Prepared by

HDR

Renew Harbor Island

Work today, protect tomorrow.

Hydrogeologic Monitoring Plan

for Compliance with Michigan Part 115 Solid Waste Management Regulation

Former J.B. Sims Generating Station

Grand Haven, MI

June 18, 2024

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Former J.B. Sims Generating Station, Grand Haven, Michigan

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1.0 Introduction

This Hydrogeologic Monitoring Plan (HMP) was prepared for the former J.B. Sims Generating Station (Facility or Site) to support compliance with Part 115 of the Michigan Natural Resources and Environmental Protection Act, Act 451 of 1984 (Part 115). Section 11512(a)(1) of Part 115 requires an approved HMP that complies with Rules 299.4440 to 299.4445, if applicable, and Rules 299.4905 to 299.4908 of the Part 115 Rules. It should be noted that Part 115 does not replace the United States Environmental Protection Agency (EPA) Coal Combustion Residuals (CCR) Rule (40 CFR Part 257) as EPA has not authorized Michigan's program.

Therefore, this HMP sets forth the requirements and procedures of the CCR groundwater monitoring program at Site. The HMP was developed in accordance with the EGLE Hydrogeologic Monitoring Plan Checklist in **Appendix A**.

1.1 Facility Description

The facility is located at 1231 North 3rd Street, on Harbor Island, in Grand Haven, Michigan (**Figure 1**). The former J.B. Sims Generating Station was operated by the Grand Haven Board of Light and Power (GHBLP) and ceased operations in February 2020. The former plant was a coal-fired steam-generating power facility with a net capacity of approximately 70.5 megawatts. The CCR generated at the former Site was stored in two CCR units: (1) the inactive Units 1/2 Impoundment and (2) the former Unit 3A/B Impoundments. Operations at the Site ceased in February 2020 and the plant subsequently was decommissioned. During deconstruction, wastewater used to cleanout boilers and infrastructure was sent to Unit 3A/B. The waste disposal into Unit 3A/B ceased in July 2020.

1.1.1 Units 1/2 Impoundment

The inactive CCR Units 1/2 Impoundment was a depression in the ground where sluiced ash was disposed. The inactive Units 1/2 Impoundment ceased receiving CCR materials in 2012. Due to the abstract size and lack of defined boundaries, Units 1/2 Impoundment was delineated by Golder in the 2019 report *CCR Impoundment Ash Delineation at the J.B. Sims Generating Station* (Golder, 2019c). Following the submission of the delineation report, a boundary of the inactive Units 1/2 Impoundment was agreed upon by GHBLP, EPA, and EGLE, which includes an area of sluiced ash disposal to the east (**Figure 2**). The parties also agreed that the former northern outlet channel from the Units 1/2 Impoundment would be evaluated for potential inclusion of the revised boundary. This area is still under investigation and awaiting feedback from EGLE and EPA (**Figure 2**). A 2016 ash investigation by ERM confirmed that no liner was present beneath the Units 1/2 Impoundment and waste was placed the topographic low area (Golder, 2019c).

Figure 1. Site Vicinity Map

Figure 2. Monitoring Well and CCR Unit Location Map

1.1.2 Unit 3A/B Impoundments

The former CCR Unit 3A/B Impoundments were constructed as two above-ground surface impoundments consisting of a clay liner; however, the engineered clay liner did not meet Part 115 CCR surface impoundment liner criteria. Golder (2020) stated that the former 3A/B Impoundments were built over a “field of ash” that was generated from Boiler Units 1 & 2; however, existing soil borings do not support that a “field of ash” is present under the former impoundments. Although the former coal-fired power generation facility ceased operations in February 2020, the Site continued to use the Unit 3A/B Impoundments to store cleanout materials from the hoppers, vessels, etc. prior to demolition of the buildings. The impoundments ceased receiving waste on July 30, 2020. Removal of CCR from the impoundments was completed on November 6, 2020 and the liner remained. Following the CCR removal, Golder conducted ash removal verification, which is documented in the Units 3A/B Impoundment – CCR Removal Documentation Report (December 11, 2020). The verification methods included:

- Comparison of excavation grades to the original construction documentation of the clay liner.
- Photographic documentation of the CCR removal process and final conditions.
- Colorimetric and microscopic quantification of ash at random grid nodes within the footprint of the impoundments.
- Soil metals analysis of the remaining clay liner.

EGLE denied the request of the GHBLP to close Unit 3A/B Impoundments for the following reasons (EGLE, 2021):

- GHBLP did not submit a certification of completion per 40 CFR §257,
- GHBLP did not have a groundwater monitoring system that represented background water quality,
- GHBLP utilized one of the six obtained soil samples to verify ash removal using colorimetric methods. EGLE stated no demonstration had been made that one sample accurately represented all liner areas,
- The methodology for microscopy did not include preprocessing of samples to ensure bottom ash could properly be identified,
- GHBLP did not address the contamination of the Unit 3A/B clay liner. Analysis of soil sample of the liner showed elevated concentrations of lithium and selenium,
- Based upon a 2014 EPA report showing photographic evidence that coal ash was present outside the Unit 3A/B boundary, EGLE determined that GHBLP did not provide sufficient demonstration that the horizontal extent of coal ash had been defined,
- Photographic evidence collected during the ash removal showed a large amount of cracking observed in the clay liner.

Further ash delineation will be conducted to define the extent of any remaining minor amount of CCR on the areas adjacent to the Unit 3A/B Impoundments.

1.2 Background

The original Groundwater Monitoring System Certification was developed for the 3A/B Impoundments by Environmental Resources Management (ERM) in November 2017 to comply with the Federal CCR Rule. The network consisted of one (1) background well (MW-01) and three (3) downgradient detection monitoring wells (MW-02, MW-03, and MW-04) (ERM, 2017). Initial background monitoring was conducted by Golder between March 13 and August 7, 2017. On May 15, 2018, the Unit 3A/B Impoundments monitoring network entered assessment monitoring after the identification of statistically significant increases (SSIs), as noted in the *Notice of Establishing Assessment Groundwater Monitoring 40 CFR §257.94(e)(3)* (Golder, 2018b). Subsequently, the monitoring network was revised to accommodate the addition of Units 1/2 Impoundment and shifted to a multi-unit network. During that time, MW-01 was converted to a piezometer, MW-05 and MW-06 were installed as additional downgradient monitoring wells, and MW-07 and MW-08 were installed as new background monitoring wells for the multi-unit network (Golder, 2019). On October 15, 2018, GHBLP published the *Updated Notice of Groundwater Protection Standard Exceedance 40 CFR §257.95(g)*, identifying that cobalt, fluoride, and lithium were detected at statistically significant levels (SSL) for Units 1/2 and Unit 3A/B (Golder, 2018c). On February 2, 2019, GHBLP published the *Notice of Initiating Assessment of Corrective Measures 40 CFR §257.95(g)(3)(i) and 40 CFR §257.95(g)(5)*, announcing that both Units 1/2 Impoundment and Unit 3A/B Impoundments were in assessment of corrective measures (Golder, 2019b). In August 2019, monitoring wells MW-09 and MW-10 were installed as additional downgradient monitoring wells and included in the multi-unit network. In 2020, the monitoring well network was converted from a multi-unit system into two separate units, one for Units 1/2 Impoundment and one for Unit 3A/B Impoundments (Golder, 2021). On July 22, 2021, GHBLP published the *Updated Notice of Groundwater Protection Standard Exceedance 40 CFR §257.95(g),* in which arsenic and chromium were added to the list of cobalt, fluoride, and lithium as being observed at SSLs (Golder, 2021b).

On January 14, 2021, GHBLP, EPA, and EGLE met to discuss documentation regarding the boundary delineation for Units 1/2 Impoundment and ultimately expanded the boundary to its current location shown on **Figure 2** (Golder, 2021). Following revisions to the Units 1/2 Impoundment boundary, the monitoring well network was deemed insufficient. In August 2021, 22 piezometers and three stilling wells were installed to further the understanding of groundwater flow and the groundwater/surface water interaction of Harbor Island to determine appropriate background well locations and monitoring network for the CCR units (Golder, 2022b). Based on groundwater flow direction data collected in 2021 and 2022, as well as boring logs from the *Field Summary Report of Results from Approved Work Plan*, it was determined that the previous background/upgradient monitoring wells (MW-07 and MW-08) were impacted by the CCR units and did not represent background water quality (Golder, 2022b). The monitoring well network was revised in the *2022 Harbor Island Work Plan for CCR Compliance* (HDR, 2022).

Background water quality sampling at the updated groundwater monitoring well network was conducted over eight events from November 2022 through August 2023. Following the

completion of background sampling, as specified in Michigan R 299.4440(8), the *Background Water Quality Statistical Certification* was submitted (HDR, 2024). The water quality data collected from the monitoring wells located upgradient of the CCR units were pooled and statistically analyzed to develop the background threshold values (BTVs) for the impoundments. The Background Report provides the selection of the statistical method for each constituent of interest (COI) for each CCR unit.

The first detection/assessment monitoring event using the updated monitoring network was conducted in October 2023 following completion of the background sampling events. Monitoring data was compared to BTVs. Following review of the first detection monitoring event that used the updated monitoring network, the memorandum *Former J.B. Sims Generating Station Determination of Statistically Significant Increases over Background per §257.93(h)(2) and R 299.4440(8) of the Michigan Part 115 Rules* was submitted to EGLE (HDR, 2024a). The SSIs identified for Units 1/2 Impoundment for the State compliance program include boron, calcium, fluoride, sulfate, and total dissolved solids (TDS). The SSIs identified for Unit 3A/B Impoundments for the State compliance program include boron, calcium, chloride, fluoride, sulfate, and TDS. The SSIs identified from the October 2023 sample event are considered revised SSIs because the updated monitoring network includes different background wells that are not impacted by the CCR units. The identification of SSIs for both CCR units keeps both Units 1/2 Impoundment and Unit 3A/B Impoundments in assessment monitoring status.

Under the assessment monitoring program, as required in Michigan Rule R 299.4441(9), the CCR owner must establish groundwater protection standards (GPS) for each constituent detected in the groundwater. The GPS values are discussed further in Section 3.2.3.

The October 2023 sample data from waste boundary wells was compared to the GPS values and several COIs were found to exceed GPS at both CCR units. To determine if an exceedance of a GPS value is statistically significant, the 95% lower confidence limit (LCL) was calculated for each of the downgradient wells. The LCLs that exceeded GPS for Units 1/2 Impoundment under the State compliance program include arsenic, boron, calcium, chloride, fluoride, lithium, lead, sulfate, and total dissolved solids. The LCLs that exceeded GPS identified for Unit 3A/B Impoundments under the State compliance program include boron, calcium, chloride, cobalt, lead, lithium, sulfate, and total dissolved solids. Further detail has been provided in the *Determination of Statistically Significant Levels over Groundwater Protection Standards per §257.95(g) and Michigan Rule R 299.4441* (HDR, 2024c)

1.3 Hydrogeology

The regional direction of groundwater flow is west to southwest towards Lake Michigan (Western Michigan University, 1981). The Grand River is located on the northern and western sides of the Site, and the South Channel is located on the south side of Harbor Island. Internal to the Island there are several influences on groundwater flow and direction, specifically:

- Various fill materials
- Surface water features, such as the inactive Units 1/2 Impoundment and wetlands

- Former coal yard area, which may have lower infiltration rates due to compaction from heavy equipment and stockpiling.

During the water level monitoring events conducted between September 2022 and October 2023, it was determined that the groundwater elevation is highest around monitoring well MW-01R, consistent with observations made by Golder between October and December 2021 (Golder, 2022). Groundwater contour maps from October 2021, September 2022, and June 2023, respectively, show groundwater flow beneath Unit 3A/B Impoundments is consistently west toward the Grand River (**Appendix B**). Groundwater flow beneath Units 1/2 Impoundment is seasonably and spatially variable; flow is generally northward toward the north wetland shown on **Figure 2**, eastward from the ponds of Units 1/2 Impoundment toward the wetland, and potentially southward near MW-05. The wetland east of the Units 1/2 Impoundment appears to be a hydraulic sink between the CCR impoundments and the wells situated to the east (PZ-23 through PZ-26, MW-27, MW-33, and MW-34). Groundwater flow in the area east of the internal wetland is consistent with regional groundwater flow and the flow of the Grand River toward the west.

The uppermost aquifer, which extends from the water table approximately 1 to 6 feet below the ground surface to a maximum depth of 45 feet below surface on the western side of the island. The aquifer consists of fine sand with gravel and silt lenses, clay, peat, ash, and municipal solid waste illustrated on the logs within **Appendix C**. All boring logs used to create the cross sections in **Appendix D** are contained within **Appendix C**. A silty clay is observed at 20.8 feet below ground surface at PZ-26 on the eastern side of the island to 45 feet below ground surface at PDR-3 on the western side of the island (see cross sections in **Appendix D**). The clay is assumed to be the bottom of the aquifer and was logged in borings CPT-5, MW-12, MW-17, PZ-16, PZ-26, PZ-24, PZ-25, MW-30, PDR-1, and PDR-3 shown in the geologic cross sections for the Site in **Appendix D**. The Cone Penetration Test (CPT) borings used in cross sections are from the *Report of Evaluation for Grand Haven Power Plant Ash Impoundment* (Soils and Structures, 2014). The GEI borings shown in cross sections are from the *Geotechnical Exploration and Engineering Evaluation for Harbor Island Reciprocating Engine Generation Site* (GEI, 2019).

Slug tests were performed at monitoring wells MW-01R, MW-02, MW-04, MW-05, MW-07, MW-08, PZ-17, PZ-20, PZ-26, and MW-31 (Golder, 2021). The average hydraulic conductivity value (between 2 and 4 tests per well), based on tests completed by Golder in 2021, is provided in **Table 1**.

Table 1. Hydraulic Conductivity Values

Well ID	Screen Interval Lithology	Average Hydraulic Conductivity (feet/day)
MW-01R	Silty fine sand with trace refuse and silt	5.41
MW-02	Silty clay and poorly graded fine sand	0.19
MW-04	Well graded fine to medium sand and sandy silt	1.70
MW-05	Fine grained ash with refuse	18.76
MW-07	Sandy peat with shell fragments and silty sand	7.99

Table 1. Hydraulic Conductivity Values		
Well ID	Screen Interval Lithology	Average Hydraulic Conductivity (feet/day)
MW-08	Refuse and clayey sand	7.90
PZ-17	Sand with some gravel and gravelly silt with trace organics	172.51*
PZ-20	Peaty sand and peaty silt	242.25*
PZ-26	Very fine to medium sand with organics	8.34
MW-31	Mucky sand with refuse and sandy peat with refuse	0.36

*This analysis is in question and these wells will be retested in 2024.

The results of the slug testing were consistent in 25 of the 29 tests performed. Generally, hydraulic conductivity values across the Site range from 0.19 feet per day at MW-02 to 18.76 feet/day at MW-05. Higher hydraulic conductivity values were calculated at PZ-17 and PZ-20 (172.51 and 242.25 feet per day, respectively). Due to the unusually high values measured at PZ-17 and PZ-20, these wells will be re-tested. Further monitoring wells MW-06, MW-27, MW-30, MW-38, MW-40 will be slug tested in the third quarter of 2024.

Hydraulic conductivity values are on the lower end when compared to reference values (10^{4} to 10^{-1} feet/day) of fine sand according to Freeze and Cherry (1979); however, the calculated values are consistent with hydraulic conductivity ranges for silt (10 to 10^{-3} feet/day) and glacial till (10^{2} to 10^{-6} feet/day) (Freeze and Cherry, 1979). Historical land use activities, such as dumping of dredge material and refuse, disposal of ash, and coal storage affect localized hydraulic conductivity and groundwater velocity.

Groundwater velocity calculation inputs are in **Table 2**. To address variable groundwater flow directions observed in the potentiometric contour maps in **Appendix B**, groundwater velocity calculations have been performed using data from both January and May 2023 using Darcy's Law. To address the heterogenous nature of the lithology, separate groundwater velocity calculations have been performed for the eastern and western sides of Harbor Island. Slug test data provided by Golder was used to calculate average hydraulic conductivity values for the eastern and western regions (Golder, 2022b). Data provided from PZ-26 was used for calculations on the eastern side of the Island. Hydraulic conductivity values from MW-01R, MW-02, MW-04, and MW-05 were averaged for the western side of the Island.

A porosity value of 0.30 was used based on varying amounts of sand, gravel, and silt observed in borings (Freeze and Cherry, 1979). Horizontal hydraulic gradients and groundwater velocities were higher in January than May of 2023. Groundwater velocities on the eastern side of the Island ranged from 0.014 to 0.058 feet/day. Groundwater velocities on the western side of the Island ranged from 0.046 to 0.162 feet/day.

Table 2. Groundwater Velocity Calculations							
Well Pair	Area of Harbor Island	Hydraulic Gradient		Porosity[1]	Hydraulic Conductivity (feet/day)	Groundwater Velocity (feet/day)	
		Jan. 2023	May 2023			Jan. 2023	May 2023
PZ-25 to PZ-26	East	0.0021	0.0005	0.30	8.34[2]	0.058	0.014
PZ-25 to PZ-23		0.0008	0.0006	0.30	8.34[2]	0.021	0.016
MW-01R to MW-03	West	0.0078	0.0035	0.30	6.23[3]	0.162	0.073
MW-01R to MW-04		0.0065	0.0029	0.30	6.23[3]	0.134	0.061
MW-01R to MW-05		0.0037	0.0022	0.30	6.23[3]	0.077	0.046
MW-01R to MW-10		0.0055	0.0034	0.30	6.23[3]	0.115	0.070

1. Porosity value estimated using reference values for poorly sorted fine to medium sand (Freeze-Cherry, 1979).
2. Average hydraulic conductivity value from Golder (2022) on PZ-26.
3. Calculated by averaging hydraulic conductivity values from wells MW-01R, MW-02, MW-04, and MW-05 (Golder, 2022).

2.0 Groundwater Monitoring Network

Part 115 Rule 299.4905(1)(a) states an HMP shall include a groundwater monitoring well system that complies with the provisions of Rule 299.4906. The following sections describe the respective groundwater monitoring networks for Units 1/2 Impoundment and Unit 3A/B Impoundments. The placement and construction requirements of R 299.4906 have been met for the groundwater monitoring locations (HDR, 2023).

2.1 Units 1/2 Impoundment Monitoring Well Network

Due to the extent of Units 1/2 Impoundment compared to the limits of Harbor Island, and variable groundwater flow direction, a traditional upgradient/downgradient groundwater monitoring system is not possible. Monitoring well locations, however, have been located on all sides of the unit as described herein.

- Background Wells: MW-27, MW-33, and MW-34
- Point of Compliance Wells (i.e. waste boundary wells): MW-06, MW-08, MW-18, MW-19, MW-20, MW-30, and MW-31
- Nature and Extent Wells: MW-07, MW-10, MW-16, MW-17, MW-28, MW-32, MW-36, and MW-37

2.1.1 Background Monitoring Wells

Potentiometric contour maps provided in **Appendix B** indicate the groundwater flow direction across the Site does not allow for traditional upgradient monitoring well locations. Monitoring locations MW-27, MW-33 and MW-34 located are on the eastern side of the Island in or near the soccer fields, and will serve as background wells. A review of groundwater contour maps indicates groundwater does not flow from the CCR units towards the background wells. Therefore, the groundwater monitored at these locations appears to represent groundwater at

Harbor Island that has not been impacted by CCR materials. The lithology observed at the screen interval of the background wells is shown in **Table 3**.

Table 3. Background Monitoring Well Screen Lithology	
Well ID	Lithology of Well Screen Interval
MW-27	Poorly graded peaty sand with trace silt and organics
MW-33	Clayey sand and poorly graded fine to medium sand with wood fragments noted at 6.5 feet below ground surface
MW-34	Poorly graded fine to medium sand with refuse noted at 11 feet below ground surface

This material or combination of materials is consistent across the Island. While the background wells are screened in material that includes trace refuse (e.g. bricks, metal, and wood fragments), this refuse has been encountered in numerous borings across the Island. Due to the presence of refuse in the screen intervals of both background and downgradient monitoring wells, the elevated constituents observed in waste boundary wells can be attributed to CCR and not refuse.

2.1.2 Point of Compliance Monitoring Wells

The certified groundwater monitoring system for the inactive Units 1/2 includes the following point of compliance wells: MW-06, MW-08, MW-18, MW-19, MW-20, MW-30, and MW-31. Given the shallow nature of the groundwater (1.52 to 8.02 feet bgs at downgradient wells) and estimated 6 to 8 feet below surface depth of Units 1/2 impoundment (ERM, 2016). Given the shallow groundwater is located between 1.52 and 8.02 feet below surface, wells screened between 8-14 feet below surface are completely within the uppermost aquifer to detect any impact to groundwater from the CCR units. Monitoring well and piezometer locations are provided in **Figure 2**, and well construction documentation is provided in **Appendix C**. Downgradient compliance well locations are spaced along the waste boundary such that if contaminants were present in the groundwater passing the waste boundary, they would be detected by one or more of the wells. The lithologies across the screened intervals are provided in **Table 4**.

Table 4. Units 1/2 Point of Compliance Well Screen Lithology	
Well ID	Lithology of Well Screen Interval
MW-06	Medium to coarse sand and refuse
MW-08	Clayey medium grained sand and refuse
MW-18	Peaty silt and gravel with sand
MW-19	Peaty silt and peaty sand
MW-20	Peaty silt and peaty sand with refuse
MW-30	Silty sand and peaty sand with refuse
MW-31	Mucky sand and sandy peat with refuse

When the lithologies provided above are compared to screen interval lithologies of the background wells MW-27, MW-33, and MW-34, the materials are consistent and representative of the shallow aquifer. The point of compliance monitoring wells have a screen length of 5 feet and total depths range from 8 to 14 feet below surface. As stated in *CCR Impoundment Ash Delineation at the J.B. Sims Generating Station*, coal ash residuals were observed from surface to approximately 8.5 feet below surface, and groundwater was observed between surface and 13 feet below surface (Golder, 2019c). Monitoring well screen intervals ranging from 3 to 9 feet below surface represent water quality of the uppermost aquifer.

2.1.3 Nature and Extent Monitoring Wells

Because SSLs were identified during the October 2023 sampling event, nature and extent wells are being identified herein to begin to delineate the extent of each contaminant plume on the Island (**Figure 2**). The nature and extent monitoring wells for the Units 1/2 Impoundment are MW-07, MW-10, MW-16, MW-17, MW-28, MW-32, MW-36, and MW-37.

During background monitoring (November 2022 – August 2023), and the first detection/ assessment monitoring event (October 2023), MW-07, MW-10, and MW-32 were utilized as the nature and extent monitoring wells. Following the observation of SSLs in October 2023, the monitoring well network has been expanded to include additional nature and extent wells: MW-16 (previously PZ-16), MW-17 (previously PZ-17), MW-28 (previously PZ-28) and MW-36 (**Figure 2)**. The nature and extent wells were chosen after review of groundwater contour maps in **Appendix B** to sample from areas potentially downgradient of the wells with SSLs.

Monitoring well MW-16 is located south of Units 1/2 Impoundment on the property boundary and south of wells MW-07 and MW-20, which had SSLs during the first detection/assessment monitoring event. As shown in **Figure 3,** and illustrated in groundwater contour maps in **Appendix B**, MW-16 has consistently had the lowest groundwater elevation of the wells nearest to its location. The location has the potential to capture possible contamination along the southern boundary, thus providing additional plume delineation data.

Similar to MW-16, monitoring wells MW-17, MW-36, and MW-37 are south of Units 1/2 and will provide additional data points for plume delineation of identified COIs. As illustrated on **Figure 3**, MW-17, MW-36 and MW-37 have shown consistently high groundwater elevations, however, their locations relative to the southern boundary of Units 1/2 Impoundment is the primary reason for their addition. In relation to MW-18, MW-17 has had consistently higher groundwater elevations during 7 of the 9 monitoring events. As MW-18 has SSLs of arsenic, calcium, fluoride, sulfate, and TDS, and the two events in which groundwater elevation is lower in MW-17, suggest contaminant migration is possible from MW-18 toward MW-17. Therefore, these locations are appropriate for the well network.

Monitoring well MW-28 (formerly PZ-28) is located to the northeast of Units 1/2 Impoundment, near the property boundary. Well MW-08 is the sample location nearest to MW-28 that is sampled. During the October 2023 sampling event, the following SSLs were identified in MW-08: arsenic, chloride, and fluoride. In 8 of the 9 monitoring events, MW-08 had a higher groundwater elevation than MW-28, indicating potential flow from MW-08 toward MW-28, shown

in **Figure 4**. MW-28 also has had lower groundwater elevations than MW-30 and MW-32 in 6 of the 9 monitoring events, both of which have SSLs. The location of MW-28 provides data regarding the eastern extent of possible contamination.

2.2 Unit 3A/B Impoundments Monitoring Well Network

The monitoring well network for the inactive Unit 3A/B Impoundments is as follows:

- Background Wells: MW-27, MW-33, and MW-34
- Point of Compliance Wells (i.e. waste boundary wells): MW-02, MW-03, MW-04, MW-11, and MW-12
- Nature and Extent Wells: MW-01R, MW-09, MW-10, and MW-38

2.2.1 Background Monitoring Wells

Potentiometric contour maps provided in **Appendix B** indicate the groundwater flow direction across the Site does not allow for traditional upgradient monitoring well locations, however, EGLE approved monitoring locations MW-27, MW-33 and MW-34 located on the eastern side of the Island in or near the soccer fields as background monitoring wells. A review of groundwater contour maps indicates groundwater does not flow from the CCR units towards the background wells. Therefore, water quality observed at the background monitoring wells represents groundwater that remains unimpacted by CCR materials. The background wells are screened in peaty sand with trace silt and poorly graded sand with trace refuse. This material or combination of materials is consistent across the Island. Due to the presence of refuse in the screen intervals of both background and downgradient monitoring wells, the elevated constituents observed in waste boundary wells can be attributed to CCR and not refuse.

2.2.2 Point of Compliance Wells

The certified groundwater monitoring system for the inactive Unit 3A/B Impoundments includes the following point of compliance wells: MW-02, MW-03, MW-04, MW-11, and MW-12. Since Unit 3A/B was an aboveground CCR impoundment, the target aquifer also is the shallow glacial aquifer as with Units 1/2 Impoundments. Groundwater elevations beneath the Unit 3A/B range from 579.42 to 582.35 feet above mean sea level (feet amsl) and the base elevation of the clay liner is reported at 585.0 feet amsl (Golder, 2020a). Given the proximity of the base of the clay liner to observed groundwater elevations validates the monitoring of the surficial aquifer for potential groundwater impacts.

Monitoring well and piezometer locations are provided in **Figure 2**, and well construction documentation is provided in **Appendix C**. The screened lithology of the downgradient compliance wells is provided in **Table 5**.

A comparison of compliance monitoring well screened lithology to background well screened lithology shows consistency in material type and therefore representative of surficial aquifer water quality. The screen lengths of compliance wells are 5 feet and total depths range from 8 to 20 feet below surface or 575.64 to 580.03 feet amsl. Given the base elevation of the clay liner of Unit 3A/B of 585.0, and the total depths of compliance monitoring wells, the screen depths are appropriate.

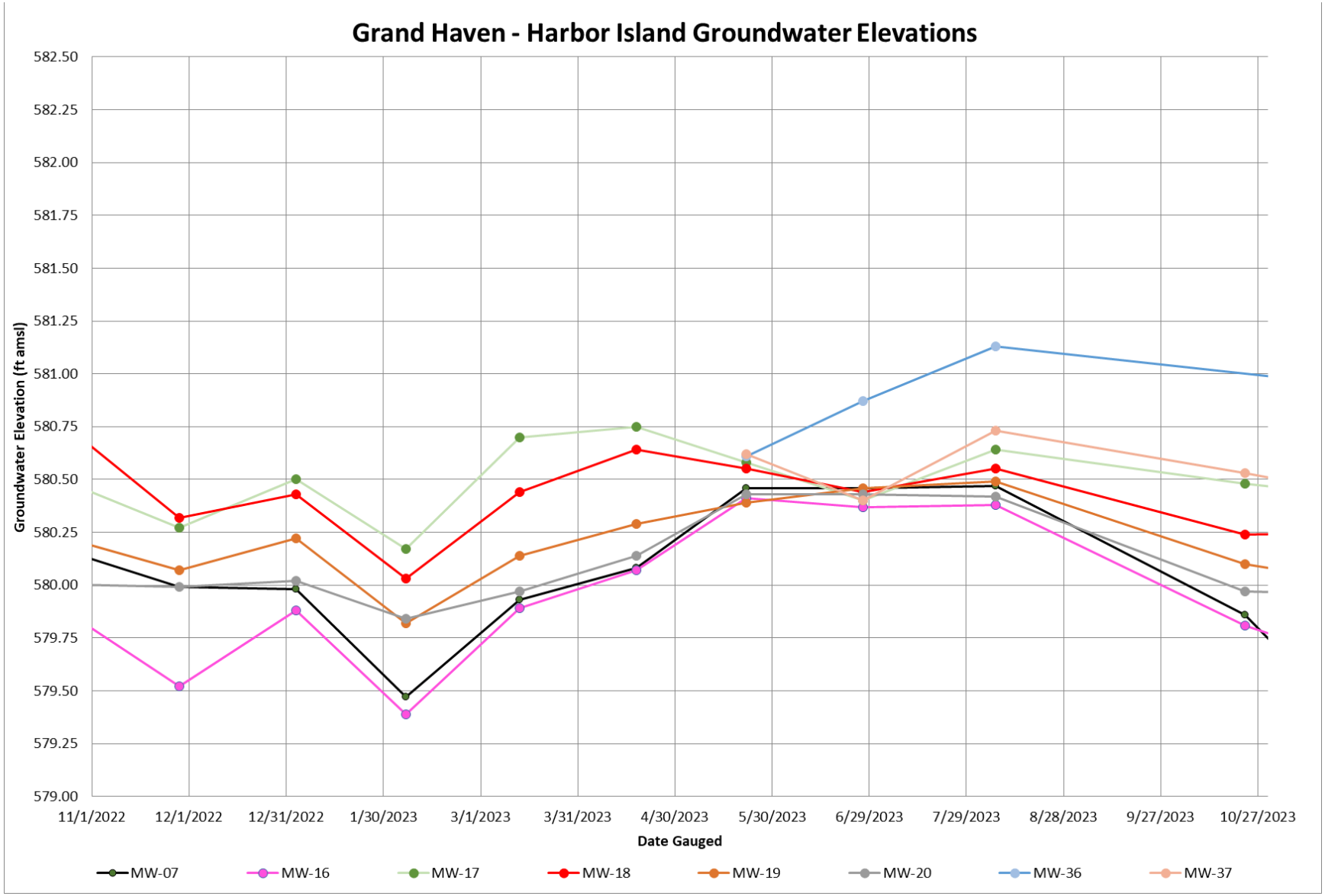


Figure 3. Hydrograph of Monitoring Wells South of Units 1/2 Impoundment

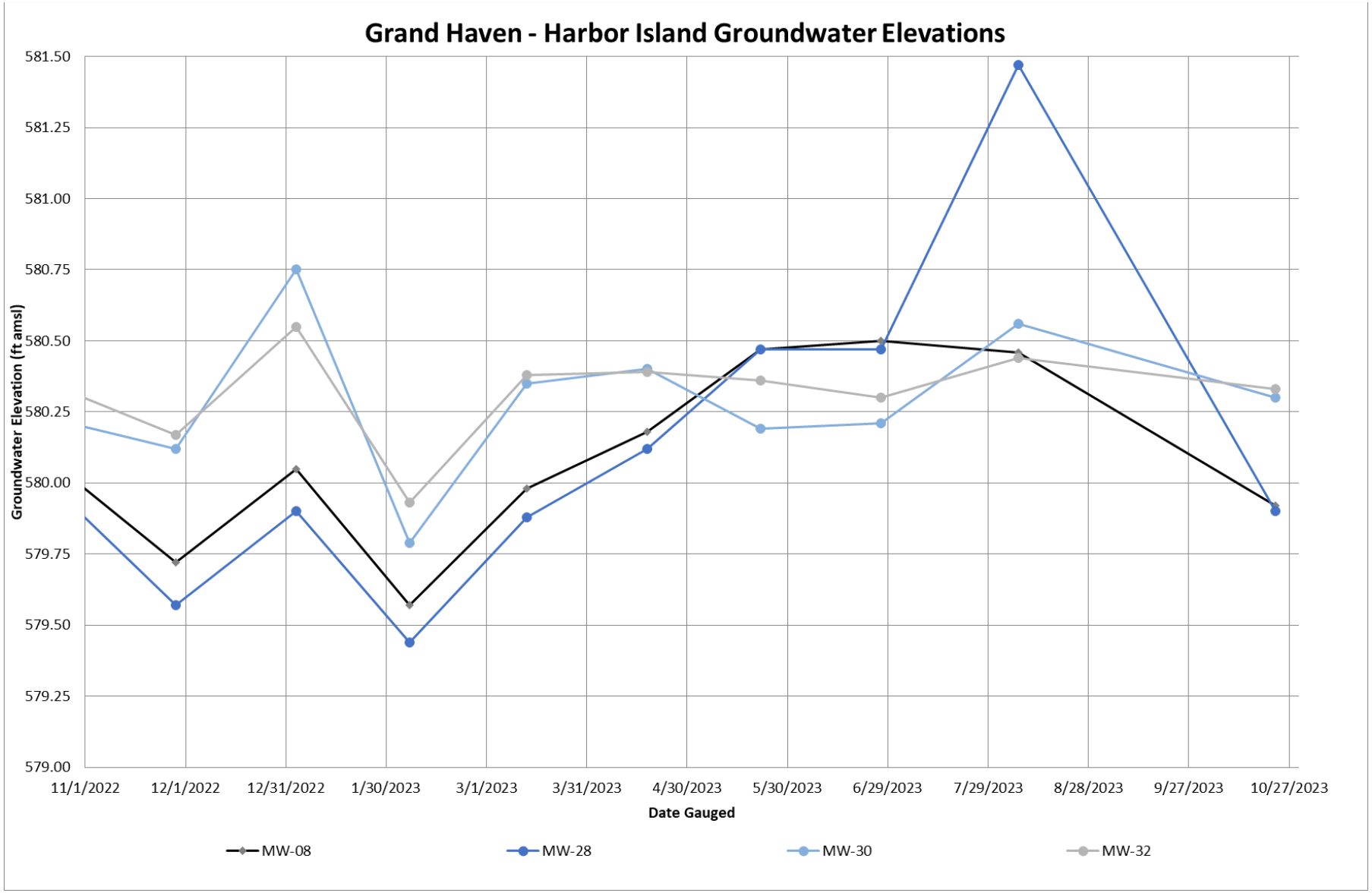


Figure 4. Hydrograph of Monitoring Wells North of Units 1/2 Impoundment

Table 5. Unit 3A/B Impoundment Point of Compliance Well Screen Lithology	
Well ID	Lithology of Well Screen Interval
MW-02	Silty clay and silty sand
MW-03	Clayey silt, poorly graded fine sand, and sandy silt
MW-04	Poorly graded fine sand and sandy silt
MW-11	Sand with refuse, and sandy clay
MW-12	Clayey peat and sand

2.2.3 Nature and Extent Monitoring Wells

The nature and extent monitoring locations for the Unit 3A/B Impoundments are MW-01R, MW-09, MW-10, and MW-38 (**Figure 2**). MW-09 and MW-10 are located within 20 feet from the shoreline. There is no room to locate any additional wells between the existing well location and the shoreline for the purpose of plume delineation. Monitoring well MW-01R has consistently had a higher groundwater elevation than the majority of the compliance wells for Unit 3A/B Impoundment and is unlikely to receive contaminants from Units 1/2 Impoundment, however data from MW-01R will be useful in plume delineation. Potentiometric contour maps provided in **Appendix B** indicate groundwater flow beneath Unit 3A/B is primarily west or northwest. Prior to monitoring MW-36 through MW-40, however, potential groundwater flow to the southwest was illustrated. **Figure 5** indicates that groundwater elevations at MW-38 are consistently lower than MW-01R and MW-12. As both wells have SSLs identified, potential contaminant transport to the southwest is possible.

2.3 Water Level Only

The following piezometers are monitored for water level only: MW-05, PZ-13, PZ-14, PZ-21, PZ-22, PZ-23, PZ-24, PZ-25, PZ-26, PZ-29, MW-35, MW-39, and MW-40, shown on **Figure 2**.

Piezometers PZ-21, PZ-22, and PZ-29 are located on the eastern side of the waste boundary. The Golder Field Summary Report 2022 stated that proper bentonite seals were unable to be verified during well installation and groundwater sampling at PZ-21, PZ-22, and PZ-29 would be unrepresentative of groundwater quality (Golder, 2022b). Due to the locations in the wetland, access to PZ-21, PZ-22, and PZ-29 is limited and water levels will be collected if conditions allow.

Pressure transducers were installed in December 2023 in 17 wells, shown on **Figure 1**. The objective of the transducer installation is to evaluate the seasonal groundwater/surface water interaction. Groundwater contour maps provided in **Appendix B** indicate seasonal variations that cause groundwater to discharge to surface water and surface water contributing to groundwater during various periods of the year. The pressure transducers collect water elevations on an hourly interval and will provide high resolution data to further develop the conceptual site model and aid in the development of remediation alternatives at Harbor Island.

2.4 Surface Water Monitoring Locations

In addition to the monitoring wells and piezometers referenced above, ten surface water gauging locations will continue to be monitored for water levels including: seven staff gauges (SG-01, SG-02, SG-03, SG-04R, SG-05, SG-06, and SG-07) and three stilling wells (STW-1, STW-2, STW-3).The surface water gauging locations are shown on **Figure 2** and were placed to gather water level data on interior surface water bodies as well as north channel, Grand River, and southern channel.

Surface water monitoring locations are shown on **Figure 2** and sampled at the same frequency as the groundwater sampling events for the same list of constituents as the groundwater. Samples were collected using a clean container affixed to a pole. As noted in **Appendix E**, before samples were collected, the following water quality parameters were measured and recorded: pH, turbidity, conductivity, dissolved oxygen, temperature, and oxidation reduction potential. The surface water samples were analyzed for the same constituents as groundwater samples. The analytical results are provided in the quarterly reports.

2.5 Well Construction

The boreholes for monitoring wells were drilled by a licensed well driller. Each well was constructed with 2-inch diameter, Schedule 40 PVC casing and screen with 0.010-inch screen slots. The wells were constructed using 5 feet of screen interval. In compliance with Michigan R 299.4906, the monitoring well construction included the placement of sieve size 10-20 washed silica sand in the annular space around the well screen, and approximately 2 feet above for the filter pack, to enable the collection of groundwater samples and maintain borehole integrity. Annular space above the sampling interval was sealed using coated bentonite pellets that extend from the top of the filter pack to the surface to prevent contamination of samples and groundwater. Monitoring wells were constructed with a locking steel stick up cover, except for MW-33, and MW-34 that were installed in the soccer field and were constructed with a flush mount cover. The wells were constructed in a manner that is properly vented and capped per R 299.4906(8). The monitoring wells have signage denoting the well name, designation, and relation to the Former J.B. Sims Generating Station groundwater monitoring program. Monitoring wells were developed and surveyed. See **Table 6** below for construction details for monitoring wells. Borings logs are provided in **Appendix C**. Further well construction details are found in the *Well Installation Report* (HDR, 2023).

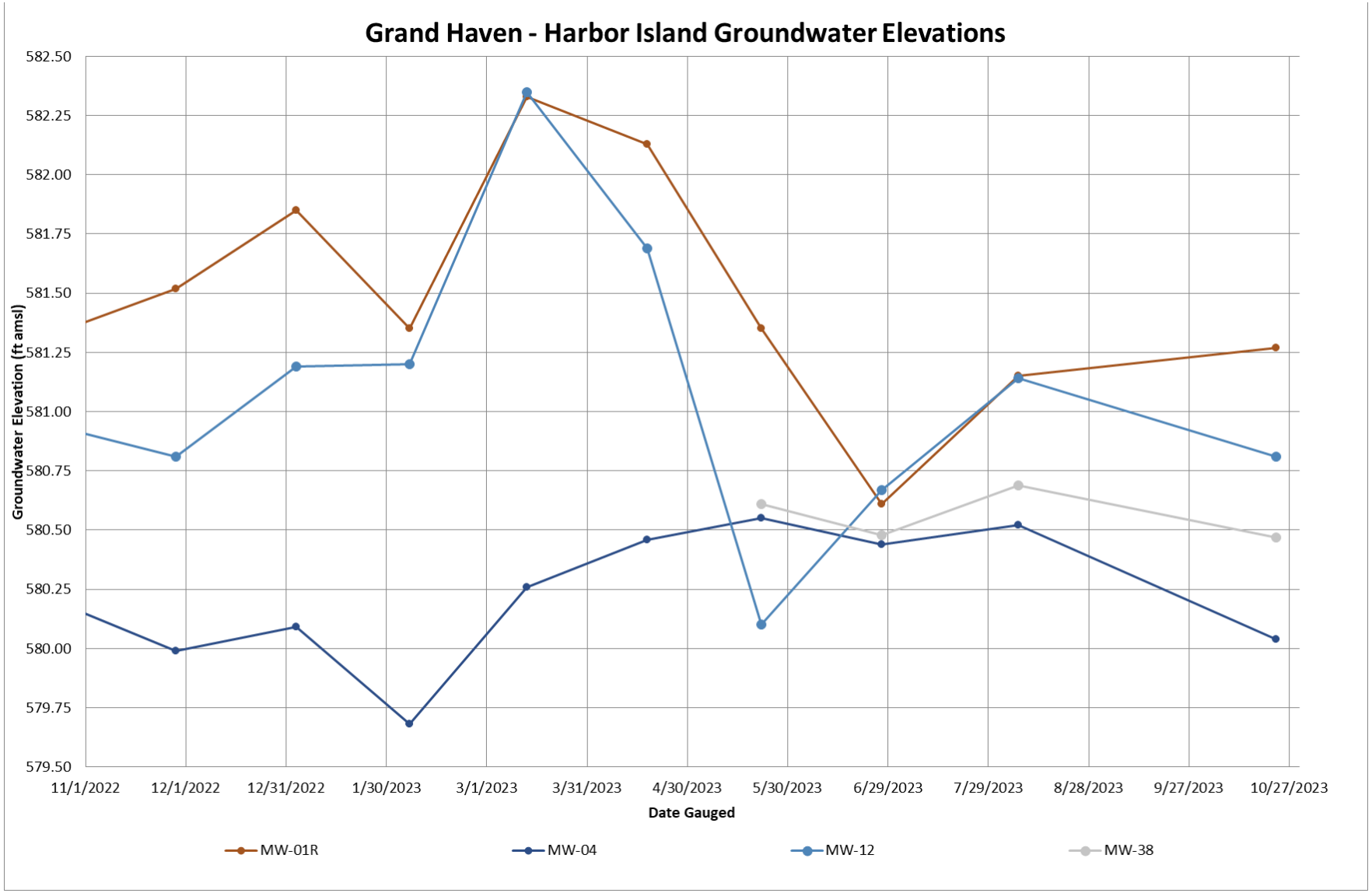


Figure 5. Hydrograph of Monitoring Wells South of Unit 3A/B Impoundment

Table 6. Well Construction Details

Well I.D.	Northing	Easting	Date Installed	Ground Surface Elevation	Top of Casing (Staff Gauge) Elevation	Total Boring Depth (feet bgs)	Total Well Depth (feet bgs)	Stickup	Screen length (feet)	Screen Interval (feet bgs)	Comments
Monitoring Wells											
MW-01	578100.82	12624468.08	1/18/2017	584.34	587.29	12.3	12.3	2.95	5.0	4.0-9.0	Abandoned
MW-01R	578101.30	12624432.00	5/1/2020	585.73	588.45	10.0	9.0	2.72	5.0	4.0-9.0	
MW-02	578241.91	12624222.64	1/18/2017	592.67	595.64	21.0	20.0	2.97	5.0	15.0-20.0	
MW-03	578125.03	12624180.40	1/18/2017	590.42	593.08	17.0	17.0	2.66	5.0	12.0-17.0	
MW-04	578003.96	12624165.24	1/18/2017	588.66	591.49	17.0	15.0	2.83	5.0	10.0-15.0	
MW-05	577970.06	12624634.16	5/22/2018	585.31	587.62	12.0	9.0	2.31	5.0	4.0-9.0	
MW-06	578229.40	12624525.24	5/22/2018	588.22	590.40	17.0	14.0	2.18	5.0	9.0-14.0	
MW-07	577585.75	12625513.56	5/22/2018	583.65	586.49	16.0	16.0	2.84	5.0	11.0-16.0	
MW-08	578261.14	12625341.26	5/22/2018	582.74	585.34	15.0	9.0	2.60	5.0	4.0-9.0	
MW-09	578241.35	12624185.62	8/12/2019	586.80	589.51	12.0	12.0	2.71	5.0	7.0-12.0	
MW-10	578367.40	12624470.20	8/12/2019	583.71	586.73	10.0	10.0	3.02	5.0	5.0-10.0	
MW-11	578236.87	12624377.19	8/19/2021	592.46	595.27	40.0	15.0	2.81	5.0	10.0-15.0	
MW-12	577987.57	12624312.28	8/17/2021	584.94	588.03	40.0	8.0	3.09	5.0	3.0-8.0	
MW-16	577273.65	12625194.83	8/25/2021	582.18	584.96	35.0	8.0	2.78	5.0	3.0-8.0	
MW-17	577652.81	12624744.16	8/17/2021	584.03	587.02	40.0	8.0	2.99	5.0	3.0-8.0	
MW-18	577919.12	12624742.18	8/18/2021	584.12	587.22	34.0	8.0	3.1	5.0	3.0-8.0	
MW-19	577938.05	12624957.16	8/20/2021	583.06	585.86	25.0	8.0	2.80	5.0	3.0-8.0	
MW-20	577722.50	12625131.40	8/18/2021	582.43	585.74	34.0	8.0	3.31	5.0	3.0-8.0	
MW-27	578303.89	12626551.81	8/23/2021	581.87	585.09	40.0	8.0	3.22	5.0	3.0-8.0	
MW-28	578314.93	12625722.71	8/23/2021	585.11	588.07	29.5	9.0	2.96	5.0	4.0-9.0	
MW-30	578196.17	12624990.23	8/19/2021	583.02	585.80	34.0	8.0	2.78	5.0	3.0-8.0	
MW-31	578307.16	12624752.70	9/1/2021	582.56	585.73	27.0	8.0	3.17	5.0	3.0-8.0	
MW-32	578348.32	12624980.14	8/30/2021	583.08	586.26	40.0	8.0	3.18	5.0	3.0-8.0	
MW-33	578403.66	12626765.24	11/28/2022	583.23	582.81	7.0	7.0	-0.42	5.0	2.0-7.0	
MW-34	578225.86	12627140.54	11/28/2022	584.69	584.44	15.0	13.0	-0.25	5.0	8.0-13.0	

Table 6. Well Construction Details

Well I.D.	Northing	Easting	Date Installed	Ground Surface Elevation	Top of Casing (Staff Gauge) Elevation	Total Boring Depth (feet bgs)	Total Well Depth (feet bgs)	Stickup	Screen length (feet)	Screen Interval (feet bgs)	Comments
MW-36	577753.42	12624605.70	1/30/2023	589.12	585.62	20.0	9.0	-3.51	5.0	4.0-9.0	
MW-37	577696.74	12624393.06	1/30/2023	585.59	589.62	20.0	9.0	4.03	5.0	4.0-9.0	
MW-38	577782.86	12624225.55	1/30/2023	586.26	590.51	20.0	9.0	4.25	5.0	4.0-9.0	
Piezometers											
PZ-13	577623.94	12624190.94	8/17/2021	583.23	585.94	34.0	9.0	2.71	5.0	4.0-9.0	
PZ-14	577191.85	12624160.04	8/16/2021	583.46	586.30	35.0	9.0	2.84	5.0	3.0-8.0	
PZ-15	577062.51	12624730.23	8/25/2021	589.32	592.38	40.0	20.0	3.06	5.0	15.0-20.0	
PZ-21	577941.39	12625280.33	8/30/2021	N/A	583.32	30.0	9.0	N/A	5.0	4.0-9.0	Seal unable to be verified, no groundwater sampling
PZ-22	578056.88	12625387.96	8/31/2021	N/A	583.42	22.0	9.0	N/A	5.0	4.0-9.0	Seal unable to be verified, no groundwater sampling
PZ-23	577627.71	12625841.35	8/25/2021	584.39	587.21	25.0	9.0	2.82	5.0	4.0-9.0	
PZ-24	577884.7	12625979.33	8/24/2021	583.92	587.25	30.0	9.0	3.33	5.0	4.0-9.0	
PZ-25	577703.65	12626240.18	8/24/2021	583.46	586.37	30.0	8.0	2.91	5.0	3.0-8.0	
PZ-26	578114.39	12626145.22	8/23/2021	583.81	586.27	30.0	8.0	2.46	5.0	3.0-8.0	
PZ-29	578138.08	12625241.56	8/30/2021	N/A	583.49	35.0	9.0	N/A	5.0	4.0-9.0	Seal unable to be verified, no groundwater sampling
MW-35	579293.34	12627013.41	1/30/2023	590.42	589.72	18.0	12.30	-0.70	5.0	7.3-12.3	
MW-39	577488.79	12624528.83	1/31/2023	583.27	587.36	20.0	7.0	4.09	5.0	2.0-7.0	
MW-40	577313.68	12624636.21	1/31/2023	582.75	586.78	10.0	6.5	4.03	5.0	1.5-6.5	
Staff Gauges											
SG-01	578234.49	12624159.06	8/12/2019	NA	585.10	NA	NA	NA	NA	NA	
SG-02	578287.85	12624784.61	8/12/2019	NA	583.43	NA	NA	NA	NA	NA	
SG-03	578201.99	12624858.11	8/12/2019	NA	584.37	NA	NA	NA	NA	NA	
SG-04	577984.43	12624649.47	8/12/2019	NA	584.53	NA	NA	NA	NA	NA	

Table 6. Well Construction Details

Well I.D.	Northing	Easting	Date Installed	Ground Surface Elevation	Top of Casing (Staff Gauge) Elevation	Total Boring Depth (feet bgs)	Total Well Depth (feet bgs)	Stickup	Screen length (feet)	Screen Interval (feet bgs)	Comments
SG-04R	577966.13	12624647.67	6/9/2020	NA	585.04	NA	NA	NA	NA	NA	
SG-05	577717.81	12624888.51	8/12/2019	NA	584.83	NA	NA	NA	NA	NA	
SG-06	578227.56	12625365.56	8/12/2019	NA	584.88	NA	NA	NA	NA	NA	
SG-07	577514.07	12625667.88	2/12/2024	NA	577.32	NA	NA	NA	NA	NA	
Stilling Wells											
STW-1	578433.87	12625522.16	4/17/2023	NA	583.03	NA	NA	NA	1	NA	
STW-2	577340.3	12625423.18	4/17/2023	NA	586.16	NA	NA	NA	5	NA	
STW-3	577771.11	12624083.74	4/17/2023	NA	592.49	NA	NA	NA	5	NA	

3.0 Groundwater Sampling and Analysis

3.1 CCR Rule Compliance Monitoring Program

This HMP was prepared in compliance with Michigan Part 115. Section 11512(a)(1) of Part 115 requires an approved HMP that complies with Rules 299.4440 to 299.4445, if applicable, and Rules 299.4905 to 299.4908. Since EPA has not authorized Michigan's CCR program, both the Federal CCR Rule (40 CFR Part 257) and Michigan Part 115 apply and are included in the following sections.

3.1.1 Background Monitoring

To comply with CCR § 257.94, eight rounds of upgradient and downgradient monitoring were performed between November 28, 2022 and August 8, 2023. Samples collected under the background monitoring phase were compliant with CCR Rule §257.94(b). Background monitoring samples were analyzed for the parameters listed in **Table 7**. The data gathered from the eight rounds of background water quality sampling at background monitoring wells MW-27, MW-33, and MW-34 was used to develop BTVs for each COI. The statistical methods for development of the BTV are described in the Statistical Procedures Plan **Appendix F**.

Table 7. Groundwater Quality Parameters in Compliance with the CCR Rule Part §257 and Michigan Part 115

Appendix III Constituents for Detection Monitoring
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids (TDS)
Appendix IV Constituents for Assessment Monitoring
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium

Table 7. Groundwater Quality Parameters in Compliance with the CCR Rule Part §257 and Michigan Part 115
Radium 226 and 228 combined
Additional Parameters
Total Suspended Solids (TSS)
Michigan Part 115 Constituents for Assessment Monitoring
Copper
Iron
Nickel
Vanadium
Silver
Zinc

3.1.2 Detection Monitoring

Upon completion of background sampling, the report *Background Water Quality Statistical Certification* was submitted to EGLE and posted on the CCR compliance website and entered into the operating record (HDR, 2024). That document outlines the statistical methods used to calculated BTVs for Appendix III, Appendix IV, and TSS constituents. The results of the first detection/assessment monitoring event (October 2023) were compared to the BTVs and values that exceeded are considered SSIs. The memorandum *Former J.B. Sims Generating Station Determination of Statistically Significant Increases over Background per §257.93(h)(2) and R 299.4440(8) of the Michigan Part 115 Rules* documents the process to identify the SSIs (HDR, 2024a). The following list of SSIs were identified after the October 2023 sample event, and are considered revised SSIs:

- Boron in MW-03, MW-04, MW-06, MW-08, MW-11, and MW-31
- Calcium in MW-18, MW-19, MW-30.
- Chloride in MW-08, MW-19, MW-30.
- Fluoride in MW-08, MW-11, MW-18, MW-19, MW-30, MW-31.
- Sulfate in MW-11, MW-18, MW-19, MW-30.
- TDS in MW-11, MW-18, MW-19, MW-30.

3.1.3 Assessment Monitoring

The first CCR Rule compliance assessment monitoring sampling event was conducted in October 2023. Samples were analyzed for COIs in Appendix IV of Part 257. In accordance with 40 CFR § 257.95(e-g), Appendix IV monitoring results were compared to BTVs and the GPS. The results were documented in the *Determination of Statistically Significant Levels over Groundwater Protection Standards per §257.95(g) and Michigan Rule R 299.4441* (HDR, 2024c). In accordance with 40 CFR § 257.95(g-h), groundwater protection standards were developed for each Appendix IV COI and identified concentrations of COIs at SSLs above the GPS at downgradient monitoring locations (HDR, 2024c). Assessment monitoring will continue quarterly for the foreseeable future. The following list of SSLs were identified after the October 2023 sampling event and are considered revised SSLs:

- Arsenic – MW-08, MW-18
- Fluoride – MW-01R, MW-02, MW-10, MW-31
- Lithium – MW-01R, MW-02, MW-09, MW-10, MW-30, MW-32

3.2 Part 115 Compliance Monitoring Program

Following the revisions to the groundwater monitoring network, eight rounds of background monitoring were conducted from November 2022 through August 2023 to achieve statistical strength and capture seasonal variation. The first detection/assessment monitoring event was conducted in October 2023 and additional events will be conducted quarterly for the foreseeable future. The following sections will address the details of background, detection, and assessment monitoring.

3.2.1 Background Monitoring

The eighth round of background monitoring was collected in August 2023 for the well networks in **Section 2**. Background monitoring samples were analyzed for the parameters listed in **Table 7**, in compliance with Michigan Part 115 regulation and CFR 40 § 257.94(b). The data gathered for background water quality was used to develop BTVs for each COI listed in **Table 7**.

3.2.2 Detection Monitoring

Following the completion of background sampling, as specified under Michigan R 299.4440(8), the *Background Water Quality Statistical Certification* was submitted (HDR, 2024). That document outlines the approach and selection of the statistical method for each COI listed in **Table 7** for each CCR unit. The water quality data collected from the monitoring wells located upgradient of the CCR units has been compiled and statistically analyzed to develop the original BTVs for the impoundments. The statistical method chosen to represent background water quality is the upper prediction limit (UPL) and is one of the methods described in Part 115 at §324.11511a(3).

The results of the first detection/assessment monitoring event (October 2023) were compared to the UPLs and values that exceeded UPLs are considered SSIs. The memorandum *Former J.B. Sims Generating Station Determination of Statistically Significant Increases over Background per §257.93(h)(2) and R 299.4440(8) of the Michigan Part 115 Rules* documents the process to identify the SSIs (HDR, 2024a). The SSIs identified for Units 1/2 Impoundment include boron, calcium, fluoride, sulfate, and total dissolved solids (TDS). The SSIs identified for Unit 3A/B include boron, calcium, chloride, fluoride, sulfate, and TDS. The following list of SSIs that were identified after the October 2023 sample event are considered “new” SSIs because they were not previously identified in 2019 Golder memorandum. The following SSIs were identified following the October 2023 groundwater monitoring event:

- Boron in MW-03, MW-04, MW-06, MW-08, MW-11, and MW-31
- Calcium in MW-18, MW-19, MW-30.
- Chloride in MW-08, MW-19, MW-30.
- Fluoride in MW-08, MW-11, MW-18, MW-19, MW-30, MW-31.
- Sulfate in MW-11, MW-18, MW-19, MW-30.

- TDS in MW-11, MW-18, MW-19, MW-30.

3.2.3 Assessment Monitoring

The identification of SSIs during detection monitoring at both Units 1/2 Impoundment and Unit 3A/B Impoundments indicates both CCR units maintain assessment monitoring status and develop GPS. Under the assessment monitoring program, the Unified Guidance recommends the upper tolerance limit (UTL) to represent the background concentration for this purpose. As required in Michigan R 299.4441(9), the CCR owner must establish GPS for each constituent detected in the groundwater. The GPS for the Part 115 compliance program shall be defined as the lowest of the following:

- U.S. EPA Maximum Contaminant Level (MCL) for constituents for which an MCL has been established;
- The applicable cleanup criteria for that constituent for groundwater as established pursuant to section 20120a of Act 451.
- Constituents for which the background level (UTL) is higher than the MCL or applicable cleanup criteria for groundwater, the background value shall be the GPS.

The UTL, MCLs, applicable state cleanup criteria, and Site GPS for both CCR units are provided in **Appendix F**.

The October 2023 sampling data from compliance wells was compared to the GPS values provided in **Appendix F**, and several COIs were found to exceed GPS at both CCR units. To determine the statistical significance of the observed concentration, the 95LCL was calculated for each of the downgradient wells. The 95LCLs were compared to GPS value and several COIs were found to have exceeded GPS, resulting in SSLs (HDR, 2024b). The identification of SSLs for both CCR units indicates both will remain in assessment monitoring. In compliance with Part 115 regulations, a Response Action Plan was submitted to EGLE within 45 days of the identification of SSIs. The Response Action Plan also was posted on the Site website and entered into the operating record on January 24, 2024. The document demonstrated the understanding of the water quality and the actions that will be taken to mitigate unacceptable risk associated with the identified release from the CCR units. According to 40 CFR §257.26(a), the Assessment of Corrective Measures (ACM) is due to be initiated within 90 days of the identification of SSLs. Following the identification of SSLs, the monitoring well network was revised as noted above to include additional wells for the purpose of delineating the COI plumes.

In compliance with 40 CFR §257.26(b), following each assessment monitoring event the LCLs will be calculated and compared to GPS to evaluate for SSLs. If additional wells are identified having SSLs, or additional COIs are identified at SSLs above GPS, a notification will be submitted to EGLE, entered into the operating record, and posted to the Harbor Island website.

3.3 Monitoring Well Schedule and Frequency

The required eight rounds of Background Monitoring ended in August 2023 and the initial Detection/Assessment monitoring was performed in October 2023. Assessment Monitoring will continue on a quarterly basis at the designated monitoring wells in the monitoring well network. The monitoring well sample locations are contained in **Table 8**, the monitoring event schedule and frequency are contained in **Table 9**.

Table 8. Groundwater Sample Locations

Background Monitoring Wells (Units 1/2 Impoundment and Unit 3A/B Impoundments)	MW-27, MW-33, MW-34	
Point of Compliance Monitoring Wells	Units 1/2 Impoundments	MW-06, MW-08, MW-18, MW-19, MW-20, MW-30, MW-31
	Unit 3A/B Impoundments	MW-02, MW-03, MW-04, MW-11, MW-12
Nature and extent monitoring wells	MW-01R, MW-07, MW-09, MW-10, MW-16, MW-17, MW-28, MW-32, MW-36, MW-38	
Total monitoring wells to be sampled per event	25	
QC samples to be collected per sample event	2 (Field Duplicate)	
Total samples to be submitted for laboratory analysis per sample event	27	

Table 9. Groundwater Sample Collection Frequency

Type of Monitoring	Year	Frequency	Number of Sample Events	Approximate Sample Collection Schedule	Water Quality Constituents of Interest[1]
Background Monitoring	2022 – 2023 (Completed)	5-Week	8	Completed first 8 events, ongoing quarterly and will be updated biennially	Appendix III, Appendix IV, Part 115, TSS
Detection Monitoring	2023 (Completed)	Semiannually	Continuous until Closure or Initiation of Assessment Monitoring	October 2023 (Completed)	Appendix III, TSS, Iron
Assessment Monitoring	2023-ongoing	Quarterly	Ongoing until return to Detection Monitoring or until Closure	First event - October 2023 Ongoing	Appendix III, Appendix IV, Part 115, TSS

1.See Table 6 for a list of constituents.
2.Federal CCR Rule and Part 115 require a minimum sampling frequency of semi-annual. Due to the variable nature of the groundwater flow direction, the assessment monitoring will be conducted quarterly for the foreseeable future.

3.4 Sampling Procedures

Appendix F provides the proposed sample collection and safety procedures. Procedures are consistent with the EPA guidelines and R 299.4440-4445 and R 299.4905-4908 of the Part 115 rules. Groundwater samples will be collected by a Contracted Consultant (CC).

3.4.1 Quality Control

Quality Control (QC) checks of both the field procedures and laboratory analyses will be used to assess and document data quality and to identify discrepancies in the measurement process that need correction. Quality control samples will be used to assess various data quality parameters such as representativeness of the environmental samples, the precision of sample collection and handling procedures, the thoroughness of the field equipment decontamination procedures, and the accuracy of laboratory analyses. In addition, sample containers, preservation methods, and holding times will be in accordance with QC requirements.

The analytical laboratory will use a series of QC samples, as identified in the laboratory's Quality Assurance Plan and specified in the standard analytical methods. The types of samples include method blanks, surrogate spikes, laboratory control samples, laboratory control sample duplicates, matrix spikes, and matrix spike duplicates. Analyses of QC samples will be performed for samples of similar matrix type and concentration and for each sample batch. Laboratory accuracy is assessed through the analysis of matrix spike/matrix spike duplicate (MS/MSD) samples. The number of MS/MSD analyses is based on laboratory quality control standards. The approved contract laboratory will run MS/MSD samples at a rate of one per batch analyzed. MS/MSD analysis results reflect the ability of the laboratory and method to accurately determine the quantity of an analyte in a particular sample. The measurement of "standards", or materials of accepted reference values, provides an assessment of the accuracy of laboratory instruments and analytical methods. Accuracy will be evaluated through the use of EPA Quality Control Samples or Standard Reference Materials. Accuracy at the laboratory is expressed as percent recovery of the control sample. Laboratory MS recovery requirement is 80 to 120 percent, and MSD maximum difference is 20 percent.

The precision of field sampling procedures will be evaluated by collection and analysis of field duplicate samples. Duplicate samples are two or more samples collected or processed so that the samples are considered to be essentially identical in composition. Duplicate samples will be used to evaluate the reproducibility (precision) of analyte concentration values reported by the laboratory. Although two replicates are not adequate to assess precision, they can be used to show whether variability of results for the samples is within the range of expected precision.

The number of duplicate samples to be collected would typically be at a rate of ten percent (approximately one for every ten samples). One duplicate sample per CCR unit for each sample event. Sample identification for duplicates will be the same as the sample identification with the addition of a "T" (e.g. MW-5 and MWT-5). The precision will be measured through the evaluation of relative percentage differences (RPDs) between sample and duplicate sample and between matrix spike and matrix spike duplicates and calculated as follows:

$$\text{Relative Percentage Difference (\%)} = \left[\frac{|SA\ concentration - SB\ concentration|}{Average\ concentration\ of\ SA+SB}\right] x\ 100$$

Where SA denotes Sample A; SB denotes the duplicate, sample B.

Duplicate RPD requirement is 20 percent. Accuracy is measured by the difference between the measured or observed value and the true or assigned value. Accuracy in the field is assessed through the adherence to sample handling, preservation, and holding times.

Calibration of field equipment is performed by the rental equipment company prior to each rental, and calibration records are included with the equipment. Therefore, calibration of field equipment measuring field parameters (YSI or similar) will be calibrated at the beginning of each sample event. The calibration record from the equipment company will be reviewed for calibration accuracy. The sample crew will photograph the calibration documentation provided with the equipment.

Laboratory data will be reviewed, validated and qualified, if necessary, prior to use. The laboratory data validation procedure is described in **Section 3.5**.

3.5 Monitoring Parameters and Analytical Methods

3.5.1 Sample Parameters

Parameters to be analyzed for each semiannual assessment monitoring event are shown on **Table 10**. These parameters include the constituents required for groundwater sampling by Part 115. Analytical testing of water samples will be performed by the approved contract laboratory. Field measurements will be collected by the sampling team during the purging process. The field measurements are specific conductance, temperature, dissolved oxygen, pH, turbidity, and oxidation/reduction potential (ORP).

Table 10. Groundwater Quality Parameters For Analysis

Constituent	Background Monitoring	Detection Monitoring	Assessment Monitoring
Antimony	✓		✓
Arsenic	✓		✓
Barium	✓		✓
Beryllium	✓		✓
Boron	✓	✓	✓
Cadmium	✓		✓
Calcium	✓	✓	✓
Chloride	✓	✓	✓
Chromium	✓		✓
Cobalt	✓		✓
Copper	✓		✓
Fluoride	✓	✓	✓
Iron	✓	✓	✓
Lead	✓		✓

Table 10. Groundwater Quality Parameters For Analysis			
Lithium	✓		✓
Mercury	✓		✓
Molybdenum	✓		✓
Nickel	✓		✓
pH	✓	✓	✓
Radium 226 and 228	✓		✓
Selenium	✓		✓
Silver	✓		✓
Sulfate	✓	✓	✓
Thallium	✓		✓
Total Dissolved Solids	✓	✓	✓
Vanadium	✓		✓
Zinc	✓		✓
Additional Constituents			
Total Suspended Solids	✓	✓	✓

3.5.2 Sample Analysis

Table 11 lists the COIs that will be analyzed by the contracted laboratory and the analytical methods, preservation, and sample holding times.

Table 11. Water Quality Parameters For Analysis						
Parameter	**Sample Bottle***	**Units to be reported**	**Preservation**	**Method**	**Holding Time**	**Laboratory Reporting Limits**
Antimony	250 mL plastic	mg/L	Nitric Acid	200.7	6 mos	0.005
Arsenic	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.002
Barium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.150
Beryllium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.001
Boron	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.04
Cadmium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.0005
Calcium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	2.5
Chloride	250 mL plastic	mg/L	Chill	300.0	28 d	10
Chromium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.005
Cobalt	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.005
Copper	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.005
Fluoride	250 mL plastic	mg/L	None	9056	28 d	1.0
Iron	250 mL plastic	mg/L	Nitric Acid	300.0	6 mos	0.02
Lead	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.003
Lithium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.005
Mercury	250 mL plastic	mg/L	HNO_3	245.1	28 d	0.0002
Molybdenum	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.005
Nickel	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.005
Radium 226 and 228	(2) 1 L plastic	pCi/L	HNO_3	SM 7500	6 mos	2.0 combined

Table 11. Water Quality Parameters For Analysis						
Selenium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.005
Silver	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.0005
Sulfate	250 mL plastic	mg/L	Chill	300.0	28 d	10
Thallium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.002
Parameter	**Sample Bottle***	**Units to be reported**	**Preservation**	**Method**	**Holding Time**	**Laboratory Reporting Limits**
Total Dissolved Solids	1 L plastic	mg/L	None	SM 2540C	NA	20
Total Suspended Solids	1 L plastic	mg/L	None	SM 2540D	NA	3
Vanadium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.005
Zinc	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.005

*Bottle volume may differ based on laboratory availability.

3.6 Data Validation

This section describes the process used for data review and validation. The CC will perform the data validation, statistical analysis, interpretation, and reporting. The scanned field forms, laboratory reports (pdf and electronic data deliverable (EDD)), and the chain of custody (COC) used during the sampling process.

3.6.1 Field Data Review

The field data review will be performed by the CC and include verification that QC checks and calibrations are recorded properly in the field data sheets and that any necessary and appropriate corrective actions were implemented and recorded. Such data will be written into field data sheets immediately after measurements are taken. If errors are made, results will be legibly crossed out and corrected in a space adjacent to the original (erroneous) entry. If transcription errors have been made, the Laboratory Supervisor (LS) and Environmental Field Technician (EFT) will address the errors to provide resolution.

Field measurement data will be entered by the CC into electronic files for data validation and data interpretation. **Table 12** lists the field records that will be validated and verified and who is responsible.

Table 12. Data Verification and Validation Inputs				
Item	**Description**	**Verification (Completeness)**	**Validation (Conformance to Specifications)**	**Who Will Verify or Validate**
Field Records				
1	Field equipment calibration records	X	X	CC
2	Chain-of-Custody forms	X		CC
3	Field decontamination documentation	X		CC
4	Sample collection field forms	X		CC
5	Drilling logs	X		CC
6	Well construction logs	X		CC
7	Well development field forms	X		CC

Table 12. Data Verification and Validation Inputs				
Analytical Data Package				
9	Cover sheet (laboratory identifying information)	X	X	CC
10	Case narrative	X	X	CC
11	Internal laboratory Chain-of-Custody forms	X	X	CC
Item	**Description**	**Verification (Completeness)**	**Validation (Conformance to Specifications)**	**Who Will Verify or Validate**
12	Sample chronology and consistency (that is, dates and times of receipt, preparation, and analysis)	X	X	CC
13	Communication records with laboratory	X	X	CC
14	EDD format consistency	X		CC
15	Sample identification, results nomenclature, and data qualifier consistency	X		CC
16	Method detection limit consistency	X	X	CC
17	Instrument calibration records	X	X	CC
18	Laboratory Report	X	X	CC
19	Field QC sample results and calculation of accuracy and precision	X	X	CC

3.6.3 Verification

Verification is a completeness check that is performed before the data review process continues in order to determine whether the required information was collected and is available. Verification is not designed for use in qualitative review but ensures the availability of information for subsequent steps of the data review process. Example inputs for conducting the completeness check are listed in **Table 8** above.

The following procedures will be performed by the CC for data verification:

- COC forms and shipping documents will be reviewed and verified for completeness and accuracy against the actual contents of the laboratory report and EDD.
- Field notes will be reviewed for completeness and accuracy.

3.6.4 Data Validation

The purposes of data validation are to review suspect analytical data, designate a data qualifier for any discovered data quality limitation, and eliminate any analytical data that does not pass validation acceptance criteria. A formal data validation will be performed by CC and will include a review of field QC sample analyses and laboratory data. The CC will determine whether the measurement performance criteria have been met and will calculate the data completeness for the project.

Evaluating Field Data

The results of field QC sample analyses associated with each laboratory data package will be reviewed by the CC to evaluate equipment blanks and other field QC samples and further

indications of the data quality. If a problem is identified through reviewing field QC data, all related field samples will be identified by the CC, and, if possible, corrective actions will be instituted and documented. If data are compromised because of a problem identified via field QC sample review, appropriate data qualifications will be used by the CC to identify the data for future data users.

The handling, preservation, and storage of samples collected during the sampling program will be monitored by the CC on an ongoing basis. The sample receipt records (a required data package deliverable) as well as the COC documentation will also be assessed by the CC during data validation. Sample handling, storage, or preservation problems identified during data validation will result in appropriate qualification of data.

Evaluating Laboratory Data

Data verification will be performed by the CC on 100 percent of the data to review completeness of the data packages. The purpose of chemistry data validation is to verify that the data are of appropriate quality, are technically valid, are defensible, and are usable for their intended purpose. The objectives of the data validation process are to:

- Verify completeness of data packages and corresponding EDDs.
- Assess compliance with project-specific procedures and programs.
- Evaluate system process control so that that no systematic errors exist within the data sets.
- Assess field QC samples to determine whether sampling has adversely affected the reported results and, therefore, usability.
- Assess both method and laboratory performance through tabulation of QC outliers.
- Provide measures of data quality in terms of precision, accuracy, and completeness so that overall usability can be determined.

Data validation will be performed by CC using the general protocols and processes described in the following documents, as applicable:

- Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (USEPA, 2010) (as a general guidance and using professional judgment for the validation in support of or in the absence of method-specific direction)
- Guidance for Labeling Externally Validated Laboratory Analytical Data (USEPA, 2009a)

One hundred percent of the data will undergo a Stage 2B validation by the CC. The following specific QC elements will be reviewed during the validation:

- Presence and completeness of COC and sample receipt documentation
- Sample index (correlation of field sample identifier [ID] to laboratory sample ID)

- Laboratory case narrative (method deviations and QC anomalies)
- Analytical holding times
- Method blank
- Field duplicate RPD values
- Laboratory duplicate RPD values
- Summaries of instrument blanks (for example, internal calibration blank [ICB] and continuous calibration blank, if specified in the method)
- Interference check samples (ICP and ICP–mass spectrophotometry [ICP-MS])
- Review of LCSs
- Serial dilutions (ICP and ICP-MS)
- Post-digestion spikes
- Summaries of internal standards

Each data package will be accompanied by an EDD prepared by the laboratory. Additional laboratory QC data can be included in the EDD as long as the data fields specified in the EDD are also maintained. EDDs will be cross checked by the CC against corresponding data reports to confirm consistency in the results reported in these two separate formats. The following data qualifiers will be applied during data validation by the CC:

U	The analyte was analyzed for, but was not detected at, a level greater than or equal to the level of the adjusted reporting limit (RL) for the sample and method.
J	The analyte was positively identified, and the associated numerical value is the approximate concentration of the analyte in the sample (due either to the quality of the data generated because certain QC criteria were not met, or to the concentration of the analyte being below the RL).
J+	Same as J, and the reported concentration is potentially biased high.
J–	Same as J, and the reported concentration is potentially biased low.
UJ	The analyte was not detected at a level greater than or equal to the adjusted method detection limit (MDL). However, the reported adjusted MDL is approximate and might be inaccurate or imprecise.
R	The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte might or might not be present in the sample.

After the fieldwork and the final analytical data have been performed and reviewed by the CC for each sampling event, a Data Quality Summary Report will be prepared by the CC for the project. The report will summarize quality assurance and audit information, including the results of the data review; will evaluate field QC sample data, such as field duplicates; and will describe corrective actions taken. The Data Quality Summary Reports will be appended to the project report.

3.6.5 Data Useability Assessment

Data collected from the field activities will be evaluated against the following data quality parameters.

Precision

Precision refers to the degree to which repeated measurements are similar to one another when obtained under prescribed conditions. Precision will be assessed by evaluating the results of field duplicates to determine RPD. QC procedures and acceptance criteria are summarized in **Table 13**.

For precision:

RPD for field duplicates percent RPD = $\left[\frac{|Amount\ in\ sample\ 1 - Amount\ in\ Sample\ 2|}{Amount\ in\ Sample\ 1 + Amount\ in\ sample\ 2}\right] x\ 100$

Accuracy

Accuracy is defined as the measure of the closeness of an individual measurement or the average of a number of measurements to the actual or "true" value. Laboratory accuracy will be assessed by evaluating LCSs and MSs and calculating the percent recovery (percentR). QC procedures and acceptance criteria are summarized in **Table 9**.

For Accuracy

Percent recovery for MS percentR = $\left(\frac{Spike\ conc. - Sample\ conc.}{Amount\ of\ spike\ added}\right) x\ 100$

Percent recovery for LCS percentR = $\left(\frac{Spike\ conc.}{Amount\ of\ spike\ added}\right) x\ 100$

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of data that was expected or planned for. A qualified datum will be considered unless it has been rejected (R), in which case it is unusable. The goal for completeness is 100 percent; however, a rejected (unusable) datum will be evaluated to determine whether data gaps exist or whether the project objectives were met without it.

For Completeness:

Percent completeness = $\left(\frac{Number\ of\ usable\ measurements}{Number\ of\ planned\ measurements}\right) x\ 100$

A brief Data Validation Report will be developed for each semiannual sample event and will document the results of the data verification and validation. This report will describe the conclusions made during the data assessment regarding data usability. Limitations on the usability of the data will be explained, including the reasons for data qualifiers, the definitions of the qualifiers, and a summary of the specific acceptance criteria that were assessed and found to be outside control limits.

Table 13. Minimum QC Procedures for Project Parameters			
Quality Check	Minimum Frequency	Acceptance Criteria	Corrective Action(s)
Metals by ICP-MS			
Laboratory control sample (percent recovery)*	One per analytical batch	85–115	Correct the problem, then reanalyze. If still out, reprep and reanalyze the LCS and all samples in the affected batch.
Laboratory matrix spike/matrix spike duplicate (percent recovery)*	One per analytical batch	70-130	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Communicate matrix effects to the prime contractor so an evaluation can be made by the PC with respect to the project quality objectives.
Field duplicate relative percent difference	One per sampling event	20	None. Field duplicates are collected to provide information about overall precision and the ability of sampling techniques to produce a representative sample.
Total Suspended Solids and Total Dissolved Solids			
Laboratory control sample (percent recovery)*	One per analytical batch	80-120	Correct the problem, then reanalyze. If still out, re-prep and reanalyze the LCS and all samples in the affected batch.
Laboratory matrix spike/matrix spike duplicate (percent recovery)*	One per analytical batch	RPD<10	Rerun if enough sample and time if not qualify the results
Field duplicate relative percent difference	One per sampling event	20	None. Field duplicates are collected to provide information about overall precision and the ability of sampling techniques to produce a representative sample.
Anions			
Laboratory control sample (percent recovery)*	One per analytical batch	90-110	Correct the problem, then reanalyze. If still out, re-prep and reanalyze the LCS and all samples in the affected batch.
Laboratory matrix spike/matrix spike duplicate (percent recovery)*	One per analytical batch	80-120	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Communicate matrix effects to the prime contractor so an evaluation can be made by the PC with respect to the project quality objectives.
Field duplicate relative percent difference	One per sampling event	20	None. Field duplicates are collected to provide information about overall precision and the ability of sampling techniques to produce a representative sample.
Radium 226/228			
Laboratory control sample (percent recovery)*	One per analytical batch	73-135	Correct the problem, then reanalyze If still out, re-prep and reanalyze the LCS and all samples in the affected batch.
Laboratory matrix spike/matrix spike duplicate (percent recovery)*	One per analytical batch	71-136	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Communicate matrix effects to the prime contractor so an evaluation can be made by the PC with respect to the project quality objectives.
Field duplicate relative percent difference	One per sampling event	20	None. Field duplicates are collected to provide information about overall precision and the ability of sampling techniques to produce a representative sample.

* Other laboratory quality controls (for example, method blanks) will be performed following the laboratory quality assurance plan. The laboratory will be responsible for reporting the data verification codes on reports.

3.7 Data Management

Project data and information must be documented in a format that is usable by project personnel. This section describes how project data and information will be documented, tracked, and managed, from generation in the field to final use and storage, in a manner that ensures data integrity and retrieval.

3.7.1 Data Package Deliverables

Data package deliverables for off-site analyses are listed below.

Sample Collection and Field Measurements Data Package Deliverables

Sample collection documentation will include field form entries, field measurements, and COC forms.

Field measurements will be taken by the sampling team for groundwater samples collected by low-flow sampling. The measurements are specific conductance, temperature, dissolved oxygen, pH, turbidity, and oxidation/reduction potential (ORP). All field and QC sample results, calibrations, and calibration verifications will be recorded by the sampling team on field forms. The hard-copy versions of the field data will be scanned by the sampling team and filed with other project data.

Off-site Laboratory Data Package Deliverables

The contract laboratory will provide laboratory data packages for each set of samples analyzed. Data and summary for the data validator to perform verification and data usability assessment are to be sent by email to the CC within 15 business days of receiving the sample. Delivery of a hard-copy data package will not be required.

The laboratory will email the CC an analytical report and an electronic data deliverable (EDD).

The information provided by the laboratory will be to review the data with respect to:

- Holding times and sample conditions
- Calibrations and instrument performance
- Detection/quantitation limits
- Spike and surrogate recoveries
- Duplicate analyses (laboratory duplicates and matrix spike [MS]/MS duplicates [MSD])
- Laboratory control sample (LCS)
- Blank contamination
- Target compound identification and quantitation

A laboratory report will be provided that includes the following hard-copy information for each analytical data package:

- Cover sheet listing the name and number of samples included in the report.
- Narrative comments describing problems encountered in analysis; identification of analyses not meeting QC criteria, including holding times; and cautions regarding unusable data due to QC results that are outside the control limit.

- COC forms.
- Documentation of extraction, clean-up, and analytical methods used.
- Tabulated results of inorganic compounds identified and quantified, with analyte-specific detection limits. Analytes will be reported for each sample as a detected concentration or as not detected above the specific limits of quantitation, which must be stated. The laboratory will also report dilution factors, date of analysis, surrogate percent recoveries, batch run logs, and analytical batch number for each sample, with corresponding sample results.
- Analytical results for QC sample spikes, laboratory duplicates, initial and continuing calibration, verifications of standards and laboratory blanks, standard procedural blanks, LCSs, laboratory reference materials, inductively coupled plasma (ICP) interference check samples, and detection limit check samples.
- Documentation of rationale for the use of method of standard addition, if required.

Corresponding to each individual laboratory report, an EDD will be prepared and submitted along with the laboratory data package.

3.7.2 Data Handling and Management

This section describes computerized and manual procedures that trace the paths of data from generation to final use and storage, as well as the associated quality checks for error detection that are performed to maintain data integrity.

Data Recording

Data recording in the field will be performed as described herein and using the forms and formats in **Appendix E**.

3.7.3 Data Tracking and Control

The project quality records will be maintained by the CC. These records, either electronic or hard copy in form, will include the following:

1. Project work plans with approved modifications, updates, and/or addendums
2. Project Sampling SOP and Statistical Method Certification, with any approved modifications, updates, and/or addendums
3. Field documentation
4. COC records
5. Laboratory documentation (results received from the laboratory will be documented in an electronic format)
6. Data validation and verification reports
7. Final project reports and deliverables

Hard-copy field and laboratory records will be maintained in the project's central data file, where original field and laboratory documents are filed chronologically for future reference. These records are also scanned to produce electronic copies in portable document format (PDF). The

electronic versions of these records will be maintained in the CC network and has a routine backup schedule.

Project records listed above will be provided and maintained on file for a minimum of three years after completion of the work. Besides acting as a central data repository, the database will further facilitate data analysis and reporting. The information stored in the database will consist of sampling information (for example, sample identification, location, and sampling date and time), and analytical chemistry data specified in different fields of the EDD format selected for the project. Field data previously transferred from hard-copy documents into electronic files and laboratory EDDs will be reviewed for completeness and accuracy by the CC.

Recordkeeping

The following groundwater monitoring information will be placed on the operating record as it becomes available:

- Annual groundwater monitoring and corrective action report
- Semiannual Remedy Selection Progress Report
- Documentation of the design, installation, development, and decommissioning of monitoring wells
- Groundwater monitoring system certification
- Selection of a statistical method certification

4.0 Statistical Approach

The statistical procedures use for the groundwater monitoring program will be in accordance with Part 115 Rule 908. These statistical procedures will be consistent with those used for the Federal CCR Rule compliance monitoring program in accordance with 40 CFR §257.93(f) and (g). **Appendix F** provides the *Statistical Procedures Plan*, including components for preliminary data analysis (outliers, distributions, serial correlation, trend analysis, seasonality); approach to computing background threshold values; the test for statistically significant levels above groundwater protection standards for assessment monitoring; and test for closure.

5.0 Groundwater Reporting

Quarterly groundwater monitoring reports will be submitted for the active life of the impoundments, to EGLE not later than 30 days after the end of the calendar quarter, in compliance with R 299.4907(11)). Reports will be submitted January 30, April 30, July 31, and October 31 each year. The quarterly groundwater monitoring report will contain the following information, to the extent available:

1. Statement regarding adherence to (or deviation from) the Hydrogeologic Monitoring Plan, with regard to sampling locations, analytical parameters, sampling technique, lab methodology, etc.

2. Brief description of the sampling event.
3. Groundwater flow direction and map for the current sampling event, pursuant to Rule 907(5).
4. A Groundwater Monitoring Exceedance Summary Table, to contain statistical exceedances from the current reporting event.
5. Discussion of statistical limit exceedances.
6. Alternate source demonstrations for the SSI's, including supporting documentation, unless these will be provided in a separate submittal.
7. Laboratory analytical results.
8. Chain of custody information.
9. Other supporting documentation, as applicable. Laboratory Quality Assurance/ Quality Control data need not be submitted but will be kept in the facility's operating record and supplied upon request. Analytical data from field and sampling blanks should be submitted.

In addition, an annual groundwater monitoring report will be submitted to EGLE not later than 30 days after the end of the calendar year. Annual reports will summarize key monitoring actions performed, describe any problems encountered and any actions to resolve any such problems, and key project activities for the upcoming year. The annual groundwater monitoring report will contain the following information, to the extent available:

1. A map showing the CCR units, background and downgradient monitoring wells;
2. Identification of monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;
3. Determine rate and direction of groundwater flow each time groundwater is sampled; and
4. In addition to the monitoring data, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs. Also, determine rate and direction of groundwater flow each time groundwater is sampled.

EGLE will be notified prior to undertaking well abandonment, plugging, replacement, or repair at the Site. EGLE will be notified when sampling and analysis program documentation has been placed in the operating record.

6.0 Assessment Monitoring Plan

As required by Part 115 Section 11519b(2), if the detection monitoring confirms an SSI over background at one of the impoundments for one or more of the constituents listed in Section 11511a(3), an Assessment Monitoring Plan (AMP) shall be developed and conducted at that impoundment, and any other impoundments would remain in detection monitoring. The following AMP components are addressed in the previous sections within the HMP:

AMP Requirement	Section within HMP
Monitoring Well Network	Section 2.0
Groundwater Sampling and Analysis	Section 3.0
Statistical Approach	Section 4.0
Groundwater Reporting	Section 5.0

7.0 Response Action Plan

According to Part 115 Section 11519b(2), if detection monitoring confirms an SSI over background, a Response Action Plan (RAP) in compliance with R 299.4442 of the Part 115 Rules shall be prepared. As stated above, the identification of SSIs was documented January 24, 2024; therefore, the RAP was submitted March 8, 2024. The report documented sources of contamination, interim response activities taken to identify possible sources of contamination and steps taken to prevent additional contamination, and termination of waste schedule. Should additional SSLs be identified, or changes be proposed to the RAP, a revised RAP will be submitted to EGLE.

8.0 Assessment of Corrective Measures

Following the submission of the RAP, an Assessment of Corrective Measures (ACM) will be compiled detailing the proposed strategies to address future mitigation, and include components required in Part 115 Rule 299.4443 . As described in HDR (2024c), SSLs were identified on February 5, 2024.Therefore, assessment of corrective measures will be initiated based on the updated SSL identified using the updated monitoring network and updated background wells and BTVs. For the ACM and groundwater remedy selection, additional data collection will be necessary to delineate the groundwater exceedances, collect additional hydrogeologic data needed for conceptual planning of remediation alternatives, and to coordinate with the per- and polyfluoroalkyl substances (PFAS) findings.

9.0 Remedy Selection and Remedial Action Plan

Remedy Selection progress reports will be submitted on a semi-annual basis as required in §257.97(a) of the CCR Rule. The report will describe progress toward selecting and designing the final remedy for the CCR unit. The final remedy will be formally selected once the options are reviewed and approved by EGLE. A public meeting will be conducted at least 30-days prior to the final selection as required under §257.96(e). At the time of remedy selection, a RAP in compliance with Michigan Part 115 R 299.4445 and §257.97 of the CCR Rule, will be prepared.

10.0 References

ERM, 2017., Groundwater Monitoring System Certification. October 31, 2017.

Ferrand, W.R., and Bell, D.L., “Quaternary Geology of Southern Michigan”. Michigan Department of Natural Resources. Geological Publication QG-01. 1982.

Golder Associates, Inc., 2018. 2017 Groundwater Monitoring and Corrective Action Report. January 30, 2018.

Golder Associates, Inc., 2018b. Notice of Establishing Assessment Groundwater Monitoring 40 CFR §257.94(e)(3). March 18, 2018.

Golder Associates, Inc., 2018c. Notice of Groundwater Protection Standard Exceedance CFR §257.95(g). October 15, 2018.

Golder Associates, Inc., 2019. Annual Groundwater Monitoring & Corrective Action Report. January 30, 2019.

Golder Associates, Inc., 2019b. Notice Initiating Assessment of Corrective Measures CFR §257.95(g)(3)(i) and 40 CFR §257.95(g)(5). February 8, 2019.

Golder Associates, Inc., 2019c. CCR Impoundment Ash Delineation at the J.B. Sims Generating Station. October 14, 2019.

GEI, 2019. Geotechnical Exploration and Engineering Evaluation for Harbor Island Reciprocating Engine Generation Site. May 15, 2019.

Golder Associates, Inc., 2020. 2019 Annual Groundwater Monitoring & Corrective Action Report. January 31, 2020.

Golder Associates, Inc., 2021. 2020 Annual Groundwater Monitoring & Corrective Action Report. January 30, 2021.

Golder Associates, Inc., 2021b. Notice of Groundwater Protection Standard Exceedance 40 CFR §257.95(g). July 22, 2021.

Golder Associates, Inc., 2022. 2021 Annual Groundwater Monitoring & Corrective Action Report. January 28, 2022.

Golder Associates, Inc., 2022b. Field Summary Report of Results from Approved Work Plan - Piezometer Installation and Additional Data Collection. February 15, 2022.

HDR, 2022. 2022 Harbor Island Work Plan for CCR Compliance. April 14, 2022. Revised June 23, 2022.

HDR, 2023. Monitoring Well Installation Report. November 27, 2023.

HDR, 2024. Background Statistical Certification Report. December 11, 2023. Revised January 24, 2024.

HDR, 2024a. Former J.B. Sims Generating Station Determination of Statistically Significant Increases over Background per §257.93(h)(2) and R 299.4440(8) of the Michigan Part 115 Rules. January 24, 2024.

HDR, 2024b. 4th Quarter 2023 Annual Groundwater Monitoring Report for Michigan Part 115 Solid Waste Regulations. January 31, 2024.

HDR, 2024c. Determination of Statistically Significant Levels over Groundwater Protection Standards per §257.95(g) and Michigan Rule R 299.4441. February 5, 2024.

Soils and Structures, 2014. Report of Evaluation for Grand Haven Power Plant Ash Impoundment. July 17, 2014.

Western Michigan University, Department of Geology. “Hydrogeologic Atlas of Michigan, Volume 1”. The Department of Geology, Kalamazoo, Michigan. 1981.

HDR, 2024a. Former J.B. Sims Generating Station Determination of Statistically Significant Increases over Background per §257.93(h)(2) and R 299.4440(8) of the Michigan Part 115 Rules. January 24, 2024.

HDR, 2024b. 4th Quarter 2023 Annual Groundwater Monitoring Report for Michigan Part 115 Solid Waste Regulations. January 31, 2024.

HDR, 2024c. Determination of Statistically Significant Levels over Groundwater Protection Standards per §257.95(g) and Michigan Rule R 299.4441. February 5, 2024.

Soils and Structures, 2014. Report of Evaluation for Grand Haven Power Plant Ash Impoundment. July 17, 2014.

Western Michigan University, Department of Geology. “Hydrogeologic Atlas of Michigan, Volume 1”. The Department of Geology, Kalamazoo, Michigan. 1981.

Appendix A

Hydrogeologic Monitoring Plan Checklist

2024

PART 115 RULES CHECKLIST
COAL ASH LANDFILL AND COAL ASH IMPOUNDMENTS
HYDROGEOLOGICAL MONITORING PLAN

Facility Name: Former J.B Sims Generating Station Date: 5/7/2024 Initials: TB

Report Name: Former J.B. Sims Generating Station Hydrogeologic Monitoring Plan

Report Date: 5/7/2024

Item No.	Item	Subpart	HMP Section where Item may be Reviewed
No. 1	Design and siting ensure groundwater will not exceed:	R306(1)	Not Applicable (N/A)
	MCLs in 40 CFR Part 257 and Appendix I. (Note: if the design and siting ensure GW will not exceed MCLs identified in Appendix I, it is likely that Michigan's cleanup criteria will not be exceeded)		
	Existing concentrations, where these already exceed 40 CFR Part 257 and Appendix I, unless groundwater has greater than 10,000 mg/L TDS.		
No. 2	Design and siting ensure that requirements of Part 31 and its rules will be met.	R306(2)	N/A
No. 3	Hydrogeologic monitoring plan for the coal ash landfill or coal ash impoundment includes the following components:	R905(1)	--
	A monitoring well system which complies with R906.	R905(1)a	2.0
	Leachate and SCS monitoring programs as specified in R432, if required.	R905(1)b	N/A – Not required, coal ash impoundment
	Surface water monitoring program for surface waters that may receive runoff from the "active work area" (see R101(g)).	R905(1)c	N/A – Not required, coal ash impoundment
No. 4	Contains the following specific information:	R905(2)	--
	All GW sampling locations.	R905(2)a	2.0
	Sampling constituents/parameters and frequency.	R905(2)b	3.1, 3.2, 3.3
	Sampling and analysis procedures for each parameter	R905(2)c	3.4, 3.5.2
	Sample collection.	R905(2)	Appendix E
	Sample preservation and shipment.		Appendix E, 3.5.2
	Analytical procedures, including detection limits.		3.5.2
	Chain of custody control.		Appendix E
	Laboratory and field quality assurance and quality control procedures.		3.6, Appendix E
	Procedures for prevention of cross contamination in wells during well installation, purging and sampling.		Appendix E
	Statistical procedures for data evaluation in compliance with R908.	R908	Appendix F
No. 5	Sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that represent the quality of:	R906(1)	2.0
	Background water quality not affected by leakage from a unit.	R906(1)a	2.1.1, 2.2.1
	Meets conditions for use of wells other than true upgradient.	R906(1)(a) i or ii	2.1.1, 2.2.1
	Downgradient groundwater and ensures detection of groundwater contamination in the uppermost aquifer, and other groundwater specified by the Director.	R906(1)b	2.1, 2.2
	Meets conditions for downgradient monitor well installation at locations other than the solid waste boundary.		2.1.2, 2.1.3 , 2.2.2, 2.2.3
	Wells installed at the closest practicable distance from the solid waste boundary.		2.1.2 , 2.2.2
No. 6	Meets conditions for a multi-unit groundwater monitoring system instead of separate monitoring systems for each landfill unit when the facility has several discrete units.	R906(2)	--

Item No.	Item	Subpart	HMP Section where Item may be Reviewed
	Monitoring wells not more than 150 meters from the solid waste boundary of each unit, located on land owned by the owner of the unit.	R906(2)a	2.1, 2.2
	Sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer.	R906(2)b	2.1, 2.2
	Is as protective of human health and environment as individual monitoring systems for each unit, based on the following:	R906(2)b	--
	Number, spacing and orientation of the units.		1.3
	Hydrogeologic setting.		1.3
	Site history.		1.1, 1.2
	Engineering design of the units.		1.1
	Type of waste accepted at the units.		1.1
No. 7	Monitoring wells cased in a manner that maintains the integrity of the well borehole.	R 906(3)	2.0, 2.5
No. 8	Well casings screened or perforated and packed with gravel or sand, where necessary, to enable the collection of groundwater samples.	R906(3)	2.0, 2.5
No. 9	Annular space in each monitoring well sealed to prevent contamination of the samples and groundwater.	R906(3)	2.0, 2.5
No.	Notified the Director that the design, installation, development, and decommission of any monitoring wells, piezometers, and other measurement, sampling, and analytical devises documentation have been placed in the operating record.	R906(4)	5.0
No.	All monitoring wells, piezometers, and other measurement, sampling, and analytical devices designed, operated and maintained to perform to design specifications throughout the life of the monitoring program.	R906(5)	2.0, 2.5
No.	Monitoring wells designed to minimize the time necessary to recharge well, given hydraulic conductivity of the aquifer.	R906(6)	2.0, 2.5
No.	Number, spacing, and depths of monitoring systems in compliance with the following conditions:	R906(7)	2.0
	Site-specific technical information that includes thorough characterization of both of the following:	R906(7)(a)	--
	The uppermost aquifer, including all of the following information:	R906(7)(a)i	1.3, 2.0
	Aquifer thickness.		1.3
	Groundwater flow rate.		1.3
	Groundwater flow direction including seasonal and temporal fluctuations in groundwater flow.		1.3
	Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including all of the following:	R906(7)(a)ii	1.3, 2.0
	Thickness.		1.3
	Stratigraphy.		1.3
	Lithology.		1.3
	Hydraulic conductivities.		1.3
	Porosities.		1.3
	Effective Porosities.		1.3
	Certified by a Geologist.	R906(7)b	Preface
	Approved by the Director. Within 14 days of this approval, the owner or operator shall notify the Director that the certification and approval have been placed in the operating record.	R906(7)c	--
No. 14	All wells clearly labeled, properly vented, capped, and locked when not in use.	R906(8)	2.5

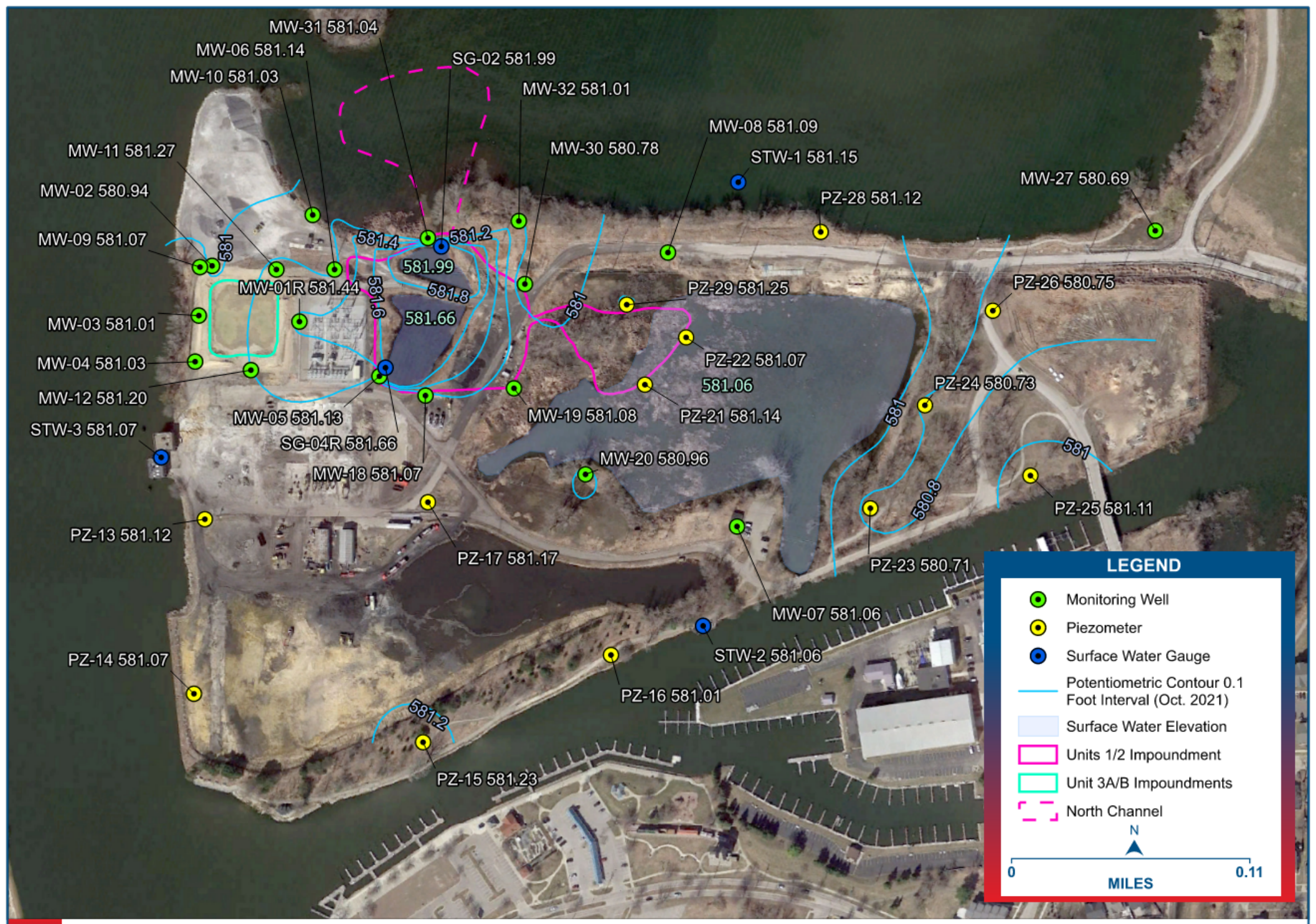
Item No.	Item	Subpart	HMP Section where Item may be Reviewed
No.	All wells visible throughout the year.	R906(8)	2.5
No.	Owner or operator to notify the Director or designee prior to undertaking well abandonment, plugging, replacement, or repair.	R906(9)	5.0
No.	Groundwater monitoring program includes sampling and analysis procedures designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and downgradient wells installed in compliance with R906.	R907(1)	3.0, Appendix F
No.	Owner or operator has notified Director that sampling and analysis program documentation has been placed in the operating record.	R907(1)	5.0
No.	The sampling and analysis program shall include all of the following:	R907(1)	--
	Sample collection.	R907(1)a	Appendix E
	Sample preservation and shipment.	R907(1)b	3.5.2, Appendix E
	Analytical procedures.	R907(1)c	3.5
	Chain of custody control.	R907(1)d	Appendix E
	Quality assurance and quality control.	R907(1)e	3.6, Appendix E
No.	Sampling and analysis programs include sampling and analytical methods appropriate for groundwater sampling and accurately measure hazardous constituents and other monitoring parameters in groundwater samples.	R907(2)	3.5, Appendix E
No.	Groundwater samples shall not be field filtered.	324.11511a(3)e	3.5, Appendix E
No.	Sampling procedures and frequency are protective of human health and the environment.	R907(3)	3.3, 3.4, Appendix E
No.	Analytical methods and practical quantitation limits for groundwater monitoring are approved by the Director.	R907(4)	3.4, 3.5.2
No.	Groundwater elevations measured immediately prior to purging each time groundwater is sampled.	R907(5)	Appendix E
No.	Owner or operator to determine rate and direction of groundwater flow each time groundwater is sampled.	R907(5)	5.0
No.	Facility to measure groundwater elevations within a period of time short enough to avoid temporal variations in groundwater flow which could preclude accurate determination of groundwater flow rate and direction.	R907(5)	Appendix E
No.	Groundwater elevations measured by methods giving precision to 1/8 inch or 0.01 foot, measured from the top of the well reference point using a determined USGS datum point.	R907(6)	Appendix E
No.	Facility has established background water quality in a hydraulically upgradient or background well or wells for each of the monitoring parameters or constituents required in groundwater monitoring program. (Background groundwater quality may be established at wells not located hydraulically upgradient from the unit if the well meets R906(1)(a)).	R907(7)	1.2, 3.1.1, 3.2.1
No.	Number of samples to establish groundwater quality data consistent with statistical procedures determined per R908. The sampling procedures are those specified pursuant to the provisions of the following:	R907(8)	3.1, 3.2, 3.3, Appendix F
	For detection monitoring	R440	3.1.2, 3.2.2, Appendix F
	For assessment monitoring	R441	3.1.3, 3.2.3, Appendix F
	For remedial action	R444	3.1.3, 3.2.3, Appendix F

Item No.	Item	Subpart	HMP Section where Item may be Reviewed
No. 30	All samples obtained shall be representative of the site's groundwater quality.	R907(9)	2.0
	Each well will be purged until dry or until not less than 3 times the amount of water in the well casing has been removed.		Appendix E
	Monitoring wells will be sampled immediately after purging where recovery rates allow.		Appendix E
	If well pumped dry during purging, samples will be taken within 24 hours.		Appendix E
No. 31	If nondedicated pumps or mobile sampling equipment is used, facility will use the following procedures to minimize the potential for cross -contamination	R907(10)	Appendix E
	Sample wells from upgradient to downgradient, except areas of known contamination will be sampled from least contaminated to most contaminated well.	R907(10)a	Appendix E
	Each piece of equipment will be thoroughly cleaned and rinsed with distilled water before use in each well.	R907(10)b	Appendix E
	Other decontamination procedures approved by the Department.	R907(10)c	Appendix E
No.	The owner and operator shall submit all monitoring results to the director or designee not later than 30 days after the end of the calendar quarter.	R907(11)	5.0
No.	The owner and operator of a landfill will sample and analyze groundwater by methods specified in “Standard Methods for the Examination of Water and Wastewater…. Or other methods approved by the director or his or her designee. (we would accept SW-846 methods).	324.11511a(4)	3.5
No.	Detection monitoring parameter list includes:	324.11511a(3)(c)	3.1.1, 3.5.1, 3.5.2
	Boron	324.11511a(3)(c)i	3.5.1
	Calcium	324.11511a(3)(c)ii	3.5.1
	Chloride	324.11511a(3)(c)iii	3.5.1
	Fluoride	324.11511a(3)(c)iv	3.5.1
	Iron	324.11511a(3)(c)v	3.5.1
	pH	324.11511a(3)(c)vi	3.5.1
	Sulfate	324.11511a(3)(c)vii	3.5.1
	Total Dissolved Solids	324.11511a(3)(c)viii	3.5.1
No.	Contains a statistics plan or statistical procedures that meets the requirements of Rule 908. (Use Part 115 Rules Checklist – Landfill Groundwater Monitoring Statistical Procedures).	R908	4.0, Appendix F
No.	Detection monitoring is conducted quarterly during the active life and semiannually during the post-closure period, except as provided for in R440(5).	R440(1)(a)	3.3
No.	Meets conditions for deletion of R452 to R454 parameters.	R440	N/A
	Parameters and breakdown products are not in leachate for not less than 2 consecutive and historic samplings.	R440(4)	N/A
No.	Meets conditions for alternative monitoring frequency for R450-451 parameters (at least semiannually) or for R452-454 parameters (at least annually) based on following factors:	R440(5)	N/A
	Lithology of aquifer and unsaturated zone.	R440(5)a	N/A
	Hydraulic conductivity of aquifer and unsaturated zone.	R440(5)b	N/A
	Groundwater flow rates.	R440(5)c	N/A
	Minimum distance from the waste and the closest downgradient well screen, or presence of SCS.	R440(5)d	N/A
	Resource value of aquifer.	R440(5)e	N/A
No.	First sampling event includes 4 independent samples from each well. Subsequent events include minimum of 1 sample from each well.	R440(7)	3.1, 3.2, 3.3

Item No.	Item	Subpart	HMP Section where Item may be Reviewed
No.	In case of statistically significant increase over background:	R440(8)	--
	Place notice in operating record within 14 days.	R440(8)a	3.1.3, 3.2.3
	Prepare assessment monitoring plan per R441 and a response action plan within 45 days.	R440(8)b	3.2.3, 7.0
No.	If statistically significant increase over background due to other source or is due to an error, has owner:	R440(9)	
	Documented a demonstration of this and placed notice in operating record within 30 days.	R440(9)	3.1-3.2
	If a successful demonstration is made,	R440(9)(a)	3.1-3.2
	Continue detection monitoring.	R440(9)(a)	3.1-3.2
	Determined if the unit remains monitorable	R440(9)(b)	3.1-3.2
	If a successful demonstration is not made, then 15 days after notification by the director, prepare an assessment monitoring plan and a response action plan.	R440(10)	3.1, 3.2, 7.0
No.	Text in the HMP indicates an assessment monitoring program will be developed if required under R441 or the Assessment Monitoring Program is included with the HMP. (use the assessment monitoring program checklist if the program is provided) or the Assessment Monitoring program has already been approved and is referenced in the HMP. Or a schedule, approved by the department, that leads to compliance by no later than December 28, 2020 has been provided.	R441 or 324.11511a(3)(f)ii	6.0
No.	Text in the HMP indicates a response action plan will be developed if required under R442 or the Response Action Plan is included. (use the response action plan checklist if a plan is provided) or the Response Action Plan has already been approved and is referenced in the HMP. Or a schedule, approved by the department, that leads to compliance by no later than December 28, 2020 has been provided.	R442 or 324.11511a(3)(f)ii	7.0
No.	Text in the HMP indicates that corrective measures will be assessed if required under R443 or the assessment of corrective measures is included in the HMP or the assessment of corrective measures has already been approved and is referenced in the HMP. Or a schedule, approved by the department, that leads to compliance by no later than December 28, 2020 has been provided.	R443 or 324.11511a(3)(f)ii	8.0
No.	Text in the HMP indicates that a remedy will be selected, if required, in compliance with R444 or the remedy selection and remedial action plan is included with the HMP or the remedy selection and remedial action plan has already been approved and is referenced in the HMP. Or a schedule, approved by the department, that leads to compliance by no later than December 28, 2020 has been provided.	R444 or 324.11511a(3)(f)ii	9.0
No.	Text in the HMP indicates that a remedial action plan will be implemented, if required, in compliance with R445 or the remedial action plan implementation details are included with the HMP or the remedial action plan has already been implemented and is referenced in the HMP. Or a schedule, approved by the department, that leads to compliance by no later than December 28, 2020 has been provided.	R445 or 324.11511a(3)(f)ii	9.0
COMMENTS:			

Appendix B

Groundwater Potentiometric Contour Maps

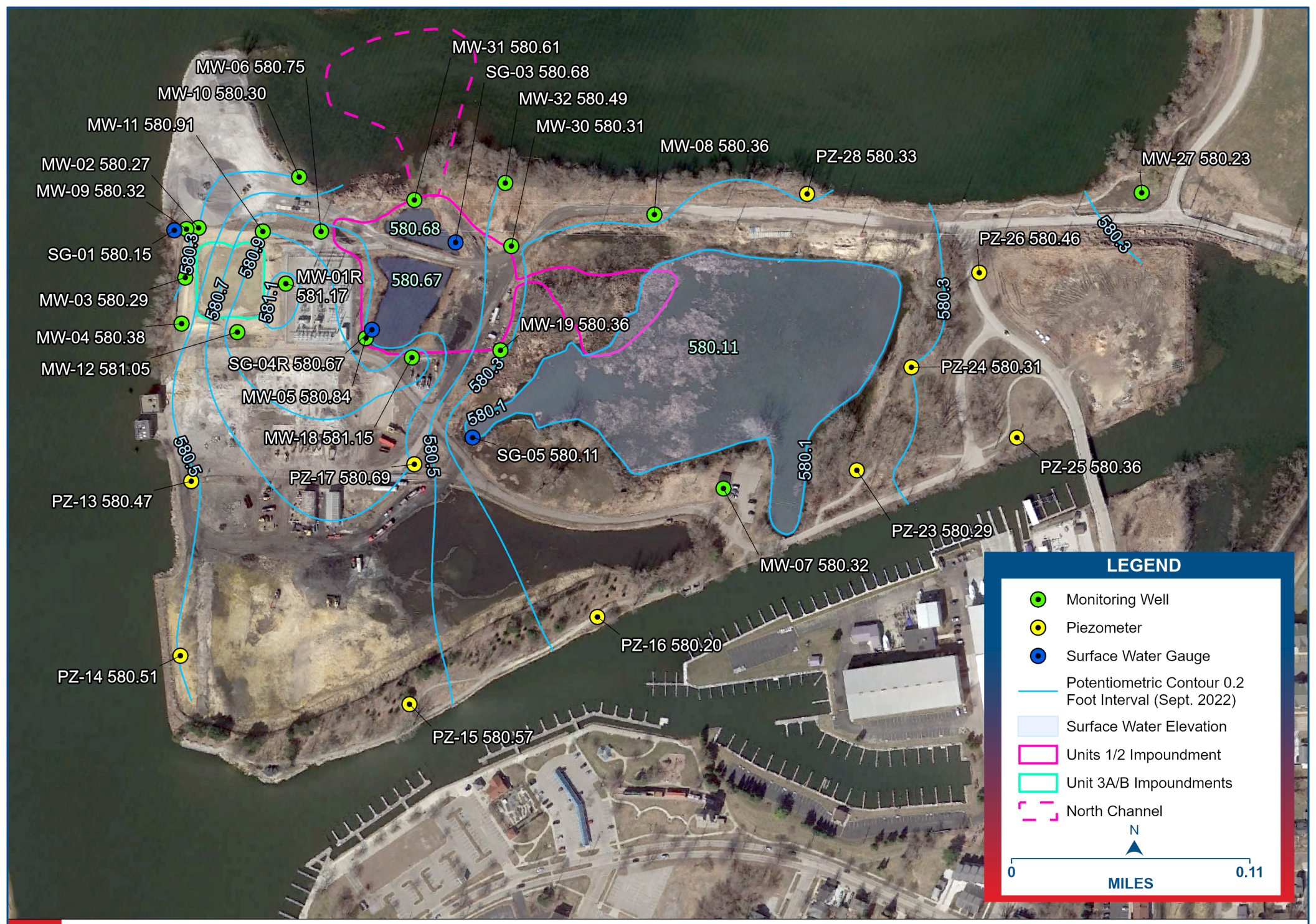


Renew Harbor Island

HDR

FORMER J.B. SIMS GENERATING STATION

CITY OF GRAND HAVEN

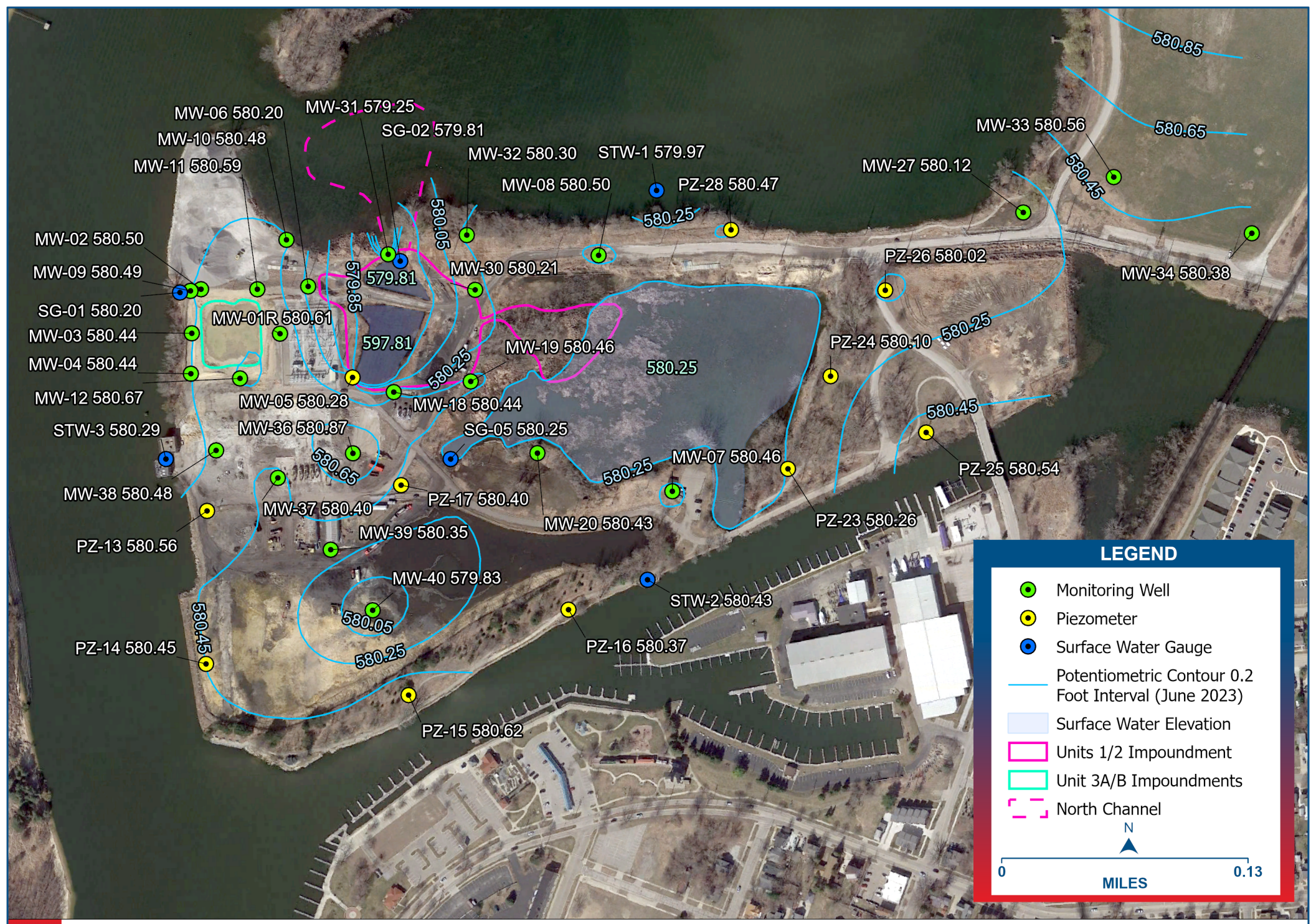


Renew Harbor Island

HDR

FORMER J.B. SIMS GENERATING STATION

CITY OF GRAND HAVEN



Renew Harbor Island

HDR

FORMER J.B. SIMS GENERATING STATION

CITY OF GRAND HAVEN

Appendix C

Boring Logs

3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
CCR Well Installation
1231 N 3rd Street
Grand Haven, Michigan

BORING # MW-01

ERM PROJECT # 0387368

SHEET 1 OF 1

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN	Sean Smith	OFFICE LOCATION	Holland, MI
DRILLING METHOD	Hollow-Stem Augers	DATE: START	01/18/2017
DRILLING EQUIPMENT	Gus Peck	FINISH	01/18/2017
HORIZONTAL DATUM (NAD 1983 StatePlane Michigan South (US Feet))		BOREHOLE DEPTH	10 ft
NORTHING	176201.037	BOREHOLE DIAMETER	
EASTING	3847934.632	DEPTH TO WATER (INITIAL) ▼	5 ft
VERTICAL DATUM (NGVD 29 (US Feet)) ELEVATION	96.08 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLING DATA: SAMPLE TYPE	RECOVERY		Observations / Remarks
		SAND (SP) poorly graded, fine grained SAND; loose, little gravel, moist, dark brown to black		SP					
	95	SAND (GW-SW) well graded, fine grained SAND; loose, some gravel, moist, brown to grayish brown	1	GW-SW					
2		SAND (SP) fine grained SAND; loose, moist, black, [Bottom ash.]	2	SP					
		SILTY SAND (SP) poorly graded, fine grained SAND; loose, little clay, moist to wet, dark brown to black, [Concrete, metal and wood fragments. Wet @ 5']	3						
4									
6	90			SP					
8									
		SILT (OL) soft, little clay, trace fine sand, wet to moist, dark grayish brown	9	OL					

REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

LAB ANALYSIS:

BORING LOG GHBLP 0387368 CCR WELLS.GPJ ERM DATA TEMPLATE.GDT 11/1/17

3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
CCR Well Installation
1231 N 3rd Street
Grand Haven, Michigan

BORING # MW-01

ERM PROJECT # 0387368

SHEET 1 OF 1

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN	Sean Smith	OFFICE LOCATION	Holland, MI
DRILLING METHOD	Hollow-Stem Augers	DATE: START	01/18/2017
DRILLING EQUIPMENT	Gus Peck	FINISH	01/18/2017

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Michigan South (US Feet))

NORTHING	176201.037
EASTING	3847934.632
Elevation/Top of Casing Elev.	96.08 ft/ 99.35 ft

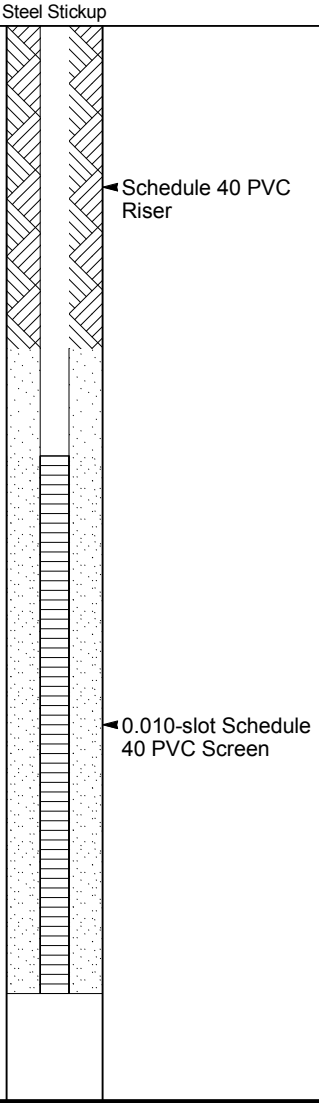
WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

WELL DEVELOPMENT
Method: *Overpumping*
Duration: *0.5 hours*
Gals. Purged: *30*

Well Permit #: *No permit required.*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG
		SAND (SP) poorly graded, fine grained SAND; loose, little gravel, moist, dark brown to black		SP	
	95	SAND (GW-SW) well graded, fine grained SAND; loose, some gravel, moist, brown to grayish brown	1	GW-SW	
2		SAND (SP) fine grained SAND; loose, moist, black, [Bottom ash.]	2	SP	
		SILTY SAND (SP) poorly graded, fine grained SAND; loose, little clay, moist to wet, dark brown to black, [Concrete, metal and wood fragments. Wet @ 5']	3		
4					
6	90			SP	
8					
		SILT (OL) soft, little clay, trace fine sand, wet to moist, dark grayish brown	9	OL	



REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

WELL INSTALLATION NOTES:

RECORD OF WELL DECOMMISSIONING: MW-01

CLIENT: Grand Haven BLP
PROJECT: GHBLP - JB Sims Generating Station
PROJECT NO: 20141048
LOCATION: Grand Haven, MI
DATE: May 01, 2020
CONTRACTOR: EDAC
ELEVATION: 584.3 ft (Ground)
COORDINATES: N: 176201.0 ft E: 3847934.6 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83 VERT DATUM: NAVD88

DRILL RIG: GP-1100 ATV Rig
DRILL METHOD: Hollow Stem Auger

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)
0	SAND, poorly graded, fine grained, loose, little gravel, moist, dark brown to black.	SP	0.0 / 583.3
1	SAND, well graded, fine grained, loose, some gravel, moist, brown to grayish brown.	SW	1.0 / 582.3
2	SAND, poorly graded, fine grained, loose, moist, black (bottom ash).	SP	2.0 / 581.3
3	Silty SAND, poorly graded, fine grained, loose, little clay, moist to wet, dark brown to black (concrete, metal, and wood fragments). Wet at 5 feet.	SC-SM	3.0 / 575.3
9	SILT, soft, little clay, trace fine sand, wet to moist, dark grayish brown.	ML	9.0 / 574.3
10	End of hole at 10.0 ft.		

SAMPLES: Hammer: ASTM D1586, Blows per 6 in 140-lb hammer, 30-in drop
NUMBER | TYPE | REC % | BLOWS | N-VALUE

WATER CONTENT PERCENT: Plastic & Liquid Limits (%); Water Content (%); NP Nonplastic
SHEAR STRENGTH: Nat Vane; Rem Vane; Pocket Pen; Q; U

ADDITIONAL LAB TESTING
ADDITIONAL OBSERVATIONS
GROUNDWATER OBSERVATIONS

CONSTRUCTION AND INSTALLATION DETAILS: 0.0 - 10.0 ft bgs: Hydrated Bentonite Chips

DEPTH SCALE: 1:53

REV:

GOLDER

LOGGED: Adam Near, CPG DATE: May 01, 2020
CHECKED: Dawn Prell, CPG DATE: Jun 11, 2020

RECORD OF BOREHOLE / WELL: MW-01R

CLIENT: Grand Haven BLP
PROJECT: GHBLP - JB Sims Generating Station
PROJECT NO: 20141048
LOCATION: Grand Haven, MI
DATE: May 01, 2020
CONTRACTOR: EDAC
ELEVATION: 585.7 ft (Ground)
COORDINATES: N: 578101.3 ft E: 12624432.0 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83 VERT DATUM: NAVD88

DRILL RIG: GP-1100 ATV Rig
DRILL METHOD: Hollow Stem Auger

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)
0	Fine SAND, loose, dark brown to black, little Gravel, moist.	SP	0.0 / 584.7
1	Fine to coarse SAND, loose, brown to gray, some Gravel, moist.	SW	1.0 / 583.7
2	Fine SAND, loose, black (bottom ash), moist.	SP	2.0 / 582.7
3	Silty fine SAND, loose, dark brown to black, some Clay, wood fragments, wet.	SP-SM	3.0 / 577.5
8	SILT, loose, dark brown to black, trace Sand, wet.	ML	8.2 / 575.7
10	End of hole at 10.0 ft.		

SAMPLES (Hammer: ASTM D1586, Blows per 6 in 140-lb hammer, 30-in drop)

NUMBER	TYPE	REC %	BLOWS	N-VALUE
	Air Knife	100		
1	SS	98	13-10-16	23
2	SS	55	5-3-3	8
3	SS	10	5-2-2	7

WATER CONTENT PERCENT: Plastic & Liquid Limits (%); Water Content (%); NP Nonplastic; 0 20 40 60 80 100

SHEAR STRENGTH: Nat Vane; Rem Vane; Pocket Pen; Q; U; 0 20 40 60 80 100

ADDITIONAL LAB TESTING

ADDITIONAL OBSERVATIONS

GROUNDWATER OBSERVATIONS

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 2.7 ft
Pipe Elev: 588.4 ft

0.0 - 0.5 ft bgs: Concrete

0.5 - 2.5 ft bgs: Hydrated Bentonite Chips

Schedule 40 PVC Riser (2-inch diameter)

2.5 - 10.0 ft bgs: Filter Sand

0.010-inch slot PVC screen

DEPTH SCALE: 1:53

REV:

GOLDER

LOGGED: Adam Near, CPG
DATE: May 01, 2020
CHECKED: Dawn Prell, CPG
DATE: Jun 11, 2020

3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
CCR Well Installation
1231 N 3rd Street
Grand Haven, Michigan

BORING # MW-02

ERM PROJECT # 0387368

SHEET 1 OF 1

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN	Sean Smith	OFFICE LOCATION	Holland, MI
DRILLING METHOD	Hollow-Stem Augers	DATE: START	01/18/2017
DRILLING EQUIPMENT	Gus Peck	FINISH	01/18/2017
HORIZONTAL DATUM (NAD 1983 StatePlane Michigan South (US Feet))		BOREHOLE DEPTH	21 ft
NORTHING	176247.026	BOREHOLE DIAMETER	
EASTING	3847865.054	DEPTH TO WATER (INITIAL) ▼	15 ft
VERTICAL DATUM (NGVD 29 (US Feet)) ELEVATION	104.49 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLING DATA: SAMPLE TYPE	RECOVERY		Observations / Remarks
		SILTY CLAY (CL) medium stiff, some silt, trace fine gravel, trace fine sand; moist, mottled, brown and gray		CL					
5	100								
10	95								
		SAND (GW-SW) well graded, fine grained SAND; loose, some gravel, little silt, trace clay; moist, dark brownish gray to black, [Wood fragments]	11	GW-SW					
		SILTY CLAY (CL) soft, little fine sand, trace gravel, moist, dark gray to black, [Glass, wood, plastic debris]	13	CL					
	90		14	CL					
15		SILTY CLAY (CL) soft, some silt, trace fine sand, moist, dark gray to dark brownish gray	14.9 ▼						
		SAND (SP) poorly graded, fine grained SAND; loose, wet, light grayish brown, [silt/clay stringers throughout.]		SP					
		SILTY CLAY (CL) soft, some silt, wet, dark gray to dark brownish gray, [Grey fine sand seams throughout]	17.25	CL					
	85	SAND (SP) poorly graded, fine grained SAND; loose, little clay, laminated, gray to dark gray	19	SP					
20		SILTY CLAY (CL) soft, some silt, wet, dark gray to dark brownish gray	20	CL					
			21						
	80								

REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

LAB ANALYSIS:

3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
CCR Well Installation
1231 N 3rd Street
Grand Haven, Michigan

BORING # MW-02

ERM PROJECT # 0387368

SHEET 1 OF 1

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN	Sean Smith	OFFICE LOCATION	Holland, MI
DRILLING METHOD	Hollow-Stem Augers	DATE: START	01/18/2017
DRILLING EQUIPMENT	Gus Peck	FINISH	01/18/2017

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Michigan South (US Feet))
NORTHING 176247.026
EASTING 3847865.054
Elevation/Top of Casing Elev. 104.49 ft/ 107.75 ft

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

WELL DEVELOPMENT
Method: *Overpumping*
Duration: *0.5 hours*
Gals. Purged: *30*

Well Permit #: *No permit required.*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG
		SILTY CLAY (CL) medium stiff, some silt, trace fine gravel, trace fine sand; moist, mottled, brown and gray		CL	
5	100				
10	95				
		SAND (GW-SW) well graded, fine grained SAND; loose, some gravel, little silt, trace clay; moist, dark brownish gray to black, [Wood fragments]	11	GW-SW	
		SILTY CLAY (CL) soft, little fine sand, trace gravel, moist, dark gray to black, [Glass, wood, plastic debris]	13	CL	
15	90	SILTY CLAY (CL) soft, some silt, trace fine sand, moist, dark gray to dark brownish gray	14	CL	
		SAND (SP) poorly graded, fine grained SAND; loose, wet, light grayish brown, [silt/clay stringers throughout.]	14.9	SP	
		SILTY CLAY (CL) soft, some silt, wet, dark gray to dark brownish gray, [Grey fine sand seams throughout]	17.25	CL	
20	85	SAND (SP) poorly graded, fine grained SAND; loose, little clay, laminated, gray to dark gray	19	SP	
		SILTY CLAY (CL) soft, some silt, wet, dark gray to dark brownish gray	20	CL	
	80		21		

WELL CONSTRUCTION
Casing Type: 6-inch Diameter Steel Stickup
Schedule 40 PVC Riser
0.010-slot Schedule 40 PVC Screen

REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

WELL INSTALLATION NOTES:

3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
CCR Well Installation
1231 N 3rd Street
Grand Haven, Michigan

BORING # MW-03

ERM PROJECT # 0387368

SHEET 1 OF 1

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN	Sean Smith	OFFICE LOCATION	Holland, MI
DRILLING METHOD	Hollow-Stem Augers	DATE: START	01/18/2017
DRILLING EQUIPMENT	Gus Peck	FINISH	01/18/2017
HORIZONTAL DATUM (NAD 1983 StatePlane Michigan South (US Feet))		BOREHOLE DEPTH	17 ft
NORTHING	176214.1	BOREHOLE DIAMETER	
EASTING	3847846.674	DEPTH TO WATER (INITIAL) ▼	13 ft
VERTICAL DATUM (NGVD 29 (US Feet)) ELEVATION	102.17 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLING DATA: SAMPLE TYPE	RECOVERY		Observations / Remarks
2	100	SAND (SW) well graded, fine grained SAND; loose, some silt, little gravel, moist, grayish brown, [Brick and concrete fragments.]		SW					
4									
6			6						
	95	SAND (SW) well graded, fine grained SAND; loose, little silt, little gravel, moist, grayish brown to dark brown		SW					
8			8						
		SAND (SW) well graded, fine grained SAND; loose, some silt, some gravel, trace clay; moist, grayish brown to dark brown, [Wood fragments.]		SW					
10									
12	90	CLAYEY SILT (ML) soft, trace fine sand, moist, dark grayish brown to dark brown	12	ML					
		SAND (SP) poorly graded, fine grained SAND; loose, moist to wet, gray, [Wet @ 13']	12.75	SP					
14			14.5						
		SANDY SILT (OL) soft, little clay, trace fine sand, moist to wet, dark gray to dark brownish gray, [Silt loam.]		OL					
16									
	85		17						
18									

REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

LAB ANALYSIS:

3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
CCR Well Installation
1231 N 3rd Street
Grand Haven, Michigan

BORING # MW-03

ERM PROJECT # 0387368

SHEET 1 OF 1

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN	Sean Smith	OFFICE LOCATION	Holland, MI
DRILLING METHOD	Hollow-Stem Augers	DATE: START	01/18/2017
DRILLING EQUIPMENT	Gus Peck	FINISH	01/18/2017

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Michigan South (US Feet))
NORTHING 176214.1
EASTING 3847846.674
Elevation/Top of Casing Elev. 102.17 ft/ 105.2 ft

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

WELL DEVELOPMENT
Method: *Overpumping*
Duration: *0.5 hours*
Gals. Purged: *30*

Well Permit #: *No permit required.*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG
2	100	SAND (SW) well graded, fine grained SAND; loose, some silt, little gravel, moist, grayish brown, [Brick and concrete fragments.]		SW	
4					
6	95	SAND (SW) well graded, fine grained SAND; loose, little silt, little gravel, moist, grayish brown to dark brown	6	SW	
8		SAND (SW) well graded, fine grained SAND; loose, some silt, some gravel, trace clay; moist, grayish brown to dark brown, [Wood fragments.]	8	SW	
10					
12	90	CLAYEY SILT (ML) soft, trace fine sand, moist, dark grayish brown to dark brown	12	ML	
			12.75		
14		SAND (SP) poorly graded, fine grained SAND; loose, moist to wet, gray, [Wet @ 13']		SP	
		SANDY SILT (OL) soft, little clay, trace fine sand, moist to wet, dark gray to dark brownish gray, [Silt loam.]	14.5	OL	
16	85				
18			17		

WELL CONSTRUCTION

Casing Type:
6-inch Diameter
Steel Stickup

Schedule 40 PVC Riser

0.010-slot Schedule 40 PVC Screen

REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

WELL INSTALLATION NOTES:

3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
CCR Well Installation
1231 N 3rd Street
Grand Haven, Michigan

BORING # MW-04

ERM PROJECT # 0387368

SHEET 1 OF 1

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN	Sean Smith	OFFICE LOCATION	Holland, MI
DRILLING METHOD	Hollow-Stem Augers	DATE: START	01/18/2017
DRILLING EQUIPMENT	Gus Peck	FINISH	01/18/2017
HORIZONTAL DATUM (NAD 1983 StatePlane Michigan South (US Feet))		BOREHOLE DEPTH	17 ft
NORTHING	176182.574	BOREHOLE DIAMETER	
EASTING	3847848.69	DEPTH TO WATER (INITIAL) ▼	8.5 ft
VERTICAL DATUM (NGVD 29 (US Feet)) ELEVATION	100.60 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLING DATA: SAMPLE TYPE	RECOVERY		Observations / Remarks
	100	GRAVELLY SAND (SW) well graded, fine grained SAND; loose, some gravel, moist, brown, [Concrete fragments]		SW					
2									
4									
	95	GRAVELLY SAND (SP) poorly graded, fine grained SAND; loose, some gravel, moist, dark brown to black	5.5	SP					
6			6.5	SW					
		SAND (SW) well graded, fine grained SAND; loose, moist, brown	7	SC					
		CLAYEY SAND (SC) soft, some silt, little gravel, moist, brown to dark gray, [Roots]	7.5	SW					
8		SAND (SW) well graded, fine grained SAND; loose, some silt, some gravel, moist, dark brown, [Concrete and wood fragments.]	8.5 ▼	SW					
10		SAND (SW) well graded, medium to coarse grained SAND; loose, wet, dark grayish brown to black, [Bottom ash and concrete fragments.]	10	SP					
	90	SAND (SP) poorly graded, fine grained SAND; loose, wet, dark grayish brown	10.5	OL					
		SANDY SILT (OL) soft, moist, dark grayish brown, [Silt loam.]	11.5	SP					
12		SAND (SP) poorly graded, fine grained SAND; loose, wet, gray	12.5	OL					
14		SANDY SILT (OL) soft, trace fine sand, trace clay, moist, dark grayish brown, [Clay stringer (14 - 14.25). Grey fine sand seam (14.25 - 14.5).]	14.5	MLS					
	85	SANDY SILT (MLS) soft, little clay, moist, dark grayish brown, [Wood fragments. Grey fine sand seam (15.75 - 16); (16.25 - 16.5); (16.75 - 17).]							
16			17						
18									

REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

LAB ANALYSIS:

3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
CCR Well Installation
1231 N 3rd Street
Grand Haven, Michigan

BORING # **MW-04**

ERM PROJECT # 0387368

SHEET 1 OF 1

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN	Sean Smith	OFFICE LOCATION	Holland, MI
DRILLING METHOD	Hollow-Stem Augers	DATE: START	01/18/2017
DRILLING EQUIPMENT	Gus Peck	FINISH	01/18/2017

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Michigan South (US Feet))

NORTHING	176182.574
EASTING	3847848.69
Elevation/Top of Casing Elev.	100.60 ft/ 103.59 ft

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

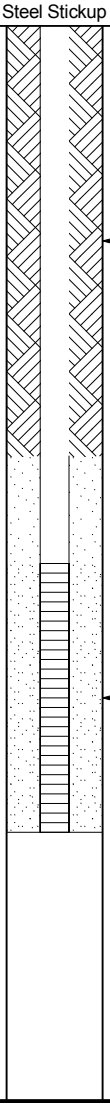
Well Permit #: *No permit required.*

WELL DEVELOPMENT
Method: *Overpumping*
Duration: *0.5 hours*
Gals. Purged: *30*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS
	100	GRAVELLY SAND (SW) well graded, fine grained SAND; loose, some gravel, moist, brown, [Concrete fragments]		SW
2				
4				
	95	GRAVELLY SAND (SP) poorly graded, fine grained SAND; loose, some gravel, moist, dark brown to black	5.5	SP
6			6.5	SW
		SAND (SW) well graded, fine grained SAND; loose, moist, brown	7	SC
		CLAYEY SAND (SC) soft, some silt, little gravel, moist, brown to dark gray, [Roots]	7.5	SW
8			8.5	SW
		SAND (SW) well graded, fine grained SAND; loose, some silt, some gravel, moist, dark brown, [Concrete and wood fragments.]	10	SP
10			10.5	OL
	90	SAND (SW) well graded, medium to coarse grained SAND; loose, wet, dark grayish brown to black, [Bottom ash and concrete fragments.]	11.5	SP
12			12.5	OL
		SAND (SP) poorly graded, fine grained SAND; loose, wet, dark grayish brown		
		SANDY SILT (OL) soft, moist, dark grayish brown, [Silt loam.]		
14			14.5	MLS
		SAND (SP) poorly graded, fine grained SAND; loose, wet, gray		
	85	SANDY SILT (OL) soft, trace fine sand, trace clay, moist, dark grayish brown, [Clay stringer (14 - 14.25). Grey fine sand seam (14.25 - 14.5).]		
16				
		SANDY SILT (MLS) soft, little clay, moist, dark grayish brown, [Wood fragments. Grey fine sand seam (15.75 - 16); (16.25 - 16.5); (16.75 - 17).]	17	
18				

GRAPHIC LOG

WELL CONSTRUCTION
Casing Type:
6-inch Diameter
Steel Stickup



REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

WELL INSTALLATION NOTES:

RECORD OF WELL LOG MW-05

SHEET 1 of 1

PROJECT: GHBLP 2018 Wells
PROJECT NUMBER: 1775416B
LOCATION: Grand Haven, Michigan
CLIENT: Grand Haven Board of Light and Power

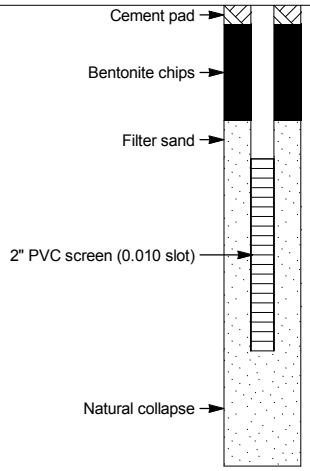
DRILLING METHOD: Hollow-Stem Auger
DRILLING DATE: 5/22/18
DRILL RIG: GP-1100 ATV

DATUM: Ground Surface
AZIMUTH: n/a
COORDS: n/a

GS ELEVATION:
TOC ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION / VEGETATION:	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	REC / ATT
0	Hand auger	0.0 - 8.5 ASH, fine-grained, many small brick fragments, black; wet at 4 ft. More coarse at bottom, some glass and wood fragments	ASH				AG		24.0
5	Hollow-stem auger					1	SS	16-13-9-9	18.0 / 24.0
		8.5 - 10.0 (SC-CL) clayey SAND, fine-medium sand; dark grey, moist, semi-cohesive	SC		8.5	2	SS	1-1-1-2	24.0 / 24.0
10		10.0 - 12.0 Sandy PEAT, some fibrous material, shell fragments; organic odor, dark grey	OL		10.0	3	SS	H-1-1-1	24.0 / 24.0
		Boring completed at 12.0 ft.							
15									
20									
25									
30									
35									
40									

NOTES
WATER LEVELS
WELL INSTALLATION
GRAPHIC



GOLDER

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: EDAC
DRILLER: SS

LOGGED: AJS
CHECKED:
DATE: 07/06/2018

ANC_WELLLOG GHBLP 2018.GPJ GLDR_ANC.GDT 7/10/18

RECORD OF WELL LOG MW-06

SHEET 1 of 1

PROJECT: GHBLP 2018 Wells
PROJECT NUMBER: 1775416B
LOCATION: Grand Haven, Michigan
CLIENT: Grand Haven Board of Light and Power

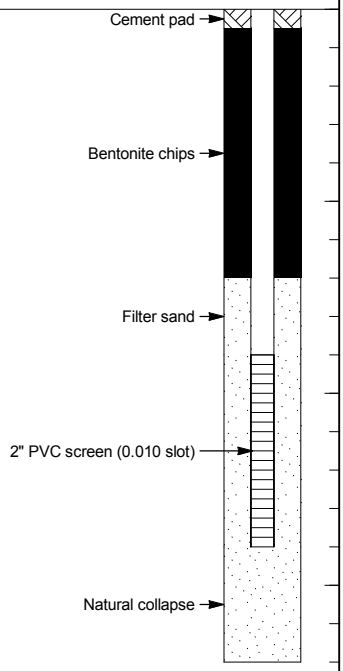
DRILLING METHOD: Hollow-Stem Auger
DRILLING DATE: 5/22/18
DRILL RIG: GP-1100 ATV

DATUM: Ground Surface
AZIMUTH: n/a
COORDS: n/a

GS ELEVATION:
TOC ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION / VEGETATION:	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	REC / ATT
0	Hand auger	0.0 - 7.5 Clayey SAND, medium sand, some 1" clay nodules (brown with reddish mottling), trace small brick fragments; dark brown	SC				AG		24/0
5						1	SS	9-19-24-24	24.0/24.0
	Hollow-stem auger	7.5 - 9.0 Refuse, plastic mesh, brick fragments; wet	Refuse		7.5	2	SS	5-2-5-5	24.0/24.0
		9.0 - 10.0 SAND, some black organic fines, rounded; wet	SP		9.0				
10		10.0 - 15.0 Refuse, black, sandy (medium with some angular coarse sand), fiberglass in top and bottom of spoon; wet; steel fragment at 14.5 ft	Refuse		10.0	3	SS	2-2-8-8	24/0
						4	SS	6-8-3-3	6.0/24.0
15		15.0 - 17.0 PEAT, black, leaf intact, fibrous wood; wet	OL		15.0	5	SS	2-2-2-3	24.0/24.0
		Boring completed at 17.0 ft.							
20									
25									
30									
35									
40									

NOTES
WATER LEVELS
WELL INSTALLATION
GRAPHIC



GOLDER

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: EDAC
DRILLER: SS

LOGGED: AJS
CHECKED: DR
DATE: 07/06/2018

ANC_WELLLOG GHBLP 2018.GPJ GLDR_ANC.GDT 7/10/18

RECORD OF WELL LOG MW-07

SHEET 1 of 1

PROJECT: GHBLP 2018 Wells
PROJECT NUMBER: 1775416B
LOCATION: Grand Haven, Michigan
CLIENT: Grand Haven Board of Light and Power

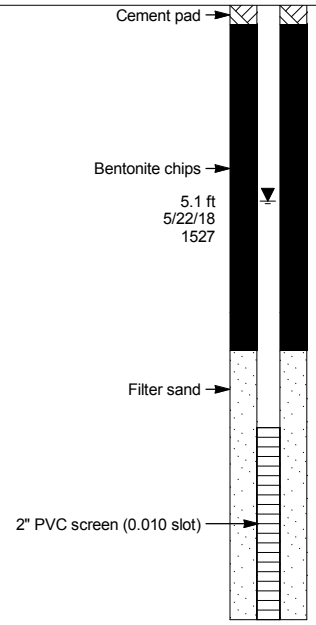
DRILLING METHOD: Hollow-Stem Auger
DRILLING DATE: 5/22/18
DRILL RIG: GP-1100 ATV

DATUM: Ground Surface
AZIMUTH: n/a
COORDS: n/a

GS ELEVATION:
TOC ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	REC / ATT
0	Hand auger	VEGETATION: 0.0 - 7.5 Sandy CLAY, some gravel; brown, stiff, w<PL	CL				AG		24.0
5						1	SS	4-5-7-9	12.0 / 24.0
10	Hollow-stem auger	7.5 - 11.5 Sandy PEAT, some shell fragments; black, moist, cohesiv, firm, cannot roll thread	OL		7.5	2	SS	0-1-3-5	24.0 / 24.0
						3	SS	1-3-5-8	24.0 / 24.0
		11.5 - 15.0 Silty SAND, some shell fragments, medium sand; black-brown; wet	SM		11.5	4	SS	6-9-11-16	24.0 / 24.0
15		Boring completed at 16.0 ft.			15.0				

NOTES
WATER LEVELS
WELL INSTALLATION
GRAPHIC



GOLDER

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: EDAC
DRILLER: SS

LOGGED: AJS
CHECKED: DR
DATE: 07/06/2018

ANC_WELLLOG GHBLP 2018.GPJ GLDR_ANC.GDT 7/10/18

RECORD OF WELL LOG MW-08

SHEET 1 of 1

PROJECT: GHBLP 2018 Wells
PROJECT NUMBER: 1775416B
LOCATION: Grand Haven, Michigan
CLIENT: Grand Haven Board of Light and Power

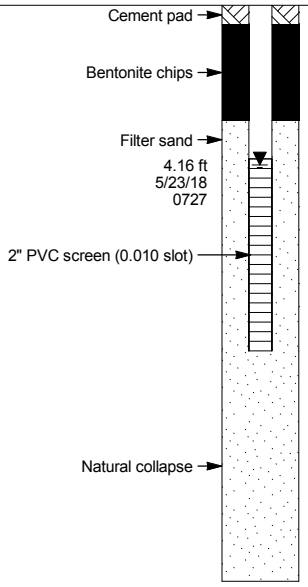
DRILLING METHOD: Hollow-Stem Auger
DRILLING DATE: 5/22/18
DRILL RIG: GP-1100 ATV

DATUM: Ground Surface
AZIMUTH: n/a
COORDS: n/a

GS ELEVATION:
TOC ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION / VEGETATION:	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	REC / ATT
0	Hand auger	0.0 - 3.5 Medium SAND, fill; wet, light brown	SP				AG		24.0
3.5	Hand auger	3.5 - 8.5 Refuse, plastic bags	Refuse		3.5	1	SS	7-2-7-4	0.0 / 24.0
8.5	Hollow-stem auger	8.5 - 15.0 Clayey SAND, medium sand, some shell fragments; brown, some pockets of cohesion; wet	SC		8.5	2	SS	2-2-2-5	12.0 / 24.0
						3	SS	0-1-3-5	3.0 / 24.0
						4	SS	2-1-2-5	6.0 / 24.0
15		Boring completed at 15.0 ft.							

NOTES
WATER LEVELS
WELL INSTALLATION
GRAPHIC



GOLDER

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: EDAC
DRILLER: SS

LOGGED: AJS
CHECKED:
DATE: 07/06/2018

ANC_WELLLOG GHBLP 2018.GPJ GLDR_ANC.GDT 7/10/18

RECORD OF WELL LOG MW-09

PROJECT: GHBLP Monitoring Wells
PROJECT NUMBER: 18113500
LOCATION: Grand Haven, Michigan
CLIENT: Grand Haven Board of Light and Power

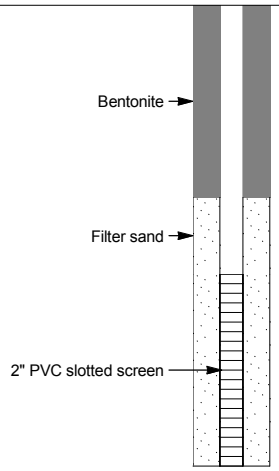
DRILLING METHOD: Direct-Push
DRILLING DATE: 8/12/2019
DRILL RIG: Geoprobe 7288DT

DATUM: Local
AZIMUTH: n/a
COORDS: N: 578,241.35 E: 12,624,185.62

SHEET 1 of 1
GS ELEVATION: 586.80
TOC ELEVATION: 589.65
INCLINATION: -90

DEPTH (ft)	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (lb hammer 30 inch drop)	REC / ATT
0	Hand Auger	VEGETATION:							
		0.0 - 0.3 Brown topsoil w/ organics, dry	Topsoil		0.3				
		0.3 - 3.8 Brown fine sand, moist	SP		583.0		AG		3.0 / 3.0
	DPT (macro core)	3.8 - 7.2 Brown fine to coarse sand some gravel, wet at 5'	SW		3.8 579.6		MC		1.6 / 2.0
5		7.2 - 8.6 Dark brown sandy silt, trace gravel, wet	ML		7.2 578.2		MC		4.5 / 5.0
		8.6 - 10.7 Dark brown silt, some sand, wet	ML		8.6 576.1				
10		10.7 - 11.7 Fine gray sand, wet	SP		10.7 575.1		MC		2.0 / 2.0
		11.7 - 12.0 Dark brown silt, some sand, wet	ML						
		Boring completed at 12.0 ft.							
15									
20									
25									
30									
35									
40									

NOTES
WATER LEVELS
WELL INSTALLATION
GRAPHIC



GOLDER

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: GeoServe
DRILLER: GeoServe

LOGGED: ACN
CHECKED: CEP
DATE: 10/24/2019

ANC_WELLLOG GHBLP 2019.GPJ GLDR_ANC.GDT 10/29/19

RECORD OF WELL LOG MW-10

PROJECT: GHBLP Monitoring Wells
PROJECT NUMBER: 18113500
LOCATION: Grand Haven, Michigan
CLIENT: Grand Haven Board of Light and Power

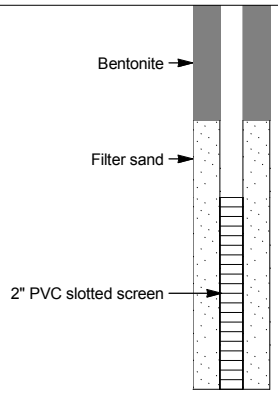
DRILLING METHOD: Direct-Push
DRILLING DATE: 8/12/2019
DRILL RIG: Geoprobe 7288DT

DATUM: Local
AZIMUTH: n/a
COORDS: N: 578,367.40 E: 12,624,470.20

SHEET 1 of 1
GS ELEVATION: 583.71
TOC ELEVATION: 586.73
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (lb hammer 30 inch drop)	REC / ATT
0	Hand Auger	VEGETATION: 0.0 - 0.3 Brown topsoil w/ organics, dry	Topsoil		0.3				
		0.3 - 4.7 Brown fine sand, trace gravel, wet at 2.8'	SP				AG		3.0 / 3.0
							MC		0.5 / 2.0
5	DPT (macro core)	4.7 - 5.1 Brown sandy silt, trace gravel, wet	ML		579.0 5.1				
		5.1 - 10.0 Brown fine to coarse sand w/ gravel, wet	SW				MC		1.0 / 5.0
10		Boring completed at 10.0 ft.			573.7				

NOTES
WATER LEVELS
WELL INSTALLATION
GRAPHIC



GOLDER

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: GeoServe
DRILLER: GeoServe

LOGGED: ACN
CHECKED: CEP
DATE: 10/24/2019

ANC_WELLLOG GHBLP 2019.GPJ GLDR_ANC.GDT 10/29/19

RECORD OF BOREHOLE: PZ-11

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI
DATE: August 19, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS
ELEVATION: 592.5 ft (Ground)
COORDINATES: N: 578236.9 ft E: 12624377.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

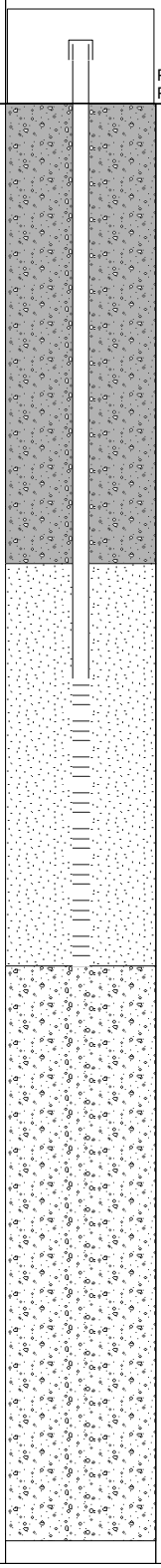
DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
0	Brown silty CLAY, dry, firm, brittle.	CL	0.0		SS	100		
5			587.3					
5	Brown fine SAND, dry, loose.	SP	5.2		SS	92		
6	Dark gray SAND, dry to moist, loose.		587.0 5.5					
8			584.5					
8	Brown and gray mottled CLAY, moist, soft to firm.	CL	8.0		SS	80		
10			582.4					
10	Brown fine SAND, dry, loose, trace gravel.	SP	10.1					
11			581.3					
11	Brown and gray sandy mottled CLAY, moist, soft to firm.	CL	11.2					
12			580.3					
12	Gray and black SAND, moist, loose, trace silt, trace gravel, glass fragments, wood present.	SP	12.2					
16			575.7					
16	Black peaty SILT, soft, moist, wood present, plastic present, glass present.	OL	16.8		SS	48		
19			573.5					
19	Black and gray fine SAND, wet, loose.	SP	19.0					
20			572.5					
20	Black peaty SILT, moist, soft, wood and glass present, shell fragments. Gray sand seams present from 25' to 30' BGS.	OL	20.0		SS	64		
25	Continued on Next Page							

ADDITIONAL OBSERVATIONS:

GROUNDWATER OBSERVATIONS:

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 2.81 ft
Pipe Elev: 595.3 ft

0.0 - 8.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

8.0 - 15.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 19, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-11

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 19, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 592.5 ft (Ground)
COORDINATES: N: 578236.9 ft E: 12624377.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26–30	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Black peaty SILT, moist, soft, wood and glass present, shell fragments. Gray sand seams present from 25' to 30' BGS.	OL				SS	100					Pipe Stickup: 2.81 ft Pipe Elev: 595.3 ft 15.0 - 40.0 ft bgs: Material Collapse
31						561.5								
31–34			Gray fine SAND, wet, loose, shell fragments.	SP		31.0 558.7		SS	60					
34			Black peaty SILT, moist, soft, wood present.	OL		33.8 558.1								
34–40			Gray fine SAND, wet, loose, medium to coarse grained from 36' to E.O.B.	SP		34.4 552.5		SS	100					
40			End of hole at 40.0 ft. Target Depth Reached Refer to diagram for well construction details.											

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 19, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-12

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI
DATE: August 17, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS
ELEVATION: 584.9 ft (Ground)
COORDINATES: N: 577987.6 ft E: 12624312.3 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
0	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Brown sandy CLAY, dry, firm.	CL		0.0 / 583.9								Pipe Stickup: 3.09 ft Pipe Elev: 588.0 ft
1			Brown SAND, wet, loose.	SP		1.0 / 577.9		SS	100					0.0 - 1.0 ft bgs: Bentonite Chips
2														2" Schedule 40 PVC
3														
4														
5														1.0 - 8.0 ft bgs: Filter Sand
6														
7			Brown clayey PEAT, moist to wet, soft, trace sand.			7.0 / 570.7		SS	66					2" Schedule 40 slotted PVC
8														
9														
10														
11														
12														
13								SS	64					
14														
15			Gray fine SAND, wet, loose.	SP		14.2 / 569.7								
16			Dark gray clayey PEAT, moist, soft, some gray sand seams present.			15.2 / 565.9								
17								SS	64					
18														
19			Gray fine SAND, wet, loose, trace medium grained sand.	SP		19.0								
20														
21														
22								SS	66					
23														
24														8.0 - 40.0 ft bgs: Material Collapse
25			Continued on Next Page											

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 17, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-12

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 17, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 584.9 ft (Ground)
COORDINATES: N: 577987.6 ft E: 12624312.3 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray fine SAND, wet, loose, trace medium grained sand.	SP				SS	72					Pipe Stickup: 3.09 ft Pipe Elev: 588.0 ft
27														
28														
29														
30														
31						553.9								
32			Gray silty fine SAND, moist, compact.	SM		31.0		SS	74					
33														
34														
35														
36														
37						547.9								
38			Gray SILT, moist, hard.	ML		37.0		SS	100					
39						545.9								
40			Gray CLAY, moist, firm to soft.	CH		39.0								
41						544.9								
42			End of hole at 40.0 ft.											
43			Target Depth Reached Refer to diagram for well construction details.											
44														
45														
46														
47														
48														
49														
50														

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 17, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-13

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI
DATE: August 17, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS
ELEVATION: 583.2 ft (Ground)
COORDINATES: N: 577623.9 ft E: 12624190.9 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
0	Brown fine SAND, dry, loose.	SP	0.0 / 582.7		SS	100		
1	Gray fine SAND, dry to moist, loose, trace silt.		0.5					
4			579.2					
4	Gray fine to medium SAND, wet, loose.		4.0 / 578.2					
5	Dark gray silty SAND, wet, loose.	SM	5.0 / 577.5		SS	68		
6	Gray fine SAND, wet, loose.	SP	5.7					
10			572.9					
10	Dark gray GRAVEL & SAND, wet, loose.	GP	10.3 / 571.7		SS	40		
11	Gray silty SAND, wet, cohesive, some organics present.	SM	11.5					
17			566.2					
17	Gray fine SAND, wet, loose, some medium grained sand present below 20' BGS.	SP	17.0		SS	66		
20					SS	50		
25	Continued on Next Page							

ADDITIONAL OBSERVATIONS:
GROUNDWATER OBSERVATIONS:

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 2.85 ft
Pipe Elev: 586.1 ft

0.0 - 2.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

2.0 - 9.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

9.0 - 34.0 ft bgs: Matieral Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 17, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-13

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 17, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.2 ft (Ground)
COORDINATES: N: 577623.9 ft E: 12624190.9 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray fine SAND, wet, loose, some medium grained sand present below 20' BGS.	SP		557.8 / 25.4								Pipe Stickup: 2.85 ft Pipe Elev: 586.1 ft
27			Gray silty fine SAND, wet, cohesive.	SM				SS	80					
28														
29														
30														
31														
32						551.2		SS	100					
33			Gray fine SAND & SILT, wet, hard.	SP-SM		32.0 / 549.2								
34			End of hole at 34.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.											
35														
36														
37														
38														
39														
40														
41														
42														
43														
44														
45														
46														
47														
48														
49														
50														

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 17, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-14

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 16, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.5 ft (Ground)
COORDINATES: N: 577191.9 ft E: 12624160.0 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

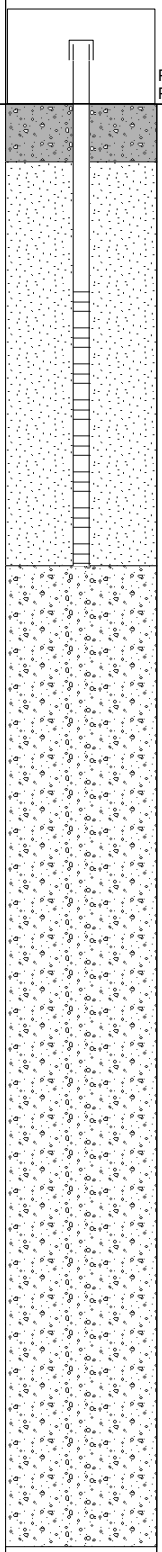
DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
0	Brown SAND, dry to wet, loose, some medium grained sand.	SP	0.0		SS	100		
6	Brown silty SAND, wet, loose.	SM	577.5 6.0					
7	Brown fine SAND, wet, loose.	SP	577.2 6.3		SS	80		
10	Black fine SAND, wet, loose, some organics present.	SP	573.2 10.3					
11	Black CLAY, moist, soft, some sand, organics present, organic scent.	CL	572.7 10.8		SS	54		
15	Brown silty SAND, wet, loose.	SM	568.5 15.0					
15	Dark gray PEAT, wet, soft, some clay present, organic scent.		568.3 15.2		SS	50		
19	Gray silty SAND, wet, loose, organics present.	SM	563.8 19.7					
21	Gray medium SAND, wet, loose.	SP	562.5 21.0		SS	70		
25	Continued on Next Page							

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

ADDITIONAL OBSERVATIONS:

GROUNDWATER OBSERVATIONS:

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 2.93 ft
Pipe Elev: 586.4 ft

0.0 - 1.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

1.0 - 8.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

8.0 - 35.0 ft bgs: Matieral Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 16, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-14

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 16, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.5 ft (Ground)
COORDINATES: N: 577191.9 ft E: 12624160.0 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
25	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray medium SAND, wet, loose.	SP		558.1								Pipe Stickup: 2.93 ft Pipe Elev: 586.4 ft
			Gray sandy SILT, wet, non-cohesive.			25.4		SS	100					
30				ML				SS	88					
						550.0								
			Gray SILT, wet, cohesive, trace sand.			33.5								
35						548.5								
			End of hole at 35.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.											

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 16, 2021
DATE: Nov 03, 2021

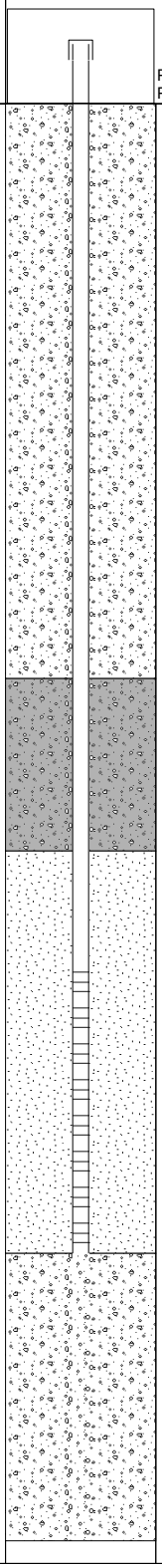
RECORD OF BOREHOLE: PZ-15

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI
DATE: August 25, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS
ELEVATION: 589.3 ft (Ground)
COORDINATES: N: 577062.5 ft E: 12624730.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
0	Brown sandy TOPSOIL, dry, loose.		0.0					
			588.8					
0	Light brown SAND, dry to moist, loose.		0.5		SS	100		
5		SP						
5					SS	50		
8			580.8					
8	COAL.		8.5					
9			579.8					
9	Black gravelly SAND, moist, loose.		9.5					
10		SP			SS	76		
12			577.0					
12	Black mucky PEAT, moist, soft, trace silt, some trash present at 14.8' BGS.		12.3					
14			574.4					
15	Black fine SAND, wet, loose, some glass present.		14.9					
15	Dark gray mucky SAND, moist to wet, soft.		574.2 15.1					
15		SP			SS	46		
20								
22			567.2					
22	Dark gray sandy PEAT, moist, soft, shell fragments present.		22.1		SS	66		
24			565.1					
24	Pale black PEAT, moist, soft. Gray sand seams present @ 24.9', 25.7', and 28.0' BGS.		24.2					
25	Continued on Next Page							

CONSTRUCTION AND INSTALLATION DETAILS



HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 25, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-15

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 25, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 589.3 ft (Ground)
COORDINATES: N: 577062.5 ft E: 12624730.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Pale black PEAT, moist, soft. Gray sand seams present @ 24.9', 25.7', and 28.0' BGS.					SS	74					Pipe Stickup: 3.05 ft Pipe Elev: 592.4 ft
27														
28														
29														
30						559.3								
31			Dark gray medium SAND, wet, loose, shell fragments present.			30.0		SS	100					20.0 - 40.0 ft bgs: Material Collapse
32						557.0								
33			Gray fine SAND, moist, loose to compact.			32.3								
34				SP										
35														
36								SS	100					
37														
38														
39						549.7								
40			Gray silty SAND, moist, compact.	SM		39.6								
			End of hole at 40.0 ft. Target Depth Reached Refer to diagram for well construction details.			549.3								
41														
42														
43														
44														
45														
46														
47														
48														
49														
50														

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 25, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-16

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI
DATE: August 25, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS
ELEVATION: 582.2 ft (Ground)
COORDINATES: N: 577273.6 ft E: 12625194.8 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
0	Brown TOPSOIL, moist, loose.		0.0					
0	Dark gray fine SAND, wet, loose.	SP	581.7 / 0.5					
1	Black GRAVEL & SAND fill, wet, loose.		581.2 / 1.0					
2	Black peaty CLAY, moist, soft.	CH	580.7 / 1.5		SS	100		
4	Gray fine SAND, wet, loose.	SP	578.2 / 4.0					
5	WOOD ORGANICS, mucky fines mixed in.		576.9 / 5.3		SS	42		
13					SS	6		
15	Black mucky PEAT, moist, soft.		567.2 / 15.0		SS	58		
20	Black mucky fine SAND, some shell fragments present.	SP	562.2 / 20.0		SS	80		
22	Dark gray medium SAND, wet, loose.		559.7 / 22.5					
25	Gray very fine SAND, moist, compact, trace silt.		557.4 / 24.8					

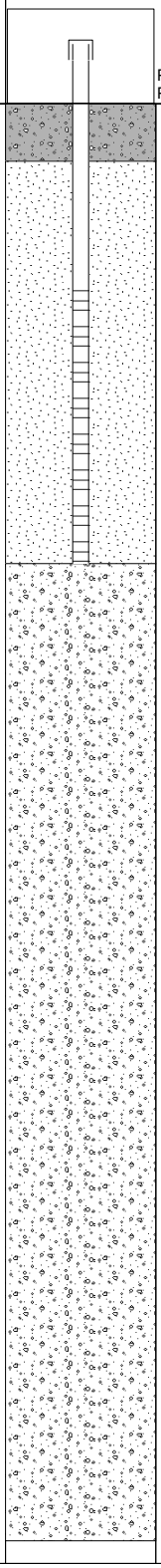
Continued on Next Page

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

ADDITIONAL OBSERVATIONS:

GROUNDWATER OBSERVATIONS:

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 2.69 ft
Pipe Elev: 584.9 ft

0.0 - 1.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

1.0 - 8.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

8.0 - 35.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 25, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-16

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 25, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 582.2 ft (Ground)
COORDINATES: N: 577273.6 ft E: 12625194.8 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26–30	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray very fine SAND, moist, compact, trace silt.	SP				SS	80					Pipe Stickup: 2.69 ft Pipe Elev: 584.9 ft
31						550.5								
31			Gray sandy SILT, moist, firm.	ML		31.7								
31–34			Gray CLAY, moist, soft, sticky, high plasticity.	CH		550.2 32.0		SS	80					
35			End of hole at 35.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.			547.2								
36–50														

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 25, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-17

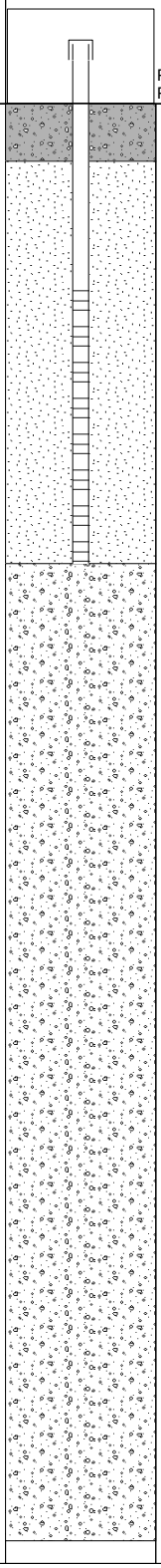
CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI
DATE: August 17, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS
ELEVATION: 584.0 ft (Ground)
COORDINATES: N: 577652.8 ft E: 12624744.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
0	Brown SAND, dry, loose, some gravel.	SP	0.0		SS	100		
5	Black SAND, moist, loose, trace organics.		579.3 4.7					
	Brown gravelly SAND, dry, compact.		579.0 5.0		SS	60		
6	Black gravelly SILT, wet, compact, trace organics present.	ML	578.5 5.5					
8			575.5					
9	Black silty PEAT, moist, soft.		8.5					
10			574.0		SS	44		
	Black sandy SILT, moist, soft, trace organics.	ML	10.0					
15					SS	50		
19			564.5					
20	Gray fine SAND, wet, loose.	SP	19.5		SS	54		
25	Continued on Next Page							

ADDITIONAL OBSERVATIONS:
GROUNDWATER OBSERVATIONS:

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 2.99 ft
Pipe Elev: 587.0 ft

0.0 - 1.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

1.0 - 8.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

8.0 - 40.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 17, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-17

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 17, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 584.0 ft (Ground)
COORDINATES: N: 577652.8 ft E: 12624744.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

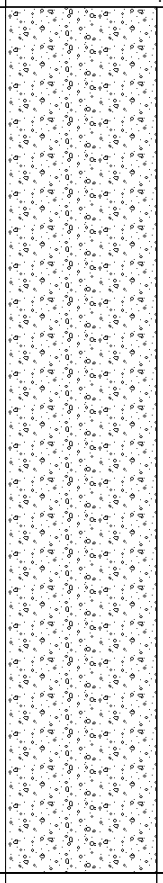
DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DEPTH (ft)	DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
26	Gray fine SAND, wet, loose.	SP		557.5		SS	100		
27	Gray silty SAND, wet, loose to compact, trace silt seams.	SM		26.5					
28									
29									
30									
31				552.9					
	Gray sandy SILT, wet, hard.	ML		31.1					
32	Gray silty SAND, wet, hard.	SM		552.5 / 31.5		SS	70		
33									
34				549.4					
35	Gray sandy SILT, wet, hard.	ML		34.6		SS	84		
36									
37									
38									
39				545.0					
	Gray CLAY, moist, soft, high plasticity.	CH		39.0					
40				544.0					
	End of hole at 40.0 ft.								
41	Target Depth Reached Refer to diagram for well construction details.								
42									
43									
44									
45									
46									
47									
48									
49									
50									

ADDITIONAL OBSERVATIONS

GROUNDWATER OBSERVATIONS

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 2.99 ft
Pipe Elev: 587.0 ft

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 17, 2021
DATE: Nov 03, 2021

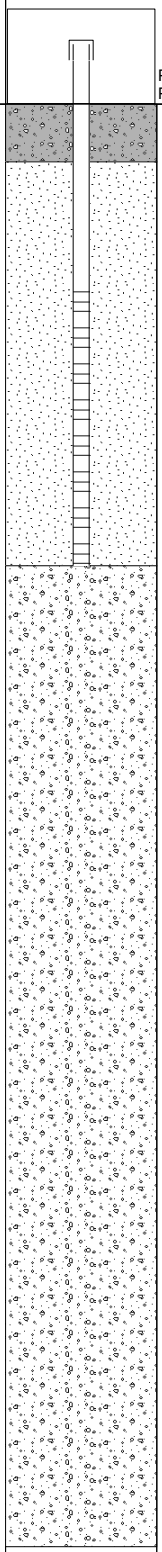
RECORD OF BOREHOLE: PZ-18

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI
DATE: August 18, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS
ELEVATION: 584.1 ft (Ground)
COORDINATES: N: 577919.1 ft E: 12624742.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DEPTH (ft)	MATERIAL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS
0	Brown TOPSOIL, dry, loose.		0.0 / 583.6							
1	Brown GRAVEL & SAND, moist to wet, loose.	GW	0.5 / 577.6		SS	100				
6	Brown peaty SILT, moist, soft, trace sand, cohesive.	ML	6.5 / 574.3		SS	60				
10	Gray fine to medium SAND, wet, loose.	SP	9.8 / 574.0							
10	Brown peaty sandy SILT, moist, soft, cohesive.	ML	10.1 / 565.6		SS	50				
18	Gray fine SAND, wet, loose, some organics and shell fragments at 23' BGS.	SP	18.5 / 559.9		SS	54				
24	Gray silty SAND, wet, loose, some organics and shell fragments present. Compact starting at 28' BGS.	SM	24.2		SS	42				
25	Continued on Next Page									

CONSTRUCTION AND INSTALLATION DETAILS



HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 18, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-18

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 18, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 584.1 ft (Ground)
COORDINATES: N: 577919.1 ft E: 12624742.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26–30	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray silty SAND, wet, loose, some organics and shell fragments present. Compact starting at 28' BGS.	SM				SS	100					Pipe Stickup: 3.10 ft Pipe Elev: 587.2 ft
30–34								SS	100					
33						550.9								
33–34			Gray sandy SILT, moist, firm to hard, cohesive.	ML		33.2 550.1								
34			End of hole at 34.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.											

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 18, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-19

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 20, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.1 ft (Ground)
COORDINATES: N: 577938.0 ft E: 12624957.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

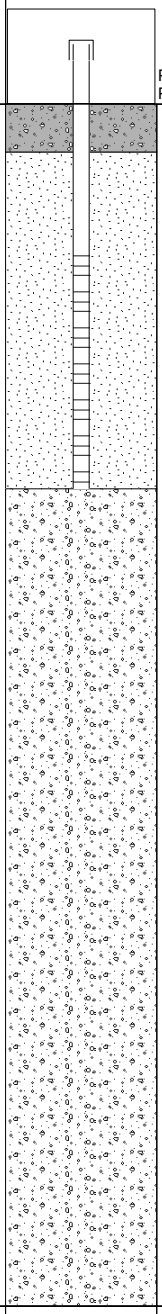
DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES REC %	SAMPLES BLOWS	SAMPLES N-VALUE
0	Black clayey TOPSOIL, moist, soft, organics present.		0.0					
			580.6		SS	100		
3	Black peaty SAND, wet, loose, trace gravel.	SP	2.5					
5			577.7					
	Black coarse SAND, wet, loose.		5.4					
6	Brown peaty SILT, moist, soft, some sand present, shell fragments present.	ML	577.4 5.7		SS	44		
11			571.6					
12	Brown fine SAND, wet, loose, trace organics present until 15' BGS.	SP	11.5		SS	52		
15					SS	92		
20			562.5					
21	Gray silty fine SAND, wet, compact.	SM	20.6		SS	86		
25			558.1					
	End of hole at 25.0 ft.							
	Refusal prior to 40-ft target depth. Refer to diagram for well construction details.							

ADDITIONAL OBSERVATIONS:

GROUNDWATER OBSERVATIONS:

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 2.80 ft
Pipe Elev: 585.9 ft

0.0 - 1.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

1.0 - 8.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

8.0 - 25.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 20, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-20

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI
DATE: August 18, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS
ELEVATION: 582.4 ft (Ground)
COORDINATES: N: 577722.5 ft E: 12625131.4 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
0	TOPSOIL		0.0 / 582.4					
0	Brown peaty SAND, wet, soft, trash present (Glass, metal, coal).		0.5 / 581.9					
5	Gray fine SAND, wet, loose.	SP	5.2 / 577.2		SS	100		
5	Brown peaty SILT, moist, soft, metal sheet present at 13' BGS.	ML	5.5 / 576.9		SS	42		
13	Gray fine SAND, wet, loose, shell fragments present.	SP	13.5 / 568.9		SS	58		
20	Brown silty SAND, wet, cohesive, shell fragments present, trace organics.	SM	20.0 / 562.4		SS	60		
23	Gray sandy SILT, moist, hard.	ML	23.2 / 559.2		SS	68		
25	Continued on Next Page							

ADDITIONAL OBSERVATIONS:

GROUNDWATER OBSERVATIONS:

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 3.32 ft
Pipe Elev: 585.7 ft

- 0.0 - 1.0 ft bgs: Bentonite Chips
- 2" Schedule 40 PVC
- 1.0 - 8.0 ft bgs: Filter Sand
- 2" Schedule 40 slotted PVC
- 8.0 - 34.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 18, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-20

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 18, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 582.4 ft (Ground)
COORDINATES: N: 577722.5 ft E: 12625131.4 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26–29	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray sandy SILT, moist, hard.	ML		552.4		SS	66					Pipe Stickup: 3.32 ft Pipe Elev: 585.7 ft
30			Gray medium SAND, wet, loose, shell fragments present.	SP		30.0 551.2								
31–32			Gray silty SAND, wet, compact.	SM		31.2		SS	100					
33						548.9								
34			Gray sandy SILT, moist, firm.	ML		33.5 548.4								
34			End of hole at 34.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.											
35–50														

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 18, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-21

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 30, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 580.3 ft (Top of Casing)
COORDINATES: N: 577941.4 ft E: 12625280.3 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
0	Marsh Master Geoprobe	Direct Push - 4-in Hole Dia.	Black sandy MUCK, wet, soft, trace organics.			0.0		SS	28					Pipe Elev: 583.3 ft; 0.0 - 0.2 ft bgs: Bentonite Chips
3						576.8								2" Schedule 40 PVC
3			Brown MUCK, wet, soft, some organics.			3.5								
5						575.3								0.2 - 9.0 ft bgs: Filter Sand
5			Gray fine SAND, wet, loose, trace silt starting at 13.5' BGS.			5.0		SS	50					2" Schedule 40 slotted PVC
10								SS	36					
15				SP		565.3								
15			Dark gray medium SAND, wet, loose.			15.0								
17						563.3								
17			Brown fine SAND, wet, loose.			17.0		SS	56					9.0 - 30.0 ft bgs: Material Collapse
20								SS	100					
25			Continued on Next Page											

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 30, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-21

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 30, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 580.3 ft (Top of Casing)
COORDINATES: N: 577941.4 ft E: 12625280.3 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26	Marsh Master Geoprobe	Direct Push - 4-in Hole Dia.	Brown fine SAND, wet, loose.	SP				SS	100					Pipe Elev: 583.3 ft
27														
28														
29														
30						550.3								
31			End of hole at 30.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details. Ground elevation survey unable to be collected due to piezometer placement in standing water.											
32														
33														
34														
35														
36														
37														
38														
39														
40														
41														
42														
43														
44														
45														
46														
47														
48														
49														
50														

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 30, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-22

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 31, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 580.4 ft (Top of Casing)
COORDINATES: N: 578056.9 ft E: 12625388.0 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Marsh Master Geoprobe
DRILL METHOD: Direct Push - 4-in Hole Dia.

DEPTH (ft)	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
0	Black sandy MUCK, wet, soft, some organics present.			0.0 / 580.4		SS	18					Pipe Elev: 583.4 ft
5	Gray fine SAND, wet, loose, shell fragments present. Trace silt starting at 14' BGS.	SP		5.1 / 575.3		SS	40					2" Schedule 40 PVC; 0.0 - 9.0 ft bgs: Filter Sand; 2" Schedule 40 slotted PVC
10						SS	58					
14	Dark gray medium SAND, wet, compact.			14.5 / 565.9								
16	Gray silty fine SAND, wet, compact.	SM		16.2 / 564.2		SS	100					9.0 - 22.0 ft bgs: Material Collapse
20						SS	100					
22	End of hole at 22.0 ft.			558.4								

Refusal prior to 40-ft target depth. Refer to diagram for well construction details.

Ground elevation survey unable to be collected due to piezometer placement in standing water.

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 31, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-23

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 25, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 584.4 ft (Ground)
COORDINATES: N: 577627.7 ft E: 12625841.4 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

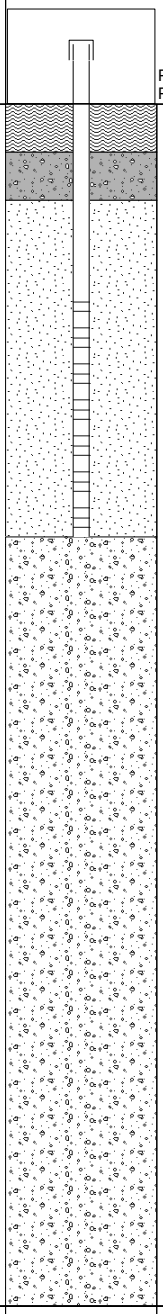
DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
0	Brown fine & medium SAND, dry to moist, loose.	SP	0.0		SS	100		
4	Gray fine SAND, wet, loose, some glass fragments present.	SP	580.4 4.0		SS	60		
6	Black PEAT, moist, loose, trace silt.		578.3 6.1					
7	Brown to gray fine SAND, wet, loose.	SP	577.7 6.7		SS	50		
12	Dark brown silty SAND, wet, loose, organics present.	SM	572.3 12.1		SS	100		
13	Brown fine to medium SAND, wet, loose.	SP	571.9 12.5					
17	Gray very fine SAND, moist, compact, trace silt.		567.9 16.5					
18	Gray fine SAND, wet, loose, trace silt starting at 22' BGS.	SP	566.6 17.8		SS	100		
24	Gray silty SAND, wet, cohesive.	SM	560.4 24.0					
25	End of hole at 25.0 ft. Refusal Completed as well - refer to diagram.		559.4					

ADDITIONAL OBSERVATIONS:

GROUNDWATER OBSERVATIONS:

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 2.82 ft
Pipe Elev: 587.2 ft

0.0 - 1.0 ft bgs: Cement

1.0 - 2.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

2.0 - 9.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

9.0 - 25.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 25, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-24

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI
DATE: August 24, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS
ELEVATION: 583.9 ft (Ground)
COORDINATES: N: 577884.7 ft E: 12625979.3 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

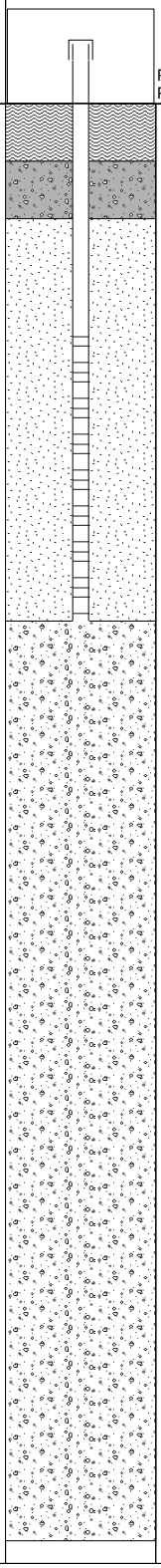
DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
0	Brown sandy TOPSOIL, dry, loose.		0.0					
	Brown fine SAND, dry, loose, trace gravel.		583.5 / 0.4					
			581.4		SS	100		
3	Dark brown SAND, moist, loose, leather, glass, metal shavings present		2.5					
		SP			SS	70		
			576.6					
7	Gray fine to medium SAND, wet, loose, shell fragments present.		7.3					
			571.9		SS	66		
12	Black PEAT, moist, soft, wood organics.		12.0					
	Gray fine SAND, wet, loose. Silty sand seam from 19-19.2' BGS.		571.7 / 12.2					
		SP			SS	100		
			561.9					
22	Gray sandy SILT, moist, firm.		22.0					
		ML			SS	80		
			559.8					
24	Gray fine SAND, wet, compact, trace silt.	SP	24.1					
25	Continued on Next Page							

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

ADDITIONAL OBSERVATIONS:

GROUNDWATER OBSERVATIONS:

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 3.41 ft
Pipe Elev: 587.3 ft

0.0 - 1.0 ft bgs: Cement

1.0 - 2.0 ft bgs: Bentonite Chip
2" Schedule 40 PVC

2.0 - 9.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

9.0 - 30.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 24, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-24

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 24, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.9 ft (Ground)
COORDINATES: N: 577884.7 ft E: 12625979.3 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray fine SAND, wet, compact, trace silt.	SP		558.6								Pipe Stickup: 3.41 ft Pipe Elev: 587.3 ft
			Gray CLAY, moist, firm, high plasticity.			25.3								
27				CH				SS	100					
28														
29														
30						553.9								
			End of hole at 30.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.											
31														
32														
33														
34														
35														
36														
37														
38														
39														
40														
41														
42														
43														
44														
45														
46														
47														
48														
49														
50														

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 24, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-25

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 24, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.5 ft (Ground)
COORDINATES: N: 577703.7 ft E: 12626240.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

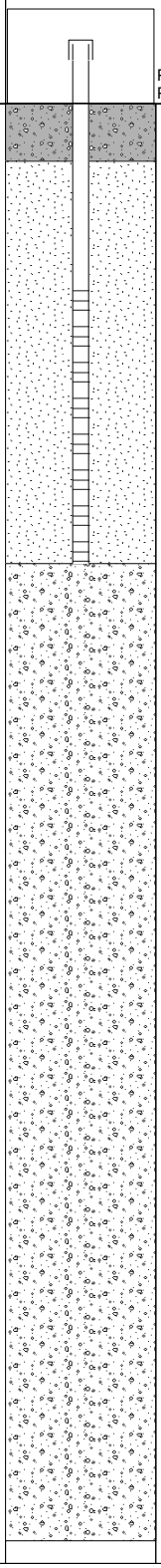
DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
0	Brown TOPSOIL, moist, loose.		0.0					
	Gray SAND, wet, loose, trace gravel.		583.1 / 0.4					
1	Black peaty SAND, wet, loose.	SP	582.5 / 1.0		SS	100		
2								
3								
4			579.5					
	Black peaty SILT, wet, loose, hydrocarbon scent, some trash present.	ML	4.0					
5					SS	48		
6								
7								
8			575.5					
	Dark gray SAND, wet, loose, shell fragments.	SP	8.0					
9								
10					SS	60		
11			572.5					
	Dark brown peaty SILT, moist, soft.	ML	11.0					
12			571.1					
	Brown fine SAND, wet, loose, shell fragments.	SP	12.4					
13								
14			568.7					
	Gray silty SAND, wet, loose to firm.	SM	14.8		SS	100		
15								
16								
17								
18								
19								
20								
21								
22			561.5					
	Gray sandy SILT, moist, compact.	ML	22.0		SS	100		
23			560.5					
	Gray CLAY, moist, firm to hard, trace sand, High plasticity.	CH	23.0					
24								
25								

Continued on Next Page

ADDITIONAL OBSERVATIONS:

GROUNDWATER OBSERVATIONS:

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 2.91 ft
Pipe Elev: 586.4 ft

0.0 - 1.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

1.0 - 8.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

8.0 - 30.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 24, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-25

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 24, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.5 ft (Ground)
COORDINATES: N: 577703.7 ft E: 12626240.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray CLAY, moist, firm to hard, trace sand, High plasticity.	CH				SS	100					Pipe Stickup: 2.91 ft Pipe Elev: 586.4 ft
27														
28														
29														
30						553.5								
31			End of hole at 30.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.											
32														
33														
34														
35														
36														
37														
38														
39														
40														
41														
42														
43														
44														
45														
46														
47														
48														
49														
50														

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 24, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-26

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 23, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.8 ft (Ground)
COORDINATES: N: 578114.4 ft E: 12626145.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
0	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Black sandy TOPSOIL			0.0								Pipe Stickup: 2.46 ft Pipe Elev: 586.3 ft
						583.3								
0			Brown fine to very fine SAND, moist to wet, loose.			0.5		SS	100					0.0 - 1.0 ft bgs: Bentonite Chips
1														2" Schedule 40 PVC
2														
3														
4														
5														1.0 - 8.0 ft bgs: Filter Sand
6								SS	50					2" Schedule 40 slotted PVC
7						576.3								
8			Dark gray medium SAND, wet, loose, some organics present.	SP		7.5								
9														
10														
11								SS	38					
12														
13														
14														
15						568.8								
			Brown fine sand, wet, loose, trace gravel.			15.0								
16														
17								SS	66					
18														
19														8.0 - 30.0 ft bgs: Material Collapse
20						563.3								
			Gray SILT, wet, compact.	ML		20.5								
21			Gray CLAY, moist, soft to firm, sticky, high plasticity.			563.0 20.8								
22														
23				CH				SS	80					
24														
25			Continued on Next Page											

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 23, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-26

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 23, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.8 ft (Ground)
COORDINATES: N: 578114.4 ft E: 12626145.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray CLAY, moist, soft to firm, sticky, high plasticity.	CH				SS	82					Pipe Stickup: 2.46 ft Pipe Elev: 586.3 ft
27														
28														
29														
30						553.8								
31			End of hole at 30.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.											
32														
33														
34														
35														
36														
37														
38														
39														
40														
41														
42														
43														
44														
45														
46														
47														
48														
49														
50														

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 23, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-27

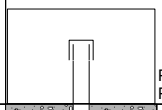
CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI
DATE: August 23, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS
ELEVATION: 581.9 ft (Ground)
COORDINATES: N: 578303.9 ft E: 12626551.8 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
0	Brown TOPSOIL, moist, soft.		0.0 / 581.4					
1	Gray medium SAND, wet, loose.	SP	0.5 / 578.4		SS	100		
4	Black SAND, wet, loose, organics present, hydrocarbon scent.	SP	3.5 / 576.4		SS	40		
5	Black peaty SAND, moist, loose, trace silt.	SP	5.5 / 573.9		SS	40		
8	Dark gray peaty SILT, moist, soft, trace sand.	ML	8.0 / 573.2		SS	54		
9	Light black peaty SAND & SILT, moist, soft, trace shell fragments.	SP-SM	8.7 / 569.4		SS	54		
13	Black peaty SILT, moist, soft, shell fragments present, trace gray sand, organics present.	ML	12.5 / 561.9		SS	66		
20	Gray fine SAND, wet, loose, trace shell fragments.	SP	20.0 / 561.1		SS	66		
21	Black peaty SILT, moist, soft, trace gray sand.	ML	20.8		SS	60		
25	Continued on Next Page							

ADDITIONAL OBSERVATIONS:
GROUNDWATER OBSERVATIONS:

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 3.21 ft
Pipe Elev: 585.1 ft

0.0 - 1.0 ft bgs: Bentonite Chips

2" Schedule 40 slotted PVC

1.0 - 8.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

8.0 - 40.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 23, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-27

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 23, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 581.9 ft (Ground)
COORDINATES: N: 578303.9 ft E: 12626551.8 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26–40	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Black peaty SILT, moist, soft, trace gray sand.	ML				SS	72					Pipe Stickup: 3.21 ft Pipe Elev: 585.1 ft
								SS	76					
								SS	90					
40						541.9								
40			End of hole at 40.0 ft. Target Depth Reached Refer to diagram for well construction details.											

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 23, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-28

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI
DATE: August 23, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS
ELEVATION: 585.1 ft (Ground)
COORDINATES: N: 578314.9 ft E: 12625722.7 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

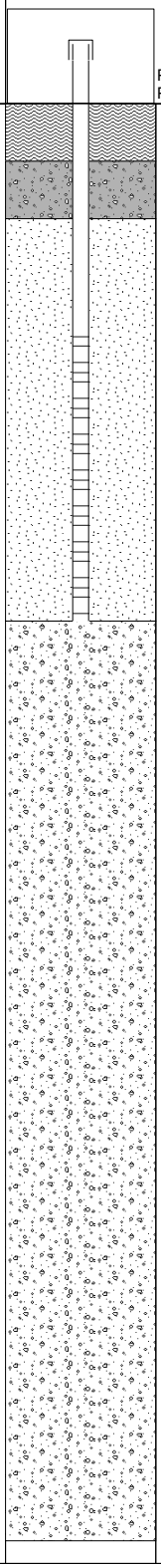
DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
0	Brown sandy TOPSOIL, dry, loose, some gravel.		581.1 / 0.0		SS	100		
4	Brown fine SAND, dry, loose, trace gravel.	SP	579.1 / 4.0					
6	Black peaty SAND, dry, loose.		578.8 / 6.0		SS	54		
7	Gray fine SAND, dry to moist, loose, organics present starting at 9.4' BGS.		575.4 / 6.3					
10	Gray GRAVEL, wet, loose.	GW	575.1 / 9.7					
10	Black gravelly SAND, wet, loose, glass and rubber trash present.	SP	574.6 / 10.0					
11	Dark gray peaty silty SAND, moist, soft.	SM	570.1 / 10.5		SS	48		
15	Black mucky SAND, wet, loose.		569.8 / 15.0					
15	Dark gray medium SAND, wet, loose, trace shell fragments.	SP	566.5 / 15.3		SS	52		
19	Gray fine SAND, wet, slightly cohesive.		563.7 / 18.6					
21	Gray silty SAND, moist, firm.	SM	562.5 / 21.4		SS	72		
23	Gray fine to very fine SAND, moist, compact. Wet from 25-28' BGS.	SP	22.6					
25	Continued on Next Page							

ADDITIONAL OBSERVATIONS:

GROUNDWATER OBSERVATIONS:

CONSTRUCTION AND INSTALLATION DETAILS



HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 23, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-28

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 23, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 585.1 ft (Ground)
COORDINATES: N: 578314.9 ft E: 12625722.7 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26–29	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray fine to very fine SAND, moist, compact. Wet from 25-28' BGS.	SP				SS	100					Pipe Stickup: 2.96 ft Pipe Elev: 588.1 ft
29						555.6								
30			End of hole at 29.5 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.											

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 23, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-29

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 30, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 580.5 ft (Top of Casing)
COORDINATES: N: 578138.1 ft E: 12625241.6 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
0	Marsh Master Geoprobe	Direct Push - 4-in Hole Dia.	Black sandy MUCK, wet, loose / soft.	SP		0.0 / 580.0		SS	26					Pipe Elev: 583.5 ft
0.5			Gray fine SAND, wet, loose.			0.5 / 576.5								2" Schedule 40 PVC
4.0			Black peaty SAND, wet, loose, metal present, glass present, paper present. Hydrocarbon scent and sheen.			4.0 / 575.2		SS	16					0.0 - 9.0 ft bgs: Filter Sand
5.3			Gray fine SAND, wet, loose, shell fragments present. Silty sand seam present from 11.5-12' BGS.			5.3								2" Schedule 40 slotted PVC
								SS	52					
								SS	76					
								SS	48					9.0 - 35.0 ft bgs: Material Collapse
25			Continued on Next Page											

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 30, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-29

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 30, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 580.5 ft (Top of Casing)
COORDINATES: N: 578138.1 ft E: 12625241.6 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Marsh Master Geoprobe
DRILL METHOD: Direct Push - 4-in Hole Dia.

DEPTH (ft)	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
25	Gray fine SAND, wet, loose, shell fragments present. Silty sand seam present from 11.5-12' BGS.	SP		555.2 / 25.3		SS	100					Pipe Elev: 583.5 ft
26	Brown SILT, wet, soft, trace sand.	ML		553.5 / 27.0								
27	Brown fine SAND, wet, loose, shell fragments present.	SP										
28												
29												
30						SS	100					
31												
32												
33				547.0 / 33.5								
34	Dark gray to gray silty SAND, wet, compact.	SM		545.5								
35	End of hole at 35.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details. Ground elevation survey unable to be collected due to piezometer placement in standing water.											
36												
37												
38												
39												
40												
41												
42												
43												
44												
45												
46												
47												
48												
49												
50												

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 30, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-30

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 19, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.0 ft (Ground)
COORDINATES: N: 578196.2 ft E: 12624990.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

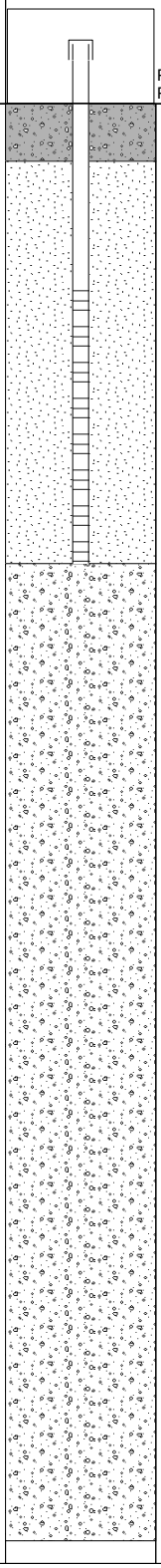
DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
0	Black sandy TOPSOIL, moist, soft, organics present.		0.0 / 582.5					
1	Black peaty SAND, moist to wet, soft, wet @ 1.5' BGS.	SP	0.5 / 580.5		SS	100		
3	Brown silty SAND, wet, loose, some trash present.	SM	2.5 / 577.0					
6	Gray sandy SILT, moist, firm.	ML	6.0 / 576.5					
7	Black peaty SAND, moist, soft, some trash present.	SP	6.5 / 574.3		SS	58		
9	Gray silty SAND, moist to wet, loose.	SM	8.7 / 572.6					
10	Gray silty SAND, wet, loose, some organics present.		10.4 / 569.0		SS	54		
14	Brown fine SAND, wet, loose.	SP	14.0 / 565.0		SS	68		
18	Gray silty SAND, wet, loose to firm.	SM	18.0 / 558.0		SS	82		
25	Continued on Next Page		25.0					

ADDITIONAL OBSERVATIONS:

GROUNDWATER OBSERVATIONS:

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 2.78 ft
Pipe Elev: 585.8 ft

0.0 - 1.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

1.0 - 8.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

8.0 - 34.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 19, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-30

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 19, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.0 ft (Ground)
COORDINATES: N: 578196.2 ft E: 12624990.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
26	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray fine SAND, wet, loose.	SP		557.2		SS	94					Pipe Stickup: 2.78 ft Pipe Elev: 585.8 ft
			Gray sandy SILT, wet, firm.	ML		25.8								
32								SS	100					
						550.2								
33			Gray silty CLAY, moist, firm, high plasticity.	CL-ML		32.8								
34						549.0								
			End of hole at 34.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.											

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 19, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-31

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: September 01, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 582.6 ft (Ground)
COORDINATES: N: 578307.2 ft E: 12624752.7 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

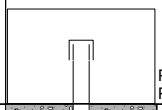
DRILL RIG: Marsh Master Geoprobe
DRILL METHOD: Direct Push - 4-in Hole Dia.

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
0	Black marshy TOPSOIL, moist, soft.		0.0					
0	Gray fine SAND, moist to wet, loose.	SP	582.2 / 0.4		SS	62		
2			579.9					
2	Black mucky SAND, wet, loose, trash present.		2.7					
4			578.4					
4	Black sandy PEAT, moist, loose, shell fragments present, wood and plastic trash present down to 5' BGS.		4.2		SS	46		
8					SS	50		
12								
14			567.6					
15	Gray fine SAND, wet, loose.	SP	15.0		SS	50		
20					SS	92		
23			559.4					
23	Gray coarse SAND, wet, loose.		23.2					
24	Gray very fine SAND, wet, firm.		558.8 / 23.8					
25					SS	100		
27			555.6					
27	End of hole at 27.0 ft.							
28	Refusal prior to 40-ft target depth. Refer to diagram for well construction details.							

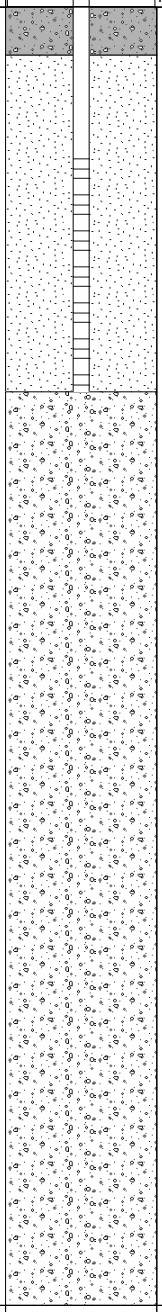
ADDITIONAL OBSERVATIONS:

GROUNDWATER OBSERVATIONS:

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 3.29 ft
Pipe Elev: 585.9 ft



0.0 - 1.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

1.0 - 8.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

8.0 - 27.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Sep 01, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-32

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 20, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.1 ft (Ground)
COORDINATES: N: 578348.3 ft E: 12624980.1 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

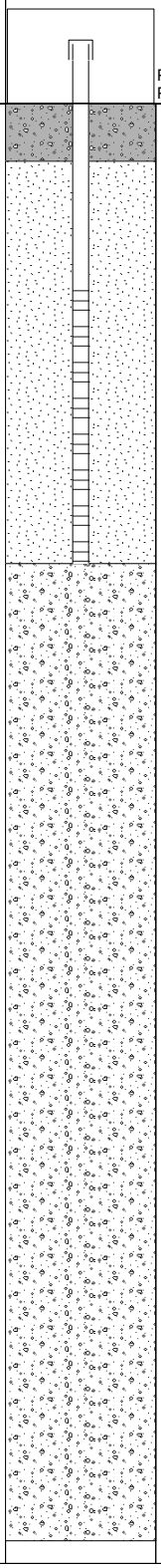
DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	SAMPLE TYPE	REC %	BLOWS	N-VALUE
0	Brown sandy TOPSOIL, moist, loose.		0.0 / 582.6					
1	Brown fine SAND, moist to wet, loose.	SP	0.5 / 580.1		SS	100		
3	Dark brown peaty SILT, moist to wet, soft, trash (glass) present down to 9' BGS. Hydrocarbon scent from 7-9' BGS. Gray sand seams present starting at 9' BGS.	ML	3.0 / 569.6		SS	40		
5					SS	36		
13	Gray fine SAND, wet, loose, shell fragments present. trace silt, some medium sand.	SP	13.5 / 567.7		SS	60		
15	Gray silty fine SAND, wet, loose, small shell fragments.	SM	15.4 / 565.1		SS	76		
17	Gray fine SAND, wet, loose.	SP	18.0 / 560.8					
22	Gray very fine sandy SILT, wet, soft.	ML	22.3					
25	Continued on Next Page							

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

ADDITIONAL OBSERVATIONS:

GROUNDWATER OBSERVATIONS:

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 3.18 ft
Pipe Elev: 586.3 ft

0.0 - 1.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

1.0 - 8.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

8.0 - 40.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 20, 2021
DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-32

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 20, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.1 ft (Ground)
COORDINATES: N: 578348.3 ft E: 12624980.1 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
25	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray very fine sandy SILT, wet, soft.	ML		557.7								Pipe Stickup: 3.18 ft Pipe Elev: 586.3 ft
26			Gray very fine SAND, wet, loose.	SP		25.4 / 556.3								
27			Gray silty SAND, wet, compact, cohesive.	SM		26.8		SS	64					
28														
29														
30														
31								SS	80					
32														
33														
34														
35														
36								SS	100					
37														
38														
39						543.1								
40			End of hole at 40.0 ft. Target Depth Reached Refer to diagram for well construction details.											
41														
42														
43														
44														
45														
46														
47														
48														
49														
50														

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton
CHECKED: Caroyln Powrozek

DATE: Aug 20, 2021
DATE: Nov 03, 2021

MW-33

CLIENT City of Grand Haven
PROJECT NAME Former J.B. Sims Generating Station
PROJECT NUMBER 10337505
PROJECT LOCATION Harbor Island - Grand Haven, MI
DATE STARTED 11/28/22 00:00 **COMPLETED** 11/28/22 00:00
GROUND ELEVATION 583.23 ft **HOLE DIAMETER** 2
DRILLING CONTRACTOR JSS **DRILLER**
GROUND WATER LEVELS:
DRILLING METHOD DPT **EQUIPMENT**
▽ **AT TIME OF DRILLING** 2.00 ft / Elev 581.23 ft
LOGGED BY Zach McCurley **CHECKED BY** Tanten Buszka
▼ **AFTER DRILLING** 1.68 ft / Elev 581.55 ft
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
0.0					Casing Top Elev: 582.81 (ft) Casing Type: 2" Sch 40 PVC
			Top Soil	582.7	Bentonite Seal
			POORLY GRADED SAND, (SP) brown, fine to medium grained, moist, loose	582.2	
			CLAYEY SAND, (SC) very dark brown and gray, moist, medium dense, Saturated at 1.8 ft bgs		
2.5					
			POORLY GRADED SAND, (SP) brown, fine to medium grained, saturated, loose	580.2	Filter Pack
					Well Screen
5.0					
			POORLY GRADED SAND, (SP) gray, fine to medium grained, saturated, loose, Wood fragments observed at 6.5 ft bgs	577.7	
				576.2	

Bottom of borehole at 7.0 feet.

MW-34

CLIENT City of Grand Haven
PROJECT NAME Former J.B. Sims Generating Station
PROJECT NUMBER 10337505
PROJECT LOCATION Harbor Island - Grand Haven, MI
DATE STARTED 01/28/22 00:00 **COMPLETED** 11/28/22 00:00
GROUND ELEVATION 584.69 ft **HOLE DIAMETER** 2
DRILLING CONTRACTOR JSS **DRILLER**
GROUND WATER LEVELS:
DRILLING METHOD DPT **EQUIPMENT**
▽ **AT TIME OF DRILLING** 9.50 ft / Elev 575.19 ft
LOGGED BY Zach McCurley **CHECKED BY** Tanten Buszka
▼ **AFTER DRILLING** 4.21 ft / Elev 580.48 ft
NOTES

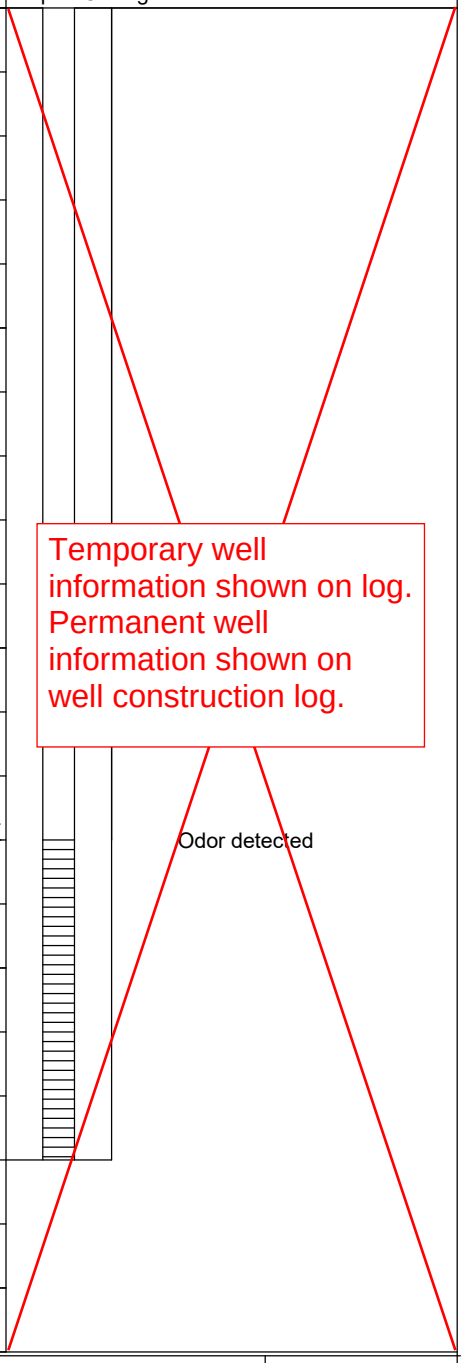
DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM
0.0					Casing Top Elev: 584.36 (ft) Casing Type: 2" Sch 40 PVC
			Topsoil	584.2	
0.5			POORLY GRADED SAND, (SP) brown, fine to medium grained, moist, loose, Trace gravel		
1.5				583.2	
2.0			POORLY GRADED SAND, (SP) black, fine to medium grained, moist, loose, Trace organics	582.7	
2.5			SILTY SAND, (SM) gray, moist, medium dense		Bentonite Seal
4.0				580.7	
			▼ POORLY GRADED SAND, (SP) gray, fine to medium grained, saturated, medium dense, Trace clay, wood fragments observed at 9.5 ft bgs.		
5.0					
7.5					
			▽		Filter Pack
10.0				574.7	Well Screen
10.0			POORLY GRADED SAND, (SP) black, saturated, hydrocarbon odor, Observed bricks, metal, and oily sheen at 11 ft bgs.		
12.5					
13.0				571.7	
			POORLY GRADED SAND, (SP) gray, fine to medium grained, saturated, medium dense, Trace gravel		
15.0				569.7	
15.0			Bottom of borehole at 15.0 feet.		

PROJECT: Former JB Sims Generating Station Harbor Island Grand Haven, Michigan	**Log of Soil Boring GP-01/MW-35**
BORING LOCATION: Harbor Island	SURFACE ELEVATION AND DATUM: TBD
DRILLING CONTRACTOR: Job Site Services	DATE STARTED: 11/29/22 / DATE FINISHED: 11/29/22
DRILLING METHOD: DPT	TOTAL DEPTH (ft.): 18.0 / SCREEN INTERVAL (ft.): 13-18
DRILLING EQUIPMENT: Geoprobe 7822DT	DEPTH TO WATER ATD (ft): 13.0 / CASING: 1", Sch-40 PVC
SAMPLING METHOD: Dual Tube	DEPTH TO WATER ATS (ft): 13.0
HAMMER WEIGHT: NA / DROP: NA	LOGGED BY: Kiersten White / REG. NO. NA

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Recovery (%)	Blow Counts	PID Reading (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plasticity, dilatancy, toughness, dry strength, consistency	Depth (ft)
				0.0	Fill (GW):	
				0.0	SILTY SAND (SM): olive, dry, fine to medium silty sand, loose	
				0.0		
				0.0		
5				0.0		
				0.0	SILTY SAND (SM): olive, dry, fine to medium silty sand, trace gravel, loose	
				0.0	SILTY SAND (SM): gray, dry, fine to medium silty sand, loose	
				0.0		
				0.0	CLAYEY SAND (SC): gray, moist, slight plasticity	
10				0.0		
				0.0		
				0.0		
				0.0	CLAYEY SAND (SC): gray, saturated, slight plasticity	▼
	GP-01			51.6		
				NM	SILTY SAND (SM): light gray, saturated, loose	
15				NM		
				NM	SILTY SAND (SM): light gray, saturated, silty sand with clay, slight plasticity	
				NM		
				NM	End of boring at 18 ft bgs.	
20						

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

Top of Casing Elevation: TBD



WELL10

Acronyms
ATD - At Time of Drilling
ATS - At Time of Sampling

Project No. 3650220203

SCREENED WELL CONSTRUCTION FORM

Site Name: Former JB Sims Generating Station, Harbor Island, Grand Haven, MI

Project Number: 3650220203.02.02

Well ID: MW-35

Location ID: GP-01

Drilling Subcontractor: Job Site Services

Installation Date: 01/30/2023

Drilling Personnel: David Mokma & Jeremiah Chapman

Decon Performed: Yes

Technician Name: Jared Walbert

Drilling Method: Direct Push

Other Amec Foster Wheeler Representatives: None.

Measurement Point (riser)
Elevation (ft msl): 589.724

Land Surface Elevation (ft): 590.421

Approximate Diameter of Borehole (in): 3.75 inches

Depth to Water (ft): 9.20
- **During Drilling:** 8.30
  - **Date:** 01/30/2023
- **Post Development:** 8.30
  - **Date:** 01/31/2023

Hydrologic Unit: NA

Water added during drilling (gal): .0

Water removed during development (gal): 20

Top of Bentonite Seal (ft): 1.0

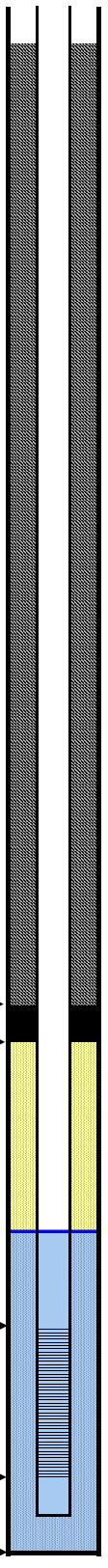
Top of Filter Pack (ft): 5.0

Top of Screen Interval (ft): 7.30

Bottom of Screened Interval (ft): 12.30

Bottom of Filter Pack (ft): 12.30

Bottom of Borehole (ft): 12.30 feet bgs



Protective Casing:
- **Type:** Flush Mount
- **Dimensions (in):** 8
- **Stickup (ft):** 0
- **Length (ft):** 1
- **Guard Post:** None

Surface Pad:
- **Dimensions:** 12”x12”
- **Type:** Concrete

Annular Seal (grout above well seal):
- **Material:** BENTONITE
- **Installation Method:** Gravity

Bentonite Seal:
- **Manufacturer:** Baroid
- **Material:** BENTONITE 3/8"
- **Type:** Chips
- **Installation Method:** Gravity
- **Hydration time (hrs):** 24

Filter Pack Material:
- **Manufacturer:** K&E
- **Material:** #2 Well Gravel
- **Size:** 0.03
- **Installation Method:** Gravity
- **Surging time:** 0.33

Well Casing (Riser):
- **Manufacturer:** ECT Manufacturing Inc
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Length:** 7.3'
- **Diameter (in):** 2

Well Screen:
- **Manufacturer:** Johnson Screens
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Diameter (in):** 2
- **Slot Size (in):** 0.010
- **Slot Type:** Factory Slot

Sump/End Cap: Point

Notes: None.

Technician Signature: Jared Walbert

Depths and heights are referenced to ground surface unless specified TOC.
All elevations are referenced to MSL (NAVD 88).

Technician Name (print): Jared Walbert

QA/QC’d by:

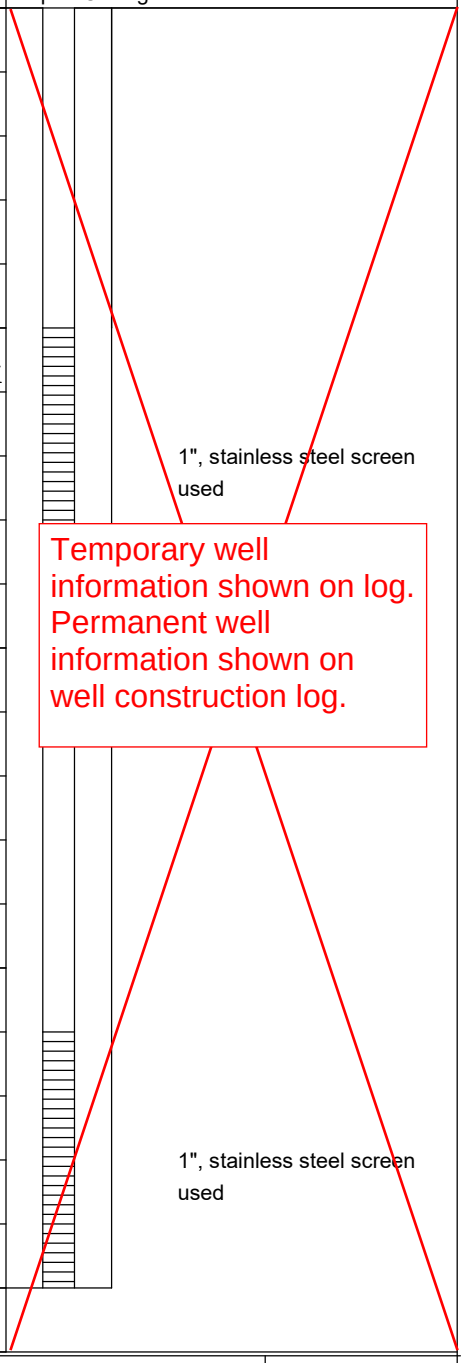
QA/QC Date:

PROJECT: Former JB Sims Generating Station Harbor Island Grand Haven, Michigan	**Log of Soil Boring VAS20/MW-36**
BORING LOCATION: Harbor Island	SURFACE ELEVATION AND DATUM: TBD
DRILLING CONTRACTOR: Job Site Services	DATE STARTED: 12/7/22 / DATE FINISHED: 12/7/22
DRILLING METHOD: DPT	TOTAL DEPTH (ft.): 20.0 / SCREEN INTERVAL (ft.): 5-9; 16-20
DRILLING EQUIPMENT: Geoprobe 7822DT	DEPTH TO WATER ATD (ft): 5.0 / CASING: 1", stainless steel
SAMPLING METHOD: Dual Tube	DEPTH TO WATER ATS (ft): 5.85
HAMMER WEIGHT: NA / DROP: NA	LOGGED BY: Jared Walbert / REG. NO. NA

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Recovery (%)	Blow Counts	PID Reading (ppm)	DESCRIPTION: NAME (USCS): color, moist, % by wt., plasticity, dilatancy, toughness, dry strength, consistency	Depth (ft)
0				0.0	POORLY-GRADED SAND (SP): yellowish brown (10 YR 5/8), moist	
				0.0		
				0.0		
				0.0		
5				0.0	POORLY-GRADED SAND (SP): yellowish brown (10 YR 5/8), saturated	
	VAS20-5-9			NM	WELL-GRADED SAND with GRAVEL (SW): yellowish brown (10 YR 5/8), saturated	
				NM	WELL-GRADED GRAVEL (GW): gray (GLEY 1 6/N), saturated	
				NM		
				NM		
10				NM		
				NM		
				NM	SILTY GRAVEL (GM): very dark brown (10 YR 2/2), saturated	
				NM		
				NM		
15				NM	CLAYEY SILT (ML): very dark brown (10 YR 2/2), saturated, low plasticity	
				NM		
	VAS20-16-20			NM	SANDY SILT (ML): dark gray (5 Y 4/1), saturated	
				NM	SILT (ML): very dark brown (10 YR 2/2), saturated	
				NM	POORLY-GRADED SAND (SP): gray (5 Y 6/1), saturated	
20				NM	End of boring at 20 ft bgs.	

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

Top of Casing Elevation: TBD



Temporary well information shown on log. Permanent well information shown on well construction log.

Acronyms
ATD - At Time of Drilling
ATS - At Time of Sampling

Project No. 3650220203

WELL10

SCREENED WELL CONSTRUCTION FORM

Site Name: Former JB Sims Generating Station, Harbor Island, Grand Haven, MI

Project Number: 3650220203.02.02

Well ID: MW-36

Location ID: VAS20

Drilling Subcontractor: Job Site Services

Installation Date: 01/30/2023

Drilling Personnel: David Mokma & Jeremiah Chapman

Decon Performed: Yes

Technician Name: Jared Walbert

Drilling Method: Direct Push

Other Amec Foster Wheeler Representatives: None

Measurement Point (riser)

Elevation (ft msl): 589.121

Land Surface Elevation (ft): 585.615

Approximate Diameter of Borehole (in): 3.75 Inches

Depth to Water (ft): 5.60

- **During Drilling:** 5.60
  - **Date:** 01/30/2023
- **Post Development:** 5.08
  - **Date:** 02/01/2023

Hydrologic Unit:

Water added during drilling (gal): .0

Water removed during development (gal): 15

Top of Bentonite Seal (ft): 1.0

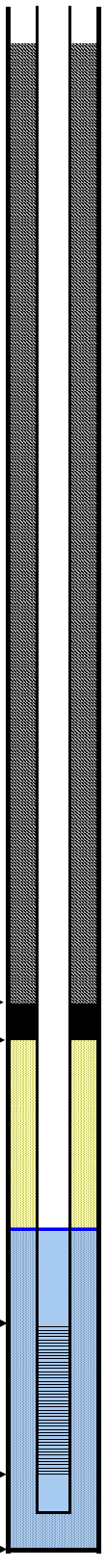
Top of Filter Pack (ft): 3.0

Top of Screen Interval (ft): 4.0

Bottom of Screened Interval (ft): 9.0

Bottom of Filter Pack (ft): 9.0

Bottom of Borehole (ft): 9.0 feet bgs



Protective Casing:

- **Type:** Round Well Monument
- **Dimensions (in):** 4
- **Stickup (ft):** 4
- **Length (ft):** 5
- **Guard Post:** None

Surface Pad:

- **Dimensions:** 12”x12”x6”
- **Type:** Concrete

Annular Seal (grout above well seal):

- **Material:** BENTONITE
- **Installation Method:** Gravity

Bentonite Seal:

- **Manufacturer:** Baroid
- **Material:** BENTONITE 3/8"
- **Type:** Chips
- **Installation Method:** Gravity
- **Hydration time (hrs):** 24

Filter Pack Material:

- **Manufacturer:** K&E
- **Material:** #2 Well Gravel
- **Size:** 0.03
- **Installation Method:** Gravity
- **Surging time:** 0.5

Well Casing (Riser):

- **Manufacturer:** ECT Manufacturing Inc
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Length:** 4'
- **Diameter (in):** 2

Well Screen:

- **Manufacturer:** Johnson Screens
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Diameter (in):** 2
- **Slot Size (in):** 0.010
- **Slot Type:** Factory Slot

Sump/End Cap: Point

Notes: None.

Technician Signature: Jared Walbert

Depths and heights are referenced to ground surface unless specified TOC.
All elevations are referenced to MSL (NAVD 88).

Technician Name (print): Jared Walbert

QA/QC’d by:

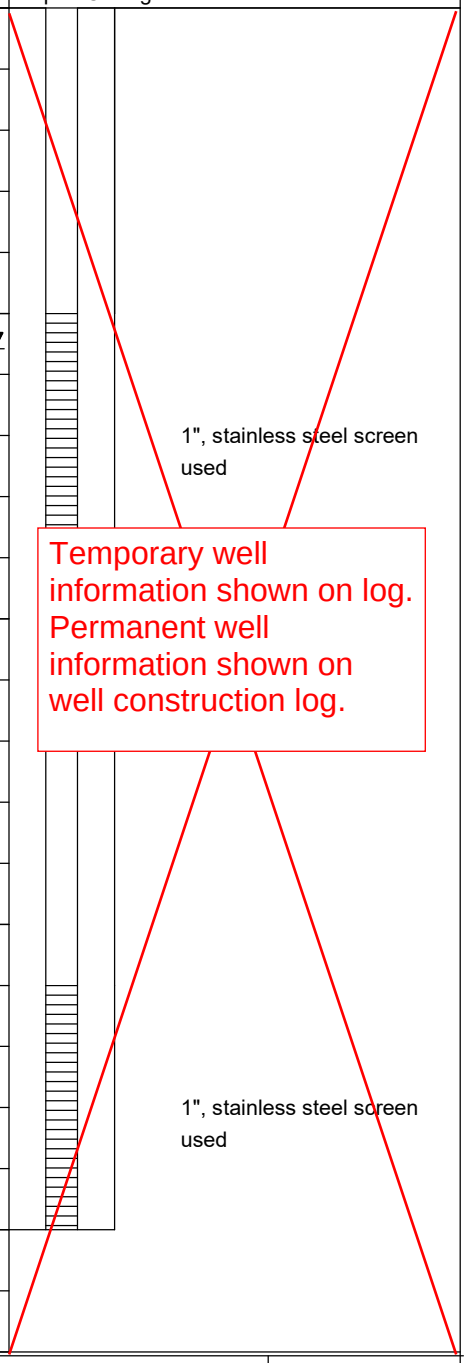
QA/QC Date:

PROJECT: Former JB Sims Generating Station Harbor Island Grand Haven, Michigan	**Log of Soil Boring VAS21/MW37**
BORING LOCATION: Harbor Island	SURFACE ELEVATION AND DATUM: TBD
DRILLING CONTRACTOR: Job Site Services	DATE STARTED: 12/7/22 / DATE FINISHED: 12/7/22
DRILLING METHOD: DPT	TOTAL DEPTH (ft.): 20.0 / SCREEN INTERVAL (ft.): 5-9; 16-20
DRILLING EQUIPMENT: Geoprobe 7822DT	DEPTH TO WATER ATD (ft): 5.0 / CASING: 1", stainless steel
SAMPLING METHOD: Dual Tube	DEPTH TO WATER ATS (ft): 5.58
HAMMER WEIGHT: NA / DROP: NA	LOGGED BY: Jared Walbert / REG. NO. NA

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Recovery (%)	Blow Counts	PID Reading (ppm)	DESCRIPTION: NAME (USCS): color, moist, % by wt., plasticity, dilatancy, toughness, dry strength, consistency	Depth (ft)
				0.0	SILTY GRAVEL (GM): gray (10 YR 6/1), damp	
				0.0	POORLY-GRADED SAND (SP): yellowish brown (10 YR 5/8), damp	
				0.0	SILTY GRAVEL (GM): very dark brown (10 YR 2/2), damp	
				0.0	POORLY-GRADED SAND (SP): brown (10 YR 5/3), moist	
5	VAS21-5-9, VAS21-SB-5-7			0.0	POORLY-GRADED SAND (SP): brown (10 YR 5/3), wet	▼
				NM	POORLY-GRADED SAND (SP): brown (10 YR 5/3), saturated, glass fragments at 7 ft bgs	
				NM	POORLY-GRADED SAND (SP): dark gray (10 YR 4/1), saturated	
				NM	POORLY-GRADED SAND (SP): black (GLEY 1 2.5/N), saturated	
10				NM		
				NM		
				NM		
				NM		
				NM	SILTY GRAVEL (GM): black (GLEY 1 2.5/N), saturated, poorly graded	
15				NM		
				NM	POORLY-GRADED SAND (SP): black (GLEY 1 2.5/N), saturated	
	VAS21-16-20			NM	SILTY CLAY (CL): very dark brown (10 YR 2/2), wet, plastic	
				NM		
				NM	POORLY-GRADED SAND (SP): dark gray (GLEY 1 4/N), saturated	
20				NM	SILTY CLAY (CL): very dark brown (10 YR 2/2), wet, plastic	
					End of boring at 20 ft bgs.	

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

Top of Casing Elevation: TBD



Acronymns
ATD - At Time of Drilling
ATS - At Time of Sampling

SCREENED WELL CONSTRUCTION FORM

Site Name: Former JB Sims Generating Station, Harbor Island, Grand Haven, MI

Project Number: 3650220203.02.02

Well ID: MW-37

Location ID: VAS21

Drilling Subcontractor: Job Site Services

Installation Date: 01/30/2023

Drilling Personnel: David Mokma & Jeremiah Chapman

Decon Performed: Yes

Technician Name: Jared Walbert

Drilling Method: Direct Push

Other Amec Foster Wheeler Representatives: None.

Measurement Point (riser)
Elevation (ft msl): 589.619

Land Surface Elevation (ft): 585.59

Approximate Diameter of Borehole (in): 3.75 inches

Depth to Water (ft): 5.30
- **During Drilling:** 5.30
  - **Date:** 01/30/2023
- **Post Development:** 5.60
  - **Date:** 02/01/2023

Hydrologic Unit: NA

Water added during drilling (gal): .0

Water removed during development (gal): 15

Top of Bentonite Seal (ft): 1.0

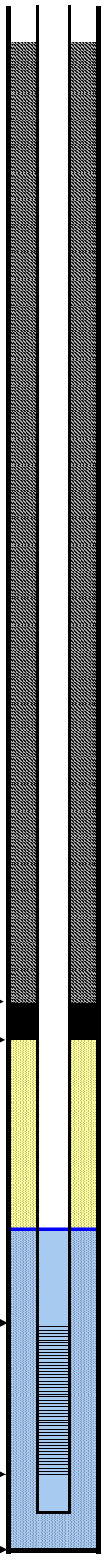
Top of Filter Pack (ft): 3.0

Top of Screen Interval (ft): 4.0

Bottom of Screened Interval (ft): 9.0

Bottom of Filter Pack (ft): 9.0

Bottom of Borehole (ft): 9.0 feet bgs



Protective Casing:
- **Type:** Round Well Monument
- **Dimensions (in):** 4
- **Stickup (ft):** 4
- **Length (ft):** 5
- **Guard Post:** None

Surface Pad:
- **Dimensions:** 12”x12”x6”
- **Type:** Concrete

Annular Seal (grout above well seal):
- **Material:** BENTONITE
- **Installation Method:** Gravity

Bentonite Seal:
- **Manufacturer:** Baroid
- **Material:** BENTONITE 3/8"
- **Type:** Chips
- **Installation Method:** Gravity
- **Hydration time (hrs):** 24

Filter Pack Material:
- **Manufacturer:** K&E
- **Material:** #2 Well Gravel
- **Size:** 0.03
- **Installation Method:** Gravity
- **Surging time:** 0.25

Well Casing (Riser):
- **Manufacturer:** ECT Manufacturing Inc
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Length:** 4
- **Diameter (in):** 2

Well Screen:
- **Manufacturer:** Johnson Screens
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Diameter (in):** 2
- **Slot Size (in):** 0.010
- **Slot Type:** Factory Slot

Sump/End Cap: Point

Notes: None

Technician Signature:

Depths and heights are referenced to ground surface unless specified TOC.
All elevations are referenced to MSL (NAVD 88).

Technician Name (print): Jared Walbert

QA/QC’d by:

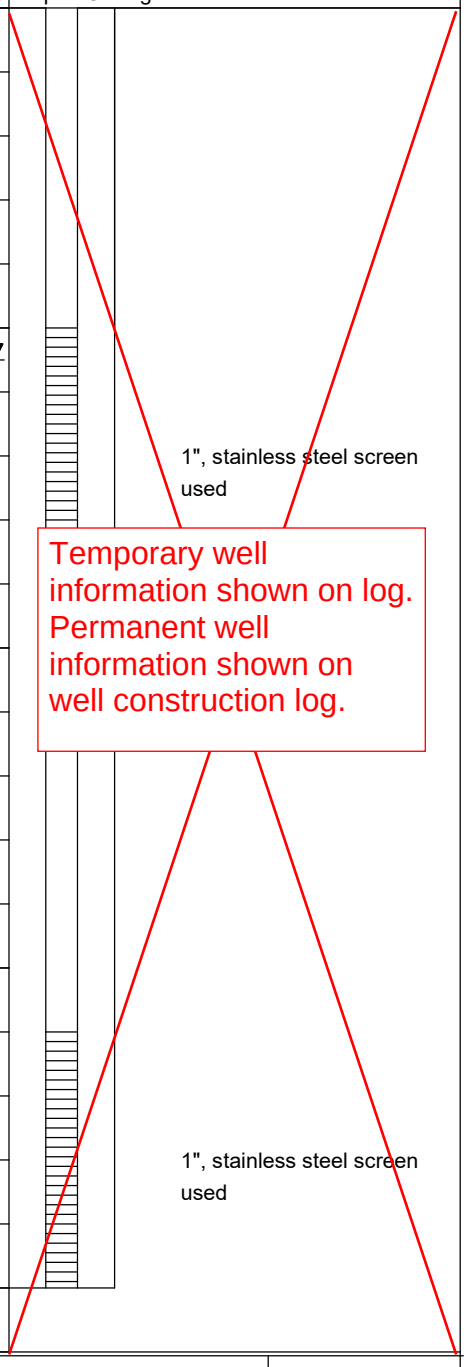
QA/QC Date:

PROJECT: Former JB Sims Generating Station Harbor Island Grand Haven, Michigan	**Log of Soil Boring VAS22/MW-38**
BORING LOCATION: Harbor Island	SURFACE ELEVATION AND DATUM: TBD
DRILLING CONTRACTOR: Job Site Services	DATE STARTED: 12/7/22 / DATE FINISHED: 12/7/22
DRILLING METHOD: DPT	TOTAL DEPTH (ft.): 20.0 / SCREEN INTERVAL (ft.): 5-9; 16-20
DRILLING EQUIPMENT: Geoprobe 7822DT	DEPTH TO WATER ATD (ft): 5.0 / CASING: 1", stainless steel
SAMPLING METHOD: Dual Tube	DEPTH TO WATER ATS (ft): 5.50
HAMMER WEIGHT: NA / DROP: NA	LOGGED BY: Jared Walbert / REG. NO. NA

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Recovery (%)	Blow Counts	PID Reading (ppm)	DESCRIPTION: NAME (USCS): color, moist, % by wt., plasticity, dilatancy, toughness, dry strength, consistency	Depth (ft)
				0.0	SILTY GRAVEL (GM): black (GLEY 1 2.5/N), damp	
				0.0		
				0.0		
				0.0		
5				0.0	POORLY-GRADED SAND (SP): black (GLEY 1 2.5/N), wet	
	VAS22-5-9			NM	POORLY-GRADED SAND (SP): brownish yellow (10 YR 6/8), saturated	
				NM	CLAYEY SILT (ML): black (GLEY 1 2.5/N), wet, coal fragments, low plasticity	
				NM	POORLY-GRADED SAND (SP): brownish yellow to black (10 YR 6/8 to GLEY 1 2.5/N), saturated, wood and coal at 9.5-10.0 ft bgs	
10				NM		
				NM	CLAYEY SILT (ML): very dark grayish brown (10 YR 3/2), saturated, low plasticity	
				NM		
				NM	POORLY-GRADED SAND (SP): very dark gray (GLEY 1 3/N), saturated	
				NM	SILT (ML): very dark gray (GLEY 1 3/N), saturated	
				NM	CLAYEY SILT (ML): very dark grayish brown (10 YR 3/2), saturated, leaves and roots at 16.0-17.0 ft bgs, low plasticity	
15				NM		
				NM		
	VAS22-16-20			NM	POORLY-GRADED SAND (SP): gray (GLEY 1 5/N), saturated	
				NM		
				NM		
20				NM	End of boring at 20 ft bgs.	

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

Top of Casing Elevation: TBD



Acronymns
ATD - At Time of Drilling
ATS - At Time of Sampling

Project No. 3650220203

WELL10

SCREENED WELL CONSTRUCTION FORM

Site Name: Former JB sims generating station, Harbor Island, Grand Haven, MI

Project Number: 3650220203.02.02

Well ID: MW-38

Location ID: VAS22

Drilling Subcontractor: Job Site Services

Installation Date: 01/30/2023

Drilling Personnel: David Mokma & Jeremiah Chapman

Decon Performed: Yes

Technician Name: Jared Walbert

Drilling Method: Direct Push

Other Amec Foster Wheeler Representatives:

Measurement Point (riser)
Elevation (ft msl): 590.51

Land Surface Elevation (ft): 586.258

Approximate Diameter of Borehole (in): 3.75

Depth to Water (ft): 5.90
- **During Drilling:** 5.90
  - **Date:** 01/30/2023
- **Post Development:** 6.37
  - **Date:** 02/01/2023

Hydrologic Unit: NA

Water added during drilling (gal): .0

Water removed during development (gal): 10.5

Top of Bentonite Seal (ft): 1.0

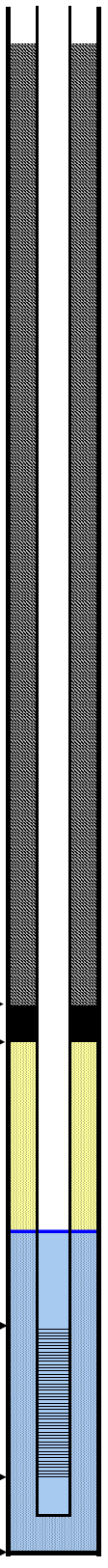
Top of Filter Pack (ft): 3.0

Top of Screen Interval (ft): 4.0

Bottom of Screened Interval (ft): 9.0

Bottom of Filter Pack (ft): 9.0

Bottom of Borehole (ft): 9.37



Protective Casing:
- **Type:** Round Well Monument
- **Dimensions (in):** 4
- **Stickup (ft):** 4
- **Length (ft):** 5
- **Guard Post:** None

Surface Pad:
- **Dimensions:** 12”x12”x6”
- **Type:** Concrete

Annular Seal (grout above well seal):
- **Material:** BENTONITE
- **Installation Method:** Gravity

Bentonite Seal:
- **Manufacturer:** Baroid
- **Material:** BENTONITE 3/8"
- **Type:** Chips
- **Installation Method:** Gravity
- **Hydration time (hrs):** 24

Filter Pack Material:
- **Manufacturer:** K&E
- **Material:** #2 Well Gravel
- **Size:** 0.03
- **Installation Method:** Gravity
- **Surging time:** 0.5

Well Casing (Riser):
- **Manufacturer:** ECT manufacturing inc
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Length:** 4'
- **Diameter (in):** 2

Well Screen:
- **Manufacturer:** Johnson Screens
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Diameter (in):** 2
- **Slot Size (in):** 0.010
- **Slot Type:** Factory Slot

Sump/End Cap: Point

Notes:
None.

Technician Signature: Jared Walbert

Depths and heights are referenced to ground surface unless specified TOC.
All elevations are referenced to MSL (NAVD 88).

Technician Name (print): Jared Walbert

QA/QC’d by:

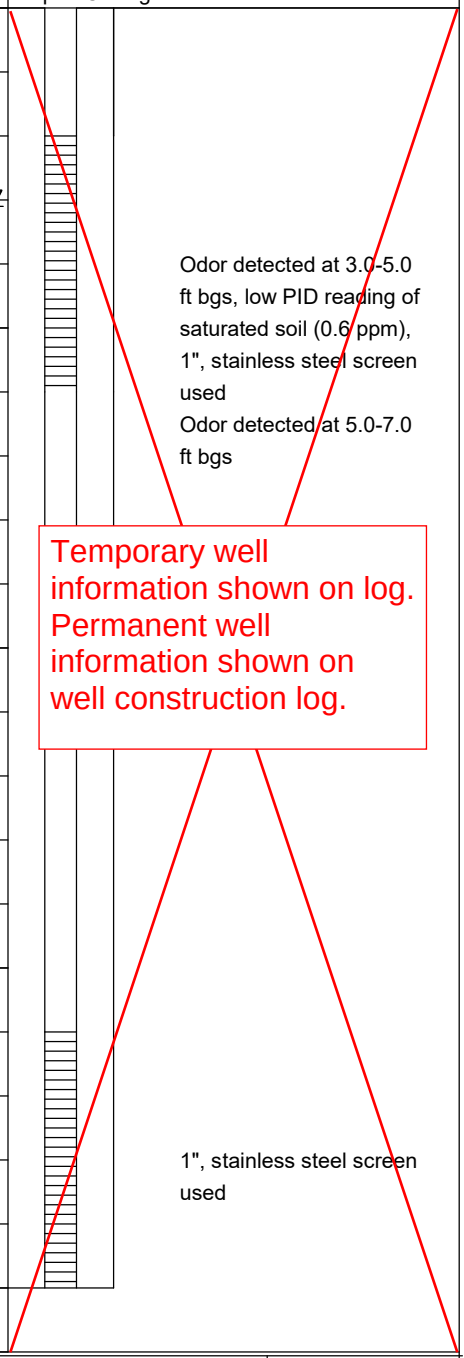
QA/QC Date:

PROJECT: Former JB Sims Generating Station Harbor Island Grand Haven, Michigan	**Log of Soil Boring VAS15/MW-39**
BORING LOCATION: Harbor Island	SURFACE ELEVATION AND DATUM: TBD
DRILLING CONTRACTOR: Job Site Services	DATE STARTED: 12/5/22 / DATE FINISHED: 12/6/22
DRILLING METHOD: DPT	TOTAL DEPTH (ft.): 20.0 / SCREEN INTERVAL (ft.): 3-7; 16-20
DRILLING EQUIPMENT: Geoprobe 7822DT	DEPTH TO WATER ATD (ft): 3.0 / CASING: 1", stainless steel
SAMPLING METHOD: Dual Tube	DEPTH TO WATER ATS (ft): 3.10
HAMMER WEIGHT: NA / DROP: NA	LOGGED BY: Jared Walbert / REG. NO. NA

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Recovery (%)	Blow Counts	PID Reading (ppm)	DESCRIPTION: NAME (USCS): color, moist, % by wt., plasticity, dilatancy, toughness, dry strength, consistency	Depth (ft)
0	VAS15-3-7, VAS15-SB-3-5			0.0	POORLY-GRADED SAND (SP): yellowish brown (10 YR 5/8), dry	0
				0.0		
				0.0	POORLY-GRADED SAND (SP): very dark brown (10 YR 2/2), saturated, waste consisting of ceramics, glass and metal	
				0.6		
5				NM	SILTY GRAVEL (GM): very dark brown (10 YR 2/2), saturated, waste consisting of ceramic and glass	
				NM		
				NM	CLAYEY SILT (ML): black to very dark gray (10 YR 2/1 to 10 YR 3/1), saturated, wood fibers, low plasticity	
				NM		
				NM	SANDY SILT (ML): brown (10 YR 5/3), saturated, shells at 9.0 ft bgs	
10				NM	CLAYEY SILT (ML): very dark grayish brown (10 YR 3/2), saturated	
				NM		
				NM		
				NM	SILTY CLAY (ML): very dark grayish brown (10 YR 3/2), wet	
				NM	CLAYEY SILT (ML): very dark grayish brown (10 YR 3/2), saturated, leaf and wood debris at 14.0-15.0 ft bgs	
15				NM		
				NM		
	VAS15-16-20			NM	POORLY-GRADED SAND (SP): gray (10 YR 6/1), saturated	
				NM		
				NM		
20				NM	End of boring at 20 ft bgs.	

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

Top of Casing Elevation: TBD



Acronyms
ATD - At Time of Drilling
ATS - At Time of Sampling

Project No. 3650220203

WELL10

SCREENED WELL CONSTRUCTION FORM

Site Name: Former JB Sims Generating Station, Harbor Island, Grand Haven, MI

Project Number: 3650220203.02.02

Well ID: MW-39

Location ID: VAS15

Drilling Subcontractor: Job Site Services

Installation Date: 01/31/2023

Drilling Personnel: David Mokma & Jeremiah Chapman

Decon Performed: Yes

Technician Name: Jared Walbert

Drilling Method: Direct Push

Other Amec Foster Wheeler Representatives: None

Measurement Point (riser)
Elevation (ft msl): 587.359

Land Surface Elevation (ft): 583.272

Approximate Diameter of Borehole (in): 3.75 inches

Depth to Water (ft): 3.10
- **During Drilling:** 2.76
  - **Date:** 01/31/2023
- **Post Development:** 3.17
  - **Date:** 02/01/2023

Hydrologic Unit: NA

Water added during drilling (gal): .0

Water removed during development (gal): 15

Top of Bentonite Seal (ft): 0.5

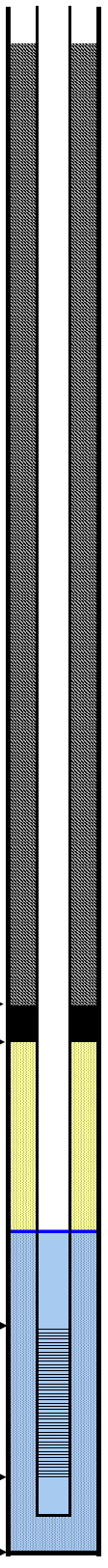
Top of Filter Pack (ft): 1.5

Top of Screen Interval (ft): 2.0

Bottom of Screened Interval (ft): 7.0

Bottom of Filter Pack (ft): 7.0

Bottom of Borehole (ft): 7.0



Protective Casing:
- **Type:** Round Well Monument
- **Dimensions (in):** 4
- **Stickup (ft):** 4.5
- **Length (ft):** 5
- **Guard Post:** None

Surface Pad:
- **Dimensions:** 12”x12”x6”
- **Type:** Concrete

Annular Seal (grout above well seal):
- **Material:** BENTONITE
- **Installation Method:** Gravity

Bentonite Seal:
- **Manufacturer:** Baroid
- **Material:** BENTONITE
- **Type:** Chips
- **Installation Method:** Gravity
- **Hydration time (hrs):** 24

Filter Pack Material:
- **Manufacturer:** K&E
- **Material:** #2 Well Gravel
- **Size:** 0.03
- **Installation Method:** Gravity
- **Surging time:** 0.5

Well Casing (Riser):
- **Manufacturer:** ECT Manufacturing inc
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Length:** 2'
- **Diameter (in):** 2

Well Screen:
- **Manufacturer:** Johnson Screens
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Diameter (in):** 2
- **Slot Size (in):** 0.010
- **Slot Type:** Factory Slot

Sump/End Cap: Point

Notes: None.

Technician Signature: Jared Walbert

Depths and heights are referenced to ground surface unless specified TOC.
All elevations are referenced to MSL (NAVD 88).

Technician Name (print): Jared Walbert

QA/QC’d by:

QA/QC Date:

PROJECT: Former JB Sims Generating Station Harbor Island
Grand Haven, Michigan

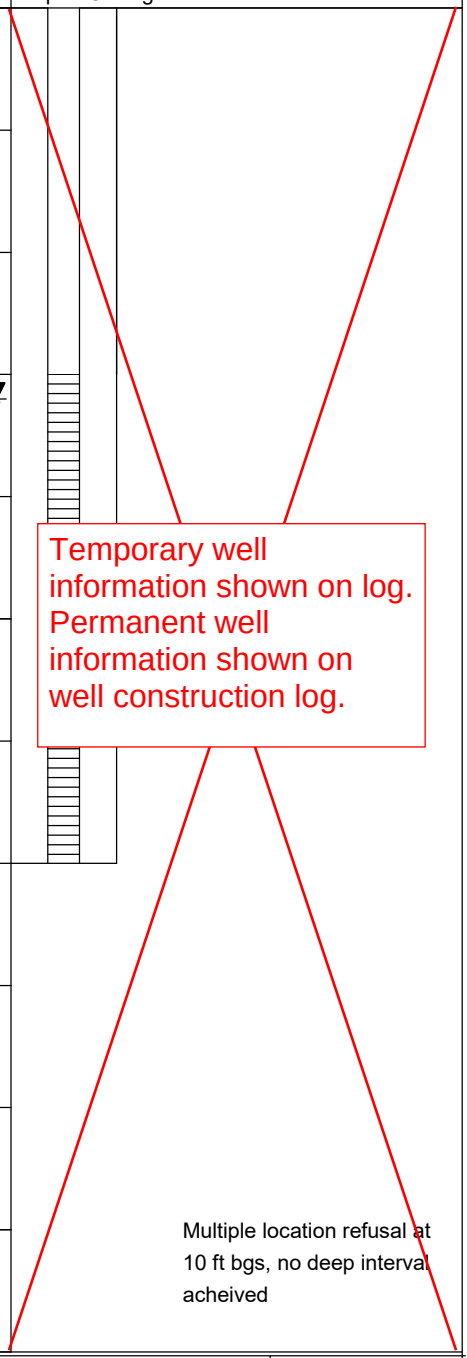
Log of Soil Boring VAS16/MW-40

BORING LOCATION: Harbor Island	SURFACE ELEVATION AND DATUM: TBD	
DRILLING CONTRACTOR: Job Site Services	DATE STARTED: 12/6/22	DATE FINISHED: 12/6/22
DRILLING METHOD: DPT	TOTAL DEPTH (ft.): 10.0	SCREEN INTERVAL (ft.): 3-7
DRILLING EQUIPMENT: Geoprobe 7822DT	DEPTH TO WATER ATD (ft): 3.0	CASING: 1", stainless steel
SAMPLING METHOD: Dual Tube	DEPTH TO WATER ATS (ft): 3.2	
HAMMER WEIGHT: NA / DROP: NA	LOGGED BY: Jared Walbert	REG. NO. NA

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Recovery (%)	Blow Counts	PID Reading (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plasticity, dilatancy, toughness, dry strength, consistency	Depth (ft)
				0.0	POORLY-GRADED SAND (SP): dark grayish brown (10 YR 4/2), damp	
				0.0	SILTY GRAVEL (GM): black (GLEY 1 2.5/N), damp, coal fragments	
				0.0	POORLY-GRADED SAND (SP): dark grayish brown (10 YR 4/2), saturated	
	VAS16-3-7			NM		
5				NM	SILTY GRAVEL (GM): grayish brown (10 YR 5/2), saturated	
				NM		
				NM		
				NM		
				NM		
10				NM	End of boring at 10 ft bgs.	

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

Top of Casing Elevation: TBD



Acronyms
ATD - At Time of Drilling
ATS - At Time of Sampling

Project No. 3650220203

WELL10

SCREENED WELL CONSTRUCTION FORM

Site Name: Former JB Sims Generating Station

Project Number: 3650220203.02.02

Well ID: MW-40

Location ID: VAS16

Drilling Subcontractor: Job Site Services

Installation Date: 01/31/2023

Drilling Personnel: David Mokma & Jeremiah Chapman

Decon Performed: Yes

Technician Name: Jared Walbert

Drilling Method: Direct Push

Other Amec Foster Wheeler Representatives: None.

Measurement Point (riser)
Elevation (ft msl): 586.783

Land Surface Elevation (ft): 582.748

Approximate Diameter of Borehole (in): 3.75

Depth to Water (ft): 3.10
- **During Drilling:** 1.50
  - **Date:** 01/31/2023
- **Post Development:** 1.46
  - **Date:** 02/01/2023

Hydrologic Unit: NA

Water added during drilling (gal): .0

Water removed during development (gal): 10

Top of Bentonite Seal (ft): 0.5

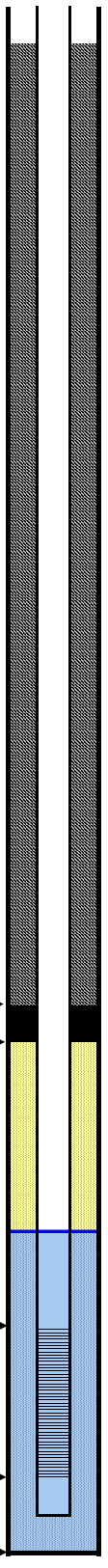
Top of Filter Pack (ft): 1.25

Top of Screen Interval (ft): 1.5

Bottom of Screened Interval (ft): 6.5

Bottom of Filter Pack (ft): 6.5

Bottom of Borehole (ft): 6.5



Protective Casing:
- **Type:** Round Well Monument
- **Dimensions (in):** 4
- **Stickup (ft):** 4
- **Length (ft):** 5
- **Guard Post:** None

Surface Pad:
- **Dimensions:** 12”x12”x6”
- **Type:** Concrete

Annular Seal (grout above well seal):
- **Material:** BENTONITE
- **Installation Method:** Gravity

Bentonite Seal:
- **Manufacturer:** Baroid
- **Material:** BENTONITE 3/8"
- **Type:** Chips
- **Installation Method:** Gravity
- **Hydration time (hrs):** 24

Filter Pack Material:
- **Manufacturer:** K&E
- **Material:** #2 Well Gravel
- **Size:** 0.03
- **Installation Method:** Gravity
- **Surging time:** 0.5

Well Casing (Riser):
- **Manufacturer:** ECT Manufacturing
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Length:** 1.5
- **Diameter (in):** 2

Well Screen:
- **Manufacturer:** Johnson Screens
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Diameter (in):** 2
- **Slot Size (in):** 0.010
- **Slot Type:** Factory Slot

Sump/End Cap: Point

Notes: None

Technician Signature:

Depths and heights are referenced to ground surface unless specified TOC.
All elevations are referenced to MSL (NAVD 88).

Technician Name (print): Jared Walbert

QA/QC’d by:

QA/QC Date:

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**

LOG OF BORING NUMBER **PDR-1**

PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**

ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

DESCRIPTION OF MATERIAL

SURFACE ELEVATION (ft.)

DEPTH (FT) ELEVATION (FT) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | PID

UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT 10 20 30 40 50 60

See CPT Log

5 10 15 20 25 30

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/12/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/12/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**

LOG OF BORING NUMBER **PDR-1**

PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**

ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

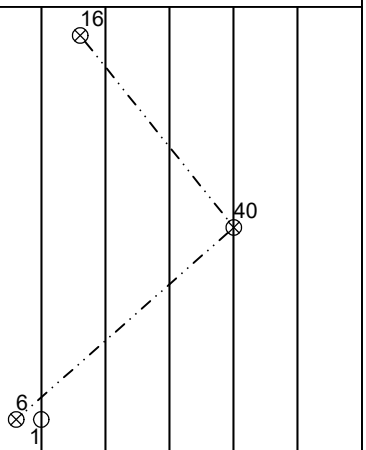
SURFACE ELEVATION (ft.)

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID
	1	SS			35.0 Fine sandy silt - gray - medium dense to dense - wet (ML)	
40	2	SS				
					41.5 Silty clay - gray - stiff (CL)	
45	3	SS				
					46.5 See CPT Log	
50						
55						
60						
65						

UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

STANDARD PENETRATION BLOWS/FT
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/12/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/12/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**

LOG OF BORING NUMBER **PDR-1**

PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**

ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT) ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID	UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2 (1 2 3 4 5) / PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) (10 20 30 40 50) / STANDARD PENETRATION BLOWS/FT (10 20 30 40 50 60)
75							
80							
85							
90							
95							
100					96.3 EOB at 96.3 feet bgs.		

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/12/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/12/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**

LOG OF BORING NUMBER **PDR-2**

PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**

ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT) ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID
					See CPT Log	
30	1	SS			30.0 Fine sandy silt - gray - extremely dense - wet (ML)	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2: 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%): 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50 60

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/16/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/16/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**	LOG OF BORING NUMBER **PDR-2**
PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**	ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

DESCRIPTION OF MATERIAL

SURFACE ELEVATION (ft.)

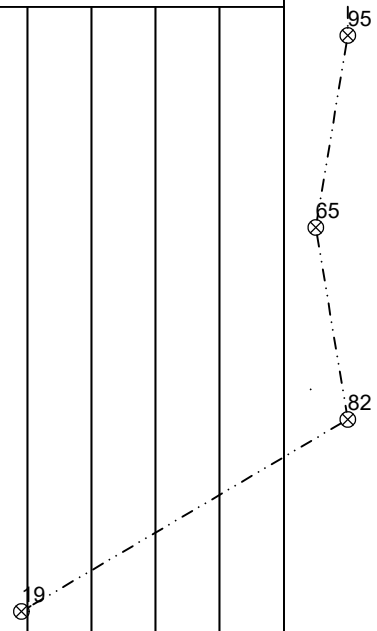
DEPTH (FT) / ELEVATION (FT) | SAMPLE NO. | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | PID

UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2: 1 2 3 4 5

PLASTIC LIMIT (%) | WATER CONTENT (%) | LIQUID LIMIT (%): 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50 60

SAMPLE NO.	SAMPLE TYPE	DEPTH (FT)	DESCRIPTION OF MATERIAL
2	SS		
3	SS	40	
4	SS	45	
			46.5 Silty clay - gray - stiff (CL)
5	SS	50	
			51.5 See CPT Log
		55	
		60	
		65	



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/16/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/16/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**

LOG OF BORING NUMBER **PDR-2**

PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**

ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT) ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID	UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2 (1 2 3 4 5) / PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) (10 20 30 40 50) / STANDARD PENETRATION BLOWS/FT (10 20 30 40 50 60)
75							
80							
85							
90							
95							
100					97.2 EOB at 97.2 feet bgs.		

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/16/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/16/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**

LOG OF BORING NUMBER **PDR-3**

PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**

ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

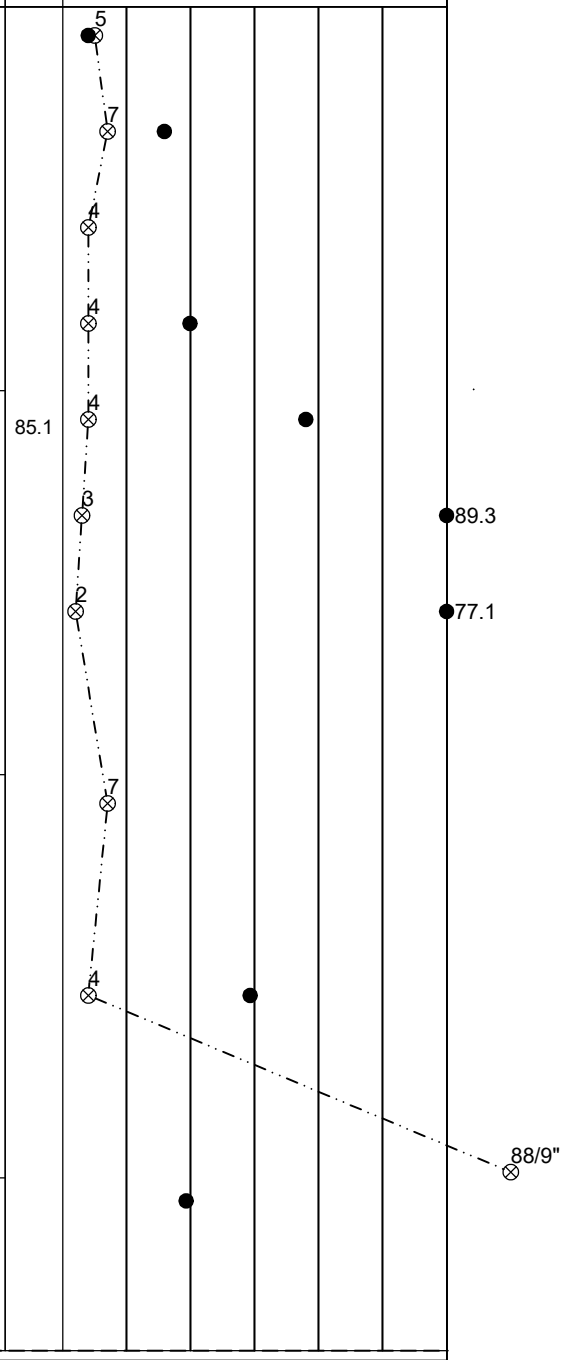
DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
	1	SS			Fill: Fine to medium sand, trace to some fine gravel, trace silt and coarse sand - brown - loose - moist to wet (SP)
	2	SS			
5	3	SS			
	4	SS			
10	5	SS			10.0 Possible Fill: Fine to medium sand, some organic silt and fine gravel, occasional glass pieces - dark gray to black - loose to very loose - wet (SM/OL)
	6	SS			
15	7	SS			
20	8	SS			20.0 Fine sand - trace silt, coarse sand and fine gravel - gray - loose to extremely dense - wet (SP)
25	9	SS			
30	10A	SS			
	10B	SS			30.5 Silty fine sand - trace medium to coarse sand and fine gravel - gray - medium dense to extremely dense - wet (SM)

PID: 85.1

UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2 (1 2 3 4 5)

PLASTIC LIMIT (%) / WATER CONTENT (%) / LIQUID LIMIT (%) (10 20 30 40 50)

STANDARD PENETRATION BLOWS/FT (10 20 30 40 50 60)



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD		BORING STARTED **4/8/2019**	GEI OFFICE **Lansing, MI**
		BORING COMPLETED **4/10/2019**	ENTERED BY **D. Elliott** / APPROVED BY
NORTHING	EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**

LOG OF BORING NUMBER **PDR-3**

PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**

ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

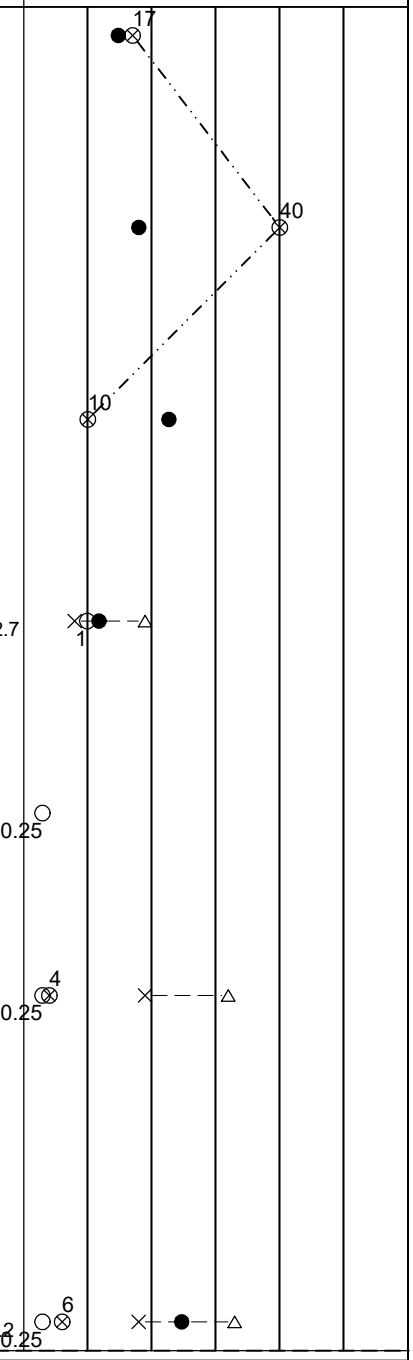
SURFACE ELEVATION (ft.)

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID
40	11	SS				
	12	SS				
45	13	SS				
					48.0 Slity clay - gray - stiff (CL) Pc = 3.1 tsf, Cc = 0.149, Ccr = 0.029	
50	14	ST				122.7
55	15	ST			55.0 Silty clay - some fine sand - trace medium sand - gray - very soft (CL)	0.25
60	16	SS				0.25
65	17	SS				98.2

UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2 1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT 10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/8/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/10/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **2** OF **5**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**

LOG OF BORING NUMBER **PDR-3**

PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**

ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
	18	ST			Unconsolidated-Undrained Triaxial Compression: c = 0.6 tsf
75	19	SS			
80	20	SS			80.0 Silty clay - trace fine sand - gray - soft to stiff (CL)
85	21	SS			
90	22	SS			
					92.0 Silty clay - some fine sand - trace medium to coarse sand - gray - hard to very stiff (CL-ML)
95	23	SS			
100	24	SS			

UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2 (1 2 3 4 5)

PLASTIC LIMIT (%) / WATER CONTENT (%) / LIQUID LIMIT (%) (10 20 30 40 50)

STANDARD PENETRATION BLOWS/FT (10 20 30 40 50 60)

PID

99.7 0.25 6 0.25 9 0.25 11 0.5 0.75 12 0.25 1.5 28 4.5 65 119.9 4.5

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/8/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/10/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **3** OF **5**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**

LOG OF BORING NUMBER **PDR-3**

PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**

ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

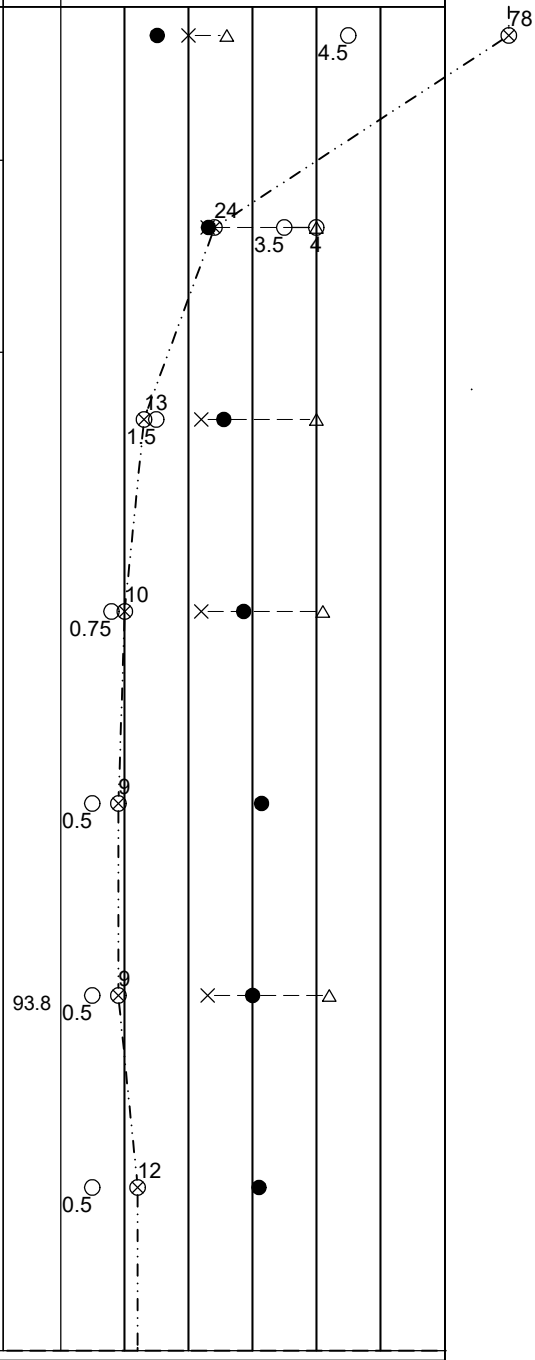
DEPTH (FT) ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
	25	SS			
110	26	SS			109.0 Silty clay - some fine sand - trace medium sand - gray (CL)
115	27	SS			114.0 Silty clay - trace fine sand - gray - stiff to medium (CL)
120	28	SS			
125	29	SS			
130	30	SS			
135	31	SS			

PID

UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

STANDARD PENETRATION BLOWS/FT
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/8/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/10/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **4** OF **5**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**

LOG OF BORING NUMBER **PDR-3**

PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**

ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

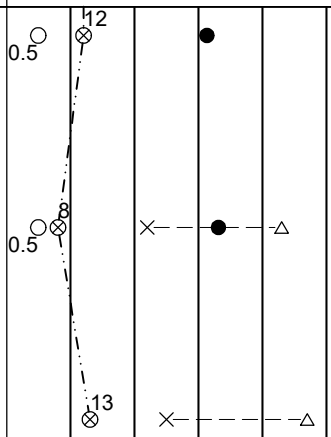
SURFACE ELEVATION (ft.)

DEPTH (FT) ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID
145	32	SS				
	33	SS				
150	34	SS				
					151.5 End of Boring @ 151.5 feet below ground surface. Borehole tremie grouted to surface.	
155						
160						
165						
170						

UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2
1 2 3 4 5

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%)
10 20 30 40 50

STANDARD PENETRATION BLOWS/FT
10 20 30 40 50 60



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/8/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/10/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **5** OF **5**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**

LOG OF BORING NUMBER **PDR-4**

PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**

ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT) ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID	UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2 (1 2 3 4 5) / PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) (10 20 30 40 50) / STANDARD PENETRATION BLOWS/FT (10 20 30 40 50 60)
					See CPT Log		
30	1	SS			30.0 Fine sandy silt - gray - medium dense to dense - wet (ML)		22

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/15/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/15/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**	LOG OF BORING NUMBER **PDR-4**
PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**	ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID	UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2 (1 2 3 4 5) / PLASTIC LIMIT (%) / WATER CONTENT (%) / LIQUID LIMIT (%) (10 20 30 40 50) / STANDARD PENETRATION BLOWS/FT (10 20 30 40 50 60)
SURFACE ELEVATION (ft.)							
	2	SS					36
					36.5 Silty clay - gray - stiff (CL)		
40	3	SS					9
							1.5
					41.5 See CPT Log		
45							
50							
55							
60							
65							

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/15/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/15/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**

LOG OF BORING NUMBER **PDR-4**

PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**

ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT) ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID	UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2 (1 2 3 4 5) / PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) (10 20 30 40 50) / STANDARD PENETRATION BLOWS/FT (10 20 30 40 50 60)
75							
80							
85							
90							
					90.8 EOB at 90.8 feet bgs.		
95							
100							

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/15/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/15/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**

LOG OF BORING NUMBER **PDR-6**

PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**

ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT) ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID
					See CPT Log	
25	1	SS			25.0 Fine sandy silt - gray - medium dense to dense - wet (ML)	
30	2	SS				

UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2 (1 2 3 4 5)

PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) (10 20 30 40 50)

STANDARD PENETRATION BLOWS/FT (10 20 30 40 50 60)

10

28

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/10/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/10/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **1** OF **3**

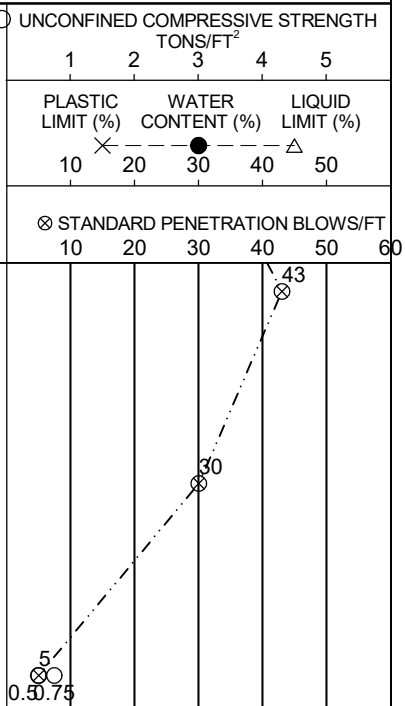
MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants	CLIENT: **Grand Haven Board of Light & Power**	LOG OF BORING NUMBER **PDR-6**
	PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**	ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT) / ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID
	3	SS				
40	4	SS				
					41.5 Silty clay - gray - medium (CL)	
45	5	SS				
					46.5 See CPT Log	
50						
55						
60						
65						



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/10/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/10/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **2** OF **3**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**

LOG OF BORING NUMBER **PDR-6**

PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**

ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT) ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID	UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2 (1 2 3 4 5) / PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) (10 20 30 40 50) / STANDARD PENETRATION BLOWS/FT (10 20 30 40 50 60)
75							
80							
85							
90					89.2 EOB at 89.2 feet bgs.		
95							
100							

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/10/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/10/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **3** OF **3**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

Grand Haven BLP
J.B. Sims Generation Station (Grand Haven,Michigan)

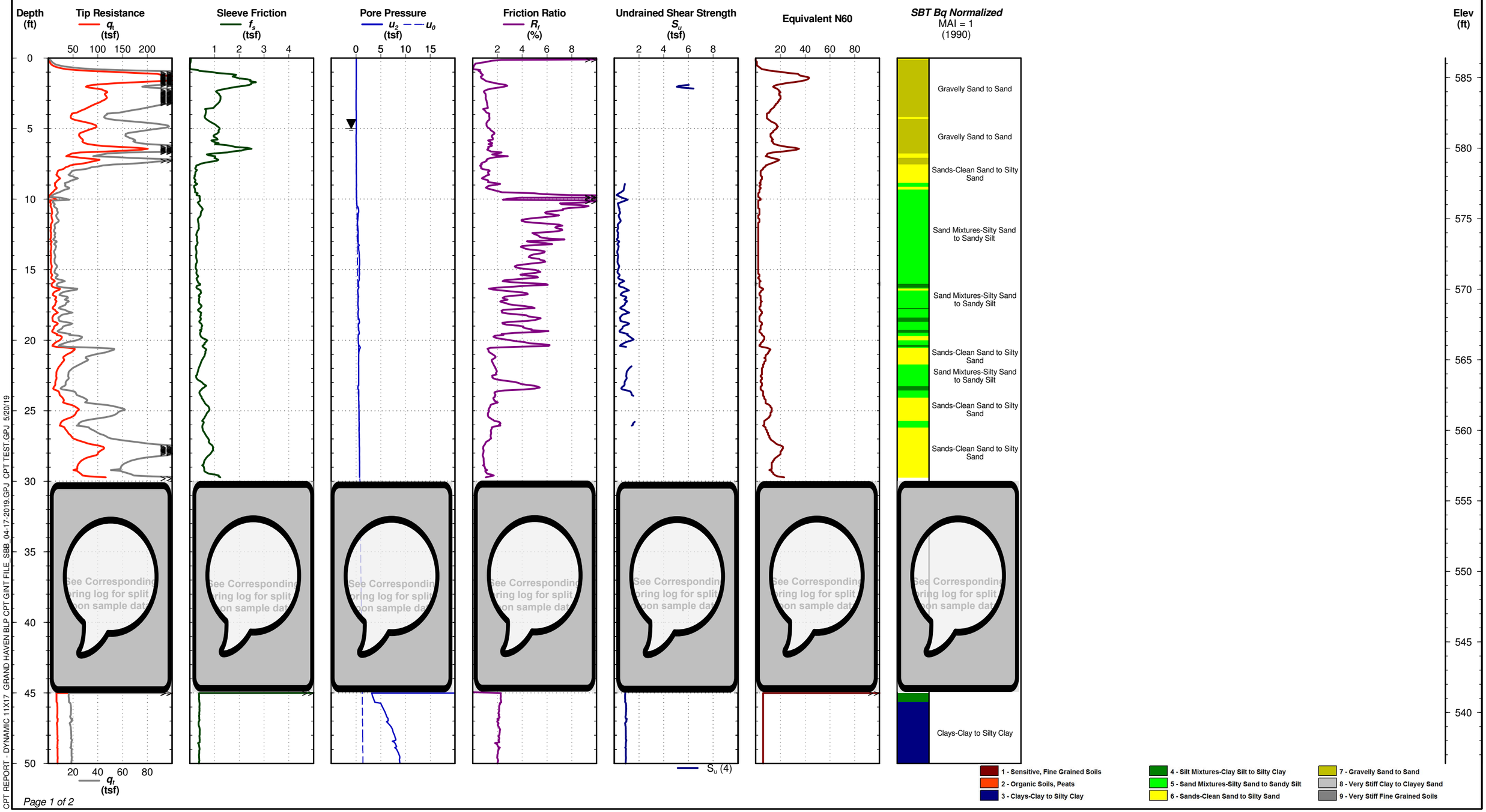
Date: Apr. 12, 2019 Project No: 1901767
Operator: CAP

Cone Penetration Test

Northing: 15645887.4
Easting: 1845035.3
Elevation: 586.4 MSL

PDR-1

Elevation: 586.4
Water Depth: 4.99
Total Depth: 96.3 ft



CPT REPORT - DYNAMIC 11X17 GRAND HAVEN BLP CPT GINT FILE SBB 04-17-2019.GPJ CPT TEST.GPJ 5/20/19

GEI Consultants

Grand Haven BLP
J.B. Sims Generation Station (Grand Haven,Michigan)

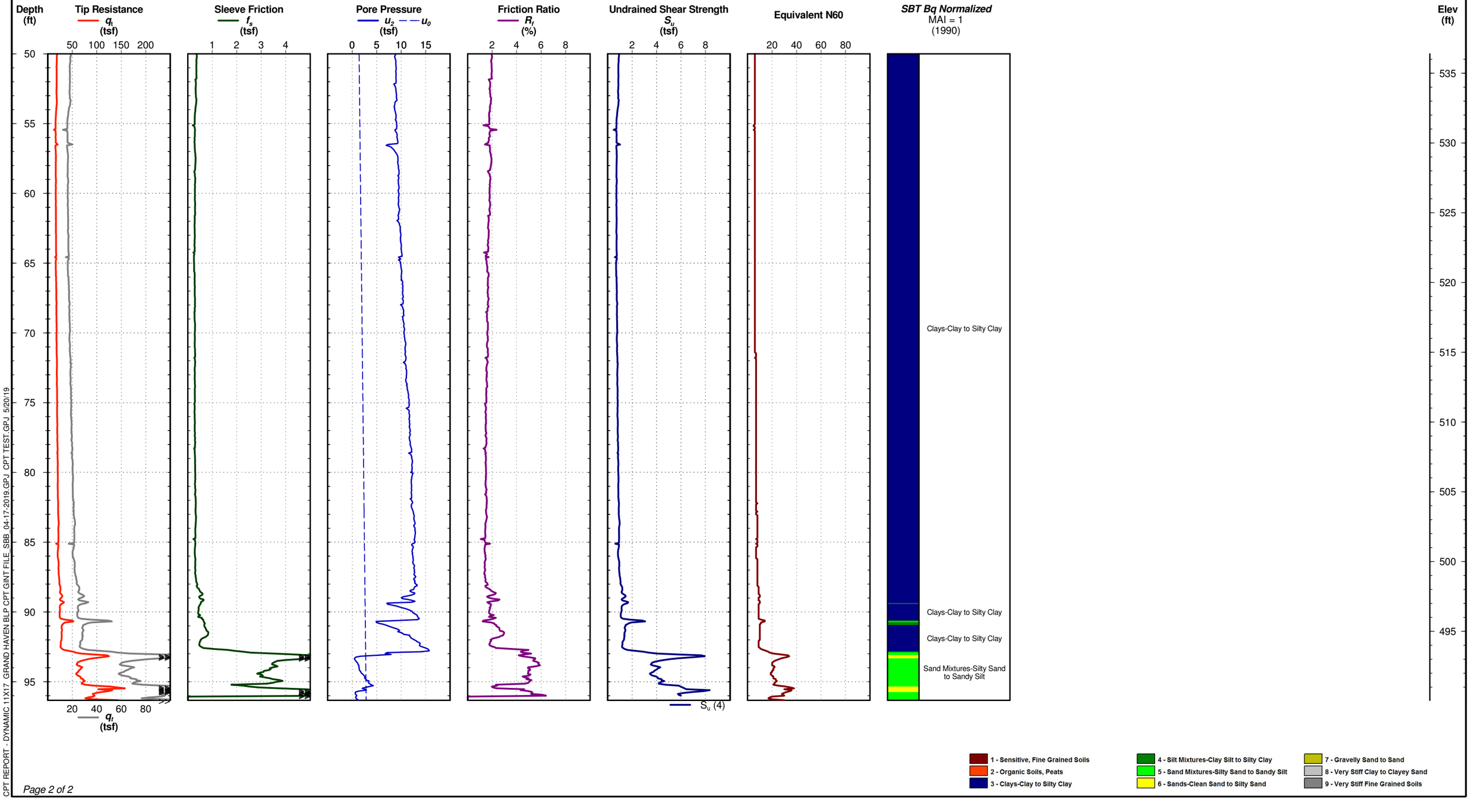
Date: Apr. 12, 2019 Project No: 1901767
Operator: CAP

Cone Penetration Test

Northing: 15645887.4
Easting: 1845035.3
Elevation: 586.4 MSL

PDR-1

Elevation: 586.4
Water Depth: 4.99
Total Depth: 96.3 ft



GEI Consultants

Grand Haven BLP
J.B. Sims Generation Station (Grand Haven,Michigan)

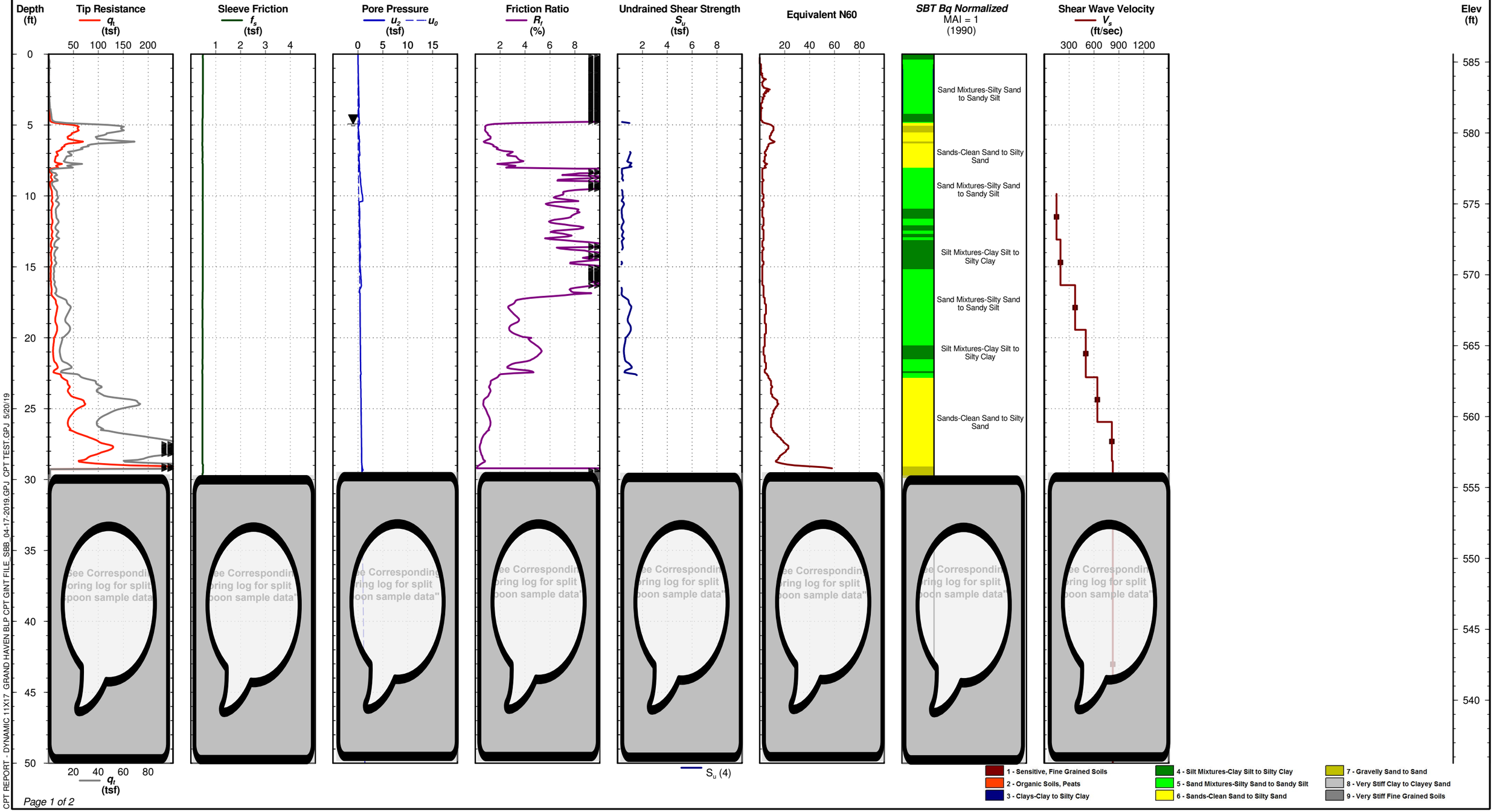
Date: Apr. 16, 2019 Project No: 1901767
Operator: CAP

Cone Penetration Test

Northing: 15646166.0
Easting: 1845094.9
Elevation: 585.6 MSL

PDR-2

Elevation: 585.6
Water Depth: 4.92
Total Depth: 97.2 ft



GEI Consultants

Grand Haven BLP
J.B. Sims Generation Station (Grand Haven,Michigan)

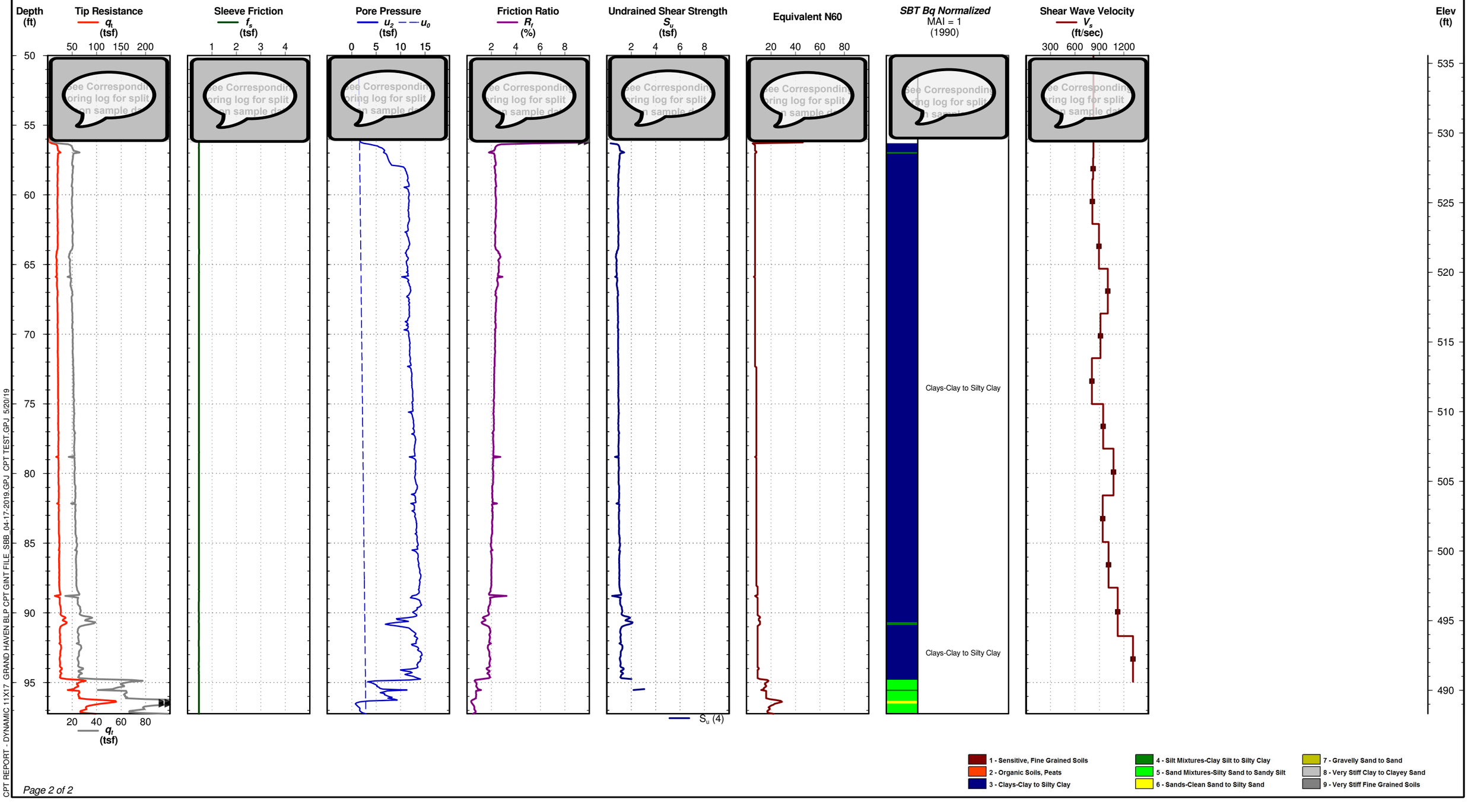
Date: Apr. 16, 2019 Project No: 1901767
Operator: CAP

Cone Penetration Test

PDR-2

Northing: 15646166.0
Easting: 1845094.9
Elevation: 585.6 MSL

Elevation: 585.6
Water Depth: 4.92
Total Depth: 97.2 ft



GEI Consultants

Grand Haven BLP
J.B. Sims Generation Station (Grand Haven,Michigan)

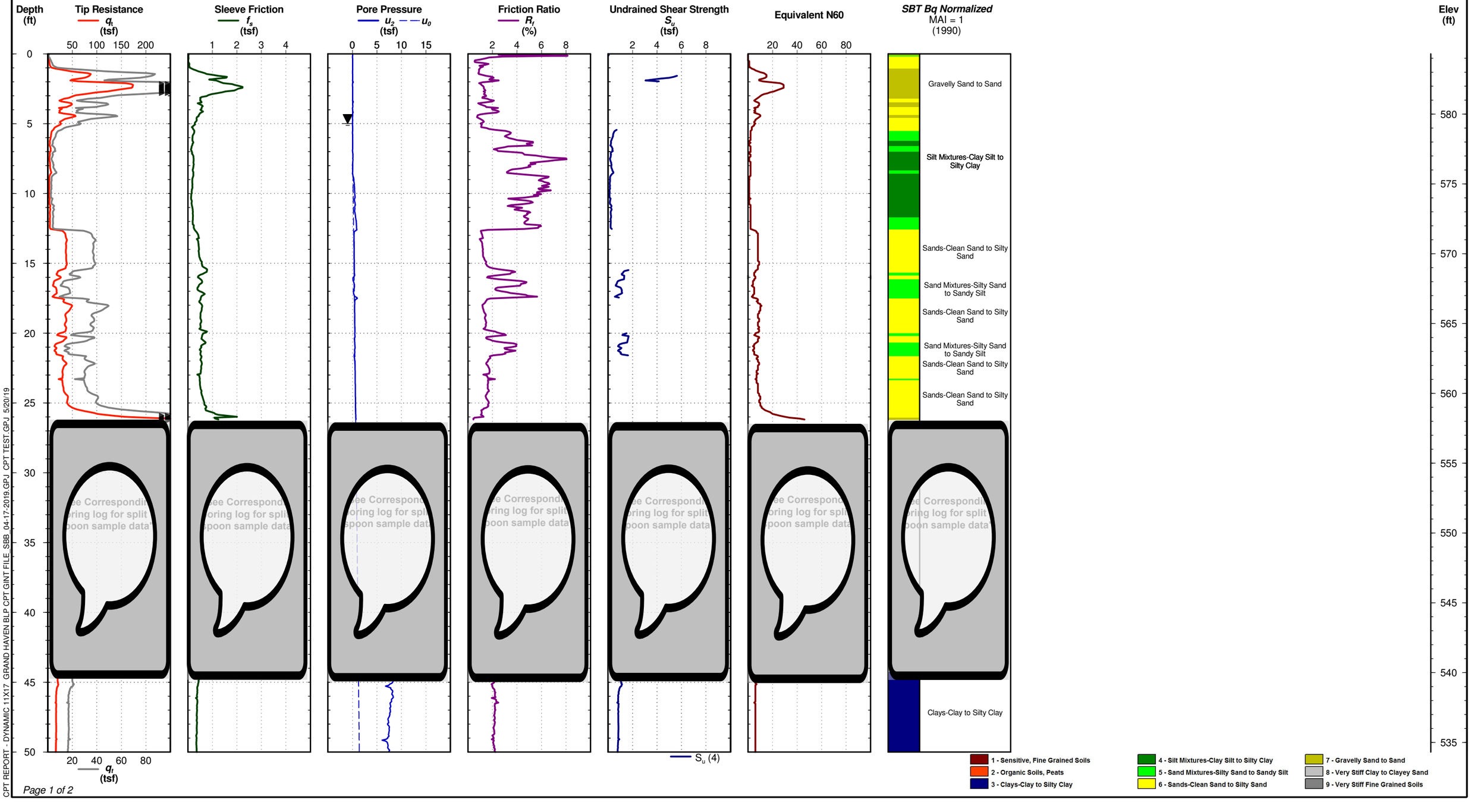
Date: Apr. 15, 2019 Project No: 1901767
Operator: CAP

Cone Penetration Test

Northing: 15645848.7
Easting: 1845259.4
Elevation: 584.3 MSL

PDR-4

Elevation: 584.3
Water Depth: 4.99
Total Depth: 90.8 ft



CPT REPORT - DYNAMIC 11X17 GRAND HAVEN BLP CPT GINT FILE SBB 04-17-2019.GPJ CPT TEST.GPJ 5/20/19

GEI Consultants

Grand Haven BLP
J.B. Sims Generation Station (Grand Haven,Michigan)

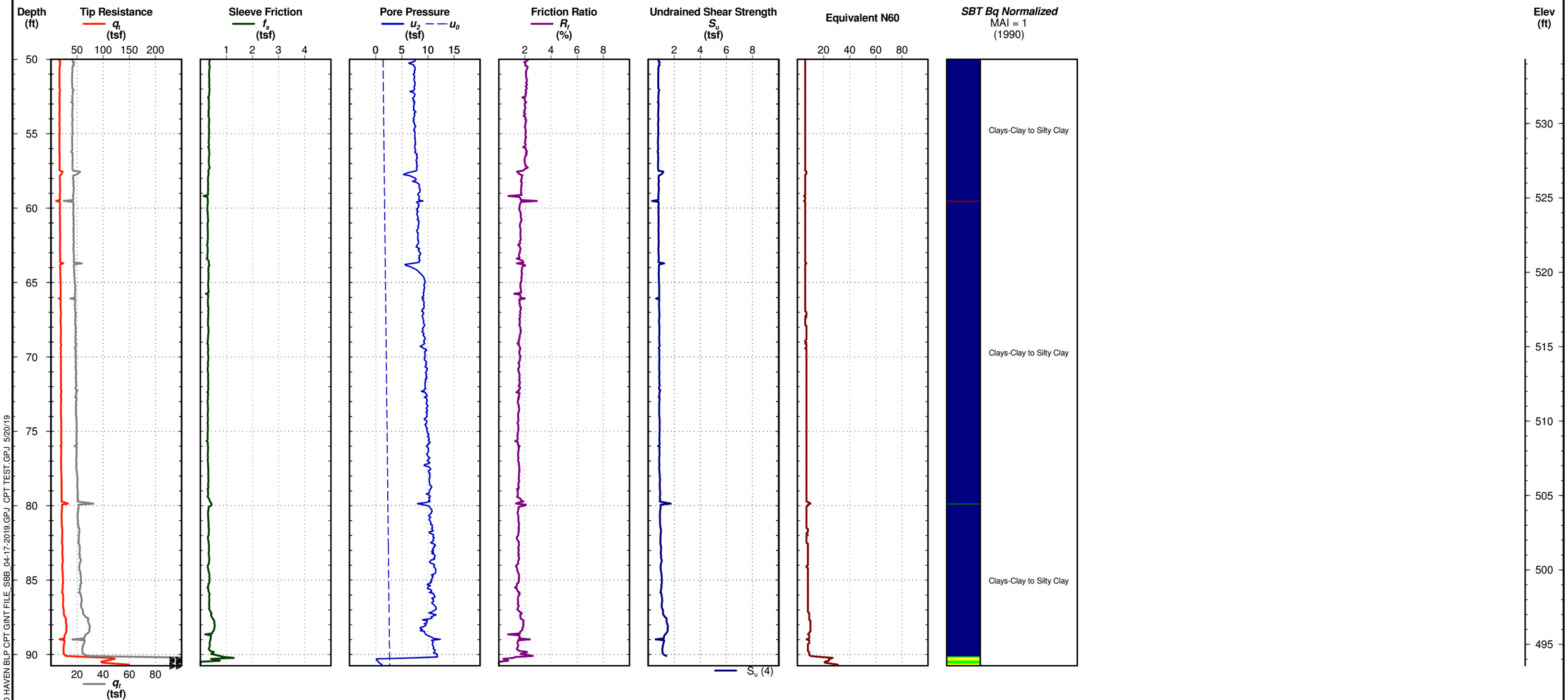
Date: Apr. 15, 2019 Project No: 1901767
Operator: CAP

Cone Penetration Test

Northing: 15645848.7
Easting: 1845259.4
Elevation: 584.3 MSL

PDR-4

Elevation: 584.3
Water Depth: 4.99
Total Depth: 90.8 ft



GEI Consultants

Grand Haven BLP
J.B. Sims Generation Station (Grand Haven,Michigan)

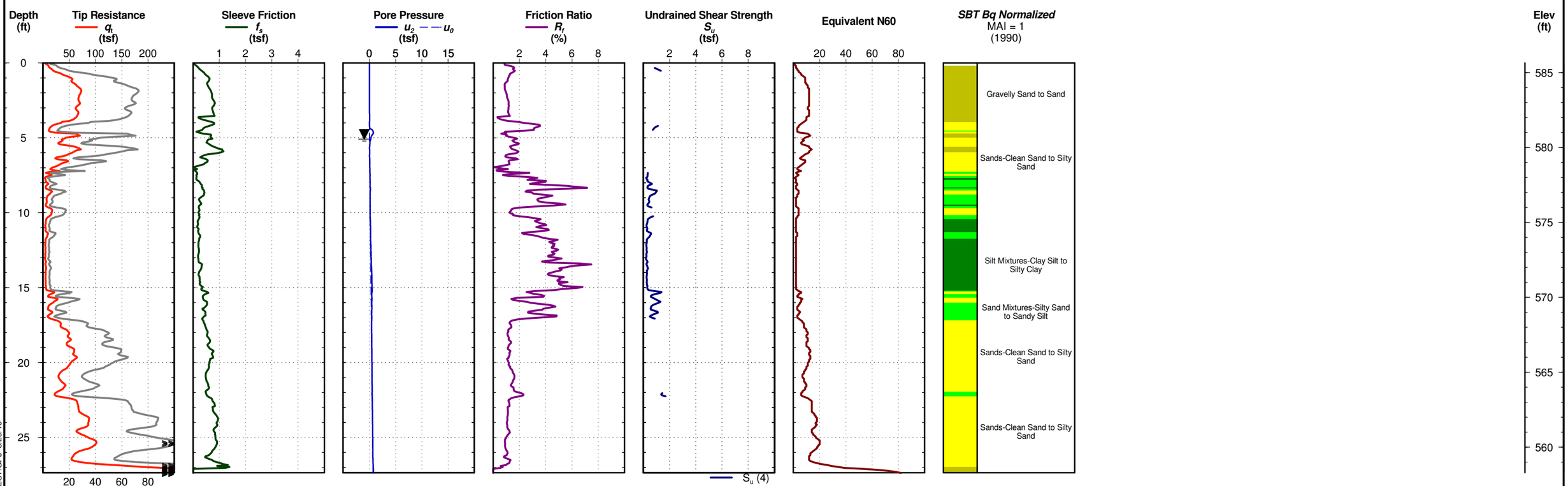
Date: Apr. 11, 2019 Project No: 1901767
Operator: CAP

Cone Penetration Test

Northing: 15645780.8
Easting: 1845173.9
Elevation: 585.6 MSL

PDR-5

Elevation: 585.6
Water Depth: 5.09
Total Depth: 27.4 ft



1 - Sensitive, Fine Grained Soils
2 - Organic Soils, Peats
3 - Clays-Clay to Silty Clay
4 - Silt Mixtures-Clay Silt to Silty Clay
5 - Sand Mixtures-Silty Sand to Sandy Silt
6 - Sands-Clean Sand to Silty Sand
7 - Gravelly Sand to Sand
8 - Very Stiff Clay to Clayey Sand
9 - Very Stiff Fine Grained Soils

Grand Haven BLP
J.B. Sims Generation Station (Grand Haven,Michigan)

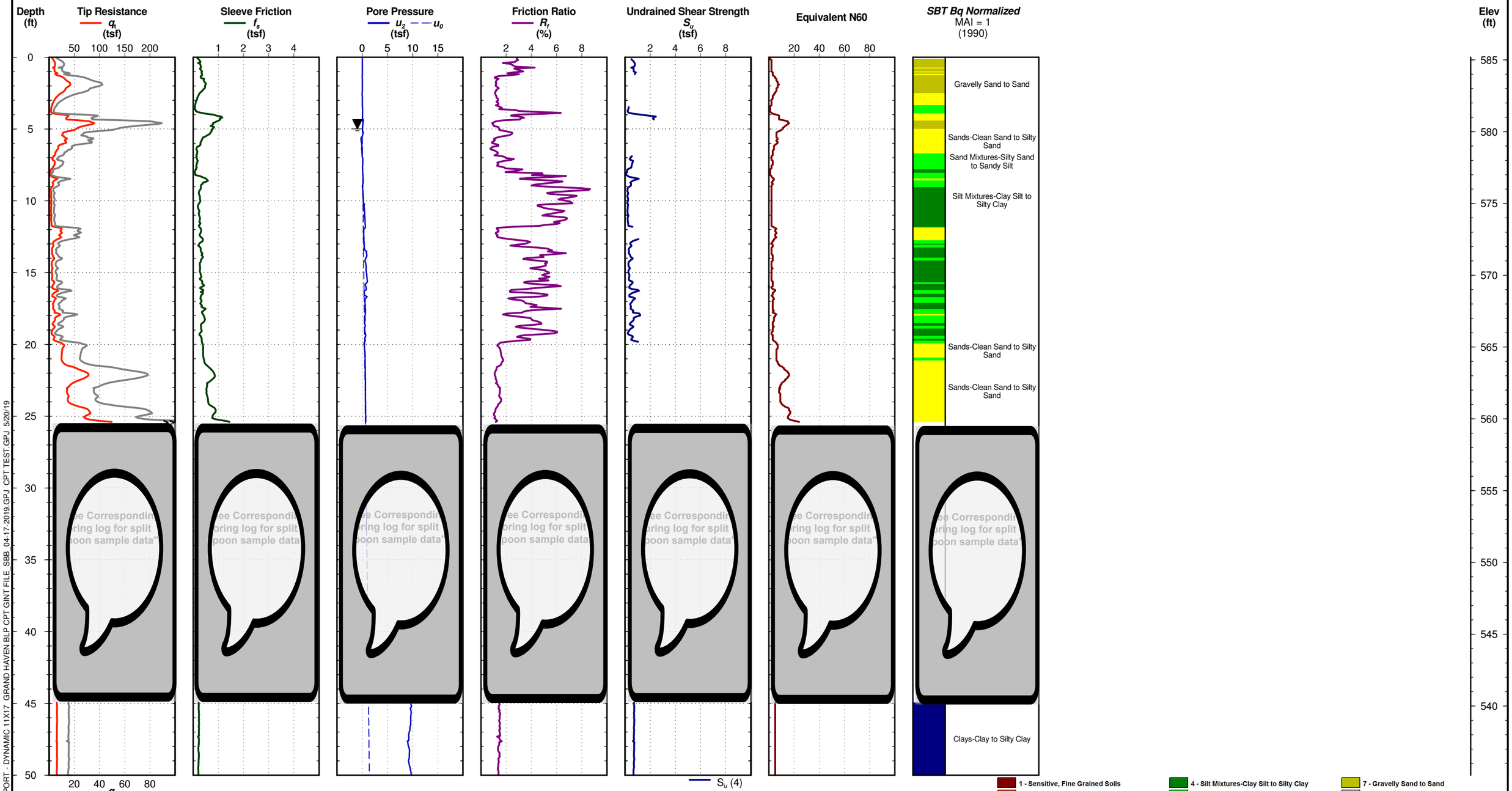
Cone Penetration Test

PDR-6

Date: Apr. 10, 2019 Project No: 1901767
Operator: CAP

Northing: 15645957.2
Easting: 1845287.4
Elevation: 585.2 MSL

Elevation: 585.2
Water Depth: 4.99
Total Depth: 89.2 ft



CPT REPORT - DYNAMIC 11X17 GRAND HAVEN BLP CPT GINT FILE SBB 04-17-2019.GPJ CPT TEST.GPJ 5/20/19

GEI Consultants

Grand Haven BLP
J.B. Sims Generation Station (Grand Haven,Michigan)

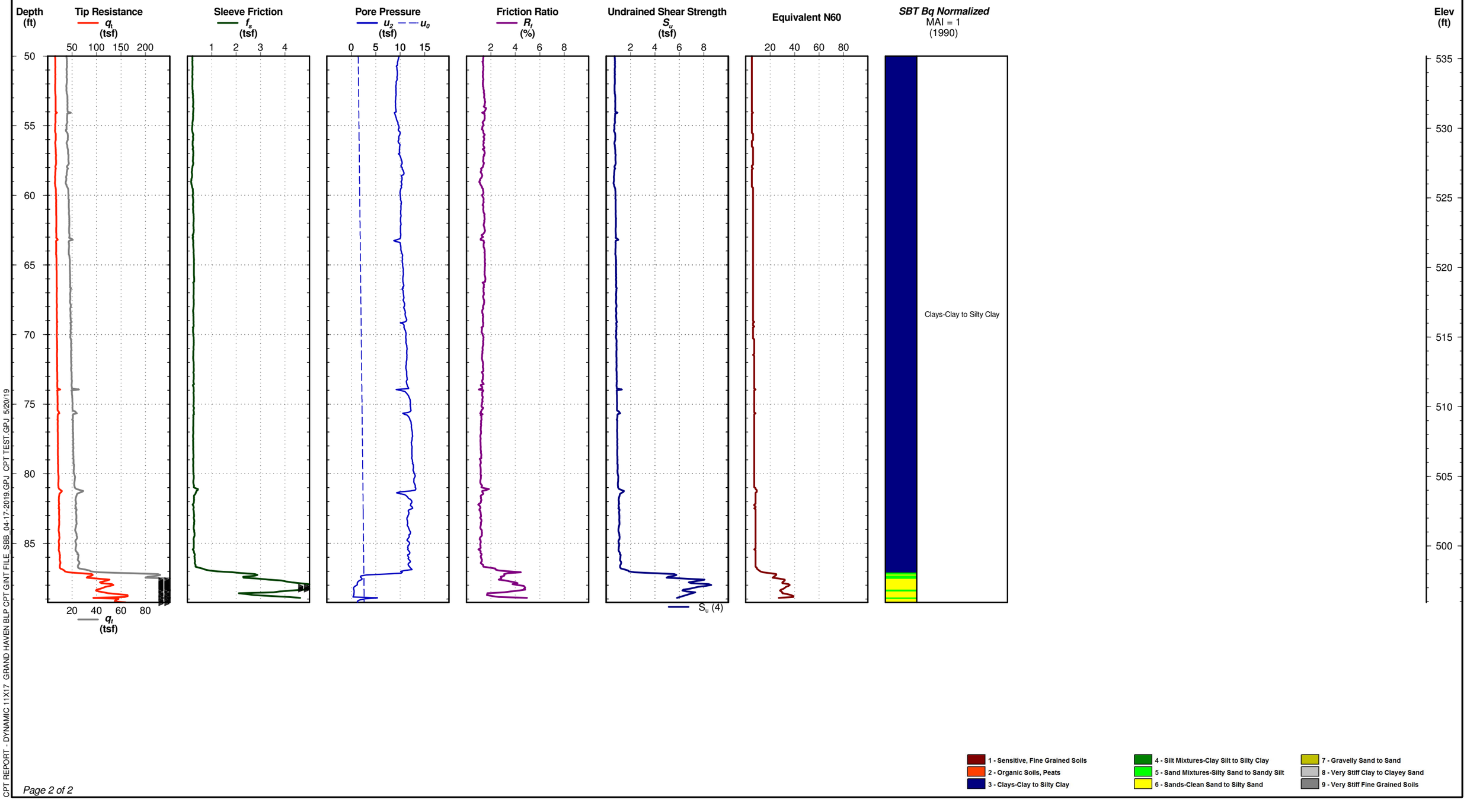
Date: Apr. 10, 2019 Project No: 1901767
Operator: CAP

Cone Penetration Test

PDR-6

Northing: 15645957.2
Easting: 1845287.4
Elevation: 585.2 MSL

Elevation: 585.2
Water Depth: 4.99
Total Depth: 89.2 ft



CPT REPORT - DYNAMIC 11X17 GRAND HAVEN BLP CPT GINT FILE SBB 04-17-2019.GPJ CPT TEST.GPJ 5/20/19

GEI Consultants

Grand Haven BLP
J.B. Sims Generation Station (Grand Haven,Michigan)

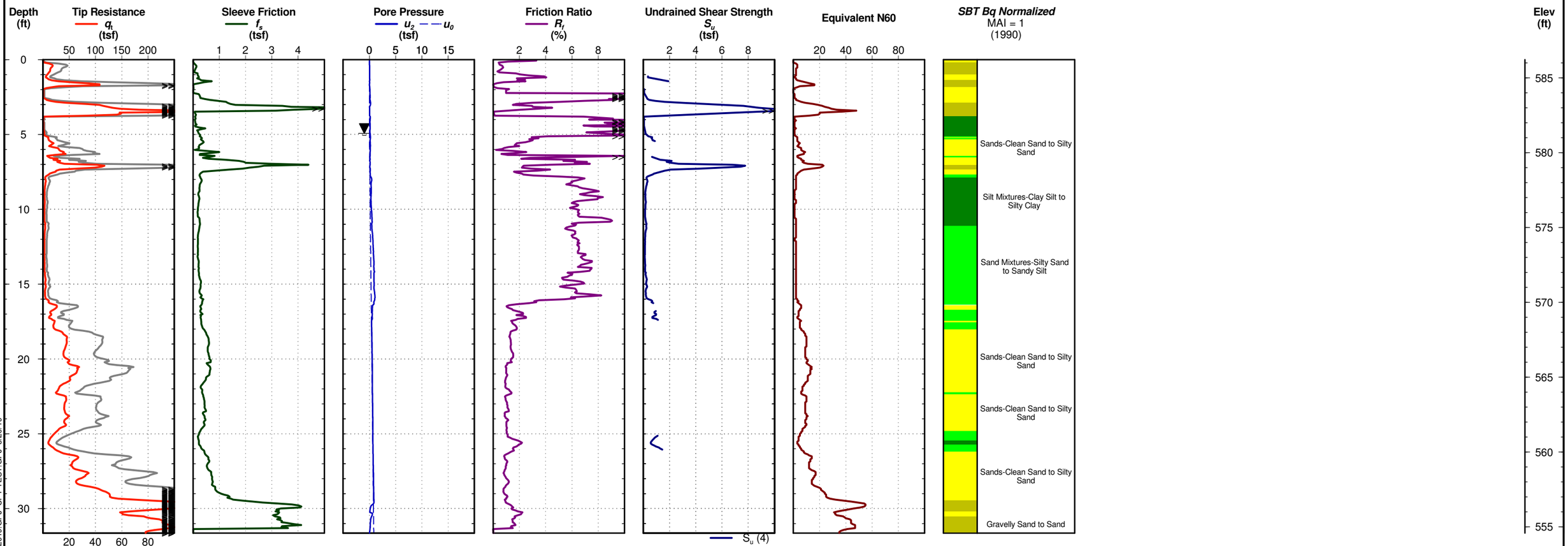
Date: Apr. 15, 2019 Project No: 1901767
Operator: CAP

Cone Penetration Test

Northing: 15646397.2
Easting: 1845099.8
Elevation: 586.2 MSL

PDR-7

Elevation: 586.2
Water Depth: 4.92
Total Depth: 31.6 ft



1 - Sensitive, Fine Grained Soils
2 - Organic Soils, Peats
3 - Clays-Clay to Silty Clay
4 - Silt Mixtures-Clay Silt to Silty Clay
5 - Sand Mixtures-Silty Sand to Sandy Silt
6 - Sands-Clean Sand to Silty Sand
7 - Gravelly Sand to Sand
8 - Very Stiff Clay to Clayey Sand
9 - Very Stiff Fine Grained Soils

CPT REPORT - DYNAMIC 11X17 GRAND HAVEN BLP CPT GINT FILE SBB 04-17-2019.GPJ CPT TEST.GPJ 5/20/19

RECORD OF BOREHOLE: SB-01

CLIENT: Grand Haven Board of Light & Power
PROJECT: GHBLP Coal Removal
PROJECT NO: 21451440
LOCATION: Grand Haven, MI
DATE: August 03, 2021
CONTRACTOR: MATECO Drilling
ELEVATION: 583.9 ft (Ground)
COORDINATES: N: 577550.0 ft E: 12624250.0 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	GROUNDWATER OBSERVATIONS	ADDITIONAL OBSERVATIONS
0	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Dark gray SAND, fill, dry, >5% coal observed down to 1' BGS.	SP		0.0 582.9							
1			Gray CLAY, moist, firm	CL		1.0 582.5							
1			Dark gray SAND, wet, >5% coal observed.	SP		1.4	1	5' Tube	50				
5						577.9							
6			Black silty SAND, wet, organics present, no coal observed.	SM		6.0	2	5' Tube	50				
10			End of hole at 10.0 ft. Backfilled with bentonite chips. Coal observed down to 5' BGS.			573.9							

HAMMER TYPE: Automatic Historic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 03, 2021
CHECKED: Kurtis Van Appledorn DATE: Nov 01, 2021

RECORD OF BOREHOLE: SB-02

CLIENT: Grand Haven Board of Light & Power
PROJECT: GHBLP Coal Removal
PROJECT NO: 21451440
LOCATION: Grand Haven, MI
DATE: August 03, 2021
CONTRACTOR: MATECO Drilling

ELEVATION: 582.2 ft (Ground)
COORDINATES: N: 577316.7 ft E: 12624250.0 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	GROUNDWATER OBSERVATIONS	ADDITIONAL OBSERVATIONS
0	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Dark brown silty SAND, fill, >5% coal observed.	SM		0.0	1	5' Tube	52				
7			Gray SAND, wet, organics present, no coal observed.	SP		575.2 7.0	2	5' Tube	52				
10			End of hole at 10.0 ft. Backfilled with bentonite chips. Coal observed down to 7' BGS			572.2							

HAMMER TYPE: Automatic Historic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 03, 2021
CHECKED: Kurtis Van Appledorn DATE: Nov 01, 2021

RECORD OF BOREHOLE: SB-03

CLIENT: Grand Haven Board of Light & Power
PROJECT: GHBLP Coal Removal
PROJECT NO: 21451440
LOCATION: Grand Haven, MI
DATE: August 03, 2021
CONTRACTOR: MATECO Drilling

ELEVATION: 583.3 ft (Ground)
COORDINATES: N: 577150.1 ft E: 12624383.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	GROUNDWATER OBSERVATIONS	ADDITIONAL OBSERVATIONS
0	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Red SAND, some gravel, dry, no coal observed.	SP		0.0	1	5' Tube	70				
3			Black silty SAND, some gravel, wet, organics present, no coal observed.	SM		580.3 3.0	2	5' Tube	70				
10			End of hole at 10.0 ft. Backfilled with bentonite chips. No coal observed in borehole			573.3							

HAMMER TYPE: Automatic Historic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 03, 2021
CHECKED: Kurtis Van Appledorn DATE: Nov 01, 2021

RECORD OF BOREHOLE: SB-04

CLIENT: Grand Haven Board of Light & Power
PROJECT: GHBLP Coal Removal
PROJECT NO: 21451440
LOCATION: Grand Haven, MI
DATE: August 03, 2021
CONTRACTOR: MATECO Drilling

ELEVATION: 582.9 ft (Ground)
COORDINATES: N: 577216.7 ft E: 12624583.4 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	GROUNDWATER OBSERVATIONS	ADDITIONAL OBSERVATIONS
0	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray CLAY, some sand, dry, >5% coal observed.	CL		0.0 / 582.4							
1			Red gravelly SAND, dry, no coal observed.	SP		0.5 / 581.2							
2			Dark brown silty SAND, wet, organics present, no coal observed.	SM		1.8 / 578.9	1	5' Tube	96				
4			Gray SAND, wet, loose, no coal observed.	SP		4.0 / 575.4							
7			Dark gray silty SAND, wet, organics present, no coal observed.	SM		7.5 / 572.9	2	5' Tube	80				
10			End of hole at 10.0 ft. Backfilled with bentonite chips. Coal observed down to 0.50' BGS.										

HAMMER TYPE: Automatic Historic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 03, 2021
CHECKED: Kurtis Van Appledorn DATE: Nov 01, 2021

RECORD OF BOREHOLE: SB-05

CLIENT: Grand Haven Board of Light & Power
PROJECT: GHBLP Coal Removal
PROJECT NO: 21451440
LOCATION: Grand Haven, MI
DATE: September 02, 2021
CONTRACTOR: MATECO Drilling
ELEVATION: 581.4 ft (Ground)
COORDINATES: N: 577416.9 ft E: 12624683.4 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	GROUNDWATER OBSERVATIONS	ADDITIONAL OBSERVATIONS
0	Marsh Master Geoprobe	Direct Push - 4-in Hole Dia.	Brown CLAY, moist, soft, no coal observed.	CL		0.0 / 581.1							
0			Brown fine SAND, wet, loose, trace gravel, no coal observed.	SP		0.3 / 577.4	1	5' Tube	46				
4			Black clayey SAND, wet, loose, glass present, no coal observed.	SP-SC		4.0 / 576.2							
5			Dark gray sandy PEAT, moist, soft to firm, no coal observed.	PT		5.2 / 572.3	2	5' Tube	44				
9			Gray fine SAND, wet, loose, no coal observed.	SP		9.1 / 571.4							
10			End of hole at 10.0 ft. No coal observed in borehole.										

HAMMER TYPE: Automatic Historic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Sep 02, 2021
CHECKED: Kurtis Van Appledorn DATE: Nov 01, 2021

RECORD OF BOREHOLE: SB-06

CLIENT: Grand Haven Board of Light & Power
PROJECT: GHBLP Coal Removal
PROJECT NO: 21451440
LOCATION: Grand Haven, MI
DATE: September 02, 2021
CONTRACTOR: MATECO Drilling
ELEVATION: 581.0 ft (Ground)
COORDINATES: N: 577515.7 ft E: 12624850.0 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	GROUNDWATER OBSERVATIONS	ADDITIONAL OBSERVATIONS
0	Marsh Master Geoprobe	Direct Push - 4-in Hole Dia.	Brown CLAY, moist, soft, no coal observed.	CL		0.0 / 580.7							
1			Brown gravelly SAND, wet, compact, trash present, glass present, no coal observed.	SP		0.3	1	5' Tube	40				
2													
3													
4													
5													
6													
7			Gray fine SAND, wet, loose, shell fragments, no coal observed.			574.0 / 7.0	2	5' Tube	24				
8													
9													
10						571.0							
			End of hole at 10.0 ft.										
			No coal observed in borehole.										
11													
12													
13													
14													
15													

HAMMER TYPE: Automatic Historic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Sep 02, 2021
CHECKED: Kurtis Van Appledorn DATE: Nov 01, 2021

RECORD OF BOREHOLE: SB-07

CLIENT: Grand Haven Board of Light & Power
PROJECT: GHBLP Coal Removal
PROJECT NO: 21451440
LOCATION: Grand Haven, MI
DATE: September 02, 2021
CONTRACTOR: MATECO Drilling
ELEVATION: 581.0 ft (Ground)
COORDINATES: N: 577450.1 ft E: 12625049.3 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	GROUNDWATER OBSERVATIONS	ADDITIONAL OBSERVATIONS
0	Marsh Master Geoprobe	Direct Push - 4-in Hole Dia.	Black MUCK, >5% coal observed.			0.0 / 580.7							
1			Brown CLAY, moist, soft, no coal observed.	CL		0.3 / 579.8							
2			Gray fine SAND, wet, loose, shell fragments, no coal observed.	SP		1.2	1	5' Tube	68				
3													
4						576.9							
5			Black SAND, wet, loose, glass present, >5% coal observed down to 6.5' BGS.			4.1							
6						574.5							
7			Gray SAND, wet, loose, trace gravel, no coal observed.			6.5	2	5' Tube	20				
8													
9													
10			End of hole at 10.0 ft. Coal observed down to 6.5' BGS.			571.0							
11													
12													
13													
14													
15													

HAMMER TYPE: Automatic Historic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Sep 02, 2021
CHECKED: Kurtis Van Appledorn DATE: Nov 01, 2021

RECORD OF BOREHOLE: SB-08

CLIENT: Grand Haven Board of Light & Power
PROJECT: GHBLP Coal Removal
PROJECT NO: 21451440
LOCATION: Grand Haven, MI
DATE: September 02, 2021
CONTRACTOR: MATECO Drilling
ELEVATION: 580.5 ft (Ground)
COORDINATES: N: 577483.0 ft E: 12625216.4 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	GROUNDWATER OBSERVATIONS	ADDITIONAL OBSERVATIONS
0	Marsh Master Geoprobe	Direct Push - 4-in Hole Dia.	Black MUCK, wet, loose, >5% coal observed down to 2' BGS.			0.0 / 578.5							
2			Gray fine SAND, wet, loose, no coal observed.	SP		2.0 / 575.5	1	5' Tube	60				
5			Black PEAT, moist, soft, no coal observed.			5.0 / 570.5	2	5' Tube	26				
10			End of hole at 10.0 ft. Coal observed down to 2' BGS										

HAMMER TYPE: Automatic Historic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Sep 02, 2021
CHECKED: Kurtis Van Appledorn DATE: Nov 01, 2021

RECORD OF BOREHOLE: SB-09

CLIENT: Grand Haven Board of Light & Power
PROJECT: GHBLP Coal Removal
PROJECT NO: 21451440
LOCATION: Grand Haven, MI
DATE: September 01, 2021
CONTRACTOR: MATECO Drilling

ELEVATION: 580.4 ft (Ground)
COORDINATES: N: 577416.6 ft E: 12625283.8 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	GROUNDWATER OBSERVATIONS	ADDITIONAL OBSERVATIONS
0	Marsh Master Geoprobe	Direct Push - 4-in Hole Dia.	Black Muck, wet, soft, potential coal powder present in muck.			0.0 / 578.7							
2			Brown CLAY, moist, soft, no coal observed.	CL		1.7 / 577.6	1	5' Tube	46				
3			Gray fine SAND, wet, loose, no coal observed.	SP		2.8 / 577.2							
3			Red fine SAND, wet, loose, no coal observed.	SP		3.2 / 575.4							
5			Gray fine SAND, wet, loose, no coal observed.	SP		5.0 / 574.3	2	5' Tube	50				
6			Gray SILT, wet, soft, no coal observe.	ML		6.1 / 574.0							
6			Black PEAT, moist, soft, no coal observe.			6.4 / 570.4							
10			End of hole at 10.0 ft. Potential coal down to 1.70' BGS.										

HAMMER TYPE: Automatic Historic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Sep 01, 2021
CHECKED: Kurtis Van Appledorn DATE: Nov 01, 2021

RECORD OF BOREHOLE: SB-10

CLIENT: Grand Haven Board of Light & Power
PROJECT: GHBLP Coal Removal
PROJECT NO: 21451440
LOCATION: Grand Haven, MI
DATE: September 01, 2021
CONTRACTOR: MATECO Drilling

ELEVATION: N/A
COORDINATES: N: 577453.5 ft E: 12625417.6 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	GROUNDWATER OBSERVATIONS	ADDITIONAL OBSERVATIONS
0	Marsh Master Geoprobe	Direct Push - 4-in Hole Dia.	Black MUCK, wet, soft, trace organics, potential coal powder present in muck.			0.0							
0.3			Red fine SAND, wet, compact, trace gravel, no coal observed.	SP		0.3							
1			Brown CLAY, moist, hard, no coal observed.	CL		1.0							
2							1	5' Tube	50				
2.5			Gray fine SAND, wet, loose, no coal observe.	SP		2.5							
3													
4													
4.7			Black PEAT, moist, soft, no coal observe.			4.7							
5													
5.5			Gray fine SAND, wet, loose, shell fragments, no coal observe.	SP		5.5							
6							2	5' Tube	44				
7													
8													
9													
10			End of hole at 10.0 ft.										
			Potential coal down to 0.30' BGS.										
11													
12													
13													
14													
15													

HAMMER TYPE: Automatic Historic

Ground elevation was not collected due to depth of water at boring location.

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Sep 01, 2021
CHECKED: Kurtis Van Appledorn DATE: Nov 01, 2021

RECORD OF BOREHOLE: SB-11

CLIENT: Grand Haven Board of Light & Power
PROJECT: GHBLP Coal Removal
PROJECT NO: 21451440
LOCATION: Grand Haven, MI
DATE: September 01, 2021
CONTRACTOR: MATECO Drilling
ELEVATION: 579.4 ft (Ground)
COORDINATES: N: 577516.5 ft E: 12625416.6 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	GROUNDWATER OBSERVATIONS	ADDITIONAL OBSERVATIONS
0	Marsh Master Geoprobe	Direct Push - 4-in Hole Dia.	Black MUCK, wet, soft, potential coal powder in muck.			0.0 / 579.2							
			Brown CLAY, moist, soft, no coal observed.	CL		0.2 / 578.6							
1			Gray fine SAND, wet, loose, trace organics, no coal observed.	SP		0.8 / 575.2	1	5' Tube	58				
4			Pale black PEAT, moist, soft, no coal observe.			4.2 / 574.0							
5			Gray fine SAND, wet, loose, shell fragments, no coal observed.	SP		5.4 / 569.4	2	5' Tube	40				
10			End of hole at 10.0 ft. Potential coal down to 0.20' BGS.										

HAMMER TYPE: Automatic Historic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Sep 01, 2021
CHECKED: Kurtis Van Appledorn DATE: Nov 01, 2021

RECORD OF BOREHOLE: SB-12

CLIENT: Grand Haven Board of Light & Power
PROJECT: GHBLP Coal Removal
PROJECT NO: 21451440
LOCATION: Grand Haven, MI
DATE: September 01, 2021
CONTRACTOR: MATECO Drilling

ELEVATION: N/A
COORDINATES: N: 577482.0 ft E: 12625351.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	GROUNDWATER OBSERVATIONS	ADDITIONAL OBSERVATIONS
0	Marsh Master Geoprobe	Direct Push - 4-in Hole Dia.	Black MUCK, wet, soft, potential coal powder in muck.			0.0							
1			Brown CLAY, moist, soft, no coal observed.	CL		0.2							
2			Gray fine SAND, wet, loose, no coal observed.	SP		1.5	1	5' Tube	76				
4			Gray sandy SILT, wet, soft, no coal observed.	ML		4.1							
5			Black PEAT, moist, soft, wood fragments, no coal observed.			4.5	2	5' Tube	40				
9			Black SAND, trace peat, wet, loose, no coal observed.	SP		9.0							
10			End of hole at 10.0 ft. Potential coal down to 0.20' BGS.										

HAMMER TYPE: Automatic Historic

Ground elevation was not collected due to depth of water at boring location.

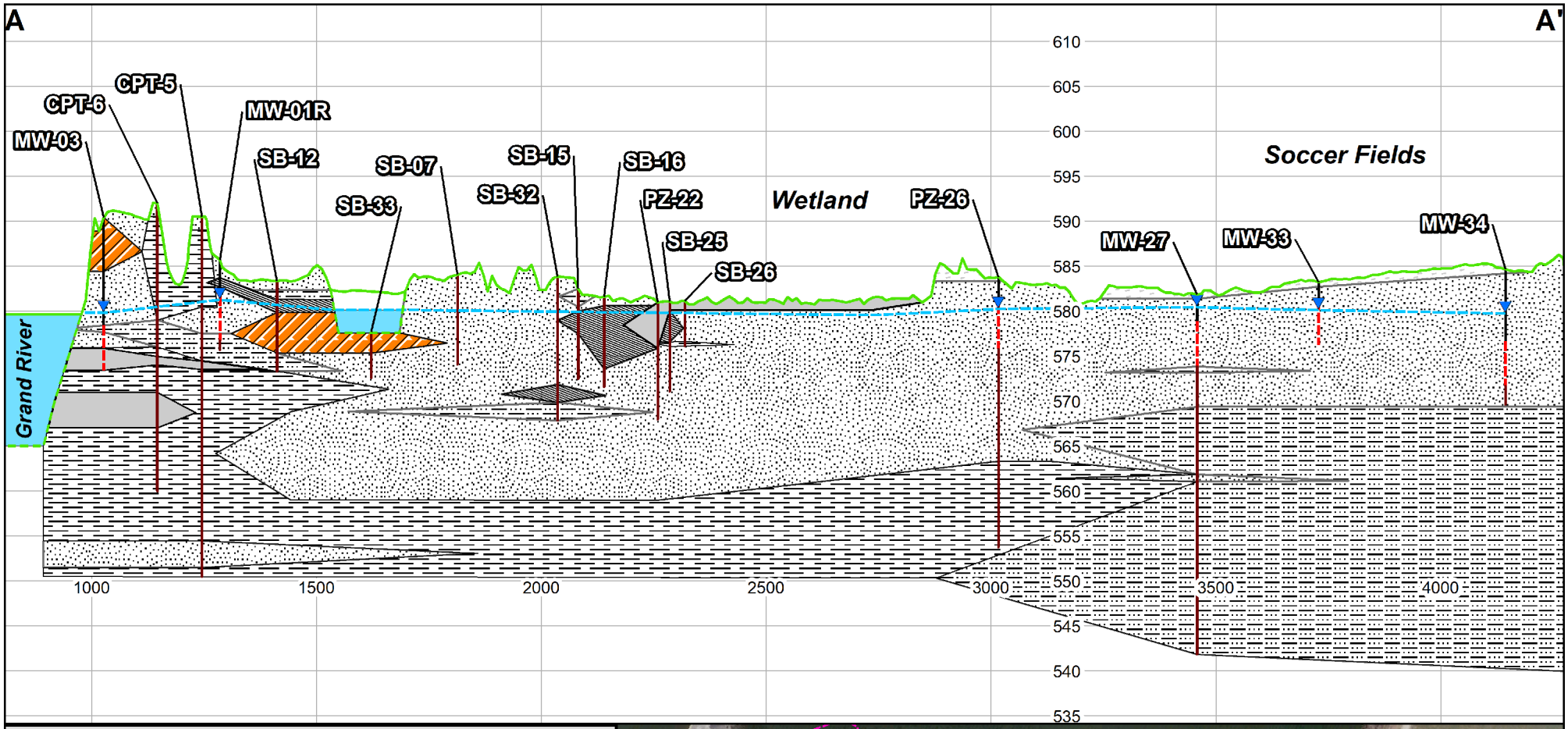
REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Sep 01, 2021
CHECKED: Kurtis Van Appledorn DATE: Nov 01, 2021

Appendix D

Cross Sections

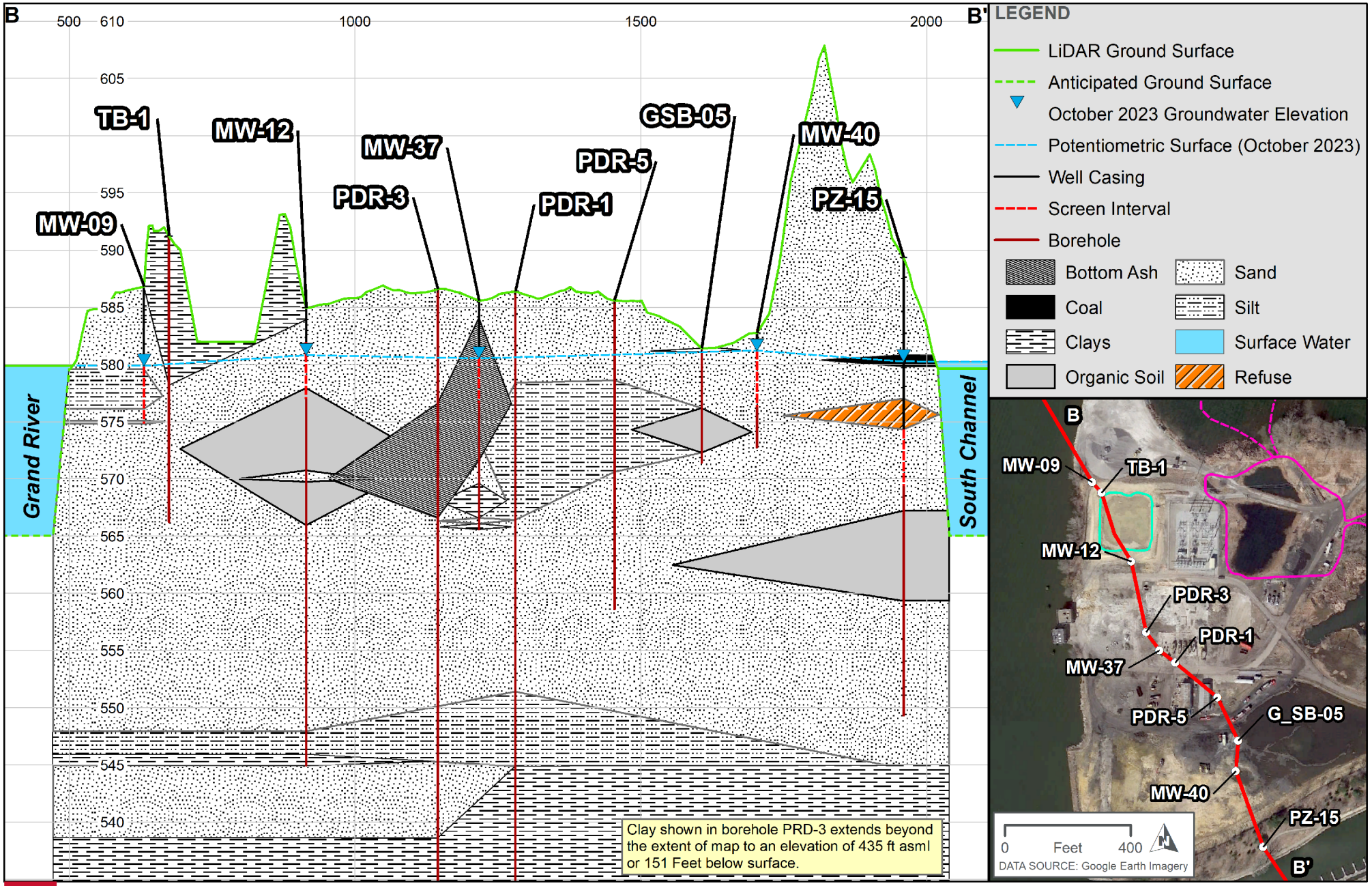


LEGEND

- LiDAR Ground Surface
- Anticipated Ground Elevation
- Groundwater Elevation (October 2023)
- Potentiometric Surface (October 2023)
- Well Casing
- Screen Interval
- Borehole
- Bottom Ash
- Clay
- Organic Soil
- Refuse
- Sand
- Silt
- Topsoil

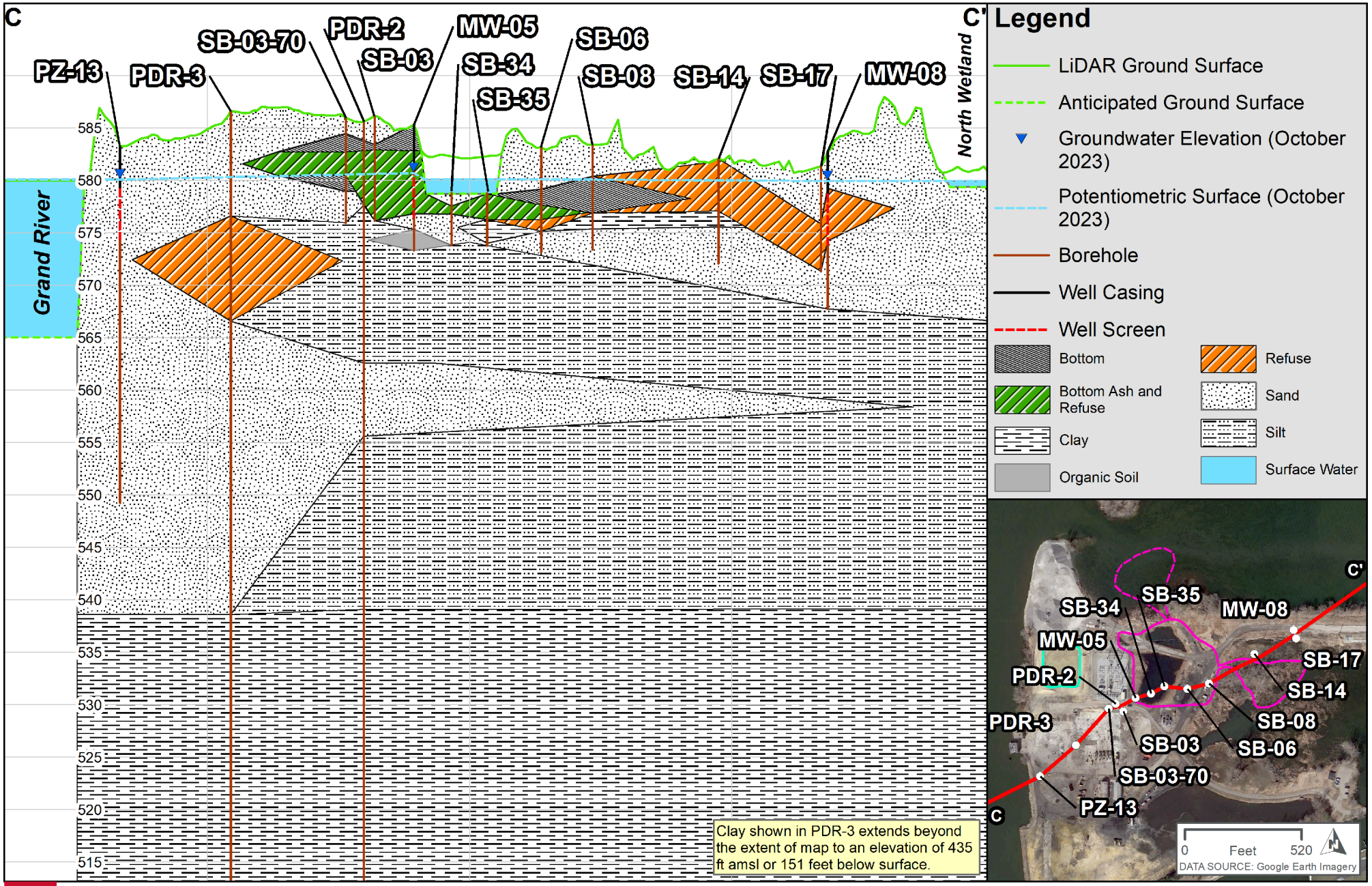
FORMER J.B. SIMS GENERATING STATION

GRAND HAVEN, MI



FORMER J.B. SIMS GENERATING STATION

GRAND HAVEN, MI



FORMER J.B. SIMS GENERATING STATION

GRAND HAVEN, MI

Appendix E

Groundwater Sampling Collection Standard Operating Procedure

Water Sample Collection Standard Operating Procedure

Former JB Sims Generating Station

City of Grand Haven

May 6, 2024

1.0 Introduction

This Standard Operating Procedure (SOP) provides guidance for groundwater sample collection at the former JB Sims Generating Station at Harbor Island located in Grand Haven, Michigan. Groundwater monitoring will support compliance with U.S. Environmental Protection Agency's (EPA) CCR Rule (40 CFR Part §257) and the solid waste regulations under Michigan Statute Part 115 for CCR ash impoundments. This SOP addresses procedures for the groundwater and surface water monitoring requirement.

1.1 Groundwater Method Applicability

The following sections outline the general method for collecting low stress/low flow groundwater samples from monitoring wells. The low flow method is the preferred technique for groundwater monitoring. This technique is appropriate for this Site due to the following characteristics:

- Casing diameter is greater than 1.0 inch
- Screen interval is ten feet or less
- Samples are analyzed for total metals
- Low turbidity is desired in sample containers
- Purge water requiring disposal is minimized, and
- Analytes are repeatable.

The proposed sample collection and safety procedures below are consistent with EPA guidelines and CCR Rule. The City of Grand Haven (the City) or their Consultant will collect all samples.

1.2 Groundwater Summary of Method

Depth to water is measured prior to purging. After depth to water is measured, tubing is placed approximately mid-screen in the well. A peristaltic pump is used to purge water from the well at a rate of approximately 100-500 mL/minute. The purged water moves through a flow cell that contains probes to measure stabilization parameters such as pH and conductivity. Once parameters have stabilized, the purged water stream is disconnected from the flow cell and used to fill sample containers for lab analysis. A detailed explanation of this procedure is in Section 5.0.

2.0 Health and Safety

2.1 Safety Documentation

Job Hazard Analyses (JHAs) must be developed prior to arriving on Site. JHAs identify potential hazards that may be present on the Site or while executing the work. JHAs are used to provide methods to minimize hazards.

The site-specific Health and Safety Plan (H&SP) is used to identify actions and precautions to prevent injury. The H&SP also includes essential emergency service contacts in case of incident. Each individual is required to have read and understood the Health and Safety Plan (HASP) for the specific project activity and signed the acknowledgement sheet confirming their review.

2.2 Safety Procedures

A safety briefing must be conducted between Site personnel and the sampling team before the start of the work each day. No sampling shall commence until all personnel have completed site specific safety training.

Complete equipment and supply checklists and verify that required documentation and equipment for field activities are on site.

Review locations for planned field activities for hazards. Each sampling site will be characterized by the following factors:

- Location of work
- Weather conditions: rainfall, temperature, and wind direction
- Ongoing activities that may influence or disrupt sampling efforts
- Accessibility to the sampling locations (e.g. road maintenance, rough terrain, fallen trees, flooding, etc.)

View monitoring well locations and confirm the monitoring wells are accessible and well identifications are clearly marked. Select location for disposal of decontamination and purge waters.

3.0 Equipment and Supplies

A complete list of equipment and supplies for surface and groundwater sampling at the Former JB Sims site are provided as Appendix A. Primary equipment needs are detailed below:

- YSI water quality meter, or similar, with flow cell and hand-held monitor. In-line probes calibrated to measure dissolved oxygen, oxidation-reduction potential (ORP), conductivity, pH, and temperature are required. Turbidity may be included as an additional probe or a separate turbidity meter may be used.
- Peristaltic pump with pump head and external power source. Bladder pump may be used if water levels are >25 feet below top of casing.
- Water level measurement tape. Must have a minimum of 0.01-foot accuracy.
- Pump head tubing (silicone) and well tubing (polyethylene). Each well is equipped with dedicated tubing; extra tubing on hand is recommended if replacement is deemed necessary.
- Large SUV. An initial safety check should be performed at the start of each shift to confirm the vehicle is in good working condition. The vehicle should then be checked daily for damage or required maintenance.
- Decontamination supplies.
- Sample containers with appropriate preservatives.
- Personal protective equipment.
- Tools and materials as listed in Appendix A.

All equipment must be calibrated according to manufacturer's instructions. Calibration of field equipment is completed by the rental equipment company prior to each rental, and calibration records are included with the equipment. Therefore, calibration of field equipment measuring field parameters (YSI or similar) will be calibrated at the beginning of each sample event. The calibration

record from the equipment company will be reviewed to ensure accurate calibration. The sample crew will photograph the calibration documentation provided with the equipment.

4.0 Quality Control Documents and Records

The following documentation and records must be taken to the jobsite and maintained for every sampling event:

- Historical documentation, including:
    - Well construction data,
    - Well location map
    - Field data from the previous sampling event
- Material Safety Data Sheets (MSDSs) for any reagents taken to the Site
- Field log book/field worksheet to document:
    - Field instrument calibration data
    - Monitoring well identification number and condition
    - Well depth and depth to water, including date and time of measurement
    - Sample tubing material, diameter, length, placement, and pump type
    - Pumping rate, water level, water quality indicator values, and date and time of measurement
    - Identification and explanation of any unacceptable water quality indicator values
    - Time and date of sample collection
    - Sample ID
    - Field observations
    - Sampler's name or initials

  See Appendix B for the Field Data Sheet to be used to record the above information.
- Chain of Custody (COC) form must include:
    - Analytical parameters requested
    - Sample time and date
    - Sampler's name or initials
    - Site location
    - Sample ID
    - Preservatives added

  See Appendix C for a sample COC form.
- Sample labels must include:
    - Sample ID
    - Sample time and date
    - Sampler's initials
    - Preservatives
    - Analysis requested

Sample bottle labels, COC form data, and information on Field Data Sheets must match *exactly*.

5.0 Sampling Procedures

5.1 Groundwater

5.1.1 Determination of Depth-to-Groundwater (DTW)

The following initial steps will be followed before purging each monitoring well and collecting groundwater samples in the field.

1. Orient the equipment upwind of the monitoring wells if possible.
2. Begin with the well that has the least contaminated groundwater (if known) and proceed in increasing order of contamination such that the well with the highest contamination is sampled last.
3. Locate the monitoring well to be sampled, confirm monitoring well ID and record the condition of the monitoring well (casing protector, lock, locking cap, and well casing). Record any abnormal observations or evidence of damage or tampering.
4. A sheet of plastic or tarp may be laid around the casing protector to provide a clean area for equipment and minimizing contamination from the ground.
5. Remove the well cap.
6. If the well casing does not have a reference point, make one. The reference point is typically a V-cut or a mark on the top of the PVC well casing.
7. Hold the water level measuring tape against the reference point to measure the DTW to 0.01 feet. Duplicate the reading. Every measurement should be taken from the same reference point. Minimize disturbance of the water column while measuring.
8. Record the DTW on the Field Data Sheet (Appendix B).
9. Decontaminate the water-level indicator and tape prior to each use. The decontamination procedure for the water level indicator is: Hand wash the calibrated tape and probe that contacted groundwater with Alconox solution (or equivalent) and rinse with deionized water.
10. Monitoring well depth can be obtained from monitoring well construction logs. Measuring total depth of monitoring wells prior to sampling should be avoided; measuring to the bottom of the monitoring well casing may cause re-suspension of settled solids.
11. Continue on to purging if sampling is to occur on the same day. Lock well casing and pack up equipment if sampling is to occur at a later date.

5.1.2 Purging Procedure

The type of pump used for sampling is dependent upon the casing diameter, depth to groundwater, depth of the monitoring well screen, and anticipated volume required for purge. A peristaltic pump is recommended for the Site. A bladder pump may be used if groundwater levels are greater than 25 feet below the top of the casing. Decontamination of portable pumps is required prior to each use.

A peristaltic pump is appropriate for monitoring wells with groundwater depths less than 25 feet below the top of the casing. The sampling protocol will be as follows for the collection of groundwater samples using a peristaltic pump (such as the Geopump-2or similar):

1. Use historical well data to cut polyethylene tubing to the appropriate length such that the tubing end can be lowered to the middle of the screen, and there is at least three to four feet of tubing at the surface to run through the pump and run into a bucket.
2. Slowly and carefully lower the tubing to the mid-point of the screened interval. In cases where the entire screen is not saturated, place the tubing inlet near the middle of the saturated screen. Take care not to allow the tubing to touch the ground and introduce contamination into the well.
3. Do not place the tubing less than two feet above the bottom of the well, as this may cause the mobilization of bottom sediments. If saturated screen length is two feet or less, collect sample using disposable bailer.
4. Allow at least one foot of water above the inlet so there is little risk of entrainment or air in the sample.
5. Attach an in-line multi-probe flow-through cell. The flow-cell will be used to monitor the indicator parameters so as not to expose the water to the atmosphere prior to measurement. During purging, water quality indicator parameters (pH, ORP, turbidity, specific conductivity, and DO) will be measured every 3-5 minutes until the parameters have stabilized. Measurement should be recorded on Appendix B. A minimum of 5 sets of water quality indicator parameters should be recorded.
6. Begin purging the monitoring well at a rate of approximately 100 mL/minute. Flow rate can range from 100 to 500 mL/min. All purge water will be put in a bucket. The buckets will be disposed of on the ground surface at least 100 feet from the well. Record the pumping rate on the Field Data Sheet (Appendix B).
7. Stabilization is achieved after three successive readings are within ± 0.1 for pH, ± 10 mV for ORP, ± 3% for specific conductance, ± 10% for DO and turbidity. Temperature will also be measured and recorded, but will not be used as a stabilization parameter. Sampling may begin once the well has stabilized.
8. Turbidity and DO usually take the longest to stabilize. Up to 2 hours of purging may be required to reach stabilization. Stabilized purge indicator trends are generally obvious and follow either an exponential or asymptotic change to stable parameter values during purging. If stabilization does not occur or turbidity is >10 NTU after two hours of purging, the ES should be contacted for direction.

5.1.3 Sample Collection Procedure

Sample bottles will be labeled prior to collecting water in the bottles. Bottle labels will be completed for each sample container collected for analysis, using ink or permanent marker. Each label will include the following:

- Site Location
- Well identification number (MW-#);
- Sample collection date: month, day, year;
- Sample collection time;
- Sample preservation method (e.g. nitric acid); and
- Initials of personnel collecting the sample.

It is critical that both the sample bottle monitoring well identification and sample times match exactly the sample name and collection time written on both the Field Data Sheet and the Chain of Custody.

Use clean nitrile gloves for each well prior to handling any sample bottles. When collecting a sample:

1. The pump will not be turned off between the purging and sampling processes.
2. Disconnect the flow cell.
3. Samples will be collected in sample containers described in Section 3.5 of the HMP. Remove the sample bottle from the plastic bag and remove the cap.
4. Rinse the bottle with the sample stream, holding the tubing approximately 1/8” outside of the open bottle. Do not place the sample tubing within the bottle or allow it to dip into the collected sample.
5. Collect samples at the same flow rate as the purging rate. Minimize potential contamination by shielding the open bottles as needed. Minimize aeration by allowing the water to flow down the side of the bottle instead of against the bottom.
6. Fill to approximately ¼” below the bottle threads. Cap the bottle and store in a plastic bag. Place the plastic bag(s) in a cooler filled with ice.
7. If recharge is low, the drawdown in the well may approach the pump depth. Purge the well to within one foot of the pump depth, and remove the pump, close the well, and determine the time to let the well recharge prior to returning to collect the sample.
8. Sampling will be performed no less than 24 hours after well development is completed. Observations made during sample collection will be recorded on the water quality sample collection form in Appendix B.
9. After all samples from a monitoring well are collected, remove the tubing unless the tubing is dedicated to the well and remains in place. Tuck any extra length of tubing down into the well casing with care not to permanently pinch the tubing.
10. Cap and lock the monitoring well protective casing.
11. Pour collected purge water on the ground, away from any wells that are to be sampled next.
12. Repeat procedure for remaining monitoring wells.

Samples will be stored in a cooler with ice. The coolers from the field will be delivered back to the lab each day that samples are collected.

5.1.4 Decontamination Procedure

The purpose of decontamination is: (1) to eliminate the transfer of contaminants from one groundwater monitor well to another, and (2) to protect the health and safety of personnel who may come in contact with contaminated equipment. Decontamination procedures described in this section will be performed at the beginning of each day of field work and between each monitor point, and whenever the equipment is suspected of having been contaminated.

All non-dedicated sampling equipment must be decontaminated before its reuse. All disposable tubing will be properly discarded and new tubing used in its place. The peristaltic pump tubing will be replaced and discarded before each sample location, or dedicated tubing will remain in each well.

Wells are equipped with dedicated tubing; however, if decontamination is required due to insufficient supply or suspected contamination, the steps are as follows:

1. Place the tubing into a bucket containing approximately 5 gallons of an Alconox / tap water solution. Run the pump within the solution for approximately 2 minutes, allowing for the soapy water to run through the tubing. Use a scrub brush if necessary.
2. Place the tubing into a bucket containing approximately 5 gallons of clean tap water. Run the pump within the water for approximately 2 minutes to rinse the pump and tubing.
3. Place the tubing into a bucket containing approximately 5 gallons of distilled water. Run the pump within the water for approximately 2 minutes.
4. Finally place the tubing into a bucket containing approximately 1 gallon (or as little volume as possible to accomplish a quick single rinse) of distilled water. Run the pump within the water for approximately 10 seconds.
5. Wrap the pump and tubing to maintain cleanliness during transport.
6. Replace water and water solutions daily.

The above steps also apply if a bladder pump is required for wells with water levels greater than 25 feet below the top of the casing.

Flow cell shall be rinsed with deionized water if debris is not flushed out during purging. If the probes are not fouled, no further action is necessary since the flow cell does not contact the sample. The cell must be filled with tap water and stored overnight.

5.1.5 Quality Control

Quality Control (QC) checks of both the field procedures and laboratory analyses will be used to assess and document data quality and to identify discrepancies in the measurement process that need correction. Quality control samples will be used to assess various data quality parameters such as representativeness of the environmental samples, the precision of sample collection and handling procedures, the thoroughness of the field equipment decontamination procedures, and the accuracy of laboratory analyses. In addition, all sample containers, preservation methods, and holding times will be in accordance with QC requirements.

The analytical laboratory will use a series of QC samples, as identified in the laboratory's Quality Assurance Plan and specified in the standard analytical methods. The types of samples include method blanks, surrogate spikes, laboratory control samples, laboratory control sample duplicates, matrix spikes, and matrix spike duplicates. The primary type used for the site is a sample duplicate. One monitoring well for every 10 will be selected to collect a duplicate sample. It requires an additional sample to be collected in the same manner as the original sample. This sample type is used by the laboratory to determine precision. Sample identification for duplicates will be the same as the sample identification with the addition of a "Duplicate" (e.g. MW-15018 and MW-15018D).

The pump tubing is dedicated in each well; therefore an equipment blank to test decontamination effectiveness is not required.

The precision will be measured through the evaluation of relative percentage differences (RPDs) between sample and duplicate samples and calculated as follows:

$$\text{Relative Percentage Difference (\%)} = \frac{\text{concentration SA-concentration SB}}{\text{Average concentration of SA+SB}} \times 100$$

Where SA denotes Sample A; SB denotes the duplicate, sample B.

Duplicate RPD requirement is 20 percent. Refer to Section 5.4 of the 2022 CCR Work Plan for additional information regarding data quality objectives.

Accuracy is measured by the difference between the measured or observed value and the true or assigned value. Accuracy in the field is assessed through the adherence to all sample handling, preservation, and holding times.

Laboratory data will be reviewed, validated and qualified if necessary prior to use. The laboratory data validation procedure is described in Section 5.4 of the 2022 CCR Work Plan.

5.2 Surface Water

5.2.1 Sample Collection Procedure

All field documentation and observations must be recorded in a field book and on field observation sheets before leaving the site (see Appendix B for field observation sheet). The following information should be documented:

- Your name and the names of those who accompany you
- Date and time of sample collection
- Sample observations should be included as well and describes anything unusual about the water (dead fish, foam, odors, unusual water color, debris, turbulence and presence of suspended sediment or surface matter).
- Collect field parameters pH, temperature, ORP, conductivity, and turbidity.

Each time a sample is taken the following steps should be followed in order to prevent contamination:

- The sampler's hands should be clean, free of grease, debris, or other substances.
- Do not smoke, eat or drink immediately before or during sampling.
- The caps must be kept on the sampling bottle until the sample is taken.
- Nothing should be placed inside the bottle except the water sample.
- Bacteria samples are sensitive to contamination and the inside of the bottles and the lids must not contact any surface during the course of sample collection.
- After removing the caps, they must be held so that the inside is not touching any surface at any time including your fingers. Do not set caps down so that the inside surfaces are touching any other surface.

Enter the water to minimize sediment disturbance. Bottles should be 6 inches below the water's surface (when possible). Bottles require no rinsing. Fill all other bottles completely. Be careful when approaching high flowing water; avoid the water if the site is unsafe. Safety is the first priority.

5.3 Sample Preservation and Handling

The sample team shall be provided with COC forms prior to sampling. The Chain of Custody (COC) form should be completed in the field as the sampling progresses and signed upon transfer of custody at the laboratory. Chain of custody procedures comprise the following elements: (1) maintaining custody of samples, and (2) documentation of the requested analysis. To document

chain of custody, an accurate record must be maintained to trace the possession of each sample from the moment of collection through analysis and reporting. The field chain of custody record is used to record the custody of all samples collected and maintained by investigators. All sample sets will be accompanied by a chain of custody record. It also serves as a sample logging mechanism for the laboratory sample custodian. The following rules apply to chain of custody records:

- All information must be supplied in the indicated spaces to complete the field chain of custody record. It is critical that the proper contact information is provided to the laboratory. This should always be the sampler or ES.
- Every person who maintained custody of the samples must sign in the designated signature block.
- The sample ID, date, and time on the chain of custody must match the sample bottle exactly.
- The total number of sample containers for each sample must be listed in the appropriate column. Total sample bottles need to be counted and double checked. Required analyses should be circled or entered in the appropriate location on the form and double checked.
- If expedited turnaround is requested, this needs to be noted clearly.
- Electronic results are required as EDDs and PDF files of the laboratory report.
- The last person receiving the samples should be the laboratory sample custodian or their designee(s).
- The chain of custody record is an accountability document and should be filled out thoughtfully.
- In cases where the samples leave the sampler's custody into an intermediate carrier, such as shipment, a seal should be placed on the container to detect unauthorized entry to the samples. Containers that arrive at the laboratory with compromised seals must be evaluated to determine if the chain of custody has been invalidated.
- If samples arrive at the laboratory without the COC document, it shall be completed by the laboratory under the supervision of the laboratory project manager. The person completing the COC at the lab shall enter the statement "COC completed by the laboratory upon receipt of sample(s)" in the remarks section of the COC and initial the entry.

A sample COC is included as Appendix C.

5.4 Closeout

Upon the completion of groundwater sampling activities, the sampler will perform the following activities:

- Check condition of field equipment.
- Review field documentation.
- Record field data sheet information into electronic project database.
- Make arrangements for shipment of samples (if applicable).
- Confirm logged analyses with the laboratory.

Appendix A

Groundwater Sampling Equipment Checklist

Former JB Sims Generating Station

Groundwater Sampling Equipment Checklist

- Monitoring well keys
- Map of wells
- List of well names, well construction logs, water level data
- Field data forms
- Field logbook
- YSI (or similar) water quality meter
- Water level indicator tape (check that the depth is in feet and length is adequate for the site conditions)
- Nitrile gloves
- Trash bags
- Watch/timer
- Camera
- Purge water bucket
- Toolbox/wrenches (for well access)
- Hose or extra tubing (may be useful for purge water for certain submersible pump/reel rental setups)
- Knife/boxcutter for slicing tubing
- Graduated cylinder or graduated bucket (for flow measurement)
- Sample bottles
- Permanent Marker
- Cooler
- Ice/Ice packs
- Black electrical tape
- Decontamination bucket(s)
- Tap water source for decontamination
- Distilled water
- Deionized water
- Alconox
- Scrub brush
    - Peristaltic Pump, such as the Geotech Geopump (groundwater <25 feet below top of casing)

- Modular battery and clips for vehicle battery and power cord
- Tubing, sufficient footage for disposal after each well or decontamination between wells (polyethylene well tubing, silicone pump head tubing)

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Appendix B

Sampling Field Data Sheet

Former JB Sims Generating Station

Water Sample Collection Field Data Sheet

Site Name:_____ Well ID.:_____

Sample I.D.(match bottle and COC form exactly):_____

Personnel:_____

Date: _____ Static Depth to Water (ft, btoc) _____

Date/Time Sample Collected (match bottle and COC form exactly):_____

Sample Method: _____

Water level meter, pump, and tubing decontaminated prior: Yes No

Sample QC: Duplicate Yes No Duplicate Sample ID: _____

Sample QC: Equipment Blank Yes No Equip Blank Sample ID: _____

Well Purging Data (Fill In All Blanks)

Depth of Sample Collection (pump depth) (ft, btoc) _____

Time Completed: _____ Total Purge _____ Units_____

Field Measurements:

Time (24 hour)	Amount purged (ml)	pH	COND (mS/cm)	TURB (NTU)	DO (mg/L)	TEMP (C°)	ORP (mV)	Water Depth (ft, btoc)

Flow Rate_____
Pump controller setting_____
General Comments:

_____

_____

_____

Appendix C

Example Chain of Custody Form

Former JB Sims Generating Station

Pace Analytical
www.pacelabs.com

CHAIN-OF-CUSTODY / Analytical Request

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

WO# : 50256085

50256085

Section A Required Client Information:	Section B Required Project Information:	Section C Invoice Information:	
Company: HDR, Inc.	Report To: Molly Reeves	Attention:	
Address: 3321 Bronson Blvd	Copy To:	Company Name:	
Kalamazoo, MI 49008		Address:	Regulatory Agency
Email: molly.reeves@hdrinc.com	Purchase Order #:	Pace Quote:	
Phone: 734-751-1790 Fax:	Project Name: Muskegon Site	Pace Project Manager: melanie.booms@pacelabs.com	State / Location
Requested Due Date	Project #:	Pace Profile #: 9219	MI

ITEM #	SAMPLE ID One Character per box. (A-Z, 0-9 / , -) Sample Ids must be unique MATRIX CODE: Drinking Water DW, Water WT, Waste Water WW, Product P, Soil/Solid SL, Oil OL, Wipe WP, Air AR, Other OT, Tissue TS	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED START DATE	COLLECTED START TIME	COLLECTED END DATE	COLLECTED END TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H2SO4	HNO3	HCl	NaOH	Na2S2O3	Methanol	Other	Analyses Test Y/N	Requested Analysis Filtered (Y/N): IN Metals, Total	IN pH	IN TDS/F, Cl, SO4	IN TSS	IN Rad-226	IN Rad-228	Residual Chlorine (Y/N)
1	MW-15002	WT	G	5-11-20	11:10a				6										X						X		
2	MW-15003				12:00p				6										X								
3	MW-15004				12:40p				6										X								
4	MW-15005				1:40p				6										X								
5	MW-15006				2:40p				6										X								
6	MW-15007				3:25p				6										X								
7	MW-15008				4:10p				6										X								
8	MW-15010				4:55p				6										X						X		
9																											
10																											
11																											
12																											

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
	HDR	5/5/20	8:33am		5-5-20	0833	

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:

SIGNATURE of SAMPLER: DATE Signed:

TEMP in C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

Appendix F

Statistical Procedures Plan

Former J.B. Sims Generating Station
Statistical Procedures Plan

1.0 Project Management

This Statistical Procedures Plan provides the procedures for analysis for the data generated during groundwater monitoring at the Former J.B. Sims Generating Station (Site or Harbor Island). The Site must comply with the U.S. Environmental Protection Agency's (USEPA) Coal Combustion Residuals Rule (CCR) and the Michigan Part 115 Solid Waste Regulations for CCR units. Groundwater monitoring of CCR facilities is an integral part of compliance with the federal CCR Rule and State solid waste permit.

This document addresses the statistical procedures for evaluating data to select statistical method(s) required for evaluating groundwater monitoring data, as required by Part 115 Rule 908 and 40 CFR 257.23 (g).

2.0 Statistical Analysis

Monitoring will include analyzing groundwater data and groundwater levels from wells upgradient and downgradient of the CCR facilities at Harbor Island. The Groundwater Monitoring System Certification for the facility describes the hydrogeologic characterization and rationale for the upgradient and downgradient sample locations for Federal CCR Rule compliance and the Hydrogeologic Monitoring Plan has been prepared in compliance with the Michigan Part 115 regulations.

This section provides the methodology to statistically evaluate the groundwater data, select appropriate statistical method(s), and develop the appropriate background threshold values (BTVs)[1] for required constituents of interest (COIs) from Part 115 Sections 11511a(3) and 11519b(2), referred to herein as the COIs. The 40 CFR §257.93(f) includes a list of statistical methods from which to choose for evaluating the groundwater monitoring data from CCR management areas. The options include:

- A parametric analysis of variance followed by multiple comparison.
- An analysis of variance based on ranks followed by multiple comparison procedures.
- A tolerance or prediction interval procedure, in which an interval for each constituent is established from the distribution of the background data and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit.
- A control chart approach that gives control limits for each constituent.

[1] The CCR Rule does not include the term "background threshold value" or any specific term to represent the upper tolerance limit, or the control limit other than references to the "background value", "background constituent concentration levels" or "background concentration". The EPA's ProUCL documentation uses the term "background threshold value" with explicit reference to upper tolerance limits throughout the documentation. For ease of reference in our planning document, we chose to use the EPA's terminology. Note that a BTV is not a fixed value. It is a statistical test for determining if there is an SSI from a groundwater sample taken at a downgradient well. Its value may change as background sample sizes change over time or if changes are made to the number of downgradient wells.

- Another statistical test method that meets the performance of 40 CFR §257.93(g).

The goal of statistical analysis is to provide a quantified means to evaluate whether a CCR management unit has released contaminants into the groundwater. Following the collection of groundwater monitoring data, detected constituents will be statistically evaluated to identify if a statistically significant increase (SSI) over background has occurred. The software application R[2], including use of its Envstats[3] R package and SPSS[4] will be used to conduct statistical analysis of groundwater analytical data collected for the Site. However, if during the period of the groundwater monitoring program at the Site an updated or more comprehensive statistical software program is available or may become available, a different software program may be used.

The steps for this process are summarized in **Figure 1** and are described in **Sections 2.1** and **2.2**. As groundwater monitoring progresses, the use of the selected statistical method will be subject to ongoing review. Other statistical tests may be used in place of, or in addition to, the methods specified in this Statistical Procedures Plan if such methods are better suited for analysis of future results. If test methods are changed, this Statistical Procedures Plan will be revised, as appropriate, and its certification updated.

When developing the BTVs for the Appendix III, IV, and Part 115 constituents at sites with multiple background wells, the data from the background wells will be evaluated to determine if it is appropriate to conduct an interwell analysis and pool the background groundwater data from multiple wells to develop a single BTV for each constituent. The assumption for pooling groundwater data is that the constituent concentrations sampled at multiple background wells, when pooled, serve as an estimate of overall well field conditions for Appendix III, IV, and Part 115 constituents at a given site.

Section 2.1 describes the statistical analyses used to assess and transform the groundwater data from the background monitoring wells where necessary such that the data can be used to produce appropriate BTVs and conduct statistical tests. This stage is referred to as the preliminary data analysis. Consideration is given to issues related to outliers, serial correlation, seasonality, spatial variability, and trends. It may be necessary to test for differences in group means across sub-groups of samples to verify assumptions or to add new groundwater samples to existing samples. For example, sub-group testing can be used to determine if background groundwater concentrations are changing over time or background groundwater concentrations are different by season. These differences are important since they determine if new background data can be pooled with historical data or if deseasonalization of the data is required.

Section 2.2 contains the steps to estimate statistically significant increases (SSIs) over background or statistically significant levels (SSLs) over a groundwater protection standard (GPS) where relevant for each of the detection, assessment, and closure phases. A suite of

[2] R: A Language and Environment for Statistical Computing, R Core Team, R Foundation for Statistical Computing, Vienna, Austria, 2022, R version 4.2.1 (2022-06-23 ucrt), https://www.R-project.org .

[3] Millard, S. (2013). EnvStats: An R Package for Environmental Statistics. Springer, New York. ISBN 978-1-4614-8455-4

[4] IBM Corp. Released 2022. IBM SPSS Statistics for Windows, Version 29.0. Armonk, NY: IBM Corp.

prediction limits, tolerance limits, and confidence limits are used to address the statistical test requirements.

As recommended by the EPA Unified Guidance (2009b) and pending confirmation as appropriate after evaluation of site-specific background water quality data, upper prediction limits (UPLs) are proposed to establish BTVs for each of the detection monitoring constituents for the purposes of complying with the detection monitoring requirements to confirm SSIs.

The assessment monitoring phase also includes a requirement to compare assessment monitoring constituents from downgradient wells to the groundwater protection standards (GPS). Under the federal CCR Rule compliance program, the GPS value is the maximum contaminant levels (MCLs) or the background value (using the 95% upper tolerance limits (UTLs)), whichever is higher, estimated from the background samples as statistically equivalent BTVs. The results of the evaluation as to whether a COI is above its GPS based on SSLs determines if the CCR Unit remains in assessment monitoring or moves into corrective action. However, under the Part 115 compliance program described herein, the GPS value is the lowest of the MCL or the applicable cleanup criteria for that constituent for groundwater as established pursuant to section 20120a of Act 451. Or for constituents for which the background level (UTL) is higher than the MCL or applicable cleanup criteria for groundwater, the background concentration will be the GPS. Therefore, at this Site, there may be a different GPS value for the Part 115 compliance program than the federal compliance program.

A decision flow chart which summarizes the logic and statistical methods used to determine which groundwater data are suitable to establish or update background and which types of BTVs can be used to describe background levels is shown in **Figure 1** below.

The decision flow diagram allows for updates to the BTVs as samples from the background wells continue to be collected at either the scheduled quarterly sampling events, depending on the quality or quantity of the samples. While the initial required 8 sampling events in 2020 will provide the minimum number of samples from which to estimate BTVs, as additional samples are collected, the BTVs may be updated at scheduled time intervals. In that way, the BTVs may change periodically. [5]

[5] "The Unified Guidance recommends that a minimum of at least 8 to 10 independent background observations be collected before running most statistical tests. Although still a small sample size by statistical standards, these levels allow for minimally acceptable estimates of variability and evaluation of trend and goodness-of fit. However, this recommendation should be considered a temporary minimum until additional background sampling can be conducted and the background sample size enlarged", page 5-3.

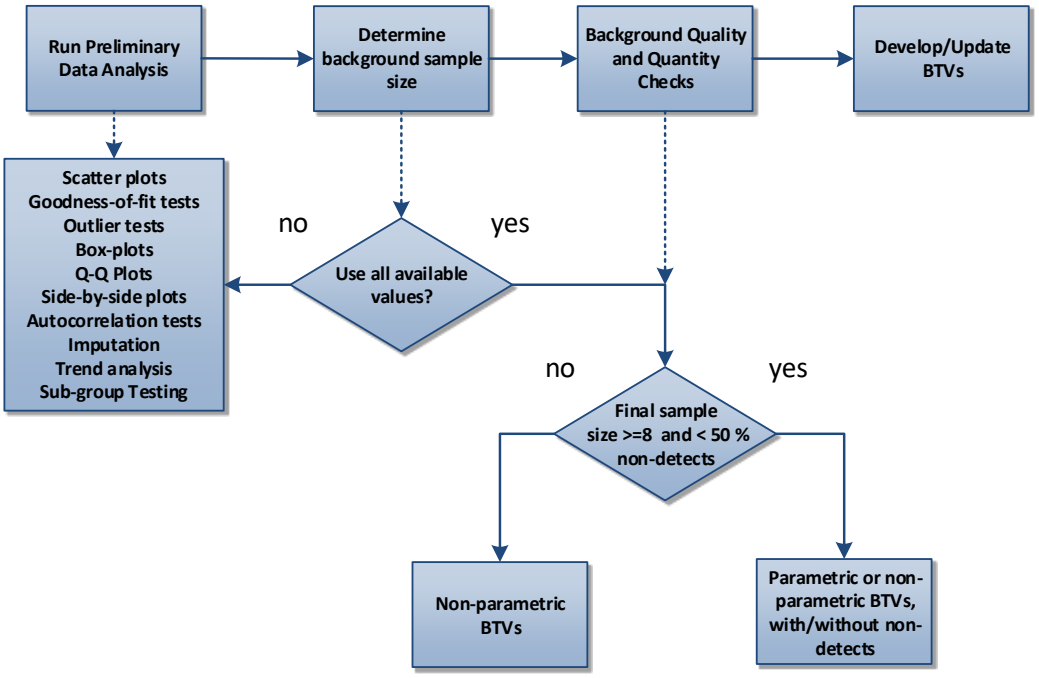

Figure 1: Decision Flow Chart for Preliminary Data Analysis and BTVs

2.1 Preliminary Data Analysis

The CCR Rule references requirements that statistical assumptions and data quality conditions associated with the test procedures are validated as described in 40 CFR 257.93 (g)(5)(6) and required by Part 115 Rule 908. A preliminary data analysis (PDA) is conducted to confirm such assumptions and bring awareness to the quality of data at the time background concentrations are estimated. A type of statistical analyses to support sub-group testing of differences in population means and medians is given special treatment at the end of this section as different aspects of the PDA will draw from it depending on the purpose of the statistical testing collected from the upgradient and downgradient wells.

2.1.1 Descriptive Statistics

Descriptive statistics will be developed per constituent from the background monitoring well and where there are multiple background wells, from the data pooled across the multiple wells. With respect to the downgradient monitoring wells, descriptive statistics will be developed per well per constituent within a location. The purpose of descriptive analysis is to characterize data and assess quality of information. The following descriptive statistics will be produced.

- Sample size
- Number of detects
- Percentage of detects
- Number of non-detects
- Percentage of non-detects
- Mean
- Median
- Minimum
- Maximum
- Standard deviation

- Number of distinct observations
- Number of distinct MDLs
- Range of collection period
- Coefficient of variation
- Skewness
- Kurtosis

2.1.2 Graphical Analysis

Scatter plots of observations will be produced as a function of time. Different colors will be used to differentiate detects from non-detects (NDs). The graphs visually provide clues as to whether the period of record is reflective of a steady-state baseline period. The graphs should be evaluated to determine if all data can be incorporated into analysis or if older historical data may need to be dropped (multiple detection limits over time may affect usability of the data). Outliers and seasonality can also be visually detected. Further statistical tests will need to be conducted to confirm assumptions from visual inspections.

2.1.3 Identify Outliers

A statistical outlier is defined as a value originating from a different statistical population than the rest of the sample. Outliers or observations not derived from the same population as the rest of the sample violate the basic statistical assumption of identically distributed measurements. If an outlier is suspected, options such as producing a probability plot of the ordered sample data versus the standardized normal distribution can be helpful, as well as, identifying observations that are greater than three standard deviations from the mean or visually inspecting box-and-whisker plots for values that are greater than three times the interquartile range above the third quartile. Such exceedances can be flagged as potential outliers.

Two tests will be used to test for possible outliers. Dixon's Outlier Test is appropriate for data series with sample sizes less than 25, and Rosner's Outlier Test is applicable to those with a sample size larger than 25. These outlier tests assume that the rest of the data except for the suspect observation(s) are normally distributed.

If outliers are found from the tests, the anomalous numbers will be investigated. If they are correct values and collected under standard, consistent protocols, they should remain in the data series. Otherwise, they can be dropped before proceeding. Some distributions naturally have anomalously low or high values. The subsequent tests for distribution types should find the best fitting distribution that can explain the anomalous values.

While some literature suggests repeating the statistical procedures with and without the outliers, the risk of this method is that the estimated distributions and statistics tend to be chosen to suit a goal. After a comparison of the estimates is made, a decision needs to be made as to which data set is representative. The decision to use or reject outliers will be done at the data collection and assessment stage. An example would be where a sample was qualified as "J+" (biased high), due to equipment blank contamination. If such a sample was seen as an outlier, it may be possible to eliminate it from further analysis for this reason. If there is a doubt as to the authenticity and reliability of the measured value, it should not be used. Otherwise, it is a value that was generated by the system regulating the water quality conditions of the tested groundwater well.

2.1.4 Identify Distributions

Since many tests make an explicit assumption concerning the distribution represented by the sample data, the form and exact type of distribution must be checked using a goodness-of-fit (GOF) test. A goodness-of-fit test assesses how closely the observed sample data resemble a proposed distributional model. The best goodness-of-fit tests attempt to assess whether the sample data closely resemble the tails of the candidate distributional model. The models under consideration for water quality samples are normal, lognormal, or gamma distributions.

The Shapiro-Wilk and Lilliefors tests will be used to test for normal distribution. Note that these two tests can be used to test for lognormal distributions after the data are transformed using the natural log function. The empirical distribution function (EDF) based methods, the Kolmogorov-Smirnov (K-S) and Anderson-Darling (A-D) test, are used to test for a gamma distribution. For determining whether the data fit an assumed distribution, the five percent level of significance is used. If all GOF tests fail, a non-parametric estimation method will be used.

The process of conducing GOF tests can produce results that show more than one parametric distribution fits the data. A decision logic is proposed that balances research that the gamma distribution is an appropriate distribution to describe variability in groundwater constituent concentrations with the risk of using small sample sizes (with often high levels of variability) to identify the appropriate distribution based on GOF tests.

With respect to small samples with less than 10 observations, GOF tests have sufficient data on which to calculate tests statistics such as critical values and probability values. Since tests are conducted at the five percent test significance level, the statistical power to correctly reject that the distribution is not parametric (in particular for tests of normality) may be low. HDR will review outcomes where parametric distributions have fit the data with small sample sizes by assessing the probability values and measure of sample skewness supplemented by visual adds such as histograms and boxplots to assess distributional fit.

Table 5 contains the logic used to determine which distribution is used to model sample statistics such as upper prediction or tolerance limits. When multiple distributions can appropriately fit the data, a determining factor is the level of sample skewness. USEPA's ProUCL Technical Guide (Singh and Singh 2015) has categorized skewness levels based on the standard deviation (sd) of the natural- logarithm (logged) of the detected data. When the sd of the logged data is less than one (<1), then the data set is symmetrically to mildly skewed; otherwise, it is moderately to highly skewed. When sample sets have symmetric to mild skewness and multiple distributions fit the data at the 5 percent level of significance, the normal takes presence as the recommended distribution. Sample sets with moderate or higher skewness levels are better described by a skewed distribution such as the gamma or lognormal distributions. However, the ProUCL Technical Guide has cautioned against using the lognormal distribution when the sd of logged values is greater than one due to the possibility of extremely high estimates for upper limits. This guidance is also considered for this procedures plan. In the table below, a FALSE indicates that the sample does not exhibit the column specific condition, while a TRUE indicates that is does. For example, for conditions one and two, since none of the three tested distributions pass the GOF test and regardless of the sd of logged detected data, a

nonparametric distribution is assumed. For condition 11, since both gamma and normal pass the GOF test and the sd of the logged detected data is less than one, the normal distribution is recommended.

Table 5. Distribution Decision Logic					
Condition	**Gamma**	**Lognormal**	**Normal**	**sd logged detected data >= 1**	**Recommended Distribution**
1	FALSE	FALSE	FALSE	FALSE	Nonparametric
2	FALSE	FALSE	FALSE	TRUE	Nonparametric
3	FALSE	FALSE	TRUE	FALSE	Normal
4	FALSE	FALSE	TRUE	TRUE	Normal
5	FALSE	TRUE	FALSE	FALSE	Lognormal
6	FALSE	TRUE	FALSE	TRUE	Nonparametric
7	FALSE	TRUE	TRUE	FALSE	Normal
8	FALSE	TRUE	TRUE	TRUE	Normal
9	TRUE	FALSE	FALSE	FALSE	Gamma
10	TRUE	FALSE	FALSE	TRUE	Gamma
11	TRUE	FALSE	TRUE	FALSE	Normal
12	TRUE	FALSE	TRUE	TRUE	Gamma
13	TRUE	TRUE	FALSE	FALSE	Gamma
14	TRUE	TRUE	FALSE	TRUE	Gamma
15	TRUE	TRUE	TRUE	FALSE	Normal
16	TRUE	TRUE	TRUE	TRUE	Gamma

2.1.5 Test for Spatial Variability

Spatial variability exists when the distribution or pattern of concentration measurements changes from well location to well location, either from natural or anthropogenic factors. Natural spatial variability refers to a pattern of changing mean levels in groundwater associated with normal geochemical conditions unaffected by human activities such as variation in contents of COIs in the soil and variation in geochemical conditions resulting in different solubility of COIs. Natural spatial variability is not an indication of groundwater contamination, even if concentrations at one or more compliance wells exceed (upgradient) background concentrations. Sources of anthropogenic spatial variability can include recent or historic releases from an on-site source or migration of contaminants from off-site sources. In groundwater monitoring, mean or median levels of a given constituent are usually compared from one well to the next to determine if natural or anthropogenic spatial variability is present.[6]

[6]Side-by-side box-and-whisker plots will be developed for each constituent at each well where data permit to evaluate the potential for natural spatial variability in the upgradient wells. If sufficient data are available on a per well basis, sub-group testing for differences in population means and medians will be conducted as described in section (i) below. Results indicating statistically significant differences among the multiple background wells will be noted; however, these results alone, and especially in light of the smaller sample sizes available from groundwater monitoring, are not sufficient to rule out a well or wells for the purpose of conducting an interwell analysis for the reasons explained above.

2.1.6 Test for Serial Correlation

Sources for serial correlation in water samples can be due to seasonal effects or temporal effects related to the timing of the sample collections. Trend analysis using regression techniques of a water quality constituent sampled over time is confounded if the data exhibits serial correlation. The regression errors from adjacent observations may be correlated. For example, if the residual from a given month's observation is high, then it is likely that the residual from the next month's observation will also be high. The same logic follows for low residuals giving rise to other low residuals. This type of correlation is referred to as serial correlation or autocorrelation. The autocorrelation function test will be run at the 1 percent level of significance.

2.1.7 Test for Seasonality

As explained in the previous paragraph, there are different reasons why a series of water quality constituent samples exhibit serial correlation. A common reason arises from changes in season as evidenced from varying temperatures and precipitation. These changes impact water quality constituents in a predictable and cyclical manner over the months. The study of water quality changes over time is focused on the ability to discern true trend through regression analysis amidst the cyclical nature of the data or its "seasonality". The correct use of these regression analyses rests on the crucial assumption that regression errors or residuals arising from the model fitting are independent of each other. This is often not the case with data that is seasonal in nature. If seasonality exists, then the autocorrelation function test described in step "f" will pick up the pattern. To better understand the type of seasonality (monthly, quarterly, bi-annually) which factors into the observed variability of data, a visual inspection of the data as a function of time is recommended.

Box-and-whisker plots of observations on a monthly or quarterly basis will be developed (provided one has at least 8-10 observations per sampling period). These results will be used to determine how to group the data into seasons. If sufficient data are available on a per season basis, sub-group testing for differences in population means and medians will be conducted as described in sub-section (i) below.

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[6] Analysis of variance (ANOVA) techniques (see Section 5.1 for details on these techniques) can also be used to establish evidence of spatial variation. If there is evidence of spatial variation, the Unified Guidance recommends using an intrawell statistical analysis instead of an interwell analysis. For an intrawell analysis to be meaningful at the downgradient sites, samples would have had to be taken prior to human activity such the installation of ash basins or ponds. Since the activity has occurred, it is important that the selection of groundwater wells at both upgradient and downgradient sites be done to minimize spatial variability to the extent possible for the purpose of conducting an interwell analysis.

2.1.8 Test for Trend

The samples from background wells represent water quality conditions exhibiting natural variability and unaffected by anthropogenic activities. As such, the measurements taken at regular intervals over time (three or more years) are expected to demonstrate a steady or stationary time series. Provided the data has more than 50 percent detected observations, the data from the background wells will be tested to determine whether trends exist (values steadily increasing or steadily decreasing). Depending on whether the data follow parametric or non-parametric distributions), one of the following linear regression tests will be selected:

- Maximum Likelihood Estimation (MLE) Regression (parametric, with or without NDs)
- Mann-Kendall (non-parametric, with or without NDs, 1 distinct value for MDL)

Both methods assume there is no seasonality in the data or if there is, the data have been deseasonalized prior to estimating average trend.

After the first initial one or two years of sampling from background wells in which a minimum of eight samples is collected, initial trends based on the first eight sampling events may change over time as additional sampling is completed. Generally, linear regression approaches detect monotonic trends and do not account for the existence of structural breaks in a parameter's time-series of observations. Linear regression attempts to fit an "average" trend based on the patterns in the observations.

A structural break may occur when the trend changes its magnitude, direction, or significance over time. As with the case with samples of groundwater quality data, the patterns can be highly erratic and generally do not follow strictly linear trends over time. A statistically significant upwards or downwards trend does not as a rule identify when groundwater quality conditions changed. The piece-wise polynomial regression approach can augment the results of the trend analysis.

Piece-wise polynomial regression has proven useful in circumstances when changes in trend may occur within the time-series for a constituent. The model provides another line of evidence that may be performed should environmental conditions or other factors indicate shifts in trends may have occurred. This approach attempts to find an appropriate mathematical model to express the relationship between the constituent's values and the sampling dates by using piece-wise regressions.

Examples of two types of piece-wise models for studying trends include the: linear-linear model and linear-linear-linear model. The linear-linear regression model assumes and identifies one structural break in a constituent's data series, in which the two portions of the data separated by the break point follow two different trends as modeled by two different linear equations. Similarly, the linear-linear-linear model attempts to identify two structural breaks to separate three different linear trends.

The piece-wise models since they do not account for censorship or if the data follow non-parametric distributions can be applied mainly as a visual guide to identify changes in trend that may have occurred within the time-series of a constituent.

For the breaks in a time-series to be meaningful, at least eight observations per segment are available. Assessment to changes in the average trend will be done at a minimum after the

second set of eight observations are collected from the background site. The pooled data will be evaluated for overall average linear trend (i.e., linear regression) and for structural breaks (i.e., piece-wise linear regression) in the pooled data over time.

The approximate date of a structural break should one be statistically significant will be used to determine if factors post-structural break date may have contributed to the change in the trend relative to the initial background data trend.

A risk in using linear or piece-wise regression analyses for the small datasets available to assess variability of overall well field conditions is that trends or structural breaks may be outcomes of spurious, shorter-term trends and that a longer time-series (e.g., 10 years or more of sampling events) would better represent overall trend patterns.

To mitigate this risk, anthropogenic, environmental, well installation methods, laboratory measurement protocols, or other factors will be determining factors as to whether or not older background sampling events should be removed, and background data is updated with the latest data.

If such external factors can be corroborated, provided there are at least eight observations in the latest available data post-structural break date, and the average of that data is statistically different from the average of previous background reference values (see Section 5.1i for statistical methods to test for differences in sub-groups), background data will be updated using the latest available data.

2.1.9 Test for Sub-Group Testing

When assessing if concentration means or medians are statistically different across wells, seasons or between two different background collection periods, various statistical procedures are available. This section describes the tests which may be used depending on the nature of the data and number of tests required. A significance level of 1 percent is used to decide whether to accept or reject the null hypothesis that there are no differences across the sub-group means or medians. In instances where multiple comparisons are made, adjustments will be incorporated to control for false positive rate (e.g., Bonferroni's adjustment) or statistical tests used with built-in functionality to address the multiple comparison issue (e.g., Tukey-Kramer test).

Before proceeding to test for differences across the sub-group means, one needs a sufficient sample size of at least 8-10 samples per sub-group. Testing for sub-groups can be done in three steps: 1. Graphical analysis, 2. Hypothesis tests for sub-group differences, and 3. Tests to identify which sub-groups are different.

Graphical Analysis

Background groundwater data can be assessed for sub-groups using graphical representation tools such as box-and-whisker plots. Multiple box-and-whisker plots can be constructed for comparing constituent concentrations and variability across potential sub-groups. Investigations may be done using Q-Q plots, if necessary, to supplement findings based on box-and-whisker plots.

Hypothesis Tests for Sub-Group Differences

The following methods can be used to detect for population differences across the sub-groups:

- ANOVA (under normal distribution assumptions)
- Log-ANOVA (under log-normal distribution assumptions)
- Kruskal-Wallis One-Way Analysis on Ranks (distribution free assumptions/non-parametric, presence of non-detects, corrected for ties)
- Kaplan-Meir (non-parametric, useful with heavy censoring).

The decision as to which test to use is predicated on the presence of censorship and whether the distribution follows a parametric distribution of either normal, log-normal, or gamma type or does not have a discernible distribution and hence is non-parametric. Note that the Log-ANOVA is simply the ANOVA approach applied to the natural-logarithm of the time series.

The ANOVA tests require that normality assumptions are valid for each sub-group. In addition, the variances across the groups should be approximately equal.

Testing for potential sub-groups within background groundwater data sets will be performed using a significance level of 1 percent.

Tests to Identify Which Sub-Groups Are Different

Provided any of the tests described above show sub-group differences, further tests may be performed to identify which sub-group(s) is different from the others provided each sub-group has at least 20-30 observations.

- Post-Hoc Test for Multiple Comparisons
  - Tukey-Kramer Test (parametric)
  - Dunn's Test (non-parametric)

2.2 Background Threshold Values

Using data from the three upgradient background well(s), MW-27, MW-33, and MW-34, to represent background field conditions for both CCR Units, the appropriate BTVs will be computed for each constituent. Since the Site has more than one background well, the upgradient data are defined by pooled samples over the wells, as appropriate.

As recommended in the Unified Guidance (2009b), background values should be updated every four to eight measurements (e.g., every one to two years if samples are collected quarterly). New background groundwater data will be evaluated against the existing background dataset, as appropriate. If the new background data does not indicate a statistically significant difference using the approaches described in the sub-group testing **Section 2.1(i)**, the new data will be combined with the existing background data to calculate updated BTVs. Increasing the background dataset will increase the power of subsequent statistical tests. If the new background data does indicate a significant difference between the two populations, the data should be reviewed to evaluate the cause of the difference. In the absence of evidence of a release, the combined dataset should be considered more representative of present-day groundwater conditions and used for background.

2.2.1 Updating Background Threshold Values

Analysis to update published BTVs will be done at a minimum after eight sampling events have been collected per well or if there is a change to the background wells.

The analysis includes tests of differences in averages between the previously established background sampling events and the newer sampling events per constituent. An evaluation of the concentration trends over time using all data collected to date will be done. To provide context to observed patterns in the concentrations over time and with interest in differences in patterns since the establishment of published BTVs, investigations will be done to check if anthropogenic activities, changes to laboratory protocols, climate events or other factors have occurred during the time since the publication of the current BTVs.

Given the smaller sample sizes available for updating and that the sample size may not capture the full natural variability in concentrations over time, interpretation of inferential test results will be informed by outlier tests (Section 2.1.3) and trend tests (Section 2.1.8) of the pooled data, sub-group testing (Section 2.1.9) between the data from the sampling events pre- and post-current BTV publication.

A discussion will be included that evaluates the sets of constituents that had statistically significant differences as to whether the differences are due to a change in the hydrogeology of the site's groundwater system or reflect the natural variability in concentrations or trends. Changes to the inclusion or exclusion of sampling events will be consistently applied across the constituent-well pairs at the site. This does not preclude removal of specific data observations that are deemed to be erroneous or not representative of groundwater conditions (e.g., observation collected during high turbidity).

If both statistical and environmental evidence suggests a shift in the background reference values at the site level at some point since the initial background sampling event (including the point in time since the publication of the current BTVs), the most recent data (with a minimum of eight samples) will be combined with previously collected data should the shift in site conditions occurred during the last background reference period. If not, the latest set of sampling events will be used exclusively to update the BTVs.

If there is not sufficient evidence to support field conditions shift in concentrations since the publication of the current BTVs, the background reference concentrations will be updated to include data from the latest set of eight or more sampling events.

For the situation where there are changes to the background wells the process to establish BTVs will anew, and all the data collected for the new background wells will be used.

Whichever sampling events or wells are used to define the background reference period, the statistical process described in this plan will be applied to that data.

2.2.2 Detection Monitoring

Under the detection monitoring programs of 40 CFR §257.94 and Michigan Part 115 Section 324.11511a(3), COI monitoring results will be statistically compared to BTVs through interwell statistical methods. As recommended by the Unified Guidance (2009b), the statistical test to define the BTV for detection monitoring is the upper prediction limit. The formulation of the

prediction limit may vary slightly with the particulars of the test to be made and the characteristics of the data involved such as whether the data follow parametric or non-parametric distributions and the percentage of NDs. For example, if the recommended distribution follows a normal distribution, a normal-based parametric prediction interval is used. If the recommended distribution follows a gamma distribution, then a gamma-based parametric prediction interval is used, and if the recommended distribution is lognormal, then a lognormal-parametric prediction interval is used. If the data cannot be explained by parametric distributions, a non-parametric prediction interval on the median is used.

The confidence level associated with each upper prediction limit test is selected such that the site-wide false positive rate does not exceed 10 percent as recommended by the Unified Guidance (2009b). The achieved per-test confidence levels will typically range between 95 and 99 percent. Whatever the formula specification, prediction limits represent a range where a future result is expected to lie at a given confidence level. Both the upper and lower prediction limits (LPL) will be produced for pH since lower and higher pH values relative to background are of concern.

Determination of Statistically Significant Increases above Background

If the groundwater concentration of any detection monitoring COI at any downgradient well is greater than the UPL, then that concentration represents an SSI over background for that CCR impoundment. One exception is pH, which can exhibit an SSI if the concentration in a monitoring well is either greater than the UPL or less than the LPL. As written in Federal CCR Rule 40 CFR 257.94(e) and Part 115 Rule R 299.4440(8), if an SSI over background is identified in a downgradient well for one or more detection monitoring COI, then the owner or operator of the CCR unit must: 1) Within 14 days of the determination, place a notice in the operating record that indicates which constituents have shown statistically significant increases from background levels and notify the director that the notice is placed in the operating record, and 2) prepare and submit to the director an assessment monitoring plan that is in compliance with R 299.4441 and a response action plan that is in compliance with R 299.4442 within 45 days of the determination; or demonstrate that a source other than the CCR unit caused the SSI over background, or demonstrate that the SSI over background resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.

If sources other than the CCR Unit, natural variability or errors have been ruled out as the reason for the SSI, a type of verification sampling method called the one-of-m pass method, as described in the Unified Guidance (2009b), allows for an efficient plan to confirm if an SSI over background identified during detection monitoring resulted from the CCR unit. Resampling of wells where an SSI has occurred can either verify the initial SSI determination or disconfirm it, thereby avoiding false positives. Depending on the number of background samples, the selected site-wide false positive rate, and the available time period in which to do the resampling, either a 1-of-2 or 3 pass method is recommended should verification sampling be considered. Initial exceedances are technically not SSIs until the verification sampling is initiated. However, as a conservative measure, the first exceedance will represent an SSI.

2.2.3 Assessment Monitoring

Under the assessment monitoring program in 40 CFR 257.95 and Michigan Part 115 Section 324.11519b(2), Appendix III, IV, monitoring results are compared to BTVs as described in 40 CFR 257.95(e). The UPLs discussed in Section 2.2.1 are also used to compare Appendix III, IV, and Part 115 assessment monitoring results to background values.

According to 40 CFR 257.95(e), the CCR unit may return from assessment monitoring to detection monitoring when all Appendix III and Appendix IV constituents are "shown to be at or below background values, using the statistical procedures in paragraph 40 CFR 257.93(g) for two consecutive sampling events." A notification letter stating that detection monitoring is resuming for the CCR unit will be placed in the facility's operating record as required by 257.105(h)(7).

Determination of Federal GPS

According to 40 CFR 257.95(f), if assessment monitoring concentrations of all Appendix III and Appendix IV constituents are above background concentrations (UPLs), and Appendix IV constituents are below the groundwater protection standard (GPS), then assessment monitoring will continue. As required in 40 CFR 257.95(h), the CCR owner must establish GPS for each constituent in Appendix IV detected in the groundwater. The GPS shall be defined as the following:

- The U.S. EPA Maximum Contaminant Level (MCL) for constituents for which an MCL has been established;
- for cobalt, lead, lithium, and molybdenum the concentrations established in §257.95(h)(2) (6, 15, 40, and 100 ug/L, respectively); or
- the background concentration for constituents for which the background level is higher than the MCL or concentrations in §257.95(h)(2).

The Unified Guidance recommends the upper tolerance limit (UTL) to represent the background concentration for this purpose. The limits can be considered as statistically equivalent BTVs to an MCL or other health-based numbers. The UTLs are derived from the same background data sourced to produce the UPLs and are used in these situations to represent the GPS. Tolerance intervals represent a range where a proportion of the population is expected at a given confidence level. For the purpose of this certification plan, a 95 percent confidence level is assumed. Similarly to the specification for prediction limits, specification for tolerance limits vary depending on whether the background data follow parametric or non-parametric distributions and the incidence of NDs. For example, if the recommended distribution follows a normal distribution, a normal-based parametric tolerance interval is used. If the recommended distribution follows a gamma distribution, then a gamma-based parametric tolerance interval is used, and if the recommended distribution is lognormal, then a lognormal-parametric tolerance interval is used. If the data cannot be explained by parametric distributions, a non-parametric tolerance interval on the median is used. Both the upper and lower tolerance limits will be produced for pH to establish lower and upper GPS.

Table 1. Federal Program Background Threshold Values and Groundwater Protection Standards			
Parameter	Site-Specific Background Level	Federal Maximum Contaminant Level (mg/L)	Federal Program Groundwater Protection Standards (mg/L)
	Upper Tolerance Limit (UTL) (mg/L)		
Antimony	0.0012	0.0060	0.0060
Arsenic	0.0040	0.010	0.010
Barium	0.58	2.0	2.0
Beryllium	0.000059	0.0040	0.0040
Cadmium	0.00015	0.0050	0.0050
Chromium	0.042	0.10	0.10
Cobalt	0.0021	0.0060*	0.0060
Fluoride	0.45	4.0	4.0
Lead	0.0016	0.015*	0.015
Lithium	0.10	0.040*	0.10
Mercury	0.00016	0.0020	0.0020
Molybdenum	0.0093	0.10*	0.10
Radium-226/228	2.6	5.0	5.0
Selenium	0.00089	0.050	0.050
Thallium	0.000075	0.0020	0.0020

*EPA adopted health-based value for constituents with no MCL.

Determination of State GPS

As required in Michigan Part 115 Rule R 299.4441(9), the CCR owner must establish GPS for each constituent detected in the groundwater. The GPS for the Part 115 compliance program shall be defined as the lowest of the following:

- U.S. EPA Maximum Contaminant Level (MCL) for constituents for which an MCL has been established;
- The applicable cleanup criteria for that constituent for groundwater as established pursuant to Section 20120a of Act 451.

Or for constituents for which the background level (UTL) is higher than the MCL or applicable cleanup criteria for groundwater, the background concentration will be the GPS. **Table 1** provides the background level, the MCL, the cleanup criteria, and the GPS values for the Site.

According to Part 115 Rule R 299.4441(6), if assessment monitoring concentrations of any assessment monitoring COIs are above background concentrations (UTLs) but all constituents are below the GPS, then:

- Assessment monitoring will continue in accordance with this rule.

- The nature and extent of the release will be characterized by installing additional monitoring wells as necessary.
- At least 1 additional monitoring well will be installed at the facility boundary in the direction of contaminant migration and sample the well.
- All persons who own the land or reside on the land that directly overlies any part of the plume of contamination if contaminants have migrated off-site as indicated by the sampling of wells in accordance with this rule will be notified.

Table 2. State Program Background Threshold Values and Groundwater Protection Standards

Parameter		Site-Specific Background Level Upper Tolerance Limit (UTL) (mg/L)	Federal Maximum Contaminant Level (mg/L)	State Non-Residential Drinking Water Cleanup Criteria for Groundwater (mg/L)*	State Groundwater Surface Water Interface (mg/L)*	Groundwater Protection Standards for Site (mg/L)
Appendix III						
B, total	Boron	4.0	NV	0.50	7.20	4.0
Ca	Calcium	250	NV	N/A	N/A	250
Cl	Chloride	120	NV	250	50	120
F	Fluoride	0.45	4.00	2.00	NV	2.00
SO_4	Sulfate	100	NV	250	NV	250
TDS	Total Dissolved Solids	950	500	500	500	950
Appendix IV						
Sb, total	Antimony	0.0012	0.0060	0.0060	0.13	0.0060
As, total	Arsenic	0.0040	0.010	0.010	0.010	0.010
Ba, total	Barium	0.58	2.00	2.00	1.3[1]	1.3[1]
Be, total	Beryllium	0.000059	0.0040	0.0040	0.036[1]	0.0040
Cd, total	Cadmium	0.00015	0.0050	0.0050	0.0025[1]	0.0025[1]
Cr, total	Chromium	0.042	0.10	0.10	0.12[1]	0.10
Co, total	Cobalt	0.0021	0.0060	0.10	0.10	0.0060
F	Fluoride	0.45	4.0	2.0	NV	2.0
Pb, total	Lead	0.0016	0.015	0.0040	0.014[1]	0.0040
Li, total	Lithium	0.10	0.040	0.35	0.44	0.10
Hg, total	Mercury	0.00016	0.0020	0.0020	0.0013	0.0013
Mo, total	Molybdenum	0.0093	0.10	0.210	3.20	0.10
Ra226/228	Radium 226 and 228	2.6	5.0	NV	NV	5.0
Se, total	Selenium	0.00089	0.050	0.050	0.0050	0.0050
Tl, total	Thallium	0.000075	0.0020	0.0020	0.0037	0.0020
Part 115						
Cu, total	Copper	0.020	1.3	1.0	0.021[1]	0.021[1]

Table 2. State Program Background Threshold Values and Groundwater Protection Standards						
Parameter		Site-Specific Background Level Upper Tolerance Limit (UTL) (mg/L)	Federal Maximum Contaminant Level (mg/L)	State Non-Residential Drinking Water Cleanup Criteria for Groundwater (mg/L)*	State Groundwater Surface Water Interface (mg/L)*	Groundwater Protection Standards for Site (mg/L)
Fe, total	Iron	83	0.30	0.30	NV	83
Ni, total	Nickel	0.023	NV	0.10	0.12[1]	0.10
Ag, total	Silver	0.00011	0.10	0.0098	0.00020	0.00020
V, total	Vanadium	0.00093	NV	0.062	0.027	0.027
Zn, total	Zinc	0.038	5.0	5.0	0.27[1]	0.27[1]

*Cleanup Criteria Requirements for Response Activity (Formerly the Part 201 Generic Cleanup Criteria and Screening Levels) found in R 299.44 Generic groundwater cleanup criteria.

NV=no value

[1]Per Footnote G of Table 1 Cleanup Criteria Requirements for Response Activity (Formerly the Part 201 Generic Cleanup Criteria and Screening Levels) of the Groundwater Surface Water (GSI) criteria list, values noted are calculated based on the hardness (expressed as CaCO3) of the receiving waters. Surface water sample from the Grand River (SG-01) had a hardness of 270 mg/L was used in the calculation of specific GSI values. The Grand River discharges into Lake Michigan, thus the GSI Criteria for Surface Water Protected for Drinking Water Use, is provided above.

Federal Program Determination of Statistically Significant Levels above GPS

The CCR Rule stipulates in 40 CFR 257.95(g) that if Appendix IV constituents are detected at statistically significant levels (SSLs) above the GPS, the following actions are required to be taken:

- Place a notification in the operating record identifying the GPS exceedances.
- Characterize the nature and extent of the release and any relevant site conditions that may affect the remedy ultimately selected in accordance with 40 CFR 257.97.
- Notify all persons who own the land or reside on the land that directly overlies any part of the plume of contamination.
- Within 90 days:
    - Prepare an alternative source determination for the exceedance, or
    - Initiate an assessment of corrective measures in accordance with 40 CFR 257.96.

Therefore, if Appendix III and detected IV COIs exceed BTVs according to 40 CFR 257.95(e), and detected Appendix IV COIs exceed GPS pursuant to 40 CFR 257.95(f), then detected Appendix IV constituents will be statistically compared to the GPS to identify SSLs above the GPS pursuant to 40 CFR 257.95(g). In order to evaluate if an exceedance of the GPS is statistically significant, the lower confidence limit of the sample mean or median concentrations from downgradient monitoring wells are used.

During the statistical analysis of confidence intervals from each detected Appendix IV constituent, if the lower confidence limit exceeds the GPS at the 95 percent confidence level, then the constituent has been detected at a SSL above the GPS at a particular monitoring well. As with the UPL and UTLs, the particularities of the lower confidence limit are based on whether

parametric or non-parametric distributions best fit the data and the incidence of NDs observed in the monitoring data. For example, if the recommended distribution follows a normal distribution according to Table 4, a normal-based parametric confidence interval is used. If the recommended distribution follows a gamma distribution, then a gamma-based parametric confidence interval is used, and if the recommended distribution is lognormal, then a lognormal-parametric confidence interval is used. If the data cannot be explained by parametric distributions, a non-parametric confidence interval on the median is used. To maintain statistical power in correctly rejecting that the average (mean or median) of downgradient concentrations is less than the GPS when the average is higher than the GPS, a minimum of eight samples will be used.

Table 22-3, page D-258 of the Unified Guidance (2009b) indicates that for detecting a true mean 50 percent higher than the GPS, a sample size of 8 achieves 50 percent power with a minimum individual test significance level of 19 percent when conservatively assuming that the population coefficient of variation is 1. Increasing the true mean by 100 percent over the GPS, a sample of eight has 80 percent power of correctly rejecting the null hypothesis when the true population mean is twice the GPS with a test significance of 31 percent. Note that the lowering the test significance level increases power for a fixed sample size and increasing sample size while holding the test significance level constant, also increases statistical power.

If waste boundary well SSLs are identified, nature and extent wells will be installed as needed to define the contaminant plume(s) including at least one well at the facility boundary in the direction of contaminant migration pursuant to 40 CFR 257.95(g)(1). These nature and extent wells will be sampled at an increased frequency (5-week frequency) immediately after installation in effort to have sufficient samples (minimum 8) from each new well (as soon as possible) to complete the statistical comparison against the GPS. Once a nature and extent well has 8 or more sample events, the entire available data set from that well is used to calculate the LCLs, and if the LCL is below the GPS then the well will not be considered part of the plume and if the LCL is above the GPS then the well will be considered part of the plume. Between the time a new nature and extent well has been installed and 8 samples have been collected (approximately a 10-month window), concentrations from each sample event will be compared to the GPS on a single event basis and the exceedance will be described in any reporting documents as single event exceedances. Determination for whether additional nature and extent wells are warranted to define the plume will not require a statistical comparison (8 sample events), nor should be made after a single sample event, but may be completed with approximately two sample events singe event comparisons to the GPS. For example, if two sample events have GPS exceedances, that will be an indication that additional nature and extent wells are warranted to define the plume, and conversely if two sample events do not have GPS exceedances, that will be an indication that additional nature and extent wells are not warranted at that time.

Michigan Program Determination of Statistically Significant Levels above GPS

If any assessment monitoring COIs exceed BTVs and exceed GPS, then COIs will be statistically compared to the GPS to identify SSLs above the GPS. In order to evaluate if an exceedance of the GPS is statistically significant, the lower confidence limit (LCL) concentrations from downgradient monitoring wells are used.

During the statistical analysis of confidence intervals from each COI, if the LCL exceeds the GPS at the 95 percent confidence level, then the constituent has been detected at a SSL above the GPS at a particular monitoring well. As with the UPL and UTLs, the particularities of the LCL are based on whether parametric or non-parametric distributions best fit the data and the incidence of NDs observed in the monitoring data. For example, in the case of normally distributed data, a normal-based parametric confidence interval is used. If the data cannot be explained by parametric distributions, a non-parametric confidence interval on the median is used.

According to Part 115 Rule R 299.4441(7), if assessment monitoring concentrations of any assessment monitoring COIs are detected at statistically significant levels above the GPS, then:

a. Within 14 days of the detection, a notice will be placed in the operating record that identifies the hazardous substances that have exceeded any criteria for groundwater established pursuant to Section 20120a of Act 451.
b. The director and all appropriate local government officials will be notified that the notice has been placed in the operating record.
c. Assessment monitoring in accordance with this rule will be continued.
d. At least 1 additional monitoring well at the facility boundary in the direction of contaminant migration will be installed and sampled.
e. The nature and extent of the release will be characterized by installing additional monitoring wells as necessary.
f. All persons who own the land or reside on the land that directly overlies any part of the plume of contamination will be notified if contaminants have migrated off-site as indicated by the sampling of wells in accordance with this rule.
g. Except as provided by R 299.4441(8), initiate an assessment of corrective measures as required by R 299.4443 within 90 days of the detection.

2.2.4 Criteria for Clean Closure

40 CFR 257.102(c) indicates that removal and decontamination of the CCR Unit are complete when constituent concentrations throughout the CCR unit and any areas affected by releases from the CCR unit have been removed and groundwater monitoring concentrations do not exceed the GPS.

If the site is in assessment monitoring, post-clean-out Appendix IV groundwater concentrations are compared to GPS and if concentrations are below GPS, the site will be re-sampled semi-annually pursuant to the guidance in §257.95(e,f). According to §257.95(e), if two consecutive sample event concentrations of Appendix III and IV constituents are below BTVs the operator may return to detection monitoring but because the site has been closed it will be considered clean closed. If such groundwater concentrations are above GPS, the site will be re-sampled following assessment monitoring semi-annual monitoring protocols and will follow the assessment monitoring guidance in §257.95(g).

If a corrective measures program is implemented to achieve remedy completion in accordance with 40 CFR 257.98(c)(2) and Michigan Part 115 R 299.4445 (5), it must be demonstrated that groundwater concentrations of constituents listed in Appendix IV have not exceeded the GPS for a period of three consecutive years using the statistical procedures and performance standards in §257.93(f) and (g). The statistical test after corrective measures have been implemented compares the downgradient wells upper control limits (UCL) to the GPS.

3.0 References

Singh, Anita and Ashok K. Singh. 2015. ProUCL Version 5.1 Technical Guide: Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. U.S. Environmental Protection Agency, EPA/600/R-07/041.

USEPA. 1992. Supplemental Guidance to RAGS: Calculating the Concentration Term. Publication EPA 9285.7-081, May 1992.

USEPA (U.S. Environmental Protection Agency). 2009a. Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use, USEPA 540-R-08-005. January 13 2009.

USEPA. 2009b. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance. Office of Resource Conservation and Recovery, Program Implementation and Information Division, U.S. Environmental Protection Agency. EPA 530/R-09-007.

USEPA. 2010. National Functional Guidelines for Inorganic Data Review, USEPA-540-R-10-011. January 2010.

USEPA, 2015. 40 CFR parts §257 and §261; Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule, Federal Register vol. 80, no. 74. Environmental Protection Agency. April 17, 2015.