



Structural Stability and Safety Factor Assessment

Whelan Energy Center

WEC Temporary Ash Disposal Area

Hasting, Nebraska

December 30, 2025

Contents

1	Introduction	1
1.1	Assessment Objectives	1
1.2	CCR Rule Requirements	1
2	Facility Description	3
2.1	CCR Waste-Streams	4
2.2	Hydraulic Structures	4
2.3	Previous Inspections	5
3	Structural Stability Assessment	5
3.1	Stable Foundations and Abutments	5
3.2	Slope Protection	6
3.3	Embankment Compaction	6
3.4	Slope Vegetation	7
3.5	Spillways Capacity	7
3.6	Hydraulic Structures Integrity	7
3.7	Downstream Slope Low Pool/Drawdown	8
3.8	Structural Stability Deficiencies and Corrective Measures	8
4	Safety Factor Assessment	9
4.1	Stability Analysis Criteria	9
4.2	Methodology	9
4.3	Critical Cross Section Geometry	9
4.4	Loading Conditions, Pond Elevations and Phreatic Conditions	9
4.5	Material Properties	10
4.6	Vehicle Loading	11
4.7	Assessment of Liquefaction Potential	11
4.8	Factors of Safety and Conclusions	11
5	References	12

List of Tables

<i>Table 1 – Loading Conditions and Minimum Required Factors of Safety</i>	10
<i>Table 2 – Summary of Material Properties Used in Analysis</i>	10
<i>Table 3 – Summary of Stability Analysis Results</i>	11

List of Attachments

Attachment 1 – Figures

- Figure 1 – Location of WEC and City of Hastings
- Figure 2 – WEC CCR Facilities and Monitoring Well Locations
- Figure 3 – Ash Disposal Area Plan 2020
- Figure 4 – Impoundment – Cross Sections 2020
- Figure 5 – Ash Disposal Area Plan 2025
- Figure 6 - Impoundment – Cross Sections 2025
- Figure 7 – Modeled Critical Cross Section 2020
- Figure 8 – Modeled Critical Cross Section 2025

Attachment 2 – Hydraulic Analyses

Attachment 3 – Boring Logs and Well Construction Diagrams

Attachment 4 – Geotechnical Testing Results

Attachment 5 – Stability Analyses Results

Attachment 6 – Excerpt from USGS Seismic-Hazard Map, 2014

Professional Engineer Certification

"Based on the information provided to HDR by Hastings, information available on Hastings' CCR website, and HDR's visual observations and analysis, this 5-year review and update of the Structural Stability Assessment and Safety Factor Assessment was conducted in accordance with the requirements of the USEPA 40 CFR Part 257-Criteria for Classification of Solid Waste Disposal Facilities and Practices; Final Rule, April 17, 2015 (CCR Rule). Based on the information currently available, I hereby certify to the best of my knowledge, that this amended Structural Stability Assessment and Safety Factor Assessment for the existing WEC Temporary Ash Disposal Area at the Whelan Energy Center, operated by Hastings Utilities / City of Hastings, Nebraska, meets the requirements of the CCR Rule 40 CFR §257.73(d) and (e) in accordance with professional standards of care for similar work. I am a duly licensed Professional Engineer under the laws of the State of Nebraska."

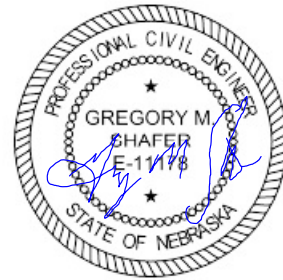
Print Name: Gregory M. Shafer

Signature:



Date: December 30, 2025

License #: E-11178



My license renewal date is December 31, 2026.

1 Introduction

On April 17, 2015, the U.S. Environmental Protection Agency (EPA) issued the final rule for the regulation and management of coal combustion residuals (CCR) under Subtitle D of the Resource Conservation and Recovery Act (RCRA) [40 CFR Part 257, Subpart D]. The federal CCR Rule requires owners or operators of an existing 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, perform periodic structural stability assessments and periodic safety factor assessments.

HDR Engineering, Inc. (HDR) has reviewed and updated this Structural Stability and Safety Factor Assessment Report for the Whelan Energy Center (WEC) surface impoundment (WEC Temporary Ash Disposal Area) near Hastings, Nebraska. WEC has two units generating CCR – the WEC Unit 1 (WEC1) and WEC Unit 2 (WEC2). The WEC Temporary Ash Disposal Area, permitted with the state of Nebraska, consists of approximately 23.2-acres. Approximately 11.3-acres (West Area) has been used as a surface impoundment, and typically half of that area is continuously dewatered for pond ash excavation and stockpiling for beneficial use markets. In early November 2025, WEC1 ash sluicing to the West Area was terminated; process waters (bottom ash forwarding tank and service water during hopper flushing) are still periodically discharged to the West Area until further plant modifications are completed during 2026. Since 2013 when WEC2 stopped ash sluicing, the East Area of the WEC Temporary Ash Disposal Area was utilized as a CCR landfill receiving moisture-conditioned scrubber ash and bottom ash. During 2023, approximately 6-acres of the northeast quadrant (i.e., north half of East Area) was retrofitted with a composite liner for a landfill cell and leachate pond.

The majority of the WEC Temporary Ash Disposal Area is incised, the north, east and west sides are below the surrounding ground surface. The south side has an embankment above adjacent natural ground surface.

1.1 Assessment Objectives

The assessments are required to assess and document the structural integrity of existing CCR surface impoundments.

1. **40 CFR §257.73(d)** – 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.
2. **40 CFR §257.73(e)** – Document whether the calculated factors of safety for each CCR unit achieve the minimum safety factors specified in 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.

1.2 CCR Rule Requirements

The following sections of this Report address the required federal CCR regulations to document whether the CCR unit has been designed, constructed, operated, and maintained with the guidelines specified in 40 CFR 257.73(d)(1)(i) through (vii) and to document whether the calculated factors of safety achieve the minimum safety factors specified in this part for the critical cross section of the embankment.

- Structural Stability Assessment Section 3:
 - **Section 3.1: 40 CFR §257.73(d)(1)(i)** – Stable foundations and abutments.
 - **Section 3.2: 40 CFR §257.73(d)(1)(ii)** – Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown.
 - **Section 3.3: 40 CFR §257.73(d)(1)(iii)** – Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit.
 - **Section 3.4: 40 CFR §257.73(d)(1)(iv)** – Vegetated slopes of dikes and surrounding areas not to exceed a height of six inches above the slope of the dike, except for slopes which have an alternate form or forms of slope protection.
 - **Section 3.5: 40 CFR §257.73(d)(1)(v)** – A single spillway or a combination of spillways configured as specified in paragraph (d)(1)(v)(A) of this section. The combined capacity of all spillways must be designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the event specified in paragraph (d)(1)(v)(B):
 - Spillways must be either of non-erodible construction and designed to carry sustained flows, or earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected.
 - Combined capacity of all spillways must adequately manage flow during and following the peak discharge from a 100-year flood for a low hazard potential CCR surface impoundment.
 - **Section 3.6: 40 CFR §257.73(d)(1)(vi)** – 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.
 - **Section 3.7: 40 CFR §257.73(d)(1)(vii)** – 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.
 - **Section 3.8: 40 CFR §257.73(d)(2)** – The periodic assessment described in paragraph (d)(1) of this section must identify any structural stability deficiencies associated with the CCR unit in addition to recommending corrective measures. If a deficiency or a release is identified during the periodic assessment, the owner or operator must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.
- Safety Factor Assessment Section 4:
 - **40 CFR §257.73(e)(1)**– The owner or operator must conduct an initial and periodic safety factor assessment for each CCR unit and document whether the calculated factors of safety for each CCR unit achieve the minimum safety factors specified in paragraphs (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.

2 Facility Description

The Whelan Energy Center, located in Hastings, Nebraska, has two coal fired electric generating units. WEC Units 1 and 2 have current net capacity ratings of 76 megawatts and 220 megawatts, respectively. Figure 1 in Attachment 1 provides the location of WEC relative to City of Hastings. Hastings Utilities / City of Hastings, Nebraska (Hastings) is the owner and operator of WEC1 and the operating agent of WEC2 for Public Power Generation Agency (PPGA). The WEC Temporary Ash Disposal Area, located at WEC, is permitted as a fossil fuel combustion ash disposal area under the Nebraska Department of Water, Energy, and Environment (DWEE) [formerly the Nebraska Department of Environment and Energy (NDEE) and formerly the Nebraska Department of Environmental Quality (NDEQ)] Title 132 – *Integrated Solid Waste Management Regulations*. Original Title 132 permitting efforts began in 1999 pursuant to NDEQ requirements. The federal CCR rule – effective on October 19, 2015 – and as subsequently amended, also applies to the WEC Temporary Ash Disposal Area.

The WEC Temporary Ash Disposal Area is currently classified as an existing CCR surface impoundment of approximately 23.2-acres in size that historically received CCR for disposal/storage and is permitted with the State of Nebraska (Permit No. NE0204129, Facility ID 58048). During 2023, approximately 6-acres of the northeast quadrant was retrofitted with a composite liner, complying with the federal CCR rule and NDEE Title 132 regulations, for a landfill cell and leachate pond. Retrofit activities included CCR removal and liner construction (August 9, 2023, to December 21, 2023), CQA documentation report submittal to NDEE (January 24, 2024), NDEE reviews, and NDEE approval letter of the CQA documentation report (June 18, 2024). With this retrofit, the permitted WEC Temporary Ash Disposal Area has both a lined landfill area and historic unlined areas of the CCR surface impoundment. The CCR landfill consists of an approximate 4-acre cell and a 1.5-acre leachate pond with composite liner, plus surrounding berms. The remaining area of existing CCR surface impoundment is approximately 17.2-acres.

The WEC Temporary Ash Disposal Area historically received CCR in sluiced and dry form for storage prior to removal for beneficial uses. CCR sluicing and disposal at this site began in 1981, the same year that WEC1 began commercial operation. The disposal area was constructed as an ash pond to provide storage for ash, sluice water, and other process waters with the option to recycle water back to the WEC. Due to ash pond size and evaporation, recycling water back to the plant did not occur. Over time, other process waters such as cooling tower blowdown were redirected away from the WEC Temporary Ash Disposal Area. With start-up of WEC2 commercial operations on May 1, 2011, scrubber ash was sluiced to the East Area and fly ash was periodically sluiced to the West Area. Sluicing of scrubber ash ended in 2013 after a pug mill was installed to load trucks with moistened scrubber ash for hauling and placement within the East Area of the WEC Temporary Ash Disposal Area. Since retrofit liner construction in 2023 was completed and approved by DWEE, CCR generation of scrubber ash, bottom ash, and if needed fly ash, is hauled to the landfill cell for temporary stockpiling and storage prior to removal for beneficial use off-site. Since August 2024, bottom ash is hauled to the new concrete lined bottom ash bunker for stockpiling prior to removal for beneficial use.

The WEC Temporary Ash Disposal Area is permitted by the State of Nebraska as a fossil fuel ash disposal area and has a groundwater monitoring network. A facility site map, Figure 2 provided in Attachment 1, shows the locations of the plant, supporting facilities, WEC Temporary Ash Disposal Area, bottom ash bunker, and groundwater monitoring wells.

2.1 CCR Waste-Streams

The WEC had generated sluiced CCR and dry CCR materials. The CCR waste streams were bottom ash and fly ash mixture (pond ash) in sluice form from WEC1, and bottom ash and scrubber ash in dry form from WEC2. Plant upgrades conducted during 2025 have resulted in ash sluicing to be ceased and all CCR will be hauled dry to various locations in the WEC Temporary Ash Disposal Area or bottom ash bunker. Currently, all WEC2 fly ash is loaded out dry directly from the WEC2 silo by the fly ash marketer under contract. Start-up and commissioning of the WEC1 fly ash silo is underway. WEC1 fly ash will be loaded out dry by the fly ash marketer.

Historically, sluiced pond ash and dry scrubber ash were separated in the WEC Temporary Ash Disposal Area by a berm created from pond ash. This created a West Area and East Area, respectively, as shown in Figure 2 (Attachment 1). Although the dry and historically sluiced CCR waste-streams are separated within the WEC Temporary Ash Disposal Area, the entire area is permitted with the DWEE as a fossil fuel combustion ash disposal area and considered one CCR unit.

2.2 Hydraulic Structures

WEC1 no longer sluices CCR into the West Area of the existing WEC Temporary Ash Disposal Area. Currently the only liquids continuing to discharge into the north side of the West Area is WEC2 bottom ash submerged chain conveyance forwarding tank discharge and WEC1 service water during bottom ash hopper flushing at approximate total flows of 24,000 gallons per day, as provided by Hastings. This flow is significantly less than the prior WEC1 CCR flows of approximately 400,000 gallons per day. The ash marketer continues to manage the routing of CCR, water flows and excavation of pond ash within the permitted limits of the WEC Temporary Ash Disposal Area.

In 2007, riser/spillway structures and the Leachate Retention Pond were constructed to transfer water from the WEC Temporary Ash Disposal Area. These structures were required by formerly NDEQ (now DWEE) in order to maintain the depth of leachate within the disposal area at a depth of approximately 12-14 inches or less under normal operations during a 25-year, 24-hour storm event. Ash sluice was directed to flow southward for settlement of ash sediment while the free liquids generally flow along the surface. The free liquids then either drained by gravity to a open area surrounding the risers or pumped directly into the Leachate Retention Pond with a portable pump and piping. Spillway invert elevations and general impoundment cross-sections for 2020 and 2025 are shown on Figures 3 through 6, in Attachment 1.

With further operational changes within the plant and ash management, the riser/spillway structures have not been regularly used for several years.

- East Area risers and spillways – Discontinued use in 2013 when pug mill installed on scrubber ash silo for loading direct into dump trucks, hauled and placed within the East Area of the WEC Temporary Ash Disposal Area.
- West Area risers and spillways – Discontinued use in 2015 when operations began using a floating pump and flexible pipe to pump free liquids to the Leachate Retention Pond. Operations began periodically pumping water into the West Area risers and spillways area as needed to avoid piping across road and monitor water levels in Leachate Retention Pond to maintain capacity.

Pumping of water from the West Area into riser/spillway area or directly into the Leachate Retention Pond has been sporadic since 2016 due to significant reductions in water use for WEC1 ash sluice pipe flushing and pond evaporation. Water in the Leachate Retention Pond either evaporates or is used for CCR dust control within the permitted boundaries of the WEC Temporary Ash Disposal Area. Although the Leachate Retention Pond is seasonally dry, structural stability modeling described in Section 4 used the normal pool depths.

Construction of the retrofit composite liner included an embankment for the new leachate pond on the south side of the liner area. The slopes were graded to 3H:1V with the longest approximately 20 FT in elevation from the leachate pond floor up to the crest above, which was considered the critical cross section.

2.3 Previous Inspections

Hastings performs weekly and annual inspections for the entire WEC Temporary Ash Disposal Area and Leachate Retention Pond. The weekly inspections are completed by qualified individuals to check for potentially hazardous conditions or structural weakness and the results of the inspections are documented on the Weekly Inspection Checklist Forms. The annual inspections are completed by a professional engineer registered in the State of Nebraska. Annual inspection reports are posted on the facility's CCR website.

There have been no reports of structural instability at the WEC Temporary Ash Disposal Area during previous inspections.

3 Structural Stability Assessment

Structural stability assessment requirements for existing CCR surface impoundments are detailed in 40 CFR 257.73: *Structural integrity criteria for existing CCR surface impoundments*. CCR Rule 40 CFR 257.73(d) states that the assessment must, at a minimum, document whether the CCR unit has been designed, constructed, operated, and maintained. The following sections document the visual observations and available site information for items specified in 40 CFR 257.73(d)(1)(i) through (vii).

3.1 Stable Foundations and Abutments

The geology and hydrogeology of the former Blaine Naval Ammunition Depot (NAD), which includes the WEC and surrounding area, have been studied extensively. The geology of the Hastings area is described by Keech and Dreeszen (1968), as reported in Layne GeoSciences (1997), as unconsolidated deposits of Pleistocene and Pliocene (Quaternary) age having a combined thickness of about 100-500 feet, with a composition of the deposits consisting of clay, silt, sand, and gravel. The site geology is somewhat complex with eolian lean clay (loess), and eolian and/or alluvial fine sand, silt and clay sediments of Pleistocene age overlying thick sequences of Pliocene/Pleistocene sands and gravels, with occasional 2-3 foot clay seams, of alluvial origin. Data from the WEC production well boring logs indicates that the subsurface conditions in the vicinity of the site consist of the following (HDR 2006b):

- 55-80 feet of brown clay and lean clay (loess) beginning at the surface,
- followed by 30-40 feet of fine to medium-grained sand and silty clay (possibly Sappa Formation or basal Loveland Formation),
- followed by fine to coarse sand and gravel (with occasional 2-to-3-foot clay layers) to total depths ranging from 221-238 feet (Pliocene/Pleistocene aquifer),

- and finally white clay or gray shale beginning at depths ranging from 238-240 feet (Cretaceous Niobrara Formation).

The WEC Temporary Ash Disposal Area has a base elevation within in-situ lean clay material of Peoria loess with permeability of approximately 10^{-4} to 10^{-8} cm/sec (HDR 2006b). Underlying the Peoria layer and above the alluvial aquifer is the upper portion of Loveland loess and Sangamon material. The permeability of these materials is approximately 8.2×10^{-5} to 2.2×10^{-7} cm/s for the Loveland loess and 3.1×10^{-6} cm/sec for the Sangamon (HDR 2006b).

The south embankment showed no signs of distress during the observations. There were no cracks or visible seepage.

3.2 Slope Protection

Interior slopes of WEC Temporary Ash Disposal Area contained vegetation on west, south and portions of the east and north sides. Stored CCR protected the remaining interior slopes up to the crest and provided several ingress/egress roads of compacted CCR into the WEC Temporary Ash Disposal Area for operations and ash management activities.

Weekly inspections performed by Hastings monitor the existing slopes for structural stability including erosion, breach of embankments, and liquids/CCR potential to overtop embankments. Hastings personnel observed no issues impacting the structural stability of the embankments. During the November 12, 2025 inspection performed by HDR, observations included:

- No animal burrow holes were observed.
- Adequate vegetation on south exterior slope to prevent erosion.
- Full vegetation was observed on the interior slopes of the south Leachate Retention Pond.

Recommended corrective actions for these items are included in Section 3.8. Currently, none of the slope observations above negatively impacted the structural stability of the embankments. In addition, no seepage was observed.

3.3 Embankment Compaction

The original ash pond was constructed for WEC1 and has been in operation since 1981. Record drawings of this existing CCR surface impoundment showed grading contours and limits of the impoundment (HDR 2016). Specifications and construction records were not available from Hastings to verify that embankments were mechanically compacted. Three sides of the WEC Temporary Ash Disposal Area are incised. The only embankment that extends above the natural ground is the south embankment.

During the November 2020 inspection, soil probing along the south embankment exterior slope showed soils consistent with the descriptions in the geotechnical boring logs throughout the various explorations completed previously. The compacted Peoria Loess material was blocky, firm to very firm, light grayish brown lean clay. A hand probe was inserted to depths ranging from 1-2 feet below existing ground surface at several locations along the south side of the south embankment.

Specifications for construction of the Leachate Retention Pond embankments required clay materials (on-site Peoria Loess), placed in 8-inch loose lifts and compacted to 95 percent of maximum dry density per ASTM D698. The same compaction requirements applied to carefully

compacted backfill placed around the installed spillways through the south embankment of the WEC Temporary Ash Disposal Area. Similar on-site clay soils and compaction efforts were assumed to apply to the original ash pond construction.

3.4 Slope Vegetation

The requirement of 40 CFR 257.73(d)(iv) requires vegetated slopes of dikes and surrounding areas not to exceed a height of 6- inches above the slope of the dike. Vegetation along the perimeter roadway and near top of slopes appeared to be maintained at height of 6-inches or less. Where interior embankment slopes contained vegetation, the vegetation was full in most locations and varied in height above 6-inches. Hastings is concerned that cutting existing vegetation down to 6-inches will harm the vegetation and cause erosion.

Recommended corrective actions for these items are included in Section 3.8.

3.5 Spillways Capacity

Per 40 CFR 257.73(d)(v), the combined capacity of all spillways must be designed, constructed, operated and maintained to adequately manage flow during and following the peak discharge. For the WEC Temporary Ash Disposal Area the peak discharge is a 100-year flood for a low hazard potential CCR surface impoundment. Spillways must be of non-erodible construction and designed to carry sustained flows.

The risers and spillways in the south embankment of the WEC Temporary Ash Disposal Area are corrugated metal pipe (CMP). Construction specifications required pipe bedding and carefully compacted backfill for the spillway installations. Monitoring and maintenance of the riser areas and spillways is described in Hastings Operational Plan within the Title 132 Permit Renewal Application (HDR 2021). However, as noted in Section 2.2 above, the riser areas and spillways have not been used in normal operations for several years.

To determine whether the WEC Temporary Ash Disposal Area could retain the flow during and following the peak discharge from a 100-year flood event, HDR had previously performed hydraulic analyses evaluating ash sluice discharge, run-on and impounded depth during this event. Model runs were performed separately for the West Area and East Area, since only the West Area operates as a CCR surface impoundment. The results showed that there was adequate storage within both areas of the WEC Temporary Ash Disposal Area without overtopping the embankment. With the construction of the landfill cell and recent termination of WEC1 ash sluicing, adequate storage continues to be available for the 100-year flood event. Inputs and reviewed hydraulic model runs are provided in Attachment 2.

3.6 Hydraulic Structures Integrity

Hydraulic structures passing through the dike of the CCR surface impoundment are to maintain structural integrity and be free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation. During the November 2025 inspection performed by HDR, observations of the hydraulic structures included:

- West Area:
 - spillways free of obstructions; and
 - vegetation and brush growing around inlets and outlets of West Area spillways.
- East Area:

- spillways clear of sediment and vegetation at outlets; and
- vegetation and brush growing around inlet of East Area spillways

Recommended corrective actions for these items are included in Section 3.8. Berms around the risers and spillway inlets prevent ash sluice and stormwater runoff from entering these structures. Only precipitation falling within the bermed area or pumped surface water could potentially flow into the risers.

East Area spillways are not required and have not been used since 2013. West Area spillways were not utilized for ash sluice free liquids for several years after 2015; when ash sluice free liquids needed to be transferred out of the West Area, Hastings personnel hooked up a portable floating pump and piping to pump water directly into the Leachate Retention Pond. However, operations do periodically pump the free liquids into the West Area spillways.

3.7 Downstream Slope Low Pool/Drawdown

No river, stream or lake exists adjacent to the WEC Temporary Ash Disposal Area. The only water body present on the downstream slope of the WEC Temporary Ash Disposal Area is the Leachate Retention Pond. This Leachate Retention Pond was specifically constructed to hold the free liquids gravity drained or pumped from the WEC Temporary Ash Disposal Area. Water in the Leachate Retention Pond either evaporates or is used for CCR dust control. At the time of this report, the Leachate Retention Pond is almost dry.

The safety factor assessment in Section 4 evaluated the critical cross section of the south embankment with the Leachate Retention Pond completely dry and at normal water levels. Computed safety factors exceed the required minimums demonstrating structural stability.

Leachate Retention Pond water is not subject to rapid drawdown, thus such condition was not considered a potential mechanism for structural instability of the south embankment exterior slope of the WEC Temporary Ash Disposal Area.

3.8 Structural Stability Deficiencies and Corrective Measures

The following recommendations are provided for corrective measures for the various categories identified in Section 3.2:

- Control weeds throughout the entire WEC Temporary Ash Disposal Area.
- Maintain vegetation on the interior slopes of the south Leachate Retention Pond.
- Repair rutting in the drainage ditch west of the northwest corner of the WEC Temporary Ash Disposal Area (west side).
- Continue to monitor for animal burrow holes.
- Hydraulic Structures Integrity:
 - West Area:
 - Remove sediment from spillways.
 - Clear vegetation and brush growing around inlets and outlets of West Area spillways.
 - East Area:
 - Remove vegetation at outlets.
 - Remove vegetation and brush from around inlet.
 - Remove sediment covering orifice openings of risers.

4 Safety Factor Assessment

This safety factor assessment is conducted in compliance with 40 CFR 257.73(e), supported by appropriate engineering calculations. Methodology, loading conditions and inputs are described in the sections below.

4.1 Stability Analysis Criteria

The CCR Rule does not stipulate the stability analysis methodology directly, although the minimum required factor of safety criteria were adopted from the U.S. Army Corp of Engineers (USACE) guidance manuals, and USACE Engineering Manual EM 1110-2-1902 is referred to by the CCR Rule as a benchmark in the dam engineering community for slope stability analyses. The methodologies in EM 1110-2-1902 were used in this assessment of the static load cases.

4.2 Methodology

For the original 2020 report, the slope stability analysis was conducted using the GeoStudio computer program Slope/W, Version 2019 (R2), which uses limit equilibrium methodologies to evaluate potential rotational and sliding block failure surfaces. For a given geometry and soil profile, the program evaluates potential failure surfaces and identifies the surface exhibiting the minimum factor of safety. For this 5-year review and update, the original files were upgraded to the most recent version of Slope/W, version 2025.1.1, and rerun.

4.3 Critical Cross Section Geometry

With three sides of the WEC Temporary Ash Disposal Area incised, the south embankment was determined to be the critical cross section. Based on geometry, the critical cross section is shown in Figures 7 and 8 and described below. The same cross section evaluated during the 2020 assessment was modeled using the upgraded version of Slope/W. In addition, a new cross section was evaluated based on the most recent survey which showed the CCR placed at a higher elevation within the containment area. See Figures 5 and 6 for the 2025 Plan and Sections. The conditions modeled were from the worst case from the 2020 evaluation (Maximum Storage Pool Long Term Seismic with Surcharge – Max CCR).

The critical cross section extends from north to south through the south embankment from the West Area to the Leachate Retention Pond. The original design provided for a 4H:1V slope into the West Area from the south embankment. However, because of some erosion due to wave action at the time of the observations, that slope was modeled as a 3H:1V down 10-feet vertical to the floor of the WEC Temporary Ash Disposal Area. The approximate 45-foot wide top of the south embankment is flat with a 4H:1V slope down approximately 18-feet vertical to the floor of the Leachate Retention Pond, elevation 1880 (NAVD 88). The top of the south embankment is elevation 1898 (NAVD 88).

4.4 Loading Conditions, Pond Elevations and Phreatic Conditions

The loading conditions that were analyzed and the CCR Rule required minimum factors of safety are summarized in Table 1 below.

Table 1 – Loading Conditions and Minimum Required Factors of Safety

Loading Conditions	Pond Elevation (NAVD 88)	Minimum Factor of Safety	CCR Rule Requirement
Maximum Storage Pool	1895.0	1.5	§257.73(e)(1)(i)
Maximum Surcharge	1898.0	1.4	§257.73(e)(1)(ii)
Seismic	1895.0	1.0	§257.73(e)(1)(iii)
Post-Earthquake – Liquefaction	NA*	1.2	§257.73(e)(1)(iv)

*N/A = Not Applicable. See Section 4.7 Assessment of Liquefaction Potential

The phreatic surfaces for the stability models were developed based on typical, Normal Pool Elevations and Maximum Storage Pool water levels conditions within the WEC Temporary Ash Disposal Area and Leachate Retention Pond. The design pond levels were provided by Hastings.

The horizontal acceleration used was determined by looking up the site location on the USGS Seismic-Hazard Map for the Conterminous United States, 2014. The peak horizontal acceleration with 2 percent probability of exceedance in 50 years was determined to be 0.036g (See Attachment 6). The horizontal acceleration used for the analysis was half that value or 0.018g.

4.5 Material Properties

Borings and well log data indicate fairly consistent geology across the site. The topography at the site is generally level, with minimal elevation change. The general soil profile used for modeling was approximately 5-feet fill material from the excavated Leachate Retention Pond. Below the fill material is approximately 20 feet (thickness) of Peoria Formation with 35-feet (thickness) of Loveland formation. The embankment stratigraphy is shown in Figures 7 and 8, the material properties used for the slope stability analysis are presented in Table 2. The estimated material engineering properties were based on test results and boring logs from:

- Hydrogeologic Characterization for Whelan Energy Center Fossil Fuel Combustion Ash Temporary Ash Disposal Area. Original May 2001; and
- Supplemental Hydrogeologic Characterization for Whelan Energy Center Fossil Fuel Combustion Ash Temporary Ash Disposal Area. Prepared for Hastings Utilities. Original December 2001

Boring logs for the monitoring wells immediately surrounding the WEC Temporary Ash Disposal Area are provided in Attachment 3. Geotechnical testing results are provided in Attachment 4. HDR used undrained (short term), and drained (long term) shear strengths related to effective stresses, as recommended by the USACE.

Table 2 – Summary of Material Properties Used in Analysis

Material Types	Elevation (feet) (NAVD 88)	Unit Weight, γ (pcf)	Short-Term (Undrained)		Long-Term (Drained)	
			Cohesion, c (psf)	Friction Angle, (degrees)	Cohesion, c (psf)	Friction Angle, (degrees)
CCR	1894	120	400	28	400	28
Fill/Embankment	1898	120	1200	0	100	28
Peoria Formation	1873-1898	115	1000	0	100	28
Loveland Formation	1838-1873	118	2000	0	150	30

4.6 Vehicle Loading

Access roads surround the WEC Temporary Ash Disposal Area at or near the top of slopes and on the crest of the south embankment. These access roads are regularly used by WEC personnel, ash marketer, and CCR market customers. Vehicle loading was used in the loading conditions with the maximum pool elevations. The surcharge was applied to simulate haul trucks with tire pressure of 100 psi.

4.7 Assessment of Liquefaction Potential

The embankment is considered to be compacted fill from on-site clay soils (CL) with foundation soils of Peoria and Loveland Formations extending to a combined thickness of 55+ feet below ground surface. Typically, and as used in the slope stability, the Peoria is about 20 feet thick and the Loveland 35 feet thick. Per EM 1110-2-1902, "Most instances of liquefaction have been associated with saturated loose sandy or silty soils. Loose gravelly soil deposits are also vulnerable to liquefaction (e.g., Coulter and Migliaccio 1966; Chang 1978; Youd et al. 1984; and Harder 1988). Cohesive soils with more than 20 percent of particles larger than 0.005 mm in diameter, or with liquid limit (LL) of 34 or greater, or with plasticity index (PI) of 14 or greater are generally considered not susceptible to liquefaction." Because the soils used for the south embankment as well as the soils below are considered lean clays to a depth of approximately 50-feet or greater, the site would not be considered susceptible to liquefaction.

4.8 Factors of Safety and Conclusions

Analysis summary diagrams for each loading condition are provided in Attachment 5. Table 3 below also summarizes the results of the stability analysis. All factors of safety exceeded the minimum requirements.

Table 3 – Summary of Stability Analysis Results

Case No.	Loading Condition	Minimum Factor of Safety	Computed Factor of Safety	Analysis Diagram
1	Normal Storage Pool Short Term Static	1.5	4.39	Attachment 5, Page 1
2	Normal Storage Pool Short Term Seismic	1.0	4.06	Attachment 5, Page 2
3	Normal Storage Pool Long Term Static	1.5	2.22	Attachment 5, Page 3
4	Normal Storage Pool Long Term Seismic	1.0	2.06	Attachment 5, Page 4
5	Maximum Storage Pool Short Term Static	1.5	4.59	Attachment 5, Page 5
6	Maximum Storage Pool Short Term Seismic	1.0	4.24	Attachment 5, Page 6
7	Maximum Storage Pool Long Term Static	1.5	2.20	Attachment 5, Page 7
8	Maximum Storage Pool Long Term Seismic	1.0	2.04	Attachment 5, Page 8
9	Maximum Storage Pool Long Term Static with Surcharge	1.4	1.53	Attachment 5, Page 9

Case No.	Loading Condition	Minimum Factor of Safety	Computed Factor of Safety	Analysis Diagram
10	Maximum Storage Pool Long Term Seismic with Surcharge	1.0	1.46	Attachment 5, Page 10
11	Normal Storage Pool Dry Leachate Retention Pond Long Term Seismic with Surcharge	1.0	1.74	Attachment 5, Page 11
12	Maximum Storage Pool Long Term Seismic with Surcharge – Max CCR	1.0	1.46	Attachment 5, Page 12
Post-Earthquake Liquefaction	Post-Earthquake Liquefaction	1.0	NA*	NA*

*N/A = Not Applicable. See Section 4.7 Assessment of Liquefaction Potential

As presented in Table 3, the factors of safety against slope instability for failure surfaces that are capable of breaching the south embankment satisfy the minimum requirements of the CCR Rule under all loading conditions.

5 References

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- HDR, Inc., 2006b. Supplemental Hydrogeologic Characterization for Whelan Energy Center Fossil Fuel Combustion Ash Temporary Ash Disposal Area. Prepared for Hastings Utilities. Original December 2001.
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- USACE. Engineer Manual, EM 1110-2-1902, Slope Stability, October 31, 2003.
- USGS Seismic-Hazard Map for the Conterminous United States, 2014.

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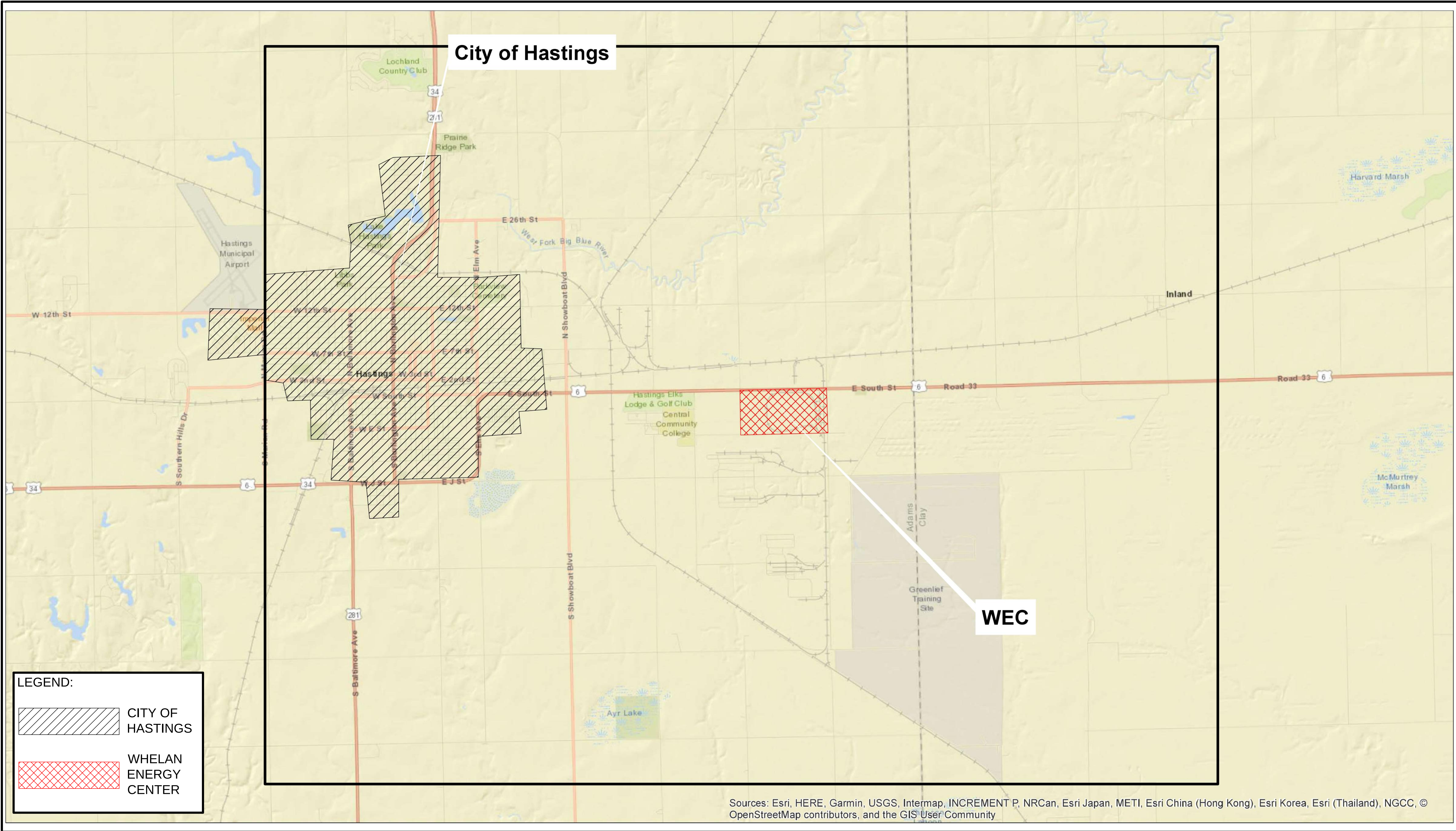


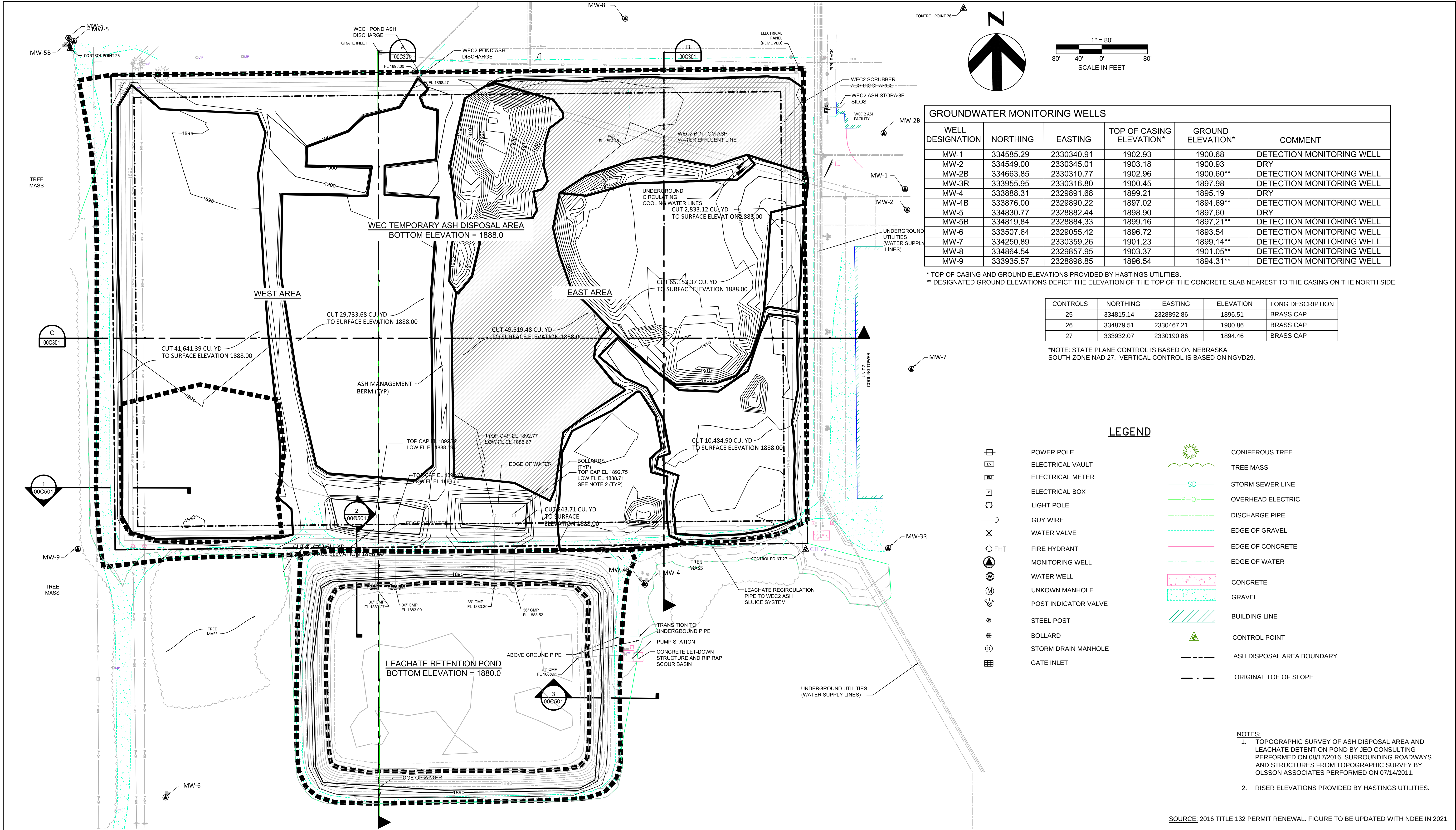
Attachment 1

Figures



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GROUNDWATER MONITORING WELLS					
WELL DESIGNATION	NORTHING	EASTING	TOP OF CASING ELEVATION*	GROUND ELEVATION*	COMMENT
MW-1	334585.29	2330340.91	1902.93	1900.68	DETECTION MONITORING WELL
MW-2	334549.00	2330345.01	1903.18	1900.93	DRY
MW-2B	334663.85	2330310.77	1902.96	1900.60**	DETECTION MONITORING WELL
MW-3R	333955.95	2330316.80	1900.45	1897.98	DETECTION MONITORING WELL
MW-4	333888.31	2329891.68	1899.21	1895.19	DRY
MW-4B	333876.00	2329890.22	1897.02	1894.69**	DETECTION MONITORING WELL
MW-5	334830.77	2328882.44	1898.90	1897.60	DRY
MW-5B	334819.84	2328884.33	1899.16	1897.21**	DETECTION MONITORING WELL
MW-6	333507.64	2329055.42	1896.72	1893.54	DETECTION MONITORING WELL
MW-7	334250.89	2330359.26	1901.23	1899.14**	DETECTION MONITORING WELL
MW-8	334864.54	2329857.95	1903.37	1901.05**	DETECTION MONITORING WELL
MW-9	333935.57	2328898.85	1896.54	1894.31**	DETECTION MONITORING WELL

* TOP OF CASING AND GROUND ELEVATIONS PROVIDED BY HASTINGS UTILITIES.
** DESIGNATED GROUND ELEVATIONS DEPICT THE ELEVATION OF THE TOP OF THE CONCRETE SLAB NEAREST TO THE CASING ON THE NORTH SIDE.

CONTROLS	NORTHING	EASTING	ELEVATION	LONG DESCRIPTION
25	334815.14	2328892.86	1896.51	BRASS CAP
26	334879.51	2330467.21	1900.86	BRASS CAP
27	333932.07	2330190.86	1894.46	BRASS CAP

*NOTE: STATE PLANE CONTROL IS BASED ON NEBRASKA SOUTH ZONE NAD 27. VERTICAL CONTROL IS BASED ON NGVD29.

LEGEND

- POWER POLE
- ELECTRICAL VAULT
- ELECTRICAL METER
- ELECTRICAL BOX
- LIGHT POLE
- GUY WIRE
- WATER VALVE
- FIRE HYDRANT
- MONITORING WELL
- WATER WELL
- UNKNOWN MANHOLE
- POST INDICATOR VALVE
- STEEL POST
- BOLLARD
- STORM DRAIN MANHOLE
- GATE INLET

CONIFEROUS TREETREE MASSSTORM SEWER LINEOVERHEAD ELECTRICDISCHARGE PIPEEDGE OF GRAVELEDGE OF CONCRETEEDGE OF WATERCONCRETEGRAVELBUILDING LINECONTROL POINTASH DISPOSAL AREA BOUNDARYORIGINAL TOE OF SLOPE

- NOTES:
- TOPOGRAPHIC SURVEY OF ASH DISPOSAL AREA AND LEACHATE DETENTION POND BY JEO CONSULTING PERFORMED ON 08/17/2016. SURROUNDING ROADWAYS AND STRUCTURES FROM TOPOGRAPHIC SURVEY BY OLSSON ASSOCIATES PERFORMED ON 07/14/2011.
 - RISER ELEVATIONS PROVIDED BY HASTINGS UTILITIES.

SOURCE: 2016 TITLE 132 PERMIT RENEWAL. FIGURE TO BE UPDATED WITH NDEE IN 2021.

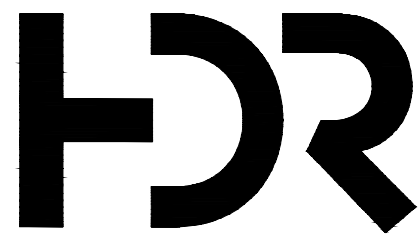
GERALD T. WHELAN ENERGY CENTER

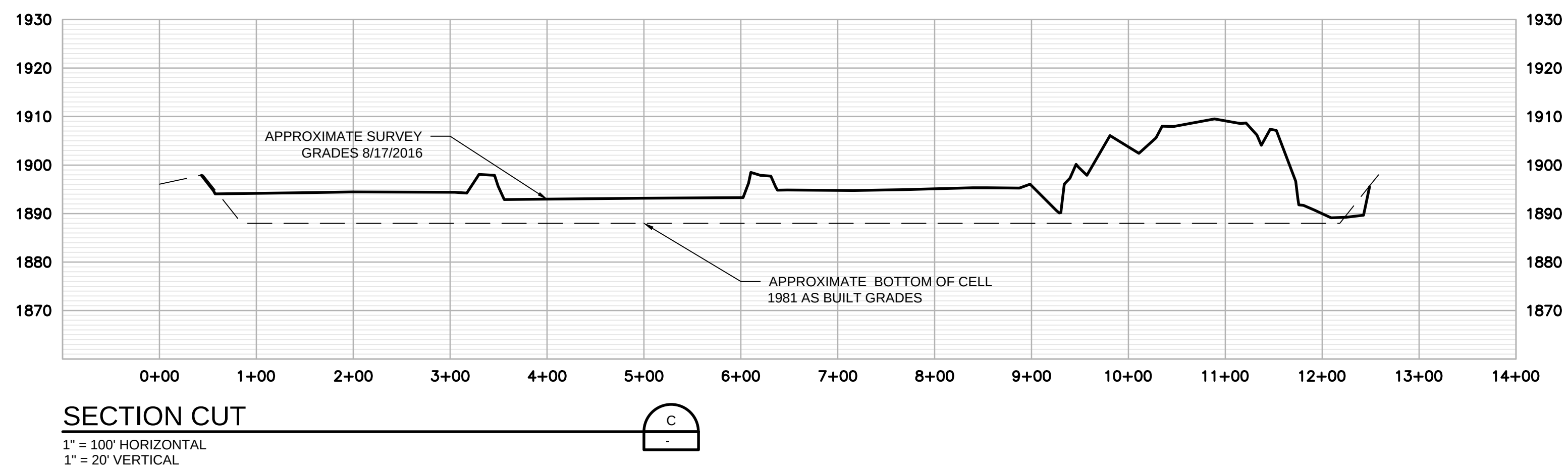
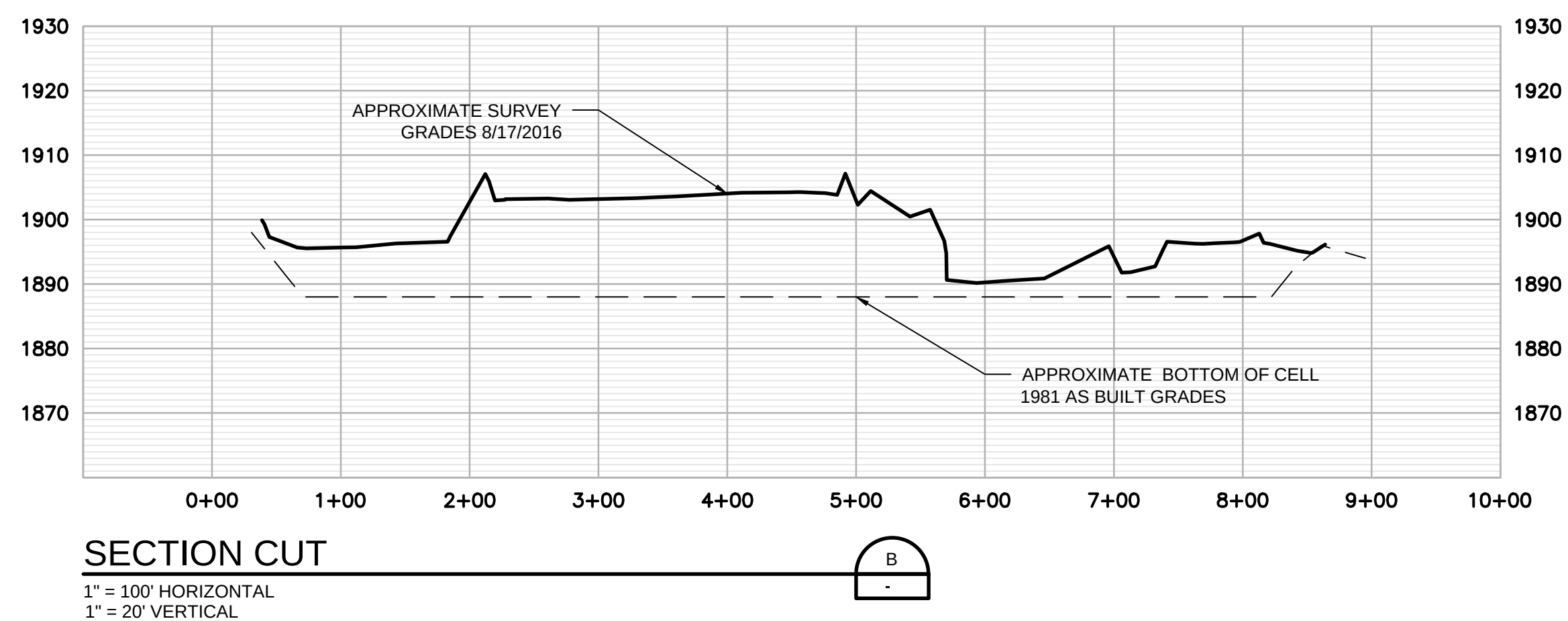
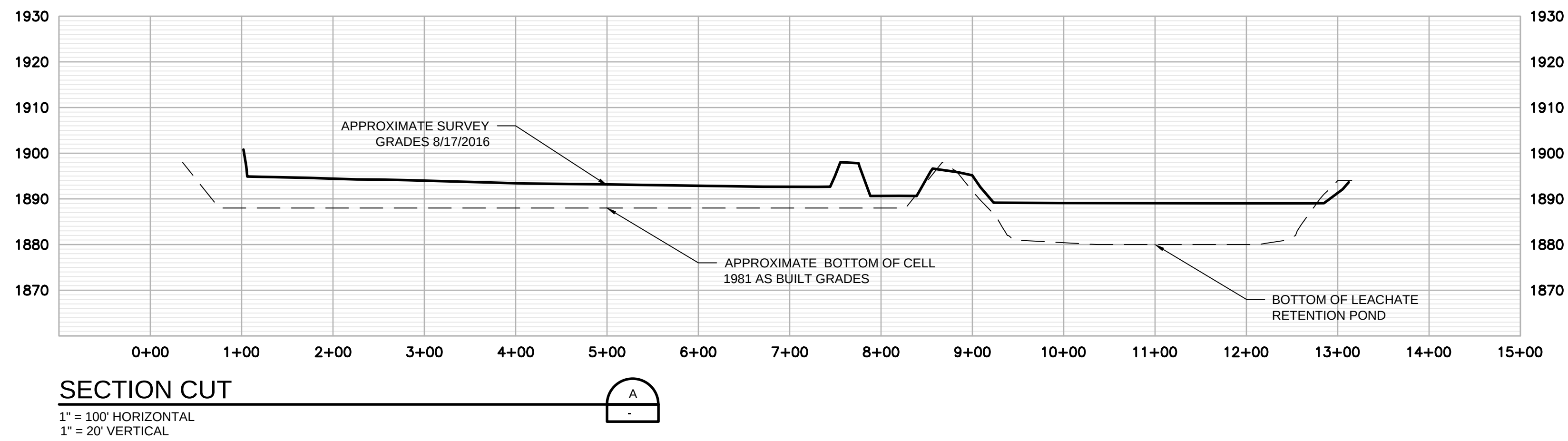
ASH DISPOSAL AREA PLAN

DATE

NOVEMBER 2020

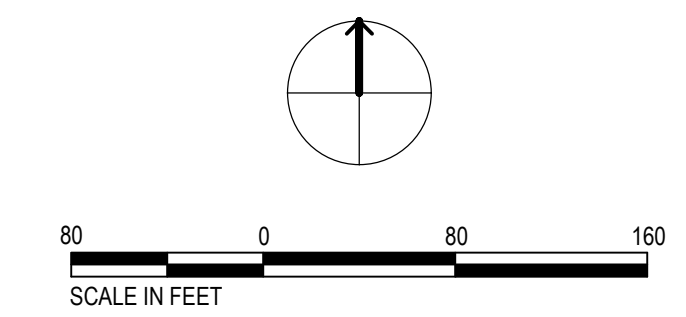
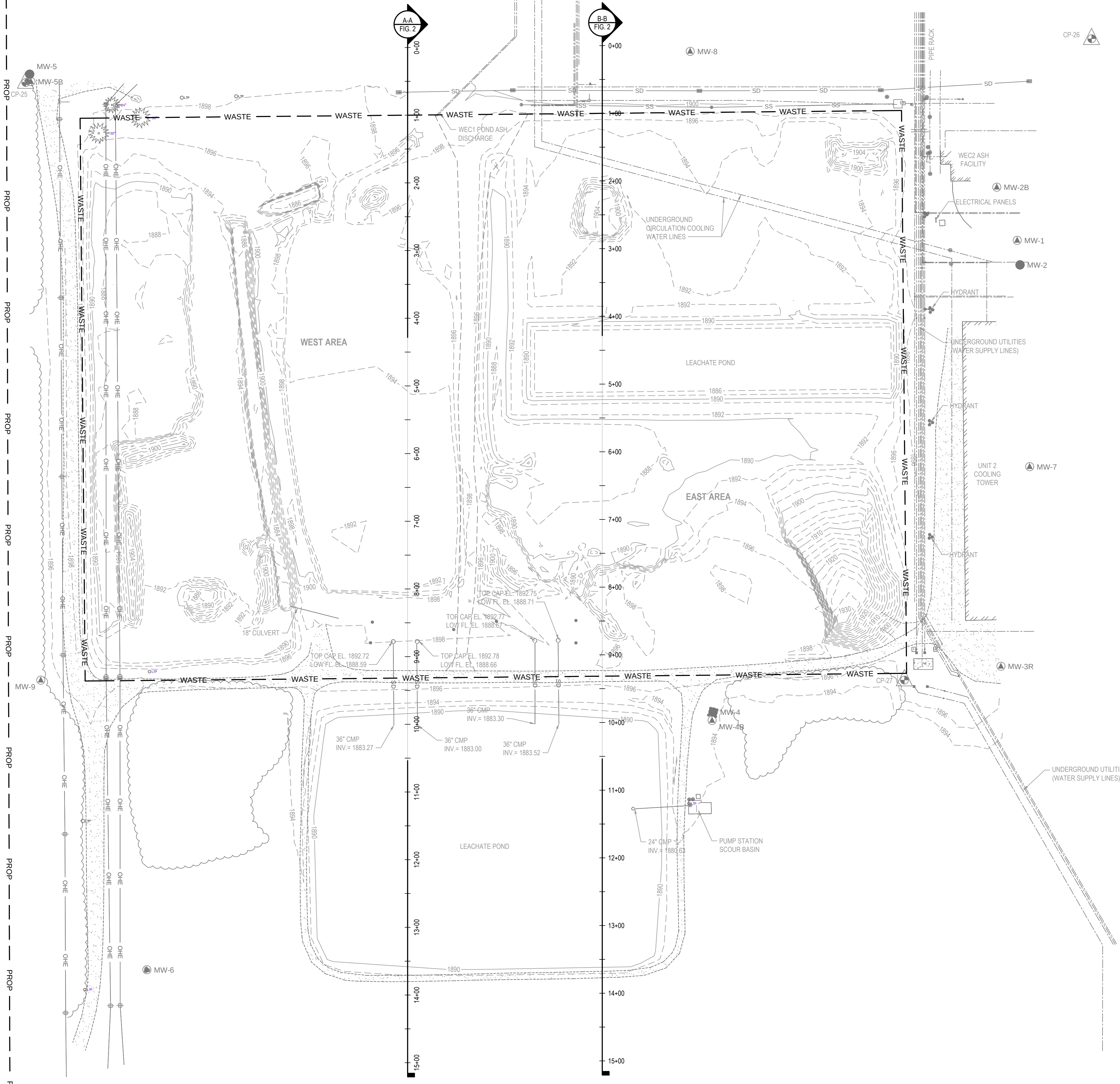
FIGURE



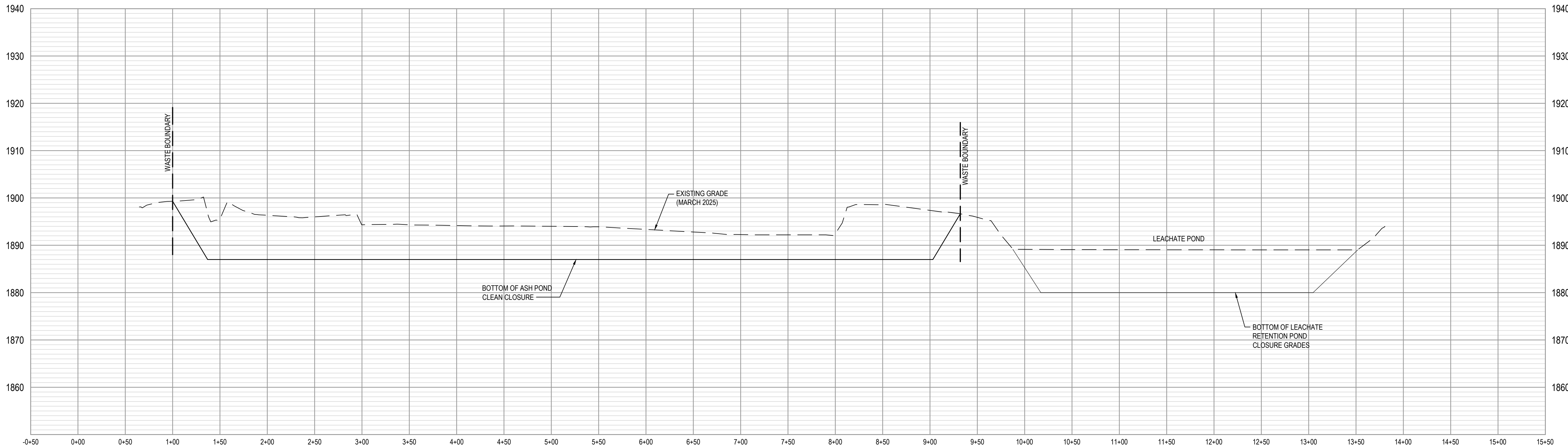


- NOTES:
1. TOPOGRAPHIC SURVEY OF ASH DISPOSAL AREA AND LEACHATE RETENTION POND BY JEO CONSULTING PERFORMED 08/17/2016.
 2. APPROXIMATE BASE GRADES OF WEC TEMPORARY ASH DISPOSAL AREA DEVELOPED BASED ON 1981 RECORD DRAWINGS FOR ORIGINAL ASH POND.

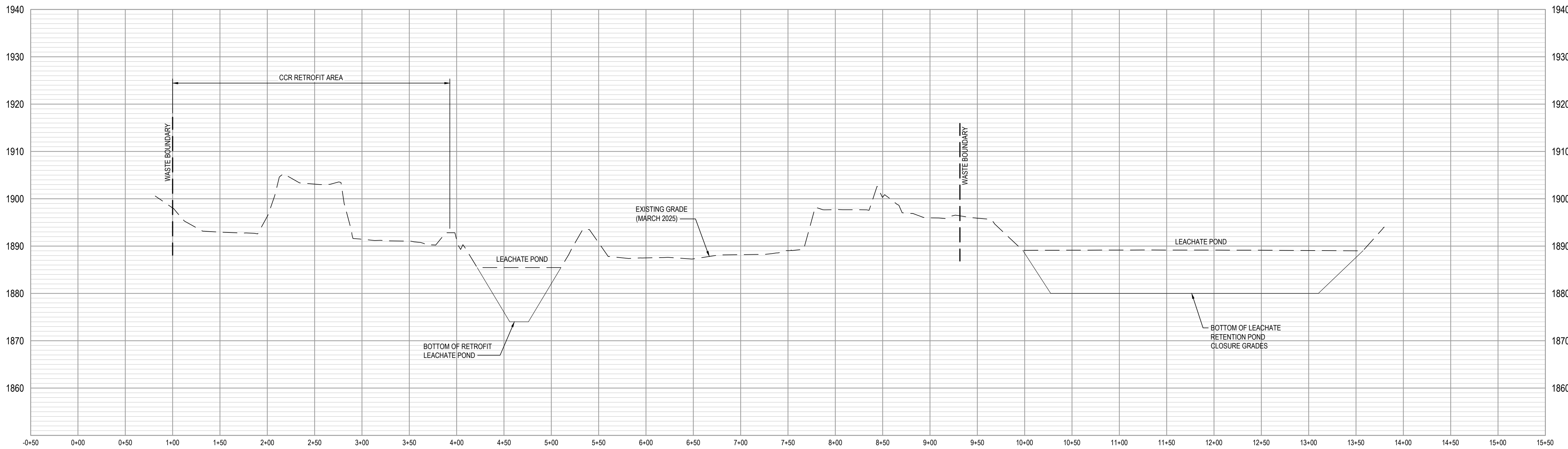
SOURCE: 2016 TITLE 132 PERMIT RENEWAL. FIGURE TO BE UPDATED WITH NDEE IN 2021.



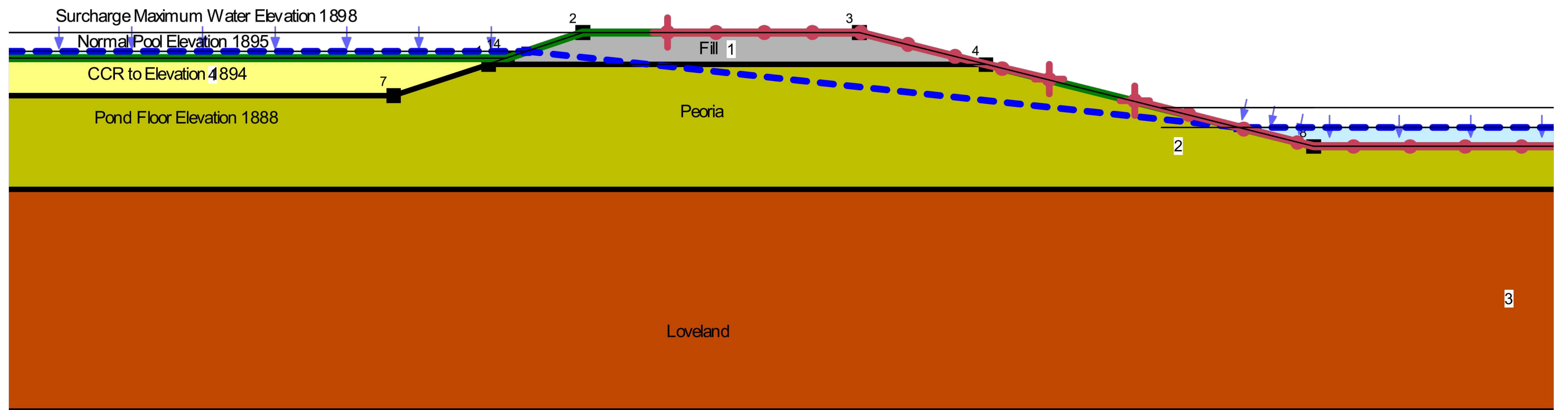
- NOTES**
1. EXISTING TOPOGRAPHY WITHIN ASH DISPOSAL AREA PROVIDED BY GRUMMER PROFESSIONAL SERVICES DATED MARCH 2025. EXISTING TOPO OF SOUTH LEACHATE POND OBTAINED FROM HISTORICAL PERMIT SURVEYS.
 2. EXISTING UTILITIES ARE A COMBINATION OF HISTORIC PERMITS AND DATA PROVIDED BY CITY OF HASTINGS AND PPGA.

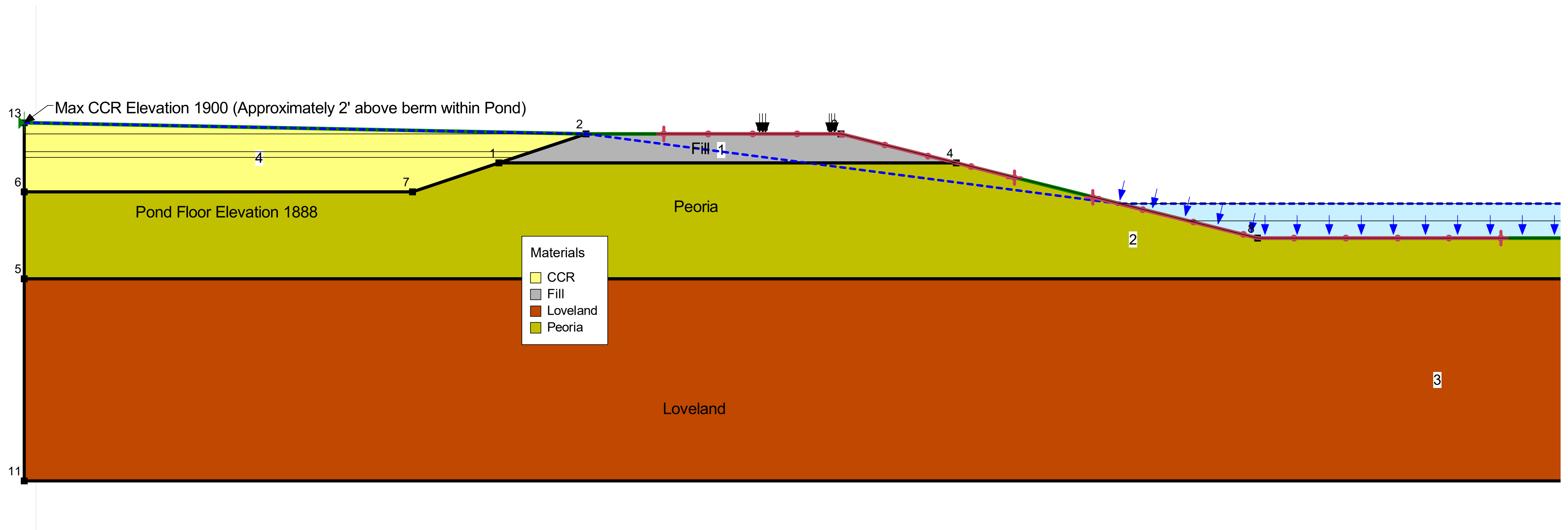


A-A SECTION A-A: WEST DISPOSAL AREA
FIG. 1 HORIZ: 1" = 60' | VERT: 1" = 12'



B-B SECTION B-B: EAST DISPOSAL AREA
FIG. 1 HORIZ: 1" = 60' | VERT: 1" = 12'





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Attachment 2

Hydraulic Analyses

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Objective: Demonstrate disposal areas can manage a 100-yr 24-hr storm event
References: Site data, historic calculations
Hydraflow, Mannings
Assumptions: 25-yr 24 hr storm event is 5.11-inches on site. (NOAA Atlas 14 Vol 8 Version 2)
100-yr 24 hr storm event is 6.70-inches on site. (NOAA Atlas 14 Vol 8 Version 2)

UPDATED 12/17/2025 & 12/23/2025

Calculations: Drainage Areas

n for smooth surfaces 0.011 0.015

	Sheet Flow (ft)*	Channel Flow (ft)*	Acres	Peak flow (cfs)	Total Volume (cf in 24-hrs)	
North Runon	50	1500	4.7	46.8	117,881	No change 2025
WEC1 Ash Sluice**	na	na	10-in forcemain	0	0	WEC1 Ash Sluice terminated November 2025
WEC2 Fly Ash Sluice	na	na	10-in forcemain	0	0	
WEC1 & WEC2 Bottom Ash Overflow/ Flushing	na	na	10-in forcemain & 3-in forcemain	0.04	3,208	Miscellaneous contact water
West Disposal Area	300	600	11.3	102.36	267,957	No change 2025
Totals for west disposal area				149.20	389,046	
East Runon***	90	0	0.7	7	15,700	Reduced area of runon
East Disposal Area***	200	450	6.5	59	154,400	Reduced East Area due to CCR landfill retrofit
Totals for east disposal area				66	170,100	

*Slopes subject to change with operations. Generally low slope. Modeled with 0.5%.

**Had been 400,000 GPD

***Peak flow and Total Volume estimated based on prior hydraulic model results and ratio of reduced acres to original acres.

Current Conditions - No discharge

Under current conditions, there is estimated to be no discharge during the 100-yr 24-hr storm event. Operations change over time on site. In order to maintain no discharge for each area, the 100-YR 24-hr volume must be held within the disposal area with 1-ft of freeboard.

Current elevation of ponded water is estimated at elev. 1893 by the site:

	Req. Storage (cf)	Area Req. if 4-ft deep (SF)	(ACRES)	
West Disposal Area	389,046	97,262	2.2	11% less storage area required than in 2020
East Disposal Area	170,100	42,525	1.0	49% less storage area required than in 2020

Future Conditions - Discharge to Leachate Retention Pond

In the event the disposal area operations displace stormwater storage volume, the discharge structures will be utilized. Assumptions are as follows:

1. Starting pool elevation is 1892.5 (limited storage before riser discharge)
2. Storage is limited to 5,000-sf, 3:1 side slopes, and maximum elevation is 1898 (approx. inlet clear area)
3. Outflow culverts are modeled as 'dual barrel' to estimate peak storage.

Total flow to the Leachate Retention Pond= 559,146 cf for 24-hrs

Leachate Retention Ppond storage*= 1,568,160 cf

*Elevation 1884 to 1893, est. available for storage. Leachate Retention Pond is 5.2 acres.

Conclusion: Conclusion in 2025 same as before:

In the 100-yr storm event, the stormwater is contained within the disposal areas without overtopping. At such time that a disposal area no longer has the storage required, the discharge culverts will be hydraulically connected and utilized, and spillways reshaped. The discharge culverts are estimated to control the design storm without exceeding the berm elevation.

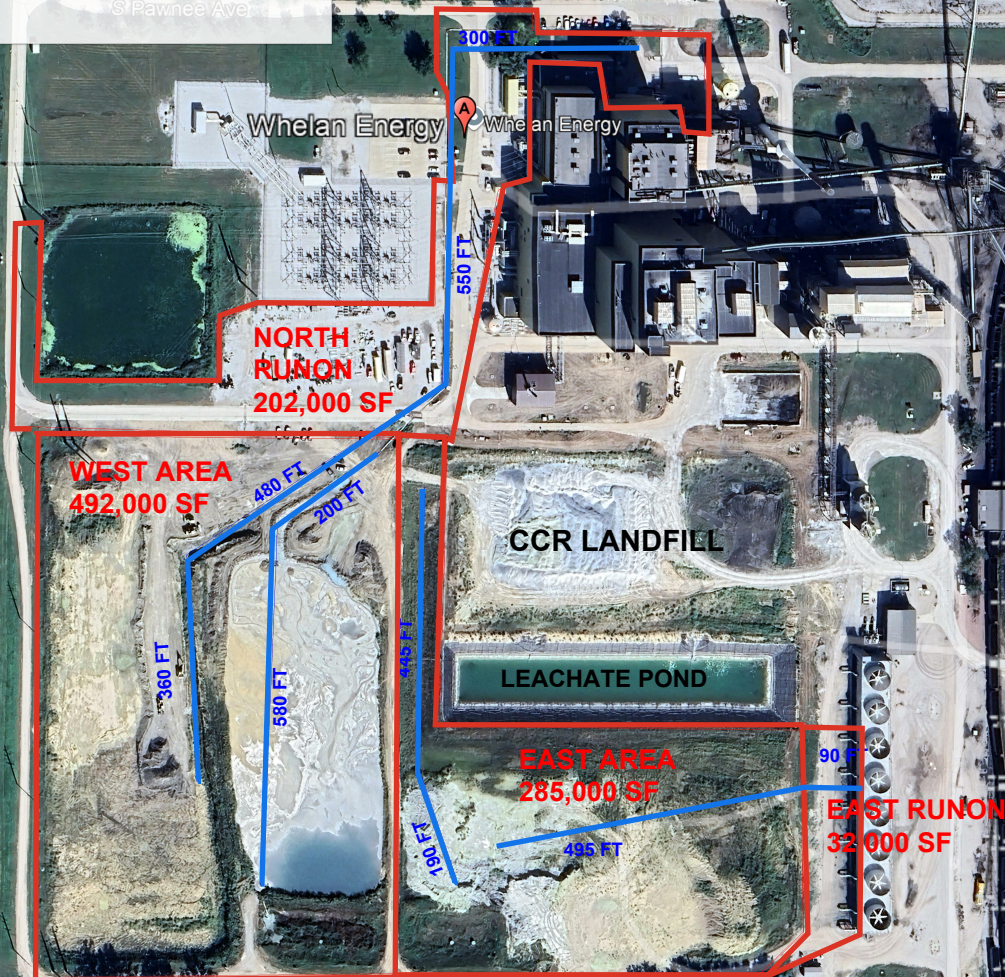
WEC DRAINAGE AREAS

September 2025

3 Pawnee Ave

Legend

 Whelan Energy



Google Earth

Image © 2025 Airbus



1000 ft

INITIAL HYDRAULIC CALCULATIONS 2020



Project: WEC
Subject: Stormwater
Task: Hydraulic Calculations

Computed by: K. Kinley Date: 11/19/2020
Checked by: L. Calub Date: 11/23/2020

Page: 1 of 1

Objective: Demonstrate disposal areas can manage a 100-yr 24-hr storm event

References: Site data, historic calculations

Hydraflow, Mannings

Assumptions: 25-yr 24 hr storm event is 5.11-inches on site. (NOAA Atlas 14 Vol 8 Version 2)

100-yr 24 hr storm event is 6.70-inches on site. (NOAA Atlas 14 Vol 8 Version 2)

Calculations: *Drainage Areas*

n for smooth surfaces 0.011 0.015

	Sheet Flow (ft)*	Channel Flow (ft)*	Acres	Peak flow (cfs)	Total Volume (cf in 24-hrs)
North Runon	50	1500	4.7	46.8	117,881
WEC1 Ash Sluice**	na	na	10-in forcemain	0.62	53,568
WEC2 Fly Ash Sluice	na	na	10-in forcemain	0	0
West Disposal Area	300	600	11.3	102.36	267,957
Totals for west disposal area				149.78	439,406
East Runon	100	0	2.3	23.44	52,442
East Disposal Area	300	400	11.9	107.8	282,184
Totals for east disposal area				131.24	334,626

*slopes subject to change with operations. Generally low slope. Modeled with 0.5%.

**400,000 GPD

Current Conditions - No discharge

Under current conditions, there is estimated to be no discharge during the 100-yr 24-hr storm event. Operations change over time on site. In order to maintain no discharge for each area, the 100-YR 24-hr volume must be held within the disposal area with 1-ft of freeboard.

Current elevation of ponded water is estimated at elev. 1893 by the site:

	Req. Storage (cf)	Area Req. if 4-ft deep (SF)
West Disposal Area	439,406	109,852
East Disposal Area	334,626	83,657

Future Conditions - Discharge to Leachate Pond

In the event the disposal area operations displace stormwater storage volume, the discharge structures will be utilized. Assumptions are as follows:

1. Starting pool elevation is 1892.5 (limited storage before riser discharge)
2. Storage is limited to 5,000-sf, 3:1 side slopes, and maximum elevation is 1898 (approx. inlet clear area)
3. Outflow culverts are modeled as 'dual barrel' to estimate peak storage.

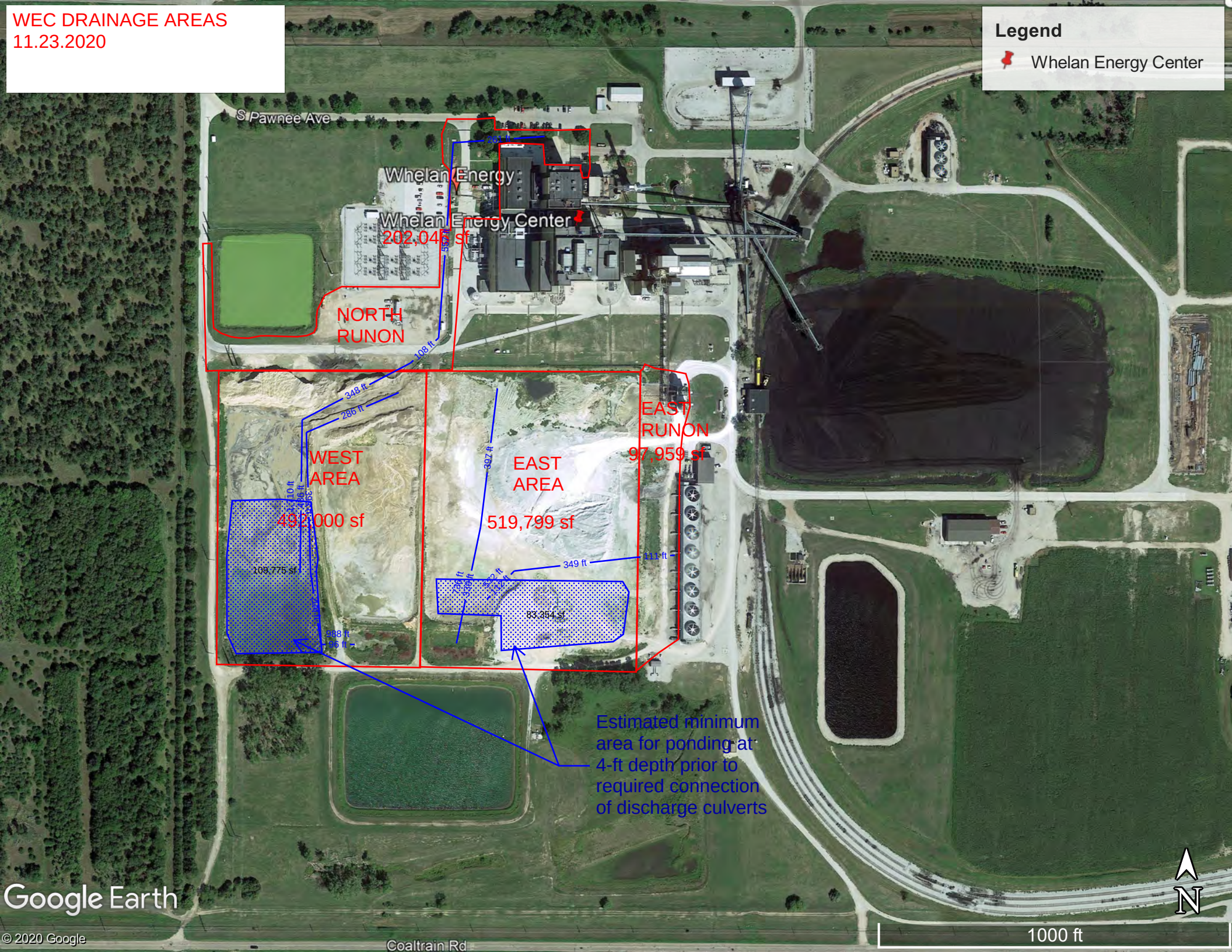
Total flow to the leachate pond= 774,032 cf for 24-hrs

Leachate pond storage*= 1,568,160 cf

*Elevation 1884 to 1893, est. available for storage. Leachate Pond is 5.2 acres.

Conclusion:

In the 100-yr storm event, the stormwater is contained within the disposal areas without overtopping. At such time that a disposal area no longer has the storage required, the discharge culverts will be hydraulically connected and utilized, and spillways reshaped. The discharge culverts are estimated to control the design storm without exceeding the berm elevation.





NOAA Atlas 14, Volume 8, Version 2
Location name: Hastings, Nebraska, USA*
Latitude: 40.5791°, Longitude: -98.314°
Elevation: 1898.24 ft**
 * source: ESRI Maps
 ** source: USGS



12.17.2025 Checked
 NOAA website at
hdsc.nws.noaa.gov/pfds
 for Hastings, Nebraska. No
 change to precipitation
 frequency for 24-hr, 25-
 year and 100-year storm.

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aeriels](#)

PF tabular

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	0.364 (0.290-0.466)	0.431 (0.342-0.551)	0.542 (0.429-0.695)	0.637 (0.501-0.818)	0.771 (0.588-1.01)	0.877 (0.654-1.15)	0.986 (0.711-1.31)	1.10 (0.760-1.48)	1.25 (0.834-1.71)	1.37 (0.890-1.88)
10-min	0.533 (0.424-0.683)	0.631 (0.501-0.807)	0.794 (0.628-1.02)	0.932 (0.734-1.20)	1.13 (0.861-1.48)	1.28 (0.957-1.69)	1.44 (1.04-1.92)	1.61 (1.11-2.17)	1.83 (1.22-2.50)	2.01 (1.30-2.75)
15-min	0.650 (0.517-0.832)	0.769 (0.611-0.985)	0.968 (0.766-1.24)	1.14 (0.895-1.46)	1.38 (1.05-1.80)	1.57 (1.17-2.06)	1.76 (1.27-2.34)	1.96 (1.36-2.64)	2.24 (1.49-3.05)	2.45 (1.59-3.36)
30-min	0.934 (0.743-1.20)	1.11 (0.880-1.42)	1.40 (1.11-1.79)	1.65 (1.30-2.11)	1.99 (1.52-2.60)	2.26 (1.69-2.98)	2.54 (1.83-3.38)	2.83 (1.96-3.81)	3.22 (2.14-4.39)	3.52 (2.28-4.82)
60-min	1.21 (0.958-1.54)	1.43 (1.13-1.83)	1.81 (1.43-2.32)	2.14 (1.68-2.75)	2.63 (2.01-3.45)	3.02 (2.26-3.99)	3.44 (2.48-4.59)	3.87 (2.69-5.24)	4.49 (2.99-6.14)	4.97 (3.23-6.82)
2-hr	1.48 (1.19-1.87)	1.74 (1.40-2.20)	2.21 (1.77-2.80)	2.63 (2.10-3.34)	3.26 (2.53-4.25)	3.78 (2.86-4.94)	4.33 (3.17-5.73)	4.92 (3.46-6.59)	5.75 (3.89-7.81)	6.42 (4.22-8.72)
3-hr	1.62 (1.31-2.04)	1.91 (1.54-2.40)	2.43 (1.96-3.05)	2.91 (2.33-3.66)	3.63 (2.85-4.72)	4.24 (3.24-5.53)	4.90 (3.61-6.46)	5.61 (3.98-7.49)	6.63 (4.52-8.96)	7.46 (4.94-10.1)
6-hr	1.88 (1.54-2.33)	2.21 (1.80-2.73)	2.80 (2.28-3.48)	3.36 (2.72-4.18)	4.21 (3.34-5.43)	4.94 (3.82-6.37)	5.73 (4.28-7.48)	6.59 (4.73-8.72)	7.83 (5.41-10.5)	8.83 (5.92-11.8)
12-hr	2.12 (1.76-2.60)	2.52 (2.08-3.08)	3.21 (2.65-3.94)	3.83 (3.14-4.70)	4.74 (3.79-6.00)	5.50 (4.28-6.97)	6.29 (4.74-8.09)	7.14 (5.18-9.31)	8.34 (5.82-11.0)	9.29 (6.30-12.3)
24-hr	2.45 (2.05-2.96)	2.85 (2.38-3.44)	3.56 (2.96-4.30)	4.18 (3.46-5.07)	5.11 (4.13-6.38)	5.88 (4.64-7.37)	6.70 (5.11-8.50)	7.57 (5.55-9.75)	8.80 (6.22-11.5)	9.78 (6.72-12.8)
2-day	2.80 (2.37-3.33)	3.21 (2.71-3.82)	3.93 (3.31-4.68)	4.57 (3.82-5.46)	5.52 (4.51-6.79)	6.30 (5.02-7.79)	7.13 (5.50-8.94)	8.01 (5.95-10.2)	9.26 (6.63-12.0)	10.3 (7.14-13.3)
3-day	3.02 (2.57-3.56)	3.46 (2.94-4.08)	4.22 (3.57-4.99)	4.89 (4.12-5.80)	5.87 (4.82-7.15)	6.67 (5.35-8.17)	7.51 (5.83-9.34)	8.40 (6.28-10.6)	9.63 (6.95-12.4)	10.6 (7.45-13.7)
4-day	3.21 (2.74-3.77)	3.68 (3.14-4.32)	4.48 (3.82-5.27)	5.18 (4.39-6.11)	6.19 (5.10-7.49)	7.00 (5.64-8.53)	7.85 (6.13-9.70)	8.74 (6.56-11.0)	9.97 (7.22-12.7)	10.9 (7.72-14.1)
7-day	3.78 (3.26-4.38)	4.31 (3.71-5.00)	5.19 (4.46-6.04)	5.95 (5.09-6.94)	7.02 (5.83-8.38)	7.88 (6.40-9.47)	8.75 (6.89-10.7)	9.65 (7.32-12.0)	10.9 (7.96-13.8)	11.8 (8.45-15.1)
10-day	4.31 (3.74-4.97)	4.89 (4.24-5.64)	5.86 (5.06-6.77)	6.67 (5.73-7.73)	7.81 (6.52-9.24)	8.70 (7.11-10.4)	9.61 (7.61-11.7)	10.5 (8.04-13.0)	11.8 (8.69-14.8)	12.8 (9.17-16.2)
20-day	5.87 (5.15-6.66)	6.62 (5.81-7.53)	7.85 (6.86-8.94)	8.86 (7.71-10.1)	10.2 (8.62-11.9)	11.3 (9.32-13.2)	12.3 (9.87-14.7)	13.4 (10.3-16.2)	14.7 (11.0-18.3)	15.7 (11.5-19.8)
30-day	7.17 (6.34-8.08)	8.09 (7.15-9.13)	9.57 (8.43-10.8)	10.8 (9.43-12.2)	12.4 (10.5-14.2)	13.5 (11.2-15.7)	14.7 (11.8-17.4)	15.8 (12.3-19.1)	17.3 (12.9-21.2)	18.3 (13.4-22.9)
45-day	8.82 (7.85-9.86)	9.98 (8.88-11.2)	11.8 (10.5-13.2)	13.2 (11.7-14.9)	15.1 (12.9-17.2)	16.5 (13.8-19.0)	17.8 (14.4-20.8)	19.0 (14.8-22.7)	20.5 (15.5-25.0)	21.5 (16.0-26.7)
60-day	10.2 (9.16-11.4)	11.6 (10.4-12.9)	13.7 (12.2-15.3)	15.4 (13.6-17.2)	17.5 (15.0-19.8)	19.0 (16.0-21.7)	20.4 (16.6-23.7)	21.7 (17.0-25.8)	23.3 (17.6-28.2)	24.3 (18.1-30.0)

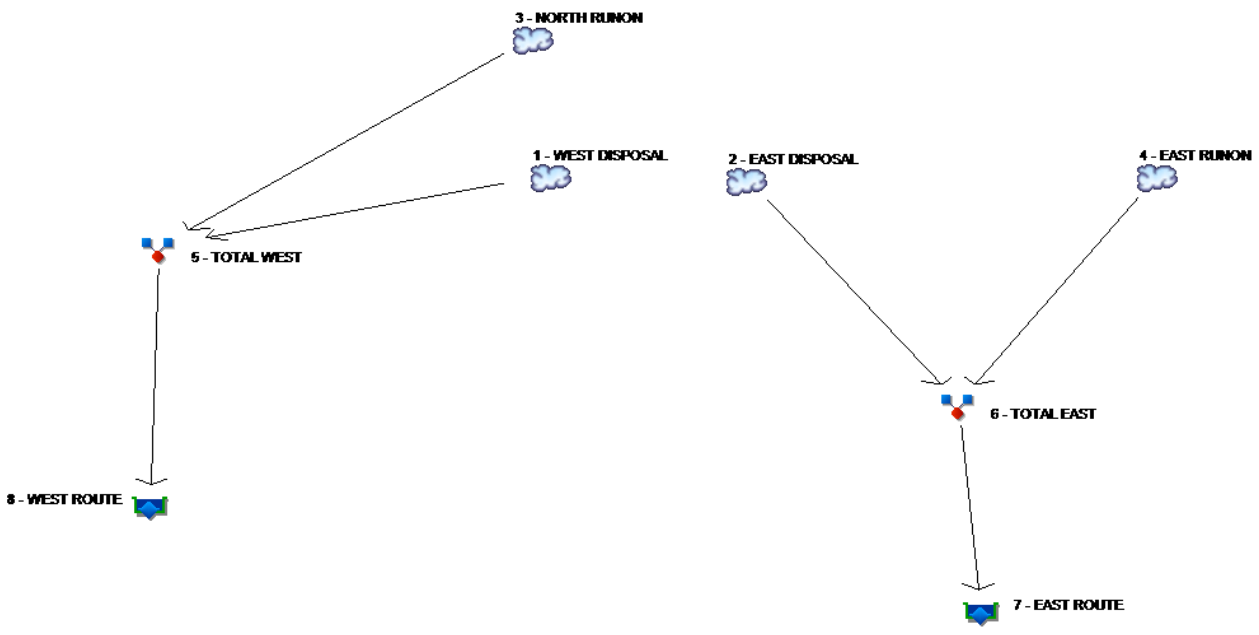
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

[Back to Top](#)

PF graphical

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020



Hydrograph Summary Report

INITIAL HYDRAULIC MODELING 2020

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	102.36	1	718	267,957	-----	-----	-----	WEST DISPOSAL
2	SCS Runoff	107.80	1	718	282,184	-----	-----	-----	EAST DISPOSAL
3	SCS Runoff	46.80	1	717	117,881	-----	-----	-----	NORTH RUNON
4	SCS Runoff	23.44	1	715	52,442	-----	-----	-----	EAST RUNON
5	Combine	148.48	1	718	385,838	1, 3,	-----	-----	TOTAL WEST
6	Combine	125.92	1	717	334,627	2, 4,	-----	-----	TOTAL EAST
7	Reservoir	93.54	1	721	320,978	6	1893.85	70,669	EAST ROUTE
8	Reservoir	110.92	1	721	376,722	5	1893.91	74,115	WEST ROUTE
STORMWATER.gpw					Return Period: 100 Year			Friday, 11 / 20 / 2020	

Hydrograph Report

INITIAL HYDRAULIC MODELING 2020

3

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

No change to WEST DISPOSAL

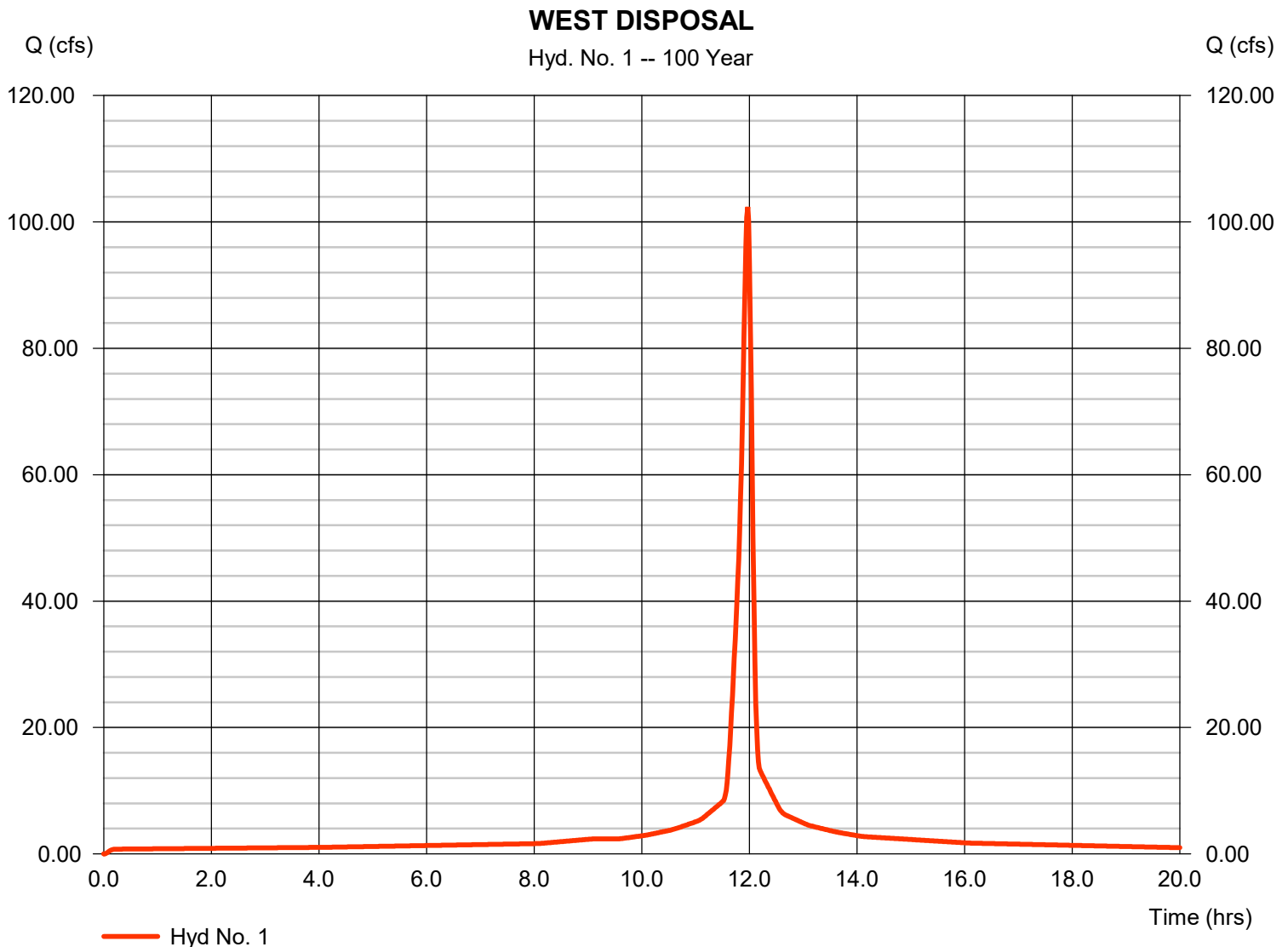
Friday, 11 / 20 / 2020

Hyd. No. 1

WEST DISPOSAL

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 1 min
Drainage area = 11.300 ac
Basin Slope = 0.5 %
Tc method = TR55
Total precip. = 6.70 in
Storm duration = 24 hrs

Peak discharge = 102.36 cfs
Time to peak = 11.97 hrs
Hyd. volume = 267,957 cuft
Curve number = 100
Hydraulic length = 900 ft
Time of conc. (Tc) = 7.60 min
Distribution = Type II
Shape factor = 484



Hydrograph Report

INITIAL HYDRAULIC MODELING 2020

4

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Friday, 11 / 20 / 2020

Hyd. No. 2

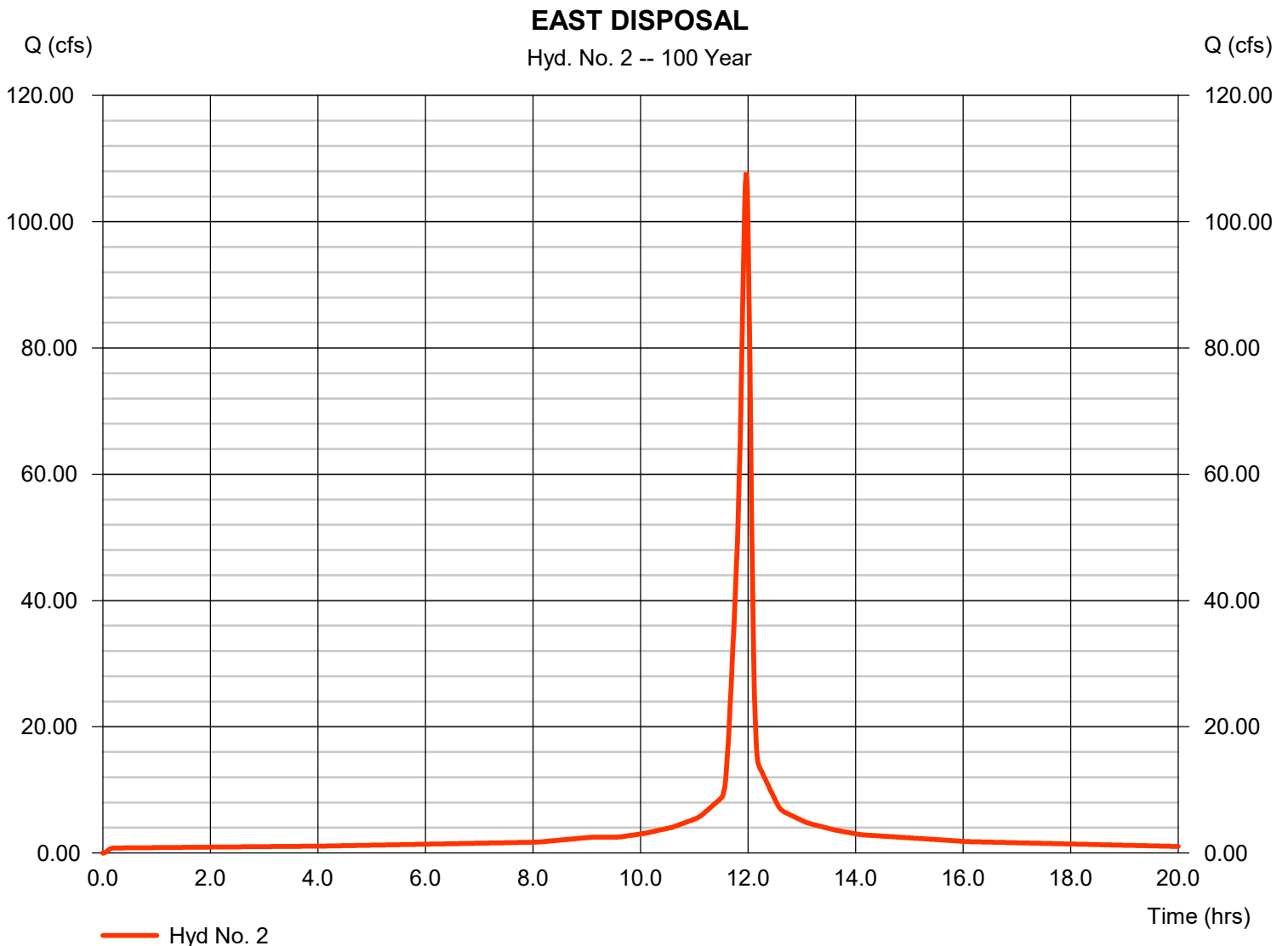
EAST DISPOSAL

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 1 min
Drainage area = ~~11.900 ac~~
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 6.70 in
Storm duration = 24 hrs

Peak discharge = 107.80 cfs
Time to peak = 11.97 hrs
Hyd. volume = 282,184 cuft
Curve number = 100
Hydraulic length = 0 ft
Time of conc. (Tc) = 7.10 min
Distribution = Type II
Shape factor = 484

2025 EAST DISPOSAL Drainage Area = 6.5 ac

Hydraulic volume for current conditions will be less due to reduced drainage area.



Hydrograph Report

INITIAL HYDRAULIC MODELING 2020

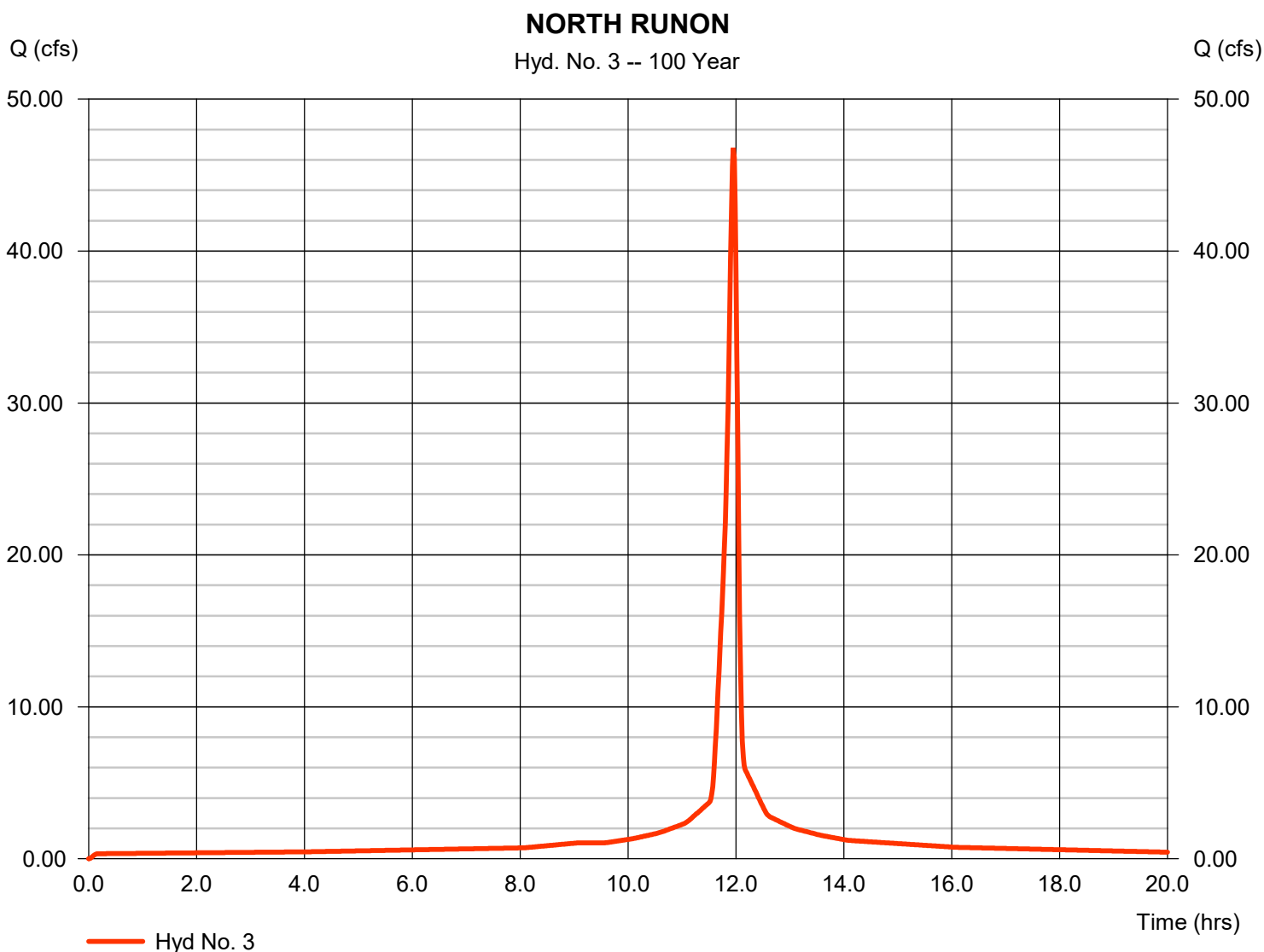
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

No change to NORTH RUNON Friday, 11 / 20 / 2020

Hyd. No. 3

NORTH RUNON

Hydrograph type	= SCS Runoff	Peak discharge	= 46.80 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.95 hrs
Time interval	= 1 min	Hyd. volume	= 117,881 cuft
Drainage area	= 4.700 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.02 min
Total precip.	= 6.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

INITIAL HYDRAULIC MODELING 2020

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

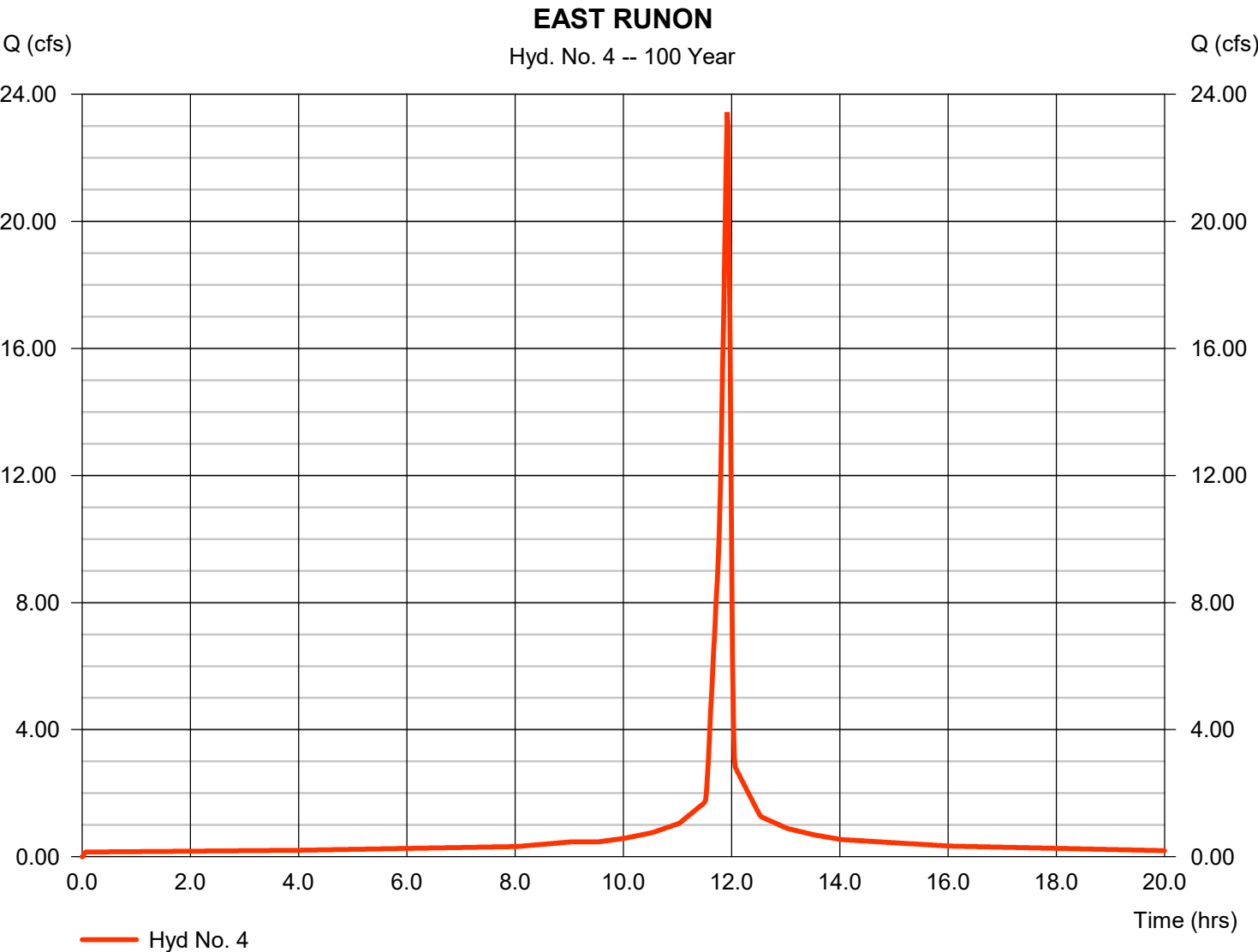
Friday, 11 / 20 / 2020

Hyd. No. 4

EAST RUNON

Hydrograph type	=	SCS Runoff	Peak discharge	=	23.44 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.92 hrs
Time interval	=	1 min	Hyd. volume	=	52,442 cuft
Drainage area	=	2.300 ac	Curve number	=	100
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	2.50 min
Total precip.	=	6.70 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

2025 EAST RUNON Drainage Area = 0.7 ac
Hydraulic volume for current conditions will be less due to reduced drainage area.



Hydrograph Report

INITIAL HYDRAULIC MODELING 2020

7

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Friday, 11 / 20 / 2020

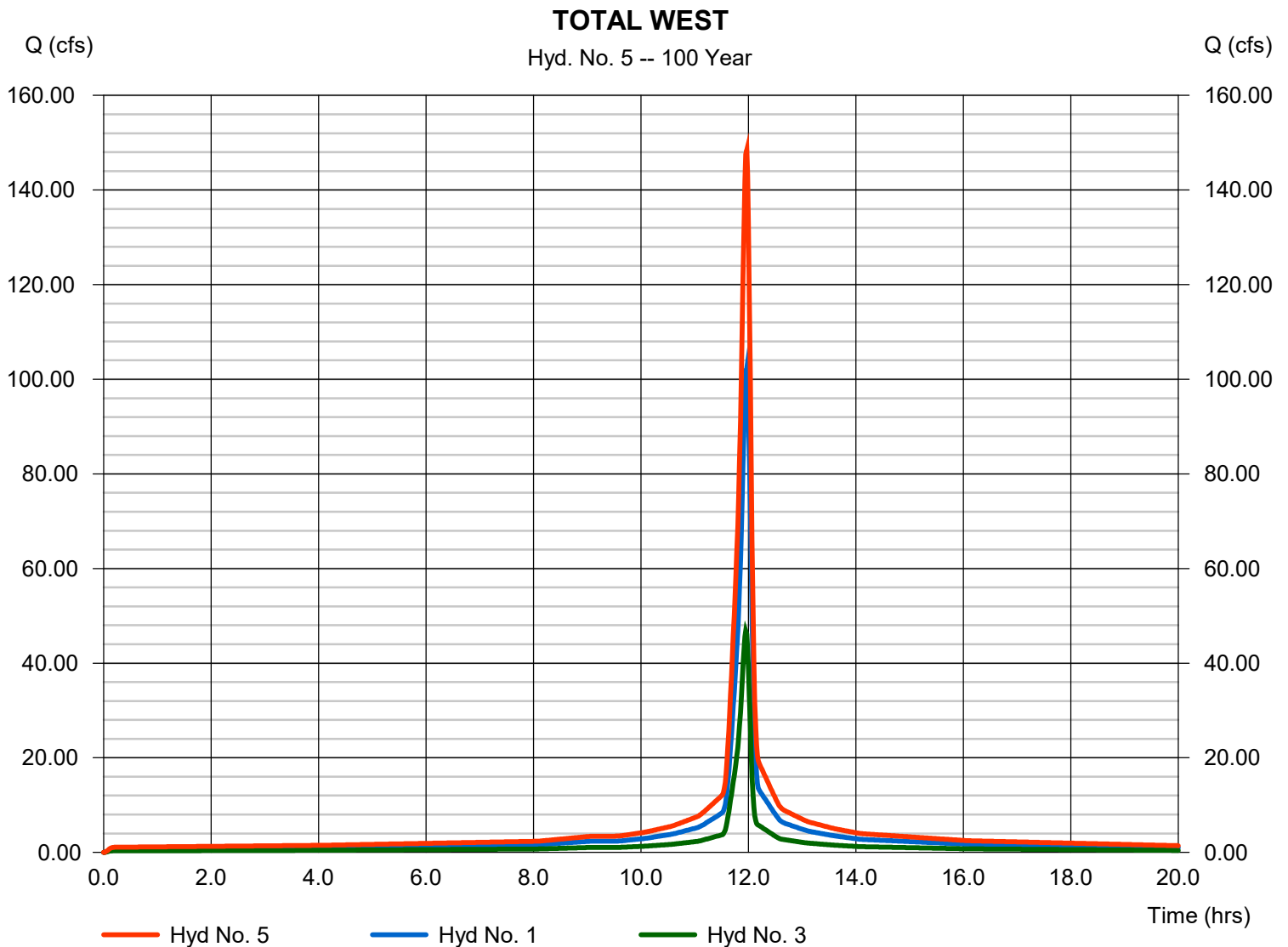
Hyd. No. 5

TOTAL WEST

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 1 min
Inflow hyds. = 1, 3

Peak discharge = 148.48 cfs
Time to peak = 11.97 hrs
Hyd. volume = 385,838 cuft
Contrib. drain. area = 16.000 ac

+0.62-CFS BASE FLOW (WEC1 Ash Sluice) = 149.1-CFS



Hydrograph Report

INITIAL HYDRAULIC MODELING 2020

8

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

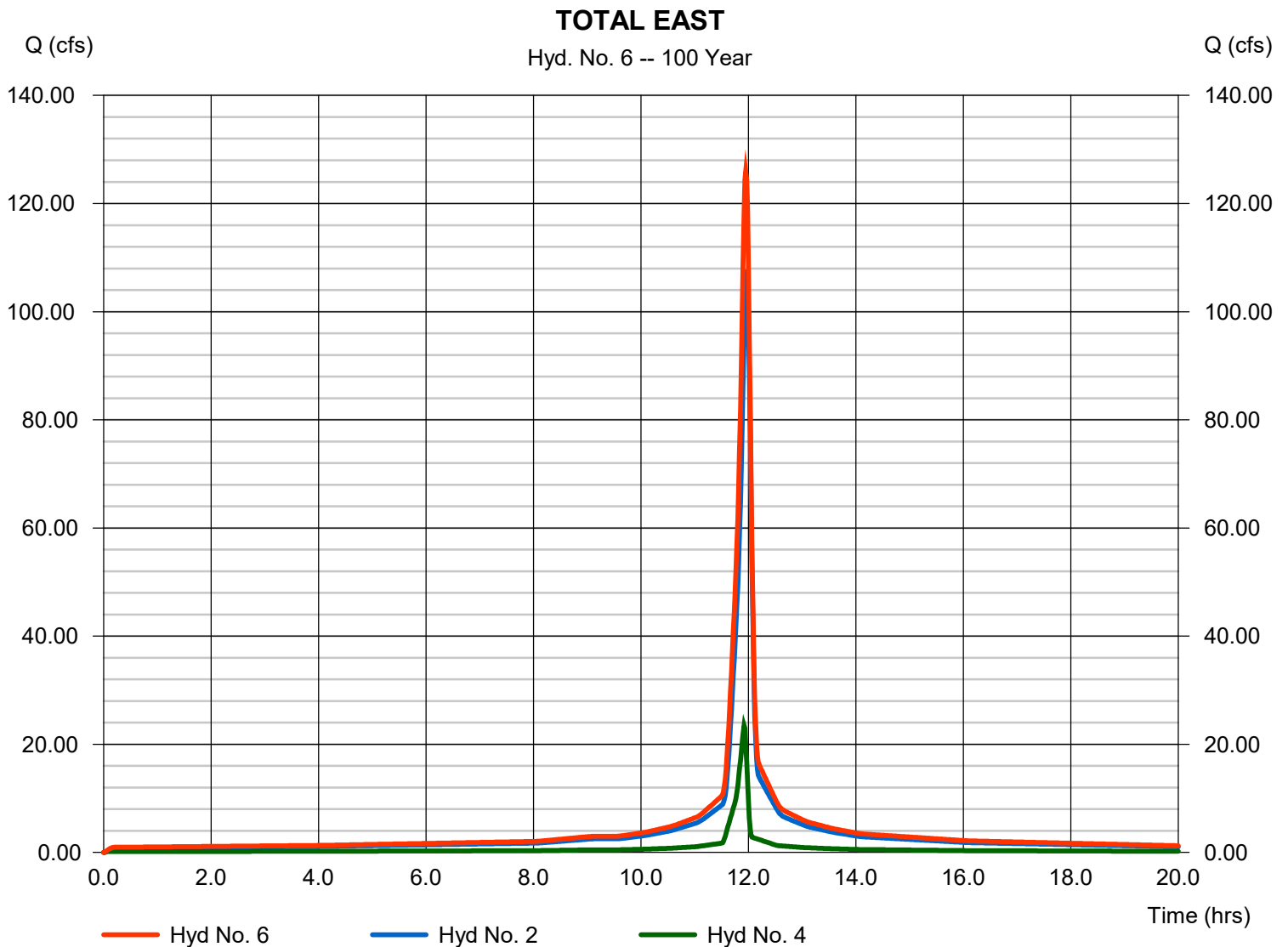
Friday, 11 / 20 / 2020

Hyd. No. 6

TOTAL EAST

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 1 min
Inflow hyds. = 2, 4

Peak discharge = 125.92 cfs
Time to peak = 11.95 hrs
Hyd. volume = 334,627 cuft
Contrib. drain. area = 14.200 ac



Hydrograph Report

INITIAL HYDRAULIC MODELING 2020

9

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Friday, 11 / 20 / 2020

Hyd. No. 7

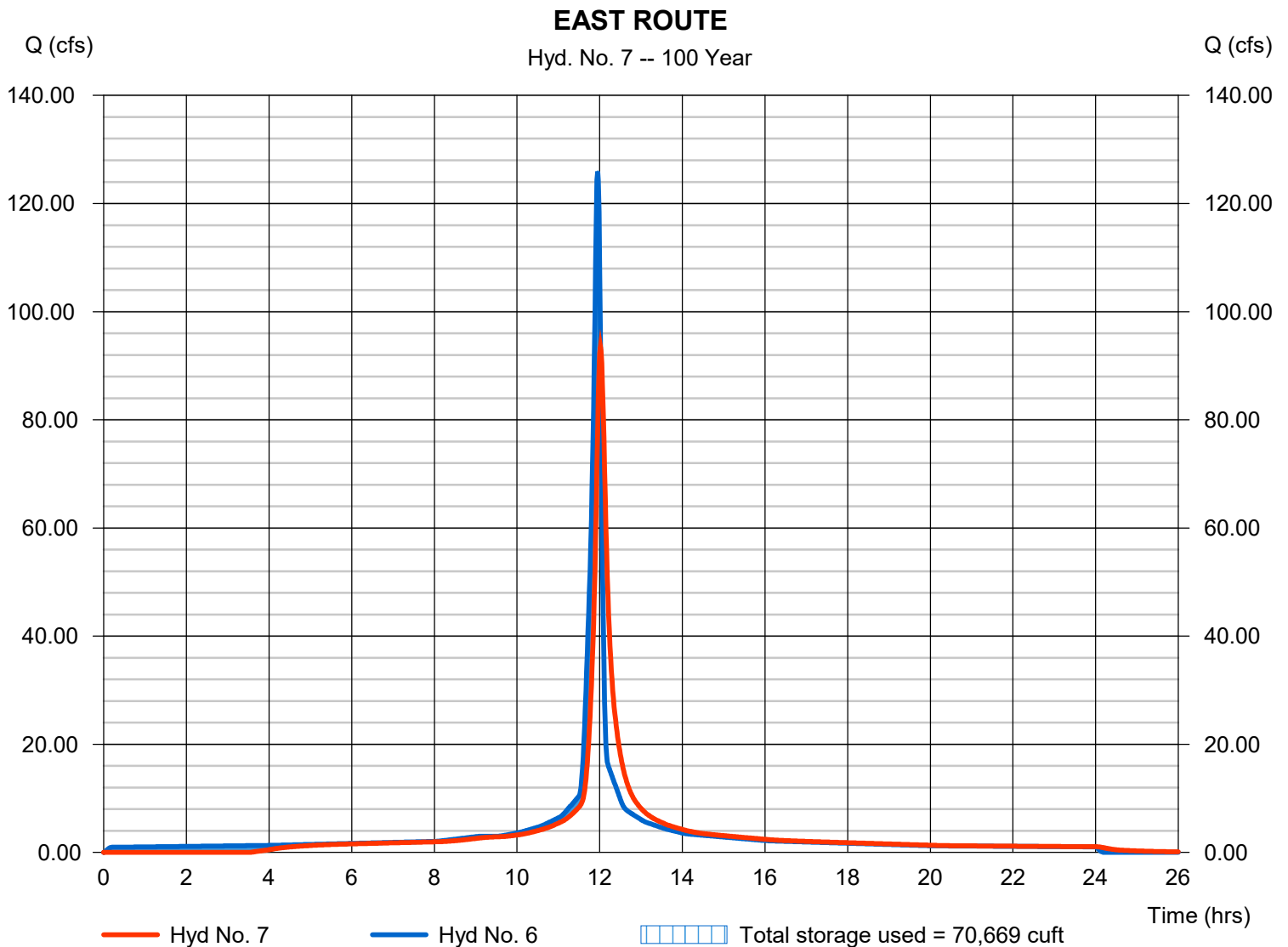
2X36" OUTLETS WITH 48" RISERS

EAST ROUTE

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 1 min
Inflow hyd. No. = 6 - TOTAL EAST
Reservoir name = EAST OUTLET

Peak discharge = 93.54 cfs
Time to peak = 12.02 hrs
Hyd. volume = 320,978 cuft
Max. Elevation = 1893.85 ft
Max. Storage = 70,669 cuft

Storage Indication method used.



Pond Report

INITIAL HYDRAULIC MODELING 2020 10

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Friday, 11 / 20 / 2020

Pond No. 1 - EAST OUTLET

2X36" OUTLETS WITH 48" RISERS

Pond Data

Trapezoid -Bottom L x W = 100.0 x 50.0 ft, Side slope = 3.00:1, Bottom elev. = 1892.50 ft, Depth = 5.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1892.50	5,000	0	0
0.55	1893.05	5,506	2,888	2,888
1.10	1893.60	6,034	3,172	6,060
1.65	1894.15	6,583	3,469	9,529
2.20	1894.70	7,154	3,777	13,306
2.75	1895.25	7,747	4,097	17,403
3.30	1895.80	8,362	4,429	21,832
3.85	1896.35	8,999	4,773	26,605
4.40	1896.90	9,657	5,129	31,734
4.95	1897.45	10,337	5,497	37,232
5.50	1898.00	11,039	5,877	43,109

CLEAR AREA ONLY

INPUT APPROX.
INVERT ELEV.
AND LENGTHS
TO MODEL
DUAL CULVERT
OUTFLOW

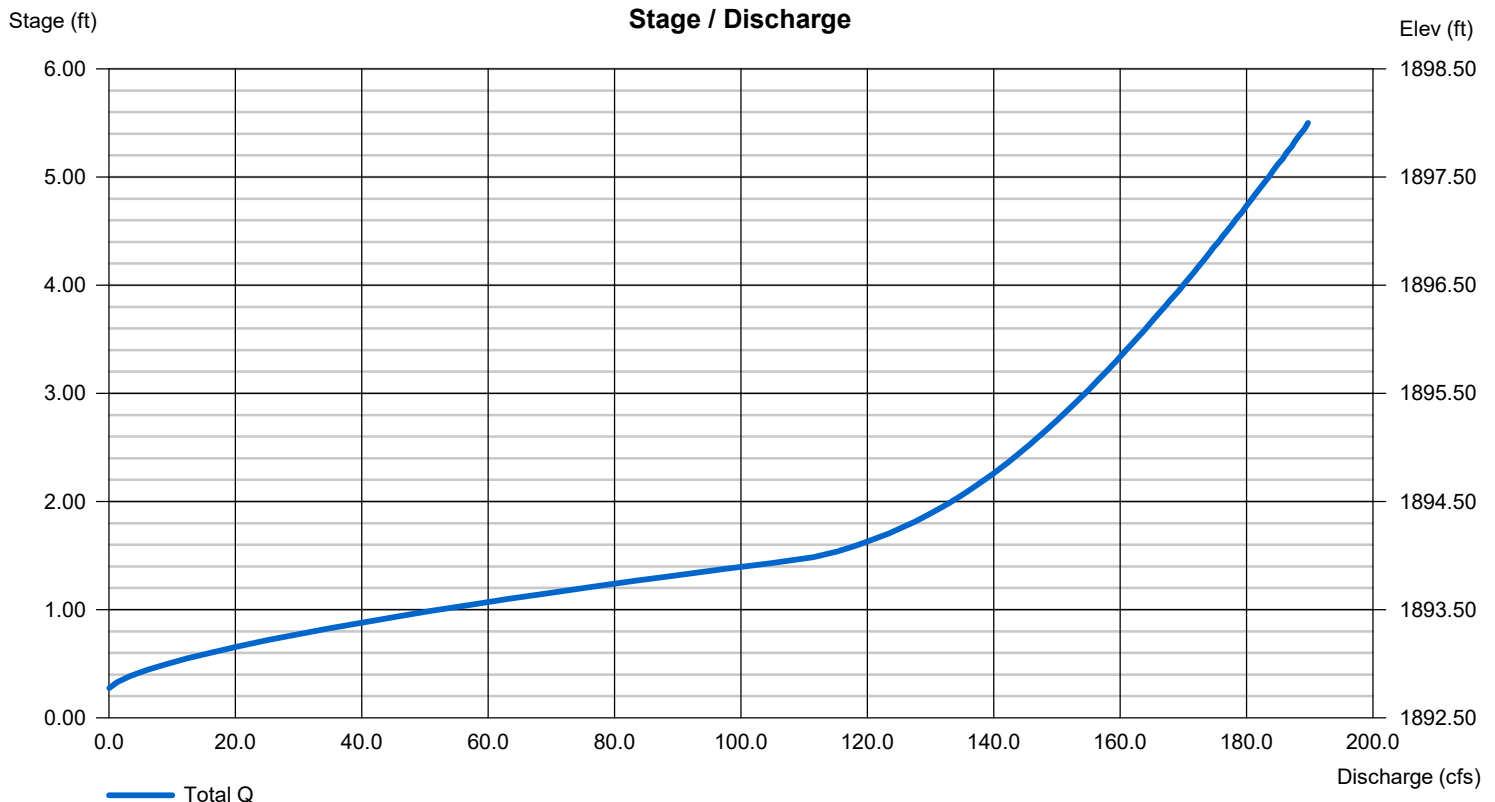
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 36.00	0.00	0.00	0.00
Span (in)	= 36.00	0.00	0.00	0.00
No. Barrels	= 2	0	0	0
Invert El. (ft)	= 1888.67	0.00	0.00	0.00
Length (ft)	= 125.00	0.00	0.00	0.00
Slope (%)	= 4.20	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 25.14	0.00	0.00	0.00
Crest El. (ft)	= 1892.77	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 0.000 (by Contour)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Hydrograph Report

INITIAL HYDRAULIC MODELING 2020

11

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Friday, 11 / 20 / 2020

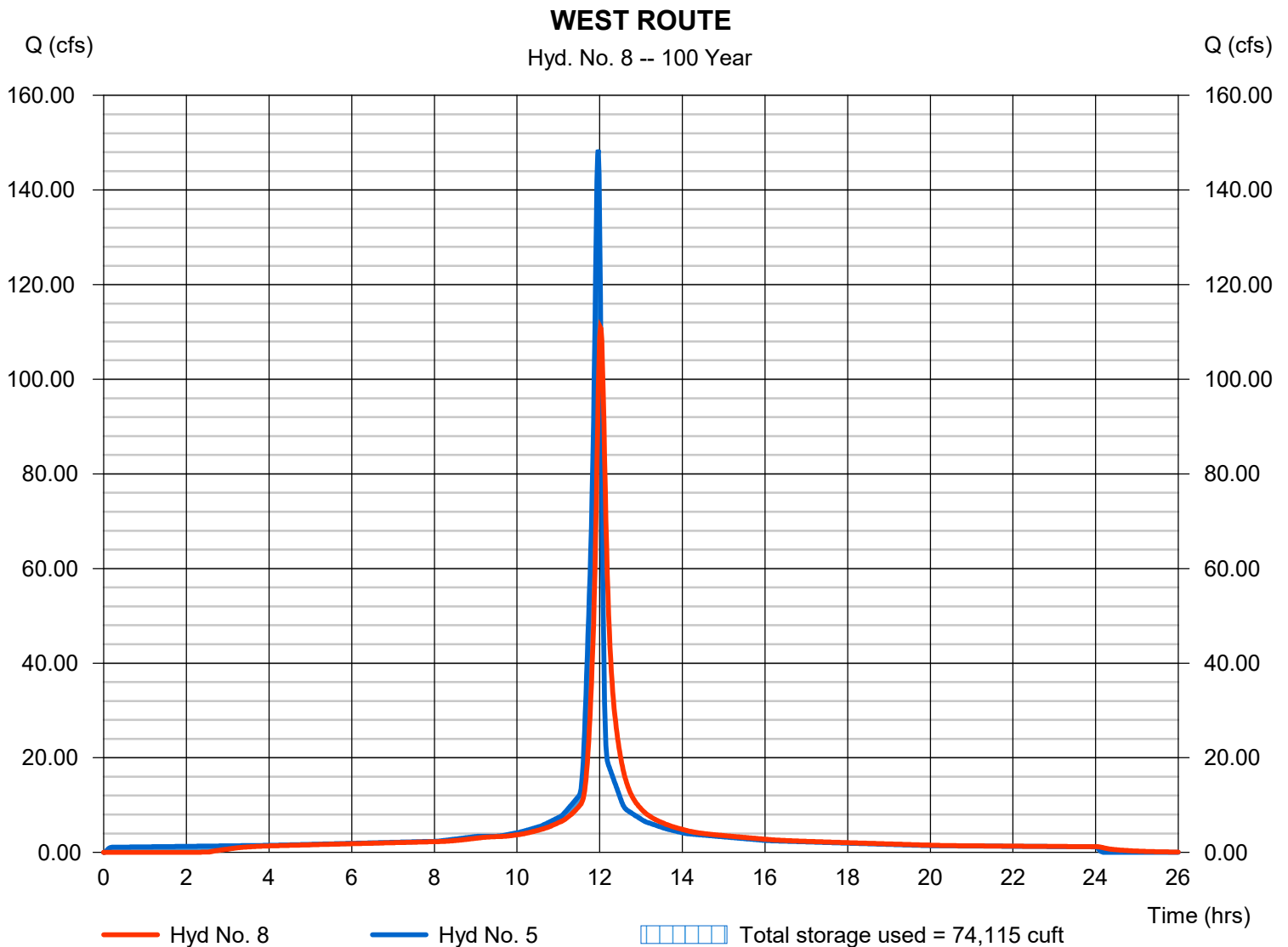
Hyd. No. 8

2X36" OUTLETS WITH 48" RISERS

WEST ROUTE

Hydrograph type	= Reservoir	Peak discharge	= 110.92 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.02 hrs
Time interval	= 1 min	Hyd. volume	= 376,722 cuft
Inflow hyd. No.	= 5 - TOTAL WEST	Max. Elevation	= 1893.91 ft
Reservoir name	= WEST OUTLET	Max. Storage	= 74,115 cuft

Storage Indication method used.



Pond No. 2 - WEST OUTLET

2X36" OUTLETS WITH 48" RISERS

Pond Data

Trapezoid -Bottom L x W = 100.0 x 50.0 ft, Side slope = 3.00:1, Bottom elev. = 1892.50 ft, Depth = 5.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1892.50	5,000	0	0
0.55	1893.05	5,506	2,888	2,888
1.10	1893.60	6,034	3,172	6,060
1.65	1894.15	6,583	3,469	9,529
2.20	1894.70	7,154	3,777	13,306
2.75	1895.25	7,747	4,097	17,403
3.30	1895.80	8,362	4,429	21,832
3.85	1896.35	8,999	4,773	26,605
4.40	1896.90	9,657	5,129	31,734
4.95	1897.45	10,337	5,497	37,232
5.50	1898.00	11,039	5,877	43,109

CLEAR AREA ONLY

INPUT APPROX.
INVERT ELEV.
AND LENGTHS
TO MODEL
DUAL CULVERT
OUTFLOW

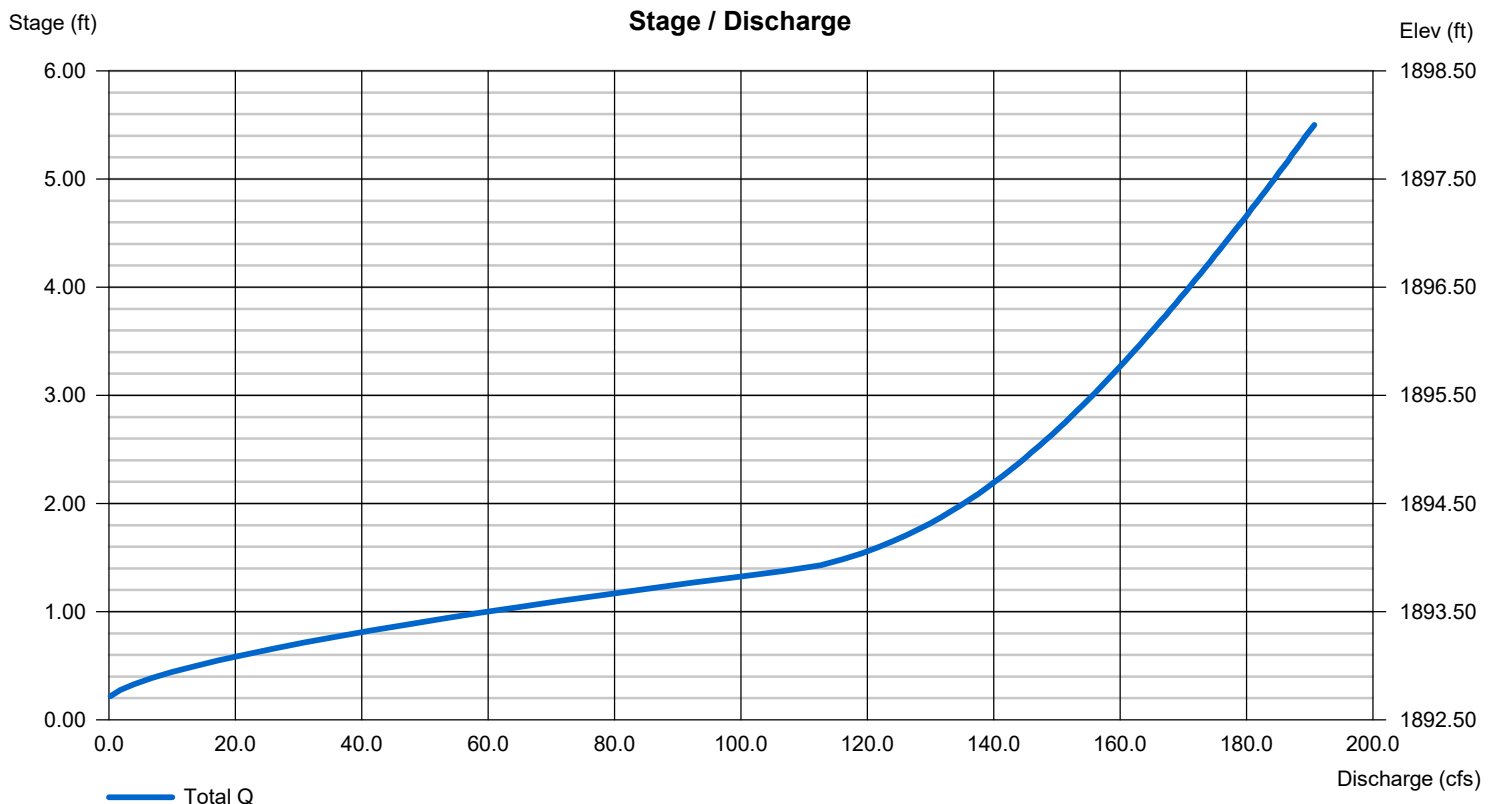
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 36.00	Inactive	0.00	0.00
Span (in)	= 36.00	36.00	0.00	0.00
No. Barrels	= 2	1	0	0
Invert El. (ft)	= 1888.60	1888.60	0.00	0.00
Length (ft)	= 125.00	125.00	0.00	0.00
Slope (%)	= 4.48	4.48	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 25.14	0.00	0.00	0.00
Crest El. (ft)	= 1892.70	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 0.000 (by Contour)			
TW Elev. (ft)	= 0.00			

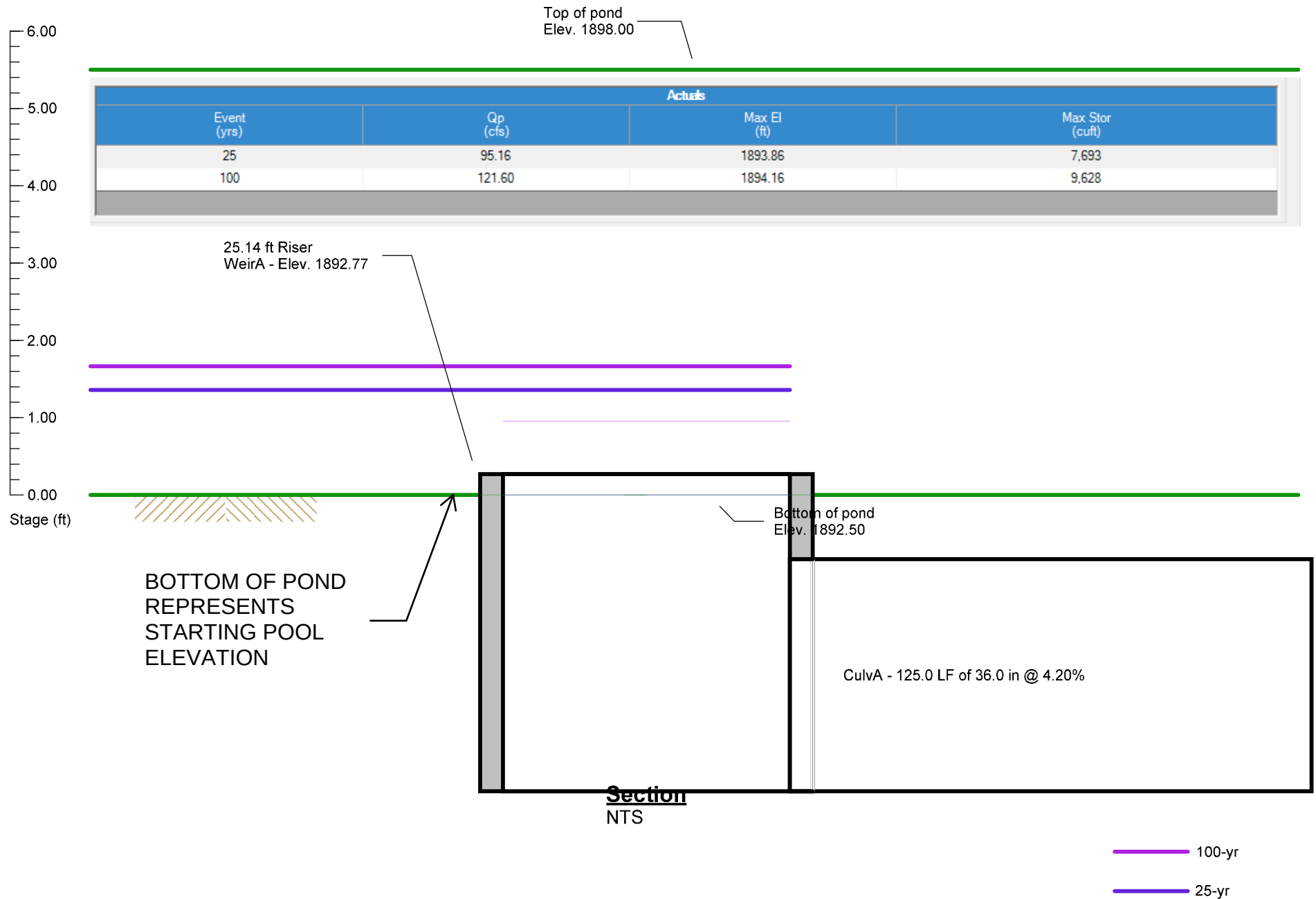
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Pond No. 1 - EAST OUTLET

INITIAL HYDRAULIC MODELING 2020

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

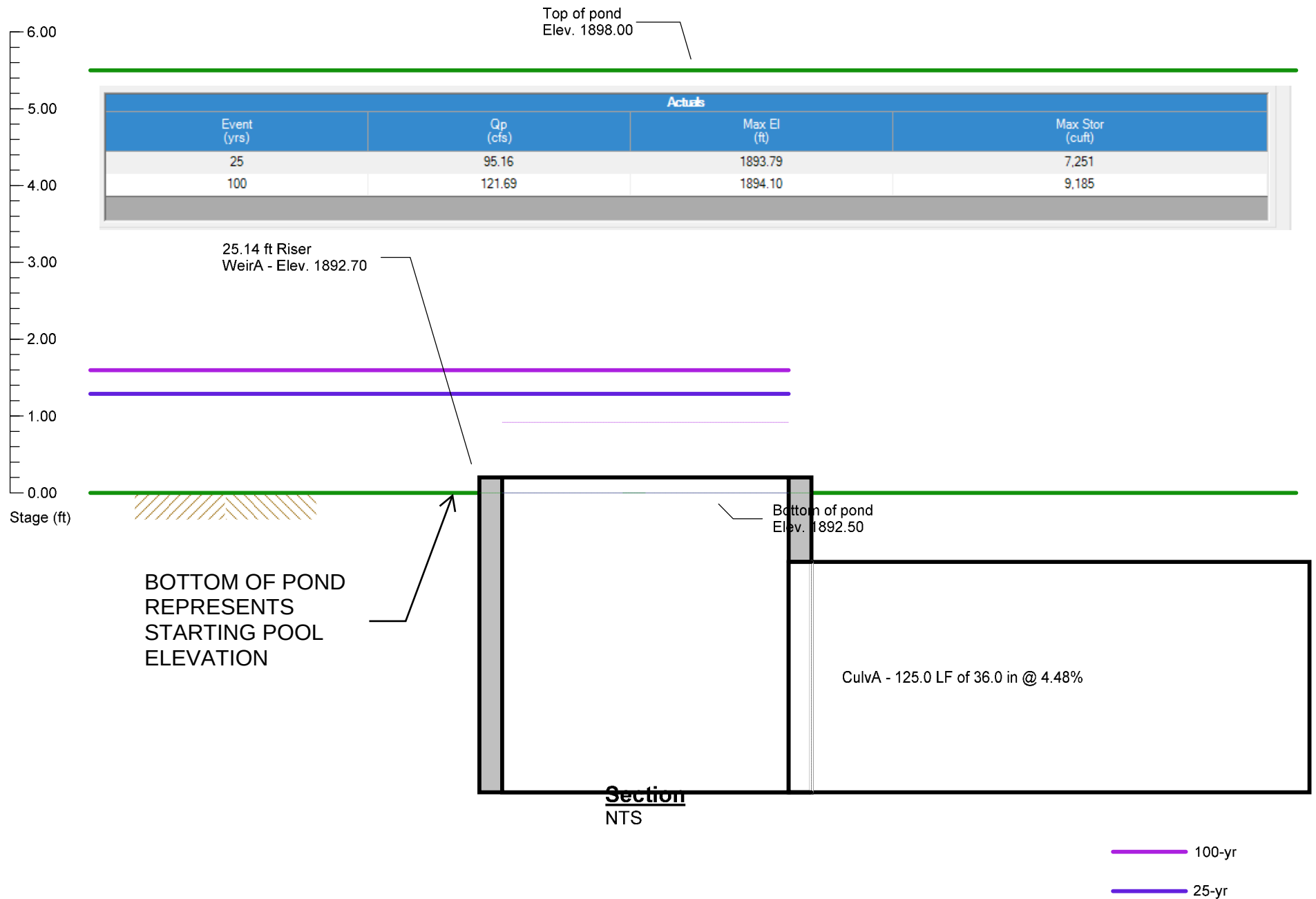


Inflow hydrograph = 6. Combine - TOTAL EAST

Pond No. 2 - WEST OUTLET

INITIAL HYDRAULIC MODELING 2020

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020



BOTTOM OF POND
REPRESENTS
STARTING POOL
ELEVATION

Inflow hydrograph = 6. Combine - TOTAL EAST

Culvert Report

INITIAL HYDRAULIC MODELING 2020

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Friday, Nov 20 2020

Circular Culvert

Invert Elev Dn (ft) = 1883.00
Pipe Length (ft) = 125.00
Slope (%) = 4.00
Invert Elev Up (ft) = 1888.00
Rise (in) = 36.0
Shape = Circular
Span (in) = 36.0
No. Barrels = 1
n-Value = 0.019
Culvert Type = Circular Corrugate Metal Pipe
Culvert Entrance = Headwall
Coeff. K,M,c,Y,k = 0.0078, 2, 0.0379, 0.69, 0.5

Max. flow for
1-culvert = 90-cfs.
Max. flow for system
is ~150-cfs.
2 culverts are
required.

Calculations

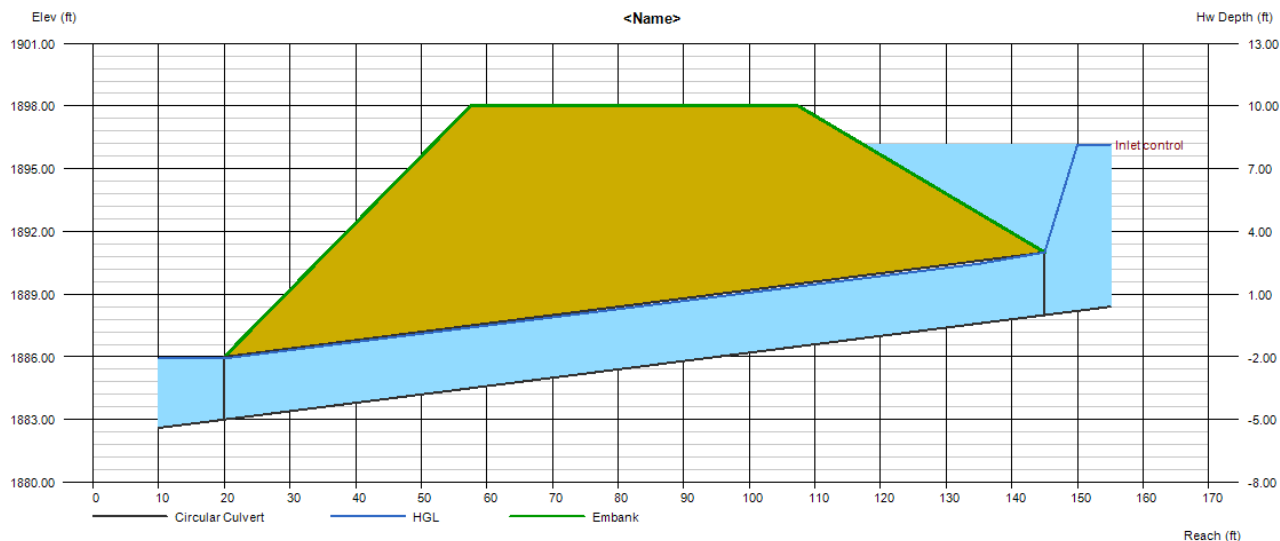
Qmin (cfs) = 0.00
Qmax (cfs) = 110.00
Tailwater Elev (ft) = (dc+D)/2

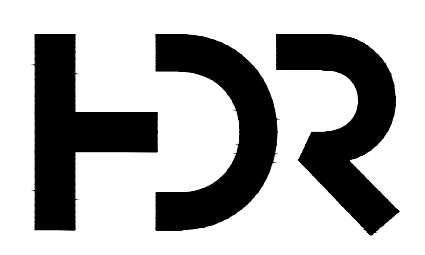
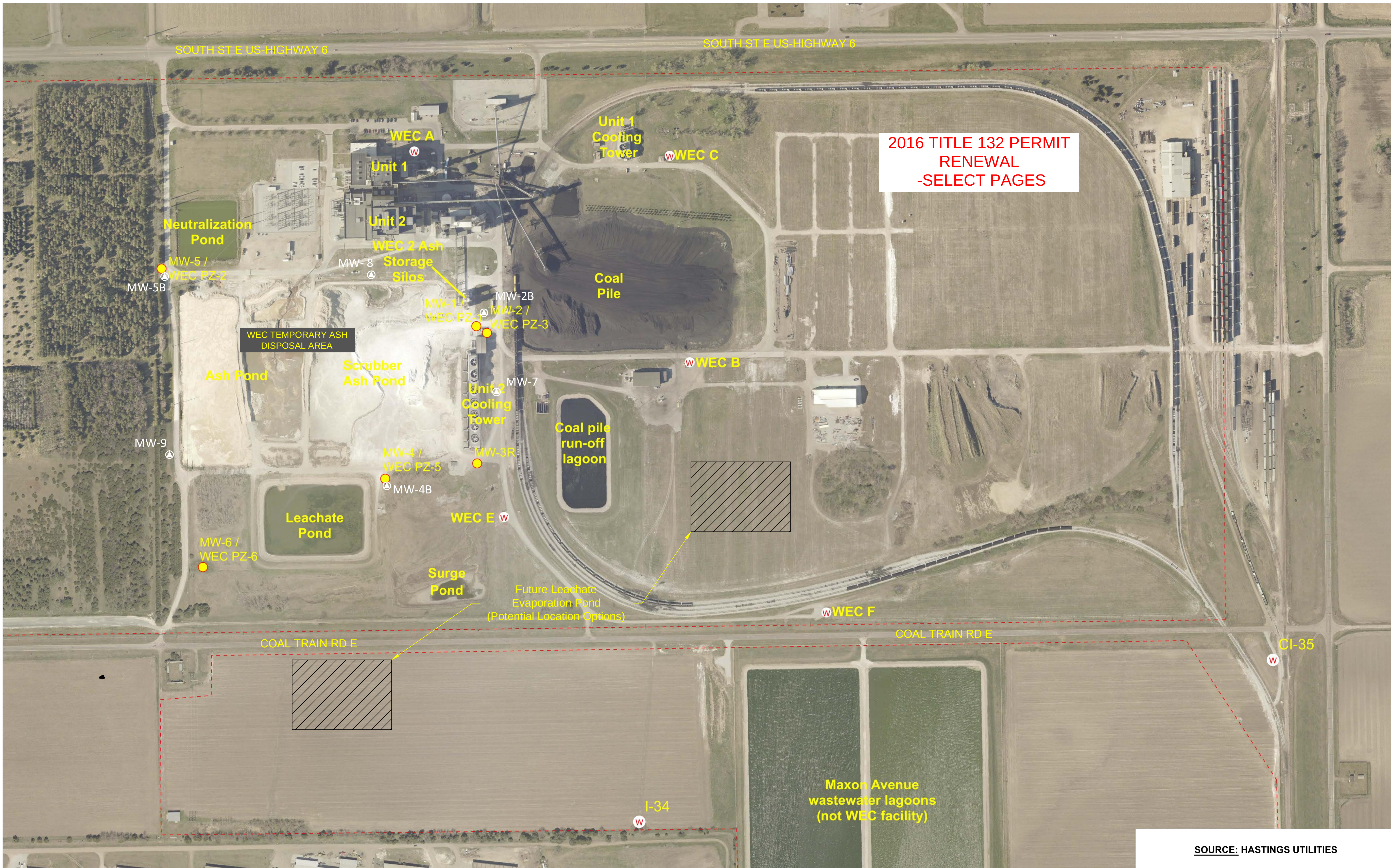
Highlighted

Qtotat (cfs) = 90.00
Qpipe (cfs) = 90.00
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 12.82
Veloc Up (ft/s) = 12.99
HGL Dn (ft) = 1885.92
HGL Up (ft) = 1890.85
Hw Elev (ft) = 1896.15
Hw/D (ft) = 2.72
Flow Regime = Inlet Control

Embankment

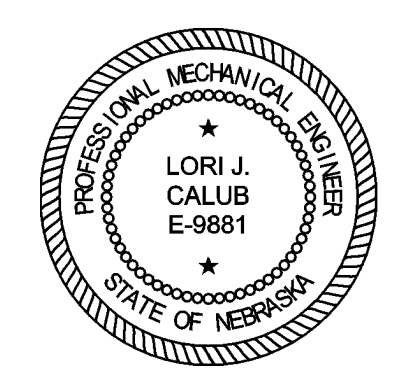
Top Elevation (ft) = 1898.00
Top Width (ft) = 50.00
Crest Width (ft) = 50.00



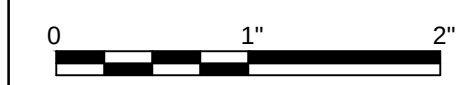


0	10/6/2016	NDEQ TITLE 132 PERMIT RENEWAL
ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	L. CALUB
PROJECT NUMBER	000000010040278

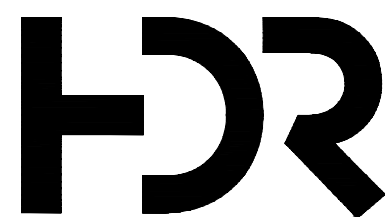
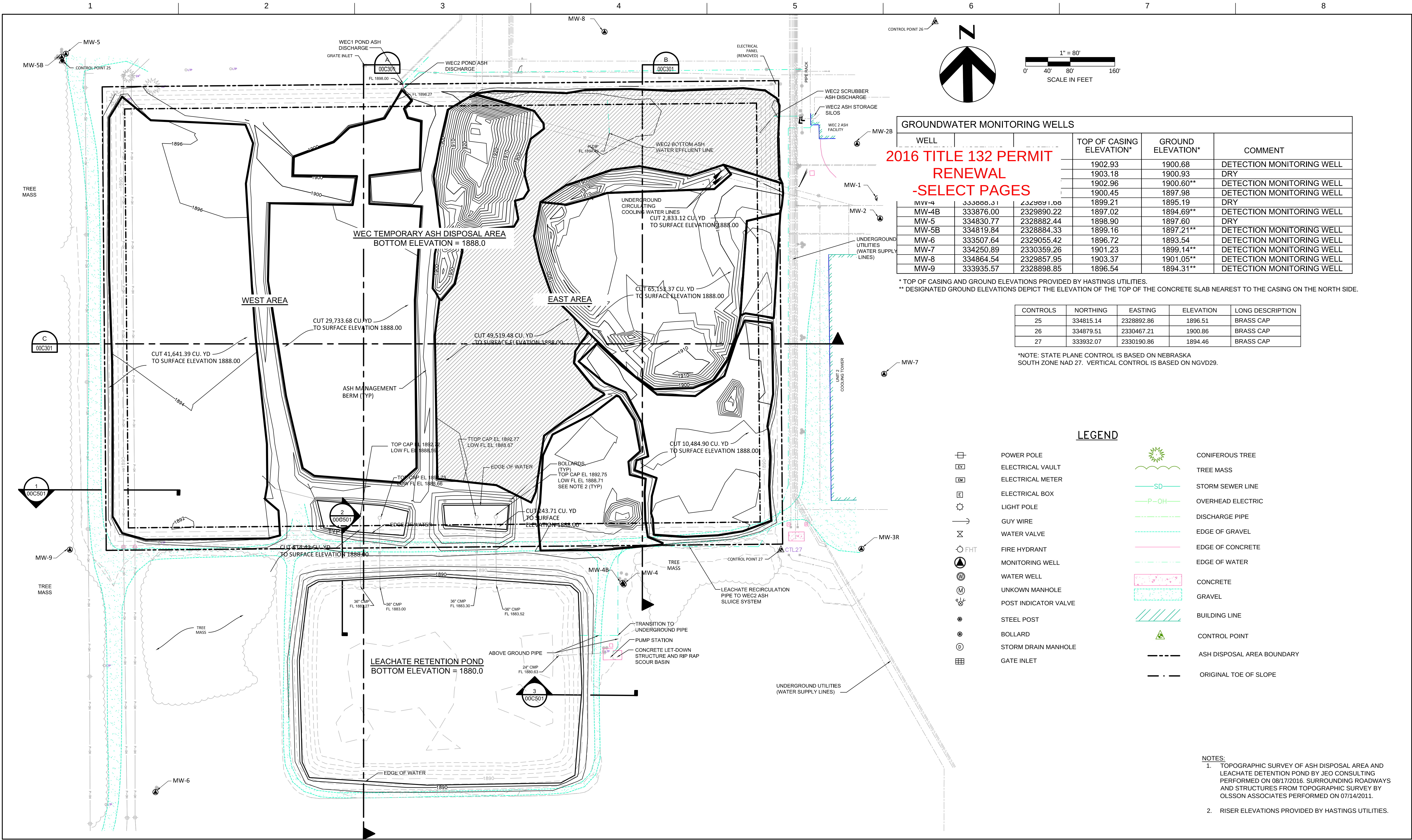


GERALD T. WHELAN ENERGY CENTER
WEC TEMPORARY ASH DISPOSAL AREA



SITE PLAN

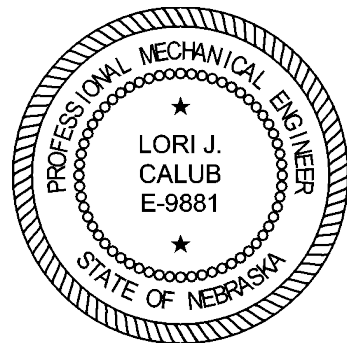
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1	11/3/2016	RESPONSE TO NDEQ COMMENTS
0	10/6/2016	NDEQ TITLE 132 PERMIT RENEWAL
ISSUE	DATE	DESCRIPTION

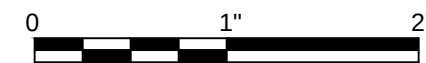
PROJECT MANAGER L. CALUB

PROJECT NUMBER 000000010040278



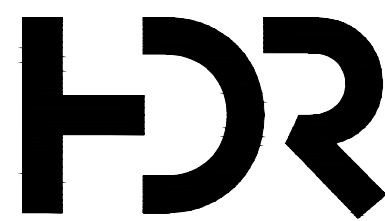
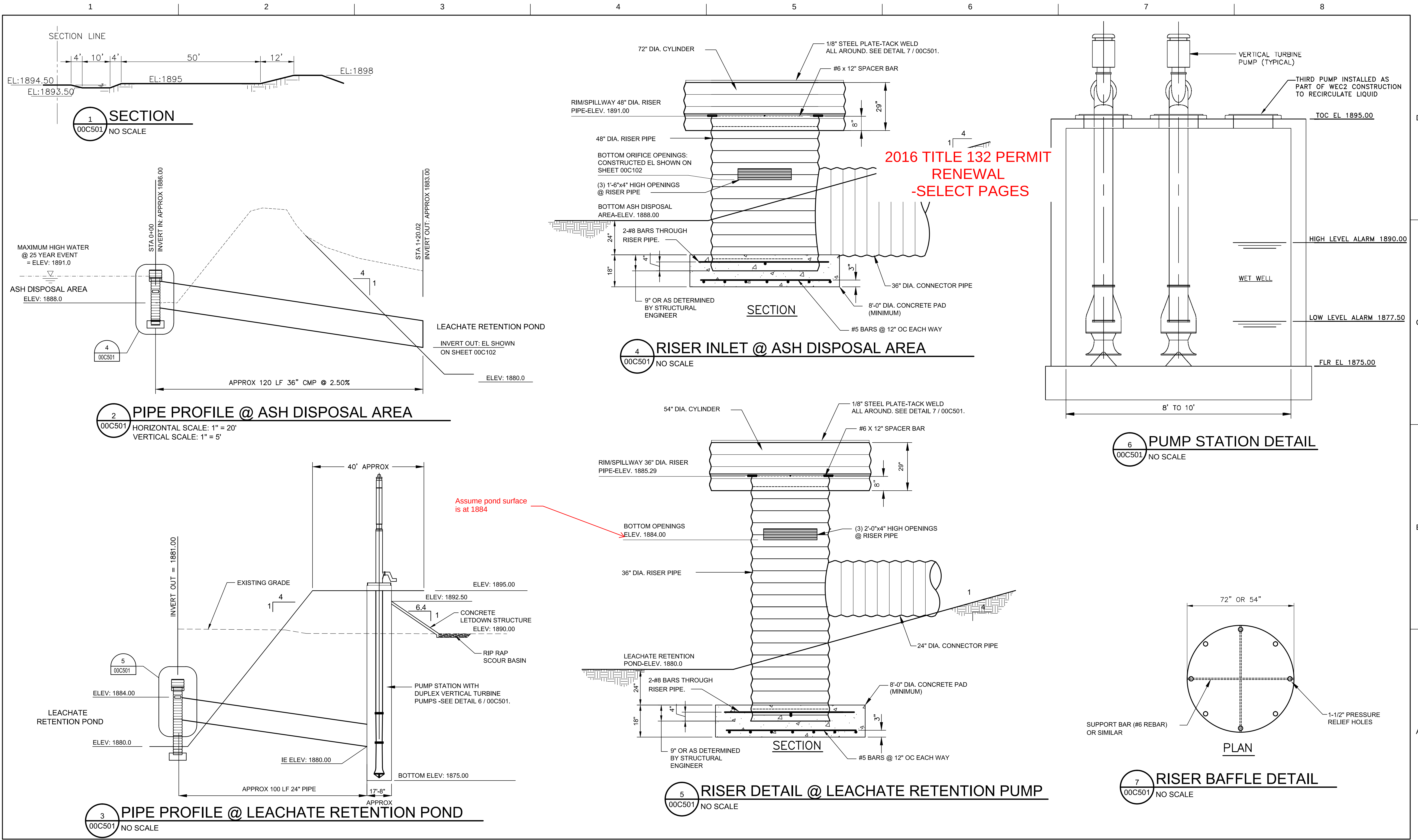
GERALD T. WHELAN ENERGY CENTER
WEC TEMPORARY ASH DISPOSAL AREA

ASH DISPOSAL AREA PLAN



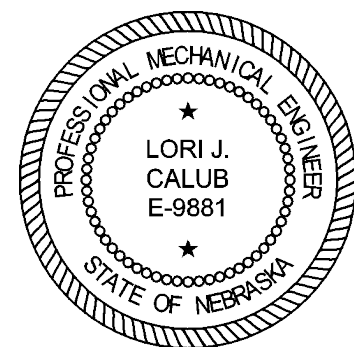
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SHEET
00C102



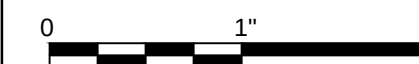
ISSUE	DATE	DESCRIPTION
1	11/3/2016	RESPONSE TO NDEQ COMMENTS
0	10/6/2016	NDEQ TITLE 132 PERMIT RENEWAL

PROJECT MANAGER	L. CALUB
PROJECT NUMBER	000000010040278



GERALD T. WHELAN ENERGY CENTER
WEC TEMPORARY ASH DISPOSAL AREA

LEACHATE MANAGEMENT DETAILS



FILENAME | 00C501.DWG
SCALE | AS SHOWN

SHEET
00C501

ORIGINAL SELECT PAGES -
FROM TITLE 132 PERMIT RENEWAL

APPENDIX M
SITE DRAINAGE CALCULATIONS

HDR ONE COMPANY | Many Solutions

Project	Hastings Utilities, Whelan Energy Center Ash Storage Area	Computed	DJM	Date	10/26/2006
Subject	Site Drainage Calculations	Checked	LJC	Date	11/7/2006
Task	Hydrology and Hydraulics	Sheet	2	Of	18

A. SIZE LEACHATE RETENTION POND

1) Total Volume Quantities (process flows peak day flow on 24 hrs basis and include safety factor of 1.5)

Daily Durations (t)=	24 hrs	or	1440 min		
No. Discharge Days =	1 day	or	1440 min		
Factor of Safety (FS)=	1.5				
1cf =	7.48 gallons				
1 acre =	43,560 sf				
V =	FS*Q*t	ac-ft			
a) Ash Sluice Water - Unit 1	Qsw =	600 gpm	Vsw=	3.98 ac-ft/day	
a) Ash Sluice Water - Unit 2	Qfa =	831 gpm	Vfa=	5.51 ac-ft/day	
c) Cooling Tower (1&2)	Qct =	0 gpm	Vct=	0.00 ac-ft/day	
d) Scrubber Ash Sluicing - Unit 2	Qb =	534 gpm	Vb=	3.54 ac-ft/day	
	Vt =	1965 gpm	Vt =	13.03 ac-ft/day	

2) Size Leachate Retention Pond to completely retain 25yr, 24 hr rainfall and process flows

Total Rainfall =	4.9 in	NOAA	
Evaporation =	0.15 in/day	Regional evaporation for Hastings (56 in/yr)	
Vap =	10 ac-ft	Ash pond runoff = (total rainfall-evaporation)*(area of East & West Ash Ponds)	
Vlr =	1.7 ac-ft	Leachate retention pond runoff =	
Side Slopes	4H:1V	(total rainfall-evaporation)*(Top of Berm Area of Water Depth with +)	

Leachate Retention Pond Design

	Water Depth ft	Floor W1 ft	L1 ft	A1 sf	Top of Berm W2 ft	L2 ft	A2 sf	Vrequired ac-ft	Vavailable ac-ft	Vavailable CF
	4	300	425	127,500	332	457	151,724	24.41	12.82	558,448
x	4.4	300	425	127,500	335	460	154,259	24.43	14.23	619,870
	5	300	425	127,500	364	489	177,996	24.65	17.53	763,740
	6	300	425	127,500	372	497	184,884	24.71	21.51	937,152
xx	7	300	425	127,500	380	505	191,900	24.77	25.66	1,117,900
	8	300	425	127,500	388	513	199,044	24.84	29.99	1,306,176
	9	300	425	127,500	396	521	206,316	24.90	34.49	1,502,172

1-indicates pond bottom dimensions and areas

2-indicates top of berm dimensions and areas

Vrequired = Vt + Vap + Vlr

x = pond dimensions to hold process water only.

xx = pond dimensions to hold process water and storm water.

Estimates are similar
for leachate pond
storage available

HDR ONE COMPANY | Many Solutions

Project	Hastings Utilities, Whelan Energy Center Ash Storage Area	Computed	DJM	Date	10/26/2006
Subject	Site Drainage Calculations	Checked	LJC	Date	11/7/2006
Task	Hydrology and Hydraulics	Sheet	3	Of	18

B. SIZE CONNECTOR PIPES (25-YEAR STORM): ASH PONDSRational Method; $Q = CiA$ 1) C = Runoff Coefficient = 1.002) T_c = Time of ConcentrationSince $T_c \sim 0$ for runoff at each Ash Pond, use $T_c = 5$ min.3) Rainfall Intensity: $i = 8.2$ in/hour for 25 year storm event, $T_c = 5$ min

Reference 1

4) Ash Pond (east) $W=640$ ft $H=860$ ft $A_e= 550,400$ SF 12.64 acres
 Ash Pond (west) $W=640$ ft $H=860$ ft $A_w= 550,400$ SF 12.64 acres

5) Calculate Runoff for $T_c = 5$ min

	Q (cfs)	C	i(in/hr)	A (acres)
A_e	104	1	8.2	12.64
A_w	104	1	8.2	12.64

6) Maximum Daily Flows during normal operating conditions

a) Ash Sluice Water - Unit 1 $Q_{sw} = 600$ gpm 1.3 cfs
 b) Ash Sluice Water - Unit 2 $Q_{fa} = 831$ gpm 1.9 cfs
 c) Cooling Tower (1&2) $Q_{ct} = 0$ gpm 0.0 cfs
 d) Scrubber Ash Sluicing - Unit 2 $Q_b = 534$ gpm 1.2 cfs
 $Q_t = 1965$ gpm 4.4 cfs

7) Determine Number of Connector Pipes to Each Pond Considering 5-minute Duration Storm

Max Q (from west pond) = $Q_w + Q_{sw} + Q_{fa} = 107$ cfsAssume number of pipes, $n = 2$ $Q_n = Q/n = 53.40$ cfsVerify Q_n Provided $Q_n = 1.48 \cdot A \cdot R^{.67} \cdot S^{.5/n}$ A = Pipe Area

slope(S) = 0.025

mannings $n = 0.024$

diameter = 36 in

 Q_n provided = 57.28 cfs OK

8) Size Ash Pond Spillway

Head on Pipe Spillway (H) = Spillway crest elevation - design high water level of leachate retention pond
 Spillway crest elevation = 1891.00 feet, from drawings
 Design high water level of leachate retention pond = 1885.29 feet, from drawings
 $H = 5.71$ feet

Table 2-8, ref. 4

For $H = 5.71$ Spillway capacity = 68.80 cfs > 53.40 cfs, OK

9) Spillway Capacity Considering Pipe length

Pipe length = 120 lf

Pipe diameter = 36 in

Table 2-8, ref. 4 Correct flow for Length of 120 lf
 Correction factor from table = 0.86

So, corrected discharge capacity = 68.80 x 0.86 = 59.17 cfs
 59.17 cfs > 53.40 cfs, OK

Q is higher for 100-yr storm

Revised estimate is 400k GPD, 0.62-cfs

Installed slope is higher

Spillway to be reshaped with culvert connection

HDR ONE COMPANY | *Many Solutions*

Project	Hastings Utilities, Whelan Energy Center Ash Storage Area	Computed	DJM	Date	10/26/2006
Subject	Site Drainage Calculations	Checked	LJC	Date	11/7/2006
Task	Hydrology and Hydraulics	Sheet	4	Of	18

10) Determine Riser Size

Required Q = 53.40 cfs

Riser size = 48 in

From Figure 2-13, ref. 4: Max. head above the orifice crest when passing required Q = 1.2 ft

Elevation of orifice crest = 1888.67 ft, from drawings

Elevation of spillway crest = 1891.00 ft, from drawings

2.33 ft >

1.2 ft, OK

1.6-ft - OK

11) Area of Orifices Required

Assume height (h) above crest of orifice =

2 inches = 0.17 ft

Qorifice = $C_d \cdot A \cdot (2gh)^{0.5}$ Q = Discharge = $1/2 \cdot Q_t \cdot FS/n$ =

Cd = Orifice Coefficient = 0.70

h = Height = 0.17 ft

g = Gravity = 32.20 ft/sec²

A = Orifice Area = 0.72 sf

Assume 3 openings, A = 0.24 sf

1.64 cfs per outlet pipe

Meets base flow from sluice

Assume orifice height = 4 inches = 0.33 ft

Orifice length = 0.72 ft

Use 3 openings 4 inch high by 1.50 ft long

12) Rise of Water in Ash Pond From 25-year 24-hour storm

From sheet 2, total rainfall from a 25-year 24-hour storm event =

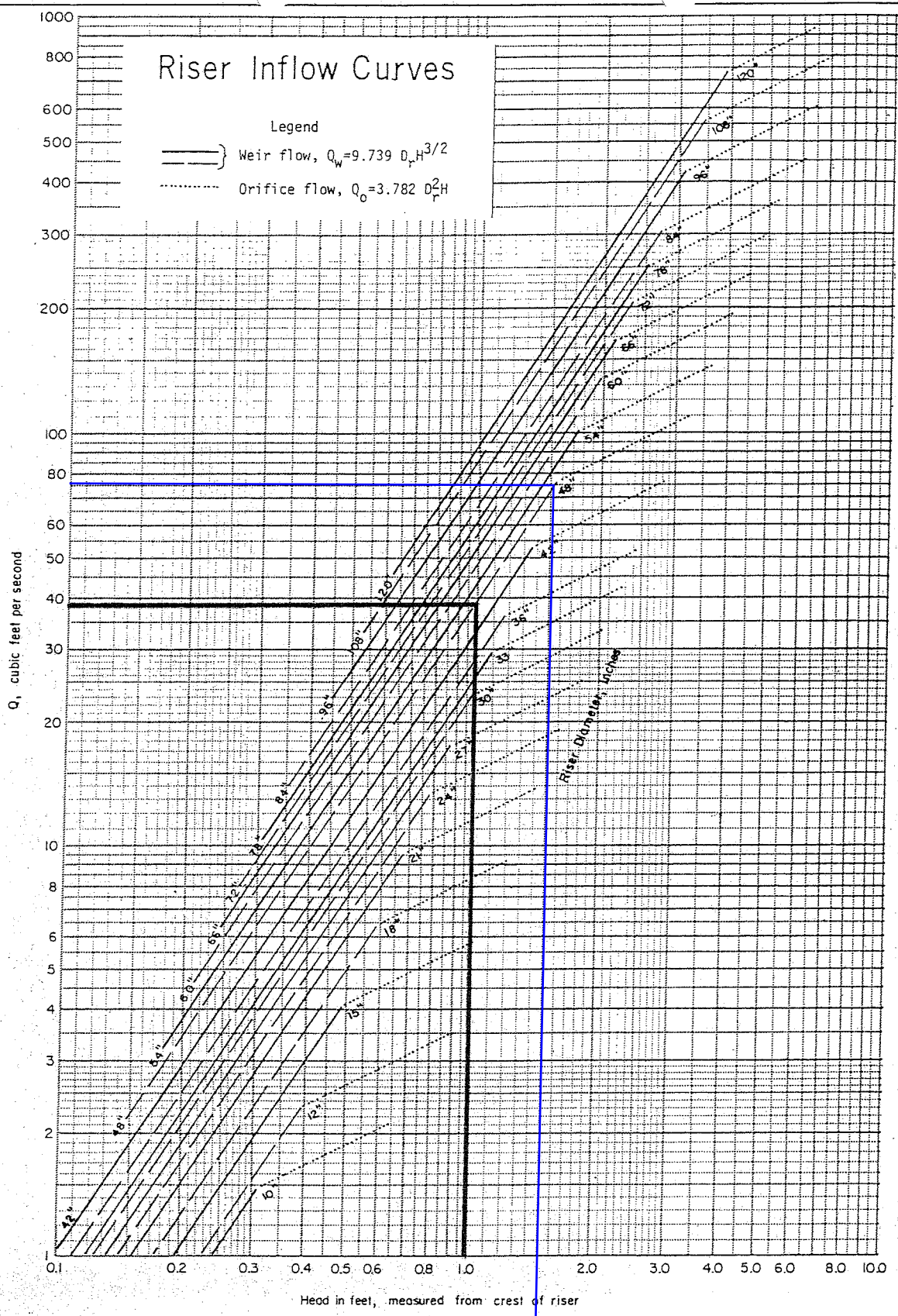
4.9 in =

0.41 ft

See hydraflow output for clear areas.

11 *H*

Ref. 4

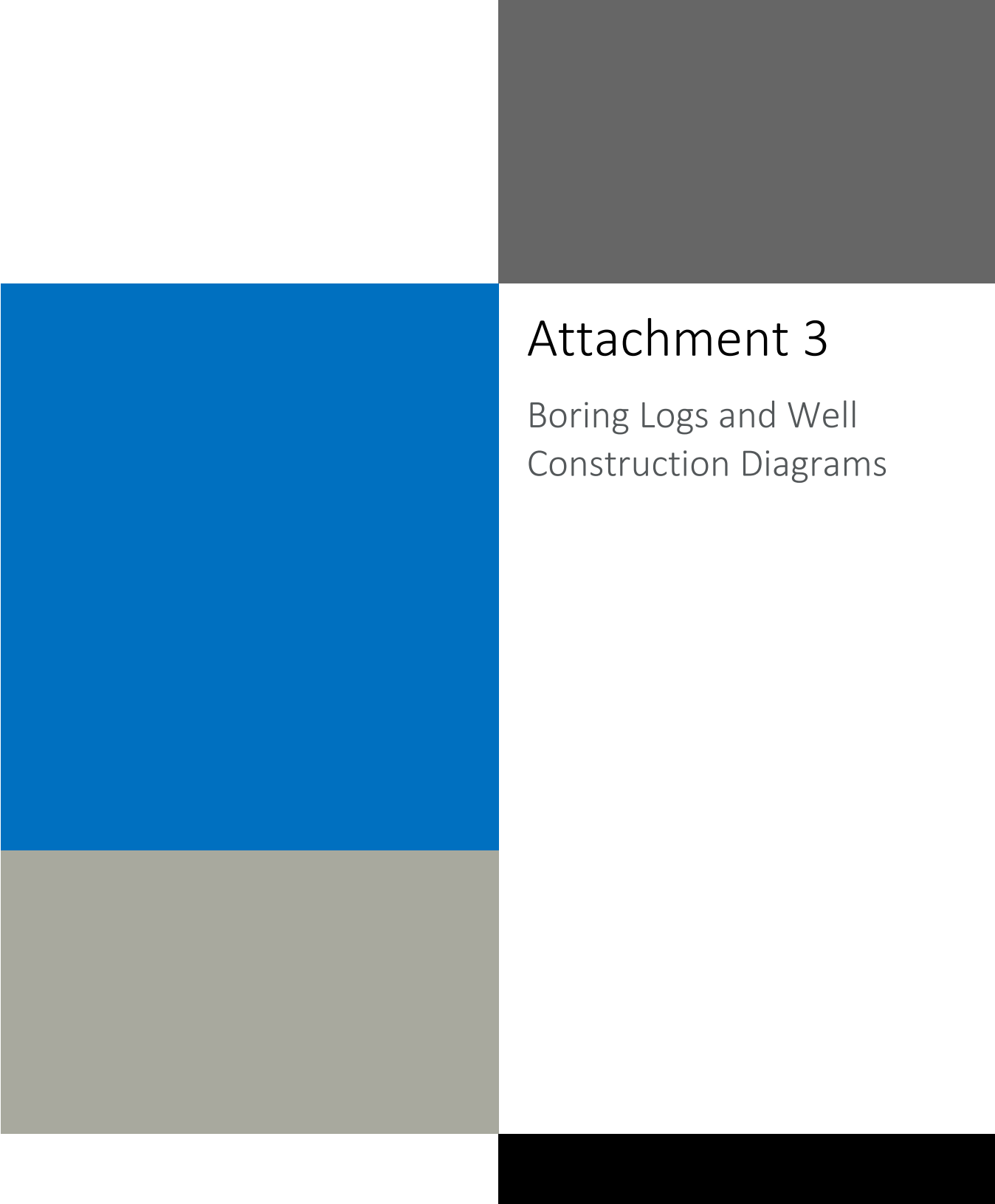


Source: Soil Conservation Service

Riser Inflow Curves Sediment Basin

Date
JAN 1993

Figure
2-13



Attachment 3

Boring Logs and Well
Construction Diagrams

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MW-1

BORING LOG

DRILL HOLE NO.		LOCATION OF DRILL HOLE		ELEVATION	DATUM	DRILLER	LOGGER							
WECPZ-1		See Boring Location Diagram				James Tinnell	Dave Petersen							
WATER LEVEL OBSERVATIONS				TYPE OF SURFACE		DRILL RIG								
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	HOURS	Grassy, Slopes to West		Mobil B-61 HDX								
				DRILLING METHOD		TOTAL DEPTH								
114'		114'		112'		4.25" I. D. Hollow Stem Augers								
114'		114'		112'		135.0'								
SAMPLE DATA				SOIL DESCRIPTION				LABORATORY DATA				DEP. FT.		
DEP. FT.	SAMPLE NO. & TYPE	"N" BLOWS /FT	% REC.	COLOR	MOIST	CONS.	GROUP NAME	GEOLOGIC DESCRIPTION & OTHER REMARKS	Pene-trometer tsf	Torvane tsf	% MC		Dry Dens pcf	Class
				Brown	Moist	Firm	Lean clay	DEVELOPED ZONE/TOPSOIL					CL	
				Brown	Moist	Firm	Lean Clay	FILL/DEVELOPED ZONE					CL	
5	U-1	100							7.5	1.75	19.7	100.6		5
				Light Brown	Moist	Firm	Lean Clay	PEORIA FORMATION					CL	
10	U-2	30						Calcareous concretions	4.0	2.00	24.3	84.3		10
15	U-3	100				Very Firm		Manganese nodules	8.1	4.00				15
20	U-4	100		Gray Brown	Very Moist	Firm		Loess formation Iron staining Root holes	3.1	2.75				20
	U-5	100							4.4	1.25	23.5	90.8		
25	U-6	100		Very Dark Brown	Very Moist	Firm	Lean Clay	SANGAMON PALESOL With fine sand (organic)	5.0	1.25			CL	25
	U-7	100		Reddish Brown	Moist	Very Firm	Lean Clay	LOVELAND FORMATION/ TRANSITION Fine sand seams Root holes	21.3	4.5+			CL	
30	U-8	100							10.0	3.50	13.0	111.4		30
35	U-9	100		Light Reddish Brown	Moist	Very Firm	Lean Clay	LOVELAND LOESS	10.0	2.25			CL	35


**Geotechnical
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Project HASTINGS UTILITIES MONITORING WELL

Location HASTINGS, NEBRASKA

Job No. 995833

Date 7/27/99

MW-1 BORING LOG														
DRILL HOLE NO.		LOCATION OF DRILL HOLE			ELEVATION		DATUM		DRILLER		LOGGER			
WECPS-1		See Boring Location Diagram							James Tinnell		Dave Petersen			
DEP. Ft.	SAMPLE NO. & TYPE	"N" BLOWS /FT	% REC.	COLOR	MOIST	CONSIST	GROUP NAME	GEOLOGIC DESCRIPTION & OTHER REMARKS	Pene-trometer tsf	Torvane tsf	% MC	Dry Dens pcf	Class	DEP. FT.
				Light Reddish Brown	Moist	Very Firm	Lean Clay	LOVELAND LOESS					CL	
40	U-10		100					Carbon staining With more sand	10	2.50				40
45	U-11		100						8.1	4.25				45
50	U-12		100					With more sand	9.4	3.25				50
55	U-13		100	Reddish Brown	Slightly Moist	Loose	Sandy Silty Clay	BASAL LOVELAND FORMATION	0.75	1.00	5.5	110.0	CL-ML	55
60	S-14	19	100			Medium					10.9			60
65	S-15	25	100	Light Brown	Slightly Moist	Dense	Poorly Graded Sand						SP	65
70	S-16	15	100								4.9			70
75	S-17	18		Reddish Brown										75



**Geotechnical
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Project HASTINGS UTILITIES MONITORING WELL

Location HASTINGS, NEBRASKA

Job No. 995833

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MW-1 BORING LOG														
DRILL HOLE NO.		LOCATION OF DRILL HOLE				ELEVATION		DATUM		DRILLER		LOGGER		
WECPZ-1		See Boring Location Diagram								James Tinnell		Dave Petersen		
DEP. Ft.	SAMPLE NO. & TYPE	"N" BLOWS /FT	% REC.	COLOR	MOIST	CONSIST	GROUP NAME	GEOLOGIC DESCRIPTION & OTHER REMARKS	Pene-trometer tsf	Torvane tsf	% MC	Dry Dens pcf	Class	DEP. FT.
80	S-18	24	100	Reddish Brown	Slightly Moist	Dense	Poorly Graded Sand	BASAL LOVELAND FORMATION					SP	80
85	S-19	37	100	Light Brown			Silty Clayey Sand				7.7		SC-SM	85
90	S-20	84		Light Brown	Slightly Moist	Very Dense	Well Graded Sand	PLEISTOCENE ALLUVIAL AQUIFER					SW	90
95	S-21	50 in 5"						With some gravel						95
100	S-22	35	100			Dense		Carbon staining						100
							Silty Sand	No gravel					SM	
105	S-23	59		Light Gray		Very Dense	Poorly Graded Sand with Silt	Very fine grained with some gravel					SP	105
110	S-24	73												110
							Well Graded Sand	Bottom of spoon - coarse sand					SW	
								Iron staining						
115	S-25	50 in 4"			Wet			Alternating coarse and fine sand						115



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Project HASTINGS UTILITIES MONITORING WELL

Location HASTINGS, NEBRASKA

Job No. 995833

Date 7/27/99

MW-1		BORING LOG												
DRILL HOLE NO.		LOCATION OF DRILL HOLE				ELEVATION		DATUM		DRILLER		LOGGER		
WECpz-1		See Boring Location Diagram								James Tinnell		Dave Petersen		
DEP. Ft.	SAMPLE NO. & TYPE	"N" BLOWS /FT	% REC.	COLOR	MOIST	CONSIST	GROUP NAME	GEOLOGIC DESCRIPTION & OTHER REMARKS	Pene-trometer tsf	Torvane tsf	% MC	Dry Dens pcf	Class	DEP. FT.
				Light Gray	Wet	Very Dense	Well Graded Sand	PLEISTOCENE ALLUVIAL AQUIFER Alternating layers of fine sand and coarse					SW	
120	S-26	39												120
125														125
				Reddish Brown			Silty Sand						SM	
130	S-27							Very fine grained sand						130
135														135
								BOTTOM OF HOLE 135.0'						
140														140
145														145
150														150
155														155

	Project HASTINGS UTILITIES MONITORING WELL	
	Location HASTINGS, NEBRASKA	
	Job No. 995833	Date 7/27/99

MW-1

MONITOR WELL SCHEMATIC

WELL NO.	LOCATION OF WELL	ELEVATION	DATUM	DRILLER	LOGGER
WECPZ-1	See Boring Location Diagram			James Tinnell	Dave Petersen
WATER LEVEL OBSERVATIONS				TYPE OF SURFACE	DRILL RIG
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	24 HOURS	Grassy	Mobil B-61 HDX
114'	114'	112'		4.25" I. D. Hollow Stem Augers	134.5'
PROTECTIVE COVER Type: <u>Steel</u> Size: <u>4" x 4" x 5'</u> Pad Size: <u>3' x 3' x 6"</u>					BRIEF GEOLOGIC DESCRIPTION See Boring Log WECPZ-1
GROUT BENTONITE Amount: <u>500</u> (lbs.) Water: <u>150</u> (gal.) PORTLAND CEMENT Type: _____ Amount: _____ (lbs.) Bentonite: _____ (lbs.) Water: _____ (gal.)					
WELL SEAL Type: <u>Bentonite chips</u> Amount: <u>125</u> (lbs.) Water: <u>15</u> (gal.)					
WELL PACK Type: <u>16-30</u> Amount: <u>850</u> (lbs.)					
NOTES: _____ _____ _____					
INITIAL PUMP DATA Rate: _____ Drawdown: _____ Time: _____ Water Level: _____ Start: _____ Stop: _____					
RISER Type: <u>PVC</u> Schedule: <u>40</u> Inside Diameter: <u>2"</u> Length: <u>10'</u> #: <u>11</u> Length: _____ #: _____					
SCREEN Type: <u>PVC</u> Schedule: <u>40</u> Slot: <u>20</u> Inside Diameter: <u>0.010"</u> Length: <u>10'</u> #: <u>3</u> Length: _____ #: _____					
END CAP Type: <u>PVC</u> Length: <u>0.4'</u>					



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Project **HASTINGS UTILITIES MONITORING WELL**

Location **HASTINGS, NEBRASKA**

Job No. **995833**

Date **7/28/99**

MW-2

BORING LOG

DRILL HOLE NO.	LOCATION OF DRILL HOLE		ELEV.	DATUM	DRILLER	LOGGER
WECpz-3	See Site Map		1901.57		James Tinnell	Doug Janulewicz
WATER LEVEL OBSERVATIONS				TYPE OF SURFACE		DRILL RIG
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	8 Days	Grass / Weeds		Mobile B-61
			116.00	4.25" I. D. Hollow Stem Augers		TOTAL DEPTH
						122.6

DEP. FT.	SAMPLE DATA				SOIL/SEDIMENT DESCRIPTION					DEP. FT.
	SAMPLE NO. & TYPE	"N" BLOWS /FT	% REC.	HEAD SPACE READING	COLOR	MOIST.	CONS.	GROUP NAME	GEOLOGIC DESCRIPTION AND OTHER REMARKS	
5					Black	Moist	Firm	Lean Clay	FILL MATERIAL Silty clay Root hairs and root holes	5
10	U-1				Light Brown	Moist	Firm	Lean Clay	PEORIAN LOESS Silty clay Carbon and rust stains Traces of fine sand	10
15										15
20	U-2				Light Tanish Brown				Silty clay Traces of fine sand Carbon filled root holes Fine sand pockets (1/8" diameter)	20
25										25
30	U-3				Dark Gray Black	Moist	Hard	Lean Clay	SANGAMON Silty clay Blocky Fine sand lenses	30
35										35



**Geotechnical
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Project

WHELAN ENERGY CENTER

Location

HASTINGS, NEBRASKA

Job No.

995833

Date

10/22/01

MW-2

BORING LOG

DRILL HOLE NO.		LOCATION OF DRILL HOLE						ELEV.	DATUM	DRILLER	LOGGER
WECpz-3		See Site Map						1901.57		James Tinnell	Doug Janulewicz
DEP. FT	SAMPLE NO. & TYPE	"N" BLOWS/ FT	% REC.	HEAD SPACE READING	COLOR	MOIST.	CONS.	GROUP NAME	GEOLOGIC DESCRIPTION AND OTHER REMARKS		DEP. FT
					Reddish Brown	Moist	Firm	Lean Clay	LOVELAND LOESS Silty clay Root holes Traces of fine sand Manganese nodules		
40	U-4										40
45											45
50	U-5										50
55					Orangish Red			Poorly Graded Sand	Fine grained sand Intermixed silt and clays		55
60	S-6	28			Light Reddish Orange				Fine grained sand Intermixed silt and clays 1/4" thick silt and clay seams		60
65											65
70	S-7	32			Light Brown				Fine grained sand Intermixed silt and clays		70
75											75


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Project

WHELAN ENERGY CENTER

Location

HASTINGS, NEBRASKA

Job No.

995833

Date

10/22/01

MW-2

BORING LOG

DRILL HOLE NO.		LOCATION OF DRILL HOLE						ELEV.	DATUM	DRILLER	LOGGER
WECPZ-3		See Site Map						1901.57		James Tinnell	Doug Janulewicz
DEP. FT	SAMPLE NO. & TYPE	"N" BLOWS/ FT	% REC.	HEAD SPACE READING	COLOR	MOIST.	CONS.	GROUP NAME	GEOLOGIC DESCRIPTION AND OTHER REMARKS		DEP. FT
					Brown	Moist	Firm	Poorly Graded Sand	Fine grained sand Intermixed silts and clays		
80	S-8	51									80
85											85
90	S-9	68			Tan				Fine to medium grained sand 1/8" thick iron stained seams		90
95											95
100	S-10	70							Fine to medium Trace of coarse sand		100
105											105
110	S-11	54							Fine to medium		110
115	S-12	80				Wet			Fine to coarse sand		115


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WHELAN ENERGY CENTER

Location

HASTINGS, NEBRASKA

Job No.

995833

Date

10/22/01

MW-2

BORING LOG

DRILL HOLE NO.		LOCATION OF DRILL HOLE				ELEV.		DATUM		DRILLER		LOGGER	
WPCPZ-3		See Site Map				1901.57				James Tinnell		Doug Janulewicz	
DEP. FT.	SAMPLE NO. & TYPE	"N" BLOWS/ FT.	% REC.	HEAD SPACE READING	COLOR	MOIST.	CONS.	GROUP NAME	GEOLOGIC DESCRIPTION AND OTHER REMARKS				DEP. FT.
120					Tan	Wet	Firm	Poorly Graded Sand					120
125									BOTTOM OF HOLE 122.6'				125
130													130
135													135
140													140
145													145
150													150
155													155



**Geotechnical
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Project

WHELAN ENERGY CENTER

Location

HASTINGS, NEBRASKA

Job No.

995833

Date

10/22/01

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Boring Log MW-2B

Page 1 of 3

Project Name WEC MW Installation			Project No. 1004517			Drilling Company GSI/GEOCORE		
Location HASTINGS, NE			Client Hastings Utilities /PPGA			Drilling Rig Type and Drilling Method 3.25" Hollow Stem Auger		
Sample	"N" blows/FT	Depth (feet)	Well Installation Details			Description (USCS)	Recovery (%)	Water Level Observations
			GROUT Type: <u>Bentonite</u> Amount: <u>650 lbs.</u>			Grassy surface Lean Clay (CL); grey; dry; firm to hard; low plasticity	No recovery, visual classification from cuttings	
		10				Dark brown; medium plasticity		
						Black; slightly moist; soft; low plasticity		
						Dark brown; slightly moist; soft		
		20				Brown		
						Very soft; high plasticity		
		30				Reddish brown; firm; medium plasticity		
						Soft		
						High plasticity		
		50				Firm; medium plasticity		
		60				Clayey sand (SC); reddish brown; slightly moist; firm; medium dense		
		70				Clayey sand (SC); reddish brown; slightly moist; medium dense		
		80				Brown		
		90				Poorly graded sand with clay (SP-SC); fine grained; brown; slightly moist; medium dense		



Boring Log MW-2B

Page 2 of 3

Project Name			Project No.			Drilling Company		
WEC MW Installation			1004517			GSI/GEOCORE		
Location			Client			Drilling Rig Type and Drilling Method		
HASTINGS, NE			Hastings Utilities /PPGA			3.25" Hollow Stem Auger		
Sample	"N" blows/FT	Depth (feet)	Well Installation Details			Description (USCS)	Recovery (%)	Water Level Observations
S1	23, 27, 28	100				Well graded sand (SW); fine to medium grained; light brown; slightly moist; medium dense; traces of medium gravel Dense; iron stains	90	
S2	27, 10, 10	105				Poorly graded sand (SP); fine to medium grained; very light brown; slightly moist; medium dense	90	
S3	10, 16, 29	110				Well graded sand (SW); medium to coarse grained; light brown; slightly moist; medium dense	100	
S4	13,, 18, 25	115				Dense; little gravel	100	
S5 (Sieve)	22, 41, 50	120				Poorly graded sand (SP); fine to medium grained; light brown; wet; medium dense	80	
S6	8, 10, 10	125				Wet	50	
S7	22, 34, 22	130				Fine grained	80	
S8 (Sieve)	23, 34, 32	135				Silty sand (SM); very fine grained; light brown; wet; loose	90	
S9	8,8,10	140				Well graded sand (SW); medium to coarse grained; light brown; wet; medium dense; iron staining	100	



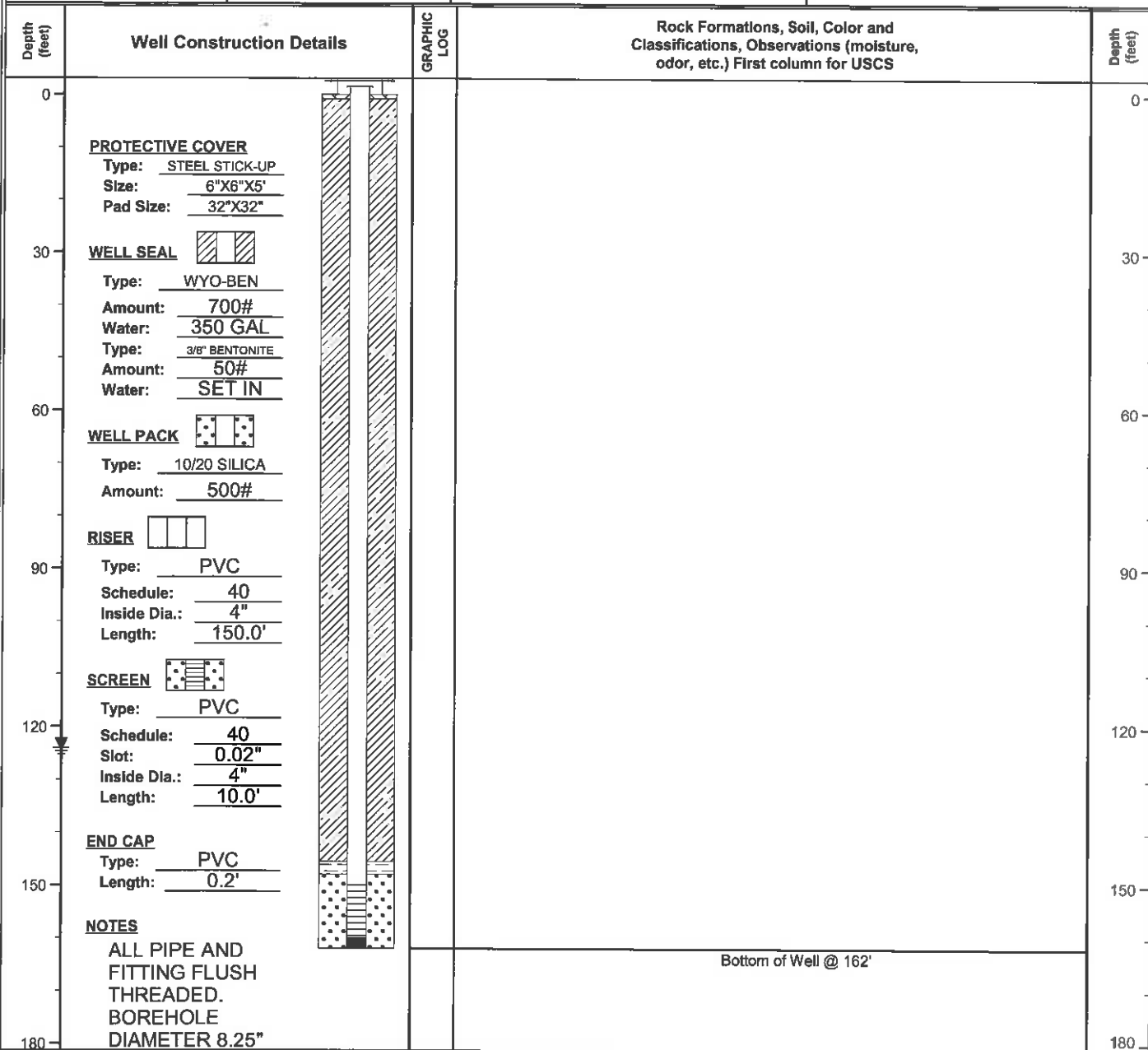
Boring Log MW-2B

Page 3 of 3

Project Name WEC MW Installation		Project No. 1004517		Drilling Company GSI/GEOCORE	
Location HASTINGS, NE		Client Hastings Utilities /PPGA		Drilling Rig Type and Drilling Method 3.25" Hollow Stem Auger	
Sample	"N" blows/FT	Depth (feet)	Well Installation Details		Recovery (%)
S10	8, 19, 36	145			50
S11	7, 10, 14	150	Poorly graded sand (SP); coarse grained; light brown; wet; medium dense		50
S12	28, 36, 47	155	Well graded sand (SW); coarse grained; light brown; wet; medium dense; some fine gravel		75
S13	22, 16, 20	160	Poorly graded sand (SP); medium grained; light brown; wet; medium dense; some fine gravel and clay layer, approx. 2'		80
S14	21, 24, 23	165	*MW-2B was installed by GEOCORE 6 feet east of boring location using a mud rotary rig GP-1100R on 10/18/2016		80
S15	7, 7, 8	170	Lean Clay (CL); ligh brown; moist; soft to firm; medium plasticity		100
S16	6, 22, 30	175	Poorly graded sand (SP); medium grained; light brown; wet; medium dense; light brown layer of clay, aprrox 3" at the end of spoon		50
Terminated Hollow Stem Auger boring @ 175 feet*					
The stratification lines represent the approximate boundary lines between soil and rock types. In-Situ transition may be gradual.					
Water Level			Logged By/Sampled By: Gaoty Williams		Drilled By: James Tinnell/David Summers
While Drilling: 124'			After Drilling: 124.1'		Date Started: 10/17/2016
					Date Completed: 10/17/2016

SOIL BORING LOG & MONITORING WELL CONSTRUCTION DIAGRAM

WELL NO.	LOCATION OF WELL	DATUM	TOC ELEVATION	SURFACE ELEVATION	DRILLER	LOGGER
MW-2B	Hastings, Nebraska		1902.96'		DAVID SUMMERS	HDR
WATER LEVEL OBSERVATIONS			TYPE OF SURFACE		DRILL RIG	
WHILE DRILLING	END OF DRILLING		GRASS		GUS PECH GT1100R	
124'	124.1'		DRILLING METHOD			TOTAL DEPTH
			ROTARY RIG			162'
NDEQ SPILL #		NDEQ IIS#		DRILLING START TIME		DRILLING STOP TIME



* SS (split spoon) HS (hollow stem auger) HA (hand auger) MC (macro-core)


GSI Geotechnical Services, Inc.
 2860 N. Diers Avenue, Grand Island, NE 68803
 (308) 381-1987 Fax (308) 381-2487

Project:	
Gerald T. Whelan Energy Center	
Location	
4520 East South Street, Hastings, NE	
Project No.:	Date:
165162	10/19/2016

BY: _____ APPROV. _____

MW-3

BORING LOG

DRILL HOLE NO.	LOCATION OF DRILL HOLE		ELEV.	DATUM	DRILLER	LOGGER			
WECpz-4	See Site Map		1894.32		James Tinnell	Doug Janulewicz			
WATER LEVEL OBSERVATIONS				TYPE OF SURFACE		DRILL RIG			
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	7 Days	Grass / Weeds		Mobile B-61			
				DRILLING METHOD		TOTAL DEPTH			
105.0'				4.25" I. D. Hollow Stem Augers		112.1			
DEP. FT.	SAMPLE DATA				SOIL/SEDIMENT DESCRIPTION		DEP. FT.		
	SAMPLE NO. & TYPE	"N" BLOWS /FT	% REC.	HEAD SPACE READING	COLOR	MOIST.		CONS.	GROUP NAME
5	U-1				Black	Moist	Firm	Lean Clay	DEVELOPED ZONE Silty clay Root hairs and root holes
10					Light Brown	Moist	Firm	Lean Clay	PEORIAN Silty clay Traces of fine sand Root hairs and root holes Rust stains Carbon deposits
15									
20					U-2	Black	Moist	Firm	Lean Clay
25	U-3				Light Reddish Brown	Moist	Firm to Hard	Lean Clay	LOVELAND Silty clay Intermixed fine sand Manganese nodules
30									
35									


**Geotechnical
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Project

WHELAN ENERGY CENTER

Location

HASTINGS, NEBRASKA

Job No.

995833

Date

10/23/01

MW-3

BORING LOG

DRILL HOLE NO.		LOCATION OF DRILL HOLE						ELEV.	DATUM	DRILLER	LOGGER
WECpz-4		See Site Map						1894.32		James Tinnell	Doug Janulewicz
DEP. FT	SAMPLE NO. & TYPE	"N" BLOWS/ FT	% REC.	HEAD SPACE READING	COLOR	MOIST.	CONS.	GROUP NAME	GEOLOGIC DESCRIPTION AND OTHER REMARKS		DEP. FT
					Light Reddish Brown	Moist	Firm to Hard	Lean Clay	LOVELAND Increasing fine sand content		
40	U-4				Reddish Brown				Sand with intermixed silts and clays Fine grained sand Poorly graded		40
45					Light Brown to Brown						45
50	S-5	24							2" thick fine to medium grained lenses at 49' Fine grained sand Intermixed silt and clays		50
55											55
60	S-6	22							Fine grained sand Intermixed silt and clays		60
65											65
70	S-7	22							Fine grained sand Intermixed silt and clays		70
75											75



**Geotechnical
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Project

WHELAN ENERGY CENTER

Location

HASTINGS, NEBRASKA

Job No.

995833

Date

10/23/01

MW-3

BORING LOG

DRILL HOLE NO.		LOCATION OF DRILL HOLE						ELEV.	DATUM	DRILLER	LOGGER
WECpz-4		See Site Map						1894.32		James Tinnell	Doug Janulewicz
DEP. FT.	SAMPLE NO. & TYPE	"N" BLOWS/ FT	% REC.	HEAD SPACE READING	COLOR	MOIST.	CONS.	GROUP NAME	GEOLOGIC DESCRIPTION AND OTHER REMARKS		DEP. FT.
					Light Brown Tan	Moist	Firm to Hard	Lean Clay	Fine grained sand Intermixed silts and clays		
80	S-8	51							Fine to medium grained sand Poorly graded		80
85											85
90	S-9	75							Fine to coarse sand Traces of fine gravel Poorly graded		90
95											95
100	S-10	97									100
105	S-11	85									105
110						Wet					110
115									BOTTOM OF HOLE 112.1'		115



**Geotechnical
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Project

WHELAN ENERGY CENTER

Location

HASTINGS, NEBRASKA

Job No.

995833

Date

10/23/01

SOIL BORING LOG & MONITORING WELL CONSTRUCTION DIAGRAM

WELL NO.	LOCATION OF WELL	DATUM	TOC ELEV.	GROUND SURF. ELEV.	DRILLER	LOGGER
MW-3R	See Boring Location Diagram				James Tinnell	Fred Jones
WATER LEVEL OBSERVATIONS		TYPE OF SURFACE			DRILL RIG	
WHILE DRILLING	END OF DRILLING	Bare Frozen Muddy Ground			Mobile B-61	
		DRILLING METHOD			TOTAL DEPTH	
115'	114.5'	4 1/4" Hollow Stem Augers			126.7'	
NDEQ SPILL #		NDEQ IIS#		DRILLING START		DRILLING STOP
				DATE	TIME	DATE
				1/27/2011		1/29/2011

Depth (feet)	Well Construction Details	SAMPLE NO. & TYPE*	Rec. (%)	Head Space Reading	GRAPHIC LOG	Rock Formations, Soil, Color and Classifications, Observations (moisture, odor, etc.) First column for USCS	Depth (feet)
0	PROTECTIVE COVER Type: <u>Steel Stick-up</u> Size: <u>6" Diameter</u> Pad Size: <u>36" Diameter</u>					CL Frozen muddy ground Dark brown, saturated, soft, lean clay Peoria Loess Light brown Moist, firm	0
15	WELL SEAL  Type: <u>Benseal &</u> Amount: <u>1300 Pounds</u> Water: <u>390 Gallons</u> Type: <u>3/8" Bentonite</u> Amount: <u>150 Pounds</u> Water: <u>15 Gallons</u>	S-1					15
30	WELL PACK  Type: <u>16/30 Silica Sand</u> Amount: <u>700 Pounds</u>	S-2				Sangamon Dark brown Loveland Formation	30
45	RISER  Type: <u>PVC</u> Schedule: <u>40</u> Inside Dia.: <u>4"</u> Length: <u>111.5'</u>	S-3				Reddish brown	45
60	SCREEN  Type: <u>PVC</u> Schedule: <u>40</u> Slot: <u>0.01</u> Inside Dia.: <u>4"</u> Length: <u>10'</u>	S-4				SC Reddish brown, moist, firm, sandy clay to clayey sand	60
75	END CAP Type: <u>PVC</u> Length: <u>0.2'</u>	S-5				SP-SC Reddish brown, moist, medium dense, poorly graded fine sand with clay, silt-size particles	75
90	NOTES All Pipes and Fittings are Flush Threaded Borehole Diameter 8"	S-6				SC Reddish brown, moist, medium dense, clayey sand, fine sand with silt	90
		S-7				SP Reddish brown, moist, medium dense, poorly graded sand, fine sand	
		S-8				Reddish brown to light brown	
		S-9					

* SS (split spoon) HS (hollow stem auger) HA (hand auger) MC (macro-core)



GSI Geotechnical Services, Inc.
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 (308) 381-1987 Fax (308) 381-2467

Project:

Hastings Utilities/Whelan Energy Center

Location

Hastings, Nebraska

Project No.:

115012

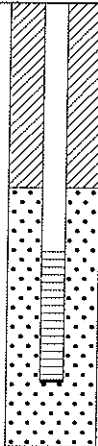
Date:

3/29/2011

BY: _____ APPROV. _____

SOIL BORING LOG & MONITORING WELL CONSTRUCTION DIAGRAM

WELL NO.	LOCATION OF WELL				DATUM	TOC ELEV.	GROUND SURF. ELEV.	DRILLER	LOGGER
MW-3R	See Boring Location Diagram							James Tinnell	Fred Jones
WATER LEVEL OBSERVATIONS					TYPE OF SURFACE			DRILL RIG	
WHILE DRILLING	END OF DRILLING				Bare Frozen Muddy Ground			Mobile B-61	
					DRILLING METHOD			TOTAL DEPTH	
115' 	114.5' 				4 1/4" Hollow Stem Augers			126.7'	
NDEQ SPILL #		NDEQ IIS#			DRILLING START		DRILLING STOP		
					DATE	TIME	DATE	TIME	
					1/27/2011		1/29/2011		

Depth (feet)	Well Construction Details	SAMPLE NO. & TYPE*	Rec. (%)	Head Space Reading	GRAPHIC LOG	Rock Formations, Soil, Color and Classifications, Observations (moisture, odor, etc.) First column for USCS	Depth (feet)	
105	PROTECTIVE COVER Type: <u>Steel Stick-up</u> Size: <u>6" Diameter</u> Pad Size: <u>36" Diameter</u> WELL SEAL  Type: <u>Benseal &</u> Amount: <u>1300 Pounds</u> Water: <u>390 Gallons</u> Type: <u>3/8" Bentonite</u> Amount: <u>150 Pounds</u> Water: <u>15 Gallons</u> WELL PACK  Type: <u>16/30 Silica Sand</u> Amount: <u>700 Pounds</u>	S-10				Fine, medium, and some coarse sand with some silt	105	
120		S-11						
		S-12						
		S-13					Very moist	
		S-14					Saturated, fine to coarse sand with silt	120
135	RISER  Type: <u>PVC</u> Schedule: <u>40</u> Inside Dia.: <u>4"</u> Length: <u>111.5'</u> SCREEN  Type: <u>PVC</u> Schedule: <u>40</u> Slot: <u>0.01</u> Inside Dia.: <u>4"</u> Length: <u>10'</u> END CAP Type: <u>PVC</u> Length: <u>0.2'</u>					Bottom of Boring @ 126.7'	135	
150							150	
165							165	
180	NOTES All Pipes and Fittings are Flush Threaded Borehole Diameter 8"						180	

BY: _____
APPROV: _____

* SS (split spoon) HS (hollow stem auger) HA (hand auger) MC (macro-core)



GSI Geotechnical
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Project:

Hastings Utilities/Whelan Energy Center

Location

Hastings, Nebraska

Project No.:

115012

Date:

3/29/2011



Boring Log MW- 4B

Page 1 of 2

Project Name WEC MW Installation			Project No. 1004517		Drilling Company GSI/GEOCORE		
Location HASTINGS, NE			Client Hastings Utilities		Drilling Rig Type and Drilling Method 3.25" Hollow Stem Auger		
Sample	"N" blows/FT	Depth (feet)	Well Installation Details		Description (USCS)	Recovery (%)	Water Level Observations
S1	26,28,29	0	GROUT Type: <u>Bentonite</u> Amount: <u>400 lbs</u>		Grassy surface Lean Clay (CL); very dark brown; dry; stiff; medium plasticity	No recovery, visual classification from cuttings	
		10			Slightly moist; firm; medium plasticity		
		20			Brown; soft ; medium to high plasticity; silty clay		
		30			Very soft; high plasticity		
		40			Medium plasticity		
		50			Clayey sand (SC); reddish brown; slightly moist; medium density; some silt		
		60			Poorly graded sand with with clay (SP-SC); fine grained; reddish brown; slightly moist; medium dense		
		70			Poorly graded sand with with clay (SP-SC); fine grained; reddish brown; slightly moist; medium dense		
		80			Clayey sand (SC); reddish brown; slightly moist; medium dense		
		90			Poorly graded sand with with clay (SP-SC); fine grained; reddish brown; slightly moist; medium dense		
		100			Well graded sand (SW); medium to coarse grained; very light brown; slightly moist; medium dense; traces of coarse aggregate	90	

MW-4

BORING LOG

DRILL HOLE NO.	LOCATION OF DRILL HOLE		ELEV.	DATUM	DRILLER	LOGGER				
WECpz-5	See Site Map		1892.15		James Tinnell	Doug Janulewicz				
WATER LEVEL OBSERVATIONS				TYPE OF SURFACE		DRILL RIG				
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	6 Days	Grass / Weeds		Mobile B-61				
103.0'			104.15	4.25" I. D. Hollow Stem Augers		TOTAL DEPTH 111.2				
DEP. FT	SAMPLE DATA				SOIL/SEDIMENT DESCRIPTION		DEP. FT			
	SAMPLE NO. & TYPE	"N" BLOWS /FT	% REC.	HEAD SPACE READING	COLOR	MOIST.	CONS.	GROUP NAME	GEOLOGIC DESCRIPTION AND OTHER REMARKS	
					Black	Moist	Firm	Lean Clay	DEVELOPED ZONE Silty clay Root hairs Traces of fine sand	
5					Light Brown	Moist	Firm	Lean Clay	PEORIAN LOESS Silty clay Traces of fine sand Rust stains Carbon deposits	5
10	U-1								Carbon filled root holes	10
15										15
20	U-2				Dark Brown to Black	Moist	Firm	Lean Clay	SANGAMON Silty clay Blocky Intermixed fine sand lenses	20
25										25
30	U-3				Reddish Brown	Moist	Firm	Lean Clay	LOVELAND LOESS Silty clay Root holes Manganese nodules	30
35										35


**Geotechnical
Services Inc.**

Project

WHELAN ENERGY CENTER

Location

HASTINGS, NEBRASKA

Job No.

995833

Date

10/24/01

MW-4

BORING LOG

DRILL HOLE NO.		LOCATION OF DRILL HOLE						ELEV.	DATUM	DRILLER	LOGGER
WECPZ-5		See Site Map						1892.15		James Tinnell	Doug Janulewicz
DEP. FT.	SAMPLE NO. & TYPE	"N" BLOWS/ FT.	% REC.	HEAD SPACE READING	COLOR	MOIST.	CONS.	GROUP NAME	GEOLOGIC DESCRIPTION AND OTHER REMARKS		DEP. FT.
					Reddish Brown	Moist	Firm	Lean Clay	LOVELAND LOESS		
40	U-4								Fine grained sand Intermixed silts and clays Carbon and manganese deposits		40
45											45
50	S-5	21							Fine grained sand Intermixed silts and clays Traces of medium sand		50
55											55
60	S-6	23							Sandy silty clay Fine sand		60
65									Increasing fine sand content		65
70	S-7	39							Fine grained sand Intermixed silts and clays		70
75											75



**Geotechnical
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Project

WHELAN ENERGY CENTER

Location

HASTINGS, NEBRASKA

Job No.

995833

Date

10/24/01

MW-4

BORING LOG

DRILL HOLE NO.		LOCATION OF DRILL HOLE						ELEV.	DATUM	DRILLER	LOGGER
WPCPZ-5		See Site Map						1892.15		James Tinnell	Doug Janulewicz
DEP. FT.	SAMPLE NO. & TYPE	"N" BLOWS/ FT.	% REC.	HEAD SPACE READING	COLOR	MOIST.	CONS.	GROUP NAME	GEOLOGIC DESCRIPTION AND OTHER REMARKS	DEP. FT.	
					Reddish Brown Tan	Moist	Firm	Lean Clay	Fine to medium grained sand Poorly graded 1/8" thick iron and rust seams		
80	S-8	93								80	
85										85	
90	S-9	45							Fine to coarse sand Poorly graded	90	
95										95	
100	S-10	74								100	
105	S-11	37				Wet				105	
110										110	
115									BOTTOM OF HOLE 111.2'	115	


**Geotechnical
Services Inc.**

Project

WHELAN ENERGY CENTER

Location

HASTINGS, NEBRASKA

Job No.

995833

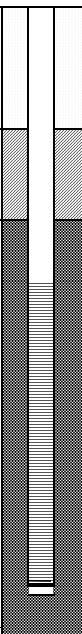
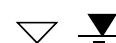
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10/24/01



Boring Log MW- 4B

Page 2 of 2

Project Name WEC MW Installation		Project No. 1004517		Drilling Company GSI/GEOCORE		
Location HASTINGS, NE		Client Hastings Utilities		Drilling Rig Type and Drilling Method 3.25" Hollow Stem Auger		
Sample	"N" blows/FT	Depth (feet)	Well Installation Details	Description (USCS)	Recovery (%)	Water Level Observations
S2	18,34,36	105	 WELL SEAL Bentonite Chips: 50 lbs	Poorly graded sand (SP); medium grained; light brown; moist; medium dense; few fine gravel	90	
S3	17,24,27	110	WELL PACK Type: 10-20 Amount: 450 lbs		90	
S4(Sieve)	17,32,35	115	Screen Slot: 0.02 Screen Depth: 109'-119'	Saturated @111 feet; some coarse gravel	90	
S5		120	END CAP Bottom of well: 119.2'	Terminated Hollow Stem Auger boring @ 120 feet*	100	
*MW-4B was installed by GEOCORE 4 feet north of boring location using a mud rotary rig GP-1100R on 10/21/2016						
Note: Well protective casing extends approximately 2.5 feet above concrete pad. Protective bollards installed around casing. See GSI records for Well construction diagram.						
The stratification lines represent the approximate boundary lines between soil and rock types. In-Situ transition may be gradual.						
Water Level				Logged By/Sampled By:		Drilled By:
While Drilling:  After Drilling: 				Gaoty Williams		James Tinnell/ David Summers
111'				Date Started: 10/18/2016		Date Completed: 10/18/2016
110.7						

SOIL BORING LOG & MONITORING WELL CONSTRUCTION DIAGRAM

WELL NO.	LOCATION OF WELL	DATUM	TOC ELEVATION	SURFACE ELEVATION	DRILLER	LOGGER
MW-4B	Hastings, Nebraska		1897.02'		DAVID SUMMERS	HDR
WATER LEVEL OBSERVATIONS			TYPE OF SURFACE		DRILL RIG	
WHILE DRILLING	END OF DRILLING		GRASS		GUS PECH GT1100R	
111.0'	110.7'		DRILLING METHOD		TOTAL DEPTH	
			ROTARY RIG		121.0'	
NDEQ SPILL #		NDEQ IIS#		DRILLING START TIME		DRILLING STOP TIME

Depth (feet)	Well Construction Details	GRAPHIC LOG	Rock Formations, Soil, Color and Classifications, Observations (moisture, odor, etc.) First column for USCS	Depth (feet)
0	PROTECTIVE COVER Type: STEEL STICK-UP Size: 6"X6"X5' Pad Size: 32"X32" WELL SEAL Type: WYO-BEN Amount: _____ Water: _____ Type: 3/8" BENTONITE Amount: 50# Water: SET IN WELL PACK Type: 10/20 SILICA Amount: # _____ RISER Type: PVC Schedule: 40 Inside Dia.: 4" Length: 150.0' SCREEN Type: PVC Schedule: 40 Slot: 0.02" Inside Dia.: 4" Length: 10.0' END CAP Type: PVC Length: 0.2' NOTES ALL PIPE AND FITTING FLUSH THREADED. BOREHOLE DIAMETER 8.25"			0
30				30
60				60
90				90
120			Bottom of Well @ 121'	120
150				150
180				180

* SS (split spoon) HS (hollow stem auger) HA (hand auger) MC (macro-core)

GSI Geotechnical Services, Inc.
 2960 N. Diers Avenue, Grand Island, NE 68803
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Project: Gerald T. Whelan Energy Center	
Location: 4520 East South Street, Hastings, NE	
Project No.: 165162	Date: 10/21/2016

BY: _____ APPROV. _____

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Boring Log MW-5B

Page 1 of 3

Project Name WEC MW Installation			Project No. 1004517		Drilling Company GSI		
Location HASTINGS, NE			Client Hastings Utilities /PPGA		Drilling Rig Type and Drilling Method 6.25" Hollow Stem Auger		
Sample	"N" blows/FT	Depth (feet)	Well Installation Details		Description (USCS)	Recovery (%)	Water Level Observations
			GROUT Type: <u>Bentonite</u> Amount: <u>950 lbs</u> Water: <u>285 gal.</u>		Grass at surface Lean Clay (CL); very dark brown; dry; stiff; medium plasticity Brown; slightly moist; firm Dark brown Reddish brown; low plasticity Clayey sand (SC); reddish brown; moist; medium dense Light brown to brown; slightly moist Poorly graded sand (SP); fine grained; light brown; slightly moist; medium dense	No recovery, visual classification from cuttings	
The stratification lines represent the approximate boundary lines between soil and rock types. In-Situ transition may be gradual.							
Water Level					Logged By/Sampled By: Gaoty Williams		Drilled By: James Tinnell
While Drilling: 		After Drilling: 			Date Started: 10/10/2016		Date Completed: 10/11/2016
114'		114'					



Boring Log MW-5B

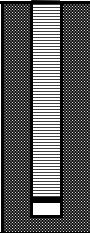
Page 2 of 3

Project Name WEC Well Installation			Project No. 1004517		Drilling Company GSI		
Location Hastings, NE			Client Hastings Utilities /PPGA		Drilling Rig Type and Drilling Method 6.25" Hollow Stem Auger		
Sample	"N" blows/FT	Depth (feet)	Well Installation	Details	Description (USCS)	Recovery (%)	Water Level Observations
S1	19, 33, 33	80			Poorly graded sand (SP); fine grained; light brown; slightly moist; medium dense	No recovery, visual classification from cuttings	
		Brown					
S2	18, 35, 50	90			Light brown	90	
		Well graded sand (SW); fine to coarse grained; light brown; slightly moist; medium dense; traces of fine gravel					
S3	13, 30, 27	100			Alternating layers of fine and medium grained; very light brown; dense; traces of fine gravel; iron stains	90	
		105					
S4(Sieve)	12, 13, 19	110			WELL SEAL Bentonite Chips: 100lbs Water: 10 gal.	100	
		115					
S5	8, 23, 47	120			WELL PACK Type: 16-30 Amount: 450 lbs	100	
		125					
					Medium grained; light brown; moist; traces of coarse aggregate		
					Poorly graded sand (SP-SM); fine grained; light brown; saturated; medium dense; some silt and little clay		
					Sreen Slot: 0.01		
The stratification lines represent the approximate boundary lines between soil and rock types. In-Situ transition may be gradual.							
Water Level					Logged By/Sampled By:		Drilled By:
While Drilling: 					Gaoty Williams		James Tinnell
After Drilling: 					Date Started: 10/10/2016		Date Completed: 10/11/2016
114'							



Boring Log MW-5B

Page 3 of 3

Project Name WEC MW Installation		Project No. 1004517		Drilling Company GSI			
Location HASTINGS, NE		Client Hastings Utilities /PPGA		Drilling Rig Type and Drilling Method 6.25" Hollow Stem Auger			
Sample	"N" blows/FT	Depth (feet)	Well Installation Details		Description (USCS)	Recovery (%)	Water Level Observations
S5	8, 23, 47	120	 END CAP		Poorly graded sand (SP-SM); fine grained; light brown; saturated; medium dense; some silt and little lay	80 Cutting	
		Terminated Boring @ 121 feet Bottom of well @ 122 feet *Note: Well protective casing extends approximately 2.5 feet above concrete pad. Protective bollards installed around casing.					
		125					
		130					
		135					
		140					
		145					
		160					
The stratification lines represent the approximate boundary lines between soil and rock types. In-Situ transition may be gradual.							
Water Level					Logged By/Sampled By: Gaoty Williams		Drilled By: James Tinnell
While Drilling:  114'		After Drilling:  114'		Date Started: 10/10/2016		Date Completed: 10/11/2016	

SOIL BORING LOG & MONITORING WELL CONSTRUCTION DIAGRAM

WELL NO.	LOCATION OF WELL	DATUM	TOC ELEVATION	SURFACE ELEVATION	DRILLER	LOGGER
MW-5B	Hastings, Nebraska		1899.16'		JAMES TINNELL	HDR
WATER LEVEL OBSERVATIONS				TYPE OF SURFACE		DRILL RIG
WHILE DRILLING	END OF DRILLING			GRASS		MOBILE B-61
114'	114'			DRILLING METHOD		TOTAL DEPTH
				6.25" HOLLOW STEM AUGERS		122'
NDEQ SPILL #		NDEQ IIS#		DRILLING START TIME		DRILLING STOP TIME

Depth (feet)	Well Construction Details	GRAPHIC LOG	Rock Formations, Soil, Color and Classifications, Observations (moisture, odor, etc.) First column for USCS	Depth (feet)
0	PROTECTIVE COVER Type: STEEL STICK-UP Size: 6"X6"X5' Pad Size: 32"X32"			0
30	WELL SEAL Type: BH-20 Amount: 900# Water: 270 GAL Type: 3/8" BENTONITE Amount: 100# Water: 10 GAL			30
60	WELL PACK Type: 16/30 SILICA Amount: 450#			60
90	RISER Type: PVC Schedule: 40 Inside Dia.: 4" Length: 111.0'			90
120	SCREEN Type: PVC Schedule: 40 Slot: 0.01" Inside Dia.: 4" Length: 10.0'			120
150	END CAP Type: PVC Length: 0.2'		Bottom of Well @ 122'	150
180	NOTES ALL PIPE AND FITTING FLUSH THREADED. BOREHOLE DIAMETER 10.25"			180

* SS (split spoon) HS (hollow stem auger) HA (hand auger) MC (macro-core)

GSI

Geotechnical Services, Inc.

2960 N. Diers Avenue, Grand Island, NE 68803
 (308) 381-1987 Fax (308) 381-2467

Project:	
Gerald T. Whelan Energy Center	
Location	
4520 East South Street, Hastings, NE	
Project No.:	Date:
165162	10/11/2016

BY: _____ APPROV. _____

HDR

Boring Log

Project Name		Project Number		Drilling Company		
Hastings Utilities				Geotechnical Services Inc.		
Boring No.	Location	Casing El.		Drilling Rig Type and Drilling Method		
MW-6	S.B.L.P.			B-61 HDX, 4.25" Hollow Stem Augers		
Sample No.	HNU Reading (ppm)	Depth (feet)	Completion	Description	Elevation (feet)	Remarks
			See MWCD	Developed Zone, black silty clay, moist, firm, root hairs/holes		
		<u>5</u>		Brown silty clay, moist, firm, traces of fine sand, carbon deposits, Peorian Loess	<u>5</u>	
S-1		<u>10</u>		Root holes, carbon filled root holes, slightly moist to moist, layered, rust stains	<u>10</u>	
		<u>15</u>			<u>15</u>	
S-2		<u>20</u>		Dark brown-black silty clay, firm-hard, moist, Sangamon	<u>20</u>	
		<u>25</u>		Intermixed fine sand pockets	<u>25</u>	
S-3		<u>30</u>		Light reddish brown silty clay, firm, moist, traces of fine sand, Loveland Loess	<u>30</u>	
		<u>35</u>			<u>35</u>	
S-4		<u>40</u>		Grey-brown mottled, blocky	<u>40</u>	
Water Level				Logged By		Sampled By
While Drilling:	After Drilling:	72 Hours After Drilling:	Doug Janulewicz		Doug Janulewicz	
110'	103'		Date Started:		Date Completed	
			10/4/2004		10/5/2004	

HDR

Boring Log

Project Name		Project Number		Drilling Company		
Hastings Utilities				Geotechnical Services Inc.		
Boring No.	Location	Casing El.		Drilling Rig Type and Drilling Method		
MW-6	S.B.L.P.			B-61 HDX, 4.25" Hollow Stem Augers		
Sample No.	HNU Reading (ppm)	Depth (feet)	Completion	Description	Elevation (feet)	Remarks
			See MWCD	Dark brown-grey mottled		
		<u>45</u>		Dark brown-black silty clay	<u>45</u>	
S-5		<u>50</u>		Light reddish brown silty clay, firm, moist, fine sand pockets, manganese nodules	<u>50</u>	
		<u>55</u>			<u>55</u>	
S-6		<u>60</u>		Increasing fine sand content	<u>60</u>	
		<u>65</u>		Sand, fine grained, poorly graded, loose, moist, light brown	<u>65</u>	
S-7		<u>70</u>		Sand, fine grained, intermixed silt/clays, rust stains, traces of medium sand	<u>70</u>	
		<u>75</u>		Sand, fine to medium grained, poorly graded	<u>75</u>	
S-8		<u>80</u>		Fine to coarse sand layer	<u>80</u>	
Water Level				Logged By		Sampled By
While Drilling:	After Drilling:	72 Hours After Drilling:	Doug Janulewicz		Doug Janulewicz	
110'	103'		Date Started: 10/4/2004		Date Completed 10/5/2004	

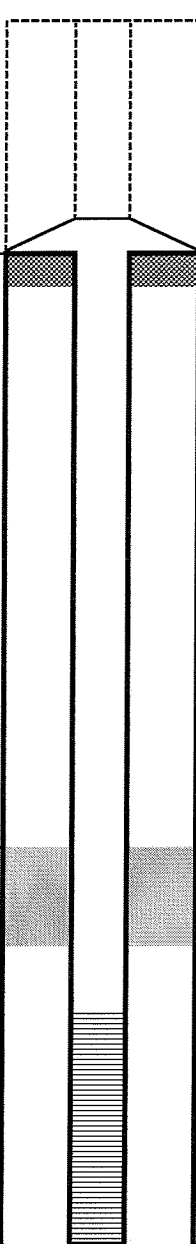
HDR

Boring Log

Project Name		Project Number		Drilling Company		
Hastings Utilities				Geotechnical Services Inc.		
Boring No.	Location	Casing El.		Drilling Rig Type and Drilling Method		
MW-6	S.B.L.P.			B-61 HDX, 4.25" Hollow Stem Augers		
Sample No.	HNU Reading (ppm)	Depth (feet)	Completion	Description	Elevation (feet)	Remarks
		85	See MWCD	Sand-fine to medium grained, poorly graded, moist, loose	85	
S-9		90		Fine-coarse sand, fine gravel layer Brown silty clay layer, firm, moist	90	
		95		Sand, fine to medium grained, poorly graded, brown, moist	95	
S-10		100			100	
		105			105	
S-11		110		4" reddish orange clay seam at 109', wet	110	
		115		Bottom of Hole at 110'	115	
		120			120	
Water Level				Logged By		Sampled By
While Drilling:	After Drilling:	72 Hours After Drilling:	Doug Janulewicz		Doug Janulewicz	
110'	103'		Date Started: 10/4/2004		Date Completed 10/5/2004	

MONITORING WELL CONSTRUCTION DATA

Date: 10/05/04		Well/Boring No: MW-6		Well Type:	
Drilling Company: G.S.I.		Project No:		Temporary Monitoring	
Drill Crew: James and Jerold Tinnell		Project Name: Hastings Utilities		Permanent Monitoring	
				Other	

 0 Feet	3' TOC Above Ground If Riser Box or Stick Up (0 feet)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2" style="background-color: #cccccc;">Decontamination</td> </tr> <tr> <td>Steam Clean</td> <td>Soap Wash</td> </tr> <tr> <td>High Pressure Hot Wash</td> <td>High Pressure Wash</td> </tr> <tr> <td colspan="2">Other</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Casing Type</td> </tr> <tr> <td>PVC</td> <td>Stainless Steel</td> </tr> <tr> <td>Teflon</td> <td>Steel</td> </tr> <tr> <td colspan="2">Other</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Joints</td> </tr> <tr> <td>Threaded</td> <td>Welded</td> </tr> <tr> <td>Coupled</td> <td>Screwed</td> </tr> <tr> <td colspan="2">Other</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Well Screen</td> </tr> <tr> <td>PVC</td> <td>Stainless Steel</td> </tr> <tr> <td>Teflon</td> <td>Continuous Wrap</td> </tr> <tr> <td colspan="2">Other</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Diameter</td> </tr> <tr> <td>2"</td> <td>4" 6" Other</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Slot</td> </tr> <tr> <td>0.010</td> <td>0.020 Other</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Drilling Method (Diameter)</td> </tr> <tr> <td>Solid Stem (inches)</td> <td>Hollow Stem (4.25")</td> </tr> <tr> <td>Direct Push</td> <td>Mud Rotary</td> </tr> <tr> <td>Hand Auger</td> <td>Air Rotary</td> </tr> <tr> <td colspan="2">Other</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Drilling Mud</td> </tr> <tr> <td>Bentonite</td> <td>Water</td> </tr> <tr> <td>None</td> <td></td> </tr> <tr> <td colspan="2">Other</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Completion (size inches)</td> </tr> <tr> <td>Flushmount (Diameter)</td> <td>Stickup 4"x4"x5'</td> </tr> <tr> <td>Riser Box</td> <td>Other</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Cuttings</td> </tr> <tr> <td>Drummed</td> <td>Spread</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Development Method (Time)</td> </tr> <tr> <td>Bailing</td> <td>Pumping</td> </tr> <tr> <td>Surge</td> <td>Other</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Amount (gallons)</td> </tr> <tr> <td colspan="2">150 gallons</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Development Water</td> </tr> <tr> <td colspan="2">Drummed (#)</td> </tr> <tr> <td colspan="2">Spread</td> </tr> <tr> <td>Water (before development)</td> <td>Silty Turbid Opaque Clear</td> </tr> <tr> <td>Water (after development)</td> <td>Silty Turbid Opaque Clear</td> </tr> <tr> <td colspan="2">Notes Added 10 gallons of water when installing well</td> </tr> </table>	Decontamination		Steam Clean	Soap Wash	High Pressure Hot Wash	High Pressure Wash	Other		Casing Type		PVC	Stainless Steel	Teflon	Steel	Other		Joints		Threaded	Welded	Coupled	Screwed	Other		Well Screen		PVC	Stainless Steel	Teflon	Continuous Wrap	Other		Diameter		2"	4" 6" Other	Slot		0.010	0.020 Other	Drilling Method (Diameter)		Solid Stem (inches)	Hollow Stem (4.25")	Direct Push	Mud Rotary	Hand Auger	Air Rotary	Other		Drilling Mud		Bentonite	Water	None		Other		Completion (size inches)		Flushmount (Diameter)	Stickup 4"x4"x5'	Riser Box	Other	Cuttings		Drummed	Spread	Development Method (Time)		Bailing	Pumping	Surge	Other	Amount (gallons)		150 gallons		Development Water		Drummed (#)		Spread		Water (before development)	Silty Turbid Opaque Clear	Water (after development)	Silty Turbid Opaque Clear	Notes Added 10 gallons of water when installing well	
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Annular Backfill Cement Bentonite Chip Bentonite Grout Portland Grout Silica Sand Native Soil Other Amount 206 gallons 300 lbs chips 92.0'	Borehole Diameter 8.25" Casing Diameter 2" Schedule 40																																																																																											
Seal 6 Feet, 100 lbs 98.0'	Bentonite Chip Masonry Sand Other																																																																																											
Filter Pack 12 Feet	100.0'																																																																																											
Type 16/35	Well Screen Length 10 Feet																																																																																											
Amount 350	110.0' B.O.S. 110.5' B.O.H.																																																																																											
Over Drill 0 Feet	Water Level-103' 10/5/04 Water Level-																																																																																											



Boring Log MW-7

Page 1 of 2

Project Name WEC MW Installation			Project No. 1004517			Drilling Company GSI		
Location HASTINGS, NE			Client Hastings Utilities /PPGA			Drilling Rig Type and Drilling Method 6.25" Hollow Stem Auger		
Sample	"N" blows/FT	Depth (feet)	Well Installation Details			Description (USCS)	Recovery (%)	Water Level Observations
			GROUT Type: <u>Bentonite</u> Amount: <u>900 lbs</u> Water: <u>270 gal.</u>			White crushed rock at surface Lean Clay (CL); dark brown; dry; firm; low plasticity	No recovery, visual classification from cuttings	
		10				Light brown; medium plasticity		
		20				Slightly moist		
		30				Dark brown; Soft		
		40				Reddish brown		
		50				Dark brown; low to medium plasticity		
		60				Clayey sand (SC); fine grained; reddish brown; dry to slightly moist; loose		
		70				Dark brown; medium dense		
		75				Poorly graded sand with clay (SC-SP); light brown; dry to slightly moist; medium dense		
		80				Poorly graded sand (SP) fine grained; light brown; dry to slightly moist; medium dense		



Boring Log MW-7

Page 2 of 2

Project Name WEC MW Installation			Project No. 1004517		Drilling Company GSI		
Location HASTINGS, NE			Client Hastings Utilities /PPGA		Drilling Rig Type and Drilling Method 6.25" Hollow Stem Auger		
Sample	"N" blows/FT	Depth (feet)	Well Installation Details		Description (USCS)	Recovery (%)	Water Level Observations
S1	38, 24, 14	90			Well graded sand (SW); fine to coarse grained; light brown; slightly moist; medium dense	100	
		100			Poorly graded sand (SP); fine to coarse grained; very light brown; slightly moist; medium dense		
S2	11, 21, 30	105			Well graded sand (SW); alternating layers of fine to medium and medium to coarse grained with few subrounded gravel; very light brown; slightly moist; medium dense		
S3	15, 41, 42	110			Moist	90	
S4	19, 23, 41	115	WELL SEAL Bentonite Chips: <u>100lbs</u> Water: <u>10 gal.</u> WELL PACK Type: <u>16-30</u> Amount: <u>350 lbs</u>		Medium to coarse grained with some silt and fine sand; saturated @120 feet	90	
S5(Sieve)	10, 26, 31	120	Screen Slot: <u>0.01</u> Screen Depth: <u>117'-127'</u>		Some medium gravel	90	
S6	5, 19, 24	125	END CAP Bottom of well: 127.2'			100	
S7	6, 12, 19	130	Terminated Boring @ 128.5 feet Note: Well protective casing extends approximately 2.5 feet above concrete pad. Protective bollards installed around casing. See GSI records for Well construction diagram.			100	
The stratification lines represent the approximate boundary lines between soil and rock types. In-Situ transition may be gradual.							
Water Level					Logged By/Sampled By:		Drilled By:
While Drilling: 					Gaoty Williams & Megan Seymour		James Tinnell
After Drilling: 					Date Started: 10/5/2016		Date Completed: 10/7/2016
120'							
118.3'							

SOIL BORING LOG & MONITORING WELL CONSTRUCTION DIAGRAM

WELL NO.	LOCATION OF WELL	DATUM	TOC ELEVATION	SURFACE ELEVATION	DRILLER	LOGGER
MW-7	Hastings, Nebraska		1901.23'		JAMES TINNELL	HDR
WATER LEVEL OBSERVATIONS			TYPE OF SURFACE		DRILL RIG	
WHILE DRILLING	END OF DRILLING		WHITE ROCK		MOBILE B-61	
120'	118.3'		6.25" HOLLOW STEM AUGERS			TOTAL DEPTH
NDEQ SPILL #		NDEQ IIS#	DRILLING START TIME		DRILLING STOP TIME	

Depth (feet)	Well Construction Details	GRAPHIC LOG	Rock Formations, Soil, Color and Classifications, Observations (moisture, odor, etc.) First column for USCS	Depth (feet)
0	PROTECTIVE COVER Type: <u>STEEL STICK-UP</u> Size: <u>6"X6"X5'</u> Pad Size: <u>32"X32"</u>			0
30	WELL SEAL Type: <u>BH-20</u> Amount: <u>1000#</u> Water: <u>300 GAL</u> Type: <u>3/8" BENTONITE</u> Amount: <u>100#</u> Water: <u>10 GAL</u>			30
60	WELL PACK Type: <u>16/30 SILICA</u> Amount: <u>350#</u>			60
90	RISER Type: <u>PVC</u> Schedule: <u>40</u> Inside Dia.: <u>4"</u> Length: <u>117.0'</u>			90
120	SCREEN Type: <u>PVC</u> Schedule: <u>40</u> Slot: <u>0.01"</u> Inside Dia.: <u>4"</u> Length: <u>10.0'</u>			120
150	END CAP Type: <u>PVC</u> Length: <u>0.2'</u>		Bottom of Well @ 128.5'	150
180	NOTES ALL PIPE AND FITTING FLUSH THREADED. BOREHOLE DIAMETER 10.25"			180

* SS (split spoon) HS (hollow stem auger) HA (hand auger) MC (macro-core)

GSI Geotechnical Services, Inc.
 2960 N. Diere Avenue, Grand Island, NE 68803
 (308) 381-1987 Fax (308) 381-2487

Project:	
Gerald T. Whelan Energy Center	
Location	
4520 East South Street, Hastings, NE	
Project No.:	Date:
165162	10/06/2016

BY: _____ APPROV. _____

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Boring Log MW-8

Page 1 of 2

Project Name WEC MW Installation			Project No. 1004517			Drilling Company GSI/ GEOCORE		
Location HASTINGS, NE			Client Hastings Utilities /PPGA			Drilling Rig Type and Drilling Method 3.25" Hollow Stem Auger		
Sample	"N" blows/FT	Depth (feet)	Well Installation Details			Description (USCS)	Recovery (%)	Water Level Observations
S1	16, 19, 20	0	GROUT Type: <u>Bentonite</u> Amount: <u>500 lbs.</u>			Grassy surface Lean Clay (CL); very dark brown; dry; stiff; medium plasticity	No recovery, visual classification from cuttings	
		10				Hard; low plasticity Brown; slightly moist; firm to hard; medium plasticity		
		20				Firm Dark brown; medium to high plasticity		
		30				Medium plasticity Soft to firm; low plasticity		
		40						
		50						
		60				Poorly graded sand with clay (SP-SC); reddish brown; slightly moist; medium dense		
		70				Clayey sand (SC); reddish brown; slightly moist; medium dense		
		80				Poorly graded sand with clay (SP-SC); reddish brown; slightly moist; medium dense		
		90				Poorly graded sand (SP); fine grained; brown; slightly moist; medium dense		
		100				Well graded sand (SW); fine, medium and coarse grained; light brown; slightly moist; medium dense; some fine gravel		
						Poorly graded		



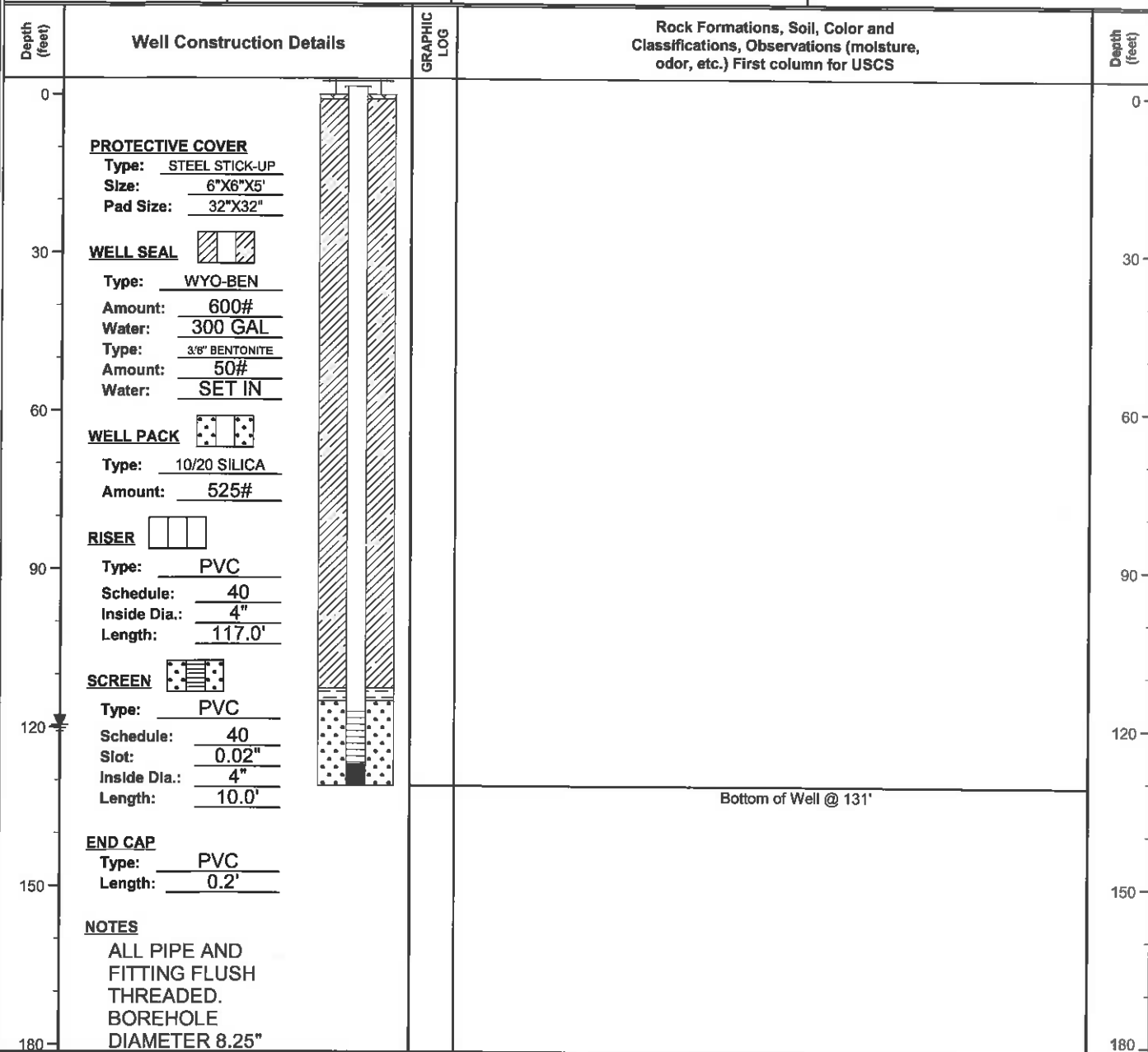
Boring Log MW-8

Page 2 of 2

Project Name WEC MW Installation			Project No. 1004517		Drilling Company GSI/ GEOCORE			
Location HASTINGS, NE			Client Hastings Utilities /PPGA		Drilling Rig Type and Drilling Method 3.25" Hollow Stem Auger			
Sample	"N" blows/FT	Depth (feet)	Well Installation Details		Description (USCS)	Recovery (%)	Water Level Observations	
S2	21,33,37	105			Medium grained; very light brown; medium dense	100		
S3	31 ,38, 41	110			Medium to coarse grained; moist; dense	80		
S4	19, 10, 17	115			WELL SEAL Bentonite Chips: 50 lbs	Medium grained; light brown;saturated @ 119.5'; medium dense		80
S5	11,34,43	120			WELL PACK Type: 10-20 Amount: 525 lbs	Poorly graded sand (SP); medium to coarse grained; light brown; saturated; medium dense		90
S6 (Sieve)	13, 21, 32	125			Screen Slot: 0.02 Screen Depth: 117'-127'			80
			END CAP Bottom of well: 127.2'		Terminated Hollow Stem Auger boring @ 125 feet*			
			*MW-8 was installed by GEOCORE 5 feet north of boring location using a mud rotary rig GP- 1100R on 10/20/2016. Note: Well protective casing extends approximately 2.5 feet above concrete pad. Protective bollards installed around casing. See GSI records for Well construction diagram.					
The stratification lines represent the approximate boundary lines between soil and rock types. In-Situ transition may be gradual.								
Water Level					Logged By/Sampled By:		Drilled By:	
While Drilling: 119.5'					Gaoty Williams Date Started: 10/18/2016		James Tinnell/David Summers Date Completed: 10/19/2016	
After Drilling: 119.6'								

SOIL BORING LOG & MONITORING WELL CONSTRUCTION DIAGRAM

WELL NO.	LOCATION OF WELL	DATUM	TOC ELEVATION	SURFACE ELEVATION	DRILLER	LOGGER
MW-8	Hastings, Nebraska		1903.37'		DAVID SUMMERS	HDR
WATER LEVEL OBSERVATIONS			TYPE OF SURFACE		DRILL RIG	
WHILE DRILLING	END OF DRILLING		GRASS		GUS PECH GT 1100R	
119.5	119.6		DRILLING METHOD			TOTAL DEPTH
			ROTARY RIG			131.0'
NDEQ SPILL #		NDEQ IIS#		DRILLING START TIME		DRILLING STOP TIME



* SS (split spoon) HS (hollow stem auger) HA (hand auger) MC (macro-core)

GSI Geotechnical Services, Inc.
 2960 N. Diers Avenue, Grand Island, NE 68803
 (308) 381-1987 Fax (308) 381-2467

Project:	
Gerald T. Whelan Energy Center	
Location	
4520 East South Street, Hastings, NE	
Project No.:	Date:
165162	10/20/2016

BY: _____ APPROV. _____

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Boring Log MW-9

Page 1 of 2

Project Name			Project No.			Drilling Company		
WEC MW Installation			1004517			GSI		
Location			Client			Drilling Rig Type and Drilling Method		
HASTINGS, NE			Hastings Utilities /PPGA			6.25" Hollow Stem Auger		
Sample	"N" blows/FT	Depth (feet)	Well Installation Details			Description (USCS)	Recovery (%)	Water Level Observations
			GROUT Type: <u>Bentonite</u> Amount: <u>1000 lbs</u> Water: <u>300 gal.</u>			Grassy surface Lean Clay (CL); very dark brown; dry; stiff; medium plasticity	No recovery, visual classification from cuttings	
		10				Slightly moist; soft to firm; medium plasticity		
						Soft; High plasticity		
		20						
						Dark brown to brown		
		30				Soft to firm		
		40				Firm		
		50						
		60				Dark brown to brown; soft to firm		
						Clayey sand (SC); brown to dark brown; slightly moist, medium plasticity		
		70				Poorly graded sand with clay (SP-SC); brown; slightly moist, medium dense		
						Poorly graded sand with clay (SP-SC); brown; slightly moist, medium dense		
		80						
						Poorly graded sand (SP); fine to medium grained; brown; loose to medium dense		
		90				Few fine gravel; medium dense		



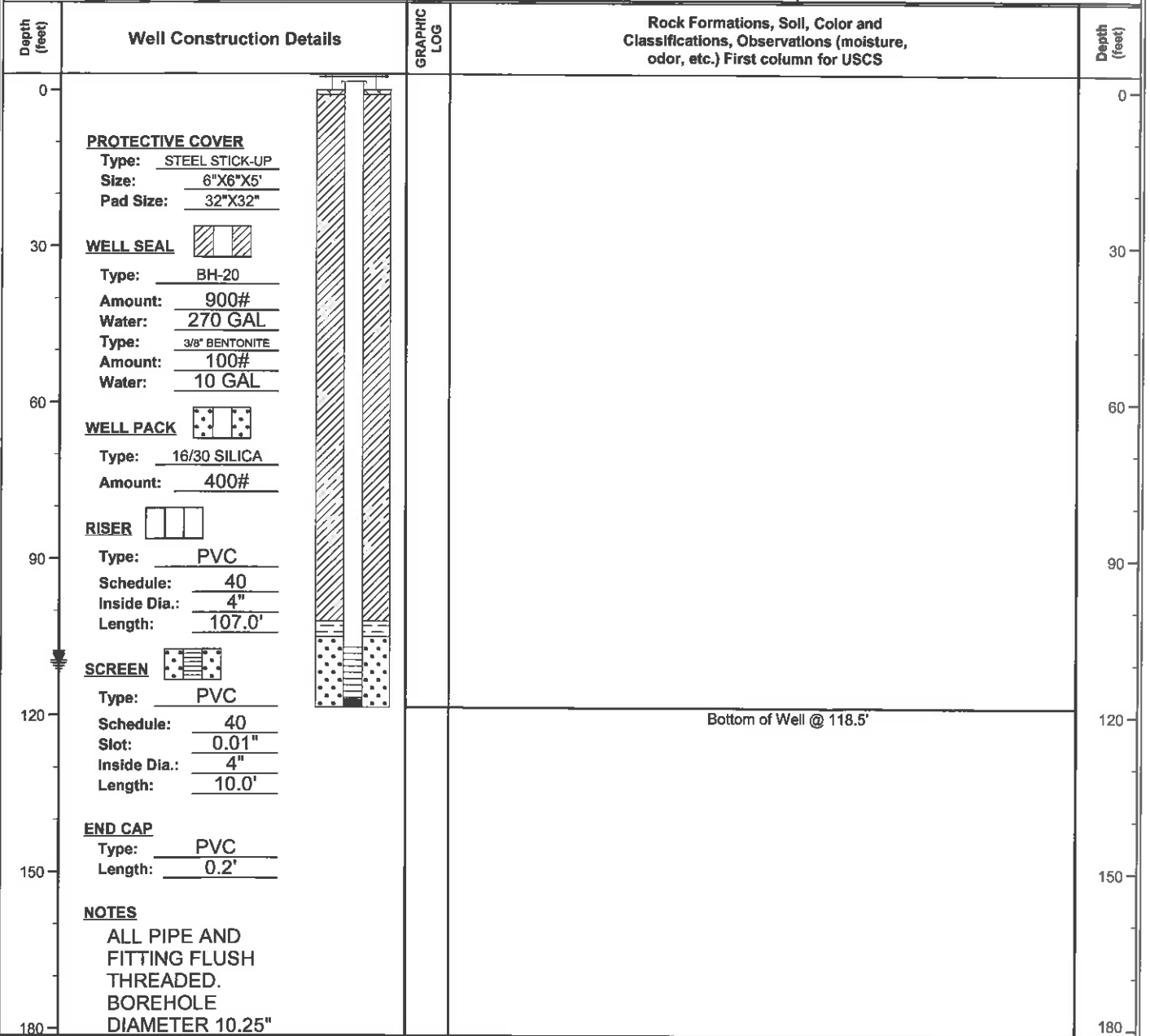
Boring Log MW-9

Page 2 of 2

Project Name WEC MW Installation			Project No. 1004517		Drilling Company GSI		
Location HASTINGS, NE			Client Hastings Utilities /PPGA		Drilling Rig Type and Drilling Method 6.25" Hollow Stem Auger		
Sample	"N" blows/FT	Depth (feet)	Well Installation Details		Description (USCS)	Recovery (%)	Water Level Observations
S1	10, 14, 22	100	WELL SEAL Bentonite Chips: 100lbs Water: 10 gal. WELL PACK Type: 16-30 Amount: 400 lbs Screen Slot: .01 Screen Depth: 107'-117' END CAP Bottom of well: 117.2'		Light brown; iron stain and few fine gravel	80	
S2	8, 30, 24	105			Well graded sand (SW); fine to medium grained; light brown; moist; medium dense; some coarse sand	70	
S3(Sieve)	11, 17, 19	110			Wet	50	
S4	15, 23, 19	115			Saturated; some fine gravel	100	
S5	7,9,33	120			Terminated Boring @ 118.5 feet Note: Well protective casing extends approximately 2.5 feet above concrete pad. Protective bollards installed around casing. See GSI records for Well construction diagram.		
					The stratification lines represent the approximate boundary lines between soil and rock types. In-Situ transition may be gradual.		
Water Level					Logged By/Sampled By: Gaoty Williams & Megan Seymour		Drilled By: James Tinnell
While Drilling: 110'		After Drilling: 109.5'		Date Started: 10/7/2016		Date Completed: 10/10/2016	

SOIL BORING LOG & MONITORING WELL CONSTRUCTION DIAGRAM

WELL NO.	LOCATION OF WELL	DATUM	TOC ELEVATION	SURFACE ELEVATION	DRILLER	LOGGER
MW-9	Hastings, Nebraska		1896.54'		JAMES TINNELL	HDR
WATER LEVEL OBSERVATIONS			TYPE OF SURFACE		DRILL RIG	
WHILE DRILLING	END OF DRILLING		GRASS		MOBILE B-61	
110.0'	109.5'		6.25" HOLLOW STEM AUGERS		TOTAL DEPTH	
NDEQ SPILL #		NDEQ IIS#	DRILLING START TIME		DRILLING STOP TIME	



* SS (split spoon) HS (hollow stem auger) HA (hand auger) MC (macro-core)

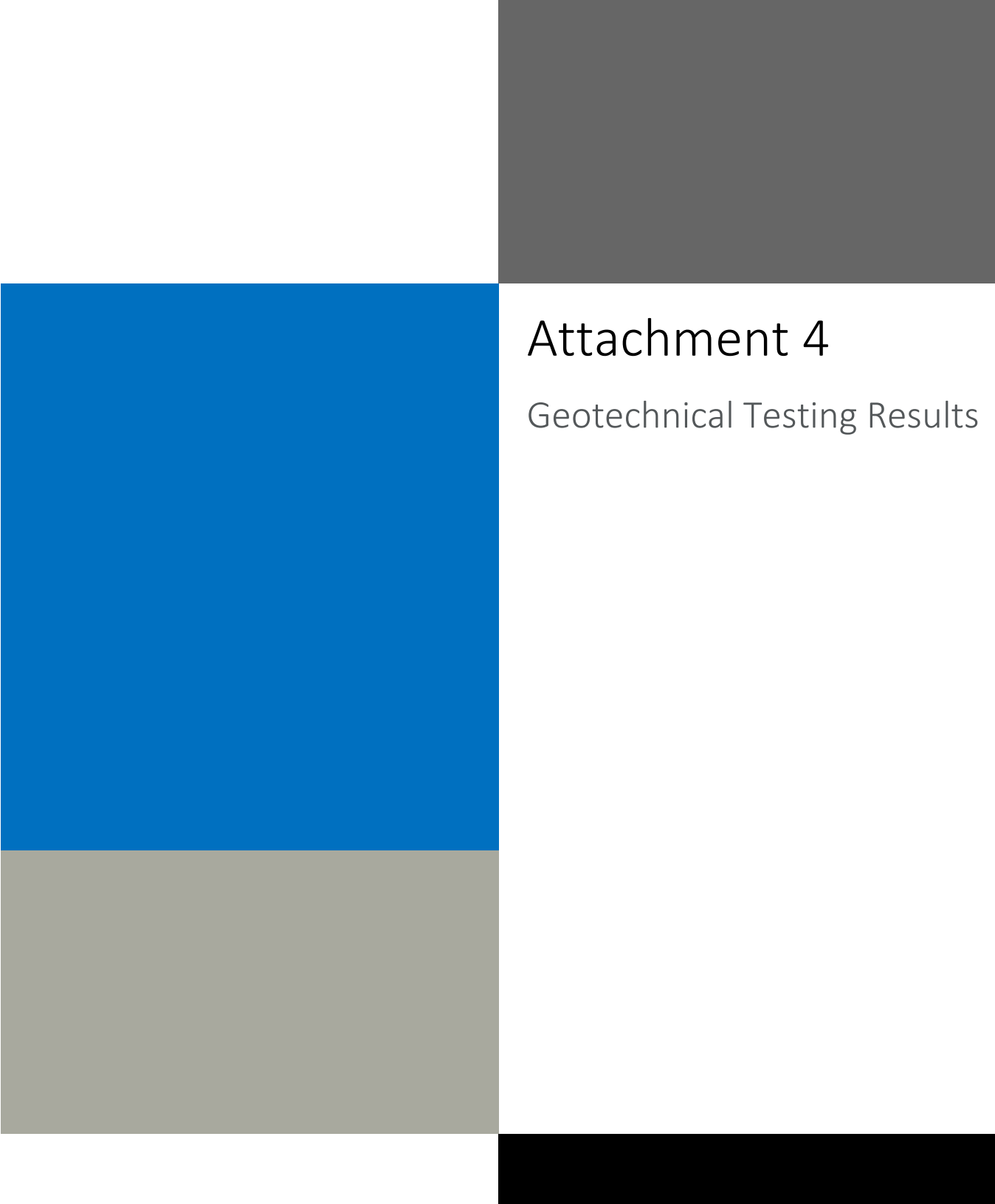


GSI Geotechnical Services, Inc.
 2960 N. Diers Avenue, Grand Island, NE 68803
 (308) 381-1987 Fax (308) 381-2487

Project: Gerald T. Whelan Energy Center	
Location: 4520 East South Street, Hastings, NE	
Project No.: 165162	Date: 10/10/2016

BY: APPROV:

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Attachment 4

Geotechnical Testing Results

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1. LABORATORY TESTING

The field boring logs were reviewed to outline the depth, thickness, and extent of the soil strata. The samples taken from the borings were examined in our laboratory and visually classified in general accordance with ASTM D2488-93, "*Description and Identification of Soils (Visual-Manual Procedure)*." A testing program was established to evaluate the engineering properties of the recovered samples. Specific tests that were performed include:

- Moisture Content (ASTM D2216-92, "*Laboratory Determination of Water (Moisture) Content of Soil and Rock*")
- Unit Weight (ASTM D2937-94, "*Density of Soil in Place by the Drive-Cylinder Method*")
- Atterberg Limits (ASTM D4318-95, "*Liquid Limit, Plastic Limit, and Plasticity Index of Soils*")
- Minus No. 200 Sieve Wash (ASTM D1140-92, "*Amount of Material in Soils Finer Than the No. 200 (75- μ m) Sieve*")
- Sieve Analysis (ASTM D422-63, "*Particle-Size Analysis of Soils*")
- Pocket Penetrometer
- Pocket Torvane
- Hydraulic Conductivity (ASTM D5084-90, "*Measurement of Hydraulic Conductivity of Saturated, Porous Materials using a Flexible Wall Permeameter*")
- Specific Gravity (ASTM D854-92, "*Specific Gravity of Soils*")

All tests were conducted in general accordance with the current ASTM test procedures.

Drill Hole No.	Sample No.	Sample Depth (ft.)	Sample Dia. (in.)	Sample Length (in.)	Water Content (%)	Density		Void Ratio	Sat. (%)	Unconfined		Atterberg Limits			Cons. Test *	% Passing #200	Classification
						Wet (pcf)	Dry (pcf)			QU (tsf)	Strain (%)	LL	PL	PI			
WECFZ-1	U-1	3.5 - 5	2.85	5.59	19.7	120.4	100.6	0.662	80			33	18	14			Assumed SpG = 2.68
	U-2	8.5 - 10	2.85	1.75	24.3	104.8	84.3	0.983	66								Assumed SpG = 2.68
	U-3	13.5 - 15															SpG = 2.639 CL
	U-5	21 - 22.5	2.85	5.59	23.5	112.1	90.8	0.842	75								Assumed SpG = 2.68
	U-6	23.5 - 25															Assumed SpG = 2.68
	U-7	26 - 27.5										35	15	20			Assumed SpG = 2.68 CL
	U-8	28.5 - 30	2.85	5.59	13.0	125.9	111.4	0.501	70			29	13	16			Assumed SpG = 2.68
	U-11	43.5 - 45															SpG = 2.696 CL
	U-13	53.5 - 55	2.85	5.59	5.5	116.0	110.0	0.520	28							14.0	Assumed SpG = 2.68
	S-14	58.5 - 60			10.9											55.4	
	S-16	68.5 - 70			4.7											5.6	
	S-19	83.5 - 85			7.7											30.2	
	S-21	93.5 - 95			3.0											6.9	
	S-23	103.5-105			4.7											7.2	
	S-25	113.5-115														7.0	
	S-26	118.5-120														7.2	
	S-27	128.5-130														16.5	
Project Hastings Utilities Fly Ash Utilization																	
Location Hastings, Nebraska																	
Job Number 995833 Date 8/12/99																	



Geotechnical Services Inc.

SUMMARY OF SOIL TESTS

e:\projects\ms83\sum.doc

HYDROMETER ANALYSIS REPORT

Sample Identification:

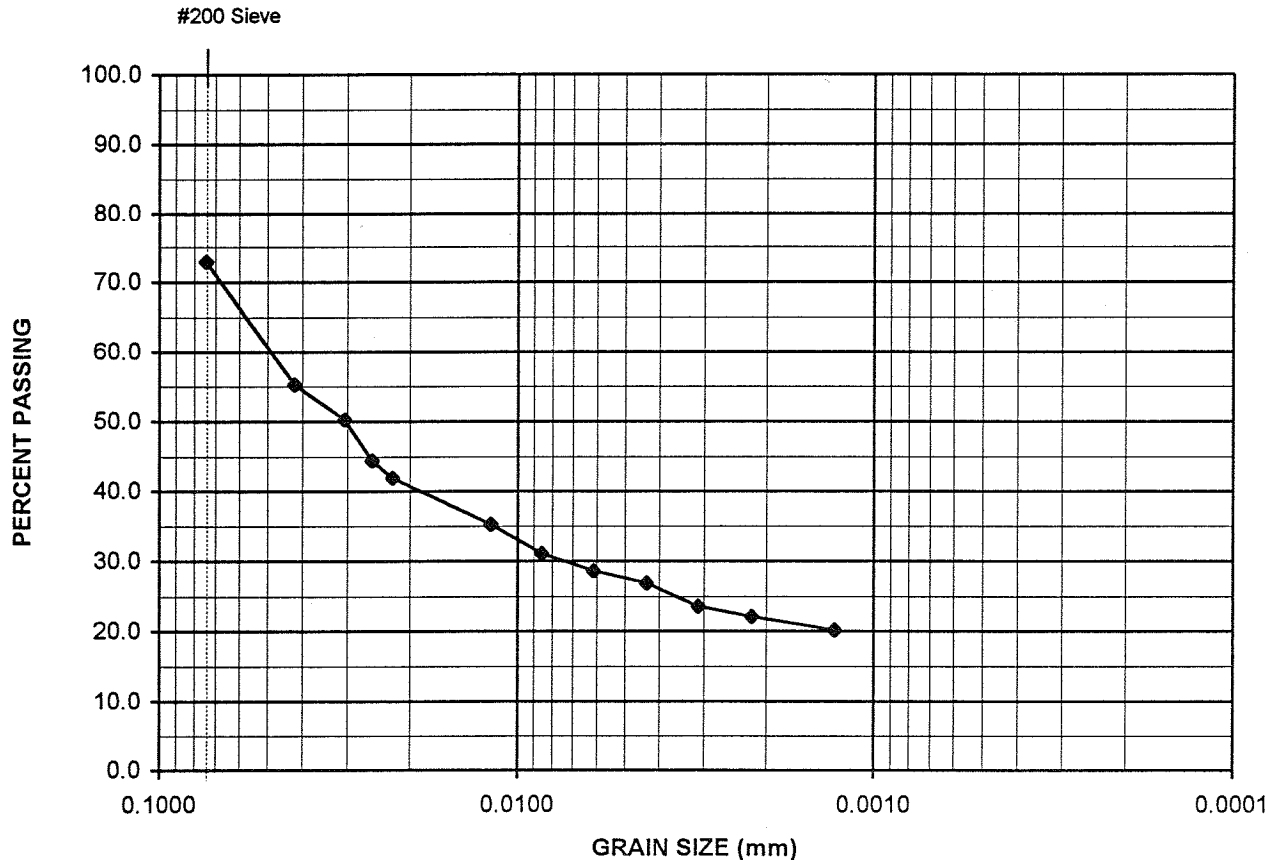
WECPZ-1, U-11, 43.5 - 45'

Sample Description:

Light Reddish Brown, CL

Percent passing the No. 10 Sieve: 100.0
Percent passing the No. 200 Sieve: 73.0
Specific gravity of sample: 2.68 (assumed)

%FINER	D(mm)
55.3	0.0421
44.4	0.0256
41.9	0.0224
35.3	0.0119
31.1	0.0085
28.6	0.0061
26.9	0.0043
22.1	0.0022
20.2	0.0013



Lab No. _____

Test conducted according to ASTM D422-63.



**Geotechnical
Services Inc.**

3826 Arch Ave. Grand Island, NE 68803 (308) 381-1987

Project

Hastings Utilities Fly Ash Utilization

Location

Hastings, Nebraska

Job Number

995833

Date

8/13/99

HYDROMETER ANALYSIS REPORT

Sample Identification:

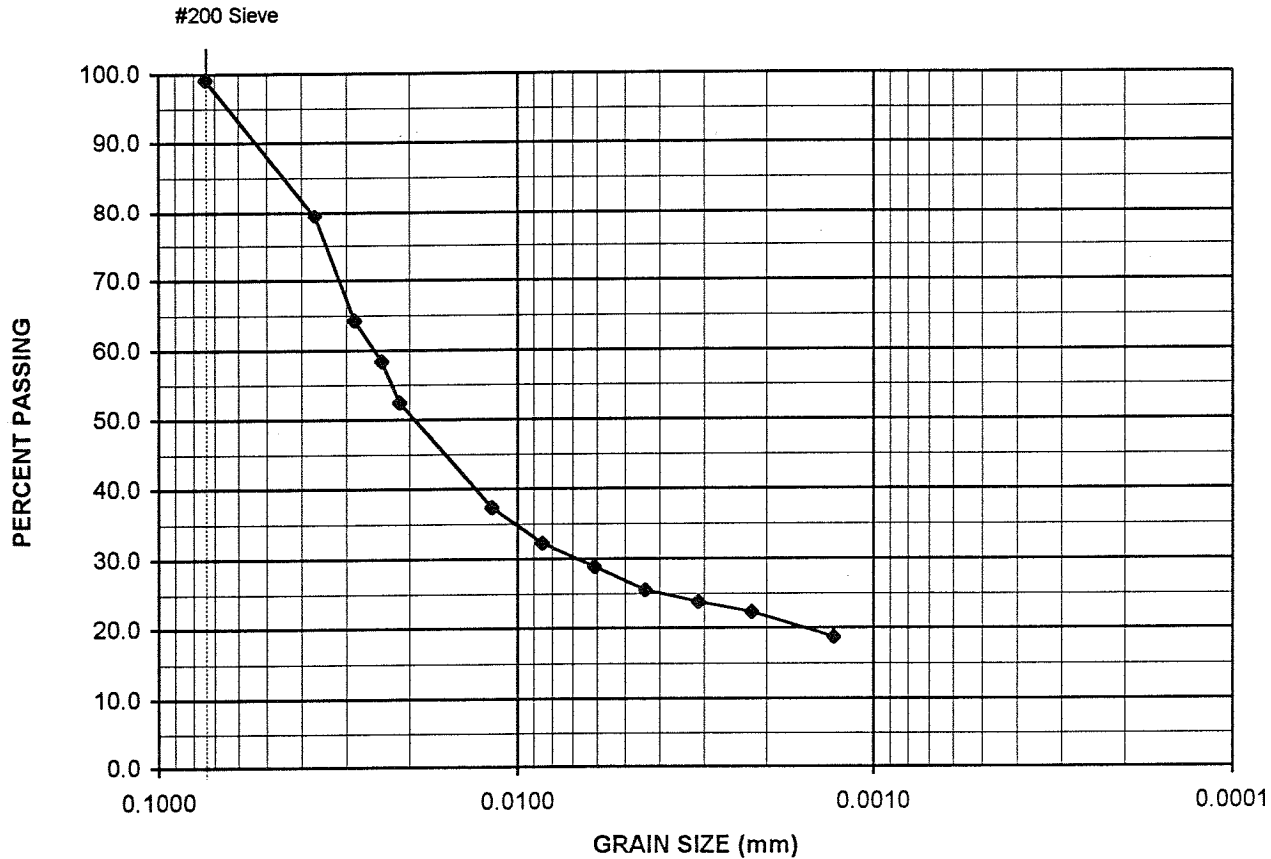
WECPZ-1, U-3, 13.5 - 15'

Sample Description:

Light Brown, CL

Percent passing the No. 10 Sieve: 100.0
Percent passing the No. 200 Sieve: 99.2
Specific gravity of sample: 2.68 (assumed)

%FINER	D(mm)
79.5	0.0368
58.4	0.0239
52.5	0.0213
37.3	0.0118
32.3	0.0085
28.9	0.0061
25.5	0.0044
22.3	0.0022
18.7	0.0013



Lab No. _____

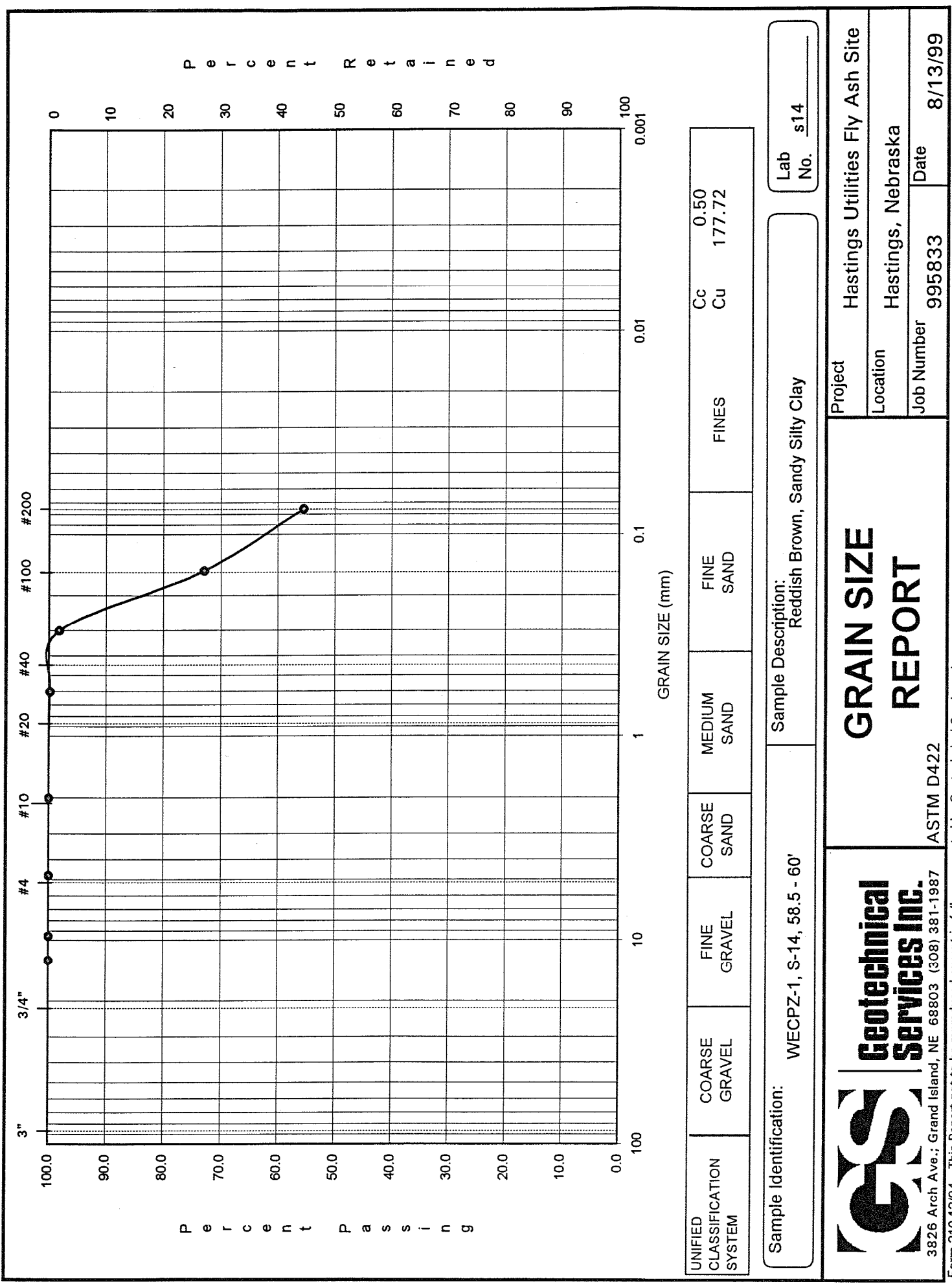
Test conducted according to ASTM D422-63.



**Geotechnical
Services Inc.**

3826 Arch Ave. Grand Island, NE 68803 (308) 381-1987

Project	Hastings Utilities Fly Ash Utilization		
Location	Hastings, Nebraska		
Job Number	995833	Date	8/13/99



UNIFIED CLASSIFICATION SYSTEM	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES	Cc Cu	0.50 177.72
-------------------------------	---------------	-------------	-------------	-------------	-----------	-------	----------	----------------

Sample Identification: WECpz-1, S-14, 58.5 - 60'

Sample Description: Reddish Brown, Sandy Silty Clay

Lab No. s14



Geotechnical Services Inc.
3826 Arch Ave.; Grand Island, NE 68803 (308) 381-1987

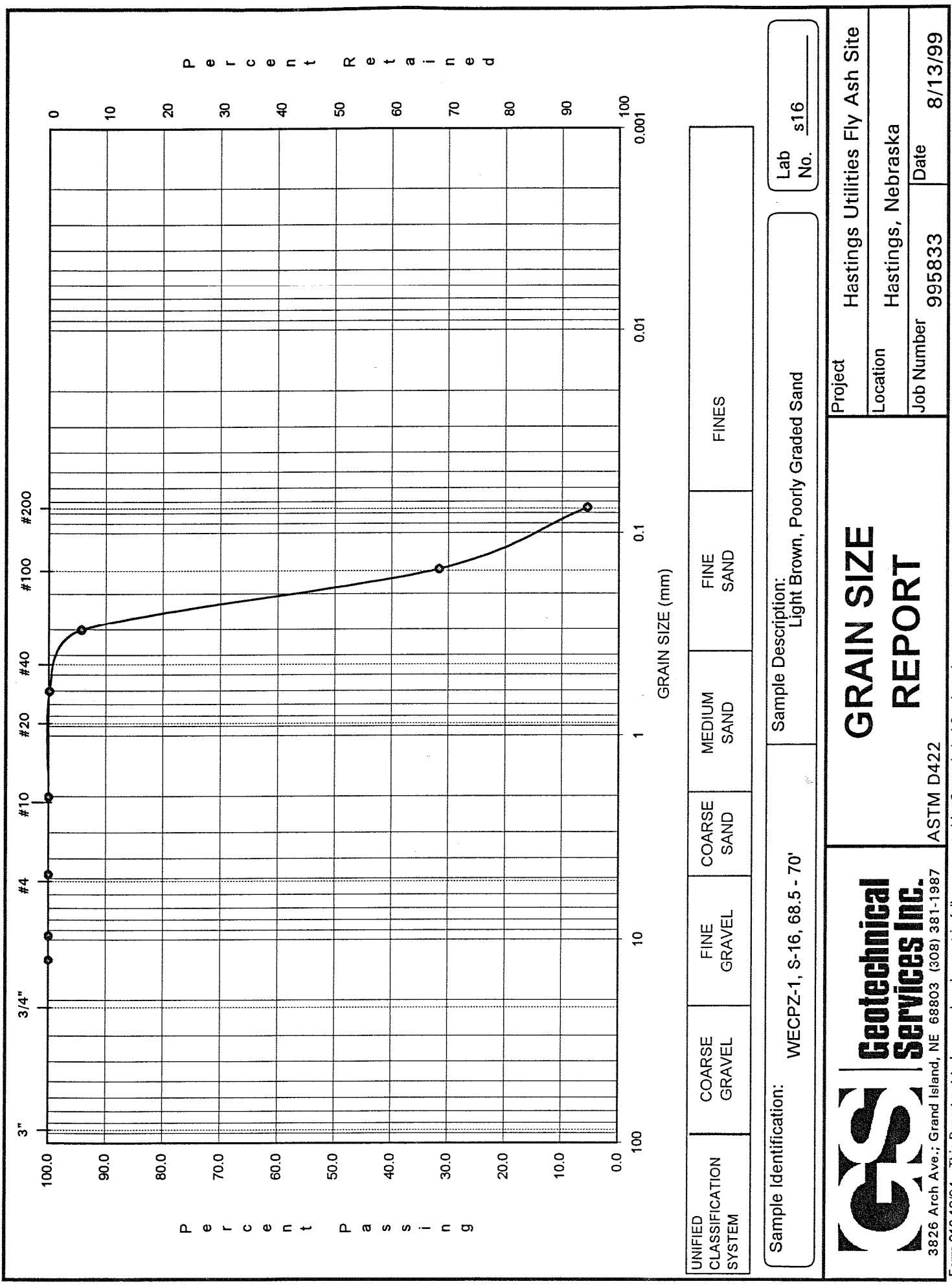
GRAIN SIZE REPORT

ASTM D422

Project: Hastings Utilities Fly Ash Site

Location: Hastings, Nebraska

Job Number: 995833 Date: 8/13/99



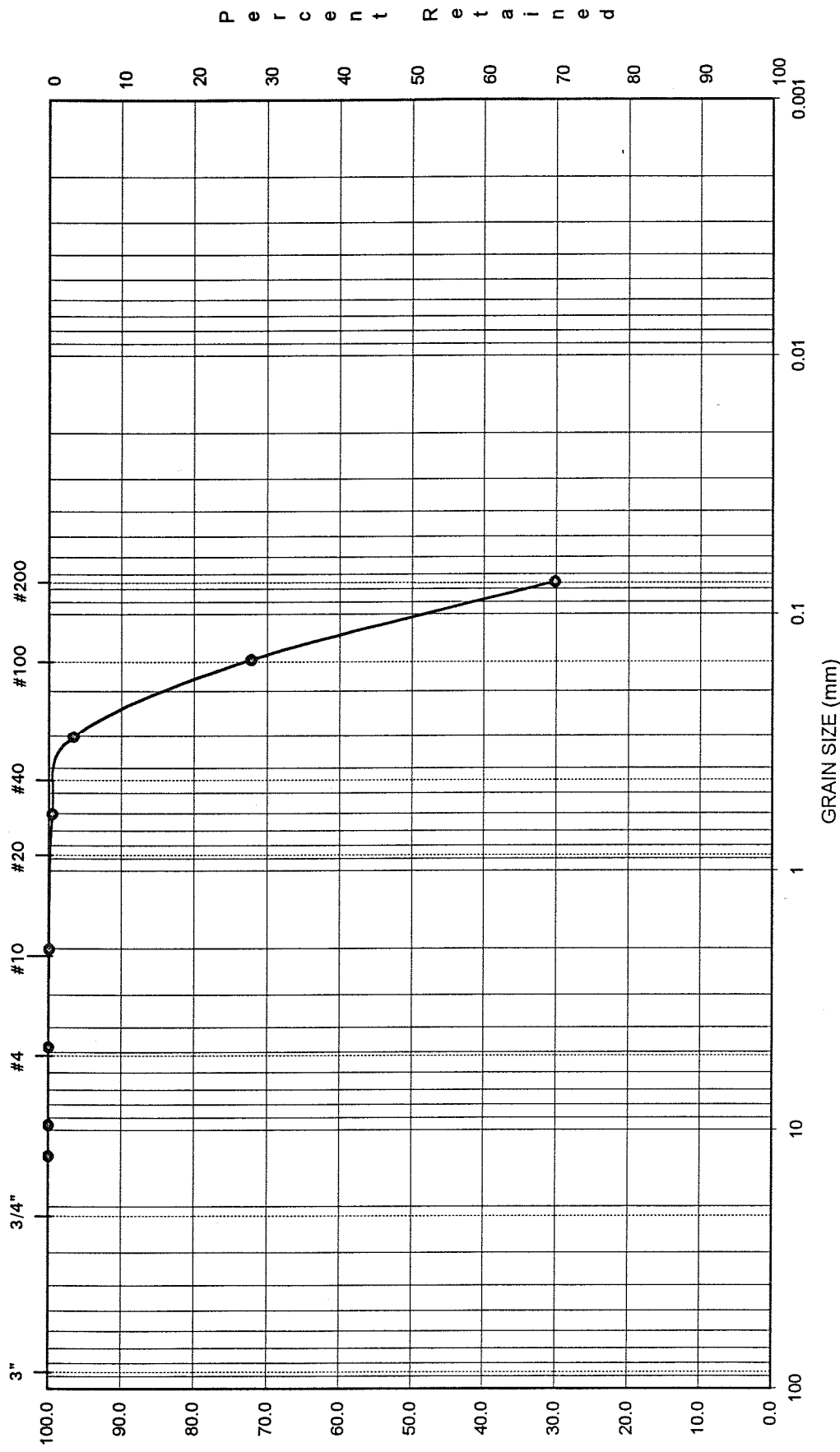
Sample Identification: WECpz-1, S-16, 68.5 - 70'

Sample Description: Light Brown, Poorly Graded Sand

Lab No. s16

UNIFIED CLASSIFICATION SYSTEM	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES
-------------------------------	---------------	-------------	-------------	-------------	-----------	-------

Geotechnical Services Inc. 3826 Arch Ave.; Grand Island, NE 68803 (308) 381-1987	GRAIN SIZE REPORT		Project	Hastings Utilities Fly Ash Site	
	ASTM D422		Location	Hastings, Nebraska	
	Form 210 12/94 This Report not to be reproduced except in full as presented by Geotechnical Services, Inc.		Job Number	995833	Date



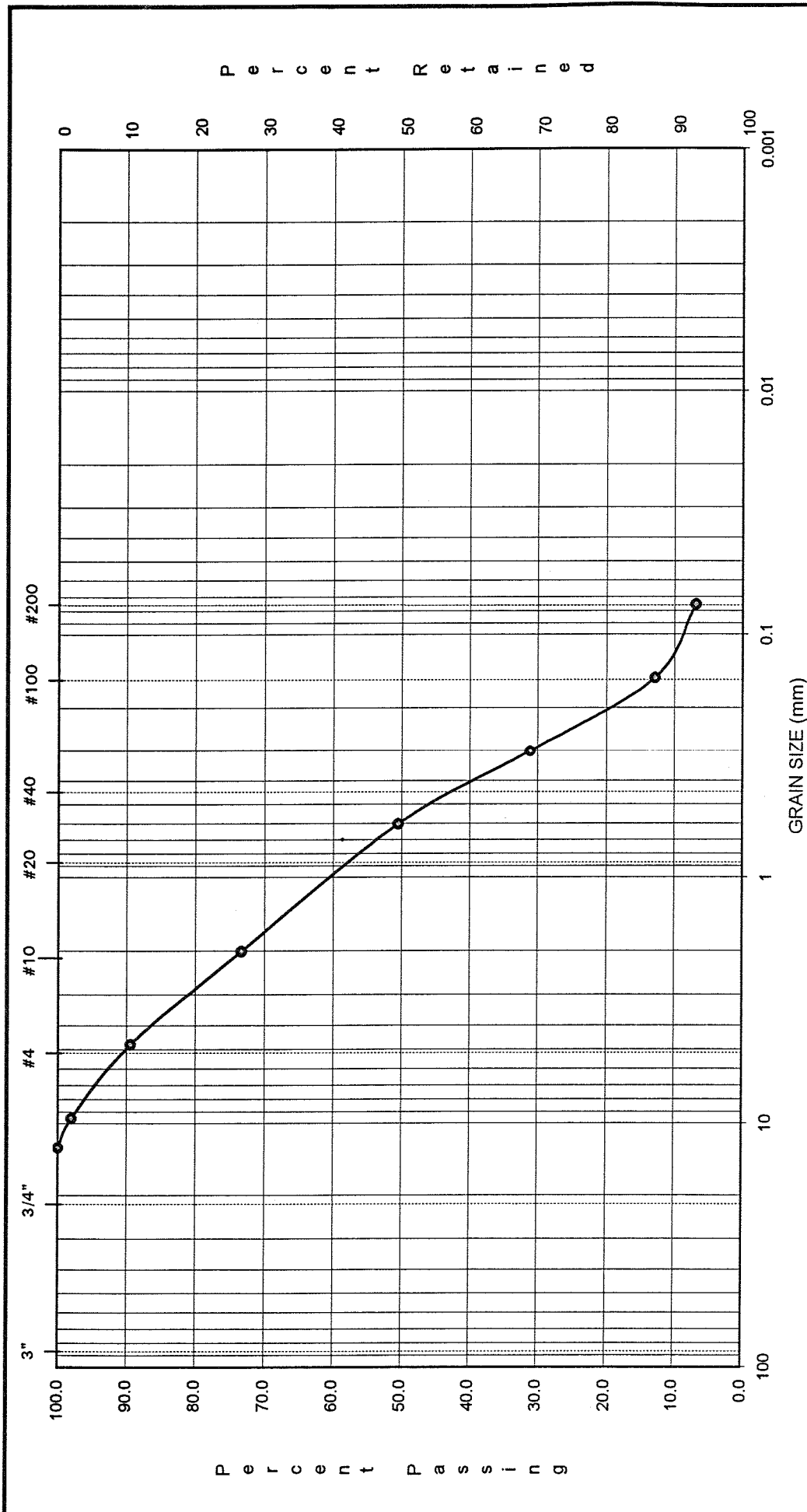
UNIFIED CLASSIFICATION SYSTEM	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES
-------------------------------	---------------	-------------	-------------	-------------	-----------	-------

Sample Identification:
WECpz-1, S-19, 83.5 - 85'

Sample Description:
Light Brown, Silty Clayey Sand

Lab No.
s19

Geotechnical Services Inc. 3826 Arch Ave.; Grand Island, NE 68803 (308) 381-1987	GRAIN SIZE REPORT ASTM D422		Project Hastings Utilities Fly Ash Site
			Location Hastings, Nebraska
	Job Number 995833	Date 8/13/99	

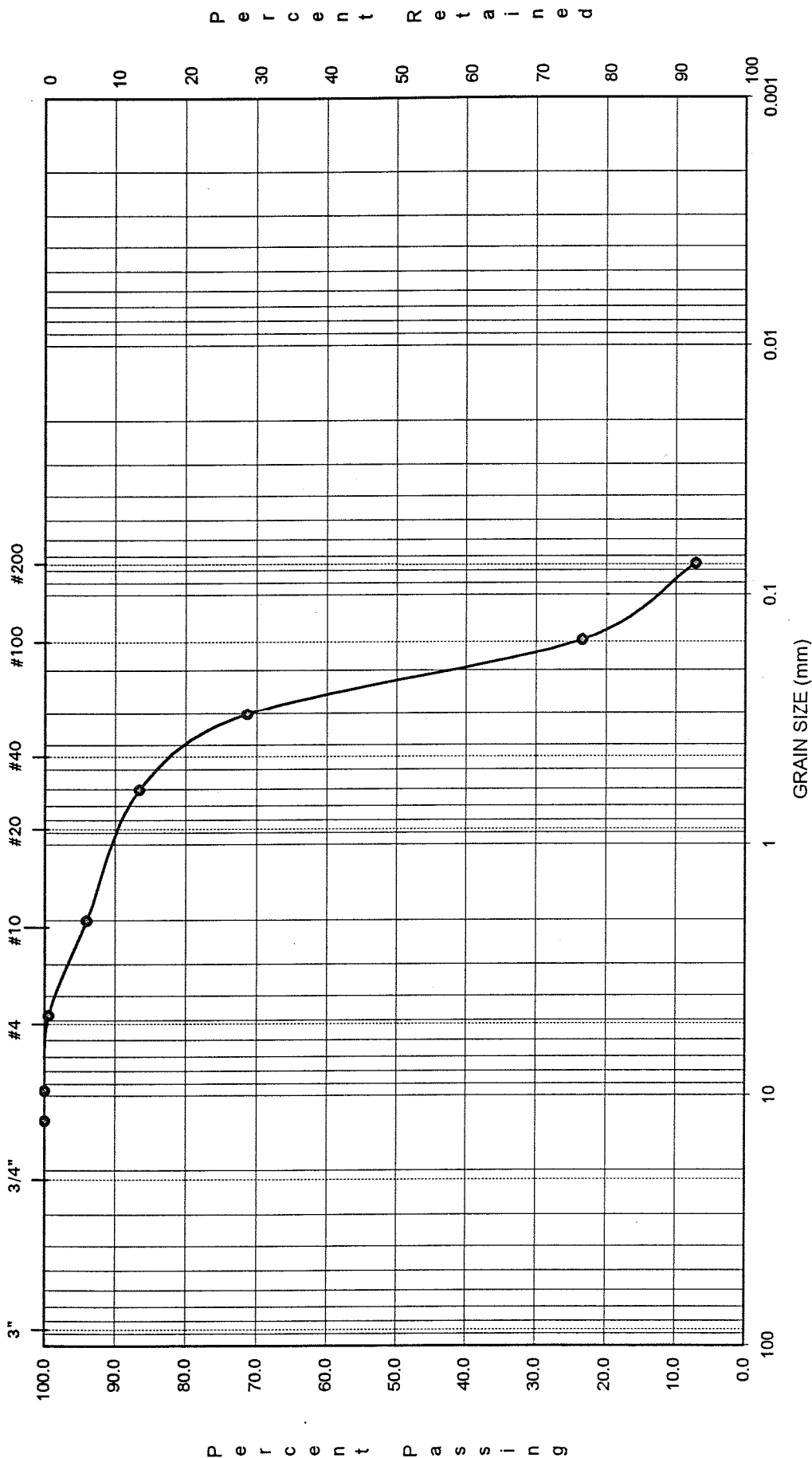


GRAIN SIZE REPORT ASTM D422		Project: Hastings Utilities Fly Ash Site Location: Hastings, Nebraska Job Number: 995833 Date: 8/13/99	
Sample Identification: WECpz-1, S-21, 93.5 - 95'		Sample Description: Light Brown, Well Graded Sand	
Lab No. s21			

UNIFIED CLASSIFICATION SYSTEM	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES
-------------------------------	---------------	-------------	-------------	-------------	-----------	-------



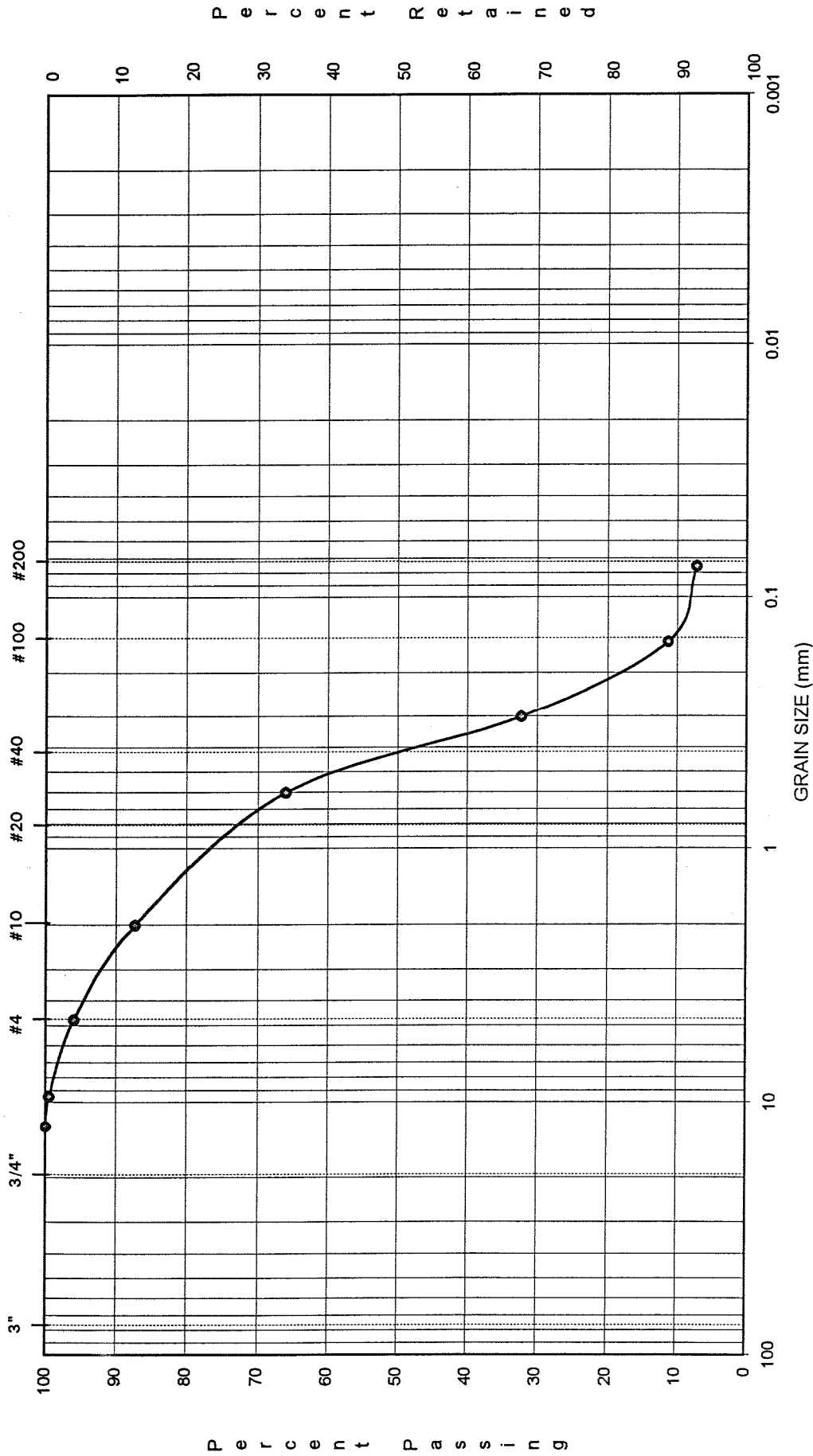
3826 Arch Ave.; Grand Island, NE 68803 (308) 381-1987
 Form 210 12/94 This Report not to be reproduced except in full as presented by Geotechnical Services, Inc.



UNIFIED CLASSIFICATION SYSTEM	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES
-------------------------------	---------------	-------------	-------------	-------------	-----------	-------

Sample Identification:	WECZ-1, S-23, 103.5 - 105'	Sample Description:	Light Brown, Poorly Graded Sand with Silt
Lab No. <u>s23</u>			

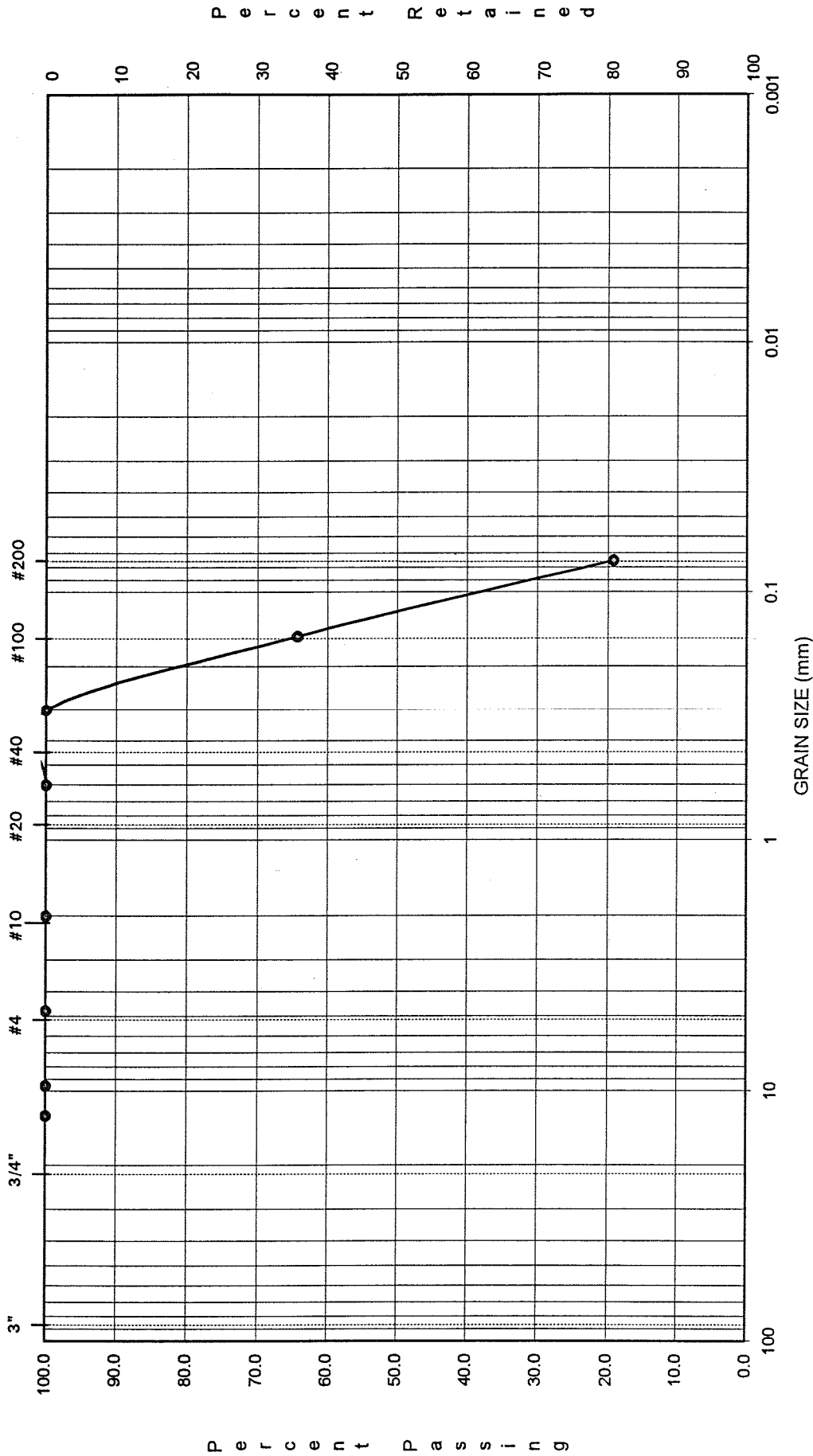
GS Geotechnical Services Inc. 3826 Arch Ave., Grand Island, NE 68803 (308) 381-1987	GRAIN SIZE REPORT ASTM D422		Project Hastings Utilities Fly Ash Site
			Location Hastings, Nebraska
	Job Number 995833	Date 8/13/99	



UNIFIED CLASSIFICATION SYSTEM	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES
-------------------------------	---------------	-------------	-------------	-------------	-----------	-------

Sample Identification:	WECPZ-1, S-26, 118.5 - 120'	Sample Description:	Light Gray, Well Graded Sand
Lab No. <u>s26</u>			

GS Geotechnical Services Inc. 3826 Arch Ave.; Grand Island, NE 68803 (308) 381-1987	GRAIN SIZE REPORT ASTM D422		
	Project	Hastings Utilities Fly Ash Site	
	Location	Hastings, Nebraska	
Job Number	995833	Date	8/13/99



UNIFIED CLASSIFICATION SYSTEM	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES

Sample Identification: WECpz-1, S-27, 128.5 - 130'

Sample Description: Reddish Brown, Silty Sand

Lab No. s27

GS Geotechnical Services Inc. 3826 Arch Ave.; Grand Island, NE 68803 (308) 381-1987	GRAIN SIZE REPORT ASTM D422		Project: Hastings Utilities Fly Ash Site
			Location: Hastings, Nebraska
	Job Number: 995833	Date: 8/13/99	

PERMEABILITY TEST REPORT

Sample Identification:

MW-1, U-3, 14 - 15'

Sample Description:

Light Brown Lean Clay with Root Holes
Peoria Formation

Preparation Remarks:

Thin Walled Tube Sample

SPECIMEN DATA

SAMPLE INFORMATION	WET UNIT WEIGHT (pcf)	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	VOID RATIO	SATURATION	POROSITY
INITIAL DATA	103.0	83.5	23.3	1.018	62%	0.504
DURING TEST DATA			37.7		100%	
FINAL DATA	112.7	83.0	35.9	1.031	94%	0.508
INITIAL SPECIMEN DIMENSIONS:						
		Diameter=	7.300	cm		
		Length=	8.985	cm		
FINAL SPECIMEN DIMENSIONS:						
		Diameter=	7.300	cm		
		Length=	8.985	cm		

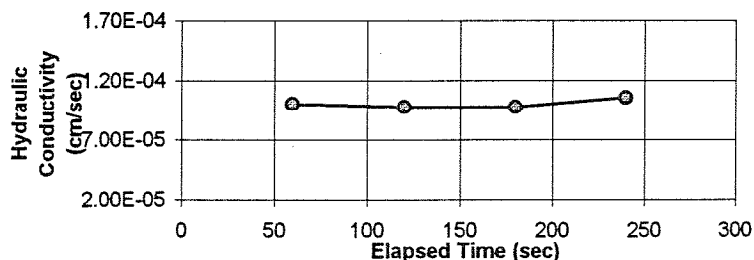
TEST INFORMATION

PERMEANT LIQUID USED: De-aired Water
MAGNITUDE OF TOTAL BACK PRESSURE: 10.0 psi
EFFECTIVE CONSOLIDATION STRESS: MAX= 3.0 psi
MIN= 2.3 psi
HYDRAULIC GRADIENT RANGE: HIGH= 12.41
LOW= 9.87

AVERAGE HYDRAULIC CONDUCTIVITY

corrected to 20°C

1.00E-04 cm/sec



Test conducted according to ASTM D5084-90.



**Geotechnical
Services Inc.**

7050 South 110th Street, Omaha, Nebraska 68128 (402)339-6104

Project	Hastings Utilities Fly Ash Utilization	
Location	Hastings, Nebraska	
Job Number	995833	Date 8/26/99

PERMEABILITY TEST REPORT

Sample Identification:

MW-1, U-7; 26 - 26.5'

Sample Description:

Dark Brown, Lean Clay
Sangamon Paleosol Sample

Preparation Remarks:

Thin Walled Tube Sample

SPECIMEN DATA

SAMPLE INFORMATION	WET UNIT WEIGHT (pcf)	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	VOID RATIO	SATURATION	POROSITY
INITIAL DATA	118.4	101.3	16.9	0.663	69%	0.399
DURING TEST DATA			24.6		100%	
FINAL DATA	122.3	98.5	24.1	0.710	92%	0.415
INITIAL SPECIMEN DIMENSIONS:		Diameter=	7.300	cm		
		Length=	10.800	cm		
FINAL SPECIMEN DIMENSIONS:		Diameter=	7.300	cm		
		Length=	10.800	cm		

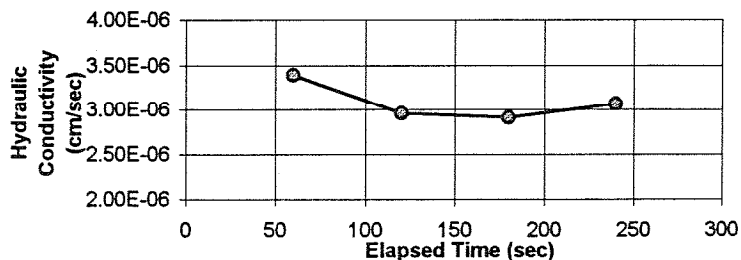
TEST INFORMATION

PERMEANT LIQUID USED: De-aired Water
MAGNITUDE OF TOTAL BACK PRESSURE: 10.0 psi
EFFECTIVE CONSOLIDATION STRESS: MAX= 4.0 psi
MIN= 2.4 psi
HYDRAULIC GRADIENT RANGE: HIGH= 16.68
LOW= 15.53

AVERAGE HYDRAULIC CONDUCTIVITY

corrected to 20°C

3.08E-06 cm/sec



Test conducted according to ASTM D5084-90.



**Geotechnical
Services Inc.**

7050 South 110th Street, Omaha, Nebraska 68128 (402)339-6104

Project

Hastings Utilities Fly Ash Utilization

Location

Hastings, Nebraska

Job Number

995833

Date

8/27/99

PERMEABILITY TEST REPORT

Sample Identification:

MW-1, U-11; 44 - 45'

Sample Description:

Light Red Brown Lean Clay with Fine Sand
Loveland Formation Sediment

Preparation Remarks:

Thin Walled Tube Sample

SPECIMEN DATA

SAMPLE INFORMATION	WET UNIT WEIGHT (pcf)	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	VOID RATIO	SATURATION	POROSITY
INITIAL DATA	116.4	102.5	13.5	0.644	57%	0.392
DURING TEST DATA			23.8		100%	
FINAL DATA	120.3	101.7	18.3	0.657	75%	0.396
INITIAL SPECIMEN DIMENSIONS:						
		Diameter=	7.300	cm		
		Length=	9.800	cm		
FINAL SPECIMEN DIMENSIONS:						
		Diameter=	7.300	cm		
		Length=	9.838	cm		

TEST INFORMATION

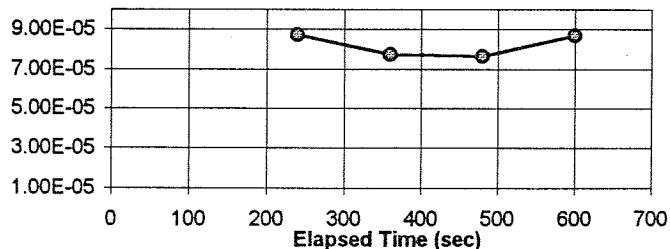
PERMEANT LIQUID USED: De-aired Water
MAGNITUDE OF TOTAL BACK PRESSURE: 10.0 psi
EFFECTIVE CONSOLIDATION STRESS: MAX= 2.0 psi
MIN= 1.7 psi
HYDRAULIC GRADIENT RANGE: HIGH= 3.69
LOW= 2.42

AVERAGE HYDRAULIC CONDUCTIVITY

corrected to 20°C

8.20E-05 cm/sec

Hydraulic Conductivity (cm/sec)



Test conducted according to ASTM D5084-90.



**Geotechnical
Services Inc.**

7050 South 110th Street, Omaha, Nebraska 68128 (402)339-6104

Project

Hastings Utilities Fly Ash Utilization

Location

Hastings, Nebraska

Job Number

995833

Date

8/27/99

SUPPLEMENTAL HYDROGEOLOGIC CHARACTERIZATION

FOR

**WHELAN ENERGY CENTER
FOSSIL BUEL COMBUSTION ASH
TEMPORARY ASH DISPOSAL AREA
ADAMS COUNTY, NEBRASKA**

PREPARED FOR:

HASTINGS UTILITIES

ISSUED: DECEMBER 2001

**REVISED: OCTOBER 2005 AND NOVEMBER 2006
FOR NDEQ-REQUESTED INFORMATION
AND REFERENCE CLARIFICATION**

PREPARED BY:

HDR ENGINEERING, INC.

Drill Hole No.	Sample No.	Sample Depth (ft.)	Sample Dia. (in.)	Sample Length (in.)	Water Content (%)	Density		Void Ratio	Sat. (%)	Unconfined		Atterberg Limits			Perm Test *	% Passing #200	Classification
						Wet (pcf)	Dry (pcf)			QU (tsf)	Strain (%)	LL	PL	PI			
PZ-2	U-2	18.5 – 20			22.6		99.0					33	18	15		96.2	Lean Clay (Peoria)
	U-4	38.5 – 40			18.4		110.2					33	16	18		90.4	Lean Clay (Loveland)
	S-7	68.5 – 70			7.3											15.3	See Grain Size Report
	S-9	88.5 – 90			1.2											3.8	See Grain Size Report
PZ-3	U-2	18.5 – 20										34	22	11	*	94.6	Lean Clay (Peoria)
	U-4	38.5 – 40			20.5		106.4					33	15	18		79.6	Lean Clay (Loveland)
PZ-4	U-1	8.5 – 10			24.7		87.4										Peoria
	U-3	28.5 – 30			18.2		113.1					34	15	20	*	69.8	Lean Clay (Loveland)
PZ-5	U-2	18.5 – 20			18.7		99.2					34	19	14		77.8	Lean Clay (Sangamon)



Geotechnical Services Inc.

3826 Arch Avenue * Grand Island, NE 68803 * Phone (308) 381-1987

SUMMARY OF SOIL TESTS

Project

Location

WHELAN ENERGY CENTER

HASTINGS, NEBRASKA

Job Number

Date

995833

11/16/01

PERMEABILITY TEST REPORT

Test conducted in general accordance with ASTM D5084-90.

Sample Location:

PZ-3, U-2, 18.5'-20'

Sample Description:

Light Olive Brown, Lean Clay (Peoria)

SPECIMEN DATA

SPECIMEN INFORMATION	Wet Unit Weight (lb/ft ³)	Dry Unit Weight (lb/ft ³)	Moisture Content (%)	Void Ratio	Saturation	Porosity
INITIAL DATA	120.0	96.1	24.9	0.754	89%	0.430
DURING TEST DATA					100%	
FINAL DATA	122.1	96.4	26.6	0.747	96%	0.428

AVERAGE INITIAL SPECIMEN DIMENSIONS: Diameter= 2.883 (in.)
Length= 2.453 (in.)

TEST INFORMATION

PERMEANT LIQUID USED: De-aired Water

MAGNITUDE OF TOTAL BACK PRESSURE: 90.0 (lb/in²)
EFFECTIVE CONSOLIDATION STRESS: MAX= 4.0 (lb/in²)
MIN= 2.0 (lb/in²)
HYDRAULIC GRADIENT RANGE: HIGH= 28.57
LOW= 22.58

AVERAGE HYDRAULIC CONDUCTIVITY

7.8E-08 cm/sec.

This is a remolded sample and may not be indicative of actual in-situ conditions.



**Geotechnical
Services Inc.**

8400 East 13th Terrace, Kansas City, Missouri 64126 (816)461-1205

Project:

Whelan Energy Center

Identification:

Hastings, NE

Job Number:

995833

Date:

11/23/01

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PERMEABILITY TEST REPORT

Test conducted in general accordance with ASTM D5084-90.

Sample Location:

PZ-4, U-3, 28.5'-30'

Sample Description:

Reddish Brown, Lean Clay (Loveland)

SPECIMEN DATA

SPECIMEN INFORMATION	Wet Unit Weight (lb/ft ³)	Dry Unit Weight (lb/ft ³)	Moisture Content (%)	Void Ratio	Saturation	Porosity
INITIAL DATA	132.0	111.9	17.9	0.505	96%	0.336
DURING TEST DATA					100%	
FINAL DATA	134.2	113.2	18.6	0.489	100%	0.328

AVERAGE INITIAL SPECIMEN DIMENSIONS:

Diameter=	2.873	(in.)
Length=	2.464	(in.)

TEST INFORMATION

PERMEANT LIQUID USED: De-aired Water

MAGNITUDE OF TOTAL BACK PRESSURE:	90.0	(lb/in ²)
EFFECTIVE CONSOLIDATION STRESS:	MAX=	4.0 (lb/in ²)
	MIN=	2.0 (lb/in ²)
HYDRAULIC GRADIENT RANGE:	HIGH=	28.29
	LOW=	27.97

AVERAGE HYDRAULIC CONDUCTIVITY

2.2E-07 cm/sec.

This is a remolded sample and may not be indicative of actual in-situ conditions.



Geotechnical Services Inc.

8400 East 13th Terrace, Kansas City, Missouri 64126 (816)461-1205

Project:

Whelan Energy Center

Identification:

Hastings, NE

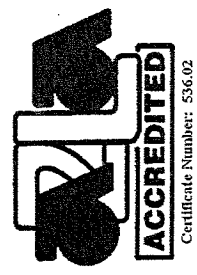
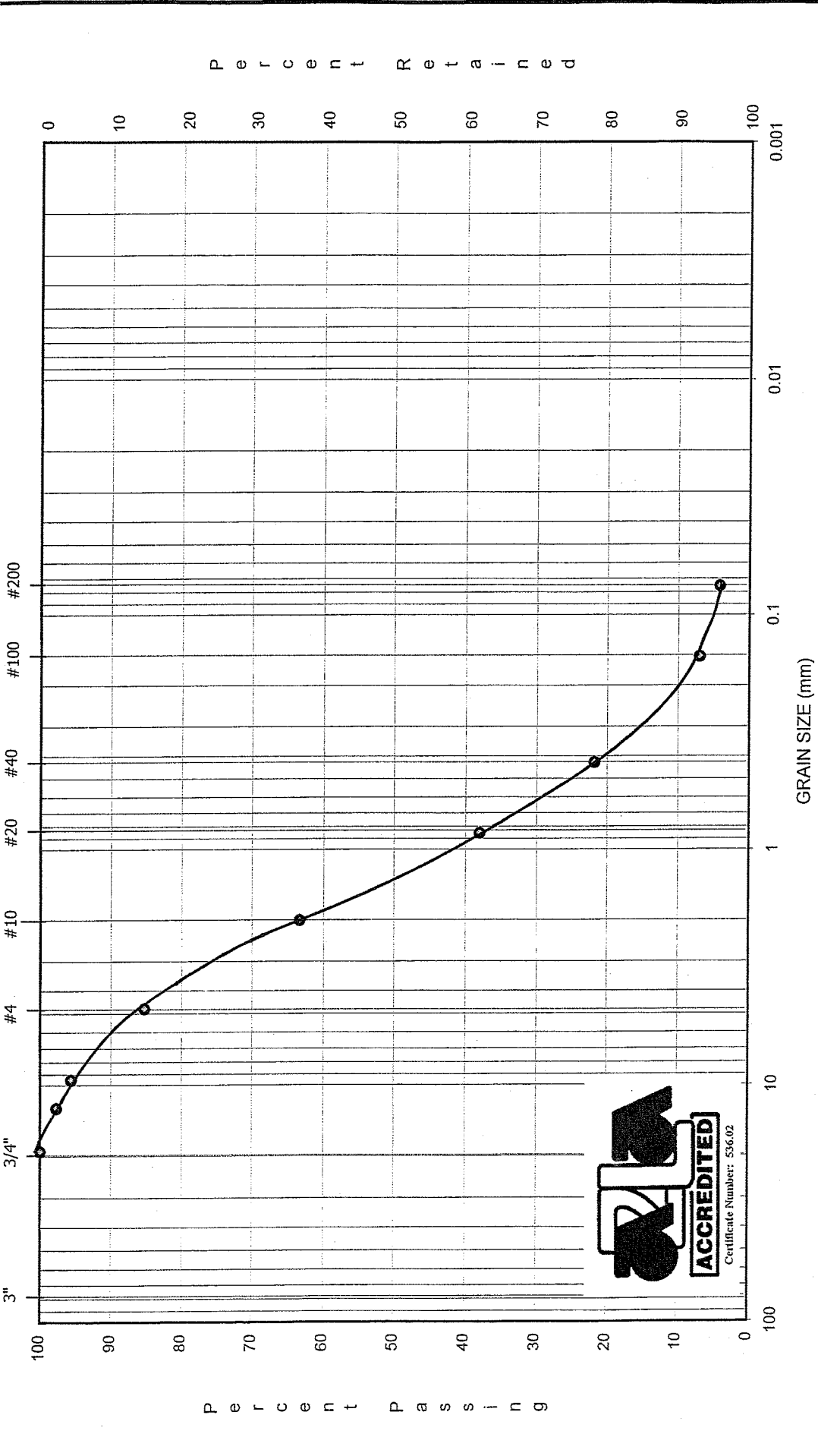
Job Number:

995833

Date:

11/23/01

This report may not be duplicated except in full without the written consent of GSI



UNIFIED CLASSIFICATION SYSTEM	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES	Cc Cu	1.09 9.62
-------------------------------	---------------	-------------	-------------	-------------	-----------	-------	----------	--------------

Sample Identification: PZ-2, S-9, 88.5-90

Sample Description: Light Brown Poorly Graded Sand

Lab No. 0

3826 Arch Ave.; Grand Island, NE 68803 (308) 381-1987

GRAIN SIZE REPORT

ASTM D422

Project: Hastings Utilities

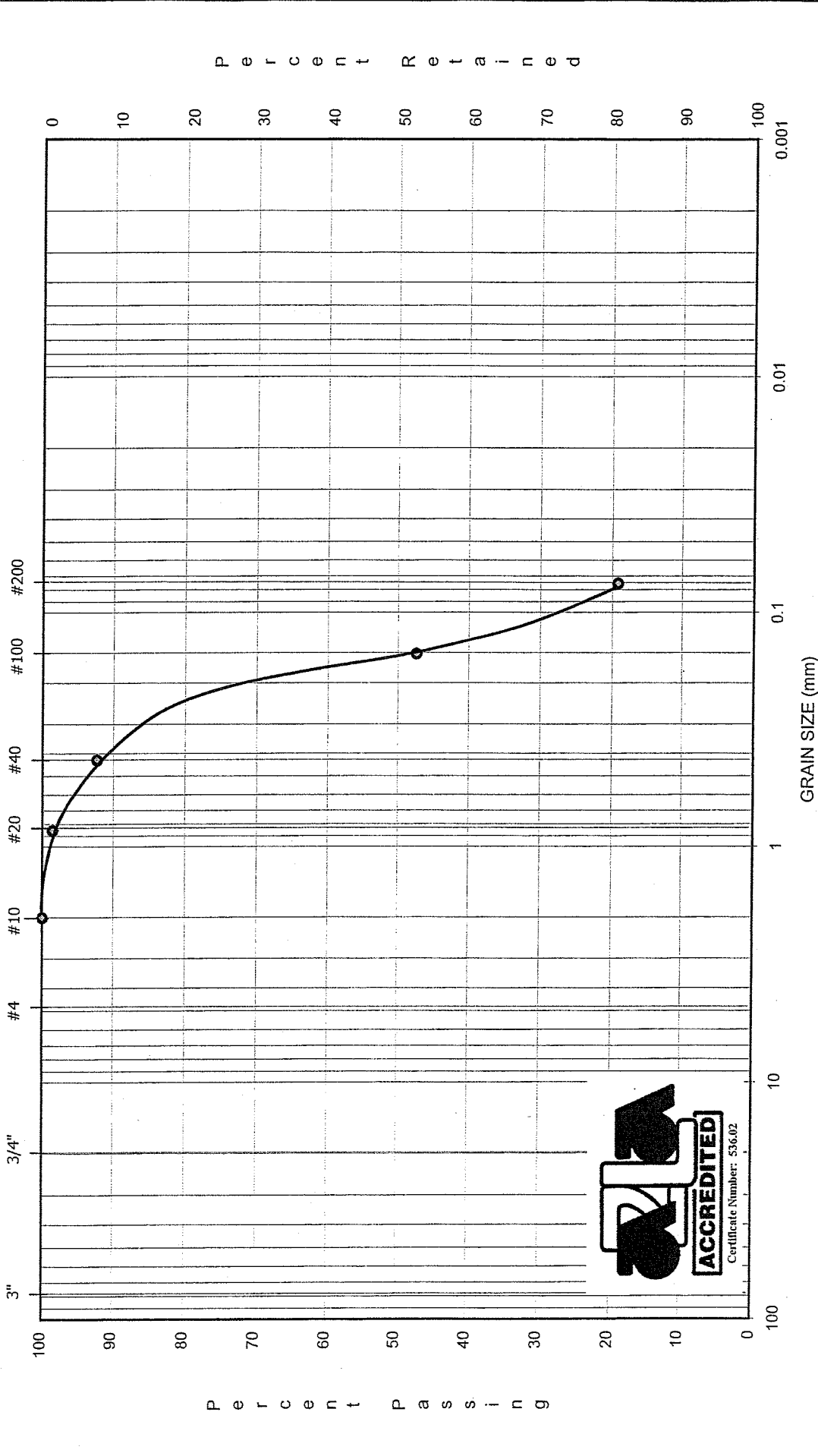
Location: Hastings, Nebraska

Job Number: 995833 Date: 11/27/01

Form 210 12/94

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Presented by J. Fred Jones, P.E.



UNIFIED CLASSIFICATION SYSTEM	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES	Cc Cu
							0.89 3.74

Sample Identification: PZ-2, S-7, 68.5-70
 Sample Description: Light Brown Poorly Graded Sand
 Lab No. 0

3826 Arch Ave.; Grand Island, NE 68803 (308) 381-1987

GRAIN SIZE REPORT

ASTM D422

Project: Hastings Utilities

Location: Hastings, Nebraska

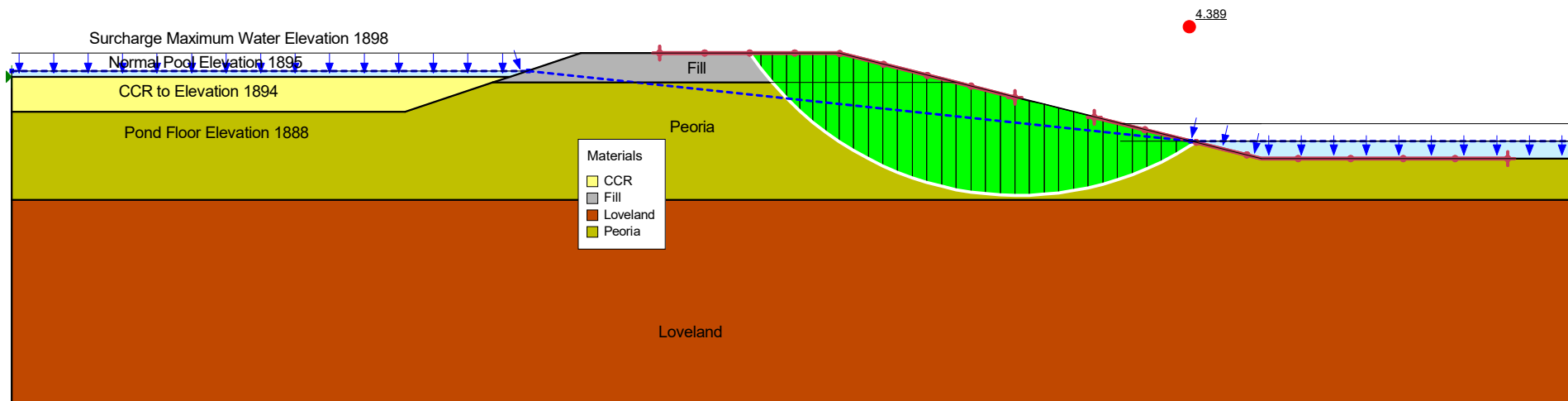
Job Number: 995833 Date: 11/27/01



Attachment 5

Stability Analysis Results

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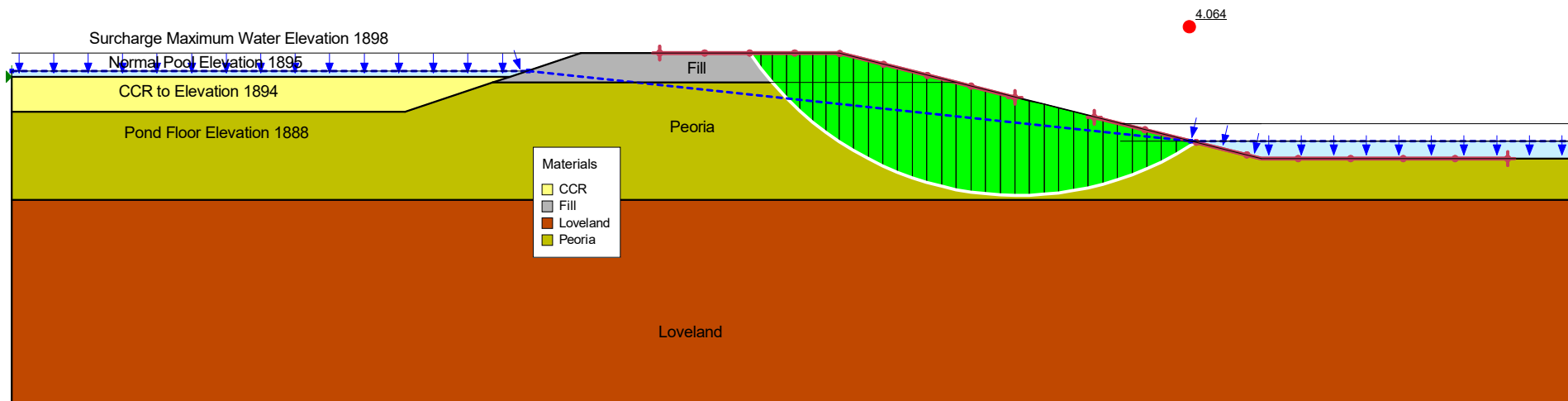


SLOPE/W Analysis

2025_01_Hastings CCR Normal Pool Short Term Static.gsz

12/02/2025

1:325

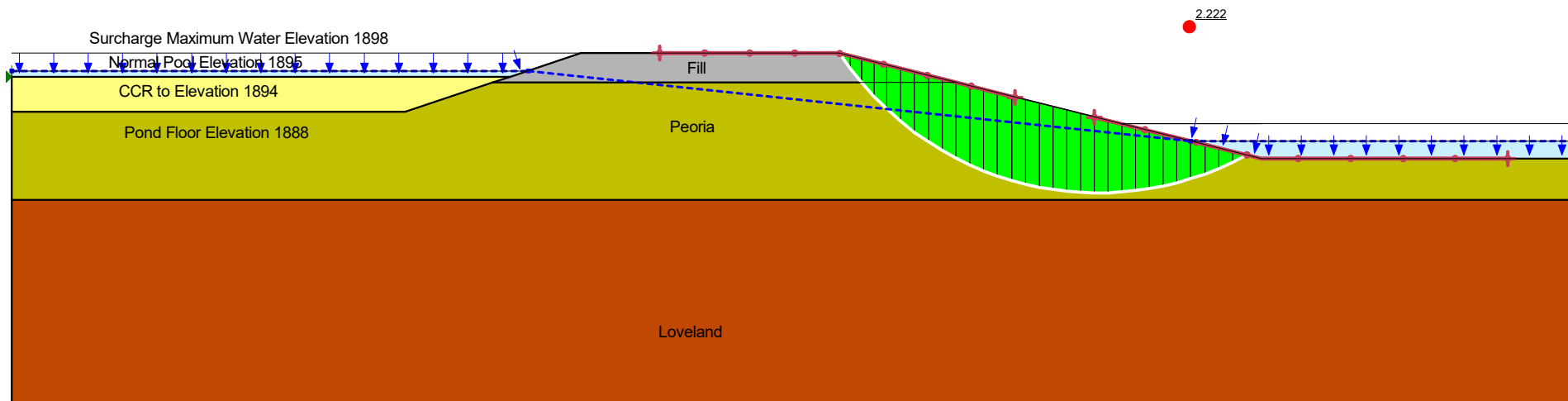


SLOPE/W Analysis

2025_02_Hastings CCR Normal Pool Short Term Seismic.gsz

12/02/2025

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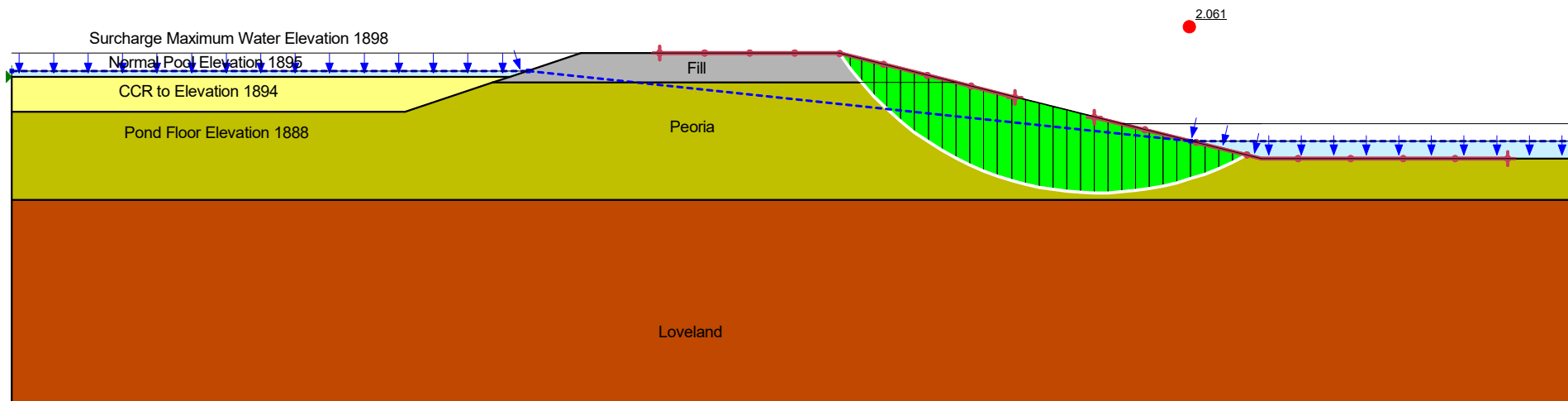


SLOPE/W Analysis

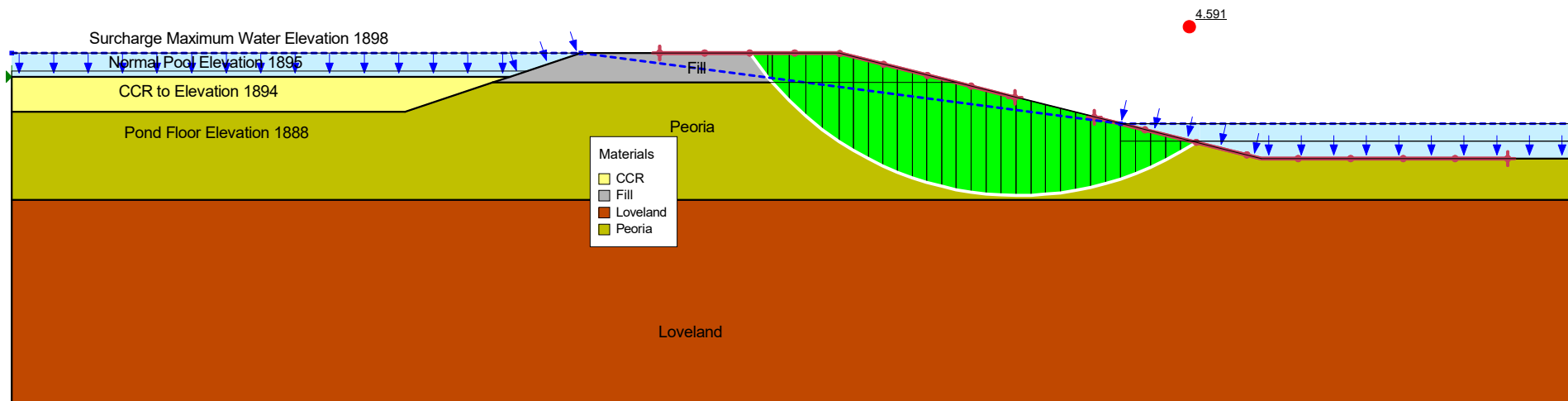
2025_03_Hastings CCR Normal Pool Long Term Static.gsz

12/02/2025

1:325



SLOPE/W Analysis	
2025_04_Hastings CCR Normal Pool Long Term Seismic.gsz	
12/02/2025	1:325

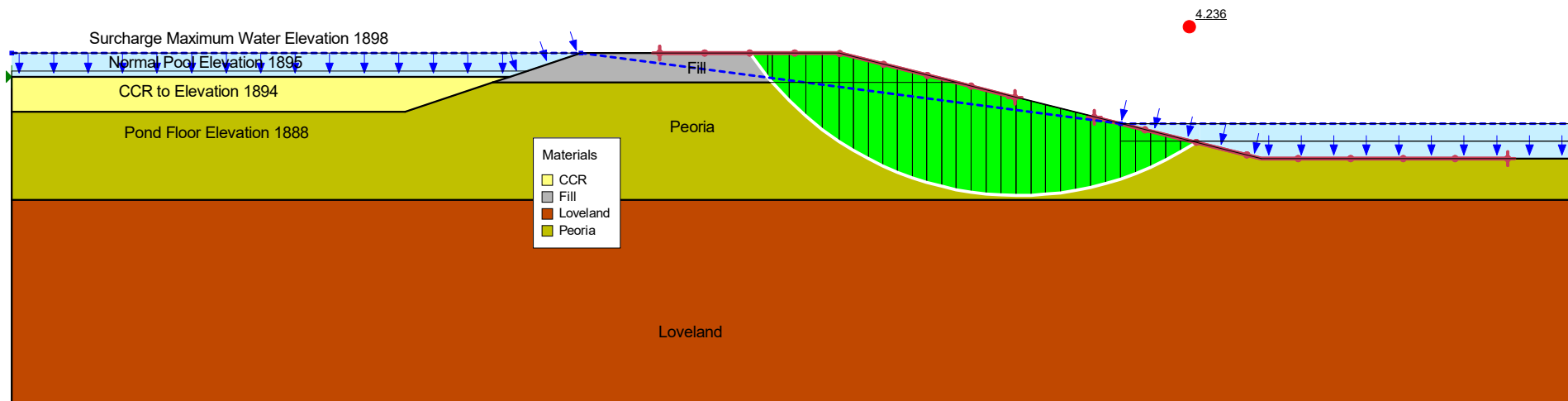


SLOPE/W Analysis

2025_05_Hastings CCR Max Pool Short Term Static.gsz

12/02/2025

1:325

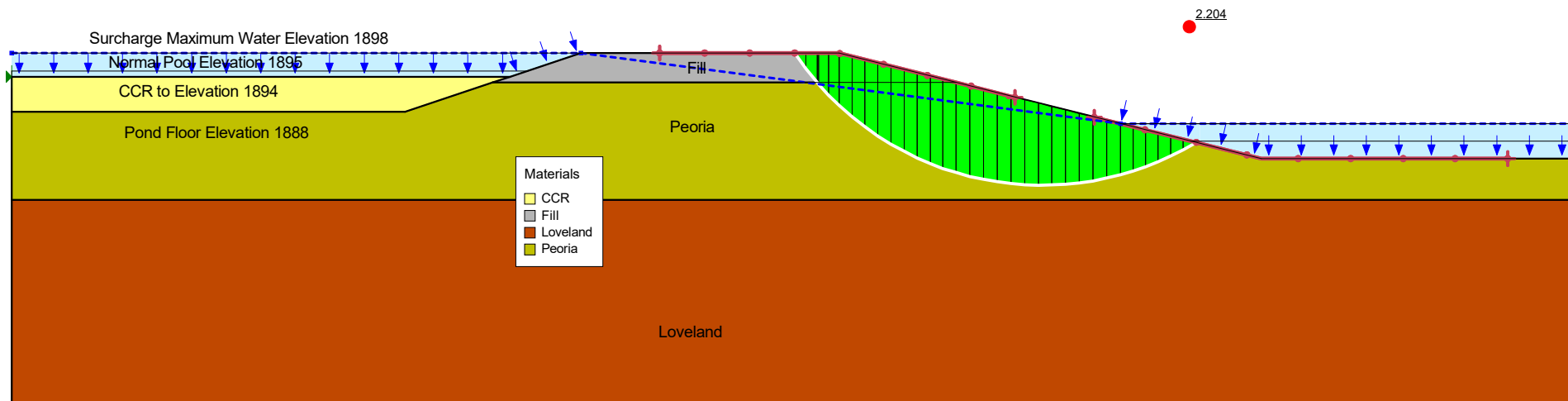


SLOPE/W Analysis

2025_06_Hastings CCR Max Pool Short Term Seismic.gsz

12/02/2025

1:325

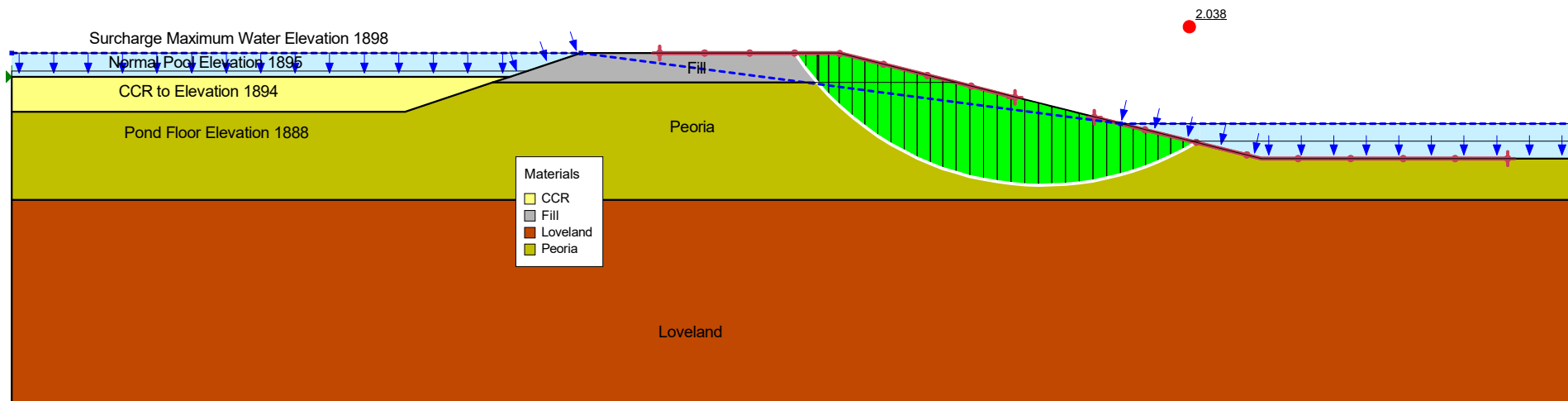


SLOPE/W Analysis

2025_07_Hastings CCR Max Pool Long Term Static.gsz

12/02/2025

1:325

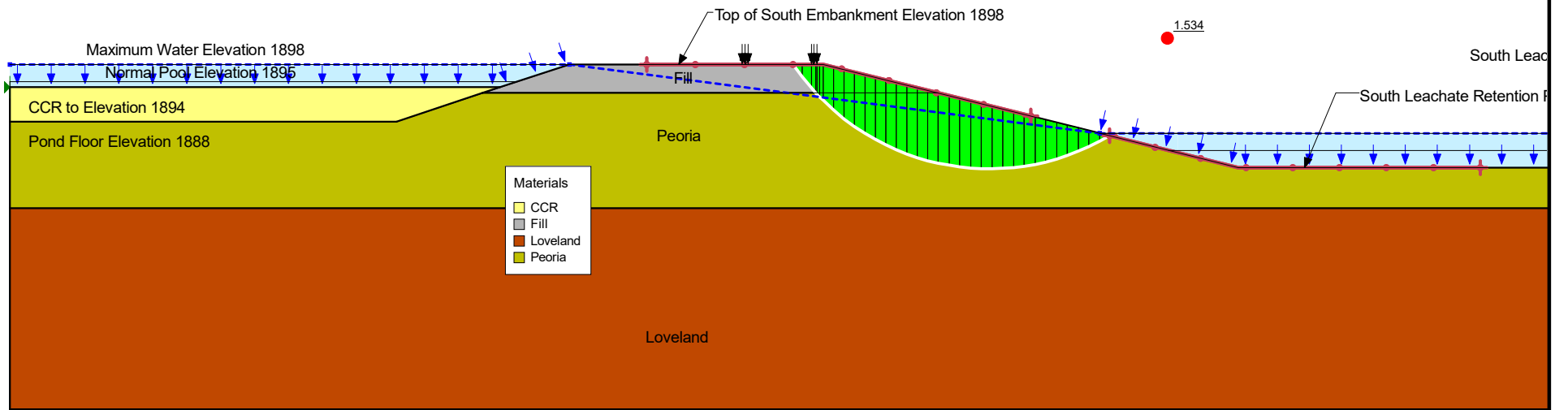


SLOPE/W Analysis

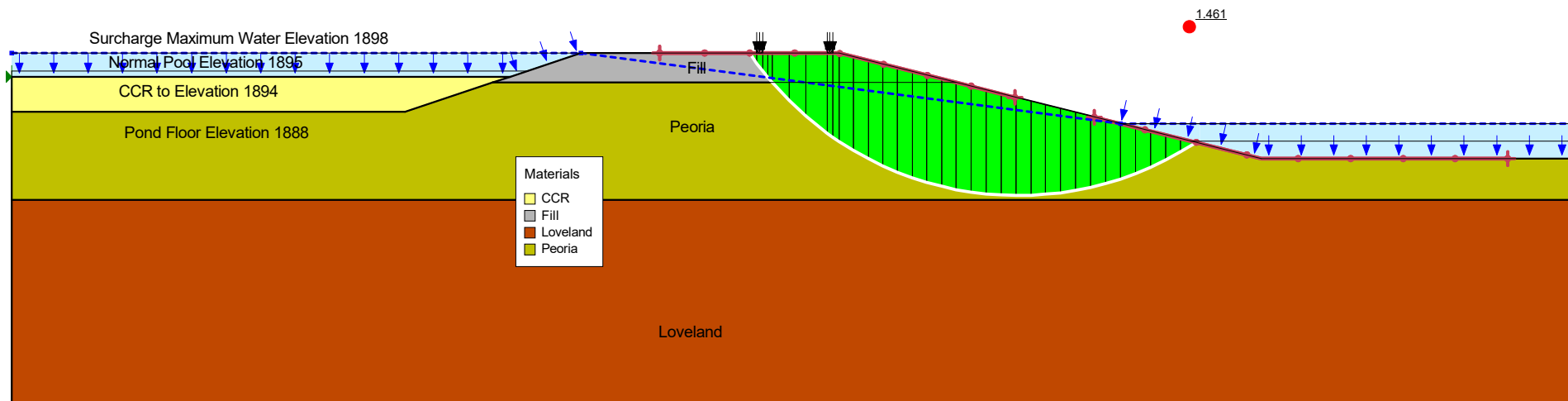
2025_08_Hastings CCR Max Pool Long Term Seismic.gsz

12/02/2025

1:325



SLOPE/W Analysis	
2025_09_Hastings CCR Max Pool Long Term Seismic w_ Surcharge.gsz	
12/02/2025	1:325

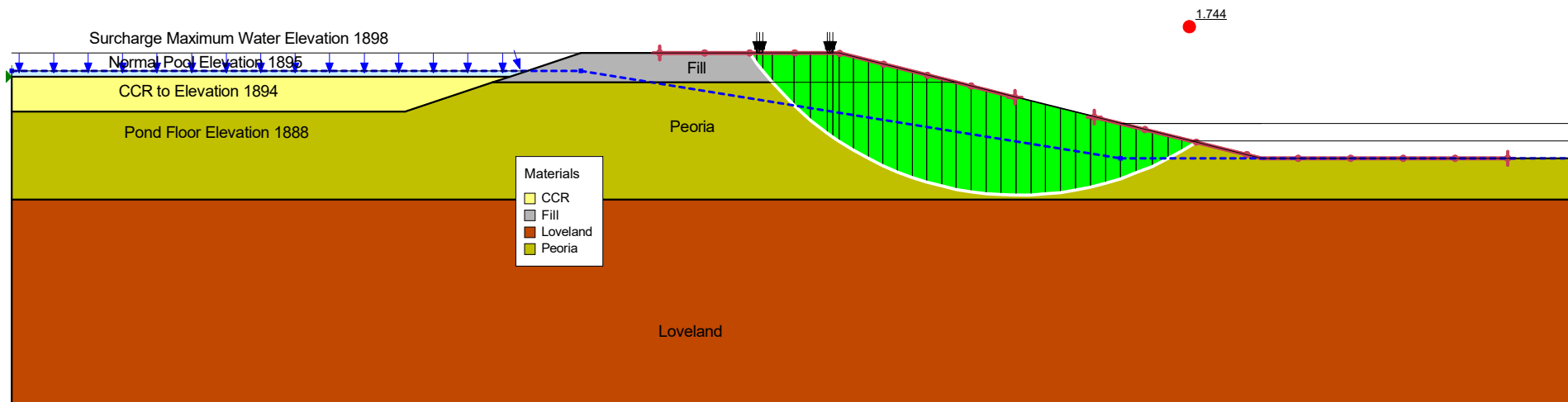


SLOPE/W Analysis

2025_10_Hastings CCR Max Pool Long Term Seismic w_Surcharge.gsz

12/02/2025

1:325

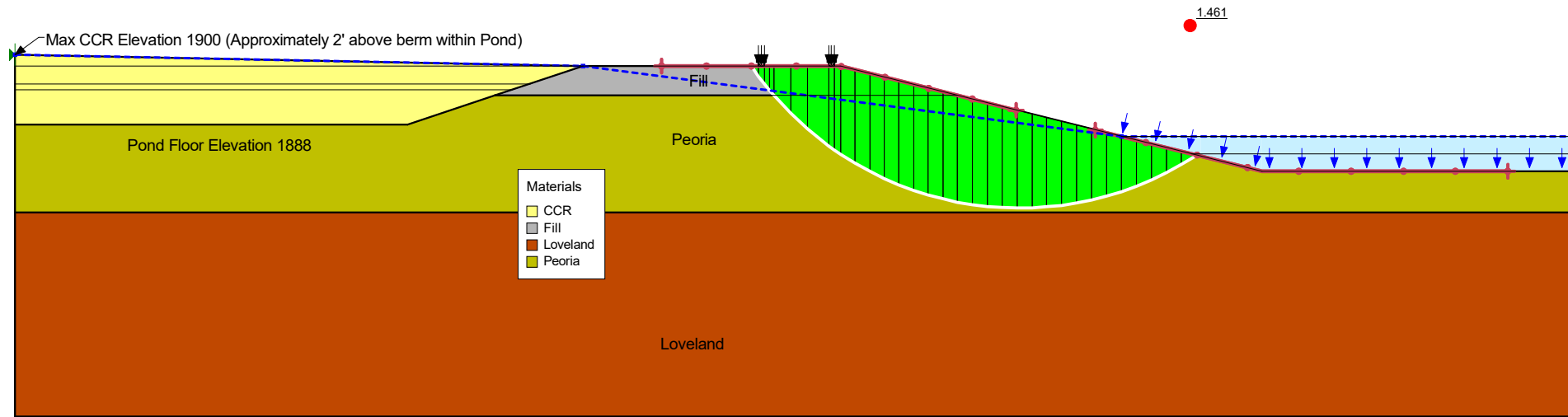


SLOPE/W Analysis

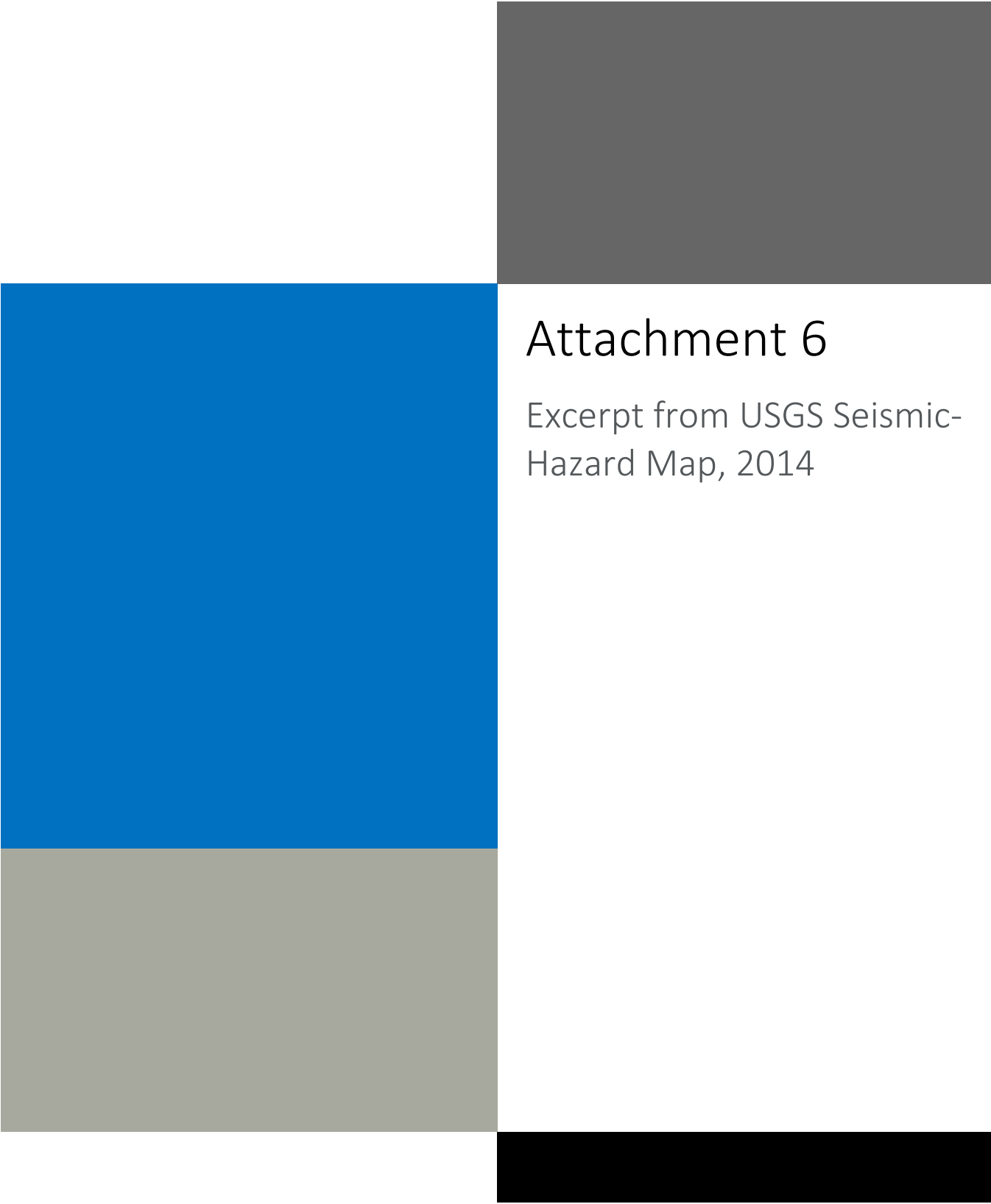
2025_11_Hastings CCR Normal Pool Dry Pond Lng Trm Seismic w_Surchar

12/02/2025

1:325



SLOPE/W Analysis	
2025_12_New.gsz	
12/17/2025	1:325



Attachment 6

Excerpt from USGS Seismic-
Hazard Map, 2014

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Unified Hazard Tool



Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the [U.S. Seismic Design Maps web tools](#) (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new [USGS Earthquake Hazard Toolbox](#) for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

^ Input

Edition

Conterminous U.S. 2014 (v4.0.x)

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

40.578

Time Horizon

Return period in years

2475

Longitude

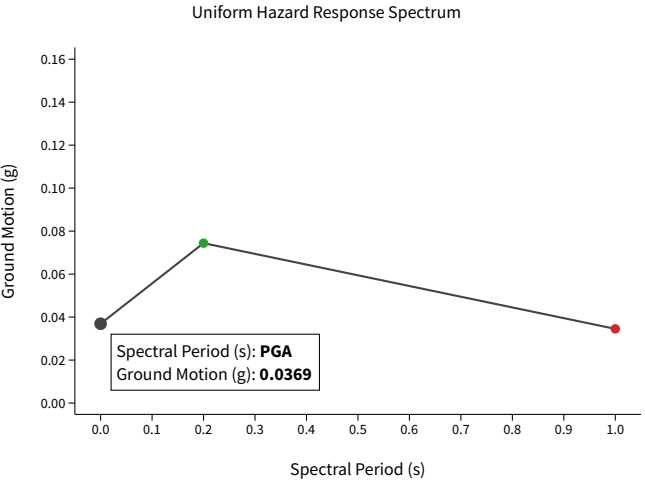
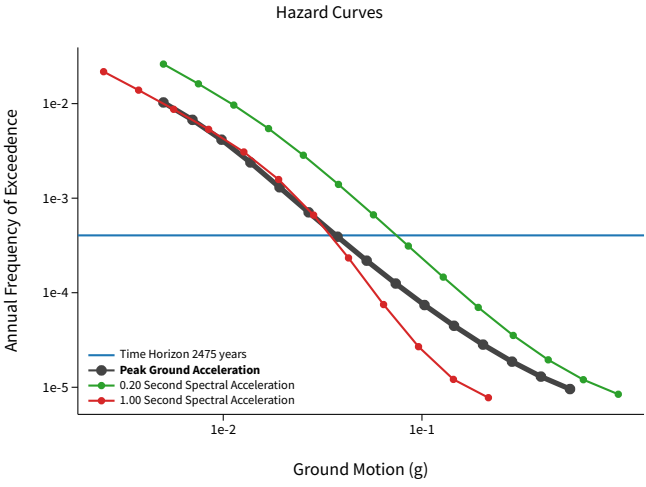
Decimal degrees, negative values for western longitudes

-98.313

Site Class

760 m/s (B/C boundary)

^ Hazard Curve



[View Raw Data](#)