Prepared by

HDR

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Remedial Alternatives Analysis

Former J.B. Sims Generating Station/Harbor Island - Grand Haven, Michigan

November 9, 2026

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List of Acronyms

AACE	Association for the Advancement of Cost Engineering
ACM	Assessment of Corrective Measures
bgs	below ground surface
CCR	Coal Combustion Residuals
CCRMU	CCR Management Unit
CFR	Code of Federal Regulations
COCs	constituents of concern
cm/s	centimeters per second
CSM	conceptual site model
CY	cubic yards
DGI	Data Gap Investigation
DWC	Drinking Water Criteria
EGLE	Department of Environment, Great Lakes, and Energy
EPA	United States Environmental Protection Agency
ERM	Environmental Resources Management
Facility or Site	Former J.B. Sims Generating Station
FER	Facility Evaluation Report
ft/d	feet per day
ft^2/d	feet squared per day
GAC	granular activated carbon
GCL	geosynthetic clay liner
GHBLP	Grand Haven Board of Light & Power
gpm	gallons per minute
GPS	groundwater protection standards
GSI	groundwater-surface water interface
GWET	groundwater extraction and treatment
HDR	HDR Michigan, Inc
ICs	institutional controls
ISS	in situ stabilization
LCL	lower confidence limit
LF	linear feet
LLDPE	linear low-density polyethylene
MNA	monitored natural attenuation
MW	monitoring well
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPV	net present value
NREPA	Natural Resources and Environmental Protection Act
O&M	operation and maintenance
PFAS	per- and polyfluoroalkyl substances
POTW	publicly owned treatment works

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PRB	permeable reactive barrier
PZ	piezometer
RAA	Remedial Alternatives Analysis
RAOs	remedial action objectives
RAP	Remedial Action Plan
RSR	Remedy Selection Report
SPT	Standard Penetration Test
TDS	total dissolved solids
USGS	United States Geological Survey
VAS	vertical aquifer sampling

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1 Introduction

HDR Michigan, Inc (HDR) has prepared this Remedial Alternatives Analysis (RAA) on behalf of the City of Grand Haven and the Grand Haven Board of Light and Power (GHBLP). The RAA serves as a planning and decision-support document for evaluating potential remedial approaches for the former J.B. Sims Generating Station (Facility or Site) located on Harbor Island. The analysis compares a range of source removal, treatment, containment, and groundwater management alternatives based on Site conditions, implementation feasibility, anticipated environmental benefits, and associated cost and schedule considerations. The purpose of this RAA is to provide a framework for comparing remedial alternatives, supporting budget development, establishing implementation schedules, and informing future Site management decisions. The findings and recommendations presented in this RAA are intended to support preparation of a Remedy Selection Report (RSR) and Remedial Action Plan (RAP), which will further define the selected remedial approach.

1.1 Facility Description

The former J.B. Sims Generating Station was a coal-fired, steam-generating power facility with a net capacity of approximately 70.5 megawatts that was operated by GHBLP. The facility is located at 1231 North 3rd Street, on Harbor Island, in Grand Haven, Michigan (**Figure 1**). The coal combustion residuals (CCR) generated at the former Site were 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 from boiler and infrastructure cleanout was sent to Unit 3A/B. The waste disposal into Unit 3A/B ceased in July 2020 (HDR 2026).

Additionally, historical records indicate portions of the Site were utilized for fishing, shipbuilding, and lumber storage prior to and into the 1900s. The use of the Site remained industrial through the 1960s with uses such as power generation, coal docks, and petroleum storage. An undefined portion of the Site operated as a municipal dump site from 1928 until 1970 when disposal operations ceased (WSP, 2023). It is suspected that municipal waste materials and possibly operations on the Island are sources of per- and polyfluoroalkyl substances (collectively referred to as “PFAS”) that have been detected in soil and groundwater, although no definitive source has been confirmed. PFAS concentrations were observed above Department of Environment, Great Lakes, and Energy (EGLE) Part 201 Residential & Non-Residential Drinking Water Criteria, as well as the Groundwater-Surface Water Interface Pathway Criteria (WSP, 2023).

1.2 Purpose and Approach

As an initial planning and decision-support tool, this RAA identifies, screens, and evaluates potential corrective action alternatives to support selection of a preferred remedial approach. The evaluation was performed using a structured process that considered Site conditions, technical feasibility, anticipated effectiveness, implementation considerations, and relative cost and schedule impacts. The results of this analysis will be used to inform development of the RSR and RAP, which will be prepared in accordance with applicable requirements of 40 Code

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of Federal Regulations (CFR) § 257.96 through § 257.98 and Michigan environmental regulations. The evaluation process included:

- Identification and screening of potentially applicable remedial technologies;
- Development of corrective action alternatives using retained technologies; and
- Comparative evaluation of alternatives based on their anticipated effectiveness, reliability, implementability, environmental impacts, implementation timeframe, and life-cycle cost.

The alternatives were developed to provide a corrective action strategy that addresses both source control and groundwater protection while considering applicable federal and state regulatory requirements, future land-use considerations, and long-term stewardship obligations.

2 Site Characterization

Key site characterization relevant to the evaluation and design of groundwater corrective action alternatives are outlined below, including hydrogeologic characteristics, the nature and extent of contamination, and Site-specific constraints that may influence remedy implementation and performance.

2.1 Conceptual Site Model

2.1.1 Site Background

The inactive CCR Units 1/2 Impoundment was a depression in the ground where sluiced ash was disposed. A 2016 ash investigation by Environmental Resources Management (ERM) confirmed that no liner was present beneath the impoundment and waste was placed into the topographic low area (ERM 2016). The former CCR Unit 3A/B Impoundments were constructed in 1982 as two above-ground surface impoundments with engineered clay liners. While the liners were constructed before the adoption of Part 115 and 40 CFR §257.71(a)(1), they do not meet the liner design criteria subsequently established under those regulations (Golder 2020). Although the plant ceased operations in 2020, the Facility continued to use the Unit 3A/B Impoundments to store cleanout materials from the hoppers, vessels, etc. prior to demolition of the buildings. Removal of CCR from the impoundments was completed in 2020 and the liner remains in place. Following the CCR removal, Golder conducted ash removal verification and submitted a report to EGLE that was denied (EGLE 2021). It was determined that any additional removal of liner or subsurface material for decontamination could potentially expose solid waste and PFAS-impacted groundwater. Therefore, the closure by removal process was suspended to investigate the non-CCR contamination at the Site.

2.1.2 Monitoring Network

2.1.2.1 Groundwater Monitoring Well Network

The groundwater monitoring well network consists of monitoring wells (MW-#) and piezometers (PZ-#) shown in **Figure 2** and described below. Monitoring wells are sampled for groundwater

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quality and monitored for groundwater elevations, whereas piezometers are monitored only for groundwater elevations.

Due to the size of Units 1/2 Impoundment compared to the size of Site and the variable groundwater flow direction, a traditional upgradient/downgradient groundwater monitoring system is not possible. Further detail explaining the locations and justification of each well location is provided in the Hydrogeologic Monitoring Plan (HDR 2024). The following wells are utilized as the groundwater monitoring network:

- Background Wells: MW-27, MW-33, and MW-34
- Point of Compliance Wells (e.g., 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, MW-37, MW-42, and MW-43.

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

- Background Wells: MW-27, MW-33, and MW-34
- Point of Compliance Wells (e.g., waste boundary wells): MW-02, MW-03, MW-04, MW-04R, MW-11, and MW-12
- Nature and Extent Wells: MW-01R, MW-01RB, MW-09, MW-10, MW-13, MW-38, MW-39, and MW-41

Additionally, 12 piezometers are monitored for water level only and are not sampled: MW-05, MW-35, MW-40, PZ-14, PZ-15, PZ-21, PZ-22, PZ-23, PZ-24, PZ-25, PZ-26, and PZ-29, shown on **Figure 2**. Transducers are also installed in some monitoring wells and stilling wells to collect groundwater elevation data on a continuous one-hour frequency.

2.1.2.2 Surface Water Monitoring Network

The surface water monitoring network coincides with the groundwater monitoring network. The stilling wells (STW-1SW, STW-2, STW-3) and staff gauges (STW-1SG, SG-01, SG-03, SG-06) are monitored for water levels only. Staff gauges SG-02, SG-04R, SG-05, and SG-07 are monitored for both water levels and surface water quality. The locations of the stilling wells and staff gauges are shown in **Figure 2**.

2.1.3 Geology and Hydrogeology

Groundwater is present at the Site in an unconfined aquifer consisting of fine to coarse sand, interbedded with silt, clay, and peat as shown in the cross sections in **Attachment D**. Discontinuous, saturated deposits of coal ash, municipal solid waste, and other fill materials are also present. The aquifer is underlain by a relatively thin, hard layer of silty sand, sandy silt, and/or clayey silt approximately 20.5 feet below ground surface (bgs) on the east side of the Site (piezometer PZ-26), and approximately 38.5 feet below grade on the western side (well PW-1). Beneath the silt exists a massive clay unit extending to at least 150 feet below grade (boring PDR-3). The clay was observed to range from soft to hard based on standard penetration test blow counts.

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The Grand River is located on the western side of Harbor Island, and the South Channel of the Grand River is located on the south side of Harbor Island. The northern side of Harbor Island is bordered by the Northern Wetland, which is typically embayed by the Grand River during high river stages. The center of Harbor Island is the Internal Wetland.

Groundwater mounding is typically present south and east of the Unit 3A/B impoundment, centered around wells MW-12 and MW-01R. Groundwater contour maps of water levels show groundwater flow beneath Unit 3A/B Impoundments is west toward the Grand River (**Figure 4**). Groundwater flow beneath Units 1/2 Impoundment is generally radial: northward toward the Northern Wetland, east from the ponds of Units 1/2 Impoundment toward the Internal Wetland, and potentially south near MW-05 (**Figure 4**). The Internal Wetland east of the Units 1/2 Impoundment hydraulically separates the CCR impoundments and the wells and piezometers located to the east (PZ-23 through PZ-26, MW-27, MW-33, and MW-34) and acts as a hydraulic sink with groundwater flowing towards the wetland from east and west.

Slug tests have been performed and analyzed at 21 monitoring wells and piezometers to date, with hydraulic conductivities ranging from 0.055 feet per day (ft/d) at well MW-14, to 242 ft/d at piezometer PZ-20 (**Table 1**). The range in hydraulic conductivity is consistent with the variable stratigraphy in the upper 20 feet of site soils. Additionally, a single recovery test was performed at well MW-44B, which was intentionally screened in clay to evaluate the hydraulic properties of the clay. For the test, MW-44B was pumped to near dryness, and the rate at which it recovered over the next 19 hours was monitored. The estimated hydraulic conductivity of 4.6E-06 ft/d (1.62E-09 centimeters per second [cm/s]) is consistent with clay.

In March 2026, a pump test was performed to collect hydrogeologic data needed to (1) evaluate the feasibility and support design of groundwater extraction at the Site as a component of the remedy and (2) inform groundwater modeling. The location of the pump test well (PW-1) is shown on **Figure 2**. At PW-1, the subsurface is conceptualized as three layers consisting of fine sand with gravel and silt lenses, clay, peat, ash, and solid waste, a sand unit that coarsens with depth, and an underlying silt and clay at the base of the aquifer that exhibits very low hydraulic conductivity. The majority of the monitoring wells are screened in the shallow fine sand with gravel and silt lenses, clay, peat, ash, and solid waste. Well PW-1 was screened in the deeper sand unit from 28 to 38 feet below ground surface.

Following development and a step drawdown test, well PW-1 was pumped at a constant rate of 112 gallons per minute (gpm) for 34 hours, during which time water level drawdown was monitored in the pumping well, nearby monitoring wells, and nearby surface water gauges. Groundwater withdrawn from the aquifer was staged in fractionation tanks (“frac tanks”) placed near the former plant footprint, south of Unit 3A/B and the substation. Water level drawdown was observed in several nearby wells, with the most representative results observed at well MW-01RB, screened in the same sand unit as PW-1. The transmissivity of the sand was estimated to be 2,800 feet squared per day (ft^2/d); based on a sand thickness of 13.5 feet, the hydraulic conductivity was estimated to be 205 feet per day (ft/d).

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No drawdown was measured in several shallow monitoring wells, including wells MW-06 and MW-11, located less than 100 feet from well PW-1. Other wells screened in fill and other materials above the sand aquifer declined slowly during testing. The materials overlying the sand aquifer are therefore interpreted as partially-confining relative to the sand unit. Where drawdown was observed in shallow wells, the vertical hydraulic conductivity across the partially-confining unit was estimated to average approximately 0.32 ft/d, or approximately three orders of magnitude lower than the horizontal hydraulic conductivity of the sand aquifer. Additional information regarding aquifer testing will be presented in an Aquifer Test Memo.

During the installation of well PW-1, four geotechnical samples were collected between 41 and 47 feet below ground surface, from within the silt unit underlying the sand aquifer. All four samples were analyzed for grain size, and two of the four were analyzed for hydraulic conductivity via permeameter testing. The grain size analyses confirmed that silt was the majority fraction in each of the four samples. The permeameter testing determined that the average hydraulic conductivity was 1.1×10^{-3} ft/d in the silt sample collected from 43 to 44 ft bgs; and 5.4×10^{-3} ft/d in the silt sample collected from 44 to 45 feet bgs.

Multiple analytical samples were collected during the pumping phase and submitted for analysis of CCR constituents and other water quality parameters. CCR-related constituents were generally low at well PW-1 during each stage of testing than at most shallow monitoring wells. Only sulfate and TDS were reported to exceed groundwater protection standards (GPS), and each were only reported above GPS in one of three samples collected from PW-1. PFAS concentrations were below groundwater protection standards in the sand layer.

2.1.4 Groundwater Flow Modeling

A 3-D numerical groundwater flow model was created by HDR in 2026 in MODFLOW 6 to better understand groundwater flow under four scenarios. The model was developed using site-specific data, hydrogeologic investigations, and information from the United States Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), and other sources. Model inputs included an annual recharge rate of 20 inches per year for the Grand Haven area based on EGLE developed statewide estimates of annual recharge for public lands (Neff et al., 2025). All four scenarios modeled a combination of capping and a barrier wall over a 50-year simulation period. The four scenarios include:

1. Largest containment area with sheet pile and fully capped area within the containment (similar to Alternative 3)
2. Smaller containment area with sheet pile and fully capped area within the containment (similar to Alternative 4)
3. Smallest containment area with sheet pile and fully capped area within the containment (similar to Alternative 5)
4. Smallest containment area with sheet pile and capped area limited to only a portion of the containment area

Only Scenarios 3 and 4, which did not include capping of the substation, are further discussed in this RAA due to their practicality of construction. Scenario 3 included 95% capping inside the

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barrier wall and resulted in a maximum hydraulic head increase of 0.90 feet after 50 years. Scenario 4 included 59% capping inside the barrier wall and resulted in a maximum hydraulic head increase of 1.11 feet after 50 years. The maximum hydraulic head increase is based on the difference between the calibrated simulated steady-state groundwater elevations and the simulated groundwater elevations for each scenario. The maximum hydraulic head represents the greatest increase in groundwater elevation during the entire 50-year simulation period. None of the modeled scenarios resulted in surface water ponding, and the barrier wall was assigned a hydraulic conductivity of 0.005 feet per day. Additional information regarding the groundwater model will be presented in a Groundwater Model Report that is expected to be published in fourth quarter of 2026.

2.1.5 PFAS Monitoring

A Data Gap Investigation (DGI) was completed in 2023 where two temporary and two permanent monitoring wells were installed, the installation of 40 VAS locations and performed baseline groundwater sample collection from monitoring wells/piezometers. The DGI was completed to provide a more comprehensive understanding of PFAS delineation on-Site. Additional information regarding PFAS monitoring is found in the DGI Report (WSP 2023).

2.1.6 Groundwater Quality

2.1.6.1 CCR

Groundwater monitoring and analysis identified statistically significant concentrations above GPS at the Units 1/2 Impoundment for arsenic, barium, boron, chloride, fluoride, lead, lithium, sulfate, and total dissolved solids (TDS) (**Table 4**), and at the Unit 3A/B Impoundments for boron, chloride, fluoride, lead, lithium, sulfate, and TDS (**Table 5**). Statistical GPS exceedances trigger corrective measures. The remedy selection will be focused on evaluating attainment of GPS for these exceedances in addition to the non-CCR groundwater impacts.

2.1.6.2 Non-CCR

A total of 34 PFAS compounds were analyzed as part of the DGI; however, only PFOS, PFOA, and PFHxS currently have Part 201 cleanup criteria. The RAA focuses on remediation of those compounds in excess of the Part 201 Criteria only. Sampling of these compounds at the Site observed concentrations in monitoring wells greater than the Part 201 Groundwater-Surface Water Interface (GSI) Criteria (**Table 6**).

The following PFAS observations were made:

- PFOA – The highest concentration observed is on the northern side of the Site near MW-08; however nearby sampling locations are noticeably lower in concentration. Wells MW-36, MW-37, and MW-38 exceed the GSI in the footprint of the Facility.
- PFOS – GSI exceedances are widespread across the Site, with the highest concentrations observed along the road between the internal wetland and the north wetland, and along the western edge near the Grand River.

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Potential PFAS sources could be associated with historical filling, including municipal and industrial waste, dredge materials, and other unknown fill activities, as well as historical operations on the Island.

Certain PFAS compounds that have been detected at the Site were first manufactured and used after the municipal landfill activities ceased. Specifically, 6:2 fluorotelomer sulfonic acid (6:2 FTS) was detected on the western portion of the Site and in the internal wetland adjacent to former power plant operations. Because 6:2 FTS was not manufactured or used until after landfill operations ended, its presence cannot reasonably be attributed to municipal waste disposed in the landfill. The source of the detected 6:2 FTS remains unknown.

2.1.7 Additional Sampling Results

2.1.7.1 Coal Ash Delineation

Preceding HDR involvement with the Site, two coal ash investigations were completed; the first by Superior Environmental Corp (Superior) in 2014 and the second by ERM (**Figure 5**). This information was used to support delineation of the Unit 1/2 Impoundment boundary and calculations of coal ash volumes (**Sheet 00C-02-A in Attachment C**).

Volume of coal ash at the Site was estimated based on the boring logs and sampling data collected during the ash investigation studies. Based on the ash characterization data, the ash is generally present between approximately 2 and 10 feet bgs.

2.1.7.2 Soil Sampling

Limited soil samples were collected at vertical aquifer sampling (VAS) locations along the northern access road (just south of the northern wetland) and in the area of historical Facility operations. Soil samples had detections of various PFAS compounds; however, there currently are no Part 201 Generic Cleanup Criteria for PFAS in soil.

2.1.7.3 Deep Groundwater Quality

During the aquifer test, water quality samples were taken to assist in treatment system design and discharge planning. Groundwater quality represents water quality in the native sand above the aquifer lower confining unit. Four groundwater samples were collected over the 34-hour aquifer test and analyzed for CCR constituents and PFAS compounds. Analytical results did not exceed the CCR-related GPS established for the Site and no regulated PFAS compounds were detected.

Groundwater was also sampled in deeper monitoring wells completed in the native sand unit, wells MW-09B, MW-01RB, and MW-15B. Analytical results did not exceed the CCR-related GPS established for the Site or the PFAS GSI Criteria.

2.1.8 Plume Delineation

2.1.8.1 CCR

The 9 CCR constituents are combined into a single plume designation represented by two discrete plumes located in the northwest and southeastern internal wetland areas of the Site (**Sheet 00C-02-C in Attachment C**). The northwestern plume is the largest and includes the

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area around the substation and the Units 1/2 and Unit 3A/B Impoundments, extending east. The southeastern plume is centered around MW-43 and MW-07 adjacent to the internal wetland. The majority of the northwestern plume occurs within the sand aquifer, which consists of varying mixtures of silt, clay, gravel, debris, and muck. The sand is predominantly poorly graded and is interpreted to represent historical fill material. MW-43 and MW-07 are screened between 3 and 8 feet bgs and 11 and 16 feet bgs, respectively, in silty sand with shell fragments.

2.1.8.2 Non-CCR

PFAS plume delineation was based on groundwater GSI Criteria exceedances for PFOS, PFOA, and PFHxS. PFAS compounds were detected in similar locations to CCR with minor differences. PFAS compounds are delineated into four plumes with the additional plumes located on the western boundary of the Site, at wells MW-13 and MW-38 and wells MW-17, MW-36, and MW-39 (**Sheet 00C-02-B in Attachment C**). The southeastern plume includes MW-43. The northwestern PFAS plume is smaller than the northwestern CCR plume and remains close to the road with a small dip into the northwestern corner of the internal wetland.

The PFAS groundwater plume was observed in wells screened at similar shallow depths as the CCR-related plumes, in the shallow sand/refuse consisting of varying mixtures.

2.1.9 Nature and Extent of Contamination

2.1.9.1 Potential for Off-Site Contaminant Transport

The GSI pathway is relevant where hazardous substances in groundwater have the potential to discharge to surface waters of the State. Based on groundwater flow directions and concentrations of PFOS, PFOA, PFHxS, and CCR constituents of concern (COCs) in monitoring wells located near the GSI at the Grand River and the internal wetland, groundwater may discharge to surface water at concentrations exceeding the applicable GSI Criteria (**Figure 6**). Shallow groundwater (ranging from 1 to 9 feet bgs) is migrating off-Site into surface waters.

There is very little potential for groundwater to migrate off-Site through deeper groundwater flow pathways due to the very low hydraulic conductivity of the clay layer underlying the Site.

2.1.9.2 Potential Receptors and Exposure Pathways

Groundwater elevations indicate that groundwater is discharging to surface water, including the Grand River on the west side of the Island, the South Channel on the south side of the Island, the north wetland area, the interior wetland areas, and Units 1/2 Impoundment.

According to EGLE's online database, no residential, commercial, or public water supply wells are located on the Site. However, 21 registered wells are located within one mile of the Site. Construction details for these wells are provided in **Table 7**, and their locations are shown in **Figure 6**. Twenty of these wells are not used for drinking water. Well 70000019132 is the only household supply well and is located northwest of the Site. Based on the regional groundwater flow direction toward the Grand River, this household supply well is likely upgradient of Site-related groundwater impacts (WSP 2023). Although all wells are located within a 1-mile radius of the Site, they are hydraulically separated from the Site by the Grand River or South Channel.

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It is anticipated that Institutional Controls (ICs), including but not limited to deed restrictions prohibiting the installation and use of potable wells on Site, will be incorporated as part of the remedial actions to address impacted groundwater at the Site. The institutional controls will eliminate the drinking water pathway; therefore, the Part 201 Drinking Water Criteria will not be applicable. Because Grand Haven's municipal water intake is located in Lake Michigan, immediately south of the mouth of the Grand River, groundwater concentrations were compared to the generic Part 201 GSI Criteria.

2.1.10 CSM Summary

The conceptual site model (CSM) for groundwater is complex due to the various fill materials and groundwater flow directions on the Site. As shown in **Figure 1**, the Site is surrounded by surface water bodies including the Grand River to the west, the South Channel on the south and east, and a wetland to the north that appears to be connected to the Grand River. CCR and PFAS impacts have been identified in several isolated areas across the Site, primarily within the western area where historical Facility operations occurred. For both CCR and PFAS impacts, the largest plume is in the northwestern area of the Site and extends east. A combined plume map is found on **Sheet 00C-02-D in Attachment C**. The GPS exceedances occur only in the shallow groundwater, which consists of varying mixtures of gravel, sand, silt, clay, refuse, and muck that includes the historical fill/waste material. The impacts to groundwater do not extend to the native sand deeper in the aquifer.

There are remaining data gaps in the understanding of the Site, primarily related to PFAS impacts that will be addressed during the PDI. The PFAS plume delineation is based on groundwater exceedances of the GSI Criteria; however PFAS impacted soil may exist outside the GSI plumes. Currently, EGLE does not have established soil criteria for PFAS; however, by addressing PFAS-impacted groundwater and CCR in remedial actions, it is expected that a substantial portion of PFAS mass present in the soil and solid waste will be included and reduce ongoing PFAS loading to groundwater and support long-term restoration of groundwater quality meeting GSI Criteria.

2.2 Site Constraints

Several Site-specific features and regulatory considerations influence the feasibility, design, implementation, and long-term operation of the corrective action alternatives evaluated in this RAA. These constraints were considered during development of the remedial alternatives and may affect remedy performance, constructability, permitting requirements, implementation schedule, and life-cycle costs.

2.2.1 Physical Site Constraints

Site geology, hydrogeology, and the distribution of impacted media present several constraints that influence corrective measure selection and implementation.

Groundwater occurs at relatively shallow depths across much of the Site, with seasonal water table fluctuations ranging from near ground surface in wetland and former impoundment areas to greater than approximately 10 feet bgs in upland portions of the Site. As a result, construction dewatering may be required during excavation activities, barrier wall installation, utility work, and

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management of excavated materials. Remedies that rely on containment of impacted materials will also require long-term groundwater management to maintain hydraulic control.

Subsurface conditions include areas of soft, low-strength soils characterized by low standard penetration tests (SPT) N-values. These conditions may limit constructability of certain remedial technologies and were identified as a primary factor in eliminating sheet pile walls as a stand-alone remedy.

CCR source materials are present across a relatively large portion of the Site, and CCR-related groundwater impacts extend beyond portions of the source area. In addition, PFAS impacts are only partially coincident with CCR impacts, and a distinct PFAS source area has not been identified (WSP 2023). These conditions complicate development of containment boundaries and influence source removal and consolidation strategies.

2.2.2 Environmental Constraints

2.2.2.1 Wetlands

Several areas exhibiting wetland characteristics are located within the Site. Construction activities within or adjacent to wetland areas will likely require additional permitting, agency coordination, access controls, and mitigation measures. Although temporary access routes may be developed where necessary, wetland conditions constrain both source removal and containment alternatives. Avoidance and minimization of wetland impacts were significant considerations during development of the remedial alternatives.

2.2.2.2 Surface Water Protection

The Site is hydraulically connected to nearby wetlands and surface water receptors, including the Grand River. Accordingly, corrective measures must effectively control contaminant migration, minimize potential constituent loading to surface water, and protect downgradient ecological receptors.

2.2.2.3 Vegetation and Ecological Resources

Existing trees, vegetation, and habitat areas may require protection during remedial implementation. Where avoidance is not feasible, vegetation removal and temporary disturbance may be necessary to facilitate construction activities. Final restoration efforts will balance remedial requirements with ecological considerations and community redevelopment objectives.

2.2.3 Infrastructure Constraints

2.2.3.1 Electrical Substation

A critical electrical substation is located within the Site and serves as an important component of the local electrical distribution system. The substation must remain operational during remedy implementation, and disturbance of existing substation infrastructure is considered unacceptable by the Site owner.

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Corrective measures must therefore incorporate engineered provisions to protect substation facilities, maintain operational access, preserve existing drainage conditions, and prevent flooding or stormwater-related impacts. Final remedy design must also accommodate applicable utility and electrical safety requirements while ensuring long-term functionality of the substation.

2.2.3.2 Utility Corridors

Numerous aboveground and underground utilities traverse the Site. Utility conflicts may affect excavation limits, barrier wall alignments, groundwater management systems, cap design, and restoration activities. Certain remedial alternatives may require utility de-energization, relocation, rerouting, protection measures, or specialized crossing details. A comprehensive utility investigation is underway and will support refinement of remedy design and implementation planning. Additional utility investigations may be needed.

2.2.3.3 Monitoring Infrastructure

Existing monitoring wells are located within the footprint of the remedial alternatives discussed herein and may interfere with construction activities. Where wells cannot feasibly be protected in place, those wells will require abandonment or replacement. In addition, selected remedies may require installation of new monitoring wells, piezometers, and extraction wells that must remain accessible throughout the life of the remedy.

2.2.4 Regulatory Considerations

Implementation of the corrective action alternatives may require federal, state, and local permits, approvals, and agency coordination activities. The type and extent of permitting requirements will depend on the selected alternative and final remedy design. Potential permitting and approval requirements may influence remedy implementability, construction sequencing, implementation schedule, and overall project cost. Coordination with EGLE and other applicable agencies will be required during remedial design to confirm permitting requirements and support remedy implementation.

In April 2026, the United States Environmental Protection Agency (EPA) proposed amendments to the CCR Rule that would rescind the existing CCR Management Unit (CCRMU) regulations while alternative regulatory approaches are evaluated. Although the proposed amendments indicate that substantial changes to the CCRMU program may be forthcoming, the nature and extent of those changes remain uncertain.

In May 2026, HDR prepared a draft Facility Evaluation Report (FER) for the Site that identified several potential CCRMUs, including areas of historic ash that may have the potential to impact groundwater. Due to the ongoing regulatory uncertainty associated with the proposed CCR Rule amendments, the desktop review (FER Part 1) and field delineation (FER Part 2) efforts have not been completed.

Because the potential CCRMUs at the Site may be impacting groundwater and could be subject to future regulation as CCR units, or under similar regulatory requirements such as groundwater monitoring and closure obligations, these areas were conservatively treated as source areas in

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this RAA. The locations of the potential CCRMUs shown on the figures represent the current understanding based on the draft FER Part 1 findings; however, these areas have not yet been field delineated and should be considered approximate.

2.2.4.1 Discharge Limitations

Several groundwater management and discharge options have been preliminarily identified for groundwater generated during construction activities and operation of potential groundwater extraction and treatment (GWET) systems, including discharge through an existing National Pollutant Discharge Elimination System (NPDES) outfall, discharge to a publicly owned treatment works (POTW), off-Site disposal, or reinjection to groundwater.

Existing data indicate that PFAS and mercury may influence treatment requirements and discharge feasibility. Additional evaluation will be required to establish anticipated extraction rates, develop treatment requirements, evaluate discharge alternatives, and determine applicable permitting requirements. If groundwater is discharged to waters of the state, applicable requirements of Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act (NREPA), including NPDES permitting requirements, may apply. Coordination with EGLE will be required to confirm discharge limitations, treatment requirements, and permitting pathways.

2.2.4.2 Permitting Requirements

Depending on the selected corrective measure alternative, permitting and approvals may include:

- Part 31, Water Resources Protection permits and approvals associated with groundwater treatment and discharge activities;
- Potential Part 301, Inland Lakes and Streams permits if future design activities identify impacts to regulated inland lakes, streams, drains, or associated bottomlands;
- Part 303, Wetlands Protection permits for activities impacting regulated wetlands, including excavation, filling, grading, barrier wall construction, temporary access roads, and other construction activities within regulated wetland areas;
- Ottawa County Water Resources Commissioner's Office erosion and sediment control permits (required for earth changes that disturb one or more acres or occur within 500 feet of a lake, stream, or county drain);
- Local grading, earthwork, utility, or construction permits; and
- Coordination with other local agencies regarding drainage features, stormwater management, and discharge locations as needed.

The extent of permitting required will vary among alternatives and may represent a significant implementability consideration, particularly for alternatives involving wetland impacts, groundwater discharge, or construction adjacent to existing infrastructure.

2.2.4.3 Federal Regulatory Requirements

This RAA was prepared in general accordance with the corrective action requirements of the CCR Rule, including the Assessment of Corrective Measures (ACM) requirements specified in

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40 CFR 257.96. Under the CCR Rule, corrective measures must be evaluated based on their performance, reliability, ease of implementation, potential impacts, implementation timeframe, and institutional requirements.

In addition, corrective measures must support the remedy objectives established under 40 CFR 257.97, including:

- Protection of human health and the environment;
- Attainment of GPS;
- Control of sources contributing to releases to groundwater;
- Removal or treatment of released constituents, as appropriate; and
- Management of remedy-generated wastes in a protective manner.

Groundwater monitoring and corrective action requirements established under 40 CFR 257.90 through 257.98 will continue to apply throughout corrective action implementation and remedy performance monitoring.

2.2.4.4 State Regulatory Requirements

Corrective measures must also be implemented in accordance with applicable Michigan environmental regulations administered by EGLE. Key regulatory considerations include:

- Part 31, Water Resources Protection, governing groundwater management activities and discharges to waters of the state;
- Part 303, Wetlands Protection, governing activities within regulated wetlands and associated avoidance, minimization, and mitigation requirements;
- Part 115, Solid Waste Management, which provides relevant considerations for long-term containment systems, cover system performance, infiltration control, stormwater management, and post-construction maintenance of CCR materials remaining in place;
- Concepts commonly applied under Part 201, Environmental Remediation, including exposure pathway management, ICs, long-term stewardship, and future land-use considerations;
- Applicable requirements associated with erosion and sedimentation control, stormwater management, restoration activities, and protection of natural resources; and
- Long-term groundwater monitoring, operation and maintenance, and institutional control requirements associated with the selected remedy.

These regulatory requirements will be evaluated and incorporated into remedial design, permitting, construction planning, and long-term operation and maintenance activities.

2.2.5 Future Land-Use Constraints

2.2.5.1 Community Visioning Considerations

Community-developed visioning layouts provide a framework for future Site restoration and redevelopment and should be considered during final remedy design. Future land-use objectives may influence restoration planning, landscaping, stormwater management, and selection of long-term Site features.

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2.2.5.2 *Future Development Limitations*

While future Site use and redevelopment opportunities have been considered in the evaluation of remedies, the specific implications of leaving CCR- and PFAS-impacted media in place depend on the nature and location of future improvements. Intrusive redevelopment activities may require additional engineering assessment and potential modification of remedy components. Accordingly, the degree of flexibility available for future redevelopment varies among the alternatives evaluated.

2.2.6 Operational Constraints

2.2.6.1 *Power Availability*

Selected remedies may require electrical power for operation of groundwater extraction systems, treatment equipment, monitoring systems, or other infrastructure. This RAA assumes a new local service can be provided from existing on-Site overhead power lines. Power requirements, availability, and potential existing system upgrades will be evaluated during the remedial design phase.

2.2.6.2 *Long-Term O&M Requirements*

Long-term stewardship obligations influence remedy reliability and life-cycle cost. Remediation technologies, green infrastructure, and community visioning layouts may require more maintenance that may not be accounted for in this RAA.

3 Remedial Action Objectives

This RAA builds upon the findings and recommendations presented in the 2024 ACM. The purpose of the RAA is to further develop, refine, and compare corrective action alternatives capable of addressing CCR- and PFAS-related impacts identified at the Site. Corrective action alternatives were developed to support compliance with applicable federal and state regulatory requirements, including GPS established under the Part 201 and the CCR Rule.

Based on the Site CSM, nature and extent of impacts, potential exposure pathways, and identified receptors, remedial action objectives (RAOs) were developed for source materials, groundwater, and surface water to meet the GSI Criteria. These objectives provide the basis for development and evaluation of the corrective action alternatives presented in this RAA.

3.1 Source Material RAOs

The source material RAOs are intended to reduce potential exposure to CCR-impacted media and minimize ongoing CCR and PFAS contributions to groundwater. Specific objectives include:

- Minimize recreational user exposure to impacted source materials.
- Minimize industrial worker exposure to impacted source materials.
- Minimize construction worker exposure to impacted source materials.
- Reduce ongoing groundwater impacts from source materials through source removal, treatment, containment, or other appropriate control measures.

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3.2 Groundwater RAOs

The groundwater RAOs are intended to control groundwater impacts and prevent exposure to impacted groundwater. Specific objectives include:

- Limit off-Site migration of impacted groundwater from Harbor Island.
- Prevent future consumption or use of impacted groundwater for potable, irrigation, industrial, or other beneficial purposes, as appropriate.
- Support attainment of applicable groundwater protection standards.
- Limit ongoing constituent loading from source materials to groundwater where practicable.

3.3 Surface Water RAOs

The surface water RAO is intended to protect aquatic receptors and surface water resources from groundwater-derived impacts. Specific objectives include:

- Prevent or minimize migration of impacted groundwater to adjacent surface water bodies.
- Protect surface water quality and aquatic life from CCR- and PFAS-related groundwater impacts.
- Address the groundwater-surface water interface pathway, where applicable.

The corrective action alternatives presented in this RAA were developed to achieve these RAOs through varying combinations of source control, treatment, containment, groundwater management, and ICs. The alternatives are described in **Section 5** and comparatively evaluated in **Sections 6 and 7**.

4 Technology Screening

This section presents the remedial technologies and process options evaluated for their ability to achieve the RAOs identified in **Section 3**. Consistent with the corrective action requirements of the CCR Rule and accepted remedy evaluation practices, potentially applicable technologies were identified and screened based on their anticipated effectiveness, implementability, and applicability to Site-specific conditions. The purpose of the screening process is to eliminate technologies that are not feasible or are unlikely to effectively achieve the RAOs, while retaining technologies that warrant further evaluation as components of corrective action alternatives.

The technology screening considered Site-specific factors discussed in **Section 2.2**. In this section, technologies are evaluated individually to assess their ability to provide source control, contaminant containment, groundwater management, treatment, monitoring, or exposure prevention, and those determined to be potentially effective are subsequently combined, where appropriate, into corrective action alternatives for detailed evaluation in **Section 5**.

As documented in the 2024 ACM, several technologies were previously evaluated and screened from further consideration, including monitored natural attenuation (MNA) and permeable

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reactive barriers (PRBs). Additional engineering and IC measures not fully evaluated in the ACM were considered during development of this RAA to support a comprehensive remedy evaluation. For this Site, the technologies identified as potentially applicable include ICs, engineering controls, source removal, in situ treatment, hydraulic containment, groundwater extraction and treatment, and engineered cover systems.

The following sections describe each remedial technology, summarize its applicability to Site conditions, identify key advantages and limitations, and discuss whether the technology is retained for further evaluation as a component of corrective action alternatives.

4.1 Administrative and Supporting Controls

4.1.1 Institutional Controls

ICs are non-engineered administrative and legal mechanisms used to minimize the potential for human exposure to impacted environmental media and support the long-term effectiveness of corrective measures. ICs may include environmental covenants, groundwater use restrictions, land-use limitations, permit conditions, zoning restrictions, deed notices, or other enforceable measures that limit activities which could result in unacceptable exposure or compromise remedy performance. ICs may also include informational measures intended to communicate the presence of residual contamination and applicable use restrictions to current and future property owners, occupants, and other stakeholders.

ICs are generally implemented as part of a broader corrective action strategy and are typically used to supplement engineering controls and other remedial measures rather than serve as a stand-alone remedy. Where contamination remains in place following corrective action, ICs may be used to prevent exposure to impacted media, maintain assumptions regarding future land and groundwater use, and preserve the integrity of remedial components. Multiple ICs may be implemented concurrently to provide overlapping layers of protection and enhance long-term remedy reliability.

This technology is retained for further evaluation.

4.1.2 Access Controls

Access controls are physical measures implemented to restrict unauthorized access to areas containing CCR materials, impacted media, or corrective measure infrastructure. Access controls may include fencing, gates, barriers, warning signage, and other Site security measures designed to reduce the potential for direct contact with impacted materials and protect remedial systems from disturbance.

Access controls are usually employed as a supplementary measure to other remedial technologies that address the principal source of contamination. They do not reduce the volume, toxicity, mobility, or concentration of contaminants but may limit human exposure by restricting access.

This technology is retained for further evaluation.

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4.2 Source Control Technologies

4.2.1 Excavation

Excavation is a commonly implemented remedial action for addressing CCR and CCR-impacted soil, waste, sediment, or other environmental media that may serve as a continuing source of contamination. This technology involves the removal of impacted materials using conventional earth-moving equipment followed by appropriate treatment, disposal, or beneficial management in accordance with applicable federal, state, and facility-specific requirements. Excavation activities may also include site grading, restoration, and placement of clean fill following removal. For sites with localized contamination and accessible source areas, excavation activities can provide an effective and reliable means of achieving RAOs by reducing contaminant mass, eliminating or minimizing ongoing release mechanisms, removing potential exposure pathways, and limiting the migration of constituents to groundwater, surface water, or other environmental media. Horizontal and vertical extents of CCR and PFAS plumes are typically refined during pre-design investigations and confirmation sampling is typically performed to verify that applicable cleanup criteria have been achieved.

This technology is retained for further evaluation.

4.2.2 In Situ Stabilization

In situ stabilization (ISS) is a corrective action technology used to reduce the mobility and leaching potential of CCR constituents within impacted media by chemically binding or immobilizing them in place. ISS typically consists of mixing stabilization amendments, such as activated carbon, Portland cement, or other proprietary reagents, directly into CCR or CCR-impacted soils using specialized mixing equipment, such as excavators or augers. Stabilization amendments react with dissolved and sorbed contaminants to reduce solubility, decrease mobility, and limit migration to groundwater and other environmental media. In some applications, the treatment process may also improve the physical properties of the treated material by increasing strength and reducing permeability.

ISS does not remove contaminants from the Site and generally does not destroy contaminants. Instead, it reduces the potential for constituent release by stabilizing contaminants within the treated media to minimize leaching. As a result, ISS is often implemented in conjunction with other corrective measures, such as engineered cover systems, source control measures, groundwater monitoring and treatment, and ICs. ISS may be an effective remedy where reducing contaminant mass flux, controlling source contributions, and minimizing groundwater plume migration are primary corrective actions. The effectiveness of ISS for PFAS stabilization remains an active area of research and is generally less established than its use for inorganic constituents commonly associated with CCR. Additional bench-scale testing may be necessary to evaluate the compatibility and effectiveness of stabilization amendments for PFAS-impacted media at the Site.

This technology is retained for further evaluation.

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4.2.3 Engineered Cap System

An engineered cap system is a containment technology designed to minimize infiltration of precipitation, and to reduce groundwater recharge through CCR and trash materials. Engineered caps function by isolating impacted materials from surface processes and reducing the potential for constituent leaching and migration to groundwater. As a result, cap systems are commonly implemented in conjunction with source containment remedies and other corrective measures to support long-term protection of human health and the environment.

This technology does not remove or destroy contaminants; rather, it provides long-term containment by reducing infiltration and eliminating direct exposure pathways. Accordingly, engineered cap systems are typically implemented in conjunction with other corrective measures, such as containment walls, groundwater extraction and treatment systems, access controls, and ICs. Long-term inspection, maintenance, and monitoring would be required to verify cap integrity and continued remedy performance.

This technology is retained for further evaluation.

4.3 Physical Containment Technologies

Containment technologies are corrective measures designed to physically isolate CCR materials and impacted environmental media, control groundwater flow, and limit the migration of contaminants. Containment technologies are frequently implemented in conjunction with source control measures, groundwater management systems, and ICs to support long-term remedy performance. The containment technology evaluated for this Site is vertical engineered barrier walls, including sheet pile walls and soil-bentonite/cement-bentonite slurry walls.

4.3.1 Sheet Pile Wall

A sheet pile wall consists of interlocking steel sheets installed vertically using heavy construction equipment, typically a crane fitted with a vibratory hammer or impact hammer. The sheets are driven into the subsurface to create a continuous barrier that limits groundwater flow and contaminant migration. Sheet pile walls are typically driven into a low-permeability geologic unit to establish hydraulic containment and are commonly used where construction access is constrained or where installation near surface water features is required. To maintain long-term containment effectiveness, sheet pile walls are often implemented in conjunction with groundwater extraction systems and groundwater gradient management.

For the Site, installation may require sheet piles to extend to the underlying low-permeability confining unit, which occurs at depths of up to approximately 50 feet below ground surface in some areas. In addition, a review of the existing geotechnical data, including field SPT results, indicates that near-surface and subsurface soils across much of the Site are relatively loose/soft and exhibit low bearing capacity. These conditions would increase construction challenges, including equipment stability and wall installation challenges, and could adversely affect constructability and performance. Combined with the substantial installation depth required to achieve a competent confining layer, these conditions would significantly increase implementation complexity and cost. Therefore, this technology is not retained for further

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evaluation as a standalone technology but will be retained for use in conjunction with other barrier wall technologies.

4.3.2 Slurry Wall

A slurry wall is a low-permeability vertical containment system designed to reduce groundwater flow and limit contaminant migration. Slurry walls are typically constructed by mixing native soils with bentonite, cement, slag, or other amendments to create a continuous low-permeability barrier. The barrier wall is generally keyed into an underlying low-permeability confining layer to minimize groundwater flow beneath the wall and establish hydraulic containment. Modern construction methods may utilize in-place mixing technologies, such as augers or one pass trenching, that produce a continuous, homogeneous barrier with minimal disturbance to surrounding soils and limited excavation requirements.

Hydraulic barrier walls are a proven containment technology that can effectively limit the migration of CCR- and PFAS-impacted groundwater when implemented in conjunction with groundwater extraction systems and hydraulic gradient management. Because barrier walls function by containing contamination rather than removing or treating it, long-term monitoring, operation and maintenance, and groundwater management are typically required to verify continued performance and maintain remedy effectiveness.

4.4 Groundwater Extraction and Treatment Technology

GWET, commonly referred to as pump and treat, is a proven corrective action technology used to capture, contain, and treat impacted groundwater. GWET systems utilize extraction wells to establish hydraulic control of a groundwater plume by directing impacted groundwater toward recovery wells, thereby limiting the migration of dissolved constituents and reducing the potential for off-Site plume expansion. Treatment technologies are used to remove, destroy, or immobilize constituents of concern in extracted groundwater prior to discharge, reinjection, reuse, or disposal. GWET is a commonly implemented groundwater remedy for dissolved inorganic constituents and is one of the few established technologies that can also be applied to PFAS-impacted groundwater when paired with appropriate treatment processes.

The extracted groundwater is conveyed to an aboveground treatment system designed to remove constituents of concern prior to discharge, reuse, or reinjection. Depending on Site-specific conditions and applicable regulatory requirements, treated groundwater may be discharged to a POTW, reinjected to the aquifer, or discharged to a surface water body under applicable permits. Treatment systems may incorporate multiple treatment processes based on the constituent profile, treatment objectives, and discharge requirements (see **Section 2.2.4**), including chemical precipitation, filtration, adsorption, ion exchange, and membrane treatment for CCR constituents and granular activated carbon (GAC), ion exchange resins, and reverse osmosis for PFAS.

GWET may be implemented to achieve corrective action objectives by controlling the migration of groundwater impacts, restoring groundwater quality, and supporting compliance with groundwater protection standards. GWET may be used in combination with source control and containment technologies, such as excavation, ISS, engineered cover systems, and hydraulic

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barrier walls, but not as a stand-alone corrective measure due to source material on Site. Groundwater monitoring, operation and maintenance, and periodic system optimization are typically required to evaluate remedy performance and progress toward corrective action objectives.

In addition to reducing constituent concentrations over time, GWET can provide hydraulic containment and groundwater gradient management to support the long-term effectiveness of corrective measures. When designed in conjunction with a hydraulic barrier wall, extraction wells installed within the barrier wall (i.e. upgradient) can be paired with piezometers installed on the outside (i.e. downgradient side) of the wall to monitor groundwater levels and maintain the desired hydraulic gradient across the barrier.

Because groundwater treatment requirements are highly dependent on influent water quality, additional evaluation and treatability testing may be necessary to support remedy design and technology selection. As a result, the final treatment approach would be determined during subsequent design and implementation phases based on groundwater characterization data, anticipated extraction rates, treatability testing results, and applicable regulatory requirements.

5 Description of Remedial Action Alternatives

The corrective action alternatives presented herein were developed based on the findings of the 2024 ACM, Site-specific conditions and constraints discussed in **Section 2**, and the RAOs identified in **Section 3**. The alternatives were developed to satisfy the requirements of the CCR Rule by protecting human health and the environment, controlling the migration of impacted groundwater, reducing or eliminating ongoing constituent loading from CCR source materials, and supporting attainment of GPS. The alternatives also address PFAS in groundwater to meet GSI Criteria. EGLE does not currently have established soil criteria for PFAS, therefore the alternatives are focused on regulated and historical CCR, CCR plume(s), and PFAS plume(s).

The alternatives represent a range of corrective action strategies, including source removal, in situ treatment, containment, groundwater management, and hybrid approaches that combine source control with long-term containment. In developing the alternatives, consideration was given to Site-specific factors including CCR and PFAS impacts, groundwater conditions, wetlands, utility corridors, existing infrastructure, future land-use considerations, and community visioning objectives. The alternatives were designed to address contaminant migration, reduce potential risks to downgradient receptors, including the Grand River, and provide long-term protection of human health and the environment. Because some historical waste materials will remain on Site outside of containment or treatment areas for each alternative, there remains a risk of potential future PFAS impacts. As a result, adaptive management measures may be required as part of each alternative to maintain compliance with applicable GSI Criteria. Additionally, all of the alternatives include the use of ICs, including but not limited to groundwater use restrictions, to address remaining groundwater impacts on Site.

The corrective action alternatives are shown in the drawings included in **Attachment C** and summarized in **Table 8**.

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The descriptions provided below outline the major remedy components, implementation activities, and long-term operation and maintenance requirements associated with each alternative. These remedy components form the basis of the conceptual cost estimates presented in **Attachment E**.

5.1 Alternative 1 – Excavation

Alternative 1 consists of excavation and off-Site disposal of regulated CCR, historical CCR, impacted soil, solid waste, and groundwater within CCR-related plume areas and PFAS-related plume areas (**Sheet 00C-03 in Attachment C**). Under this alternative, CCR materials, groundwater impacted from soils containing CCR and PFAS, soils, and solid waste within the area serving as a continuing source of groundwater contamination would be excavated and transported to an appropriately permitted off-Site disposal facility. Excavation limits would be established based on CCR and historical CCR limits, CCR plume delineation, and PFAS GSI plume delineation data and confirmed through field screening and confirmation sampling to verify attainment of applicable remedial objectives and cleanup criteria. Excavation activities would focus on impacted media associated with documented groundwater exceedances and would not remove all historical waste materials located across the Site. During excavation, treatment of impacted groundwater will be conducted as part of the dewatering activities. In addition to treatment of impacted groundwater within the excavation areas, ICs, including but not limited to deed restrictions prohibiting the installation and use of potable wells on Site, will be incorporated to address remaining impacted groundwater on Site.

Although long-term groundwater monitoring would likely remain necessary to evaluate post-remedy groundwater conditions and document progress toward achievement of GPS and RAOs, this alternative provides the highest degree of source control and remedy permanence among the alternatives evaluated. The major components of Alternative 1 are described below.

5.1.1 Pre-Design and Pre-Construction Activities

Prior to remedy implementation, additional subsurface investigation activities would be completed to refine the horizontal and vertical extent of historical CCR and PFAS groundwater plumes to more refine the excavation extents. Investigation activities would include advancement of soil borings and collection of representative samples to further delineate historical ash and PFAS in groundwater, support remedial design, and develop excavation volume estimates. Information obtained during the pre-design investigation would be used to establish excavation boundaries, verify constructability assumptions, and support preparation of final design documents.

Utility potholing and daylighting would be performed to identify locations of existing infrastructure. Additional investigations may include utility coordination studies, geophysical surveys to identify buried concrete or subsurface structures, soil sampling to confirm buried coal ash extents, and other assessments necessary to support design and construction planning.

5.1.2 Site Preparation

Prior to initiation of excavation activities, site preparation measures would be completed to establish work areas, protect existing Site features, and install proper soil erosion and sediment

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control measures. Site preparation would include field staking of work limits, environmentally sensitive areas, and known infrastructure. Utility clearance activities would include notification of MISS DIG (811) and completion of a private utility locating program, as necessary, to identify and mark subsurface utilities within and adjacent to the construction area. Wetland boundaries, the substation, and other areas requiring protection would be clearly delineated, and appropriate construction signage would be installed throughout the work area. Existing monitoring wells located within the excavation footprint would be properly abandoned in accordance with applicable requirements to prevent vertical migration of groundwater and contaminants.

Before contractor mobilization of heavy equipment, temporary protection measures would be installed around sensitive Site features anticipated to remain in place during construction, including the electrical substation, utility poles, Site lighting, and significant trees located adjacent to construction activities. Protective barriers, such as concrete traffic barriers (K-rails) or similar measures, would be used as necessary to minimize the potential for accidental damage during excavation and material handling operations.

Clearing and grubbing would be performed within the limits of disturbance to facilitate access and construction. Smaller trees, shrubs, and brush would be removed and stockpiled for subsequent loading, transportation, and disposal at an appropriately permitted off-Site disposal facility. Disposal activities would include transportation, landfill placement, and payment of applicable disposal and tipping fees. Following completion of clearing and grubbing activities, the Site would be prepared for implementation of excavation and material management operations associated with Alternative 1.

5.1.3 Excavation and Disposal

Under Alternative 1, the excavation area was determined by including:

- Regulated CCR,
- Historical CCR,
- CCR groundwater plume, and
- PFAS groundwater plume.

Therefore, within the excavation area, regulated and historical CCR, soils, and solid waste, as well as groundwater impacted by PFAS and CCR that is removed as part of construction dewatering (generally referred to as “impacted materials”) would be excavated above the clean sand and transported off Site for disposal at an appropriately permitted facility. Excavation activities would be preceded by installing temporary sheet pile along the Grand River, removal and stockpiling of clean surface soils, where practicable, for potential reuse during Site restoration. Contaminated soils would then be excavated using conventional earthmoving equipment. In areas where excavation must occur in close proximity to sensitive infrastructure, including the electrical substation, existing monitoring wells, and underground utilities, hydro excavation techniques would be utilized to minimize the potential for damage to existing facilities. Materials generated through hydro excavation activities would be managed and transported for appropriate off-Site disposal.

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During excavation, clean and impacted materials would be segregated to the extent practicable to minimize disposal volumes and maximize opportunities for beneficial reuse of suitable materials. Saturated soils may require treatment with Portland cement or other stabilization amendments to improve material handling characteristics and facilitate transportation and disposal. Existing concrete structures located within the excavation footprint would be removed to the depth necessary to access underlying CCR and CCR-impacted materials. Concrete debris would be processed, stockpiled, loaded, and transported off Site for disposal or recycling, as appropriate. Confirmation sampling would be conducted throughout excavation activities to verify the extent of removal and demonstrate attainment of remedial objectives and clean closure criteria.

Dewatering is anticipated during excavation activities due to the depth of excavation and anticipated groundwater conditions. Dewatering would be performed through the excavation, utilizing localized sump areas or excavation low points to collect groundwater and stormwater encountered during construction. Collected water would be pumped to a mobile treatment system and managed in accordance with applicable permit requirements prior to discharge. Field monitoring and analytical sampling would be conducted as necessary to support dewatering operations and verify compliance with applicable discharge criteria.

Although a discrete PFAS source has not been identified, the PFAS groundwater plumes are included within the proposed excavation areas. Excavation below the water table and construction dewatering in the area would facilitate removal of PFAS-impacted groundwater present within the excavation footprint. Soils and solid waste excavated from within the delineated PFAS plume areas would be removed and transported off Site for appropriate disposal. Collectively, these activities are expected to remove a substantial portion of the PFAS mass present, reduce ongoing PFAS loading to groundwater, and support long-term restoration of groundwater quality.

Excavated CCR materials, impacted soils, and concrete debris would be loaded and transported to appropriately permitted off-Site disposal facilities. Transportation, disposal, and associated tipping fees would be incorporated into remedy implementation. Following completion of excavation activities and confirmation sampling, excavated areas would be backfilled with imported clean fill and suitable on-Site materials, where appropriate. Backfill would be placed and compacted in accordance with engineering specifications to restore grade and provide long-term stability. Final grading would be completed to promote positive drainage and prepare the Site for restoration and future use.

This alternative would permanently remove the majority of CCR source materials from the Site and eliminate or substantially reduce ongoing constituent loading to groundwater from CCR. CCR source material beneath the substation would remain in place to avoid disturbing critical infrastructure upon which the City of Grand Haven relies. It is anticipated that this alternative also will remove the majority of the PFAS source material in each plume area due to the likelihood that the source material is located inside the PFAS groundwater plume area that is proposed to be excavated; however, some PFAS source material may remain on Site. This

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alternative provides the highest degree of source control and remedy permanence among the alternatives evaluated.

5.1.4 Site Restoration

Upon completion of excavation, confirmation sampling, backfilling, and grading activities, the Site would be restored to establish long-term stability, minimize erosion, promote stormwater management, and support future Site use. Site restoration activities would be designed to comply with applicable federal, state, and local requirements and would be coordinated with the overall remedial design to ensure protection of human health and the environment. Where construction activities result in temporary or permanent impacts to jurisdictional wetlands, wetland restoration or mitigation measures would be implemented in accordance with applicable permit requirements.

Final restoration planning will consider the community visioning layouts developed during stakeholder engagement activities. These layouts represent potential future land use concepts identified by the surrounding community and will be considered during development of the final restoration design to the extent practicable. The final restoration plan will balance community preferences with engineering, environmental, operational, and regulatory considerations associated with implementation of the selected remedy.

Following restoration, the Site would be monitored as necessary to verify successful establishment of vegetation, evaluate the performance of stormwater controls, and identify any maintenance needs. Supplemental seeding, planting, grading, or repairs may be performed during the establishment period to ensure restoration objectives are achieved and long-term Site stability is maintained.

5.1.5 O&M and Periodic Monitoring Activities

Following implementation of Alternative 1, annual operation and maintenance (O&M) activities would primarily consist of environmental monitoring and inspection activities intended to verify continued remedy performance and document progress toward achievement of corrective action objectives. Annual O&M activities may include:

- Groundwater monitoring and sampling in accordance with the approved monitoring program;
- Laboratory analysis of groundwater samples for CCR constituents, PFAS, mercury, and other constituents of concern, as required;
- Data validation, evaluation, and reporting;
- Routine Site inspections to evaluate Site conditions, drainage features, restored areas, and revegetation success;
- Minor maintenance of restored areas, including localized grading repairs, erosion repair, vegetation management, and replacement of damaged signage, where necessary; and
- Regulatory reporting and project management associated with annual monitoring and maintenance activities.

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Because CCR source materials would be removed from the Site under this alternative, long-term operation of active remedial systems, maintenance of engineered containment structures, and management of residual source materials are not expected to be required.

Following excavation and backfill, groundwater monitoring would be used to evaluate the effectiveness in meeting GSI Criteria and document changes in groundwater conditions following implementation. Because this alternative does not include removal of all historical waste materials located across the Site, there remains a risk of future PFAS impacts to groundwater beyond the treated zones. As a result, adaptive management measures may be required to maintain compliance with applicable GSI Criteria.

Periodic maintenance activities may be required throughout the post-construction monitoring period to address settlement, erosion, vegetation establishment, and other Site conditions that develop over time. Periodic O&M activities may include:

- Supplemental seeding, planting, and revegetation efforts;
- Replacement of trees, shrubs, or other vegetation that fail to establish;
- Repair and restoration of stormwater management features, including swales, drainage channels, culverts, energy dissipation features, and erosion-control measures;
- Localized regrading to address settlement or drainage issues;
- Repair or replacement of access roads utilized for monitoring and maintenance activities;
- Periodic maintenance or replacement of fencing, signage, and other access-control features, if retained following restoration; and
- Five-year remedy performance evaluations or other periodic regulatory reviews, as required.

Periodic maintenance activities would be implemented on an as-needed basis following inspection findings or to address normal deterioration associated with environmental conditions and Site use.

5.2 Alternative 2 – In Situ Stabilization

Alternative 2 consists of ISS of regulated and historical CCR, soils, solid waste, and groundwater impacted by PFAS and CCR remaining in place (**Sheet 00C-04 in Attachment C**). Under this alternative, stabilization amendments would be mixed directly into impacted media to reduce constituent mobility and leachability, thereby solidifying the waste and reducing or eliminating constituent loading to groundwater. Unlike Alternative 1, contaminated materials would remain on Site following remedy implementation, and long-term remedy effectiveness would depend on the performance of the stabilized treatment zone. Because ISS will only stabilize source material and not groundwater, an on-Site treatment system will be installed and operated to maintain compliance with groundwater standards.

ISS bench testing was performed demonstrating that ISS recipes can achieve a performance standard of low permeability and high strength at the Site; however, leachate testing has not been performed and would be required by EGLE to approve this technology. Additional bench-

scale testing would be anticipated to evaluate stabilization effectiveness for CCR metals and PFAS and support final amendment selection and dosage requirements. Long-term groundwater monitoring would be required to evaluate treatment performance and document progress toward achievement of GPS and RAOs. The major components of Alternative 2 are described below.

5.2.1 Pre-Design Investigation

Prior to remedy implementation, additional subsurface investigation activities would be completed to refine the horizontal and vertical extent of historical CCR and PFAS groundwater plumes proposed for treatment. Investigation activities would include advancement of soil borings and collection of representative samples to support remedial design and develop treatment volume estimates. Information obtained during the pre-design investigation would be used to establish treatment boundaries, verify constructability assumptions, and support preparation of final design documents.

Utility potholing and daylighting would be performed to identify locations of existing infrastructure. Additional investigations may include utility coordination studies, geophysical surveys to identify buried concrete or subsurface structures, and other assessments necessary to support design and construction planning.

Because PFAS has been identified as a COC at the Site, additional bench-scale treatability testing would be performed to evaluate the effectiveness of proposed stabilization amendments for PFAS. Previous bench-scale testing has demonstrated the effectiveness of the proposed treatment reagents for stabilization of CCR-related constituents; however, additional testing would be required to evaluate treatment performance for PFAS and support final amendment selection and dosage requirements.

5.2.2 Pre-Construction Submittals, Mobilization, and Demobilization

Prior to field implementation, the selected contractor would prepare and submit construction work plans, health and safety plans, quality assurance and quality control documentation, material specifications, and other required submittals for review and approval. Following approval of the required pre-construction documentation, personnel, equipment, treatment materials, and support infrastructure would be mobilized to the Site.

Mobilization activities would include delivery of specialized stabilization equipment, amendment storage and handling systems, temporary construction facilities, erosion and sediment control measures, and utility locating and protection measures. Upon completion of remedy implementation, all temporary equipment, materials, and construction support facilities would be removed from the Site and the contractor would demobilize in accordance with approved project requirements.

5.2.3 Site Preparation

Site preparation activities would be conducted prior to treatment operations to establish safe and efficient work areas and protect existing Site infrastructure. These activities would include field staking of treatment areas, utility corridors, wetland boundaries, the electrical substation,

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and other sensitive features. Utility locating would be completed through MISS DIG (811) and private utility locating services, as applicable. Construction signage and access-control measures would be installed to identify active work areas and minimize unauthorized entry into the construction zone.

Existing monitoring wells located within treatment areas would be properly abandoned in accordance with applicable requirements prior to stabilization activities. Surface features anticipated to remain in place, including the electrical substation, utility poles, lighting infrastructure, and significant trees outside the treatment area, would be protected through the installation of temporary protective barriers and other measures as necessary to prevent damage during construction.

5.2.4 Source Control – In Situ Stabilization

The objective of ISS is to reduce constituent mobility and leaching potential by mechanically mixing stabilization amendments directly into impacted media to chemically bind or immobilize constituents. Unlike excavation, this alternative does not remove impacted materials from the Site. Instead, it treats impacted materials in place to reduce ongoing constituent loading to groundwater and supports achievement of corrective action objectives, but it does not treat existing impacted groundwater as a standalone remedy. A groundwater extraction and treatment system would be installed as a component of this alternative to treat impacted groundwater and maintain Site compliance.

A discrete PFAS source has not been identified, and data indicate PFAS occurrence may be widespread across the Island. Consequently, the delineated treatment areas were established based on the distribution of PFAS-impacted groundwater rather than identified source areas. Because the locations and extent of PFAS source materials remain uncertain, the observed groundwater impacts may not be fully coincident with all areas contributing PFAS impacts to groundwater. While ISS would reduce PFAS mobility within treated areas, there remains the potential for PFAS source materials outside the treatment footprint to continue contributing to groundwater impacts, even if treatment objectives are achieved within the stabilized footprint. This uncertainty is an important consideration in the design and implementation of the ISS alternative and alternatives that provide source removal versus hydraulic containment.

Prior to treatment, concrete structures, slabs, buried debris, and other subsurface obstructions that could interfere with stabilization equipment would be removed as necessary. Temporary sheet pile would be installed along the Grand River. Work pads and equipment access areas would then be established and maintained to facilitate safe and efficient treatment operations. Stabilization activities would be performed using specialized mixing equipment capable of blending amendments uniformly throughout the target treatment interval.

Based on preliminary contractor evaluations and bench-scale testing results, treatment amendments are anticipated to include Portland cement and carbon-based additives. For planning-level cost estimating purposes, a Portland cement addition rate of approximately 15 percent by weight and a carbon amendment addition rate of approximately 2 percent by weight have been assumed. Final amendment selection and application rates would be confirmed

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during remedy design and may be modified based on additional characterization data, field observations, and treatability testing results.

The stabilization process is expected to reduce constituent mobility by decreasing permeability and reducing constituent leachability within treated materials. Following treatment, quality assurance and quality control activities may include collection of verification samples, treatment performance testing, and evaluation of physical and chemical treatment objectives to verify successful implementation of the remedy.

5.2.5 Groundwater Treatment System Installation

Because ISS will only stabilize source material and not groundwater, an on-Site treatment system will be installed and operated to maintain compliance with groundwater standards. The system would consist of groundwater extraction wells, an on-Site treatment plant, and associated conveyance lines and electrical equipment. The extraction wells would be used to monitor hydraulic conditions and evaluate the effectiveness of ISS to reduce leachability to groundwater.

Groundwater extraction wells would be operated as necessary to control groundwater elevations and minimize groundwater flow off Site. Extraction would be initiated when the hydraulic head measured within an extraction well exceeds a certain threshold to be determined in the PDI. This operational threshold will be based on Site-specific hydrogeologic conditions and the hydraulic properties of the underlying low-permeability confining clay unit.

Extracted groundwater would be conveyed to an on-Site treatment system for treatment and management in accordance with applicable regulatory requirements. Groundwater levels within the extraction wells would be routinely monitored to evaluate system performance, guide extraction well operation, and verify the remedy system continues to meet performance expectations.

5.2.6 Cover System Installation

Following the addition of treatment amendments and groundwater gradient control system, an engineered cover system would be installed within the barrier wall containment area. Prior to cap construction, the contained area would be fine graded and proof rolled to establish a suitable foundation for cover installation.

For the Site, the engineered cap system would consist of a geosynthetic clay liner (GCL) overlain by a 40-mil linear low-density polyethylene (LLDPE) geomembrane, a geocomposite drainage layer, 42 inches of protective soil cover, and 6 inches of topsoil. The GCL and geomembrane would serve as the primary low-permeability barrier and would be designed to satisfy CCR Rule closure performance requirements by minimizing infiltration and achieving an equivalent permeability less than or equal to the permeability of the underlying liner system or natural subsoils, or no greater than 1×10^{-5} cm/sec, whichever is less. The protective cover and topsoil layers are included to account for potential post-construction Site uses and will be refined or confirmed in the remedial design.

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The geocomposite drainage layer would promote lateral drainage and minimize hydraulic head on the underlying barrier layers, while the protective soil and topsoil layers would protect the geosynthetic components, support vegetation establishment, minimize erosion, and enhance long-term stability. The engineered cap would be installed over CCR and PFAS remaining in place within the containment area to reduce infiltration, minimize the generation of impacted groundwater, and limit the migration of constituents from source materials. The cover system would also be designed to satisfy applicable CCR Rule performance requirements and function as the primary infiltration control component of the containment remedy.

Special design considerations would be required where the cover system interfaces with existing infrastructure, including the electrical substation, utility poles, monitoring wells, and other Site features that must remain operational following remedy implementation. Final design would include development of cap tie-in details, utility penetrations, monitoring well completions, anchor trenches, and localized drainage controls necessary to maintain cap integrity while preserving access to critical infrastructure and environmental monitoring locations. Particular consideration would be required for the numerous utility poles and monitoring wells located within the proposed containment footprint to ensure continued operation and long-term monitoring capabilities without compromising the performance of the cover system.

Because CCR and PFAS would remain in place beneath the engineered cover system, future land use within the capped area would be subject to restrictions necessary to protect remedy integrity. Activities that could damage or penetrate the cap system, including construction of large buildings, foundations, underground utilities, or other intrusive improvements including trees and deep-rooted shrubs, would generally be prohibited unless additional engineering evaluation and regulatory approval were obtained. Future development requiring disturbance of the cap and underlying amended impacted materials would likely require removal of affected portions of the cover system, excavation and off-Site management, installation of clean backfill, and restoration of the cover system or other approved corrective measures. As a result, future Site development opportunities within the capped area may be limited compared to alternatives that achieve closure through source removal.

5.2.7 Site Restoration

Following completion of stabilization activities, disturbed areas would be restored to promote long-term stability, effective stormwater management, and compatibility with futureSsite use objectives. Restoration activities would include grading treatment areas, repair of access routes and work pads as necessary, placement of topsoil in disturbed areas, and re-establishment of vegetation.

Final Site restoration will consider the community visioning layouts developed during stakeholder engagement activities and will incorporate those concepts to the extent practicable so as to maintain remedial performance objectives. Revegetation would utilize species consistent with applicable local, state, and federal requirements and may include a combination of native grasses, shrubs, and trees. Stormwater management features would be incorporated

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into the final design as necessary to reduce erosion, maintain stable drainage patterns, and support long-term remedy performance.

Following restoration, periodic inspections and maintenance activities would be conducted to evaluate vegetation establishment, drainage conditions, erosion control measures, and overall Site stability. Supplemental grading, seeding, planting, or maintenance activities would be performed as necessary to ensure restoration objectives are achieved.

5.2.8 O&M and Periodic Monitoring Activities

Following implementation of Alternative 2, annual O&M activities would be conducted to evaluate remedy performance and verify that treated materials continue to effectively reduce constituent mobility and leaching potential. Annual O&M activities would primarily consist of environmental monitoring, Site inspections, and reporting requirements associated with the long-term management of stabilized materials.

Annual O&M activities may include:

- Groundwater monitoring and sampling in accordance with the approved monitoring program;
- Laboratory analysis of groundwater samples for CCR constituents, PFAS, mercury, and other constituents of concern;
- Evaluation of groundwater quality trends and remedy performance;
- Routine inspections of restored treatment areas to identify evidence of settlement, erosion, ponding, or other conditions that may affect remedy performance;
- Inspection and maintenance of stormwater management features and drainage controls;
- Vegetation management and invasive species control, as necessary;
- Maintenance of access controls, signage, and other Site features;
- Implementation and maintenance of institutional controls, if required; and
- Preparation of annual monitoring reports and regulatory submittals.

Because treated CCR and PFAS would remain in place under this alternative, long-term groundwater monitoring would be expected to remain an important component of remedy management and performance verification.

Periodic maintenance activities would be conducted as needed to maintain Site stability, support long-term remedy performance, and address conditions identified during inspections or monitoring activities. These activities would generally occur less frequently than annual O&M activities but may require greater effort or cost when implemented.

Periodic O&M activities may include:

- Supplemental revegetation, tree planting, and restoration of disturbed areas;
- Replacement of vegetation that fails to establish or meet performance objectives;
- Localized regrading to address settlement, drainage issues, or erosion;
- Repair or replacement of stormwater management features, including swales, culverts, energy dissipation structures, and erosion-control measures;

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- Repair or maintenance of access roads used for monitoring and maintenance activities;
- Additional monitoring, sampling, or performance evaluations if groundwater monitoring results indicate changing Site conditions;
- Reassessment of institutional controls and land-use restrictions, as necessary; and
- Periodic remedy performance reviews and regulatory evaluations.

Depending on the results of long-term groundwater monitoring, periodic performance assessments may also be conducted to evaluate whether the stabilized materials continue to achieve corrective action objectives and effectively limit constituent migration. If monitoring data indicate that treatment performance is not meeting expectations, additional investigation, treatability testing, or implementation of supplemental corrective measures may be required.

5.3 Alternative 3 – Full Containment

Alternative 3 consists of hydraulic containment of regulated and historical CCR, soils, solid waste, and PFAS and CCR plumes through construction of a barrier wall, installation of an engineered cover system, and implementation of a groundwater gradient control system (**Sheet 00C-05 in Attachment C**). Under this alternative, CCR and PFAS source materials would remain in place and be isolated through a combination of infiltration reduction, hydraulic containment, and groundwater management measures. The remedy is intended to limit constituent migration, reduce groundwater recharge through impacted materials, and support long-term protection of downgradient receptors. ICs, including but not limited to deed restrictions prohibiting the installation and use of potable wells on Site, will be incorporated to address the impacted groundwater on Site. Because impacted materials would remain on Site, long-term operation, maintenance, and monitoring of the containment system and groundwater gradient control system would be required. The major components of Alternative 3 are described below.

5.3.1 Pre-Design Investigation

Prior to design and construction, additional field investigations would be completed to support final engineering design of the containment system. Investigation activities would include advancement of geotechnical borings along the proposed barrier wall alignment to characterize subsurface conditions, identify the depth and continuity of the underlying confining layer, refine the horizontal and vertical extent of historical CCR and PFAS groundwater plumes, and evaluate constructability considerations. Additional utility investigations, including utility potholing and daylighting, would be performed to verify the location and depth of existing utilities and infrastructure that may conflict with barrier wall construction.

Additional evaluations may include utility coordination, identification of required outages or temporary service interruptions, geophysical investigations to identify buried structures or concrete features, and other activities necessary to support final design. Information obtained during these investigations would be used to refine the barrier wall alignment, evaluate utility conflicts, establish tie-in details, and support preparation of construction documents.

5.3.2 Pre-Construction Submittals, Mobilization, and Permitting

Prior to construction, the selected contractor would prepare and submit required work plans, health and safety plans, quality assurance and quality control documentation, construction

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sequencing plans, and material specifications for review and approval. Necessary permits (e.g. EGLE Part 303 wetland permit) and regulatory approvals would be obtained prior to initiating construction activities. Because the proposed barrier wall alignment traverses jurisdictional wetland areas, implementation of the remedy may require permitting and coordination with applicable federal, state, and local agencies.

Mobilization activities would include delivery of specialized barrier wall construction equipment, construction materials, temporary facilities, and erosion and sediment control measures. Upon completion of construction, all temporary equipment and support facilities would be removed from the Site and the contractor would demobilize.

5.3.3 Site Preparation

Site preparation activities would be completed to establish safe working conditions and support construction of the containment system. Erosion and sediment control measures would be installed prior to earth-disturbing activities and maintained throughout construction. Work limits, wetlands, utilities, the electrical substation, and other sensitive features would be surveyed and staked in the field. Utility locating activities would include coordination with MISS DIG (811) and private utility locating services, as appropriate. Construction signage and access-control measures would be installed to identify active work areas.

Existing monitoring wells located within construction areas would be abandoned or removed, as necessary, in accordance with applicable requirements. Surface infrastructure anticipated to remain in place, including the electrical substation, utility poles, Site lighting, and significant trees outside construction limits, would be protected through installation of temporary barriers or other protective measures.

Clearing and grubbing activities would be performed within the limits of disturbance to facilitate barrier wall construction. Vegetation, brush, and small trees would be removed and managed appropriately. Construction through wetland areas may require establishment of temporary working platforms using imported fill, timber mats, or other measures to provide sufficient equipment access while minimizing disturbance to saturated soils and wetlands. Utility relocation or rerouting may also be required where existing infrastructure conflicts with the proposed barrier wall alignment.

5.3.4 Barrier Wall Installation

Alternative 3 includes construction of a continuous low-permeability hydraulic barrier wall designed to fully surround assumed CCR and PFAS source materials and associated impacted groundwater. The barrier wall would function as a hydraulic containment system intended to reduce groundwater flow through the source area and limit migration of dissolved constituents beyond the containment boundary.

Prior to full-scale construction, laboratory testing would be completed to develop a Site-specific wall mix design and evaluate hydraulic performance characteristics. A pilot or test section may be constructed to verify constructability and demonstrate that design performance objectives can be achieved. Following successful completion of the test section, the barrier wall would be

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installed along the full containment alignment using in-place soil mixing techniques that blend native soils with bentonite and other amendments to create a continuous low-permeability barrier keyed into the underlying confining layer.

Construction activities may require temporary isolation, de-energization, relocation, or rerouting of utilities that conflict with the barrier wall alignment. Following wall installation, utilities crossing the containment boundary would be re-established using engineered penetrations and sealing methods designed to maintain the integrity of the containment system.

Barrier wall construction is anticipated to generate excess soil and mixed materials requiring off-Site management. Saturated soils may require stabilization prior to transportation and disposal. All generated materials would be characterized and managed in accordance with applicable regulatory requirements.

5.3.5 Groundwater Gradient Control System Installation

To support long-term hydraulic containment, a groundwater gradient control system would be installed in conjunction with the barrier wall. The system would consist of paired groundwater extraction wells located within the containment area and groundwater monitoring piezometers installed outside the barrier wall. The paired wells and piezometers would be used to monitor hydraulic conditions across the containment boundary and evaluate the effectiveness of the remedy in maintaining hydraulic containment.

The gradient control system would maintain the assumed 1-foot head differential between each paired well and piezometer, with an estimated treatment flow rate of approximately 19 gpm. The assumed gradient control of 1-foot is used for all containment alternatives and was established for costing purposes. The gradient control will be defined in the remedial design.

Groundwater extraction wells would be operated as necessary to control groundwater elevations within the contained area and minimize groundwater mounding. Extraction would be initiated when the hydraulic head measured within an extraction well exceeds the hydraulic head measured in the associated exterior piezometer by a specific operational threshold. This operational threshold will be based on Site-specific hydrogeologic conditions and the hydraulic properties of the underlying low-permeability confining clay unit. Maintaining the target head differential would minimize the potential for groundwater migration beneath the barrier wall through the confining layer and support long-term containment performance.

Extracted groundwater would be conveyed to an on-Site treatment system for treatment and management in accordance with applicable regulatory requirements. Groundwater levels within the extraction wells and paired piezometers would be routinely monitored to evaluate system performance, guide extraction well operation, and verify the containment system continues to maintain the desired hydraulic conditions.

5.3.6 Cover System Installation

Following completion of the soil consolidation and grading activities, an engineered cover system would be installed over the contained and consolidated impacted materials. Prior to cap

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installation, the containment area would be fine graded and prepared to provide a suitable foundation for cover placement.

The engineered cover system would likely consist of a GCL, a 40-mil LLDPE geomembrane, a geocomposite drainage layer, 42 inches of protective soil cover, and 6 inches of topsoil. The cover system would function as the primary infiltration control component of the remedy and would be designed to minimize precipitation infiltration, reduce groundwater recharge through CCR materials, and support long-term containment performance. The protective cover and topsoil layers are included to account for potential post-construction Site uses and will be refined or confirmed in the remedial design.

Special design considerations would be required at locations where the cover interfaces with existing infrastructure, including the electrical substation, utility poles, utility corridors, and long-term monitoring points. Final design would incorporate anchor trenches, utility penetrations, monitoring well completions, and stormwater controls necessary to maintain cap integrity while allowing continued operation of critical infrastructure and environmental monitoring systems.

Because impacted materials would remain beneath the engineered cover system, future land use within the capped area would be subject to restrictions necessary to maintain remedy performance. Construction of buildings, foundations, underground utilities, or other intrusive improvements would generally require additional engineering evaluation, regulatory coordination, and potential removal of impacted materials and affected portions of the cover system.

5.3.7 Site Restoration

Following installation of the engineered cover system, disturbed areas would be restored to provide long-term stability, effective stormwater management, and compatibility with future Site uses. Final restoration planning would consider the community visioning layouts developed through stakeholder engagement and would seek to balance community preferences with the engineering and operational requirements necessary to maintain remedy performance.

Restoration activities would focus on establishment of a stable vegetative cover and integration of stormwater management features into the final Site configuration. Revegetation would be performed in accordance with applicable local, state, and federal requirements and may include native grasses, shrubs, and tree plantings located outside capped areas where root systems could adversely impact remedy components. Species selection, planting density, and habitat considerations would be developed during final design and, if appropriate, would be refined based on the selected community visioning layout.

Stormwater management features would be incorporated throughout the restored Site to promote positive drainage, minimize erosion, and support long-term performance of the containment remedy. Potential stormwater controls may include vegetated swales, drainage channels, energy dissipation structures, detention or retention features, and other best management practices as appropriate. Stormwater management infrastructure would be

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engineered based on Site-specific hydrologic and hydraulic analyses while considering the selected visioning layout and future land use objectives.

Following restoration, long-term monitoring, inspection, and maintenance activities would be required to evaluate barrier wall performance, groundwater conditions, cap integrity, stormwater management features, vegetation establishment, and overall remedy effectiveness.

5.3.8 O&M and Periodic Monitoring Activities

Following construction of the barrier wall, groundwater gradient control system, engineered cover system, and Site restoration features, annual O&M activities would be required to verify remedy performance and maintain long-term containment of CCR and PFAS materials remaining in place. Annual O&M activities would focus on monitoring, inspection, operation of hydraulic control infrastructure, and maintenance of remedy components.

Annual O&M activities may include:

- Groundwater level monitoring within extraction wells and paired piezometers to evaluate hydraulic containment performance and verify maintenance of the target groundwater gradient;
- Operation of the groundwater extraction system when groundwater elevations within the containment area exceed established operating criteria;
- Groundwater monitoring and sampling for CCR constituents, PFAS, mercury, and other constituents of concern;
- Laboratory analysis, data validation, trend analysis, and preparation of annual monitoring reports;
- Routine inspection of the barrier wall system for evidence of settlement, erosion, changes in Site conditions, or conditions that could affect containment performance;
- Inspection of the engineered cover system to evaluate surface conditions, drainage patterns, vegetation establishment, erosion, settlement, animal burrowing, and potential impacts to geosynthetic components;
- Inspection and maintenance of stormwater management features, including drainage channels, swales, culverts, energy dissipation structures, and other best management practices;
- Inspection and maintenance of extraction wells, piezometers, monitoring wells, groundwater treatment system and associated monitoring infrastructure;
- Maintenance of access controls, signage, and institutional controls, as applicable; and
- Routine Site management, regulatory reporting, and project administration activities.

Long-term operation of the groundwater gradient control system is anticipated under this alternative to manage groundwater elevations within the containment area and minimize the potential for groundwater migration beneath the barrier wall.

Periodic maintenance activities would be performed on an as-needed basis throughout the life of the remedy to maintain the integrity and effectiveness of the containment system. These

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activities would generally occur at longer intervals and may require more significant expenditures than routine annual maintenance activities.

Periodic O&M activities may include:

- Repair of localized settlement, erosion, or surface drainage issues affecting the engineered cover system;
- Replacement or restoration of vegetative cover in areas where vegetation fails to establish or maintain adequate coverage;
- Repair, replacement, or enhancement of stormwater management infrastructure;
- Rehabilitation, redevelopment, or replacement of extraction wells, monitoring wells, or piezometers;
- Repair of damaged cap tie-ins around utilities, monitoring wells, or other infrastructure penetrations;
- Maintenance and repair of barrier wall transitions and utility crossing locations;
- Restoration of access roads required for monitoring and maintenance activities;
- Regrading of localized areas where settlement affects cap performance or stormwater management;
- Residuals disposal of treatment amendments;
- Periodic review and renewal of institutional controls, environmental covenants, or other land-use restrictions, as required; and
- Comprehensive remedy performance evaluations and regulatory reviews to assess the effectiveness of the containment system and determine whether modifications or additional corrective measures are warranted.

Because impacted materials would remain in place beneath the engineered cover system, long-term monitoring and maintenance would remain necessary throughout the life of the remedy. Future repairs or modifications may also be required to accommodate changing Site conditions, aging infrastructure, evolving regulatory requirements, or future land-use considerations.

For planning-level cost estimating purposes, annual O&M costs are assumed to include groundwater monitoring, cap inspections, stormwater system maintenance, extraction well operation, regulatory reporting, and institutional control management. Periodic O&M costs are assumed to include extraction well rehabilitation, cap repairs, stormwater infrastructure repairs, vegetation replacement, and periodic remedy performance evaluations.

5.4 Alternative 4 – Hybrid Containment

Alternative 4 consists of targeted excavation, on-Site consolidation of impacted materials, hydraulic containment, and groundwater management (**Sheet 00C-06 in Attachment C**). Alternative 4 addresses the same impacted areas as Alternative 3, however, the hydraulic containment area is smaller and focused on the Impoundments, while excavation is used to address impacted materials in the southern portion of the Site. Under this alternative, CCR and identified PFAS impacted solid materials located outside the containment footprint would be excavated and consolidated within a reduced-footprint barrier wall designed to avoid wetland impacts to the extent practicable. Remaining impacted materials would be contained through a

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barrier wall, engineered cover system, and groundwater gradient control system. During excavation, treatment of impacted groundwater will be conducted as part of the dewatering activities. In addition to treatment of impacted groundwater within the excavation areas, ICs, including but not limited to deed restrictions prohibiting the installation and use of potable wells on Site, will be incorporated to address remaining impacted groundwater on Site.

This alternative combines source control and long-term containment to reduce ongoing constituent loading to groundwater while minimizing the extent of material requiring long-term management. Long-term monitoring and maintenance of the containment and groundwater management systems would be required. The major components of Alternative 4 are described below.

5.4.1 Pre-Design Investigation

Prior to remedy implementation, additional field investigations would be completed to support final design of the containment system, refine horizontal and vertical extent of historical CCR and PFAS groundwater plumes, and consolidation footprint. Investigation activities would include advancement of geotechnical borings along the proposed barrier wall alignment to verify subsurface conditions, characterize the underlying confining layer, and support engineering design of the hydraulic barrier. Utility potholing and daylighting would be performed to identify potential conflicts between existing infrastructure and the proposed barrier wall alignment. Additional investigations may include utility coordination studies, geophysical surveys to identify buried concrete or subsurface structures, and other assessments necessary to support design and construction planning.

The pre-design investigation would also refine the extents of historical CCR, and PFAS materials based on the location of the PFAS groundwater plumes, proposed for excavation and relocation, confirm consolidation area requirements, and provide the information necessary to support preparation of construction documents and permitting activities.

5.4.2 Pre-Construction Submittals, Mobilization, and Permitting

Prior to construction, the selected contractor would prepare and submit required work plans, health and safety plans, quality assurance and quality control documentation, material specifications, construction sequencing plans, and other project-specific submittals for review and approval. Permits and regulatory approvals necessary to support construction activities would be obtained prior to mobilization.

Mobilization activities would include delivery of specialized barrier wall equipment, excavation equipment, dewatering equipment, temporary treatment systems, construction materials, and erosion and sediment control measures. Following completion of construction, temporary infrastructure would be removed and the contractor would demobilize from the Site.

5.4.3 Site Preparation

Site preparation activities would be completed to establish safe working conditions and facilitate construction. Erosion and sediment controls would be installed and maintained throughout construction activities. Wetlands, utilities, the electrical substation, work limits, and other

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sensitive features would be surveyed and staked in the field prior to disturbance. Utility locating activities would include coordination with MISS DIG (811) and private utility locating services, as appropriate.

Monitoring wells located within disturbance areas would be abandoned as necessary in accordance with applicable requirements. Surface infrastructure anticipated to remain in service, including the electrical substation, utility poles, Site lighting, and significant trees, would be protected through the use of barriers and other protective measures.

Clearing and grubbing would be conducted within the limits of disturbance to facilitate construction access. Vegetation and organic materials unsuitable for reuse would be transported off Site for disposal. Temporary construction access improvements, including working platforms within wetland-adjacent areas, may be required to support barrier wall installation. Utility relocation or temporary rerouting may also be necessary where conflicts with the proposed barrier wall alignment are identified.

5.4.4 Barrier Wall Installation

Alternative 4 includes construction of a reduced-footprint hydraulic barrier wall designed to maximize containment of impacted soils and groundwater while avoiding wetland impacts to the extent practicable. Compared to Alternative 3, the barrier wall footprint would be reduced primarily to avoid encroachment into wetland areas; however, the alignment would continue to encompass the majority of the suspected non-wetland CCR and PFAS source areas and groundwater impacts.

Prior to installation, laboratory testing would be completed to establish a Site-specific barrier wall mix design and verify hydraulic performance characteristics. A pilot test section would be constructed to confirm constructability and performance prior to full-scale implementation. Following successful completion of the test section, a low-permeability hydraulic barrier wall would be installed using in-place soil mixing techniques that blend native soils with bentonite, cement, and other amendments to form a continuous containment system keyed into the underlying confining unit.

Construction may require temporary utility outages, isolation of utility segments, rerouting of select infrastructure, and installation of engineered utility crossings. Excess soils generated during construction would be managed and disposed of in accordance with applicable regulatory requirements.

5.4.5 Source Control and On-Site Consolidation

Unlike Alternative 3, Alternative 4 incorporates targeted excavation outside of the barrier wall footprint. Targeted excavation would be used to address impacted media located outside the containment footprint. The limits of excavation would be established such that CCR and PFAS source material associated with identified groundwater impacts not encompassed by the barrier wall would be removed and consolidated within the contained area. This approach allows the containment footprint to be reduced while maintaining source control in areas excluded from hydraulic containment.

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Excavation activities would include hydro excavation in sensitive areas surrounding utilities, conventional excavation of accessible CCR and PFAS, and implementation of construction dewatering measures. Confirmation sampling would be conducted to verify successful removal of impacted materials from areas designated for excavation.

Rather than transporting all excavated impacted materials off Site for disposal, some impacted materials removed from outside the containment area would be relocated and consolidated within the barrier wall footprint. Consolidated materials would be graded and incorporated into the final contained area prior to installation of the engineered cover system. This approach reduces off-Site disposal requirements while simultaneously shrinking the containment footprint and minimizing the amount of CCR and PFAS remaining outside hydraulic containment.

Construction dewatering may be required during excavation activities. Water generated during excavation would be collected, treated as necessary, and discharged in accordance with applicable permit requirements.

5.4.6 Groundwater Gradient Control System Installation

To support long-term hydraulic containment, a groundwater gradient control system would be installed in conjunction with the barrier wall. The system would consist of paired groundwater extraction wells located within the containment area and groundwater monitoring piezometers installed outside the barrier wall. The gradient control system would maintain the assumed 1-foot head differential between each paired well and piezometer, with an estimated treatment flow rate of approximately 11 gpm. The paired wells and piezometers would be used to monitor hydraulic conditions across the containment boundary and evaluate the effectiveness of the remedy in maintaining hydraulic containment.

Groundwater extraction wells would be operated as necessary to control groundwater elevations within the contained area and minimize groundwater mounding. Extraction would be initiated when the hydraulic head measured within an extraction well exceeds the hydraulic head measured in the associated exterior piezometer by a specific operational threshold. This operational threshold will be based on Site-specific hydrogeologic conditions and the hydraulic properties of the underlying low-permeability confining clay unit. Maintaining the target head differential would minimize the potential for groundwater migration beneath the barrier wall through the confining layer and support long-term containment performance.

Extracted groundwater would be conveyed to an on-Site treatment system for treatment and management in accordance with applicable regulatory requirements. Groundwater levels within the extraction wells and paired piezometers would be routinely monitored to evaluate system performance, guide extraction well operation, and verify the containment system continues to maintain the desired hydraulic conditions.

5.4.7 Cover System Installation

Following completion of soil consolidation and grading activities, an engineered cover system would be installed over the consolidated and contained CCR and PFAS. Prior to cap installation,

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the containment area would be fine graded and prepared to provide a suitable foundation for cover placement.

The engineered cover system would likely consist of a GCL, a 40-mil LLDPE geomembrane, a geocomposite drainage layer, 42 inches of protective soil cover, and 6 inches of topsoil. The cover system would function as the primary infiltration control component of the remedy and would be designed to minimize precipitation infiltration, reduce groundwater recharge through CCR materials, and support long-term containment performance. The protective cover and topsoil layers are included to account for potential post-construction Site uses and will be refined or confirmed in the remedial design.

Special design considerations would be required at locations where the cover interfaces with existing infrastructure, including the electrical substation, utility poles, utility corridors, and long-term monitoring points. Final design would incorporate anchor trenches, utility penetrations, monitoring well completions, and stormwater controls necessary to maintain cap integrity while allowing continued operation of critical infrastructure and environmental monitoring systems.

Because impacted materials would remain beneath the engineered cover system, future land use within the capped area would be subject to restrictions necessary to maintain remedy performance. Construction of buildings, foundations, underground utilities, or other intrusive improvements would generally require additional engineering evaluation, regulatory coordination, and potential removal of impacted materials and affected portions of the cover system.

5.4.8 Site Restoration

Following completion of corrective measure construction, disturbed areas would be restored to provide long-term stability, effective stormwater management, and compatibility with future Site uses. Restoration planning would consider the community visioning layouts developed through stakeholder engagement and integrate those concepts into the final Site design to the extent practicable so as to maintain remedy performance objectives.

Vegetative restoration may incorporate native grasses, shrubs, and tree plantings, where appropriate, and would be designed in accordance with applicable local, state, and federal requirements. Stormwater management features would be incorporated into the final design to control runoff, minimize erosion, and support long-term performance of both the cover system and barrier wall remedy. Potential features may include vegetated swales, drainage channels, detention areas, and other engineered best management practices.

Following restoration, long-term monitoring, inspection, and maintenance activities would be required to evaluate barrier wall performance, groundwater conditions, cap integrity, gradient control system performance, stormwater management infrastructure, vegetation establishment, and overall remedy effectiveness.

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5.4.9 O&M and Periodic Monitoring Activities

Following construction of the barrier wall, groundwater gradient control system, engineered cover system, and Site restoration features, annual O&M activities would be required to verify remedy performance and maintain long-term containment of impacted materials remaining in place. Annual O&M activities would focus on monitoring, inspection, operation of hydraulic control infrastructure, and maintenance of remedy components.

Annual O&M activities may include:

- Groundwater level monitoring within extraction wells and paired piezometers to evaluate hydraulic containment performance and verify maintenance of the target groundwater gradient;
- Operation of the groundwater extraction system when groundwater elevations within the containment area exceed established operating criteria;
- Groundwater monitoring and sampling for CCR constituents, PFAS, mercury, and other constituents of concern;
- Laboratory analysis, data validation, trend analysis, and preparation of annual monitoring reports;
- Routine inspection of the barrier wall system for evidence of settlement, erosion, changes in Site conditions, or conditions that could affect containment performance;
- Inspection of the engineered cover system to evaluate surface conditions, drainage patterns, vegetation establishment, erosion, settlement, animal burrowing, and potential impacts to geosynthetic components;
- Inspection and maintenance of stormwater management features, including drainage channels, swales, culverts, energy dissipation structures, and other best management practices;
- Inspection and maintenance of extraction wells, piezometers, monitoring wells, groundwater treatment system, and associated monitoring infrastructure;
- Maintenance of access controls, signage, and institutional controls, as applicable; and
- Routine Site management, regulatory reporting, and project administration activities.

Long-term operation of the groundwater gradient control system is anticipated under this alternative to manage groundwater elevations within the containment area and minimize the potential for groundwater migration beneath the barrier wall.

Periodic maintenance activities would be performed on an as-needed basis throughout the life of the remedy to maintain the integrity and effectiveness of the containment system. These activities would generally occur at longer intervals and may require more significant expenditures than routine annual maintenance activities.

Periodic O&M activities may include:

- Repair of localized settlement, erosion, or surface drainage issues affecting the engineered cover system;

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- Replacement or restoration of vegetative cover in areas where vegetation fails to establish or maintain adequate coverage;
- Repair, replacement, or enhancement of stormwater management infrastructure;
- Rehabilitation, redevelopment, or replacement of extraction wells, monitoring wells, or piezometers;
- Repair of damaged cap tie-ins around utilities, monitoring wells, or other infrastructure penetrations;
- Maintenance and repair of barrier wall transitions and utility crossing locations;
- Restoration of access roads required for monitoring and maintenance activities;
- Regrading of localized areas where settlement affects cap performance or stormwater management;
- Residuals disposal of treatment amendments;
- Periodic review and renewal of institutional controls, environmental covenants, or other land-use restrictions, as required; and
- Comprehensive remedy performance evaluations and regulatory reviews to assess the effectiveness of the containment system and determine whether modifications or additional corrective measures are warranted.

Because impacted materials would remain in place beneath the engineered cover system, long-term monitoring and maintenance would remain necessary throughout the life of the remedy. Future repairs or modifications may also be required to accommodate changing Site conditions, aging infrastructure, evolving regulatory requirements, or future land-use considerations.

For planning-level cost estimating purposes, annual O&M costs are assumed to include groundwater monitoring, cap inspections, stormwater system maintenance, extraction well operation, regulatory reporting, and institutional control management. Periodic O&M costs are assumed to include extraction well rehabilitation, cap repairs, stormwater infrastructure repairs, vegetation replacement, and periodic remedy performance evaluations.

5.5 Alternative 5 – Reduced-Footprint Hybrid

Alternative 5 consists of enhanced excavation, on-Site consolidation of impacted materials, hydraulic containment, and groundwater management (**Sheet 00C-07 in Attachment C**). Similar to Alternative 4, impacted materials located outside the containment footprint would be excavated and consolidated within a contained area. However, the barrier wall footprint would be further reduced to minimize conflicts with existing utilities and infrastructure while continuing to avoid wetland impacts to the extent practicable. Additional excavation would be performed to address areas excluded from the containment footprint, including portions of CCR and PFAS source materials associated with the identified groundwater plumes. The resulting remedy provides a balance between source control, containment, constructability, and long-term operation and maintenance requirements. Like Alternative 4, ICs, including but not limited to deed restrictions prohibiting the installation and use of potable wells on Site, will be incorporated to address remaining impacted groundwater on Site. Long-term monitoring and maintenance of the containment and groundwater management systems would be required. The major components of Alternative 5 are described below.

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5.5.1 Pre-Design Investigation

Prior to remedy implementation, additional field investigations would be completed to support final design of the barrier wall, source removal areas, groundwater control system, and consolidation footprint. Investigation activities would include geotechnical borings along the proposed barrier wall alignment to characterize subsurface conditions, verify the depth and continuity of the underlying confining layer, and support engineering design of the containment system.

Utility potholing and daylighting would be performed along the proposed barrier wall alignment to verify utility locations and identify potential conflicts with existing infrastructure. Additional investigations may include utility coordination studies, geophysical surveys to identify buried structures and concrete features, and other evaluations necessary to support remedy design, construction planning, and permitting activities.

The pre-design investigation would also refine excavation limits for source removal areas located outside the containment footprint and establish the final volume of impacted materials requiring consolidation within the barrier wall.

5.5.2 Pre-Construction Submittals, Mobilization, and Permitting

Prior to construction, the selected contractor would prepare and submit required work plans, health and safety plans, quality assurance and quality control documentation, construction sequencing plans, and material specifications for review and approval. Applicable permits and regulatory approvals would be obtained before initiation of construction activities.

Mobilization would include delivery of barrier wall construction equipment, excavation equipment, dewatering systems, temporary water treatment equipment, construction materials, and erosion and sediment control measures. Upon completion of construction activities, temporary infrastructure would be removed and the contractor would demobilize from the Site.

5.5.3 Site Preparation

Site preparation activities would be completed prior to construction and would include installation of erosion and sediment controls, staking of work limits, identification of wetlands and environmentally sensitive areas, utility locating through MISS DIG (811) and private utility locating services, and installation of construction signage.

Monitoring wells located within disturbance areas would be abandoned or removed as necessary in accordance with applicable requirements. Existing infrastructure intended to remain in service, including the electrical substation, utility poles, Site lighting, and significant trees, would be protected through installation of temporary barriers and other protective measures.

Clearing and grubbing activities would be performed within the limits of disturbance to support construction access and remedy implementation. Temporary work pads, including stabilization measures within wetland-adjacent areas, may be required to support equipment access. Because the Alternative 5 barrier wall alignment is designed to avoid several utility corridors and

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major utility crossings, utility relocation and de-energization requirements are anticipated to be less extensive than those required under Alternative 4.

5.5.4 Barrier Wall Installation

Alternative 5 includes construction of a reduced-footprint hydraulic barrier wall designed to avoid wetland impacts to the extent practicable while also minimizing conflicts with existing utilities and Site infrastructure. Compared to Alternative 4, the barrier wall alignment would be approximately 750 linear feet shorter and would avoid several utility corridors that would otherwise require utility rerouting, temporary outages, or de-energization during construction.

Prior to full-scale construction, laboratory testing would be completed to establish a Site-specific mix design and evaluate hydraulic performance characteristics. A pilot test section would be installed to confirm constructability and demonstrate achievement of design performance objectives. Following successful testing, the barrier wall would be constructed using in-place soil mixing techniques that blend native soils with bentonite, cement, and other amendments to create a continuous low-permeability barrier keyed into the underlying confining layer.

The reduced footprint would substantially reduce the area requiring long-term containment and cap maintenance. However, certain areas that contain PFAS sources to the groundwater plumes and minor CCR source materials would remain outside the containment footprint and therefore require additional source removal activities to address those areas.

Soils generated during barrier wall construction would be managed in accordance with applicable regulatory requirements. Saturated materials may require stabilization prior to transportation and disposal.

5.5.5 Source Control and On-Site Consolidation

Alternative 5 incorporates a greater degree of excavation than Alternative 4 to compensate for the smaller containment footprint. CCR materials, CCR- impacted soils, and PFAS materials associated with the identified groundwater plumes located outside the barrier wall would be excavated to reduce or eliminate ongoing source contributions to groundwater outside the containment area.

Excavation activities would include hydro excavation in areas adjacent to utilities and the electrical substation, conventional excavation of accessible impacted materials, removal of concrete structures and subsurface obstructions, implementation of construction dewatering measures, and confirmation sampling to verify removal objectives have been achieved. Because the Alternative 5 containment footprint is smaller than Alternative 4, the area requiring excavation is anticipated to be approximately 4.5 acres greater and would include additional concrete demolition and removal activities.

Rather than transporting the excavated impacted materials off Site, some impacted materials suitable for consolidation would be transported to the area enclosed by the barrier wall and incorporated into the contained area. This approach allows the containment footprint to be reduced while maintaining source control in areas excluded from hydraulic containment.

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Construction dewatering may be required during excavation activities. Water generated during excavation would be collected, treated as necessary, and discharged in accordance with applicable permit requirements.

5.5.6 Groundwater Gradient Control System Installation

To support long-term hydraulic containment, a groundwater gradient control system would be installed in conjunction with the barrier wall. The system would consist of paired groundwater extraction wells located within the containment area and groundwater monitoring piezometers installed outside the barrier wall. The gradient control system would maintain the assumed 1-foot head differential between each paired well and piezometer, with an estimated treatment flow rate of approximately 7 gpm, the lowest amount of treatment water in containment alternatives. The paired wells and piezometers would be used to monitor hydraulic conditions across the containment boundary and evaluate the effectiveness of the remedy in maintaining hydraulic containment.

Groundwater extraction wells would be operated as necessary to control groundwater elevations within the contained area and minimize groundwater mounding. Extraction would be initiated when the hydraulic head measured within an extraction well exceeds the hydraulic head measured in the associated exterior piezometer by a specific operational threshold. This operational threshold will be based on Site-specific hydrogeologic conditions and the hydraulic properties of the underlying low-permeability confining clay unit. Maintaining the target head differential would minimize the potential for groundwater migration beneath the barrier wall through the confining layer and support long-term containment performance.

Extracted groundwater would be conveyed to an on-Site treatment system for treatment and management in accordance with applicable regulatory requirements. Groundwater levels within the extraction wells and paired piezometers would be routinely monitored to evaluate system performance, guide extraction well operation, and verify the containment system continues to maintain the desired hydraulic conditions.

5.5.7 Cover System Installation

Following completion of source consolidation activities, an engineered cover system would be installed over the impacted materials remaining within the containment area. Prior to cap installation, the contained area would be fine graded and prepared to establish a suitable foundation for construction.

The engineered cover system would likely consist of a GCL, a 40-mil LLDPE geomembrane, a geocomposite drainage layer, 42 inches of protective soil cover, and 6 inches of topsoil. The cover system would be designed to minimize infiltration, reduce groundwater recharge through CCR materials, and support long-term containment performance. The protective cover and topsoil layers are included to account for potential post-construction Site uses and will be refined or confirmed in the remedial design.

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Because the barrier wall footprint is smaller than Alternative 4, the area requiring capping would be reduced by approximately 7.5 acres. This reduction would decrease the extent of long-term cap inspection, maintenance, and repair requirements.

Special design considerations would be required where the cover system interfaces with existing infrastructure, including the electrical substation, utility poles, utility corridors, and monitoring locations. Final design would incorporate anchor trenches, utility penetrations, monitoring well completions, and stormwater controls necessary to maintain cover integrity while preserving critical Site functions and monitoring capabilities.

Because CCR and PFAS would remain beneath the engineered cover system, future land use within the capped area would be subject to restrictions necessary to maintain remedy performance. Construction of buildings, foundations, underground utilities, or other intrusive improvements would generally require additional engineering evaluation and potential removal of impacted materials and portions of the cover system.

5.5.8 Site Restoration

Following completion of construction activities, disturbed areas would be restored to provide long-term stability, effective stormwater management, and compatibility with future Site use objectives. Final restoration planning would consider the community visioning layouts developed during stakeholder engagement and would balance community preferences with the engineering requirements of the selected remedy.

Restoration activities would include establishment of vegetative cover, native seeding, and tree and shrub plantings where appropriate and compatible with long-term remedy performance. Stormwater management features would be incorporated into the final design to control runoff, minimize erosion, and support long-term performance of the barrier wall and cover system. Potential features may include vegetated swales, drainage channels, detention areas, and other engineered best management practices.

Following restoration, long-term monitoring, inspection, and maintenance activities would be required to evaluate groundwater conditions, gradient control system performance, barrier wall performance, cap integrity, stormwater management infrastructure, vegetation establishment, and overall remedy effectiveness.

5.5.9 O&M and Periodic Monitoring Activities

Following construction of the barrier wall, groundwater gradient control system, engineered cover system, and Site restoration features, annual O&M activities would be required to verify remedy performance and maintain long-term containment of impacted materials remaining in place. Annual O&M activities would focus on monitoring, inspection, operation of hydraulic control infrastructure, and maintenance of remedy components.

Annual O&M activities may include:

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- Groundwater level monitoring within extraction wells and paired piezometers to evaluate hydraulic containment performance and verify maintenance of the target groundwater gradient;
- Operation of the groundwater extraction system when groundwater elevations within the containment area exceed established operating criteria;
- Groundwater monitoring and sampling for CCR constituents, PFAS, mercury, and other constituents of concern;
- Laboratory analysis, data validation, trend analysis, and preparation of annual monitoring reports;
- Routine inspection of the barrier wall system for evidence of settlement, erosion, changes in Site conditions, or conditions that could affect containment performance;
- Inspection of the engineered cover system to evaluate surface conditions, drainage patterns, vegetation establishment, erosion, settlement, animal burrowing, and potential impacts to geosynthetic components;
- Inspection and maintenance of stormwater management features, including drainage channels, swales, culverts, energy dissipation structures, and other best management practices;
- Inspection and maintenance of extraction wells, piezometers, monitoring wells, groundwater treatment system, and associated monitoring infrastructure;
- Maintenance of access controls, signage, and institutional controls, as applicable; and
- Routine Site management, regulatory reporting, and project administration activities.

Long-term operation of the groundwater gradient control system is anticipated under this alternative to manage groundwater elevations within the containment area and minimize the potential for groundwater migration beneath the barrier wall.

Periodic maintenance activities would be performed on an as-needed basis throughout the life of the remedy to maintain the integrity and effectiveness of the containment system. These activities would generally occur at longer intervals and may require more significant expenditures than routine annual maintenance activities.

Periodic O&M activities may include:

- Repair of localized settlement, erosion, or surface drainage issues affecting the engineered cover system;
- Replacement or restoration of vegetative cover in areas where vegetation fails to establish or maintain adequate coverage;
- Repair, replacement, or enhancement of stormwater management infrastructure;
- Rehabilitation, redevelopment, or replacement of extraction wells, monitoring wells, or piezometers;
- Repair of damaged cap tie-ins around utilities, monitoring wells, or other infrastructure penetrations;
- Maintenance and repair of barrier wall transitions and utility crossing locations;
- Restoration of access roads required for monitoring and maintenance activities;

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- Regrading of localized areas where settlement affects cap performance or stormwater management;
- Residuals disposal of treatment amendments;
- Periodic review and renewal of institutional controls, environmental covenants, or other land-use restrictions, as required; and
- Comprehensive remedy performance evaluations and regulatory reviews to assess the effectiveness of the containment system and determine whether modifications or additional corrective measures are warranted.

Because CCR and PFAS would remain in place beneath the engineered cover system, long-term monitoring and maintenance would remain necessary throughout the life of the remedy. Future repairs or modifications may also be required to accommodate changing Site conditions, aging infrastructure, evolving regulatory requirements, or future land-use considerations.

For planning-level cost estimating purposes, annual O&M costs are assumed to include groundwater monitoring, cap inspections, stormwater system maintenance, extraction well operation, regulatory reporting, and institutional control management. Periodic O&M costs are assumed to include extraction well rehabilitation, cap repairs, stormwater infrastructure repairs, vegetation replacement, and periodic remedy performance evaluations.

6 Evaluation Criteria

Consideration of corrective action alternatives to address both the CCR and PFAS related impacts are discussed in this section. Consistent with 40 CFR 257.96 and Michigan Administrative Code R299.4443, evaluation criteria considered in the remedy selection are discussed below.

6.1 Performance

Factors considered in evaluating the performance of each corrective action alternative include the ability of the alternative to achieve corrective action objectives, reduce or eliminate ongoing source contributions, control contaminant migration, and attain applicable GPS at the point(s) of compliance. Performance considerations also include the degree to which the alternative removes, treats, isolates, or contains constituents of concern and the long-term effectiveness of the remedy in protecting human health and the environment.

6.2 Reliability

Factors considered in evaluating the reliability of a corrective action alternative include the effectiveness and durability of engineering and institutional controls, the anticipated service life of remedy components, the potential need for future repair, replacement, or maintenance activities, and other operational factors that may influence long-term remedy performance and protectiveness.

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6.3 Ease of Implementation

Factors considered in evaluating the ease of implementation of a corrective action alternative include the degree of difficulty associated with constructing, operating, and maintaining the alternative given Site-specific conditions. Considerations include the need to obtain property access, permits, utility relocations, infrastructure modifications, regulatory approvals, and specialized equipment or labor, as well as the availability and capacity of treatment, storage, and disposal services.

6.4 Potential Impacts of the Alternative

Factors considered in evaluating the potential impacts of a corrective action alternative include risks to the community, Site workers, and the environment during implementation and long-term operation of the remedy. Considerations include potential impacts associated with excavation, material transportation and disposal, dewatering, construction within environmentally sensitive areas, containment of CCR and PFAS, and implementation of groundwater control systems. Evaluation also includes potential cross-media impacts and the potential for human or ecological exposure to constituents of concern following remedy implementation.

6.5 Time Required to Begin and Complete the Alternative

Factors considered in evaluating the time required to begin and complete a corrective action alternative include the time necessary for remedy design, permitting, procurement, construction, startup, and operation, as well as the estimated timeframe required to achieve corrective action objectives and applicable groundwater protection standards at the point(s) of compliance.

6.6 Cost

Michigan Administrative Code R299.4443 also requires that the analyses address the cost of remedy implementation. An alternative's cost evaluates the capital expenditure of construction, annual operation and maintenance, and net present value (NPV). An Association for the Advancement of Cost Engineering International (AACE) Class 5 estimate (-50% to 100% accuracy range) has been prepared for each alternative to support the cost evaluation. Consistent with this RAA, costs are based on conceptual design information and parametric assumptions, intended for screening-level comparison of alternatives.

Cost estimates were developed using a combination of vendor quotations and RSMeans Data (GORDIAN), based on the Grand Rapids, Michigan (ZIP Codes 493, 495) location with a 2026 Quarter 2 release. Supporting cost worksheets are provided in **Attachment E**. The cost evaluation includes the following components:

- Capital Costs: Includes direct and indirect costs associated with design, procurement, and construction. Direct costs are based on vendor costs and RSMeans line items (with line numbers provided for reference), while indirect costs include mobilization, contractor overhead and profit, engineering, and contingencies. Assumptions for each cost item are documented.
- Annual O&M Costs: Includes routine costs required to operate and maintain the system over its service life, such as labor, utilities, consumables, inspections, and minor repairs.

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- Periodic O&M Costs: Includes non-annual costs such as major maintenance, equipment replacement, or rehabilitation activities that occur at defined intervals during project life.
- NPV: Represents the total life-cycle cost of alternative, calculated by discounting capital, O&M, and periodic costs over a 30-year evaluation period to present-day dollars.

Cost estimates were developed to support comparison of corrective action alternatives and do not represent final design or construction costs. Actual implementation costs may vary based on final remedy design, permitting requirements, utility modifications, treatment system requirements, material management decisions, and Site-specific construction conditions.

7 Evaluation of Alternatives

The remedial alternatives were comparatively evaluated using a qualitative ranking approach based on the evaluation factors identified in 40 CFR 257.96(c) and Site-specific considerations. Evaluation criteria included performance, reliability, implementability, potential impacts, time to implementation, and estimated cost. **Table 9** presents a comparative summary of these evaluations and serves as the basis for selection of the preferred alternative.

Each alternative was assigned a qualitative ranking of high, moderate, or low based on engineering judgement, Site-specific conditions, and professional experience with similar remedial systems. The rankings provide a relative comparison of the strengths and limitations of each alternative and were considered collectively in identifying the preferred alternative.

7.1 Alternative 1 – Excavation

7.1.1 Performance

Alternative 1 provides the highest degree of source control of CCR by removing CCR and CCR-impacted materials from the Site through excavation and off-Site disposal. Removal of CCR source materials eliminates or substantially reduces ongoing CCR-related constituent loading to groundwater and provides the greatest opportunity for attainment of GPS and long-term restoration of groundwater quality.

It also is expected that excavation activities will remove a substantial portion of the PFAS mass present, reduce ongoing PFAS loading to groundwater, and support long-term restoration of groundwater quality. However, because the specific sources and location of PFAS are unknown, there remains a risk of future PFAS impacts to groundwater beyond the excavated areas. As a result, adaptive management measures may be required to maintain compliance with applicable GSI Criteria.

Because impacted materials are removed rather than treated or contained in place, this alternative provides the highest level of remedy permanence.

7.1.2 Reliability

Alternative 1 is considered highly reliable because long-term remedy performance is not dependent on the continued effectiveness of engineered containment systems, treatment

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amendments, or groundwater extraction systems. Following successful implementation and confirmation sampling, only routine monitoring and maintenance activities would be required. As a result, this alternative has the lowest reliance on long-term O&M among the alternatives evaluated.

7.1.3 Ease of Implementation

Alternative 1 presents significant implementation challenges due to the volume of material requiring excavation, transportation, and off-Site disposal. Additional challenges include material handling in proximity to the electrical substation and existing utilities, construction dewatering requirements, waste characterization, and transportation logistics. However, excavation and off-Site disposal are well-established technologies that have been successfully implemented at numerous remediation sites.

7.1.4 Potential Impacts of the Alternative

Alternative 1 has the greatest short-term construction impacts of the alternatives considered due to extensive excavation activities, material transportation, dust generation, noise, traffic, and construction dewatering requirements. Temporary impacts to Site operations and infrastructure may occur during implementation. However, once construction is completed, the alternative provides the lowest long-term environmental risk because source materials are permanently removed from the Site.

7.1.5 Time Required to Begin and Complete the Alternative

Implementation of Alternative 1 would require significant construction effort but relies primarily on conventional earthwork and disposal activities. The time required to achieve RAOs may be shorter than alternatives that leave source materials in place because ongoing constituent loading to groundwater would be substantially reduced or eliminated following source removal.

7.1.6 Cost

Alternative 1 has the highest estimated capital cost of the alternatives evaluated due to extensive excavation, material handling, transportation, off-Site disposal, construction dewatering, backfilling, and Site restoration activities. The estimated capital cost for Alternative 1 is approximately $85.8 million (**Attachment E**).

Although annual O&M requirements are minimal relative to the containment-based alternatives, consisting primarily of groundwater monitoring, inspections, and regulatory reporting, the substantial upfront construction and disposal costs dominate the overall life-cycle cost. As a result, Alternative 1 has the highest estimated NPV, approximately $86.2 million, among the alternatives evaluated. The high cost is primarily attributable to the volume of material requiring excavation and off-Site disposal; however, this alternative also provides the highest degree of source control and remedy permanence.

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7.2 Alternative 2 – In Situ Stabilization

7.2.1 Performance

Alternative 2 reduces the mobility and leachability of CCR and PFAS through in situ treatment of impacted materials. By mixing stabilization amendments directly into impacted media, the alternative is intended to reduce constituent migration to groundwater and decrease ongoing source contributions. However, unlike Alternative 1, impacted materials remain in place following remedy implementation and the alternative relies on long-term treatment performance to achieve RAOs. In addition, while bench-scale testing has demonstrated the effectiveness of the proposed stabilization amendments for CCR-related constituents, additional treatability testing would be required to evaluate treatment effectiveness for PFAS. As a result, some uncertainty remains regarding the overall performance of the remedy for PFAS, therefore ranking the performance lowest of the alternatives.

7.2.2 Reliability

Alternative 2 is considered the least reliable because remedy effectiveness depends upon the long-term performance and durability of the stabilized treatment zone. While ISS has been successfully applied at numerous sites to reduce constituent mobility and leaching potential, treated materials remain on Site and long-term monitoring is necessary to verify continued remedy effectiveness. The potential need for additional treatment or supplemental corrective measures would depend on post-implementation groundwater monitoring results and long-term treatment performance.

7.2.3 Ease of Implementation

Alternative 2 is considered moderate to implement compared to alternatives requiring extensive excavation or construction of large containment systems. The alternative minimizes off-Site transportation and disposal of impacted materials, reduces construction-related disturbances, and utilizes established stabilization technologies and readily available treatment amendments. However, implementation would require specialized mixing equipment, bench-scale mix design development, and additional PFAS-specific treatability testing prior to full-scale construction. Proper treatment verification and quality control would also be necessary to confirm that remedial objectives are achieved.

7.2.4 Potential Impacts of the Alternative

Alternative 2 is considered to have moderate impacts because CCR and PFAS will remain in place. Alternative 2 is anticipated to have fewer short-term impacts than excavation-based alternatives because large-scale material removal, transportation, and disposal activities are not required. Construction impacts would primarily be associated with mobilization of treatment equipment, preparation of work areas, temporary disturbance of surface features, noise, dust generation, and localized traffic associated with delivery of stabilization amendments. Because CCR and PFAS remain in place following treatment, long-term exposure prevention depends on treatment performance and any associated institutional or engineering controls that may be required.

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7.2.5 Time Required to Begin and Complete the Alternative

Alternative 2 is expected to be implemented more quickly than alternatives requiring extensive excavation, transportation, disposal, or construction of large containment structures. After completion of design activities, treatability testing, and contractor mobilization, treatment can generally be conducted efficiently using specialized mixing equipment. However, additional laboratory testing and evaluation of PFAS treatment effectiveness would likely be required prior to implementation. While treatment can be completed relatively quickly, time may be needed following construction to evaluate groundwater monitoring data and confirm achievement of RAOs.

7.2.6 Cost

Alternative 2 has a high capital cost due to the implementation of ISS across a large treatment area, including site preparation, work pad construction, amendment procurement, mixing operations, and an on-Site treatment system. Major cost drivers include full-scale stabilization activities, installation of a cover system over completed ISS areas, the installation of an extraction and treatment system to manage contaminant mass in groundwater not addressed by ISS. The estimated capital cost for Alternative 2 is approximately $75.2 million (**Attachment E**).

Annual operation and maintenance costs are higher than Alternative 1 due to O&M activities associated with the extraction and treatment system and the cover system. These ongoing obligations, coupled with the substantial capital investment, result in an estimated NPV of approximately $84.4 million, which is lower than Alternative 1 but significantly higher than the containment-based alternatives. While Alternative 2 avoids excavation and off-Site disposal costs, the scale of treatment required and continued monitoring obligations contribute to a relatively high life-cycle cost.

7.3 Alternative 3 – Full Containment

7.3.1 Performance

Alternative 3 provides a comprehensive containment remedy through implementation of a hydraulic barrier wall, engineered cover system, and groundwater gradient control system. Together, these remedy components are designed to contain impacted materials, reduce infiltration, minimize groundwater recharge, and limit migration of impacted groundwater beyond the containment boundary. The barrier wall and extraction system provide hydraulic containment, while the cover system reduces the potential for leaching by minimizing precipitation infiltration into the contained CCR and PFAS.

Although Alternative 3 is expected to effectively control contaminant migration and support attainment of GPS, CCR and PFAS remain in place beneath the cover system. Consequently, the alternative does not eliminate the source of contamination and relies on long-term containment and groundwater management to achieve corrective action objectives. For this reason, the overall performance of Alternative 3 is considered moderate and lower than alternatives incorporating source removal.

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7.3.2 Reliability

Alternative 3 is considered moderately reliable because it utilizes several proven remedial technologies that have been successfully implemented at numerous waste containment and environmental remediation sites. The barrier wall, engineered cover system, and groundwater extraction system are each well-established technologies with predictable performance characteristics when properly designed, constructed, monitored, and maintained.

However, long-term remedy effectiveness is dependent upon the continued performance of multiple engineered remedy components. Maintenance of hydraulic containment requires continued operation and monitoring of the groundwater gradient control system, while long-term protectiveness depends on preserving the integrity of both the barrier wall and cover system. As a result, the alternative exhibits greater long-term operational dependence than source removal alternatives.

7.3.3 Ease of Implementation

Alternative 3 is considered relatively difficult to implement due to the complexity and scale of construction activities required. The barrier wall alignment would extend through wetland areas and across multiple utility corridors, creating challenges associated with permitting, construction access, utility coordination, and infrastructure protection. Construction of the barrier wall would require specialized equipment, temporary work platforms in saturated areas, utility modifications, and careful sequencing of activities to maintain Site operations.

In addition, long-term implementation includes operation of the groundwater extraction and treatment system, monitoring infrastructure, engineered cover system, and associated institutional controls. Although all required technologies are commercially available and proven, the overall remedy presents substantial construction and implementation challenges relative to other alternatives.

7.3.4 Potential Impacts of the Alternative

Alternative 3 has the potential to result in moderate short-term environmental impacts during construction. Installation of the barrier wall, cap system, and extraction infrastructure would require clearing, grading, utility modifications, and construction activities within or adjacent to wetland areas. Construction may result in temporary noise, dust, traffic, vegetation removal, and disruption of Site operations.

Because CCR and PFAS remain contained on Site, long-term impacts are largely dependent on the continued performance of the engineered systems. If properly maintained, the alternative is expected to effectively reduce the potential for future exposure and contaminant migration. Because impacted materials remain within the contained area, institutional controls and land-use restrictions likely would be required to preserve remedy integrity and prevent disturbance of the cover system.

7.3.5 Time Required to Begin and Complete the Alternative

Alternative 3 is expected to require a relatively long implementation period due to the need for permitting, pre-design investigations, utility coordination, barrier wall construction, cap

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installation, gradient control system installation, and restoration activities. Wetland permitting and utility modifications may further extend implementation timelines.

Although physical construction could be completed within a reasonable timeframe following design and permitting, long-term operation of the groundwater gradient control system would likely be required to maintain containment performance. Consequently, achievement of RAOs would remain dependent on sustained operation and maintenance of the remedy components.

7.3.6 Cost

Alternative 3 offers a lower estimated capital cost than the non-containment alternatives (Alternatives 1 and 2), although its capital cost is relatively high compared to the other containment alternatives. Major cost drivers include construction of the hydraulic barrier wall, engineered cover system, groundwater extraction and treatment infrastructure, monitoring network, utility modifications, and restoration activities. The estimated capital cost for Alternative 3 is approximately $74.9 million (**Attachment E**).

Annual operation and maintenance costs are the highest among the alternatives evaluated due to the long-term operation of the groundwater gradient control system, groundwater monitoring network, groundwater treatment system, cap inspections, barrier wall performance monitoring, stormwater management maintenance, and institutional controls. Because of the higher O&M costs and significant capital cost, Alternative 3 has with an NPV of approximately $74.9 million.

While Alternative 3 relies on long-term management of CCR and PFAS remaining in place, the combination of relatively low capital cost and manageable long-term maintenance requirements makes it the lowest-cost alternative evaluated.

7.4 Alternative 4 – Hybrid Containment

7.4.1 Performance

Alternative 4 provides a high level of performance by combining source removal, source consolidation, hydraulic containment, infiltration control, and groundwater management into a single corrective measure. Regulated and historical CCR, soil, solid waste and PFAS and CCR materials associated with impacted plumes located outside the barrier wall footprint would be excavated and consolidated within the contained area, thereby reducing the volume of source material remaining outside containment. The excavation areas would also be dewatered during construction and the removed water would be treated; this would remove some CCR and PFAS constituents in groundwater. The barrier wall, engineered cover system, and groundwater gradient control system would then function together to contain the remaining impacted materials and minimize future constituent migration. Because the specific source of PFAS is unknown, continuous monitoring will be necessary to verify the remedy's performance.

Compared to Alternative 3, Alternative 4 provides a greater degree of consolidation because impacted materials located outside the barrier wall footprint would be excavated rather than left in place. At the same time, the alternative retains the benefits of hydraulic containment and groundwater management for the remaining source materials. As a result, Alternative 4 is

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expected to effectively reduce ongoing constituent loading to groundwater while maintaining long-term containment of remaining impacted materials. Although the remedy does not achieve complete source removal, it significantly reduces the footprint area of impacted material requiring long-term management and provides a higher degree of overall protectiveness.

7.4.2 Reliability

Alternative 4 is considered highly reliable because it utilizes multiple established remedial technologies that perform complementary functions. Removal of impacted materials from areas outside the containment footprint reduces the areal extent of long-term engineered controls relative to Alternative 3, while the barrier wall, cover system, and groundwater gradient control system provide redundancy through multiple containment mechanisms.

The combination of source removal, hydraulic containment, infiltration reduction, and groundwater extraction reduces the potential for remedy failure associated with any single component. Although long-term monitoring and maintenance of engineered controls would remain necessary, the reduction in impacted material outside the containment area improves long-term confidence in remedy performance and reduces the potential for future groundwater impacts.

7.4.3 Ease of Implementation

Alternative 4 is considered moderately implementable. The alternative requires construction of a hydraulic barrier wall, installation of a cover system, implementation of a groundwater gradient control system, and excavation and relocation of CCR and PFAS-impacted materials located outside the containment footprint. However, unlike Alternative 3, the barrier wall alignment is specifically designed to avoid wetland impacts to the extent practicable, reducing permitting complexity and construction challenges associated with work in saturated wetland areas.

The alternative would still require utility coordination, potential utility relocation, and temporary disruptions associated with barrier wall installation. In addition, source removal activities would require excavation, dewatering, treatment of dewatered material, material handling, confirmation sampling, and consolidation of CCR and PFAS-impacted materials within the containment area. While implementation is more complex than Alternative 2, the technologies required are well-established and commercially available.

7.4.4 Potential Impacts of the Alternative

Alternative 4 is expected to result in moderate short-term impacts during construction. Implementation would require excavation, material handling, barrier wall construction, dewatering, utility modifications, traffic associated with equipment and material transport, and temporary disturbance of vegetation and surface features. However, by reducing the barrier wall footprint and avoiding wetlands to the extent practicable, the alternative minimizes environmental impacts relative to Alternative 3.

Long-term impacts are expected to be limited provided that the containment system, cover system, and groundwater control components are properly maintained. Because impacted materials remain within the contained area, institutional controls and land-use restrictions likely

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will be required to preserve remedy integrity and prevent disturbance of the cover system. Nevertheless, the reduction of source materials outside the containment footprint decreases the potential for future exposure and migration compared to containment-only alternatives.

7.4.5 Time Required to Begin and Complete the Alternative

Alternative 4 is expected to require a moderate implementation timeframe. Additional design activities, permitting, utility coordination, source removal, barrier wall construction, cap installation, and groundwater system installation would be required prior to completion of remedy construction. While the reduced containment footprint may shorten certain construction activities relative to Alternative 3, implementation remains more involved than treatment-only alternatives such as Alternative 2.

Following construction, groundwater monitoring and operation of the gradient control system would continue as part of long-term remedy management. However, because some source materials are removed rather than simply contained, the timeframe required to achieve corrective action objectives may be shorter than Alternative 3.

7.4.6 Cost

Alternative 4 offers a lower estimated capital cost than the non-containment alternatives (Alternatives 1 and 2), although it has the highest capital cost of the containment alternatives due to the combination of source removal, impacted media consolidation, barrier wall construction, engineered cover system installation, groundwater extraction infrastructure, and restoration activities. Additional costs associated with excavation, dewatering, confirmation sampling, and material management outside the containment footprint increase the capital expenditure relative to Alternative 3. The estimated capital cost for Alternative 4 is approximately $61.7 million (**Attachment E**).

Annual operation and maintenance costs are lower than Alternative 3 due to the reduced containment footprint and corresponding reduction in long-term maintenance requirements associated with the barrier wall and cover system. However, continued groundwater monitoring, extraction system operation, groundwater treatment system operation, cap inspections, stormwater management maintenance, institutional controls, and periodic repairs remain necessary. The estimated NPV for Alternative 4 is approximately $69.7 million.

Although Alternative 4 is more expensive than Alternatives 3 and 5, the increase in cost reflects the additional source removal and reduction of CCR and PFAS remaining outside containment. Consequently, Alternative 4 provides a balance between source control and long-term containment while avoiding many of the wetland-related challenges associated with Alternative 3.

7.5 Alternative 5 – Reduced-Footprint Hybrid

7.5.1 Performance

Alternative 5 provides a high degree of overall remedy performance through a combination of source removal, source consolidation, hydraulic containment, infiltration control, and

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groundwater management. Regulated and historical CCR, soils, solid waste, and CCR and PFAS-impacted material associated with the plume located outside the containment footprint would be excavated and relocated within the barrier wall footprint, thereby reducing potential ongoing source contributions from areas not encompassed by the containment system. The barrier wall, engineered cover system, and groundwater gradient control system would function together to limit constituent migration and support attainment of RAOs.

Compared to Alternative 4, the reduced barrier wall footprint excludes certain PFAS groundwater plumes and minor CCR source and groundwater impacts that would otherwise be contained. Additional source removal is incorporated to address these areas; however, Alternative 5 ultimately contains a smaller overall volume of impacted media. As a result, Alternative 5 is expected to provide a high level of protectiveness but is considered slightly less comprehensive than Alternative 4.

7.5.2 Reliability

Alternative 5 is considered highly reliable because it utilizes proven source removal, containment, groundwater management, and infiltration control technologies. Similar to Alternative 4, the remedy incorporates multiple protective mechanisms, including source reduction through excavation, containment through the barrier wall, infiltration control through the engineered cover system, and hydraulic containment through groundwater extraction and treatment.

The smaller containment footprint reduces the overall extent of engineered systems requiring long-term management and may reduce opportunities for future maintenance issues. However, because CCR and PFAS remain within the contained area, long-term monitoring and maintenance of the barrier wall, cover system, and groundwater control infrastructure remain necessary to ensure continued remedy performance.

7.5.3 Ease of Implementation

Alternative 5 is considered highly implementable relative to the other containment alternatives. The reduced barrier wall alignment was specifically developed to avoid wetland impacts to the extent practicable while also minimizing conflicts with existing utilities and Site infrastructure. Compared to Alternative 4, fewer utility crossings are anticipated, reducing the need for utility rerouting, temporary outages, de-energization, and reconstruction activities.

Although the alternative requires a greater extent of excavation and source removal than Alternative 4, the reduction in barrier wall length, overall containment footprint, and utility conflicts is expected to simplify construction sequencing and reduce implementation challenges. The technologies required for implementation are well-established and readily available within the remediation industry.

7.5.4 Potential Impacts of the Alternative

Alternative 5 is expected to result in moderate short-term construction impacts. Construction activities would include excavation, dewatering, treatment of dewatered materials, material handling, consolidation of CCR and PFAS, barrier wall installation, cap construction, and

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groundwater system installation. Additional excavation activities compared to Alternative 4 may increase temporary impacts associated with noise, dust generation, equipment operation, and material handling.

However, the alternative substantially reduces potential impacts associated with utility modifications and avoids wetland impacts to the extent practicable, therefore Alternative 5 has the least potential impacts of all the alternatives. Following construction, long-term impacts are expected to be limited provided that the containment and groundwater management systems continue to perform as intended. Because impacted materials remain within the containment area, future land use restrictions and institutional controls likely will be required to preserve remedy integrity.

7.5.5 Time Required to Begin and Complete the Alternative

Alternative 5 is expected to require a moderate implementation timeframe. Additional excavation and source removal activities may increase construction duration relative to Alternative 4. However, reductions in barrier wall length, containment footprint, utility conflicts, and associated utility coordination activities are expected to offset a portion of the additional excavation effort.

As with Alternative 4, long-term groundwater monitoring and operation of the groundwater gradient control system and treatment of extracted groundwater would continue following construction. The inclusion of targeted source removal is expected to improve the rate at which corrective action objectives are achieved compared to alternatives that rely solely on containment.

7.5.6 Cost

Alternative 5 has the lowest capital cost of all alternatives and is anticipated to have a moderate overall life-cycle cost. Compared to Alternative 4, capital costs associated with reduced barrier wall construction, cover system installation, utility modifications, and long-term containment infrastructure are reduced due to the smaller containment footprint. These savings are partially offset by increased excavation, dewatering, material handling, concrete removal, confirmation sampling, and source consolidation activities. The estimated capital cost for Alternative 5 is approximately $52.3 million (**Attachment E**).

Alternative 5 is anticipated to have a moderate overall life-cycle cost. Annual operation and maintenance costs remain comparable to Alternative 4 but benefit from the reduced barrier wall length, smaller cap footprint, and reduced extent of long-term containment infrastructure requiring inspection and maintenance. The estimated NPV for Alternative 5 is approximately $59.2 million, making it the lowest cost alternative evaluated.

Overall, Alternative 5 provides a favorable balance between source control, containment, constructability, and life-cycle cost. Relative to Alternative 4, it achieves a reduction in capital and long-term maintenance costs while minimizing utility conflicts and maintaining a high degree of groundwater protection.

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8 Recommended Alternative

Based on the evaluation of corrective measure alternatives presented herein, Alternative 5 – Reduced Footprint Hybrid (**Sheet 00C-07 in Attachment C**) is recommended for advancement into design and implementation.

Alternative 5 provides a balanced corrective action approach that combines source consolidation and removal, hydraulic containment, infiltration reduction, and groundwater management using proven remedial technologies. The alternative incorporates targeted excavation and removal of CCR and PFAS located outside the containment footprint and consolidating those materials within a hydraulically controlled containment area. The barrier wall, engineered cover system, and groundwater gradient control system function collectively to reduce ongoing constituent loading to groundwater, limit contaminant migration, and support attainment of groundwater protection standards.

Key factors supporting selection of Alternative 5 include:

- Relative to Alternative 1: Alternative 5 achieves significant source control while reducing the volume of material requiring excavation, transportation, and off-Site disposal.
- Relative to Alternative 2: Alternative 5 relies on established containment and source control technologies and does not require the demonstration of long-term PFAS stabilization effectiveness that ISS does.
- Relative to Alternative 3: Alternative 5 substantially reduces wetland impacts by minimizing the containment footprint while maintaining containment of the majority of non-wetland CCR and PFAS groundwater impacts.
- Relative to Alternative 4: Although Alternative 4 provides a greater degree of containment with a smaller excavation footprint, Alternative 5 provides a high degree of source control and groundwater protection while reducing utility conflicts, containment footprint, and overall life-cycle costs relative to Alternative 4

The evaluation of performance, reliability, ease of implementation, potential impacts, implementation timeframe, and life-cycle cost indicates that Alternative 5 provides the most effective balance among the alternatives evaluated. Although Alternative 4 provides a somewhat greater degree of containment, Alternative 5 achieves comparable remedial objectives while reducing construction complexity and lowering estimated life-cycle costs. The estimated net present value of Alternative 5 is approximately $59.2 million, compared to approximately $69.7 million for Alternative 4.

Accordingly, Alternative 5 is recommended for advancement into the remedial design phase. During design, additional investigations, engineering analyses, permitting evaluations, and construction planning activities should be completed to refine the barrier wall alignment, groundwater management and treatment system, engineered cover system, and long-term

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monitoring requirements. Further design-level evaluation should also be completed to verify constructability assumptions, utility interfaces, and hydraulic containment performance.

9 Conclusions

This RAA evaluated corrective measure alternatives to address CCR and PFAS impacts at the Site, including PFAS concentrations exceeding applicable Michigan Part 201 Groundwater Cleanup Criteria. The evaluation was completed in accordance with the requirements of 40 CFR 257.96, Michigan Administrative Code R 299.4443, and the applicable provisions of Part 201, Environmental Remediation, of the Michigan NREPA, 1994 PA 451, as amended.

The evaluation considered the ability of each alternative to achieve RAOs, attain GPS, meet regulatory closure requirements, reduce or control constituent migration, and provide long-term protection of human health and the environment.

The following alternatives were evaluated:

- Alternative 1 – Excavation
- Alternative 2 – In Situ Stabilization
- Alternative 3 – Full Containment
- Alternative 4 – Hybrid Containment
- Alternative 5 – Reduced-Footprint Hybrid

The alternatives were comparatively evaluated based on performance, reliability, ease of implementation, potential impacts, implementation timeframe, and life-cycle cost. The evaluation considered Site-specific factors including CCR source materials, PFAS impacts, groundwater conditions, wetlands, utility constraints, existing infrastructure, community visioning objectives, and long-term operation and maintenance requirements.

Key conclusions of the evaluation include:

- Source control alternatives generally provide greater long-term reduction of constituent loading to groundwater than containment-only alternatives.
- ISS may effectively reduce the mobility of CCR-related constituents; however, additional testing would be required to evaluate long-term treatment effectiveness for PFAS-impacted media and support full-scale implementation.
- Containment alternatives utilizing barrier walls, engineered cover systems, and groundwater gradient control systems are expected to effectively contain impacted groundwater and prevent off-Site migration of contaminants but require long-term operation, monitoring, maintenance, and possible treatment and or off-Site disposal of extracted groundwater.
- Hybrid alternatives combining source removal with containment offer a balance between remedy effectiveness, constructability, and long-term management requirements.
- Alternatives 4 and 5 reduce wetland impacts relative to Alternative 3 while maintaining a high degree of source control and groundwater protection.

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- Utility conflicts, wetland impacts, implementation complexity, and life-cycle costs represent key differentiating factors among the alternatives evaluated.
- The evaluated alternatives are capable of supporting closure of the CCR units in accordance with applicable CCR Rule requirements while addressing CCR- and PFAS-related impacts.

Based on the comparative evaluation presented herein, the alternative identified for further consideration is Alternative 5. The Reduced Footprint Hybrid alternative offers the most effective balance of remedial performance, reliability, implementability, environmental impacts, implementation schedule, and life-cycle cost, and is therefore recommended for advancement into remedial design. Because some historical waste materials remain on Site outside of treatment areas, there remains a risk of future PFAS impacts to groundwater. As a result, adaptive management measures may be required to maintain compliance with applicable GSI Criteria. Final remedy selection should consider the detailed cost evaluation, constructability considerations, permitting requirements, long-term operation and maintenance obligations, stakeholder objectives, and regulatory input.

10 Next Steps

Following selection of a preferred corrective measure alternative, additional investigations, engineering evaluations, and regulatory coordination activities should be completed to support remedial design and implementation. These activities will provide the information necessary to refine design assumptions, reduce uncertainty, support permitting, and develop construction documents. A schedule of future remedial activities is shown in **Table 10**.

Key next steps may include:

- Completion of additional geotechnical and environmental investigations to refine the horizontal and vertical extent of historical CCR and PFAS groundwater plumes and Site-specific design parameters.
- Advancement of borings and other subsurface investigations along proposed barrier wall alignments to support final engineering design and confirm suitability of the underlying confining layer.
- Utility investigations, including utility locating, potholing, daylighting, and coordination with utility owners to identify conflicts and develop relocation or protection plans, as necessary.
- Additional characterization of buried infrastructure, concrete features, and other subsurface obstructions that may influence remedy implementation. Additional characterization may result in the determination buried infrastructure will stay in place, such as concrete footings.
- Refinement of GWET design, including evaluation of extraction requirements, treatment technologies, discharge options, monitoring locations, and operational criteria.

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- Development of final cover system grading, drainage, stormwater management, and infrastructure tie-in details, including interfaces with the electrical substation, utility corridors, monitoring wells, and other existing Site features.
- Evaluation of restoration opportunities consistent with the community visioning layouts and future land-use objectives identified through stakeholder engagement.
- Completion of wetland delineation updates and permitting evaluations, as necessary, to support implementation of the selected alternative.
- Coordination with EGLE and other applicable regulatory agencies to confirm design assumptions, permitting requirements, monitoring expectations, and corrective action objectives.
- Development of long-term monitoring, O&M, and IC requirements associated with the selected remedy.
- Preparation of detailed engineering plans, technical specifications, construction sequencing requirements, and implementation cost estimates to support remedial design and construction.

Completion of these activities will support advancement of the selected corrective measure into final design and implementation and provide the information necessary to optimize remedy performance, reduce implementation uncertainty, and support long-term protection of human health and the environment.

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Attachment A

Figures



Figure 1 Site Vicinity Map

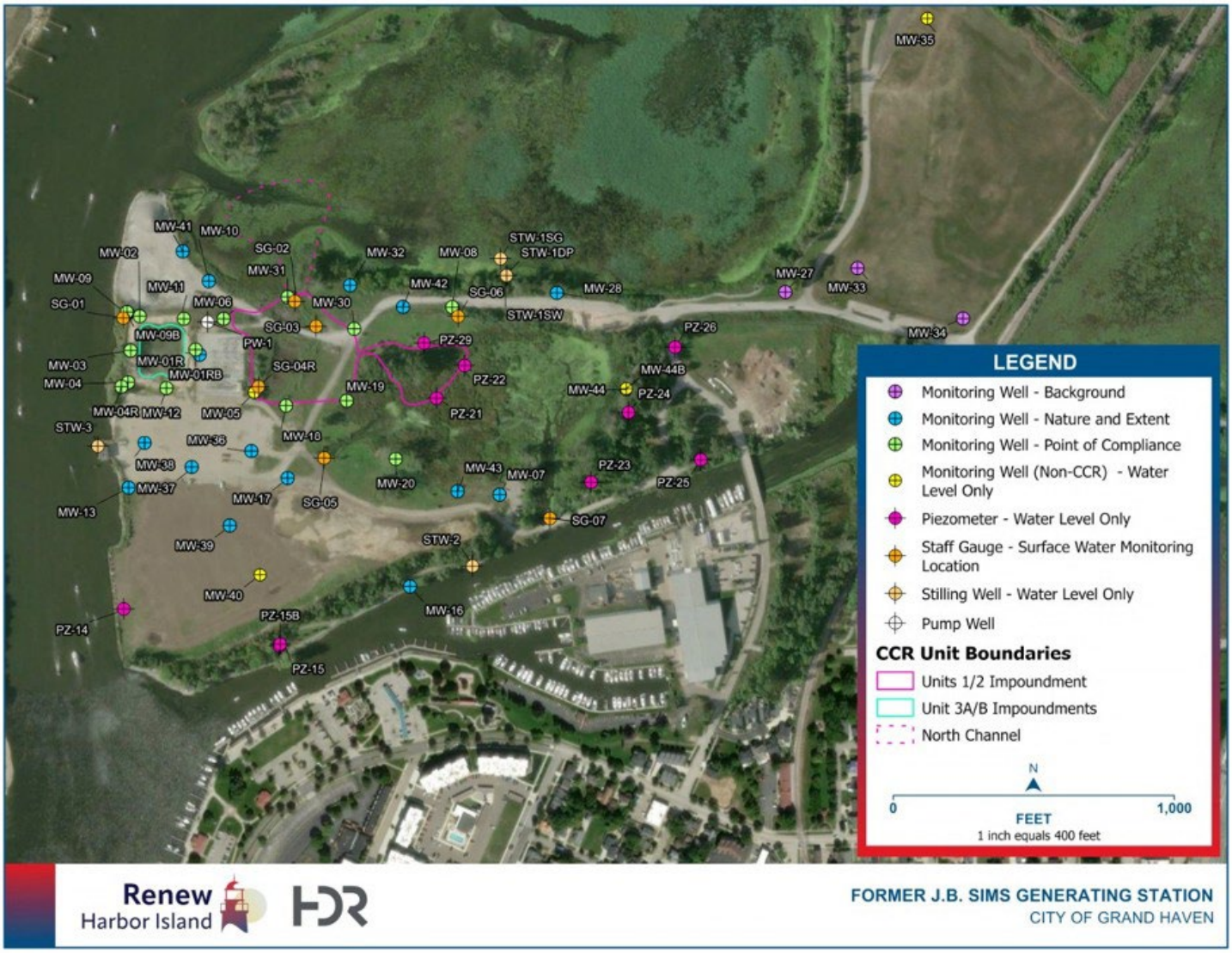


Figure 2 Former JB Sims CCR Units & Monitoring Wells



Figure 3 Transducer Deployment Map

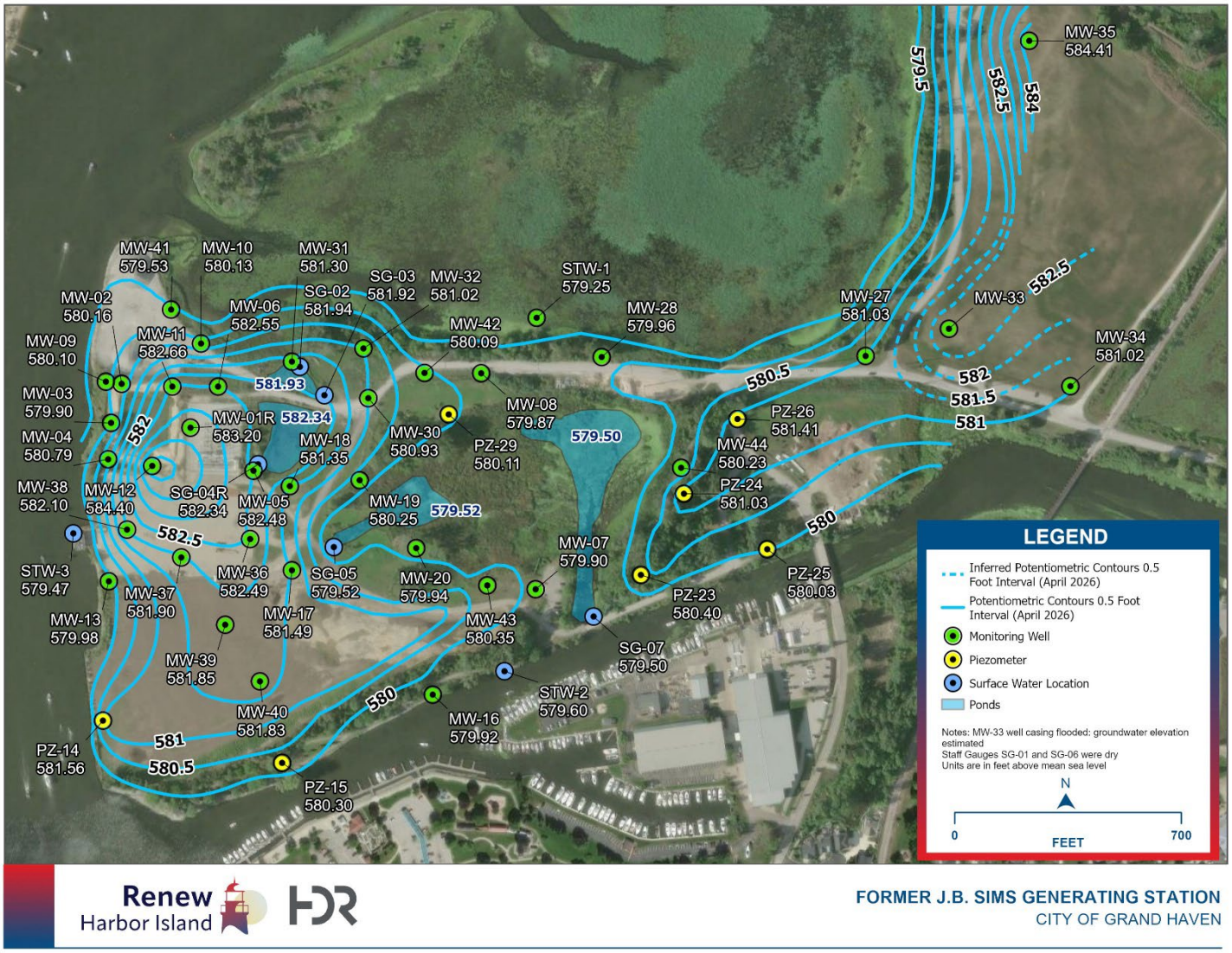


Figure 4 Potentiometric Map

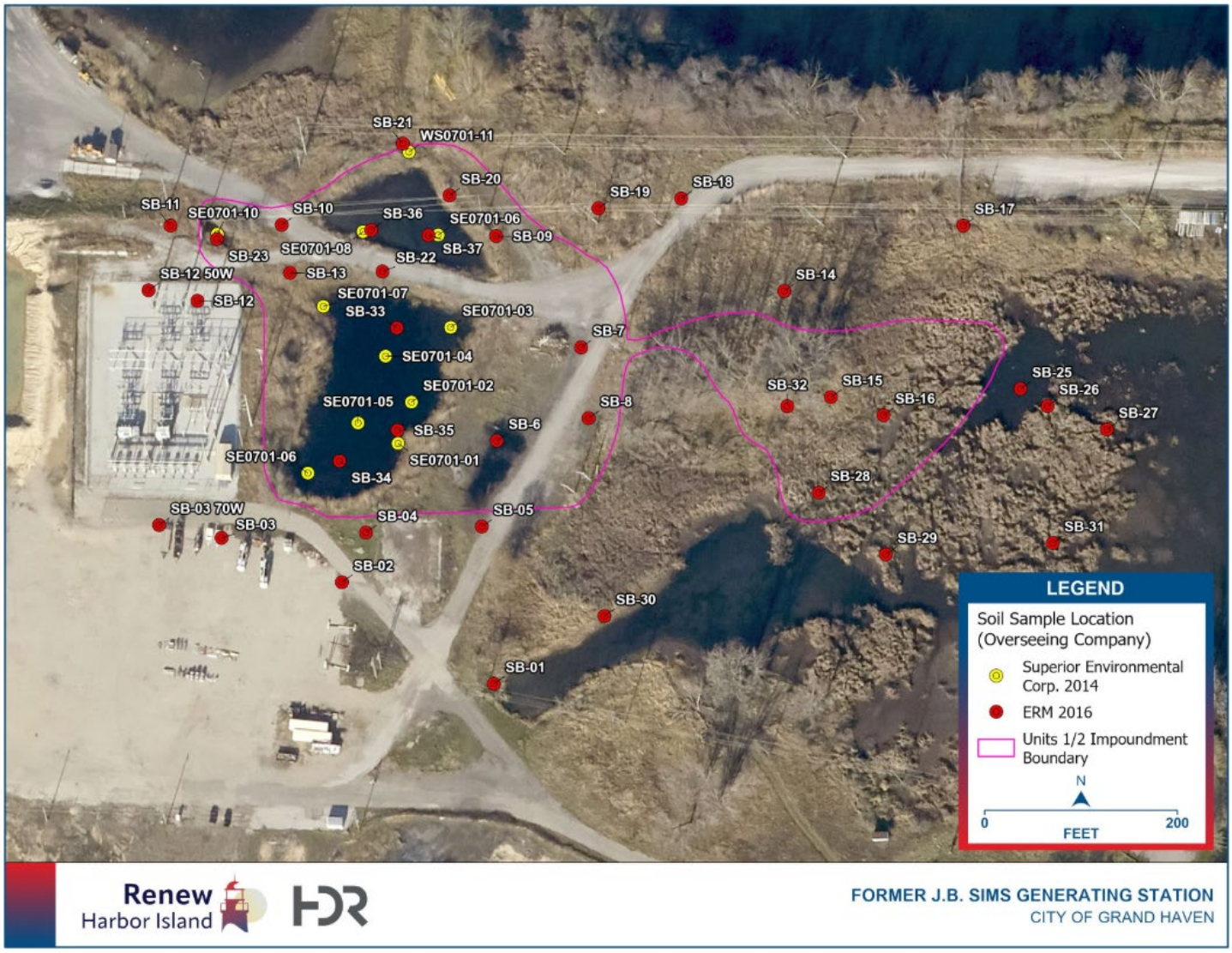


Figure 5 Ash Delineation Borings

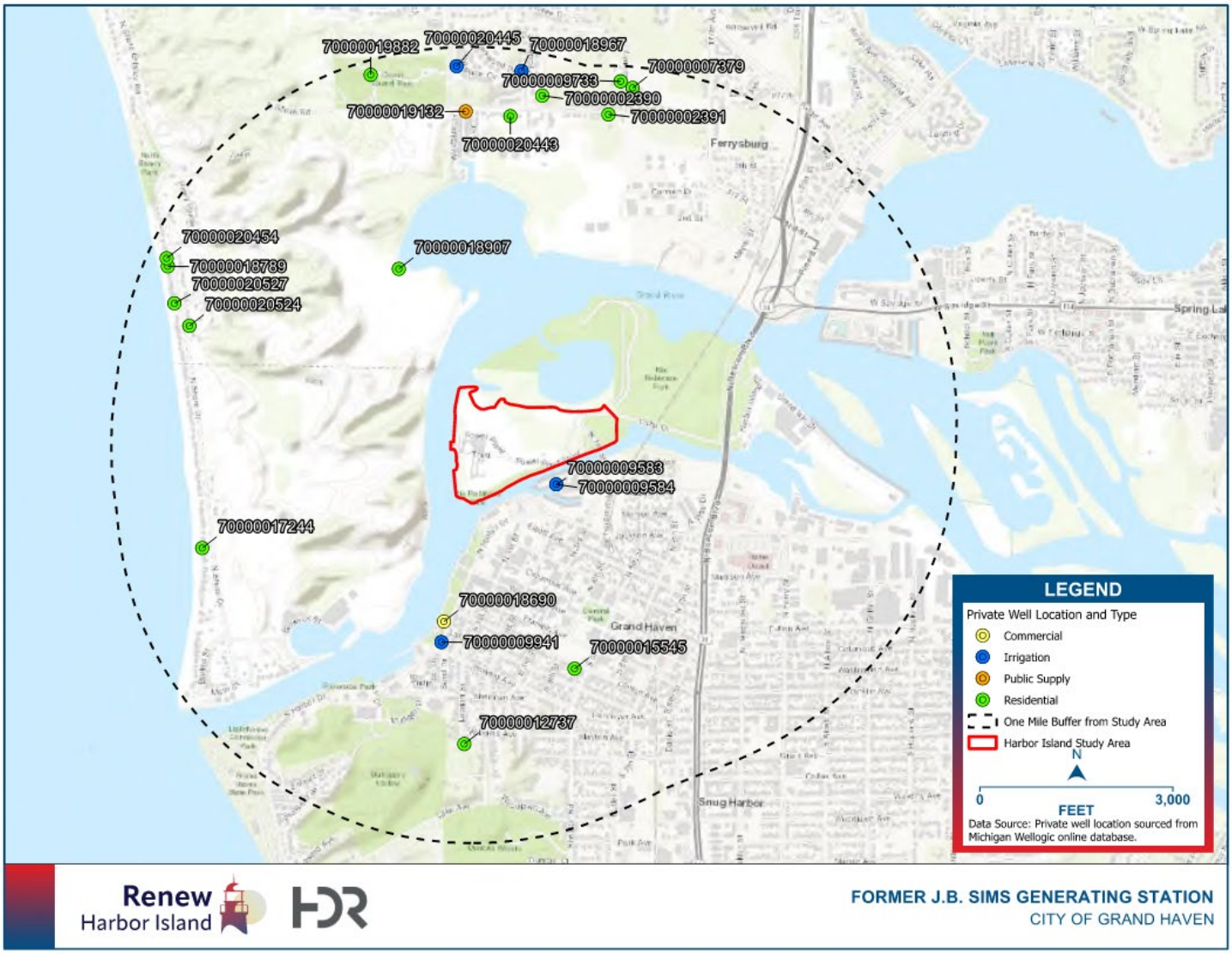


Figure 6 Registered Wells Within One Mile of the Site

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Attachment B

Tables

Table 1 Hydraulic Conductivity Values (Golder 2021 and HDR 2024)

Well ID	Screen Interval Lithology	Average Hydraulic Conductivity (feet/day)
MW-01R	Silty fine sand with trace refuse and silt	5.4
MW-01RB	Poorly graded sand	181
MW-02	Silty clay and poorly graded fine sand	0.2
MW-04	Well graded fine to medium sand and sandy silt	1.7
MW-05	Fine grained ash with refuse	18.8
MW-07	Sandy peat with shell fragments and silty sand	7.9
MW-08	Refuse and clayey sand	7.9
MW-10	Coarse sand and gravel	14.5
MW-12	Sand above clayey organic peat	14
PZ-15	Fine sand	1.5
PZ-15B	Sandy silt, well graded sand	2.2
MW-16	Fine sand, wood and organics	15.9
PZ-17/ MW-17	Sand with some gravel and gravelly silt with trace organics	173/263
PZ-20/ MW-20	Peaty sand and peaty silt	242/328
PZ-26	Very fine to medium sand with organics	8.3
MW-31	Mucky sand with refuse and sandy peat with refuse	0.4
MW-32	Peaty sand, refuse	24.4
MW-36	Sand and gravel	23.7
MW-40	Sand and gravel	1.4
MW-41	Well graded gravel with sand, sandy silt, poorly graded sand, well graded gravel with silt, clayey silty sand with gravel	0.05
MW-44	Silty sand, poorly graded sand, well graded sand with gravel	3.7
MW-44B	Fat clay	$1.6x10^{-9}$

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Table 2 Federal Compliance Program Groundwater Protection Standards

Parameter	Site-Specific Background Level Upper Tolerance Limit (UTL) (mg/L)	Federal Maximum Contaminant Level (mg/L)	Federal Program Groundwater Protection Standards (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[1]	0.0060
Fluoride	0.45	4.0	4.0
Lead	0.0016	0.015[1]	0.015
Lithium	0.10	0.040[1]	0.10
Mercury	0.00016	0.0020	0.0020
Molybdenum	0.0093	0.10[1]	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

[1]EPA adopted health-based values for constituents with no MCL.

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Table 3 State Compliance Program 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)[2]	State Groundwater Surface Water Interface (mg/L)[2]	Groundwater Protection Standards for Site (mg/L)
Antimony	0.0012	0.0060	0.0060	0.13	0.0060
Arsenic	0.0040	0.010	0.010	0.010	0.010
Barium	0.58	2.00	2.00	1.3[3]	1.3[3]
Beryllium	0.000059	0.0040	0.0040	0.036[3]	0.0040
Boron	4.0	NV	0.50	7.20	4.0
Cadmium	0.00015	0.0050	0.0050	0.0025	0.0025[3]
Calcium	250	NV	N/A	N/A	250
Chloride	120	NV	250	NV	250
Chromium	0.042	0.10	0.10	0.12	0.10
Cobalt	0.0021	0.0060	0.10	0.10	0.0060
Copper	0.020	1.3	1.0	0.021[3]	0.021[3]
Fluoride	0.45	4.0	2.0	NV	2.0
Iron	83	0.30	0.30	NV	83
Lead	0.0016	0.015	0.0040	0.014[3]	0.0040
Lithium	0.10	0.040	0.35	0.44	0.10
Mercury	0.00016	0.0020	0.0020	0.0000013	0.0000013
Molybdenum	0.0093	0.10	0.210	3.2	0.10
Nickel	0.023	NV	0.10	0.12[3]	0.10
Radium-226/228	2.6	5.0	NV	NV	5.0
Selenium	0.00089	0.050	0.050	0.0050	0.0050
Silver	0.00011	0.10	0.0098	0.00020	0.00020
Sulfate	100	NV	250	NV	250
TDS	950	500	500	500	950

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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)[2]	State Groundwater Surface Water Interface (mg/L) [2]	Groundwater Protection Standards for Site (mg/L)
Thallium	0.000075	0.0020	0.0020	0.0037	0.0020
Vanadium	0.00093	NV	0.0062	0.027	0.0062
Zinc	0.038	5.0	5.0	0.27[3]	0.27[3]

[2] Cleanup Criteria Requirements for Response Activity (Formerly the Part 201 Generic Cleanup Criteria and Screening Levels) found in Michigan Administrative Code R299.44 Generic groundwater cleanup criteria.
[3]Per Footnote G of Table 1 Cleanup Criteria Requirements for Response Activity of the GSI Criteria list, values noted are calculated based on the hardness (expressed as $CaCO_3$) of the receiving waters. Surface water sample from the Grand River (SG-01) of 270 mg/L hardness 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 was provided.

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Table 4 April 2026 Lower Confidence Limits (LCLs) that Exceed GPS for the Units 1/2 Impoundment

Constituent	Federal GPS (mg/L)	State GPS (mg/L)	Well	95LCL
Arsenic	0.010	0.010	MW-08	0.033
			MW-18	0.023
			MW-36	0.011
Barium	2.0	1.3	MW-06	1.4
Boron	None	4.0	MW-06	8.8
			MW-07	11
			MW-08	5.4
			MW-10	16
			MW-31	4.6
Chloride	None	120	MW-10	250
Fluoride	4.0	2.0	MW-10	4.7
			MW-18	3.6
			MW-31	4.5
Lead	0.015	0.004	MW-36	0.0087
Lithium	0.10	0.10	MW-06	0.16
			MW-10	0.84
			MW-30	0.12
			MW-32	0.12
Sulfate	None	250	MW-10	400
			MW-18	660
			MW-19	890
			MW-30	820
TDS	None	950	MW-06	1,200
			MW-10	1,900
			MW-18	1,200
			MW-19	1,700
			MW-30	2,200

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Table 5 April 2026 LCLs that Exceed GPS for the Unit 3A/B Impoundments

Constituent	Federal GPS (mg/L)	State GPS (mg/L)	Well	95LCL
Boron	None	4.0	MW-01R	94
			MW-02	97
			MW-09	5.1
			MW-10	16
			MW-11	5.4
Chloride	None	120	MW-02	140
			MW-03	130
			MW-10	250
Fluoride	4.0	2.0	MW-01R	11
			MW-02	9.4
			MW-09	2.4
			MW-10	4.7
Lead	0.0016	0.004	MW-38	0.0065
Lithium	0.10	0.10	MW-01R	2.0
			MW-02	1.3
			MW-09	0.30
Sulfate	None	250	MW-01R	310
			MW-04	520
			MW-09	450
			MW-10	400
TDS	None	950	MW-01R	2,300
			MW-02	1,900
			MW-03	1,700
			MW-04	1,700
			MW-09	1,400
			MW-10	1,900

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Table 6 Summary of Vertical Aquifer Sampling of Shallow Groundwater Results with GSI Exceedances (WSP, 2023)

PFAS Compounds with GSI Exceedances	Total Number of Groundwater Samples	Number of Samples with Detections	Maximum Detection (ng/L) (Location)	GSI Criteria (ng/L)	Number of Samples > GSI	Residential & Non-Residential Drinking Water Criteria (DWC) (ng/L)	Number of Results > DWC
PFOA	40	35	110 (VAS34-3-7)	66	4	8	24
PFOS	40	36	250 (VAS34-3-7)	11	17	16	14
PFHxS	40	29	110 (VAS21-5-9)	59	1	51	1

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Table 7 Registered Wells Within One Mile of the Site

Well ID	Well Depth (feet bgs)	Date of Construction	Static Water Level (feet bgs)	Latitude	Longitude	Elevation (feet)	Well Type
2390	87	4/30/1971	68	43.085	-86.231	610	Residential
2391	83	6/30/1971	63	43.084	-86.227	591	Residential
7379	30	10/19/2006	4	43.086	-85.225	587	Residential
9583	50	7/25/2012	0	43.069	-86.229	582	Commercial
9584	21	8/15/2012	6	43.069	-86.229	582	Commercial
9733	30	2/12/2013	2	43.086	-86.226	592	Residential
9941	63	9/10/2013	43	43.062	-86.236	605	Commercial
12737	58	1/25/2019	26	43.058	-86.234	614	Residential
15545	65	10/20/1971	37	43.061	-86.228	611	Residential
17244	52	3/31/1972	30	43.066	-86.250	597	Residential
18690	52	Not provided	0	43.063	-86.236	595	Commercial
18789	35	2/14/1972	22	43.078	-86.252	595	Residential
18907	43	6/11/1990	6	43.078	-86.239	586	Residential
18967	42	7/12/1990	9	43.086	-86.232	607	Commercial
19132	53	8/18/1966	17	43.084	-86.235	609	Public Supply
19882	42	4/24/1972	5	43.086	-86.241	607	Residential
20443	35	10/7/1967	10	43.084	-86.232	600	Residential
20445	38	5/1/1967	3	43.086	-86.236	602	Commercial
20454	21	6/10/1972	9	43.078	-86.252	596	Residential
20524	37	6/6/1972	10	43.075	-86.251	593	Residential
20527	40	5/25/1971	0	43.076	-86.252	599	Residential

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Table 8 Alternative Description Summary

Alternative	Alternative Description	Key Remedy Components	Annual O&M Activities	Periodic O&M Activities	State Permitting / Regulatory Considerations	Federal Permitting / Regulatory Considerations
1 – Excavation	Excavation and off-Site disposal of impacted materials. Removes the source of groundwater impacts with contaminant removal and treatment during construction dewatering. Provides the highest degree of remedy permanence. Does not remove CCR underneath substation. ICs, including groundwater use restrictions and long-term monitoring, will be used to address the remaining GW impacts on Site	Site preparation; excavation of impacted soils; hydro excavation near utilities and substation; concrete removal; construction dewatering; off-Site disposal; confirmation sampling; backfill; Site restoration. Because this alternative does not intend to remove all historical waste materials located across the Site, there remains a risk of future PFAS exceedances beyond the treated zones. As a result, adaptive management measures may be required to maintain compliance with applicable GSI Criteria.	Groundwater monitoring and reporting; routine Site inspections; minor vegetation and stormwater maintenance; regulatory reporting.	Supplemental seeding and planting; stormwater repairs; access road maintenance; periodic remedy reviews.	Construction dewatering approvals; groundwater discharge permits (if applicable); waste profiling and disposal approvals; wetland permits if impacts occur; local grading/earthwork permits.	Complete excavation and off-Site disposal of impacted materials to achieve clean closure. Removes the source of groundwater impacts and provides the highest degree of remedy permanence.
2 – In Situ Stabilization	In-place treatment of impacted material using stabilization amendments to reduce constituent mobility and groundwater loading. CCR and PFAS remain on Site in stabilized soils following treatment. GWET removes CCR and PFAS remaining in groundwater after completion of ISS. ICs, including groundwater use restrictions and long-term monitoring, will be used to address the remaining GW impacts on Site	Pre-design investigation; PFAS treatability testing; concrete removal; work pad preparation; ISS mixing; Portland cement amendment; carbon amendment; Site restoration, GWET construction.	Groundwater monitoring; extraction system operation, treatment performance monitoring; inspections of restored areas; vegetation maintenance; regulatory reporting.	Supplemental stabilization evaluation (if needed); vegetation replacement; stormwater repairs; periodic remedy performance reviews.	PFAS treatability testing; construction stormwater controls; Part 31 discharge requirements, potential groundwater discharge permits during implementation; local construction permits.	In-place treatment of impacted materials using stabilization amendments to reduce constituent mobility and groundwater loading. CCR and PFAS remain on Site following treatment. Discharge and/or disposal associated with the GWET system.
3 – Full Containment	Hydraulic containment of impacted materials using a barrier wall, engineered cover system, and groundwater gradient control & treatment system. ICs, including groundwater use restrictions and long-term monitoring, will be used to address the remaining GW impacts on Site.	Barrier wall installation; groundwater extraction wells; monitoring piezometers; GWET system; engineered cap; stormwater controls; long-term containment infrastructure.	Groundwater monitoring; extraction well operation; cap inspections; barrier wall monitoring; stormwater maintenance; institutional control management; regulatory reporting.	Cap repairs; extraction well rehabilitation; stormwater system repairs; vegetation replacement; monitoring system upgrades; periodic remedy reviews.	Part 303 wetland permitting; Part 31 discharge permitting; utility coordination and relocations; groundwater extraction and discharge approvals; local permits and approvals.	Hydraulic containment using a barrier wall, engineered cover system, and groundwater gradient control system.
4 – Hybrid Containment	Excavation outside the containment footprint combined with on-Site consolidation, barrier wall containment, engineered cover system, and groundwater gradient control & treatment system. Designed to avoid wetland impacts while maximizing source containment.	Excavation outside barrier wall; on-Site consolidation; barrier wall; groundwater extraction wells and piezometers; engineered cap; construction dewatering; restoration.	Groundwater monitoring; extraction system operation; cap inspections; barrier wall performance monitoring; stormwater maintenance; regulatory reporting.	Cap repairs; extraction well rehabilitation; stormwater repairs; vegetation replacement; remedy performance evaluations.	Reduced wetland permitting relative to Alternative 2; Part 31 discharge requirements; utility coordination; groundwater extraction permits; local permits and approvals.	Excavation outside the containment footprint combined with on-Site consolidation, barrier wall containment, engineered cover system, and groundwater gradient control. Designed to avoid wetland

Alternative	Alternative Description	Key Remedy Components	Annual O&M Activities	Periodic O&M Activities	State Permitting / Regulatory Considerations	Federal Permitting / Regulatory Considerations
	ICs, including groundwater use restrictions and long-term monitoring, will be used to address the remaining GW impacts on Site.					impacts while maximizing source containment.
5 – Reduced-Footprint Hybrid	Enhanced excavation and on-Site consolidation combined with a reduced-footprint barrier wall, engineered cover system, and groundwater gradient control & treatment system. Designed to minimize utility conflicts and long-term containment footprint. ICs, including groundwater use restrictions and long-term monitoring, will be used to address the remaining GW impacts on Site	Expanded excavation and concrete removal; on-Site consolidation; reduced-footprint barrier wall; groundwater extraction wells and piezometers; engineered cap; construction dewatering; restoration.	Groundwater monitoring; extraction system operation; cap inspections; barrier wall monitoring; stormwater maintenance; regulatory reporting.	Cap repairs; extraction well rehabilitation; stormwater repairs; vegetation replacement; remedy performance evaluations.	Reduced wetland and utility impacts relative to Alternatives 2 and 3; Part 31 discharge requirements; utility coordination; local permits and approvals.	Enhanced excavation and on-Site consolidation combined with a reduced-footprint barrier wall, engineered cover system, and groundwater gradient control. Designed to minimize utility conflicts and long-term containment footprint.

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Table 9 Remedial Action Alternatives Comparison

Alternative	Performance	Reliability	Implementability	Environmental & Community Impacts	Schedule	Cost
1 – Excavation	High	High	Moderate	Low	Moderate	Low
2 – In Situ Stabilization	Low	Low	Moderate	Moderate	High	Low
3 – Full Containment	Moderate	Moderate	Low	Moderate	Low	Moderate
4 – Hybrid Containment	High	High	Moderate	Moderate	Moderate	Moderate
5 – Reduced-Footprint Hybrid	High	High	High	High	Moderate	High

[6]

Ranking	Definition
High	Most favorable relative to the other alternatives
Moderate	Generally acceptable but includes limitations, tradeoffs, or uncertainty
Low	Least favorable relative to the other alternatives

Table 10 Project Milestone Schedule

Milestone	Completion Date*
Remedial Action Plan/Remedial Section Report	February 2027
RAA Public Engagement	July-December 2026
Remedial Design	October 2027-August 2029
Permitting and Approvals	January 2028-June 2028
Contractor Procurement Period	August 2029-January 2030
Construction	January 2030-July 2030
System Startup (Substantial Completion)	July 2030
Long-Term Operation and Monitoring	2030-2060

*These dates are dependent on EGLE review times (Remediation Action Plan, design reviews, groundwater model, wetland permitting, NPDES permitting), weather, and contractor availability.

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Work today, protect tomorrow.

Attachment C

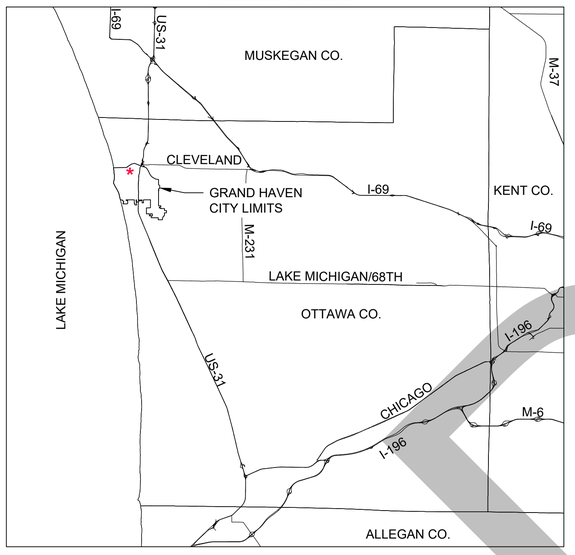
Alternative Drawings

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STATE OF MICHIGAN



PROJECT VICINITY MAP
OTTAWA COUNTY



PROJECT LOCATION MAP
CITY OF GRAND HAVEN



DATUM AND PROJECTION:
MICHIGAN STATE PLANE COORDINATE SYSTEM
NAD83 - INTERNATIONAL FEET
VERTICAL DATUM: NAVD 88

CITY OF GRAND HAVEN

FORMER J.B. SIMS GENERATING STATION HARBOR ISLAND REMEDIAL ALTERNATIVES

PROJECT NO.
10337505

GRAND HAVEN, MICHIGAN
OCTOBER 2026

INDEX TO SHEETS

SHEET NO.	DESCRIPTION
00G-01	COVER SHEET / VICINITY MAP
00C-01	EXISTING CONDITIONS
00C-02-A	PLUME LOCATIONS - 01 COAL ASH LIMITS
00C-02-B	PLUME LOCATIONS - 02 PFAS PLUME
00C-02-C	PLUME LOCATIONS - 03 CCR PLUME
00C-02-D	PLUME LOCATIONS - 04
00C-03	ALTERNATIVE 1 EXCAVATION
00C-04	ALTERNATIVE 2 IN-SITU STABILIZATION
00C-05	ALTERNATIVE 3 FULL CONTAINMENT
00C-06	ALTERNATIVE 4 HYBRID CONTAINMENT
00C-07	ALTERNATIVE 5 REDUCED FOOTPRINT HYBRID

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PROJECT MANAGER L. ZAWAIDEH
PROJECT NUMBER 10337505

HARBOR ISLAND
FORMER J.B. SIMS GENERATION STATION
REMEDIAL ALTERNATIVES

COVER SHEET / VICINTY MAP

0 1" 2"

FILENAME CV-01.dwg
SCALE AS SHOWN

SHEET
00G-01



N

NOTES:

1. CONTOURS ARE BASED ON LIDAR AND BATHYMETRIC POLING SURVEY BY THE MANNIK & SMITH GROUP, INC. (MSG) COMPLETED ON MAY 8, 2026.
2. VERTICAL DATUM: NAVD 88.
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4. UTILITIES INCLUDED ARE BASED ON HISTORIC DOCUMENTATION. SITE UTILITY INVESTIGATION REQUIRED TO IDENTIFY AND LABEL ALL UNDERGROUND AND OVERHEAD UTILITY LINES

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- 585 — EXISTING CONTOUR
- PROPERTY BOUNDARY
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- MONITORING WELL/ PIEZOMETER
- IMPOUNDMENT
- NORTH CHANNEL COAL ASH

FOUNDATION AREA - FACING WEST
NOT TO SCALE

FOUNDATION AREA - FACING NORTH
NOT TO SCALE



FOUNDATION AREA - FACING EAST
NOT TO SCALE

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REMEDIAL ALTERNATIVES

EXISTING CONDITIONS

0 1" 2"

FILENAME ----

SCALE 1" = 100

SHEET 00C-01



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PLUME LOCATIONS - 01
COAL ASH LIMITS

0 1" 2"

FILENAME ----

SCALE 1" = 100'

SHEET **00C-02-A**



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PLUME LOCATIONS - 02
PFAS PLUME

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FILENAME ----

SCALE 1" = 100'

SHEET **00C-02-B**



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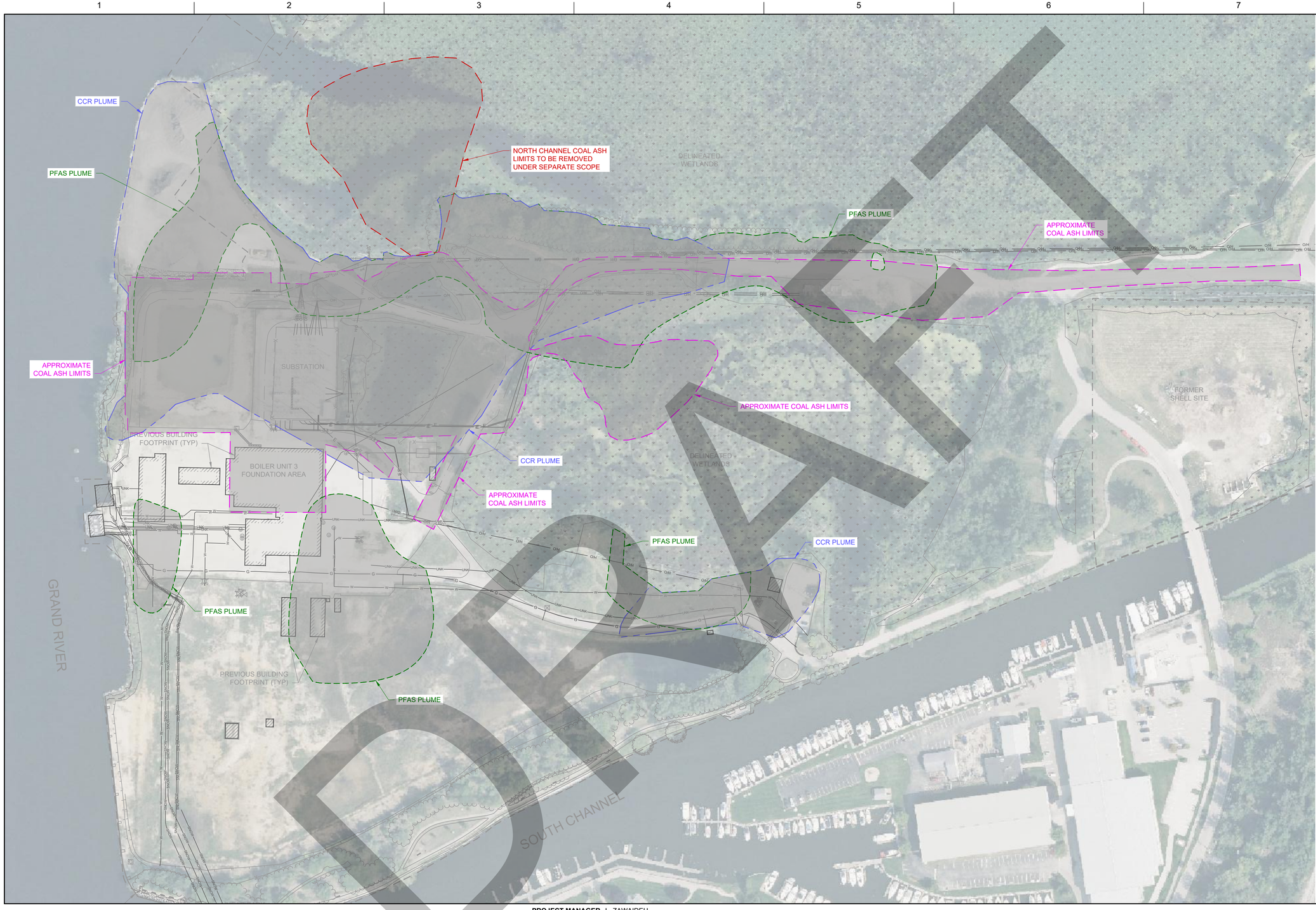
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SCALE 1" = 100'

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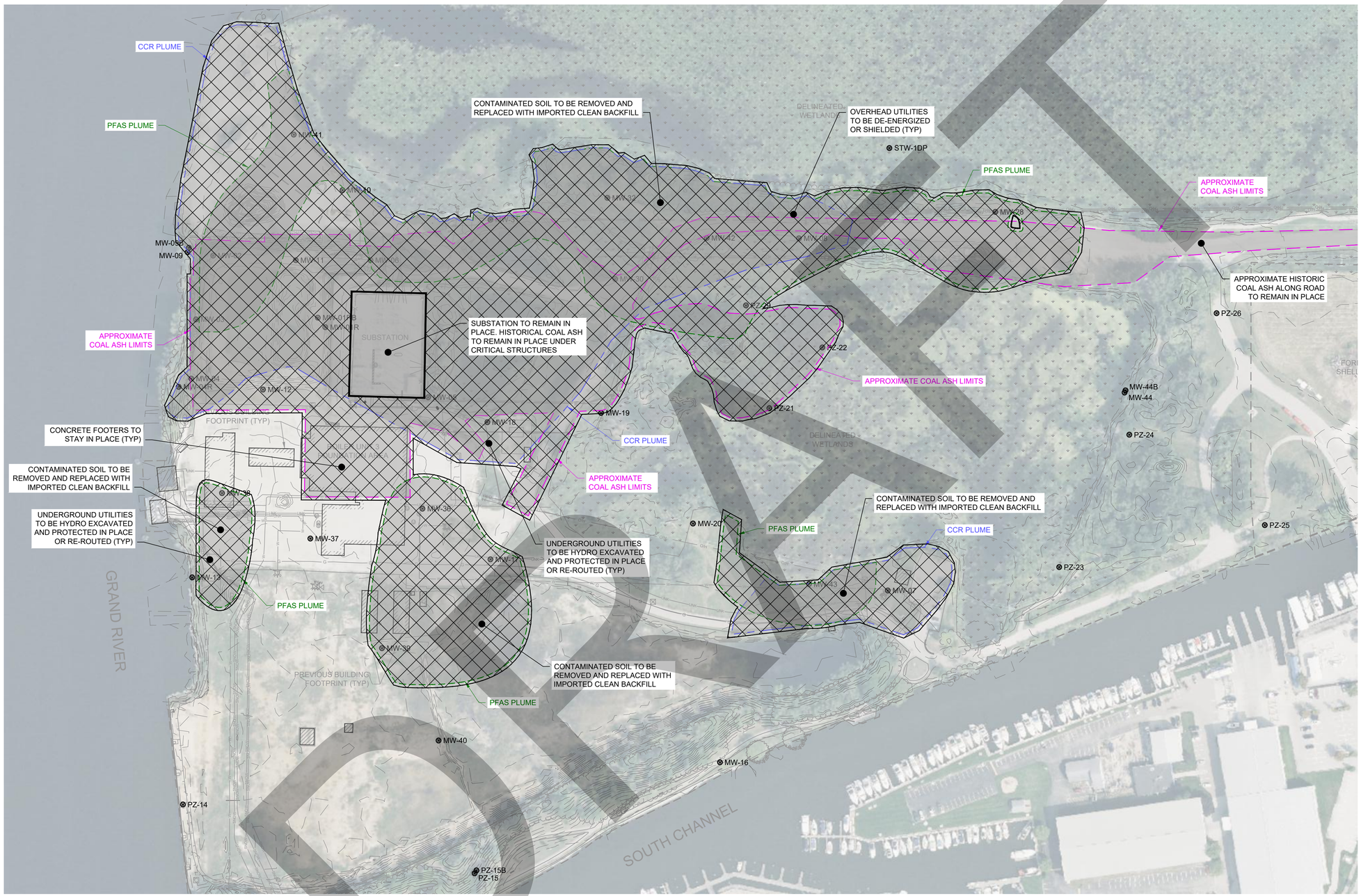
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SCALE 1" = 100'

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5. EXCAVATION MATERIAL WILL BE SEGREGATED INTO CLEAN AND CONTAMINATED MATERIAL BASED ON VISUAL INSPECTION AND CONFIRMED VIA SAMPLING.
6. SATURATED EXCAVATED MATERIAL WILL BE LOCALLY STOCKPILED AND STABILIZED WITH CEMENT PRIOR TO LOADOUT AND DISPOSAL.

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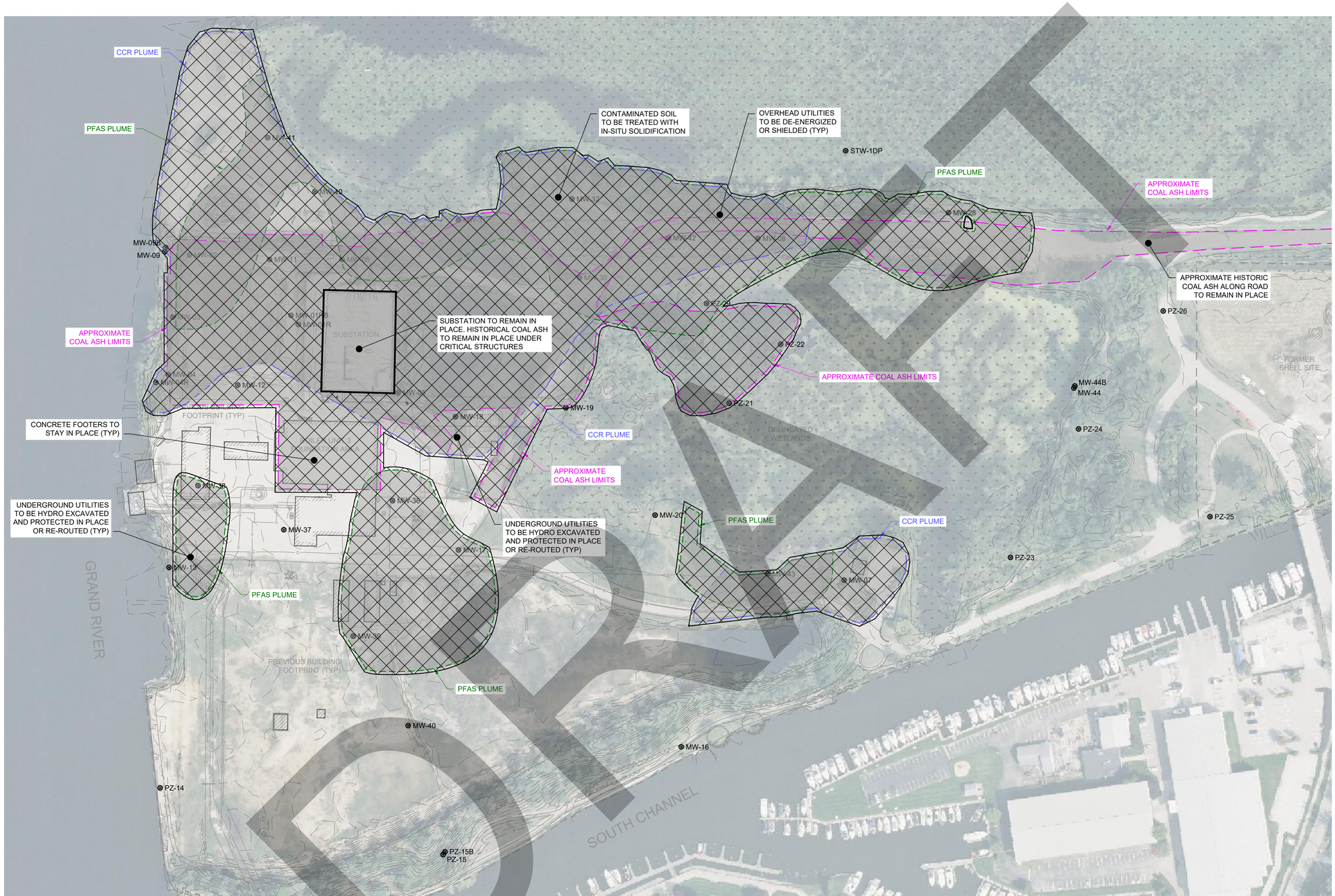
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EXCAVATION

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FILENAME ----

SCALE 1" = 100'

SHEET **00C-03**



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PROJECT NUMBER 10337505

HARBOR ISLAND
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REMEDIAL ALTERNATIVES

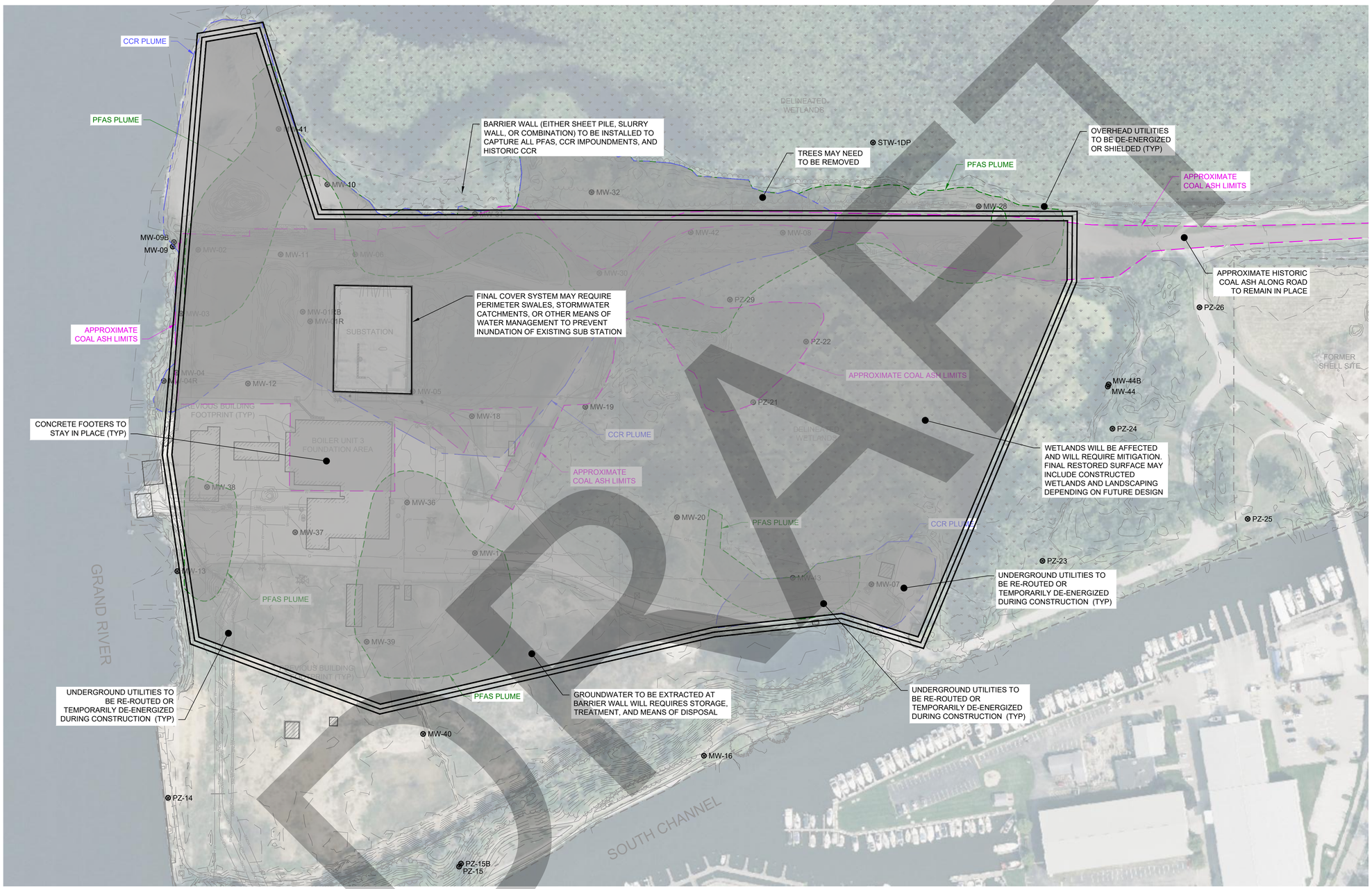
ALTERNATIVE 2
IN-SITU STABILIZATION

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FILENAME ----

SCALE 1" = 100'

SHEET 00C-04



N

NOTES:

1. CONTOURS ARE BASED ON LIDAR AND BATHYMETRIC POLING SURVEY BY THE MANNIK & SMITH GROUP, INC. (MSG) COMPLETED ON MAY 8, 2026.
2. VERTICAL DATUM: NAVD 88.
3. HORIZONTAL DATUM: MICHIGAN STATE PLANE SOUTH (NAD 83) INTERNATIONAL FEET
4. UTILITIES INCLUDED ARE BASED ON HISTORIC DOCUMENTATION. SITE UTILITY INVESTIGATION REQUIRED TO IDENTIFY AND LABEL ALL UNDERGROUND AND OVERHEAD UTILITY LINES

LEGEND:

- 585 — EXISTING CONTOUR
- PROPERTY BOUNDARY
- CCR UNIT BOUNDARIES
- WETLAND
- TREELINE
- EDGE OF PAVEMENT
- PREVIOUS BUILDING
- FIRE HYDRANT
- POLE
- GUY
- O/H — OVERHEAD UTILITY
- E — UNDERGROUND ELECTRIC
- W — WATER PIPE
- G — GAS LINE
- SNOW — SNOW MELT PIPE
- UNK — UNKNOWN UTILITY
- (W) MONITORING WELL/PIEZOMETER
- BARRIER WALL AND CAP
- PFAS PLUME
- CCR PLUME
- APPROXIMATE COAL ASH LIMITS, INCLUDES HISTORIC COAL ASH

DRAFT

DRAFT DOCUMENTS - NOT INTENDED FOR CONSTRUCTION

ISSUE	DATE	DESCRIPTION
0	10/21/2026	ISSUED FOR 10% DESIGN

PROJECT MANAGER L. ZAWAIDEH

PROJECT NUMBER 10337505

HARBOR ISLAND
FORMER J.B. SIMS GENERATION STATION
REMEDIAL ALTERNATIVES

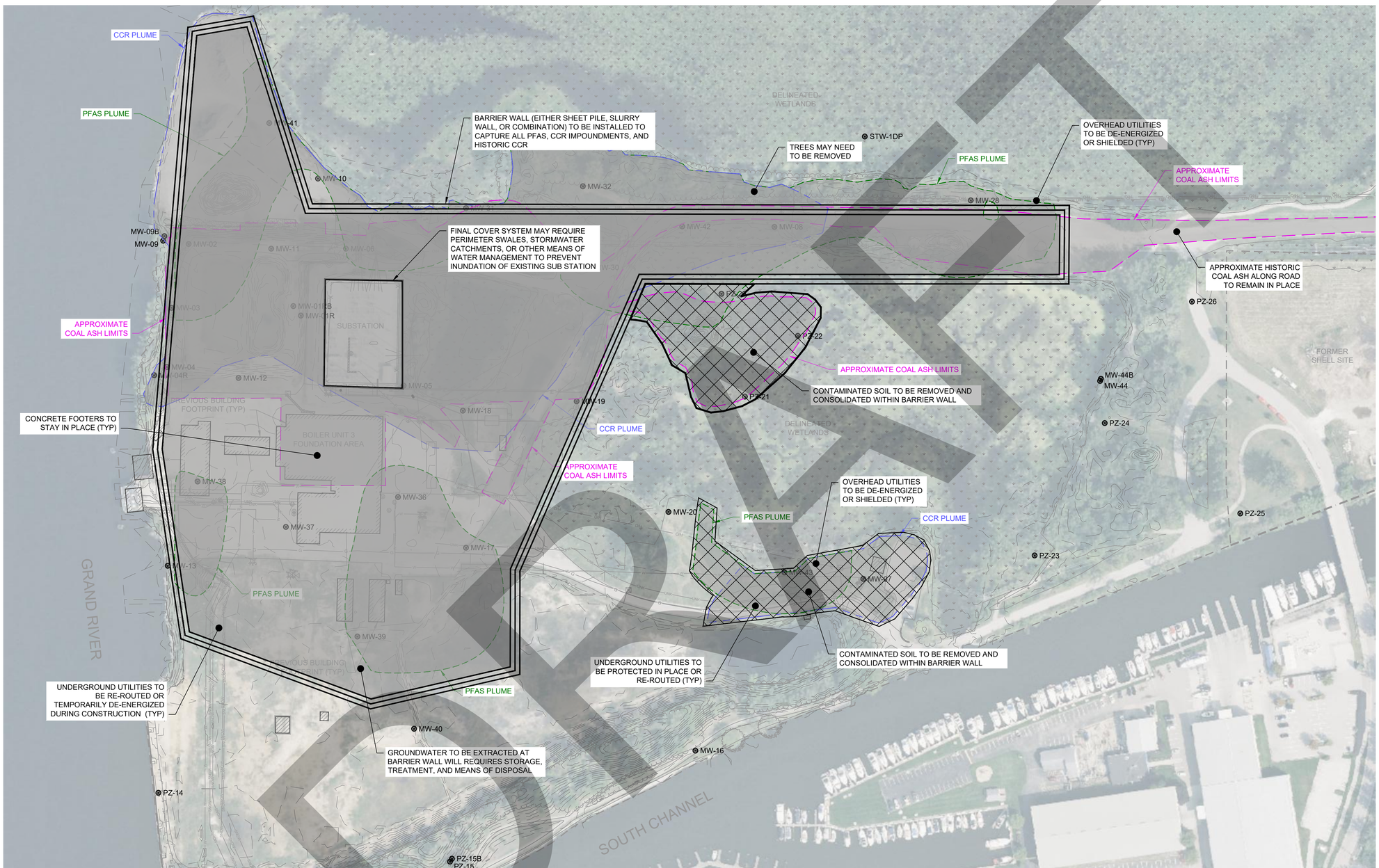
ALTERNATE 3
FULL CONTAINMENT

0 1" 2"

FILENAME ----

SCALE 1" = 100'

SHEET **00C-05**



N

NOTES:

1. CONTOURS ARE BASED ON LIDAR AND BATHYMETRIC POLING SURVEY BY THE MANNIK & SMITH GROUP, INC. (MSG) COMPLETED ON MAY 8, 2026.
2. VERTICAL DATUM: NAVD 88.
3. HORIZONTAL DATUM: MICHIGAN STATE PLANE SOUTH (NAD 83) INTERNATIONAL FEET
4. UTILITIES INCLUDED ARE BASED ON HISTORIC DOCUMENTATION. SITE UTILITY INVESTIGATION REQUIRED TO IDENTIFY AND LABEL ALL UNDERGROUND AND OVERHEAD UTILITY LINES

LEGEND:

- 585 — EXISTING CONTOUR
- PROPERTY BOUNDARY
- CCR UNIT BOUNDARIES
- WETLAND
- TREELINE
- EDGE OF PAVEMENT
- PREVIOUS BUILDING
- FIRE HYDRANT
- POLE
- GUY
- O/H — OVERHEAD UTILITY
- E — UNDERGROUND ELECTRIC
- W — WATER PIPE
- G — GAS LINE
- SNOW — SNOW MELT PIPE
- UNK — UNKNOWN UTILITY
- (W) — MONITORING WELL/ PIEZOMETER
- EXCAVATION LIMITS
- BARRIER WALL AND CAP
- PFAS PLUME
- CCR PLUME
- APPROXIMATE COAL ASH LIMITS, INCLUDES HISTORIC COAL ASH

DRAFT DOCUMENTS - NOT INTENDED FOR CONSTRUCTION

ISSUE	DATE	DESCRIPTION
0	10/21/2026	ISSUED FOR 10% DESIGN

PROJECT MANAGER L. ZAWAIDEH

PROJECT NUMBER 10337505

HARBOR ISLAND
FORMER J.B. SIMS GENERATION STATION
REMEDIAL ALTERNATIVES

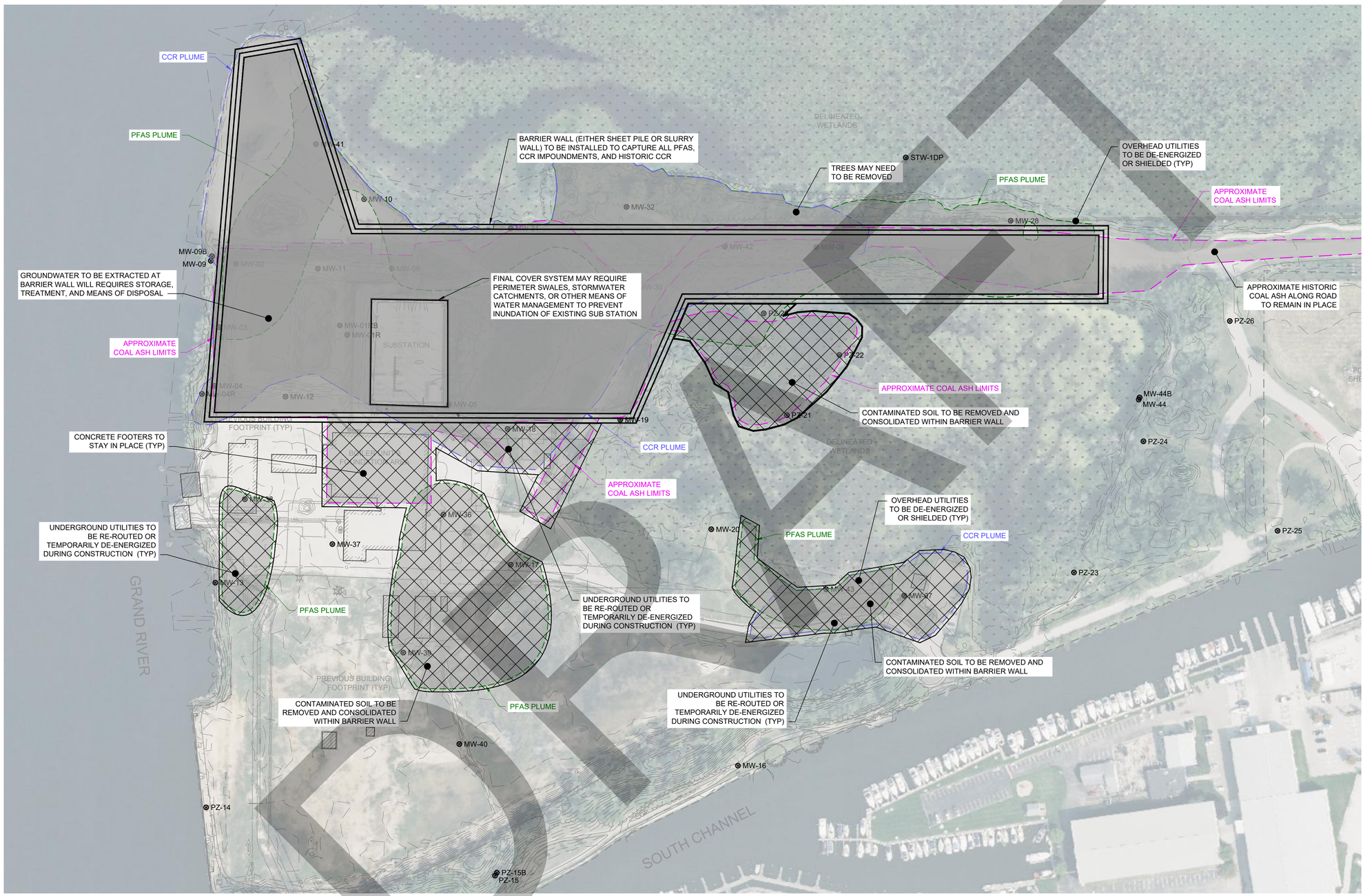
ALTERNATIVE 4
HYBRID CONTAINMENT

0 1" 2"

FILENAME ----

SCALE 1" = 100'

SHEET 00C-06



N

NOTES:

1. CONTOURS ARE BASED ON LIDAR AND BATHYMETRIC POLING SURVEY BY THE MANNIK & SMITH GROUP, INC. (MSG) COMPLETED ON MAY 8, 2026.
2. VERTICAL DATUM: NAVD 88.
3. HORIZONTAL DATUM: MICHIGAN STATE PLANE SOUTH (NAD 83) INTERNATIONAL FEET
4. UTILITIES INCLUDED ARE BASED ON HISTORIC DOCUMENTATION. SITE UTILITY INVESTIGATION REQUIRED TO IDENTIFY AND LABEL ALL UNDERGROUND AND OVERHEAD UTILITY LINES

LEGEND:

- 585 — EXISTING CONTOUR
- PROPERTY BOUNDARY
- CCR UNIT BOUNDARIES
- WETLAND
- TREELINE
- EDGE OF PAVEMENT
- PREVIOUS BUILDING
- FIRE HYDRANT
- POLE
- GUY
- O/H — OVERHEAD UTILITY
- E — UNDERGROUND ELECTRIC
- W — WATER PIPE
- G — GAS LINE
- SNOW — SNOW MELT PIPE
- UNK — UNKNOWN UTILITY
- (W) — MONITORING WELL/ PIEZOMETER
- EXCAVATION LIMITS
- BARRIER WALL AND CAP
- PFAS PLUME
- CCR PLUME
- APPROXIMATE COAL ASH LIMITS, INCLUDES HISTORIC COAL ASH

DRAFT DOCUMENTS - NOT INTENDED FOR CONSTRUCTION

CITY OF GRAND HAVEN MICHIGAN

HDR

ISSUE	DATE	DESCRIPTION
0	10/21/2026	ISSUED FOR 10% DESIGN

PROJECT MANAGER L. ZAWAIDEH

PROJECT NUMBER 10337505

HARBOR ISLAND
FORMER J.B. SIMS GENERATION STATION
REMEDIAL ALTERNATIVES

ALTERNATIVE 5
REDUCED FOOTPRINT HYBRID

0 1" 2"

FILENAME ----

SCALE 1" = 100'

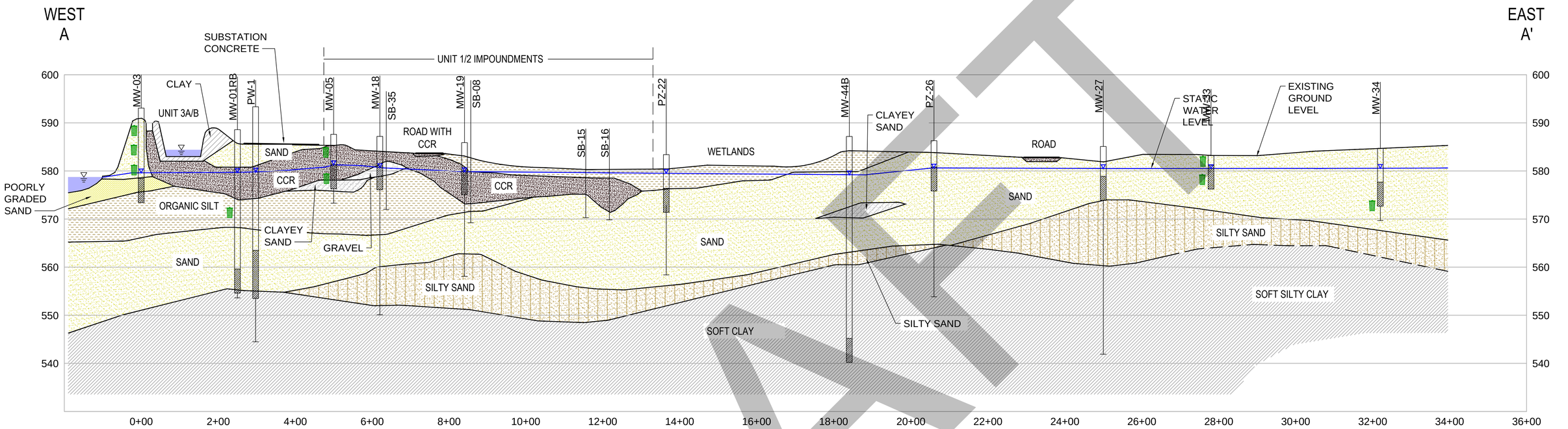
SHEET 00C-07

Renew Harbor Island
Work today, protect tomorrow.

Attachment D

Geological Cross Sections

FORMER J.B. SIMS GENERATING STATION
CITY OF GRAND HAVEN
GEOLOGIC CROSS SECTION A-A'

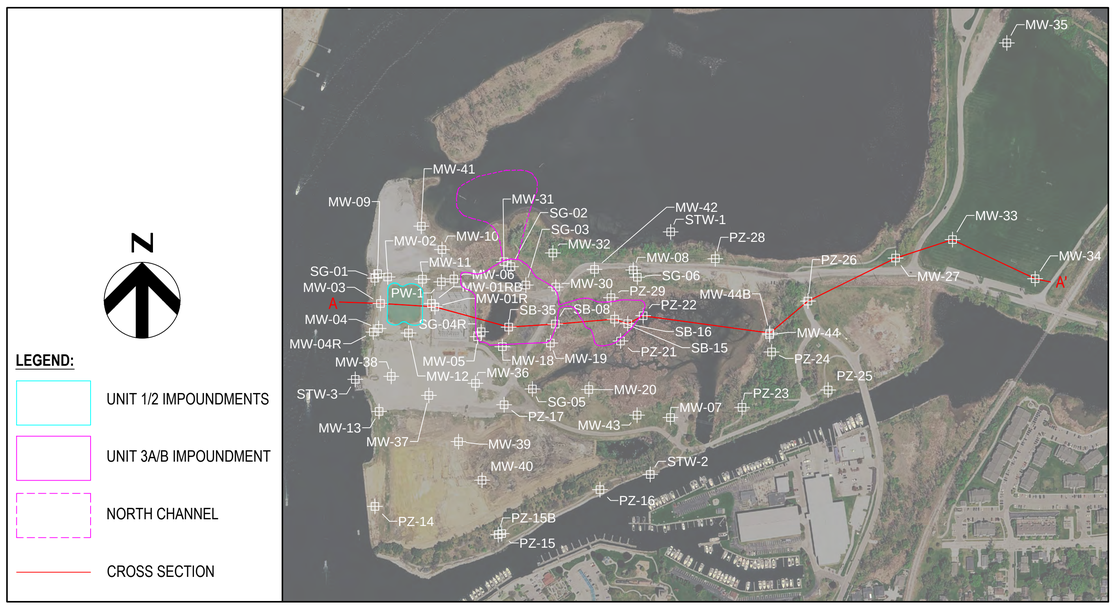


LEGEND:

- TOPSOIL
- SAND
- SILTY SAND
- CLAY
- SILTY GRAVEL
- POORLY GRADED SAND
- SOFT CLAY
- ORGANIC SILT
- GRAVEL
- PEAT
- CCR
- FILL/DEBRIS
- SILT
- SILTY CLAY
- CLAYEY SAND
- COAL
- WATER
- WELL SCREEN

NOTES:

1. MONITORING WELLS PW-1, MW-05, MW-18, AND MW-19 ARE NOT ON THE ALIGNMENT FOR CROSS SECTION A-A'. THESE MONITORING WELLS ARE PROJECTED ON CROSS SECTION A-A' FOR UNDERLYING GEOLOGY.
2. TRASH CAN SYMBOL (🗑) INDICATES REFUSE FOUND DURING DRILLING.
3. ▽ POTENTIOMETRIC SURFACE 4/20/2026



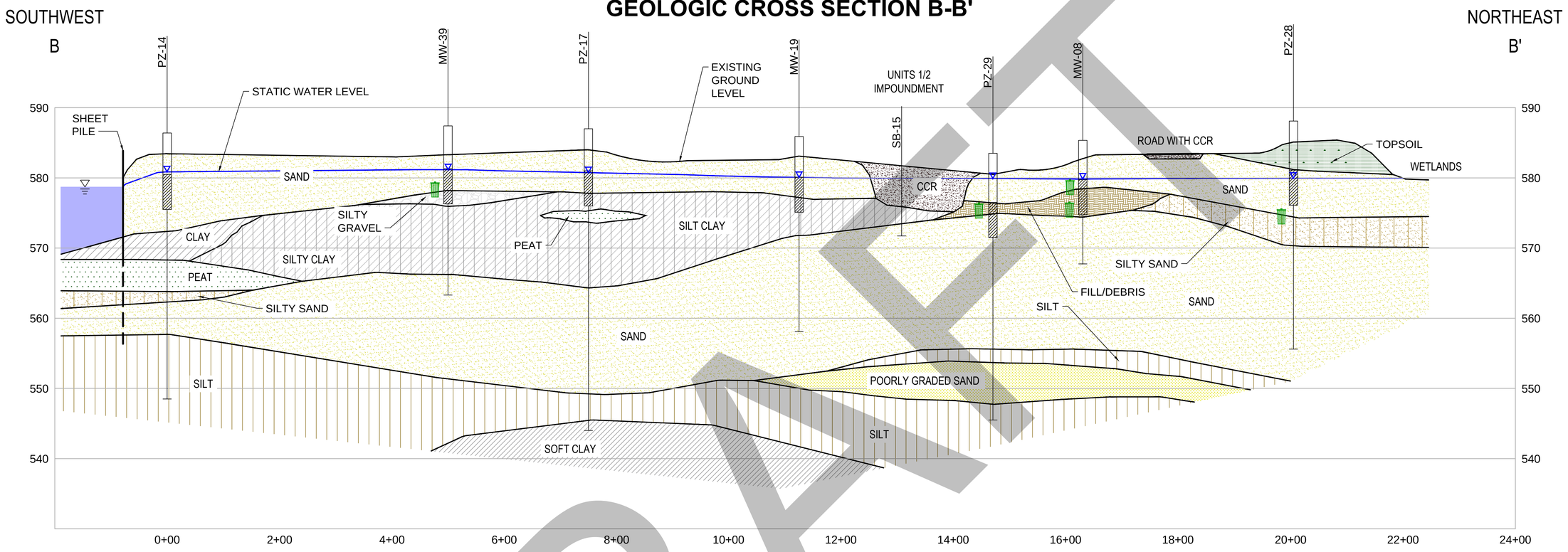
DRAFT

FORMER J.B. SIMS GENERATING STATION
CITY OF GRAND HAVEN
A-A' GEOLOGIC CROSS SECTION

DATE: JUNE 2026
FIGURE: 1

C:\Users\MICVALSH\OneDrive - HDR, Inc\City of Grand Haven\Cross Section\01C-XS01-01.dwg, A-A', 7/6/2026 11:45:55 AM, MICVALSH

FORMER J.B. SIMS GENERATING STATION
CITY OF GRAND HAVEN
GEOLOGIC CROSS SECTION B-B'

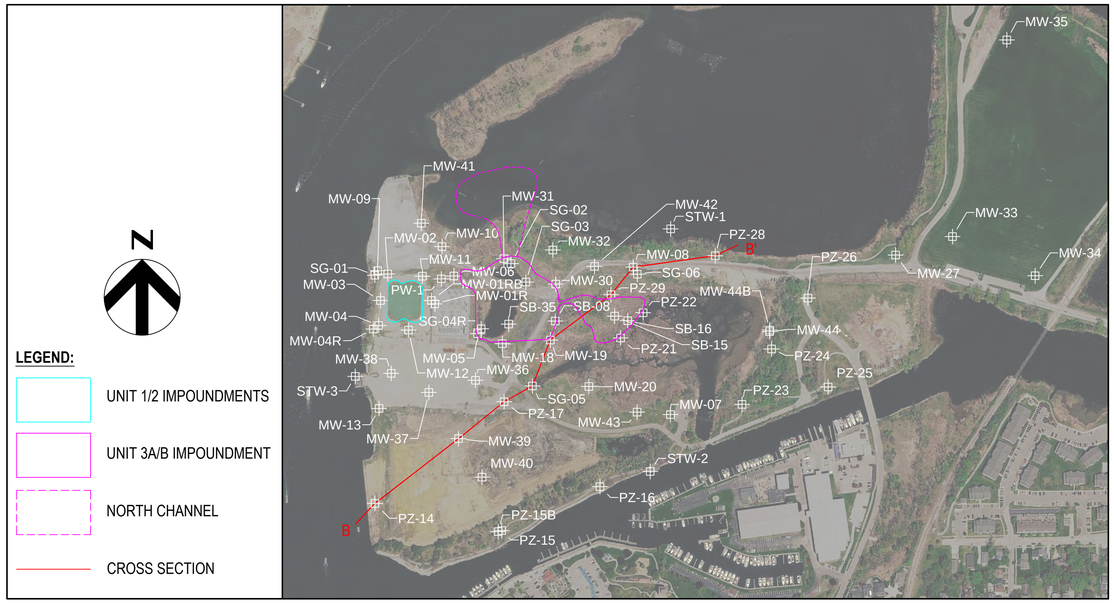


LEGEND:

- TOPSOIL
- SAND
- SILTY SAND
- CLAY
- SILTY GRAVEL
- POORLY GRADED SAND
- SOFT CLAY
- ORGANIC SILT
- GRAVEL
- PEAT
- CCR
- FILL/DEBRIS
- SILT
- SILTY CLAY
- CLAYEY SAND
- COAL
- WATER
- WELL SCREEN

NOTES:

1. TRASH CAN SYMBOL (🗑) INDICATES REFUSE FOUND DURING DRILLING.
2. POTENTIOMETRIC SURFACE 4/20/2026



DRAFT

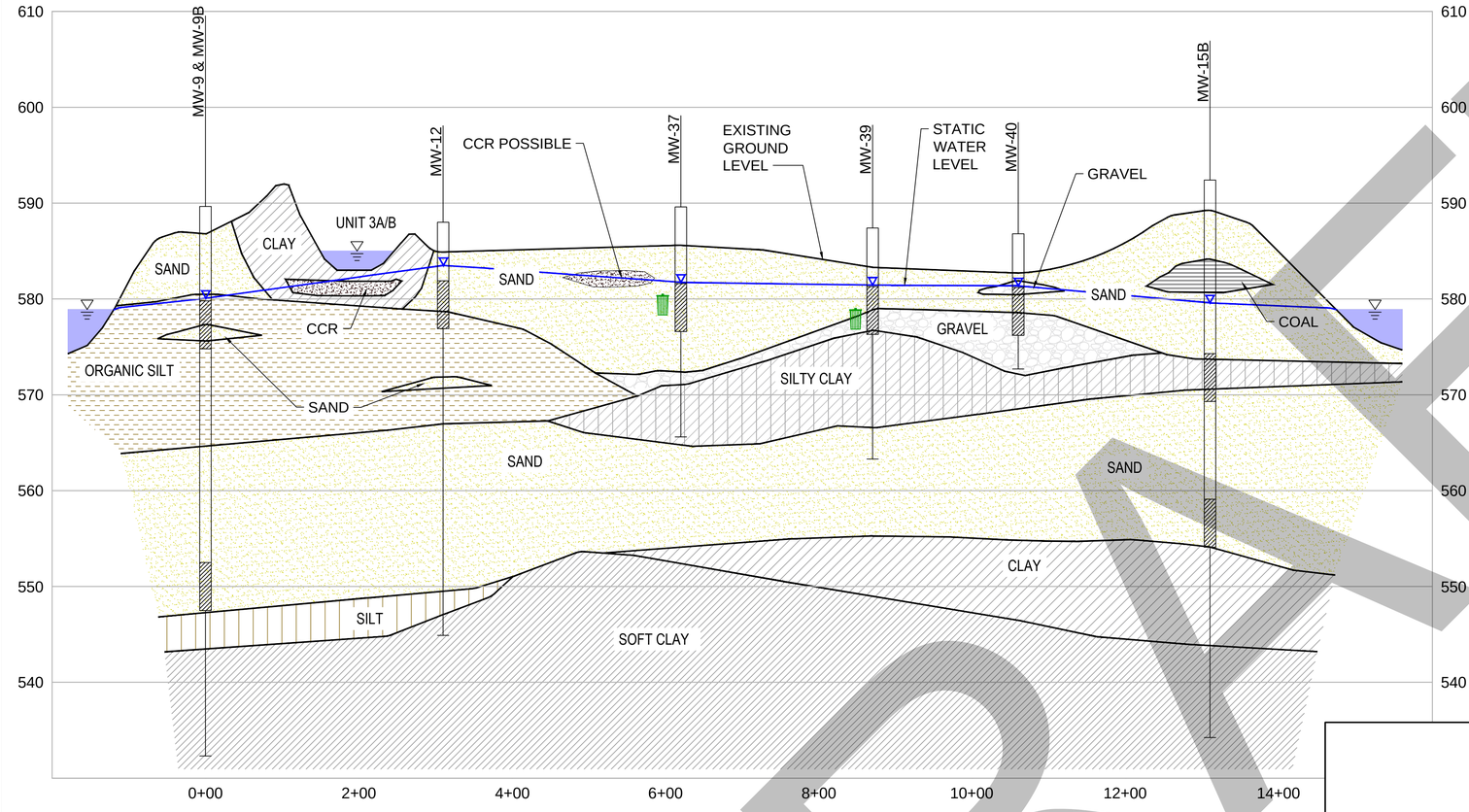
FORMER J.B. SIMS GENERATING STATION
CITY OF GRAND HAVEN
B-B' GEOLOGIC CROSS SECTION

DATE: JUNE 2026
FIGURE: 2

C:\Users\MICWALSH\OneDrive - HDR, Inc\City of Grand Haven\Cross Section\01C-XS01-01.dwg, B-B', 7/6/2026 11:46:12 AM, MICWALSH

FORMER J.B. SIMS GENERATING STATION
CITY OF GRAND HAVEN
GEOLOGIC CROSS SECTION C-C'

NORTH C — SOUTH C'

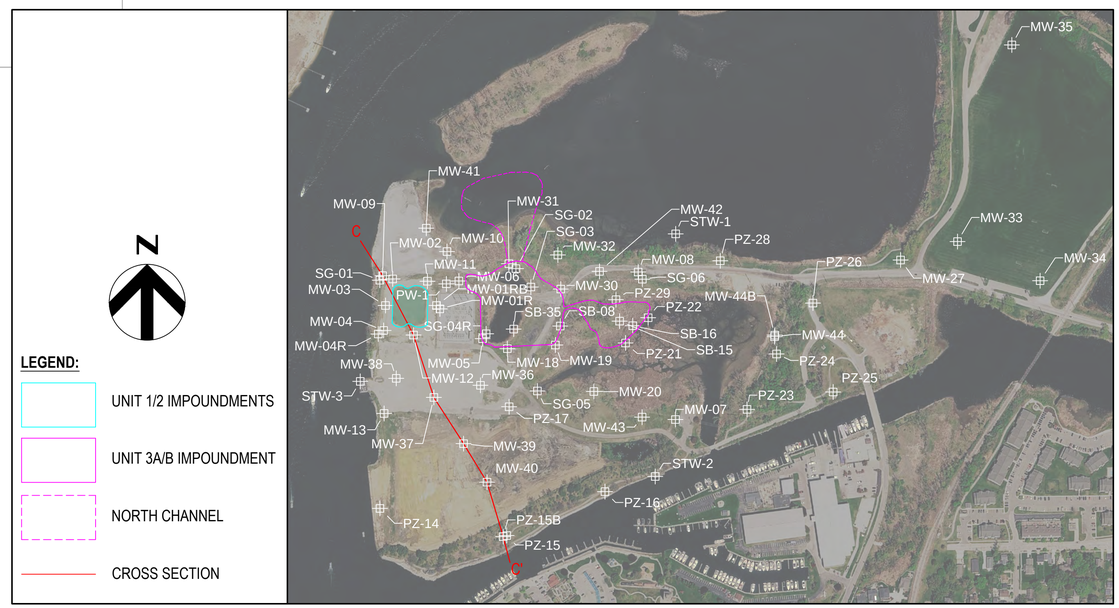


LEGEND:

- TOPSOIL
- SAND
- SILTY SAND
- CLAY
- SILTY GRAVEL
- POORLY GRADED SAND
- SOFT CLAY
- ORGANIC SILT
- GRAVEL
- PEAT
- CCR
- FILL/DEBRIS
- SILT
- SILTY CLAY
- CLAYEY SAND
- COAL
- WATER
- WELL SCREEN

NOTES:

1. TRASH CAN SYMBOL (🗑) INDICATES REFUSE FOUND DURING DRILLING.
2. ▽ POTENTIOMETRIC SURFACE 4/20/2026



DRAFT

FORMER J.B. SIMS GENERATING STATION
CITY OF GRAND HAVEN
C-C' GEOLOGIC CROSS SECTION

DATE: JUNE 2026
FIGURE: 3

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Renew Harbor Island
Work today, protect tomorrow.

Attachment E

Cost Estimates

DRAFT

Alternative 1
Excavation

COST ESTIMATE SUMMARY

Site: Grand Haven Harbor Island
Location: Grand Haven, MI
Phase: Remedial Alternatives Analysis, Class V (-50% - +100%)
Base Year: 2026, Q1
Date: November 1, 2026

Description: Clean closure includes removal of all CCR materials except those underlying the substation, which will remain in place. Other activities include:

- Hydro excavation of all buried utilities, which will remain in place for the duration of construction.
- Installation of temporary sheet pile to stabilize excavations near Grand River
- Excavation of 203,900 CY of total material, segregated into clean material (62,950 CY which is reused as clean fill) and CCR (140,950 CY, stabilized with Portland cement and disposed of at Autumn Hills landfill).
- 79,200 CY of material excavated to 10 feet below ground surface in PFAS plume areas is assumed to be contaminated and disposed of at the landfill.
- Import of 148,100 CY of clean fill to be placed with clean excavated material, backfilling excavation extents to pre-construction grade.

CAPITAL COSTS: Cost assumptions included in Description

Item No.	Description	RSMeans Line #	Quantity	Unit	Unit Cost	Total	Notes
0	**Pre-Design Investigation**						
	Sub-Total					**$ 125,000**	
1	**Pre-Construction Submittals, Mobilization, & Demobilization**						
	Sub-Total					**$ 2,350,000**	
2	**Site Preparation**						
	Sub-Total					**$ 353,150**	
3	**Source Control - Removal**						
	Sub-Total					**$ 41,771,123**	
4	**Site Restoration**						
	Sub-Total					**$ 275,770**	
5	**Compensatory Mitigation**						
	Sub-Total					**$ 1,650,000**	
6	**Monitoring Well Installation**						
	Sub-Total					**$ 24,000**	
	Sub-Total					**$ 46,549,043**	Sub-Total All Construction Costs.
	Contingency	N/A	50%			$ 23,275,000	
	Sub-Total					**$ 69,824,043**	
	Remedial Design	N/A	10%			$ 6,982,000	
	Project Management	N/A	5%			$ 3,491,000	
	Engineering Support & Quality Assurance	N/A	8%			$ 5,586,000	
	TOTAL CAPITAL COST					**$ 85,883,043**	

ANNUAL OPERATIONS AND MAINTENANCE (O&M) COST:

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
	O&M					
1	**Routine Inspections & Monitoring**					
	Sub-Total				**$ 10,000**	Sub-Total All Annual O&M Costs
	Contingency	50%			$ 5,000	
	Sub-Total with Contingency				**$ 15,000**	
	Project Management	8%			$ 1,200	
	Technical Support	8%			$ 1,200	
	TOTAL ANNUAL O&M COST				**$ 17,400**	

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Site Closeout**	**30**					
	Sub-Total					**$ 45,000**	
	Contingency		50%			$ 23,000	
	Sub-Total with Contingency					**$ 68,000**	
	TOTAL PERIODIC COST					**$ 68,000**	

PRESENT VALUE ANALYSIS: Rate of Return: 7% Interest Rate: 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0	$ 85,883,043	$ 85,883,043	
2	**Annual O&M Cost**	1-30	$ 17,400	$ 306,000	*Cost for 30 years of O&M activities*
3	**Periodic Costs**	30	$ 68,000	$ 22,000	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 86,211,000**	**30 year evaluation period**

DRAFT

Alternative 2
In-Situ Stabilization

COST ESTIMATE SUMMARY

Site: Grand Haven Harbor Island
Location: Grand Haven, MI
Phase: Remedial Alternatives Analysis, Class V (-50% - +100%)
Base Year: 2026, Q1
Date: November 1, 2026

Description: ISS includes bucket mixing of all CCR materials except those underlying the substation, which will remain in place. Groundwater plume areas outside of ISS treatment may require ex situ treatment. Other activities include:

- Hydro excavation of all buried utilities, which will remain in place for the duration of construction.
- Installation of temporary sheet pile to stabilize ISS areas near Grand River.
- ISS (via bucket mixing) of 203,900 CY of total material.
- Removal of 2,500 CY of concrete, sized and disposed of at Autumn Hills landfill.
- Installation of a ~15 acres cover system to protect stabilized source materials.

Item No.	Description	RSMeans Line #	Quantity	Unit	Unit Cost	Total	Notes
CAPITAL COSTS:							Cost assumptions included in Description
0	**Pre-Design Investigation**						
	Sub-Total					**$ 185,000**	
1	**Pre-Construction Submittals, Mobilization, & Demobilization**						
	Sub-Total					**$ 1,950,000**	
2	**Site Preparation**						
	Sub-Total					**$ 353,150**	
3	**Source Control - Removal & ISS**						
	Sub-Total					**$ 16,396,970**	
4	**Cover System Installation**						
	Sub-Total					**$ 7,722,259**	
5	**Site Restoration**						
	Sub-Total					**$ 500,000**	
6	**Compensatory Mitigation**						
	Sub-Total					**$ 1,650,000**	
7	**Monitoring Well Installation**						
	Sub-Total					**$ 24,000**	
8	**Groundwater Extract and Treat System**						
	Sub-Total					**$ 12,000,000**	
	Sub-Total					**$ 40,781,379**	Sub-Total All Construction Costs.
	Contingency	N/A	50%			$ 20,391,000	
	Sub-Total					**$ 61,172,379**	
	Remedial Design	N/A	10%			$ 6,117,000	
	Project Management	N/A	5%			$ 3,059,000	
	Engineering Support & Quality Assurance	N/A	8%			$ 4,894,000	
	TOTAL CAPITAL COST					**$ 75,242,379**	

ANNUAL OPERATIONS AND MAINTENANCE (O&M) COST:

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
	O&M					
1	**Annual Cover System O&M**					
	Sub-Total				**$ 70,500**	
2	**Annual GWET System O&M**					
	Sub-Total				**$ 140,000**	
	Sub-Total				**$ 210,500**	Sub-Total All Annual O&M Costs
	Contingency	50%			$ 105,000	
	Sub-Total with Contingency				**$ 315,500**	
	Project Management	8%			$ 25,200	
	Technical Support	8%			$ 25,200	
	TOTAL ANNUAL O&M COST				**$ 365,900**	

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Residuals Management**	**Every 2nd year**					
	Sub-Total					**$ 300,000**	Includes 50% contingency
2	**Maintenance**	**Every 5th Year**					
	Sub-Total					**$ 84,500**	Includes 50% contingency
3	**Site Close-out**	**Year 30**					
	Sub-Total					**$ 435,000**	Includes 50% contingency
						$ -	
	Contingency		50%			$ 218,000	
	Sub-Total with Contingency					**$ 653,000**	
	TOTAL PERIODIC COST					**$ 653,000**	

PRESENT VALUE ANALYSIS: Rate of Return: 7% Interest Rate: 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0	$ 75,242,379	$ 75,242,379	
2	**Annual O&M Cost**	1-30	$ 365,900	$ 6,418,000	*Cost for 30 years of O&M activities*
3	**Periodic Costs**	2nd, 5th, YR 30		$ 2,733,000	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 84,393,400**	**30 year evaluation period**

DRAFT

Alternative 3
Full Containment

COST ESTIMATE SUMMARY

Site: Grand Haven Harbor Island
Location: Grand Haven, MI
Phase: Remedial Alternatives Analysis, Class V (-50% - +100%)
Base Year: 2026, Q1
Date: November 1, 2026

Description: Full containment includes the installation of a barrier wall to encapsulate CCR material and contaminant plumes to minimize off-site migration. Other activities include:
- Hydro excavation of buried utilities within barrier wall footprint, which will be temporarily de-energized and/or re-routed for construction.
- Installation of temporary sheet pile to stabilize trenching activities near Grand River.
- Installation of a ~5,180 LF slurry wall using one pass trench methodology.
- Installation of a ~31 acres cover system to cap the contained area of the barrier wall.
- Installation of a gradient management system (extraction and treatment).

CAPITAL COSTS:

Item No.	Description	RSMeans Line #	Quantity	Unit	Unit Cost	Total	Notes
							Cost assumptions included in Description
0	**Pre-Design Investigation**						
	Sub-Total					**$ 125,000**	
1	**Pre-Construction Submittals, Mobilization, & Demobilization**						
	Sub-Total					**$ 1,300,000**	
2	**Site Preparation**						
	Sub-Total					**$ 433,150**	
3	**Barrier Wall Installation**						
	Sub-Total					**$ 4,268,286**	
4	**Cover System Installation**						
	Sub-Total					**$ 17,523,997**	
5	**Site Restoration**						
	Sub-Total					**$ 1,000,000**	
6	**Compensatory Mitigation**						
	Sub-Total					**$ 2,150,000**	
7	**Monitoring Well Installation**						
	Sub-Total					**$ 24,000**	
8	**Groundwater Extract and Treat System**						
	Sub-Total					**$ 8,500,000**	
	Sub-Total					**$ 35,324,433**	Sub-Total All Construction Costs.
	Contingency	N/A	50%			$ 17,662,000	
	Sub-Total					**$ 52,986,433**	
	Remedial Design	N/A	10%			$ 5,299,000	
	Project Management	N/A	5%			$ 2,649,000	
	Engineering Support & Quality Assurance	N/A	8%			$ 4,239,000	
	TOTAL CAPITAL COST					**$ 65,173,433**	

ANNUAL OPERATIONS AND MAINTENANCE (O&M) COST:

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
	O&M					
1	**Annual Cover System O&M**					
	Sub-Total				**$ 100,500**	
2	**Annual GWET System O&M**					
	Sub-Total				**$ 140,000**	
	Sub-Total				**$ 240,500**	Sub-Total All Annual O&M Costs
	Contingency	50%			$ 120,000	
	Sub-Total with Contingency				**$ 360,500**	
	Project Management	8%			$ 28,800	
	Technical Support	8%			$ 28,800	
	TOTAL ANNUAL O&M COST				**$ 418,100**	

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Maintenance**	**Every 2nd Year**					
	Sub-Total					**$ 225,000**	Includes 50% contingency
2	**Maintenance**	**Every 5th Year**					
	Sub-Total					**$ 173,000**	Includes 50% contingency
3	**Site Closeout**	**30**					
	Sub-Total					**$ 68,000**	Includes 50% contingency

PRESENT VALUE ANALYSIS: Rate of Return: 7% Interest Rate: 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0	$ 65,173,433	$ 65,173,433	
2	**Annual O&M Cost**	1-30	$ 418,100	$ 7,334,000	*Cost for 30 years of O&M activities*
3	**Periodic Costs**	N/A	$ 699,000	$ 2,371,000	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 74,878,400**	**30 year evaluation period**

DRAFT

Alternative 4
Hybrid Containment

COST ESTIMATE SUMMARY

Site: Grand Haven Harbor Island
Location: Grand Haven, MI
Phase: Remedial Alternatives Analysis, Class V (-50% - +100%)
Base Year: 2026, Q1
Date: November 1, 2026

Description: Hybrid containment includes the installation of a barrier wall to partially encapsulate CCR material and contaminant plumes. Source areas outside of the barrier wall are excavated and consolidated within the barrier wall area. Other activities include:

- Hydro excavation of buried utilities within barrier wall footprint, which will be temporarily de-energized and/or re-routed for construction.
- Installation of temporary sheet pile to stabilize trenching activities near Grand River.
- Installation of a ~5,230 LF slurry wall using one pass trench methodology.
- Excavation of 96,900 CY of total material, segregated into clean material (5,100 CY which is reused as clean fill) and CCR (91,800 CY, stabilized with Portland cement and disposed of at Autumn Hills landfill).
- 79,200 CY of material excavated to 10 feet below ground surface in PFAS plume areas is assumed to be contaminated.
- Import of 135,300 CY of clean fill to be placed with clean excavated material, backfilling excavation extents to pre-construction grade, in addition to the fill required for cover system construction.
- Installation of a ~18 acres cover system to cap the contained area of the barrier wall.

CAPITAL COSTS:

Item No.	Description	RSMeans Line #	Quantity	Unit	Unit Cost	Total	Notes
							Cost assumptions included in Description
0	**Pre-Design Investigation**						
	Sub-Total					**$ 125,000**	
1	**Pre-Construction Submittals, Mobilization, & Demobilization**						
	Sub-Total					**$ 1,550,000**	
2	**Site Preparation**						
	Sub-Total					**$ 338,150**	
3	**Barrier Wall Installation**						
	Sub-Total					**$ 4,094,463**	
4	**Source Control - Removal & On-Site Consolidation**						
	Sub-Total					**$ 7,800,478**	
5	**Cover System Installation**						
	Sub-Total					**$ 9,267,221**	
6	**Site Restoration**						
	Sub-Total					**$ 600,000**	
7	**Compensatory Mitigation**						
	Sub-Total					**$ 1,650,000**	
8	**Monitoring Well Installation**						
	Sub-Total					**$ 24,000**	
9	**Groundwater Extract and Treat System**						
	Sub-Total					**$ 8,000,000**	
	Sub-Total					**$ 33,449,312**	Sub-Total All Construction Costs.
	Contingency	N/A	50%			$ 16,725,000	
	Sub-Total					**$ 50,174,312**	
	Remedial Design	N/A	10%			$ 5,017,000	
	Project Management	N/A	5%			$ 2,509,000	
	Engineering Support & Quality Assurance	N/A	8%			$ 4,014,000	
	TOTAL CAPITAL COST					**$ 61,714,312**	

ANNUAL OPERATIONS AND MAINTENANCE (O&M) COST:

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
	O&M					
1	**Annual Cover System O&M**					
	Sub-Total				**$ 80,500**	
2	**Annual GWET System O&M**					
	Sub-Total				**$ 140,000**	
	Sub-Total				**$ 220,500**	Sub-Total All Annual O&M Costs
	Contingency	50%			$ 110,000	
	Sub-Total with Contingency				**$ 330,500**	
	Project Management	8%			$ 26,400	
	Technical Support	8%			$ 26,400	
	TOTAL ANNUAL O&M COST				**$ 383,300**	

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Maintenance**	**Every 2nd Year**					
	Sub-Total					**$ 113,000**	Includes 50% contingency
2	**Maintenance**	**Every 5th Year**					
	Sub-Total					**$ 122,500**	Includes 50% contingency
3	**Site Closeout**	**30**					
	Sub-Total					**$ 68,000**	Includes 50% contingency

PRESENT VALUE ANALYSIS: Rate of Return: 7% Interest Rate: 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0	$ 61,714,312	$ 61,714,312	
2	**Annual O&M Cost**	1-30	$ 383,300	$ 6,723,000	*Cost for 30 years of O&M activities*
3	**Periodic Costs**	N/A	$ 455,500	$ 1,295,000	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 69,732,300**	**30 year evaluation period**

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Alternative 5
Reduced-Footprint Hybrid

COST ESTIMATE SUMMARY

Site: Grand Haven Harbor Island
Location: Grand Haven, MI
Phase: Remedial Alternatives Analysis, Class V (-50% - +100%)
Base Year: 2026, Q1
Date: November 1, 2026

Description: Hybrid containment includes the installation of a barrier wall to partially encapsulate CCR material and contaminant plumes. Source areas outside of the barrier wall are excavated and consolidated within the barrier wall area. Other activities include:

- Hydro excavation of buried utilities within barrier wall footprint, which will be temporarily de-energized and/or re-routed for construction.
- Installation of temporary sheet pile to stabilize trenching activities near Grand River.
- Installation of a ~4,500 LF slurry wall using one pass trench methodology.
- Excavation of 104,900 CY of total material, segregated into clean material (9,300 CY which is reused as clean fill) and CCR (95,600 CY, stabilized with Portland cement and disposed of at Autumn Hills landfill).
- 79,200 CY of material excavated to 10 feet below ground surface in PFAS plume areas is assumed to be contaminated.
- Import of 122,200 CY of clean fill to be placed with clean excavated material, backfilling excavation extents to pre-construction grade.
- Installation of a ~11 acres cover system to cap the contained area of the barrier wall.
- Installation of a gradient management system (extraction and treatment).

CAPITAL COSTS:

Item No.	Description	RSMeans Line #	Quantity	Unit	Unit Cost	Total	Notes
0	**Pre-Design Investigation**						Cost assumptions included in Description
	Sub-Total					**$ 125,000**	
1	**Pre-Construction Submittals, Mobilization, & Demobilization**						
	Sub-Total					**$ 1,400,000**	
2	**Site Preparation**						
	Sub-Total					**$ 343,150**	
3	**Barrier Wall Installation**						
	Sub-Total					**$ 3,079,906**	
4	**Source Control - Removal**						
	Sub-Total					**$ 8,237,860**	
5	**Cover System Installation**						
	Sub-Total					**$ 5,663,350**	
6	**Site Restoration**						
	Sub-Total					**$ 350,000**	
7	**Compensatory Mitigation**						
	Sub-Total					**$ 1,650,000**	
8	**Monitoring Well Installation**						
	Sub-Total					**$ 24,000**	
9	**Groundwater Extract and Treat System**						
	Sub-Total					**$ 7,500,000**	
	Sub-Total					**$ 28,373,266**	Sub-Total All Construction Costs.
	Contingency	N/A	50%			$ 14,187,000	
	Sub-Total					**$ 42,560,266**	
	Remedial Design	N/A	10%			$ 4,256,000	
	Project Management	N/A	5%			$ 2,128,000	
	Engineering Support & Quality Assurance	N/A	8%			$ 3,405,000	
	TOTAL CAPITAL COST					**$ 52,349,266**	

ANNUAL OPERATIONS AND MAINTENANCE (O&M) COST:

Item No.	Description	Quantity	Unit	Unit Cost	Total	Notes
	O&M					
1	**Annual Cover System O&M**					
	Sub-Total				**$ 62,500**	
2	**Annual GWET System O&M**					
	Sub-Total				**$ 140,000**	
	Sub-Total				**$ 202,500**	Sub-Total All Annual O&M Costs
	Contingency	50%			$ 101,000	
	Sub-Total with Contingency				**$ 303,500**	
	Project Management	8%			$ 24,300	
	Technical Support	8%			$ 24,300	
	TOTAL ANNUAL O&M COST				**$ 352,100**	

PERIODIC COSTS:

Item No.	Description	Year	Quantity	Unit	Unit Cost	Total	Notes
1	**Maintenance**	**Every 2nd Year**					
	Sub-Total					**$ 50,000**	Includes 50% contingency
2	**Maintenance**	**Every 5th Year**					
	Sub-Total					**$ 84,500**	Includes 50% contingency
3	**Site Closeout**	**30**					
	Sub-Total					**$ 68,000**	Includes 50% contingency

PRESENT VALUE ANALYSIS: Rate of Return: 7% Interest Rate: 3%

Item No.	Cost Type	Year	Total Cost	Present Value	Notes
1	**Capital Cost**	0	$ 52,349,266	$ 52,349,266	
2	**Annual O&M Cost**	1-30	$ 352,100	$ 6,176,000	*Cost for 30 years of O&M activities*
3	**Periodic Costs**	N/A	$ 303,500	$ 662,000	
	TOTAL PRESENT VALUE OF ALTERNATIVE			**$ 59,187,300**	**30 year evaluation period**

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