided in Attachment B of the report. A complete report that includes the graphical CPT logs and the results of the SCPTu and PPD tests is included in Attachment D of the report. The geotechnical exploration locations are shown on Figure 2-1 – Hennepin East Ash Pond Geotechnical Site Plan in Attachment A of the report.

Based on the results of the investigation, five main stratigraphic materials were identified at the site. These are listed below and briefly summarized:

Road Fill: A gravel road surrounds the perimeter of the Hennepin East Ash Pond. The material is generally comprised of gravel with varying amounts of sand, silt, and clay. The relative density of the road fill measured by the standard penetration test was very dense.

Table F-1: Road Fill Material Summary

Category	Min.	Max.	Representative Average
First Encountered (ft bgs)	<0.5	<0.5	<0.5
Thickness (feet)	0.5	7.5	1.3
SPT-N	32	62	51
Pocket Penetrometer (tsf)	1.25	4.5	2.8
Cone Resistance (tsf)	20.0	654.6	334.7
Sleeve Resistance (tsf)	0.03	4.9	1.7
Cone/Sleeve Ratio (%)	0.01	1.6	0.5
SCPTu Shear Wave Velocity (ft/sec)	N/A	N/A	N/A

Embankment Fill: The perimeter embankment / dike of the Hennepin East Ash Pond was constructed in two stages, with an original embankment, and a later raise constructed on top of the existing dike. This raise was completed in the early 2000s, raising the dike crest from an original elevation around 483 ft to the current elevation ranging from 494 to 500 ft. As indicated by the CPT logs, the new dike section was backfilled primarily with clay, although some zones of silty sand and gravel were also encountered. The consistency of the fill, as measured by the standard penetration test and pocket penetrometer tests, ranged from stiff to hard. Per construction drawings, the backfill material was to be compacted to 95 percent (minimum) ASTM D698. Historical compaction data for the fill material was not available, but field data are generally indicative of well-compacted materials.

Table F-2: Embankment Fill Material Summary

Category	Min.	Max.	Representative Average
First Encountered (ft bgs)	0.5	10	4.7
Thickness (feet)	4.5	10	6.9
SPT-N	11	50	28
Pocket Penetrometer (tsf)	0.5	4.5	3.2
Cone Resistance (tsf)	16.1	891.5	63.5
Sleeve Resistance (tsf)	0	4.9	1.5
Cone/Sleeve Ratio (%)	0	8.7	3.2
SCPTu Shear Wave Velocity (ft/sec)	860	861	861

Alluvial Foundation: Gravel materials with varying amounts of silt and clay were encountered in the borings drilled around the perimeter of the Hennepin East Ash Pond. The relative density of the alluvial foundation as measured by the standard penetration test ranged from medium dense to very dense.

Table F-3: Alluvial Foundation Material Summary

Category	Min.	Max.	Representative Average
First Encountered (ft bgs)	6	20	14
Thickness (feet)	5	36	16.8
SPT-N	17	120	55.5
Pocket Penetrometer (tsf)	1.5	1.5	1.5
Cone Resistance (tsf)	16.7	720.3	233.6
Sleeve Resistance (tsf)	0	9.7	3.4
Cone/Sleeve Ratio (%)	0	5.7	1.8
SCPTu Shear Wave Velocity (ft/sec)	1080	2038	1451

Fly Ash (Impounded CCR Materials): AECOM did not want to compromise the existing liner system within the Hennepin East Ash Pond, so borings and CPTs were not performed within the footprint of the impoundment. CPT's were obtained in the adjacent unlined impoundment, Hennepin East Ash Pond No. 2. CCR material properties for the Hennepin East Ash Pond are estimated based on materials encountered in the Hennepin East Ash Pond No. 2. The material was generally silt to sand size with some gravel and clay.

Liner System: Per record drawings, the Hennepin East Ash Pond has a 4 ft compacted clay liner on the bottom and side slopes of the pond. Underlying the clay liner is a 6 in thick sand filter layer on the bottom of the pond and 12 in thick sand layer on the side slopes of the pond. The bottom of the sand layer was constructed at an approximate elevation of 456 ft sloping up at a 4:1 on the sides of the pond to an elevation of approximate 483. In the early 2000's, the perimeter dike was raised from an elevation of 483 ft to current grades ranging from 494 to approximately 500 ft at 3:1 slopes. The liner system from top to bottom was comprised of a 45 mil thick reinforced polypropylene geomembrane, a 12-inch thick clay layer, and a 8 oz/sy polypropylene geotextile. In some areas, 2 layers of geomembrane were used. CPT's and borings were not performed within the lined area and construction documentation data was not available, therefore material properties for the liner system were estimated based on AECOM's experience.

Bedrock: Bedrock was not encountered in the soil borings. It is estimated that bedrock is greater than 100 ft below ground surface based on borings completed within the vicinity.

Other Materials: Other materials were encountered in relatively small quantities at the site, appearing at only two exploration locations, and were not considered part of the site-wide stratigraphy. These materials include ash fill material within the road embankment at boring HEN-B030 and a 6 in dense sand layer encountered in boring HEN-B034. The ash fill material was modeled in the slope stability analyses as an embankment fill layer based on CPT readings in HEN-C030. The sand layer was modeled with the gravel layer in the slope stability analysis.

3. Laboratory Testing Program

Representative samples were collected at regular intervals from the borings and were utilized for laboratory testing. The laboratory tests were assigned to characterize the site materials including index (moisture content, unit weight, Atterberg limits, specific gravity, and particle size analysis), permeability and consolidation tests. Strength testing included isotropically consolidated-undrained triaxial tests with pore pressure measurements (CIU), Unconfined Compression (UC) tests, and direct shear tests (DS) on the native clay materials, embankment materials, and ash materials.

Table F-4: Laboratory Testing Program for East Ash Pond

ASTM Designation	Test Type	Number of Tests				
		Total	Road Fill	Embankment Fill	Alluvial Foundation	Other Material
D2216	Moisture Content	45	5	16	22	2
D4318	Atterberg Limits	3	-	3	-	-
T311[1], D1140, D422	Gradation / Hydrometer	6	1	-	5	-
D854	Specific Gravity	3	-	2	1	-
D5084	Hydraulic Conductivity	0	-	-	-	-
D2435	Consolidation	1	-	1	-	-
D 2166	Unconfined Compression	1	-	1	-	-
D4767	Consolidated Undrained Triaxial (CIU)	1	-	1	-	-
D6528	Direct Shear (DS)	1	-	1	-	-

[1] American Association of State Highway and Transportation Officials (AASHTO) test designation

Compete results of the laboratory tests are included in Attachment E of the report.

4. Material Properties

Material properties for slope stability analyses were developed using both laboratory testing data (index and strength testing) and strength correlations from SPT and CPT data.

The following specific material properties were developed for the road fill, embankment fill, alluvial foundation, fly ash, and liner system for use in the various stability analyses performed as part of this study:

- Unit Weight
- Drained and Undrained Shear Strength of Fine-Grained Soil Strata
- Drained and Undrained Shear Strength of Ash

Material properties for the liner system were conservatively estimated based on empirical correlations and experience with similar materials.

Unit Weight

Unit weight for the road fill, embankment fill, and alluvial foundation materials were evaluated using measured results from samples collected. Values were plotted and design unit weight lines were then fit to the plotted data, and layers were divided where warranted by differences in the data. Plots of these measured values are included as Attachments F.1 through F.3 at the end of this document.

For materials that could not be directly measured for unit weight (fly ash and the liner system materials), estimates of the unit weight were based on empirical correlations and experience with similar materials.

Refer to table F-5 for total unit weights used in the stability analyses.

Drained Shear Strength Selection

Drained shear strengths were selected for all materials for use in the Long Term and Max Pool analyses. Drained strengths were primarily based on results from DS and CIU testing. Plots of both effective friction angle and effective cohesion values were created for each material type to estimate average values across each material. To supplement the effective friction angle measured in laboratory testing, correlated values of phi' were calculated using the procedure developed by Peck, Hanson, and Thornburn, 1974, based on corrected SPT blow counts. Measured laboratory values were given precedence when selecting design values. For materials that could not be directly measured for drained shear strength (fly ash and the liner systerm materials), the above correlation was used for effective friction angles. Effective cohesion values for these materials were conservatively estimated based on experience with similar materials. Design strength lines were then fit to the plotted data, and layers were divided where warranted by differences in the data. Plots of the measured and correlated drained shear strength values for the materials are included as Attachments F.1 through F.3.

Undrained Shear Strength Selection

Undrained shear strengths were selected for the cohesive materials for use in the analysis. Undrained strengths were based on results from CIU and UC testing, and correlated values of undrained shear strength from the CPT tests. Plots of undrained shear strength were created for each material type to estimate average values across each material. To supplement the undrained shear strengths measured in laboratory testing, correlated values were calculated using the procedure developed by Aas, et al (1986), based on CPT data. An NKT factor of 18 was selected for use in this correlation based on published values. Su / σ'vo lines were also calculated and plotted for comparison purposes. Design strength lines were then fit to the plotted data, and layers were divided where warranted by differences in the data. Plots of the measured and correlated undrained shear strength values for the materials are included as Attachments F.1 through F.3.

5. Material Properties for Analysis

The table below summarizes the material parameters used in the stability analysis, based on the analysis and strength selection procedures and considerations presented in the preceding sections.

Table F-5: Summary of Material Parameters used in Stability Analysis

Material	Total Unit Weight (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters	
		c' (psf)	**Φ**' (°)	c (psf)	**Φ** (°)
Road Fill	130	0	38	0	38
Embankment Fill	105	30	32	2500	0
Alluvial Foundation	135	0	38	0	38
Fly Ash	105	100	27	600	0
Liner System	120	60	30	2500	0

6. References

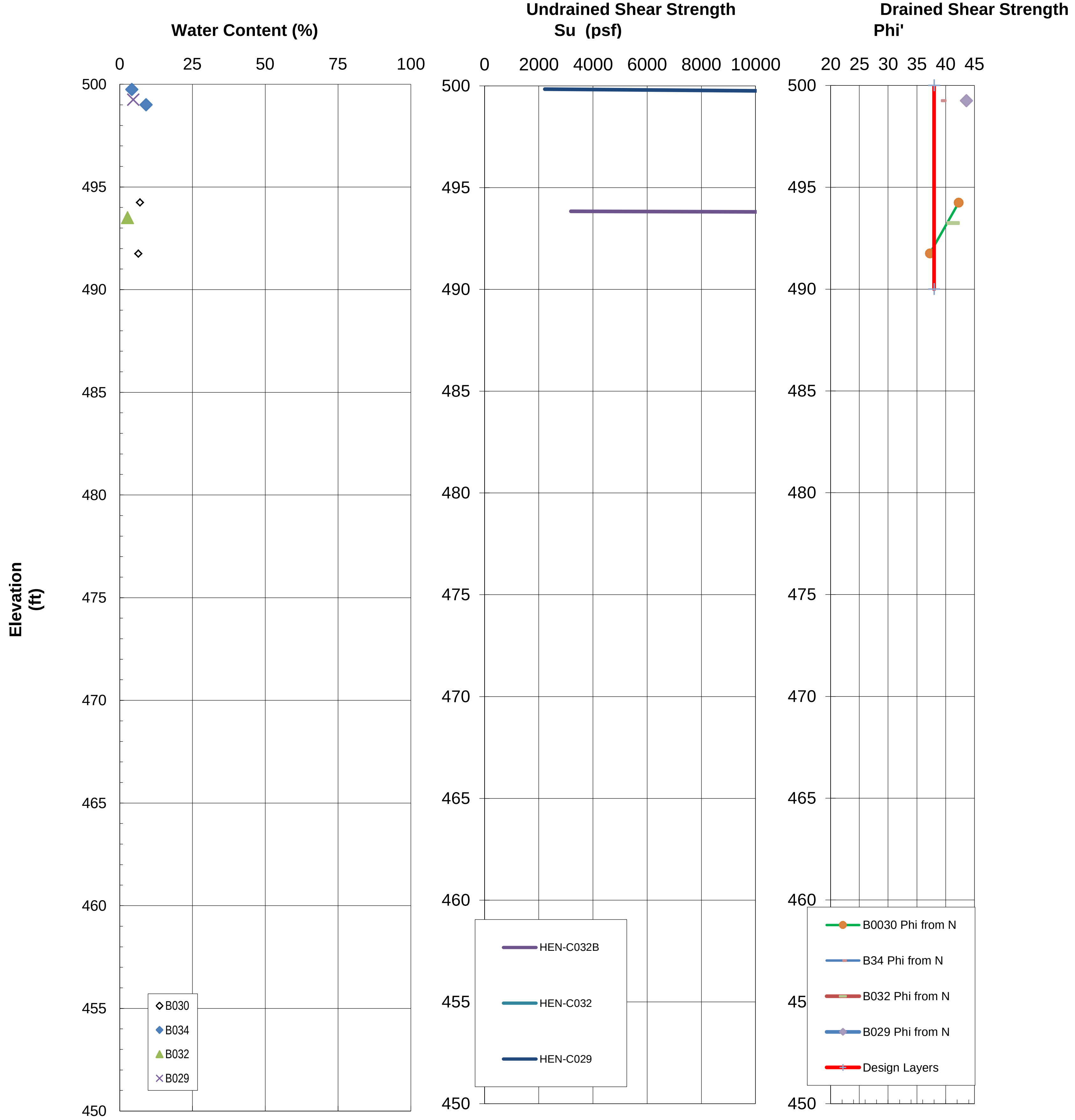
Aas, G., Lacasse, S., Lunne, I., and Hoeg, K. (1986). "Use of In situ Tests for Foundation Design in Clay," Proceedings, In Situ 86, American Society of Civil Engineers, pp. 30.

Peck, R.B., Hanson, W.E. and Thornburn, T.H., 1974. Foundation Engineering, 2nd edition, John Wiley and Sons, Inc.

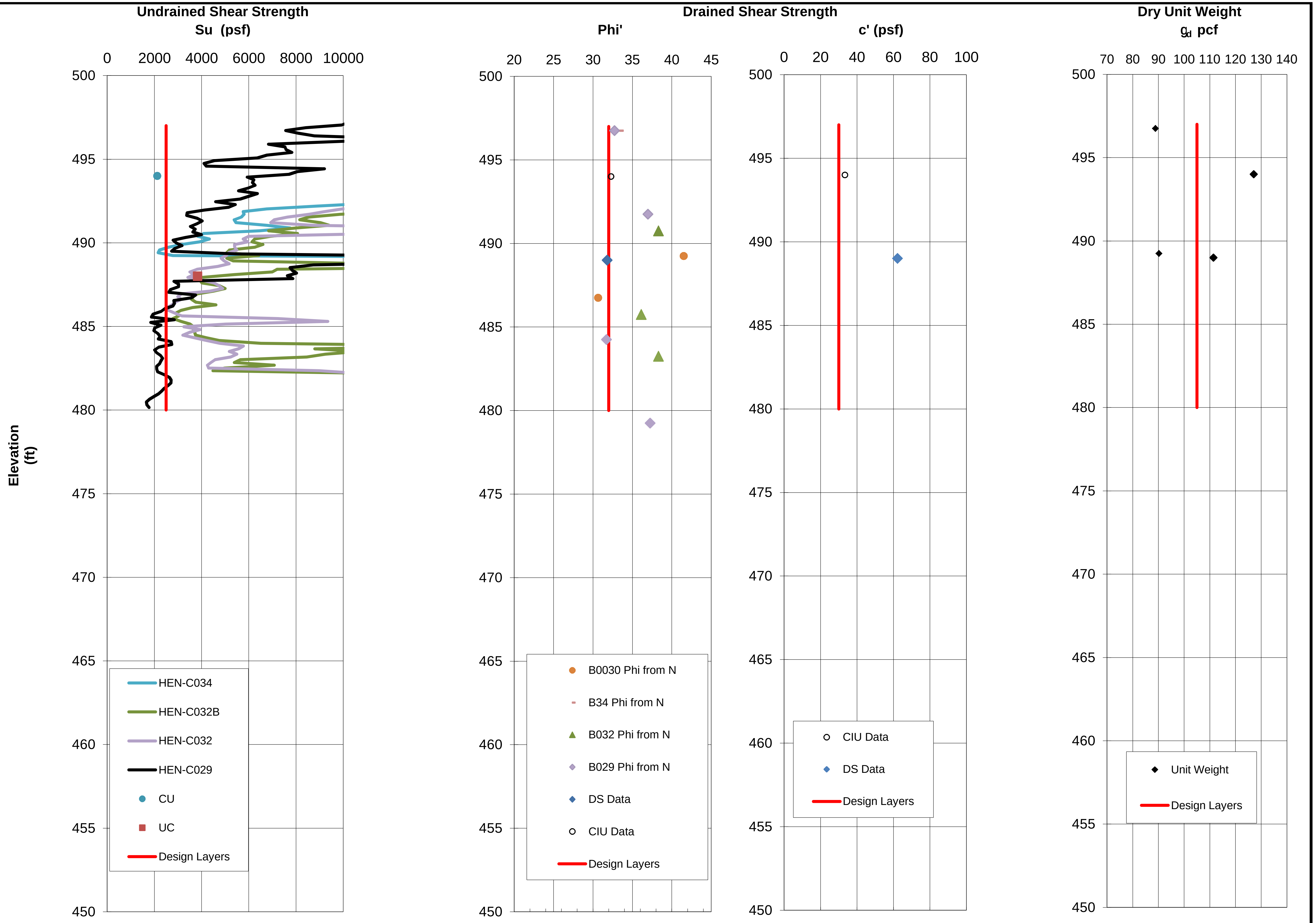
Idriss, I. M., and Boulanger, R. W. (2008). Soil Liquefaction During Earthquakes. Earthquake Engineering Research Institute, Oakland, California, USA.

7. Attachments

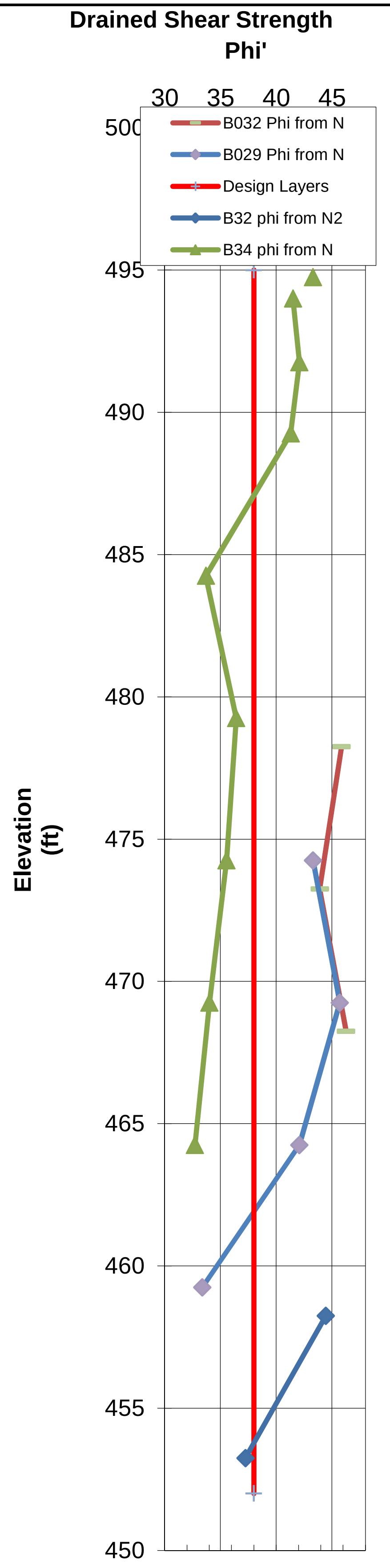
F.1 Material Characterization Plot – Road Fill
F.2 Material Characterization Plot – Embankment Fill
F.3 Material Characterization Plot – Alluvial Foundation

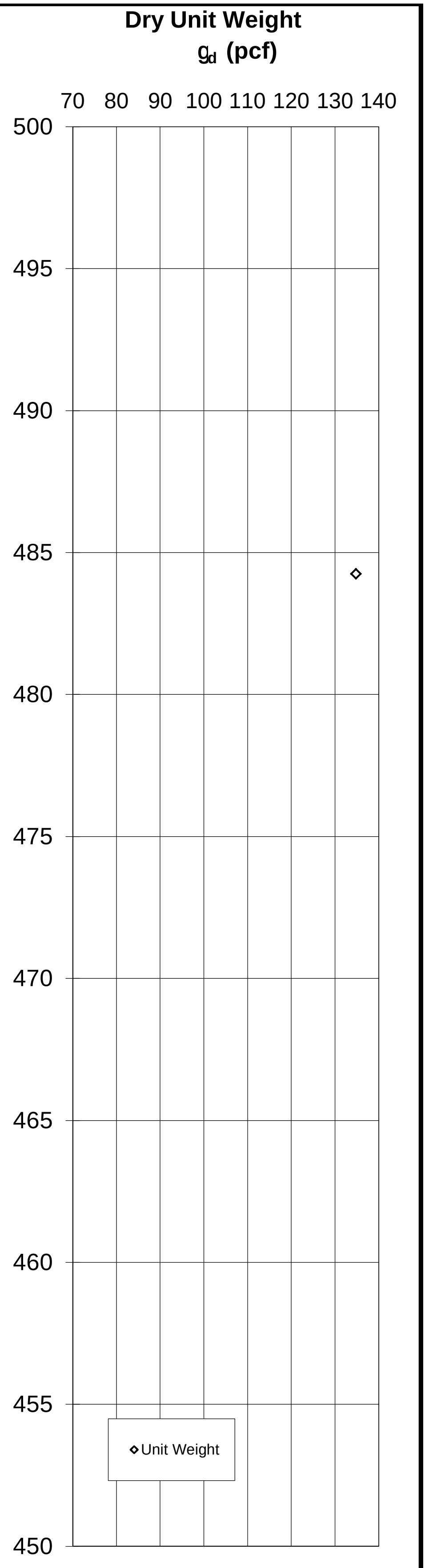


Dynegy Hennepin Hennepin, IL East Ash Pond	Project No. 60439752	Summary of Index and Engineering Properties - Road Fill	DRN. BY: NDS DSGN. BY: AJW CHKD. BY: JMT	Attachment F.1



Dynegy Hennepin Hennepin, IL East Ash Pond	Project No. 60439752	Summary of Index and Engineering Properties - Embankment Fill	AECOM	DRN. BY: NDS DSGN. BY: AJW CHKD. BY: JMT	Attachment F.2





Dynegy Hennepin
Hennepin, IL
East Ash Pond

Project No.
60439752

Summary of Index and Engineering Properties - Alluvial Foundation

AECOM

DRN. BY: NDS
DSGN. BY: AJW
CHKD. BY: JMT

Attachment
F.3

Attachment G. Slope Stability Analysis

1. Objective & Introduction

This calculation package summarizes the limit equilibrium slope stability analyses for both the static and seismic loading conditions performed in support of the Hennepin East Ash Pond CCR Unit Geotechnical Report for the Hennepin Power Station. Figures, calculations and computer program outputs are provided as attachments and are referenced herein. Slope stability analyses have been completed for two cross-sections within the Hennepin East Ash Pond to evaluate the stability of the embankment under the loading conditions described below.

The objective for the slope stability analysis is to determine factors of safety (FS) at critical cross section locations across the Hennepin East Ash Pond dike for the following loading cases:

- Static, Steady-State, Normal Pool Conditions;
- Static, Maximum Pool Surcharge Conditions;
- Seismic Slope Stability Analysis;

The methodology used to perform the slope stability analysis and the results of the analyses are summarized in the subsequent sections listed below.

2. Development of Cross-Sections for Analysis

Two cross-sections (SL-10 and SL-12) were utilized to evaluate the perimeter embankment stability at the Hennepin East Ash Pond. The north and south sides of the pond were not analyzed because the downstream side of the north embankment is filled with ash and the south side is not an embankment but is incised; therefore, neither the north nor south represent critical sections for slope stability analyses. A cross section on the east and west embankments, SL-12 and SL-10, respectively, were analyzed. The location of these sections can be found in **Attachment A, Figure 2**.

The section geometry for each analysis cross-section was determined based on the site specific aerial and bathymetric survey completed by Weaver Consultants Group in September 2015. The survey is spatially referenced to the Illinois NAD 1983 State Plane West, Zone 12020. Elevations are in feet and referenced with respect to the North American Vertical Datum 1988 (NAVD 88).

3. Subsurface Conditions

Subsurface materials and extents (stratigraphy) at each cross section were developed by utilizing nearby subsurface explorations (CPTs and borings) from AECOM's exploration activities and historic geotechnical explorations. The subsurface strata generally encountered across the exploration locations can be generalized into five typical layers. These layers are listed below and are further described in **Appendix F – Material Characterization**.

- Road Fill
- Embankment Fill
- Alluvial Foundation
- Fly Ash
- Liner System

Material interfaces inferred from the subsurface explorations nearest to the cross-sections were transposed onto the profile and a reasonable interpretation of the subsurface stratigraphy between the exploration locations was developed. Table G-1 below summarizes the exploration locations utilized to construct each cross-section:

Table G-1
Cross-section Locations for Slope Stability Analyses

Cross-Section	Location (Crest/Toe)	Boring/CPT Number
SL-10	CREST	HEN-B029, HEN-C029
SL-12	CREST	HEN-B032, HEN-C032, HEN-C032B

Additionally, design drawings from “1995 Ash Facility Hennepin Power Station” by Illinois Power Company (1993) and “Modification to Primary Ash Pond Hennepin Power Station” by Sargent & Lundy (2003) were used to supplement the subsurface investigation in developing the subsurface embankment geometry.

Phreatic surfaces were modeled as a piezometric line in SLOPE/W. Elevations and configuration of the piezometric lines were established based on the phreatic water water levels recorded from the piezometers installed during the 2015 AECOM exploration ranging from approximately 449 to 452 and the normal pool elevation of 490.4 ft impounded in the Hennepin East Ash Pond, based on the 2016 AECOM Hydraulics and Hydrology report (AECOM, 2016).

4. Analysis Methodology

Analyses were performed using Spencer’s Method which is a limit equilibrium slope stability analysis procedure. The computer program SLOPE/W 2012 by Geo-Slope International was utilized. The program analyzes a large number of potential slip surface geometries and identifies the geometry that results in a critical (i.e. lowest) factor of safety (FS). Additional information on the program is available at http://www.geo-slope.com/. Circular shaped failure surfaces, with optimization, were analyzed for the each of the loading cases considered. The optimization option within SLOPE/W allows the checking of non-circular failure surfaces by incrementally altering the location of the failure surface to find the lowest factor of safety. This procedure allows the failure surface to follow thin layers of lower strength, and interface boundaries to calculate a more critical factor of safety.

To account for the two piezometric lines in each cross section, the piezometric line within the Hennepin East Ash Pond was applied only to the fly ash and liner system. A second piezometric line was used to model phreatic water and was applied the alluvial foundation, embankment fill and road fill. This piezometric surface was modeled at elevation 450 ft and 452 ft for SL-12 and SL-10, respectively. At SL-12, the phreatic surface was assumed to rise to meet the typical pool elevation for the East Polishing Pond (482.2 ft).

Each section was analyzed for the following cases:

- **Static, Steady-State, Normal Pool Condition:** This case models the conditions under static, long-term conditions, under the normal storage water level within the impoundment. Drained (effective stress) shear strength parameters were used for all materials, and phreatic conditions were estimated based on available data as described above. A target **Factor of Safety of 1.50** is needed for this loading condition. The operating water level of the Ash Pond is El. 490.4 ft for the Hennepin East Ash Pond..

- **Static, Maximum Surcharge Pool Condition:** This case models the conditions under short term surcharge pool conditions. Drained (effective stress) shear strength parameters were used for all materials, as the change in pool elevation is temporary and fairly small, and is unlikely to initiate total stress mechanisms of failure. Because the impoundment is lined, the phreatic surface does not extend past the embankment. Therefore, the phreatic surface in the foundation was modeled equivalent to the steady state case. A target **Factor of Safety of 1.40** is needed for this loading condition. The water level of the East Ash Pond was modeled at El. 492.2 ft for this case. This value is from the 2016 AECOM Hydraulics and Hydrology report generated for this project.

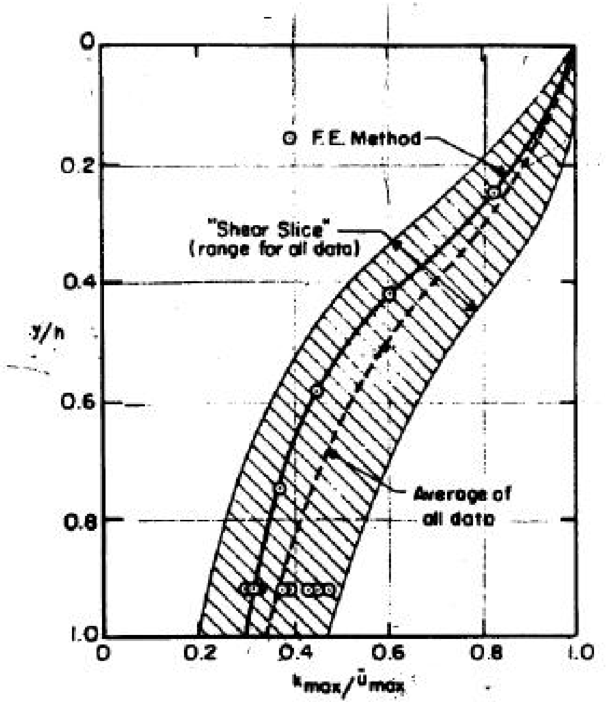
- **Seismic Stability Condition:** These analyses incorporate a horizontal seismic coefficient kh selected to be representative of expected loading during the design earthquake event (i.e., a "pseudostatic" analysis). The analyses utilized peak undrained strength parameters in soils that are not consider to be rapidly draining materials, and peak drained strengths in soils considered to freely drain. The phreatic surface and pore water pressures corresponding to the Steady State Normal Storage Pool case from the static analyses were utilized. Seismic loading was included in this analysis using a pseudostatic coefficient (kh). A **Factor of Safety of 1.00** is required for this loading condition.

Ground motion parameters for the pseudostatic analysis were estimated using the USGS Interactive Deaggregation tool (http:earthquake.usgs.gov/hazards/apps/). This application generates acceleration values, including peak ground acceleration (PGA), and mean and modal moment magnitudes, based on user entered values of location, exceedance probability, and spectral period. Results are computed based on the 2008 NSHMP PSHA Seismic Hazard Maps.

For the Hennepin Power Station, the calculated PGA for a 2,500-year event was 0.072g for top of hard rock. To determine the free-field, ground surface horizontal acceleration, the site was classified according to the site classes defined in IBC (2003) and amplified using the site amplification factors found in NEHRP (2009). The site class was determined based on the weighted average of the shear wave velocity of the foundation soils ($600 \leq vs \leq 1,200$ ft/s) and found to be Site Class D. This corresponds to a NEHRP amplification factor of 1.6, resulting in a ground surface acceleration of 0.119g. The Peak Transverse Acceleration at the dike crest was estimated using the ground surface acceleration and the procedure proposed by Idriss (2015), resulting in a crest acceleration of 0.35g.

The pseudostatic coefficient was calculated based on the simplified procedure developed by Makdisi and Seed (1978). Specifically, the pseudostatic coefficient was taken as the parameter kmax, which represents the peak average acceleration along the failure surface. As shown in Figure 1 below (excerpted from the above reference), the ratio kmax/umax (where umax is the peak acceleration at the crest of the embankment) for a full height failure surface (y/H = 1.0) is 0.34. From the procedure noted above, the anticipated maximum peak crest acceleration is approximately 0.35g. Therefore, the pseudostatic coefficient kh was estimated as kh= 0.34*0.35g = 0.119g for these analyses.

The seismic hazard deaggregation output and calculations for the pseudostatic coefficient are provided at the back of this document.



VARIATION OF "MAXIMUM ACCELERATION RATIO" WITH
DEPTH OF SLIDING MASS

Figure 1: Determination of Maximum Average Acceleration Along Failure Surface

5. Material Properties for Analysis

Material properties for slope stability analyses were developed using both laboratory testing data (index and strength testing) and strength correlations from CPT and SPT data. Details of the material characterization and strength parameter selection for each stratum are provided in **Attachment F** of this report. The properties used in the stability analysis are summarized in the table below:

Table G-2: Summary of Material Parameters used in Stability Analysis

Material	Unit Weight Above WT (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters	
		c’ (psf)	Φ’ (°)	c (psf)	Φ (°)
Road Fill	130	0	38	0	38
Embankment Fill	105	30	32	2500	0
Alluvial Foundation	135	0	38	0	38
Fly Ash	105	100	27	600	0
Liner System	120	60	30	2500	0

6. Results

Table G-3 summarizes the results of the stability analyses for each section, and output figures from the SLOPE/W models are provided at the back of this document.

Table G-3: Summary of Minimum Slope Stability Factors

Cross Section	Factor of Safety		
	Drained		Undrained
	Steady State (Normal Pool)	Surcharge Pool (Flood)	Seismic (Pseudostatic)
CCR Rule Criteria	*FS ≥ 1.50*	*FS ≥ 1.40*	*FS ≥ 1.00*
SL-10	2.14	2.14	4.23
SL-12	2.81	2.81	2.53

7. Conclusions

Load cases analyzed for this study included static (steady-state) normal pool, maximum flood surcharge pool and seismic (pseudostatic). The calculated factors of safety from the limit equilibrium slope stability analysis satisfy the USEPA CCR Rule § 257.73(e) requirements for all the load cases analyzed at the critical analysis sections for the perimeter of the impoundment.

8. References

AECOM (2016). Hydrologic and Hydraulic Summary Report for Hennepin Power Station, Primary Ash Pond CCR Unit. (DRAFT)

GEO-SLOPE International Ltd. (2015). “GeoStudio 2012 (SLOPE/W and SEEP/W).” Calgary, Alberta, Canada.

Idriss, I. M., and Boulanger, R. W. (2008). Soil Liquefaction During Earthquakes. Earthquake Engineering Research Institute, Oakland, California, USA.

International Code Council, (2003), 2003 International Building Code.

Weaver Consultants Group. (September 2015). Survey data.

Makdisi, F.I. and Seed, B. H., August, 1977. “A Simplified Procedure for Estimating Earthquake-Induced Deformations in Dams and Embankments”, Earthquake Engineering Research Center Report No. UCB/EERC-77/19, University of California, Berkeley, CA.

NEHRP (National Earthquake Hazards Reduction Program), (2009) Recommended Seismic Provisions for New and Other Structures, (FEMA P-750), 2009 Edition.

U.S. Environmental Protection Agency [USEPA]. (2015). Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments. 40 CFR §257. Federal Register 80, Subpart D, April 17, 2015.

9. Attachments

G.1	Slope Stability Analysis Output Data
G.2	Seismic Parameter Calculations

Attachment G.1 Slope Stability Analysis Output Data

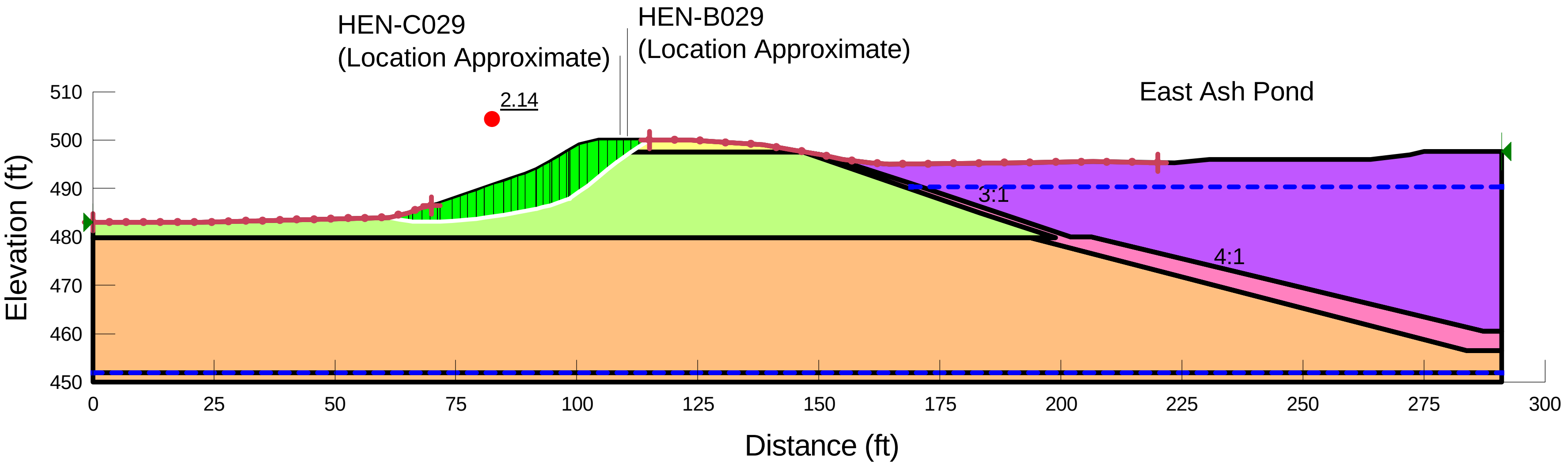
Hennepin East Ash Pond
Cross Section SL-10
Effective (Drained)-Static Normal Pool

Calculated By: ZJF Date:9-21-2016
Checked By: LPC Date:9/22/16

Materials

- 🟨 Road Fill
- 🟧 Alluvial Foundation
- 🟥 Liner System (Drained)
- 🟪 Fly Ash (Drained)
- 🟩 Embankment Fill (Drained)

Name: Road Fill Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38 ° Piezometric Line: 1
Name: Alluvial Foundation Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38 ° Piezometric Line: 1
Name: Liner System (Drained) Unit Weight: 120 pcf Cohesion': 60 psf Phi': 30 ° Piezometric Line: 2
Name: Fly Ash (Drained) Unit Weight: 105 pcf Cohesion': 100 psf Phi': 27 ° Piezometric Line: 2
Name: Embankment Fill (Drained) Unit Weight: 105 pcf Cohesion': 30 psf Phi': 32 ° Piezometric Line: 1



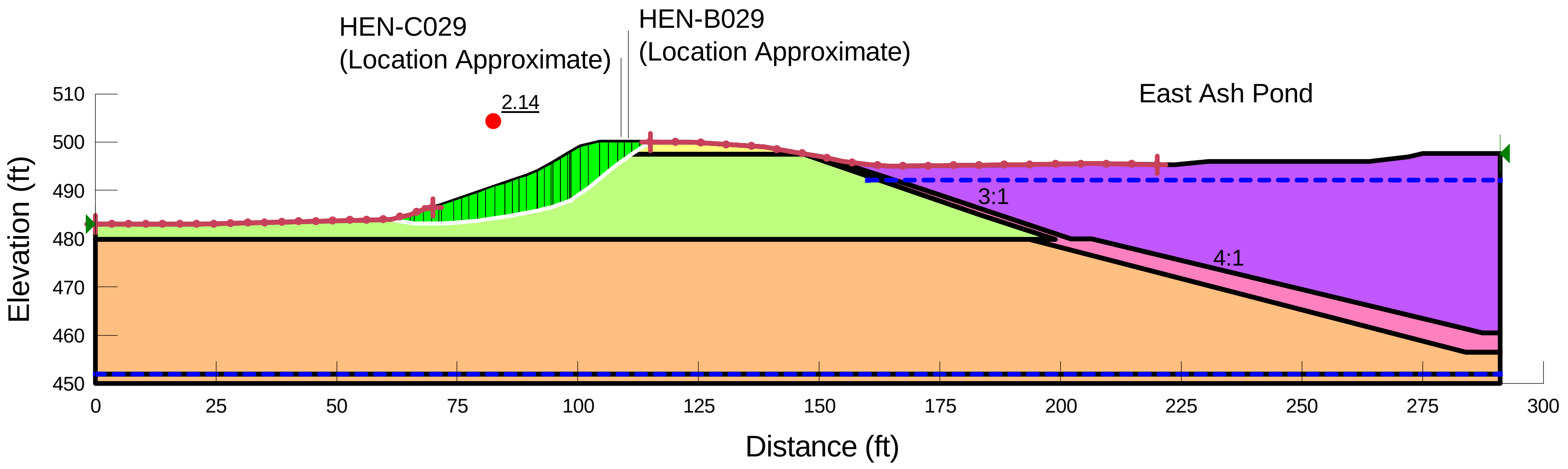
Hennepin East Ash Pond
Cross Section SL-10
Effective (Drained) - Static Max Pool

Calculated By: ZJF Date:9-21-2016
Checked By:LPC Date:9/22/16

Materials

- 🟨 Road Fill
- 🟧 Alluvial Foundation
- 🟥 Liner System (Drained)
- 🟪 Fly Ash (Drained)
- 🟩 Embankment Fill (Drained)

Name: Road Fill Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38 ° Piezometric Line: 1
Name: Alluvial Foundation Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38 ° Piezometric Line: 1
Name: Liner System (Drained) Unit Weight: 120 pcf Cohesion': 60 psf Phi': 30 ° Piezometric Line: 2
Name: Fly Ash (Drained) Unit Weight: 105 pcf Cohesion': 100 psf Phi': 27 ° Piezometric Line: 2
Name: Embankment Fill (Drained) Unit Weight: 105 pcf Cohesion': 30 psf Phi': 32 ° Piezometric Line: 1



Hennepin East Ash Pond
Cross Section SL-10
Total (Undrained) - Pseudostatic

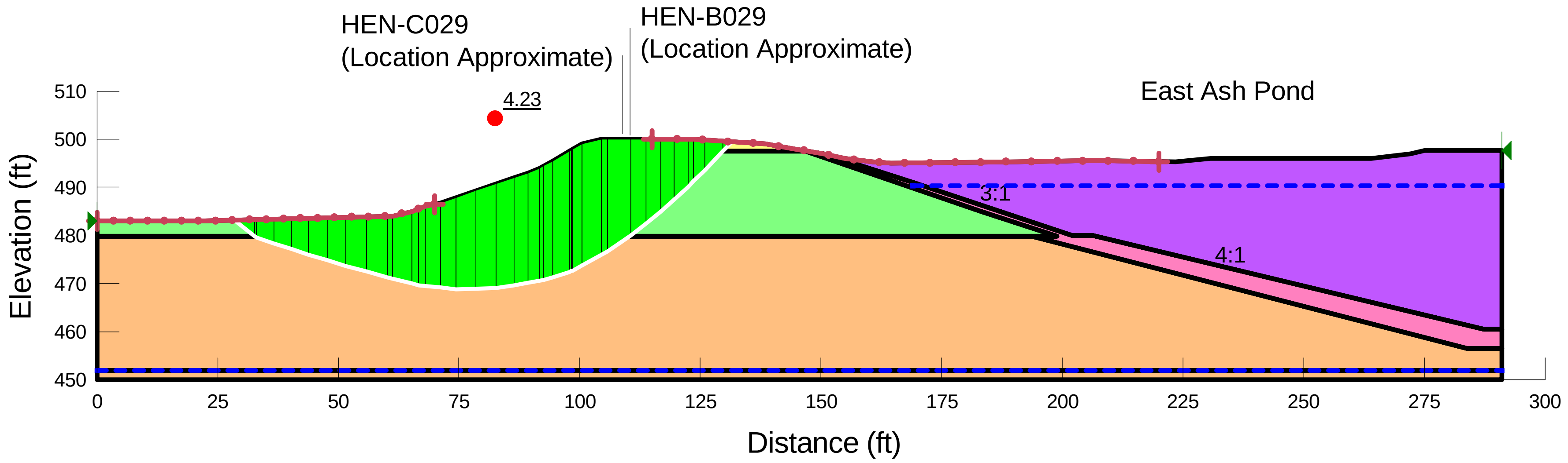
Calculated By: ZJF Date:9-21-2016
Checked By: LPC Date:9/22/16

Horz Seismic Coef.: 0.119

Materials

🟨 Road Fill
🟧 Alluvial Foundation
🟥 Liner System (Undrained)
🟪 Fly Ash (Undrained)
🟩 Embankment Fill (Undrained)

Name: Road Fill   Unit Weight: 130 pcf   Cohesion': 0 psf   Phi': 38 °   Piezometric Line: 1
Name: Alluvial Foundation   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 38 °   Piezometric Line: 1
Name: Liner System (Undrained)   Unit Weight: 120 pcf   Cohesion': 2,500 psf   Phi': 0 °   Piezometric Line: 2
Name: Fly Ash (Undrained)   Unit Weight: 105 pcf   Cohesion': 600 psf   Phi': 0 °   Piezometric Line: 2
Name: Embankment Fill (Undrained)   Unit Weight: 105 pcf   Cohesion': 2,500 psf   Phi': 0 °   Piezometric Line: 1



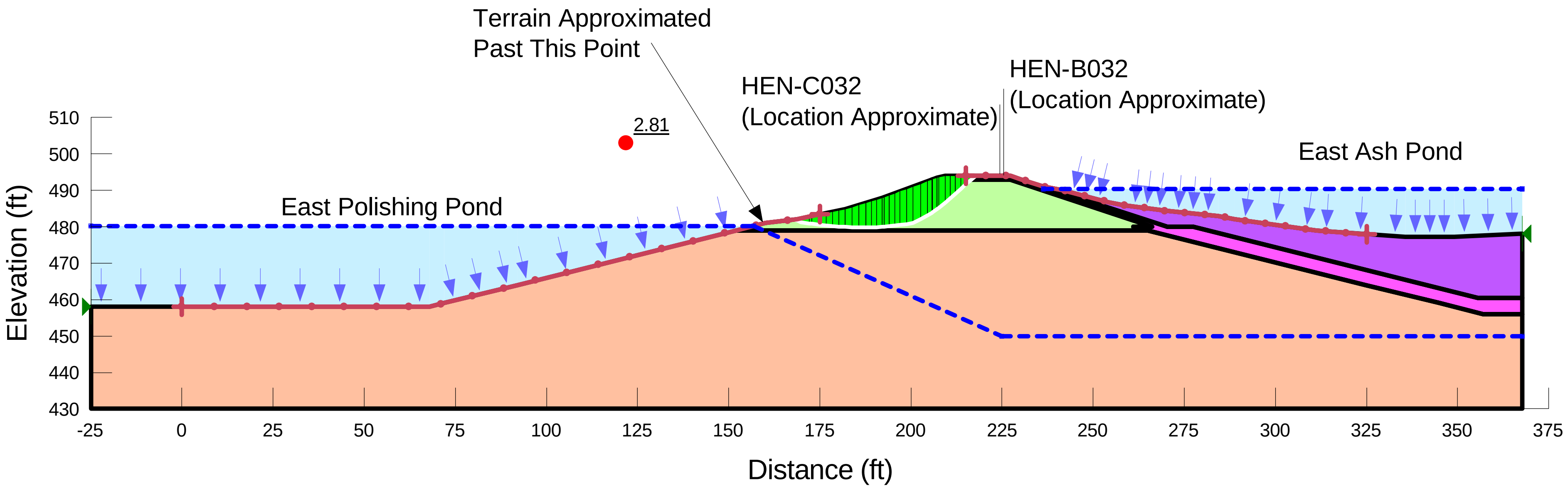
East Ash Pond
Cross Section SL-12
Effective (Drained) - Static Normal Pool

Calculated By: ZJF Date: 9/21/16
Checked By: LPC Date: 9/22/16

Materials

🟨 Road Fill
🟧 Alluvial Foundation
🟪 Fly Ash (Drained)
🟪 Liner System (Drained)
🟩 Embankment Fill (Drained)

Name: Road Fill Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38 ° Piezometric Line: 2
Name: Alluvial Foundation Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38 ° Piezometric Line: 2
Name: Fly Ash (Drained) Unit Weight: 105 pcf Cohesion': 100 psf Phi': 27 ° Piezometric Line: 1
Name: Liner System (Drained) Unit Weight: 120 pcf Cohesion': 60 psf Phi': 30 ° Piezometric Line: 1
Name: Embankment Fill (Drained) Unit Weight: 105 pcf Cohesion': 30 psf Phi': 32 ° Piezometric Line: 2



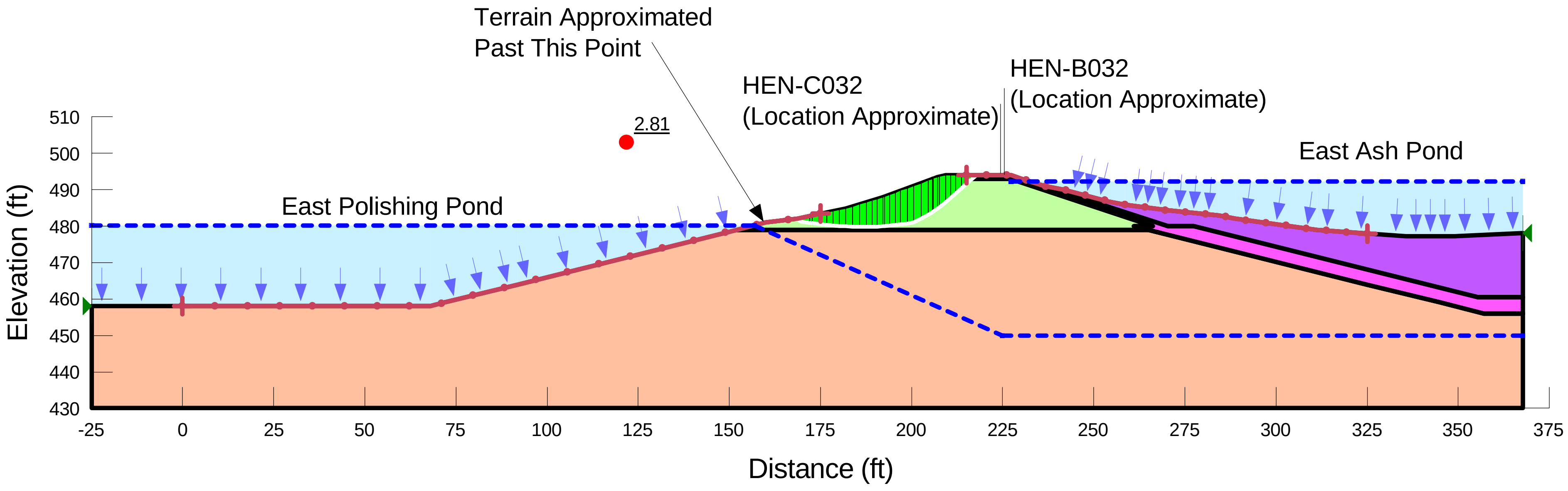
East Ash Pond
Cross Section SL-12
Effective (Drained) - Static Max Pool

Calculated By: ZJF Date: 9/21/16
Checked By: LPC Date: 9/22/16

Materials

🟨 Road Fill
🟧 Alluvial Foundation
🟪 Fly Ash (Drained)
🟪 Liner System (Drained)
🟩 Embankment Fill (Drained)

Name: Road Fill Unit Weight: 130 pcf Cohesion': 0 psf Phi': 38 ° Piezometric Line: 2
Name: Alluvial Foundation Unit Weight: 135 pcf Cohesion': 0 psf Phi': 38 ° Piezometric Line: 2
Name: Fly Ash (Drained) Unit Weight: 105 pcf Cohesion': 100 psf Phi': 27 ° Piezometric Line: 1
Name: Liner System (Drained) Unit Weight: 120 pcf Cohesion': 60 psf Phi': 30 ° Piezometric Line: 1
Name: Embankment Fill (Drained) Unit Weight: 105 pcf Cohesion': 30 psf Phi': 32 ° Piezometric Line: 2



East Ash Pond
Cross Section SL-12
Total (Undrained) - Pseudostatic

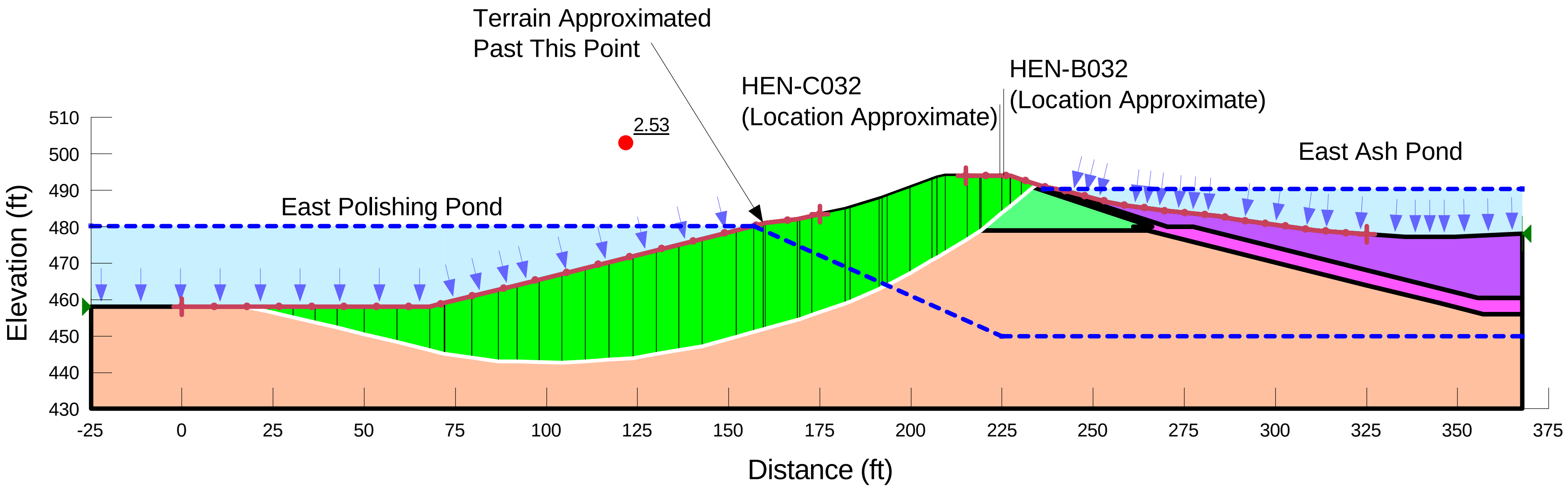
Calculated By: ZJF Date: 9/21/16
Checked By: LPC Date: 9/22/16

Horz Seismic Coef.: 0.119

Materials

- 🟨 Road Fill
- 🟧 Alluvial Foundation
- 🟪 Liner System (Undrained)
- 🟪 Fly Ash (Undrained)
- 🟩 Embankment Fill (Undrained)

Name: Road Fill   Unit Weight: 130 pcf   Cohesion': 0 psf   Phi': 38 °   Piezometric Line: 2
Name: Alluvial Foundation   Unit Weight: 135 pcf   Cohesion': 0 psf   Phi': 38 °   Piezometric Line: 2
Name: Liner System (Undrained)   Unit Weight: 120 pcf   Cohesion': 2,500 psf   Phi': 0 °   Piezometric Line: 1
Name: Fly Ash (Undrained)   Unit Weight: 105 pcf   Cohesion': 600 psf   Phi': 0 °   Piezometric Line: 1
Name: Embankment Fill (Undrained)   Unit Weight: 105 pcf   Cohesion': 2,500 psf   Phi': 0 °   Piezometric Line: 2



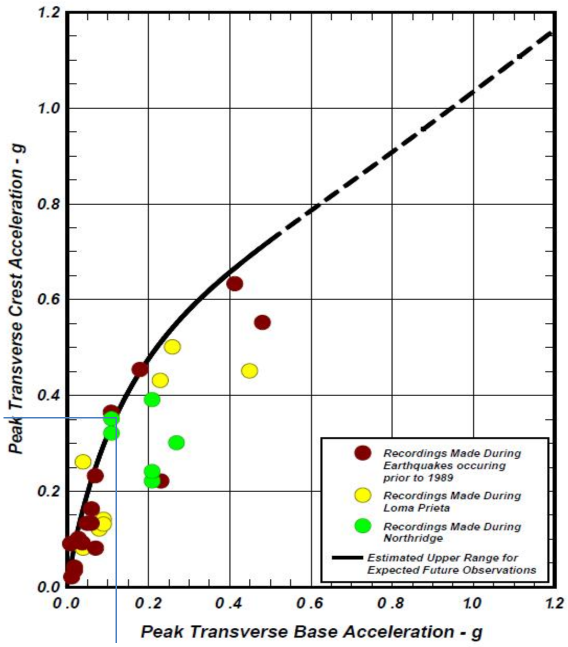
Attachment G.2 Seismic Parameter Calculations

Calc By:	AJW
Date:	2/23/2016
Check By:	JMT
Date:	2/24/2016

Calculation of K_h for Pseudostatic Analysis

Objective: Estimate kh for pseudostatic analysis.

Given:
Seismic Hazard Deaggregation with PGA_{BC} = 0.07298, M=5.9
Site Class D, based on IBC (2008)
FPGA = 1.6, based on NEHRP (2009)
Holzer (1998) Figure for estimation of crest acceleration
Makdisi Seed (1978) Figure for Max Acc of Slide Mass



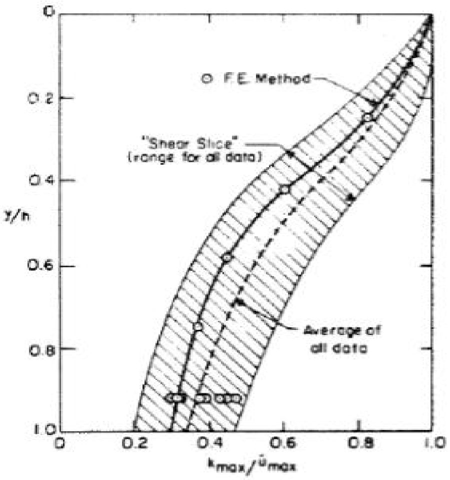


Figure 4. Variations of Maximum Acceleration Ratio with Depth of Sliding Mass (Makdisi and Seed, 1977). Maximum Acceleration Ratio is the Ratio between $(PGA)_{base\ of\ slide\ mass}$ and $(PGA)_{crest}$.

Figure 3. Variations of Recorded Peak Crest Accelerations versus those Recorded at the Base of Earth and Rock Fill Dams by Idriss (2015). Source of recorded values for Loma Prieta Earthquake and prior earthquakes: Holzer, (1998).

PGA_{BC}	Site class	F_{PGA}	PGA_{BASE}	PGA_{CREST}	Makdisi -Seed reduction for full height failure	k_h
0.07298	D	1.6	0.117	0.35	0.34	0.119

Results:

Use k_h = 0.119 for pseudostatic analyses.

Appendix C. Hydrologic and Hydraulic Report

AECOM

AECOM
1001 Highlands Plaza Drive West
Suite 300
St. Louis, MO 63110-1337
www.aecom.com

314.429.0100 tel
314.429.0462 fax

October 7, 2016

Mr. Matt Ballance, PE
Senior Project Engineer
Dynegy Inc.
1500 Eastport Plaza Drive
Collinsville, Illinois 62234

RE: Hydrologic and Hydraulic Summary Report
Hennepin Power Station
East Ash Pond

Dear Mr. Ballance:

AECOM is pleased to provide this Summary Report of Hydrologic and Hydraulic Modeling for the Dynegy Midwest Generation, LLC (DMG) Hennepin Power Station East Ash Pond Coal Combustion Residual (CCR) Unit. This analysis was performed to document that the facility meets the requirements of 40 CFR §257.82(a) with regard to the Inflow Design Flood Control Plan. Based on AECOM's analysis, the East Ash Pond meets all hydraulic requirements for certification per 40 CFR §257.82(a).

AECOM looks forward to providing continued support to DMG and working together on this important program. Please do not hesitate to call Ron Hager at 314-429-0100 (office) / 440-591-7868 (mobile), if you have any questions.

Sincerely,

AECOM

Ronald H. Hager

Site Manager
Jeremy.thomas@aecom.com

Program Manager
ronald.hager@aecom.com

cc: Mark Rokoff, PE – AECOM

Attachments:

A. Location Maps
B. Impoundment Capacity and Impoundment Calculations
C. Inflow Design Flood Computations

1. INTRODUCTION

1.1. ***Purpose of This Memorandum***

This report presents the results of the hydrologic and hydraulic analysis prepared by AECOM for the Dynegy Midwest Generation, LLC (DMG)[1] East Ash Pond Coal Combustion Residual (CCR) Unit at the Hennepin Power Station, located 4 miles northeast of Hennepin, Illinois in Putnam County (See Attachment A for Location Map). This analysis was completed in accordance with the Environmental Protection Agency (EPA) 40 CFR Part §257, Subpart D, regulations for the disposal of CCR. As required by §257.82(a), by October 17, 2016, owners and operators of existing CCR surface impoundments must develop an Inflow Design Flood Control Plan that documents how the inflow design flood control system has been designed and constructed to meet the following requirements:

- *(40 CFR 257.82 (a)(1)* - The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood.

- *(40 CFR 257.82 (a)(2)* - The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood.

The East Ash Pond has a significant hazard potential, based on the initial hazard potential classification assessment performed by Stantec in 2016, in accordance with 257.73(a)(2). The "Significant Hazard" category indicates that the inflow design flood for risk analysis is the 1,000-year storm event. This event is the basis for AECOM's certification.

1.2. ***Brief Description of Impoundments***

The Hennepin Power Station is a coal-fired facility that sluices bottom ash, fly ash, boiler slag, and plant process water into the East Ash Pond. Flow from the East Ash Pond is discharged downstream to the East Leachate Pond non-CCR unit through the primary 18 in. diameter reinforced concrete pipe (RCP) culvert with an invert elevation of 489.9 feet. The East Ash Pond also utilizes a 7 ft. wide x 9 ft. wide concrete riser structure (invert elevation of 490.6 feet) with a 36-inch diameter RCP as a secondary outflow to the non-CCR unit East Polishing Pond. Flow from the East Leachate Pond is discharged through a drop inlet structure into the East Polishing Pond. The East Polishing Pond discharges to the Illinois River through a 7 ft. wide x 9 ft. wide concrete vertical drop structure (invert elevation of 480.2 feet) with a 36-inch diameter RCP in accordance with NPDES permit No. IL0001554.

A site specific aerial and bathymetric survey of the East Ash Pond and Phase I Landfill was completed by Weaver Consultants Group in 2015 (Weaver Consultants Group, 2015). However, the 2015 survey did not include the East Leachate Pond or East Polishing Pond, which are non-CCR units. Therefore, AECOM supplemented this information with pertinent historic drawings provided by DMG. These ponds are hydraulically connected and were therefore included in the modeling efforts. Additional information can be found in Attachments B and C.

---

[1] Although the Hennepin Power Station and East Ash Pond are owned and operated by DMG, Dynegy Administrative Services Company (*Dynegy*) contracted AECOM to develop this Hydrologic and Hydraulic Summary Report on behalf of DMG. Therefore, "Dynegy" is referenced in materials attached to this hydrologic and hydraulic report.

2. IMPOUNDMENT CAPACITY / IMPOUNDMENT COMPUTATIONS

Topographic and bathymetric survey information from the 2015 survey described in Section 1.2 above was used to describe the East Ash Pond geometry. Supplemental topographic information for the East Leachate Pond and the East Polishing Pond was taken from the Initial Facility Report Drawings plan set developed for DMG by Civil & Environmental Consultants, Inc. (Civil & Environmental Consultants Inc., 2010). AECOM used this historic survey data to estimate storage capacity curves for the three impoundments using the conical basin volume equation in HydroCAD. Additional information is provided in in Attachment B.

3. HYDROLOGIC AND HYDRAULIC ANALYSIS OF HENNEPIN PONDS

3.1. *Rainfall Data*

The Rainfall information used in the HydroCAD modeling was based on the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 volume 2, Version 3 which provides rainfall data for storm events with average recurrence intervals ranging from 1 to 1,000 years and durations ranging from 5 minutes to 60 days. The design storm rainfall depth, obtained from NOAA website, is 9.70 in for the 24-hour, 1,000-year storm. The Soil Conservation Service (SCS) Type II storm used by AECOM is appropriate to use for storms up to the 1,000-year flood at the project site. The 100-year flood elevation of the Illinois River (462.0 feet) was used to model the expected tailwater conditions during the 1,000-year storm, as the ultimate outfall from the East Polishing Pond would be submerged by the Illinois River during a 100-year river flood event.

3.2. *Plant Operations and Base-Flow*

Plant operation base-flows include approximately 3.4 million gallons per day (MGD) from process water summarized in the current NPDES permit, dated May 24, 2011. The plant base-flows were added as constant inflow into the East Ash Pond during and after the storm event.

3.3. *Runoff Computations*

The HydroCAD Version 10.0 software, by HydroCAD Software Solutions, LLC, was used to model the East Ash Pond and outlet structure capacities during peak discharges.

The analyzed scenario assumes the starting water surface elevation is elevation of 490.4 feet in the East Ash Pond, based on the 2015 Weaver Consultants Group survey. This is assumed to include process flows and it is 0.5 feet above the invert elevation of the primary spillway of the East Ash Pond. Process water inflow and outflow are included in the analysis as discussed in Section 3.2. Please refer to Attachment B for further details and modeling results.

4. CONCLUSIONS

The inflow design flood control system of the East Ash Pond adequately manages flow from the CCR unit to collect and control the peak discharge resulting from the 1,000-year frequency storm event inflow design flood. Results of the model are summarized in Table 4.1.

Table 4.1
Hennepin Summary of Hydrologic and Hydraulic Analysis,
1,000-Year, 24-Hour Storm

CCR Unit	Beginning WSE[1] (ft)	Peak WSE (ft)	Minimum Crest Elevation (ft)
East Ash Pond	490.4	492.2	493.0

Notes:
[1] WSE = Water Surface Elevation

The peak water surface elevation of 492.2 feet is contained within the embankment crest of East Ash Pond. The East Ash Pond meets the hydraulic requirements of 40 CFR §257.82(a) for certification.

5. LIMITATIONS

Background information, design basis, and other data, which AECOM has used in preparing this report have been furnished to AECOM by DMG. AECOM has relied on this information as furnished, and is not responsible for the accuracy of this information. Our recommendations are based on available information from previous and current investigations. These recommendations may be updated as future investigations are performed.

The conclusions presented in this report are intended only for the purpose, site location, and project indicated. The recommendations presented in this report should not be used for other projects or purposes. Conclusions or recommendations made from these data by others are their responsibility. The conclusions and recommendations are based on AECOM's understanding of current plant operations, maintenance, stormwater handling, and ash handling procedures at the station, as provided by DMG. Changes in any of these operations or procedures may invalidate the findings in this report until AECOM has had the opportunity to review the changes, and revise the report if necessary.

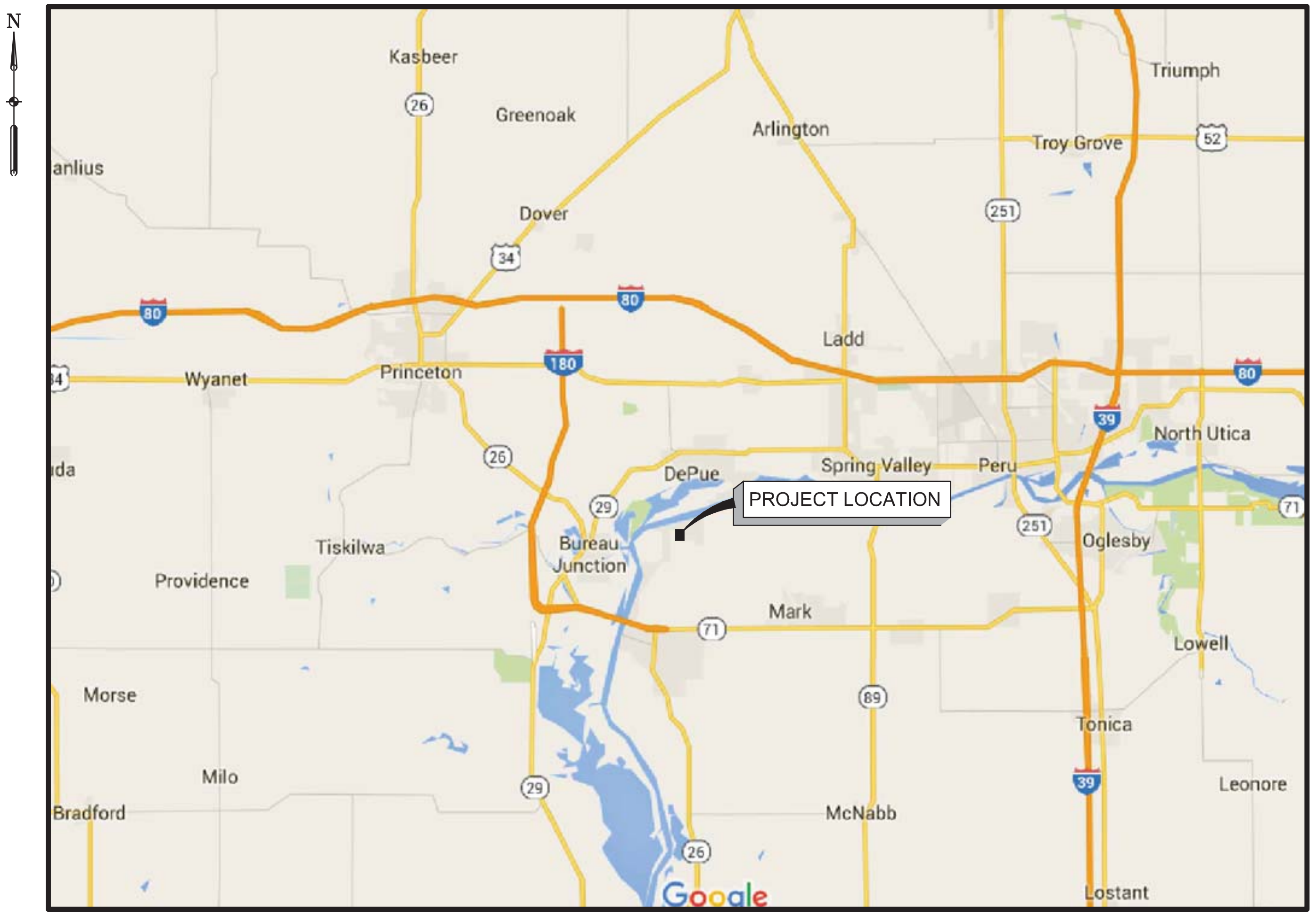
This hydrologic and hydraulic analysis was performed in accordance with the standard of care commonly used as state-of-practice in our profession. Specifically, our services have been performed in accordance with accepted principles and practices of the engineering profession. The conclusions presented in this report are professional opinions based on the indicated project criteria and data available at the time this report was prepared. Our services were provided in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation is intended.

6. REFERENCES

1. Civil & Environmental Consultants, Inc. Initial Facility Report Design Drawings, Hennepin Power Station, November 2010.
2. Weaver Consultants Group, 2015. Topographic and Bathymetric Survey, Hennepin East Ash Pond, performed in 2015. Hennepin, Illinois.

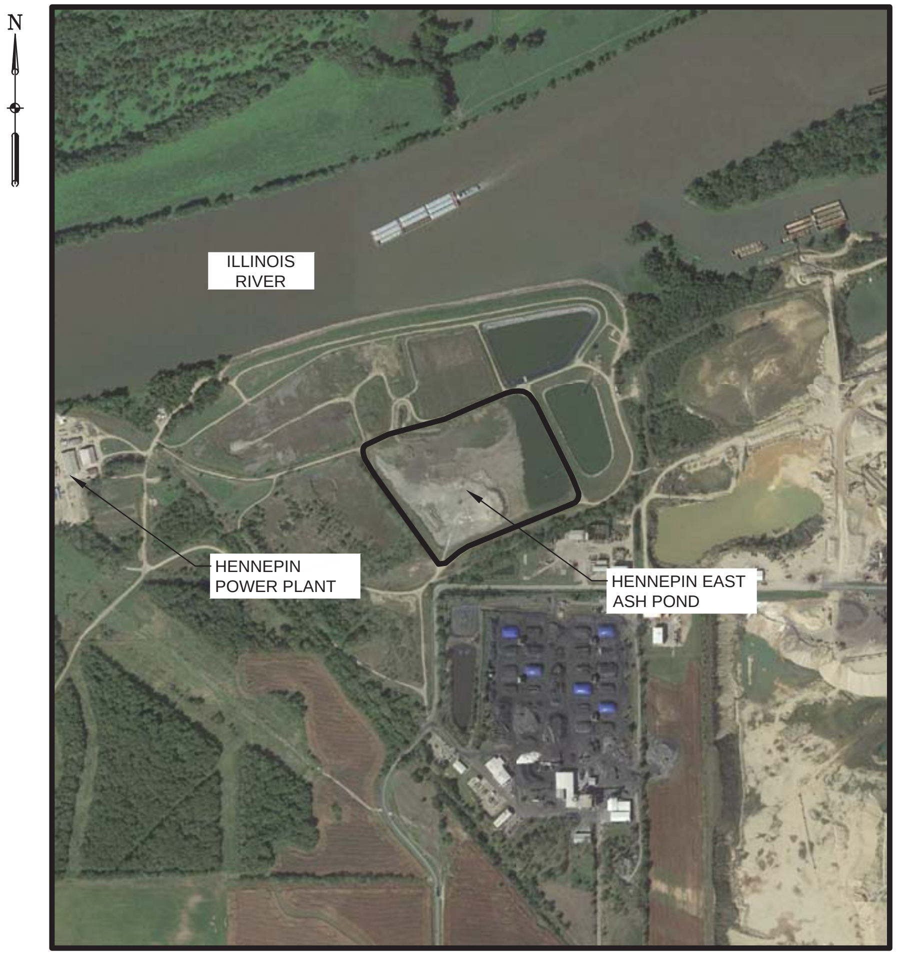
Attachment A

A1 – Location Map and Site Vicinity Map
A2 – Site Map



LOCATION MAP

NOT TO SCALE



VICINITY MAP

NOT TO SCALE

AERIAL FROM GOOGLE EARTH PRO
MAP FROM GOOGLE

AECOM
558 N Main Street
Oshkosh, Wisconsin
920 235-0270 (phone)
920 235-0321 (fax)

DYNEGY
Dynegy Inc.
1500 East Port Plaza Drive
Collinsville, IL 62234

CCR RULE ASSESSMENT
OF PLANTS

HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

H&H REPORT
EAST ASH POND

ISSUED FOR BIDDING DATE BY

ISSUED FOR CONSTRUCTION DATE BY

REVISIONS

NO.	DESCRIPTION	DATE
△		
△		
△		
△		
△		

AECOM PROJECT NO:	60439752
DRAWN BY:	TPB
DESIGNED BY:	TPB
CHECKED BY:	SRA
DATE CREATED:	2/25/2016
PLOT DATE:	2/26/2016
SCALE:	AS SHOWN
ACAD VER:	2014

SHEET TITLE

LOCATION MAP AND
SITE VICINITY MAP

Attachment A-1

AECOM
558 N Main Street
Oshkosh, Wisconsin
920 235-0270 (phone)
920 235-0321 (fax)

DYNEGY
Dynegy Inc.
1500 East Port Plaza Drive
Collinsville, IL 62234

CCR RULE ASSESSMENT OF PLANTS

HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

H&H REPORT
EAST ASH POND

ISSUED FOR BIDDING ______ DATE BY

ISSUED FOR CONSTRUCTION ______ DATE BY

REVISIONS

NO.	DESCRIPTION	DATE
△		
△		
△		
△		
△		

AECOM PROJECT NO: 60439752
DRAWN BY:
DESIGNED BY:
CHECKED BY:
DATE CREATED: 2/17/2016
PLOT DATE: 2/17/2016
SCALE: AS SHOWN
ACAD VER: 2014

SHEET TITLE

SITE MAP

ATTACHMENT A-2

Attachment B

Hydrologic and Hydraulic Analysis

AECOM

Job	**Hennepin Power Station**	Project No.	**60439752**	Sheet	1 of 5
Description	**Site H&H Analysis**	Computed by	**PDD**	Date	**02/23/16**
	East Ash Pond Certification	Checked by	**GK**	Date	**02/23/16**

Objective: This analysis describes the independent investigation and design calculations and considerations of the on-site hydrology and hydraulics as required by the Environmental Protection Agency's (EPA's) Final Coal Combustion Residuals (CCR) Rule. In particular, the analysis investigates the performance of the existing spillways and outlet structures for the Hennepin East Ash Pond during the 1000-year/24-hour storm event as required by the EPA's CCR Rule. AECOM evaluated how the onsite hydraulics will be affected by the existing conditions of the East Ash Pond. In addition, the analyses evaluate how large flows from off-site affect the station's operations.

- **Overview**

The East Ash Pond is part of a multi-pond complex which includes the East Leachate Pond and the East Polishing Pond. Flow from the East Ash Pond which is then discharged into either the East Leachate Pond through the primary spillway structure or into the East Polishing Pond through the secondary spillway structure. The East Polishing Pond discharges into the Illinois River. All three ponds were included in the analysis to accurately model the pond complex.

East Ash Pond

The East Ash Pond receives plant process water flow of approximately 3.4 million galls per day (MGD) and discharges to the East Leachate Pond through an 18-inch reinforced concrete pipe (RCP) through its primary spillway. Its secondary spillway consists of a 7-foot by 9-foot vertical drop inlet structure and discharges to the East Polishing Pond. The normal water surface elevation (WSE) of the East Ash Pond is 490.43 feet as determined from the aerial and bathymetric survey conducted by Weaver Consultants Group in 2015. AECOM assumed that this surveyed WSE includes the process flows as it is higher than the primary spillway invert elevation of 489.9 feet.

East Leachate Pond

The East Leachate Pond receives flows from the landfill to the west and the East Ash Pond. The East Leachate Pond discharges to the East Polishing Pond through a 48-inch by 72-inch vertical drop inlet structure. The normal WSE of the Clarification Pond is 485.0 feet, based on the invert elevation of the outfall structure. The water surface elevation in the East Leachate Pond was not surveyed in 2015.

East Polishing Pond

The East Polishing Pond receives flows from the East Leachate Pond and the East Ash Pond. The East Polishing Pond discharges to the Illinois River through a 7-foot by 9-foot vertical drop inlet structure in accordance with NPDES permit No. IL0001554. The normal WSE of the East Polishing Pond is 480.2 feet, based on the invert elevation of the outfall structure. The water surface elevation in the East Polishing Pond was not surveyed in 2015.

Selected Methods:

AECOM developed a hydrologic model for the pond system using HydroCAD-10 modeling software. Development of the model includes the most recent and available information that best represent the existing conditions at the site. Existing site features and outlet structure information from previous analyses were used as a basis for the model. This information was verified against topographic survey, design drawings, and as-built plans. Bathymetric and topographical survey data performed by Weaver in 2015 was used to update the model. Site soil characteristics from NRCS were used to input hydrologic parameters. Curve numbers were assigned based on soil and land use data. Times of concentrations were calculated in the model based on the longest hydraulic flow path for each sub-catchment. Additional elevations from as-built drawings and current NPDES permitted outflows were used to generate the existing model.

All storm calculations are to include the assumption that the tailwater conditions in the Illinois River during 1000-year/24-hour flood are at elevation 462.0 feet, which is the 100-year flood elevation, and the outlet pipe from the East Polishing Pond would be complete submerged during this condition.

Data & Assumptions

Watershed Area

The Hennepin East Ash Pond complex watershed is separated by the perimeter dike system that surrounds the site. The watershed delineation was performed using topographic survey provided by Dynegy, and supplemented with a 1/9 arc second Digital Elevation Model (DEM) obtained by AECOM from the U.S. Geologic Survey National Map website (http://nationalmap.gov), as the 2015 Weaver survey was limited to the extents of the East Ash Pond and the adjacent Phase 1 landfill and did not extend to adjacent watersheds. The watershed delineation is provided in **Appendix A**. The East Ash Pond complex watershed was sub divided into four Sub-Watersheds to describe the total watershed. The watersheds include the East Ash Pond Watershed (which includes a low area that is part of Ash Pond 2), the East Polishing Pond watershed, the East Leachate Pond watershed, and the Phase 1 landfill watershed that drains into the East Leachate Pond. The sub-watersheds are summarized in Table 1 below.

Table 1 Summary of Sub-Watersheds

Sub-Watershed	Area (acres)	Area (square miles)	Drainage Path Description
East Ash Pond	23.75	0.0371	Direct runoff to East Ash Pond
Phase 1 Landfill	6.32	0.0099	Direct runoff from Landfill to East Leachate Pond
East Leachate Pond	8.18	0.0097	Direct runoff to East Leachate Pond
East Polishing Pond	8.80	0.0138	Direct runoff to East Polishing Pond
Total:	**45.05**	**0.0705**	-

Rainfall Depths

The 1000-year/24-hour storm was evaluated to meet the CCR Rule. The National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Point Precipitation Frequency Estimates near the Hennepin Power Station was used to obtain the design storm depth of 9.7 inches. The data obtained from NOAA Atlas is presented in **Appendix B.**

Loss Rates

The runoff loss rates are dependent upon land use, hydrologic soil groups, and antecedent moisture conditions. The land use at the project site includes reservoirs, gravel roads and industrial. The underlying soil at the project site is a combination of urban land, orthents, and silty loams based on the Natural Resources Conservation Service (NRCS) Web Soil Survey with a hydrologic soil group of predominately Group C. Group C infiltration rates are estimated to be between 0 to 0.05 in. per hour. An Antecedent Moisture Condition (AMC) of II was used to describe average moisture condition before the storm events. The Web Soil Survey Report is included in **Appendix C**. These factors were combined to estimate a SCS Runoff Curve Number (RCN). A high RCN indicates low infiltration rates with greater runoff volumes, while a low RCN indicates high infiltration rates with lesser runoff volumes. For this analysis, a RCN of 96 was selected for gravel surfaces, 91 for industrial areas, 74 to 89 for grass cover, and 98 for water surfaces. Calculations for the weighted runoff curve numbers for each sub-watershed were performed in HydroCAD and are included in **Appendix F**.

Unit Hydrograph Methods

The SCS Type II Rainfall Distribution was used for the 1000-year/24-hour storm event.

Illinois River Water Levels

The final outfall of the East Ash Pond complex is through a 36-inch RCP pipe that discharges into the Illinois River from the East Polishing Pond. Since the 36-inch RCP discharges directly into the Illinois River, high water surface elevations in the river may submerge the pipe and reduce its capacity. The Illinois River was included in the HydroCAD model to determine tailwater effects on the Ash Pond outfall performance.

The 100-year water surface elevation of Illinois River was used as the elevation of the river during the PMP storm event. In this condition, the 36-inch RCP discharge pipe through the dike was fully submerged resulting in no discharge flow from the Ash Pond during the design storm event. The FEMA Flood data (**Appendix D**) reported the 100-year water surface elevation to be approximately 462.0 feet.

Plant Operations and Base-Flow

Plant operation base-flows include approximately 3.4 million gallons per day (MGD) from process water included in the bottom ash, fly ash and plant sumps. These base flows were taken from the NPDES permit Renewal Application Dated May 24, 2011. It was assumed that these base flows were included in the surveyed WSE of East Ash Pond, as the surveyed WSE in the East Ash Pond was approximately 0.5 feet higher than the invert elevation of the outfall structure.

- ## Results

Flood Stage Hydraulic Analysis Results Summary

Table 2 below gives details of the maximum pond water surface elevation for the design storm for the East Ash Pond, and inflow and discharge rates for the 1000-year/24-hour storm event.

Table 2 – East Ash Pond– 1000-year/24-hour storm

Storm Event	Rainfall Depth (inches)	Peak IDF Inflow (cfs)	Inflow Design Flood Pool (feet)	Outflow (cfs)	Beginning WSE (ft)	Peak WSE (ft)	Minimum Crest Elevation (ft)
1000-year/24-hour	9.7	266	491.8	40	490.4	492.2	493.0

- ## Conclusions

Based on the HydroCAD model results, the East Ash Pond does not overtop its crest during the 1000-year/24-hour storm event. Nearby off-site drainage does not enter the East Ash Pond through culverts or overtopping of the outside berms. Therefore, the Hennepin Power Station East Ash Pond meets the hydrologic and hydraulic requirements for certification under CCR regulations.

- ## List of Appendices

Appendix A – HydroCAD Model Schematic

Appendix B – Significant Hazard Rainfall Depths (NOAA)

AECOM

Job	**Hennepin Power Station**	Project No.	**60439752**	Sheet	5	of	5
Description	**Site H&H Analysis**	Computed by	**PDD**	Date	**02/23/16**		
	East Ash Pond Certification	Checked by	**GK**	Date	**02/23/16**		

Appendix C – NRCS Soil Survey

Appendix D – FEMA Flood Insurance Rate Map

Appendix E – PMP/24-hour storm HydroCAD Output

Appendix A

HydroCAD Model Schematic

AECOM

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Oshkosh, Wisconsin
920 235-0270 (phone)
920 235-0321 (fax)

DYNEGY

Dynegy Inc.
1500 East Port Plaza Drive
Collinsville, IL 62234

CCR RULE ASSESSMENT OF PLANTS

HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

H&H REPORT
EAST ASH POND

ISSUED FOR BIDDING ____ DATE BY

ISSUED FOR CONSTRUCTION ____ DATE BY

REVISIONS

NO.	DESCRIPTION	DATE
△		
△		
△		
△		
△		

AECOM PROJECT NO:	60439752
DRAWN BY:	
DESIGNED BY:	
CHECKED BY:	
DATE CREATED:	2/17/2016
PLOT DATE:	2/17/2016
SCALE:	AS SHOWN
ACAD VER:	2014

SHEET TITLE

HYDROCAD
MODEL
SCHEMATIC

ATTACHMENT C-1

Appendix B

Significant Hazard Rainfall Depths (NOAA)

AECOM

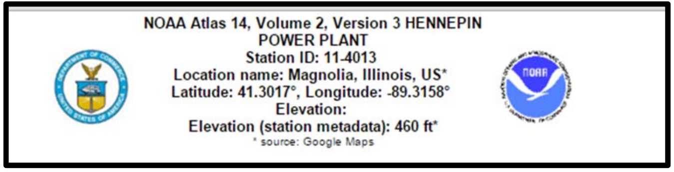
Project: Hennepin
Client: Dynegy, Inc.
Location: Hennepin Ash Pond Assessment
Project #: 60439752

Prepared By: J. Jacak
Date: 12/28/2015
Checked By:P. Drew
Date:01/14/2016

Project: Hennepin Ash Pond Assessment

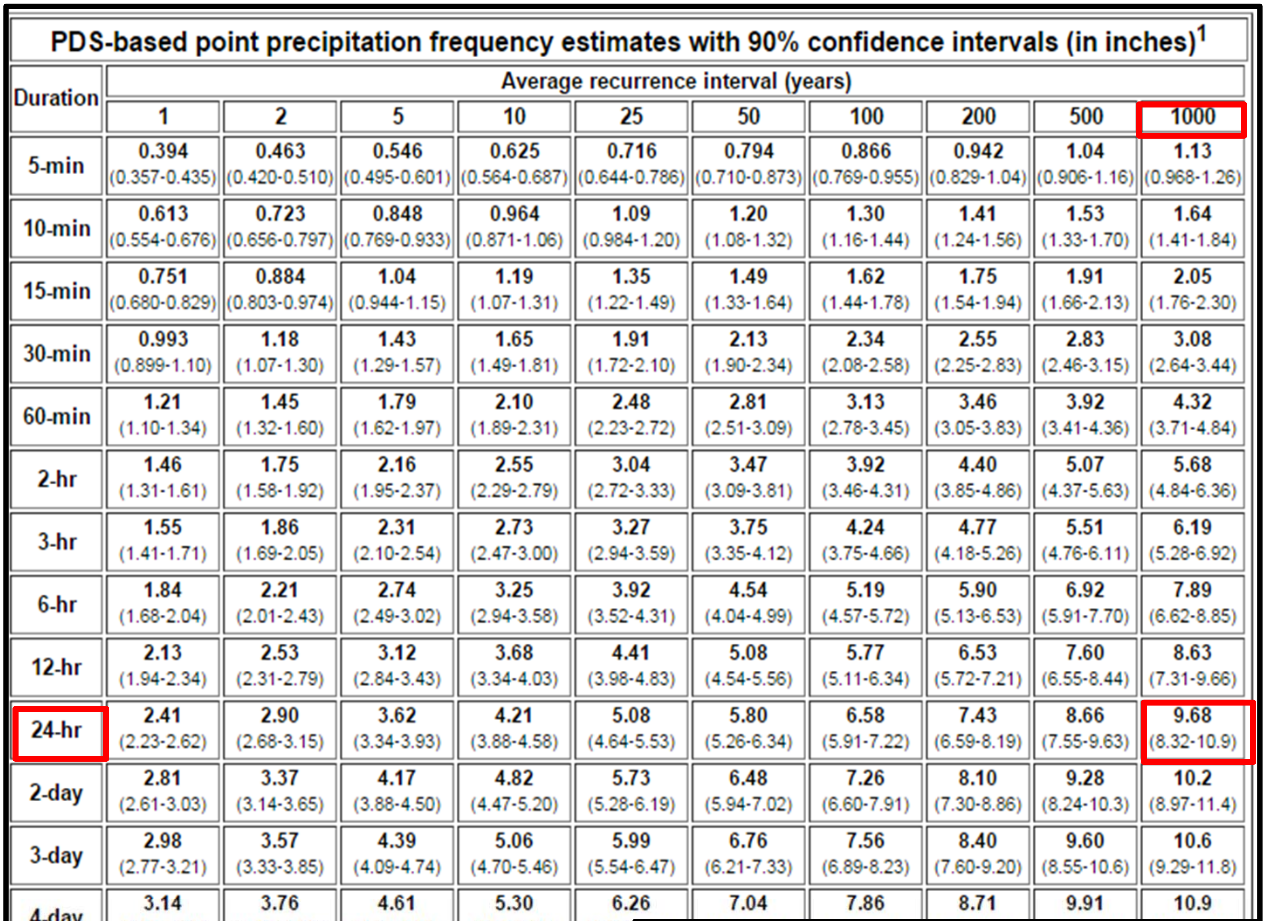
1,000 - Year Rainfall Depth

Significant Hazard Rating IDF



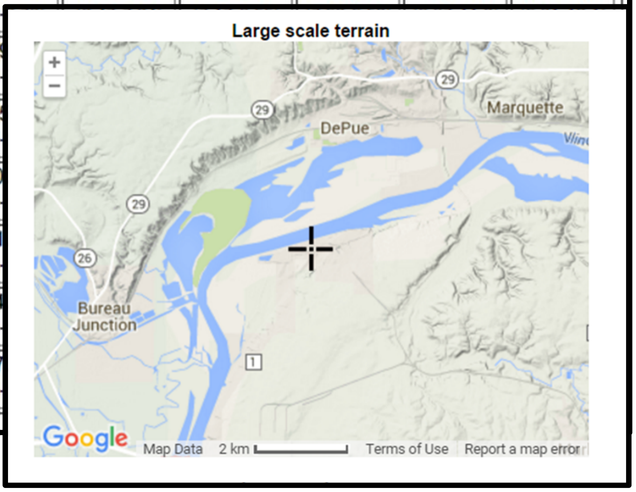
NOAA Atlas 14, Volume 2, Version 3 HENNEPIN
POWER PLANT
Station ID: 11-4013
Location name: Magnolia, Illinois, US*
Latitude: 41.3017°, Longitude: -89.3158°
Elevation:
Elevation (station metadata): 460 ft*
* source: Google Maps

Source: NOAA Atlas 14 Point Precipitation Frequency Estimates: At Hennepin Power Plant
http://dipper.nws.noaa.gov/hdsc/pfds/



PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.394 (0.357-0.435)	0.463 (0.420-0.510)	0.546 (0.495-0.601)	0.625 (0.564-0.687)	0.716 (0.644-0.786)	0.794 (0.710-0.873)	0.866 (0.769-0.955)	0.942 (0.829-1.04)	1.04 (0.906-1.16)	1.13 (0.968-1.26)
10-min	0.613 (0.554-0.676)	0.723 (0.656-0.797)	0.848 (0.769-0.933)	0.964 (0.871-1.06)	1.09 (0.984-1.20)	1.20 (1.08-1.32)	1.30 (1.16-1.44)	1.41 (1.24-1.56)	1.53 (1.33-1.70)	1.64 (1.41-1.84)
15-min	0.751 (0.680-0.829)	0.884 (0.803-0.974)	1.04 (0.944-1.15)	1.19 (1.07-1.31)	1.35 (1.22-1.49)	1.49 (1.33-1.64)	1.62 (1.44-1.78)	1.75 (1.54-1.94)	1.91 (1.66-2.13)	2.05 (1.76-2.30)
30-min	0.993 (0.899-1.10)	1.18 (1.07-1.30)	1.43 (1.29-1.57)	1.65 (1.49-1.81)	1.91 (1.72-2.10)	2.13 (1.90-2.34)	2.34 (2.08-2.58)	2.55 (2.25-2.83)	2.83 (2.46-3.15)	3.08 (2.64-3.44)
60-min	1.21 (1.10-1.34)	1.45 (1.32-1.60)	1.79 (1.62-1.97)	2.10 (1.89-2.31)	2.48 (2.23-2.72)	2.81 (2.51-3.09)	3.13 (2.78-3.45)	3.46 (3.05-3.83)	3.92 (3.41-4.36)	4.32 (3.71-4.84)
2-hr	1.46 (1.31-1.61)	1.75 (1.58-1.92)	2.16 (1.95-2.37)	2.55 (2.29-2.79)	3.04 (2.72-3.33)	3.47 (3.09-3.81)	3.92 (3.46-4.31)	4.40 (3.85-4.86)	5.07 (4.37-5.63)	5.68 (4.84-6.36)
3-hr	1.55 (1.41-1.71)	1.86 (1.69-2.05)	2.31 (2.10-2.54)	2.73 (2.47-3.00)	3.27 (2.94-3.59)	3.75 (3.35-4.12)	4.24 (3.75-4.66)	4.77 (4.18-5.26)	5.51 (4.76-6.11)	6.19 (5.28-6.92)
6-hr	1.84 (1.68-2.04)	2.21 (2.01-2.43)	2.74 (2.49-3.02)	3.25 (2.94-3.58)	3.92 (3.52-4.31)	4.54 (4.04-4.99)	5.19 (4.57-5.72)	5.90 (5.13-6.53)	6.92 (5.91-7.70)	7.89 (6.62-8.85)
12-hr	2.13 (1.94-2.34)	2.53 (2.31-2.79)	3.12 (2.84-3.43)	3.68 (3.34-4.03)	4.41 (3.98-4.83)	5.08 (4.54-5.56)	5.77 (5.11-6.34)	6.53 (5.72-7.21)	7.60 (6.55-8.44)	8.63 (7.31-9.66)
24-hr	2.41 (2.23-2.62)	2.90 (2.68-3.15)	3.62 (3.34-3.93)	4.21 (3.88-4.58)	5.08 (4.64-5.53)	5.80 (5.26-6.34)	6.58 (5.91-7.22)	7.43 (6.59-8.19)	8.66 (7.55-9.63)	9.68 (8.32-10.9)
2-day	2.81 (2.61-3.03)	3.37 (3.14-3.65)	4.17 (3.88-4.50)	4.82 (4.47-5.20)	5.73 (5.28-6.19)	6.48 (5.94-7.02)	7.26 (6.60-7.91)	8.10 (7.30-8.86)	9.28 (8.24-10.3)	10.2 (8.97-11.4)
3-day	2.98 (2.77-3.21)	3.57 (3.33-3.85)	4.39 (4.09-4.74)	5.06 (4.70-5.46)	5.99 (5.54-6.47)	6.76 (6.21-7.33)	7.56 (6.89-8.23)	8.40 (7.60-9.20)	9.60 (8.55-10.6)	10.6 (9.29-11.8)
4-day	3.14 (2.93-3.39)	3.76 (3.51-4.06)	4.61 (4.30-4.97)	5.30 (4.93-5.72)	6.26 (5.79	7.04	7.86	8.71	9.91	10.9
7-day	3.65 (3.41-3.93)	4.35 (4.07-4.69)	5.25 (4.91-5.66)	5.96 (5.56-6.43)	6. (6.43-					
10-day	4.15 (3.89-4.45)	4.94 (4.62-5.30)	5.89 (5.51-6.32)	6.62 (6.18-7.12)	7. (7.07-					
20-day	5.57 (5.22-5.93)	6.61 (6.21-7.07)	7.87 (7.39-8.41)	8.80 (8.25-9.42)	10 (9.37-					
30-day	6.87 (6.48-7.28)	8.14 (7.68-8.65)	9.54 (8.98-10.1)	10.6 (9.94-11.2)	11 (11.1-					
45-day	8.62 (8.15-9.11)	10.2 (9.64-10.8)	11.9 (11.2-12.6)	13.1 (12.4-13.8)	14 (13.8-					
60-day	10.3 (9.72-10.9)	12.1 (11.5-12.8)	14.0 (13.3-14.8)	15.4 (14.5-16.3)	17 (16.1-					

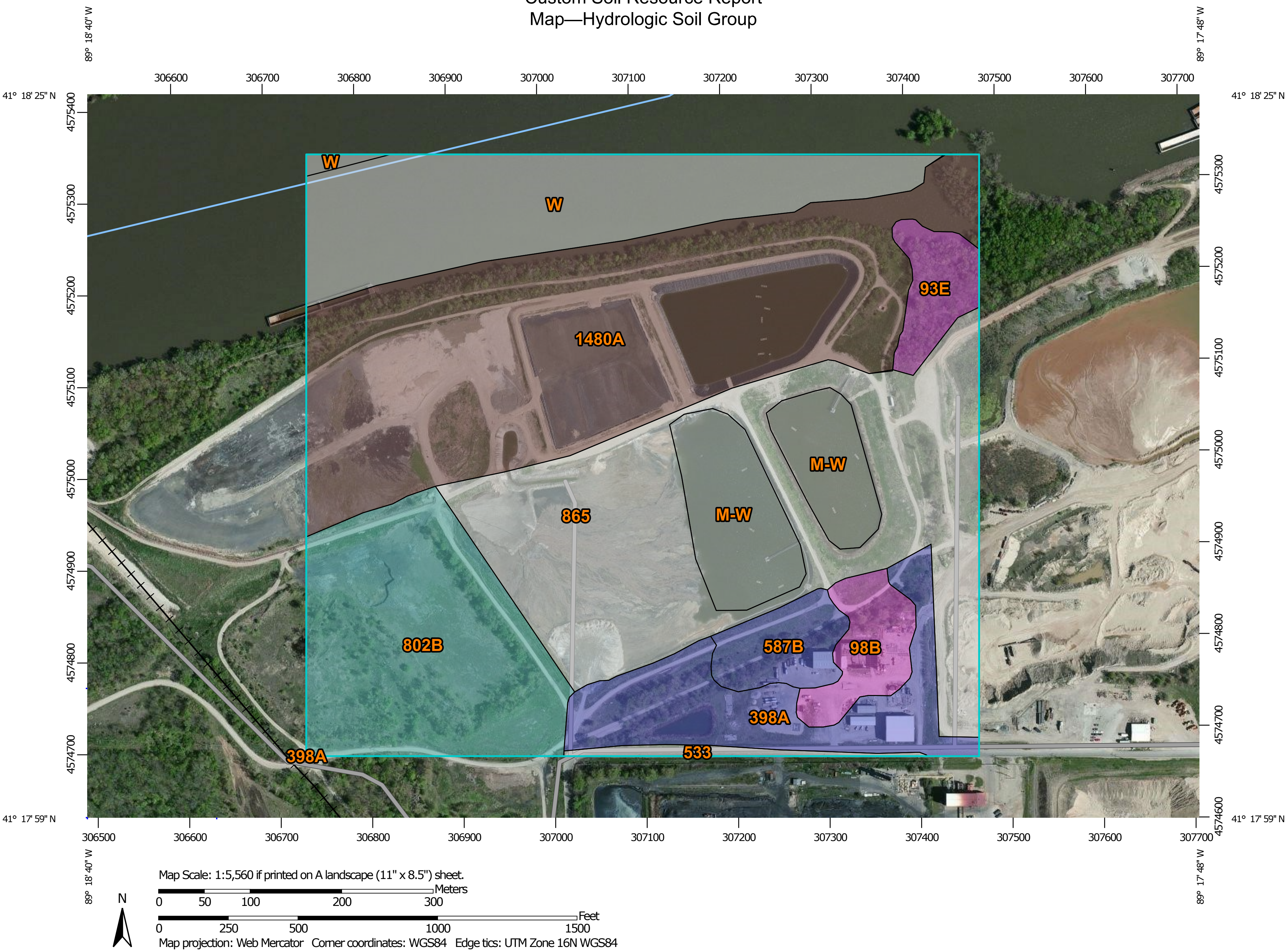


Large scale terrain

Appendix C

NRCS Soil Survey

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:5,560 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

- □ Area of Interest (AOI)

Soils

Soil Rating Polygons

- 🟪 A
- 🟩 A/D
- 🟦 B
- 🟫 B/D
- 🟦 C
- 🟨 C/D
- 🟥 D
- ⬜ Not rated or not available

Soil Rating Lines

- 〰 A
- 〰 A/D
- 〰 B
- 〰 B/D
- 〰 C
- 〰 C/D
- 〰 D
- 〰 Not rated or not available

Soil Rating Points

- 🟪 A
- 🟩 A/D
- 🟦 B
- 🟫 B/D
- 🟦 C
- 🟫 C/D
- 🟥 D
- ⬜ Not rated or not available

Water Features

- 〰 Streams and Canals

Transportation

- ┼┼┼ Rails
- 〰 Interstate Highways
- 〰 US Routes
- 〰 Major Roads
- 〰 Local Roads

Background

- 🟩 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:12,000 to 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bureau County, Illinois
Survey Area Data: Version 13, Sep 25, 2015

Soil Survey Area: Putnam County, Illinois
Survey Area Data: Version 10, Sep 25, 2015

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Data not available.

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Bureau County, Illinois (IL011)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
W	Water		0.3	0.2%
Subtotals for Soil Survey Area			**0.3**	**0.2%**
Totals for Area of Interest			**119.7**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — Putnam County, Illinois (IL155)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
93E	Rodman gravelly sandy loam, 12 to 20 percent slopes	A	2.5	2.1%
98B	Ade loamy fine sand, 1 to 6 percent slopes	A	3.0	2.5%
398A	Wea silt loam, 0 to 2 percent slopes	B	8.4	7.0%
533	Urban land		0.8	0.7%
587B	Terril loam, 2 to 5 percent slopes	B	2.9	2.4%
802B	Orthents, loamy, undulating	C	16.1	13.4%
865	Pits, gravel		25.9	21.7%
1480A	Moundprairie silty clay loam, undrained, 0 to 2 percent slopes, frequently flooded	B/D	35.7	29.9%
M-W	Miscellaneous water		8.4	7.0%
W	Water		15.7	13.1%
Subtotals for Soil Survey Area			**119.4**	**99.8%**
Totals for Area of Interest			**119.7**	**100.0%**

Rating Options—Hydrologic Soil Group

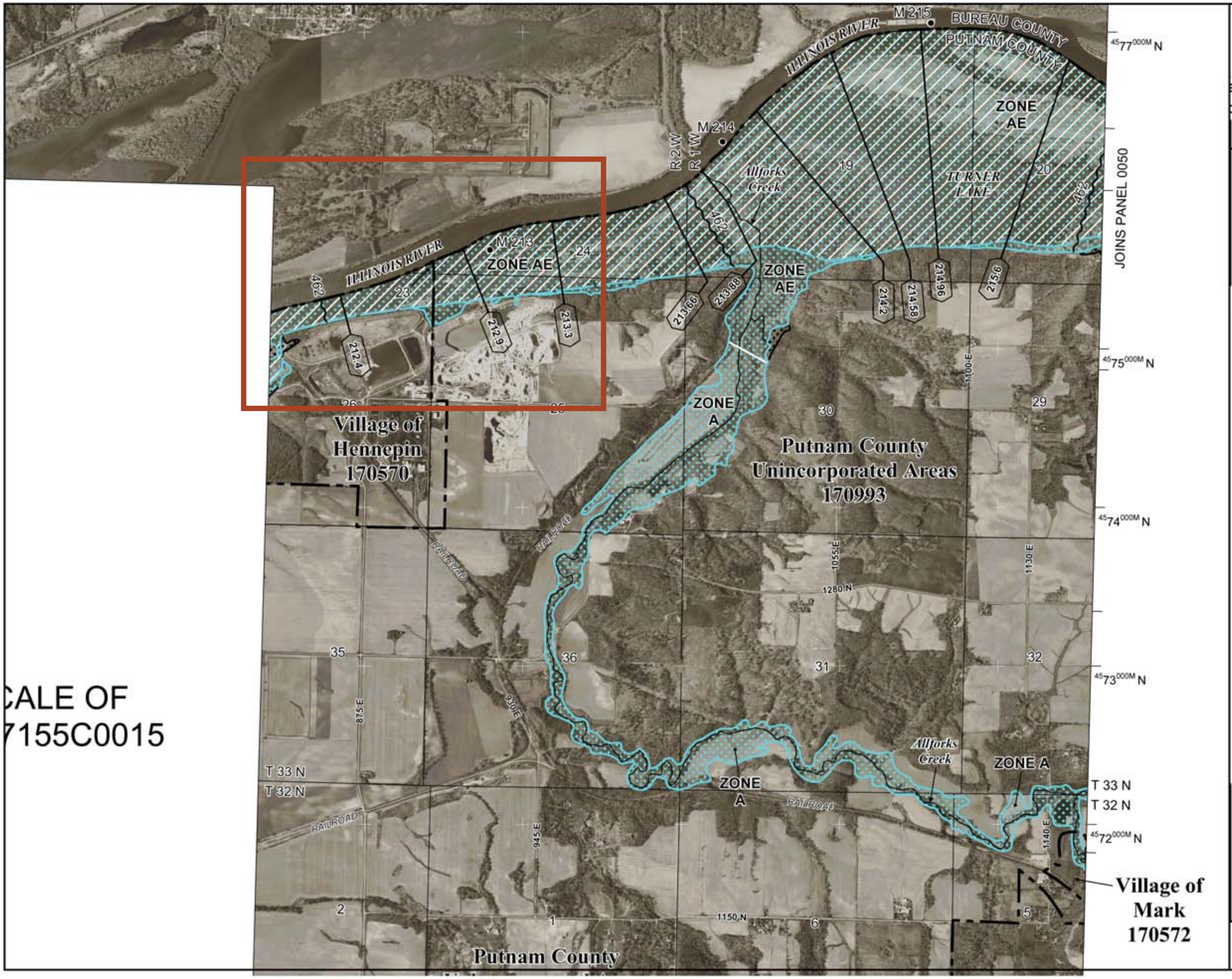
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix D

FEMA Flood Insurance Rate Map



MAP SCALE 1" = 2000'

0 2000 4000 FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0025E

FIRM
FLOOD INSURANCE RATE MAP
PUTNAM COUNTY, ILLINOIS
AND INCORPORATED AREAS

PANEL 25 OF 175

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
HENNEPIN, VILLAGE OF	170570	0025	E
MARK, VILLAGE OF	170572	0025	E
PUTNAM COUNTY	170993	0025	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
17155C0025E

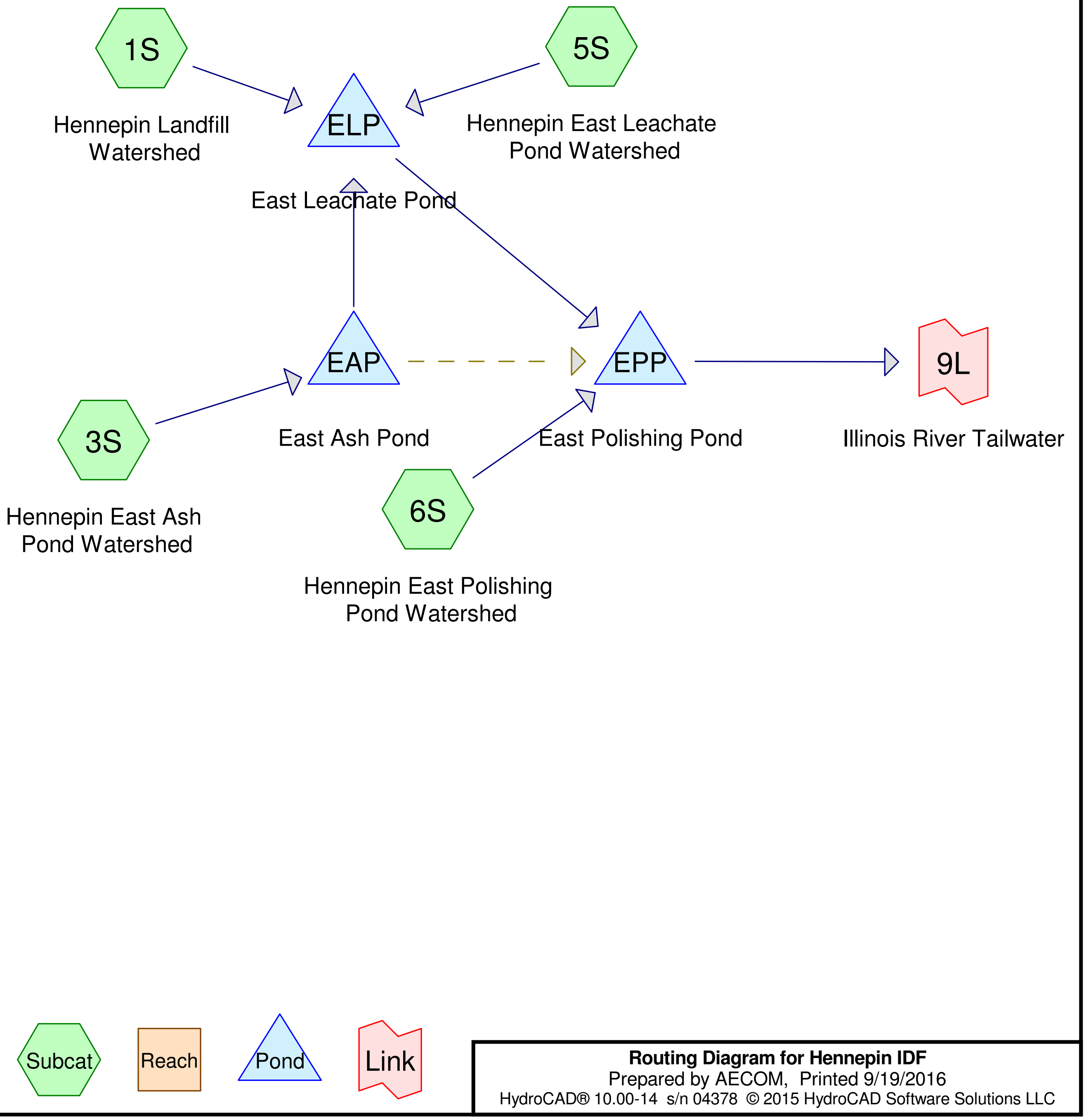
EFFECTIVE DATE
FEBRUARY 4, 2011

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Appendix E

1000-year/24-hour Storm HydroCAD Output



Routing Diagram for Hennepin IDF
Prepared by AECOM, Printed 9/19/2016
HydroCAD® 10.00-14 s/n 04378 © 2015 HydroCAD Software Solutions LLC

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 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: Hennepin Landfill Runoff Area=6.318 ac 0.00% Impervious Runoff Depth=8.48"
Flow Length=830' Tc=22.9 min CN=90 Runoff=51.51 cfs 4.466 af

Subcatchment 3S: Hennepin East Ash Runoff Area=23.752 ac 62.90% Impervious Runoff Depth=8.48"
Flow Length=817' Tc=12.3 min CN=90 Runoff=260.59 cfs 16.791 af

Subcatchment 5S: Hennepin East Leachate Runoff Area=6.183 ac 85.38% Impervious Runoff Depth=9.22"
Flow Length=86' Slope=0.1100 '/' Tc=6.0 min CN=96 Runoff=85.32 cfs 4.749 af

Subcatchment 6S: Hennepin East Runoff Area=8.803 ac 44.04% Impervious Runoff Depth=8.11"
Flow Length=361' Tc=6.0 min CN=87 Runoff=115.40 cfs 5.951 af

Pond EAP: East Ash Pond Peak Elev=491.92' Storage=33.569 af Inflow=260.59 cfs 16.791 af
Primary=9.61 cfs 10.276 af Secondary=23.61 cfs 8.011 af Outflow=33.22 cfs 18.286 af

Pond ELP: East Leachate Pond Peak Elev=485.96' Storage=17.093 af Inflow=122.14 cfs 19.491 af
Outflow=28.69 cfs 19.414 af

Pond EPP: East Polishing Pond Peak Elev=482.27' Storage=52.078 af Inflow=151.86 cfs 33.375 af
Outflow=44.55 cfs 33.176 af

Link 9L: Illinois River Tailwater Inflow=44.55 cfs 33.176 af
Primary=44.55 cfs 33.176 af

Total Runoff Area = 45.056 ac Runoff Volume = 31.958 af Average Runoff Depth = 8.51"
46.52% Pervious = 20.960 ac 53.48% Impervious = 24.096 ac

Summary for Subcatchment 1S: Hennepin Landfill Watershed

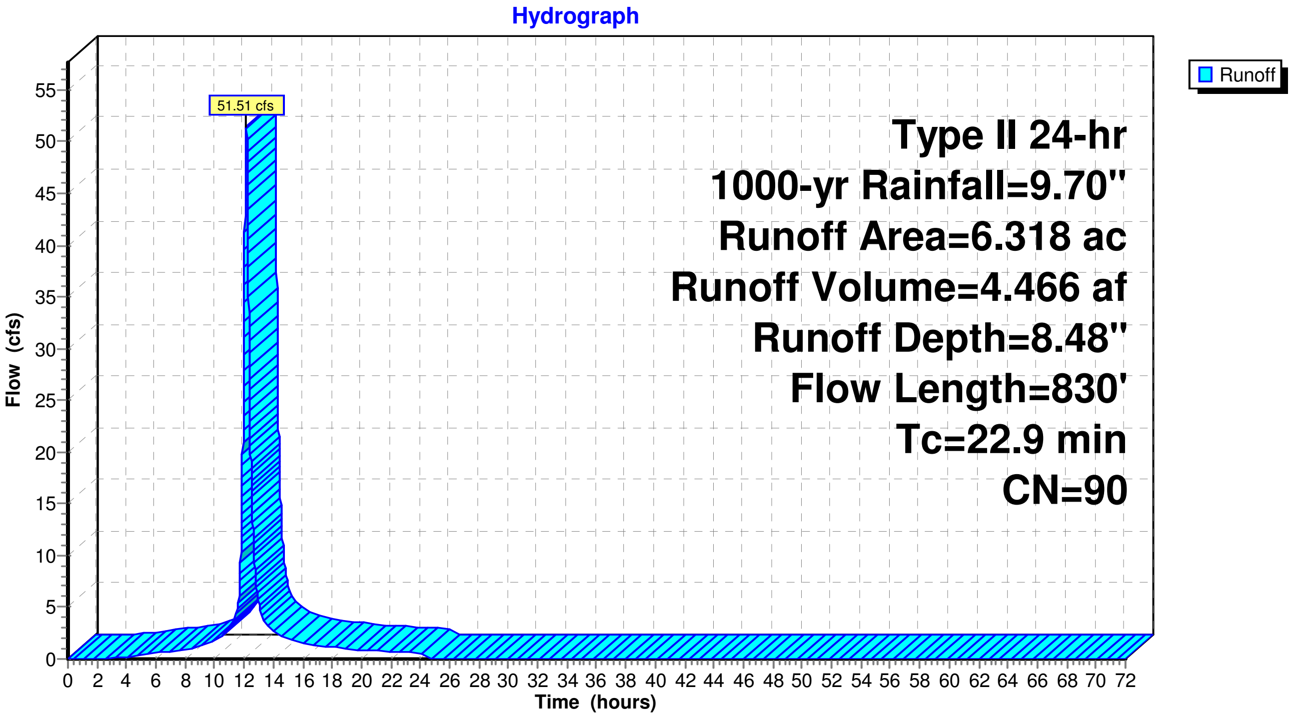
Runoff = 51.51 cfs @ 12.14 hrs, Volume= 4.466 af, Depth= 8.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000-yr Rainfall=9.70"

Area (ac)	CN	Description
1.065	96	Gravel surface, HSG D
5.253	89	<50% Grass cover, Poor, HSG D
6.318	90	Weighted Average
6.318		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.9	100	0.0050	0.09		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.90"
4.6	392	0.0090	1.42		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.4	338	0.0210	13.57	42.62	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.010 PVC, smooth interior
22.9	830	Total			

Subcatchment 1S: Hennepin Landfill Watershed



Summary for Subcatchment 3S: Hennepin East Ash Pond Watershed

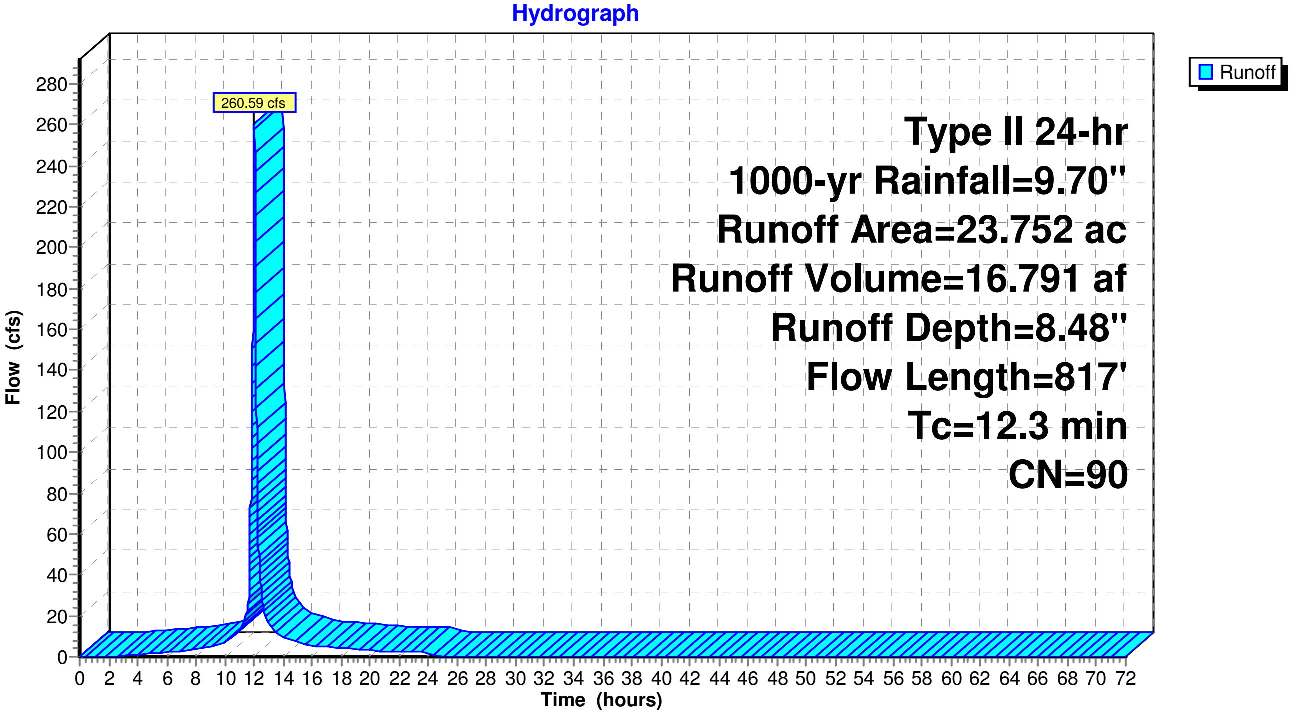
Runoff = 260.59 cfs @ 12.04 hrs, Volume= 16.791 af, Depth= 8.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000-yr Rainfall=9.70"

Area (ac)	CN	Description
7.757	98	Water Surface, HSG C
1.095	96	Gravel surface, HSG C
4.924	74	>75% Grass cover, Good, HSG C
9.976	91	Urban industrial, 72% imp, HSG C
23.752	90	Weighted Average
8.812		37.10% Pervious Area
14.940		62.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	100	0.0350	0.49		**Sheet Flow, Sheet Flow** Fallow n= 0.050 P2= 2.90"
8.9	717	0.0070	1.35		**Shallow Concentrated Flow, Overland Flow** Unpaved Kv= 16.1 fps
12.3	817	Total			

Subcatchment 3S: Hennepin East Ash Pond Watershed



Summary for Subcatchment 5S: Hennepin East Leachate Pond Watershed

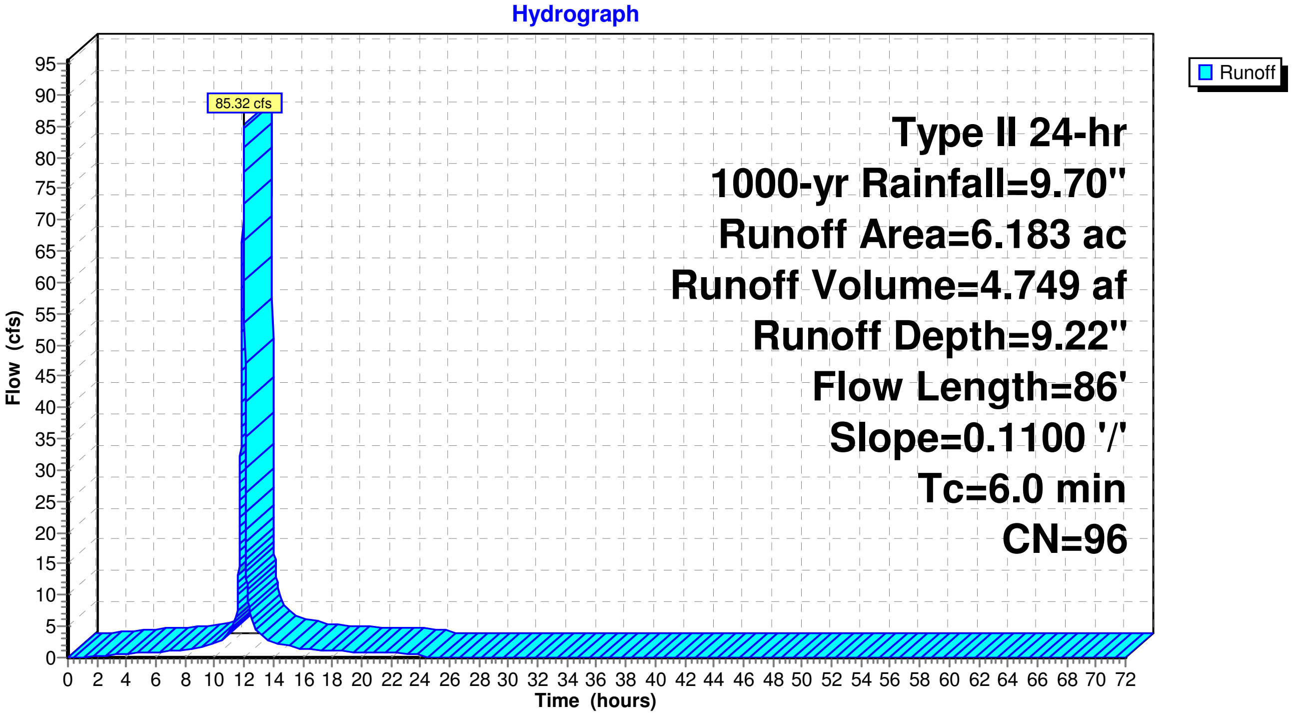
Runoff = 85.32 cfs @ 11.97 hrs, Volume= 4.749 af, Depth= 9.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000-yr Rainfall=9.70"

Area (ac)	CN	Description
5.279	98	Water Surface, HSG D
0.170	96	Gravel surface, HSG D
0.734	84	50-75% Grass cover, Fair, HSG D
6.183	96	Weighted Average
0.904		14.62% Pervious Area
5.279		85.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	86	0.1100	0.31		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.90"
4.6	86	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 5S: Hennepin East Leachate Pond Watershed



Summary for Subcatchment 6S: Hennepin East Polishing Pond Watershed

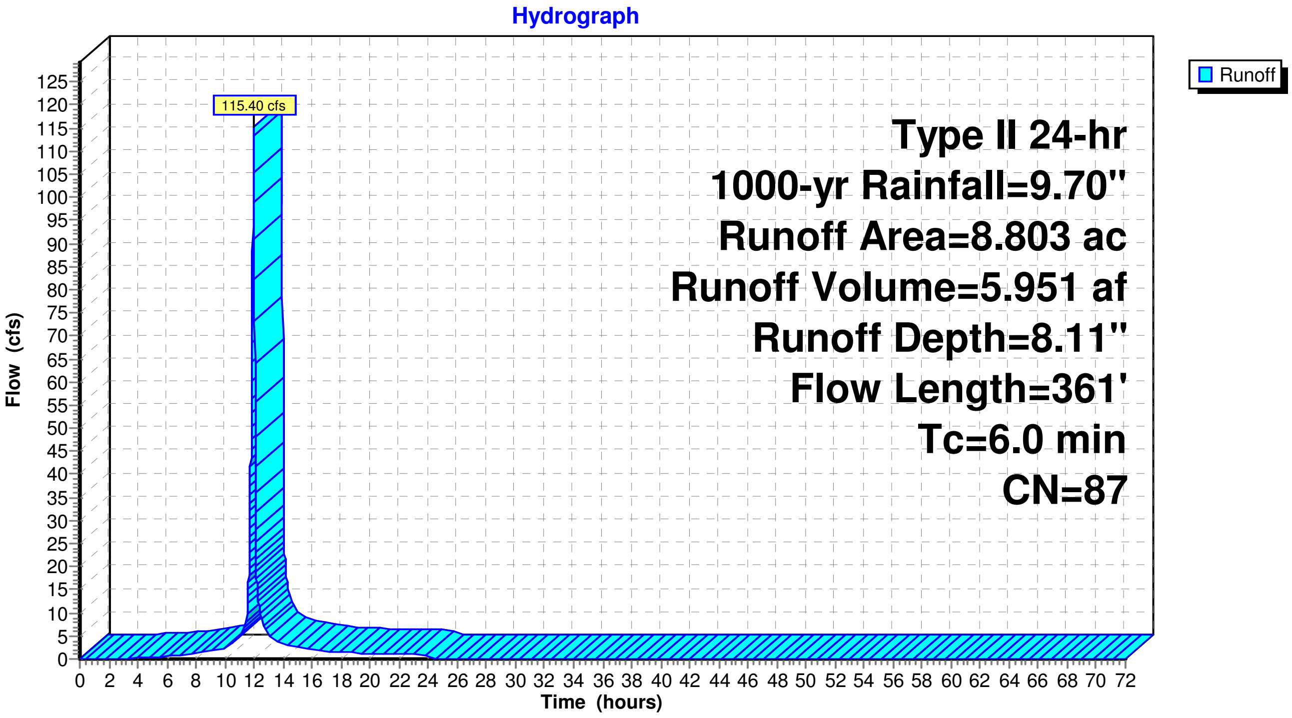
Runoff = 115.40 cfs @ 11.97 hrs, Volume= 5.951 af, Depth= 8.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 1000-yr Rainfall=9.70"

Area (ac)	CN	Description
3.316	98	Water Surface, HSG C
0.869	96	Gravel surface, HSG C
3.839	74	>75% Grass cover, Good, HSG C
0.779	91	Urban industrial, 72% imp, HSG C
8.803	87	Weighted Average
4.926		55.96% Pervious Area
3.877		44.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	100	0.0400	0.51		**Sheet Flow,** Fallow n= 0.050 P2= 2.90"
2.1	261	0.0840	2.03		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
5.3	361	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 6S: Hennepin East Polishing Pond Watershed



Summary for Pond EAP: East Ash Pond

Inflow Area = 23.752 ac, 62.90% Impervious, Inflow Depth = 8.48" for 1000-yr event
Inflow = 260.59 cfs @ 12.04 hrs, Volume= 16.791 af
Outflow = 33.22 cfs @ 12.47 hrs, Volume= 18.286 af, Atten= 87%, Lag= 26.3 min
Primary = 9.61 cfs @ 12.47 hrs, Volume= 10.276 af
Secondary = 23.61 cfs @ 12.47 hrs, Volume= 8.011 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Starting Elev= 490.43' Surf.Area= 4.363 ac Storage= 25.199 af
Peak Elev= 491.92' @ 12.47 hrs Surf.Area= 6.515 ac Storage= 33.569 af (8.369 af above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 329.4 min (1,102.1 - 772.8)

Volume	Invert	Avail.Storage	Storage Description
#1	475.00'	57.957 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
475.00	0.040	0.000	0.000	0.040
476.00	0.120	0.076	0.076	0.120
477.00	0.310	0.208	0.284	0.310
478.00	0.480	0.392	0.676	0.481
479.00	0.650	0.563	1.239	0.651
480.00	0.840	0.743	1.982	0.842
481.00	1.010	0.924	2.905	1.012
482.00	1.210	1.108	4.014	1.213
483.00	1.420	1.314	5.328	1.424
484.00	1.690	1.553	6.881	1.695
485.00	2.090	1.886	8.767	2.096
486.00	2.420	2.253	11.020	2.427
487.00	2.850	2.632	13.652	2.858
488.00	3.220	3.033	16.685	3.229
489.00	3.410	3.315	20.000	3.421
490.00	3.580	3.495	23.494	3.594
491.00	5.520	4.515	28.010	5.534
492.00	6.600	6.052	34.062	6.615
493.00	7.520	7.055	41.117	7.536
494.00	8.340	7.926	49.043	8.358
495.00	9.500	8.914	57.957	9.519

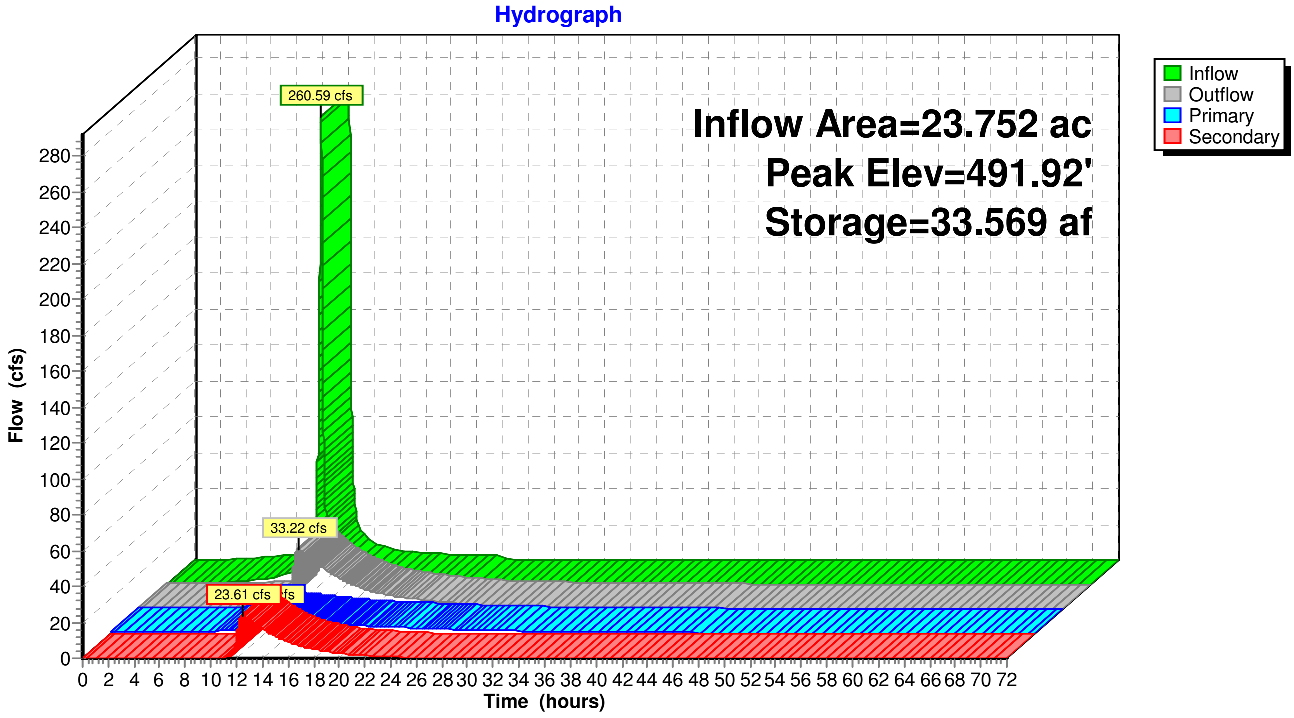
Device	Routing	Invert	Outlet Devices
#1	Primary	489.90'	**18.0" Round Culvert** L= 70.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 489.90' / 487.20' S= 0.0386 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf
#2	Secondary	458.00'	**36.0" Round Culvert** L= 300.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 458.00' / 457.50' S= 0.0017 '/' Cc= 0.900

			n= 0.012 Concrete pipe, finished, Flow Area= 7.07 sf
#3	Device 2	490.60'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Device 2	493.20'	**60.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=9.61 cfs @ 12.47 hrs HW=491.92' TW=485.95' (Dynamic Tailwater)
└—**1=Culvert** (Inlet Controls 9.61 cfs @ 5.44 fps)

Secondary OutFlow Max=23.61 cfs @ 12.47 hrs HW=491.92' TW=481.87' (Dynamic Tailwater)
└—**2=Culvert** (Passes 23.61 cfs of 98.21 cfs potential flow)
  ├—**3=Sharp-Crested Rectangular Weir** (Weir Controls 23.61 cfs @ 3.76 fps)
  └—**4=Orifice/Grate** (Controls 0.00 cfs)

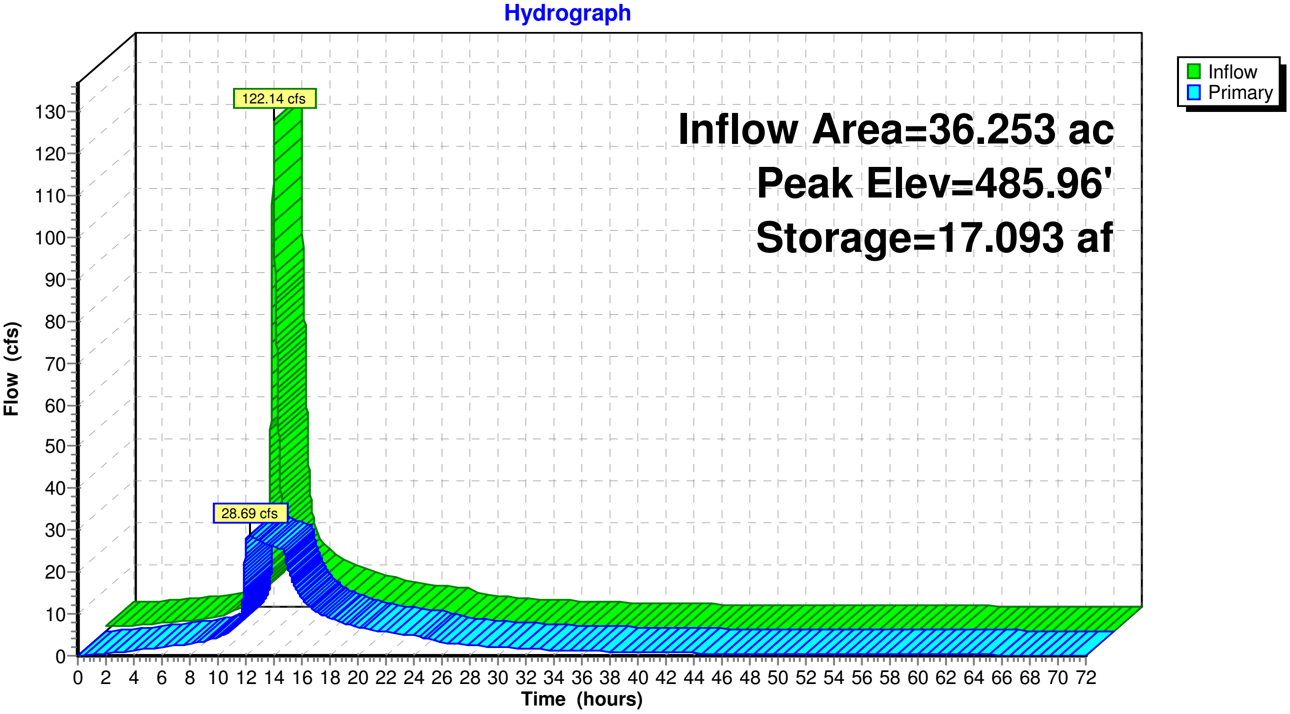
Pond EAP: East Ash Pond



Summary for Pond ELP: East Leachate Pond

```
Inflow Area =       36.253 ac,  55.77% Impervious,  Inflow Depth >   6.45"    for  1000-yr event
Inflow      =      122.14 cfs @   11.98 hrs,  Volume=          19.491 af
Outflow     =       28.69 cfs @   12.29 hrs,  Volume=          19.414 af,  Atten= 77%,  Lag= 18.7 min
Primary     =       28.69 cfs @   12.29 hrs,  Volume=          19.414 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Starting Elev= 485.00'   Surf.Area= 4.310 ac   Storage= 12.877 af
Peak Elev= 485.96' @ 12.58 hrs   Surf.Area= 4.483 ac   Storage= 17.093 af   (4.217 af above start)

Plug-Flow detention time= 1,160.3 min calculated for 6.536 af (34% of inflow)
Center-of-Mass det. time= 99.9 min ( 1,121.0 - 1,021.1 )

Volume        Invert    Avail.Storage   Storage Description
   #1         479.00'        64.034 af  Custom Stage Data (Conic) Listed below (Recalc)

Elevation       Surf.Area          Inc.Store        Cum.Store        Wet.Area
   (feet)          (acres)        (acre-feet)      (acre-feet)          (acres)
   479.00            0.080              0.000            0.000            0.080
   480.00            0.880              0.408            0.408            0.880
   481.00            1.600              1.222            1.631            1.600
   482.00            2.240              1.911            3.542            2.241
   483.00            2.800              2.515            6.056            2.801
   484.00            3.280              3.037            9.093            3.282
   485.00            4.310              3.783           12.877            4.313
   486.00            4.490              4.400           17.276            4.496
   487.00            4.640              4.565           21.841            4.651
   488.00            4.820              4.730           26.571            4.834
   489.00            4.960              4.890           31.461            4.979
   490.00            5.100              5.030           36.490            5.124
   491.00            5.240              5.170           41.660            5.270
   492.00            5.390              5.315           46.975            5.425
   493.00            5.560              5.475           52.450            5.599
   494.00            5.770              5.665           58.115            5.813
   495.00            6.070              5.919           64.034            6.116

Device    Routing            Invert   Outlet Devices
   #1     Primary            480.48'  24.0"  Round Culvert
                                      L= 162.0'   RCP, square edge headwall,  Ke= 0.500
                                      Inlet / Outlet Invert= 480.48' / 479.73'   S= 0.0046 '/'   Cc= 0.900
                                      n= 0.012  Concrete pipe, finished,  Flow Area= 3.14 sf
   #2     Device 1           485.00'  48.0" x 72.0" Horiz. Orifice/Grate    C= 0.600
                                      Limited to weir flow at low heads

Primary OutFlow  Max=28.66 cfs @ 12.29 hrs  HW=485.90'  TW=481.74'   (Dynamic Tailwater)
↑—1=Culvert  (Outlet Controls 28.66 cfs @ 9.12 fps)
   ↑—2=Orifice/Grate  (Passes 28.66 cfs of 55.90 cfs potential flow)
```

Pond ELP: East Leachate Pond



Summary for Pond EPP: East Polishing Pond

```
Inflow Area =        45.056 ac,  53.48% Impervious,  Inflow Depth >   8.89"    for  1000-yr event
Inflow       =      151.86 cfs @   11.97 hrs,  Volume=          33.375 af
Outflow      =       44.55 cfs @   14.22 hrs,  Volume=          33.176 af,  Atten= 71%,  Lag= 134.7 min
Primary      =       44.55 cfs @   14.22 hrs,  Volume=          33.176 af
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Starting Elev= 480.20' Surf.Area= 3.481 ac Storage= 44.423 af
Peak Elev= 482.27' @ 14.22 hrs Surf.Area= 3.878 ac Storage= 52.078 af (7.655 af above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 158.8 min (1,167.4 - 1,008.6)

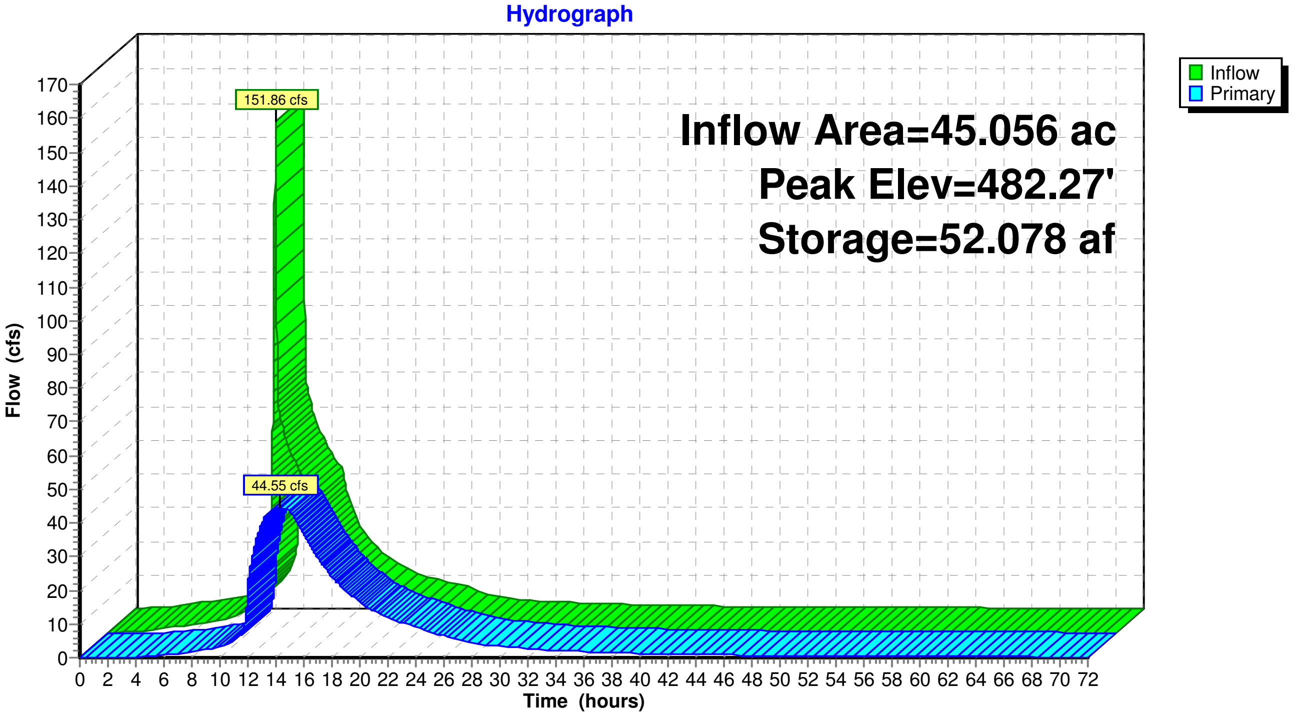
Volume	Invert	Avail.Storage	Storage Description
#1	463.00'	122.821 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
463.00	1.780	0.000	0.000	1.780
464.00	1.870	1.825	1.825	1.873
465.00	1.900	1.885	3.710	1.911
466.00	2.050	1.975	5.684	2.063
467.00	2.140	2.095	7.779	2.156
468.00	2.230	2.185	9.964	2.249
469.00	2.320	2.275	12.239	2.343
470.00	2.410	2.365	14.604	2.437
471.00	2.510	2.460	17.064	2.540
472.00	2.610	2.560	19.623	2.644
473.00	2.710	2.660	22.283	2.748
474.00	2.810	2.760	25.043	2.852
475.00	2.910	2.860	27.903	2.956
476.00	3.010	2.960	30.863	3.060
477.00	3.110	3.060	33.923	3.164
478.00	3.220	3.165	37.087	3.278
479.00	3.320	3.270	40.357	3.383
480.00	3.430	3.375	43.732	3.497
481.00	3.690	3.559	47.291	3.759
482.00	3.830	3.760	51.051	3.903
483.00	4.010	3.920	54.971	4.086
484.00	4.620	4.311	59.282	4.697
485.00	4.880	4.749	64.032	4.960
486.00	5.070	4.975	69.006	5.153
487.00	5.260	5.165	74.171	5.347
488.00	5.440	5.350	79.521	5.532
489.00	5.630	5.535	85.056	5.726
490.00	5.810	5.720	90.775	5.910
491.00	6.000	5.905	96.680	6.105
492.00	6.190	6.095	102.775	6.299
493.00	6.390	6.290	109.065	6.504
494.00	6.850	6.619	115.683	6.966
495.00	7.430	7.138	122.821	7.548

Device	Routing	Invert	Outlet Devices
#1	Primary	458.00'	**36.0" Round Outfall to Illinois River** L= 613.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 458.00' / 452.00' S= 0.0098 '/' Cc= 0.900 n= 0.015 Concrete sewer w/manholes & inlets, Flow Area= 7.07 sf
#2	Device 1	480.20'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Device 1	494.30'	**60.0" x 36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=44.55 cfs @ 14.22 hrs HW=482.27' TW=462.00' (Dynamic Tailwater)
↑—**1=Outfall to Illinois River** (Passes 44.55 cfs of 93.72 cfs potential flow)
  ↑—**2=Sharp-Crested Rectangular Weir** (Weir Controls 44.55 cfs @ 4.70 fps)
  └—**3=Orifice/Grate** (Controls 0.00 cfs)

Pond EPP: East Polishing Pond



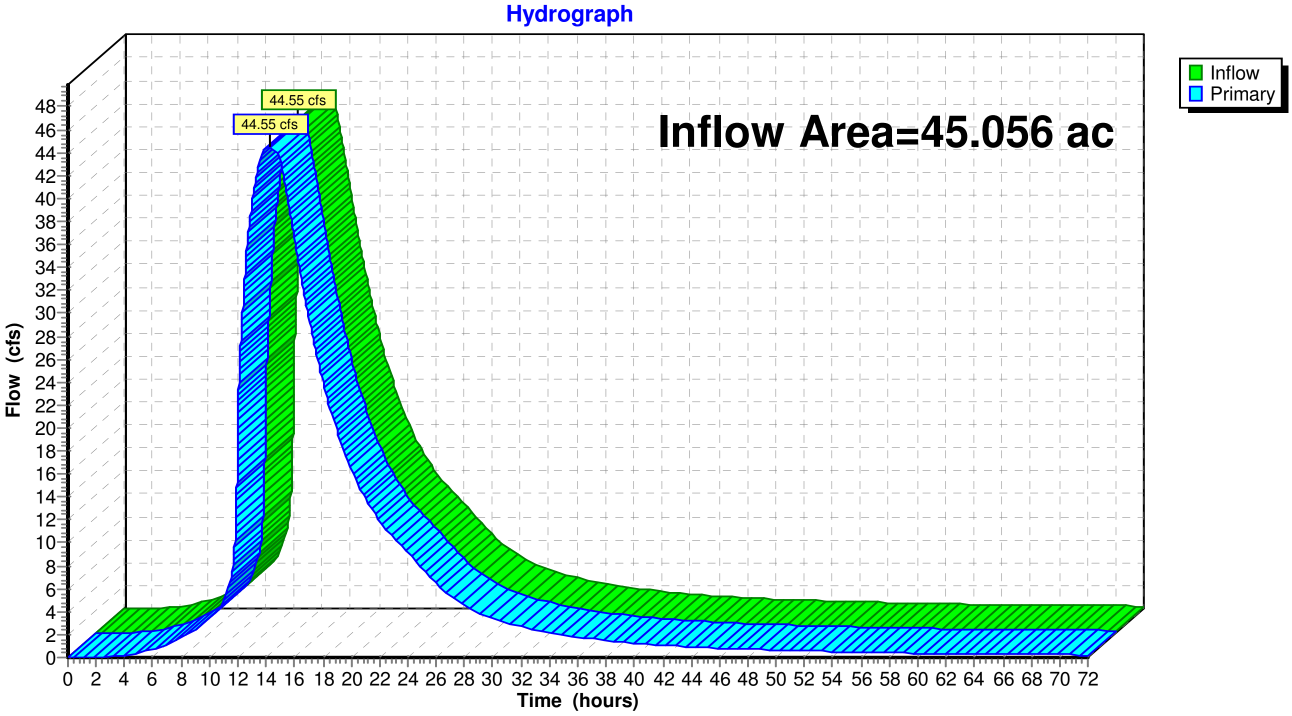
Summary for Link 9L: Illinois River Tailwater

Inflow Area = 45.056 ac, 53.48% Impervious, Inflow Depth > 8.84" for 1000-yr event
Inflow = 44.55 cfs @ 14.22 hrs, Volume= 33.176 af
Primary = 44.55 cfs @ 14.22 hrs, Volume= 33.176 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Fixed water surface Elevation= 462.00'

Link 9L: Illinois River Tailwater



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St. Louis, MO 63110
1-314-429-0100

About AECOM

AECOM (NYSE: ACM) is a global provider of professional technical and management support services to a broad range of markets, including transportation, facilities, environmental, energy, water and government. With nearly 100,000 employees around the world, AECOM is a leader in all of the key markets that it serves. AECOM provides a blend of global reach, local knowledge, innovation, and collaborative technical excellence in delivering solutions that enhance and sustain the world’s built, natural, and social environments. A Fortune 500 company, AECOM serves clients in more than 100 countries and has annual revenue in excess of $19 billion.

More information on AECOM and its services can be found at www.aecom.com.

Attachment C

Federal Emergency Management Agency
Washington, D.C. 20472

July 1, 2022

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

IN REPLY REFER TO:
Case No.: 22-05-0122P

The Honorable Kevin J. Coleman
Mayor, Village of Hennepin
627 East High Street
Hennepin, IL 61327

Community Name: Village of Hennepin, IL
Community No.: 170570
FIRM Panel Affected: 1755C0015E

116

Dear Mayor Coleman:

In a Letter of Map Revision (LOMR) dated February 8, 2022, you were notified of proposed flood hazard determinations affecting the Flood Insurance Rate Map (FIRM) for the Village of Hennepin, Putnam County, Illinois. These determinations were for Illinois River - from approximately River Mile 211.6 to River Mile 211.2, left overbank. The 90-day appeal period that was initiated on February 23, 2022, when the Department of Homeland Security's Federal Emergency Management Agency (FEMA) published a notice of proposed Flood Hazard Determinations in *The Putnam County Record*, has elapsed.

FEMA received no valid requests for changes to the modified flood hazard information. Therefore, the modified flood hazard information for your community that became effective on June 23, 2022, remains valid and revises the FIRM that was in effect prior to that date.

The modifications are pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (Public Law 93-234) and are in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, Public Law 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. The community number(s) and suffix code(s) are unaffected by this revision. The community number and appropriate suffix code as shown above will be used by the National Flood Insurance Program (NFIP) for all flood insurance policies and renewals issued for your community.

FEMA has developed criteria for floodplain management as required under the above-mentioned Acts of 1968 and 1973. To continue participation in the NFIP, your community must use the modified flood hazard information to carry out the floodplain management regulations for the NFIP.

If you have any questions regarding the necessary floodplain management measures for your community or the NFIP in general, please contact the Mitigation Division Director, FEMA Region V, in Chicago, Illinois, either by telephone at (312) 408-5500, or in writing at Federal Emergency Management Agency, Region V, 536 South Clark Street, Sixth Floor, Chicago, Illinois 60605.

If you have any questions regarding the LOMR, the proposed flood hazard determinations, or mapping issues in general, please call the FEMA Mapping and Insurance eXchange, toll free, at (877) 336-2627 (877-FEMA MAP).

Sincerely,

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

cc: Mr. Anthony Comerio
Chief Water Resources Engineer
Hanson Professional Services, Inc.

Ms. Dianna Tickner
Dynegy Midwest Generation, LLC

Mr. Steve Altman
Acting NFIP State Coordinator, IL
Illinois Department of Natural Resources

Federal Emergency Management Agency
Washington, D.C. 20472

February 8, 2022

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

IN REPLY REFER TO:

Case No.:	22-05-0122P
Community Name:	Village of Hennepin, IL
Community No.:	170570
Effective Date of This Revision:	June 23, 2022

The Honorable Kevin J. Coleman
Mayor, Village of Hennepin
627 East High Street
Hennepin, IL 61327

Dear Mayor Coleman:

The Flood Insurance Rate Map for your community has been revised by this Letter of Map Revision (LOMR). Please use the enclosed annotated map panel revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals issued in your community.

Additional documents are enclosed which provide information regarding this LOMR. Please see the List of Enclosures below to determine which documents are included. Other attachments specific to this request may be included as referenced in the Determination Document. If you have any questions regarding floodplain management regulations for your community or the National Flood Insurance Program (NFIP) in general, please contact the Consultation Coordination Officer for your community. If you have any technical questions regarding this LOMR, please contact the Director, Mitigation Division of the Department of Homeland Security's Federal Emergency Management Agency (FEMA) in Chicago, Illinois, at (312) 408-5500, or the FEMA Mapping and Insurance eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at https://www.fema.gov/flood-insurance.

Sincerely,

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

List of Enclosures:

Letter of Map Revision Determination Document
Annotated Flood Insurance Rate Map

cc: Mr. Anthony Comerio
Chief Water Resources Engineer
Hanson Professional Services, Inc.

Ms. Dianna Tickner
Dynegy Midwest Generation, LLC

Ms. Marilyn L. Sucoe
Acting NFIP State Coordinator, IL
Illinois Department of Natural Resources

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	**Village of Hennepin** **Putnam County** **Illinois** **COMMUNITY NO.: 170570**	**FILL**	**1D HYDRAULIC ANALYSIS** **UPDATED TOPOGRAPHIC DATA**
IDENTIFIER	Dynegy Midwest Generation's Hennepin Power Station, Hennepin, Illinois	**APPROXIMATE LATITUDE & LONGITUDE: 41.300, -89.324** **SOURCE:** Other **DATUM:** NAD 83	

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 1755C0015E DATE: February 4, 2011	NO REVISION TO THE FLOOD INSURANCE STUDY REPORT

Enclosures reflect changes to flooding sources affected by this revision.
* FIRM - Flood Insurance Rate Map;

FLOODING SOURCE(S) & REVISED REACH(ES)

Illinois River – From approximately River Mile 211.6 to River Mile 211.2, left overbank

SUMMARY OF REVISIONS

Flooding Source	**Effective Flooding**	**Revised Flooding**	**Increases**	**Decreases**
Illinois River	Zone AE	Zone AE	NONE	YES
	Floodway	Floodway	NONE	YES
	Zone X (shaded)	Zone X (shaded)	YES	NONE

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Mapping and Insurance eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/flood-insurance.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

NFIP regulations Subparagraph 60.3(b)(7) requires communities to ensure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management ordinances; therefore, responsibility for maintenance of the altered or relocated watercourse, including any related appurtenances such as bridges, culverts, and other drainage structures, rests with your community. We may request that your community submit a description and schedule of maintenance activities necessary to ensure this requirement.

COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance flood discharges computed in the FIS for your community without considering subsequent changes in watershed characteristics that could increase flood discharges. Future development of projects upstream could cause increased flood discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on discharges and could, therefore, indicate that greater flood hazards exist in this area.

This revision has met our criteria for removing an area from the 1-percent-annual-chance floodplain to reflect the placement of fill. However, we encourage you to require that the lowest adjacent grade and lowest floor (including basement) of any structure placed within the subject area be elevated to or above the Base (1-percent-annual-chance) Flood Elevation.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Mapping and Insurance eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/flood-insurance.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION (CONTINUED)

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Mary Beth Caruso
Director, Mitigation Division
Federal Emergency Management Agency, Region V
536 South Clark Street, Sixth Floor,
Chicago, IL 60605
(312)408-5500

STATUS OF THE COMMUNITY NFIP MAPS

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panel(s) and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Mapping and Insurance eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/flood-insurance.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

A notice of changes will be published in the *Federal Register*. This information also will be published in your local newspaper on or about the dates listed below, and through FEMA's Flood Hazard Mapping website at https://www.floodmaps.fema.gov/fhm/bfe_status/bfe_main.asp

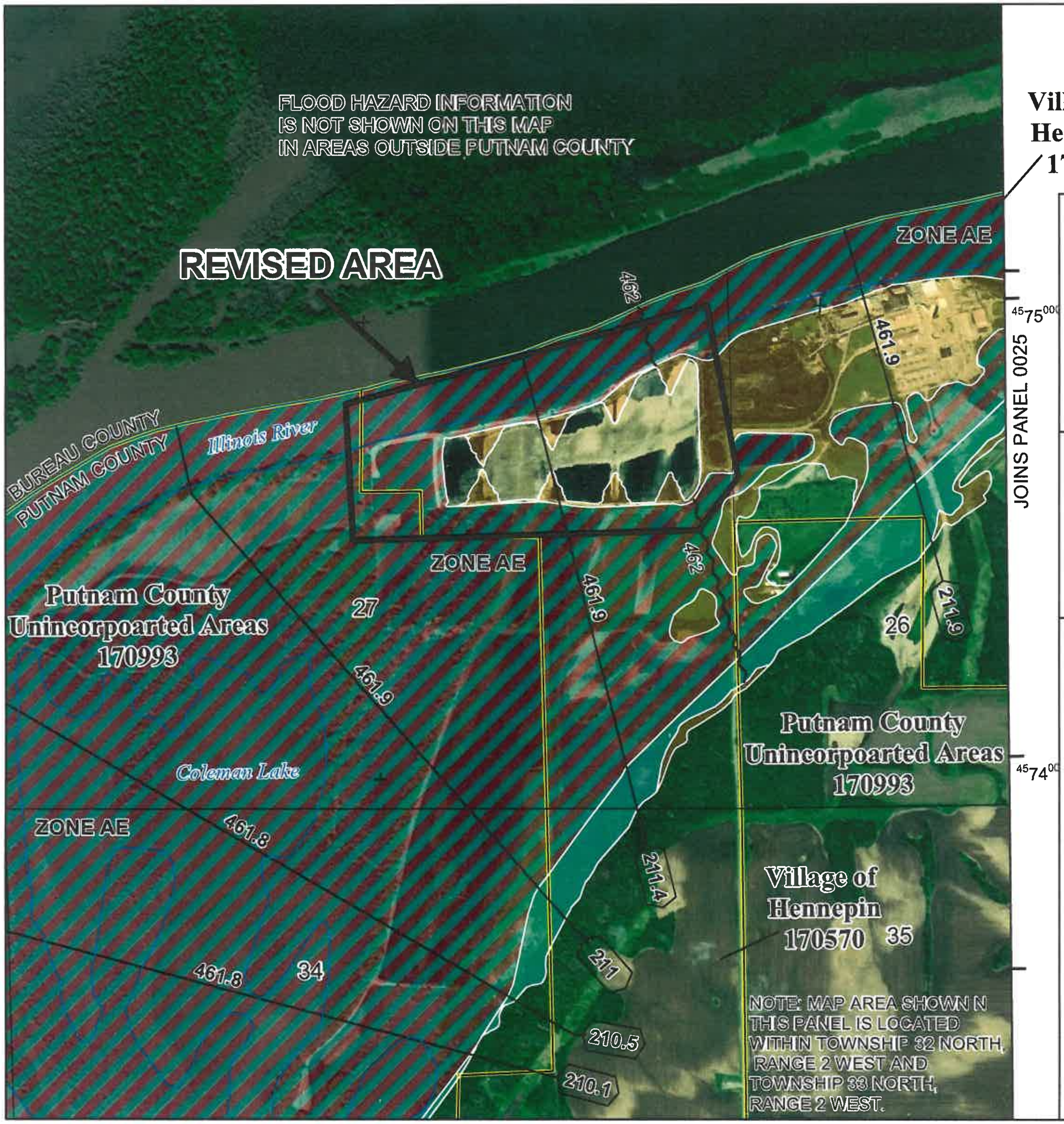
LOCAL NEWSPAPER

Name: *The Putnam County Record*
Dates: February 16, 2022 and February 23, 2022

Within 90 days of the second publication in the local newspaper, any interested party may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised flood hazard determination presented in this LOMR may be changed.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Mapping and Insurance eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at https://www.fema.gov/flood-insurance.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration



SPECIAL FLOOD HAZARD AREAS	▨	Without Base Flood Elevation (BFE) *Zone A,V, A99* With BFE or Depth *Zone AE, AO, AH, VE, AR*
	▨	Regulatory Floodway
	▨	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	▨	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
OTHER AREAS OF FLOOD HAZARD	▨	Area with Reduced Flood Risk due to Levee See Notes. *Zone X*

SCALE

Map Projection:
NAD 1983 StatePlane Illinois West FIPS 1202 Feet;
Western Hemisphere; Vertical Datum: NAVD 88

1 inch = 1,000 feet 1:12,000

Feet: 0 500 1,000 2,000

Meters: 0 150 300 600

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

PUTNAM COUNTY, ILLINOIS
AND INCORPORATED AREAS

PANEL **15** OF **175**

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
HENNEPIN, VILLAGE OF	170570	0015	E
PUTNAM COUNTY	170993	0015	E

REVISED TO REFLECT
LOMR EFFECTIVE
JUNE 23, 2022

VERSION NUMBER
2.6.5.0

MAP NUMBER
17155C0015E

EFFECTIVE DATE
February 4, 2011

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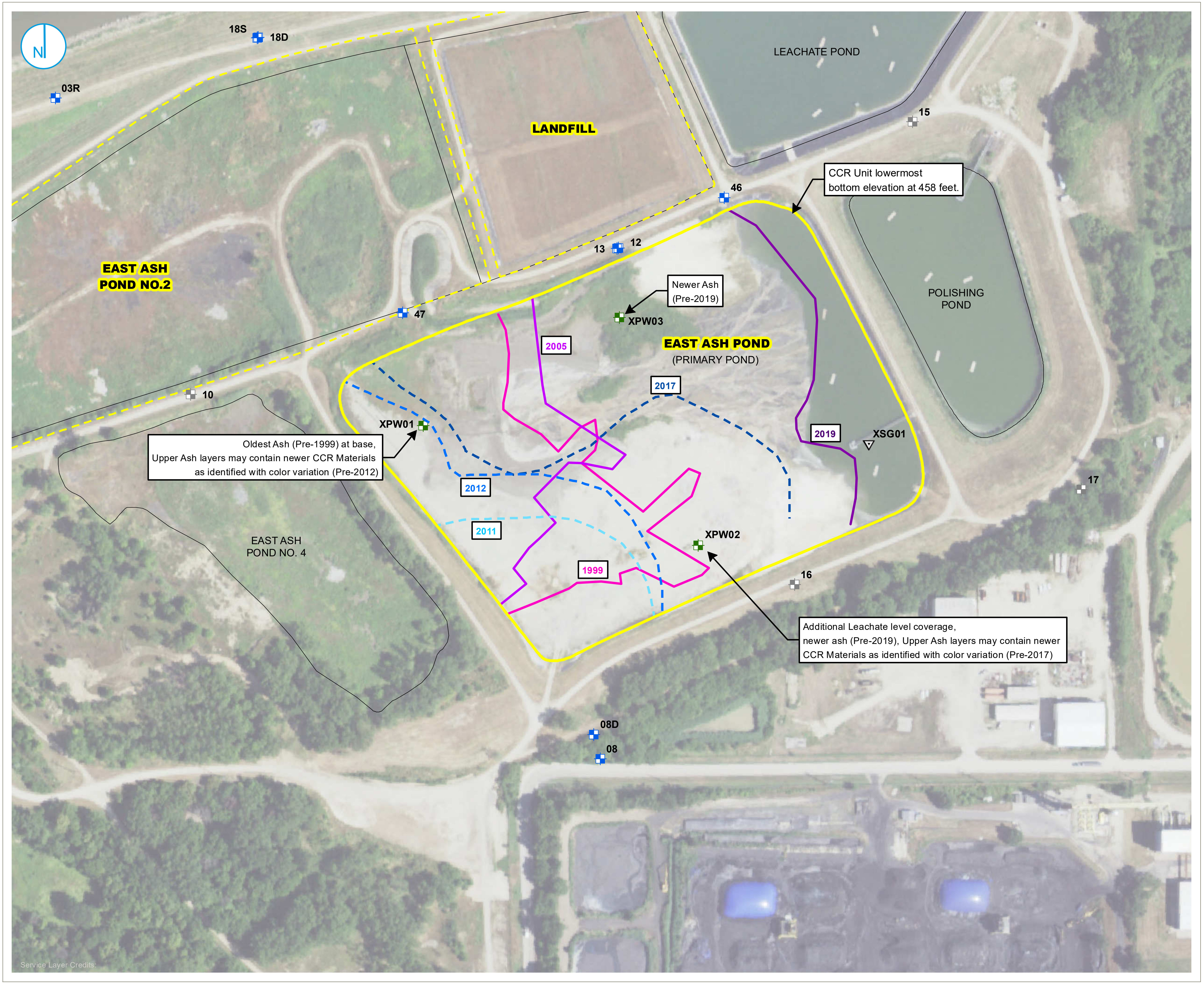
S. Fuller
ILLINOIS
PRAIRIE RESEARCH INSTITUTE
Illinois State Water Survey
2204 Griffith Drive
Champaign, IL 61820

Mr. Anthony Comerio
Chief Water Resources Engineer
Hanson Professional Services, Inc.
1525 S. 6th Street
Springfield, IL 62703

Attachment D



CCR Unit lowermost bottom elevation at 458 feet.

Newer Ash (Pre-2019)

Oldest Ash (Pre-1999) at base, Upper Ash layers may contain newer CCR Materials as identified with color variation (Pre-2012)

Additional Leachate level coverage, newer ash (Pre-2019), Upper Ash layers may contain newer CCR Materials as identified with color variation (Pre-2017)

Y:\Mapping\Projects\22\2285\MXD\845\Hennepin_East\Figure 5_Proposed CCR Characterization Points.mxd

PROJECT: 169000XXXX | DATED: 11/17/2020 | DESIGNER: galarnmc

- ⊕ CCR MONITORING WELL
- ⊕ NON-CCR MONITORING WELL
- ⊕ PROPOSED LEACHATE WELL LOCATION
- ▽ PROPOSED STAFF GAUGE LOCATION
- — APPROXIMATE LIMITS OF ASH BASED ON 1999 AERIAL
- — APPROXIMATE LIMITS OF ASH BASED ON 2005 AERIAL
- — APPROXIMATE LIMITS OF ASH BASED ON 2019 AERIAL
- - - APPROXIMATE LIMITS OF VARIANCE IN CCR MATERIAL COLORATION AS OBSERVED IN 2011 AERIAL
- - - APPROXIMATE LIMITS OF VARIANCE IN CCR MATERIAL COLORATION AS OBSERVED IN 2012 AERIAL
- - - APPROXIMATE LIMITS OF VARIANCE IN CCR MATERIAL COLORATION AS OBSERVED IN 2017 AERIAL
- ☐ CCR UNIT BOUNDARY, SUBJECT SITE
- ☐ CCR UNIT BOUNDARY
- ☐ ONSITE FACILITY BOUNDARY

0 100 200
Feet

CCR CHARACTERIZATION MAP

HENNEPIN EAST ASH POND (UNIT ID: 803)

HENNEPIN POWER STATION
HENNEPIN, ILLINOIS

FIGURE - 1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

TABLE 2-2. ASH ANALYTICAL RESULTS
HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
HENNEPIN POWER PLANT
EAST ASH POND
HENNEPIN, ILLINOIS

Sample Location	Sample Depth (ft BGS)	Sample Date	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Boron (mg/kg)	Cadmium (mg/kg)	Calcium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Lead (mg/kg)	Lithium (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Selenium (mg/kg)	Thallium (mg/kg)
XPW01	8-10	01/14/2021	0.96	7.53	4150	2.12	299	0.68	100000	32.7	15.4	22.5	21.6	0.129	2.86	1.17	<0.2
XPW01	14-15	01/14/2021	<0.38	2.7	2580	1.85	117	0.25	71000	20.3	9.19	4.76	23.5	<0.015	2.08	<0.96	<0.19
XPW02	6-8	01/15/2021	<0.75	20.9	4120	2.68	600	1.28	97600	49.6	18.7	32.5	26.9	2.92	9.87	11	1.43
XPW02	16-18	01/15/2021	0.52	6.19	4660	2.31	398	0.68	124000	41	19.2	22.2	22.1	0.274	3.94	1.66	0.41
XPW03	4-6	01/14/2021	1.28	15.6	4200	2.38	379	0.85	105000	46.8	18.6	25	25	0.363	6.1	4.45	0.59
XPW03	16-18	01/14/2021	1.46	9.08	4140	2.2	341	0.69	102000	43.6	18.5	22.7	22.2	0.094	4.43	1.45	0.48

Notes:
< = concentration is less than the concentration shown, which corresponds to the reporting limit for the method.
BGS = below ground surface
ft = feet
mg/kg = milligrams per kilogram

generated 10/05/2021, 4:11:24 PM CDT

Attachment E

Intended for
Dynegy Midwest Generation, LLC

Date
October 25, 2021

Project No.
1940100806-005

GROUNDWATER MONITORING PLAN

EAST ASH POND
HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

GROUNDWATER MONITORING PLAN
EAST ASH POND

Project Name	**Hennepin Power Plant East Ash Pond**
Project No.	**1940100806-005**
Recipient	**Dynegy Midwest Generation, LLC**
Document Type	**Groundwater Monitoring Plan**
Revision	**FINAL**
Date	**October 25, 2021**

Ramboll
234 W. Florida Street
Fifth Floor
Milwaukee, WI 53204
USA

T 414-837-3607
F 414-837-3608
https://ramboll.com

Brian G. Hennings, PG
Senior Managing Hydrogeologist

Eric J. Tlachac, PE
Senior Managing Engineer

Nathaniel R. Keller
Senior Hydrogeologist

Chase J. Christenson, PG
Hydrogeologist

LICENSED PROFESSIONAL CERTIFICATIONS

35 I.A.C. § 845.630 Groundwater Monitoring Systems (PE)

I, Eric J. Tlachac, a qualified professional engineer in good standing in the State of Illinois, certify that the groundwater monitoring system described in this document (Groundwater Monitoring Plan, Hennepin Power Plant East Ash Pond), has been designed and constructed to meet the requirements of 35 I.A.C. § 845.630. The monitoring system was developed based on information included in the Hydrogeologic Site Characterization Report (Ramboll 2021; included in the Operating Permit to which this Groundwater Monitoring Plan is attached).

Eric J. Tlachac
Qualified Professional Engineer
062-063091
Illinois
Date: October 25, 2021

ERIC J. TLACHAC
062-063091

35 I.A.C. § 845.630 Groundwater Monitoring Systems (PG)

I, Brian G. Hennings, a qualified professional geologist in good standing in the State of Illinois, certify that the groundwater monitoring system described in this document (Groundwater Monitoring Plan, Hennepin Power Plant East Ash Pond), has been designed and constructed to meet the requirements of 35 I.A.C. § 845.630. The monitoring system was developed based on information included in the Hydrogeologic Site Characterization Report (Ramboll 2021; included in the Operating Permit to which this Groundwater Monitoring Plan is attached).

Brian G. Hennings
Professional Geologist
196.001482
Illinois
Date: October 25, 2021

BRIAN G. HENNINGS
196.001482

CONTENTS

TABLES (IN TEXT)

TABLES (ATTACHED)

FIGURES (ATTACHED)

APPENDICES

ACRONYMS AND ABBREVIATIONS

§	Section
35 I.A.C.	Title 35 of the Illinois Administrative Code
40 C.F.R.	Title 40 of the Code of Federal Regulations
AP2	Ash Pond No. 2
AP4	Ash Pond No. 4
ASD	Alternate Source Demonstration
bgs	below ground surface
CCR	coal combustion residuals
CCWL	Coal Combustion Waste Landfill
cm/s	centimeters per second
CSM	conceptual site model
DMG	Dynegy Midwest Generation, LLC
EAP	East Ash Pond
EAPS	East Ash Pond System, includes CCWL, EAP, AP2, and AP4
GMP	Groundwater Monitoring Plan
GWPS	groundwater protection standard
HCR	Hydrogeologic Site Characterization Report
HPP	Hennepin Power Plant
ID	identification
IEPA	Illinois Environmental Protection Agency
IFR	Initial Facility Report
MW	megawatts
NAVD88	North American Vertical Datum of 1988
NID	National Inventory of Dams
No.	number
NRT	Natural Resource Technology, Inc.
Part 845	Residuals in Surface Impoundments: Title 35 of the Illinois Administrative Code § 845
PMP	potential migration pathway
QA/QC	quality assurance/quality control
Ramboll	Ramboll Americas Engineering Solutions, Inc.
RL	reporting limit
SI	surface impoundment
Site	Hennepin EAP
STMI	Science & Technology Management, Inc.
TDS	total dissolved solids
USEPA	United States Environmental Protection Agency

1. INTRODUCTION

1.1 Overview

In accordance with requirements of the Standards for the Disposal of Coal Combustion Residuals (CCR) in Surface Impoundments (SIs): Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845 (Part 845) (Illinois Environmental Protection Agency [IEPA], April 15, 2021), Ramboll Americas Engineering Solutions, Inc. (Ramboll) has prepared this Groundwater Monitoring Plan (GMP) on behalf of Hennepin Power Plant (HPP) (**Figure 1-1**), operated by Dynegy Midwest Generation, LLC (DMG). This report will apply specifically to the CCR Unit referred to as the East Ash Pond (EAP) (Vistra identification [ID] Number [No.] 803, IEPA ID No. W1550100002-05, and National Inventory of Dams [NID] No. IL50363). The EAP is a lined 21-acre CCR SI used to manage CCR and non-CCR waste streams at the HPP. This GMP includes Part 845 content requirements specific to 35 I.A.C. § 845.630 (Groundwater Monitoring System), 35 I.A.C. § 845.640 (Groundwater Sampling and Analysis), and 35 I.A.C. § 845.650 (Groundwater Monitoring Program) for the EAP at HPP.

A checklist which identifies the specific requirements of 35 I.A.C. § 845.630, 35 I.A.C. § 845.640, and 35 I.A.C. § 845.650 is included in **Table 1-1**. The table provides references to sections, tables, and figures included in this document to locate the information that meets specific requirements of 35 I.A.C. § 845.630, 35 I.A.C. § 845.640, and 35 I.A.C. § 845.650.

1.2 Site Location and Background

The EAP is located in northcentral Illinois in Putnam County, approximately four miles northeast of the Village of Hennepin, located within the northeast quarter of Section 26, Township 33 North, Range 2 West (**Figure 1-1**). The HPP is an approximately 504-acre property consisting of 19 parcels, including a retired coal-fired power plant, CCR landfill and SIs, and farmland. The HPP ceased operations in 2019 when the power plant was retired.

The HPP construction history includes construction of Unit 1 in 1953 and Unit 2 in 1959 with capacities of 70 megawatts (MW) and 210 MW, respectively. The plant initially burned high-sulfur Illinois coal and switched to sub-bituminous Powder River Basin coal in 1999 (Science and Technology Management, Inc. [STMI], 1996).

The three CCR Units located adjacent to, or in the vicinity of, each other in the eastern portion of the HPP are referred to as the East Ash Pond System (EAPS). The CCR Units associated with the EAPS are situated south and adjacent to the Illinois River. The area is also bounded to the east and south by industrial properties owned by Tri-Con Materials and Washington Mills, respectively (**Figure 1-2**). The HPP provides the western boundary for the CCR Units with agricultural land to the southwest. Additionally, a 9-acre parcel between the HPP property and Washington Mills (south of the CCR Units) was previously occupied by American Asphalt but operations are no longer active, and the property contains several abandoned buildings. The current owner of this parcel is listed as Tri-Con Materials.

Figure 1-2 depicts the location of the CCR Units and non-CCR Units within the EAPS. The four Hennepin EAPS CCR units consist of the following: one existing landfill (Coal Combustion Waste Landfill [CCWL; Vistra ID No. 801]), one existing SI (EAP), and two IEPA-approved, closed SIs (Ash Pond No. 2 [AP2; Vistra ID No. 802, IEPA ID No. W1550100002-04, and NID No. IL50663] and Ash Pond No. 4 [AP4; Vistra ID No. 805 and IEPA ID No. W1550100002-07]). Information regarding the CCWL, AP2, and AP4 CCR Units is solely for background information, as this report applies specifically to the EAP CCR Unit, which will hereinafter be referred to as the Site.

1.3 Conceptual Model

Significant site investigation has been completed at the HPP to characterize the geology, hydrogeology, and groundwater quality. Based on extensive investigation and monitoring, the EAP has been well characterized and detailed in the Hydrogeologic Site Characterization Report (HCR; included in the Operating Permit to which this Plan is attached). A conceptual site model (CSM) has been developed and is discussed below.

The Site is characterized by two hydrostratigraphic units:

- **Uppermost Aquifer**: Includes the unlithified natural geologic materials of the Cahokia Alluvium and Henry Formation extending from the upper saturated zone to the bedrock. This unit was encountered in all borings advanced at the EAP in 2021 and is identified as the potential migration pathway (PMP).
- **Bedrock Confining Unit**: Comprised of shales with thin limestone, sandstone, and coal beds. This bedrock confining unit is encountered at the EAP at elevations ranging from 399.2 to 410.2 feet North American Vertical Datum of 1988 (NAVD88).

In the vicinity of the EAP groundwater generally flows from the south beneath the EAP toward the Illinois River (**Figure 1-3**) through the uppermost aquifer which is the primary pathway for contaminant migration. Periodic and temporary flow reversals are possible during periods of high river elevations or flooding (**Figure 1-4**). Vertical migration is limited by the underlying Pennsylvanian-age shale bedrock unit which acts as a confining layer. No PMPs have been identified outside of the uppermost aquifer.

Part 845 parameters were monitored in the uppermost aquifer monitoring wells at the EAP as part of the Title 40 of the Code of Federal Regulations (40 C.F.R.) § 257 monitoring program beginning in 2015. These data were supplemented with sampling of additional locations in 2021. The results indicate that the following parameters were detected at concentrations greater than the applicable 35 I.A.C. § 845.600 groundwater protection standards (GWPSs) and are considered potential exceedances:

- Chloride – at background uppermost aquifer wells 08 and 08D;
- Cobalt – at background uppermost aquifer wells 07, 08, and 08D; at uppermost aquifer compliance well 53; and at bedrock confining unit compliance well 55;
- Lithium – at bedrock confining unit compliance well 55 in April 2021;
- pH – at background uppermost aquifer wells 07, 08, and 08D;
- Thallium – at background uppermost aquifer well 08; and at compliance uppermost aquifer well 52; and
- Total Dissolved Solids (TDS) – at background uppermost aquifer wells 08 and 08D.

Concentration results for the above parameters were compared directly to the GWPS, without an evaluation of background concentrations. Evaluation of background groundwater quality has been completed as part of this GMP, and compliance with Part 845 will be determined following the first round of groundwater sampling. The first round of groundwater sampling for compliance will be completed the quarter following issuance of the Operating Permit and in accordance with this GMP.

2. GROUNDWATER MONITORING SYSTEMS

2.1 Existing Monitoring Well Network and Analysis

Several monitoring programs are being conducted as required by the IEPA and the United States Environmental Protection Agency (USEPA) to evaluate the CCR Units associated with the HPP EAPS and the CCWL. The networks have changed over time and many of the wells and parameters overlap as a result of previously approved GMPs and permits which were developed to focus on specific (and separate) units at the EAPS. The monitoring networks for each of the CCR and non-CCR Units at the EAPS include:

- CCWL
  - Initial Facility Report (IFR) (Section 28)
  - 40 C.F.R. § 257
- AP2 and AP4
  - 40 C.F.R. § 257 for AP2 (AP4 was classified as capped or otherwise maintained and not subject to 40 C.F.R. § 257)
  - IEPA Closure Plan (2019 GMP included in Closure and Post-Closure Care Plan for the Hennepin AP2) and proposed network for Part 845
- EAPS (also includes Leachate Pond and Polishing Pond)
  - IEPA Water Pollution Control Permit 2019-EO-64097 – Special Condition No. 4
- EAP (subject of this GMP)
  - 40 C.F.R. § 257
  - Proposed network for Part 845

This GMP is being provided to propose a groundwater monitoring network and monitoring program specific to the EAP that will comply with Part 845. Monitoring networks and programs that apply to other units are not discussed in this GMP. Those programs will continue to be performed as specified in IEPA approvals. Upon approval of the Operating Permit applications (and by extension the GMPs) for AP2 and AP4 and the EAP, the IEPA Water Pollution Control Permit 2019-EO-64097 Special Condition No. 4 will be discontinued following approval of a future permit modification submittal and will be replaced by the proposed Part 845 monitoring program. The remaining discussion in this document will include only the networks and monitoring programs that are applicable and specific to the EAP, specifically the 40 C.F.R. § 257 network and the proposed Part 845 monitoring network.

2.1.1 40 C.F.R. § 257 Monitoring Program

The 40 C.F.R. § 257 well network for the EAP consists of seven monitoring wells installed nearby or adjacent to the EAP within the uppermost aquifer. The EAP 40 C.F.R. § 257 well network consists of three background monitoring wells (07, 08, and 08D) and four compliance monitoring wells (12, 13, 46, and 47). Monitoring wells 16 and 17 are being considered as additional background wells to represent groundwater quality impacts from off-site, upgradient sources. The boring logs, well construction forms, and other related monitoring well forms are available in the Operating Records as required by 40 C.F.R. § 257.91 for each monitored CCR Unit or CCR

Multi-Unit, and are included in Appendix A of the HCR (included in the Operating Permit to which this Plan is attached).

Assessment monitoring in accordance with 40 C.F.R. § 257.95 was initiated on April 9, 2018. Details on the procedures and techniques used to fulfill the groundwater sampling and analysis program requirements are found in the Sampling and Analysis Plan for the EAP (Natural Resource Technology, Inc. [NRT], 2017).

Groundwater samples are collected semiannually and analyzed for the following laboratory and field parameters from Appendix III and Appendix IV of 40 C.F.R. § 257, summarized in **Table A** below.

Table A. 40 C.F.R. § 257 Groundwater Monitoring Program Parameters

Field Parameters[1]			
Groundwater Elevation	pH		
Appendix III Parameters (Total, except TDS)			
Boron	Chloride	Sulfate	
Calcium	Fluoride	TDS	
Appendix IV Parameters (Total)			
Antimony	Cadmium	Lead	Selenium
Arsenic	Chromium	Lithium	Thallium
Barium	Cobalt	Mercury	Radium 226 and 228 combined
Beryllium	Fluoride	Molybdenum	

[1] Dissolved oxygen, temperature, specific conductance, oxidation/reduction potential, and turbidity are recorded during sample collection.

Results and analysis of groundwater sampling are reported annually by January 31 of the following year and made available on the CCR public website as required by 40 C.F.R. § 257.

2.1.2 Part 845 Well Installation and Monitoring

In 2021, four additional monitoring wells (52, 53, 54, and 55) were installed along the perimeter of the EAP to assess the vertical and horizontal lithology, stratigraphy, chemical properties, and physical properties of geologic layers to a minimum of 100 feet below ground surface (bgs) as specified in 35 I.A.C. § 845.620(b). Additionally, three leachate monitoring wells (XPW01, XPW02, and XPW03) were installed within the EAP to characterize the CCR materials.

Prospective Part 845 monitoring wells were sampled for eight rounds from February to August 2021 and the results were assessed for selection of the EAP Part 845 monitoring well network. Groundwater samples were collected and analyzed for 35 I.A.C. § 845.600 parameters as summarized in **Table B** below.

Table B. Part 845 Groundwater Monitoring Program Parameters

Field Parameters[1]			
Groundwater Elevation	pH	Turbidity	
Metals (Total)			
Antimony	Boron	Cobalt	Molybdenum
Arsenic	Cadmium	Lead	Selenium
Barium	Calcium	Lithium	Thallium
Beryllium	Chromium	Mercury	
Inorganics (Total)			
Fluoride	Sulfate	Chloride	TDS
Other (Total)			
Radium 226 and 228 combined			

[1] Dissolved oxygen, temperature, specific conductance, and oxidation/reduction potential were recorded during sample collection.

Data and results from the Part 845 background monitoring were included in the water quality discussion included in the HCR (included in the Operating Permit to which this Plan is attached). The data collected from background locations during the Part 845 monitoring were used to evaluate and calculate background concentrations for the EAP. The evaluation and discussion are included in **Section 3.2** of this report.

Data collected from the 40 C.F.R. § 257 monitoring network from 2015 to 2021, and from the Part 845 background monitoring were used for selection of the Part 845 monitoring well network proposed in **Section 2.2**.

2.2 Proposed Part 845 Monitoring Well Network

The groundwater monitoring network proposed in this plan will include 11 monitoring wells screened in the uppermost aquifer (07, 08, 08D, 12, 13, 16, 17, 46, 47, 52, and 54) and two temporary water level only surface water staff gages (XSG01 and SG02). The proposed network is summarized in **Table C** below and displayed on **Figure 2-1**. Eleven wells (five background and six compliance) will be used to monitor groundwater concentrations within the uppermost aquifer.

The groundwater samples collected from the 11 wells will be used to monitor and evaluate groundwater quality and demonstrate compliance with the groundwater quality standards listed in 35 I.A.C. § 845.600(a). The proposed monitoring wells will yield groundwater samples that represent the quality of downgradient groundwater at the CCR boundary (as required in 35 I.A.C. § 845.630(a)(2)). Monitoring well depths and construction details are listed in **Table 2-1** and summarized in **Table C** below.

Table C. Proposed Part 845 Monitoring Well Network

Well ID	Monitored Unit	Well Screen Interval (feet bgs)	Well Type[1]
07	UA	67.5 – 77.5	Background
08	UA	51.5 – 61.5	Background
08D	UA	83.0 – 88.0	Background
12	UA	49.5 – 59.5	Compliance
13	UA	67.0 – 69.0	Compliance
16	UA	56.0 – 66.0	Background
17	UA	58.1 – 68.1	Background
46	UA	50.0 – 60.0	Compliance
47	UA	50.0 – 60.0	Compliance
52	UA	51.0 – 61.0	Compliance
54	UA	65.0 – 75.0	Compliance
XSG01[2,3]	CCR	NA	WLO
SG02[2,3]	Surface Water	NA	WLO

[1] Well type refers to the role of the well in the monitoring network.

[2] Surface water level measuring points

[3] Location is temporary pending implementation of impoundment closure per an approved Construction Permit Application.

NA = not applicable

UA = uppermost aquifer

WLO = water level only

2.3 Well Abandonment

No wells are currently proposed for abandonment.

3. APPLICABLE GROUNDWATER QUALITY STANDARDS

3.1 Groundwater Classification

Groundwater at the EAP meets the definition of Class I – Potable Resource Groundwater (35 I.A.C. § 620.210), based on the following criteria:

- Groundwater in the uppermost aquifer extends ten feet or more below the land surface; and
- Field hydraulic conductivity tests from wells screened within the uppermost aquifer resulted in an overall (geometric mean) horizontal hydraulic conductivity of 8.4×10^{-2} centimeters per second (cm/s), which exceeds the 1×10^{-4} cm/s criterion.

3.2 Statistical Evaluation of Background Groundwater Data

A Statistical Analysis Plan (**Appendix A**) has been developed to describe procedures that will be used to establish background conditions and implement compliance monitoring as necessary and required by 35 I.A.C. § 845.640 and 35 I.A.C. § 845.650. The Statistical Analysis Plan was prepared in accordance with the requirements of 35 I.A.C. § 845.640(f), with reference to the acceptable statistical procedures provided in USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (*Unified Guidance,* March 2009), and is intended to provide a logical process and framework for conducting the statistical analysis of the data obtained during groundwater monitoring.

In accordance with 35 I.A.C. § 845.640(f)(1), the statistical method chosen for analysis of background groundwater quality was either the tolerance interval or the prediction interval procedure for each constituent listed in 35 I.A.C. § 845.600(a)(1) at this CCR unit per 35 I.A.C. § 845.640(f)(1)(C). A comparison of the statistical background concentrations and groundwater quality standards listed in 35 I.A.C. § 845.600(a)(1) and the resulting GWPSs are summarized in **Table 3-1**.

3.3 Applicable Groundwater Protection Standards

The applicable GWPSs will be established in accordance with 35 I.A.C. § 845.600(a) (greater of the background concentration or numerical limit specified in 35 I.A.C. § 845.600(a)(1)). The results of the statistical analysis of background groundwater data (**Table 3-1**) indicate that most background concentrations in the uppermost aquifer are less than the groundwater quality standards listed in 35 I.A.C. § 845.600(a)(1). Therefore, for these parameters, the groundwater quality standards listed in 35 I.A.C. § 845.600(a)(1) will be applied to the results from the proposed groundwater monitoring network. The exceptions include chloride, cobalt, and TDS, where the background concentration is greater than the 35 I.A.C. § 845.600(a)(1) standard. In these instances, the GWPS will be the background concentration.

Under most circumstances, the GWPS will be compared to the lower confidence limit for the observed concentrations for each constituent in each compliance well. Exceptions are when there are high percentages (greater than 50 percent) of non-detects in compliance well data, for which a future mean (for 50 to 70 percent non-detects) or median (for greater than 70 percent non-detects) will be compared to the GWPS. Consistent with the *Unified Guidance*, the same general statistical method of confidence interval testing against a fixed GWPS is recommended in compliance and corrective action programs. Confidence intervals provide a flexible and statistically accurate method to test how a parameter estimated from a single sample compares to a fixed numerical limit. Confidence intervals explicitly account for variation and uncertainty in the sample data used to construct them.

Evaluation of the applicable standards will occur in conjunction with the analysis of groundwater quality results. Background calculations and the resulting concentrations may be updated as appropriate, in accordance with the Statistical Analysis Plan included in **Appendix A.**

4. GROUNDWATER MONITORING PLAN

The GMP will monitor and evaluate groundwater quality to demonstrate compliance with the groundwater quality standards included in 40 C.F.R. § 257.94(e), 40 C.F.R. § 257.95(h), and 35 I.A.C. § 845.600(a). The groundwater monitoring program will include sampling and analysis procedures that are consistent and that provide an accurate representation of groundwater quality at the background and downgradient wells as required by 35 I.A.C. § 845.630. As discussed in **Section 2**, two monitoring programs specific to the EAP exist, the 40 C.F.R. § 257 monitoring program and the proposed Part 845 monitoring program. These networks will continue to be monitored until USEPA approves Part 845. It is expected that upon USEPA approval of Part 845, the 40 C.F.R. § 257 monitoring program and reporting will be eliminated, and the proposed Part 845 monitoring and reporting included in this Plan will continue until requirements of Part 845 have been achieved. Upon approval of the Operating Permit applications (and by extension the GMPs) for AP2 and AP4 and the EAP, the IEPA Water Pollution Control Permit 2019-EO-64097 Special Condition No. 4 will be discontinued following approval of a future permit modification submittal and will be replaced by the proposed Part 845 monitoring program.

4.1 Monitoring Networks and Parameters

4.1.1 40 C.F.R. § 257 Groundwater Monitoring

The existing 40 C.F.R. § 257 monitoring program was discussed in detail in **Section 2.1.1**. Seven wells (three background and four compliance) are sampled for Appendix III and Appendix IV parameters on a semi-annual frequency. Monitoring wells 16 and 17 are being considered as additional background wells to represent groundwater quality impacts from off-site, upgradient sources. Well locations and parameters will continue to be monitored and reported as required by 40 C.F.R. § 257 until USEPA approves Part 845.

4.1.2 Part 845 Groundwater Monitoring

The proposed Part 845 Monitoring Network will consist of five background monitoring wells (07, 08, 08D, 16, and 17), six compliance monitoring wells (12, 13, 46, 47, 52, and 54), and two temporary water level only staff gages (XSG01 and SG02) to monitor potential impacts from the EAP (**Figure 2-1**). These monitoring wells are screened within the uppermost aquifer along the perimeter of the EAP. Groundwater samples will be collected and analyzed for the following laboratory and field parameters in **Table D** below.

Table D. Part 845 Groundwater Monitoring Program Parameters

Field Parameters[1]			
Groundwater Elevation	pH	Turbidity	
Metals (Total)			
Antimony	Boron	Cobalt	Molybdenum
Arsenic	Cadmium	Lead	Selenium
Barium	Calcium	Lithium	Thallium
Beryllium	Chromium	Mercury	
Inorganics (Total)			
Fluoride	Sulfate	Chloride	TDS
Other (Total)			
Radium 226 and 228 combined			

[1] Dissolved oxygen, temperature, specific conductance, and oxidation/reduction potential will be recorded during sample collection.

All parameters listed above were sampled a minimum of eight times by October 18, 2021 to establish background groundwater quality in accordance with 35 I.A.C. § 845.650 (b)(1)(A). Discussion of background groundwater quality is included in **Section 3.2**.

4.2 Sampling Schedule

Groundwater sampling for the Part 845 monitoring well network will initially be performed quarterly according to the following schedule:

Table E. Part 845 Sampling Schedule

Frequency	Duration
Monthly (groundwater elevations only)	Begins: the quarter following approval of this plan and issuance of the Operating Permit.
	Ends: Following the 30-year post closure care period and following IEPA approval of documentation that groundwater concentrations are below standards in 35 I.A.C. § 845.600 and concentrations exceeding background are not increasing and meet requirements in 35 I.A.C. § 845.780 (c)(2)(B)(i) and (ii).
Quarterly (groundwater quality)	Begins: the quarter following approval of this plan and issuance of the Operating Permit.
	Ends: Following the 30-year post closure care period and following IEPA approval of documentation that groundwater concentrations are below standards in 35 I.A.C. § 845.600 and concentrations exceeding background are not increasing and meet requirements in 35 I.A.C. § 845.780 (c)(2)(B)(i) and (ii), or upon IEPA approval of an alternate schedule as allowed by 35 I.A.C. § 845.650(b)(4).
Semi-annual (groundwater quality)	Begins: Following 5 years of quarterly groundwater monitoring and IEPA approval of a demonstration that groundwater concentrations are below standards in 35 I.A.C. § 845.600 and not exhibiting statistically-significant increasing trends, monitoring effectiveness is not compromised by a semi-annual schedule, and sufficient data has been collected to characterize groundwater.
	Ends: Following detection of a statistically-significant increasing trend in groundwater concentrations or an exceedance of the standards in 35 I.A.C. § 845.600 (quarterly monitoring shall be resumed in these circumstances), or following the 30-year post closure care period and following IEPA approval of documentation that groundwater concentrations

	are below standards in 35 I.A.C. § 845.600 and concentrations exceeding background are not increasing and meet requirements in 35 I.A.C. § 845.780 (c)(2)(B)(i) and (ii).

4.3 Groundwater Sample Collection

Groundwater sampling procedures have been developed and the collection of groundwater samples is being implemented to meet the requirements of 35 I.A.C. § 845.640. In addition to groundwater well samples, quality assurance samples will be collected as described in **Section 4.5** (**Table 4-1**).

4.4 Laboratory Analysis

Laboratory analysis will be performed consistent with the requirements of 35 I.A.C. § 845.640(j) by a state-certified laboratory using methods approved by IEPA and USEPA. Laboratory methods may be modified based on laboratory equipment availability or procedures, but the Reporting Limit (RL) for all parameters analyzed, regardless of method, will be lower than the applicable groundwater quality standard. RLs for the applicable parameters are summarized in **Table 4-2**. Concentrations lower than the RL will be reported as less than the RL.

4.5 Quality Assurance Program

Consistent with the requirements of 35 I.A.C. § 845.640(a)(5), the sampling and analysis program includes procedures and techniques for quality assurance/quality control (QA/QC). Additional quality assurance samples to be collected will include the following:

- Field duplicates will be collected at a frequency of one per group of ten or fewer investigative water samples.
- One equipment blank sample will be collected and analyzed for each day of sampling. If dedicated sampling equipment is used, then equipment blank samples will not be collected.

The duplicate and equipment blank quality assurance samples will be supplemented by the laboratory QA/QC program, which typically includes:

- Regular generation of instrument calibration curves to assure instrument reliability
- Laboratory control samples and/or quality control check standards that have been spiked, and analyses to monitor the performance of the analytical method
- Matrix spike/matrix spike duplicate analyses to determine percent recoveries and relative percent differences for each of the parameters detected
- Analysis of replicate samples to check the precision of the instrumentation and/or methodology employed for all analytical methods
- Analysis of method blanks to assure that the system is free of contamination

Water quality meters used to measure pH and turbidity will be calibrated according to manufacturer’s specifications. At a minimum, it is recommended that calibration of pH occur daily prior to sampling and checked for accuracy at the end of each day. Unusual or suspect pH measurements during sampling events will be flagged, evaluated, and additional calibration may be performed throughout the sampling events. Turbidity meters will be checked daily, prior to and following sampling. Unusual measurements or erratic meter performance will be flagged and evaluated for overall effects on the data prior to reporting.

4.6 Groundwater Monitoring System Maintenance Plan

Consistent with the requirements of 35 I.A.C. § 845.630(e)(2), maintenance will be performed as needed to assure that the monitoring wells provide representative groundwater samples. Monitoring wells will be inspected during each groundwater sampling event; inspections will consist of the following:

- Visual inspection, clearing of vegetation, replacement of markers, and painting of protective casings as needed to assure that monitoring wells are clearly marked and accessible
- Visual inspection and repair or replacement of well aprons as needed to assure that they are intact, drain water away from the well, and have not heaved
- Visual inspection and repair or replacement of protective casings as needed to assure that they are undamaged, and that locks are present and functional
- Checks to assure that well caps are intact and vented, unless in flood-prone areas in which case caps will not be vented
- Annual measurement of monitoring well depths to determine the degree of siltation within the wells. Wells will be redeveloped as needed to remove siltation from the screened interval if it impedes flow of water into the well
- Checks to assure that wells are clear of internal obstructions, and flow freely

If maintenance of a monitoring well cannot address an identified deficiency, a replacement well will be installed.

4.7 Statistical Analysis

Statistical analysis will be consistent with procedures listed in 35 I.A.C. § 845.640(f). A Statistical Analysis Plan, provided in **Appendix A**, has been developed to summarize the statistical procedures that will be used to evaluate the groundwater results.

4.8 Data Reporting

Data reporting for the 40 C.F.R. § 257 monitoring well network will be consistent with recordkeeping, notification, and internet posting requirements described in 40 C.F.R. § 257.105 through 257.107.

Groundwater monitoring and analysis completed in accordance with the Part 845 monitoring under an approved monitoring program will be reported to IEPA within 60 days after completion of sampling and the data placed in the facility's operating record as required by 35 I.A.C. § 845.610(b)(3)(D). Within 14 days of posting to the operating record, information will be posted to the publicly accessible internet site "Illinois CCR Rule Compliance Data and Information" as required by 35 I.A.C. § 845.810(d). Information will also be submitted to IEPA annually by January 31 as required by 35 I.A.C. § 845.550, for data collected the preceding year. The report will include the status of the groundwater monitoring and any required corrective action plan for the EAP in addition to other requirements detailed in 35 I.A.C. § 845.610(e).

4.9 Compliance with Applicable On-site Groundwater Protection Standards

In accordance with 35 I.A.C. § 845.600(a)(1), the groundwater protection standard at the waste boundary will be the higher of either the 35 I.A.C. § 845.600 standard or the concentration determined by background groundwater monitoring.

As provided in 35 I.A.C. § 845.780(c)(2), at the end of the 30-year post-closure care period, groundwater monitoring will continue to be conducted in post-closure care until the groundwater results show the concentrations are:

- Below the GWPS in 35 I.A.C. § 845.600; and
- Not increasing for those constituents over background, using the statistical procedures and performance standards in 35 I.A.C. § 845.640(f) and (g), provided that:
  - Concentrations have been reduced to the maximum extent feasible; and
  - Concentrations are protective of human health and the environment.

If one or more constituents are detected and confirmed by an immediate resample, to be greater than the GWPS in any sampling event, an Alternate Source Demonstration (ASD) will be evaluated as described in **Section 4.10**.

4.10 Alternate Source Demonstrations

As allowed in 35 I.A.C. § 845.650(e), following detection of an exceedance of the GWPS, an ASD will be evaluated and, if completed, submitted to IEPA within 60 days. The ASD will provide lines of evidence that a source other than the EAP caused the contamination and the EAP did not contribute to the contamination, or that the exceedance of the GWPS resulted from error in sampling, analysis, statistical evaluation, natural variation in groundwater quality, or a change in the potentiometric surface and groundwater flow direction.

The ASD will include information and analysis that supports the conclusions and a certification of accuracy by a qualified professional engineer. Once the ASD is approved by IEPA, the Part 845 groundwater monitoring will continue as defined in **Section 4.1.2**.

If an ASD is not completed and submitted, or IEPA does not approve the ASD, a notification of the exceedance will be provided to IEPA and placed in the operating record. Additional actions will also be completed as required by 35 I.A.C § 845.650(d)(1) through (3), including initiation of an assessment of corrective measures under 35 I.A.C § 845.660. As allowed in 35 I.A.C § 845.650(e)(7) a petition for review of IEPA's non-concurrence under 35 I.A.C. § 105 may also be filed

4.11 Assessment of Corrective Measures and Corrective Action

As described in 35 I.A.C. § 845.660, if the ASD summarized in **Section 4.10** has not been approved by IEPA, an assessment of corrective measures will be initiated within 90 days of the detection of a result exceeding 35 I.A.C. § 845.600 standards (*i.e.,* receipt of laboratory data). The assessment of corrective measures will include at least the following (35 I.A.C. § 845.660(c)):

- The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination;

- The time required to begin and complete the corrective action plan; and
- The institutional requirements, such as State or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the corrective action plan.

Within one year of completing the assessment of corrective measures, a corrective action plan will be developed to identify the selected remedy in accordance with 35 I.A.C. § 845.670. If closure of the CCR Unit is required, a closure alternatives analysis will be completed as specified in 35 I.A.C. § 845.710. The analysis and selected alternative will be submitted to IEPA in a Closure Plan as specified by 35 I.A.C. § 845.720. Groundwater monitoring proposed in this Addendum will continue as specified until the post closure care period has expired and IEPA has approved termination of post-closure care.

5. REFERENCES

Illinois Environmental Protection Agency, 2021. *Standards for the Disposal of Coal Combustion Residuals in Surface Impoundments: Title 35 of the Illinois Administrative Code § 845.* April 15, 2021.

Natural Resource Technology, Inc. (NRT), 2017. *Sampling and Analysis Plan. Hennepin East Ash Pond Hennepin Power Station. Hennepin, IL*. October 17, 2017.

Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2021. *Hydrogeologic Site Characterization Report. Hennepin East Ash Pond. Hennepin Power Plant. Hennepin, Illinois*.

Science and Technology Management, Inc. (STMI), 1996. *Investigation of Site Closure Options at Illinois Power Company's Hennepin East Ash Impoundment. Report No. STMI/135/96-02*. Brookfield, Wisconsin. June 1996.

United States Environmental Protection Agency (USEPA), March 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance*. Office of Resource Conservation and Recovery, Program Implementation and Information Division, United States Environmental Protection Agency, Washington D.C. EPA/530/R-09/007.

United States Environmental Protection Agency (USEPA), 2015. *Title 40 of the Code of Federal Regulations, Part 257*.

TABLES

TABLE 1-1. PART 845 REQUIREMENTS CHECKLIST

GROUNDWATER MONITORING PLAN
HENNEPIN POWER PLANT
EAST ASH POND
HENNEPIN, ILLINOIS

Part 845 Reference	**Part 845 Components**	**Location of Information in GMP**
845.630	**Groundwater Monitoring Systems**	
845.630(a)(2)	Potential contaminant pathways must be monitored.	Sections 2.1.2, 2.2, & 4.1.2 Table 2-1 Figure 2-1
845.630(a) 845.630(b) 845.630(c)	At least two upgradient wells and four downgradient wells (min. 1 and 3, but requires additional documentation)	Sections 2.1.2, 2.2, & 4.1.2 Table 2-1 Figure 2-1
845.630(a) 845.630(b) 845.630(c)	Downgradient Well Density	Figure 2-1
845.630(a)(2)	Downgradient wells at waste boundary	Figure 2-1
845.640	**Groundwater Sampling and Analysis Requirements**	
845.640(a)	Consistent sampling and analysis procedures	Section 4 Tables 4-1 & 4-2
845.640(b)	Methods are appropriate	Section 4 Tables 4-1 & 4-2
845.640(c)	Groundwater elevations must be measured in each well prior to purging, each time groundwater is sampled.	Section 4.3
845.640 (d)(e)(f)(g)(h)	Establishment of background and application of statistical methods	Sections 3 & 4.7 Appendix A
845.640(i)	Analyze total recoverable metals	Section 4.1.2
845.640(j)	Analyze groundwater samples using a certified laboratory	Section 4.4

TABLE 1-1. PART 845 REQUIREMENTS CHECKLIST

GROUNDWATER MONITORING PLAN
HENNEPIN POWER PLANT
EAST ASH POND
HENNEPIN, ILLINOIS

Part 845 Reference	Part 845 Components	Location of Information in GMP
845.650	**Groundwater Monitoring Program**	
845.650(a)	Must include monitoring for all constituents with a groundwater protection standard in Section 845.600(a), calcium, and turbidity	Section 4.1.2
845.650(b)(c)	Groundwater Monitoring Frequency	Sections 4.1.2 & 4.2
845.650(d)(e)	Exceedances of the groundwater protection standard	Sections 4.9, 4.10, & 4.11
845.650(b)(2) and (3)	Staff gauge/ piezometer to monitor head in impoundment	Sections 2.2 & 4.1.2 Figure 2-1 (XSG01)
NA	Staff gauge/ piezometer to monitor head of neighboring surface water body	Sections 2.2 & 4.1.2 Figure 2-1 (SG02)

[O: NRK 08/17/21; U: CJC 09/16/21; C: LDC 09/20/21]

Notes:
GMP = Groundwater Monitoring Plan
NA = Not Applicable

TABLE 2-1. MONITORING WELL LOCATIONS AND CONSTRUCTION DETAILS

GROUNDWATER MONITORING PLAN
HENNEPIN POWER PLANT
EAST ASH POND
HENNEPIN, ILLINOIS

Well Number	Type	HSU	Date Constructed	Top of PVC Elevation (ft)	Measuring Point Elevation (ft)	Measuring Point Description	Ground Elevation (ft)	Screen Top Depth (ft BGS)	Screen Bottom Depth (ft BGS)	Screen Top Elevation (ft)	Screen Bottom Elevation (ft)	Well Depth (ft BGS)	Bottom of Boring Elevation (ft)	Screen Length (ft)	Screen Diameter (inches)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
07	B	UA	11/15/1984	518.27	518.27	Top of PVC	515.10	67.50	77.50	447.61	437.61	78.00	437.10	10	2	41.297986	-89.305712
08	B	UA	11/17/1984	501.38	501.38	Top of PVC	498.70	51.50	61.50	447.24	437.24	62.00	436.70	10	2	41.300698	-89.3044
08D	B	UA	04/17/2009	501.34	501.34	Top of PVC	498.80	83.00	88.00	415.79	410.79	90.00	408.80	5	2	41.300799	-89.304522
12	C	UA	03/28/1995	498.44	498.44	Top of PVC	495.16	49.45	59.50	445.71	435.71	60.00	435.20	10	2	41.303663	-89.304304
13	C	UA	03/01/1995	498.47	498.47	Top of PVC	495.38	67.00	69.00	428.38	426.38	75.00	420.40	2	2	41.303658	-89.304315
16	B	UA	03/30/1995	501.74	501.74	Top of PVC	500.30	56.00	66.00	444.28	434.28	68.00	432.30	10	2	41.30168	-89.302861
17	B	UA	03/30/1995	507.13	507.13	Top of PVC	504.80	58.06	68.10	446.77	436.77	68.00	436.80	10	2	41.3022	-89.3006
46	C	UA	08/11/2015	498.75	498.75	Top of PVC	496.44	50.00	60.00	446.44	436.44	60.00	436.40	10	2	41.303953	-89.303472
47	C	UA	08/11/2015	502.65	502.65	Top of PVC	499.07	50.00	60.00	452.13	442.13	60.00	442.10	10	2	41.303301	-89.305994
52	C	UA	02/11/2021	500.93	500.93	Top of PVC	497.70	51.00	61.00	446.74	436.74	60.90	436.80	10	2	41.302466	-89.306369
54	C	UA	02/09/2021	500.30	500.30	Top of PVC	497.10	65.00	75.00	432.14	422.14	74.06	423.10	10	2	41.303439	-89.30522
XSG01	WLO	CCR	--	--	493.49	Staff gauge	--	--	--	--	--	--	--	--	--	41.302583	-89.302249
SG02	WLO	SW	--	--	--	Staff gauge	--	--	--	--	--	--	--	--	--	41.303678	-89.31531

Notes:
All elevation data are presented relative to the North American Vertical Datum 1988 (NAVD88), GEOID 12A
Type refers to the role of the well in the monitoring network: background (B), compliance (C), or water level measurements only (WLO)
WLO wells are temporary pending implementation of impoundment closure per an approved Construction Permit application
-- = data not available
BGS = below ground surface
CCR = Coal Combustion Residual
ft = foot or feet
HSU = Hydrostratigraphic Unit
PVC = polyvinyl chloride
SW = surface water
UA = uppermost aquifer

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TABLE 3-1. BACKGROUND GROUNDWATER QUALITY AND STANDARDS

GROUNDWATER MONITORING PLAN
HENNEPIN POWER PLANT
EAST ASH POND
HENNEPIN, ILLINOIS

Parameter	Background Concentration	845 Limit	Groundwater Protection Standard	Unit
Antimony, total	0.001	0.006	0.006	mg/L
Arsenic, total	0.001	0.010	0.010	mg/L
Barium, total	0.212	2.0	2.0	mg/L
Beryllium, total	0.001	0.004	0.004	mg/L
Boron, total	0.163	2	2	mg/L
Cadmium, total	0.0023	0.005	0.005	mg/L
Chloride, total	435	200	435	mg/L
Chromium, total	0.001	0.1	0.1	mg/L
Cobalt, total	0.038	0.006	0.038	mg/L
Fluoride, total	0.12	4.0	4.0	mg/L
Lead, total	0.0015	0.0075	0.0075	mg/L
Lithium, total	0.019	0.04	0.04	mg/L
Mercury, total	0.0002	0.002	0.002	mg/L
Molybdenum, total	0.0017	0.1	0.1	mg/L
pH (field)	7.5 / 6.6	9.0 / 6.5	9.0 / 6.5	SU
Radium 226 and 228 combined	2	5	5	pCi/L
Selenium, total	0.0014	0.05	0.05	mg/L
Sulfate, total	215	400	400	mg/L
Thallium, total	0.001	0.002	0.002	mg/L
Total Dissolved Solids	1620	1200	1620	mg/L

Notes:
For pH, the values presented are the upper / lower limits
Groundwater protection standards for calcium and turbidity do not apply per 35 I.A.C. § 845.600(b)
mg/L = milligrams per liter
SU = standard units
pCi/L = picocuries per liter

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TABLE 4-1. SAMPLING AND ANALYSIS SUMMARY

GROUNDWATER MONITORING PLAN
HENNEPIN POWER PLANT
EAST ASH POND
HENNEPIN, ILLINOIS

Parameter	Analytical Method [1]	Number of Samples	Field Duplicates [2]	Field Blanks [3]	Equipment Blanks [3]	MS/MSD [4]	Total	Container Type	Minimum Volume [5]	Preservation (Cool to 4 °C for all samples)	Sample Hold Time from Collection Date
Metals											
Metals [6]	6020, Li - EPA 200.7	11	2	0	0	1	14	plastic	600 mL	HNO_3 to pH<2	6 months
Mercury	7470A or 6020	11	2	0	0	1	14	plastic	400 mL	HNO_3 to pH<2	28 days
Inorganic Parameters											
Fluoride	9214 or EPA 300	11	2	0	0	1	14	plastic	300 mL	Cool to 4 °C	28 days
Chloride	9251 or EPA 300	11	2	0	0	1	14	plastic	100 mL	Cool to 4 °C	28 days
Sulfate	9036 or EPA 300	11	2	0	0	1	14	plastic	50 mL	Cool to 4 °C	28 days
Total Dissolved Solids	SM 2540 C	11	2	0	0	1	14	plastic	200 mL	Cool to 4 °C	7 days
Radium											
Radium 226	9315 or EPA 903	11	0	0	0	0	11	plastic	1000 mL	HNO_3 to pH<2	6 months
Radium 228	9320 or EPA 904	11	0	0	0	0	11	plastic	1000 mL	HNO_3 to pH<2	6 months
Field Parameters											
pH	SM 4500-H+ B	11	NA	NA	NA	NA	11	flow-through cell	NA	none	immediately
Dissolved Oxygen [8]	SM 4500-O/405.1	11	NA	NA	NA	NA	11	flow-through cell	NA	none	immediately
Temperature [8]	SM 2550	11	NA	NA	NA	NA	11	flow-through cell	NA	none	immediately
Oxidation/Reduction Potential [8]	SM 2580 B	11	NA	NA	NA	NA	11	flow-through cell	NA	none	immediately
Specific Conductance [8]	SM 2510 B	11	NA	NA	NA	NA	11	flow-through cell	NA	none	immediately
Turbidity [7]	SM 2130 B	11	NA	NA	NA	NA	11	flow-through cell or hand-held turbidity meter	NA	none	immediately

[O: NRK 08/17/21; C: CJC 09/16/21]

Notes:

[1] Analytical method numbers are from SW-846 unless otherwise indicated. Analytical methods may be updated with more recent versions as appropriate.

[2] Field duplicates will be collected at a frequency of one per group of 10 or fewer investigative water samples. Field duplicates will not be collected for radium analysis.

[3] Field blanks will be collected at the discretion of the project manager; Equipment blanks will be collected at a rate of 1 per sampling event if non-dedicated equipment is used.

[4] Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples will be collected at a frequency of one per group of 20 or fewer investigative water samples per CCR unit/multi-unit. Additional volume to be determined by laboratory.

[5] Sample volume is estimated and will be determined by the laboratory.

[6] Metals = antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, lead, lithium, molybdenum, selenium, thallium. Metals may be analyzed via ICP/ ICP-MS USEPA methods 6010 or 6020 depending on laboratory instrument availability

[7] If turbidity exceeds 10 NTUs, a duplicate sample filtered through a .45 micron filter may be collected for metals analysis in addition to the unfiltered sample. Both samples would be submitted for analysis.

[8] Parameter collected for quality assurance and quality control for field sampling purposes only; not required to be collected or reported under Part 845; collection of parameter may be discontinued without notification.

< = less than
°C = degrees Celsius
HNO_3 = nitric acid
mL = milliliter
NA = not applicable
NTU = nephelometric turbidity unit

TABLE 4-2. DETECTION AND REPORTING LIMITS FOR PART 845 PARAMETERS

GROUNDWATER MONITORING PLAN
HENNEPIN POWER PLANT
EAST ASH POND
HENNEPIN, ILLINOIS

Constituent	**CAS**	**Unit**	**Analytical Methods** [1]	**USEPA MCL** [2]	**35 I.A.C. § 845.600**	**RL** [4, 5]	**MDL** [5]
Metals							
Antimony	7440-36-0	mg/L	6020	0.006	0.006	0.003	0.00036
Arsenic	7440-38-2	mg/L	6020	0.01	0.01	0.001	0.00013
Barium	7440-39-3	mg/L	6020	2	2	0.001	0.00028
Beryllium	7440-41-7	mg/L	6020	0.004	0.004	0.001	0.000017
Boron	7440-42-8	mg/L	6020	NS	2	0.01	0.0023
Cadmium	7440-43-9	mg/L	6020	0.005	0.005	0.001	0.000042
Calcium	7440-70-2	mg/L	6020	NS	NS	0.15	0.15
Chromium	7440-47-3	mg/L	6020	0.1	0.1	0.004	0.00027
Cobalt	7440-48-4	mg/L	6020	0.006	0.006	0.002	0.000017
Lead	7439-92-1	mg/L	6020	0.015	0.0075	0.001	0.000025
Lithium	7439-93-2	mg/L	6020 or EPA 200.7	0.04	0.04	0.02	0.0001
Mercury	7439-97-6	mg/L	6020 or 7470A	0.002	0.002	0.0002	0.000078
Molybdenum	7439-98-7	mg/L	6020	0.1	0.1	0.001	0.000063
Selenium	7782-49-2	mg/L	6020	0.05	0.05	0.001	0.00032
Thallium	7440-28-0	mg/L	6020	0.002	0.002	0.001	0.000062
Inorganics							
Fluoride	7681	mg/L	9214 or EPA 300	4	4	0.25	0.065
Chloride	16887-00-6	mg/L	9251 or EPA 300	250 [3]	200	1	0.15
Sulfate	18785-72-3	mg/L	9036 or EPA 300	250 [3]	400	1	0.24
Total Dissolved Solids	10052	mg/L	SM 2540C	500 [3]	1200	17	--
Other							
Radium 226 and 228 combined	7440-14-4	pCi/L	9315/9320 or EPA 903/904	5	5	-- [6]	-- [7]
Field							
pH	NA	SU	SM 4500-H+ B	NS	6.5-9.0	NA	NA
Oxidation/Reduction Potential	NA	mV	SM 2580 B	NS	NS	NA	NA
Dissolved Oxygen	NA	mg/L	SM 4500-O/405.1	NS	NS	NA	NA
Temperature	NA	°C	SM 2550	NS	NS	NA	NA
Specific Conductance	NA	µS/cm	SM 2510 B	NS	NS	NA	NA

TABLE 4-2. DETECTION AND REPORTING LIMITS FOR PART 845 PARAMETERS

GROUNDWATER MONITORING PLAN
HENNEPIN POWER PLANT
EAST ASH POND
HENNEPIN, ILLINOIS

Constituent	CAS	Unit	Analytical Methods [1]	USEPA MCL [2]	35 I.A.C. § 845.600	RL [4, 5]	MDL [5]
Turbidity	NA	NTU	SM 2130 B	NS	NS	NA	NA

[O: NRK 08/17/21; C: CJC 09/16/21]

Notes:

[1] Analytical method numbers are from SW-846 unless otherwise indicated. Metals will be analyzed via Method 6020 or 6010 depending on laboratory equipment availability. Selected method will ensure reporting limits (RL) are below Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845.600 groundwater protection standards.

[2] USEPA MCL = United States Environmental Protection Agency Maximum Contaminant Level.

[3] USEPA SMCL = United States Environmental Protection Agency Secondary Maximum Contaminant Level.

[4] RLs will be less than the 35 I.A.C. § 845.600 groundwater protection standards.

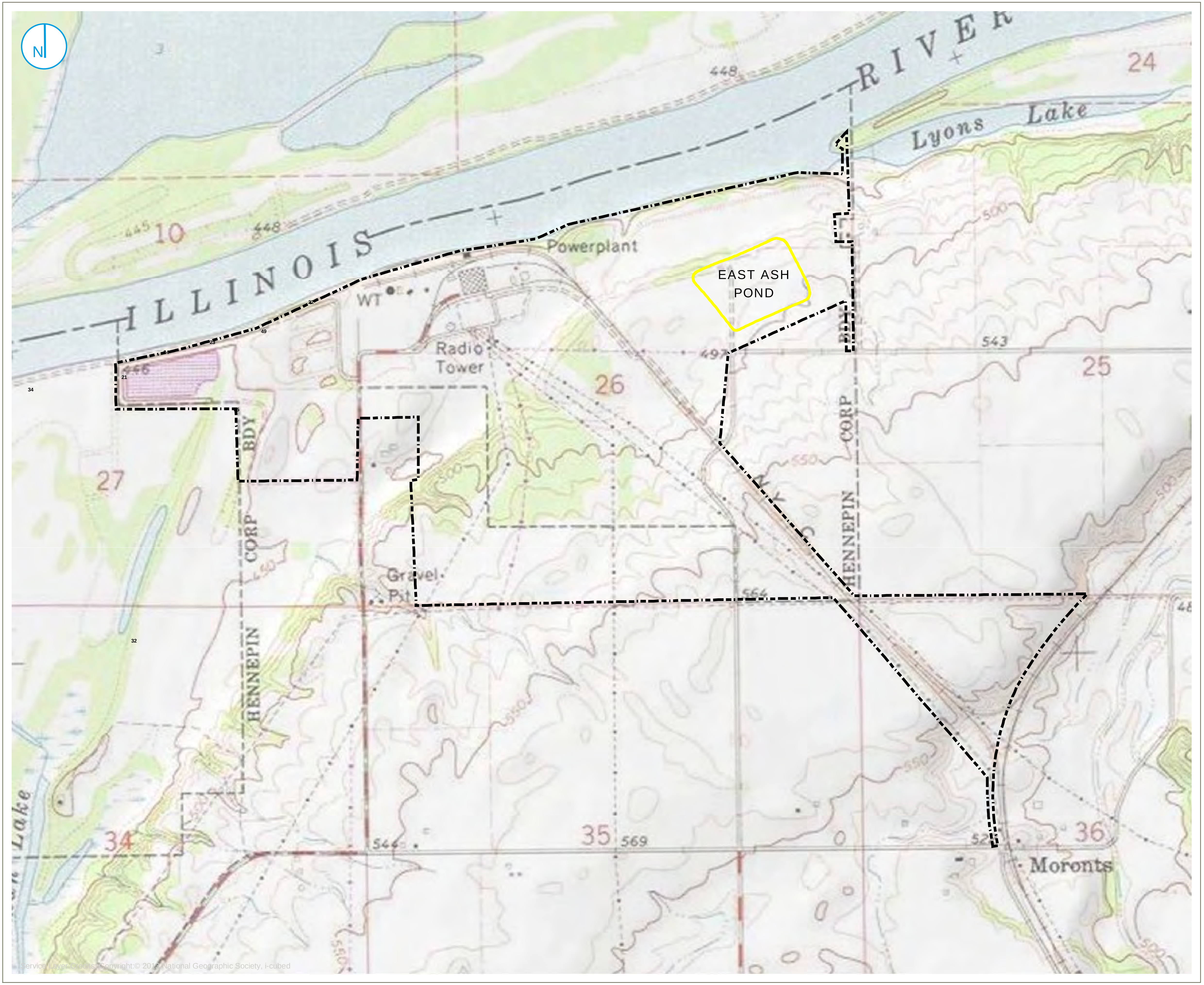
[5] RLs and method detection limits (MDL) will vary depending on the laboratory performing the work.

[6] All radium results will be reported (values may be positive or negative) and will include uncertainty and the calculated MDC.

[7] Laboratories calculate a minimum detectable concentration (MDC) based on the sample.

^{o}C = degrees Celsius
µS/cm = microsiemens per centimeter
CAS = Chemical Abstract Number
MDL = Method detection limit as established by the laboratory
mg/L = milligrams per liter
mV = millivolts
NS = No standard
NTU = nephelometric turbidity unit
pCi/L = picocuries per liter
RL = Reporting limit as established by the laboratory
SM = Standard Methods for the Examination of Water and Wastewater
SU = Standard Units

FIGURES



▭ PART 845 REGULATED UNIT (SUBJECT UNIT)

▭ PROPERTY BOUNDARY

0 500 1,000 Feet

SITE LOCATION MAP

GROUNDWATER MONITORING PLAN
EAST ASH POND
HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

FIGURE 1-1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Hennepin\GMP\Figure 1-1_Site Location Map.mxd

PROJECT: 169000XXXX | DATED: 9/29/2021 | DESIGNER: STOLZSD

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Hennepin\GMP\Figure 1-2_Site Map.mxd

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

🟨 PART 845 REGULATED UNIT (SUBJECT UNIT)
☐ SITE FEATURE
▨ LIMITS OF FINAL COVER
⬚ PROPERTY BOUNDARY

0 175 350 Feet

SITE MAP

GROUNDWATER MONITORING PLAN
EAST ASH POND
HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

FIGURE 1-2

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

PROJECT: 169000XXXX | DATED: 9/29/2021 | DESIGNER: STOLZSD

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Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Hennepin\GMP\Figure 1-3_GWE Contours 20210224_26.mxd

PROJECT: 169000XXXX | DATED: 9/29/2021 | DESIGNER: STOLZSD

✚	BACKGROUND WELL
✚	MONITORING WELL
✚	SOURCE SAMPLE LOCATION
◒	STAFF GAGE
—	GROUNDWATER ELEVATION CONTOUR (1-FT CONTOUR INTERVAL, NAVD88)
- -	INFERRED GROUNDWATER ELEVATION CONTOUR
→	GROUNDWATER FLOW DIRECTION
☐	PART 845 REGULATED UNIT (SUBJECT UNIT)
☐	SITE FEATURE
▨	LIMITS OF FINAL COVER
☐	PROPERTY BOUNDARY

NOTE:
ELEVATIONS IN PARENTHESIS WERE NOT USED FOR CONTOURING.

0 175 350
Feet

UPPERMOST AQUIFER GROUNDWATER ELEVATION CONTOURS FEBRUARY 24-26, 2021

GROUNDWATER MONITORING PLAN
EAST ASH POND
HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

FIGURE 1-3

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Hennepin\GMP\Figure 1-4_GWE Contours 20210407.mxd

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

▣ BACKGROUND WELL
▣ MONITORING WELL
▣ SOURCE SAMPLE LOCATION
◒ STAFF GAGE
— GROUNDWATER ELEVATION CONTOUR (1-FT CONTOUR INTERVAL, NAVD88)
- - INFERRED GROUNDWATER ELEVATION CONTOUR
→ GROUNDWATER FLOW DIRECTION
▭ PART 845 REGULATED UNIT (SUBJECT UNIT)
▭ SITE FEATURE
▨ LIMITS OF FINAL COVER
⬚ PROPERTY BOUNDARY

NOTE:
ELEVATIONS IN PARENTHESIS WERE NOT USED FOR CONTOURING.

0 175 350
Feet

UPPERMOST AQUIFER GROUNDWATER ELEVATION CONTOURS APRIL 7, 2021

GROUNDWATER MONITORING PLAN
EAST ASH POND
HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

FIGURE 1-4

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

PROJECT: 169000XXXX | DATED: 9/29/2021 | DESIGNER: STOLZSD

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Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Hennepin\GMP\Figure 2-1_Proposed Monitoring Well Network.mxd

PROJECT: 169000XXXX | DATED: 10/13/2021 | DESIGNER: HOTCALD

PROPOSED PART 845 GROUNDWATER MONITORING WELL NETWORK

GROUNDWATER MONITORING PLAN
EAST ASH POND
HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

FIGURE 2-1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

APPENDIX A
STATISTICAL ANALYSIS PLAN

Prepared for

Dynegy Midwest Generation, LLC

Date

October 25, 2021

Project No.

1940100806-005

STATISTICAL ANALYSIS PLAN

EAST ASH POND
HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

Bright ideas. Sustainable change.

STATISTICAL ANALYSIS PLAN
HENNEPIN POWER PLANT EAST ASH POND

Project Name	**Hennepin Power Plant East Ash Pond**
Project No.	**1940100806-005**
Recipient	**Dynegy Midwest Generation, LLC**
Document Type	**Statistical Analysis Plan**
Version	**FINAL**
Date	**October 25, 2021**

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Senior Managing Hydrogeologist

Eric J. Tlachac, PE
Senior Managing Engineer

Rachel Banoff

Rachel A. Banoff, EIT
Project Statistician

LICENSED PROFESSIONAL CERTIFICATIONS

This certification is based on the description of the statistical methods selected to evaluate groundwater as presented in the following Statistical Analysis Plan; Hennepin Power Plant East Ash Pond. The procedures described in the plan will be used to establish background conditions and implement compliance monitoring as necessary and required by 35 I.A.C. § 845.640 and 35 I.A.C. § 845.650. The Statistical Analysis Plan was prepared in accordance with the requirements of 35 I.A.C. § 845.640(f), with reference to the acceptable statistical procedures provided in the United States Environmental Protection Agency (USEPA)'s *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (*Unified Guidance,* March 2009), and is intended to provide a logical process and framework for conducting the statistical analysis of the data obtained during groundwater monitoring. In accordance with 35 I.A.C. § 845.640(f)(1), the statistical method chosen for analysis of background groundwater quality will be either the tolerance interval or the prediction interval procedure for each constituent listed in 35 I.A.C. § 845.600(a)(1) at this CCR unit per 35 I.A.C. § 845.640(f)(1)(C). Groundwater Protection Standards (GWPS) will be established in accordance with 35 I.A.C. § 845.600(a) (greater of the background concentration or numerical limit specified in 35 I.A.C. § 845.600(a)(1)). The GWPS will be compared to the lower confidence limit for the observed concentrations for each constituent in each compliance well. Consistent with the *Unified Guidance*, the same general statistical method of confidence interval testing against a fixed GWPS is recommended in compliance and corrective action programs. Confidence intervals provide a flexible and statistically accurate method to test how a parameter estimated from a single sample compares to a fixed numerical limit. Confidence intervals explicitly account for variation and uncertainty in the sample data used to construct them.

Description of the statistical methods chosen for analysis of groundwater monitoring data and application of these methods for determining exceedances of the GWPS identified in 35 I.A.C. § 845.600(a) is provided in this Statistical Analysis Plan.

35 I.A.C. § 845.640 Statistical Analysis (PE)

I, Eric J. Tlachac, a qualified professional engineer in good standing in the State of Illinois, certify that the statistical methods summarized above and described in this document (Statistical Analysis Plan; Hennepin Power Plant East Ash Pond) are appropriate for evaluating the groundwater monitoring data collected as described in the attached document and are in substantial compliance with 35 I.A.C. § 845.640.

Eric J. Tlachac
Qualified Professional Engineer
062-063091
Illinois
Date: October 25, 2021

ERIC J. TLACHAC
062-063091

35 I.A.C. § 845.640 Statistical Analysis (PG)

I, Brian G. Hennings, a qualified professional geologist in good standing in the State of Illinois, certify that the statistical methods described in this document (Statistical Analysis Plan; Hennepin Power Plant East Ash Pond) are appropriate for evaluating the groundwater monitoring data collected as described in the attached document and are in substantial compliance with 35 I.A.C. § 845.640.

BRIAN G. HENNINGS
196.001482

____
Brian G. Hennings
Professional Geologist
196.001482
Illinois
Date: October 25, 2021

35 I.A.C. § 845.640 Statistical Analysis

I, Rachel A. Banoff, a qualified professional, certify that the statistical methods described in this document (Statistical Analysis Plan; Hennepin Power Plant East Ash Pond), are appropriate for evaluating the groundwater monitoring data collected as described in the attached document and are in substantial compliance with 35 I.A.C. § 845.640.

Rachel Banoff
____
Rachel A. Banoff, EIT
Project Statistician
Date: October 25, 2021

CONTENTS

TABLES (IN TEXT)

ACRONYMS AND ABBREVIATIONS

§	Section
35 I.A.C.	Title 35 of the Illinois Administrative Code
ANOVA	analysis of variance
CCR	coal combustion residuals
COC	constituents of concern
GWPS	groundwater protection standard
IEPA	Illinois Environmental Protection Agency
LCL	lower confidence limit
LTL	lower tolerance limit
MSE	mean squared error
P	probability
Part 845	Residuals in Surface Impoundments: Title 35 of the Illinois Administrative Code § 845
RCRA	Resource Conservation and Recovery Act
RL	reporting limit
ROS	regression on order statistics
SI	surface impoundment
SSI	statistically significant increase
SWFPR	site-wide false positive rate
Unified Guidance	*Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (USEPA, 2009)
UPL	upper prediction limit
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit

1. INTRODUCTION

In April 2021, the Illinois Environmental Protection Agency (IEPA) issued a final rule for the regulation and management of Coal Combustion Residuals (CCR) in surface impoundments (SIs) under the Standards for the Disposal of CCR in Surface Impoundments: Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845 (Part 845). Facilities regulated under Part 845 are required to develop and sample a groundwater monitoring well network to evaluate whether impounded CCR materials are impacting downgradient groundwater quality. The groundwater quality evaluation must include selection and certification by a qualified professional engineer of the statistical procedures to be used. The procedures described in the evaluation will be used to establish background conditions and implement compliance and corrective action monitoring as necessary and required by 35 I.A.C. § 845.640 and 35 I.A.C. § 845.650. This Statistical Analysis Plan was prepared in accordance with the requirements of 35 I.A.C. § 845.640(f), with reference to the acceptable statistical procedures provided in United States Environmental Protection Agency's (USEPA's) *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (*Unified Guidance*) (March 2009).

This Statistical Analysis Plan does not include procedures for groundwater sample collection and analysis, as these activities are conducted in accordance with the Sampling and Analysis Plan prepared for each CCR unit in accordance with 35 I.A.C. § 845.640. This Statistical Analysis Plan will be used as the primary reference for evaluating groundwater quality during operation and post-closure care.

1.1 Statistical Analysis Objectives

This Statistical Analysis Plan is intended to provide a logical process and framework for conducting the statistical analyses of data obtained during groundwater monitoring conducted in accordance with the Sampling and Analysis Plan for each CCR unit. The Statistical Analysis Plan will enable a qualified professional engineer to certify that the selected statistical methods are appropriate for evaluating the groundwater monitoring data for the applicable CCR unit(s).

1.2 Statistical Analysis Plan Approach

The main sections of this Statistical Analysis Plan should be viewed as a "generic" outline of statistical methods utilized for each CCR unit and constituent required to be monitored. The statistical analysis of the groundwater monitoring data, however, will be conducted on an individual-constituent or well basis, and may involve the use of appropriate statistical procedures depending on multiple factors such as detection frequency and normality distributions.

The CCR Rule outlines two phases of groundwater monitoring:

- Background Monitoring in accordance with 35 I.A.C. § 845.650(b)(1)
- Compliance Monitoring in accordance with 35 I.A.C. § 845.650

Each phase of the groundwater monitoring program requires specific statistical procedures to accomplish the intended purpose. During the background monitoring phase, background groundwater quality will be established utilizing upgradient and background wells and downgradient groundwater quality data will be collected to facilitate statistics in subsequent phases. Compliance Monitoring is then initiated through the evaluation of the downgradient groundwater monitoring data for exceedances of the groundwater protection standard (GWPS) established by Part 845 (concentration specified in 35 I.A.C. § 845.600 or an IEPA-approved background concentration). The developed statistical analysis plan will be implemented for each monitoring phase and in accordance with the statistical procedures.

2. BACKGROUND MONITORING AND DATA PREPARATION

The background and compliance monitoring wells were sampled and analyzed for constituents, as listed in Part 845 (antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chloride, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, pH, radium 226 and 228 combined, selenium, sulfate, thallium, total dissolved solids, and turbidity), during the baseline phase of the groundwater monitoring program.

The background monitoring well(s) were placed upgradient of the CCR unit, or at an alternative background location, where they are not affected by potential leakage from the CCR unit. Compliance monitoring wells were placed at the waste boundary of the CCR unit, along the same groundwater flow path. As 35 I.A.C. § 845.630(a) specifies, the location of these wells ensures that background accurately represents the quality of unaffected groundwater, while compliance wells accurately represent groundwater quality at the waste boundary and monitor all potential contaminant pathways.

As required by 35 I.A.C. § 845.650(a)(1), eight sampling events were completed within 180 days of April 21, 2021. As outlined, groundwater sampling procedures included sampling of the background and compliance wells using low-flow sampling methods, collection of one field quality control sample per event, and groundwater samples were not field filtered before laboratory analysis of total recoverable metals.

Following completion of the eight sampling events, background groundwater quality was established for Part 845 constituents. Groundwater monitoring will be conducted quarterly for at least the first five years. In accordance with 35 I.A.C. § 845.650(b)(4), after the first five years, a request to reduce the monitoring frequency to semiannual may be submitted to IEPA if all of the following can be demonstrated:

- Groundwater monitoring effectiveness will not be compromised by the reduced frequency
- Sufficient data has been collected to characterize groundwater
- Monitoring to date does not show any statistically significant increasing trends
- The concentrations of monitored constituents at the compliance monitoring wells are below the applicable GWPSs established in 35 I.A.C. § 845.600

The following subsections outline the statistical tests and procedures (methods) that will be utilized to evaluate data collected for each constituent in both background and compliance wells for Background and Compliance Monitoring. When necessary and contingent upon equivalent statistical power, an alternative test not included in this Statistical Analysis Plan may be chosen due to site-specific data requirements.

2.1 Sample Independence

Independence of sample results is a major assumption for most statistical analyses. To ensure physical independence of groundwater sampling results, the minimum time between sampling events must be longer than the time required for groundwater to move through the monitoring well. The sampling schedules for both the baseline and compliance monitoring periods are specified in 35 I.A.C. § 845.650(b) and may conflict with the statistical assumption of independence of sample results.

2.2 Non-Detect Data Processing

The reporting limit (RL) will be used as the lower level for the reporting of non-detected groundwater quality data. For all summary statistics (box plots, timeseries, etc.), the RL will be substituted for concentrations reported below the RL, including non-detects. With professional judgement, analytical results between the RL and the method detection limit, *i.e.,* estimated values, typically identified with a "J" flag, may be utilized if provided by the laboratory.

For all statistical test procedures:

- If the frequency of non-detect data are less than or equal to 15 percent, half of the RL will be substituted for these data
- If the non-detect frequency is between 15 percent and 50 percent, either the Kaplan-Meier or robust regression on order statistics (ROS) will be used to estimate the mean and standard deviation adjusted for the presence of left-censored values
- If the non-detect frequency is greater than 50 percent, a non-parametric test will be used
- If only one background result is detected that value will be used as the non-parametric upper prediction limit (UPL)

2.3 Testing for Normality

Many statistical analyses assume that sample data are normally distributed (parametric). However, environmental data are frequently not normally distributed (nonparametric). 35 I.A.C. § 845.640(g) requires the knowledge of the background data distribution for comparison to compliance results. The *Unified Guidance* document recommends the Shapiro-Wilk normality test for sample sizes of 50 or less, and the Shapiro-Francia normality test for sample sizes greater than 50.

When possible, transformation of datasets to achieve normal distributions is preferred.

2.4 Testing for Outliers

Part 845 constituents will be screened for the existence of outliers using a method described by the *Unified Guidance*. Outliers are extreme data points that may represent an anomaly or erroneous data point. To test for outliers, one or more of the following outlier tests will be utilized:

- Dixon's test, for well-constituent pairs with less than 25 samples, assumes normally distributed data.
- Rosner's test, for well-constituent pairs with more than 20 samples, assumes normally distributed data.
- Grubb's test for well-constituent pairs with seven or more samples, assumes normally distributed data.
- Time series, box-whisker plots, and probability plots provide visual tools to identify potential outliers, and evaluation of seasonal, spatial, or temporal variability for both normally and non-normally distributed data.

Data quality control, groundwater geochemistry, and sampling procedures will be evaluated as potential sources of error leading to an outlier result. The outlier tests cannot be used alone to determine whether a value is a true outlier that should be excluded from future statistical analysis. Corroborating evidence needed to exclude values includes a discrete data reporting or analytical error, or potential laboratory bias. Absent corroborating evidence, the flagged values are considered true, but extreme, values in the data set. Professional judgement will be used to exclude extreme outliers from further statistical analyses. Outliers will be retained in the database.

With professional judgement, a confirmatory sample may be collected to allow for the distinction between an outlier and a true representation of groundwater quality at the monitoring point. If re-sampling is conducted, this sample will be collected within 90 days following outlier identification. If the confirmatory sample indicates the original result as an outlier, it will be reported as such.

2.5 Trend Analysis

Statistical analyses supporting the lack of trend are a fundamental step to confirm the assumption that groundwater quality values are stationary or constant over time at a CCR unit. These analyses allow for evaluation of variation in the background and compliance data for each constituent over time. A statistically significant increasing trend in background data could indicate an existing release from the CCR unit or alternate source, requiring further investigation. In addition, statistically significant trending background data can result in increased standard deviation and, therefore, greater prediction or control limits. Consequently, the increased prediction or control limit will have less power or ability to identify a release from the CCR unit.

A linear regression, coupled with a t-test for slope significance at a 95 percent confidence level (0.05 significance level), may be used on datasets for each constituent with few non-detects and a normally distributed variance of the mean to evaluate time trends. The Theil-Sen trend line, coupled with the Mann-Kendall test for slope significance at a 95 percent confidence level (0.05 significance level), will be used for datasets with frequent non-detects or non-normal variance. Similarly, trend analyses could also be used on compliance data to evaluate a possible release from the CCR unit.

2.6 Spatial Variation

Spatial trends and/or variation between background wells could indicate an existing release from a CCR unit. If the spatial variability is not due to an existing release, intrawell comparisons in compliance wells may be used to account for spatial variability and monitor for a future release. However, the CCR unit being monitored was placed into service prior to the start of groundwater monitoring and it is unknown whether a previous release has occurred. Accordingly, intrawell comparisons in compliance wells cannot be used to determine the occurrence of a future release. Interwell comparisons between compliance wells and background wells will be used.

2.7 Temporal Variation

Time series plots can be used to identify temporal dependence. Potentially significant temporal components of variability can be identified by graphing single constituent data from multiple wells together on a time series plot. With temporal dependence, the time series plot as a pattern of parallel traces, in which the individual wells will tend to rise and fall together across the sequence of sampling dates. Time series plots can be helpful by plotting multiple constituents over time for the same well, or averaging values for each constituent across wells on each sampling event and then plotting the averages over time. In either case, the plots can signify whether the general concentration pattern over time is simultaneously observed for different constituents. If so, it may indicate that a group of constituents is highly correlated in groundwater or that the same artifacts of sampling and/or lab analysis impacted the results of several monitoring parameters.

Hydrologic factors such as drought, recharge patterns or regular (*e.g.,* seasonal) water table fluctuations may be responsible for the temporal variation. In these cases, it may be useful to test for the presence of a significant temporal effect by first constructing a parallel time series plot and then running a formal one-way analysis of variance (ANOVA) ($\alpha = 0.05$) for temporal effects. A one-way ANOVA for temporal effects considers multiple well data sets for individual sampling events or seasons as the relevant statistical factor. If event-specific analytical differences or seasonality appear to be an important temporal factor, the one-way ANOVA for temporal effects can be used to formally identify seasonality, parallel trends, or changes in lab performance that affect other temporal effects. The one-way ANOVA for temporal effects assumes that the data groups are normally distributed with constant variance. It is also assumed that for each of a series of background wells, measurements are collected at each well on sampling events or dates common to all the wells. Results of the ANOVA can also be used to create temporally stationary residuals, where the temporal effect has been ‘subtracted from’ the original measurements. These stationary residuals may be used to replace the original data in subsequent statistical testing.

If the data cannot be normalized, a similar test for a temporal or seasonal effect can be performed using the Kruskal-Wallis test ($\alpha = 0.05$). Each sampling event should be treated as a separate ‘well,’ while each well is treated as a separate ‘sampling event.’ In this case, no residuals can be computed since the Kruskal-Wallis test employs ranks of the data rather than the measurements themselves.

Where both spatial and temporal variation occur, two-way ANOVA can be considered where both well location and sampling event/season are treated as statistical factors. This procedure is described in Davis (1994).

2.8 Updating Background

Updating the background dataset periodically by adding recent results to an existing background dataset can improve the statistical power and accuracy of the statistical analysis, especially for non-parametric prediction intervals. The *Unified Guidance* recommends updating statistical limits (background) when at least four to eight new measurements (every 1 to 2 years under a quarterly monitoring program), are available for comparison to historical data. Professional judgement will be used to evaluate whether any background data appear to be affected by a release and need to be excluded from a background update. A t-test for equal means (if normal data distribution) or appropriate non-parametric test (if non-normal data distribution) such as a Mann-Whitney (or Wilcoxon) rank-sum or box-whisker plots, will be conducted to evaluate whether the two groups of background sample populations are statistically different prior to updating any background datasets. A 0.05 significance level will be utilized when evaluating the two populations, with the null hypothesis that they are equivalent. In addition, time series graphs or other trend evaluation statistics will be conducted on the new background dataset to verify the absence of a release or changing groundwater quality. If the tests indicate that there are no statistical differences between the two background populations, the new data will be combined with the existing dataset. If the two populations are found to be different, the data will be reviewed to evaluate the cause of the difference. If the differences appear to be caused by a release (if the new data are significantly higher, or lower for pH), then the previous background dataset may continue to be used. Furthermore, verified outliers will not be added to an existing background dataset. In accordance with the *Unified Guidance*, continual background updates will not be conducted due to the lack of sufficient samples for a statistical comparison.

3. COMPLIANCE MONITORING

Compliance monitoring is designed to monitor groundwater for evidence of a release by comparing Part 845 constituents in compliance wells to both background concentrations and the GWPS. Compliance Monitoring will begin the 1st quarter following approval of this Groundwater Monitoring Plan and issuance of the Operating Permit. The selected Compliance Monitoring statistical method used to compare compliance groundwater quality data for each constituent to the GWPS will provide for adequate statistical power, error levels and individual test false positive rates, and be appropriate for the distribution and detection frequency of the background dataset. Statistical power is the ability of a statistical test to detect a true exceedance.

In accordance with 35 I.A.C. § 845.610(b)(3)(D), compliance monitoring statistical analyses will be completed and submitted to IEPA within 60 days after completion of sampling.

3.1 GWPS Establishment and Exceedance Determination

In accordance with 35 I.A.C. § 845.600(a), the GWPS will be the constituent concentrations specified in 35 I.A.C. § 845.600(a)(1) except for when the background concentration is greater, or no concentration is specified (*i.e.,* for calcium and turbidity), in which case the GWPS will be the background concentration. The GWPS based on background concentration will be calculated using a parametric upper tolerance limit (UTL), a parametric UPL for a future mean, or a non-parametric UPL for a future median.

Statistical calculations that will be utilized in Compliance Monitoring procedures are summarized in **Table A** below and listed in **Sections 3.1.1** through **3.1.7**. Depending on the distribution of the data and the percentage of non-detects, it may be more appropriate to use a parametric model over a non-parametric model. As necessary, other techniques as mentioned in the *Unified Guidance* and/or new methods will be implemented.

Table A. Statistical Calculations Used in Compliance Monitoring Procedures

Compliance Monitoring						
Significant Trend?	Background Data			Compliance Data		
	Percent Non-Detects	Distribution	GWPS Determination	Percent Non-Detects	Distribution	Method to Determine Exceedance
No	0 ≤ 50	Normal	35 I.A.C § 845.600(a)(1) constituent concentration or The Upper Tolerance Limit	≤75	Normal	Parametric Lower Confidence Limit around a Normal Mean
				≤75	Log-Normal	Parametric Lower Confidence Limit around a Lognormal Geometric Mean
				NA	Non-Normal	Non-Parametric Lower Confidence Limit around a Median
				>75	Unknown/ Cannot be determined	
	50 ≤ 70	Normal	The Upper Prediction Limit for a Future Mean	NA	NA	Future mean
	>70	Non-Normal	Upper Prediction Limit for a Future Median	NA	NA	Future median
	100	Non-Normal	Double Quantification Rule	NA	NA	Individual Retesting Values
Yes	0 ≤ 50	Normal	UCL of Confidence Band around Linear Regression	≤75	Residuals after subtracting trend are normal, equal variance	Lower Limit from Confidence Band around Linear Regression
	50 ≤ 100	Non-Normal	UCL of Confidence Band around Thiel-Sen trend line	≤75	Residuals not normal	Lower Limit from Confidence Band around Thiel-Sen

3.1.1 The Upper Tolerance Limit

The UTL will be used to calculate the GWPS when pooled background data are normally distributed, with a non-detect frequency of 50 percent or less. When non-detect frequency is 15 percent or less, half the RL will be substituted for non-detects. The *Unified Guidance* recommends 95 percent confidence level and 95 percent coverage (95/95 tolerance interval).

- When non-detect frequency is 15 percent or less, half the RL will be substituted for non-detects (simple substitution), and the normal mean and standard deviation will be calculated.

- The Kaplan-Meier or the ROS method will be used when the detection frequency is between 15 percent and 50 percent. The Kaplan-Meier method assesses the linearity of a censored probability plot to determine whether the background sample can be approximately normalized. If so, then the Kaplan-Meier method will be used to compute estimates of the mean and standard deviation adjusted for the presence of left-censored values. The Kaplan-Meier or ROS estimate of the mean and standard deviation will be substituted for the sample mean and standard deviation.
- If background normality cannot be achieved, non-parametric UTLs will not be calculated until a minimum of 60 background samples have been collected (to achieve 95 percent coverage).

The parametric UTL on a future mean will be calculated from the background dataset as follows:

$$UTL = \overline{x} + \kappa\,(n, \gamma, \alpha - 1) \cdot s$$

$\overline{x}$ = background sample mean

s = background sample standard deviation

$\kappa\,(n, \gamma, \alpha - 1)$ = one-sided normal tolerance factor based on the chosen coverage (γ) and confidence level (α -1) and the size of the background dataset (n). Values are tabulated in Table 17-3 in Appendix D of the *Unified Guidance*. If exact values are not provided, then κ values can be estimated by linear interpolation.

If the UTL is constructed on the logarithms of original observations to achieve normality, where $\overline{y}$ and s_y are the log-mean and log-standard deviation, the limit will be exponentiated for back-transformation to the concentration scale as follows:

$$UTL = \exp\left[\overline{y} + \kappa\,(n, \gamma, \alpha - 1) \cdot s_y\right]$$

$\overline{y}$ = background sample log-mean

s_y = background sample log-standard deviation

When the GWPS is based on the 35 I.A.C. § 845.600(a)(1) constituent concentrations or a UTL derived from the background dataset, an exceedance in compliance wells relative to the GWPS will be evaluated using confidence intervals. A confidence interval defines the upper and lower bound of the true mean of a constituent concentration in groundwater within a specified confidence range.

- Non-detects in compliance data will be handled similarly to upgradient analyses, with half the RL substituted for non-detects when the frequency is 15 percent or less.
- The Kaplan-Meier, or the ROS method, will be used when the detection frequency is between 15 percent and 50 percent to compute estimates of the mean and standard deviation adjusted for the presence of left-censored values. These estimates will then be substituted for the sample mean and standard deviation.

Once the GWPS is established for background data using the UTL, either parametric or non-parametric confidence intervals will be computed for each constituent in compliance wells to identify GWPS exceedances.

3.1.2 Parametric Confidence Intervals around a Mean

If compliance data are approximately normal, one-sided parametric confidence intervals around a sample mean will be constructed for each constituent and well pair. The lower confidence limit (LCL) will be calculated as:

$$LCL_{1-\alpha} = \bar{x} - t_{1-\alpha,n-1} \cdot \frac{s}{\sqrt{n}}$$

$\bar{x}$ = compliance sample mean

s = compliance sample standard deviation

n = compliance sample size

$t_{1-\alpha,n-1}$ = obtained from a Student's t-table with (n–1) degrees of freedom (Table 16-1 in Appendix D of the *Unified Guidance*)

The chosen t value will aim to achieve both a low false-positive rate, and high statistical power. Minimum α values are tabulated in Table 22-2 of Appendix D of the *Unified Guidance*. The selected minimum α value, from which the t value will be derived, will have at least 80 percent power ($1-\beta = 0.8$) when the underlying mean concentration is twice the GWPS.

If compliance data are distributed lognormally, the LCL will be computed around the lognormal geometric mean as:

$$LCL_{1-\alpha} = \exp\left(\bar{y} - t_{1-\alpha,n-1} \cdot \frac{s_y}{\sqrt{n}}\right)$$

$\bar{y}$ = compliance sample log-mean

s_y = compliance sample log-standard deviation

3.1.3 Non-Parametric Confidence Intervals around a Median

Non-parametric confidence intervals around the median will be computed if the compliance data contain greater than 50 percent non-detects or are not normally distributed. The mathematical algorithm used to construct non-parametric confidence intervals is based on the probability (*P*) that any randomly selected measurement in a sample of n concentration measurements will be less than an unknown *P* x 100th percentile of interest (where *P* is between 0 and 1). Then the probability that the measurement will exceed the *P* x 100th percentile is (1–*P*). The number of sample values falling below the *P* x 100th percentile out of a set of n should follow a binomial distribution with parameters n and success probability *P*, where 'success' is defined as the event that a sample measurement is below the *P* x 100th percentile. The probability that the interval formed by a given pair of order statistics will contain the percentile of interest will then be determined by a cumulative binomial distribution *Bin(x;n,p)*, representing the probability of *x* or fewer successes occurring in *n* trials with success probability p. *P* will be set to 0.50 for an interval around the median.

The sample size n will be ordered from least to greatest. Given *P* = 0.50, candidate interval endpoints will be chosen by ordered data values with ranks close to the product of (n+1) x 0.50. If the result of (n+1) x 0.50 is a fraction (for even-numbered sample sizes), the rank values immediately above and below will be selected as possible candidate endpoints. If the result of (n+1) x 0.50 is an integer (for odd-numbered sample sizes), one will be added to and subtracted from the result to get the upper and lower candidate endpoints. The ranks of the endpoints will be denoted L* and U*. For a one-sided LCL, the confidence level associated with endpoint L* will be computed as:

$$1 - \alpha = Bin(L^{*} - 1; n, 0.50) = \sum_{x=L^{*}}^{n} \binom{n}{x} \left(\frac{1}{2}\right)^{n}$$

If the candidate endpoint(s) do not achieve the desired confidence level, new candidate endpoints (L*–1) and (U*+1) and achieved confidence levels will be calculated. If one candidate endpoint equals the data minimum or maximum, only the rank of the other endpoint will be changed. Achievable confidence levels are tabulated using these equations in Table 21-11 in Appendix D of the *Unified Guidance*.

Both parametric and non-parametric confidence limits will then be compared to the GWPS. The CCR unit is considered to be in compliance if the LCL is equal to or lower than the GWPS for all detected constituents at all compliance monitoring wells. A GWPS exceedance is determined if the LCL exceeds the GWPS.

3.1.4 The Upper Prediction Limit for a Future Mean

The parametric UPL for a future mean will be used to calculate the GWPS if the pooled background data contain 50 to 70 percent non-detects and normality can be achieved. The Kaplan-Meier or ROS methods will be used to estimate the mean and standard deviation. The non-parametric UPL for a future median will be calculated as the GWPS if background samples cannot be normalized or contain greater than 70 percent non-detects. The parametric UPL for a future mean will be calculated from the background dataset at follows:

$$UPL_{1-\alpha} = \overline{x} + \kappa s$$

$\overline{x}$ = background sample mean

s = background standard deviation

κ = multiplier based on the order (p) of the future mean to be predicted, the number of compliance wells to be tested (w), the background sample size (n) the number (c) of constituents of concern (COCs), the "1-of-m" retesting scheme, and the evaluation schedule (annual, semi-annual, quarterly). Values are tabulated in 19-5 to 19-9 in Appendix D of the *Unified Guidance*.

The mean of order p will be computed for each well and compared against the UPL. For any compliance point mean that exceeds the limit, p additional resamples may be collected at that well for a 1-of-2 retesting scheme. Resample means will then be compared to the UPL. A GWPS exceedance has been deemed to occur at a compliance well when the initial mean and all resample means exceed the UPL.

3.1.5 The Non-Parametric Upper Prediction Limit for a Future Median

The non-parametric UPL for a future median will be used to calculate the GWPS if the pooled background data contain greater than 70 percent non-detects and normality cannot be achieved. Non-parametric methods assume that the data does not have an underlying distribution. To calculate the non-parametric UPL on a future value, the target per-constituent false positive rate (α_{const}) will be determined as follows:

$$\alpha_{const} = 1 - (1 - \alpha)^{1/c}$$

α = the site-wide false positive rate (SWFPR) of 0.10 recommended by the *Unified Guidance*

c = the number of monitoring constituents

The number of yearly statistical evaluation (nE) will be multiplied by the number of compliance wells (w) to determine the look-up table entry, w*. The background sample size (n) and w* will be used to select an achievable per-constituent false positive rate value in Table 19-24 of Appendix D in the *Unified Guidance*. The chosen achievable per-constituent false positive rate value will determine the type of non-parametric prediction limit (maximum or 2nd highest value in background) and a retesting scheme for a future median. The background data will be sorted in ascending order, and the upper prediction limit will be set to the appropriate order statistic previously determined by the achievable per-constituent false positive rate value in Table 19-24. If all constituent measurements in a background sample are non-detect, the Double Quantification rule will be used. The use of the Double Quantification rule in Compliance Monitoring will only be applicable if the RL is above the 35 I.A.C. § 845.600(a)(1) constituent concentration or a constituent concentration is not specified in § 845.600(a)(1). This scenario is highly unlikely. The constituent will also be removed from calculations identifying the target false positive rate.

Two initial measurements per compliance well will be collected. If both do not exceed the upper prediction limit, a third initial measurement will not be collected since the median of order 3 will also not exceed the limit. If both exceed the prediction limit, a third initial measurement will not be collected since the median will also exceed the limit. If one initial measurement is above and one below the limit, a third initial observation may be collected to determine the position of the median relative to the UPL. Up to three resamples will be collected in order to assess the resample median. In all cases, if two or more of the compliance point observations are non-detect, the median will be set equal to the RL. The median value for each compliance well will be compared to the UPL. For the 1-of-2 retesting scheme, if any compliance point median exceeds the limit, up to three additional resamples will may be collected from that well. The resample median will be computed and compared to the UPL. A GWPS exceedance has been deemed to occur at a compliance well when either the initial median, or both the initial median and resample median exceed the UPL.

If the concentrations of detected constituents are below the established GWPS, Compliance Monitoring will continue.

3.1.6 Parametric Linear Regression and Confidence Band

If the t-test detects a significant trend in the parametric linear regression line using either background or compliance data for a particular constituent, confidence bands accounting for trends will be constructed to account for the trend-induced variation. If this is not accounted for, a wider confidence interval will inevitably be calculated for a given confidence level and sample size (n). A wider confidence interval will result in less statistical power, or ability to demonstrate an exceedance or return to compliance. When a linear trend line has been estimated, a series of confidence intervals is estimated at each point along the trend. This creates a simultaneous confidence band that follows the trend line. As the underlying population mean increases or decreases, the confidence band does also to reflect this change at that point in time.

Linear regression will be used when background or compliance data are approximately normally distributed, with a constant sample variance around the mean, and the frequency of non-detects is low. The linear regression of concentration against sampling date (time) will be computed as follows:

$$\hat{b} = \sum_{i=1}^{n} (t_i - \overline{t}) \cdot x_i / (n-1) \cdot s_t^2$$

x_i = i^{th} concentration value and

t_i = i^{th} sampling date

$\overline{t}$ = sampling mean date

s_t^2 = variance of the sampling dates

This estimate leads to the following regression equation:

$$\hat{x} = \overline{x} + \hat{b} \cdot (\mathrm{t} - \overline{t})$$

$\overline{x}$ = mean concentration level

$\hat{x}$ = estimated mean concentration at time t

The regression residuals will also be computed at each sampling event to ensure uniformity and lack of significant skewness. Regression residuals will be computed at each sampling event as follows:

$$r_i = x_i - \hat{x}_i$$

The estimated variance around the regression line, or mean squared error (MSE) will be computed as follows:

$$s_e^2 = \frac{1}{n-2} \sum_{i=1}^{n} r_i^2$$

The confidence intervals around a linear regression trend line given confidence level (1-ɑ) and a point in time (t_0), will be computed as follows:

$$LCL_{1-\alpha} = \hat{x}_0 - \sqrt{2 s_e^2 \cdot F_{1-2\alpha,2,\mathrm{n}-1} \cdot \left[\frac{1}{n} + \frac{\left(t_0 - \overline{t}\right)^2}{(n-1) \cdot s_t^2}\right]}$$

$$UCL_{1-\alpha} = \hat{x}_0 - \sqrt{2 s_e^2 \cdot F_{1-2\alpha,2,\mathrm{n}-2} \cdot \left[\frac{1}{n} + \frac{\left(t_0 - \overline{t}\right)^2}{(n-1) \cdot s_t^2}\right]}$$

$\hat{x}_0$ = estimated mean concentration from the regression equation at time t_0

$F_{1-2\alpha,2,\mathrm{n}-2}$ = upper $(1\text{-}2\alpha)^{\text{th}}$ percentage point from an F-distribution with 2 and (n-2) degrees of freedom

For background data, the UCL around the linear regression line will be used as the GWPS for the trending constituent. For compliance data, confidence bands around the linear regression line will be compared to the GWPS. The CCR unit is considered to be in compliance if the LCL is equal to or lower than the GWPS for all detected constituents at all compliance wells. A GWPS exceedance is determined when the LCL based on the trend line first exceeds the GWPS.

3.1.7 Non-Parametric Thiel-Sen Trend Line and Confidence Band

If the Mann-Kendall test detects a significant trend in the non-parametric Thiel-Sen line using either background or compliance data for a particular constituent, confidence bands accounting for trends will be constructed to account for the trend-induced variation. The Thiel-Sen trend line will be used as a non-parametric alternative to linear regression when trend residuals cannot be normalized or if there are a higher percentage of non-detects in either background or compliance data. The Thiel-Sen trend line estimates the median concentration over time by combining the median pairwise slope with the median concentration value and the median sample date. To compute the Thiel-Sen line, the data will first be ordered by sampling event x1, x2, xn. All possible distinct pairs of measurements (x_i, x_j) for j > i will be considered and the simple pairwise slope estimate will be computed for each pair as follows:

$$m_{ij} = (x_j - x_i)/(j - i)$$

With a sample size of n, there will be a total of N = n(n-1)/2 pairwise estimates (m_{ij}). If a given observation is a non-detect, half the RL will be substituted. The N pairwise slope estimates (m_{ij}) will be ordered from least to greatest (renamed m(1), m(2),..m(N)). The Thiel-Sen estimate of slope (Q) will be calculated as the median value of the list depending on whether N is even or odd as follows:

$$Q = \begin{cases} m_{([N+1]/2)} \; if \; N \; is \; odd \\ (m_{(N/2)} + m_{([N+2]/2)})/2 \; if \; N \; is \; even \end{cases}$$

The sample concentration magnitude will be ordered from least to greatest, x(1), x(2), to x(n) and the median concentration will be calculated as follows:

$$\tilde{x} = \begin{cases} x_{([n+1]/2)} \; if \; n \; is \; odd \\ (x_{(n/2)} + x_{([n+2]/2)})/2 \; if \; n \; is \; even \end{cases}$$

The median sampling date ($\tilde{t}$) with ordered times (t(1), t(2), to t(n)) will also be determined in this way. The Thiel-Sen trend line will then be computed for an estimate at any time (t) of the expected median concentration (x) as follows:

$$x = \tilde{x} + Q \cdot (\mathrm{t} - \tilde{t}) = (\tilde{x} - Q \cdot \tilde{t}) + Q \cdot \mathrm{t}$$

To construct a confidence band around the Thiel-Sen line, sample pairs (ti, xi) will be formed with a sample date (ti) and the concentration measurement from that date (xi). Bootstrap samples (B) will be formed by repeatedly sampling n pairs at random with replacement from the original sample pairs. This will be repeated 500 times. For each bootstrap sample, a Thiel-Sen trend line will be constructed using the equation above. A series of equally spaced time points (tj) will be identified along the range of sampling dates represented in the original sample, j =1 to m. The Thiel-Sen trend line associated with each bootstrap replicate will be used to compute an estimated concentration ($\hat{x}_j^B$). An LCL will be constructed for the lower α^{th} percentile $\hat{x}_j^{[\alpha]}$ from the distribution of estimated concentrations at each time point (tj). For a UCL, compute the upper $(1-\alpha)^{th}$ percentile, $\hat{x}_j^{[1-\alpha]}$ at each time point (tj).

For background data, the UCL around the Thiel-Sen trend line will be used as the GWPS for the trending constituent. For compliance data, confidence bands around the Thiel-Sen trend line will be compared to the GWPS. The CCR unit is considered to be in compliance if the LCL is equal to or lower than the GWPS for all detected constituents at all compliance wells. A GWPS exceedance is confirmed when the LCL based on the trend line first exceeds the GWPS.

3.2 Determination of Statistically Significant Increases over Background

In accordance with 35 I.A.C. §§ 845.610(b)(3)(B) and 845.640(h), individual monitoring event concentrations for each constituent detected in the compliance monitoring wells during compliance monitoring sampling events will be compared to the background concentration as determined by the methods described above. An exceedance of the background concentration for any constituent measured at any compliance monitoring well, or constituent detection if not detected in the background samples, constitutes a Statistically Significant Increase (SSI). An exception to this method is pH, where two-sided (upper and lower) tolerance limits are established from the distribution of the background groundwater quality data. An exceedance of either the UTL or lower tolerance limit (LTL) would constitute an SSI for pH.

4. REFERENCES

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Attachment F

35 I.A.C. § 845 SAFETY AND HEALTH PLAN

DECEMBER 29, 2023

HENNEPIN POWER PLANT
EAST ASH POND

CONTENTS

APPENDICES

ACRONYMS & ABBREVIATIONS

%	Percent
§	Section
35 I.A.C.	Title 35 of the Illinois Administrative Code
29 C.F.R.	Title 29 of the Code of Federal Regulations
ACGIH	American Conference of Governmental Industrial Hygienists
CCR	Coal Combustion Residual
CDC	Centers for Disease Control and Prevention
DMG	Dynegy Midwest Generation, LLC
EAP	East Ash Pond
HAZWOPER	Hazardous Waste Operations and Emergency Response
HPP	Hennepin Power Plant
ID	identification
IDLH	Immediately Dangerous to Life and Health
IEPA	Illinois Environmental Protection Agency
kV	kilovolt
NID	National Inventory of Dams
NIOSH	National Institute for Occupational Safety and Health
No.	number
OSHA	Occupational Safety and Health Administration
Part 845	35 I.A.C. Part 845: Residuals in Surface Impoundments
PEL	Permissible Exposure Level
PFAS	Per- and polyfluoroalkyl substances
PFD	Personal Flotation Device
PNOR	particulates not otherwise recognized
POC	Point of Contact
PPE	personal protective equipment
ppm	parts per million
SDS	Safety Data Sheet
STEL	Short Term Exposure Limit
TLV	Threshold Limit Value
TWA	time-weighted averages
USCG	United States Coast Guard

REVISION SUMMARY

Revision Date	**Description of Changes** (Section title or number – description)
12/30/2022	2.1 –Removed reference to COVID screening 3.8 – Revised to follow CDC guidelines 4.6 – Added the table found in 29 C.F.R. § 1926.1408(h) 5.1 – Updated PEL for iron oxide and TLV for titanium dioxide Appendix D – Removed COVID-19 Vistra Site Guidelines Appendix E – Moved Safety Data Sheets to Appendix D
12/29/2023	Annual update as required by 35 I.A.C. § 845.530 3.0 - Included additional information regarding storage of training records and summary of training program 3.1 – Added “that informs them of the hazards at the facility” to the first sentence6.2 – Update hospital information 6.1 – Updated Local Hospital Information

PREFACE

Dynegy Midwest Generation, LLC (DMG) has prepared this Safety and Health Plan in accordance with requirements set forth in Title 35 of the Illinois Administrative Code (35 I.A.C.) Part 845: Residuals in Surface Impoundments (Part 845), Section (§) 845.530. DMG assessed health and safety hazards of its coal combustion residual (CCR) surface impoundments to develop and update this Safety and Health Plan.

This document describes the minimum anticipated protective measures necessary for worker health and safety at Hennepin Power Plant (HPP) East Ash Pond (EAP; Vistra identification [ID] number [No.] 803, Illinois Environmental Protection Agency [IEPA] ID No. W1550100002-05, National Inventory of Dams [NID] No. IL50363). Employees of DMG, contract workers, and third-party contractors must read and comply with the contents of this document. The contents of this document are not intended to cover all situations that may arise nor to waive any provisions specified in Federal, State, and local regulations or site owner / contractor health and safety requirements.

Third-party contractors are accountable for the health and safety of their employees. Third-party contractors are required to prepare a Safety and Health Plan that meets the minimum requirements herein. However, no requirements or provisions within this plan shall be construed as an assumption of DMG of their legal responsibilities as an employer.

This Safety and Health Plan will be reviewed and updated annually, at a minimum. The Safety and Health Plan will also be updated if facility operations change, or a new hazard is identified.

1. INTRODUCTION

This Safety and Health Plan has been developed to outline the requirements to be met by employees of DMG, contract workers, and third-party contractors while performing any activity to construct, operate, or close the EAP. This Safety and Health Plan has been developed to meet the requirements of 35 I.A.C. § 845.530 and describes the responsibilities, training requirements, protective equipment, and safety procedures necessary to minimize the risk of injury, fires, explosion, chemical spills, material damage incidents, and near misses related to CCR activities. This Safety and Health Plan incorporates by reference the Occupational Safety and Health Administration (OSHA) regulations contained in Title 29 of the Code of Federal Regulations (29 C.F.R.) § 1910 and 29 C.F.R. § 1926.

The requirements and guidelines in this Safety and Health Plan are based on a review of available information and data, and an evaluation of identified on-site hazards. This Safety and Health Plan will be reviewed with persons assigned to work in the EAP and will be available on-site.

1.1 Site Description/History

The HPP is a retired coal-fired power plant located in northcentral Illinois in Putnam County, approximately four miles northeast of the Village of Hennepin, located within the northeast quarter of Section 26, Township 33 North, Range 2 West. The HPP is an approximately 504-acre property consisting of 19 parcels, including the former power plant, CCR landfill and surface impoundments, and farmland. The HPP ceased operations in 2019 when the power plant was retired.

The EAP is situated south and adjacent to the Illinois River. The area is also bounded on the east and south by industrial properties owned by Tri-Con Materials and Washington Mills, respectively. The power plant provides the western boundary of the EAP, with agricultural land to the southwest (Appendix A).

1.2 Facility Personnel

The following table outlines key personnel with respect to facility operations and health and safety.

Name	Position	Phone Number
Jason Stuckey	Plant Manager / Point-of-Contact	815-719-0540 (mobile)
Security (24/7)	Site Security / Emergency Contact	309-660-7153
Mike Olle	Environmental Manager	815-875-7022 (mobile)
Matt Ballance	Engineering Manager	618-792-7274 (mobile)
Jason Campbell	Dam Safety Manager	271-753-8904 (Springfield) 217-622-3491 (mobile)
Stu Cravens	Senior Technical Expert	217-390-1503 (mobile)
Vic Modeer	Engineering Manager	618-541-0878
Charles Koudelka	Plant Closure Director	903-235-8633

1.3 Responsibilities

The following persons have responsibilities associated with communicating and implementing the Safety and Health Plan for the EAP.

1.3.1 DMG Point of Contact

The DMG Point of Contact (POC) is a management-level person who is requiring employees, contract workers, or third-party contractors to enter the EAP. The DMG POC is responsible to communicate Safety and Health Plan information and requirements to employees, contract workers, and third-party contractors, and oversee work performed in the EAP to the extent necessary to confirm implementation of Safety and Health Plan requirements.

1.3.2 DMG Employees

DMG employees are directly hired by DMG. They are required to implement and/or follow Safety and Health Plan requirements as applicable to their work and exercise their "stop work authority" if safety requirements are unclear or unanticipated site conditions or hazards are observed.

1.3.3 Contract Workers

Contract workers are those hired by DMG through an agency firm. Similar to DMG employees, contract workers are required to implement and/or follow Safety and Health Plan requirements as applicable to their work and exercise their "stop work authority" if safety requirements are unclear or unanticipated site conditions or hazards are observed.

1.3.4 Third-Party Contractor Employees

Third-party contractor employees work for firms under contract to DMG. Third-party contractors include prime contractors and all of their lower tier subcontractors. Similar to DMG employees, third-party contractors are required to implement Safety and Health Plan requirements as applicable to their work and exercise their "stop work authority" if safety requirements are unclear or unanticipated site conditions or hazards are observed.

1.3.5 Third-Party Contractor Safety Competent Person

Third-party contractors will be required to designate a Safety Competent Person. The Safety Competent Person must be in a management position (*e.g.,* superintendent, foreman, etc.) with OSHA 30-hour construction safety certification who may perform other duties, unless DMG requires a dedicated Safety Competent Person. A Safety Competent Person must be on site at all times when the subcontractor has employees performing work for DMG and must possess a sound working knowledge of pertinent OSHA regulations, this Safety and Health Plan, and other applicable safety requirements related to the scope of work. Third-party contractors must also designate a backup Safety Competent Person that possesses the same authority and training. The competent person will ensure timely correction of safety deficiencies identified by DMG. The Safety Competent Person is responsible to ensure Safety and Health Plan requirements have been communicated to lower-tier subcontractors and enforce Safety and Health Plan requirements.

2. SITE ACCESS & CONTROL

This section outlines requirements for ensuring that only authorized personnel and visitors are permitted in the EAP.

2.1 Facility Security

Elements of site control include restricting access to the EAP to persons until they have met the training requirements outlined in this Safety and Health Plan and have been authorized to do so by HPP POC or their representative.

Upon arriving to the facility, all DMG employees, contract workers, and third-party contractors must sign in/out with Security at the main gate. All personnel must also sign out upon leaving the EAP.

2.2 Third-Party Contractor Management

Prior to working at the EAP, all third-party prime contractors must maintain an active registration with ISNetworld and maintain a grade of A or B. Lower tier subcontractors are currently not required to be registered in ISNetworld, but this requirement may change at the discretion of DMG.

2.3 Third-Party Contractor Safety and Health Plan

Prior to being authorized to conduct work at the EAP, third-party contractors must develop and submit a Safety and Health Plan. The third-party contractor’s Safety and Health Plan must be specific to the scope of work that they will be performing at the EAP. The third-party contractor’s Safety and Health Plan must meet or exceed all the requirements in this Safety and Health Plan, other DMG requirements, and applicable regulations. All lower tier subcontractors of third-party contractors must meet the requirements in this Safety and Health Plan as well as the requirements outlined in the Safety and Health Plan of the third-party with whom they are contracted.

2.4 Authorized Personnel

At a minimum, authorized personnel who will be granted unescorted access to the project include DMG employees, contract workers, and third-party contractors that meet the following:

- Reviewed this Safety and Health Plan and other applicable safety planning documentation
- Have completed all the training, medical surveillance, and drug screen and background investigation requirements as outlined in Section 3 of this Safety and Health Plan.
- Received a Pre-Job Brief/Site Orientation Training

2.5 Visitors

Visitors must be escorted by Authorized Personnel through the EAP if they have not reviewed this Safety and Health Plan or completed the training requirements outlined in Section 3 of this Safety and Health Plan. Visitors may not undertake any activity to construct, operate, or close a CCR surface impoundment.

2.6 Communication

Communication between workers and emergency services must be maintained at all times. Cellular service is not consistently available and cannot be relied upon to summon emergency services.

In lieu of using mobile phones, handheld radios must be used to communicate with Security. Third-party contractors are responsible for providing their radios and must leave one at Security upon arrival to the site.

3. TRAINING & MEDICAL REQUIREMENTS

Project personnel must be properly trained for the type of work being performed and in accordance with 35 I.A.C. § 845.530, 29 C.F.R. § 1926 and 29 C.F.R. § 1910, and DMG policies. Additionally, personnel working in areas regulated by the OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) standards (29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65) must have current medical surveillance. All employees, contractors, and third-party contractors must complete the following prior to beginning any activity to construct, operate, or close the EAP.

The facility maintains an outline of the training programs used and a brief description of training program updates. Training records are located in the Corporate Headquarters in accordance with 35 I.A.C. § 845.530(c)(1).

The training program ensures that employees, contract workers, and third-party contractors understand and are able to respond effectively to the following as outlined in 35 I.A.C. § 845.530(c)(2):

A) Procedures for using, inspecting, repairing, and replacing facility emergency and monitoring equipment (see Section 3.4);

B) Communications or alarm systems (see Section 3.5);

C) Response to fires or explosions (see Section 6.5);

D) Response to a spill or release of CCR (see Sections 6.7 and 6.8);

E) The training under the Occupational Safety and Health Standards in 29 CFR 1910.120, 29 CFR 1926.65, and the OSHA 10-hour or 30-hour construction safety training (see Sections 3.1 and 3.2);

F) Information about chemical hazards and hazardous materials identified in subsection (b) (see Section 5.3); and

G) The use of engineering controls, administrative controls, and personal protective equipment (see Section 4).

3.1 HAZWOPER Training

35 I.A.C. § 845.530(c)(2)(E) requires that all employees, contract workers, and third-party contractors be trained in accordance with 29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65 that informs them of the hazards at the facility. The following training will be completed as required by job function:

- **OSHA 40-Hour Training** per 29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65, for those personnel who are expected to have extensive contact with contaminated materials and/or may be required to wear a respirator.
- **OSHA 24-Hour Training** per 29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65, for those personnel who are expected to have minimal contact with contaminated materials and will NOT be required to wear a respirator.
- **OSHA 8-hour Supervisor Training** per 29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65, for Site Supervisors, Foremen, Superintendents, and others who will be directing and managing site activities.
- **OSHA 8-hour Refresher** per 29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65, completed within 12 months of initial 40-hour or 24-hour training and annually thereafter.

The following matrix outlines HAZWOPER training requirements based on typical job functions at the EAP. It is not intended to be all inclusive, new job functions must be evaluated per 29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65.

Training	Job Function
OSHA 40-hour	Ash handlers
OSHA 24-hour	Personnel not required to handle CCR materials
OSHA 8-hour Supervisor Training	Third-Party Contractor Safety Competent Persons
OSHA 8-hour refresher	All personnel

3.2 OSHA Construction Outreach Training

35 I.A.C. § 845.530(c)(2)(E) requires that all employees, contract workers, and third-party contractors complete an OSHA 10-hour or 30-hour construction safety training. These trainings will be completed as follows:

- All employees, contract workers, and third-party contract employees: OSHA 10-hour or 30-hour construction outreach training.
- Supervisors, superintendents, foreman and safety professionals: OSHA 30-hour construction outreach training.

3.3 EAP Safety and Health Plan Review

Pursuant to 35 I.A.C. § 845.530(d)(e), before beginning any activity at the EAP, and annually thereafter, all DMG employees, contract workers, and third-party contractors must review the content of this HASP. After reviewing this Safety and Health Plan all personnel will understand the following:

- Procedures for using, inspecting, repairing, and replacing facility emergency and monitoring equipment
- Communications or alarm systems outlined in Section 6
- Response to fires and explosions outlined in Section 6
- Response to a spill or release of CCR
- Information about chemical hazards and hazardous materials outlined in Section 5
- The use of engineering controls, administrative controls, and personal protective equipment (PPE) outlined in Section 4

All personnel will acknowledge this HASP by signing the *Safety and Health Plan Acknowledgment Form (Appendix B).*

3.4 Emergency and Monitoring Equipment Training

All DMG employees, contract workers, and third-party contractors must be aware of how to respond to alarms and other emergencies as outlined in Section 6 of this plan. Individuals may only use facility emergency and monitoring equipment if they have been trained in their use and authorized to do so by the designated POC. Additionally, a written release may need to be completed as required by Vistra Corporate Procedure FFA-POL-0006.

Individual DMG employees and contract workers may be responsible for using, inspecting, repairing and replacing facility emergency monitoring equipment. These individuals will be trained in accordance with procedures identified by DMG. These individuals will review and adhere to the manufacturer’s instructions, where applicable.

Third-party contractors are responsible for inspecting, repairing, and replacing any owned emergency (*i.e.*, fire extinguishers) and monitoring equipment (*i.e.*, air monitoring equipment). Third-party contractors will maintain procedures for using inspecting, repairing, and replacing owned emergency and monitoring equipment that is consistent with the manufacturer’s requirements. Third-party contractor employees who are responsible for this equipment will be trained in procedures for using, inspecting, and repairing owned equipment by their employer.

3.5 Hazard Communication

All employees, contract workers, and third-party contractors must be trained in chemical hazards (if any) associated with their work in accordance with 29 C.F.R. § 1910.1200. Work tasks performed on the EAP may include exposure to compounds identified in the Hazard Communication section of this Safety and Health Plan and is included as part of the Safety and Health Plan Review outlined in Section 3.3.

3.6 Medical Surveillance

All employees, contract workers, and third-party contractors engaged in operations specified in 29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65 and meet one of the criteria outlined in 29 C.F.R. § 1910.120(f)(2) and 29 C.F.R. § 1926.65(f)(2) must participate in a medical surveillance program that is administered by their employer. The criteria for participating in a medical surveillance program are:

- All employees who are or may be exposed to hazardous substances at or above the established permissible exposure limit, without regard to the use of respirators, for 30 days or more a year;
- All employees who wear a respirator for 30 days or more a year; or
- All employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation.

The medical surveillance program must result in documentation that an individual is cleared to work on sites covered by 29 C.F.R. § 1910.120 and 20 C.F.R. § 1926.65 and is medically fit to wear a respirator when applicable.

3.7 Drug Screen and Background Investigations

DMG requires that contract worker agencies and third-party contractors are responsible for ensuring that all personnel have completed and passed a drug and alcohol test and background investigation prior to on-site work as described in Appendix C.

3.8 COVID-19 Site Entry Guidelines

All personnel entering Vistra work sites shall review and adhere to the Centers for Disease Control and Prevention (CDC) guidelines related to COVID-19.

3.9 Document Management

DMG will maintain employee and contract employee training and medical surveillance records at corporate headquarters. Third-party contractors are responsible for maintaining training and medical surveillance documentation for their employees. Third-party contractors will produce documentation upon DMG request.

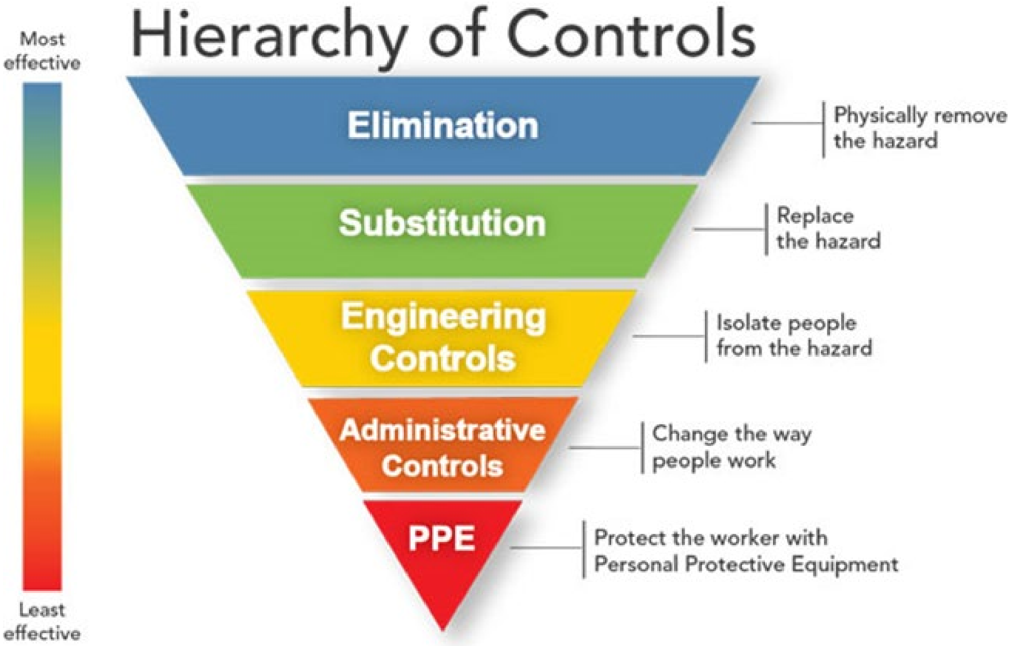
3.10 Industrial Hygiene Sampling Records

Upon receipt of exposure sampling results DMG and third-party contractors must distribute exposure sampling results to employees within 15 business days unless otherwise required by applicable regulation. All personnel exposure sampling results and records must be maintained by the employee’s company for at least 30 years following termination of employment.

4. HAZARD & CONTROLS

The following section outlines general controls for the hazards and controls. Third-party contractors are still responsible for developing a Safety and Health Plan that incorporates requirements of this Safety and Health Plan, other safety requirements for the HPP, as well as the third-party contractor's safety policies and procedures. Safety and Health Plans developed by third-party contractors must be specific to the site and the anticipated work means and methods. Safety and Health Plans that consist of only standard operating procedures or are not otherwise specific to the work performed at the EAP will not be accepted by DMG.

DMG requires that a hierarchy of controls be considered when performing work at the EAP. Implement controls that favor elimination, substitution, and engineering over the use of administrative controls and PPE when feasible. See the figure below for additional guidance (courtesy of the National Institute for Occupational Safety and Health [NIOSH]).



4.1 Ash/Unstable Surfaces

Prior to working in or on an ash pond, third-party contractors must notify the POC. Work in or on an ash pond may not begin until the facility POC has approved the work. Upon completion of the work third-party contractors must notify the POC that they have left the ash pond.

All individuals must check in with the POC upon arrival and departure of the EAP.

When working on ash ponds or unstable surfaces the following requirements must be implemented where applicable and feasible. The following table summarizes safety controls for work performed in ash ponds and on unstable surfaces and are aligned to the hierarchy of controls:

Elimination	Substitution	Engineering	Administrative	PPE
Change the work task or work methods so that work on ash ponds is no longer required	Use the lightest available tracked equipment to reduce ground pressure	Use crane mats or other cribbing to support heavy equipment on ash ponds	Traverse compacted paths that have previously been used by heavy equipment	Use a restraint (tethering) system to prevent falls or slips into unstable ash pond surfaces or surface water that represents a drowning hazard

Elimination	Substitution	Engineering	Administrative	PPE
			If an unstable condition exists, complete a Next Level Up Pre-Job Brief prior to accessing the ash pond.	
			Approach the ash pond from the most stable direction	
			Inspect travel paths for recent terrain shifts, particularly following heavy rains or rapid dewatering	
			Working alone on ash ponds is prohibited without pre-approval from the POC.	
			When a drowning hazard exists, implement requirements for working on/near water as outlined in Section 4.4.	
			Implement an emergency response plan with trained responders for falls into (or engulfment by) ash	

4.2 Ash Inhalation/Airborne Exposure

Ash that becomes airborne due to site activities or environmental conditions may result in an exposure to its components as outlined in Section 5.1. DMG and third-party contractors are responsible for ensuring their respective employees’ and contract workers’ exposures are below occupational exposure limits. Upon request, third-party contractors must demonstrate to DMG that exposure control methods are adequate. The following table summarizes airborne exposure controls and is aligned to the hierarchy of controls:

Elimination	Substitution	Engineering	Administrative	PPE
Change the work task or work methods so that work on ash ponds is no longer required	Substitute manual work methods for those that can be completed from the cab of a vehicle	Continually wet work areas to reduce the amount of ash that becomes airborne Equip vehicles and heavy equipment cabs with filters. Clean and change filters as required	Conduct air monitoring or exposure sampling to confirm that airborne exposure is below regulatory limits	If exposure levels are above the PEL, equip employees with respirators appropriate to the level of exposure

4.3 Stuck Vehicles/Equipment

If a vehicle or piece of equipment becomes stuck, a third-party towing or wrecking company who is trained in vehicle extraction must be retained and the DMG will be notified. Third-party contractors may extract their own vehicle if they have an approved extraction plan, and a competent person is on site to implement the extraction. The extraction plan shall be included as part of the third-party contractor’s reviewed and approved Safety and Health Plan. The above notifications are still required.

The hazards presented by stuck vehicles/equipment must not be underestimated. While the weight of the stuck equipment can be calculated, it’s impossible to precisely calculate the other forces that are pulling against the towing vehicle which requires special training and experience to properly size towing equipment and select towing techniques. This is especially true for “complex” or high-hazard extractions involving equipment stuck at axle depth (or beyond) or sloped surfaces or any area where extraction activities could trigger shifts in the ground surface. No chains shall be used to remove stuck vehicles/equipment.

The following table summarizes safety controls related to stuck vehicles and equipment and are aligned to the hierarchy of controls:

Elimination	Substitution	Engineering	Administrative	PPE
Change the work task or work methods so that work on ash ponds is no longer required	Use the lightest available tracked equipment to reduce ground pressure Substitute tracked equipment for wheeled equipment	Use crane mats or other cribbing to support heavy equipment on ash ponds Lighten the load – Remove materials from stuck vehicles or equipment prior to extraction if possible	Only persons trained in vehicle extraction are permitted to remove stuck vehicles/equipment A professional towing/wrecking service is required Prepare for spills (damage to fuel or hydraulic systems)	All persons involved in removing stuck equipment must wear PPE that includes hard hat, safety boots, safety glasses, high visibility vests, and cut resistant gloves

4.4 Working Near/Over Water

All employees, contract workers, and third-party contractors must wear a United States Coast Guard (USCG) approved personal floatation device (PFD), when within 6 feet of water, over water, and/or wading in water where the danger of drowning exists. The PFD must be properly secured to the wearer, free of all defects including rips, tears, stress, and fading, and be kept clean and free of excessive dirt and oil.

If the possibility of falling into water has been eliminated through the use of guardrails, fall restraint, or other method, the use of a PFD is no longer required.

When performing work on water from a vessel, at least one lifesaving rescue vessel (*e.g.,* a skiff) shall be immediately available at locations where employees are working over, in, on, or adjacent to water where the danger of drowning exists. However, if the water is so shallow that rescuers could simply walk/run into the water body without endangering themselves and/or others or the work was being conducted very close to shore (*e.g.,* the length of the skiff from shore would be greater than the working distance from shore and/or the skiff would foul on the bottom), a skiff would not be required.

The following table summarizes the requirements for working over/near water where a drowning hazard exists and are aligned to the hierarchy of controls:

Elimination	**Substitution**	**Engineering**	**Administrative**	**PPE**
Change the work task or work methods so that work near a drowning hazard is no longer required		Install guardrails that separate work areas from the drowning hazard	All work to be performed by at least two people where each is equipped with proper safety gear and capable of summoning emergency rescue	All personnel are required to wear suitable PFDs
		Utilize equipment (crowd-control barricades, safety fence, etc.) that will keep personnel at least 6 feet from a drowning hazard	When working on water use of a rescue skiff as outlined above	
			Use of a ring buoy with 90 feet of braided polycarbonate (or equivalent) line	
			Ring buoys must be positioned within 100 feet of work (maximum of 200 feet spacing)	

4.5 Heavy Equipment

All heavy equipment operators must be competent and authorized to operate each piece of heavy equipment. Forklift and telehandler (*e.g.,* Lull, JLG) operators must have a license or certificate that indicates they have passed a written test and "road" test for the equipment they will be operating within the last 3 years. Third-party contractors will provide proof of qualification upon request of DMG.

Persons working around heavy equipment must implement the “25 Foot Rule.” The 25 Foot Rule requires that persons get the operator’s attention and permission prior to approaching closer than 25 feet to heavy equipment. Persons must walk quickly through blind spots. Loitering in heavy equipment blind spots (especially to the rear) must be avoided.

Temporary fuel storage tanks will be labelled as to their content and be protected from collision by Site vehicles using solid barricades including balusters, chain link fence, or equivalent. Spill kit (55-gallon sorbent capacity contained in an overpack) and one 20-pound Type ABC fire extinguisher will be located within 45 feet of fueling areas. Tanks will be rated for above ground use and provided with secondary containment. Tanks will be rated for above ground use and will be double walled or have secondary containment in case of a leak. Tanks and dispensing hose will be bonded and grounded. On-site filling of fuel storage tanks will be completed with trucks that have automatic over-flow shutoffs. These trucks will be properly bonded to the storage tank and meet all of the other storage tank requirements. Temporary secondary containment must be provided in the refueling area that includes the storage tank and dispensing hoses.

Elimination	**Substitution**	**Engineering**	**Administrative**	**PPE**
		Heavy equipment (and vehicles) must be equipped with backup alarms, horns, roll-over protection (when feasible)	Operators must be competent and authorized	Operators must use seatbelts when equipped
		Vehicles and heavy equipment operated at night must have headlights, tail lamps, and reflectors	Forklift operators must have a current license or certificate (within 3 years)	High visibility vests are required when working around heavy equipment
			All vehicles and equipment must be turned off when not in use	
			Operators must inspect equipment daily prior to use	
			Persons working near heavy equipment must follow the “25 Foot Rule” and avoid lingering in blind spots as outlined above	
			Always obey site speed limits – 15 mph unless otherwise posted	

4.6 Overhead Powerlines

All overhead powerlines must be assumed to be energized until confirmed otherwise. The minimum clearance distance for equipment working near energized power lines must be in accordance with the table of minimum clearance distances shown on the following page, as found in 29 C.F.R. § 1926.1408(h).

Voltage (nominal, kV, alternating current)	Minimum clearance distance (feet)
up to 50	10
over 50 to 200	15
over 200 to 350	20
over 350 to 500	25
over 500 to 750	35
over 750 to 1,000	45
over 1,000	(as established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution).

Note: The value that follows "to" is up to and includes that value. For example, over 50 to 200 means up to and including 200kV.

The following table summarizes safety controls for work near energized power lines:

Elimination	Substitution	Engineering	Administrative	PPE
Plan to work away from powerlines	Use heavy equipment with shorter booms/attachments to avoid coming close to power lines	Contact the utility owner to deenergize the line	Install signs to warn personnel of overhead powerlines	
		Contact the utility owner to install insulated sleeves over energized lines	Install a non-conductive distance marker to delineate minimum clearance	
			Use a dedicated spotter to ensure equipment does not enter minimum clearance distances	

4.7 Severe Weather

Severe weather conditions include but are not limited to high winds, electrical storms, heavy rain, and tornados can cause hazardous conditions at CCR surface impoundments. The primary control for severe weather is monitoring weather reports prior to beginning work and as work occurs throughout the day.

Monitor lightning using a commercially available mobile application if cellular service is available. When lightning is observed within 10 miles of the CCR surface impoundment, or a storm is imminent, take shelter in the nearest solid structure or fully enclosed vehicle. If possible secure all tools, materials, and equipment prior to the storm arriving. Work may resume 30 minutes after the last lightning strike is observed within 10 miles. The following locations are acceptable shelter locations near the EAP:

- The stairwell inside the front door of the Main Plant
- The breakroom on the 2nd floor of the Main Plant

Do not conduct work on a CCR surface impoundment when there is a risk for tornados in the area. If on a CCR surface impoundment and a tornado forms, seek the nearest substantial shelter. The closest tornado shelters are the locations listed above; shelter locations will be reviewed during the Site Orientation Training. If no shelter is available, attempt to evacuate to a shelter using a vehicle. If a tornado forms and you are not in a shelter, take one of the following actions:

- Stay in a vehicle with the seat belt on, keep your head below the windows and cover it with your hands
- If there is an area which is noticeably lower than the work area, lie in that area and cover your head with your hands.

The following table summarizes safety controls related to severe weather:

Elimination	Substitution	Engineering	Administrative	PPE
Plan outdoor tasks on days with low potential for severe weather.			Prior to beginning outdoor work monitor the day's weather.	
			Periodically monitor weather throughout the day. Use a weather app which issues alerts for severe weather and lightning, assuming cell service is available	
			Utilize a weather radio if cellular service is inconsistent	
			Stop all outdoor work and seek shelter when lightning is observed	

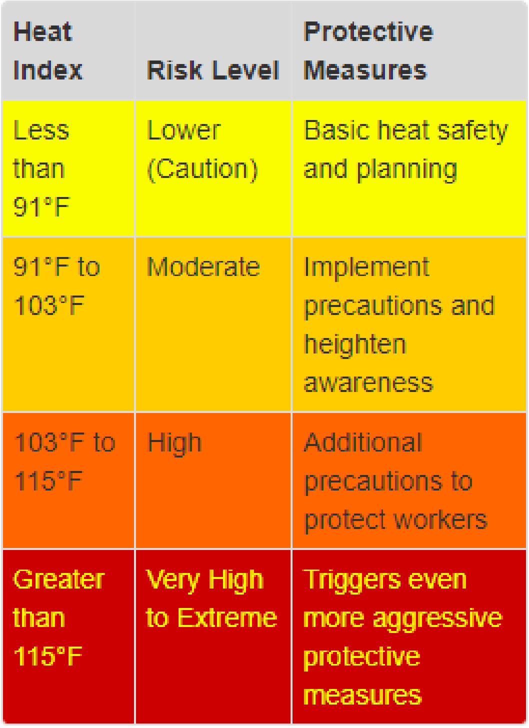
4.8 Heat Stress

Heat stress can be a significant hazard, especially for workers wearing protective clothing. Depending on the ambient conditions and the work being performed, heat stress can occur very rapidly, within as little as 15 minutes. Employees, contract workers, and third-party contractors will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim, and in the prevention of heat stress incidents.

Workers will be encouraged to immediately report any heat-related problems that they experience or observe in fellow workers. Any worker exhibiting signs of heat stress and exhaustion should be made to rest in a cool location and drink plenty of water. Emergency help by a medical professional is required immediately for anyone exhibiting symptoms of heat stroke, such as red, dry skin, confusion, delirium, or unconsciousness. Heat stroke is a life-threatening condition that must be treated immediately by competent medical authority.

4.8.1 Heat Stress Prevention

To prevent heat stress, DMG employees, contract workers, and third-party contractors will implement heat stress prevention measures as outlined in OSHA's Heat Index (below). A summary of these precautions is described below.



Heat Index	Risk Level	Protective Measures
Less than 91°F	Lower (Caution)	Basic heat safety and planning
91°F to 103°F	Moderate	Implement precautions and heighten awareness
103°F to 115°F	High	Additional precautions to protect workers
Greater than 115°F	Very High to Extreme	Triggers even more aggressive protective measures

Know the Symptoms: Some symptoms associated with heat stress are: Employees should be aware of these symptoms with themselves and with their co-workers:

- Elevated heart rate, lack of concentration, difficulty focusing on a task, fatigue
- Irritability and/or sickness
- Cramps, rash, headache
- Loss of desire to drink water
- Fainting
- Skin clammy, moist, and pale (severe heat exhaustion)
- Skin extremely dry and red (heat stroke)

Acclimatize: When high heat stress conditions arise, employees should be exposed to the heat for short work periods followed by longer periods of work. Acclimatization usually takes five (5) days and should be provided for all new employees and employees returning from an absence of two (2) weeks or more. Contact Corporate Health and Safety for proper procedures.

Hydration & Pace of Work: Make sure all employees intake plenty of water throughout the work day (sometimes as much as a quart per worker per hour) and let employees know where the drinking water is located. Adjust your work pace and expectations on how much work can be done during periods of high heat stress. Workers cannot do as much during periods of high heat stress compared with similar periods of low heat stress. After acclimatization, workers may be able to resume a more "normal" work pace as long as fluid intake is adequate.

Work/Rest Periods: If possible, heavy work should be scheduled during the cooler parts of the day (*i.e.,* early morning) and rest periods should be taken in cool areas for longer periods.

Personal Protective Equipment (PPE): Employees using PPE (*i.e.*, Tyvek® suits or other equipment which may retain heat) can be more susceptible to heat stress due to the fact that heat/sweat often cannot escape the suits and/or the equipment. Persons wearing PPE that contributes to heat stress require more hydration, longer rest periods, or a reduced pace of work. Also, more careful monitoring of each person's health status is required by co-workers and management.

The following table summarizes safety controls for heat related illnesses:

Elimination	Substitution	Engineering	Administrative	PPE
Perform outdoor, strenuous, tasks at cooler times of day/year	Use mechanized equipment in place of manual labor	Install fans or air conditioning units in the work area	Train all personnel to know the signs of heat stress/stroke and how to prevent it	Implement the use of cooling vests or other similar PPE
		Install a canopy to provide shade to work areas	Allow workers to acclimatize to the work environment	
		Provide cool, shaded break areas	Adjust work pace to allow for the effects of heat	
			Implement work/rest periods	

4.9 Cold Stress

The four environmental conditions that cause cold-related stress are low temperatures, high/cool winds (wind chill), dampness, and cold water. One, or any combination of these factors, can cause cold-related hazards. Cold stress, including frostbite and hypothermia, can result in severe health effects. Employees, contract employees, and third-party contractors will be instructed in the identification of a cold stress victim, the first-aid treatment procedures for the victim and in the prevention of heat stress incidents.

A dangerous situation of rapid heat loss may arise for any individual exposed to high winds and cold temperatures. Major risk factors for cold-related stresses include:

- Wearing inadequate or wet clothing thus increasing the effects of cold on the body.
- Taking certain drugs or medications such as alcohol, nicotine, caffeine, and medication thus inhibiting the body's response to the cold and/or impairing judgment.
- Having a cold or certain disease, such as diabetes, heart, vascular and thyroid problems, and thereby increasing susceptibility to the winter elements.
- Lower body-fat composition or other physiological differences. Statistics show that men experience far greater death rates due to cold exposure than women, potentially attributable to participation in risk-taking activities, lower body-fat composition and/or other physiological differences.
- Becoming exhausted or immobilized, especially due to injury or entrapment, thus speeding up the effects of cold weather.

The following table provides the resulting equivalent chill temperature to exposed skin because of increasing wind speeds at decreasing actual temperatures. Personnel shall be aware of predicted weather conditions before beginning site work and stay apprised of changes.

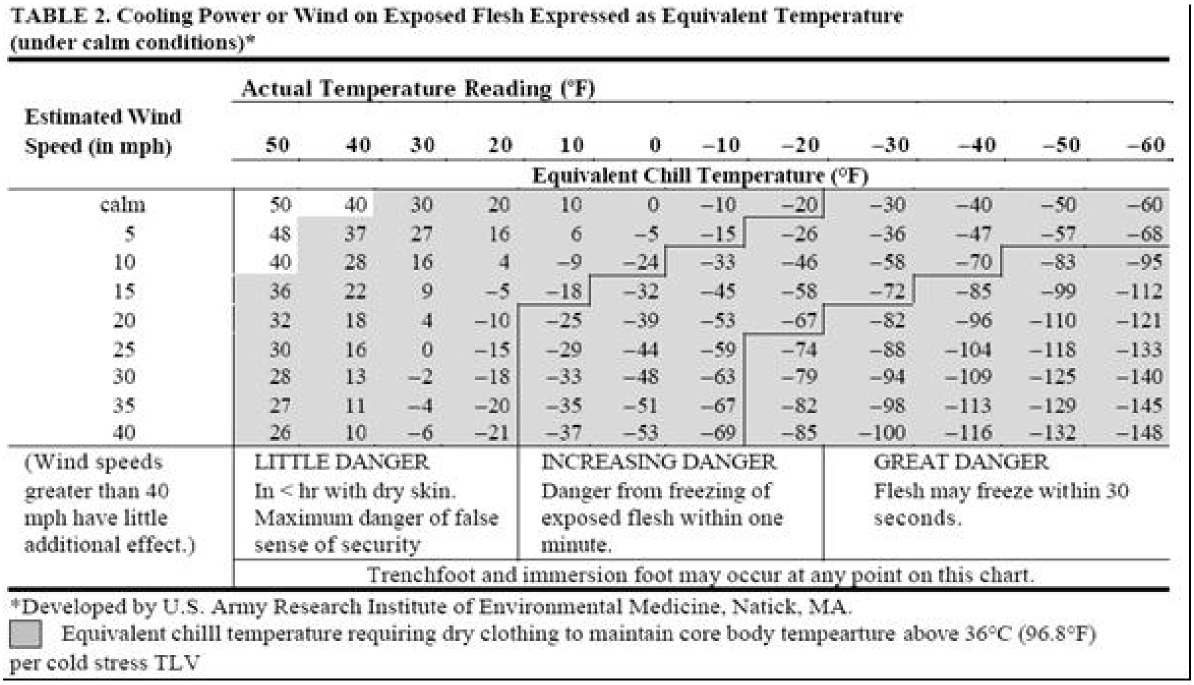


TABLE 2. Cooling Power or Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)*

	Actual Temperature Reading (°F)											
Estimated Wind Speed (in mph)	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
5	48	37	27	16	6	−5	−15	−26	−36	−47	−57	−68
10	40	28	16	4	−9	−24	−33	−46	−58	−70	−83	−95
15	36	22	9	−5	−18	−32	−45	−58	−72	−85	−99	−112
20	32	18	4	−10	−25	−39	−53	−67	−82	−96	−110	−121
25	30	16	0	−15	−29	−44	−59	−74	−88	−104	−118	−133
30	28	13	−2	−18	−33	−48	−63	−79	−94	−109	−125	−140
35	27	11	−4	−20	−35	−51	−67	−82	−98	−113	−129	−145
40	26	10	−6	−21	−37	−53	−69	−85	−100	−116	−132	−148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER In < hr with dry skin. Maximum danger of false sense of security				INCREASING DANGER Danger from freezing of exposed flesh within one minute.				GREAT DANGER Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

*Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.

▨ Equivalent chilll temperature requiring dry clothing to maintain core body tempearture above 36°C (96.8°F) per cold stress TLV

The following table summarizes safety controls for preventing cold stress:

Elimination	Substitution	Engineering	Administrative	PPE
Perform work during warm parts of the day or warmer parts of the year		Install heaters in enclosed work areas	Train all personnel on the symptoms of cold stress and how to prevent it	All personnel must wear multiple layers of clothing
		Provide a warm break area	Implement work/rest schedule	Utilize hand/foot warmers when required

An additional hazard in cold weather conditions is the increased risk for slips from the accumulation of ice and snow in general work areas, ruts where water is accumulated, and heavy equipment. The following table outlines controls that may be used for preventing slips:

Elimination	Substitution	Engineering	Administrative	PPE
Perform work during warm parts of the day or in areas free of accumulated areas		Clear snow in work areas		Use traction control devices (*i.e.,* YakTrax) on work boots to provide additional traction.
		Apply salt/sand to icy areas		
		Use equipment to access work areas		

4.10 Biological Hazards

The following are biological hazards that may be present at the EAP.

4.10.1 Ticks (Lyme Disease) & Mites

Although Lyme disease has been detected throughout the continental United States, it is prevalent primarily in certain areas in New England, the Mid-Atlantic and the northern Midwest states. Although Lyme disease is the most common tickborne illness, other tickborne illnesses include southern tick-associated rash illness, Rocky Mountain spotted fever, ehrlichiosis, and tularemia. More information on Lyme disease and other tickborne illnesses can be found from the CDC.

Prevention

- Standard field gear (work boots, socks, and light colored coveralls) provides good protection against tick bites, particularly if the joints are taped. However, even when wearing field gear, the following precautions shall be taken when working in areas that might be infested with ticks:
    - Wear long pants and long-sleeved shirts that fit tightly at the ankles and wrists, tape cuffs if necessary
    - Wear light colored clothing so ticks can be easily spotted
    - Per- and polyfluoroalkyl substances (PFAS)-free tick repellents (DEET <u>and</u> Permethrin) must be used when walking in all overgrown areas. DEET (≥25 percent [%]) must be applied to skin while permethrin must be applied to clothes and allowed to dry. Spray outer clothing, particularly your pant legs and socks, BUT NOT YOUR SKIN, with an insect repellent that contains permethrin. For heavily infested tick areas, wear spun polypropylene coveralls that have been sprayed with permethrin.
    - Inspect clothing frequently
    - Inspect head and body thoroughly when you return from the field, particularly on your lower legs and areas covered with hair
    - When walking in wooded areas, wear a hard hat, and avoid contact with bushes, tall grass, or brush as much as possible

Removal

- Remove any ticks by tugging with tweezers or special tick removal tools
- Do not squeeze or crush the tick
- DO NOT use matches, a lit cigarette, nail polish, or any other type of chemical to "coax" the tick out

Treatment

- Disinfect the area with alcohol or a similar antiseptic after removal
- Notify the Safety Competent Person of the embedded tick
- For several days to several weeks after removal of the tick, look for the signs of the onset of Lyme disease, such as a rash.
- No further treatment is necessary for ticks embedded <48 hours.
- If other signs or symptoms of Lyme are observed (fever/chills, aches, and pains), then notify the Safety Competent Person and seek medical attention

The following table summarizes safety controls to reduce the hazards associated with ticks and mites.

Elimination	Substitution	Engineering	Administrative	PPE
Use mechanical equipment to remove overgrown vegetation		Remove overgrowth and excessive vegetation from walkways and work areas (provide safe access)	Train personnel on tick and mite prevention. Areas of vegetation overgrowth and/or debris piles should be considered "high risk" areas	Wear light colored long-sleeved shirt tucked into pants. Tuck pant legs into socks
			Perform frequent tick checks in the field and a thorough tick check after completing work activities	Apply Permethrin to clothes and DEET (20% or more) to exposed skin
			Call licensed pesticide contractors to remove infestations of bees, wasps, fire ants, etc.	

4.10.2 Insect Bites/Stings

Stinging/biting insects at the EAP include spiders, wasps, and bees. Contact with these insects may result in project personnel experiencing adverse health effects that range from being mildly uncomfortable to being life-threatening. Therefore, insects present a serious hazard to project personnel, and extreme caution must be exercised whenever Site and weather conditions increase the risk of encountering stinging insects. Some of the factors related to stinging insects that increase the degree of risk associated with accidental contact are as follows:

- The nests for these insects are frequently found in remote wooded or grassy areas or equipment staging areas where equipment has not been moved recently.
- Some people are hypersensitive to the toxins injected by a sting, and when stung, experience a violent and immediate allergic reaction resulting in a life-threatening condition known as anaphylactic shock. Anaphylactic shock manifests itself very rapidly and is characterized by extreme swelling of the body, eyes, face, mouth, and respiratory passages.
- The hypersensitivity needed to cause anaphylactic shock, can in some people accumulate over time and exposure, therefore even if someone has been stung previously and not experienced an allergic reaction, there is no guarantee that they will not have an allergic reaction if they are stung again
- Spider bites generally only cause localized reactions such as swelling, pain, and redness. However, bites from a Black Widow or Brown Recluse, or if you are allergic to spiders, can cause symptoms that are more serious.
- ***If a worker knows that they are hypersensitive to bee, wasp, or hornet stings, or other insects, they must inform the Safety Competent Person prior to site work. Persons who have been prescribed epi-pens by their physician must have an epi-pen on the Site.***
- Inspect any clothing or PPE that has been left for a period of time prior to putting it on. Shake out the clothing and inspect the inside of safety shoes/boots prior to putting them on
- Nests in active work areas must be eradicated. Small nests may be handled by Site personnel using consumer-type insecticide. A pest control contractor should be hired to handle large or difficult to reach nests.

The following table outlines safety controls to reduce the risk of hazards associated with stinging/biting insects.

Elimination	Substitution	Engineering	Administrative	PPE
Use mechanical equipment to remove overgrown vegetation		Remove overgrowth and excessive vegetation from walkways and work areas (provide safe access)	Train personnel on stinging/biting insect prevention. Areas of vegetation overgrowth and/or debris piles should be considered "high risk" areas	Wear light colored long-sleeved shirt tucked into pants. Tuck pant legs into socks
		Eradicate nests in the work area as outlined above.	Instruct personnel to inspect/shake out clothing and work boots that have been left for a period of time.	Apply Permethrin to clothes and DEET (20% or more) to exposed skin – NOTE this will not repel bees/wasps
			Instruct employees who are hypersensitive to insect bites/stings to carry their epi-pen while on site	

4.10.3 Venomous Snakes

There are four species of venomous snakes in Illinois, they are:

- Copperhead
- Cottonmouth Water Moccasin
- Timber rattlesnake
- Eastern Massasauga

Generally, these snakes are found in the southern one-third of the state, with the Cottonmouth Water Moccasin found mostly in the southernmost portions of Illinois. Snakes are generally found in tall grass, wood piles, or other covered areas. Snakes are generally not aggressive towards humans, but if they are encountered avoid the snake and do not provoke it. If bitten by a snake that may be venomous seek medical treatment.

The following table outlines safety controls to reduce the hazard associated with venomous snakes.

Elimination	Substitution	Engineering	Administrative	PPE
Use mechanical equipment to remove overgrown vegetation		Remove debris piles, overgrowth and excessive vegetation from walkways and work areas (provide safe access)	Train personnel on the identification of venomous snakes. Areas of vegetation overgrowth and/or debris piles should be considered "high risk" areas	If working in area with snakes cannot be avoided, wear snake chaps
			Instruct personnel to not disturb snakes if they identify one in their work area	

Elimination	Substitution	Engineering	Administrative	PPE
			Use caution when moving staged tools or materials into which snakes may have moved	

4.10.4 Poisonous Plants and Plant Hazards

Poison ivy and poison oak may be present at the Site. Poison ivy thrives in all types of light and usually grows in the form of a trailing vine; however, it can also grow as a bush and can attain heights of 10 feet or more. Poison ivy has pointed leaves that grow in clusters of three. Poison oak resembles poison ivy except that the poison oak leaves are more rounded rather than jagged like poison ivy, and the underside of poison oak leaves are covered with hair.

The skin reaction associated with contacting these plants is caused by the body's allergic reaction to toxins contained in oils produced by the plant. Becoming contaminated with the oils does not require contact with just the leaves. Contamination can be achieved through contact with other parts of the plant such as the branches, stems or berries, or contact with contaminated items such as tools and clothing. The allergic reaction associated with exposure to these plants will generally cause the following signs and symptoms:

Symptoms

- Blistering at the site of contact, usually occurring within 12 to 48 hours after contact and in many cases, persons experience almost immediate irritation.
- Reddening, swelling, itching, and burning at the site of contact.
- Pain, if the reaction is severe.
- Conjunctivitis, asthma, and other allergic reactions if the person is extremely sensitive to the poisonous plant toxin.

Prevention

- The best treatment appears to be removal of the irritating oil before it has had time to cause inflammation by wiping exposed skin with rubbing alcohol followed by washing with soap and water.
- A visual Site inspection and identification of the plants should be completed prior to starting work so that all individuals are aware of the potential exposure. Avoid contact with any poisonous plants on the Site, and keep a steady watch to identify, report, and mark poisonous plants found on the Site.
- Avoid contact with, and wash daily, contaminated tools, equipment, and clothing.
- Barrier creams (Ivy Block®) and orally administered desensitization may prove effective and should be tried to find the best preventive solution.
- Keeping the skin covered as much as possible (*i.e.*, long pants and long-sleeved shirts) in areas where these plants are known to exist will limit much of the potential exposure. PFAS-free spun polypropylene coveralls or Tyvek® may be worn to prevent contact of skin and clothes with poison ivy.

The following table outlines safety controls to mitigate the hazards associated with poisonous plants.

Elimination	Substitution	Engineering	Administrative	PPE
Use mechanical equipment to remove overgrown vegetation		Remove overgrowth and excessive vegetation from walkways and work areas (provide safe access)	Train personnel on the identification of poisonous plants	Wear pants and long sleeves when working in overgrown areas
			Instruct personnel to avoid areas where poisonous plants have been identified	Consider the use of a coverall when working in areas where these plants are present, especially for hypersensitive employees.
			Provide isopropyl alcohol along with soap and water to remove oils from skin, tools, and equipment.	

4.11 Working Alone

As outlined in Section 4.1, working alone while on the EAP must be pre-approved by the POC. Working alone is prohibited for tasks deemed to be high risk by DMG including, but not limited to, handling highly hazardous chemicals (sulfuric acid), work over/near water, excavation and trenching, hot work (grinding, welding and torch cutting), and elevated work that requires personal fall arrest. Third-party contractors are responsible for identifying potential high-risk tasks in their Safety and Health Plan and requiring that a buddy system be implemented while high risk work is performed. The buddy must be located in a safe area but may perform other tasks that do not prevent observing the person performing high risk work. Working alone may occur on and around other parts of the EAP when there is no drowning hazard or risk of severe injury due to high-risk work.

Elimination	Substitution	Engineering	Administrative	PPE
	Modify work methods by substituting lower hazard methods for high hazard methods	Varies depending on the hazard, but for example, could include installing guardrails (temporary or permanent) which mitigates a fall hazard reducing the risk to levels where working alone may be permitted	Prohibit working alone on ash ponds and for other high hazard tasks without prior approval form the POC	
			Implement a buddy system whenever feasible (required for high hazard work)	

Elimination	Substitution	Engineering	Administrative	PPE
			Implement a worker check-in, emergency alerting, and monitoring system	

5. HAZARD COMMUNICATION

As required by 35 I.A.C. § 845.530, the OSHA HAZWOPER standards (29 C.F.R. § 1910.120 and 29 C.F.R. § 1926.65) and OSHA Hazard Communication Standard, site personnel, subcontractors, and visitors must be informed of chemical hazards associated with their work area. The information in this section is based on:

- Recommendations in the most recent "NIOSH Pocket Guide to Chemical Hazards" by the Department of Health and Human Services, Centers for Disease Control and Prevention, and the NIOSH Pocket Guide.
- Requirements set forth in the OSHA regulations from as defined in Chapter 17 of 29 C.F.R. § 1910.1200(c) for all hazards not otherwise classified.

5.1 Coal Combustion Residuals

Primary exposure to CCR is through inhalation and skin contact. CCR is typically a fine, black, grey, or tan particulate. CCR is comprised of several components. The following table outlines the components of the CCR. The exact percentage of each component will vary based on the type of ash and location at the surface impoundment.

Chemical	Percentage	PEL	IDLH	ACGIH TLV	Symptoms of Exposure & Health Effects
Crystalline Silica	20-60% (total)	0.05 mg/m^3 (respirable)	25 mg/m^3 (respirable)	0.025 mg/m^3 (respirable)	Cough, dyspnoea (breathing difficulty), wheezing; decreased pulmonary function, progressive respiratory symptoms (silicosis); irritation eyes; [potential occupational carcinogen]
Iron oxide	1-10%	10 mg/m^3	2500 mg/m^3	5 mg/m^3	Benign pneumoconiosis with X-ray shadows indistinguishable from fibrotic pneumoconiosis (siderosis)
Calcium oxide	10-30%	5 mg/m^3	25 mg/m^3	2 mg/m^3	irritation eyes, skin, upper respiratory tract; ulcer, perforation nasal septum; pneumonitis; dermatitis
Titanium dioxide	<3%	15 mg/m^3	ND	0.2 mg/m^3 (nanoscale particles) 2.5 mg/m^3 (fine-scale particles)	Lung fibrosis; [potential occupational carcinogen]
Aluminosilicates	10-60%	15 mg/m^3 (PNOR)	ND	10 mg/m^3 (PNOR)	irritation eyes, skin, throat, upper respiratory system
Magnesium oxide	2-10%				
Magnesium dioxide	<2%				
Phosphorous pentoxide	≤2%				
Sodium oxide	1-10%				
Potassium oxide	≤1%				
Bromide salt	<0.1%				

Footnotes:

All values are 8-hour time-weighted averages (TWAs) unless otherwise indicated.

- PEL: Permissible Exposure Limit, the concentration an employee may be exposed to for an 8-hour work day for a 40-hour work week for which nearly all employees may be repeatedly exposed without adverse health effects.
- IDLH: IMMEDIATELY Dangerous to Life and Health, contaminant concentration which present the possibility for severe health consequences if exposed to the IDLH concentration without the appropriate personal protective equipment (PPE).
- ACGIH TLV: American Conference of Governmental Industrial Hygienists Threshold Limit Value
- mg/m^3 = milligrams per cubic meter of air
- PNOR: Particulates Not Otherwise Regulated
- ND: Not Determined

5.2 Safety Data Sheets

Pursuant to 35 I.A.C. § 845.530(b)(3), DMG will provide Safety Data Sheets (SDSs) to all employees, contract workers, and third-party contractors for the CCR located in the plant closure office trailer. Third-party contractors will provide SDSs to the POC prior to bringing a material on site. SDSs are provided in Appendix D.

5.3 Signage

The absence of any of the following signage does not mean that a potential hazard does not exist. Signage will be posted by DMG, but employees, contract workers, and third-party contractors must remain vigilant for changing site conditions.

To aid in hazard communication and pursuant to 35 I.A.C. § 845.530(f), DMG will post the following signs at the EAP:

- Signs identifying the hazards of CCR, including dust inhalation when handling CCR.
- Signs identifying unstable CCR areas that make the operation of heavy equipment hazardous.
- Signs identifying the necessary safety measures and necessary precautions, including the proper use of PPE.

The following signs may also be posted at the CCR units to aid in hazard communication:

- Overhead electrical lines that may be struck by heavy equipment of vehicles will have signs warning drivers of their presence.

6. EMERGENCY RESPONSE PLAN

This emergency response section details actions to be taken in the event of site emergencies. This section is consistent with the EAP Emergency Action Plan. All personnel on site must be familiar with emergency signals and the content of this section.

6.1 Emergency Phone Numbers & Notifications

Emergency Number	
Site Address	**Emergency Phone Number**
13498 E 800th St Hennepin, IL 61327	911
	Security (24/7): 309-660-7153 (m)

Medical Treatment	
Local Hospital	**Phone Number**
OSF Saint Claire Medical Center 530 Park Ave E Princeton, IL 61356	815-875-2811

Incident Notifications		
Title	**Name**	**Contact Number**
POC	Jason Stuckey	815-719-0540

6.2 Evacuation Signal

Upon hearing verbal notification to evacuate all personnel will leave the work area and proceed to the muster point.

6.3 Muster Point

The muster point for the EAP is the flagpole in front of the Main Plant. The following locations are acceptable severe weather shelter locations near the EAP:

- The stairwell inside the front door of the Main Plant
- The breakroom on the 2nd floor of the Main Plant

The muster point and severe weather shelter locations will be communicated during the Site Orientation Training.

6.4 Calls for Emergency Support

In the case of an emergency, site personnel will call 911. Security will coordinate the arrival of on-site emergency personnel. The individual calling for emergency support will briefly explain the nature of the emergency and site conditions as follows:

- Indicate his/her name
- Location of emergency
- Description of emergency conditions that may require special rescue equipment, such as confined spaces, excavations, and elevated work platforms
- Potential chemical hazards and recommended PPE

6.5 Fire & Explosion Response Plan

Trained site personnel may respond to incipient stage fires using a 20-pound Type ABC dry chemical fire extinguisher or hose. An incipient stage fire is a fire which is in the initial or beginning stage and which can be controlled or extinguished by portable fire extinguishers, Class

II standpipe or small hose systems without the need for protective clothing or breathing apparatus. Personnel shall only attempt to extinguish the fire if it is safe to do so.

A fire that CANNOT be readily extinguished with a fire extinguisher will require evacuation of the work area personnel to Muster Point areas per this Safety and Health Plan. If personal injuries result from any fire or explosion, the procedures outlined in the Personal Injury Response Plan will also be followed.

All fires or explosions must be reported to the contacts outlined in Section 6.1 of this Safety and Health Plan.

6.6 Injury Response Plan

Treatment for minor injuries will be provided on site using available first aid supplies and personnel trained in first aid. All third-party contractors must have at least one individual on site who is trained in first aid, CPR, and AED use. Third-party contractors must provide their own first aid kits and AED. For minor injuries that are not life-threatening but require further medical attention, employees should be treated by occupational physicians at occupational clinics whenever possible. Treatment of minor injuries by emergency room or personal physicians should be avoided. When injured workers are released back to work with restrictions, all subcontractors are expected to accommodate those restrictions.

Emergency medical incidents include puncture wounds to the head, chest, and abdomen, serious head and spinal cord injuries, and loss of consciousness must be treated at the hospital emergency room listed in Section 6.1 of this Safety and Health Plan.

All injuries must be reported to the contacts outlined in Section 6.1 of this Safety and Health Plan.

6.7 Spill Response Plan

In general, DMG employees, contract workers, and third-party contractors are trained and equipped to handle small spills associated with their work. Third-party contractors must include an approved spill response plan in their Safety and Health Plan. Site personnel will generally respond to spills as follows:

- Stop the leak immediately if it can be done without directly contacting the leaking material.
- Remove or stop all ignition sources (hot work, generators, etc.) that are within 25 feet of any part of the spill.
- On-site personnel should immediately secure the area to prevent unauthorized entry into the spill area.
- Although not likely given the anticipated types of spills, site personnel must immediately initiate evacuation if a spill may cause an explosion, death, or serious injury.
- Site personnel may only respond to incipient stage fires regardless of whether such fires are associated with a spill.
- PPE for spills to open areas generally requires Modified Level D PPE (poly-coat Tyvek®, nitrile gloves, and boot covers or boot decontamination). Over-boots or boot covers may also be used if persons cleaning the spill would have to walk on spilled materials. Latex gloves are not acceptable and will degrade with exposure to petroleum products.

6.8 CCR Spill or Release Response Plan

Response to minor or incidental spills of CCR will be managed as outlined in the General Spill Response Plan. An incidental release is a release of a hazardous substance which does not pose a significant safety or health hazard to employees in the immediate vicinity or to the employee cleaning it up, nor does it have the potential to become an emergency within a short time frame. Incidental releases are limited in quantity, exposure potential, or toxicity and present minor safety or health hazards to employees in the immediate work area or those assigned to clean them up. An incidental spill may be safely cleaned up by employees who are familiar with CCR. Response to major releases of CCR will be in accordance with the HPP Emergency Action Plan, which can be found on the Luminant CCR website at https://www.luminant.com/ccr/.

6.9 Ash Pond Rescue

Ash ponds may be unstable and represent an engulfment hazard if persons and equipment traverse the surface, berms, or other unstable areas. Special training is required on behalf of emergency responders to retrieve persons and equipment who become trapped in unstable ash. **Untrained persons must not enter unstable areas** in an attempt to conduct rescue because of the significant potential that they will also become victims. Call the HPP emergency number and state that an "ash pond rescue" is required. The HPP emergency contact will notify the designated service to perform the ash pond rescue. On-site personnel should remain on stand-by to support the ash pond rescue team as necessary.

6.10 Incident Reporting

All incidents must be reported to the contacts outlined in Section 6.1 of this Safety and Health Plan. An Incident Report must be completed for all injuries, illnesses, spills, fire, explosion, or property damage. The absence of an injury does not preclude the need to complete an Incident Report as such incidents will be classified as "near miss" or "other." It will include, but is not limited to, the nature of the problem, time, location, and corrective actions taken to prevent recurrence.

APPENDIX A
SITE MAP

🟨 PART 845 REGULATED UNIT (SUBJECT UNIT)
☐ SITE FEATURE
⬚ PROPERTY BOUNDARY

0 175 350 Feet

SITE MAP

PART 845 SAFETY AND HEALTH PLAN
HENNEPIN POWER PLANT
HENNEPIN, ILLINOIS

APPENDIX A

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Hennepin\Appendix A_HEN_Site Map_SnHP.mxd

PROJECT: 169000XXXX | DATED: 8/13/2021 | DESIGNER: COOKEDT

APPENDIX B
SAFETY AND HEALTH PLAN ACKNOWLEDGMENT FORM

SAFETY AND HEALTH PLAN ACKNOWLEDGEMENT FORM

I HEREBY CERTIFY THAT I HAVE READ AND UNDERSTOOD ALL HEALTH AND SAFETY PROCEDURES AS STATED HEREIN:

Name and Affiliation (printed)	**Signature**	**Date**

APPENDIX C
DRUG SCREEN POLICIES AND SUPPLEMENTAL TERMS

VISTRA ENERGY

Drug and Background Investigations

Contractor is solely responsible for ensuring that all members of Contractor Project Team have completed and passed all drug and alcohol tests and background investigations required under this Attachment and under Contractor's own programs before assigning such personnel to perform Work. Contractor is also solely responsible for ensuring that such testing and investigations are performed in accordance with all applicable laws.

1. Required Investigations. Except as otherwise required by applicable law, Required Investigations shall consist of all of the following:

   1.1 a 7-panel drug screening;

   1.2 a background investigation that includes a criminal records check in all counties where the applicable person has resided for at least the last seven (7) years;

   1.3 a third-party verification of previous employment and the highest education level completed by the applicable person;

   1.4 a check of the National Sex Offender Registry and Terrorist Watch List (Denied Parties); and

   1.5 a check of Motor Vehicles Record (if work to be performed by the applicable person requires driving as part of the defined duties).

2. Notices to Tested Persons Regarding Background Checks. All background checks will be conducted in compliance with applicable provisions of the Fair Credit Reporting Act.
3. Forms and Testing Organization for Drug Tests. Except for those positions subject to Department of Transportation ("DOT") drug and alcohol testing regulations, all drug testing shall be performed using the Universal Toxicology four part "Non-DOT" Chain of Custody and Request Form with white and blue top page, and shall be conducted by an independent third-party organization.

4. Pass/Fail Standards – Background Checks. A person shall be deemed to have failed the applicable background check if:

   4.1 information is reported through the background check process indicating that such person has failed to disclose or misrepresented information requested at any time about such a person's criminal background history; or

   4.2 such person has ever committed any felony constituting a violent crime, crime against a person, sexual offense or fraud; or

   4.3 such person has committed any other felony, or has been incarcerated for a felony, within ten (10) years prior to the date of such background check (i.e., for these felonies there must be a ten (10) year lapse in time from the later of the commission and the end of any period of incarceration); or

   4.4 such person has committed any misdemeanor that:

      4.4.1 involves violence that is sexually related; or

4.4.2 consists of a DUI that is the second (or more) DUI in the last two (2) years prior to the date of the background check; or

4.4.3 consists of a theft-related offense; provided that there can be no more than one theft by check and it must have been for an amount less that $100; or

4.4.4 consists of any drug-related misdemeanor committed at any time within forty-eight (48) months prior to the date of the background check.

4.4 For purposes of both felonies and misdemeanors, a person is deemed to have committed the applicable offense if he/she is convicted or enters a plea of guilty or nolo contendere for such offense (to include, without limitation, sentences of probation and deferred adjudication).

5. **Pass/Fail Standards – Drug Tests.** A person shall be deemed to have failed the applicable drug test if any of the following maximum cut-off levels are exceeded, unless there is a legitimate medical explanation for the presence of a tested substance at or above the applicable cut-off level:

5.1	Amphetamines	500ng/mL
5.2	Barbiturates	150ng/mL
5.3	Benzodiazepines	150ng/mL
5.4	Cocaine	150ng/mL
5.5	Marijuana	150ng/mL
5.6	Opiates	2000ng/mL
5.7	Phencyclidine	25ng/mL

For any positions subject to DOT drug and alcohol testing requirements, testing shall be conducted according to the applicable DOT panel and cutoff levels.

6. **Other Requirements.**

6.1 Background checks and drug tests will be paid for by Contractor without reimbursement by Company.

6.2 Contractor will keep background checks and drug test records while the applicable persons are working pursuant to this Agreement and for three (3) years thereafter.

6.3 Upon request, Contractor will provide a certification to Company that no person required hereunder to pass a background check or drug test has failed such investigation or test. Contractor will not provide the specific results of the background check or drug test of any individual to Company.

6.4 If any person required under this Agreement to pass a background check or drug test fails such check or test, Contractor will not report the specific results of such check or test to Company and will not allow such individual to perform any Work for Company. Although such person may not be assigned to perform any Work for Company, nothing in this Attachment requires Contractor to take any other action with respect to such person's employment with Contractor.

Supplemental Terms for Onsite Services

1. SAFETY

1.1 Contractor agrees that any safety-related assistance or initiatives undertaken by Company will not relieve Contractor while on Company Property from responsibility for the implementation of, and compliance with, safe working practices, as developed from their own experience, or as imposed by law or regulation, and will not in any way, affect the responsibilities resting with Contractor under the provisions of any agreement to which these policies are attached and to meet all safety requirements as specified by the Occupational Safety & Health Administration (OSHA), the Mine Safety Health Administration (MSHA), including the "Mining Contractor Safety Reference Handbook" located at http://www.vistraenergy.com/wp-content/uploads/2016/12/Contractors-Safety-Handbook_Final-MC-08262016.pdf, the Department of Transportation (DOT) and any other applicable state or federal safety and health laws or regulations.

1.2 In the event that a material safety data sheet, warning label, or other documentation concerning the use of hazardous chemicals at any property owned or controlled by Company or any of its affiliates (collectively, "**Company Properties**"), applies to any materials or equipment provided by Contractor as an aspect of the Work, such documentation will be provided by Contractor to Company prior to the commencement of any such Work.

1.3 Contractor will report to Company all accidents involving personal injuries (including death) and damage to property occurring directly or indirectly as a result of the Work performed by Contractor hereunder immediately, but in no event, no later than 24 hours after the occurrence of any such accident. Any accident or incident occurring directly or indirectly as a result of the Work which Contractor must report to a regulatory agency (e.g. OSHA, MSHA, TCEQ) must also be reported to Company immediately following notification to the regulatory agency.

2. SECURITY

2.1 It will be the affirmative duty of Contractor to ensure that Contractor Group assists in carrying out all security measures, to include reporting all information or knowledge of matters adversely affecting security to Company's designated security personnel.

2.2 Company reserves the right to exclude any of Contractor's employees from any Company Property by denial of access, suspension or revocation of access authorization, preemptory expulsion, or by any other means, without notice or cause. Former Company employees, and any of Contractor's employees who previously have been excluded from any Company Property, may be brought onto Company property or facilities only if prior approval from Company is obtained. If Contractor terminates a member of Contractor Group performing Work on Company's premises, Contractor shall inform Company immediately, but in no event, no later than twenty-four (24) hours after such employee is terminated in order for Company to remove access to Company Property for such employee.

2.3 Company measures may also include investigations, whether by Company or law enforcement officials. Contractor agrees to cooperate in such investigations and understands that Company reserves the right to require anyone in Contractor Group to authorize appropriate agencies to release his or her criminal records to Contractor as a condition of either initial or continued permission for access to any Company Property. Investigations may include searches of Contractor Group. Such searches may include searches of facilities assigned to Contractor Group, search of all Company Property areas and property at such Company Property areas, searches of including, but not limited to, offices, lockers, desks, lunch boxes, packages and motor vehicles (regardless of ownership). Without limiting the foregoing, Contractor acknowledges and agrees that all members of Contractor Group, to the extent that Company reasonably determines that such members require security badge access prior to entering onto any Company Property, shall be required to comply with Company's standard security badge requirements, including without limitation a background check to be performed by Company.

3. ISNETWORLD

3.1 Contractor agrees to maintain at Contractor's expense a subscription with ISNetworld (www.ISNetworld.com), Company's safety compliance program or any replacement program therefor, as directed by Company, for the Term of the Agreement. Contractor shall also furnish ISNetworld with any information requested by ISNetworld relating to ISNetworld's evaluation of the Contractor's safety program and practices. As a minimum, requested documents will be related to safety, health, and insurance (i.e., regulatory required training, certifications, safety plans, safe and secure workplace practices, insurance certificates, etc.), OSHA and MSHA injury rates and Experience Modification Rate (EMR).

3.2 Contractor has and during the performance of this Agreement shall continue to report full, complete and accurate information to ISNetworld concerning Contractor's employees.

4. MATERIALS, EQUIPMENT AND LABOR. Contractor will be solely responsible for the proper storage, transportation and disposal of any product or waste, other than sandblasting waste, used or generated in connection with the Work in accordance with all applicable Environmental Laws. Contractor will dispose of all waste materials, other than sandblasting waste, at an off-site disposal facility approved for such waste materials pursuant to applicable Environmental Laws and will complete and sign all waste manifests as the generator of such waste. Company will be responsible for the storage, transportation and disposal of any sandblasting waste generated during the performance of the Work.

5. CONDITIONS AFFECTING WORK

5.1 Contractor will investigate and acquaint itself with the conditions affecting the Work, including but not limited to those related to the transportation, disposal, handling and storage of materials and waste; availability of labor, water, electric power and roads; the uncertainties of weather, river stages or similar physical conditions at the site; the conformation and condition of the ground; and the character of equipment and facilities needed preliminary to and during prosecution of the Work. Contractor has satisfied itself as to the character, quality and quantity of surface and subsurface materials or obstacles to be encountered. Contractor's failure to acquaint itself with any conditions affecting the Work or any available related information will not relieve it from responsibility for properly estimating the difficulty or cost of successfully performing the Work.

5.2 Contractor assumes full responsibility for investigating conditions and determining the existence and magnitude of any hazards to the physical well-being of property of Contractor, the employees, agents, and servants of Contractor, or any other person or entity who is or may become involved in the performance of Work, and any and all other persons in the vicinity of the Work. Contractor will advise all of the above-specified persons or entities of any hazards relating to Work, and will ensure that those persons or entities are advised of and fully understand the nature of the hazards and safety precautions that can be taken to eliminate or minimize dangers relating to the hazards.

5.3 Contractor will provide information to Company regarding hazardous chemicals and/or consumable products that contain constituents listed in 40 CFR 372.65 used at any Company Property. Contractor will report the amount of such material carried on and off the site, the amount actually used and the manner of use. Contractor will provide the maximum quantity of the material stored on site at any one time and if a waste material was collected, where it was disposed of (location name and address). Contractor will provide information on the amount of material used for the previous calendar year by the first of February.

5.4 Contractor will use its best efforts to ensure that the Work is performed so as to minimize any adverse impact upon natural resources and the environment and will use best industry practices in this regard at all times.

5.5 Contractor acknowledges and agrees that all members of Contractor Group performing Work at any Company Generation or Mining Property are required to view Company's "Contractor/Visitor Safety Orientation" video (in the case of Company Generation property), when applicable, and to read and adhere to Company's "Contractor/Visitor Safety Booklet" (in the case of Company Mining property) prior to performing any Work at any Company Generation or Mining Property.

5.6 Contractor will immediately notify Company as soon as Contractor has reason to believe that Contactor, or any employee or other person performing the Work, is not or may not be performing the Work in compliance with applicable Environmental Laws. Contractor will provide Company with written notice to Company of such actual or potential non-compliance within three (3) days following the discovery thereof. Contractor will take immediate steps to ensure compliance with all applicable Environmental Laws and will, if directed by Company, cease all Work until authorized by Company to resume the Work.

5.7 Contractor will report to Company all accidents involving personal injuries (including death) and damage to property occurring directly or indirectly as a result of the Work performed by Contractor hereunder immediately, but in no event, no later than 24 hours after the occurrence of any such accident. Any accident or incident occurring directly or indirectly as a result of the Work which Contractor must report to a regulatory agency (e.g. OSHA, MSHA, TCEQ) must also be reported to Company immediately following notification to the regulatory agency.

6. WORK SITE PERMITS AND LICENSES

6.1 Subject to the following two paragraphs, Contractor will obtain, prior to the commencement of the Work, and provide to Company upon request, all permits, licenses and governmental authorizations, at its sole expense, required for the performance of the Work. Contractor will be solely responsible for maintaining compliance with such permits, licenses and governmental authorizations.

6.2 In the event that a storm water discharge permit is required for the performance of the Work, (i) Contractor will be responsible for filing a Notice of Intent with respect to the Work, in addition to any Notice of Intent that Company may be required to file, and (ii) Contractor will coordinate with

Company in the preparation and execution of a Storm Water Pollution Prevention Plan for the Work Site.

6.3 In the event that the performance of the Work involves the handling or abatement of asbestos-containing materials, Contractor will coordinate with Company in the preparation and filing of all required notification forms.

7. **ACCESS.** Should Contractor desire access to the Work Site over any land not controlled by Company, it will, at its sole expense, obtain all proper permits or written permission necessary for that access.

8. **COMPANY FACILITIES.** Contractor will not use Company's sanitary facilities, changehouses, shops, parks, storage buildings, tools, equipment or other facilities unless so directed by Company. Contractor will not discharge, without Company's prior written authorization, any product or waste used or generated in connection with the Work through any (i) Company-permitted outfall, (ii) Company-owned or operated pollution control equipment, or (iii) storm or sanitary sewer located at or in the vicinity of the Work Site. Any request for authorization to discharge will include, at a minimum, either a copy of the Material Safety Data Sheet for the product or a written description of the waste, including a list of the constituents of the waste and the relative concentrations thereof.

9. ENVIRONMENTAL

9.1 In the event that Contractor discovers during the performance of the Work any substance at the Work Site that is not the subject of the Work or has not otherwise been identified by Company for Contractor, which substance Contractor has reason to believe is or may be a Hazardous Substance that (i) has been or may be released or spilled into the soil, surface water, or groundwater or in a building or structure, or (ii) consists of asbestos-containing materials, lead-based paint, batteries, thermostats, lighting equipment, or equipment containing polychlorinated biphenyls, Contractor will immediately stop Work and notify Company of the discovery. Contractor will not resume the Work until receiving authorization from Company to do so.

9.2 The term "**Hazardous Substance**" means any product, waste, emission or substance defined, listed or designated as a hazardous or toxic substance, hazardous waste, hazardous material or pollutant by or pursuant to any Environmental Law and includes, but is not limited to, any petroleum-based product, substance or waste, including any additives associated therewith, pesticides, fertilizers, solvents, polychlorinated biphenyls, mercury, lead, lead-based paint, asbestos-containing material or explosives.

9.3 Contractor will immediately notify Company in the event of a spill or release of any material which Contractor knows or has reason to believe is a Hazardous Substance, whether onto the ground, into any body of water, a storm or sanitary sewer, or the air, or anywhere on property owned or controlled by Company, including within any building or structure. Contractor will be solely responsible, as may be required by applicable Environmental Laws, for, in consultation with Company, (i) notifying the appropriate governmental agencies of such spill or release caused or permitted by the acts or omissions of Contractor and (ii) for the cleanup and remediation of such spill or release.

10. **PROTECTION OF HIGHWAYS AND RAILROADS.** Contractor will make suitable arrangements with governmental authorities and railroads for the construction of all structures, whether underneath or over roads, railroads or rights-of-way to protect the public from accident or delay. Contractor will repair, at its

own expense, to the satisfaction of the governmental authorities or other owners, all roads, railroads and bridges that may be damaged by, or given undue wear due to the Work.

11. CLEANING UP

11.1 Contractor will at all times keep the Work Site free of waste materials or rubbish caused by the Work. After completing the Work, Contractor will remove all its waste materials, rubbish, tools, supplies, equipment and surplus materials from and about the Work Site.

11.2 If Contractor fails to keep the Work Site clean or to clean up after completing the Work, Company may do so and charge all costs of cleaning up to Contractor. Those costs may be deducted from the final payment to Contractor.

12. COLLATERAL WORK. Company and other contractors may be working at the Work Site. Company reserves the right to coordinate the performance of Contractor's Work with the work of others. Contractor will cooperate with and will not delay, impede or otherwise impair the work of others. Company does not guarantee Contractor continuous uninterrupted access to the Work Site, but will provide such access as good construction practices will allow, considering the other activities in the area.

13. ALCOHOLIC BEVERAGES, DRUGS AND WEAPONS. Contractor will inform all members of Contractor Group who may be involved in the performance of any Work of the following Company rules relating to alcoholic beverages, drugs and weapons, with which all personnel are expected to comply:

13.1 Bringing, attempting to bring, possessing, using or being under the influence of intoxicants, drugs, or narcotics while on any Company Property, including but not limited to parking areas, is prohibited. Possessing alcoholic beverages in sealed containers is permitted, however, in designated parking areas.

13.2 Prescription or over-the-counter medications that could affect the performance of safety-sensitive work are allowed on Company Property only if they have been previously cleared by Contractor. Contractor must confirm that the medication and dosage do not impair an individual's ability to perform safety-sensitive work before clearing the individual to perform such work while under the influence of the medication.

13.3 Bringing, attempting to bring, possessing or using firearms, whether classified as legal or illegal, while on any Company Property, including but not limited to buildings, parking areas, recreation facilities, equipment and vehicles, is prohibited, unless otherwise required by applicable law. Use or possession of firearms for specific situations is permitted if approved by function or higher level management of Company.

13.4 Off-the-job involvement with intoxicants, illegal drugs, or illegal narcotics that adversely affects Company's business, to include impairing the individual's ability to perform his job or the public trust in the safe operation of Company, is prohibited.

13.5 Any conduct on any Company Property which is in violation of any state or federal law or regulation is considered a violation of these rules and a breach of any agreement to which these policies are attached.

13.6 In order to enforce these rules, all individuals with access to any Company Property as well as the vehicles, offices, lockers and any personal belongings of such individuals on any Company Property are subject to search by Company and its agents, to include security representatives appointed or employed by Company. Individuals may be required to take a blood, urinalysis or Breathalyzer test, or submit to other recognized investigatory tests or procedures as are deemed appropriate or necessary by Company in the investigation of a violation of these rules.

14. TITLE AND RIGHT. Nothing in the Agreement will vest Contractor with any right of property in materials used after they have been attached to or incorporated into the Work, nor materials for which Contractor has received full or partial payment. All those materials, upon being so attached, incorporated or paid for, will become the property of Company. Any gravel, sand, stone, minerals, timber or other materials excavated, uncovered, developed or obtained in the Work, or on any land belonging to Company may be used, in the performance of the Work, provided such materials meet the requirements of this Agreement. Any objects or natural materials or animals excavated or exposed that may have historical significance or constitute a threatened or endangered species must be brought to the attention of Company.

15. PROTECTION AGAINST LIENS AND ENCUMBRANCES

15.1 Contractor will not at any time permit any lien, attachment or other encumbrance ("**Encumbrance**") by any person or persons whosoever or by reason of any claim or demand against Contractor to be placed or remain on the property of Company, including, but not limited to, the Work Site upon which Work is being performed or equipment and materials that are being furnished. To prevent an Encumbrance from being placed on the property of Company, Contractor will furnish during the progress of any Work, as requested from time to time, verified statements showing Contractor's total outstanding indebtedness in connection with the Work.

15.2 If Contractor allows any indebtedness to accrue to subcontractors or others and fails to pay or discharge that indebtedness within five (5) days after demand, then Company may withhold any money due Contractor until that indebtedness is paid or pay the indebtedness and apply that amount against the money due Contractor.

15.3 If Contractor allows any Encumbrances, whether valid or invalid to be placed on the property of Company, any and all claims or demands for payment to Contractor will be denied by Company until the Encumbrance is removed. If the Encumbrance is not removed immediately, Company may pay that claim or demand and deduct the amount paid, together with all related expenses, including attorneys' fees, from any further payment due Contractor, or at Company's election, Contractor will, upon demand, reimburse Company for the amount paid and all related expenses. Any payment made in good faith by Company will be binding on Contractor.

16. TERMINATION FOR DEFAULT

16.1 If a petition in bankruptcy should be filed by Contractor, or if Contractor should make a general assignment for the benefit of creditors, or if a receiver should be appointed due to the insolvency of Contractor, or if Contractor should refuse or fail to supply enough properly skilled workmen or proper equipment, materials or services or should fail to make prompt payment to subcontractors, or to pay promptly for materials or labor, or disregard laws, ordinances or the instruction of Company's Contract Coordinator, or if Contractor should refuse or fail to abide by the SOW Construction Schedule or otherwise violate any provisions of the Agreement or SOW, then Company, upon a determination by Company’s Contract Coordinator that sufficient cause exists to justify such action, may, without prejudice to any other right or remedy available to it after giving Contractor seven (7) days’ written notice, terminate the Agreement or the SOW and take possession of the Work Site. In the event of such a termination, Company may use all or part of Contractor’s equipment and materials and may finish the Work by whatever method Company may deem expedient. In such event, Contractor will not be entitled to receive any further payment hereunder until the Work is finished. If the unpaid balance of the SOW fees will exceed the expense of finishing the Work, including compensation of Company’s Contract Coordinator, other Company personnel, third party engineering companies, or other contractors for additional services, such excess will be paid to Contractor. If the expense of finishing the Work will exceed such unpaid balance, Contractor will pay the difference to Company within fifteen (15) days of receiving an invoice for same. The expenses incurred by Company herein, and the damage incurred through Contractor’s default, will be determined by Company’s Contract Coordinator, in its sole discretion, and such determination will be binding as between the parties.

16.2 In the event of a termination under the provisions of this Section 3, Contractor will transfer and assign to Company, in accordance with Company’s instructions, all Work, all construction records, reports, permits, data and information, other materials (including all Company-supplied materials), supplies, Work in progress and other goods for which Contractor is entitled to receive reimbursement hereunder, and any and all plans, drawings, sketches, specifications, and information in connection with the Work, and will take such action as may be necessary to secure Company, at Company’s sole election, the rights of Contractor under any or all orders and subcontracts made in connection with the Work.

16.3 In the event that Company so directs or authorizes, Contractor will sell at a price approved by Company, or retain at a mutually agreeable price, any such materials, supplies, Work in progress, or other goods as referred to in the preceding paragraph. In any event, Company will receive any and all records, plans, drawings, data, permits, specifications, sketches, reports, or other information relating to the Work. The proceeds of any such sale or the agreed price will be paid or credited to Company in such manner as Company may direct so as to reduce the amount payable by Company under this Section 3.

APPENDIX D
SAFETY DATA SHEETS

Safety Data Sheet

Section 1
Identification of the Substance and of the Supplier

1.1 Product Identifier

Product Name/Identification:	ASTM Bottom Ash
Synonyms:	Ash; Ashes; Ash residues; Ashes, residues, bottom; Bottom ash; Bottom ash residues; Coal Fly Ash; Pozzolan; Waste solids.
Formula:	UVCB Substance

1.2 Relevant Identified Uses of the Substance or Mixture and Uses Advices Against

Relevant Identified Uses:	Component of wallboard, concrete, roofing material, bricks, cement kiln feed.
Uses Advised Against:	None known.

1.3 Details of the Supplier of the SDS

Manufacturer/Supplier:	Dynegy, Inc.
Street Address:	601 Travis Street, Suite 1400
City, State and Zip Code:	Houston, TX 77002
Customer Service Telephone:	800-633-4704

Section 2
Hazards Identification

2.1 Classification of the Substance

GHS Classification(s) according to OSHA Hazard Communication Standard (29 CFR 1910.1200):

- Eye Irritant, Category 2A
- STOT-SE, Category 3 (Respiratory Irritation)
- Carcinogen, Category 1A
- STOT-RE, Category 1 (Lungs)
- Toxic to Reproduction, Category 2

2.2 Label Elements

Labelling according to 29 CFR 1910.1200 Appendices A, B and C*	
Hazard Pictogram(s):	
Signal word:	**DANGER**
Hazard Statement(s):	*Causes serious eye irritation.* *May cause respiratory irritation.* *May cause damage to lungs after repeated/prolonged exposure via inhalation.* *May cause cancer of the lung.* *Suspected of damaging fertility or the unborn child.*
Precautionary Statement(s):	*Obtain special instructions before use.* *Do not handle until all safety precautions have been read and understood.* *Avoid breathing dust.* *Wash thoroughly after handling.* *Do not eat drink or smoke when using this product.* *Wear protective gloves/protective clothing/eye protection/face protection.* *Use outdoors or in a well-ventilated area.* *If exposed or concerned: Get medical advice/attention.* *Store in a secure area.* *Dispose of product in accordance with local/national regulations.*

** Fly ash and other coal combustion products (CCPs) are UVCB substances (unknown or variable composition or biological). Various CCPs, noted as ashes/ash residuals; Ashes, residues, bottom; Bottom ash; Bottom ash residues; Waste solids, ashes under TSCA are defined as: "The residuum from the burning of a combination of carbonaceous materials. The following elements may be present as oxides: aluminum, calcium, iron, magnesium, nickel, phosphorus, potassium, silicon, sulfur, titanium, and vanadium." Ashes including fly ash and fluidized bed combustion ash are identified by CAS number 68131-74-8. The exact composition of the ash is dependent on the fuel source and flue additives composed of many constituents. The classification of the final substance is dependent on the presence of specific identified oxides as well as other trace elements.*

2.3 Other Hazards

Listed Carcinogens:

-Respirable Crystalline Silica

IARC: [Yes] **NTP:** [Yes] **OSHA:** [Yes] **Other:** **(ACGIH)** [Yes]

Section 3
Composition/Information on Ingredients

Substance	*CAS No.*	*Percentage (%)*	*GHS Classification*
Crystalline Silica	*14808-60-7*	*20 - 40%*	*Repeat Dose STOT, Category 1* *Carcinogen, Category 1A*
Silica, crystalline respirable (RCS)	*14808-60-7*	*See Footnote 1*	*Repeat Dose STOT, Category 1* *Carcinogen. Category 1A*
Aluminosilicates[2]	*Various, see Footnote 2*	*10 - 60%*	*Single Exposure STOT, Category 3*
Calcium oxide (CaO)	*1305-78-8*	*10 - 30%*	*Skin Irritant, Category 2* *Eye Irritant, Category 1* *Single Exposure STOT, Category 3*
Iron oxide	*1309-37-1*	*1 - 10%*	*Not Classified*
Manganese dioxide (MnO_2)	*1313-13-9*	*<2%*	*Skin Irritant, Category 2* *Eye Irritant, Category 2B*
Magnesium oxide	*1309-48-4*	*2 - 10%*	*Not Classified*
Phosphorus pentoxide (P_2O_5)	*1314-56-3*	*≤2%*	*Skin Irritant, Category 2* *Eye Irritant, Category 2B*
Sodium oxide	*1313-59-3*	*1 - 10%*	*Not Classified*
Potassium oxide (K_2O)	*12136-45-7*	*≤1%*	*Skin Irritant Category 2* *Eye Irritant Category 2B*
Titanium dioxide (TiO_2)	*13463-67-7*	*<3%*	*Not Classified*
Bromide salt (calcium)	*7789-41-5*	*See Footnote 3*	*Toxic to Reproduction Category 2*

[1] *The percentage of respirable crystalline silica has not been determined. Therefore, a GHS classification of Carcinogen 1A has been assigned.*

[2] *Aluminosilicates (CAS# 1327-36-2) may be in the form of mullite (CAS# 1302-93-8); aluminosilicate glass; pozzolans (CAS# 71243-67-9); or calcium aluminosilicates such as tricalcium aluminate (C3A), or calcium sulfoaluminate (C4A3S). The form is dependent on the source of the coal and or the process used to create the CCP. Pulverized coal combustion would be more likely to create high levels of pozzolans. Aluminosilicates may have inclusions of calcium, titanium, iron, potassium, phosphorus, magnesium and other metal oxides.*

[3] *Analytical data are not available to demonstrate that the concentration of bromide salt is <0.1%; therefore, a GHS classification of Toxic to Reproduction Category 2 has been assigned.*

Section 4
First Aid Measures

4.1 Description of First Aid Measures

Inhalation:	If product is inhaled and irritation of the nose or coughing occurs, remove person to fresh air. Get medical advice/attention if respiratory symptoms persist.
Skin Contact:	If skin exposure occurs, wash with soap and water.
Eye Contact:	If product gets into the eye, rinse copiously with water for several minutes. Remove contact lenses, if present and easy to do. Seek medical attention/advice if irritation occurs or persists.
Ingestion:	No specific first aid measures are required.

4.2 Most Important Health Effects, Both Acute and Delayed

Acute Effects: Direct exposure may cause respiratory irritation, eye irritation and skin irritation. The product dust can dry and irritate the skin and cause dermatitis and can irritate eyes and skin through mechanical abrasion.

Chronic Effects: Chronic exposure may cause lung damage from repeated exposure. Prolonged inhalation of respirable crystalline silica above certain concentrations may cause lung diseases, including silicosis and lung cancer. Repeated exposure to dusts containing inorganic bromide salts may affect fertility and/or result in effects to the unborn child.

4.3 Indication of Any Immediate Medical Attention and Special Treatment Needed

Seek first aid or call a doctor or Poison Control Center if contact with eyes occurs and irritation remains after rinsing. Get medical advice if inhalation occurs and respiratory symptoms persist.

Section 5
Firefighting Measures

5.1 Extinguishing Media

Suitable Extinguishing Media:	Product is not flammable. Use extinguishing media appropriate for surrounding fire.
Unsuitable Extinguishing Media:	Not applicable, the product is not flammable.

5.2 Special Hazards Arising from the Substance or Mixture

Hazardous Combustion Products:	None known.

5.3 Advice for Firefighters

Special Protective Equipment and Precautions for Firefighters:	As with any fire, wear self-contained breathing apparatus (NIOSH approved or equivalent) and full protective gear.

Section 6
Accidental Release Measures

6.1 Personal Precautions, Protective Equipment and Emergency Procedures

Personal precautions/Protective Equipment:	See Section 8.2.2 Individual Protective Measures. For concentrations exceeding Occupational Exposure Levels (OELs), use a self-contained breathing apparatus (SCBA).
Emergency procedures:	Use scooping, water spraying/flushing/misting or ventilated vacuum cleaning systems to clean up spills. Do not use pressurized air.

6.2 Environmental Precautions

Environmental precautions:	Prevent contamination of drains or waterways and dispose according to local and national regulations.

6.3 Methods and Material for Containment and Cleaning Up

Methods and materials for containment and cleaning up:	Do not use brooms or compressed air to clean surfaces. Use dust collection vacuum and extraction systems. Large spills of dry product should be removed by a vacuum system. Dampened material should be removed by mechanical means and recycled or disposed of according to local and national regulations.

See Sections 8 and 13 for additional information on exposure controls and disposal.

Section 7
Handling and Storage

7.1 Precautions for Safe Handling

Practice good housekeeping. Use adequate exhaust ventilation, dust collection and/or water mist to maintain airborne dust concentrations below permissible exposure limits (note: respirable crystalline silica dust may be in the air without a visible dust cloud).

Do not permit dust to collect on walls, floors, sills, ledges, machinery, or equipment. Maintain and test ventilation and dust collection equipment. In cases of insufficient ventilation, wear a NIOSH approved respirator for silica dust when handling or disposing dust from this product. Avoid contact with skin and eyes. Wash or vacuum clothing that has become dusty. Avoid eating, smoking, or drinking while handling the material.

7.2 Conditions for Safe Storage, Including any Incompatibilities

Minimize dust produced during loading and unloading.

Section 8
Exposure Controls/Personal Protection

8.1 Control Parameters

OCCUPATIONAL EXPOSURE LIMITS					
SUBSTANCE		**OSHA PEL TWA (mg/m^3)**	**NIOSH REL TWA (mg/m^3)**	**ACGIH TLV TWA (mg/m^3)**	**CA - OSHA PEL (mg/m^3)**
Calcium oxide		5	2	2	2
Particulates Not Otherwise Regulated	Total	15	15	10	10
	Respirable	5	5	3	5
Respirable Crystalline Silica	Respirable	0.05	0.05	0.025	0.05
Manganese dioxide (as manganese compounds)	Total	5 (Ceiling)	1 3 (STEL)	0.1	0.2
	Respirable	-	-	0.02	-

8.2 Exposure Controls

8.2.1 Engineering Controls

Provide ventilation to maintain the ambient workplace atmosphere below the occupational exposure limit(s). Use general and local exhaust ventilation and dust collection systems as necessary to minimize exposure.

8.2.2 Personal Protective Equipment (PPE)

Respiratory protection:	Wear a NIOSH approved particulate respirator if exposure to airborne particulates is unavoidable and where occupational exposure limits may be exceeded. If airborne exposures are anticipated to exceed applicable PELs or TLVs, a self-contained breathing apparatus or airline respirator is recommended.
Eye and face protection:	If eye contact is possible, wear protective glasses with side shields. Avoid contact lenses.
Hand and skin protection:	Wear gloves and protective clothing. Wash hands with soap and water after contact with material.

Section 9
Physical and Chemical Properties

9.1 Information on Basic Physical and Chemical Properties

Property: Value	Property: Value
Appearance (physical state, color, etc.): Fine tan/ gray particulate	**Upper/lower flammability or explosive limits:** Not applicable
Odor: Odorless[1]	**Vapor Pressure (Pa):** Not applicable
Odor threshold: Not applicable	**Vapor Density:** Not applicable
pH (25 °C) (in water): 8 - 11	**Specific gravity or relative density:** 2.2 – 2.9
Melting point/freezing point (°C): Not applicable	**Water Solubility:** Slight
Initial boiling point and boiling range (°C): Not applicable	**Partition coefficient: n-octane/water:** Not determined
Flash point (°C): Not determined	**Auto ignition temperature (°C):** Not applicable
Evaporation rate: Not applicable	**Decomposition temperature (°C):** Not determined
Flammability (solid, gas): Not combustible	**Viscosity:** Not applicable

[1] The use of urea or aqueous ammonia injected into the flue gas to reduce nitrogen oxides (NOx) emissions may result in the presence of ammonium sulfate or ammonium bisulfate in the ash at less than 0.1%. When ash containing these substances becomes wet under high pH (>9), free ammonia gas may be released resulting in objectionable/nuisance ammonia odor and potential exposure to ammonia gas especially in confined spaces.

Section 10
Stability and Reactivity

10.1 Reactivity:	The material is an inert, inorganic material primarily composed of elemental oxides.
10.2 Chemical stability:	The material is stable under normal use conditions.
10.3 Possibility of hazardous reactions:	The material is a relatively stable, inert material; however, when ash containing ammonia becomes wet under high pH (>9), free ammonia gas may be released resulting in an objectionable/nuisance ammonia odor and potential exposure to ammonia gas especially in confined spaces. Polymerization will not occur.
10.4 Conditions to avoid:	Product can become airborne in moderate winds. Dry material should be stored in silos. Materials stored out of doors should be covered or maintained in a damp condition.
10.5 Incompatible materials:	None known.
10. 6 Hazardous decomposition products:	None known.

Section 11
Toxicological Information

11.1 Information on Toxicological Effects

Endpoint	Data
Acute oral toxicity	LD50 > 2000 mg/kg
Acute dermal toxicity	LD50 > 2000 mg/kg
Acute inhalation toxicity	LD50 > 5.0 mg/L
Skin corrosion/irritation	Does not meet the classification criteria but may cause slight skin irritation. Product dust can dry the skin which can result in irritation.
Eye damage/irritation	Causes serious eye irritation. Positive scores for conjunctiva irritation and chemosis in 2/3 animals based on average of 24, 48 and 72-hour scores with irritation clearing within 21 days; no corneal or iritis effects observed.
Respiratory/skin sensitization	Not a respiratory or dermal sensitizer.
Germ cell mutagenicity	Not mutagenic in in-vitro and in-vivo assays with or without metabolic activation.
Carcinogenicity	Not available. Respirable crystalline silica has been identified as a carcinogen by OSHA, NTP, ACGIH and IARC.
Reproductive toxicity	No developmental toxicity was observed in available animal studies. Reproductive studies on CCPs showed either no reproductive effects, or some effects on male and female reproductive organs and parameters but without a clear dose response. Inorganic bromide salts have been shown to have adverse effects on reproductive parameters in some animal studies.
STOT-SE	CCPs when present as a nuisance dust may result in respiratory irritation.
STOT-RE	In a 180-day inhalation study with fly ash dust, no effects were observed at the highest dose tested. NOEC = 4.2 mg/m^3; it is not possible to assess the level at which toxicologically significant effects may occur. Repeated inhalation exposures to high levels of respirable crystalline silica may result in lung damage (i.e., silicosis).
Aspiration Hazard	Not applicable based product form.

Section 12
Ecological Information

12.1 Toxicity

Fly Ash (CAS# 68131-74-8)	
Toxicity to Fish	LC50 > 100 mg/L
Toxicity to Aquatic Invertebrates	Data indicates that the test substance is not toxic to *Daphnia magna* (EC50 undetermined)
Toxicity to Aquatic Algae and Plants	EC50 = 10 mg/L
Calcium oxide CAS# 1305-78-8	
Toxicity to Fish	LC50 = 50.6 mg/L The findings were closely related to the pH of the test solutions; therefore, pH is considered to be the main reason for the effects.
Toxicity to Aquatic Invertebrates	EC50 = 49.1 mg/L The findings were closely related to the pH of the test solutions; therefore, pH is considered to be the main reason for the effects.
Toxicity to Aquatic Algae and Plants	NOEC =48 mg/L @ 72 hours based on $Ca(OH)_2$ The initial pH of the test medium was not directly related to the biologically relevant effects. The formation of precipitates is likely the result of the reaction between CO_2 dissolved in the medium.

12.2 Persistence and Degradability

Not relevant for inorganic materials.

12.3 Bioaccumulative Potential

This material does not contain any compounds that would bioaccumulate up the food chain.

12.4 Mobility in Soil

No data available.

12.5 Results of PBT and vPvB Assessment

This material does not contain any compounds classified as “persistent, bioaccumulative or toxic” nor as “very persistent/very bioaccumulative”.

12.6 Other Adverse Effects

None known.

Section 13
Disposal Considerations

See Sections 7 and 8 above for safe handling and use, including appropriate industrial hygiene practices.

Dispose of all waste product and containers in accordance with federal, state and local regulations.

Section 14
Transport Information

Regulatory entity: U.S. DOT	Shipping Name:	Not Regulated
	Hazard Class:	Not Regulated
	ID Number:	Not Regulated
	Packing Group:	Not Regulated

Section 15
Regulatory Information

15.1 Safety, Health and Environmental Regulations/Legislation Specific for the Mixture

- TSCA Inventory Status

  All components are listed on the TSCA Inventory.

- California Proposition 65

  The following substances are known to the State of California to be carcinogens and/or reproductive toxicants:

  - Respirable crystalline silica
  - Titanium dioxide

- State Right-to-Know (RTK)

Component	**CAS**	**MA[1,2]**	**NJ[3,4]**	**PA[5]**	**RI[6]**
Ammonium bisulfate	7803-63-6	No	Yes	No	No
Ammonium sulfate	7783-20-2	Yes	No	Yes	No
Calcium oxide	1305-78-8	Yes	Yes	Yes	No
Iron oxide	1309-37-1	Yes	Yes	Yes	No
Magnesium oxide	1309-48-4	No	Yes	No	No
Phosphorus pentoxide (or phosphorus oxide)	1314-56-3	Yes	Yes	Yes	No
Potassium oxide	12136-45-7	No	Yes	No	No
Silica-crystalline (SiO_2), quartz	14808-60-7	Yes	Yes	Yes	No
Sodium oxide	1313-59-3	No	Yes	No	No
Titanium dioxide	13463-67-7	Yes	Yes	Yes	Yes

[1] Massachusetts Department of Public Health, no date
[2] 189th General Court of The Commonwealth of Massachusetts, no date
[3] New Jersey Department of Health and Senior Services, 2010a
[4] New Jersey Department of Health, 2010b
[5] Pennsylvania Code, 1986
[6] Rhode Island Department of Labor and Training, no date

Section 16
Other Information, Including Date of Preparation or Last Revision

16.1 Indication of Changes

Date of preparation or last revision: February 23, 2018

16.2 Abbreviations and Acronyms

- ACGIH: American Conference of Industrial Hygienists
- CA: California
- CAS: Chemical Abstract Services
- CCP: Coal Combustion Product
- CFR: Code of Federal Regulations
- EPA: Environmental Protection Agency
- GHS: Globally Harmonized System of Classification and Labelling
- IARC: International Agency for Research on Cancer
- LC50: Concentration resulting in the mortality of 50 % of an animal population
- LD50: Dose resulting in the mortality of 50 % of an animal population
- MA: Massachusetts
- NA: Not Applicable
- NJ: New Jersey
- NOEC: No observed effect concentration
- NIOSH: National Institute of Occupational Safety and Health
- NOx: Nitrogen oxides
- NTP: US National Toxicology Program
- OEL: Occupational Exposure Limit
- OSHA: Occupational Safety and Health Administration
- PA: Pennsylvania
- PBT: Persistent, Toxic and Bioaccumulative
- PEL: Permissible exposure limit
- PPE: Personal Protective Equipment
- REL: Recommended exposure limit
- RI: Rhode Island
- RCS: Respirable Crystalline Silica
- RTK: Right-to-Know
- SCBA: Self-contained breathing apparatus
- SDS: Safety Data Sheet
- STEL: Short-term exposure limit
- STOT-RE: Specific target organ toxicity-repeated exposure
- STOT-SE: Specific target organ toxicity-single exposure
- TLV: Threshold limit value
- TSCA: Toxic Substances Control Act
- TWA: Time-weighted average
- UEL: Upper explosive limit
- UVCB: Unknown or Variable Composition/Biological
- U.S.: United States
- U.S. DOT: United States of Department of Transportation

16.3 Other Hazards

Hazardous Materials Identification System (HMIS) Degree of hazard (0= low, 4 = extreme)							
Health:	2*	**Flammability:**	0	**Physical Hazards:**	0	**Personal protection:****	

** Chronic Health Effects*
****** Appropriate personal protection is defined by the activity to be performed.*
See Section 8 for additional information.

DISCLAIMER:

This SDS has been prepared in accordance with the Hazard Communication Rule 29 CFR 1910.1200. Information herein is based on data considered to be accurate as of date prepared. No warranty or representation, express or implied, is made as to the accuracy or completeness of this data and safety information. No responsibility can be assumed for any damage or injury resulting from abnormal use, failure to adhere to recommended practices, or from any hazards inherent in the nature of the product.

Safety Data Sheet

Section 1
Identification of the Substance and of the Supplier

1.1 Product Identifier

Product Name/Identification:	ASTM Class C Fly Ash
Synonyms:	Coal Fly Ash, Pozzolan
Formula:	UVCB Substance

1.2 Relevant Identified Uses of the Substance or Mixture and Uses Advices Against

Relevant Identified Uses:	Component of wallboard, concrete, roofing material, bricks, cement kiln feed.
Uses Advised Against:	None known.

1.3 Details of the Supplier of the SDS

Manufacturer/Supplier:	Dynegy, Inc.
Street Address:	601 Travis Street, Suite 1400
City, State and Zip Code:	Houston, TX 77002
Customer Service Telephone:	800-633-4704

Section 2
Hazards Identification

2.1 Classification of the Substance

GHS Classification(s) according to OSHA Hazard Communication Standard (29 CFR 1910.1200):

- Eye Irritant, Category 2A
- STOT-SE, Category 3 (Respiratory Irritation)
- Carcinogen, Category 1A
- STOT-RE, Category 1 (Lungs)
- Toxic to Reproduction, Category 2

2.2 Label Elements

Labelling according to 29 CFR 1910.1200 Appendices A, B and C*	
Hazard Pictogram(s):	
Signal word:	**DANGER**
Hazard Statement(s):	*Causes serious eye irritation.* *May cause damage to lungs after repeated/prolonged exposure via inhalation.* *May cause respiratory irritation.* *May cause cancer of the lung.* *Suspected of damaging fertility or the unborn child.*
Precautionary Statement(s):	*Obtain special instructions before use.* *Do not handle until all safety precautions have been read and understood.* *Avoid breathing dust.* *Wear protective gloves/protective clothing/eye protection/face protection.* *Wash thoroughly after handling.* *Do not eat drink or smoke when using this product.* *Use outdoors or in a well-ventilated area.* *If exposed or concerned: Get medical advice/attention.* *Store in a secure area.* *Dispose of product in accordance with local/national regulations.*

** Fly ash and other coal combustion products (CCPs) are UVCB substances (unknown or variable composition or biological). Various CCPs, noted as ashes/ash residuals; Ashes, residues, bottom; Bottom ash; Bottom ash residues; Waste solids, ashes under TSCA are defined as: "The residuum from the burning of a combination of carbonaceous materials. The following elements may be present as oxides: aluminum, calcium, iron, magnesium, nickel, phosphorus, potassium, silicon, sulfur, titanium, and vanadium." Ashes including fly ash and fluidized bed combustion ash are identified by CAS number 68131-74-8. The exact composition of the ash is dependent on the fuel source and flue additives composed of many constituents. The* *classification of the final substance is dependent on the presence of specific identified oxides as well as other trace elements.*

2.3 Other Hazards

Listed Carcinogens:

-Respirable Crystalline Silica

IARC: [Yes] **NTP:** [Yes] **OSHA:** [Yes] **Other:** **(ACGIH)** [Yes]

Section 3
Composition/Information on Ingredients

Substance	*CAS No.*	*Percentage (%)*	*GHS Classification*
Crystalline Silica	*14808-60-7*	*30 - 60%*	*Repeat Dose STOT, Category 1* *Carcinogen, Category 1A*
Silica, crystalline respirable (RCS)	*14808-60-7*	*See Footnote 1*	*Repeat Dose STOT, Category 1* *Carcinogen, Category 1A*
Aluminosilicates	*71243-67-9* *1327-36-2*	*30 - 60%*	*Single Exposure STOT, Category 3*
Iron oxide	*1309-37-1*	*1 - 10%*	*Not Classified*
Calcium oxide (CaO)	*1305-78-8*	*20 - 30%*	*Skin Irritant, Category 2* *Eye Irritant, Category 1* *Single Exposure STOT, Category 3*
Magnesium oxide	*1309-48-4*	*2 - 10%*	*Not Classified*
Phosphorus pentoxide (P_2O_5)	*1314-56-3*	*≤2%*	*Skin Irritant, Category 2* *Eye Irritant, Category 2B*
Sodium oxide	*1313-59-3*	*1-8%*	*Not Classified*
Potassium oxide (K_2O)	*12136-45-7*	*≤1%*	*Skin Irritant, Category 2* *Eye Irritant, Category 2B*
Titanium dioxide (TiO_2)	*13463-67-7*	*<3%*	*Not Classified*
Bromide salt (calcium)	*7789-41-5*	*See Footnote 2*	*Toxic to Reproduction, Category 2*

Footnote 1: The percentage of respirable crystalline silica has not been determined. Therefore, a GHS classification of Carcinogen, Category 1A has been assigned.

Footnote 2: Analytical data are not available to demonstrate that the concentration of bromide salt is <0.1%; therefore, a GHS classification of Toxic to Reproduction, Category 2 has been assigned.

Section 4
First Aid Measures

4.1 Description of First Aid Measures

Inhalation:	If product is inhaled and irritation of the nose or coughing occurs, remove person to fresh air. Get medical advice/attention if respiratory symptoms persist.
Skin Contact:	If skin exposure occurs, wash with soap and water.
Eye Contact:	If product gets into the eye, rinse copiously with water for several minutes. Remove contact lenses, if present and easy to do. Seek medical attention/advice if irritation occurs or persists.
Ingestion:	No specific first aid measures are required.

4.2 Most Important Health Effects, Both Acute and Delayed

Acute Effects: Direct exposure may cause respiratory irritation, eye irritation and skin irritation. The product dust can dry and irritate the skin and cause dermatitis and can irritate eyes and skin through mechanical abrasion.

Chronic Effects: Chronic exposure may cause lung damage from repeated exposure. Prolonged inhalation of respirable crystalline silica above certain concentrations may cause lung diseases, including silicosis and lung cancer. Repeated exposure to dusts containing inorganic bromide salts may affect fertility and/or result in effects to the unborn child.

4.3 Indication of Any Immediate Medical Attention and Special Treatment Needed

Seek first aid or call a doctor or Poison Control Center if contact with eyes occurs and irritation remains after rinsing. Get medical advice if inhalation occurs and respiratory symptoms persist.

Section 5
Firefighting Measures

5.1 Extinguishing Media

Suitable Extinguishing Media:	Product is not flammable. Use extinguishing media appropriate for surrounding fire.
Unsuitable Extinguishing Media:	Not applicable, the product is not flammable.

5.2 Special Hazards Arising from the Substance or Mixture

Hazardous Combustion Products:	None known.

5.3 Advice for Firefighters

Special Protective Equipment and Precautions for Firefighters:	As with any fire, wear self-contained breathing apparatus (NIOSH approved or equivalent) and full protective gear.

Section 6
Accidental Release Measures

6.1 Personal Precautions, Protective Equipment and Emergency Procedures

Personal precautions/Protective Equipment:	See Section 8.2.2 Individual Protective Measures. For concentrations exceeding Occupational Exposure Levels (OELs), use a self-contained breathing apparatus (SCBA).
Emergency procedures:	Use scooping, water spraying/flushing/misting or ventilated vacuum cleaning systems to clean up spills. Do not use pressurized air.

6.2 Environmental Precautions

Environmental precautions:	Prevent contamination of drains or waterways and dispose according to local and national regulations.

6.3 Methods and Material for Containment and Cleaning Up

Methods and materials for containment and cleaning up:	Do not use brooms or compressed air to clean surfaces. Use dust collection vacuum and extraction systems. Large spills of dry product should be removed by a vacuum system. Dampened material should be removed by mechanical means and recycled or disposed of according to local and national regulations.

See Sections 8 and 13 for additional information on exposure controls and disposal.

Section 7
Handling and Storage

7.1 Precautions for Safe Handling

Practice good housekeeping. Use adequate exhaust ventilation, dust collection and/or water mist to maintain airborne dust concentrations below permissible exposure limits (note: respirable crystalline silica dust may be in the air without a visible dust cloud).

Do not permit dust to collect on walls, floors, sills, ledges, machinery, or equipment. Maintain and test ventilation and dust collection equipment. In cases of insufficient ventilation, wear a NIOSH approved respirator for silica dust when handling or disposing dust from this product. Avoid contact with skin and eyes. Wash or vacuum clothing that has become dusty. Avoid eating, smoking, or drinking while handling the material.

7.2 Conditions for Safe Storage, Including any Incompatibilities

Minimize dust produced during loading and unloading.

Section 8
Exposure Controls/Personal Protection

8.1 Control Parameters

OCCUPATIONAL EXPOSURE LIMITS					
SUBSTANCE		**OSHA PEL TWA (mg/m^3)**	**NIOSH REL TWA (mg/m^3)**	**ACGIH TLV TWA (mg/m^3)**	**CA - OSHA PEL (mg/m^3)**
Calcium oxide		5	2	2	2
Particulates Not Otherwise Regulated	Total	15	15	10	10
	Respirable	5	5	3	5
Respirable Crystalline Silica	Respirable Crystalline Silica	0.05	0.05	0.025	0.05
Titanium dioxide	Total	15	2.4 (fine) 0.3 (ultrafine)	10	10
Manganese dioxide (as manganese compounds)	Total	5 (Ceiling)	1 3 (STEL)	0.1	0.2
	Respirable	-	-	0.02	-

8.2 Exposure Controls

8.2.1 Engineering Controls

Provide ventilation to maintain the ambient workplace atmosphere below the occupational exposure limit(s). Use general and local exhaust ventilation and dust collection systems as necessary to minimize exposure.

8.2.2 Personal Protective Equipment (PPE)

Respiratory protection:	Wear a NIOSH approved particulate respirator if exposure to airborne particulates is unavoidable and where occupational exposure limits may be exceeded. If airborne exposures are anticipated to exceed applicable PELs or TLVs, a self-contained breathing apparatus or airline respirator is recommended.
Eye and face protection:	If eye contact is possible, wear protective glasses with side shields. Avoid contact lenses.
Hand and skin protection:	Wear gloves and protective clothing. Wash hands with soap and water after contact with material.

Section 9
Physical and Chemical Properties

9.1 Information on Basic Physical and Chemical Properties

Property: Value	Property: Value
Appearance (physical state, color, etc.): Fine tan/ gray particulate	**Upper/lower flammability or explosive limits:** Not applicable
Odor: Odorless[1]	**Vapor Pressure (Pa):** Not applicable
Odor threshold: Not applicable	**Vapor Density:** Not applicable
pH (25 °C) (in water): Not Determined	**Specific gravity or relative density:** 2.2 – 2.9
Melting point/freezing point (°C): Not applicable	**Water Solubility:** Slight
Initial boiling point/boiling range (°C): NA	**Partition coefficient: n-octane/water:** NA
Flash point (°C): Not determined	**Auto ignition temperature (°C):** Not applicable
Evaporation rate: Not applicable	**Decomposition temperature (°C):** Not determined
Flammability (solid, gas): Not combustible	**Viscosity:** Not applicable

[1] The use of urea or aqueous ammonia injected into the flue gas to reduce nitrogen oxides (NOx) emissions may result in the presence of ammonium sulfate or ammonium bisulfate in the ash at less than 0.1%. When ash containing these substances becomes wet under high pH (>9), free ammonia gas may be released resulting in objectionable/nuisance ammonia odor and potential exposure to ammonia gas especially in confined spaces.

Section 10
Stability and Reactivity

10.1 Reactivity:	The material is an inert, inorganic material primarily composed of elemental oxides.
10.2 Chemical stability:	The material is stable under normal use conditions.
10.3 Possibility of hazardous reactions:	The material is a relatively stable, inert material; however, when ash containing ammonia becomes wet under high pH (>9), free ammonia gas may be released resulting in an objectionable/nuisance ammonia odor and potential exposure to ammonia gas especially in confined spaces. Polymerization will not occur.
10.4 Conditions to avoid:	Product can become airborne in moderate winds. Dry material should be stored in silos. Materials stored out of doors should be covered or maintained in a damp condition.
10.5 Incompatible materials:	None known.
10. 6 Hazardous decomposition products:	None known.

Section 11
Toxicological Information

11.1 Information on Toxicological Effects

Endpoint	Data
Acute oral toxicity	LD50 > 2000 mg/kg
Acute dermal toxicity	LD50 > 2000 mg/kg
Acute inhalation toxicity	LD50 > 5.0 mg/L
Skin corrosion/irritation	Does not meet the classification criteria but may cause slight skin irritation. Product dust can dry the skin which can result in irritation.
Eye damage/irritation	Causes serious eye irritation. Positive scores for conjunctiva irritation and chemosis in 2/3 animals based on average of 24, 48 and 72-hour scores with irritation clearing within 21 days; No corneal or iritis effects observed.
Respiratory/skin sensitization	Not a respiratory or dermal sensitizer.
Germ cell mutagenicity	Not mutagenic in in-vitro and in-vivo assays with or without metabolic activation.
Carcinogenicity	Not available. Respirable crystalline silica has been identified as a carcinogen by OSHA, NTP, ACGIH and IARC.
Reproductive toxicity	No developmental toxicity was observed in available animal studies. Reproductive studies on CCPs showed either no reproductive effects, or some effects on male and female reproductive organs and parameters but without a clear dose response. Inorganic bromide salts have been shown to have adverse effects on reproductive parameters in some animal studies.
STOT-SE	CCPs when present as a nuisance dust may result in respiratory irritation.
STOT-RE	In a 180-day inhalation study with fly ash dust, no effects were observed at the highest dose tested. NOEC = 4.2 mg/m^3; it is not possible to assess the level at which toxicologically significant effects may occur. Repeated inhalation exposures to high levels of respirable crystalline silica may result in lung damage (i.e., silicosis).
Aspiration Hazard	Not applicable based product form.

Section 12
Ecological Information

12.1 Toxicity

Fly Ash C (CAS# 68131-74-8)	
Toxicity to Fish	LC50 > 100 mg/L
Toxicity to Aquatic Invertebrates	Data indicates that the test substance is not toxic to *Daphnia magna* (EC50 undetermined).
Toxicity to Aquatic Algae and Plants	EC50 = 10 mg/L

Calcium oxide CAS# 1305-78-8	
Toxicity to Fish	LC50 = 50.6 mg/L The findings were closely related to the pH of the test solutions; therefore, pH is considered to be the main reason for the effects.
Toxicity to Aquatic Invertebrates	EC50 = 49.1 mg/L The findings were closely related to the pH of the test solutions; therefore, pH is considered to be the main reason for the effects.
Toxicity to Aquatic Algae and Plants	NOEC =48 mg/L @ 72 hours based on $Ca(OH)_2$ The initial pH of the test medium was not directly related to the biologically relevant effects. The formation of precipitates is likely the result of the reaction between CO_2 dissolved in the medium.

12.2 Persistence and Degradability

Not relevant for inorganic materials.

12.3 Bioaccumulative Potential

This material does not contain any compounds that would bioaccumulate up the food chain.

12.4 Mobility in Soil

No data available.

12.5 Results of PBT and vPvB Assessment

This material does not contain any compounds classified as “persistent, bioaccumulative or toxic” nor as “very persistent/very bioaccumulative”.

12.6 Other Adverse Effects

None known.

Section 13

Disposal Considerations

See Sections 7 and 8 above for safe handling and use, including appropriate industrial hygiene practices.

Dispose of all waste product and containers in accordance with federal, state and local regulations.

Section 14

Transport Information

Regulatory entity: U.S. DOT	Shipping Name:	Not Regulated
	Hazard Class:	Not Regulated
	ID Number:	Not Regulated
	Packing Group:	Not Regulated

Section 15
Regulatory Information

15.1 Safety, Health and Environmental Regulations/Legislation Specific for the Mixture

- TSCA Inventory Status

  All components are listed on the TSCA Inventory.

- California Proposition 65.

  The following substances are known to the State of California to be carcinogens and/or reproductive toxicants:

  - Respirable crystalline silica

- State Right-to-Know (RTK)

Component	**CAS**	**MA**[1,2]	**NJ**[3,4]	**PA**[5]	**RI**[6]
Ammonium bisulfate	7803-63-6	No	Yes	No	No
Ammonium sulfate	7783-20-2	Yes	No	Yes	No
Calcium oxide	1305-78-8	Yes	Yes	Yes	No
Iron oxide	1309-37-1	Yes	Yes	Yes	No
Magnesium oxide	1309-48-4	No	Yes	No	No
Manganese oxide-as manganese compounds	1313-13-9; Various	No	No	Yes	Yes
Phosphorus pentoxide (or phosphorus oxide)	1314-56-3	Yes	Yes	Yes	No
Potassium oxide	12136-45-7	No	Yes	No	No
Silica-crystalline (SiO2), quartz	14808-60-7	Yes	Yes	Yes	No
Sodium oxide	1313-59-3	No	Yes	No	No
Titanium dioxide	13463-67-7	Yes	Yes	Yes	Yes

[1] Massachusetts Department of Public Health, no date
[2] 189th General Court of The Commonwealth of Massachusetts, no date
[3] New Jersey Department of Health and Senior Services, 2010a
[4] New Jersey Department of Health, 2010b
[5] Pennsylvania Code, 1986
[6] Rhode Island Department of Labor and Training, no date

Section 16
Other Information, Including Date of Preparation or Last Revision

16.1 Indication of Changes

Date of preparation or last revision: February 23, 2018

16.2 Abbreviations and Acronyms

ACGIH:	American Conference of Industrial Hygienists
CA:	California
CAS:	Chemical Abstract Services
CCP:	Coal Combustion Product
CFR:	Code of Federal Regulations
EPA:	Environmental Protection Agency

- GHS: Globally Harmonized System of Classification and Labelling
- IARC: International Agency for Research on Cancer
- LC50: Concentration resulting in the mortality of 50 % of an animal population
- LD50: Dose resulting in the mortality of 50 % of an animal population
- MA: Massachusetts
- NA: Not Applicable
- NJ: New Jersey
- NOEC: No observed effect concentration
- NIOSH: National Institute of Occupational Safety and Health
- NOx: Nitrogen oxides
- NTP: US National Toxicology Program
- OEL: Occupational Exposure Limit
- OSHA: Occupational Safety and Health Administration
- PA: Pennsylvania
- PBT: Persistent, Toxic and Bioaccumulative
- PEL: Permissible exposure limit
- PPE: Personal Protective Equipment
- REL: Recommended exposure limit
- RI: Rhode Island
- RCS: Respirable Crystalline Silica
- RTK: Right-to-Know
- SCBA: Self-contained breathing apparatus
- SDS: Safety Data Sheet
- STEL: Short-term exposure limit
- STOT-RE: Specific target organ toxicity-repeated exposure
- STOT-SE: Specific target organ toxicity-single exposure
- TLV: Threshold limit value
- TSCA: Toxic Substances Control Act
- TWA: Time-weighted average
- UEL: Upper explosive limit
- UVCB: Unknown or Variable Composition/Biological
- U.S.: United States
- U.S. DOT: United States of Department of Transportation

16.3 Other Hazards

Hazardous Materials Identification System (HMIS)

Degree of hazard (0= low, 4 = extreme)

Health:	2*	**Flammability:**	0	**Physical Hazards:**	0	**Personal protection:****	

** Chronic Health Effects*
****** *Appropriate personal protection is defined by the activity to be performed.*
See Section 8 for additional information.

DISCLAIMER:

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Attachment G

Closure Alternatives Analysis Groundwater Modeling Review at the Coffeen Power Plant, Edwards Power Plant, Newton Power Plant, and Hennepin Power Plant

Expert Report of Andrew Bittner, P.E.

Prepared by

Andrew Bittner, M.Eng., P.E.

Prepared for
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Table of Contents

List of Tables

Abbreviations

AP1	Ash Pond 1
CAA	Closure Alternatives Analysis
CBR	Closure By Removal
CCR	Coal Combustion Residual
CIP	Closure In Place
DMG	Dynegy Midwest Generation, LLC
EAP	East Ash Pond
GMF GSP	Gypsum Management Facility Gypsum Stack Pond
GMF RP	Gypsum Management Facility Recycle Pond
GWPS	Groundwater Protection Standards
HELP	Hydrologic Evaluation of Landfill Performance
ID	Identification
IEPA	Illinois Environmental Protection Agency
IPGC	Illinois Power Generating Company
IPRG	Illinois Power Resources Generating, LLC
K_d	Distribution Coefficient
mL/g	Milliliters Per Gram
NID	National Inventory of Dams
No.	Number
PAP	Primary Ash Pond
PE	Professional Engineer
SIs	Surface Impoundments
TDS	Total Dissolved Solids

1 Introduction and Background

1.1 Scope and Objectives

On behalf of Dynegy Midwest Generation, LLC (DMG); Illinois Power Resources Generating Company (IPRG); and Illinois Power Generating Company (IPGC), I have been retained to provide opinions related to the Illinois Environmental Protection Agency (IEPA) Initial Review Letters (IEPA, 2023a, 2023b, 2023c, 2023d) in response to the Construction Permit Applications for coal combustion residual (CCR) surface impoundments (SIs) at the Coffeen Power Plant, the Edwards Power Plant, the Newton Power Plant, and the Hennepin Power Plant (Golder Associates USA Inc., 2022a, 2022b, 2022c; IngenAE, LLC 2022; HDR Inc., 2022; Geosyntec Consultants, 2022). Specifically, my opinions relate to groundwater models that were developed in support of the Closure Alternatives Analysis (CAA). In their Initial Review Letters (IEPA, 2023a, 2023b, 2023c, 2023d), IEPA raised concerns regarding the adequacy of groundwater modeling that was conducted related to current and former CCR SIs located at each facility. Specifically, IEPA raised concerns regarding the sufficiency of only modeling selected CCR-related constituents at each facility, as opposed to modeling all CCR-related constituents. IEPA's Initial Review Letters indicate that "all constituents listed in Section 845.600 that have been found to be present in the CCR surface impoundment" must "be assessed in the groundwater model" (IEPA, 2023a, 2023b, 2023c, 2023d).

The opinions presented in this report are based on the information that I have reviewed and cited as of the date of this report, as well as my education and experience. I reserve the right to modify my opinions based on additional information that may become available.

1.2 Background

Part 845 of the Illinois Administrative Code (Title 35, Subtitle G, Chapter I, Subchapter j; IEPA, 2021), hereafter referred to as "Part 845", sets standards and requirements pertaining to the design, construction, operation, groundwater monitoring, corrective action, closure, and post-closure care of certain CCR SIs in the State of Illinois. In particular, Part 845 (IEPA, 2021) requires the development of a CAA (Section 845.710) prior to undertaking closure activities. One specific requirement of the CAA [845.710(d)(2)] is that the time to achieve groundwater protection standards (GWPS) must be evaluated for each closure alternative:

> The analysis for each alternative completed pursuant to this Section must… contain the results of groundwater contaminant transport modeling and calculations showing how the closure alternative will achieve compliance with the applicable groundwater protection standards (IEPA, 2021)

In response to this requirement, Ramboll developed groundwater models at selected facilities (Ramboll, 2022a, 2022b, 2022c, 2022d, 2022e) that evaluate the duration required for each closure alternative to achieve the GWPSs. In these models, selected CCR-related constituents were evaluated. Specific CCR SIs for which groundwater models were developed, and that were addressed in IEPA Initial Review Letters (IEPA, 2023a, 2023b, 2023c, 2023d), include the following:

- Ash Pond 1 (AP1; Vistra Identification [ID] Number [No.] 101, Illinois Environmental Protection Agency [IEPA] ID No. W1350150004-01, and National Inventory of Dams [NID] No. IL50722) at the Coffeen Power Plant in Coffeen, IL;
- The Gypsum Management Facility Gypsum Stack Pond (GMF GSP; Vistra ID No. 103, IEPA ID No. W1350150004-03, and NID No. IL50579) and the Gypsum Management Facility Recycle Pond (GMF RP; Vistra ID No. 104, IEPA ID No. W1350150004-04, and NID No. IL50578) at the Coffeen Power Plant in Coffeen, IL;
- The Ash Pond (Vistra ID No. 301, IEPA ID No. W1438050005-01, and NID No. IL50710) at the Edwards Power Plant near Bartonville, IL;
- The Primary Ash Pond (PAP; Vistra ID No. 501, IEPA ID No. W0798070001-01, NID No. IL50719) at the Newton Power Plant, in Newton, IL; and
- The East Ash Pond (EAP); Vistra ID No. 803, IEPA ID No. W1550100002-05, NID No. IL50363) at the Hennepin Power Plant in Hennepin, IL.

A summary of the groundwater modeling results, including an estimate of the time by which each closure alternative is expected to achieve the GWPSs, was provided to IEPA in the CAA (Gradient, 2022a; Gradient 2022b; Gradient 2022c; Gradient 2022d; Gradient 2021a) and the Groundwater Modeling Report (Ramboll, 2022a, 2022b, 2022c, 2022d, 2022e) for each facility, which in turn was included as part of the Construction Permit Application for each facility (Golder Associates USA Inc., 2022a, 2022b, 2022c; IngenAE, LLC, 2022; HDR Inc., 2022; Geosyntec Consultants, 2022).

1.3 Qualifications

I am a Principal at Gradient, an environmental consulting firm located in Boston, Massachusetts, and a licensed professional engineer (PE). With over 25 years of professional experience, I have consulted and testified regarding a variety of projects related to the fate and transport of constituents in the environment, hydrogeology, groundwater and surface water modeling, site characterization, and remediation system design. I have a master's degree in environmental engineering from the Massachusetts Institute of Technology and bachelor's degrees in environmental engineering and physics from the University of Michigan. A copy of my *curriculum vitae* is provided in Appendix A.

I have published and presented on a variety of topics, including groundwater and surface water fate and transport modeling of coal ash constituents, assessments of former coal-fired power plants, mass flux and mass discharge of constituents in groundwater, remedial system optimization, and the impact of environmental regulations in the United States and abroad. As a consultant during the past 25 years, I have applied my knowledge of fate and transport processes to address a range of complex challenges in the electric power, oil and gas, chemical manufacturing, pharmaceutical, mining, agrichemical, and waste disposal sectors. In particular, for the electric power industry, my experience includes projects involving regulatory comment, closure assessments, fate and transport modeling, and risk assessment. Moreover, I have worked on and been involved with projects at approximately 70 different CCR SIs.

I have served as a testifying expert and provided expert testimony, both in deposition and in front of regulatory bodies, on range of coal ash matters, including coal ash surface impoundment closure standards and the fate and transport of CCR-related constituents in the environment. A list of my prior testimony experience is provided in my *curriculum vitae* in Appendix A.

2 Summary of Opinions

A summary of my opinions that are provided in this report is provided below.

2.1 Modeling surrogate constituents is an appropriate approach to achieve model objectives in support of the CAA

Modeling selected constituents is a common approach for evaluation of environmental systems and is sufficient to achieve the model objectives in support of the CAA. All environmental models are, in some regard, simplifications of complex systems; one common model simplification is to use one or more surrogate constituents to conservatively represent the potential behavior of a larger group of constituents. During the selection of surrogate constituents, a model's objectives must be considered.

For the groundwater modeling performed in support of the CAA at the AP1, the GMF GSP, and the GMF RP at the Coffeen Power Plant, the Ash Pond at the Edwards Power Plant, the PAP at the Newton Power Plant, and the EAP at the Hennepin Power Plant, model objectives were to evaluate the effects of various closure alternatives (*i.e.*, source control measures) on groundwater quality and to specifically predict for each closure alternative the time at which GWPSs will be achieved for constituents with GWPS exceedances that are attributable to the unit. A reasonable approach to achieve this model objective is to select, as a surrogate, the constituent at each site that will likely require the longest time to achieve its GWPS. The constituents that have been detected in groundwater at the highest concentrations relative to their GWPSs and with the highest frequency of GWPS exceedances are the constituents that will likely take the longest time to achieve their GWPSs. For these objectives, it is not necessary to model all constituents that have been detected at lower concentrations relative to their GWPSs and with lower frequencies of GWPS exceedances, because these constituents will likely achieve their GWPSs faster than the selected surrogate constituent.

Based on this approach, sulfate was selected as the constituent to evaluate in the groundwater model at the AP1, the GMF GSP, and the GMF RP at the Coffeen Power Plant, and at the PAP at the Newton Power Plant; and boron was selected as the constituent to evaluate in the groundwater model at the Ash Pond at the Edwards Power Plant and at the EAP at the Hennepin Power Plant. These surrogate constituents have similar groundwater transport characteristics as the other constituents that have been detected with potential GWPS exceedances; therefore, subsurface transport during closure conditions would be similar for all of the constituents that have been detected with potential GWPS exceedances. Because each of these constituents is expected to behave in a similar manner during closure, it is appropriate to only model the surrogate constituents and use the surrogate constituents to determine when each closure alternative will likely achieve the GWPSs for all constituents.

2.2 Part 845 does not require that all constituents listed in Section 845.600 be evaluated in a groundwater model

Part 845 does not require that groundwater models developed in support of the CAA, as required by Section 845.710(d)(2) (IEPA, 2021), evaluate "all constituents listed in Section 845.600 that have been found to be present in the CCR surface impoundment" (IEPA, 2023a, 2023b, 2023c, 2023d). Part 845 requires only that groundwater modeling evaluate "how the closure alternative will achieve compliance with the applicable groundwater protection standards" (IEPA, 2021). There is no language in Part 845 suggesting that the groundwater model must evaluate all constituents that have been detected in an SI.

The surrogate constituents that were selected for evaluation in the groundwater models are the constituents that will likely take the longest under each closure scenario to decline to levels below the GWPS and, thus, are appropriate constituents to determine when each closure alternative will achieve the GWPSs, as required in Section 845.710(d)(2) (IEPA, 2021).

2.3 It would be a costly and data-intensive endeavor to model all constituents, and it wouldn't provide any additional useful information

The process of modeling all constituents in an SI would be costly and data-intensive and, ultimately, would not provide any additional information beyond that provided by only modeling the surrogates for evaluating how the closure alternative will achieve compliance with the GWPS. There are a number of CCR-related constituents that have been identified in literature. For example, Appendix III and IV of the 2015 Federal CCR Rule list 22 CCR-related constituents that must be monitored as part of detection and assessment monitoring (US EPA, 2015). Part 845.600 lists 20 CCR-related constituents for which GWPSs have been established (IEPA, 2021).

Building a groundwater model that evaluates all of these potential constituents would be an onerous process. First of all, an extensive amount of groundwater data and evaluation would be required for each constituent, including an evaluation of background groundwater quality and an evaluation of individual partitioning coefficients for each constituent. Subsequently, individual groundwater solute transport models would be need to be developed and calibrated for each constituent. Finally, separate model simulations would need to be evaluated for each closure alternative and for each constituent. Despite the significantly increased effort, the models would not result in any additional useful information for evaluating closure alternatives.

3 Overview of Groundwater Modeling

US EPA's Guidance on the Development, Evaluation, and Application of Environmental Models (US EPA, 2009) defines a model as "a simplification of reality that is constructed to gain insights into select attributes of a particular physical, biological, economic, or social system." In the case of a groundwater model, the physical system being simulated is the subsurface flow of water and the model is "a simplified representation of the complex hydrogeologic conditions in the subsurface" (Anderson *et al*., 2015). There are a variety of different types of models (NRC, 2007):

- Physical models are usually smaller-scale physical versions of the systems being modeled (*e.g*., using laboratory tanks or columns packed with sand or other porous material) (Anderson *et al*., 2015);
- Conceptual models use visual (*e.g*., schematics, flow-charts) or verbal descriptions of important processes and medium properties (US EPA, 1992);
- Empirical models use "statistical equations derived from the available data to calculate an unknown variable" (Anderson *et al*., 2015); and
- Numerical models, which are the types of models that were used to simulate conditions at the Coffeen Power Plant, the Edwards Power Plant, the Newton Power Plant, and the Hennepin Power Plant, involve mathematical representations of processes that govern physical processes.

Different types of numerical groundwater models are used for different applications. Groundwater flow models simulate flow of groundwater through a transmissive media (*e.g*., soil or bedrock). Examples include hydrologic models used to manage water resources and evaluate water supply, rainfall-runoff models that simulate streamflow generation and routing, and models that simulate groundwater-surface water interactions, *etc*. (Anderson *et al*., 2015). Contaminant fate and transport models simulate movement (or "transport") of contaminants through the subsurface due to advection and dispersion[1], and their chemical alteration (or "fate") due to sorption[2] and other chemical reactions or biological processes (OhioEPA, 2007). Contaminant fate and transport models usually rely upon, and work in coordination with, a calibrated groundwater flow model (OhioEPA, 2007). Contaminant fate and transport models are often used to simulate subsurface contaminant migration from a source (*e.g*., a waste disposal facility or a contaminant release) toward potential downgradient receptors (*e.g*., surface water or groundwater supply well) or to support forensic investigations, (*i.e*., to determine sources and age of contaminants present in groundwater).

"The starting point of every groundwater modeling application is to identify the purpose of the model" (Anderson *et al*., 2015). "The purpose of modeling can vary widely, and the approach used may depend on site-specific needs, current understanding of the hydrogeologic system, availability of input data, and expectation and use of the model results" (OhioEPA, 2007). Numerical groundwater models are often used for two primary purposes – to "diagnose" (*i.e*., to re-create the conditions for a past event); or to "forecast"

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[1] Advection describes contaminant transport in the primary groundwater flow direction. Mechanical dispersion describes the multidirectional movement of constituents due to differences in flow paths along pore channels or other subsurface heterogeneities (Ramaswami *et al*., 2005).

[2] Sorption (chemical interaction between a contaminant and soil particles) leads to a reduction in the average travel velocity of a contaminant relative to groundwater (Ramaswami *et al*., 2005). The effects of sorption can be quantified using a soil-water partition coefficient, or K_d, which is the constituent concentration that is sorbed to soil particles divided by the concentration that is freely dissolved in groundwater.

(*i.e.*, to predict the effect of a future events) (US EPA, 2009; Anderson *et al*., 2015). Some examples of groundwater modeling objectives (OhioEPA, 2007; US EPA, 1992) are listed below:

- evaluation of groundwater flow direction and velocity;
- evaluation of interaction between hydrogeologic systems;
- evaluation of potential impacts of contamination to wells or surface water;
- estimation of the extent of a contaminant plume;
- estimation of well capture zones and wellhead protection areas;
- development of water supply systems;
- evaluation of physical or hydraulic containment systems; and
- design and assessment of corrective action alternatives.

"The objectives dictate which features of the investigated problem should be represented in the model, and to what degree of accuracy" (US EPA, 1992). Thus, the modeling objective determines the level of complexity required in the model.

US EPA's guidance specifically states that "models are based on simplifying assumptions and cannot completely replicate the complexity inherent in environmental systems" (US EPA, 2009). Different simplifying assumptions can be made in a model based on the model objectives and availability of data. As noted in US EPA's guidance, "[t]he scope (*i.e.*, spatial, temporal and process detail) of models that can be used for a particular application can range from very simple to very complex depending on the problem specification and data availability, among other factors." (US EPA, 2009). Generally, "parsimony (economy or simplicity of assumptions) is desirable in a model" because "model complexity influences uncertainty" (US EPA, 2009). As discussed further in US EPA's guidance, "[m]odels tend to uncertainty as they become increasingly simple or increasingly complex. Thus complexity is an important parameter to consider… [and] the optimal choice generally is a model that is no more complicated than necessary" (US EPA, 2009).

Common simplifications made in a model relate to "the geometry of the investigated domain, the way various heterogeneities [are] smoothed out, the nature of the porous medium (*e.g.*, its homogeneity, isotropy)[3]," as well as the physical and chemical processes being simulated, and the number of constituents considered (US EPA, 1992). Some examples of simplifications that can be made in a model are listed below:

- Numerical models can either be transient (time-varying) or steady state (time-invariant). Steady state models assume that groundwater levels and/or constituent concentrations remain approximately constant over time, whereas transient models account for changing hydraulic or chemical conditions over time (Ramaswami *et al*., 2005). Steady state conditions are often assumed in models if the model is being used to represent average, long-term conditions.
- Models can be one-, two-, or three-dimensional depending "on the purpose of the model, the complexity of the hydrostratigraphy, and the flow system" (Anderson *et al*., 2015).

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[3] A porous medium is called homogeneous when its properties are constant throughout the medium. A porous medium is called isotropic if its properties are the same in all directions.

- Homogeneous and isotropic conditions are often used in groundwater models (*i.e.*, aquifer properties are assumed to be constant throughout the aquifer and in all directions, respectively).
- The number of chemical constituents modeled can be limited depending on the model objective. For example, a model application discussed in US EPA's Ground-Water Modeling Compendium (US EPA, 1994) modeled chloride to determine the maximum extent of contamination in the aquifer because chloride "is most mobile and non-retarded" and "its plume would represent the outermost limits of the plumes of the other contaminants of interest."

4 Summary of Site-Specific Groundwater Modeling for Closure Alternatives Analysis

Part 845 (IEPA, 2021) requires the development of a CAA (Section 845.710) prior to undertaking closure activities at certain SIs that contain CCRs. One specific requirement of the CAA [845.710(d)(2)] is that the time to achieve GWPSs must be evaluated for each closure alternative:

> The analysis for each alternative completed pursuant to this Section must… contain the results of groundwater contaminant transport modeling and calculations showing how the closure alternative will achieve compliance with the applicable groundwater protection standards (IEPA, 2021)

In response to this requirement, Ramboll developed groundwater flow and contaminant transport models at selected facilities (Ramboll, 2022a, 2022b, 2022c, 2022d, 2022e) to evaluate the duration required for each closure alternative to achieve the GWPSs.

The three models used by Ramboll for groundwater modeling at these sites (HELP, MODFLOW, and MT3DMS) are widely used, industry-standard models. Brief descriptions of the three models are provided below:

- Hydrologic evaluation of landfill performance (HELP) is a model developed by US EPA that simulates "water movement across, into, through and out of landfills" and "is useful for predicting the amounts of runoff, drainage, and … the buildup of leachate above the [landfill] liner" (Schroeder *et al*., 1994).
- MODFLOW is a finite difference groundwater flow model developed by USGS (Harbaugh, 2005). It is used to simulate two- or three-dimensional, "transient ground-water flow in anisotropic, heterogeneous, layered aquifer systems. It calculates piezometric head distributions, flow rates and water balances" (US EPA, 1994).
- MT3DMS is a contaminant transport model and an update to the modular three-dimensional transport model, MT3D (Zheng and Wang, 1999). MT3DMS simulates changes in contaminant concentrations in groundwater due to "advection, dispersion, diffusion and some basic chemical reactions" (Zheng and Wang, 1999).

A summary of each of these site-specific groundwater models is provided below.

4.1 Ash Pond 1 at the Coffeen Power Plant

The Coffeen Power Plant is a retired electric power generating facility operated by IPGC with coal-fired units located approximately two miles south of the City of Coffeen, Illinois. The plant operated as a coal-fired power plant from 1964 until November 2019 and has five CCR management units. AP1 is a 23-acre, unlined SI with a total storage capacity of 300 acre-feet that was used to manage CCR and non-CCR waste streams (Ramboll, 2022a; Gradient, 2022e).

Based on groundwater monitoring data collected between 2015 and 2021, potential GWPS exceedances of boron, sulfate, and total dissolved solids (TDS) were identified at groundwater monitoring wells near and downgradient of AP1 (Ramboll, 2022a)[4,5]. For boron, sulfate, and TDS, the maximum detected concentrations (based on data collected between 2015 and 2021 from 17 wells near and downgradient of AP1) were 7.5 mg/L, 2,400 mg/L, and 4,000 mg/L, respectively (Gradient, 2022e). Sulfate was the constituent detected at the highest concentration relative to its GWPS.

Ramboll prepared a groundwater modeling report (Ramboll, 2022a) for AP1 that was submitted to IEPA as part of the Construction Permit Application (Golder Associates USA Inc., 2022a). The objective of the groundwater modeling was "to evaluate the effects of closure (source control measures) for AP1 on groundwater quality," and, specifically, to predict the time to meet GWPS in the compliance wells under two proposed closure scenarios – closure in place (CIP) and closure by removal (CBR) (Ramboll, 2022a). The CIP scenario considered would involve "removal of CCR from the eastern portion of AP1, consolidation into the western portion of AP1, and construction of a cover system over the remaining CCR," whereas CBR would involve "removal of all CCR and regrading of the removal area" (Ramboll, 2022a).

Ramboll's modeling approach involved using the HELP model to estimate recharge under the different closure scenarios, using MODFLOW 2005 to simulate groundwater flow in three dimensions, and using MT3DMS model to simulate the three-dimensional transport of sulfate (Ramboll, 2022a). "Sulfate was selected for transport modeling … because: (i) it is commonly present in coal ash leachate; and (ii) it is mobile and typically not very reactive but conservative (*i.e.*, low rates of sorption or degradation) in groundwater" (Ramboll, 2022a). Sulfate was modeled as a conservative substance that does "not significantly sorb or chemically react with aquifer solids (distribution coefficient [Kd] was set to 0 milliliters per gram [mL/g])" (Ramboll, 2022a).

4.2 GMF Gypsum Stack Pond and Recycle Pond at the Coffeen Power Plant

The GMF GSP and the GMF RP at the Coffeen Power Plant were put in operation in 2010 and were used to manage CCR and non-CCR waste streams. The GMF GSP is a 77-acre lined SI and the GMF RP is a 17-acre lined SI (Ramboll 2022b; Gradient, 2022f).

Based on groundwater monitoring data collected between 2015 and 2021, potential GWPS exceedances of boron, sulfate, and TDS were identified at groundwater monitoring wells near and downgradient of the GMF GSP and the GMF RP (Ramboll, 2022b)[6]. The maximum detected concentrations (based on data collected between 2015 and 2021 from 43 wells near and downgradient of the GMF GSP and the GMF RP) for boron, sulfate, and TDS were 4.6 mg/L, 1,800 mg/L, and 3,400 mg/L, respectively (Gradient, 2022f). Sulfate was the constituent detected at the highest concentration relative to its GWPS.

Ramboll prepared a groundwater modeling report (Ramboll, 2022b) for the GMF GSP and the GMF RP that was submitted to IEPA as part of the Construction Permit Application (Golder Associates USA Inc., 2022b, 2022c). The objective of the groundwater modeling was "to evaluate the effects of closure (source

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[4] Cobalt and pH were also detected in groundwater downgradient of AP1 at concentrations in excess of their respective GWPSs, but investigations provided at the time of modeling concluded that these constituents are not related to AP1 (Ramboll, 2022a).

[5] Due to the conservative nature of the site-specific risk assessment that was conducted at AP1 and the attempt to "screen-in" rather than "screen-out" constituents (Gradient, 2022e), risks were calculated for constituents at concentrations that may not be associated with AP1 and may not have been identified as potential groundwater exceedances, which are based on statistical evaluations of the full dataset rather than single measurements.

[6] Due to the conservative nature of the site-specific risk assessment that was conducted at GMF GSP and GMF RP and the attempt to "screen-in" rather than "screen-out" constituents (Gradient, 2022f), risks were calculated for constituents at concentrations that may not be associated with GMF GSP and GMF RP, and may not have been identified as potential groundwater exceedances, which are based on statistical evaluations of the full dataset rather than single measurements.

control measures) for the GMF GSP and GMF RP on groundwater quality," and, specifically, to predict the time to meet GWPS in the compliance wells under two proposed closure scenarios – CIP and CBR (Ramboll, 2022b). The CIP scenario considered would involve "removal of CCR from the GMF RP and the southern portion of the GSP, consolidation into the northern portion of the GSP, and construction of a cover system over the remaining CCR," whereas CBR would involve "removal of all CCR and SI liner and regrading of the removal area for both GMF GSP and GMF RP" (Ramboll, 2022b).

Ramboll's modeling approach involved using HELP to estimate recharge under the different closure scenarios, using MODFLOW 2005 to simulate groundwater flow in three dimensions, and using MT3DMS to simulate the three-dimensional transport of sulfate (Ramboll, 2022b). "Sulfate was selected for transport modeling … because: (i) it is commonly present in coal ash leachate; and (ii) it is mobile and typically not very reactive but conservative (*i.e.*, low rates of sorption or degradation) in groundwater" (Ramboll, 2022b). Sulfate was modeled as a conservative substance that does "not significantly sorb or chemically react with aquifer solids (distribution coefficient [Kd] was set to 0 milliliters per gram [mL/g])" (Ramboll, 2022b).

4.3 Ash Pond at the Edwards Power Plant

The Edwards Power Plant is a retired electric power generating facility operated by IPRG with coal-fired units located near Bartonville, Illinois. The plant began operations in 1960 and ceased operations in December 2022. The facility has one SI for CCR storage known as the Ash Pond which covers approximately 91 acres (Ramboll, 2022c; Gradient, 2022g).

Based on groundwater monitoring data collected between 2015 and 2021, potential GWPS exceedances of boron, sulfate and TDS were identified at groundwater monitoring wells near and downgradient of the Ash Pond (Ramboll, 2022c)[7,8]. For boron, sulfate, and TDS, the maximum detected concentrations (based on data collected between 2015 and 2021 from 28 wells near and downgradient of the Ash Pond) were 12 mg/L, 570 mg/L and 2,600 mg/L, respectively (Gradient, 2022g). Boron was the constituent detected at the highest concentration relative to its GWPS.

Ramboll prepared a groundwater modeling report (Ramboll, 2022c) for the Ash Pond that was submitted to IEPA as part of the Construction Permit Application (IngenAE, LLC 2022). The objective of the groundwater modeling conducted by Ramboll was to "evaluate the effects of closure (source control) measures (CCR consolidation and CIP and CBR scenarios) for the Ash Pond on groundwater quality following initial corrective action measures, which includes removal of free liquids from the Ash Pond" (Ramboll, 2022c). More specifically, the objective of groundwater modeling was to predict the time to meet GWPS under two proposed closure scenarios – CIP and CBR. The CIP scenario considered would involve "CCR removal from the northwest areas of the Ash Pond, consolidation to the northeast, central and southern areas of the Ash Pond, and construction of a cover system over the remaining CCR" (Ramboll, 2022c).

Ramboll's modeling approach involved using HELP to estimate recharge under the two closure scenarios, using MODFLOW 2005 to simulate groundwater flow in three dimensions and using MT3DMS to simulate the three-dimensional transport of boron (Ramboll, 2022c). "Boron was selected for transport modeling …

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[7] Barium, lithium, and chloride were also detected in groundwater downgradient of the Ash Pond at concentrations in excess of their respective GWPSs, but investigations provided at the time of modeling concluded that these constituents are not related to the Ash Pond (Ramboll, 2022c).

[8] Due to the conservative nature of the site-specific risk assessment that was conducted at the Ash Pond and the attempt to "screen-in" rather than "screen-out" constituents (Gradient, 2022g), risks were calculated for constituents at concentrations that may not be associated with the Ash Pond and may not have been identified as potential groundwater exceedances, which are based on statistical evaluations of the full dataset rather than single measurements.

because: (i) it is commonly present in coal ash leachate; (ii) it is mobile and typically not very reactive but conservative (*i.e.*, low rates of sorption or degradation) in groundwater; and (iii) it is less likely than other constituents to be present in background groundwater from natural or other anthropogenic sources. The only significant source of boron is the Ash Pond" (Ramboll, 2022c). Boron was modeled as a conservative substance that does "not significantly sorb or chemically react with aquifer solids (distribution coefficient [Kd] was set to 0 mL/g)" (Ramboll, 2022c).

4.4 Primary Ash Pond at the Newton Power Plant

The Newton Power Plant is an electric power generating facility operated by IPGC with coal-fired units located near Newton, Illinois. The plant began operating in approximately 1977 and has one SI for CCR storage known as the PAP which covers approximately 404 acres (Ramboll, 2022d; Gradient, 2022h).

Based on groundwater monitoring data collected between 2015 and 2021, potential GWPS exceedances of lithium, sulfate, and TDS were identified at groundwater monitoring wells near and downgradient of the PAP (Ramboll, 2022d)[9,10]. For lithium, sulfate, and TDS, the maximum detected concentrations (based on data collected between 2015 and 2021 from 29 wells near and downgradient of the PAP) were 0.3 mg/L, 3,200 mg/L, and 5,500 mg/L, respectively (Gradient, 2022h). Sulfate was the constituent detected at the highest concentration relative to its GWPS.

Ramboll prepared a groundwater modeling report (Ramboll, 2022d) for the PAP that was submitted to IEPA as part of the Construction Permit Application (HDR Inc., 2022). The objective of the groundwater modeling conducted by Ramboll was "to evaluate the effects of Closure (source control measures) for the PAP on groundwater quality," and specifically, to predict the time to meet GWPS in the compliance wells under two proposed closure scenarios – CIP and CBR (Ramboll, 2022d). The CIP scenario considered would involve "removal of CCR from the southern portion of the PAP, consolidation into the northern portion of the PAP, and construction of a cover system over the remaining CCR," whereas CBR would involve "removal of all CCR and regrading of the removal area" (Ramboll, 2022d).

Ramboll's modeling approach involved using HELP to estimate recharge under the different closure scenarios, using MODFLOW 2005 to simulate groundwater flow in three dimensions, and using MT3DMS to simulate the three-dimensional transport of sulfate (Ramboll, 2022d). "Sulfate was selected for transport modeling … because: (i) it is commonly present in coal ash leachate; and (ii) it is mobile and typically not very reactive but conservative (*i.e.*, low rates of sorption or degradation) in groundwater" (Ramboll, 2022d). Sulfate was modeled as a conservative substance that does "not significantly sorb or chemically react with aquifer solids (distribution coefficient [Kd] was set to 0 milliliters per gram [mL/g])" (Ramboll, 2022d).

4.5 East Ash Pond at the Hennepin Power Plant

The Hennepin Power Plant is a retired electric power generating facility operated by DMG with coal-fired units located in Hennepin, Illinois. The plant began operations in the early 1950s and was retired in 2019.

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[9] pH was also detected in groundwater downgradient of the PAP outside of its acceptable range, but investigations provided at the time of modeling concluded that pH impacts to groundwater are not related to the PAP (Ramboll 2022d).

[10] Due to the conservative nature of the site-specific risk assessment that was conducted at the PAP and the attempt to "screen-in" rather than "screen-out" constituents (Gradient, 2022h), risks were calculated for constituents at concentrations that may not be associated with the PAP and may not have been identified as potential groundwater exceedances, which are based on statistical evaluations of the full dataset rather than single measurements.

CCRs associated with plant operation were stored in several ponds including the EAP, which covers approximately 21 acres (Ramboll, 2022e; Gradient, 2021b).

Based on groundwater monitoring data collected between 2015 and 2021 at 13 wells near and downgradient of the EAP, no potential GWPS exceedances attributable to the EAP were identified (Ramboll, 2022e; Gradient, 2021b)[11]. Ramboll prepared a groundwater modeling report (Ramboll, 2022e) for the EAP that was submitted to IEPA as part of the Construction Permit Application (Geosyntec Consultants, 2022). The objective of the groundwater modeling conducted by Ramboll was "to simulate future conditions and groundwater concentrations of boron for proposed closure alternatives for the EAP. Boron was selected for modeling because it is one of the most common and mobile CCR-related constituents. A total of three scenarios were simulated: no action, EAP CIP, and EAP CBR" (Ramboll, 2022e). The no action scenario assumed "no closure at the EAP (current conditions retained)" (Ramboll, 2022e). Under the CIP scenario, the EAP was assumed to "be graded and covered with a geomembrane and soil layers," whereas the CBR scenario assumed that "CCR materials from the EAP will be removed" and "[t]he existing liner system and 1 foot of material beneath the side slope and bottom liner will be excavated" (Ramboll, 2022e). The three scenarios also assumed closure of the Coal Combustion Waste Landfill, which is located adjacent to and north of the EAP (Ramboll, 2022e).

Ramboll's modeling approach involved using HELP to estimate recharge under the different closure scenarios, using MODFLOW to simulate groundwater flow in three dimensions and using MT3DMS to simulate the three-dimensional transport of boron (Ramboll, 2022e). "Boron was selected for groundwater transport modeling … because: (i) it is commonly present in coal ash leachate; (ii) it is mobile and typically not very reactive but conservative (*i.e.*, low rates of sorption or degradation) in groundwater; and (iii) it is less likely than other constituents to be present in background groundwater from natural or other anthropogenic sources" (Ramboll, 2022e). Boron was modeled as a conservative substance that "minimally adsorbs and does not decay, and mixing and dispersion are the primary attenuation mechanisms in groundwater" (Ramboll, 2022e).

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[11] Due to the conservative nature of the site-specific risk assessment that was conducted at the EAP and the attempt to "screen-in" rather than "screen-out" constituents (Gradient, 2021b), risks were calculated for constituents at concentrations that may not be associated with the EAP and may not have been identified as potential groundwater exceedances, which are based on statistical evaluations of the full dataset rather than single measurements.

5 Modeling surrogate constituents is an appropriate approach to achieve model objectives in support of the CAA.

All environmental models are, in some regard, simplifications of complex systems, and it is common to make simplifications to models based on the model objectives. Using one or more surrogate constituents to represent the potential behavior of a larger group of constituents, with the surrogate constituents selected in accordance with the model objectives, is a simplification that is commonly made in environmental models.

For the groundwater modeling performed in support of the CAAs at AP1, the GMF GSP, and the GMF RP at the Coffeen Power Plant, the Ash Pond at the Edwards Power Plant, the PAP at the Newton Power Plant, and the EAP at the Hennepin Power Plant, the model objectives were to evaluate the effects of various closure alternatives on groundwater quality and to specifically predict the time at which GWPSs will be achieved for each closure alternative. For each of these SIs, the constituent with the highest concentration relative to its GWPS (*i.e.*, "Exceedance Ratio"; Table 5.1) was selected for transport modeling because it will likely be the constituent that takes the longest time to achieve its GWPS. It is not necessary to model other constituents that have been detected at lower concentrations relative to their GWPSs because these constituents will likely achieve their GWPSs faster than the surrogate constituent. Thus, the approach of modeling the constituent with the highest concentration relative to its GWPS is reasonable and sufficient to achieve the model objectives.

Table 5.1 Summary of Potential GWPS Exceedances at Downgradient Monitoring Wells Between 2015 and 2021

Constituents with a Detected Potential GWPS Exceedance	Maximum Detected Concentration (mg/L)	GWPS (mg/L)	Exceedance Ratio	Surrogate Constituent (Modeled in Support of CAA)
Coffeen Ash Pond 1				
Boron	7.5	2	3.8	Sulfate
Sulfate	2,400	400	**6.0**	
TDS	4,000	1,200	3.3	
Coffeen GMF Gypsum Stack Pond and Recycle Pond				
Boron	4.6	2	2.3	Sulfate
Sulfate	1,800	400	**4.5**	
TDS	3,400	1,200	2.8	
Edwards Ash Pond				
Boron	12	2	**6.0**	Boron
Sulfate	570	400	1.4	
TDS	2,600	1,200	2.2	
Newton Primary Ash Pond				
Lithium	0.3	0.04	7.5	Sulfate
Sulfate	3,200	400	**8.0**	
TDS	5,500	1,200	4.6	

Constituents with a Detected Potential GWPS Exceedance	Maximum Detected Concentration (mg/L)	GWPS (mg/L)	Exceedance Ratio	Surrogate Constituent (Modeled in Support of CAA)
Hennepin East Ash Pond				
Boron[a]	1.41	2	0.7	Boron

Notes:

Sources: Ramboll (2022a, 2022b, 2022c, 2022d, 2022e); Gradient (2022e, 2022f, 2022g, 2022h, 2021b).

CAA = Closure Alternatives Analysis; CCR = Coal Combustion Residual; GMF = Gypsum Management Facility; GWPS = Groundwater Protection Standards; TDS = Total Dissolved Solids.

(a) No GWPS exceedances were identified for the Hennepin East Ash Pond but Boron was selected as the constituent for transport modeling because boron is one of the most common and mobile CCR-related constituents (Ramboll, 2022e).

Model surrogate constituent selection also considered the number of locations where a GWPS was exceeded and the size of each constituent's footprint in groundwater. In general, constituents with the highest frequency of GWPS exceedances correlated with constituents that were detected at the highest concentrations relative to their GWPSs. Thus, the approach of modeling the constituent with the highest concentration relative to its GWPS is reasonable and sufficient to achieve the model objectives.

Based on this approach, the following constituents were selected as the surrogate constituents to be evaluated in the groundwater model:

- sulfate at the AP1 at the Coffeen Power Plant;
- sulfate at the GMF GSP, and the GMF RP at the Coffeen Power Plant;
- boron at the Ash Pond at the Edwards Power Plant;
- sulfate at the PAP at the Newton Power Plant; and
- boron at the EAP at the Hennepin Power Plant.

Moreover, the other constituents with potential GWPS exceedances that have been identified – boron and TDS at AP1, the GMF GSP, and the GMF RP at the Coffeen Power Plant; sulfate and TDS at the Ash Pond at the Edwards Power Plant; and lithium and TDS at the PAP at the Newton Power Plant (Table 5.1) – have similar groundwater transport characteristics to the selected surrogate constituents. Specifically, the surrogate constituents have a similar propensity to sorb to soils as the other constituents with potentially identified GWPS exceedances (*i.e.*, all constituents have relatively small values of K_d; Table 5.2); therefore, subsurface transport during closure conditions would be similar for all of the constituents that have been detected with potential GWPS exceedances. Because each of these constituents is expected to behave in a similar manner during closure, it is appropriate to only model the surrogate constituents and use the surrogate constituents to determine when each closure alternative will achieve the GWPSs for all constituents.

Table 5.2 Soil-Water Partition Coefficient (K_d) for Constituents with GWPS Exceedances

Chemical Constituent	Soil-Water Partition Coefficient, K_d (L/kg)
Boron[a]	1.1×10^{-5}
Lithium[b]	0
Sulfate[c]	0
TDS[c]	0

Notes:

GWPS = Groundwater Protection Standards; TDS = Total Dissolved Solids; US EPA = United States Environmental Protection Agency.

(a) US EPA (2014) reported select percentiles of chemical-specific K_d values for SIs containing combined ash. The 50th percentile value of K_d in saturated zone is used here.

(b) US EPA (2014) noted that "lithium does adsorb weakly to clay soils" but "sufficient information was not available to develop chemical-specific K_d values for lithium," and a K_d of 0 was used "to estimate lithium fate and transport".

(c) Ions such as "[c]alcium, magnesium, sodium, potassium, bicarbonate, sulfate, chloride, nitrate, and silica typically make up most of the dissolved solids in water" (USGS, 2014). These ions do not significantly sorb to soil and their K_d is generally assumed to be zero. For example, US EPA (2014) used a K_d of 0 for chloride.

6 Part 845 does not require that all constituents listed in Section 845.600 be evaluated in CAA models.

In its Initial Review Letters, IEPA raised concerns regarding the sufficiency of only modeling selected constituents at each facility by noting that "[t]he Agency requires all constituents listed in Section 845.600 that have been found to be present in the CCR surface impoundment to be assessed in the groundwater model" (IEPA, 2023a, 2023b, 2023c, 2023d; emphasis added). However, there is no language in Part 845 suggesting that the groundwater model must evaluate all constituents that have been detected in an SI. Part 845 requires only that groundwater modeling evaluate "how the closure alternative will achieve compliance with the applicable groundwater protection standards" for each closure alternative (Section 845.710(d)(2) in IEPA, 2021).

The surrogate constituents that were selected for evaluation in the groundwater model for each SI are the constituents that will likely take the longest time to achieve their GWPS and, thus, are appropriate choices to achieve the CAA modeling objectives and to fulfill the requirements of Section 845.710(d)(2) (IEPA, 2021). All of the other constituents that have been detected in the SI are either already at levels below their respective GWPSs or will likely achieve their GWPSs faster than the surrogate constituent. Therefore, for each SI, the groundwater modeling performed by Ramboll predicted the time at which all of the constituents will likely have achieved compliance with the GWPSs for each closure alternative (*i.e.*, the time at which each closure alternative will achieve compliance with GWPSs), thereby satisfying Part 845 requirements.

7 It would be a costly and data-intensive endeavor to model all constituents, and it would not provide any additional useful information.

A number of CCR-related constituents have been identified in literature. For example, Part 845.600 lists 20 CCR-related constituents for which GWPSs have been established (IEPA, 2021) and Appendix III and IV of the 2015 Federal CCR Rule list 22 CCR-related constituents that must be monitored as part of detection and assessment monitoring (US EPA, 2015). The process of modeling all of these constituents would be significantly more data-intensive and costly than the process of modeling a single constituent.

Building a groundwater model that evaluates the time to achieve GWPSs for all constituents detected in an SI would involve collection of a large amount of data for each constituent (*e.g.*, to evaluate background groundwater quality, to determine whether observed concentrations are related to the SI or to an alternative source, to evaluate individual partitioning coefficients, *etc*.). Subsequently, individual groundwater solute transport models would need to be developed and calibrated for each constituent, and separate model simulations would need to be performed for each closure alternative with each constituent. The overall effort will likely scale with the number of constituents being considered (*i.e.*, the effort will be 20 times higher if 20 constituents are being evaluated instead of one), and the process would be onerous.

Despite the significantly increased effort, the models would not result in any additional useful information for meeting the CAA objectives that could not be obtained by modeling just the surrogate constituent. The predicted time to achieve GWPSs will likely be the longest for the constituent detected at the highest concentration relative to its GWPS (*i.e.*, the surrogate constituent) as the other constituents will either already be present at levels below their GWPSs or will likely achieve their GWPSs faster than the surrogate constituent. Thus, the additional information obtained from modeling all constituents (*i.e.*, the predicted time to achieve GWPSs for each constituent) will likely not affect the time at which all the constituents achieve compliance with the GWPSs for each closure alternative, which is the primary objective of the groundwater modeling performed in support of the CAA.

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Gradient. 2021b. "Human Health and Ecological Risk Assessment, East Ash Pond, Hennepin Power Plant, Hennepin, Illinois (Draft)." 46p., November 8.

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Appendix A

Curriculum Vitae and Testimony History of Andrew Bittner, M.Eng., P.E.

Andrew B. Bittner, M.Eng., P.E.
Principal
(he/him)

abittner@gradientcorp.com

Areas of Expertise

Contaminant fate and transport in porous and fractured media, migration of coal ash combustion products in groundwater and surface water, non-aqueous phase liquid (NAPL) transport, surface water and groundwater hydrology, groundwater and surface water modeling, remedial investigation design, remedy evaluation and optimization, cost allocation, international regulatory compliance and remediation.

Education & Certifications

M.Eng., Environmental Engineering and Water Resources, Massachusetts Institute of Technology, 2000

B.S.E., Environmental Engineering, University of Michigan, 1997

B.S., Physics, University of Michigan, 1997

Licensed Professional Engineer: Idaho, New Hampshire

Professional Experience

2000 – Present GRADIENT, Boston, MA
Environmental Engineer. Specializes in the fate and transport of contaminants in groundwater and surface water, coal combustion products, groundwater hydrology, groundwater flow and contaminant transport modeling, NAPL transport, and remedial investigation and design. Has served as principal-in-charge, testifying expert, and consulting expert on large, multi-disciplinary projects at coal combustion product surface impoundments and landfills, pharmaceutical facilities, automotive facilities, manufacturing plants, dry cleaning facilities, and Superfund sites. Extensive experience in South America and at other international sites.

1997 – 1999 PARSONS ENGINEERING SCIENCE, Canton, MA
Environmental Engineer. Specialized in industrial wastewater treatability. On-site supervisor for bioremediation bench scale treatment and laboratory study for a major pharmaceutical company. Built hydraulic models for pharmaceutical wastewater treatment facilities. Designed hazardous waste treatment systems for a major pharmaceutical company. Performed site investigations to delineate NAPL plumes and design remedial recovery plans.

12/7/2022

Professional Affiliations

National Ground Water Association; Chi Epsilon – Environmental Engineering Honor Society

Technical Session Chair:

- World of Coal Ash Conference. Lexington, KY. May 8-11, 2017. Session title: "Groundwater."
- Battelle Conference on Remediation of Chlorinated and Recalcitrant Compounds. Palm Springs, CA. May 23-26, 2016. Session title: "Coal Ash Facility Restoration".
- Battelle Conference on Remediation of Chlorinated and Recalcitrant Compounds. Monterey, CA. May 21-24, 2012. Session title: "Environmental Remediation in Emerging Markets."
- Defense Research Institute. Panelist for session titled "Groundwater-Surface Water Connectivity and the Clean Water Act." New Orleans, LA. May 13-14, 2019.
- World of Coal Ash Conference. St. Louis, MO. May 13-16, 2019. Session title: "Project-Specific Case Studies."
- World of Coal Ash Conference. Covington, KY. May 16-19, 2022. Session title: "Regulatory."

Projects – *Coal Combustion Products*

Electric Power Research Institute: Modeled groundwater impacts from coal combustion product (CCP) surface impoundments with intersecting groundwater conditions and evaluated hydrogeological factors and other characteristics that influence risks to human health and the environment (HHE).

Utility Client: Served as litigation consulting expert regarding the fate and transport of metal constituents in groundwater from 18 different coal combustion residual (CCR) disposal facilities at 7 sites in the Midwest.

Utility Client: Prepared expert report and provided testimony related to the fate and transport of metal constituents in groundwater from 11 different coal combustion residual (CCR) disposal facilities at 6 sites in West Virginia, Virginia, and Ohio.

Utility Client: Prepared expert report in support of "Petition for a Finding of Inapplicability or, in the Alternative, an Adjusted Standard from 35 ILL. Admin. Code Part 845". Report assessed current risks to human and environmental receptors and evaluated net environmental benefits (*i.e.*, NEBA) of potential closure options at a former CCR disposal facility.

Utility Client: Prepared Closure Alternatives Assessment (CAA), Corrective Measures Assessment (CMA), and Corrective Action Alternatives Analysis (CAAA) for multiple CCR surface impoundments located at a series of Midwestern power plants. Reports were prepared consistent with requirements of 35 ILL. Admin. Code Part 845.

Utility Client: Evaluated risks to human health and the environment associated with CCR surface impoundments at six coal fired power plants in the Southern US. Evaluations included assessing CCR constituent migration in groundwater and the flux of constituents into nearby surface waters.

Utility Client: Calculated alternative groundwater protection standards (GWPSs) at a coal fired power plant facility in the Midwestern US. Alternative standards were calculated based on site-specific human and ecological receptors and attenuation factors.

Utility Client: Prepared expert report and testified before state pollution control board regarding proposed coal ash disposal regulations.

Electric Power Research Institute: Evaluated the performance of alternative liners, including engineered clay liners, natural clay liners, and geomembrane composite-lined systems at CCP impoundments. Used a probabilistic approach to model the flux of CCP constituents through each liner and the subsequent transport of constituents through the underlying vadose and saturated zone.

Industry Research Group: Developed methodology to evaluate performance equivalency of various surface impoundment liner systems. The methodology, which was submitted to US EPA in order to inform future rulemakings, presented a process to evaluate and compare hydraulic flux and travel times through different liner systems including geocomposite, compacted clay, and natural clay liners.

Confidential Client: Developed a screening level risk assessment for a manufacturing facility beneficially using coal fly ash as a soil stabilizer. The risk assessment compared estimated coal ash constituent exposure concentrations in soil, groundwater, and surface water to relevant benchmarks protective of human health and the environment.

Manufacturing Client: Performed beneficial use risk assessments consistent with US EPA Federal Coal Combustion Residual (CCR) Rule and Secondary Use Guidance for multiple commercial and construction products containing coal ash – including carpet backing, interior and exterior trim, and backer board. Analysis evaluated risks to groundwater, surface water, indoor air, and soil. Evaluation also considered exposure pathways for residents, construction workers, and landfill workers associated with installation of products, active life of the installed products, and post-life disposal in a landfill.

Electric Power Research Institute: Developed framework for creating alternative groundwater standards at CCP storage sites. The framework considers the development of alternative standards for the protection of human health and the environment, current and future uses of groundwater near CCP management units, and potential attenuation that may occur between the current point of compliance and a relevant point of exposure.

Utility Client: Prepared expert report and provided testimony related to the fate and transport of metal constituents in groundwater, including sulfate, boron, and arsenic, from over 30 different coal combustion residual surface impoundments at 15 sites in North Carolina and South Carolina.

Industry Research Group: Prepared technical comments regarding proposal to add boron to list of Appendix IV constituents to the Federal CCR Rule. Evaluated technical practicability and cost implications associated with the potential boron addition.

Industry Research Group: Prepared technical comments regarding portion of Federal CCR Rule that requires the groundwater protection standard (GWPS) of Appendix IV constituents with no MCL to be the background concentration. Evaluated technical practicability, cost implications, and potential benefits associated with the requirement for the four current Appendix IV constituents with no established MCL - cobalt, lithium, molybdenum, and lead.

Confidential Client: Developed a screening level risk assessment for a steel production and recycling facility that is beneficially using coal fly ash as a soil stabilizer. The risk assessment addressed a requirement in the Federal Coal Combustion Residuals (CCR) Disposal Rule for a characterization of risk from unencapsulated beneficial use of CCR. Used the Industrial Waste Evaluation Model (IWEM) to evaluate potential transport of coal ash constituents, including arsenic, in groundwater as a result of the beneficial reuse.

Utility Client: Prepared expert report interpreting data produced during a field investigation performed at a large Midwestern coal ash landfill.

Utility Client: For litigation support, modeled the fate and transport of arsenic and other coal ash related constituents in groundwater and surface water downgradient of a large Midwestern coal ash surface impoundment located in a karst environment. Model simulations compared potential impacts to groundwater and surface water resulting from potential surface impoundment closure scenarios.

Manufacturing Client: Performed beneficial use risk assessments consistent with US EPA Federal Coal Combustion Residual (CCR) Rule and Secondary Use Guidance for multiple commercial and construction products containing coal ash. Analysis evaluated risks to groundwater, surface water, indoor air, worker safety, and residential safety. Evaluation also considered exposure pathways associated with installation of products, active life of the installed products, and post-life disposal in a landfill. Used the Industrial Waste Evaluation Model (IWEM) to evaluate potential transport of coal ash constituents, including arsenic, in groundwater as a result of the beneficial reuse.

Industry Research Group: Developed a groundwater fate and transport model to evaluate the level of groundwater protection provided by various coal ash surface impoundment closure options, including closure in place and closure by removal. Model simulated transport of arsenic (III) and arsenic (V) in groundwater downgradient of coal ash disposal facilities. Model results are being used by utilities in support of closure planning which is required by Federal Coal Combustion Residual Rule.

Confidential Client: Prepared expert report on human health and ecological risks due to a potential spill of barged coal combustion byproducts (CCBs) on a large Midwestern river. Modeled the fate and transport of key CCB constituents, including arsenic, in surface water for a range of spill scenarios and river flow conditions and estimated potential downstream concentrations at drinking water intake locations.

Industry Research Group: Evaluated technical approach used by United States Environmental Protection Agency (US EPA) to simulate the migration of arsenic, selenium, and other metals in groundwater from overlying coal combustion storage units. Model analyses were included in regulatory comments submitted in response to US EPA's 2010 Coal Combustion Product Risk Assessment.

Industry Research Group: Developed relative risk framework to assess impacts to groundwater associated coal combustion product (CCP) surface impoundment closure scenarios. Framework identified potential deterministic and probabilistic modeling approaches to simulate potential migration of CCP constituents, including arsenic, boron, selenium, and molybdenum through the vadose and saturated zones for each closure alternative.

Industry Research Group: Modeled the downward migration of leachate from unlined coal combustion product surface impoundments using a probabilistic framework for a wide range of climatic and site conditions. Model results provided estimated durations for interactions between the impoundment leachate and nearby surface and groundwater.

Industry Research Group: As part of a relative risk framework, performed detailed sensitivity analysis of all factors associated with a coal ash surface impoundment closure that may impact the fate and transport of constituents in groundwater. Factors analyzed included surface impoundment characteristics (*e.g.*, volume, depth, and leachate quality), hydrogeological conditions (*e.g.*, hydraulic conductivity, hydraulic gradient, soil type, depth to groundwater, and surface water proximity), climatic characteristics (*e.g.*, precipitation), and closure details (*e.g.*, closure type and duration).

Projects – *Fate & Transport and Modeling*

Manufacturing Client: Consulting expert for a class certification case. Evaluated PFAS transport from known and potential sources.

Natural Gas Processing Facility: Prepared an expert report evaluating the hydrogeological conditions at and downgradient of a natural gas processing plant and provided assessment of the fate and transport over time of light non-aqueous phase liquids (LNAPLs) released from the plant and associated pipelines.

Confidential Client, Rhode Island: Designed and calibrated a groundwater flow and solute transport model for multiple chlorinated organic constituents at a Northeastern Superfund Site. Used one year long tracer test to calibrate model. Model was used to predict the future effectiveness of various remedial alternatives.

Confidential Client: Designed and calibrated a groundwater flow and solute transport model for a Superfund site that has groundwater impacted with volatile organic compounds including benzene, tetrachloroethylene, trichloroethylene, and vinyl chloride. The model was used successfully to present the case to US EPA for shutting down the source remedy.

Confidential Client, Brazil: Developed 3-D numerical groundwater and solute transport model using MODFLOW and MT3D for volatile organic compounds and pesticides. Used model to evaluate and design remediation alternatives. Managed multiple site investigation and characterization studies. Projects involved calculation of risks to human health from exposure to soils, groundwater, indoor air, and outdoor air.

Savage Well Superfund Site: For a potentially responsible party (PRP) group, managed the development of a 3-D numerical groundwater and solute transport model for tetrachloroethylene (PCE) at a Superfund site in New Hampshire. Calibrated the model using approximately 10 years of data with review and oversight by US EPA and United States Geological Survey (USGS). Designed an optimization algorithm to develop the optimal groundwater pump and treat system.

Confidential Client, Massachusetts: Developed a 2-D contaminant transport model for PCE to demonstrate that contaminant contribution from a dry cleaning operation to the town water supply wells was insignificant compared to contribution from other potential sources. Managed the installation and operation of a pump and treat system at the Site.

Confidential Client, Argentina: Developed a 2-D numerical groundwater and solute transport model using MODFLOW and MT3D. Used the calibrated model to design a hydraulic barrier system to control off-site migration.

Confidential Client: Performed site-specific vapor intrusion modeling using the Johnson-Ettinger model at a pharmaceutical facility. Performed a detailed sensitivity analysis for each model input parameter.

Confidential Client: Performed NAPL transport and travel time calculations through porous media vadose and saturated zones and clay confining layers.

Confidential Client: Wrote critique of US EPA geochemistry model.

Projects – *Remediation*

Confidential Client: Evaluated potential liabilities related to range of issues including waste surface impoundment closure, groundwater remediation, and regulatory compliance at sites around the world that were involved in a corporate transaction.

Manufacturing Client, New Hampshire: Served as consulting expert for a case related to a failed groundwater remedy. Evaluated remedy design and installation and performed probabilistic modeling to determine appropriate design factors.

PRP Group, Nevada: Provided hydrogeological support at an industrial site with groundwater impacts due to benzene, chlorobenzene, chloroform, perchlorate, and chromium. Evaluated and critiqued a Remedial Investigation (RI) Report related to a neighboring property and developed a conceptual site model (CSM) describing the fate and transport mechanisms of constituents in groundwater. Prepared submittals and presented conclusions at meetings with the State Environmental Agency.

Confidential Client, Brazil: Designed and implemented nano-scale zero valent iron remedy to prevent off-site arsenic migration. Upon completion of remedy, negotiated site closure with state of Rio de Janeiro environmental agency.

Confidential Client, Brazil: Designed and implemented a pilot scale enhanced *in-situ* bioremediation remedy for groundwater impacted with chlorinated organic compounds at a former agricultural product manufacturing facility.

Confidential Client, New Hampshire: As an independent third party, performed a review of a proposed Electrical Resistive Heating remedy for a chlorinated solvent dense non-aqueous phase liquid (DNAPL) source zone.

Confidential Client, New York: Provided regulatory comments regarding a US EPA Proposed Remedial Action Plan at a Region II Superfund Site on Long Island. Provided support during mediation and during negotiations with US EPA.

Confidential Client, New Jersey: Provided regulatory comments regarding a US EPA Proposed National Priorities List (NPL) listing at a Region II Superfund Site.

Confidential Client, Brazil: Managed multiple conceptual and detailed engineering remedial design projects for a soil vapor extraction system, dual-phase extraction system, and a pump and treat system. Remediation efforts focused on soil and groundwater contamination by pesticides and chlorinated solvents.

Confidential Client, Brazil: Managed site remediation projects to operate and maintain a soil vapor extraction system, dual-phase extraction system, and a hydraulic barrier system.

Confidential Client, Argentina: Managed conceptual and detailed engineering remedial design project for dual-phase extraction system focused on the remediation of volatile organic compounds in soil and groundwater.

Confidential Client: On-site supervisor for bioreactor bench scale study at a pharmaceutical wastewater treatment plant. Performed an in-depth investigation on the bio-inhibitory effects due to the chronic exposure of biomass to manganese. Performed laboratory work required to support the bioreactors including tests for mixed liquor volatile suspended solids (MLVSS), total suspended solids (TSS), chemical oxygen demand (COD), dissolved oxygen (DO), ammonia (NH_3), and respirometry.

Confidential Client: Lead environmental engineer for a belt filter press replacement project for a pharmaceutical company wastewater treatment plant. Designed and sized polymer addition system.

Projects – *Site Characterization*

Confidential Client, Brazil: Provided strategic oversight for a series of environmental investigations, remedial actions, and agency negotiations for an automotive facility located in São Paolo.

Confidential Client: Managed large-scale cost allocation at a Midwestern Superfund site. Forensically evaluated the sources of tar to river sediments considering site industrial operational history, contaminant fate and transport, chemistry, site modification and filling history, and observed contaminant patterns. Calculated the mass of tar present in the environment using both visual observations and analytical data.

Confidential Client, Brazil: Managed large-scale site investigations and human health risk assessment projects at a former pharmaceutical facility located in São Paulo. Key compounds were petroleum hydrocarbons and volatile organic compounds.

Confidential Client, New York: Served as consulting expert for large cost allocation involving over 16 responsible parties and chlorinated organic groundwater plumes extending for nearly 2 miles. Evaluated lateral and vertical groundwater flow direction, chemical usage history, and groundwater chemistry to support a *de minimis* contribution argument for our client.

Confidential Client, Ohio: Served as consulting expert for cost allocation project at a Midwestern landfill. Evaluated differences in toxicity and risk associated with municipal solid waste and industrial hazardous waste. Used data to devise risk-weighted allocation approach for remedy costs.

Confidential Client, Brazil: Managed site investigation to evaluate groundwater responses due to seasonal precipitation events and their effect on potential contaminant fate & transport.

Confidential Client: Managed site investigation project identifying sources of PCE present at a former electrical resistor manufacturing facility. Soil, groundwater, and soil gas data were evaluated and used to identify individual sources of PCE to the subsurface. The impact of each source on remediation costs related to the site was evaluated and successfully used as a tool to mediate between responsible parties. Served as consulting expert during mediation between responsible parties.

Confidential Client, New Jersey: Delineated NAPL plumes and investigated spill history, sewer maps, and gas chromatography fingerprint results at East Coast Superfund Site. Designed French Drain to recover NAPL from subsurface.

City of Pittsfield, Massachusetts: Technical consultant to the city for mediation between General Electric (GE) and governmental agencies. Evaluated reports and clean-up standards, and attended mediation sessions on behalf of the city.

Projects – *Clean Water Act*

Municipal Client, Ohio: Consulting expert for significant nexus evaluation to determine whether wetlands and surface water tributaries are jurisdictional waters of the United States.

Publications/Presentations

Radloff, KA; Lewis, AS; Bittner, AB; Zhang Q; Minkara, R. 2022. "A Risk Evaluation of Controlled Low-Strength Materials (CLSM) Containing Coal Combustion Products (CCPs) in Construction Projects." Presented at the World of Coal Ash (WOCA) Conference, Covington, KY. May 17.

Kondziolka, J; Radloff, KA; Bittner, AB. 2022. "Emerging Clean Water Act Issues for CCR Surface Impoundments." Presented at the World of Coal Ash (WOCA) Conference, Covington, KY. May 17.

Bittner, AB; Kondziolka, J. 2022. "Alternative Liner Performance Demonstrations – A Science-Based Approach to Inform Policy Development ." Presented at the World of Coal Ash (WOCA) Conference, Covington, KY. May 18.

Bittner, AB. 2022. "Decision Analysis Applied to CCR Surface Impoundment Closure and Corrective Action." Presented at the World of Coal Ash (WOCA) Conference, Covington, KY. May 18.

Lewis, AS; Bittner, AB; Radloff, KA. 2022. "Using Human Health and Ecological Risk Assessment at Coal Combustion Product (CCP) Sites to Meet Closure Objectives ." Presented at the World of Coal Ash (WOCA) Conference, Covington, KY. May 18.

Radloff, KA; Lewis, AS; Bittner, AB. 2021. "Challenges Using Data Generated by LEAF Methods in Risk Evaluations." Presented at the USWAG CCR Webinar. August 5.

Register, JR; Bittner A. 2020. "USEPA Reconsideration of CCR Regulations Impacting the Geosynthetic Industry." Presented to the Fabricated Geomembrane Institute. October 8.

Dale, A, Kondziolka, J, de Lassus, C, Bittner, A, Hensel, B. 2020. "Probabilistic Modeling of Leaching from Coal Ash Impoundment Liners: A Case Study in Science Informing Policy Development." Presented at the International Society of Exposure Science Virtual Meeting, California, September 21.

Briggs, N; Lewis, AS; Bittner, AB. 2020. "Evaluating Climate Change Impacts on CCP Surface Impoundments and Landfills." Presented at the World of Coal Ash (WOCA) Conference, St. Louis, Missouri, May 16.

Bittner, AB; Lewis, AS. 2020. "Beneficial use assessment of building materials containing CCPs." *Gradient Trends: Risk Science and Application* 77 (Winter):3,5.

Register, JR; Bittner A. 2019. "Insane in the Geomembrane." Presented to the Fabricated Geomembrane Institute. August 6..

Bittner, AB; Spak, MS; Cox, WS. 2019. "Carving out the Contours: The Clean Water Act and the Migration of Affected Groundwater to Waters of the United States." *For the Defense* 61(6):55-59.

Bittner, A. Lewis, A. 2019. "CCP Beneficial Use Risk Assessment: Case Studies for Three Different Applications." Presented at the World of Coal Ash (WOCA) Conference, St. Louis, Missouri, May 14.

Lewis, A. Bittner, A. 2019. "Risk Based Considerations for Establishing Alternative Groundwater Standards at Coal Combustion Product Sites." Presented at the World of Coal Ash (WOCA) Conference, St. Louis, Missouri, May 15.

Lewis, AS; Bittner, A. 2018. "Risk-Based Approaches for Establishing Alternative Standards at Coal Combustion Sites." Presented at the World of Coal Ash (WOCA) Ponded Ash Workshop, Louisville, Kentucky, October 30-31.

Lewis, AS; Bittner, A. 2017. "The Relative Impact Framework for Evaluating Coal Combustion Residual Surface Impoundment Closure Options: Application and Lessons Learned." *Coal Combustion and Gasification Products (CCGP)* 9:1-3.

Lewis, AS; Dube, EM; Bittner, A. 2017. "Key role of leachate data in evaluating CCP beneficial use." *ASH at Work* 1:32-34.

Lewis, AS; Bittner, AB; Lemay, JC. 2017. "Achieving Groundwater Protection Standards for Appendix IV Constituents: The Problem with Using Background Concentrations in the Absence of Maximum Contaminant Levels (MCLs)." Presented at the 2017 World of Coal Ash Conference (WOCA), Lexington, KY, May 8-11.

Bittner, A. 2017. "Evaluation of Groundwater Protectiveness of Potential Surface Impoundment Closure Options." Presented at the American Coal Ash Association's 7th Annual World of Coal Ash Conference, Lexington, KY, May 11.

Lewis, A; Bittner A; Radloff, K; Hensel, B. 2017. "Storage of coal combustion products in the United States: Perspectives on potential human health and environmental risks." In *Coal Combustion Products (CCPs): Characteristics, Utilization and Beneficiation, 1st Edition*. Woodhead Publishing, May 2.

Bittner, AB; Kondziolka, JM; Lewis, A; Hensel, B; Ladwig, K. 2016. "Groundwater Assessment Framework for Evaluating the Relative Impacts of Coal Ash Surface Impoundment Closure Options." Presented at Battelle's Tenth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Palm Springs, CA, May 22-26.

Bittner, AB; Kondziolka, JM; Sharma, M; Nangeroni, P; McGrath, R. 2016. "Using Tracer Test Data to Calibrate a Groundwater Flow and Solute Transport Model." Presented at Battelle's Tenth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Palm Springs, CA, May 22-26.

Bittner, A. 2016. "A Retrospective Look at Remediation in the State of Rio de Janeiro, Brazil: And What Lessons We Can Apply to Remediation Projects in Other Emerging International Markets." Presented at Battelle's Tenth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Palm Springs, CA, May 22-26. 17p.

Bittner, A. 2016. "The Federal CCR Rule and How it is Impacting Coal Ash Disposal." Presented at Battelle's Tenth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Palm Springs, CA, May 22-26. 17p.

Bittner, A. 2016. "Coal Ash Beneficial Reuse Assessment Consistent with Requirements of the 2015 Federal CCR Rule." Presented at EUCI's Sixth Annual Coal Combustion Residuals and Effluent Limitation Guidelines Conference, Charlotte, NC, March 30-31. 30p.

Herman, K; Flewelling, S; Bittner, AB; Tymchak, M; Swamy, M. 2015. "Alternate Endpoints for Remediating NAPL-Impacted Sites." Presented at the EPRI/AWMA Env-Vision Conference, Crystal City, VA, May 14.

Lewis, A; Bittner, AB; Herman, K; Dubé, E; Long, C; Hensel, B; Ladwig, K. 2015. "Framework for Evaluating Relative Impacts for Surface Impoundment Closure Options." Presented at the 2015 World of Coal Ash Conference, Nashville, TN, May 8.

Bittner, AB. Lewis, A; Herman, K; Dubé, E; Long, CM; Kondziolka, K, Hensel, B; Ladwig, K. 2015 "Groundwater Assessment Framework to Evaluate Relative Impacts of Surface Impoundment Closure Options." Presented at the 2015 World of Coal Ash Conference, Nashville, TN, May 7.

Bittner, AB. 2014. "Evolving environmental regulations in Brazil." *Gradient Trends: Risk Science and Application* 59 (Winter):4.

Bittner, AB. 2013. "Modeling Mass Discharge from the Source Zone." Presented at Second International Symposium on Bioremediation and Sustainable Environmental Technologies, Jacksonville, FL, June 11.

Bittner, AB. 2013. "Successful Implementation of a Risk-based Remedial Solution in Brazil." Presented at the 2013 NGWA Groundwater Summit, San Antonio, TX, April 28.

Bittner, AB. 2013. "Evolving methods for evaluating vapor intrusion." *Gradient Trends: Risk Science and Application* 57(Spring): 4.

Esakkiperumal, C; Bittner, A. 2013. "Use of Mass-Flux Based Approach to Optimize the Design of a Hydraulic Containment System." Presented at the 2013 NGWA Groundwater Summit, San Antonio, TX, April 28.

Bittner, A. 2010. "A Weight-of-Evidence Approach to Assess NAPL Mobility." Presented at the 7th International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 27.

Herman, K; Bittner, A. 2010. "How Much Tar is In the Mud? – Reducing Uncertainty in Characterizing the Distribution and Mass of DNAPL in Sediments." Presented at the EPRI MGP 2010 Symposium, January 28.

Bittner, AB. 2009. "Is your NAPL mobile?" *Gradient Trends: Risk Science & Application* 45(Spring):3.

Herman, K; Bittner, A. 2008. "Reducing Uncertainty in DNAPL Characterization." Presented at the 24th Annual International Conference on Soils, Sediments, and Water, October 23.

Bittner, AB; Baffrey, RN; Esakkiperumal, C. 2006. "Using Sediment Transport Modeling to Support Environmental Forensic PCB Analyses." Presented at Society of Environmental Toxicology and Chemistry Conference, Montreal, Canada, November 8.

Bittner, AB. 2006. "Groundwater and Air Modeling Used to Support Forensic Analyses." Presented at the Gradient Breakfast Seminar Titled: Forensic Chemistry – The Intersection of Science and Law, May 16.

Bittner, AB. 2006. "M&A emerging issues and requirements." *Gradient Trends: Risk Science & Application* 36(Spring):4.

Sharma, M; Saba, T; Bittner, A. 2003. "Optimization of Groundwater Pump and Treat Systems." Presented at the 19th Annual International Conference on Contaminated Soil, Sediments and Water, Amherst, MA, October 23.

Sharma, M; Saba, T; Bittner, A. 2003. "Optimization of Groundwater Pump and Treat Systems Using Numerical Modeling and the Monte Carlo Approach." Presented at the National Ground Water Association Mid-South Focus Conference, Nashville, TN, September 19.

Bittner, AB; Halsey, P; Khayyat, A; Luu, K; Maag, B; Sagara, J; Wolfe, A. 2002. "Drinking water quality assessment and point-of-use treatment in Nepal." *Civil Eng. Practice* 17:5-24.

Bittner, AB. 2000. "Drinking Water Quality Assessment in Nepal: Nitrates and Ammonia [Thesis]." Submitted to Massachusetts Institute of Technology.

ANDREW BITTNER, P.E.
Testimony Experience

Mr. Bittner has provided testimony in the following matters.

1. MACTEC Engineering & Consulting, Inc. v. Hitchiner Manufacturing Co., Inc., and Thomas & Betts Corporation vs. Dragin Drilling, Inc. and Windham Environmental Corporation, d/b/a Remede Products and d/b/a Redux Technology. American Arbitration Association No. 111920064106. Provided testimony (2007) in deposition related to contaminant fate and transport and groundwater flow modeling.

2. Ernest Hardy, et al. v. Cheshire Oil Company, Inc. and Gabrielle Realty, LLC. Prepared expert report (2008) regarding the fate and transport of methyl tertiary butyl ether in groundwater. Case settled prior to deposition.

3. Sierra Club v. Pennsylvania Department of Environmental Protection and FirstEnergy Generation, LLC, Permittee. Commonwealth of Pennsylvania, Environmental Hearing Board Docket No. 2015-093-R. Prepared expert report (2017) in support of permittee regarding the fate and transport coal combustion constituents in surface water. Case settled prior to deposition.

4. Davis Gas Processing, Inc. *et al*. v. Western Gas Resource, Inc. *et al*. Railroad Commission of Texas Hearings Division. Oil and Gas Docket No. 09-0304555. Prepared expert report (2018) titled "Evaluation of Groundwater Hydrogeology and LNAPL Fate and Transport at the Davis Gas Processing Plant and Surrounding Area in Bowie, Texas." Case Settled prior to deposition.

5. The Estate of Bobby Clary *et al*., v. American Electric Power Co. Inc. *et al*. Gavin Landfill Litigation. Circuit Court of Raleigh County, West Virginia. Civil Action No. 16-C-8000. Prepared expert report (2018) titled "Assessment of January 2017 Field Investigation and Results at the Gavin Landfill in Cheshire, Ohio." Case Settled prior to deposition.

6. Duke Energy Carolinas, LLC and Duke Energy Progress, LLC *v*. AG Insurance SA/NV (f/k/aL'Etoile S.A. Belge d'Assurances) *et al*. Prepared export report (April 2020), rebuttal report (May 2020), and surrebuttal report (June 2020). Provided testimony (September 2020) in deposition related to fate and transport of coal combustion product constituents at multiple coal ash disposal facilities and coal-fired power plants.

7. Provided pre-filed testimony (August 2020) related to the Illinois Environmental Protection Agency (IEPA) Proposed Part 845 Rulemaking of the Illinois Administrative Code (Title 35, Subtitle G, Chapter I, Subchapter j). Provided oral testimony (September 2020) related to the proposed rule before the Illinois Pollution Control Board.

8. Draft Allocation for the Lower Passaic River. Prepared expert rebuttal report "Comments on the Draft Allocation Recommendation for TFCFA" (November 2020).

9. Expert Report submitted in support of "Petition for a Finding of Inapplicability or, in the Alternative, an Adjusted Standard from 35 ILL. Admin. Code Part 845." "Human Health and Ecological Risk Evaluation and Relative Impact Assessment. Joppa Generating Station – Joppa West, Joppa, Illinois" (May 11, 2021).

10. AEP Generation Resources Inc. *et al*. *v*. AG Insurance SA/NV (f/k/a AG de 1830 Compagnie Belge and as Successor to L'Etoile S.A. Belge d'Assurances and Transferor to Bothnia International

Insurance Company Ltd.) *et al*. Prepared export report (June 2022) and rebuttal report (September 2022) related to fate and transport of coal combustion product constituents at multiple coal ash disposal facilities and coal-fired power plants. Provided testimony (October and November 2022) in deposition.

Attachment H

Hennepin Power Plant
Operating Permit Application: Floodplain Compliance for 35 I.A.C. 845.340(c)

Dynegy Midwest Generation, LLC

Revision 1
10/20/2021

Hennepin Power Plant Operating Permit Application: Floodplain Compliance for 35 I.A.C. 845.340(c)

prepared for

Dynegy Midwest Generation, LLC
Village of Hennepin, Illinois

Revision 1
10/20/2021

prepared by

Burns & McDonnell
Kansas City, Missouri

INDEX AND CERTIFICATION

Dynegy Midwest Generation, LLC
Hennepin Power Plant
Operating Permit Application: Floodplain Compliance for 35 I.A.C. 845.340(c)

Report Index

Certification

I hereby certify, as a Professional Engineer in the state of Illinois, that the information in this document was assembled under my direct personal charge. This report is not intended or represented to be suitable for reuse by the Dynegy Midwest Generation, LLC or others without specific verification or adaptation by the Engineer. I hereby certify, for East Ash Pond CCR impoundment discussed herein, that demonstration regarding floodplains meets requirements of 35 I.A.C. 845.340(c).

Madison R. Gibler, P.E., IL, 062.070771

Signature: Madison R Gibler

Date of Signing: October 20, 2021

Date of License Expiration: November 30, 2021

MADISON R. GIBLER
062.070771

TABLE OF CONTENTS

LIST OF TABLES

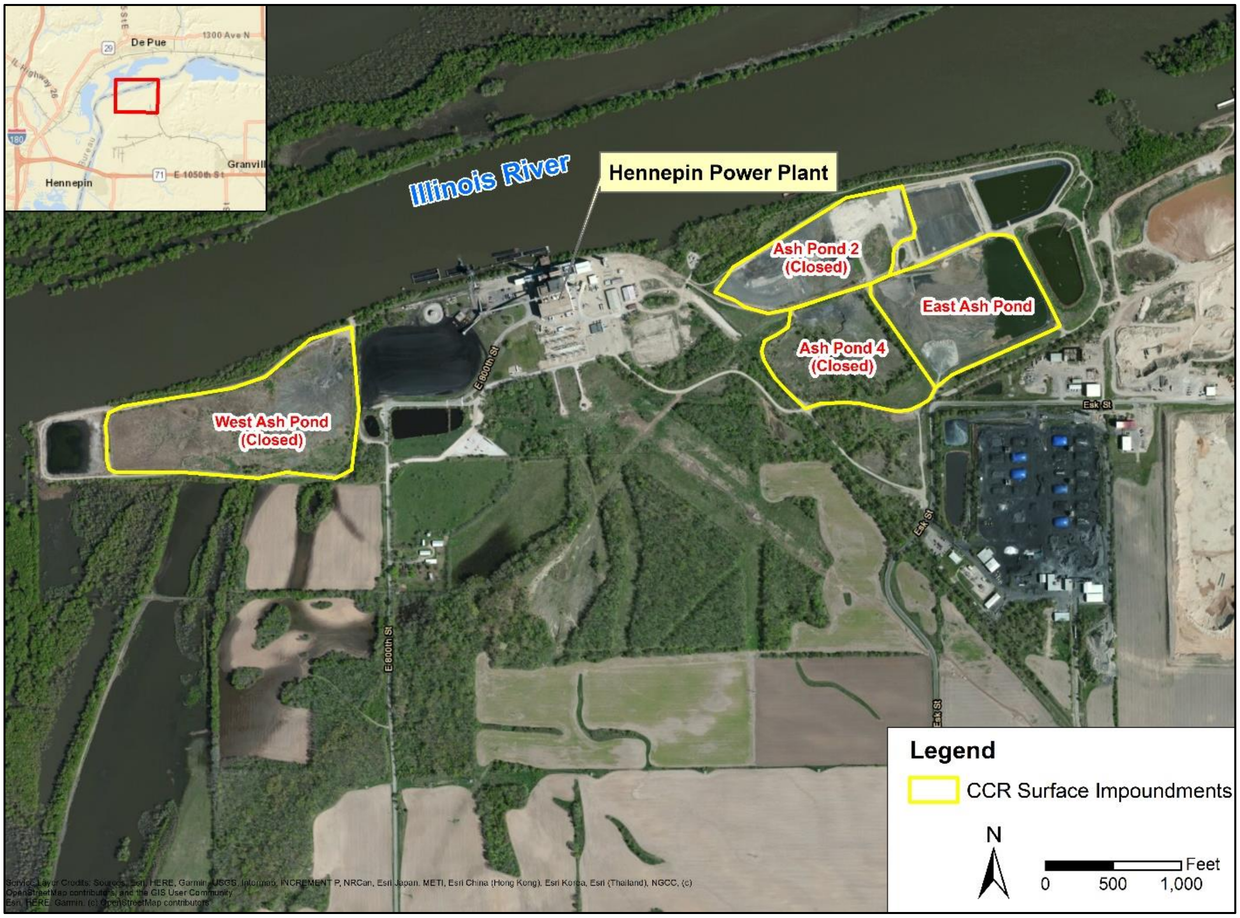
Page No.

LIST OF FIGURES

Page No.

1.0 INTRODUCTION

Burns & McDonnell was hired by Dynegy Midwest Generation, LLC to evaluate compliance with *35 I.A.C. 845.340(c)* (2021) for the existing coal combustion residual (CCR) surface impoundment at the Hennepin Power Plant in the Village of Hennepin, Putnam County, Illinois. The Hennepin Power Plant (plant) currently has one CCR impoundment in operation, the East Ash Pond. The plant also had three additional CCR impoundments that have since been closed: the West Ash Pond, Ash Pond 2, and Ash Pond 4. The East Ash Pond was constructed and went into operation in 1996. The Hennepin Power Plant and CCR surface impoundments are located south of the Illinois River, as shown in Figure 1-1.



Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Esri, HERE, Garmin, (c) OpenStreetMap contributors

Figure 1-1: Hennepin Power Plant CCR Surface Impoundments

This report summarizes the evaluation of the existing East Ash Pond CCR impoundment for compliance with *35 I.A.C. 845.340(c)* (2021), herein referred to as “floodplain compliance.” See Appendix A – Excerpt from 35 I.A.C. 845.340(c) for compliance requirements.

2.0 DATA AVAILABILITY AND ANALYSIS

2.1 Flood Insurance Rate Maps

The Hennepin Power Plant is split between two current Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs), 17155C0015E and 17155C0025E, both with an effective date of February 4, 2011. The currently operating East Ash Pond and the closed Ash Pond 2 and Ash Pond 4 are included in map number 17155C0025E, while the closed West Ash Pond is depicted on map number 17155C0015E. Copies of the FIRMS are provided in Appendix B – FEMA Flood Insurance Rate Maps. The East Ash Pond is located between river mile 212.4 and 212.9 and is delineated in “red” on Figure 2-1.

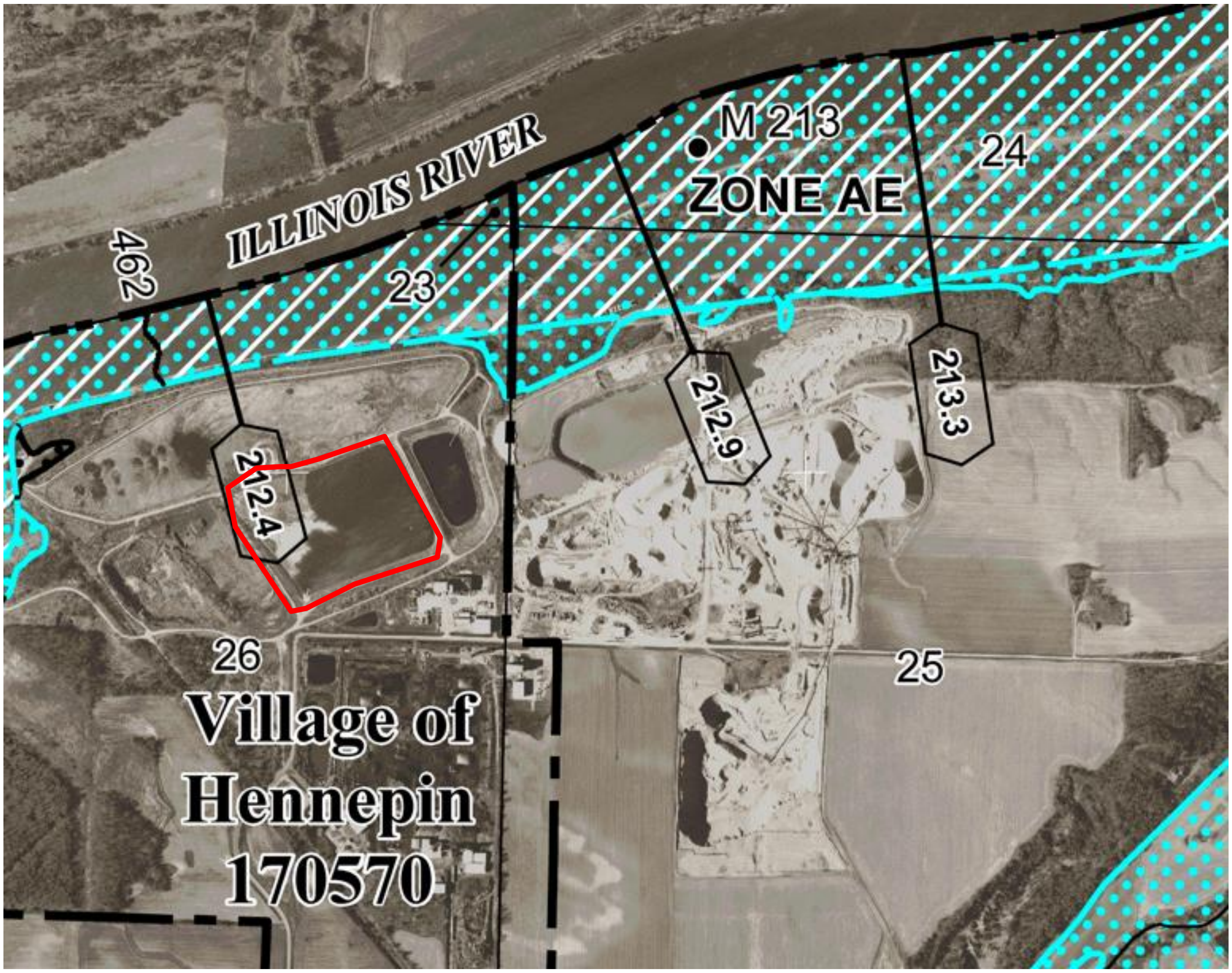


Figure 2-1: East Ash Pond on FIRM 17155C0025E

After review of the effective FIRM number 17155C0025E, the East Ash Pond appears to be located outside of the regulatory floodway and the area inundated by the base flood (the 1% annual chance flood), Zone AE in Figure 2-1.

2.2 Flood Insurance Study

The effective FEMA Flood Insurance Study (FIS) for Putnam County, study number 17155CV000A, has an effective date of February 4, 2011. According to the FIS, the hydrologic and hydraulic analysis was based on the *Upper Mississippi River System Flow Frequency Study* published in January 2004 (FEMA, 2011c). Cross sections for the Illinois River between river mile 80.2 and 286, which includes the area near the Hennepin Power Plant, were created using data from 1998 aerial photography and photogrammetry as well as digital hydrographic surveys collected from 1997 or later and supplemented with United States Geological Survey (USGS) National Elevation Dataset 1/3 arc second coverage (FEMA, 2011c). Because the East Ash Pond CCR impoundment was constructed in 1996, its impacts would have been accounted for in the 2011 FIS.

According to the FIS floodway data table, the base flood elevation for the cross sections at river miles 212.9 and 212.4, upstream and downstream of East Ash Pond, is 462.0 and 461.9 feet North American Vertical Datum of 1988 (NAVD88), respectively. Therefore, the base flood elevation of the East Ash Pond is estimated to be 462.0 feet. Unless otherwise noted, all elevations referenced in this report refer to NAVD88.

2.3 Effective Hydraulic Model

A copy of the effective hydraulic model for the Illinois River between river mile 157.75 and 230.91 was obtained from the FEMA Engineering Library on August 19, 2021, (USACE Rock Island District, 2005). The model was developed in 2005 using HEC-RAS version 3.1.3. The 100-year water surface elevations were calibrated to the results developed from the January 2004 *Upper Mississippi River System Flow Frequency Study*. The model files were converted to HEC-RAS version 6.0, and results were compared to the regulatory base flood elevations. Review of the model files confirmed that the CCR impoundment was represented in the ground elevations for the cross section at river mile 212.4.

Geospatial locations of the cross sections and the river centerline were obtained from the FEMA's National Flood Hazard Layer (NFHL) geographic information system (GIS) data (FEMA, 2011d). Figure 2-2 provides the locations of these cross sections.

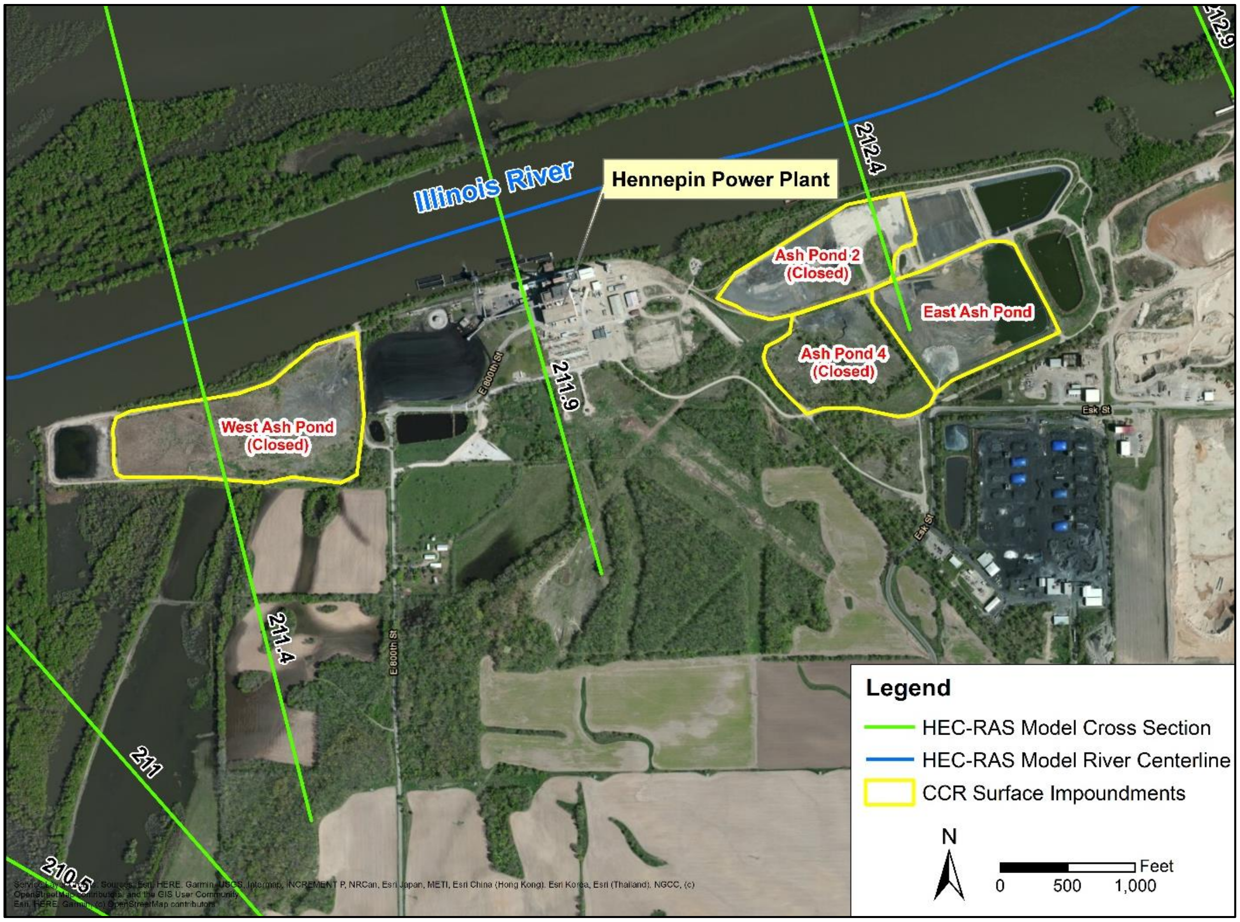


Figure 2-2: Illinois River Cross Sections Near Hennepin Power Plant

Modeling results were within 0.1-feet of the base flood elevations published in the FIS. Table 2-1 provides a comparison of the FIS base flood elevation and model results.

Table 2-1: Base Flood Elevations (BFEs)

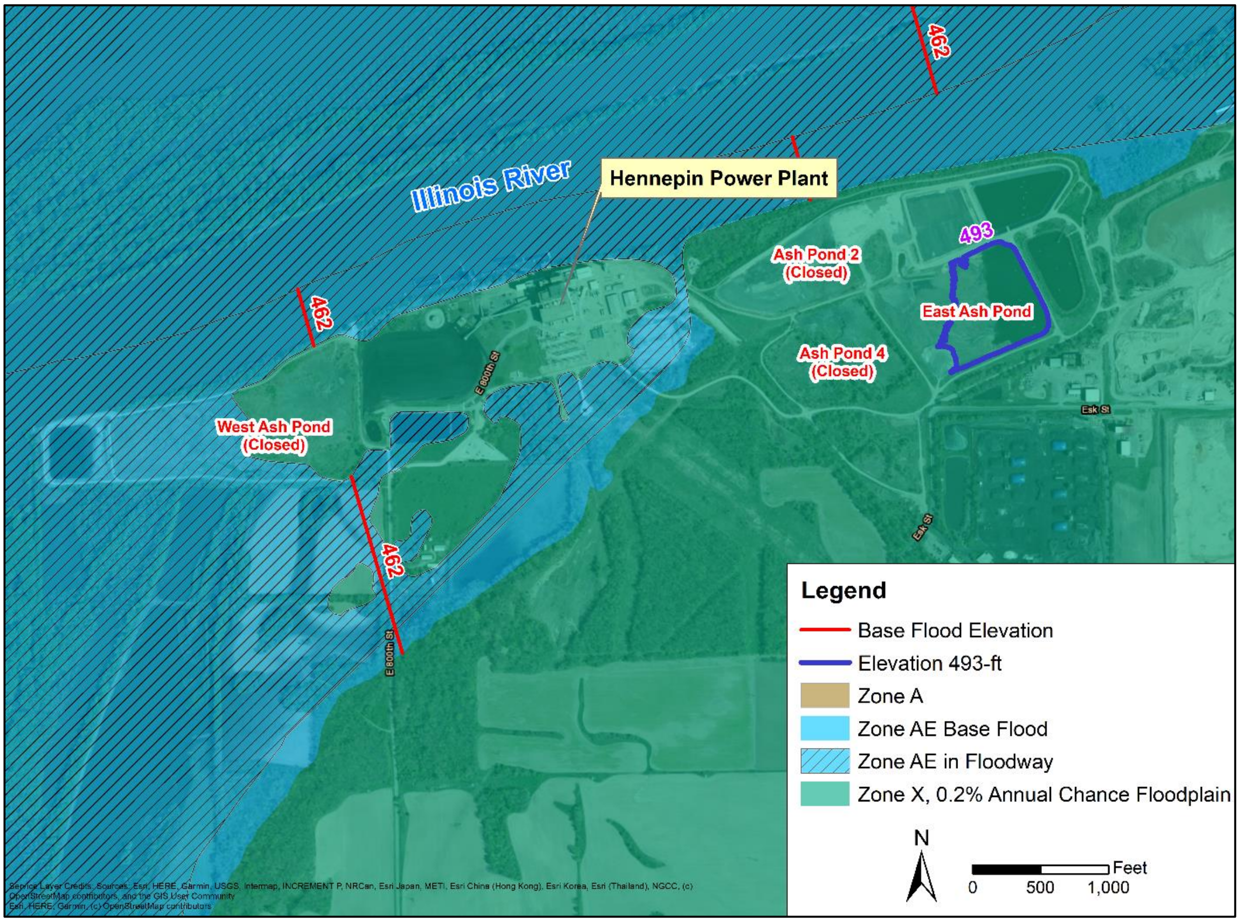
Cross Section (River Mile)	FIS BFE (feet)	Model BFE (feet)
211.4	461.9	462.0
211.9	461.9	462.0
212.4	461.9	462.0
212.9	462.0	462.1

2.4 Closure of West Ash Pond

Closure of West Ash Pond was documented in *Technical Assessment of River and Dam Safety Impacts for the Closure of CCR Ponds* (Hanson Professional Services, Inc., 2020). The report states that the closure of the West Ash Pond was approved by the Illinois Environmental Protection Agency on June 19, 2018, with construction anticipated to be completed by November 17, 2020. The report also references a hydraulic analysis for the "worst-case", stating that the "[post-closure] grading creates a maximum water surface elevation over [pre-closure] of 0.00-ft and increase in channel velocity of 0.01-ft/s for all flows modeled." However, Appendix G of the report, which contains the model output summary, was not included. Model files developed for the report by Hanson Professional Services were not evaluated as part of this analysis. Therefore, it is assumed that the base flood was included in the "worst-case" analysis, which resulted in no increase in water surface elevation. No Letter of Map Amendment (LOMA) was available on FEMA's Map Service Center related to the West Ash Pond closure project.

3.0 CONCLUSION

Topographic/contour data at the Hennepin Power Plant and CCR impoundments was obtained from the Illinois Geospatial Data Clearinghouse (Illinois Geospatial Data Clearinghouse, 2012). Based on the topographic data, the top of embankment elevation for East Ash Pond is 493 feet. The effective regulatory floodway, areas inundated by the 1% and 0.2% annual chance floods, base flood elevations, and the contour line of the top of embankment elevation for East Ash Pond is provided in Figure 3-1.



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Esri, HERE, Garmin, (c) OpenStreetMap contributors

Figure 3-1: Inundation Extents and Significant Elevations

As seen in Figure 3-1, the top of embankment for East Ash Pond is located outside of the area subject to inundation by the 1% annual chance flood and has a top of embankment elevation of 493 feet. This is above the base flood elevation of 462.0 feet. Therefore, East Ash Pond is not subject to inundation by the base flood.

Since the construction of the East Ash Pond was completed in 1996 and the topographic information used to develop the hydraulic model (from which the regulatory floodway and the area inundated by the based flood was defined) was collected in 1997, the East Ash Pond does not restrict the flow of the base flood and does not reduce the temporary water storage capacity of the floodplain. The regulatory floodway is defined as the area that "must be reserved in order to discharge the base flood" (FEMA, 2020). Therefore, since the topography of the East Ash Pond was already included in the hydraulic model that determined the regulatory floodway, the East Ash Pond does not restrict this base flood discharge. Likewise, the topography of the East Ash Pond was included in the hydraulic model that determined the extents of the area inundated by the base flood. Therefore, the East Ash Pond does not reduce the compensatory storage of the base flood.

Based on the analysis included herein the existing Hennepin Power Plant East Ash Pond CCR surface impoundment complies with the requirements included in *35 I.A.C. 845.340(c)* (2021).

- The East Ash Pond does not restrict the flow of the base flood because it was included in the hydraulic modeling that defined the regulatory floodway, the area reserved to discharge the base flood.
- The East Ash Pond does not reduce the temporary water storage capacity of the 100-year floodplain because it was included in the hydraulic modeling that defined the special flood hazard area subject to inundation by the based flood or 1% annual chance flood.
- The East Ash Pond is not subject to carrying away of CCR by waters of the base flood because the top of embankment elevation for the CCR impoundment greater than the base flood elevation.

4.0 REFERENCES

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APPENDIX A – EXCERPT FROM 35 I.A.C. 845.340(C)

b) The owner or operator of the CCR surface impoundment must obtain a certification from a qualified professional engineer stating that the demonstration meets the requirements of subsection (a).

c) The owner or operator of an existing CCR surface impoundment must complete the demonstration required by subsection (a) and submit the completed demonstration, along with the qualified professional engineer’s certification to the Agency with the facility's initial operating permit application.

d) The owner or operator of a new CCR surface impoundment or a lateral expansion of a CCR surface impoundment must submit plans and specifications in a construction permit application that demonstrate the CCR surface impoundment will be constructed under subsection (a). Upon completion of construction, the owner or operator must obtain a certification from a qualified professional engineer that the CCR surface impoundment or lateral expansion was constructed in accordance with the requirements of subsection (a) and submit the certification to the Agency in the facility's initial operating permit application.

Section 845.340 Unstable Areas and Floodplains

a) An existing or new CCR surface impoundment, or any lateral expansion of a CCR surface impoundment, must not be located in an unstable area unless the owner or operator demonstrates that recognized and generally accepted engineering practices have been incorporated into the design of the CCR surface impoundment to ensure that the integrity of the structural components of the CCR surface impoundment will not be disrupted.

b) The owner or operator must consider all the following factors, at a minimum, when determining whether an area is unstable:

1) On-site or local soil conditions, including ~~but not limited to~~ liquefaction, that may result in significant differential settling;

2) On-site or local geologic or geomorphologic features; and

3) On-site or local human-made features or events (both surface and subsurface).

c) An existing or new CCR surface impoundment, or any lateral expansion of a CCR surface impoundment, must not be located in a floodplain unless the owner or operator demonstrates that recognized and generally accepted engineering practices have been incorporated into the design of the CCR surface impoundment to ensure that the CCR surface impoundment will not restrict the flow of the base flood, reduce the temporary water storage capacity of a floodplain, or result in washout of CCR, so as to pose a hazard to human life, wildlife, or land or water resources. For this subsection (c):

1) Base flood means a flood that has a 1 percent or greater chance of recurring in any year or a flood of a magnitude equaled or exceeded once in 100 years on average within the time of historical river level records.

2) Floodplain means the lowland and relatively flat areas adjoining inland and coastal waters, including flood-prone areas of offshore islands, which are inundated by the base flood.

3) Washout means the carrying away of CCR by waters of the base flood.

d~~c~~) The owner or operator of the CCR surface impoundment must obtain a certification from a qualified professional engineer stating that the demonstration meets the requirements of subsections (a) and (c).

e~~d~~) The owner or operator of an existing CCR surface impoundment must complete the demonstration required by subsections (a) and (c) of this Section and submit the completed demonstration, along with a qualified professional engineer's certification, to the Agency with the facility's initial operating permit application.

f~~e~~) The owner or operator of a new CCR surface impoundment, or a lateral expansion of a CCR surface impoundment, must submit plans and specifications in a construction permit application that demonstrate the CCR surface impoundment will be constructed under subsections (a)and (c). Upon completion of construction, the owner or operator must obtain a certification from a qualified professional engineer that the CCR surface impoundment or lateral expansion was constructed in accordance with the requirements in subsections (a) and (c) and submit the certification to the Agency in the facility's initial operating permit application.

Section 845.350 Failure to Meet Location Standards

a) An owner or operator of an existing CCR surface impoundment who fails to demonstrate compliance with the requirements of this Subpart is subject to the requirements of Section 845.700.

b) An owner or operator of a new CCR surface impoundment, or any lateral expansion of a CCR surface impoundment, who fails to make the demonstration showing compliance with the requirements of this Subpart is prohibited from placing CCR in the CCR surface impoundment.

SUBPART D: DESIGN CRITERIA

Section 845.400 Liner Design Criteria for Existing CCR Surface Impoundments

APPENDIX B – FEMA FLOOD INSURANCE RATE MAPS

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or flood plain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or flood plain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

In the State of Illinois, any portion of a stream or watercourse that lies within the **floodway fringe** of a studied (AE) stream may have a state regulated floodway. The FIRM may not depict these state regulated floodways.

Floodways restricted by anthropogenic features such as bridges and culverts are drawn to reflect natural conditions and may not agree with the model computed widths listed in the Floodway Data table in the Flood Insurance Study report.

Multiple **topographic sources** may have been used in the delineation of Special Flood Hazard Areas. See Flood Insurance Study report for details on source resolution and geographic extent.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services, NOAA, N/NGS12
National Geodetic Survey SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at www.ngs.noaa.gov.

Base map information shown on this FIRM was provided in digital format by the United States Geological Survey. Digital orthoimagery with a spatial resolution of 0.5 meter ground sample distance were photogrammetrically compiled from aerial photography acquired during the leaf-off period of spring 2005.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The Special Flood Hazard Areas and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

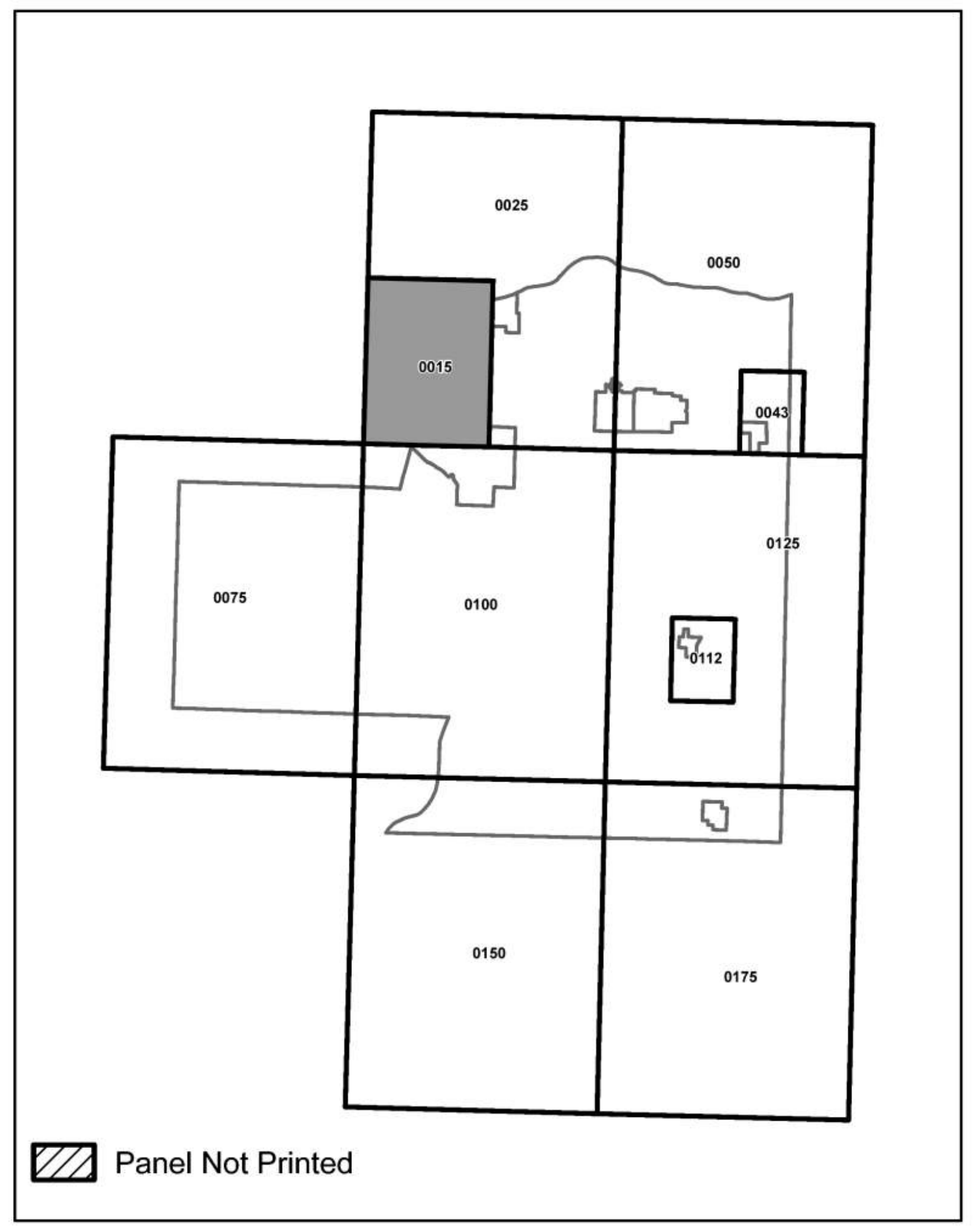
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

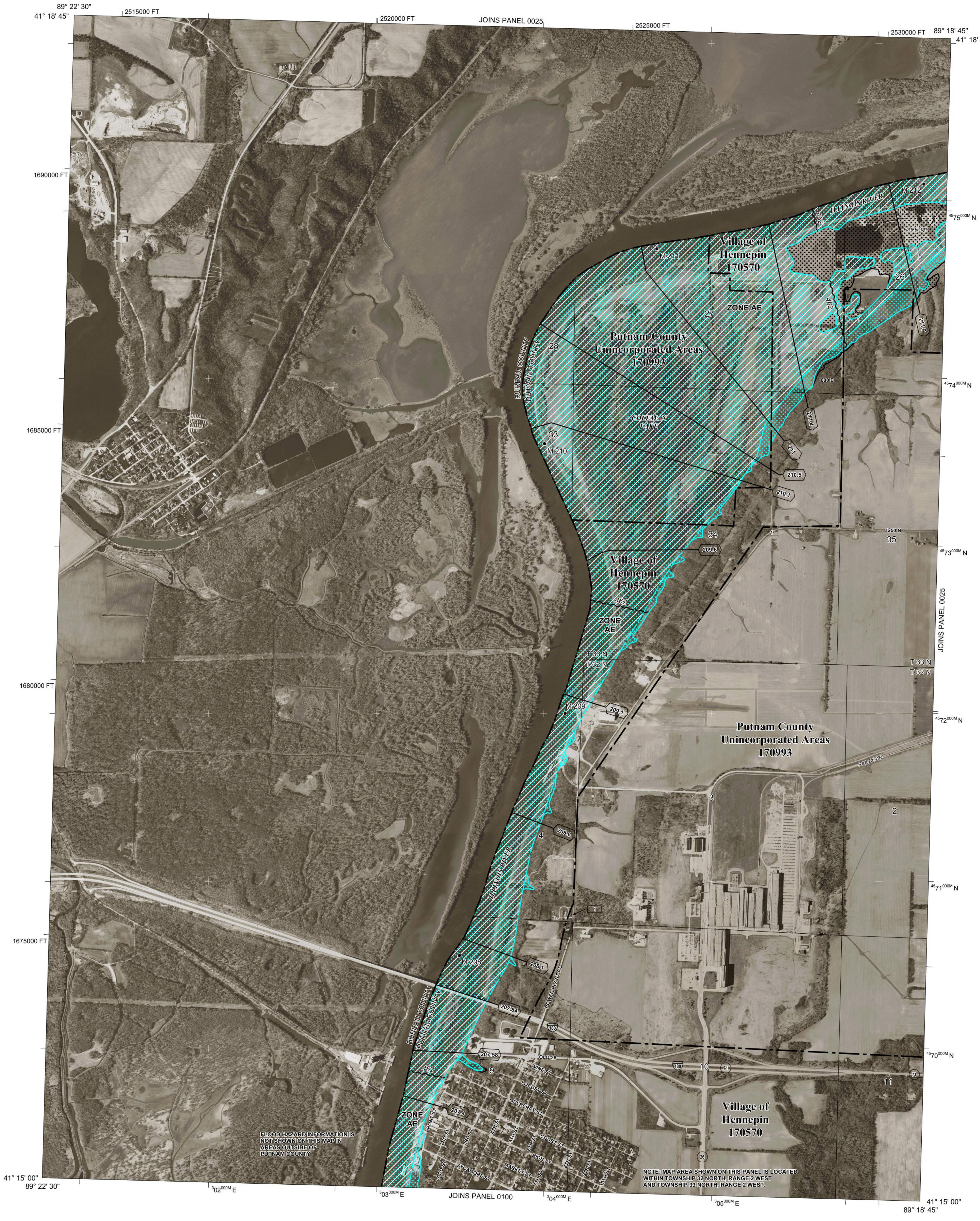
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the Map Service Center (MSC) website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

PANEL INDEX





LEGEND

▨ SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

▨ FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

▨ OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

☐ OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

▨ COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

▨ OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

———	1% annual chance floodplain boundary
———	0.2% annual chance floodplain boundary
— —	Floodway boundary
– —— —— –	Zone D boundary
• • • • • • • • • • • • •	CBRS and OPA boundary
▨ ←	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
~~513~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

⟨A⟩——⟨A⟩	Cross section line
(23)- - - - - -(23)	Transect line
45° 02' 08", 93° 02' 12"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
— $^{49}89^{000M}$ N	1000-meter Universal Transverse Mercator grid values, zone 16
— 1565000 FT	5000-foot grid tick: Illinois State Plane West Coordinate System, 3801 zone (FIPSZONE 1202) Transverse Mercator
DX5510×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
FEBRUARY 4, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0015E

FIRM
FLOOD INSURANCE RATE MAP
PUTNAM COUNTY, ILLINOIS
AND INCORPORATED AREAS

PANEL 15 OF 175

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
HENNEPIN, VILLAGE OF	170570	0015	E
PUTNAM COUNTY	170993	0015	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
17155C0015E

EFFECTIVE DATE
FEBRUARY 4, 2011

Federal Emergency Management Agency

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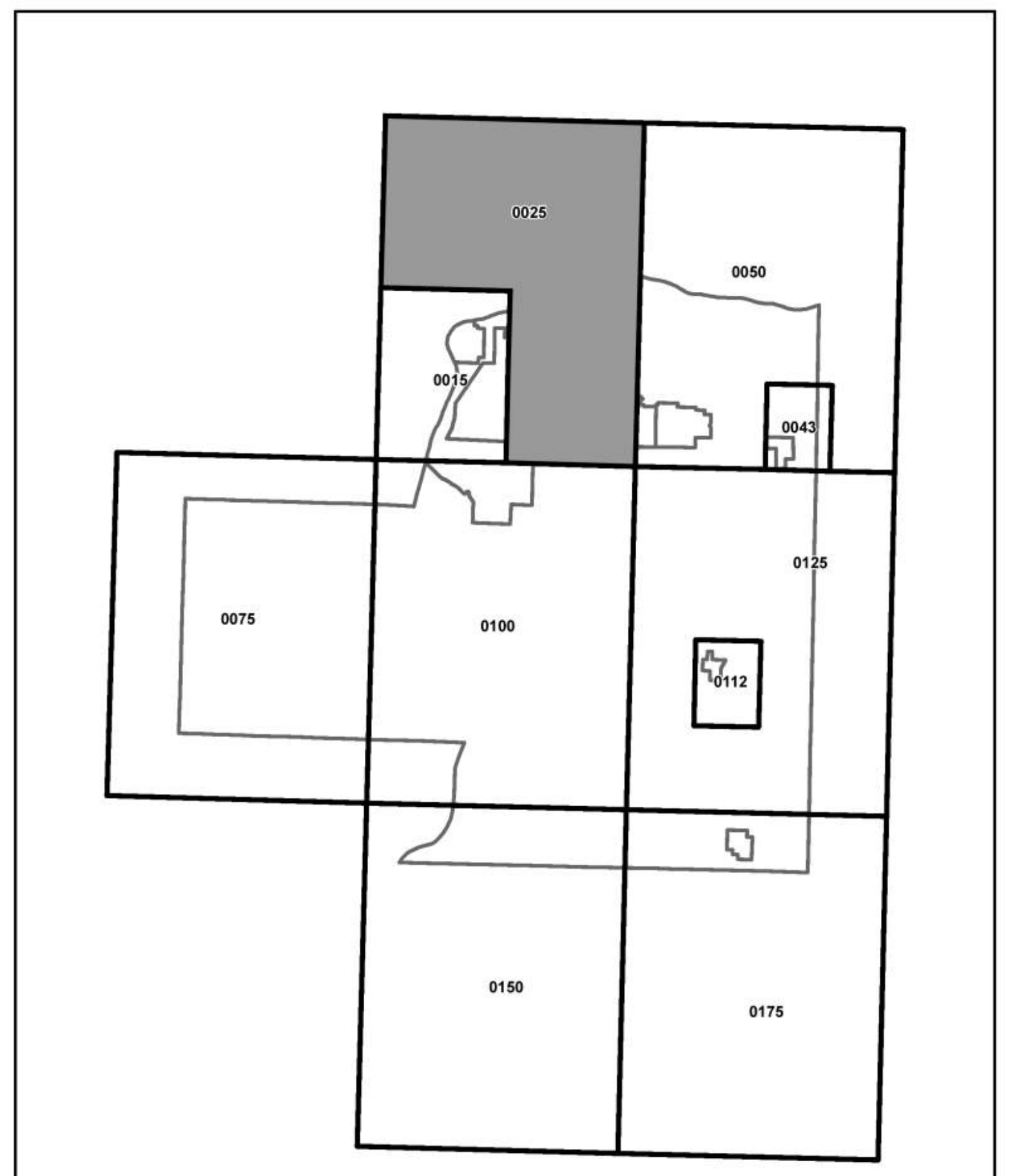
PANEL INDEX



▨ Panel Not Printed

THIS AREA SHOWN AT A SCALE OF
1" = 1000' ON MAP NUMBER 17155C0015

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

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FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
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COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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———	1% annual chance floodplain boundary
———	0.2% annual chance floodplain boundary
— —	Floodway boundary
– — — –	Zone D boundary
•••••••••••••	CBRS and OPA boundary
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~~513~~	Base Flood Elevation line and value; elevation in feet*
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4989000M N	1000-meter Universal Transverse Mercator grid values, zone 16
1565000 FT	5000-foot grid tick: Illinois State Plane West Coordinate System, 3801 zone (FIPSZONE 1202) Transverse Mercator
DX5510×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
FEBRUARY 4, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET
600 0 600 1200 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0025E

FIRM
FLOOD INSURANCE RATE MAP
PUTNAM COUNTY, ILLINOIS
AND INCORPORATED AREAS

PANEL 25 OF 175

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
HENNEPIN, VILLAGE OF	170570	0025	E
MARK, VILLAGE OF	170572	0025	E
PUTNAM COUNTY	170993	0025	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
17155C0025E

EFFECTIVE DATE
FEBRUARY 4, 2011

Federal Emergency Management Agency

APPENDIX C – TECHNICAL ASSESSMENT OF RIVER AND DAM SAFETY IMPACTS FOR THE CLOSURE OF CCR PONDS

Hanson Professional Services Inc.
1525 South Sixth Street
Springfield, Illinois 62703
ph (217) 788-2450
fax (217) 788-2503

www.hanson-inc.com

Additional Documentation

Riverine Structures Form

- Section D.4 – Closure of the Old West Ash Pond (OWAP) has been approved by the Illinois Department of Natural Resources Office of Water Resources under permit No. DS2021007 (see attached). The dam has been assigned a hazard classification of Class III (Low Hazard). The OWAP was closed through the installation of geomembrane in addition to fill within the pond. Ponded surface water was removed from the OWAP. The geomembrane cover consists of a 40-mil textured LLDPE and soil cover system. The cover system was constructed above the pre-closure top of dam eliminating the pre-closure impounding capacity of the structure. The post-closure cover system freely drains to the Illinois river and the structure will no longer be intended to impound water. The attached permit No. DS2021007 includes the related drawings, specifications and supporting design information for the OWAP closure.

- Section D.7 – Old West Ash Pond is a Class III: Low Hazard Dam. Per IDNR Part 3702 Rule 3702.40 the dam does not require a formal Operation & Maintenance Plan.

Pertinent excerpts from the Technical Assessment in support of permit No. DS2021007 are attached.

Draft Notice:

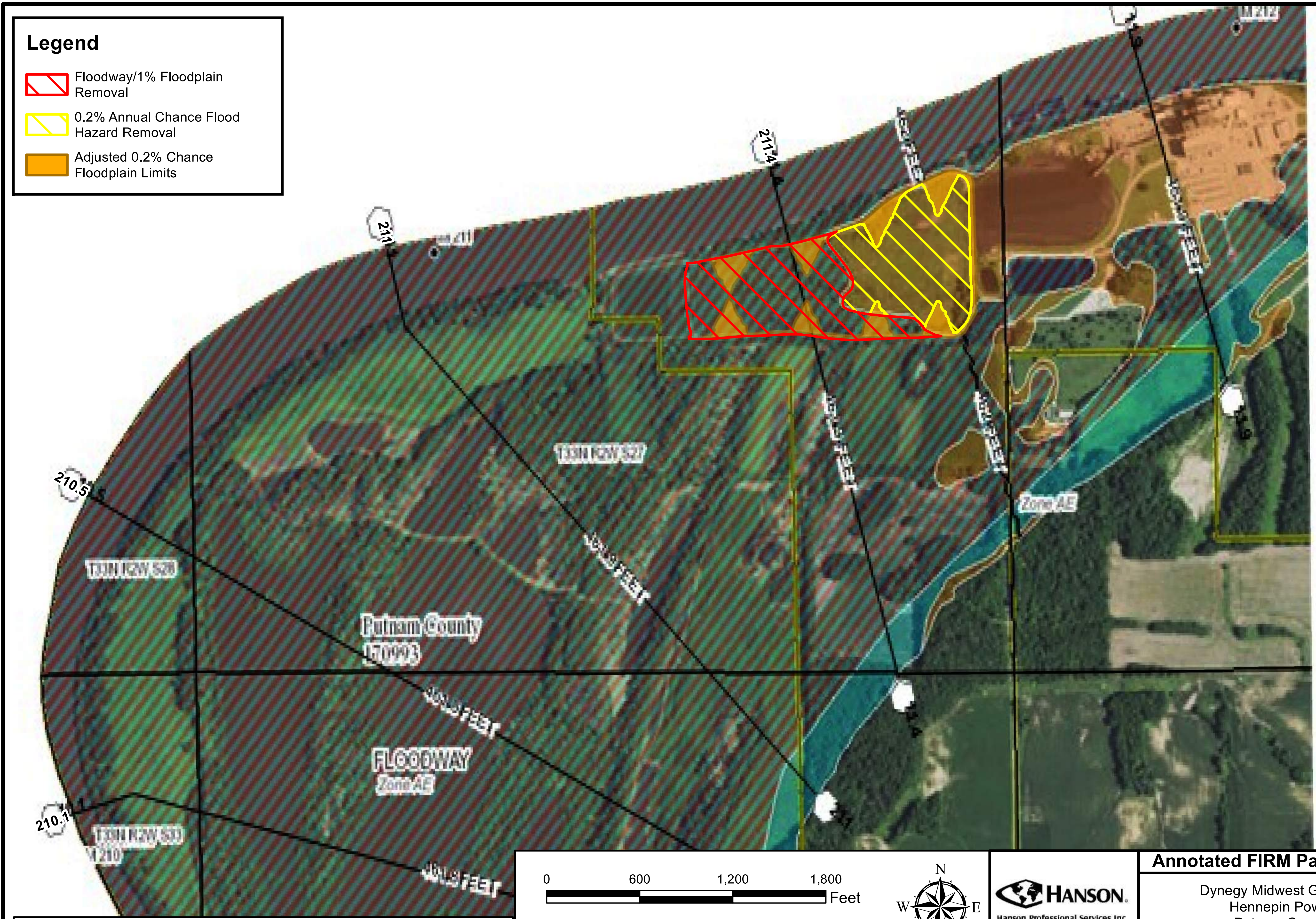
The Putnam County Zoning and Floodplain Office, in accordance with National Flood Insurance Program regulation 65.7(b)(1), hereby gives notice of Putnam County's intent to revise the flood hazard information, generally located on the south bank of the Illinois River along the Hennepin Power Station Old West Ash Pond (OWAP). Specifically, the flood hazard information will be revised over the Old West Ash Pond (OWAP). The flood hazard revisions are being proposed as part of a Letter of Map Revision (LOMR) Case No. xx-xx-xxxxx to incorporate the closure of the Hennepin Power Station OWAP.

1. The floodway and floodplain over OWAP will be revised to remove an area about 1800-ft by 1000-ft.
2. Base Flood Elevations (BFEs) will not change.

Maps and detailed analysis of the revision can be reviewed at the Putnam County Clerk Office at 120 N. Fourth Street, Hennepin IL. Interested persons may call Jim Burger, Zoning and Floodplain Office - Enforcement Officer at (972) 624-3109 or pczoning@co.putnam.il. for additional information from Monday – Friday : 9:00 am - 4:00pm.

Figure TBD.
SAMPLE PUBLIC NOTIFICATION FOR PROPOSED FLOOD HAZARD REVISIONS
(to be used by community when placing a notice in a newspaper)

Please note that a newspaper notice may not be used to fulfill the notification requirement of NFIP Regulation 65.12.



Vertical Datum: NAVD88
Coordinate System: NAD 1983 NSRS2007 StatePlane Illinois West FIPS 1202 Ft US

0 600 1,200 1,800 Feet

1 inch = 600 feet

N
W E
S

HANSON
Hanson Professional Services Inc.

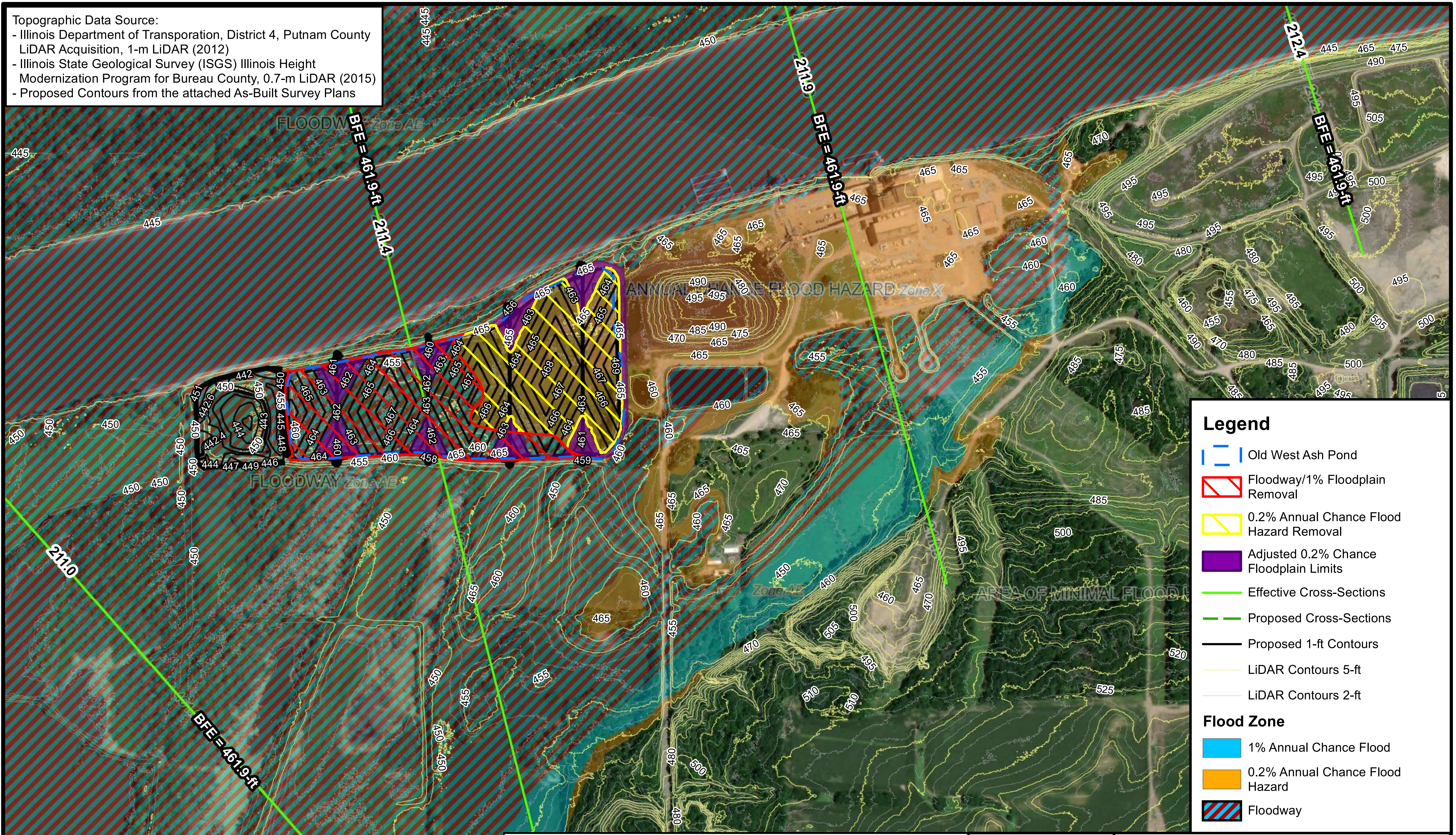
Annotated FIRM Panel 17155C0015E

Dynegy Midwest Generation, LLC
Hennepin Power Station
Putnam County, Illinois

Job Number 19E0096B

I:\19jobs\19E0096B\CAD\GIS\Projects\MT-2 FIRM_0015.mxd

Topographic Data Source:
- Illinois Department of Transporation, District 4, Putnam County LiDAR Acquisition, 1-m LiDAR (2012)
- Illinois State Geological Survey (ISGS) Illinois Height Modernization Program for Bureau County, 0.7-m LiDAR (2015)
- Proposed Contours from the attached As-Built Survey Plans



Legend

▭	Old West Ash Pond
▨	Floodway/1% Floodplain Removal
▨	0.2% Annual Chance Flood Hazard Removal
🟪	Adjusted 0.2% Chance Floodplain Limits
—	Effective Cross-Sections
- -	Proposed Cross-Sections
—	Proposed 1-ft Contours
—	LiDAR Contours 5-ft
—	LiDAR Contours 2-ft

Flood Zone

🟦	1% Annual Chance Flood
🟧	0.2% Annual Chance Flood Hazard
▨	Floodway

Vertical Datum: NAVD88
Coordinate System: NAD 1983 NSRS2007 StatePlane Illinois West FIPS 1202 Ft US

0 500 1,000 1,500 Feet

1 inch = 500 feet

N E S W

HANSON
Hanson Professional Services Inc.

Topographic Work Map

Dynegy Midwest Generation, LLC
Hennepin Power Station
Putnam County, Illinois

Job Number 19E0096B

I:\19Jobs\19E0096B\CAD\GIS\Projects\MT-2 Floodplain Removal.mxd

PERMIT NO. DS2021007
DATE: February 11, 2021

State of Illinois

Department of Natural Resources, Office of Water Resources

Permission is hereby granted to:

Dynegy Midwest Generation, LLC
1500 Eastport Plaza Drive
Collinsville, Illinois 62234

To modify, operate and maintain the West Ash Pond Dam, an intermediate size Class II dam located in Section 27, Township 33 North, Range 2 West of the 3rd Principal Meridian in Putnam County, in accordance with an application dated October 30, 2020. The plans and specifications are entitled:

HENNIPEN POWER STATION
PERMIT DRAWINGS FOR THE CLOSURE OF THE
OLD WEST ASH POND AND OLD WEST POLISHING POND
Sheets G100, G110, C100, C200, C210, C220, C300, C310, C320, C330, C400, C410 and C420
Dated May 1, 2020
Technical Specifications
Sections 01 11 01, 01 42 13, 01 43 00, 01 57 19 01 78 00: Division 02 and Division 31
Dated January 28, 2019

The construction authorization covers removal of the surface impounding capacity, shaping of the embankment slopes and general site drainage work. The construction activities were previously completed.

Examined and Recommended:	**Approval Recommended:**
______________________________	______________________________
Paul Mauer, Jr., P.E. **State Dam Safety Engineer**	**Loren A. Wobig, Director** **Office of Water Resources**

Approved:

____
Colleen Callahan, Director
Department of Natural Resources

This PERMIT is subject to the terms and special conditions contained herein.

PERMIT NO. DS2021007

THIS PERMIT IS SUBJECT TO THE FOLLOWING CONDITIONS:

1) This permit is granted in accordance with the Rivers, Lakes and Streams Act [615 ILCS 5].

2) This permit does not convey title to the permittee or recognize title of the permittee to any submerged or other lands, and furthermore, does not convey, lease or provide any right or rights of occupancy or use of the public or private property on which the activity or any part thereof will be located, or otherwise grant to the permittee any right or interest in or to the property, whether the property is owned or possessed by the State of Illinois or by any private or public party or parties.

3) This permit does not release the permittee from liability for damage to persons or property resulting from the work covered by this permit, and does not authorize any injury to private property or invasion of private rights.

4) This permit does not relieve the permittee of the responsibility to obtain other federal, state or local authorizations required for the construction of the permitted activity; and if the permittee is required by law to obtain approval from any federal or other state agency to do the work, this permit is not effective until the federal and state approvals are obtained.

5) The permittee shall, at the permittee's own expense, remove all temporary piling, cofferdams, false work, and material incidental to the construction of the project, from the floodway, river, stream or lake in which the work is done. If the permittee fails to remove such structures or materials, the State may have removal made at the expense of the permittee. If the construction is on a public body of water and if future need for public navigation or other public interest of any character, by the State or federal government, necessitates changes in any part of the structure or structures, such changes shall be made by and at the expense of the permittee or the permittee's successors as required by the Department of Natural Resources or other properly constituted agency, within sixty (60) days from receipt of written notice of the necessity from the Department or other agency, unless a longer period of time is specifically authorized.

6) The execution and details of the work authorized shall be subject to the supervision and approval of the Department. Department personnel shall have the right of access to accomplish this purpose.

7) The permittee shall file with the Department a properly executed acceptance of all terms and conditions of the permit within sixty (60) days of receipt of the permit; however, starting work on the construction authorized will be considered full acceptance by the permittee of the terms and conditions of the permit.

8) The Department in issuing this permit has relied upon the statements and representations made by the permittee; if any substantive statement or representation made by the permittee is found to be false, the permit may be revoked at the option of the Department; and when a permit is revoked all rights of the permittee under the permit are voided.

9) If the project authorized by this permit is located in or along Lake Michigan or a meandered Lake, the permittee and the permittee’s successors shall make no claim whatsoever to any interest in any accretions caused by the project.

10) In issuing this permit, the Department does not ensure the adequacy of the design or structural strength of the structure or improvement.

11) Noncompliance with the conditions of this permit will be considered grounds for revocation.

12) If the construction activity permitted is not completed on or before ______n/a_____, this permit shall cease and be null and void.

THIS PERMIT IS SUBJECT TO THE FOLLOWING SPECIAL CONDITIONS:

PERMIT NO. DS2021007

PERMIT ACCEPTANCE

This Acceptance must be signed and returned to the address below to validate this permit.

ILLINOIS DEPARTMENT OF NATURAL RESOURCES
OFFICE OF WATER RESOURCES
One Natural Resources Way
Springfield, Illinois 62702-1271

The undersigned permittee, personally, or if a corporation by its duly authorized officers, hereby accepts the permit bearing the above permit number subject to all conditions named therein, on this ____________day of _______________________, 20__.

____

By__________________________

By__________________________

If a corporation
affix seal here.

Date

Illinois Department of
Natural Resources

One Natural Resources Way Springfield, Illinois 62702-1271
www.dnr.illinois.gov

JB Pritzker, Governor
Colleen Callahan, Director

February 11, 2021

SUBJECT: Permit No. DS2021007
Modification, Operation and Maintenance
West Ash Pond Dam – IL00698
Putnam County

Dynegy Midwest Generation, LLC
Attn: Ms. Dianna Tickner
1500 Eastport Plaza Drive
Collinsville, IL 62234

Dear Ms. Tickner:

Enclosed is Illinois Department of Natural Resources, Office of Water Resources Permit No. DS2021007, authorizing the modification, operation and maintenance of the West Ash Pond Dam at Hennepin Power Station. This permit authorizes the removal of the surface impounding capacity, work on the embankment slopes and work on the drainage of the adjacent coal yard area. These items were previously completed and are approved on an after-the-fact basis. It also authorizes the future operation and maintenance of the structure.

The application included information related to several other aspects of the work. The result of our consideration of those items is as follows:

- Floodway delineation – the current FEMA maps indicate that the surface of the ash pond was in the floodway. The topographic information indicates that the top of the embankments has been above the BFE. This prevents the area which includes the top of the embankment and the interior of the impoundment from conveying flood flows of the BFE event. By definition, this area cannot be part of the floodway. The previous delineation appears to be in error. The Department supports the correction of the map by removing the areas above the BFE from the floodplain.

- Application of the Part 3704 rules – The application documents show that the work occurred above the 50% duration elevation of the Illinois River. The construction requirements in the Part 3704 rules do not apply. The permittee is reminded that the public's rights related to the public waters follow the water. Public use of the public waters shall not be impacted without authorization from the Department.

- Application of Part 3702 Rules – The application includes a partial analysis of the potential for the material within the structure to meet the criteria for deregulation of the structure. The investigation did not consider all parts of the impoundment and indicated that during the design seismic event some material may be subject to liquefaction. The result is that the structure still meets the definition of a dam and remains a regulated dam. Based on the analysis, the classification of the dam is reduced to Class III. The periodic inspection requirement is modified to require inspections only once every 5 years.

- Operation and Maintenance Plan – this authorization incorporates the Operation and Maintenance Plan for the East Ash Pond Dam, as applicable to the West Ash Pond Dam.

This permit does not supersede any other federal, state or local authorizations that may be required for the project.

If any changes of the permitted work are found necessary, revised plans should be submitted promptly to this office for review and approval.

Please feel free to contact me at 217/782-4427 if you have any questions concerning this authorization.

Sincerely,

Paul Mauer, Jr., P.E.
State Dam Safety Engineer

PM:cjp

Enclosure

cc: Mr. Tony Comerio, Hanson Professional Services (e-mail)

SPECIAL CONDITIONS
DYNEGY MIDWEST GENERATION
HENNEPIN WEST ASH POND DAM – IL00698
DS2021007

a. There shall be no change from the plans submitted and hereby approved unless the proposed change in plans shall first have been submitted to and approved, in writing, by the State of Illinois acting by and through its Department of Natural Resources, Office of Water Resources.

b. The Permittee shall operate, inspect, and maintain the dam and appurtenances in accordance with the approved plans and in accordance with the latest edition of the "Rules for Construction and Maintenance of Dams" adopted by the Department of Natural Resources. If the approved operation, inspection and maintenance plans are not complied with by the Permittee, this permit shall cease and be null and void.

c. The Permittee grants the Department of Natural Resources, Office of Water Resources, the right of access to inspect the dam site and immediate vicinity beginning from the date of this permit, for the life of the dam and appurtenances.

d. The Permittee authorizes the Department of Natural Resources, Office of Water Resources, in the event that the dam is found to be in immediate danger of failure, to enter upon the dam property, if necessary, to prevent or alleviate any dam breach damage. The Permittee agrees to compensate the Office of Water Resources for costs reasonably incurred by such emergency action.

e. The Permittee shall have the dam and appurtenances inspected once every 5 years and shall have the engineer prepare and submit an inspection report on forms provided by the Department of Natural Resources to the Department of Natural Resources, Office of Water Resources. In the intervening years the Permittee shall complete and submit the Owner's Maintenance Statement. The first inspection report will be due in 2021 and shall serve as the baseline condition for the modified structure for future inspections.

HANSON

TELEPHONE MEMORANDUM

Date: 2/22/2021	Time: 8:30am

Person Called: Chris Hanstad (ISWS)

Person Calling: Garrett Litteken (Hanson)

Project No.: 19E0096B

Project Name: Closure of Old West Ash Pond at Hennepin Power Station, Hennepin, Illinois

Subject: FEMA MT-2 Submittal Coordination

Copy to File, Others: File

The following expresses our understanding of the items discussed. Please respond in writing within five (5) days of receipt if any changes are required.

On Monday, February 22, 2021, Garrett Litteken (Hanson) called Chris Hanstad (ISWS) to discuss submittal requirements for a MT-2 application in support of a Letter of Map Revision (LOMR) for the removal of the Hennepin Power Station Old West Ash Pond (OWAP) from the 1% annual chance flood hazard based on fill and a floodway mapping error. The primary topic of discussion was the requisite MT-2 forms required for approval of the map change.

Chris Hanstad (ISWS) requested the following information for the MT-2 application:

- The Riverine Structures form should be provided in support of removing the OWAP based on fill.
- Based on preliminary information provided during the call and IDNR OWR permit DS2021007, Chris concurred that the area within the OWAP is improperly mapped as floodway.
  - The Riverine Hydrology and Hydraulics form should be included to document the request to modify the floodway based on a mapping error.
  - Two hydraulic models were used to develop flood hazard information in the subject reach.
    - A UNET model was used to develop the BFE
    - The USACE HEC-RAS Unsteady model was used to develop floodway limits.
    - The unsteady HEC-RAS model does not produce water surface elevations identical to the UNET model.
  - The USACE floodway model should be provided with the conveyance and storage to the OWAP blocked.
    - Effective Cross-Section 211.4 crosses the OWAP. Additional Cross-Sections are not required
  - Garrett noted that changes in water surface resulting from removal of the area within the OWAP are negligible.
  - Chris will make an internal determination if the model should be provided to FEMA
    - Inclusion of the hydraulic model is primarily for administrative purposes and should not impact receipt of a Letter of Map Revision for the OWAP.

JOINT APPLICATION FORM FOR ILLINOIS

ITEMS 1 AND 2 FOR AGENCY USE

1. Application Number	2. Date Received

3. and 4. (SEE SPECIAL INSTRUCTIONS) NAME, MAILING ADDRESS AND TELEPHONE NUMBERS

3a. Applicant's Name: Dynegy Midwest Generation, LLC Company Name (if any) : Dynegy Midwest Generation, LLC Address: 1500 Eastport Plaza Drive Collinsville, IL 62234 Email Address: dianna.tickner@vistracorp.com	3b. Co-Applicant/Property Owner Name (if needed or if different from applicant): Company Name (if any): Address: Email Address:	4. Authorized Agent (an agent is not required): Company Name (if any): Address: Email Address:
Applicant's Phone Nos. w/area code Business: 618-381-3124 Residence: Cell: Fax:	Applicant's Phone Nos. w/area code Business: Residence: Cell: Fax:	Agent's Phone Nos. w/area code Business: Residence: Cell: Fax:

STATEMENT OF AUTHORIZATION

I hereby authorize, ______________________________ to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

Applicant's Signature

Date

5. ADJOINING PROPERTY OWNERS (Upstream and Downstream of the water body and within Visual Reach of Project)

Name	Mailing Address	Phone No. w/area code
a. IDNR	1 Natural Resources Way, Springfield, IL 62702	
b. David Urnikis ET AL	11183 E Power Plant Rd., Granville, IL 61326	
c.		
d.		

6. PROJECT TITLE:
Closure of the Old West Ash Pond and the Old West Polishing Pond

7. PROJECT LOCATION:
Hennepin Power Station

LATITUDE: 41.30057 °N LONGITUDE: 89.32116 °W	UTMs Northing: 4574722.62 Easting: 305669.53				
STREET, ROAD, OR OTHER DESCRIPTIVE LOCATION 13498 E 800th St.	LEGAL DESCRIPT	QUARTER NE	SECTION 27	TOWNSHIP NO. 33N	RANGE 2W

☐ IN OR ☒ NEAR CITY OF TOWN (check appropriate box)
Municipality Name
Hennepin

COUNTY	STATE	ZIP CODE	WATERWAY	RIVER MILE (if applicable)
Putnam County	IL	61327	Illinois River	211.4

Revised 2010

☐ Corps of Engineers ☒ IL Dep't of Natural Resources ☐ IL Environmental Protection Agency ☐ Applicant's Copy

8. PROJECT DESCRIPTION (Include all features):

Hanson Professional Services Inc. (Hanson) was retained by Dynegy Midwest Generation, LLC to perform a hydraulic study for closure of the Old West Ash Pond (OWAP) and Old West Polishing Pond (OWPP) resulting in floodplain fill above the left bank of the Illinois River near Hennepin, Illinois. Closure of the OWAP includes construction of a 40-mil textured LLDPE geomembrane cover above the existing grade which will result in fill within the Illinois River effective floodway. Permits are being applied for the Title 17 Illinois Administrative Code (IAC), Illinois Department of Natural Resources (IDNR) Part 3700 Construction in Floodways of Rivers, Lakes, and Streams, Part 3702 Construction and Maintenance of Dams, and Part 3704 Regulation of Public Waters, and Part 3708 Floodway Construction in support of the pond closures.

9. PURPOSE AND NEED OF PROJECT:

Dynegy Midwest Generation, LLC submitted Notices of Intent to close the OWAP and OWPP to the Illinois Environmental Protection Agency (IEPA) in accordance with 40 Code of Federal Regulations (CFR) Part 257, Subpart D, which is known as the United States Environmental Protection Agency (USEPA) Coal Combustion Residuals (CCR) Final Rule, or the CCR Rule.

COMPLETE THE FOLLOWING FOUR BLOCKS IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

10. REASON(S) FOR DISCHARGE:

11. TYPE(S) OF MATERIAL BEING DISCHARGED AND THE AMOUNT OF EACH TYPE IN CUBIC YARDS FOR WATERWAYS:

TYPE:

AMOUNT IN CUBIC YARDS:

12. SURFACE AREA IN ACRES OF WETLANDS OR OTHER WATERS FILLED (See Instructions)

13. DESCRIPTION OF AVOIDANCE, MINIMIZATION AND COMPENSATION (See instructions)

14. Date activity is proposed to commence August 6, 2019

Date activity is expected to be completed November 17, 2020

15. Is any portion of the activity for which authorization is sought now complete? Yes ☒ No ☐

Month and Year the activity was completed October 26, 2020

NOTE: If answer is "YES" give reasons in the Project Description and Remarks section. Indicate the existing work on drawings.

16. List all approvals or certification and denials received from other Federal, interstate, state, or local agencies for structures, construction, discharges or other activities described in this application.

Issuing Agency	Type of Approval	Identification No.	Date of Application	Date of Approval	Date of Denial
IEPA	CCR Closure		Dec 20, 2017	June 19, 2018	

17. CONSENT TO ENTER PROPERTY LISTED IN PART 7 ABOVE IS HEREBY GRANTED. Yes ☒ No ☐

18. APPLICATION VERIFICATION (SEE SPECIAL INSTRUCTIONS)

Application is hereby made for the activities described herein. I certify that I am familiar with the information contained in the application, and that to the best of my knowledge and belief, such information is true, complete, and accurate. I further certify that I possess the authority to undertake the proposed activities.

Signature of Applicant or Authorized Agent — Date 10/30/2020

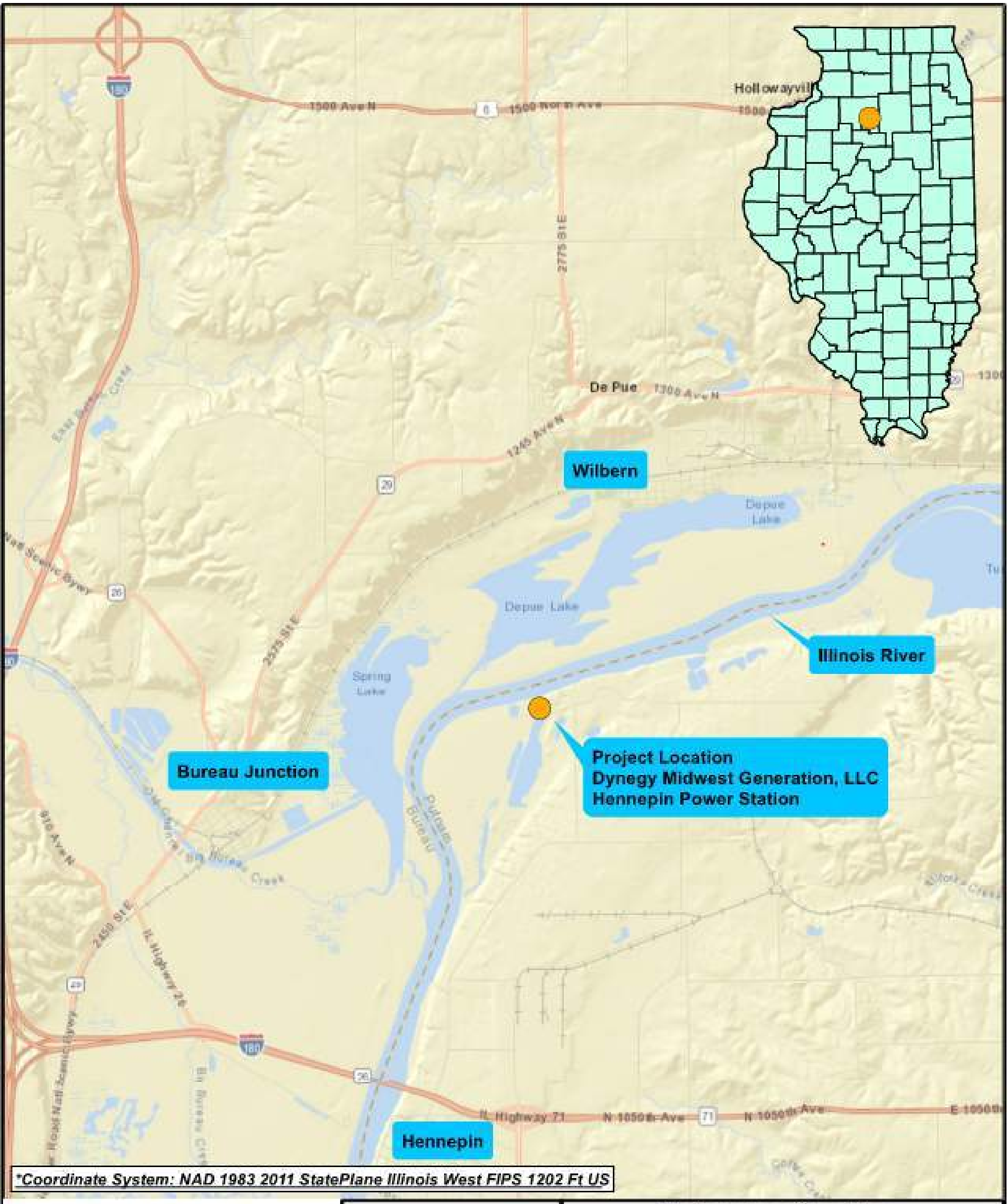
Signature of Applicant or Authorized Agent — Date

Signature of Applicant or Authorized Agent — Date

☐ Corps of Engineers ☒ IL Dep't of Natural Resources ☐ IL Environmental Protection Agency ☐ Applicant's Copy

Revised 2010

SEE INSTRUCTIONS FOR ADDRESS



**Coordinate System: NAD 1983 2011 StatePlane Illinois West FIPS 1202 Ft US*

1 inch = 5,000 feet

0 2,500 5,000
Feet

HANSON.
Hanson Professional Services Inc.

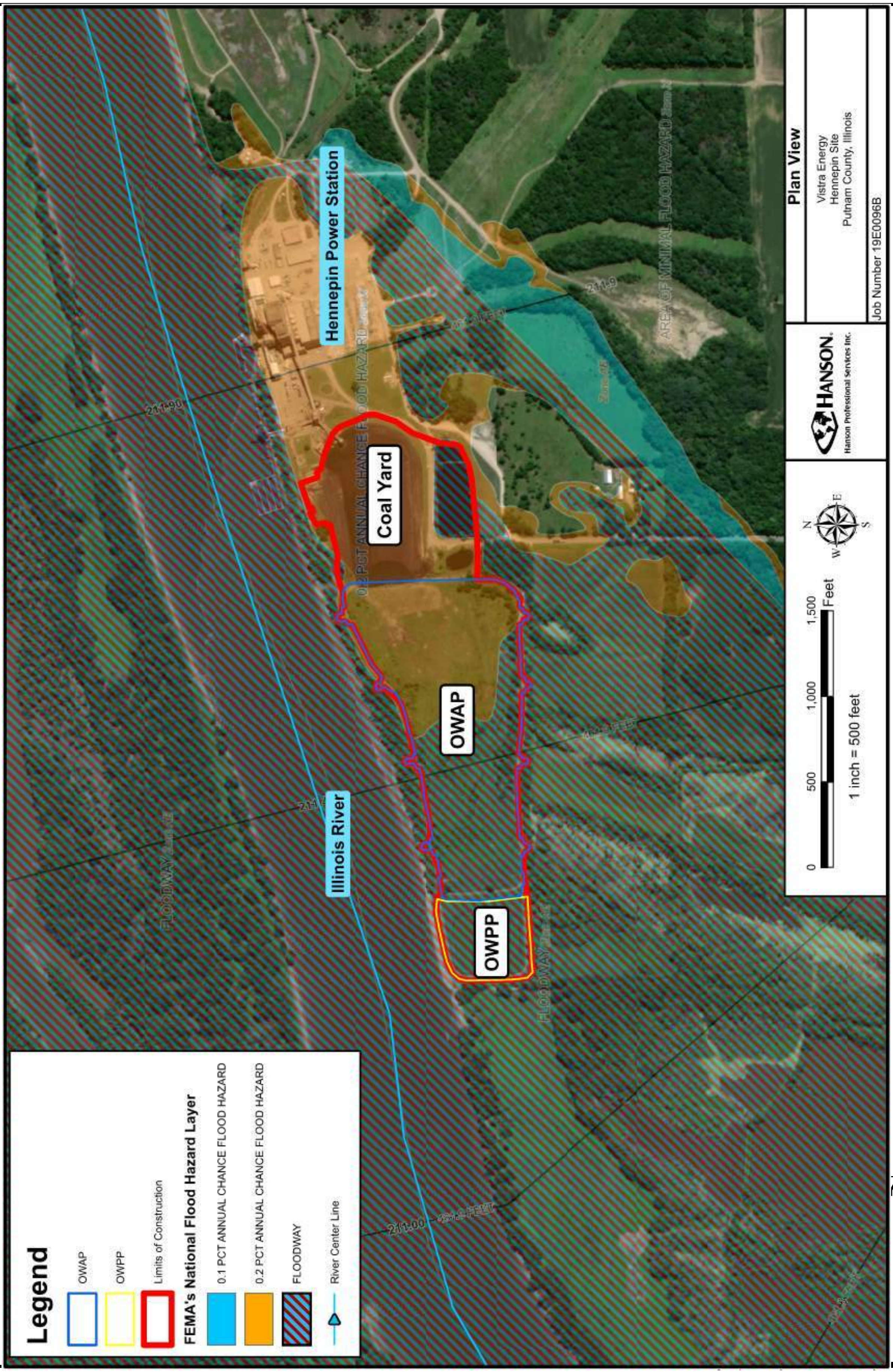
Project Location Map

Dynegy Midwest Generation, LLC
Hennepin Power Station
Putnam County, Illinois

Job Number: 19E0096B

Revised 2010

☐ Corps of Engineers ☒ IL Dep't of Natural Resources ☐ IL Environmental Protection Agency ☐ Applicant's Copy



Revised 2010

☐ Corps of Engineers ☒ IL Dep't of Natural Resources ☐ IL Environmental Protection Agency ☐ Applicant's Copy

Technical Assessment of River and Dam Safety Impacts for the Closure of CCR Ponds

Hennepin Power Station

Putnam County, Illinois

Prepared For: Dynegy Midwest Generation, LLC

Prepared By: Hanson Professional Services Inc.
October 28, 2020

HANSON
Engineering | Planning | Allied Services

Table of Contents

Figures and Tables

Figures

Tables

List of Appendices 8

1. Introduction

Hanson Professional Services Inc. (Hanson) was retained by Dynegy Midwest Generation, LLC (Dynegy). to perform a technical assessment of the potential river and dam safety impacts from the closure of the Old West Ash Pond (OWAP) and Old West Polishing Pond (OWPP) at Hennepin Power Station, near Hennepin, Illinois. The impoundments are located 3 miles north of Hennepin, latitude 41°18'0.62"N and longitude 89°19'28.52"W, in the NE ¼ of Section 27, Township 33 North, Range 2 West of the 3rd Principal Meridian. A site location map is included in Appendix A. Hennepin Power Station is a retired coal fired power plant owned and operated by Dynegy who has pursued closure of the OWAP and OWPP ponds. Closure of the OWAP includes construction of a 40-mil textured LLDPE geomembrane and soil cover system above the coal combustion residuals (CCR) reservoir elevation and will result in fill within the Illinois River effective floodway. The OWPP was closed by removal of CCR residuals and the perimeter embankments degraded to allow free flow to the Illinois River. Closure of the OWPP and capping of the OWAP began on August 6, 2019 and will be substantially completed on November 17, 2020.

The results of this assessment, which included the development of a detailed Illinois River hydraulics model comparing pre-closure and post-closure conditions, show that the activities are permittable under Title 17 Illinois Administrative Code (IAC), Illinois Department of Natural Resources -Office of Water Resources (IDNR-OWR) Part 3700 Construction in Floodways of Rivers, Lakes, and Streams, Part 3702 Construction and Maintenance of Dams, and Part 3704 Regulation of Public Waters.

2. Data Collection

FEMA Data

The FEMA Flood Insurance Rate Maps (FIRM) for unincorporated areas of Putnam County, effective February 2011, indicate that the Dynegy Hennepin Site is located in a Zone AE with portions of the site in the defined regulatory floodway. This means the floodplain has been delineated based on detailed methods, which include Base Flood Elevations (BFE's) for the 100-yr event. The entirety of the OWPP and a portion of the OWAP are located within the defined regulatory floodway, as shown in Figure 1. A copy of the FEMA map is provided in Appendix B. A 2005 US Army Corp of Engineers (USACE) unsteady HEC-RAS model of the Illinois River is the effective FEMA model at the project location. This model was obtained from FEMA and was supplemented with site specific information associated with the pond closures to determine the hydraulic impacts of the post-closure fill in the Illinois River floodplain.

LiDAR Data

Light detection and ranging (LiDAR) data representing ground elevation for Putnam and Bureau Counties are available from the Illinois Height Modernization Program through IDOT via the Illinois Geospatial Data Clearinghouse. The data was recorded in 2012 and 2015, respectively, and was used in combination with the effective FEMA model to develop full floodplain cross-sections of Illinois River in the hydraulic model. All survey and elevation data, which was used to create the hydraulic models, was collected using the North American Vertical Datum of 1988 (NAVD88). All elevations listed in this report are NAVD88 unless otherwise noted.

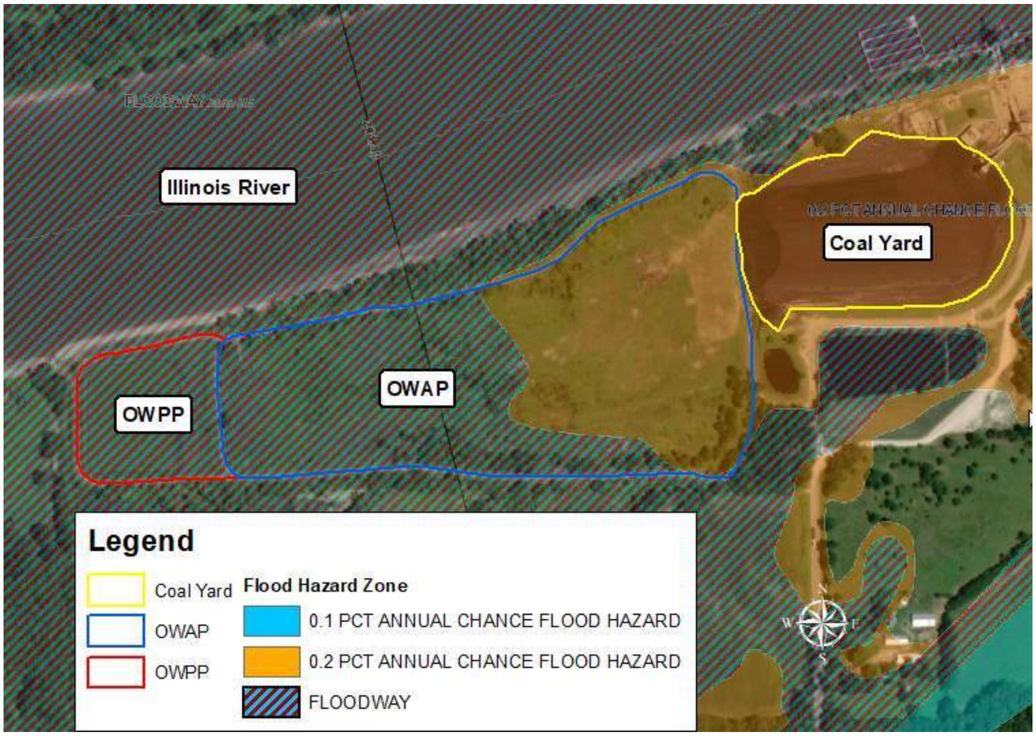


Figure 1: Pre-Construction Pond and Coal Yard Locations

Geosyntec Data

In June 2020, Hanson received data from Geosyntec including survey, As-Built plans and CAD files for the project site. This data was used to generate pre-closure and post-closure topographic surfaces for use with the hydraulic modeling effort. In September 2020, Hanson received Geosyntec's Stormwater Pollution Prevention Plan (SWPPP) and the closure plan for the site which was submitted to and approved by the Illinois Environmental Protection Agency (IEPA). The pre-construction plans are provided along with the IEPA closure plan and SWPPP in Appendixes H and I, respectively. Also provided by Geosyntec is a Construction Quality Assurance (CQA) plan and Geotechnical Calculations for Closure Design included in Appendix J and K, respectively.

3. Pre-Closure Site Description

This site prior to closure includes two ponds, OWAP and OWPP, which have a surface area of approximately 29 acres and 5 acres, respectively. The ponds are located on the Illinois River's left (South) bank and are shown in Figure 1. The OWPP perimeter berm and interior elevations are below the 100-yr BFE of 461.9-ft. The interior elevations of the OWAP are below the BFE. However, the perimeter berm is above the BFE and preventing the OWAP from actively conveying flow or providing floodplain storage. The pre-closure berms are not FEMA accredited levees. Therefore, per FEMA criteria, the area within the OWAP is mapped as floodplain. However, since the pre-closure OWAP berm is above the 100-yr floodplain, the area within OWAP does not have access to the Illinois River floodplain and would not provide conveyance for a river flooding event within the bermed area. While the area within the OWAP containment berm cannot convey flow, the area within OWAP was modeled as effective flow for pre-closure site conditions to provide a conservative estimate of potential project impacts. Effective flow areas are locations where the flow velocity is greater than zero. The pre-closure site plan with the certified pre-construction survey contours is provided in Appendix C.

4. Hydrology

The Illinois River has an approximate drainage area of 13,000-mi² to the project location. Discharge estimates for the Illinois River were based on the 2005 USACE Upper Mississippi River System Flow Frequency Study (UMRSFFS). These discharges were acquired from USACE Flow Frequency Query (FFQ) website and are included in Appendix D. The FEMA Flood Insurance Study (FIS) provides flow estimates at river miles 157.7 and 231.1 and were interpolated to river mile 211.4. The UMRSFFS was the basis for the effective 2005 USACE unsteady HEC-RAS model. The effective model captures detail within the Peoria Pool that is not taken into consideration by the FFQ and FIS. As shown in Table 1, the HEC-RAS unsteady regulatory model discharges used in determination of the BFE are significantly lower than those documented in the FFQ and the FIS. The discharges provided by the FFQ include a flow range that encompasses both the FEMA FIS and regulatory model discharges. As a result, the flows from the FFQ were used as the basis for a worst-case hydraulic analysis of the impacts to the Illinois River to determine compliance with IDNR-OWR floodway construction regulations. This analysis meets the worst-case analysis criteria outlined by 17 IAC 3700.20. Documentation of all discharges used in this assessment are provided in Appendix D. Table 1 shows a discharge comparison of the UMRSFFS and FEMA FIS interpolated values.

Table 1: Published Steady Discharges for Illinois River

Source	Frequency (yr)							
	2	5	10	25	50	100	200	500
USACE Flow Frequency Study (FFQ website)	67,000	95,000	114,000	136,000	153,000	169,000	185,000	201,000
FEMA FIS (Interpolated)	-	-	86,485	-	113,459	124,386	-	149,775
2005 Effective USACE Unsteady HEC-RAS Model	-	-	-	-	-	114,000	-	-

5. Hydraulics

To determine compliance with IDNR-OWR regulations regarding construction activities in a floodway, a worst-case hydraulic analysis of potential impacts to the Illinois River was prepared. The FEMA effective model from the USACE is an unsteady model using the Hydrologic Engineering Center’s River Analysis System program version 3.1.3 (HEC-RAS). A duplicate effective model was run in HEC-RAS version 3.1.3 and served as the baseline for the study. Three (3) models were developed as part of this assessment which included a duplicate effective, corrected effective (existing/pre-closure conditions), and a proposed conditions (post-closure).

Duplicate Effective Model

The effective USACE HEC-RAS unsteady model v. 3.1.3 was run in v. 3.1.3 to ensure that the model ran successfully. Results showed that there was no change in computed water surface between the effective and duplicate effective hydraulic models.

Corrected Effective (Existing/Pre-Closure Conditions) Model

The duplicate effective model serves as the baseline for the corrected effective model. The duplicate effective model was imported into the current version of HEC-RAS, version 5.0.7 and was modified as follows to develop the corrected effective condition. To prepare the worst-case assessment of the proposed (post-closure) project, all cross-sections outside of river mile 213.66 to 208.60 were removed from the corrected effective model. Several cross-sections between the FEMA cross-sections 211.9 and 211.0 were added to the corrected effective model geometry to capture more detail for the project site geometry and proposed flow area changes. The corrected effective model was also converted to a steady state model to simplify the worst-case assessment. The downstream boundary condition was set as the water surface elevation of the downstream cross-section in the effective model. Hydraulic cross-section location maps are provided in Appendix E.

The corrected effective model serves as the existing model (pre-closure) on the basis that the pre-closure survey information does not contain man-made changes at the project site constructed since the effective date of the effective hydraulic modeling of the Illinois River.

Geometry for the added cross-sections was developed from a combination of interpolated channel geometry and LiDAR topography for the overbanks. The OWAP, OWPP and coal yard were further refined for the corrected effective model from pre-construction survey data provided by Geosyntec and incorporated into all relevant sections. A plan of the pre-construction site is included in Appendix C. Manning’s n-values were assigned to the additional cross-sections using aerial imagery and corresponding to values in the effective model. A Manning’s n-value of 0.025 was used for the natural channel. In the overbanks, values range from 0.045 in areas of moderate vegetation to 0.12 for areas of heavy vegetation and ineffective ponded water, including OWAP and OWPP, with a value of 0.03 for wetland areas.

Figure 2 includes FEMA FIRM data and shows divided flow around the project site. This appears to be a mapping error based on 2012 LiDAR topographic data. This area is not hydraulically connected at the upstream and downstream extent of this split in the floodplain. The topo data shows that areas upstream and downstream of the project site are above the BFE. However, for modeling purposes, these areas were modeled as effective flow through the project site as a conservative estimate of the potential project impacts to water surface elevations on the river.

Proposed Conditions (Post-Closure) Model

The proposed (post-closure) grading plan includes a soil cap on the OWAP and closure by removal through excavation of CCR in the OWPP. The existing (pre-closure) coal pile and coal yard has been regraded to provide additional storage and positive drainage to the Illinois River. The ponds and coal yards are shown in Figure 1. A plan of the proposed grading with the certified As-Built survey contours is provided in Appendix F. Utilizing the site grading plans from Geosyntec, a proposed conditions HEC-RAS model was created based upon the existing conditions HEC-RAS model where the proposed grading replaced the existing grading at the project site.

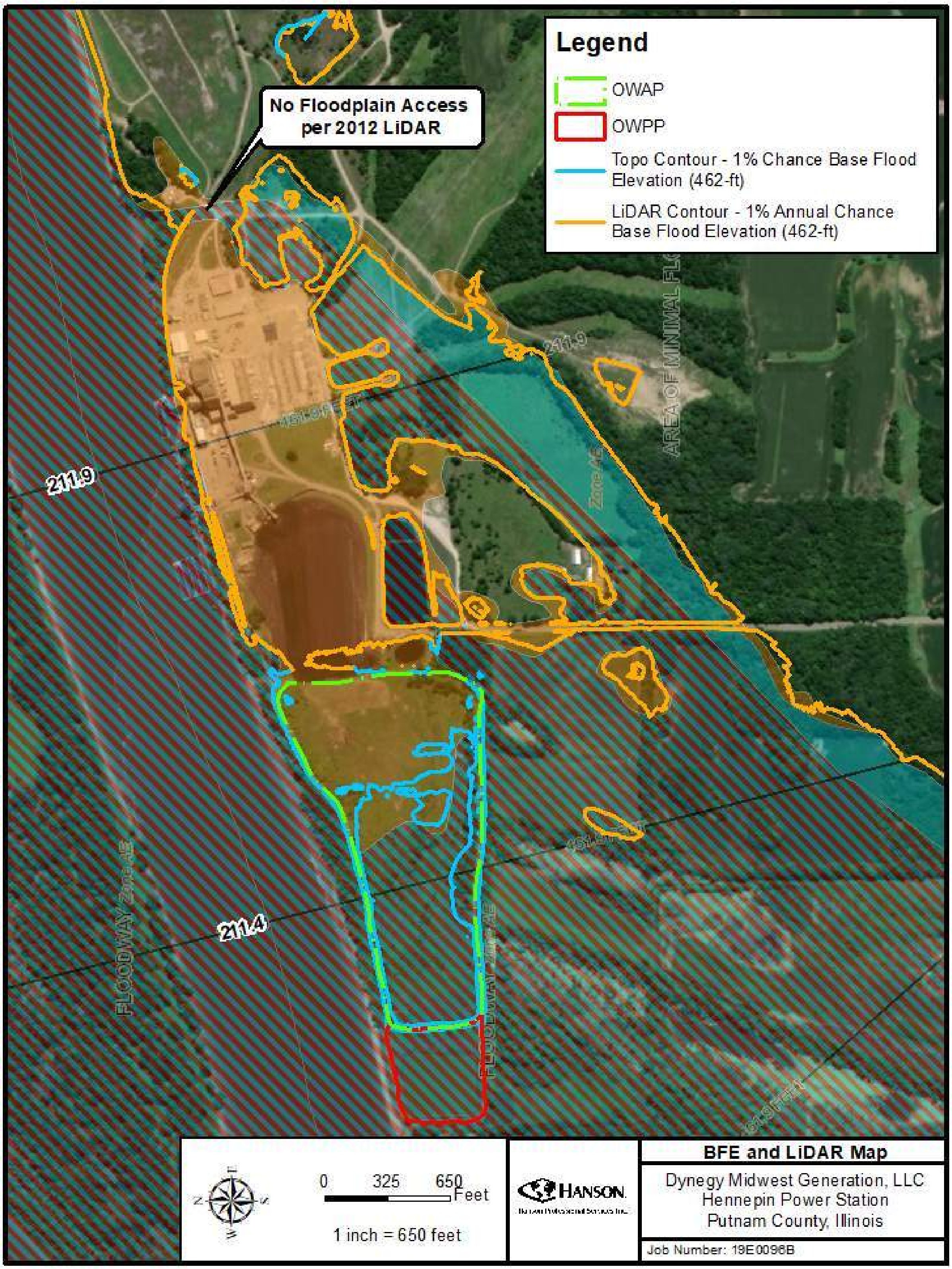


Figure 2: Topo and LiDAR Contours at Project Site

Worst-Case Analysis Results

Results from this model show the proposed (post-closure) grading creates a maximum increase in water surface elevation over existing conditions (pre-closure) of 0.00-ft for all flows modeled. In addition, the maximum increase in channel velocity from existing to proposed is 0.01-ft/s. Existing conditions channel velocities do not exceed 3-ft/s, which, together, demonstrate that there is not an increase in scour potential in the river channel. The model results, including water surfaces elevations and velocity comparison tables, are provided in Appendix G.

6. Dam Safety

The OWAP and OWPP surface impoundment dams are earthen embankment structures separating the ponds from the Illinois River. The primary purpose of the dams was impoundment of coal combustion residuals (CCR). The OWAP dam has a length of approximately 5,100-ft at the crest, with a height of 16-ft and a crest at elevation 464.0-ft. The OWAP pond has a surface area of 28.9 acres at the dam crest with a maximum pre-construction impounding volume of 78.6 acre-feet. The OWPP pond shares its east dam embankment with the OWAP pond. The OWPP dam has a length of approximately 1,900-ft at the crest, with a height of 11-ft and a crest at elevation 459.0-ft (NAVD 88). The OWPP pond has a surface area of 5.2 acres at the dam crest with a maximum pre-construction impounding volume of 43.4 acre-feet. The OWAP and OWPP dams are located on the southern bank of the Illinois River and failure of the dams could potentially discharge directly to the Illinois River to the north and to the Illinois River floodplain to the south. According to 40 CFR 257.73, the OWAP and OWPP ponds are significant hazard potential classification CCR surface impoundments.

Pond Closure Methods

The closure plan for the ponds, submitted by Geosyntec on behalf of Dynegy, was approved by IEPA on June 19, 2018. The IEPA approval letter and closure plans are included in Appendix H. According to these plans, Dynegy has completed the closure of the OWPP and OWAP as follows:

- The OWPP was closed-by-removal. CCR was removed from the impoundment and the perimeter dikes will be degraded to elevation 450-ft, equal to the Illinois River flood stage of 450.0-ft. The perimeter dike was breached to allow the area to freely drain to the Illinois River. A sheet pile wall provided temporary support between the OWPP and OWAP during construction, and a compacted clay buttress will serve as long-term support. Completion of construction on the OWPP allows for free surface drainage and the structure will no longer be intended to impound water.
- The OWAP was closed through the installation of a geomembrane in addition to fill within the pond. Ponded surface water was removed from the OWAP. The OWAP impoundment was regraded to support the final cover system. The geomembrane cover consists of a 40-mil textured LLDPE and soil cover system. Vegetation will be established on the soil cover layer using native grasses. The cover system was constructed above the pre-closure top of dam eliminating the pre-closure impounding capacity of the structure. The post-closure cover system freely drains to the Illinois River and the structure will no longer be intended to impound water.

Detail on construction activities and related documentation are provided in the Stormwater Pollution Prevention Plan (SWPPP) and Construction Quality Assurance (CQA) plan included in Appendix I and Appendix J, respectively.

Regulatory Criteria

The OWAP and OWPP ponds are regulated in accordance with 17 Illinois Administrative Code (IAC), IDNR-OWR Part 3702 Rules for the Construction and Maintenance of Dams. A failure of the OWAP and OWPP dams under any circumstances would discharge to the Illinois River and have a low probability for causing loss of life. No permanent structures for human habitation are located in the breach inundation area. Under pre-closure operation, the dams are considered small-size Class II (significant hazard potential) dams due to the environmental risk associated with the impounded CCR material. In accordance with CCR design requirements for the pre-closure condition of the OWAP and OWPP ponds act as a closed loop system and the normal operating water surface is maintained by portable pumps.

Removal of CCR material from the OWPP and capping the OWAP began on August 6, 2019 and will be substantially completed on November 17, 2020. Closure of the OWPP and OWAP ponds met IEPA criteria for Closure and Post-Closure Care of CCR surface impoundments under Title 35 Illinois Administrative Code 620.250 per the IEPA approval letter of the closure plan included in Appendix H.

A supporting geotechnical evaluation for closure by capping of the OWAP was provided by Geosyntec. The geotechnical analysis was developed in accordance with 40 CFR Part 257.73 Subpart D. The geotechnical calculations received from Geosyntec, provided in Appendix K, indicate that the OWAP closure will meet the requirements for dam abandonment based on the following special conditions:

1. The pre-closure impounded material is of a non-flowable nature;
2. The material is not susceptible to liquefaction under seismic loading. The containing dam embankment provides a sufficient factor of safety under static conditions;
3. The OWAP cap is graded to freely drain. The OWAP cover consists of a 40-mm textured LLDPE geomembrane and does not permit resaturation of the CCR material; and
4. A final inspection report will be completed and submitted within 1 year of abandonment.

7. Compensatory Storage

17 IAC, IDNR-OWR Part 3708 outlines the rules for floodway construction in specific northeastern Illinois counties. This project is not located in one of the northeastern counties listed under Part 3708. However, IDNR-OWR made a special request that compensatory storage be provided for the floodplain fill associated with the closure of the OWAP and OWPP. The compensatory storage must be placed between the post-closure normal water elevation and the post-closure 100-yr flood elevation at a 1-to-1 ratio. The site has been graded to meet this special request and has been documented in the post-closure grading plans by Geosyntec shown in Appendix F. Table 2 shows the net compensatory storage calculation.

Hanson believes that the completed closure of the OWPP and OWAP ponds meet this special request. The basis of this determination is that the site work meets the following special conditions:

- Floodplain access to the OWPP and Coal Yard compensatory storage are provided within the property limits of Dynegy.
- Compensatory storage provided in the OWPP, Coal Yard, Coal Yard Pond East and Coal Yard Pond West will be free draining.

- The post-closure OWAP cover system produces 78,868 cu. yd. of fill below the Effective BFE of 461.9-ft. The regrading of the coal pile, Coal Yard Pond East and Coal Yard Pond West adds an additional 1,232 cu. yd of fill for a total of 80,100 cu. yd of fill below the Effective BFE. Removal of CCR material from the OWPP in addition to the regrading of OWAP, Coal Pile, Coal Yard Pond East and Coal Yard Pond West result in 77,857 cu. yd. of cut below the Effective BFE. This produces a net fill of 2,243 of cu. yd. However, the total volume of water in the ponds below the Effective BFE prior to construction was 23,217 cu. yd., while the total volume of water in the ponds was reduced to 15,999 cu. yd. after construction through the replacement or regrading of the pond outlet structures to drop the normal pool elevation. This provides an additional 7,218 cu. yd. of cut to provide storage below the Effective BFE. The resulting net volume below the Effective BFE is 4,975 cu. yd of cut.
- All post-closure material removed is between the normal water elevation and the post-closure 100-yr flood elevation.

Table 2: Cut and Fill Volumes

Location	Cut Below EL 461.9-ft (Cu. Yards)	Pre-Construction Impounded Water Volume (Cu. Yards)	Fill Below EL 461.9-ft (Cu. Yards)	Post-Construction Impounded Water Volume (Cu. Yards)
OWAP	2,099	0	78,868	0
OWPP	51,359	10,047	0	9
Coal Pile	11,992	0	679	0
Coal Yard Pond East	9,041	12,815	163	14,077
Coal Yard Pond West	3,366	355	390	1,913
Total	77,857	23,217	80,100	15,999
Total Cut & Fill	101,074		96,099	
Cut - Fill	**4,975**			

8. Public Waters

All construction associated with the pond closure will be outside the banks of the Illinois River or any public water, indicating that the requirements of 17 IAC, IDNR Part 3704 would not be applicable to this assessment.

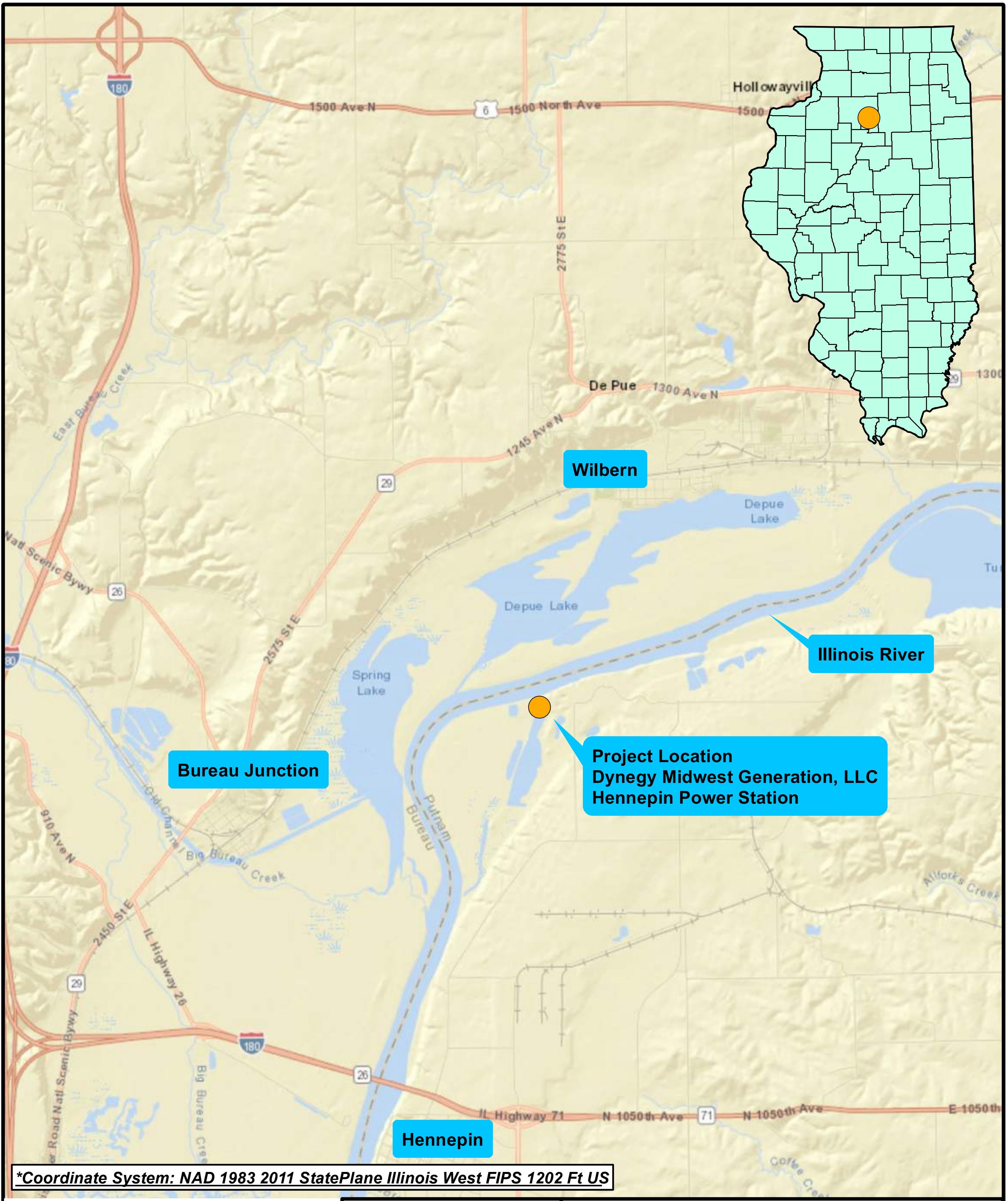
9. Conclusion

Based on the information presented in this technical assessment, the post-closure plans meets 17 IAC, IDNR Part 3700, 3702, and 3704. Sections 7 and 8 outline how the conditions for Parts 3702 and 3704 are met, while the post-closure grading meets Parts 3700 and 3704 through the following conditions:

1. The post-closure construction associated with the closure of the OWAP and OWPP will not have an adverse impact on Illinois River water surfaces profiles.
2. The post-closure construction does not increase in average channel velocity beyond the scour velocity.
3. No construction is within the banks of the Illinois River.

Appendix A

Site Location Map



Coordinate System: NAD 1983 2011 StatePlane Illinois West FIPS 1202 Ft US

1 inch = 5,000 feet

0 2,500 5,000
Feet

N
W E
S

HANSON
Hanson Professional Services Inc.

Project Location Map

Dynegy Midwest Generation, LLC
Hennepin Power Station
Putnam County, Illinois

Job Number: 19E0096B

I:\19jobs\19E0096B\CAD\GIS\Projects\Project Location Map.mxd

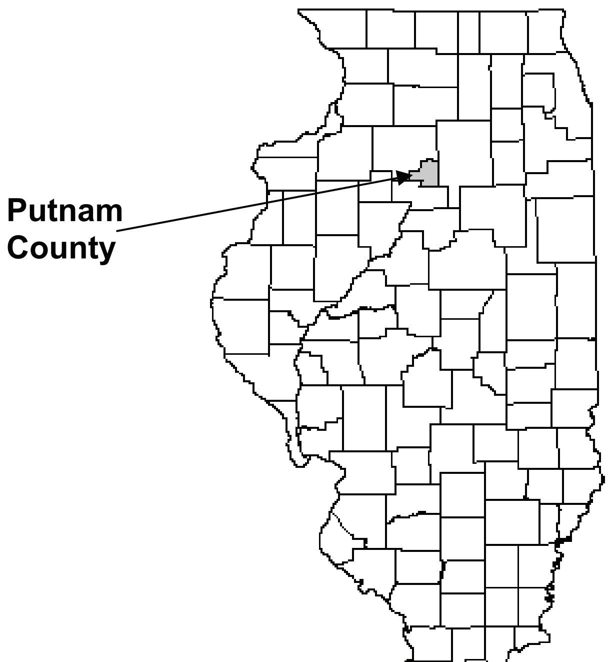
Appendix B

FEMA Data

FLOOD INSURANCE STUDY

PUTNAM COUNTY, ILLINOIS

AND INCORPORATED AREAS



COMMUNITY NAME	COMMUNITY NUMBER
*GRANVILLE, VILLAGE OF	171308
HENNEPIN, VILLAGE OF	170570
*MAGNOLIA, VILLAGE OF	170571
MARK, VILLAGE OF	170572
MC NABB, VILLAGE OF	170573
PUTNAM COUNTY (UNINCORPORATED AREAS)	170993
STANDARD, VILLAGE OF	171012

*NO SPECIAL FLOOD HAZARD AREAS IDENTIFIED

FEBRUARY 4, 2011

U.S. DEPARTMENT OF HOMELAND SECURITY

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER

17155CV000A

flooding of the Illinois River from Lockport to the mouth, the Missouri River below the Gavins Point Dam to the mouth, and the Mississippi River from St. Paul to the confluence with the Ohio River. The St. Louis District conducted the study of the Illinois River from the confluence with the Mississippi River to the La Grange Lock and Dam tailwater (river mile 80.2). The Rock Island District conducted the study of the Illinois River from river mile 80.2 to Lockport, IL.

Technical aspects of the study include impacts of levees, land use change, and climate variation The Illinois River flows were determined using data from the period 1940 to 1998. In situations where historic records were not adequate to develop discharge frequency relationships or to verify the results, hydrologic modeling was used to create synthetic flows based on rainfall.

A summary of the drainage area-peak discharge relationships for all the streams studied by detailed methods is shown in Table 4, "Summary of Discharges."

Table 4- Summary of Discharges

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	*Drainage Area (square miles)*	*10-Percent-Annual-Chance*	*2-Percent-Annual-Chance*	*1-Percent-Annual-Chance*	*0.2-Percent-Annual-Chance*
Illinois River					
At Peoria Lock & Dam RM (157.7)	14,550	66,000	82,000	90,000	111,000
At Starved Rock Lock and Dam RM (231.1)	11,060	94,000	125,000	137,000	164,000

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Pre-Countywide FIS

New detailed study data on the Illinois River supersedes the pre-countywide hydraulic analyses. No other detailed studies were included previously.

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY FROM UNET MODEL	WITHOUT FLOODWAY FROM UNET MODEL	WITH FLOODWAY	INCREASE
Illinois River (continued)								
206.5	206.5	16,023/4,715[2]	*	*	461.6	461.6	*	*
207	207	12,276/685[2]	*	*	461.6	461.6	*	*
207.4	207.4	12,069/579[2]	*	*	461.6	461.6	*	*
207.58	207.58	11,992/954[2]	*	*	461.6	461.6	*	*
207.84	207.84	12,098/1,040[2]	*	*	461.6	461.6	*	*
208.1	208.1	12,210/992[2]	*	*	461.7	461.7	*	*
208.6	208.6	12,065/601[2]	*	*	461.7	461.7	*	*
209.1	209.1	11,675/556[2]	*	*	461.7	461.7	*	*
209.6	209.6	11,507/1,952[2]	*	*	461.8	461.8	*	*
210.1	210.1	9,331/4,286[2]	*	*	461.8	461.8	*	*
210.5	210.5	9,120/4,971[2]	*	*	461.8	461.8	*	*
211	211	9,652/4,268[2]	*	*	461.9	461.9	*	*
211.4	211.4	9,102/3,066[2]	*	*	461.9	461.9	*	*
211.9	211.9	6,932/1,101[2,3]	*	*	461.9	461.9	*	*
212.4	212.4	6,531/485[2]	*	*	461.9	461.9	*	*
212.9	212.9	6,194/1,121[2]	*	*	462.0	462.0	*	*
213.3	213.3	6,547/1,445[2]	*	*	462.0	462.0	*	*
213.66	213.66	6,904/1,735[2]	*	*	462.0	462.0	*	*
213.88	213.88	5,445/1,907[2]	*	*	461.9	461.9	*	*
214.2	214.2	6,597/3,857[2]	*	*	462.1	462.1	*	*
214.58	214.58	6,102/4,296[2]	*	*	462.1	462.1	*	*
214.96	214.96	5,052/4,524[2]	*	*	462.2	462.2	*	*

[1] Miles above confluence with the Mississippi River

[2] Total width / width within county

[3] Widths include areas not inundated by the 1-percent-annual-chance flood

* Data not available.

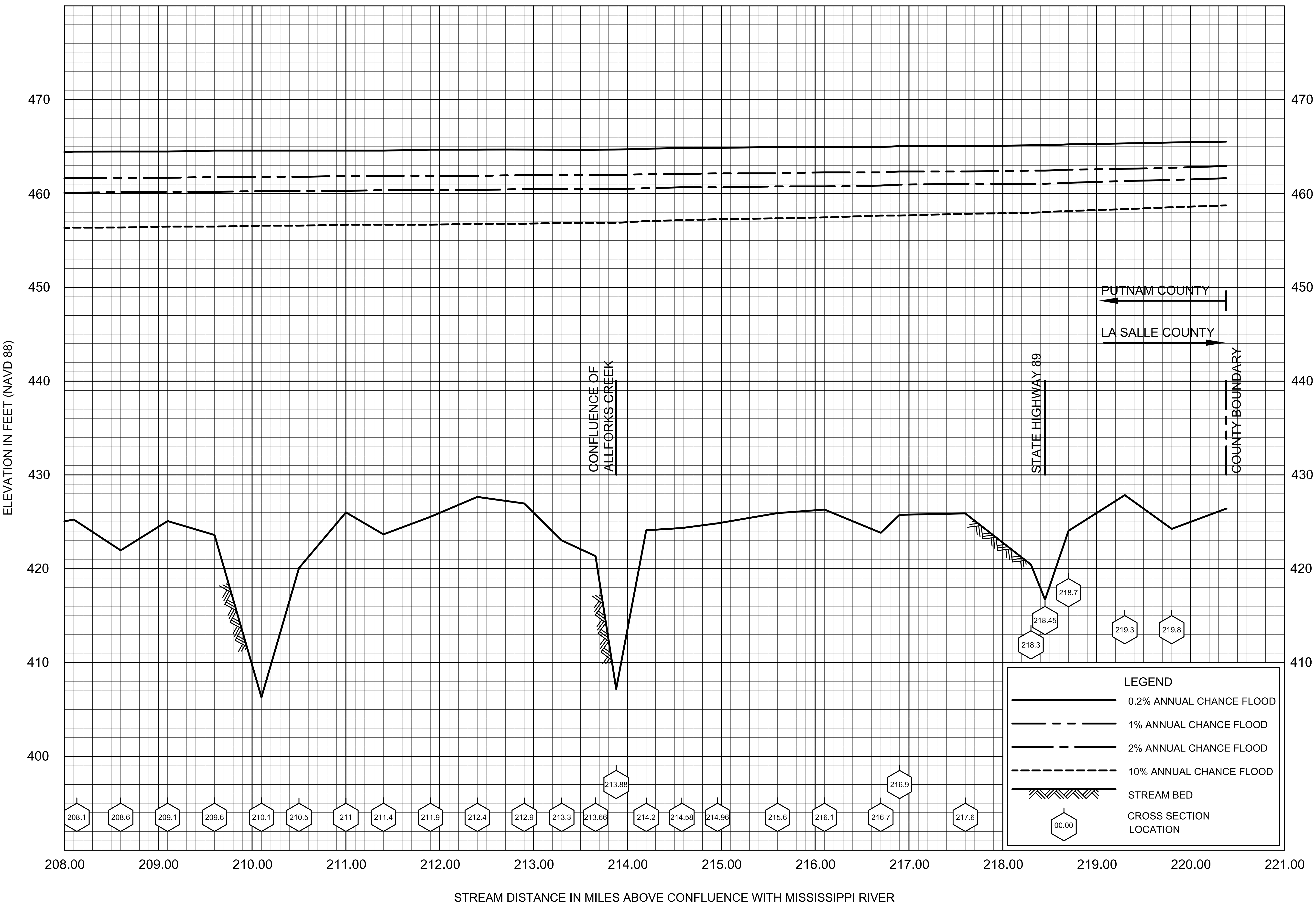
TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

PUTNAM COUNTY, IL
AND INCORPORATED AREAS

FLOODWAY DATA

ILLINOIS RIVER



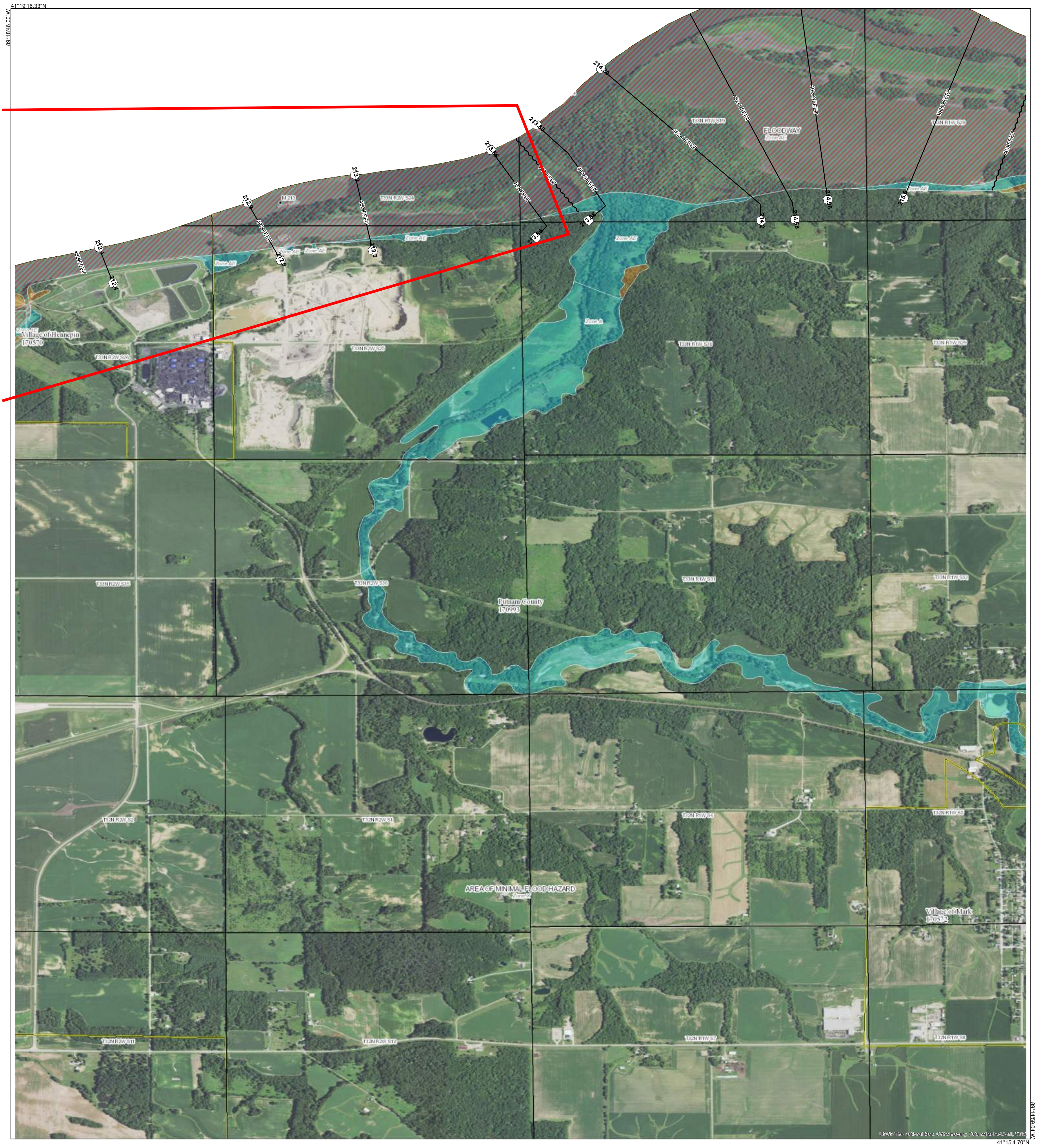
FLOOD PROFILES

ILLINOIS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

PUTNAM COUNTY, IL

AND INCORPORATED AREAS



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	▨	**Without Base Flood Elevation (BFE)** *Zone A, V, A99* **With BFE or Depth** *Zone AE, AO, AH, VE, AR*
	▨	**Regulatory Floodway**
OTHER AREAS OF FLOOD HAZARD	▨	**0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile** *Zone X*
	▨	**Future Conditions 1% Annual Chance Flood Hazard** *Zone X*
	▨	**Area with Reduced Flood Risk due to Levee See Notes.** *Zone X*
	▨	**Area with Flood Risk due to Levee** *Zone D*
OTHER AREAS	NO SCREEN	**Area of Minimal Flood Hazard** *Zone X*
	☐	**Effective LOMRs**
	▨	**Area of Undetermined Flood Hazard** *Zone D*
GENERAL STRUCTURES	- - - -	**Channel, Culvert, or Storm Sewer**
	ı ı ı ı ı ı	**Levee, Dike, or Floodwall**
OTHER FEATURES	(B) 20.2	**Cross Sections with 1% Annual Chance**
	17.5	**Water Surface Elevation**
	(8) - - - -	**Coastal Transect**
	- - - -	**Coastal Transect Baseline**
	— - - —	**Profile Baseline**
	——	**Hydrographic Feature**
	513	**Base Flood Elevation Line (BFE)**
	——	**Limit of Study**
	——	**Jurisdiction Boundary**

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can beordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

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This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 1,000 feet 1:12,000

0 500 1,000 2,000 3,000 4,000 Feet

Meters
0 105 210 420 630 840

FEMA
National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

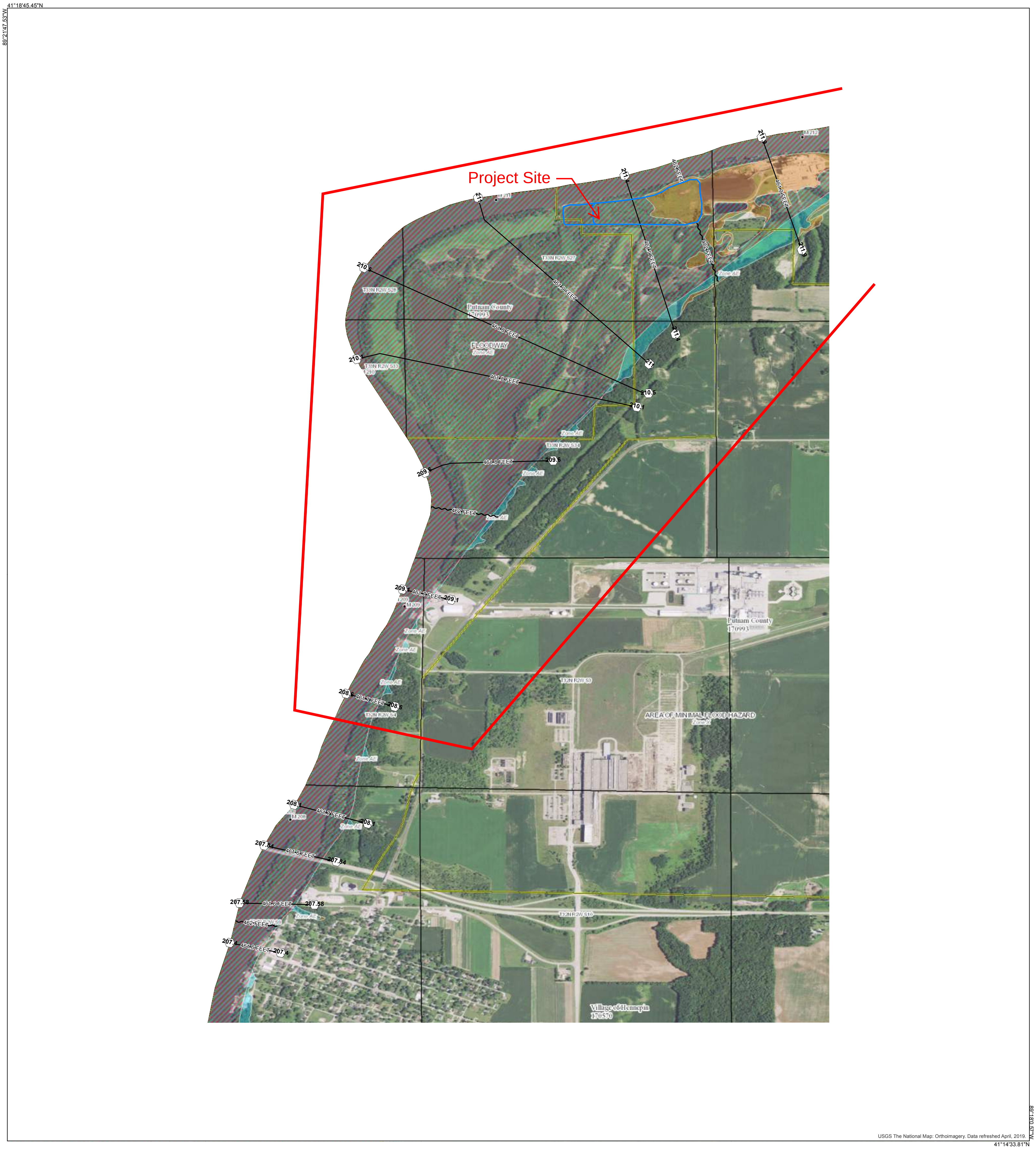
PUTNAM COUNTY, ILLINOIS AND INCORPORATED AREAS

PANEL **25** OF **175**

Panel Contains:

COMMUNITY	NUMBER	PANEL
VILLAGE OF HENNEPIN ILLINOIS	170570	0025
BUREAU COUNTY ILLINOIS	170729	0025
PUTNAM COUNTY ILLINOIS	170993	0025
VILLAGE OF MARK ILLINOIS	170572	0025
VILLAGE OF DEPUE ILLINOIS	170012	0025

MAP NUMBER
17155C0025E
EFFECTIVE DATE
02/04/2011



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	🟦	**Without Base Flood Elevation (BFE)** *Zone A, V, A99* **With BFE or Depth** *Zone AE, AO, AH, VE, AR*
	▨	**Regulatory Floodway**
OTHER AREAS OF FLOOD HAZARD	🟧	**0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile** *Zone X*
	▨	**Future Conditions 1% Annual Chance Flood Hazard** *Zone X*
	▨	**Area with Reduced Flood Risk due to Levee See Notes.** *Zone X*
	▨	**Area with Flood Risk due to Levee** *Zone D*
OTHER AREAS	NO SCREEN	**Area of Minimal Flood Hazard** *Zone X*
	☐	**Effective LOMRs**
	🟧	**Area of Undetermined Flood Hazard** *Zone D*
GENERAL STRUCTURES	— — — —	**Channel, Culvert, or Storm Sewer**
	ꞁꞁꞁꞁꞁꞁꞁ	**Levee, Dike, or Floodwall**
OTHER FEATURES	(B) 20.2	**Cross Sections with 1% Annual Chance**
	17.5	**Water Surface Elevation**
	(8) - - - -	**Coastal Transect**
	—-—-—	**Coastal Transect Baseline**
	— - —	**Profile Baseline**
	——	**Hydrographic Feature**
	~~ 513 ~~~	**Base Flood Elevation Line (BFE)**
	——	**Limit of Study**
	——	**Jurisdiction Boundary**

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SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 1,000 feet 1:12,000

0 500 1,000 2,000 3,000 4,000 Feet

0 105 210 420 630 840 Meters

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

PUTNAM COUNTY, ILLINOIS AND INCORPORATED AREAS

PANEL **15** OF **175**

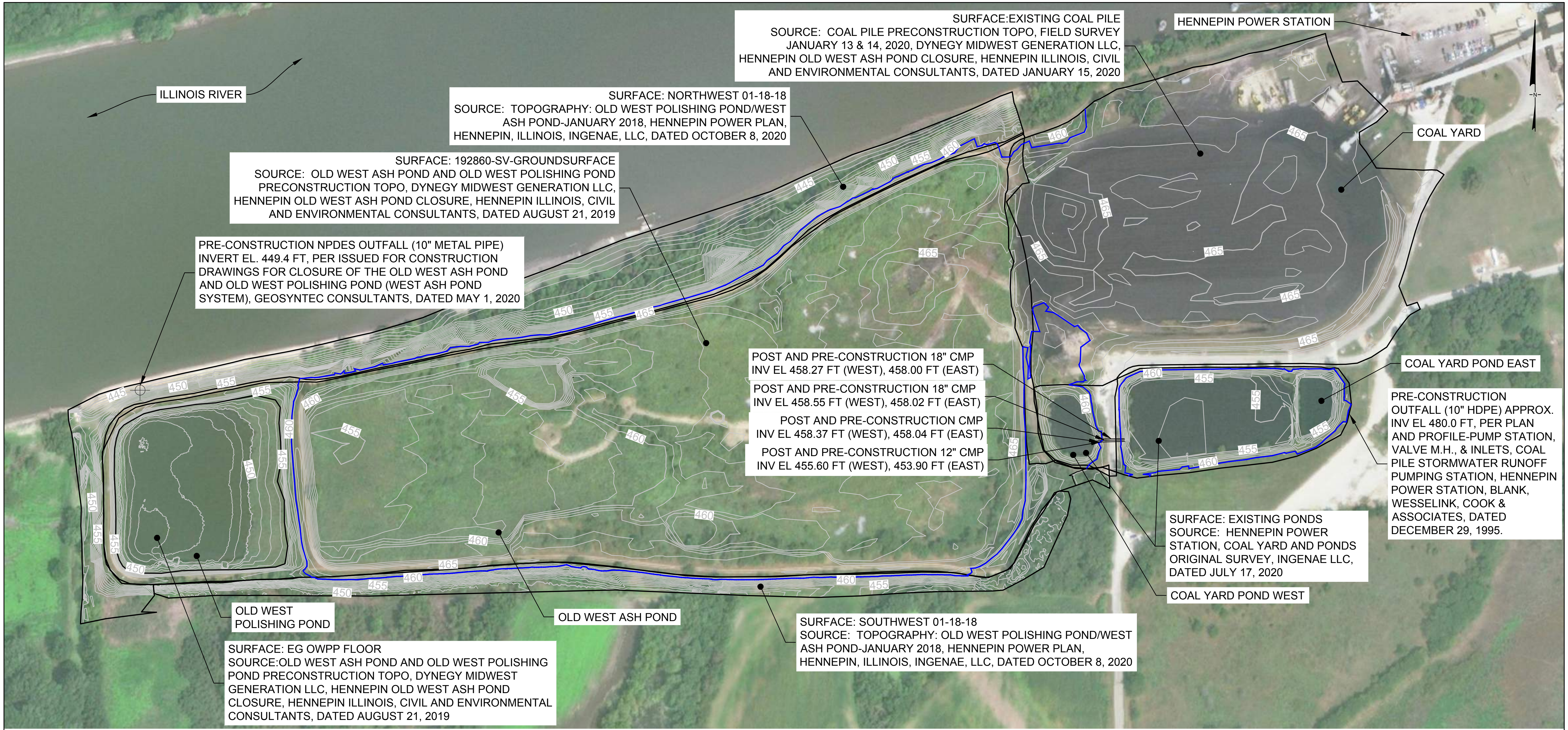
Panel Contains:

COMMUNITY	NUMBER	PANEL
VILLAGE OF HENNEPIN ILLINOIS	170570	0015
BUREAU COUNTY ILLINOIS	170729	0015
PUTNAM COUNTY ILLINOIS	170993	0015

MAP NUMBER
17155C0015E
EFFECTIVE DATE
02/04/2011

Appendix C

Existing Site Plan



SURFACE:EXISTING COAL PILE
SOURCE: COAL PILE PRECONSTRUCTION TOPO, FIELD SURVEY JANUARY 13 & 14, 2020, DYNEGY MIDWEST GENERATION LLC, HENNEPIN OLD WEST ASH POND CLOSURE, HENNEPIN ILLINOIS, CIVIL AND ENVIRONMENTAL CONSULTANTS, DATED JANUARY 15, 2020

SURFACE: NORTHWEST 01-18-18
SOURCE: TOPOGRAPHY: OLD WEST POLISHING POND/WEST ASH POND-JANUARY 2018, HENNEPIN POWER PLAN, HENNEPIN, ILLINOIS, INGENAE, LLC, DATED OCTOBER 8, 2020

SURFACE: 192860-SV-GROUNDSURFACE
SOURCE: OLD WEST ASH POND AND OLD WEST POLISHING POND PRECONSTRUCTION TOPO, DYNEGY MIDWEST GENERATION LLC, HENNEPIN OLD WEST ASH POND CLOSURE, HENNEPIN ILLINOIS, CIVIL AND ENVIRONMENTAL CONSULTANTS, DATED AUGUST 21, 2019

PRE-CONSTRUCTION NPDES OUTFALL (10" METAL PIPE) INVERT EL. 449.4 FT, PER ISSUED FOR CONSTRUCTION DRAWINGS FOR CLOSURE OF THE OLD WEST ASH POND AND OLD WEST POLISHING POND (WEST ASH POND SYSTEM), GEOSYNTEC CONSULTANTS, DATED MAY 1, 2020

POST AND PRE-CONSTRUCTION 18" CMP
INV EL 458.27 FT (WEST), 458.00 FT (EAST)

POST AND PRE-CONSTRUCTION 18" CMP
INV EL 458.55 FT (WEST), 458.02 FT (EAST)

POST AND PRE-CONSTRUCTION CMP
INV EL 458.37 FT (WEST), 458.04 FT (EAST)

POST AND PRE-CONSTRUCTION 12" CMP
INV EL 455.60 FT (WEST), 453.90 FT (EAST)

PRE-CONSTRUCTION OUTFALL (10" HDPE) APPROX. INV EL 480.0 FT, PER PLAN AND PROFILE-PUMP STATION, VALVE M.H., & INLETS, COAL PILE STORMWATER RUNOFF PUMPING STATION, HENNEPIN POWER STATION, BLANK, WESSELINK, COOK & ASSOCIATES, DATED DECEMBER 29, 1995.

SURFACE: EXISTING PONDS
SOURCE: HENNEPIN POWER STATION, COAL YARD AND PONDS ORIGINAL SURVEY, INGENAE LLC, DATED JULY 17, 2020

SURFACE: SOUTHWEST 01-18-18
SOURCE: TOPOGRAPHY: OLD WEST POLISHING POND/WEST ASH POND-JANUARY 2018, HENNEPIN POWER PLAN, HENNEPIN, ILLINOIS, INGENAE, LLC, DATED OCTOBER 8, 2020

SURFACE: EG OWPP FLOOR
SOURCE:OLD WEST ASH POND AND OLD WEST POLISHING POND PRECONSTRUCTION TOPO, DYNEGY MIDWEST GENERATION LLC, HENNEPIN OLD WEST ASH POND CLOSURE, HENNEPIN ILLINOIS, CIVIL AND ENVIRONMENTAL CONSULTANTS, DATED AUGUST 21, 2019

0 250
SCALE IN FEET

NOTES:

1. TOPOGRAPHIC SURVEY DATA WAS COLLECTED BY MULTIPLE SURVEYORS ON MULTIPLE DATES AND MERGED INTO A COMPOSITE PRE-CONSTRUCTION TOPOGRAPHIC SURFACE FOR THE AREAS INDICATED ON THIS DRAWING.
2. SURVEY DATA USED TO CREATE THIS FIGURE WAS COLLECTED IN THE NAD83 HORIZONTAL DATUM AND THE NAVD88 VERTICAL DATUM.
3. THE BACKGROUND AERIAL IMAGE WAS OBTAINED FROM GOOGLE EARTH AND WAS COLLECTED ON SEPTEMBER 20, 2015.

LEGEND

—— 465 ——	SURFACE ELEVATIONS
————	SURVEY BOUNDARY
————	LIMITS OF BASE FLOOD ELEVATION 461.9 FT

DRAFT

COMPOSITE PRE-CONSTRUCTION GRADES
HENNEPIN POWER STATION
WEST ASH POND SYSTEM CLOSURE

Geosyntec
consultants

FIGURE
4

PROJECT NO: CHE8400
OCTOBER 2020

L:\CADD\D\DYNEGY\HENNEPIN\CLOSURE DESIGN - CHE8356B\VOLUMES\CHE8356B-X001 - COMBINED EG TOPO SURFACES - Last Saved by: SNichols on 10/11/20

REVISION RECORD

NO	DATE	DESCRIPTION
1	09/26/2019	ADDED POLISHING POND CONTOURS TO EXISTING TOPOGRAPHIC CONDITIONS
2	10/07/2020	ADD CONTROL DATUM & SURVEYOR'S CERTIFICATE

SUBMITTAL RECORD

NO	DATE	DESCRIPTION

SURVEYOR'S CERTIFICATE

STATE OF ILLINOIS
COUNTY OF DUPAGE } *SS*

I HEREBY CERTIFY THAT THIS PLAT, AND THE SURVEY UPON WHICH IT IS BASED, HAS BEEN PREPARED UNDER MY DIRECT SUPERVISION. ALL DISTANCES ARE GIVEN IN FEET AND DECIMALS THEREOF.

THIS PLAT HAS BEEN PREPARED BY CIVIL & ENVIRONMENTAL CONSULTANTS, INC. ILLINOIS LICENSED PROFESSIONAL DESIGN FIRM NO. 184.004002, LICENSE EXPIRES APRIL 30, 2021. FOR THE EXCLUSIVE USE OF THE CLIENT NOTED HEREON. REPRODUCTION OF USE BY THIRD PARTIES IS STRICTLY PROHIBITED WITHOUT THE WRITTEN PERMISSION OF THE UNDERSIGNED. THIS PROFESSIONAL SERVICE CONFORMS TO THE CURRENT ILLINOIS MINIMUM STANDARDS FOR A BOUNDARY SURVEY.

FIELDWORK WAS COMPLETED ON AUGUST 29, 2019.

GIVEN UNDER MY HAND AND SEAL THIS 7TH DAY OF OCTOBER, 2020.

Douglas R. McClintic

ILLINOIS LICENSED PROFESSIONAL LAND SURVEYOR NO. 035-002992
LICENSED VALID THROUGH NOVEMBER 30, 2020

DOUGLAS R. McCLINTIC
035-002992
PROFESSIONAL LAND SURVEYOR
NAPERVILLE, IL
STATE OF ILLINOIS

REFERENCE

1. TOPOGRAPHIC INFORMATION BASE ON ILLINOIS WEST ZONE STATE PLANE NAD 83 (2011) NAVD 88 (VRS) GEOID 18. SURVEY CONDUCTED BY CIVIL & ENVIRONMENTAL CONSULTANTS, INC. ON JANUARY 15, 2020.
2. CONTROL POINTS 50, 51, 52, 53, 54 AND 55 COORDINATES AND ELEVATION ARE SHOWN, WERE USED TO OBTAIN THIS SURVEY. IT IS RECOMMENDED TO VERIFY A MINIMUM OF TWO CONTROL POINTS PRIOR TO ANY WAY WORK BEING DONE.

CEC
Civil & Environmental Consultants, Inc.
1230 East Diehl Road, Suite 200 - Naperville, IL 60563
Ph: 630.963.6026 · 877.963.6026 · Fax: 630.963.6027
www.cecinc.com

DYNEGY MIDWEST GENERATION LLC
HENNEPIN OLD WEST ASH POND CLOSURE
HENNEPIN, ILLINOIS

DRAWN BY:	MSK	CHECKED BY:	DRM	APPROVED BY:	DRM*
DATE:	08/21/2019	DWG SCALE:	1"=80'	PROJECT NO:	192-860.AW00

OLD WEST ASH POND AND
OLD WEST POLISHING POND
PRECONSTRUCTION TOPO

DRAWING NO.: **1**
SHEET 1 OF 1

NOTE:
1. THIS SURVEY WAS PERFORMED BY INGENAE PERSONNEL ON JANUARY 17 AND 18 OF 2018
2. THE CONTOURS, COORDINATES AND ELEVATIONS AS SHOWN HEREON WHERE OBTAINED BY USE OF PROFESSIONAL SURVEY PRECISION GRADE GPS AND/OR ROBOTIC TOTAL STATION EQUIPMENT. THE DATUM USED AND AS SHOWN HEREON IS BASED ON, HORIZONTAL: NAD 1983 STATE PLANE COORDINATE ZONE-ILLINOIS WEST (US SURVEY FEET) AND VERTICAL: NAVD 88 (US SURVEY FEET).

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IngenAE
514 Earth City Plaza
Earth City, MO 63045
www.ingenae.com

MICHAEL J. GRAMINSKI
35-2901

10/8/2020

Submissions / Revisions:	Date:
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	

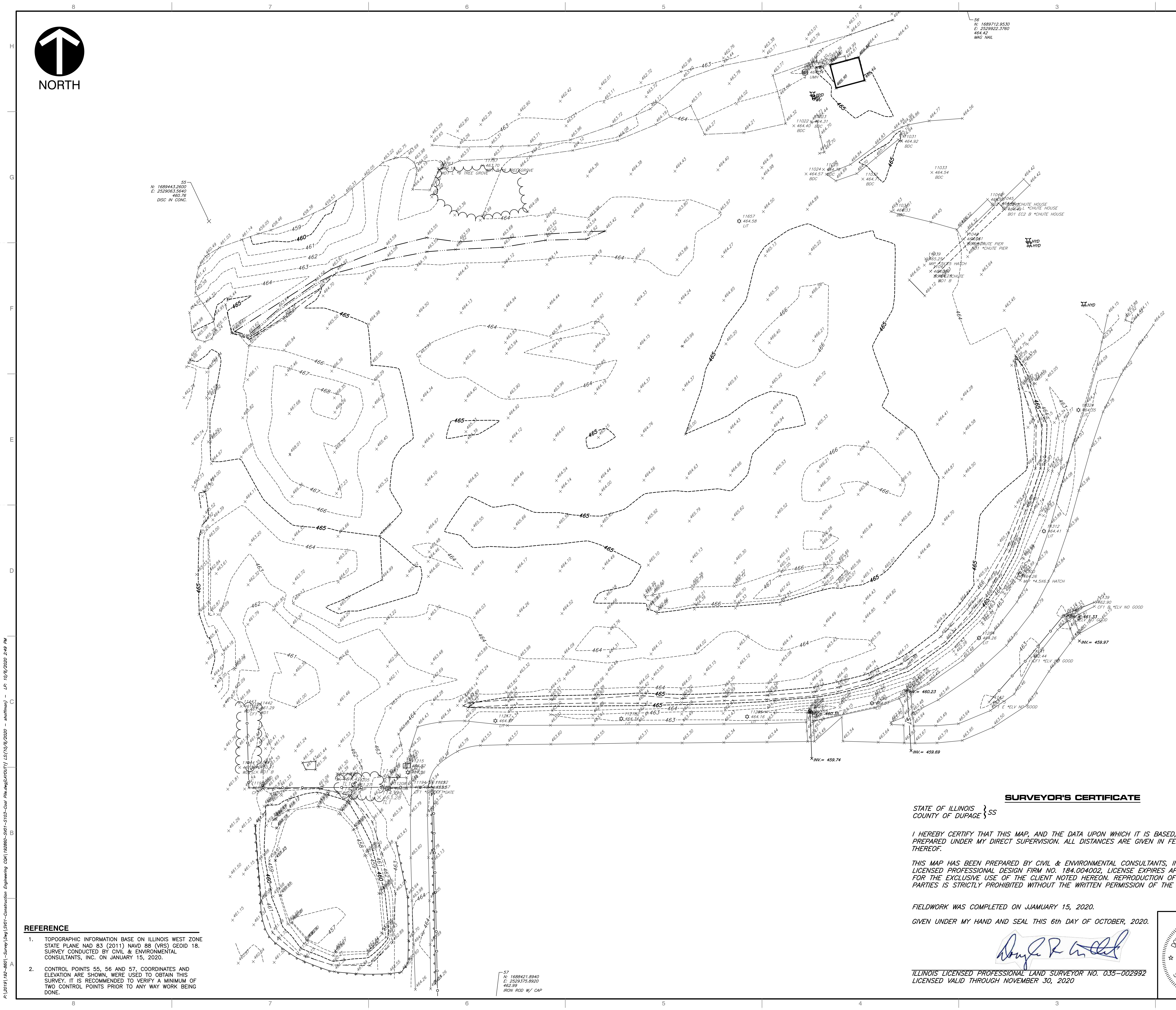
VISTRA ENERGY

Project Name & Location:

HENNEPIN
POWER PLANT
HENNEPIN, IL

Drawing Name:
TOPOGRAPHY: OLD WEST POLISHING POND/WEST ASH POND-JANUARY 2018

Date: 10/8/2020
Project No.:
Type: SITE
Drawing No.: 1
Drawn By: CB
Approved By: MG
Scale: AS NOTED



REVISION RECORD		
NO	DATE	DESCRIPTION
△1	10/06/2020	ADD CONTROL DATUM & SURVEYOR'S CERTIFICATE
△		
△		
△		

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

SCALE IN FEET
0 50 100

SURVEYOR'S CERTIFICATE

STATE OF ILLINOIS } SS
COUNTY OF DUPAGE }

I HEREBY CERTIFY THAT THIS MAP, AND THE DATA UPON WHICH IT IS BASED, HAS BEEN PREPARED UNDER MY DIRECT SUPERVISION. ALL DISTANCES ARE GIVEN IN FEET AND DECIMALS THEREOF.

THIS MAP HAS BEEN PREPARED BY CIVIL & ENVIRONMENTAL CONSULTANTS, INC. ILLINOIS LICENSED PROFESSIONAL DESIGN FIRM NO. 184.004002, LICENSE EXPIRES APRIL 30, 2021. FOR THE EXCLUSIVE USE OF THE CLIENT NOTED HEREON. REPRODUCTION OF USE BY THIRD PARTIES IS STRICTLY PROHIBITED WITHOUT THE WRITTEN PERMISSION OF THE UNDERSIGNED.

FIELDWORK WAS COMPLETED ON JJAMUARY 15, 2020.

GIVEN UNDER MY HAND AND SEAL THIS 6th DAY OF OCTOBER, 2020.

Douglas R McClintic

ILLINOIS LICENSED PROFESSIONAL LAND SURVEYOR NO. 035–002992
LICENSED VALID THROUGH NOVEMBER 30, 2020

DOUGLAS R. McCLINTIC
035–002992

REFERENCE

1. TOPOGRAPHIC INFORMATION BASE ON ILLINOIS WEST ZONE STATE PLANE NAD 83 (2011) NAVD 88 (VRS) GEOID 18. SURVEY CONDUCTED BY CIVIL & ENVIRONMENTAL CONSULTANTS, INC. ON JANUARY 15, 2020.
2. CONTROL POINTS 55, 56 AND 57, COORDINATES AND ELEVATION ARE SHOWN, WERE USED TO OBTAIN THIS SURVEY. IT IS RECOMMENDED TO VERIFY A MINIMUM OF TWO CONTROL POINTS PRIOR TO ANY WAY WORK BEING DONE.

Civil & Environmental Consultants, Inc.
333 Baldwin Road · Pittsburgh, PA 15205
Ph: 412.429.2324 · 800.365.2324 · Fax: 412.429.2114
www.cecinc.com

DYNEGY MIDWEST GENERATION LLC
HENNEPIN OLD WEST ASH POND CLOSURE
HENNEPIN, ILLINOIS

DRAWN BY:	MSK	CHECKED BY:	DRAFT	APPROVED BY:	DRAFT
DATE:	01/15/2020	DWG SCALE:	1"=50'	PROJECT NO:	192-860.0001

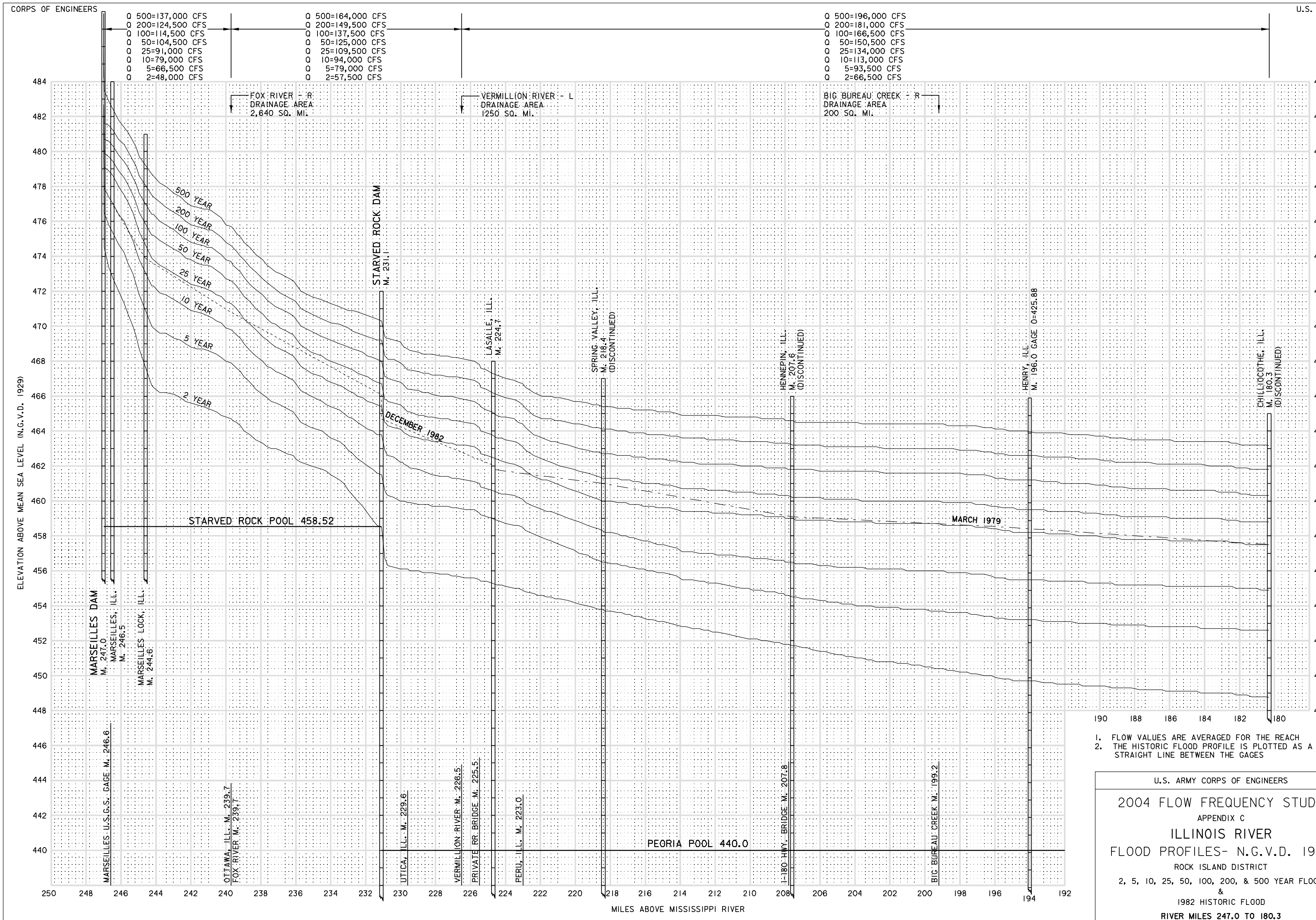
COAL PILE PRECONSTRUCTION TOPO
FIELD SURVEY JANUARY 13 &14, 2020

DRAWING NO.: 1
SHEET 1 OF 1

Appendix D

Hydrology

HANSON



1. FLOW VALUES ARE AVERAGED FOR THE REACH
2. THE HISTORIC FLOOD PROFILE IS PLOTTED AS A STRAIGHT LINE BETWEEN THE GAGES

U.S. ARMY CORPS OF ENGINEERS

2004 FLOW FREQUENCY STUDY
APPENDIX C
ILLINOIS RIVER
FLOOD PROFILES- N.G.V.D. 1929
ROCK ISLAND DISTRICT
2, 5, 10, 25, 50, 100, 200, & 500 YEAR FLOOD
&
1982 HISTORIC FLOOD
RIVER MILES 247.0 TO 180.3
PLATE # 2

Flow Frequency Query

Upper Mississippi River

United States Army Corps of Engineers

Mississippi Valley Division

Developed by Rock Island District

[Disclaimers]|[Help]

River:

Illinois River

Datum:

1929

Return Period:

2-year

River Mile:

211.4 Submit

Flow: 67,000 CFS

Surface Elevation: 452.4 Ft

Located in the pool of Peoria Lock and Dam

Download PDF for a profile plot in the vicinity of the River Mile selection.

Or Select a Pool Reach*

Select a PDF Plate of Pool

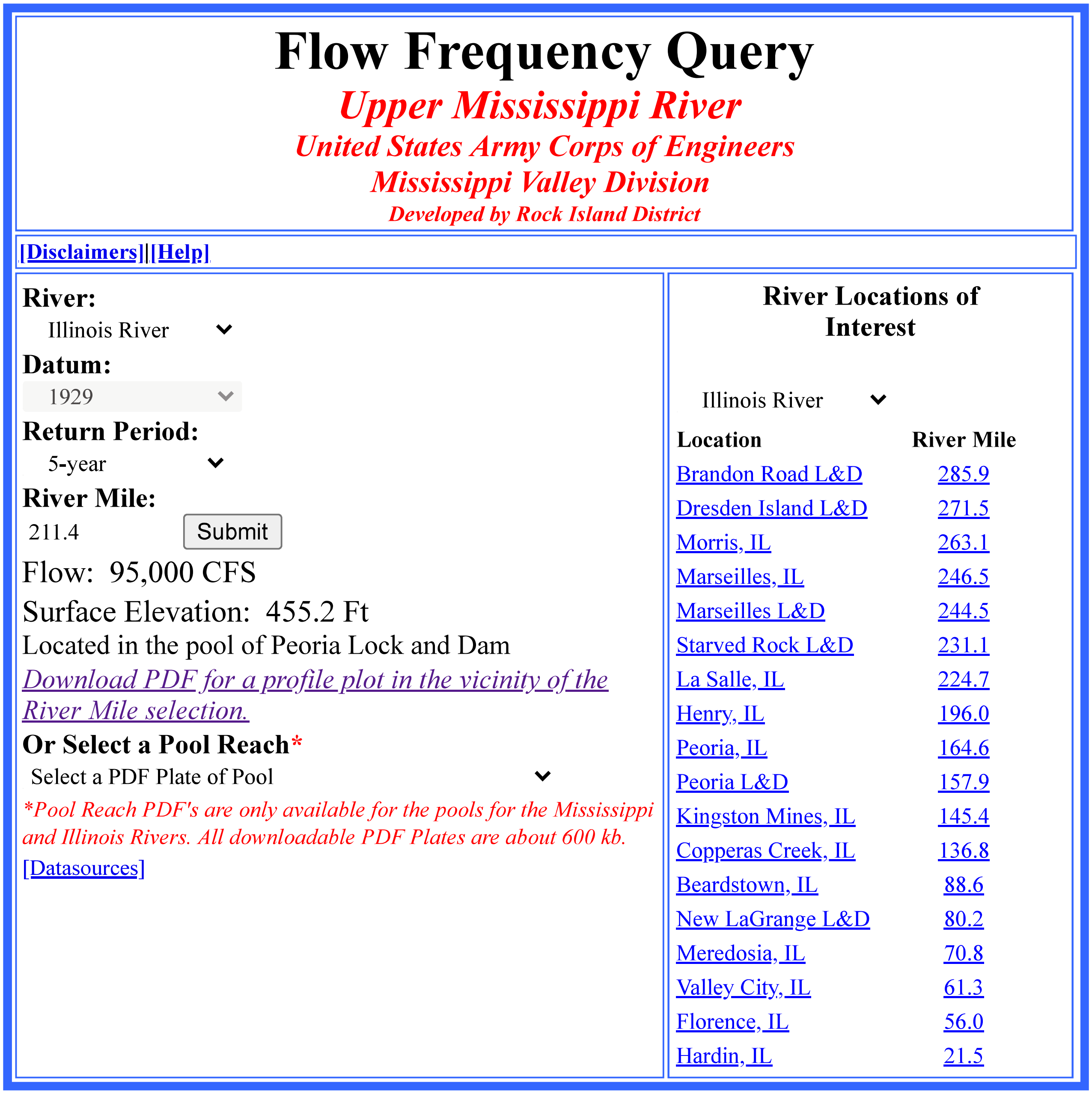
**Pool Reach PDF's are only available for the pools for the Mississippi and Illinois Rivers. All downloadable PDF Plates are about 600 kb.*

[Datasources]

River Locations of Interest

Illinois River

Location	River Mile
Brandon Road L&D	285.9
Dresden Island L&D	271.5
Morris, IL	263.1
Marseilles, IL	246.5
Marseilles L&D	244.5
Starved Rock L&D	231.1
La Salle, IL	224.7
Henry, IL	196.0
Peoria, IL	164.6
Peoria L&D	157.9
Kingston Mines, IL	145.4
Copperas Creek, IL	136.8
Beardstown, IL	88.6
New LaGrange L&D	80.2
Meredosia, IL	70.8
Valley City, IL	61.3
Florence, IL	56.0
Hardin, IL	21.5



Flow Frequency Query

Upper Mississippi River

United States Army Corps of Engineers

Mississippi Valley Division

Developed by Rock Island District

[Disclaimers][Help]

River:

Illinois River

Datum:

1929

Return Period:

5-year

River Mile:

211.4 Submit

Flow: 95,000 CFS

Surface Elevation: 455.2 Ft

Located in the pool of Peoria Lock and Dam

Download PDF for a profile plot in the vicinity of the River Mile selection.

Or Select a Pool Reach*

Select a PDF Plate of Pool

**Pool Reach PDF's are only available for the pools for the Mississippi and Illinois Rivers. All downloadable PDF Plates are about 600 kb.*

[Datasources]

River Locations of Interest

Illinois River

Location	River Mile
Brandon Road L&D	285.9
Dresden Island L&D	271.5
Morris, IL	263.1
Marseilles, IL	246.5
Marseilles L&D	244.5
Starved Rock L&D	231.1
La Salle, IL	224.7
Henry, IL	196.0
Peoria, IL	164.6
Peoria L&D	157.9
Kingston Mines, IL	145.4
Copperas Creek, IL	136.8
Beardstown, IL	88.6
New LaGrange L&D	80.2
Meredosia, IL	70.8
Valley City, IL	61.3
Florence, IL	56.0
Hardin, IL	21.5

Flow Frequency Query

Upper Mississippi River

United States Army Corps of Engineers

Mississippi Valley Division

Developed by Rock Island District

[Disclaimers][Help]

River:

Illinois River

Datum:

1929

Return Period:

10-year

River Mile:

211.4 Submit

Flow: 114,000 CFS

Surface Elevation: 456.9 Ft

Located in the pool of Peoria Lock and Dam

Download PDF for a profile plot in the vicinity of the River Mile selection.

Or Select a Pool Reach*

Select a PDF Plate of Pool

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[Datasources]

River Locations of Interest

Illinois River

Location	River Mile
Brandon Road L&D	285.9
Dresden Island L&D	271.5
Morris, IL	263.1
Marseilles, IL	246.5
Marseilles L&D	244.5
Starved Rock L&D	231.1
La Salle, IL	224.7
Henry, IL	196.0
Peoria, IL	164.6
Peoria L&D	157.9
Kingston Mines, IL	145.4
Copperas Creek, IL	136.8
Beardstown, IL	88.6
New LaGrange L&D	80.2
Meredosia, IL	70.8
Valley City, IL	61.3
Florence, IL	56.0
Hardin, IL	21.5

Flow Frequency Query

Upper Mississippi River

United States Army Corps of Engineers

Mississippi Valley Division

Developed by Rock Island District

[Disclaimers]|**[Help]**

River:

Illinois River ⌄

Datum:

1929 ⌄

Return Period:

25-year ⌄

River Mile:

211.4 [Submit]

Flow: 136,000 CFS

Surface Elevation: 459.3 Ft

Located in the pool of Peoria Lock and Dam

Download PDF for a profile plot in the vicinity of the River Mile selection.

Or Select a Pool Reach*

Select a PDF Plate of Pool ⌄

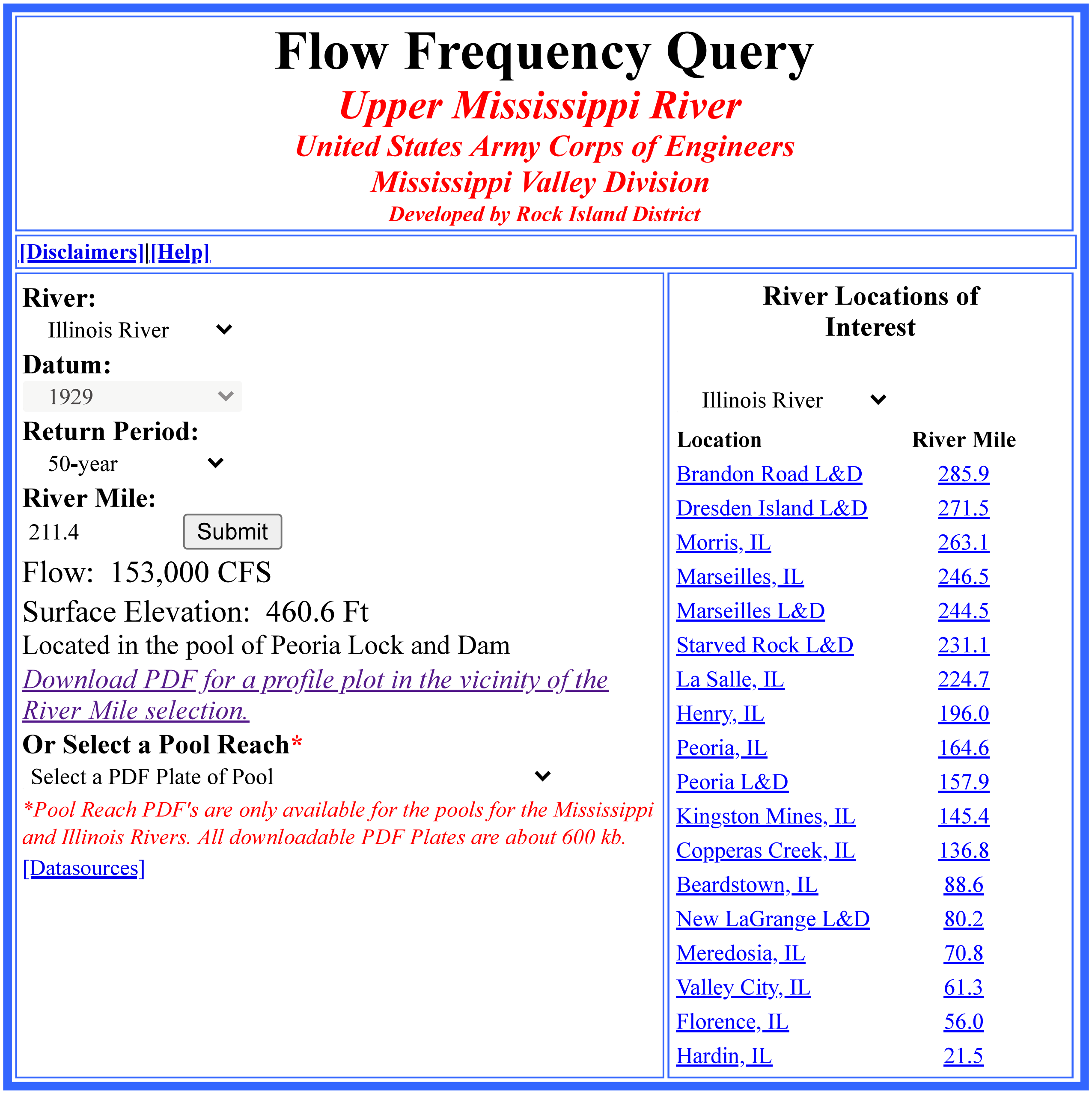
**Pool Reach PDF's are only available for the pools for the Mississippi and Illinois Rivers. All downloadable PDF Plates are about 600 kb.*

[Datasources]

River Locations of Interest

Illinois River ⌄

Location	River Mile
Brandon Road L&D	285.9
Dresden Island L&D	271.5
Morris, IL	263.1
Marseilles, IL	246.5
Marseilles L&D	244.5
Starved Rock L&D	231.1
La Salle, IL	224.7
Henry, IL	196.0
Peoria, IL	164.6
Peoria L&D	157.9
Kingston Mines, IL	145.4
Copperas Creek, IL	136.8
Beardstown, IL	88.6
New LaGrange L&D	80.2
Meredosia, IL	70.8
Valley City, IL	61.3
Florence, IL	56.0
Hardin, IL	21.5



Flow Frequency Query

Upper Mississippi River

United States Army Corps of Engineers

Mississippi Valley Division

Developed by Rock Island District

[Disclaimers][Help]

River:
Illinois River

Datum:
1929

Return Period:
50-year

River Mile:
211.4

Flow: 153,000 CFS

Surface Elevation: 460.6 Ft

Located in the pool of Peoria Lock and Dam

Download PDF for a profile plot in the vicinity of the River Mile selection.

Or Select a Pool Reach*
Select a PDF Plate of Pool

**Pool Reach PDF's are only available for the pools for the Mississippi and Illinois Rivers. All downloadable PDF Plates are about 600 kb.*

[Datasources]

River Locations of Interest

Illinois River

Location	**River Mile**
Brandon Road L&D	285.9
Dresden Island L&D	271.5
Morris, IL	263.1
Marseilles, IL	246.5
Marseilles L&D	244.5
Starved Rock L&D	231.1
La Salle, IL	224.7
Henry, IL	196.0
Peoria, IL	164.6
Peoria L&D	157.9
Kingston Mines, IL	145.4
Copperas Creek, IL	136.8
Beardstown, IL	88.6
New LaGrange L&D	80.2
Meredosia, IL	70.8
Valley City, IL	61.3
Florence, IL	56.0
Hardin, IL	21.5

Flow Frequency Query

Upper Mississippi River

United States Army Corps of Engineers

Mississippi Valley Division

Developed by Rock Island District

[Disclaimers][Help]

River:

Illinois River ⌄

Datum:

1929 ⌄

Return Period:

100-year ⌄

River Mile:

211.4 Submit

Flow: 169,000 CFS

Surface Elevation: 462.1 Ft

Located in the pool of Peoria Lock and Dam

Download PDF for a profile plot in the vicinity of the River Mile selection.

Or Select a Pool Reach*

Select a PDF Plate of Pool ⌄

**Pool Reach PDF's are only available for the pools for the Mississippi and Illinois Rivers. All downloadable PDF Plates are about 600 kb.*

[Datasources]

River Locations of Interest

Illinois River ⌄

Location	River Mile
Brandon Road L&D	285.9
Dresden Island L&D	271.5
Morris, IL	263.1
Marseilles, IL	246.5
Marseilles L&D	244.5
Starved Rock L&D	231.1
La Salle, IL	224.7
Henry, IL	196.0
Peoria, IL	164.6
Peoria L&D	157.9
Kingston Mines, IL	145.4
Copperas Creek, IL	136.8
Beardstown, IL	88.6
New LaGrange L&D	80.2
Meredosia, IL	70.8
Valley City, IL	61.3
Florence, IL	56.0
Hardin, IL	21.5

Flow Frequency Query

Upper Mississippi River

United States Army Corps of Engineers
Mississippi Valley Division

Developed by Rock Island District

[Disclaimers][Help]

River:
Illinois River

Datum:
1929

Return Period:
200-year

River Mile:
211.4 Submit

Flow: 185,000 CFS

Surface Elevation: 463.5 Ft

Located in the pool of Peoria Lock and Dam

Download PDF for a profile plot in the vicinity of the River Mile selection.

Or Select a Pool Reach*
Select a PDF Plate of Pool

**Pool Reach PDF's are only available for the pools for the Mississippi and Illinois Rivers. All downloadable PDF Plates are about 600 kb.*

[Datasources]

River Locations of Interest

Illinois River

Location	River Mile
Brandon Road L&D	285.9
Dresden Island L&D	271.5
Morris, IL	263.1
Marseilles, IL	246.5
Marseilles L&D	244.5
Starved Rock L&D	231.1
La Salle, IL	224.7
Henry, IL	196.0
Peoria, IL	164.6
Peoria L&D	157.9
Kingston Mines, IL	145.4
Copperas Creek, IL	136.8
Beardstown, IL	88.6
New LaGrange L&D	80.2
Meredosia, IL	70.8
Valley City, IL	61.3
Florence, IL	56.0
Hardin, IL	21.5

Flow Frequency Query

Upper Mississippi River

United States Army Corps of Engineers
Mississippi Valley Division

Developed by Rock Island District

[Disclaimers]|[Help]

River:

Illinois River

Datum:

1929

Return Period:

500-year

River Mile:

211.4 Submit

Flow: 201,000 CFS

Surface Elevation: 464.8 Ft

Located in the pool of Peoria Lock and Dam

Download PDF for a profile plot in the vicinity of the River Mile selection.

Or Select a Pool Reach*

Select a PDF Plate of Pool

**Pool Reach PDF's are only available for the pools for the Mississippi and Illinois Rivers. All downloadable PDF Plates are about 600 kb.*

[Datasources]

River Locations of Interest

Illinois River

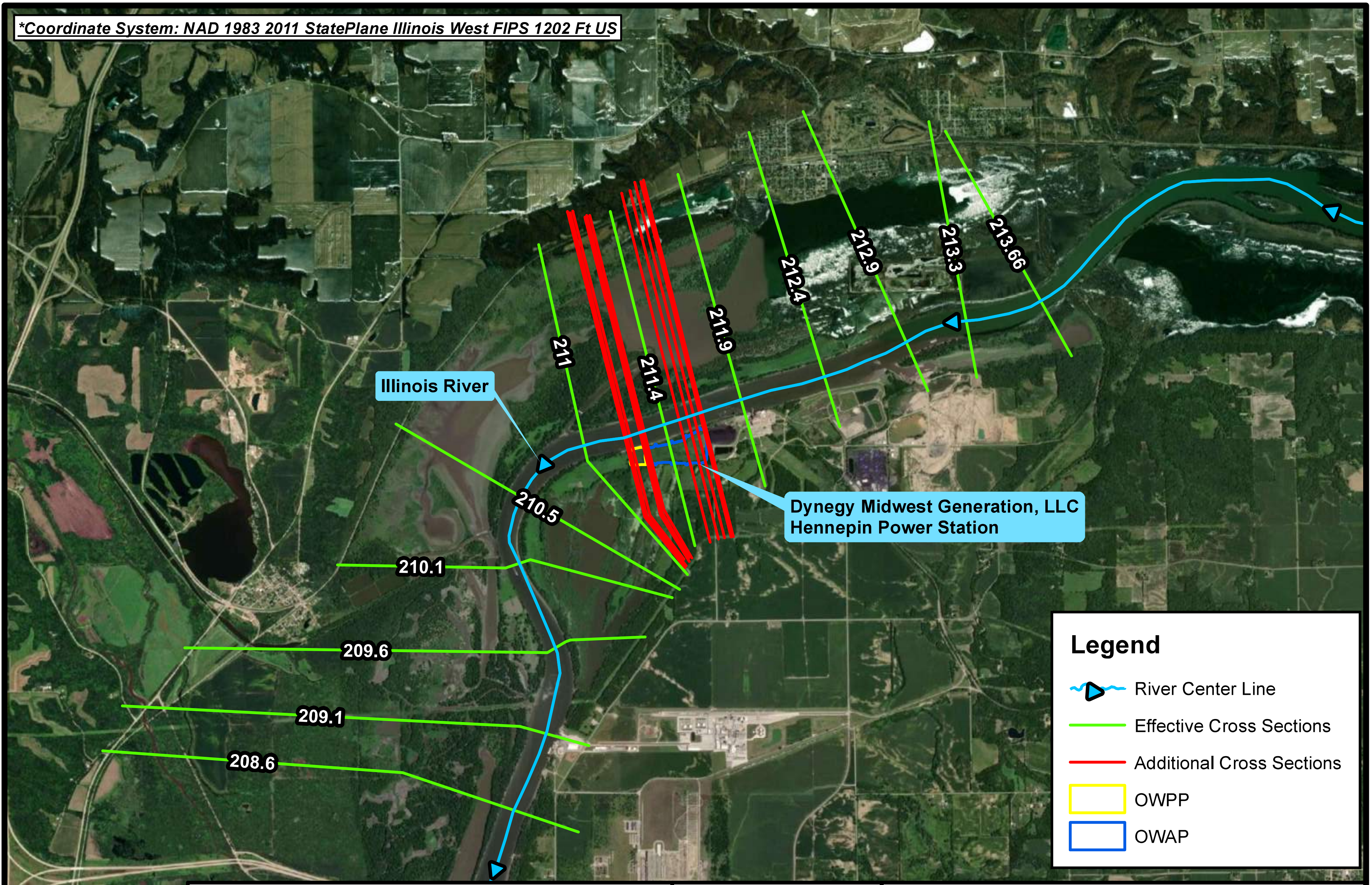
Location	River Mile
Brandon Road L&D	285.9
Dresden Island L&D	271.5
Morris, IL	263.1
Marseilles, IL	246.5
Marseilles L&D	244.5
Starved Rock L&D	231.1
La Salle, IL	224.7
Henry, IL	196.0
Peoria, IL	164.6
Peoria L&D	157.9
Kingston Mines, IL	145.4
Copperas Creek, IL	136.8
Beardstown, IL	88.6
New LaGrange L&D	80.2
Meredosia, IL	70.8
Valley City, IL	61.3
Florence, IL	56.0
Hardin, IL	21.5

FEMA FIS Interpolated Flows (cfs)

River Mile	Flood Frequency (yr)			
	10	50	100	500
157.7	66,000	82,000	90,000	111,000
231.1	94,000	125,000	137,000	164,000
Interpolated Flows				
211.4	**86,485**	**113,459**	**124,386**	**149,775**

Appendix E

Hydraulic Cross-Section Maps



HANSON
Hanson Professional Services Inc.

Cross-Section Map

Dynegy Midwest Generation, LLC
Hennepin Power Station
Putnam County, Illinois

Job Number: 19E0096B

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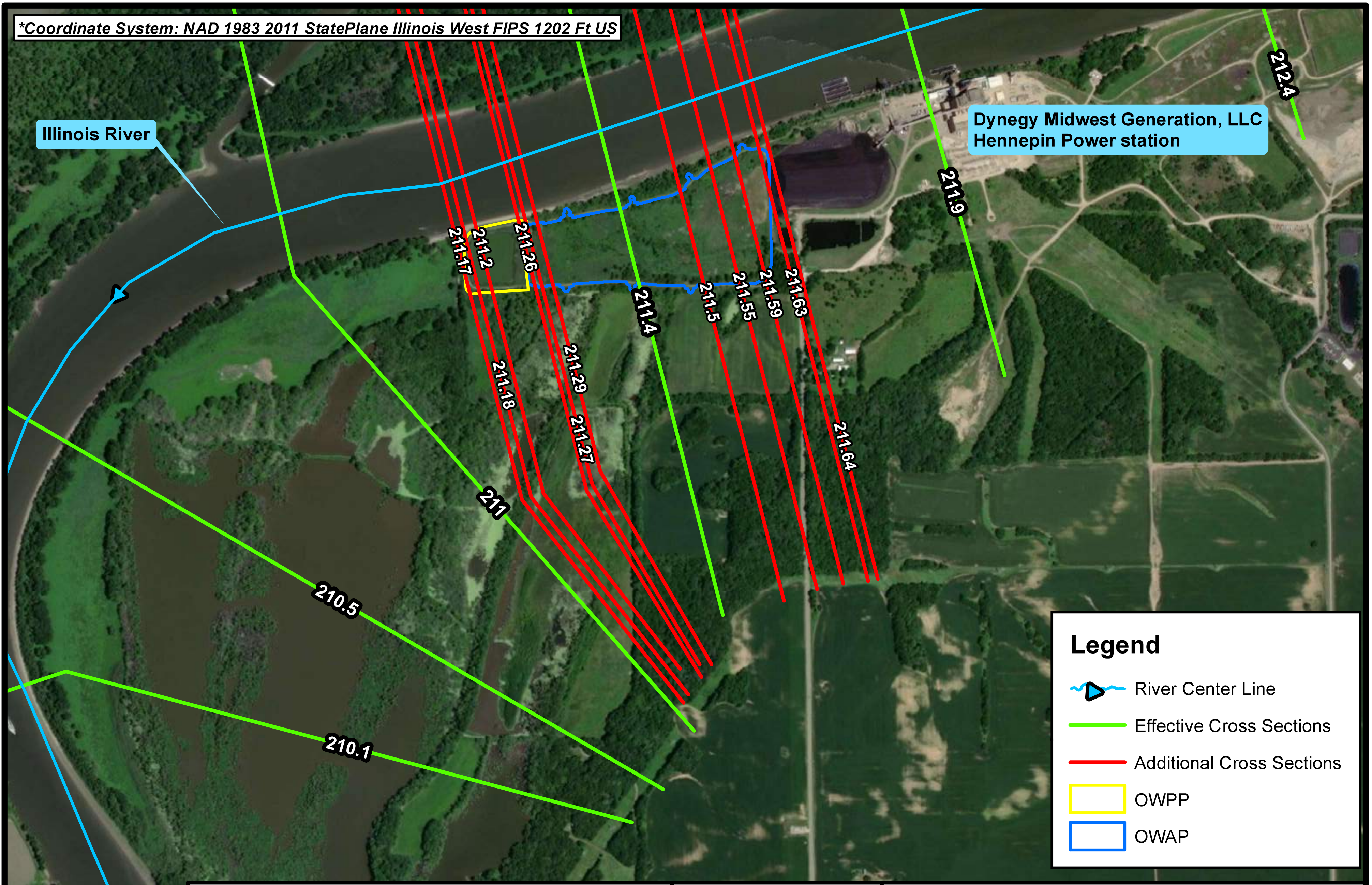


Hanson Professional Services Inc.

Project Site Cross-Section Map

Dynegy Midwest Generation, LLC
Hennepin Power Station
Putnam County, Illinois

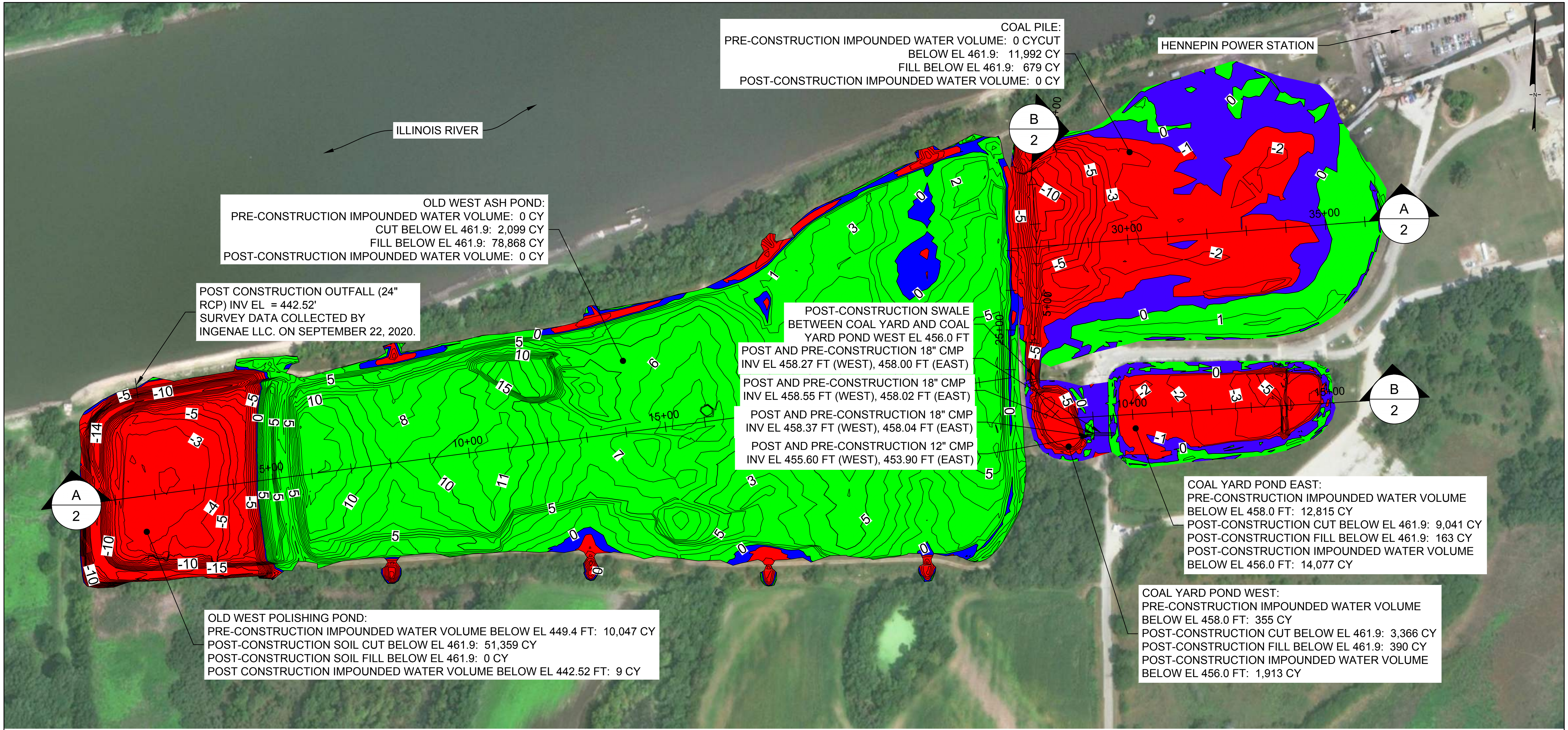
Job Number: 19E0096B

I:\19jobs\19E0096B\CAD\GIS\Projects\Project Site Cross-Section Map.mxd

Appendix F

Proposed Site Plans

HANSON



COAL PILE:
PRE-CONSTRUCTION IMPOUNDED WATER VOLUME: 0 CYCUT
BELOW EL 461.9: 11,992 CY
FILL BELOW EL 461.9: 679 CY
POST-CONSTRUCTION IMPOUNDED WATER VOLUME: 0 CY

OLD WEST ASH POND:
PRE-CONSTRUCTION IMPOUNDED WATER VOLUME: 0 CY
CUT BELOW EL 461.9: 2,099 CY
FILL BELOW EL 461.9: 78,868 CY
POST-CONSTRUCTION IMPOUNDED WATER VOLUME: 0 CY

POST CONSTRUCTION OUTFALL (24" RCP) INV EL = 442.52'
SURVEY DATA COLLECTED BY INGENAE LLC. ON SEPTEMBER 22, 2020.

POST-CONSTRUCTION SWALE BETWEEN COAL YARD AND COAL YARD POND WEST EL 456.0 FT

POST AND PRE-CONSTRUCTION 18" CMP INV EL 458.27 FT (WEST), 458.00 FT (EAST)

POST AND PRE-CONSTRUCTION 18" CMP INV EL 458.55 FT (WEST), 458.02 FT (EAST)

POST AND PRE-CONSTRUCTION 18" CMP INV EL 458.37 FT (WEST), 458.04 FT (EAST)

POST AND PRE-CONSTRUCTION 12" CMP INV EL 455.60 FT (WEST), 453.90 FT (EAST)

COAL YARD POND EAST:
PRE-CONSTRUCTION IMPOUNDED WATER VOLUME BELOW EL 458.0 FT: 12,815 CY
POST-CONSTRUCTION CUT BELOW EL 461.9: 9,041 CY
POST-CONSTRUCTION FILL BELOW EL 461.9: 163 CY
POST-CONSTRUCTION IMPOUNDED WATER VOLUME BELOW EL 456.0 FT: 14,077 CY

COAL YARD POND WEST:
PRE-CONSTRUCTION IMPOUNDED WATER VOLUME BELOW EL 458.0 FT: 355 CY
POST-CONSTRUCTION CUT BELOW EL 461.9: 3,366 CY
POST-CONSTRUCTION FILL BELOW EL 461.9: 390 CY
POST-CONSTRUCTION IMPOUNDED WATER VOLUME BELOW EL 456.0 FT: 1,913 CY

OLD WEST POLISHING POND:
PRE-CONSTRUCTION IMPOUNDED WATER VOLUME BELOW EL 449.4 FT: 10,047 CY
POST-CONSTRUCTION SOIL CUT BELOW EL 461.9: 51,359 CY
POST-CONSTRUCTION SOIL FILL BELOW EL 461.9: 0 CY
POST CONSTRUCTION IMPOUNDED WATER VOLUME BELOW EL 442.52 FT: 9 CY

0 250
SCALE IN FEET

NOTES:

1. THE 100-YEAR FLOOD ELEVATION FOR THE SITE IS EL. 461.9 FT, PER THE FEMA FLOOD INSURANCE STUDY FOR PUTNAM COUNTY, ILLINOIS (17155CV000A, DATED FEBRUARY 2011).
2. CUT CONTOURS, ZERO CONTOURS, AND FILL CONTOURS REFER TO THE DIFFERENCE BETWEEN PRE-CONSTRUCTION GRADES AND FINAL AS-BUILT GRADES.
3. COMPOSITE PRE-CONSTRUCTION AND POST-CONSTRUCTION SURVEY GRADES ARE SHOWN ON FIGURES 2 AND 3.
4. SURVEY DATA USED TO CREATE THIS FIGURE WAS COLLECTED IN THE NAD83 HORIZONTAL DATUM AND THE NAVD88 VERTICAL DATUM.
5. THE BACKGROUND AERIAL IMAGE WAS OBTAINED FROM GOOGLE EARTH AND WAS COLLECTED ON SEPTEMBER 20, 2015.

LEGEND

-1	CUT CONTOURS
0	ZERO CONTOURS
1	FILL CONTOURS

DRAFT

SUMMARY OF CUT AND FILL VOLUMES
BELOW ELEVATION 461.9 FT
HENNEPIN POWER STATION
WEST ASH POND SYSTEM CLOSURE

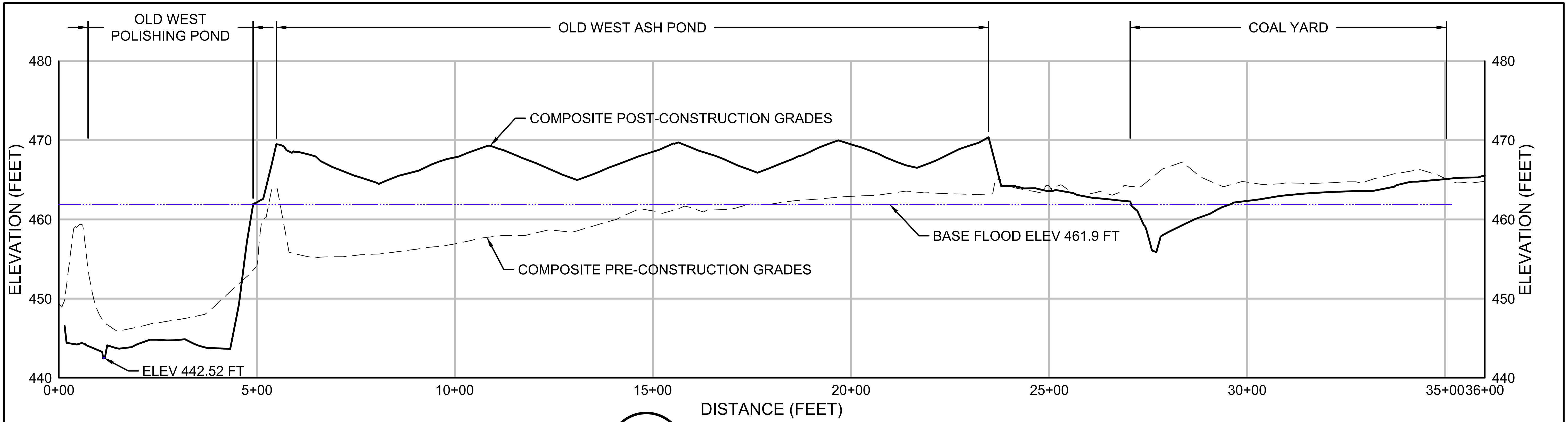
Geosyntec
consultants

PROJECT NO: CHE8400
OCTOBER 2020

FIGURE
1

L:\CADD\D\DYNEGY\HENNEPIN\CLOSURE DESIGN - CHE8356B\VOLUMES\CHE8356B-V002 - Last Saved by: SNichols on 10/14/20

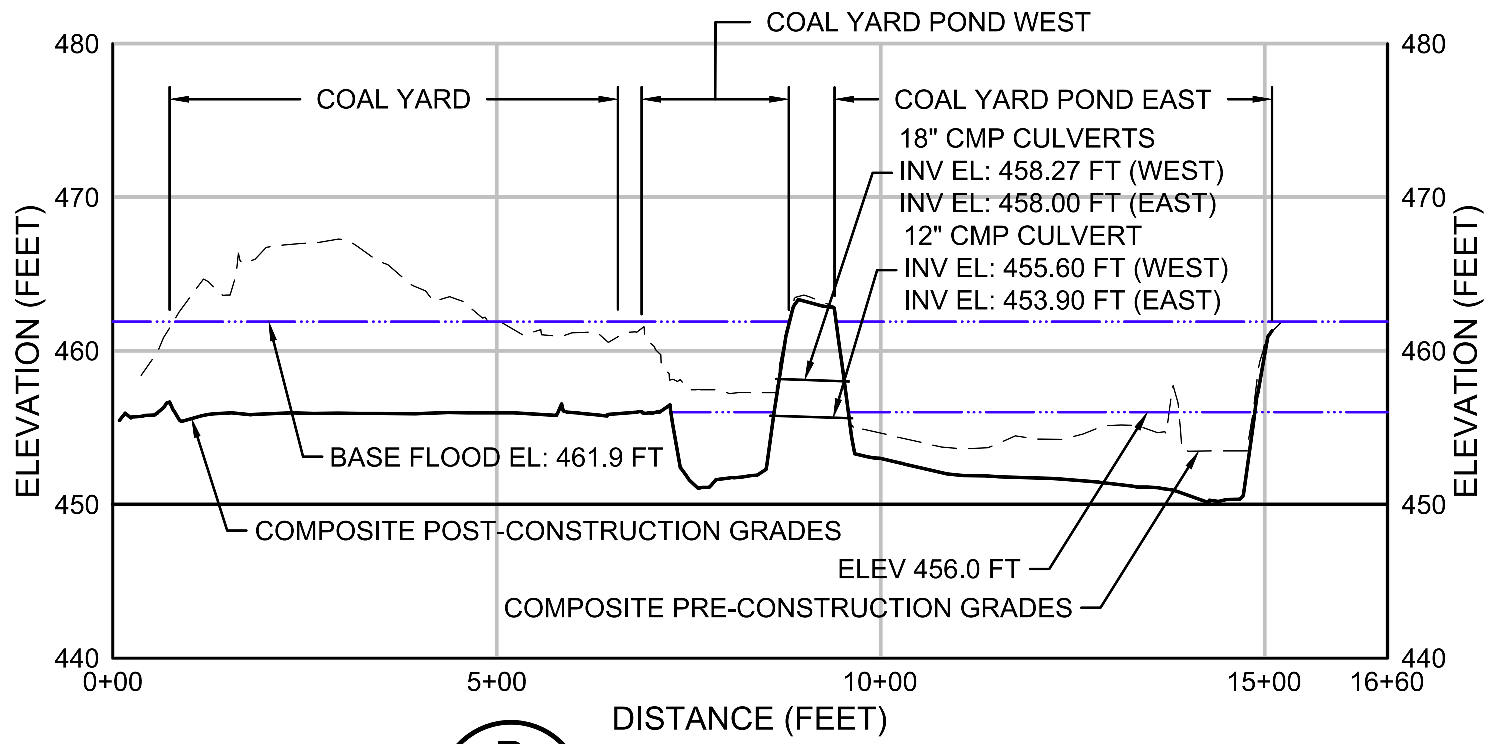
L:\CADD\DYNEGY\HENNEPIN\CLOSURE DESIGN - CHE8356B\VOLUMES\CHE8356B-V002 - Last Saved by: SNichols on 10/14/20



A
1

SECTION
WEST TO EAST

SCALE: 1" = 250' (HORIZONTAL)



B
1

SECTION
NORTH TO SOUTH

SCALE: 1" = 250' (HORIZONTAL)

DRAFT

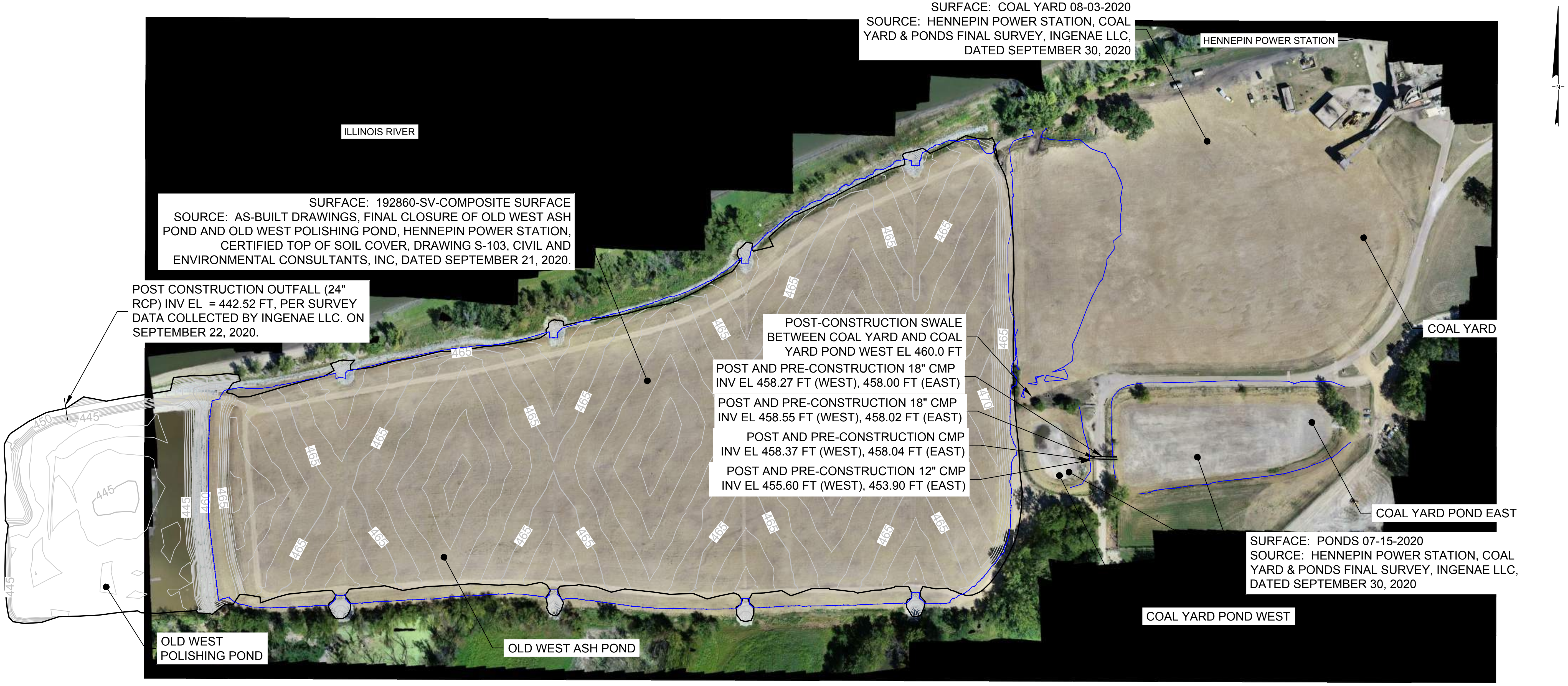
HORIZONTAL SCALE IN FEET

CROSS SECTIONS
HENNEPIN POWER STATION
WEST ASH POND SYSTEM CLOSURE

Geosyntec
consultants

FIGURE
2

PROJECT NO: CHE8400
OCTOBER 2020



SURFACE: COAL YARD 08-03-2020
SOURCE: HENNEPIN POWER STATION, COAL YARD & PONDS FINAL SURVEY, INGENAE LLC, DATED SEPTEMBER 30, 2020

SURFACE: 192860-SV-COMPOSITE SURFACE
SOURCE: AS-BUILT DRAWINGS, FINAL CLOSURE OF OLD WEST ASH POND AND OLD WEST POLISHING POND, HENNEPIN POWER STATION, CERTIFIED TOP OF SOIL COVER, DRAWING S-103, CIVIL AND ENVIRONMENTAL CONSULTANTS, INC, DATED SEPTEMBER 21, 2020.

POST CONSTRUCTION OUTFALL (24" RCP) INV EL = 442.52 FT, PER SURVEY DATA COLLECTED BY INGENAE LLC. ON SEPTEMBER 22, 2020.

POST-CONSTRUCTION SWALE BETWEEN COAL YARD AND COAL YARD POND WEST EL 460.0 FT

POST AND PRE-CONSTRUCTION 18" CMP INV EL 458.27 FT (WEST), 458.00 FT (EAST)

POST AND PRE-CONSTRUCTION 18" CMP INV EL 458.55 FT (WEST), 458.02 FT (EAST)

POST AND PRE-CONSTRUCTION CMP INV EL 458.37 FT (WEST), 458.04 FT (EAST)

POST AND PRE-CONSTRUCTION 12" CMP INV EL 455.60 FT (WEST), 453.90 FT (EAST)

SURFACE: PONDS 07-15-2020
SOURCE: HENNEPIN POWER STATION, COAL YARD & PONDS FINAL SURVEY, INGENAE LLC, DATED SEPTEMBER 30, 2020

SCALE IN FEET

NOTES:

1. TOPOGRAPHIC SURVEY DATA WAS COLLECTED BY MULTIPLE SURVEYORS ON MULTIPLE DATES AND MERGED INTO A COMPOSITE POST-CONSTRUCTION TOPOGRAPHIC SURFACE FOR THE AREAS INDICATED ON THIS DRAWING.
2. SURVEY DATA USED TO CREATE THIS FIGURE WAS COLLECTED IN THE NAD83 HORIZONTAL DATUM AND THE NAVD88 VERTICAL DATUM.
3. THE BACKGROUND AERIAL IMAGE WAS PROVIDED BY RYAN CENTRAL, INCORPORATED, AND COLLECTED ON JULY 23, 2020.

LEGEND

—— 465 ——	SURFACE ELEVATIONS
————	SURVEY BOUNDARY
————	LIMITS OF BASE FLOOD ELEVATION 461.9 FT

DRAFT

COMPOSITE POST-CONSTRUCTION GRADES
HENEPIN POWER STATION
WEST ASH POND SYSTEM CLOSURE

Geosyntec consultants

PROJECT NO: CHE8400
OCTOBER 2020

FIGURE
3

L:\CADD\D\DYNEGY\HENNEPIN\CLOSURE DESIGN - CHE8356B\VOLUMES\CHE8356B-X002 - COMBINED FG TOPO SURFACES - Last Saved by: SNichols on 10/11/20

REVISION RECORD		
NO	DATE	DESCRIPTION
△1	10/08/2020	REVISE PER GEOSYNTEC REVIEW
△		
△		
△		

SUBMITTAL RECORD		
NO	DATE	DESCRIPTION

SCALE IN FEET
0 80 160

SURVEYOR'S CERTIFICATE

STATE OF ILLINOIS
COUNTY OF DUPAGE } *SS*

I HEREBY CERTIFY THAT THIS PLAT, AND THE SURVEY UPON WHICH IT IS BASED, HAS BEEN PREPARED UNDER MY DIRECT SUPERVISION. ALL DISTANCES ARE GIVEN IN FEET AND DECIMALS THEREOF.

THIS PLAT HAS BEEN PREPARED BY CIVIL & ENVIRONMENTAL CONSULTANTS, INC. ILLINOIS LICENSED PROFESSIONAL DESIGN FIRM NO. 184.004002, LICENSE EXPIRES APRIL 30, 2021. FOR THE EXCLUSIVE USE OF THE CLIENT NOTED HEREON. REPRODUCTION OF USE BY THIRD PARTIES IS STRICTLY PROHIBITED WITHOUT THE WRITTEN PERMISSION OF THE UNDERSIGNED. THIS PROFESSIONAL SERVICE CONFORMS TO THE CURRENT ILLINOIS MINIMUM STANDARDS FOR A BOUNDARY SURVEY.

FIELDWORK WAS COMPLETED ON MAY 29, 2020.

GIVEN UNDER MY HAND AND SEAL THIS 9TH DAY OF OCTOBER, 2020.

Douglas R McClintic

ILLINOIS LICENSED PROFESSIONAL LAND SURVEYOR NO. 035–002992
LICENSED VALID THROUGH NOVEMBER 30, 2020

DOUGLAS R. McCLINTIC
035–002992
PROFESSIONAL LAND SURVEYOR
NAPERVILLE, IL

LEGEND

– – – 462 – – –	CERTIFIED 1 FOOT SOIL COVER CONTOUR
—— 465 ——	CERTIFIED 5 FOOT SOIL COVER CONTOUR
——	LIMITS OF BASE FLOOD ELEVATION 461.9
– – – –	APPROXIMATE LOCATION OF BASE FLOOD ELEVATION 461.9

GENERAL NOTES

1. BASE FLOOD ELEVATION BASED ON COMPOSITE SURFACE OF MAY 29, 2020 MONTHLY FIELD DATA TOPOGRAPHY TIED INTO AUGUST 4, 2020 TOP OF SOL COVER TOPOGRAPHY.
2. MAP IS BASED ON ILLINOIS STATE PLANE WEST ZONE.
3. ALL ELEVATIONS ARE REFERENCED TO THE VRS NETWORK NAVD 88 VERTICAL DATUM.

REFERENCE

1. AERIAL IMAGE PROVIDED COURTESY OF RYAN INCORPORATED CENTRAL, JANESVILLE, WISCONSIN.

Civil & Environmental Consultants, Inc.
1230 East Diehl Road, Suite 200 - Naperville, IL 60563
Ph: 630.963.6026 · 877.963.6026 · Fax: 630.963.6027
www.cecinc.com

AS-BUILT DRAWINGS
FINAL CLOSURE OF OLD WEST ASH POND AND OLD WEST POLISHING POND
HENNEPIN POWER STATION

DRAWN BY:	MSK	CHECKED BY:	DRM	APPROVED BY:	DRAFT
DATE:	09/25/2020	DWG SCALE:	1"=80'	PROJECT NO:	192-860.0001

CERTIFIED FINAL GRADES

DRAWING NO.: S-103

SHEET 3 OF 17

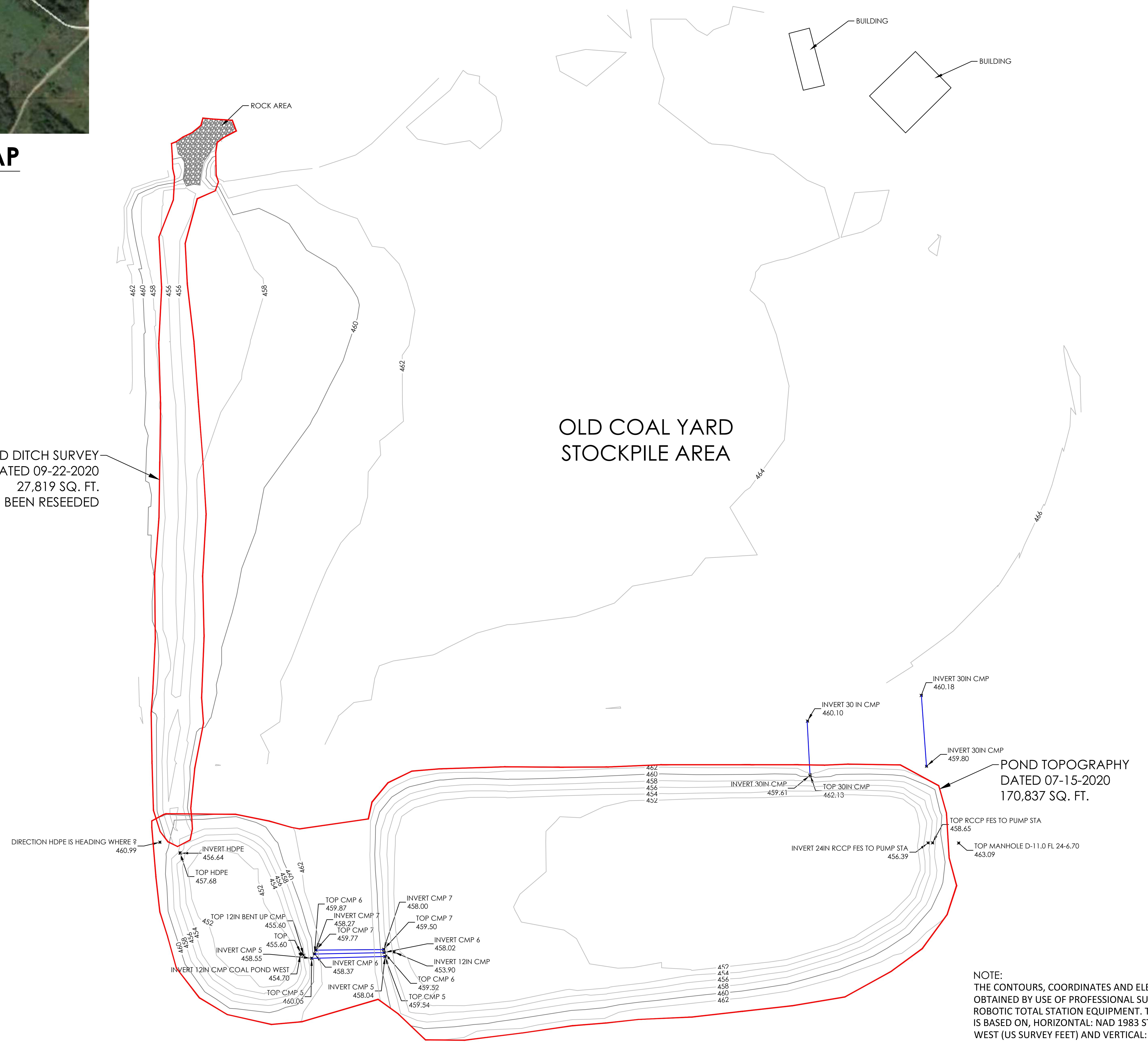
P:\2019\192-860\-Survey\Dwg\SV01-Final Documents\192860-SV01-S103-Certified Soil Cover.dwg{S-103} LS:(10/9/2020 – shoffman) – LP: 10/9/2020 11:59 AM

HENNEPIN POWER STATION

OLD COAL YARD STOCK AREA 08-03-2020
COAL YARD SETTLEMENT POND AREA 07-15-2020
DITCH SURVEY 09-22-2020

SITE LOCATION MAP

N.T.S.



REGRADED DITCH SURVEY
DATED 09-22-2020
27,819 SQ. FT.
AREA HAS BEEN RESEEDED

SEE SURVEY POINT FILE FOR
ADDTIONAL PIPE SURVEY
POINTS 7201-7203 & 7206-7207

POND TOPOGRAPHY
DATED 07-15-2020
170,837 SQ. FT.

NOTE:
THE CONTOURS, COORDINATES AND ELEVATIONS AS SHOWN HEREON WHERE OBTAINED BY USE OF PROFESSIONAL SURVEY PRECISION GRADE GPS AND/OR ROBOTIC TOTAL STATION EQUIPMENT. THE DATUM USED AND AS SHOWN HEREON IS BASED ON, HORIZONTAL: NAD 1983 STATE PLANE COORDINATE ZONE-ILLINOIS WEST (US SURVEY FEET) AND VERTICAL: NAVD 88 (US SURVEY FEET).

N

0' 60' 120'

IngenAE

502 Earth City Plaza, Suite 120
Earth City, MO 63045
www.ingenae.com

MICHAEL J. GRAMINSKI
35-2901

10/8/2020

Submissions / Revisions:	Date:
1 REVISED	9/25/20
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	

VISTRA
ENERGY

Project Name & Location:

HENNEPIN
POWER STATION

DO NOT SCALE PLANS
Copying, Printing, Software and other processes required to produce these prints can stretch or shrink the actual paper or layout. Therefore, scaling of this drawing may be inaccurate. Contact IngenAE with any need for additional dimensions or clarifications.

Drawing Name:
COAL YARD
& PONDS
FINAL SURVEY

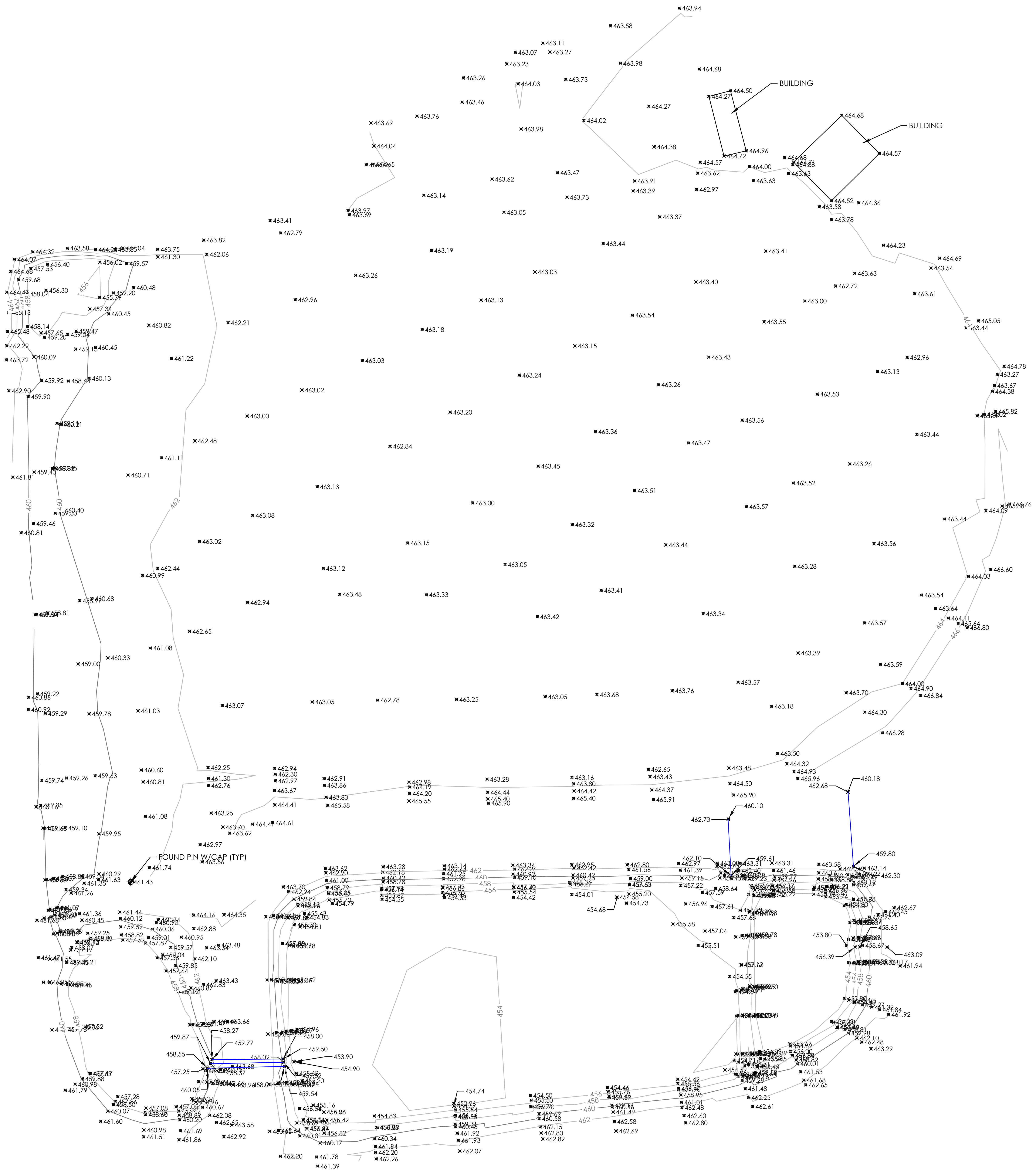
Date: 10/13/2020
Project No.
Type: SITE
Drawing No. 1
Drawn By: CB
Approved By: MG
Scale: AS NOTED

HENNEPIN POWER STATION

OLD COAL YARD STOCK AREA AND STORM WATER RUN-OFF COLLECTION POND SURVEY

SITE LOCATION MAP

N.T.S.

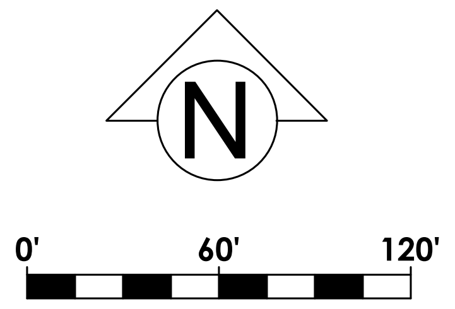


NOTES:
1. ORIGINAL SURVEY COMPLETED ON OR AROUND JUNE 24, 2020.
2. THE SURVEYS AS SHOWN HERE ON WERE MADE BY USE OF DATA COLLECTED BY TRIMBLE G-8 GPS EQUIPMENT. THAT DATA IS BASED ON THE ILLINOIS STATE PLANE WEST COORDINATE SYSTEM. NAD1983 U.S. SURVEY FEET, NAVD 88 U.S. SURVEY FEET.

STATE OF ILLINOIS
MICHAEL J. GRAMINSKI
35-2901
REGISTERED LAND SURVEYOR

MICHAEL J. GRAMINSKI
IPLS NO. 035-2901

DATE



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Earth City, MO 63045
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Submissions / Revisions:		Date:
1		
2		
3		
4		
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6		
7		
8		
9		
10		
11		
12		
13		

Project Name & Location:

HENNEPIN
POWER STATION

Drawing Name:
COAL YARD AND PONDS ORIGINAL SURVEY

Date: 7/17/2020	Project No.
Type: SITE	Drawing No. 1
Drawn By: CB	
Approved By: MG	
Scale: AS NOTED	

BURNS & McDONNELL℠

CREATE AMAZING.

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