978021

PMC Groundwater Superfund Site

Petoskey, Emmet County, Michigan

Interim Record of Decision

U.S. Environmental Protection Agency Region 5

77 W. Jackson Blvd.
Chicago, IL 60604

September 2022

Table of Contents

ATTACHMENT 1: FIGURES

Figure 1: Site Location Map

Figure 2: Excavation History and Former Building Features Overlaid on Current Buildings

Figure 3: Conceptual Site Model

Figure 4: HHRA Conceptual Exposure Model

Figure 5: Ecological Risk Assessment

Figure 6: TCE Results in Groundwater

Figure 7: TCE Results in Soil

Figure 8: TCE Results in Exterior Soil Vapor

Figure 9: TCE Results in Sewer Gas

Figure 10: AS Layout

Figure 11: SVE Layout

ATTACHMENT 2: TABLES

Table 1: Summary of Media/Receptor COCs

Table 2: Remedy Selection Criteria Evaluation

Table 3: Applicable or Relevant and Appropriate Requirements

Table 4: Alternative 2 Cost Estimate

ATTACHMENT 3: ADMINISTRATIVE RECORD INDEX

ATTACHMENT 4: MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY LETTER OF CONCURRENCE

This Interim Record of Decision (ROD) documents the remedy selected for the PMC Groundwater Site ("Site" or "PMC Site") in Petoskey, Emmet County, Michigan. This Interim ROD selects a remedy to address the source of contamination for the vapor intrusion pathway by treating vapor, soil, and groundwater contamination present at the source area of the Site. The Interim ROD is organized in three sections: Part I contains the *Declaration* for the Interim ROD, Part II contains the *Decision Summary*, and Part III contains the *Responsiveness Summary*.

PART I – DECLARATION

This section summarizes the information presented in the Interim ROD and includes the authorizing signature of the United States Environmental Protection Agency (EPA) Region 5 Superfund & Emergency Management Division Director.

1.1 Site Name and Location

PMC Groundwater
CERCLIS ID# MID006013049
Petoskey, Emmet County, Michigan

1.2 Statement of Basis and Purpose

This decision document presents the Selected Interim Remedy for the PMC Site in Petoskey, Emmet County, Michigan. The remedy was developed in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

Specifically, this decision document has been prepared in compliance with CERCLA Section 117 and NCP Section 300.430(f). This decision document explains the factual and legal basis for selecting the remedy for the Site. This decision is based on the Administrative Record file for the Site. The Administrative Record file is available for review online at www.epa.gov/superfund/pmc-groundwater and at the following locations:

Site information repository
Petoskey District Library
500 E. Mitchel St.
Petoskey, MI 49770
231-758-3100

EPA Region 5 Records Center
77 West Jackson Boulevard
Chicago, IL 60604
312-353-1063
(call for appointment)

The State of Michigan has concurred with the Selected Remedy. The State's concurrence letter is provided in Attachment 4 and has been added to the Administrative Record.

1.3 Assessment of Site

The response action selected in this Interim ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

1.4 Description of Selected Remedy

EPA's Selected Interim Remedy addresses the vapor, soil, and groundwater contamination present at the source of the PMC Site by air sparge and soil vapor extraction, an in situ treatment of the contaminated groundwater and soil contributing to vapor contamination. There are some buildings surrounding the source area where the remedial investigation occurred (shown as the "Study Area" in Figure 1) that have not been fully assessed for vapor intrusion due to either an inability to gain access at the time of the investigation or the need for additional data to make a determination. Therefore, the Selected Interim Remedy addresses future human health risk posed by vapor intrusion at buildings within the Study Area by preemptively installing vapor intrusion mitigation systems (VIMS) based on soil vapor sampling results. EPA has not identified any principal threat wastes at the Site. The major components of the Selected Remedy for the PMC Site include the following:

- Installation of horizontal segmented air sparge (AS) wells into the subsurface to inject air and treat contamination present in the groundwater at the source area (former PMC property);
- Installation of horizontal segmented soil vapor extraction (SVE) wells into the subsurface to capture vapors released from the air sparging and to treat contaminated soils at the source area (former PMC property);
- Installation of vertical AS/SVE wells as needed based on the remedial design (RD);
- Installation of AS/SVE system components;
- Operation of the AS/SVE until source control objective is achieved;
- Management of investigation derived wastes (IDW) and waste streams;
- Installation of VIMS within the Study Area where soil gases exceed interim remedial goals;
- Implementing engineering controls (such as signs, fencing, etc.) necessary to protect public safety during construction and, if applicable, operation of the remedy;
- Further characterizing the source area during the pre-design investigation and providing information necessary to complete the remedial design and to obtain information on which buildings will need VIMS;
- Monitoring environmental media (groundwater, soil vapor, indoor air, and sewer gas) to evaluate the impact of the selected remedial action and to ensure that vapors are not migrating into uncaptured areas.

1.5 Statutory Determinations

This interim action is protective of human health and the environment in the short term and is intended to provide adequate protection until a final ROD is signed; complies with (or waives)

those federal and state requirements that are applicable or relevant and appropriate for this limited-scope action; and is cost-effective. This interim action meets the statutory preference for remedies that employ treatment to reduce toxicity, mobility, or volume as a principal element. Subsequent actions will be planned to address fully the threats posed by conditions at this Site if any threats remain after implementation of the interim action. Because this remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted to ensure that the remedy continues to provide adequate protection of human health and the environment within five years after commencement of the remedial action. This review will be conducted in conjunction with the on-going periodic reviews of the remedy protectiveness, which were initiated within 5 years of commencement of the initial remedial action. Because this is an interim action ROD, review of this Site and remedy will be ongoing as EPA continues to develop appropriate final remedial alternatives for the PMC Site.

1.6 Data Certification Checklist

The following information is included in the *Decision Summary* section of this ROD. Additional information can be found in the Administrative Record file for this Site.

Information Item	**Section(s) in Interim ROD**
Contaminants of concern (COCs) and their respective concentrations	Sections 2.1, 2.5.1, and 2.5.4
Baseline risk represented by the COCs	Section 2.7
Cleanup levels established for the COCs and the basis for these levels	Section 2.12.2
How source materials constituting principal threats are addressed	Section 2.11
Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD	Sections 2.6 and 2.12.2
Potential land and groundwater use that will be available at the Site as a result of the Selected Remedy	Sections 2.6 and 2.12.2
Estimated capital, annual costs for running the system, and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected	Sections 2.9; 2.12.1; and 2.12.2
Key factor(s) that led to selecting the remedy (i.e., describe how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision)	Sections 2.10

1.7 Authorizing Signatures

EPA, as the lead agency for the PMC Groundwater Site (MID006013049), formally authorizes this ROD.

X  for

Douglas Ballotti, Director
Superfund & Emergency Management Division
Signed by: Environmental Protection Agency

EPA Region 5

September 27, 2022

Date

PART II – DECISION SUMMARY

2.1 Site Name, Location, and Brief Description

The PMC Site (MID006013049) is located in Petoskey, Emmet County, Michigan. The former PMC property (shown and referred to as the "source area" in Figure 1) has been redeveloped as a condominium complex and is located approximately 500 feet south of Little Traverse Bay of Lake Michigan. It is bordered to the north by another condominium complex, to the east and south by residential structures, and to the west by the Bayfront Park access easement and a parking lot associated with the Fraternal Order of Eagles' Lodge. Additional single-family residential structures lie to the east, west, and south (Figure 1). The Site boundary is depicted on Figure 1 as the "Study Area" which spans from Ingalls Avenue on the west to approximately 200 feet east of Wachtel Avenue and from Little Traverse Bay to the north to Jefferson Street in the south. Bear Creek, which drains into Little Traverse Bay, is located approximately 500 feet east of the former PMC property. Immediately south of Lake Street (behind a row of homes) is a steep bluff running approximately parallel to the shoreline.

The contaminants of concern (COC) at the Site, which are CERCLA hazardous substances, consist of chlorinated volatile organic compounds (VOCs), primarily trichloroethene (TCE), in vapor, soil and groundwater. Additional VOCs that will be monitored under this Interim ROD are tetrachlorethylene (PCE), benzene, and ethylbenzene.

EPA is the lead agency for the Site, and the Michigan Department of Environment, Great Lakes and Energy (EGLE) formerly known as the Michigan Department of Environmental Quality (MDEQ) serves as the support agency. The selected remedial action is expected to be funded through federal remedial action funding with associated state cost share.

2.2 Site History and Enforcement Activities

2.2.1 Site History

Petoskey Manufacturing Company (PMC) was a small fabricating operation established in 1946 as a die-cast manufacturer and continued with painting operations into the late 1960s. The company then began die casting zinc parts for the automotive industry and continued its operation until fall 2000 when the business was closed.

While in operation, PMC used TCE as a solvent to clean paint masks which was stored in a 1,000-gallon aboveground storage tank (AST) (Figure 2) that the MDEQ determined had leaked. There were likely multiple points of discharge at the facility as observed during a 2001 Site inspection. Additionally, disposal of spent solvents and/or paint sludge on the ground surface outside the PMC building contaminated soils and groundwater.

Contamination at the PMC Site was first discovered in September 1981 when drinking water samples were collected from a municipal supply well (the Ingalls Avenue Well) downgradient of the Site. The sample showed elevated levels of TCE, cis-1,2 dichloroethene, and trihalomethanes. The City of Petoskey requested assistance from MDEQ to aid in identifying responsible parties and to conduct a hydrogeological investigation to find the source of the contamination.

2.2.2 Previous Investigations

Initial Response

Results from the MDEQ soil and groundwater sampling indicated elevated concentrations of several VOCs, including xylene, toluene, TCE, and ethylbenzene near the Site, which was attributed to PMC. MDEQ subsequently asked PMC to determine the extent of the contaminated soil, and to remove and dispose of the impacted material. In 1982, PMC, under the direction of MDEQ, completed a partial soil removal from the west side of the facility's building to a depth ranging from 2 to 5 feet. Subsequently, the Site was proposed for the National Priorities List and listed in 1983.

In 1984, EPA negotiated an administrative order on consent (AOC) with PMC to conduct further hydrogeological studies. PMC completed the work under the direction of EPA and MDEQ. In 1987, EPA and PMC signed another AOC agreeing to conduct a full groundwater remedial investigation (RI) and feasibility study (FS) to determine the nature and extent of contamination and investigate appropriate remedial alternatives. In 1990, EPA relieved PMC of conducting further RI and FS work, and entered into a State Cooperative Agreement with MDEQ, with the State agreeing to perform the RI and FS with funding provided by EPA.

In 1992, MDEQ retained first EDER Associates, and then Malcom-Pirnie, Inc., to complete Site investigation activities. Concurrently with the state-led RI, EPA began a focused feasibility study (FFS) to examine the impact of Site-related groundwater contamination on the municipal well, the Ingalls Street Well.

1995 Interim Remedial Action

The first interim ROD for the Site was signed in 1995 and called for air stripping of the drinking water from the Ingalls Avenue Well. In 1997, the State of Michigan provided partial funding for an enhancement to the remedy that consisted of removing the Ingalls Avenue Well and constructing an alternative municipal supply well. This alternative enhancement outlined in the 1995 interim ROD allowed for EPA to contribute the capital costs for the remedy to be used by the State to partially defray the City's cost of replacing the well. Therefore, the drinking water treatment remedial components in the 1995 interim ROD were not fully implemented.

1998 Remedial Action

EPA issued a final ROD on September 30, 1998. The 1998 ROD selected a remedy to address the remaining soil and groundwater contamination at the Site. The remedial goals identified for the Site in the 1998 ROD were to:

- Prevent direct contact with or ingestion of soil under current industrial and future residential land-use scenarios (to the extent necessary based on risk assessment results and chemical-specific applicable or relevant and appropriate requirements [ARARs]).
- Protect groundwater from being contaminated at levels exceeding maximum contaminant levels (MCLs) by leaching of residual contamination from soil to groundwater.
- Prevent future exposure to groundwater containing Site-related contamination at concentrations exceeding MCLs.
- Restore the aquifer to its highest beneficial use (i.e., drinking water).
- Protect surface water from Site-related contaminants in groundwater in accordance with provisions set forth in Part 201 of the Michigan Natural Resources and Environmental

Protection Act (NREPA), 1994 pa 451, as amended, and Part 31 and associated rules.

The following are the major components of the selected remedy as described in the 1998 ROD:

- Soil excavation to meet future residential direct contact and ingestion criteria and to remove the potential source of groundwater contamination to meet MDEQ soil criteria for protection of groundwater and surface water quality. Soil to be excavated to a depth of 5 feet below ground surface (bgs), resulting in an excavated soil volume of 2,050 cubic yards (yd^3).
- SVE to remove soil contamination deeper than 5 feet bgs in the northeast corner of the PMC building.
- Monitored Natural Attenuation (MNA) of the groundwater to allow for groundwater to be restored to drinking water standards. Development of a monitoring program to track the decrease in contaminant concentration and installation of additional monitoring wells to support the monitoring.
- Preparation of a contingency plan in the Long-Term Monitoring Plan to protect human health and the environment if environmental monitoring predicts or detects statistically significant exceedances of the Point of Compliance criteria that demonstrate that MNA is not occurring sufficiently or at an acceptable rate.
- Establishment of Institutional Controls (ICs) on and around the former PMC property that restrict excavation of soils and the use of groundwater.

Remedy Implementation

The following activities were conducted as part of the remedy implementation:

- Soil Excavation. In November 1999, a total of 2,740 tons of contaminated soil were excavated in the areas shown in Figure 2 and disposed of offsite. Soil was excavated from the northern portion of the Site to a depth of up to 15 feet bgs. Deeper contaminated soil was left in place, to a depth of approximately 17 feet below grade.
- SVE. A SVE system, located at the northwest corner of the PMC building, was installed in November 1999, operated intermittently in 1999 and 2000, and removed in December 2000. Overall operation of the SVE system removed 753 grams of TCE from the subsurface.
- MNA of the Groundwater. This included the development of a groundwater monitoring plan, and an initial 3-year period of monitoring, followed by long-term monitoring.
- Establishment of ICs. A restrictive covenant on the former PMC property has been in place since 2005. The City of Petoskey ordinance has successfully prevented the installation of any drinking water wells on the rest of the Site however, it is not consistent with certain State administrative requirements and is being addressed under the Site's five-year reviews.

Additional Activities

A soil removal was conducted in fall 2000 across an 8-foot by 10-foot area where hydraulic fluid leaked from a compressor in the northwest corner of the PMC building. Soil samples were collected in November 2001 through the floor of the facility at depths of 1 to 6 feet. TCE was detected above the method detection limit of 50 micrograms per kilogram (µg/kg) in about half of the samples analyzed; the maximum concentration detected was 1,300 µg/kg.

Source Removal by Developer
The former PMC facility was sold in April 2003 to a developer, and the PMC building was demolished in July 2004. The developer collected additional rounds of soil samples as the slab was removed, and the developer excavated approximately 140 cubic yards of additional soil from the east end of the Site. This work was completed in September 2004 in conjunction with construction activities (Figure 2). The construction of the residential condominium complex started in September 2004, and by 2008, 10 of the planned 16 residences were completed. In fall 2009, the property was in foreclosure because the developer went bankrupt. Construction for the remaining six units was completed in 2014 by a subsequent developer.

The developer reported to EPA that it had installed a barrier consisting of a polyvinyl chloride membrane beneath a portion of the complex in 5 of the units, which left 12 units either partially or completely without an engineered barrier. However, the developer did not formally document this installation of the membrane in a report to EPA. In its Due Care and Demolition Summary Report dated October 24, 2004, the developer reported that the membrane was installed "to prevent storm water infiltration and storm water contact with impacted soils." Presence of the membrane was confirmed when it was encountered at 4 feet bgs during drilling activities conducted for the most recent RI investigations. The incomplete installation likely limits the barrier's effectiveness, and subsequent data indicate that it has not effectively addressed the vapor intrusion (VI) at the Site, but its continued presence could influence the performance of future remedial systems.

Groundwater Monitoring
EPA finalized a groundwater monitoring plan in 2006 and began quarterly monitoring. However, groundwater monitoring ceased in 2007 until wells damaged during a park reconstruction project in 2005 were replaced or repaired by the City. Groundwater monitoring was then conducted in 2009, and the results were presented in the second five year review (FYR), which was signed on December 23, 2009.

In July 2011, groundwater samples were collected for analysis of VOCs from 20 monitoring wells. Groundwater samples were also collected for total and dissolved zinc from three wells to determine if galvanized steel casings contributed to historically detected zinc concentrations. Details of this sampling event are presented in Technical Memorandum Groundwater Monitoring Report for Long-Term Monitoring Activities – July 2011.

2017 Removal Action
EPA completed the third FYR in 2014. VI was identified as a potential issue at the former PMC Site and EPA began investigation in October 2016. The EPA Removal Program was contacted upon receipt of the initial results of the VI investigation due to elevated concentrations of TCE in the subslab samples. The Removal Program conducted additional subslab and indoor air sampling which showed results above the removal management levels (RMLs) for TCE that prompted a removal action at the Site. The Removal Program installed subslab depressurization (SSD) mitigation systems to address the VI at 11 condominium units on the former PMC property and an adjacent commercial property. EPA conducted a subsequent removal action in 2019 to preemptively mitigate VI at the remaining six condominium units on the former PMC property. Three private properties to the west of the Site were also identified as needing preemptive

mitigation. However, due to the construction of the buildings, the Removal Program could not install the standard SSD mitigation systems in those buildings. EPA plans to install the appropriate preemptive VI mitigation systems at these three buildings during this Interim Remedial Action. The type of mitigation system will be determined during the RD. Currently, all condominium units on the former PMC property have SSD mitigation systems and EPA is pursuing access agreements to sample additional private properties within the Study Area.

2.2.3 Remedial Investigation/Feasibility Study

While the Removal Program conducted the removal actions at the Site, the Remedial Program continued the RI and FFS for this interim action from October 2016 through September 2021 and details are presented in the respective reports.

The RI activities, data collection methodologies, resulting data, physical characteristics of the Site, nature and extent of contamination, contaminant fate and transport, and conceptual site model (CSM) are documented in detail in the RI report and summarized in Section 2.5. EPA finalized the RI in July 2019.

EPA prepared an FFS to develop and evaluate remedial alternatives to address unacceptable risks and hazards to human health and the environment, as identified in the Final RI report, and meet all ARARs. The evaluation of remedial alternatives conducted in the FFS are summarized in later sections of this Interim ROD. EPA finalized the FFS report in September 2021.

Additional details are contained in the Final RI and FFS Reports and other documents in the Site's Administrative Record.

A human health risk assessment (HHRA) and a screening-level ecological risk assessment (SLERA) were also completed as part of the RI. The HHRA and SLERA are presented as Appendix H in the RI report and summarized in Section 2.7

2.3 Community Participation Activities

The RI Report, FFS Report, Proposed Plan, and other related documents for the Site are in the Administrative Record file, which is and was available to the public at the following locations: the information repository maintained at the EPA Region 5 Records Center, 77 West Jackson Boulevard (7th Floor), Chicago, Illinois; the Site information repository located at the Petoskey District Library, 500 E. Mitchel Street, Petoskey, Michigan; and online at www.epa.gov/superfund/pmc-groundwater . The notice of the availability of these documents was published in *The Petoskey News-Review* on June 18, 2022. A public comment period was held from June 22, 2022, to July 22, 2022. Due to COVID-19 restrictions, EPA held a virtual-format public meeting on June 29, 2022, instead of an in-person public meeting, to avoid in-person contact. EPA made this decision in accordance with the Centers for Disease Control guidance urging the postponement of mass gatherings. In addition, EPA posted an online, pre-recorded presentation describing the Proposed Plan. The presentation was available to the public throughout the comment period and contained the same information that would have been presented during an in-person meeting.

Members of the public were advised that they could submit comments on the Proposed Plan in a number of ways: (1) using the comment form on EPA's webpage at www.epa.gov/superfund/pmc-groundwater ; (2) submitting a written comment via email to kondreck.cheryl@epa.gov; (3) submitting a written comment by mail to U.S. EPA Region 5, Attention: Cheryl Kondreck, 77 West Jackson Boulevard (Mail Code: SR-6J), Chicago, Illinois 60604-3590; or (4) leaving a verbal comment by voicemail at 312-353-4872.

EPA's responses to the comments received during the public comment period are included in the *Responsiveness Summary,* which is provided in Part III of this Interim ROD.

2.4 Scope and Role of Operable Unit or Response Action

EPA's overall strategy for the Site is to continue to address unacceptable risks from the Site, then to address groundwater restoration.

This interim action will remove additional residual source material under the former PMC property that contributes to both vapor and groundwater contamination in support of EPA's goal of eliminating the vapor intrusion pathway and restoring groundwater. This interim action will also allow EPA to mitigate Site-related vapor intrusion as needed.

This action follows and will complement previous source removal and vapor intrusion mitigation efforts. The source removal will reduce groundwater concentrations, but groundwater restoration is not the anticipated endpoint for this interim action. Additional response action(s) may be required, and a final decision document will be issued to address the downgradient groundwater plume and any remaining unacceptable contamination at the Site. EPA expects that the remedy selected in a future final ROD will eliminate the vapor intrusion threats, if any, restore groundwater to drinking water standards, and allow termination of any VIMS.

2.5 Site Characteristics

2.5.1 Conceptual Site Model for PMC Groundwater Site

The conceptual site model (CSM) provides an understanding of the Site based on the sources of the COCs, potential transport pathways, and environmental receptors. Based on the nature and extent of contamination and the fate and transport mechanisms described in the RI and FFS reports, the refined CSM for the Site identified the following COC for human health receptors:

- Trichloroethene was identified as the COC for residential inhalation exposure to subslab soil vapor exposures via volatilization to indoor air (vapor intrusion).

A graphical depiction of the CSM for the source area of the Site is shown in Figure 3. The CSM for the HHRA is shown in Figure 4 and the CSM for the SLERA is shown in Figure 5.

2.5.2 Site Overview

The Site is located in the City of Petoskey, Emmet County, Michigan. For the purpose of this interim remedial action, the Study Area encompasses the former PMC property and surrounding

area which is shown on Figure 1. The location of the source of contamination is depicted on Figure 1 as the former PMC property boundary, currently the Water Street Condominiums.

The Site is located in a small resort community on the shore of Little Traverse Bay in the northern portion of the Lower Peninsula of Michigan. The City's population as of the 2020 Census is 5,877.

The municipal water source is groundwater pumped from seven municipal water wells maintained by the City. A City ordinance restricts potable use of groundwater through private wells.

2.5.3 Geologic/Hydrogeologic Setting

The Study Area rests on dark brown to black fill composed of fine-grained sand with gravel and occasional trace clay that ranges from 3 to 5 feet in thickness. The fill beneath the approximate footprint of the former PMC building, currently the Water Street Condominiums, is underlain by friable limestone with unconsolidated lacustrine gravel (including boulder and cobble size) and sand. Additionally, within the friable limestone layers, locally discontinuous layers of gravel, silt sand with gravel, and gravelly silty clay are noted. These layers are similar to beach face or foreshore deposits; in particular, they indicate a regressive sequence (coursing upward) likely associated with post-glacial deposition caused by changes in historical Lake Michigan stage levels.

The friable limestone and unconsolidated deposits are present over the more competent fractured limestone bedrock described as shaley and slightly argillaceous (Charlevoix Limestone).
The friable limestone and unconsolidated deposits are typically identified to approximately 40 feet bgs.

The unconsolidated surficial deposits and shallow limestone bedrock underlying the Site compose a single unconfined aquifer. Water levels in the area generally range from 5 to 19 feet bgs. Depth to water at the former PMC property averages about 13 feet bgs. Specifically, upgradient of the Site along Lake Street, depth to water averages about 15 feet bgs; downgradient of the Site near the Fraternal Order of Eagles' Lodge, the average depth to water is about 12 feet bgs. Groundwater is shallower near the shore as noted at well PS-10A (see Figure 6 for well location), at the Sunset Shores Condominiums, where depth to water averages 9 feet bgs.

The direction of groundwater flow at the Site is highly variable because of frequent short-term changes in lake stage, which have been observed to induce reversals in the groundwater flow direction. Long-term lake stage fluctuations may also affect groundwater flow direction that can result in groundwater mounding inland from the shoreline until the groundwater elevation reaches that of the lake. Historically, the groundwater plume at the Site was drawn toward the Ingalls Well while it was in use. However, since the Ingalls Well was removed from service, the groundwater flow has fluctuated with reversals occurring toward and away from the lake. Groundwater elevation data indicate that the groundwater flow gradient is essentially flat. The groundwater flow velocity calculated using June 1, 2018 groundwater elevation data was between 0.0002 to 0.0006 foot per day or 0.08 to 0.22 foot per year, indicating virtually no net advective flow. The lack of net advective flow coupled with the observed periodic groundwater flow reversals inland of the shoreline are a likely contributor to slow dilution and dispersion of the TCE plume. Furthermore,

virtually no vertical gradient was noted at four of the five well pairs. At the PS-105S/PS-105D well pair, a downward vertical gradient of 0.12 was noted.

2.5.4 Extent of Contamination

The RI determined that the contamination remaining under the former PMC property is the primary contributor to the vapor intrusion in the Study Area. The contaminated soils and groundwater are the sources of contaminated vapor found above screening levels. EPA conducted the RI between October 2016 and July 2019. The significant findings and conclusions from the Site characterization activities completed during the RI are summarized below. The July 2019 Final RI report provides additional detail about Site investigations and can be found at: www.epa.gov/superfund/pmc-groundwater . The primary contaminant found above screening levels was TCE.

Groundwater

Groundwater samples were collected at 25 monitoring wells and 9 grab sample locations to support the 2019 RI. Results were compared to EPA tap water regional screening levels (RSLs), EPA vapor intrusion screening levels (VISLs), and EGLE site-specific residential Volatilization to Indoor Air Criteria (VIAC). The EPA RSL, EPA VISL and EGLE VIAC for TCE are 0.49 microgram per liter (µg/L), 1.19 µg/L and 7.1 µg/L, respectively. The highest concentration of TCE (36 µg/L) collected from monitoring wells was at PS-4, located at the source area adjacent to where the TCE AST and soil contamination was located. The highest concentration of TCE (15 µg/L) from the grab sample locations was located at SVB-12, near the middle of the former PMC property.

Figure 6 shows the extent of TCE in groundwater. The highest concentrations of TCE were detected in groundwater near the footprint of the former PMC facility, and concentrations above screening levels were detected extending from the former facility to the northwest towards the lake, where the plume historically migrated due to active pumping of the former municipal supply well.

Vertical profiling of TCE was conducted at monitoring well location CMW-01 by collecting grab groundwater samples from multiple depths prior to installing the well. Samples from four intervals indicate that concentrations decrease with depth (Figure 6) in the former source area. Downgradient of the source area, two shallow/deep well pairs, PS-4/PS-104 and PS-CS/PS-CD shows decreasing or similar concentrations with depth, respectively. Concentrations in the deeper aquifer further downgradient of the Site (at PS-CS/PS-CD) are attributed to vertical migration from historical pumping.

No TCE degradation products were detected in 2018, indicating that intrinsic bioremediation via reductive dechlorination is not occurring due to the aerobic environment. Volatilization and dispersion are expected to be the primary attenuation mechanisms at the Site.

Soil

Soil samples collected at multiple depths from 11 borings were analyzed for VOCs. Such bulk soil samples are considered only a secondary line of evidence in vapor intrusion evaluations. Soil samples collected during the RI investigation were likely underestimated because the samples were heated due to difficult sonic drilling through the weathered bedrock. Results were compared to EPA residential soil RSLs and site-specific Michigan VIAC for residential soils. Figure 7 presents the TCE results in soil. Concentrations of TCE above screening levels appear

to fall primarily within the western portion of the former PMC property. The highest concentrations of TCE were detected both above (1,100 µg/kg) and below (2,700 µg/kg) the water table. With some exceptions, concentrations are higher at depth (Figure 7), likely due to historical excavation of shallow impacted soil. Lower concentrations of TCE were also detected under the parking lot to the northwest, at SVB-05.

Soil Vapor
Exterior soil vapor sampling was performed at 15 multi-depth probes in June 2018 and October/November 2018 (Figure 8). Results were compared to EPA residential VISL and residential Michigan VIAC. TCE in exterior soil vapor above both screening levels was identified within or adjacent to the shallow groundwater TCE plume and TCE impacted soils, with the highest concentration (15,000 micrograms per cubic meter [$\mu g/m^3$]) occurring in the western portion of the former PMC property (SVB-12). Concentrations are higher in shallow soil vapor compared to deeper samples collected within the former property boundary, indicating that TCE in soil is acting as a source to soil vapor in addition to the TCE in groundwater. The distribution of TCE in shallow soil vapor beyond the former PMC property boundary showed the greatest offsite extension north of Lake Street and west of the former PMC manufacturing Site. The concentration of TCE in soil vapor beyond the former PMC property increases with depth indicating the groundwater plume is the primary source of TCE in the soil vapor.

Sewer Vapor Sampling
Sewer gas samples were collected in 2018 in June (5 sanitary sewers; 4 storm sewers) and October (6 sanitary sewers; 6 storm sewers). The results were compared to the EPA soil vapor VISL of 16 $\mu g/m^3$ and the Michigan recommended interim action screening level (RIASL) of 67 $\mu g/m^3$. Figure 9 shows the extent of TCE in sewer gas. Analytical results indicated that TCE exceeds only the EPA Soil Vapor VISL and exceedances are limited to three sanitary sewer locations: SA-01, SA-03, and SA-07. Of these, SA-01 is located within the footprint of the former PMC property and SA 03 and SA-07 are adjacent to the property. Although utility lines can potentially play a role in vapor transport, the data indicates there is no evidence that the sewer network is currently acting as a preferential pathway to neighboring buildings beyond the Site.

Vapor Intrusion Sampling
The VI investigation was completed across five sampling events in 2017 and 2018. A total of 25 properties were sampled, which included two properties with multiple residences, one commercial property, and 22 residential properties with single-family or duplex houses. Field investigation activities consisted of collecting indoor, crawlspace, and outdoor air samples and subslab or near-slab soil vapor samples at the individual properties.

From the 25 properties where samples were collected, two properties have had mitigation systems installed (one with multiple condominium units) based on exceedances of health-based screening levels. The properties with mitigation systems were on or adjacent to the source area. Based on VI sampling conducted in 2017 and 2018, there may be additional properties adjacent to the source area or near/above the groundwater plume that warrant mitigation.

2.6 Current and Potential Future Land and Resource Uses

Current Land Use
The land use throughout the Study Area is mostly residential mixed with a few business or commercial properties. Many of the properties located in the Study Area are rental properties, used as vacation homes, or combination. Currently, the former PMC property has been redeveloped into the Water Street Condominiums. Bay Front Park is within the Study Area and is used for public recreational purposes.

Future Land Use
Future land use at the Site is not expected to differ significantly from current land use. Future land use within residential areas is expected to remain the same.

Groundwater
The groundwater under the PMC Site is currently not being used for potable purposes. The City of Petoskey has established an ordinance prohibiting the use of private potable wells. Potable water is distributed to residents by the City of Petoskey municipal water supply system from groundwater wells located outside of the Study Area. This Interim ROD is focused on addressing sources to vapor intrusion contamination at the Site. Groundwater downgradient of the source area will be addressed further upon completion of this interim remedial action.

2.7 Summary of Site Risks

The 2019 RI included a baseline risk assessment (BRA) to determine the current and potential future effects of constituents of potential concern (COPCs) on human health and the environment. The Site and surrounding area are mainly for residential use with only a couple of commercial/mixed use properties and future land use is not expected to differ from the current land use. Therefore, a range of potential future users were evaluated including residential (adult and child) and construction worker. The overall level of Site risk indicated the need for remedial action and an FFS to evaluate remedial action alternatives. The BRA included a baseline HHRA and SLERA.

The HHRA was prepared for indoor air, soil vapor (subslab and exterior), and subsurface soil. The contribution to VI from groundwater is not included in the HHRA because the HHRA used the extensive subslab and soil vapor analytical data available to assess risk associated with vapor intrusion. The current risk associated with the groundwater ingestion pathway is being addressed under the 1998 ROD. Currently, the groundwater within the plume is not used for potable uses. Potable water for all residents within the Study Area is supplied by the City's municipal water system from groundwater wells located outside of Study Area.

2.7.1 Human Health Risks

The HHRA estimates the risks at a site if no remedial action is taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the HHRA that was conducted for the Site.

For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk (ELCR) is calculated from the following equation:

ELCR = EC x IUR

where:

ELCR = Excess lifetime cancer risk, a unitless probability (e.g., $2x10^{-5}$) of an individual's developing cancer
EC = Exposure concentration ($\mu g/m^3$)
IUR = Inhalation unit risk $(\mu g/m^3)^{-1}$

These risks are probabilities that usually are expressed in scientific notation (e.g., $1x10^{-6}$). An excess lifetime cancer risk (ELCR) of $1x10^{-6}$ indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site-related exposures is 10^{-4} to 10^{-6}. For the PMC Site, the HHRA established a total cancer risk acceptable risk threshold of 1 in 100,000 or $1x10^{-5}$, consistent with Michigan's preferred target cancer risk limit.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference concentration (RfC) derived for a similar exposure period. An RfC represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ < 1 indicates that a receptor's dose of a single contaminant is less than the RfC, and that toxic noncarcinogenic effects from that contaminant are unlikely. The hazard index (HI) is generated by adding the HQs for all COCs that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI < 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI > 1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = EC/RfC

where:

HQ = hazard quotient
EC = exposure concentration
RfC = reference concentration

EC and RfC are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

The RI sample results were evaluated in the HHRA to identify the COCs in various media that pose a current and/or future potential risk to human receptors. A contaminant was carried through the risk assessment as a COC if it posed an ELCR greater than $1x10^{-5}$ (1 in 100,000 chance) for cancer risks or exceeded an HI of 1 for non-cancer risks and was above background.

Potential risks associated with indoor air exposures to COPCs in site media were quantified for current and reasonably foreseeable future exposure scenarios for individual building and/or dwelling units (i.e. each condominium unit) that did not have a VIMS at the time the HHRA was conducted. Operational VIMS render the VI pathway incomplete (and therefore no associated risk or within EPA-acceptable risk levels). It is assumed that each SSD system and other VIMS will remain operational until the vapor source below the building has been reduced to acceptable levels. However, if the VIMS is shut off prior to the vapor source being reduced to acceptable levels, indoor air risks may be unacceptable. A total of 8 separate buildings and four condominium units were evaluated.

The ELCR and HIs were calculated for the following exposure scenarios:

- Current resident at the Water Street Condominiums without VIMS at the time of the HHRA (indoor air data)
- Current resident at individual residential properties (indoor air data)
- Current/future resident at individual residential properties (modeled indoor air data from exterior soil vapor data)
- Future resident at Water Street Condominiums without VIMS at the time of the HHRA (modeled indoor air exposure from subslab data)
- Future resident at individual residential properties (modeled indoor air data from subslab soil vapor data)

Final COCs and HHRA Results

The future resident scenario, both from the Water Street Condominiums and individual residential properties, estimated HIs above 1 for TCE. Therefore, subslab soil vapor exposure via volatilization to indoor air was identified as the media where a contaminant presents an unacceptable future risk. The contaminant identified as the COC in subslab soil vapor is TCE.

Table 1 presents a summary of ELCR COCs and HIs COCs for the future resident scenario. The Site poses unacceptable risks because the non-cancer HIs exceed 1 (up to an HI of 6) for TCE modeled in indoor air from subslab soil vapor, therefore providing a basis for taking action.

After the HHRA was completed, EGLE updated their screening levels and identified several other potential COCs. The compounds are benzene, ethylbenzene, and PCE. The remedy for the Site will treat all VOCs therefore, for this Interim ROD, the HHRA was not updated to expedite the implementation of a remedy. During implementation of the remedy these three compounds will be evaluated as possibly triggering risk and documented as such if appropriate.

2.7.2 Ecological Risks

The ecological risk assessment and related habitat assessment was conducted in accordance with *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (EPA 1997)* and *Guidelines for Ecological Risk Assessment (EPA 1998)*. Within the Study Area, there are no significant habitat areas present. Concentrations of TCE in groundwater nearest the Little Traverse Bay did not exceed water quality criteria and the groundwater plume is mitigated by the periodic reversals in groundwater direction. While the soil vapor exposure pathway is theoretically complete, the lack of habitat suggests that the potential exposure to wildlife species is limited; therefore, the soil vapor exposure pathway is considered complete but insignificant. Based on the information gathered through the screening level ecological risk assessment, no significant exposure pathways to ecological receptors are present at the PMC Site; therefore, no further risk analysis was warranted.

2.7.3 Basis for Action

The response action selected in this Interim ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

2.8 Remedial Action Objectives

Remedial action objectives (RAOs) are goals for protecting human health and the environment. RAOs are developed to address the contaminant levels and exposure pathways that present unacceptable current or potential future risk to human health and the environment. RAOs were developed for the Site based on the contaminant levels and exposure pathways estimated to pose an unacceptable risk to human health and the environment, as determined during the RI.

The following RAOs were developed to protect human health receptors from potentially unacceptable VI risk at the Site. Achieving final Site cleanup levels is not a goal of this interim remedial action.

Source Reduction:

- Reduce the mass of TCE and other potential COCs in soil and groundwater under the former PMC property acting as ongoing sources for exposure to humans via inhalation until the mass recovered reaches asymptotic conditions or until soil vapor, groundwater, and indoor air all reach the cleanup goals based on an estimated lifetime cancer risk of 10^{-5} and noncancer hazard quotient of 1.

Vapor Intrusion:

- Mitigate vapor in buildings within the Study Area that pose an unacceptable current and future risk to human health via inhalation at an estimated lifetime cancer risk of 10^{-5} and noncancer hazard quotient of 1 based on multiple lines of evidence.

The vapor intrusion RAO will be to preemptively address potential VI where subslab or near-slab (for buildings without slabs) vapor samples indicate an unacceptable risk.

Soil contamination is a source of VI however, a soil to vapor RAO is not proposed for this interim action. Since soil vapor and bulk soil are in equilibrium, technologies that durably reduce

concentrations in soil vapor will also remediate bulk soil and sampling the soil vapor will provide sufficient information on the progress of the interim action in meeting the source reduction RAO.

2.9 Description of Alternatives

Remedial alternatives for the PMC Site are presented below. The alternatives are numbered to correspond with the numbers in the FFS Report and are further explained in the FFS Report.

Capital costs are those expenditures that are required to construct a remedial alternative. Because this is an Interim ROD treating the source of contamination, there are no operation and maintenance (O&M) costs, however this Interim ROD includes treatment of the contamination and costs associated with keeping the system operational and is presented as Annual Operating Costs. The "present worth" cost is the amount of money which, if invested in the current year, would be sufficient to cover all the costs over time associated with a project. The present worth costs for the remedial alternatives below were calculated using a discount rate of seven percent and a 10-year time interval.

2.9.1 Description of Common Elements Among Remedial Alternatives

All of the remedial alternatives evaluated in the FFS, except the no action alternative, include the following common elements:

Mitigation Systems

For this Interim ROD, the term "remediation" is used to refer to treatment of environmental media such as soil, soil vapor, or groundwater. The term "mitigation" is used to describe actions taken directly at an individual building to control indoor air concentrations. According to EPA guidance (2015), mitigation is viewed only as a temporary measure in most cases until remediation can address the source of the VOC contamination. Although not directly stated within the discussion of each remedial alternative below, existing and proposed preemptive mitigation systems will need to be maintained until final cleanup goals are met. Currently there are 19 mitigation units installed at the Site where EGLE has assumed or plans to assume the post removal site control efforts. As discussed above, there may be a need to install additional VIMS on properties near the treatment area and within the Study Area based on future sampling. Once the VIMS are deemed operational and functional, EGLE will take over O&M of all VIMS at the Site until the final cleanup goals are met and the systems can be shut down.

Building-specific analyses will be completed to determine what type of active VIMS will be preemptively installed where the interim cleanup goals are exceeded. Some potential systems include standard SSD systems; submembrane depressurization coupled with sprayed or hung plastic wall sealing; SVE systems surrounding or beneath buildings; and whole-house air purifiers. SSD systems are similar in concept to most common radon mitigation systems and are used at properties with concrete or other impermeable foundations. Where impermeable foundations are not present, such as Michigan-style basements identified within the Study Area, the flooring and walls need to be sealed before depressurization is effective for standard SSD systems. Depressurization systems need to be carefully designed to avoid carbon monoxide risk from combustion appliance backdrafting. Combustion appliances have been observed in several of the Michigan-style basements. Other engineered solutions such as SVE systems will be explored during the RD to ensure the systems selected properly mitigate the vapors in a safe and effective manner. If other systems are not feasible,

permanent, or portable whole-house air purifying systems may be used as a last option for mitigation which will rely on filter maintenance to maintain effectiveness. Whole-house air purifying systems can be filter-based units installed in furnace systems and air intake points, duct-based units installed into air duct path, before or after the air handler in a central forced air heating, ventilation, and air-conditioning unit, or portable stand-alone systems installed in the house. During the RD phase, various property-specific options for mitigation will be explored with a preference to mitigate the vapors beneath the properties rather than reliance on in-home air purifying systems.

Soil vapor monitoring will be required as part of each alternative evaluated. Semiannual monitoring is the proposed baseline sampling frequency because less monitoring is required after mitigation than before mitigation for a similarly situated house, because the continued operation of mitigation provides substantial protection and reduces temporal variability.

The general capital cost per house for mitigation using an active system with monitoring and maintenance over the initial period ranges from $20,000 to $60,000, depending on the system required for the property and proposed monitoring frequency. For the purpose of estimating costs, each unit is assumed to cost $50,000.

Pre-design investigation
A pre-design investigation to refine the extents of the source area and provide specific design information is necessary. This investigation is anticipated to include soil, soil vapor, and groundwater sampling; monitoring well installation and sampling; geophysics; and soil vapor well installation and sampling. VI investigation outside of the source area will also be needed at buildings where access was not granted in the past and where additional data is needed to confirm whether VIMS are needed.

Institutional Controls
Institutional and engineering controls (such as signs, fencing, etc.) necessary to protect public safety during construction and, if applicable, operation of the remedy, will be implemented.

2.9.2 Description of Remedial Alternatives

Alternative 1 - No Action

EPA is required to evaluate a "no-action" alternative when considering potential remedial actions for a site to provide a baseline for comparison to the other potential response actions. Under this alternative, no remedial actions would be undertaken to reduce the levels of TCE in soil, groundwater, soil gas, subslab vapors, or indoor air. Additionally, this alternative would not include continued operation of vapor mitigation systems. Therefore, the potential human health and environmental risks associated with exposure to the COCs which EPA identified in its risk assessments would not be addressed.

Estimated Costs for Alternative 1

Direct Capital Costs:	$0
Annual Operating Costs:	$0
Total Periodic Costs:	$0
Total Present Value:	$0

Alternative 2 – Air Sparge with Soil Vapor Extraction

Air Sparge/Soil Vapor Extraction (AS/SVE) is an in-situ technology where air is injected into the saturated zone to induce mass transfer (stripping) of VOCs dissolved in groundwater and uses SVE to capture the liberated VOCs. The SVE system is also used to treat the unsaturated soils. Alternative 2 includes use of AS/SVE technology to treat VOCs at the source. Based on previous experience using AS/SVE at sites with similar conditions, active treatment with AS/SVE may continue up to 5 years. Due to the heterogeneity of the subsurface materials at the source area, the length of time to remediate both the soils and groundwater contamination that is contributing to the soil gas contamination may take longer and back diffusion is likely to occur. Back diffusion may occur when contamination trapped in fine-grained soils gets released and mobilized into the environment. Monitoring will occur as part of this interim action after the system is turned off to assess whether additional treatment is necessary to further remediate the source area.

Horizontal AS wells would be installed to distribute air through the treatment area with the use of segmented well systems, such as the Vertebrae^{TM} well system, to better refine and remediate the contamination at the source. This alternative was developed assuming Vertebrae^{TM} wells, but other wells would be acceptable provided the cost and performance is comparable. The Vertebrae^{TM} system is a single diameter horizontal well that contains multiple isolated screen segments; an engineered multi-port well that is installed horizontally beneath the building instead of vertically. The Vertebrae^{TM} system is unique with many discrete screen zones running horizontally along its length with separate, small diameter tubing plumbed from each screen to the surface. Grout is used to isolate the individual tailor-designed screen intervals. Because the monitoring points are installed horizontally instead of vertically there is improved coverage along the width of the plume at targeted depths with highest concentrations of contaminants. The approach is advantageous because multiple closely spaced measuring points across a transect can be easily installed from a single boring (reducing costs) and contaminant zones that may have been previously inaccessible via vertical boreholes can be characterized, in this case, beneath the Water Street Condominiums. An accurate understanding of contaminant distribution within the Site hydrostratigraphy from vertical borings is still required to optimize placement of the horizontal wells, and to select target intervals for the monitoring zones. Therefore, as part of the RD phase, pre-design investigation costs are included to refine the data presented in the RI. Additionally, the Vertebrae^{TM} well system can be used for multiple remediation alternatives (AS and in situ chemical oxidation [ISCO]), in a combined application or consecutively. This would allow flexibility to change remedies if needed.

Based on the data obtained from the RI, the following design concept has been developed to reduce the VOC concentrations at the source. Final design would be determined during the RD. As shown in Figure 10, three AS well systems would be installed using horizontal directional drilling (HDD) techniques with a total of 18 well segments distributed throughout the three horizontal well systems installed to a depth of approximately 30 feet bgs to effectively treat VOCs in groundwater in the source area.

Four SVE Vertebrae^{TM} well systems would be installed above the AS wells in the vadose zone of the source area to capture the vapors released from the AS of the groundwater and to remediate the soil vapor in the vadose zone as shown on Figure 11. The SVE Vertebrae^{TM} wells would be installed with a total of 22 well segments among the four well systems at

approximately 10 feet bgs using HDD techniques (to pass under existing building footings and utilities). The capture zone for the horizontal SVE at 10 feet bgs is expected to extend upward to the base of the slabs with an approximate 30-foot radius of influence. In addition to the horizontal wells, vertical SVE wells may be installed to maximize vertical coverage of the contamination at locations of highest soil gas concentrations.

The conceptual layout, including the additional drilling length to get to the required depth of the proposed horizontal AS/SVE system, is shown in Figure 10 and 11 for the AS and SVE well systems, respectively. These figures show the horizontal wells being drilled from Bayfront Park for the AS well oriented northwest to southeast and from the Fraternal Order of Eagles parking lot for the SVE oriented approximately east-west.

An estimated 3,000 feet of conveyance pipe would be installed in approximately 150 feet of trench to connect the 18 AS and 22 SVE independent wells (wellheads located near the laydown areas shown in Figure 10 and 11) to the remediation equipment compound location currently proposed at the southern portion of Bayfront Park, northwest of the Water Street Condominiums.

Figures 10 and 11 also show the potential location for the remediation equipment building. A remediation building would house compressors, blowers, and other equipment to service the AS and SVE wells and provide enough AS injection capacity to deliver up to 175 standard cubic feet per minute (scfm) of air flow (0.65 scfm per foot of screen) and an SVE capacity to extract up to 880 scfm (1.6 scfm per foot of screen), compared to a maximum capacity of 300 scfm in the historical system. Two 5,000-pound vapor-phase granular activated carbon (VGAC) vessels would be needed to treat the extracted soil vapors before discharging to the atmosphere. Security fencing would need to be installed around the equipment building. This alternative would operate and comply with air permitting requirements associated with discharge of treated soil vapor. In addition, this alternative would operate and comply with requirements associated with Class V injection wells.

All properties within the treatment area would require periodic subslab/soil gas well and indoor air monitoring to confirm that the SVE system is capturing all liberated VOCs. Additionally, groundwater monitoring would be conducted to demonstrate progress toward meeting the groundwater interim cleanup goal and the effectiveness of the AS system.

In summary, Alternative 2 would contain the following major components:

- Installation of horizontal AS and SVE segmented wells for source control
- Installation of vertical wells as needed based on the RD
- Installation of the AS/SVE system components
- Operation of the AS/SVE until source control RAO is achieved
- Management of IDW and waste streams
- Monitoring environmental media (groundwater, soil vapor, indoor air, and sewer gas)
- Air permit-required sampling and associated reporting

The FFS estimated that operation of the AS/SVE systems would continue for up to five years to

meet the source control RAO. It is also estimated that an additional five years of monitoring would occur upon completion of the operation of the AS/SVE system to monitor the contaminant rebound and determine whether additional operation of the AS/SVE system is necessary.

Estimated Costs for Alternative 2:

Direct Capital Costs:	$3,054,000
Annual Operating Costs:	$65,000 - $495,000
Total Present Value:	$5,500,000

The estimated direct capital costs above include pre-design investigation, design and installation of AS/SVE system, and installation of mitigation systems. The annual operational costs were calculated to include running the AS/SVE system for first five years of which the first three years include quarterly sampling of groundwater and soil vapor ($495,000); annual system operation, groundwater and soil vapor sampling years 4 through 5 ($285,000); and annual groundwater and soil vapor sampling years 6 through 10 ($65,000). Additional periodic costs of five-year reviews in year 5 and 10 are $40,000.

Alternative 3 – In-Situ Chemical Oxidation with Soil Vapor Extraction

Alternative 3 includes treating groundwater in-situ within the source area using in-situ chemical oxidation (ISCO) technology to oxidize TCE and other VOCs into innocuous compounds. Oxidants have been shown to effectively and reliably treat a wide range of organic contaminants, including TCE. Key factors influencing the effectiveness of ISCO are total oxidant demand and contact between the COC and the oxidant, which is facilitated through the selected distribution mechanism. This alternative was developed assuming Vertebrae™ wells and hydrogen peroxide as a reagent, but other wells and oxidants would be acceptable provided the cost and performance is comparable.

The following describes details of the design concept but would be subject to change based on information gathered during the pre-design investigation and the RD process. The design concept for this alternative proposes to use a catalyzed hydrogen peroxide that is simultaneously activated and stabilized such that it forms a slow-release hydrogen peroxide-based generation of the desired free radicals to be injected into the appropriate wells utilizing the Vertebrae™ well system. The oxidant can remain reactive over months if the demand of the aquifer is low. As described for the AS in Alternative 2, the ISCO distribution would utilize the Vertebrae™ well system to better target the contamination in the saturated zone at depth with the highest TCE concentration. Based on the current RI data, the highest soil concentration collected from the saturated zone is from the 19.5-20-foot bgs interval along the southern boundary of the former PMC property. Additional data would be collected during the pre-design investigation to refine the known area and depths of contamination. The HDD wells installed as described in the AS alternative (3 well systems with 18 independent well segments) would be used to inject the oxidant. Because the Vertebrae™ system can be utilized for the introduction of fluids with low viscosities and low solids content, and/or the introduction of gases, technologies may be switched to produce more effective results. However, if the well systems were to be utilized for the subsequent introduction of fluids and or gases (i.e., change in remedial technologies), it is recommended that a pilot test be conducted, utilizing the installed HDD well systems, in order to determine the vertical and horizontal radius of influence

associated with the well systems.

The design and effectiveness of the SVE element of this alternative is as discussed for Alternative 2. As part of this alternative, SVE would also serve to treat unsaturated soil and capture potential off-gas from the oxidation process.

This alternative describes the use of catalyzed hydrogen peroxide, but other oxidants would be acceptable provided the cost and performance is comparable. A bench-scale test would be required during the RD phase to determine the best oxidant for the Site. The bench-scale testing conducted during the RD phase would also field test reagent distribution. The Vertebrae^{TM} well system would allow for the oxidant slurry to be injected at locations of highest groundwater concentration beneath the Water Street Condominiums. Due to the lack of advective flow at the Site, additional vertical borings can be advanced to deliver the oxidant to the subsurface and supplement the HDD wells based on the pre-design investigation. Vertical extraction wells may be installed to move the oxidant through the aquifer and will be explored during the RD phase.

Because ISCO will not volatilize VOCs at a high rate and SVE will collect vapors, additional vapor mitigation efforts would not be anticipated and monitoring during application of the ISCO would be implemented to ensure protectiveness.

In summary, Alternative 3, would contain the following major components:

- Installation of horizontal ISCO and SVE segmented wells for source control
- Installation of vertical wells as needed based on the RD
- Installation of the SVE system components
- Operation of the SVE until source control RAO is achieved
- Injection of oxidant in the ISCO wells to achieve source control RAO (multiple rounds as necessary)
- Management of investigation derived wastes (IDW) and waste streams
- Monitoring environmental media (groundwater, soil vapor, indoor air, and sewer gas)
- Air permit-required sampling and associated reporting

The FFS estimated that operation of the SVE system would continue for up to 5 years to meet the source control RAO. The ISCO application is assumed to release oxidants for at least 3 months or longer per injection event. It is anticipated that three injection events would be needed followed by diffusion and dispersion of the oxidant to meet the groundwater to vapor interim cleanup goal, which may also take up to 5 years but is anticipated to occur within 3 years allowing time to monitor concentration reductions prior to the five-year review. It is also estimated that an additional five years of monitoring would occur upon completion of the operation of the SVE system to determine whether additional operation of the SVE system is necessary due to contaminant rebound.

Estimated Costs for Alternative 3:

Direct Capital Costs:	$3,191,000
Annual Operation Costs:	$112,000 - $385,000
Total Present Value:	$5,200,000

The estimated direct capital costs above include pre-design investigation, design and installation of ISCO/SVE system, injection of chemical oxidants and installation of mitigation systems. The annual operational costs were calculated to include the operation of the ISCO/SVE system for first five years of which the first two years include quarterly groundwater and soil vapor sampling ($385,000); annual system operations and soil vapor sampling years 3 through 5 ($203,000); and annual soil vapor sampling years 6 through 10 ($112,000). Additional periodic costs of five-year reviews in years 5 and 10 are $40,000.

2.10 Comparative Analysis of Alternatives

As required by CERCLA, nine criteria were used to evaluate the different remediation alternatives individually and against each other in order to select a remedy. This section of the Interim ROD profiles the relative performance of each alternative against the nine criteria, noting how they compare to the other options under consideration. The nine evaluation criteria are discussed below. The "Detailed Analysis of Alternatives" can be found in the FFS Report. Table 2 provides a summary of this evaluation.

The nine criteria fall into three groups: threshold criteria, primary balancing criteria, and modifying criteria. Threshold criteria, which include overall protection of human health and the environment and compliance with ARARs, are requirements that each alternative must meet to be eligible for selection. Primary balancing criteria, which include long-term effectiveness and permanence; reduction of toxicity, mobility, or volume of contaminants through treatment; short-term effectiveness; implementability; and cost; are used to weigh major tradeoffs among alternatives. Modifying criteria, which include state/support agency acceptance and community acceptance, can be fully considered only after public comment is received on the Proposed Plan; therefore, modifying criteria were not evaluated in the FFS. In the final balancing of trade-offs between alternatives, upon which the final remedy selection is based, modifying criteria are of equal importance to the balancing criteria.

2.10.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or ICs.

EPA is required to select remedies that will protect human health and the environment. All the retained alternatives – with the exception of the "No Action" alternative – would protect human health and the environment. Because the "No Action" alternative would not protect human health and the environment, it was eliminated from consideration and will not be discussed further under the remaining eight criteria. For the two remaining alternatives, the vapor intrusion RAO would be achieved upon installation of VIMS. The source area RAO would be achieved by

treatment of the soil and groundwater contamination at the source area. The discussion below summarizes how the remaining alternatives for each area would achieve protectiveness.

Immediate risk reduction is provided by the two retained alternatives. VIMS will be installed to ensure exposures to human health via vapor intrusion are mitigated until the final remedy for the Site is implemented. Additionally, sewer vapor sampling will be conducted prior to and during the start-up of the system to ensure vapors are not migrating through other preferential pathways into buildings. This Interim ROD's main objective is to reduce the mass of contaminants at the source area. Reducing the contaminant mass at the source will aide in achieving the long-term protection of human health from vapors and the groundwater restoration objective from the 1998 ROD.

2.10.2 Compliance with ARARs

Section 121(d) of CERCLA and NCP § 300.430(f)(l)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4). For interim remedial actions, only those ARARs applicable to the limited scope of the action will have to be met.

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be applicable or relevant and appropriate.

Compliance with ARARs addresses whether a remedy will meet all the applicable or relevant and appropriate requirements of federal and state environmental statutes or provides a basis for invoking a waiver. Alternatives 2 and 3 comply with ARARs for this interim action. This Interim ROD's main objective is to reduce the mass of contaminants at the source area, not necessarily to achieve an ARAR-based cleanup goal. However, site-specific risk-based cleanup goals were established for comparison purposes and to determine when VIMS are needed for preemptive mitigation (see Section 2.12.2). Specific ARARs for this Interim ROD are listed in Table 3.

2.10.3 Long-term Effectiveness and Permanence

Long-term effectiveness and permanence refer to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

Both of the remaining alternatives evaluated for the Site are considered proven and effective

alternatives for VOC contaminated soil and groundwater sites such as the PMC Site. Both alternatives will use SVE to treat soils in the unsaturated zone as well as capture the volatized contaminants from the groundwater. Due to the heterogeneity of the subsurface at the treatment area, vertical SVE wells may also be installed to target specific locations and depths outside of the zone of influence of the horizontal wells. The number and locations of these vertical and horizontal wells will be determined after the pre-design investigation during the RD phase. The source reduction RAO for the Site is to reduce the mass until asymptotic conditions are met or interim cleanup goal are achieved based on soil gas and groundwater sampling. Once this RAO is achieved, the implementation of the interim action will be assessed to determine whether additional action is necessary after which a final site-wide ROD will be issued. The SSD systems and any additional VIMS installed would provide long-term protection and continue to run to provide protection for structures until they are no longer needed. Existing SSD systems and any potential VIMS would continue to operate until final cleanup goals in a final ROD are achieved.

The main difference between the two alternatives is the effectiveness of source removal from groundwater. Alternative 2 is expected to offer better long-term effectiveness and permanence than Alternative 3 due to the lack of net advective groundwater flow. Vertical extraction wells may be installed to move the oxidant through the aquifer for Alternative 3 to be more effective. There is uncertainty in the volume of the groundwater plume that can be treated using Alternative 3, making this alternative potentially less effective than Alternative 2.

Under Alternative 2, contaminant mass from groundwater is transferred to vapor by injecting air into the saturated zone and utilizing SVE to capture the volatilized contaminants. AS under Alternative 2 must not only treat the more permeable portions of the formation, but also operate long enough for mass to diffuse out of potential lower-permeability zones where mass is typically stored. Although the majority of the Site is friable limestone with sand and gravel, some silt and clay were noted beneath the Site. AS strategies would need to accommodate the mix of consolidated and unconsolidated materials found at the Site. VOCs removed from the saturated zone and volatilized and stripped from groundwater would be permanently removed from the subsurface through the SVE wells. Groundwater and soil vapor monitoring would be conducted to determine if RAOs have been achieved. The AS/SVE system is expected to run for 5 years followed by 5 years of monitoring however, this may change based on the actual data collected during the implementation of the remedy.

ISCO technology under Alternative 3 would destroy VOCs in groundwater through oxidation and capturing VOCs through the SVE system in the vadose zone. Active release of the oxidants is expected to continue for approximately three months per application for a total of 9 to 12 months with three applications, to reduce COC concentrations along and adjacent to the three Vertebrae^{TM} well systems. Additional vertical borings may be advanced to distribute the oxidants in the groundwater as well as vertical extraction wells or recirculation wells installed to move the oxidant through the aquifer. It is expected that diffusion of the oxidants within the groundwater would reduce COC concentrations however, it may take longer than the estimated 3 years for the reagent to be distributed due to the lack of groundwater flow at the Site. Groundwater and soil vapor monitoring would be conducted to determine if RAOs have been achieved. The SVE system would be expected to run for 5 years followed by 5 years of monitoring, however, this may change based on the actual data collected during the implementation of the remedy.

In accordance with CERCLA, reviews would be required at least every five years to evaluate

the effectiveness of any of the selected alternatives if contaminants are at concentrations above health-based levels for unrestricted use. See CERCLA Section 121(c), 42 U.S.C. Section 9621(c), and 40 C.F.R. 300.430(f)(4)(ii).

2.10.4 Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Treatment Processes

Alternatives 2 and 3 both use SVE to treat the soils and any off-gas that results from the groundwater treatment. The contamination captured by the SVE will be transfered to another media, the activated carbon, prior to destruction off-site. Alternative 2 uses air sparging as a primary means of removing contaminants from water, transferring the contaminants from one media (groundwater) to another (vapor). Alternative 3 directly treats the contaminants, destroying them in situ. Both Alternatives will use SVE to remove the VOCs from the soils, transferring the contaminants from one media (soil) to another (vapor). The contaminated vapor collected by the SVE system will be treated through an activated carbon filter to capture the contaminants and the filter destroyed off site. The remaining air will be released to the atmosphere and discharge will be done in accordance with proper air discharge permitting requirements.

Amount of contaminants that will be destroyed

The amount of contaminants expected to be destroyed is similar in Alternatives 2 and 3. Both alternatives utilize SVE to treat the contaminants in the soils and, in case of Alternative 2, SVE will treat contaminants release from groundwater. Alternative 2 may remove more contaminant mass than Alternative 3 because of the little to no groundwater flow at the Site, which hinders the movement of the oxidant in Alternative 3 to optimally treat the groundwater. However, Alternative 2 is likely to remove groundwater contaminants at a slower rate than Alternative 3. Alternative 3 directly treats the groundwater contaminants.

Degree of expected reduction in toxicity, mobility, or volume and specification

Successful implementation of Alternatives 2 and 3 requires a pre-design investigation to more precisely locate the depth of contaminant mass targeted for treatment. Both Alternatives 2 and 3 have the same level contaminant reduction however Alternative 2 would take longer to achieve RAOs than Alternative 3. Alternative 3 relies on the oxidant having direct contact with the contaminated groundwater and therefore would require the use of extraction or recirculation wells to ensure movement of the groundwater which is not required for Alternative 2.

Degree of irreversibility

The treatment provided by Alternatives 2 and 3 is irreversible. Alternative 2 would transfer the contaminant from the groundwater phase to the vapor phase and Alternative 3 would destroy the groundwater contaminants in place. No breakdown products of the contaminants are anticipated with the use of either of these Alternatives. Both Alternatives capture contaminants in the collected vapors of the SVE.

Type and quantity of residuals

Properly designed and implemented, no toxic residuals should be produced from the treatment provided by Alternatives 2 or 3.

2.10.5 Short-term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved.

Protection of Community

Alternatives 2 and 3 present similar short-term risks to the community which can be mitigated using common approaches. However, ISCO uses strong oxidizers, which, while safe if handled properly, provide slightly more risk to the community should there be an accident in chemical handling. Both alternatives use the same design of installing horizontal wells beneath the source area and will be equally disruptive during the construction of the remedy. Alternative 3 would require additional extraction and/or recirculation wells which would cause additional disturbance to the community over Alternative 2. Both Alternatives require installation of the system components building northwest of the former PMC property. Once the building and system components are in place there will be minimal impact to the community with the exception of periodic vapor intrusion sampling that will be conducted to ensure safety of building occupants and to measure the remedy performance. Noise from the system blowers and system components will be mitigated to the extent possible using various combinations of choosing blowers that have the lowest noise level output, installing noise reduction material inside the system building, and adding silencing components to the intake and/or exhaust of the blowers.

Protection of Workers

Alternatives 2 and 3 are expected to have similar levels of risk to the workers due to construction activities. Alternative 3 adds risk from the oxidizing reagent, which can be dangerous if mishandled. With properly executed Health and Safety Plans, the risks to workers for all of the options are minimal.

Environmental Impacts

Alternatives 2 and 3 would have similar impacts on the environment as their implementation is very similar. Alternative 3 potentially has more environmental impact than Alternative 2 because of the use of the oxidizing regent which, if mishandled or spilled, can pose a threat to the environment. Both Alternatives 2 and 3 impact the environment due to the electrical power needed to operate the systems, as well as similar amounts of IDW generated from the pre-design activities that will need offsite disposal.

Time required to Implement Remedial Action and Achieve RAOs

Alternatives 2 and 3 are expected to achieve RAOs with respect to the soil in a similar time period as the process for remediating the soils contributing to vapor intrusion is the same for both alternatives (five years of SVE). Alternative 2 is expected to take longer than Alternative 3 for the groundwater remediation portion (five years of AS) as the injected air volatilizes the contaminants rather than chemically destroying the contaminants in Alternative 3 (two to three years for ISCO). The cleanup goals established for this interim ROD are used for comparison purposes. The source

reduction RAO is to recover contaminant mass until reaching asymptotic conditions. Alternatives 2 and 3 will similarly contribute to the RAO to mitigate vapor intrusion exposures.

2.10.6 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Technical Feasibility

Both Alternatives 2 and 3 use reliable technologies and conventional, well-understood processes and common mechanical components such as compressors, blowers, and carbon filters. The use of the Vertebrae^{TM} well systems is novel but has been proven to be effective at sites with similar subsurface and access challenges as at the PMC Site. The HDD will allow for remediation under current condominiums with minimal disturbance to the residents. The flexibility of the Vertebrae^{TM} well system will allow other remedies to be implemented at the Site should it be determined that the remedy is not functioning as intended. For example, ISCO could be applied to the existing Vertebrae^{TM} well system, or a combination of treatment technologies could be implemented.

Administrative Feasibility

Alternatives 2 and 3 are expected to have similar administrative feasibility (excluding cost considerations, which are evaluated separately). Both Alternatives treat the source materials. Operation of the constructed treatment system until reaching the RAOs under both Alternatives is not considered operation and maintenance, thus not the sole responsibility of the State of Michigan. Cost for construction and operation of both Alternatives treatment systems would be funded through federal remedial action funding with associated state cost share. Additional VIMS will be installed by EPA under the Interim ROD and the operations and maintenance of these VIMS will be transferred over to the State once they are deemed operational and functional.

Availability of Required Resources

Alternatives 2 and 3 both use resources which are readily available. Both Alternatives use segmented well systems which may limit the number of vendors providing the well systems, however, the HDD for installation of the wells is performed by many drilling companies due to increased use at remedial sites.

2.10.7 Cost

An overview of the cost analysis performed for this evaluation and the detailed breakdowns for each of the alternatives are presented in Appendix C of the FFS report. Total Present Value costs are summarized below:

Alternative 2	Alternative 3
$5.5 million	$5.2 million

2.10.8 State/Support Agency Acceptance

This criterion considers the state's position and key concerns about the preferred alternatives and other alternatives identified in the Proposed Plan.

As the state support agency, the Michigan EGLE supports the selection of Alternative 2 for the Site and has concurred with the Selected Remedy. The State's concurrence letter is provided in Attachment 4 and has been added to the Administrative Record.

2.10.9 Community Acceptance

This criterion considers the community's support of, reservations about, or opposition to the preferred alternatives and other alternatives identified in the Proposed Plan.

Based on the comments received during the public comment period, the community generally expressed support for the preferred remedy for the Site. EPA's response to the public comments is included later in this ROD, in *Part III – Responsiveness Summary*.

2.11 Principal Threat Waste

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water or air, or acts as a source for direct exposure. Contaminated groundwater generally is not considered to be a source material. Source materials may be considered either principal threat wastes or low-level threat wastes. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. Low-level threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of release. Low-level threat wastes include source materials that exhibit low toxicity, low mobility in the environment, or are near health-based levels.

EPA has not identified any principal threat wastes at the Site. Instead, the contaminated groundwater and any source material are considered low-level threat waste materials.

2.12 Selected Remedy

Based on the evaluation of alternatives described in Section 2.10 above and the associated Administrative Record file, EPA has selected Alternative 2: Air Sparge with Soil Vapor Extraction as the Selected Remedy for the Site.

The following major components are included in the Selected Remedy:

- Installation of horizontal AS and SVE segmented wells for source control
- Installation of vertical wells as needed based on the RD
- Installation of the AS/SVE system components

- Operation of the AS/SVE until source control RAO is achieved
- Management of IDW and waste streams
- Monitoring environmental media (groundwater, soil vapor, indoor air, and sewer gas) to evaluate the impact of the selected remedial action and to ensure vapors are not migrating into uncaptured areas
- Installation of VIMS based on sampling data
- Air permit-required sampling and associated reporting
- Institutional and engineering controls (such as signs, fencing, etc.) necessary to protect public safety during construction and, if applicable, operation of the remedy.
- A pre-design investigation with the objective of characterizing the source area in finer details to provide information necessary for designing the source reduction system (AS/SVE). This investigation is anticipated to include soil, soil vapor, and groundwater sampling, MW installation and sampling, and analyses (for VOCs and other parameters such as grain size), and alternative-specific analyses. Additional investigation includes determining if VIMS are needed outside of the source area to mitigate vapor intrusion based on multiple lines of evidence. There are buildings that were never sampled for vapor intrusion due to lack of access and other buildings that need further assessment. Preemptive mitigation will be conducted to ensure health and safety of the building occupants based on subslab and soil vapor sampling results. Some buildings will not allow for the traditional SSDs to be installed due to the building construction and safety. Therefore, building specific information will need to be gathered during the pre-design investigation to engineer the safest and most optimal system to mitigate vapor intrusion.

2.12.1 Summary of Estimated Remedy Costs

The estimated total present worth cost of implementing the Selected Remedy at the Site is $5,500,000. This is based on anticipated capital costs of $3,045,000 and annual operating costs ranging from $65,000 to $495,000. A detailed cost estimate for the Selected Remedy is provided in Table 4. These are order-of-magnitude engineering cost estimates that are expected to be within +50 to -30 percent of the actual project cost. The cost estimate is based on the best available information regarding the anticipated scope of the remedial alternatives. Changes in the cost elements are likely to occur based on new information and data collected during the engineering design of the remedial alternatives. Major changes in the remedial action cost may be documented in the form of a memorandum in the Administrative Record file, an Explanation of Significant Differences, or a ROD amendment.

2.12.2 Expected Outcomes of Selected Remedy

There are two primary objectives for the Selected Remedy: 1) to eliminate the vapor intrusion pathway by reducing COCs to the maximum extent possible at the source area through treatment of the affected media, soil and groundwater; and 2) to preemptively mitigate the current or future human health risk from vapor intrusion in the buildings at the Site based on the site-specific cleanup goals developed for this Interim ROD.

This Interim ROD will be implemented by EPA until the RAO for source reduction is achieved. Because this is performance-based (the RAO is to reduce mass until mass recovered reaches asymptotic conditions or until soil vapor, groundwater, and indoor air all reach the cleanup goals

based on an estimated lifetime cancer risk of 10^{-5} and noncancer hazard quotient of 1) the time frame to complete this remedial action is estimated (five years based on the information obtained from the RI and FFS). The actual time to shut down the system will depend on the soil vapor and groundwater sampling that will be conducted to assess the remedy. Sampling will be conducted on a regular basis (determined during the RD) to calculate the rate at which the COCs are decreasing at the source area. When it is determined that COCs are no longer decreasing, the system will be assessed to determine if optimization is possible, and modifications will be made. The system may also be turned off and sampling will continue to assess any rebound/back diffusion that may occur. Depending upon the amount of rebound/back diffusion, the system may be turned on to further reduce COC concentrations if they are above the cleanup goals presented below. At the completion of the interim remedial action, a performance assessment will be conducted to determine whether additional source remediation is necessary and to address the downgradient groundwater plume which will be documented in a future final ROD for the PMC Site.

After completion of the interim remedial action, land use at the Site is not expected to differ significantly from current land use. Future land use within residential areas is expected to remain the same.

Cleanup Goals

The cleanup goals for this Interim ROD at the PMC Site are the same as the PRGs presented in the June 2022 Proposed Plan and were developed in the same manner as explained in the FFS. PRGs are considered preliminary until cleanup levels are selected in a ROD. Cleanup goals will be used in this Interim ROD for determining when VIMS are necessary at a building and for comparison purposes for the source reduction RAO. The final cleanup levels for the Site will be memorialized in the future final ROD for the PMC Site.

EPA used protective risk-based cleanup goals factoring site-specific conditions into the calculation. Site-specific conditions include shallow groundwater present as some portions of the Study Area and dirt-floor basements and crawlspaces that are present in some buildings. Details on how the cleanup goals were calculated are presented in Appendix A of the FFS.

The main COC for the PMC Site is TCE, however, after the risk assessment was completed, EGLE updated their screening levels and identified several other potential COCs (benzene, ethylbenzene, PCE). The remedy for the Site will treat all VOCs and EPA will monitor the potential COCs along with TCE during implementation of the remedy.

The cleanup goals by media are shown in the table below.

Cleanup Goals[1] for TCE and Potential COCs

Media	Groundwater to vapor[2], µg/L	Soil Gas µg/m^3		Indoor Air[3], µg/m^3
		Near/Subslab Soil Gas, µg/m^3 (full concrete slab present, slab-on-grade or basement)	Dirt Floor Soil Gas, µg/m^3 (dirt floor, no concrete slab or beneath a partial basement slab)	
COC				
TCE	1	70	7	2.1

Media	Groundwater to vapor[2], µg/L	Soil Gas µg/m^3		Indoor Air[3], µg/m^3
		Near/Subslab Soil Gas, µg/m^3 (full concrete slab present, slab-on-grade or basement)	Dirt Floor Soil Gas, µg/m^3 (dirt floor, no concrete slab or beneath a partial basement slab)	
Potential COCs				
Benzene	3.2	120	12	3.6
Ethylbenzene	8.5	374	37.4	11.2
PCE	13.2	1,390	139	41.7

Notes:

1. Cleanup Goals were calculated based on the EPA vapor intrusion screening level (VISL) calculator for indoor air and Site-specific attenuation factors (AFGW = 1 x 10^{-2}; AFSS = 0.3 for dirt floor soil gas; and AFSS = 0.03 for near/subslab soil gas).
2. Groundwater to vapor Cleanup Goals were calculated based on VISL for indoor air and Site-specific groundwater attenuation factor of 1x10^{-2} at a temperature of 9.5°C
3. Indoor air Cleanup Goal was determined using the EPA VISL calculator (EPA 2022) using a hazard quotient of 1.0 and target risk of 1x10^{-5}. The indoor air Cleanup Goal will be used to determine current risk to human health within the building and will not be used solely for the determination on whether a VIMS is necessary or whether VIMS can be discontinued.

AFGW = Attenuation factor for groundwater
AFSS = Attenuation factor for soil gas
µg/L = micrograms per liter
µg/m^3 = micrograms per cubic meter

Anticipated Community Impacts

Implementation of the Selected Remedy will eliminate the vapor intrusion exposure pathway that may currently exist as well as mitigate any future risks to human health by installing the VIMS. Implementation of the Selected Remedy will aide in eventual discontinued use of the SSDs and VIMS by addressing the source of the vapor intrusion. Additionally, remediating the source area is expected to have a positive effect on the downgradient groundwater plume and help achieve aquifer restoration. Potential short-term impacts during implementation of the remedy are discussed in Section 2.10.5.

2.13 Statutory Determinations

Under CERCLA § 121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the toxicity, mobility, or volume of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the Selected Remedy meets these statutory requirements.

Protection of Human Health and the Environment

The Selected Remedy provides overall protection of human health and the environment from impacted soil vapor contamination volatilizing into indoor air. Protection of human health and

the environment will be achieved through installation of VIMS and this Interim ROD will treat low-level threat waste until a final ROD is established for the Site. The Selected Remedy will reduce exposure levels to protective ARAR- or risk-based cleanup levels, reducing risks to within EPA's generally acceptable risk range of 10^{-4} to 10^{-6} for carcinogenic risk and below the HI of 1 for non-carcinogens. The Selected Remedy also will provide adequate protection of the environment.

No unacceptable short-term risks are anticipated by implementation of the remedy. Some short-term risks (such as increased traffic, general construction, noise, etc.) will be created, but these risks can be minimized through proper mitigative measures during construction. EPA intends to work with the local community and property owners in developing a plan that would strive to minimize adverse impacts related to noise and traffic during the cleanup. In addition, no adverse cross-media impacts are expected from the Selected Remedy.

Compliance with Applicable or Relevant and Appropriate Requirements
The Selected Remedy will comply with all federal and state ARARs. The ARARs are presented in detail in Table 3. Table 3 also includes "to be considered" information that does not constitute ARARs but that will be appropriately considered during implementation of the remedy.

Cost-Effectiveness
The Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." (NCP § 300.430(f)(1)(ii)(D)). This was accomplished by evaluating the "overall effectiveness" of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness. The relationship of the overall effectiveness of the Selected Remedy was determined to be proportional to its estimated present worth cost of $5,500,000, so the Selected Remedy represents a reasonable value for the money to be spent and is cost-effective. The Selected Remedy provides the greatest effectiveness proportional to its cost as compared to the other alternatives that meet all threshold criteria.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable
This is an Interim ROD to address the risks posed by vapor intrusion. The VIMS are not permanent solutions but will protect human health and the environment while working toward achieving final cleanup levels in a future final ROD for the PMC Site. The Selected Remedy does utilize treatment technologies to reduce contamination at the source however, a permanent solution will be included in a final ROD which addresses not only the vapor intrusion pathway but the aquifer restoration downgradient of the source. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that the Selected Remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and bias against off-site treatment and disposal and considering State and community acceptance.

The Selected Remedy treats the source of vapor intrusion (soil vapor, soil, and groundwater), providing a solution for reducing the source of contamination for the low-level threat waste at the Site and does not present short-term risks different from the other alternative. Any current or future human health risk will be mitigated by installation of the VIMS. It is anticipated any implementability concerns at the Site will be addressed during the design phase.

Preference for Treatment as a Principal Element
The Selected Remedy for this Interim ROD satisfies the statutory preference for treatment as a principal element of the remedy (i.e., treatment to reduce the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants is a principal element of the remedy), although not a permanent solution. The preference for treatment will also be evaluated in the future final ROD.

Five-Year Review Requirements
Because this remedy may result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of the interim remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

2.14 Documentation of Significant Changes

The Proposed Plan for the PMC Site was released for public comment in June 2022. The Proposed Plan identified Alternative 2 as the Preferred Alternative. EPA reviewed all written and verbal comments submitted during the public comment period. It was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

PART III – RESPONSIVENESS SUMMARY

In accordance with CERCLA Section 117, 42 U.S.C. Section 9617, EPA released the Proposed Plan and Administrative Record for the PMC Site on June 22, 2022, and held a public comment period from June 22, 2022, through July 22, 2022, to allow interested parties to comment on the Proposed Plan. Due to COVID-19 restrictions, EPA held a virtual-format public meeting on June 29, 2022, instead of an in-person public meeting, to avoid in-person contact. EPA made this decision in accordance with the Centers for Disease Control guidance urging the postponement of mass gatherings. In addition, EPA posted an online, pre-recorded presentation describing the Proposed Plan. The presentation was available to the public throughout the comment period and contained the same information that would have been presented during an in-person meeting.

This Responsiveness Summary provides both a summary of the public comments EPA received regarding the Proposed Plan and EPA's response to those comments. EPA received written comments via the comment form available on EPA's web page, via handwritten mailed correspondence, via electronic mail, and via voicemail recordings. EPA received a total of seven comments from citizens of which three needed additional clarification and responses.

EPA is required by law to consider and address only those comments that are pertinent and significant to the remedial action being selected. EPA is not required to address comments that pertain to the allocation of liability for the remedial action nor potential enforcement action to implement the remedial action, as these matters are independent of the selection of the remedial action and EPA's Proposed Plan. Additionally, EPA is not required to reprint verbatim the comments received and may paraphrase where appropriate. In this Responsiveness Summary, EPA has included large segments of the original comments. However, persons wishing to see the full text of the comments should refer to the commenters' submittals to EPA, which have been included in the Administrative Record. A written transcript of the virtual public meeting is also included in the Administrative Record. The Administrative Record index is provided in Attachment 3.

Public Comments and EPA Responses

1) One commenter questioned whether the air sparging could cause contamination upgradient of the current groundwater plume due to the high pressure of air being injected in the groundwater.

EPA Response: EPA's Selected Remedy includes air sparging where EPA currently estimates that the injection capacity will deliver up to 175 standard cubic feet per minute (scfm) of air flow which will equate to approximately 0.65 scfm per foot of screen. While EPA does not expect any groundwater plume movement due to this amount of air being injected into the groundwater, it cannot be completely ruled out. Therefore, groundwater sampling as well as soil vapor sampling will be conducted during the startup of the system to ensure contaminants are being contained. EPA consulted some experts that have installed these types of systems at various sites for over 30 years and they have not observed plume migration due to air sparging.

2) One commenter asked whether EPA could provide information on residents' feedback from other sites that have used this type of remediation, specifically in regards to the noise, testing procedures, and effectiveness.

EPA Response: AS/SVE systems are relatively common technologies used to treat contaminated

groundwater and soil for VOCs. Hundreds of sites across the country have utilized this technology to great success, reducing VOC concentrations to acceptable levels. However, each site is unique due to the varying subsurface materials and therefore the length of time required to run the system will differ for every site. Currently EPA estimates that the system for the PMC Site will run for five years, however, that may change once the remedy is implemented. In Region 5, we have not received specific feedback from residents regarding this type of remediation.

Though EPA cannot eliminate all noise generated from running the system, option**s** to reduce the noise level will be explored and implemented such as choosing quieter blowers, noise reduction materials to be installed inside the system building, using silencing components to the intakes and exhaust of the blowers, etc.

In regards to the sampling procedures for the vapor intrusion (i.e., subslab and indoor air sampling) and monitoring the effectiveness of the remedy, EPA currently anticipates that sampling procedures will remain the same as during the investigation. Sampling was conducted utilizing evacuated stainless-steel canisters that are left inside the building for 24 hours to collect indoor air samples or the canisters connected to a subslab sampling port to draw air from beneath the structure. However, as more information is obtained and technologies are developed, different methods of sampling may be utilized to minimize disturbance to building occupants. EPA anticipates increased sampling of buildings in the Study Area during the startup of the system to ensure there are no adverse effects (i.e., no increased vapor intrusion). Once confirmation is received that the system is operating as intended, the sampling frequency will be reduced. The proposed frequency of sampling will be determined during the RD.

3) One commenter questioned if the current mitigation systems will be removed once the project is completed or if the systems need to stay in place and the homeowner be responsible for maintenance of these systems.

EPA Response: The mitigation systems will be shut down and removed once the threat for vapor intrusion has been removed. In other words, the soils and groundwater would need to be remediated to the cleanup level, determined in a future final ROD, that will not pose a risk to human health or the environment. The systems are currently being maintained by the State who will continue to do so until the systems can be shut down. Additional VIMS will be installed by EPA under the Interim ROD and the operations and maintenance of these VIMS will be transferred over to the State once they are deemed operational and functional.

ATTACHMENT 1:
FIGURES

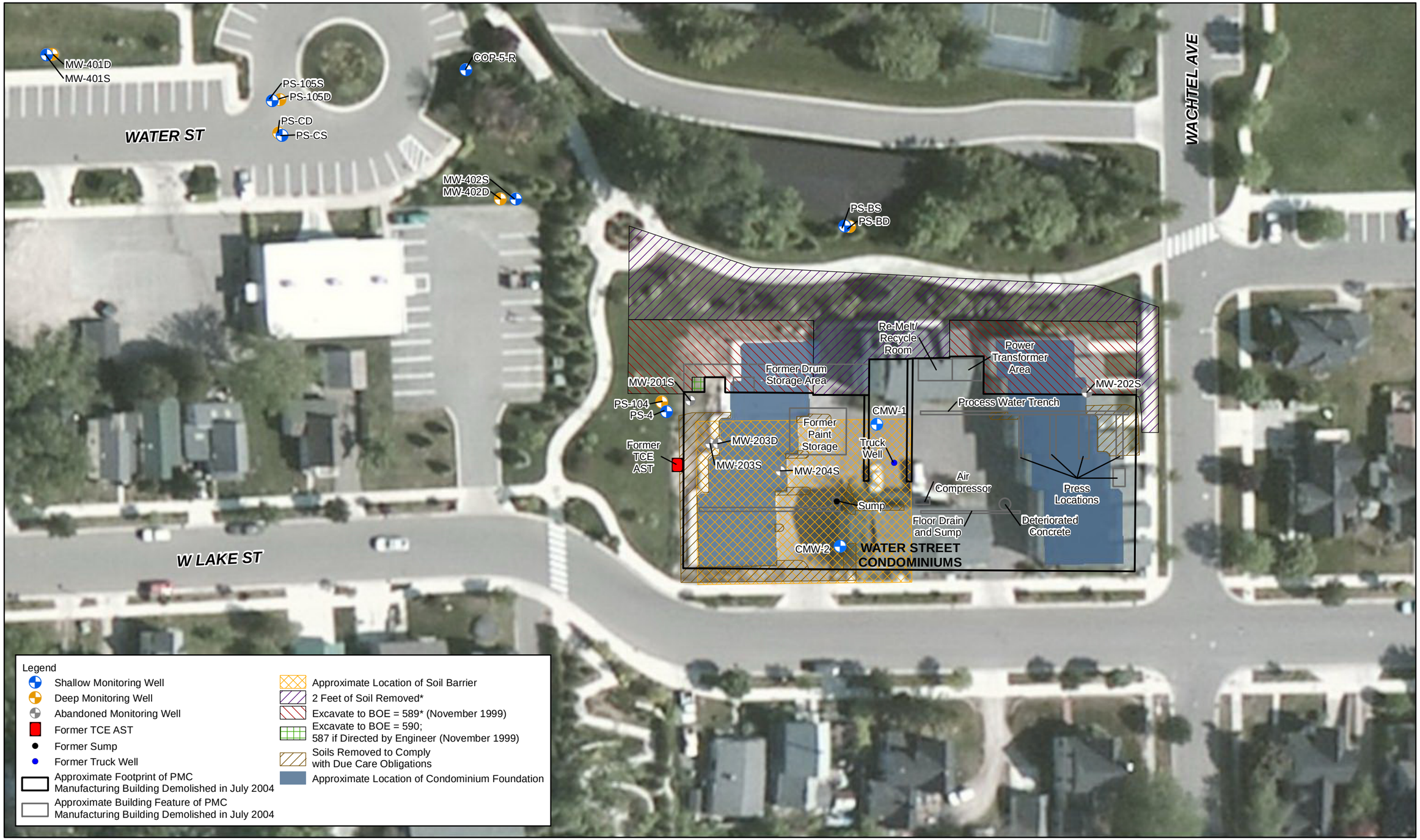
0 100 200
Feet

N

Figure 1
Site Location Map
Focused Feasibility Study
PMC Groundwater Superfund Site
Petoskey, Michigan

ch2m

\\BROOKSIDEFILES\GIS_SHARE\ENBG\00_PROJ\E\EPA\407664_PMC\MAPFILES\2019_REQUESTS\FFS\FIG01-01_PMC_SITE LOCATION MAP_FFS.MXD MPETERSH 6/5/2019 3:12:13 PM



0 50
Feet

N

Notes:
1. Abandoned monitoring well locations and "soils to be removed to comply with due care obligations" based on ***Due Care and Demolition Summary Report*** (Perazza Products, LLC. November 2004).
2. *Soil areas based on Soil Excavation Plan (Tetra Tech EM Inc. July 1999); all other excavations occurred in 2004.
3. Former TCE AST based on page 23 of ***BEA*** (EC&S, Inc. November 2003).
4. Condominium foundation area based on ***200 W. Lake Street Condominiums Units 9-14*** foundation plan (Oppenhuizen Architects, August 2013).
5. Features within Former PMC Building based on ***Soil Sample Location Map*** (Environmental Solutions Inc., December 13, 2001) and table in Section 4 Report (December 14, 2001).
6. Locations are approximate.
7. TCE = Trichloroethene
8. AST = Above-ground Storage Tank

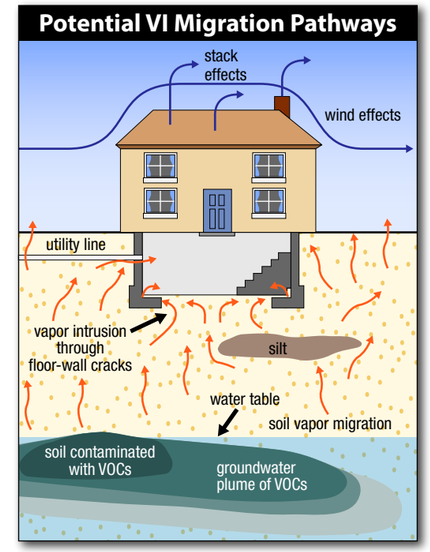
Figure 2
Excavation History and Former Building Features Overlaid on Current Buildings
Focused Feasibility Study
PMC Groundwater Superfund Site
Petoskey, Michigan

ch2m.

\\DC1VS01\GISPROJ\E\EPA\407664_PMC\MAPFILES\2020_REQUESTS\UPDATEDTARGETTREATMENTZONE\MAPFILES\FIG01-02_PMC_EXCAVATION HISTORY AND FORMER BUILDING FEATURES OVERLAID ON CURRENT BUILDINGS_FFS.MXD MPETERSH 1/12/2021 2:48:10 PM

Legend

- Fill - Dark brown to black fine grained sand with gravel and occasional trace clay
- Silt and Sand with Gravel
- Sand and gravel, primarily weathered limestone
- Gravel
- Friable limestone with lacustrine sand and gravel
- Silty Sand
- Gravelly silt and clay
- Limestone Bedrock
- Soil Removal*
- TCE Plume
- Hydraulic influence of Lake Michigan
- Residual TCE
- Underground Utility
- Water and Sewer Lines with Backfill
- Generalized Groundwater Elevation
- Potential Vapor Migration
- Deep Monitoring Well
- Shallow Monitoring Well
- No net advective flow

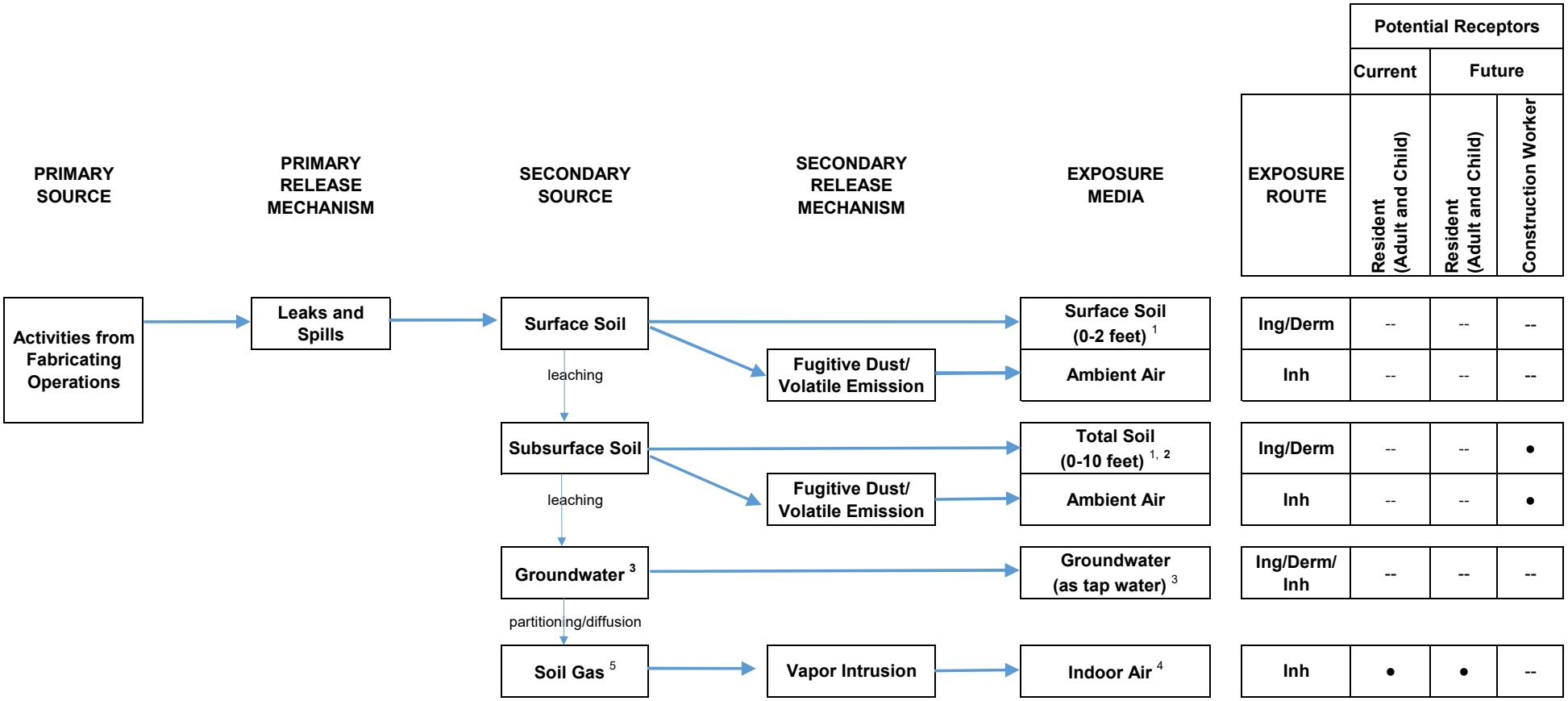


Notes:
* Soil Removal Area is approximate to show some level of source removal. The volume removed is not accurately presented on this figure and is conceptual.
VOCs - volatile organic compounds
TCE - trichloroethene
ft AMSL - feet above mean sea level

PMC_CSM_v7.ai 11-29-2018 DCD

FIGURE 3
Conceptual Site Model
Remedial Investigation
PMC Groundwater Superfund Site
Petoskey, Michigan

ch2m



Notes:
-- Negligible or Incomplete Pathway
● Potentially Complete Pathway to be Evaluated
Ing - Ingestion, Der - Dermal, Inh - Inhalation
1) Soil exposures by residents at the condominium complex are insignificant and will not be quantified.
2) Future soil exposures are evaluated for total soil, assuming surface and subsurface soil become mixed during future development activities. Construction worker exposures to total soil will be evaluated as one exposure unit.
3) Groundwater was evaluated in a previous remedial investigation.
4) Indoor air/crawl space air data will be used to evaluate current exposure scenarios at a property. Subslab soil vapor data (or if not available, exterior soil vapor data) will be used to evaluate future exposure scenarios at a property. For properties where indoor air/crawl space air data were not collected, subslab soil vapor data (or exterior soil vapor data) will be used to evaluate both current and future indoor air exposure scenarios.
5) Buildings with subslab depressurization systems will not be evaluated in the HHRA.

FIGURE 4
HHRA Conceptual Exposure Model
PMC Superfund Site
Petoskey, Emmet County, Michigan

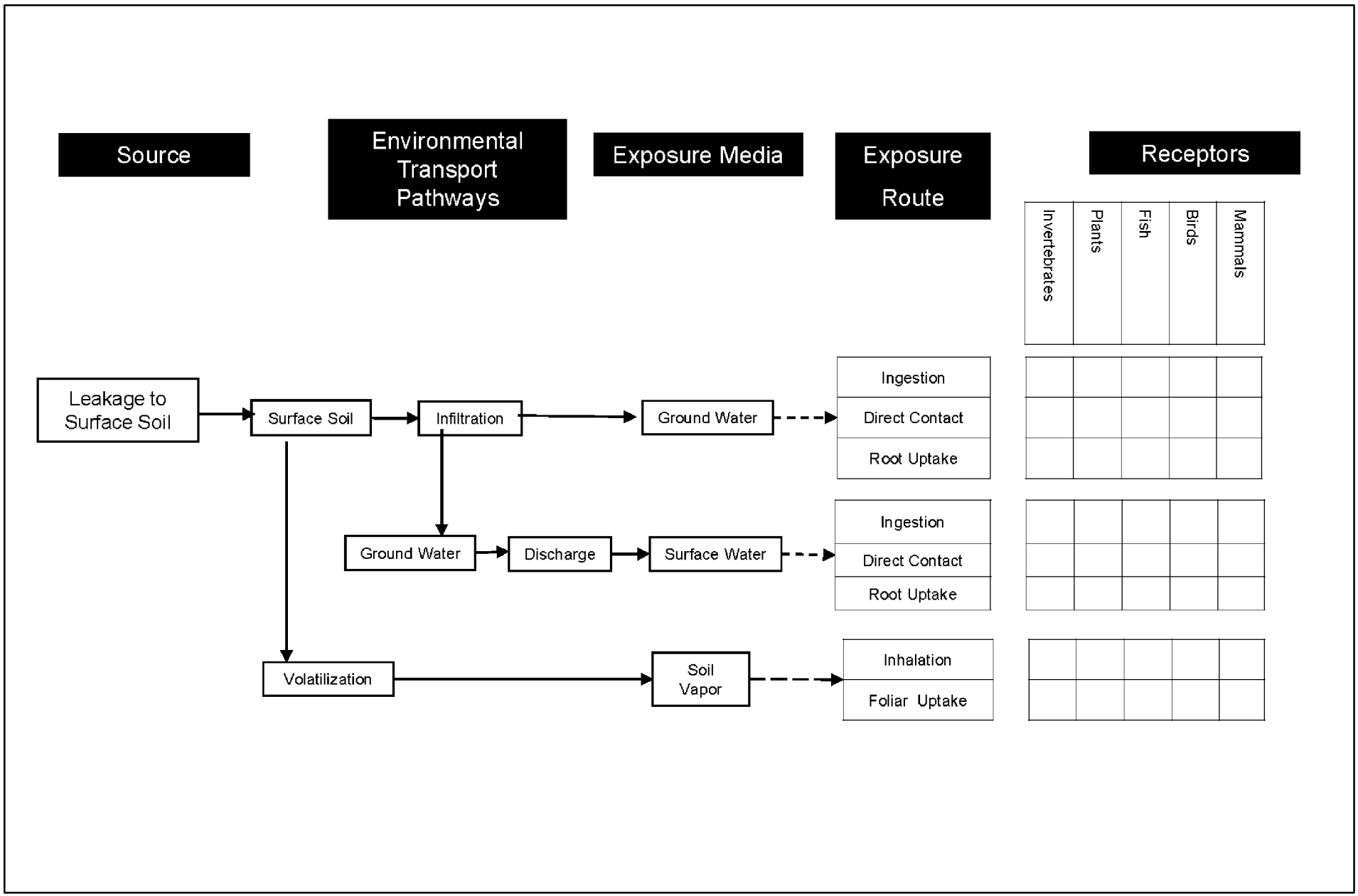


Figure 5
Ecological Risk Assessment From
Remedial Investigation
PMC Groundwater Superfund Site
Petoskey, Michigan

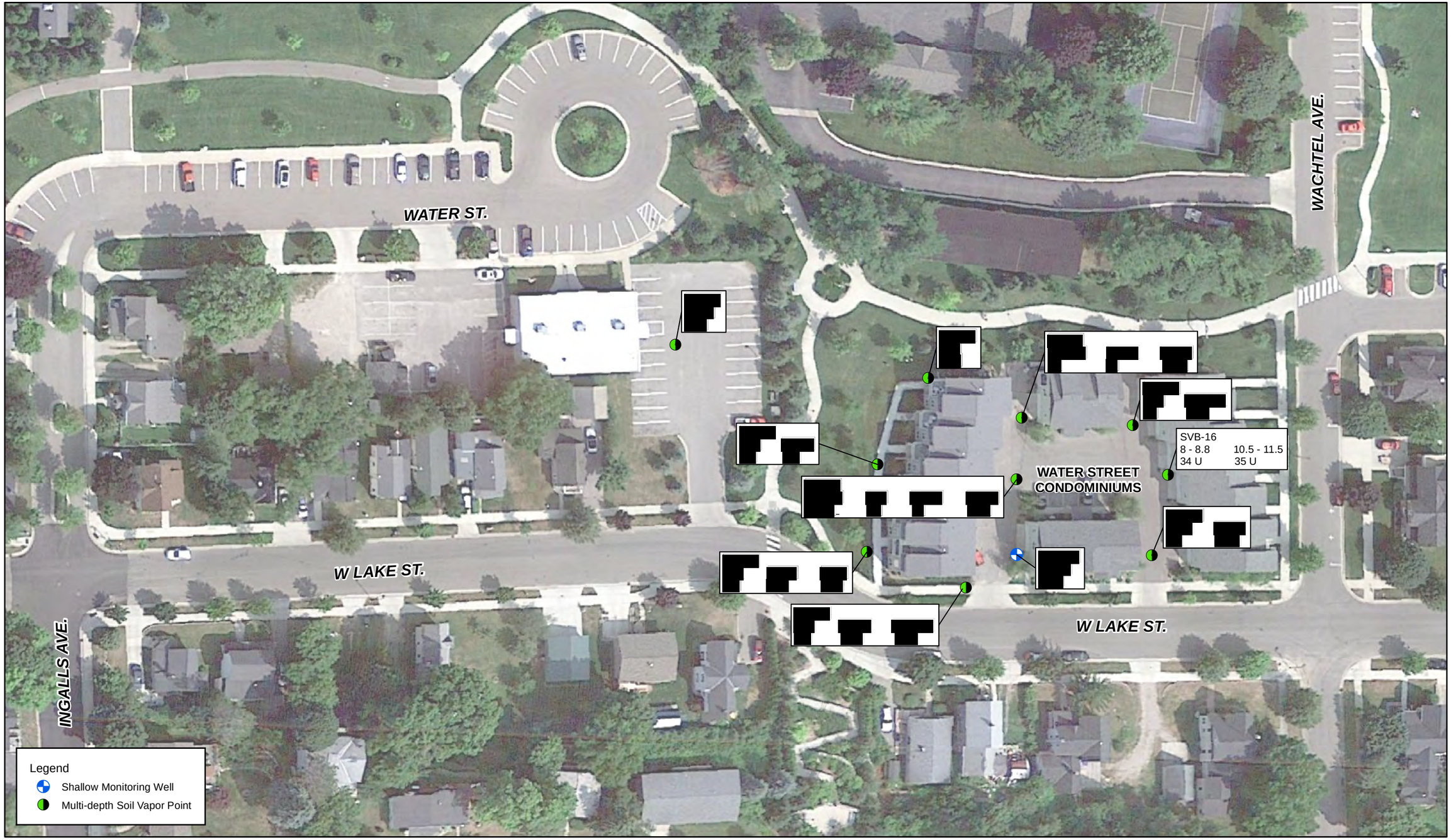
Notes:
All concentrations are in µg/L.
All depths are in feet below ground surface.
µg/L = micrograms per liter
EPA = U.S. Environmental Protection Agency
MDEQ = Michigan Department of Environmental Quality
TCE = trichloroethene
TCR = target cancer risk
THQ = target hazard quotient

J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the action limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

1. The EPA tap water regional screening levels (RSLs; EPA, November 2017) are based on a TCR of 1×10^{-6} and a THQ of 1. Exceedances of this criterion are bold.
2. The EPA residential groundwater vapor intrusion screening levels (VISLs) were developed from the EPA VISL calculator using the November 2017 EPA RSLs. The VISLs were calculated based on a TCR of 1×10^{-6} and a THQ of 1. Exceedances of this criterion are shaded grey.
3. The MDEQ residential shallow groundwater media-specific volatilization to indoor air recommended interim action screening levels (RIASLs; MDEQ, August 2017). Exceedances of this criterion are underlined.

Figure 6
TCE Results in Groundwater
Focused Feasibility Study
PMC Groundwater Superfund Site
Petoskey, Michigan

ch2m.



N

0 60 120

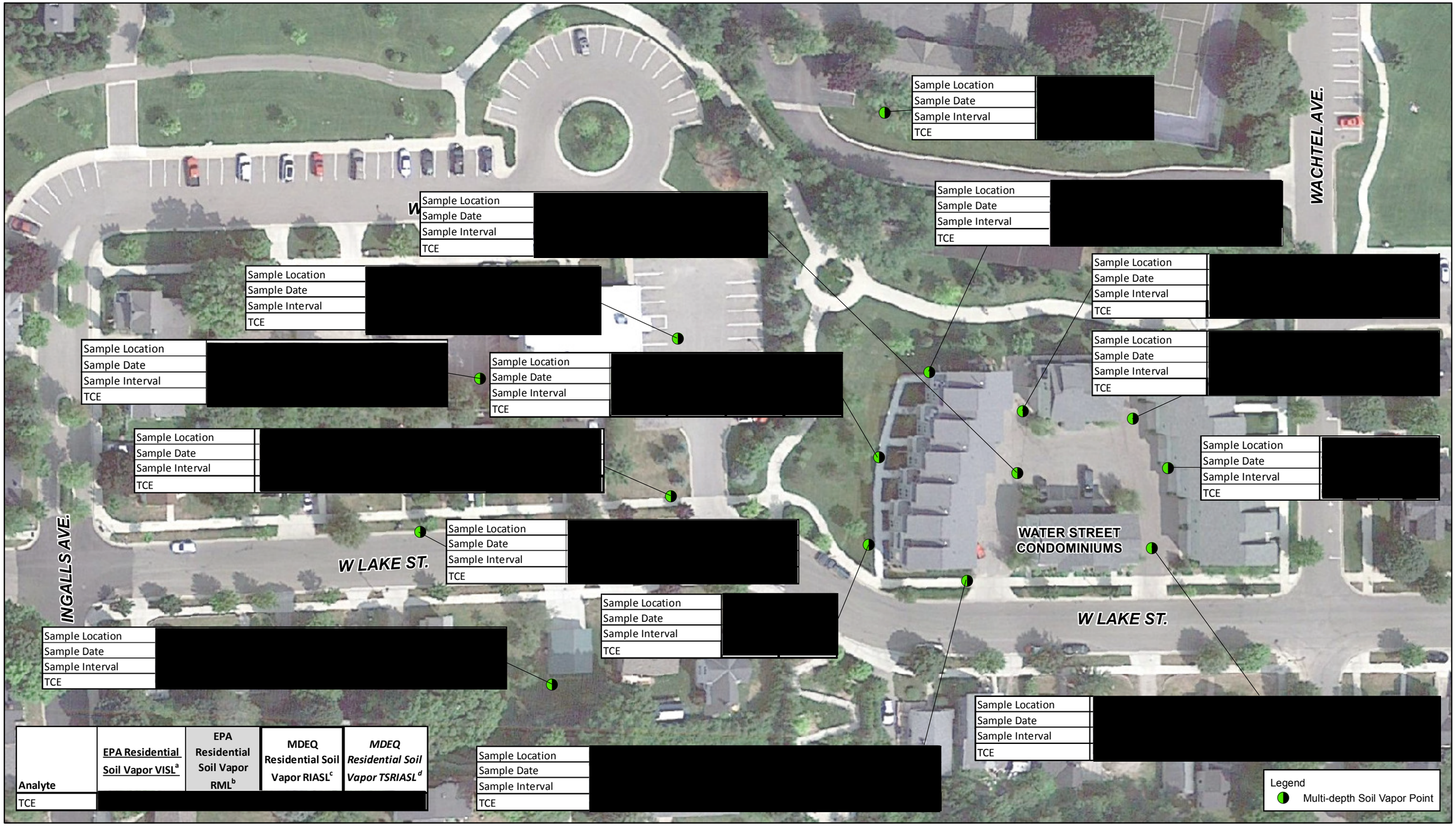
Feet

Notes:
All concentrations are in µg/kg.
All depths are in feet below ground surface.
µg/kg = micrograms per kilogram
EPA = U.S. Environmental Protection Agency
MDEQ = Michigan Department of Environmental Quality
NA = compound not reported by the laboratory
TCE = Trichloroethene
TCR = target cancer risk
THQ = target hazard quotient

J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
1. The EPA Residential Soil Regional Screening Levels (RSLs; EPA, November 2017) are based on a TCR of 1 × 10-6 and a THQ of 1. Exceedances of this criterion are underlined.
2. The MDEQ Residential Volatilization to Indoor Air Criteria are unrestricted site-specific criteria that apply to a residential house with a basement in Emmet County, a site-specific depth to groundwater of 13 feet, and USDA soil type of sand. In accordance with Sec. 20120a(10), because the target detection limit (TDL) for TCE is greater than the cleanup criterion, the criterion is the TDL (50 µg/kg). Exceedances are bold.

Figure **7**
TCE Results in Soil
Focused Feasibility Study
PMC Groundwater Superfund Site
Petoskey, Michigan

ch2m:



Analyte	EPA Residential Soil Vapor VISL[a]	EPA Residential Soil Vapor RML[b]	MDEQ Residential Soil Vapor RIASL[c]	*MDEQ Residential Soil Vapor TSRIASL[d]*
TCE				

0 60 120
Feet
N

Notes:
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
MDEQ = Michigan Department of Environmental Quality
MDL = method detecton limit
RL = reporting limit
Sample Intervals are in feet below ground surface
TCE = Trichloroethylene
Results are presented in µg/m3
TCR = target cancer risk
THQ = target hazard quotient
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
Only sampled locations presented on this figure

µg/m3= micrograms per cubic meter
EPA = US Environmental Protection Agency
[a] The EPA residential soil vapor vapor intrusion screening levels VISL) were developed from the EPA VISL Calculator using the November 2017 EPA regional screening level. The VISLs were calculated based on a TCR = 1 x 10^{-6} and a THQ = 1. Use of an attenuation factor of 0.03 for screening sewer gas is a default in the absence of established guidance, and is based on the assumption that similar ratio of soil gas entry rate (Qsoil) vs. overall building ventilation rate (QB) would hold similarly for sewer gas and for subslab soil vapor. Exceedances of this criteria are bold and underlined.
[b] The EPA residential soil vapor removal management level (RML) was developed from the EPA VISL Calculator using the November 2017 EPA Regional Screening Levels. The RML was calculated based on a TCR = 1 x 10^{-5} and a THQ = 3, except for TCE where a THQ =1 was used.

Use of an attenuation factor of 0.03 for screening sewer gas is a default in the absence of established guidance, and is based on the assumption that similar ratio of soil gas entry rate (Qsoil) vs. overall building ventilation rate (QB) would hold similarly for sewer gas and for subslab soil vapor. Exceedances of this criterion are shaded grey.
[c] The MDEQ Residential Volatilization to Indoor Air Criteria (VIAC) are unrestricted site-specific criteria that apply to a residential house with a basement located in Emmet County, the depth to groundwater submitted for this site (i.e. 13 ft), and USDA soil type of sand.

Figure 8
TCE Results in Exterior Soil Vapor
Remedial Investigation
PMC Groundwater Superfund Site
Petoskey, Michigan

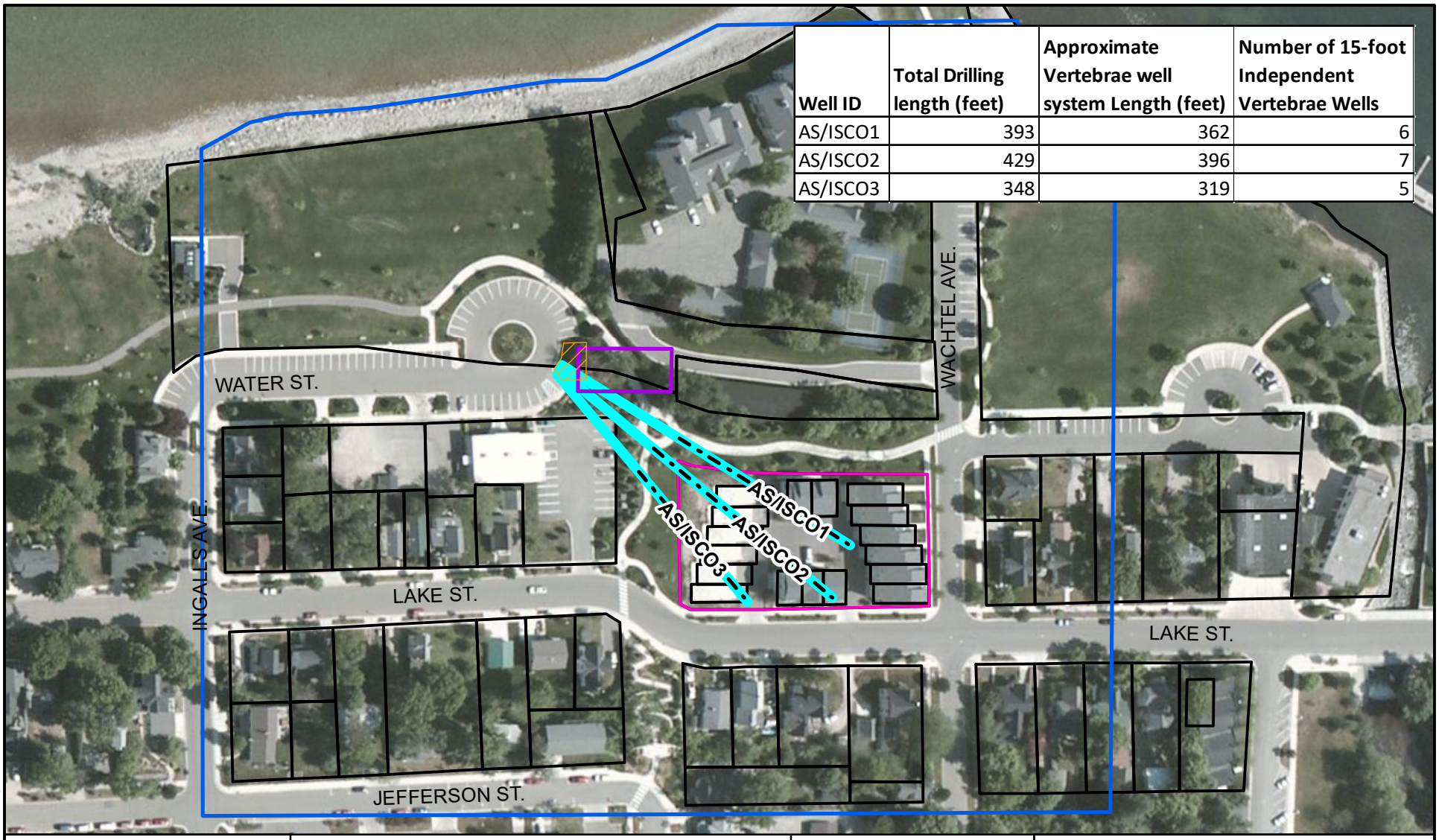
Notes:
All concentrations are in µg/m^3
µg/m^3 = micrograms per cubic meter
EPA = U.S. Environmental Protection Agency
MDEQ = Michigan Department of Environmental Quality
MDL = method detection limit
RL = reporting limit
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

[a] The EPA residential soil vapor vapor intrusion screening levels (VISLs) were developed from the EPA VISL Calculator using the November 2017 EPA regional screening levels.
The VISLs were calculated based on a TCR = 1 x 10-^{6} and a THQ = 1. Use of an attenuation factor of 0.03 for screening sewer vapor is a default in the absence of established guidance, and is based on the assumption that similar ratio of soil vapor entry rate (Qsoil) vs. overall building ventilation rate (QB) would hold similarly for sewer vapor and for subslab soil vapor. Exceedances of this criteria are bold and underlined

[b] The EPA residential soil vapor removal management levels (RMLs) were developed from the EPA VISL Calculator using the November 2017 EPA Regional Screening Levels. The RMLs were calculated based on a TCR = 1 x 10-^{4} and a THQ = 3, except for TCE where a THQ =1 was used. Use of an attenuation factor of 0.03 for screening sewer vapor is a default in the absence of established guidance, and is based on the assumption that similar ratio of soil vapor entry rate (Qsoil) vs. overall building ventilation rate (QB) would hold similarly for sewer vapor and for subslab soil vapor. Exceedances of this criteria are shaded grey.

[c] The MDEQ Residential Volatilization to Indoor Air Criteria (VIAC) are unrestricted site-specific criteria that apply to a residential house with a basement located in Emmet County, the depth to groundwater submitted for this site (i.e. 13 ft), and USDA soil type of sand. Exceedances of this criteria are bold boxed.

Figure 9
TCE Results in Sewer Gas
Focused Feasibility Study
PMC Groundwater Superfund Site
Petoskey, Michigan



Well ID	Total Drilling length (feet)	Approximate Vertebrae well system Length (feet)	Number of 15-foot Independent Vertebrae Wells
AS/ISCO1	393	362	6
AS/ISCO2	429	396	7
AS/ISCO3	348	319	5

Legend

- Approximate location of AS/SVE Equipment Building
- Laydown Area
- HDD Bore Path
- Vertebrae Well Segment
- Study Area
- Parcel Boundary/Target Treatment Zone
- Parcel Boundary

Notes:
ISCO - In situ chemical oxidation
AS - air sparging

N

100 0 100

Feet

PMC Groundwater Site
Petoskey, Emmet County, MI

Figure 10

AS/ISCO Layout

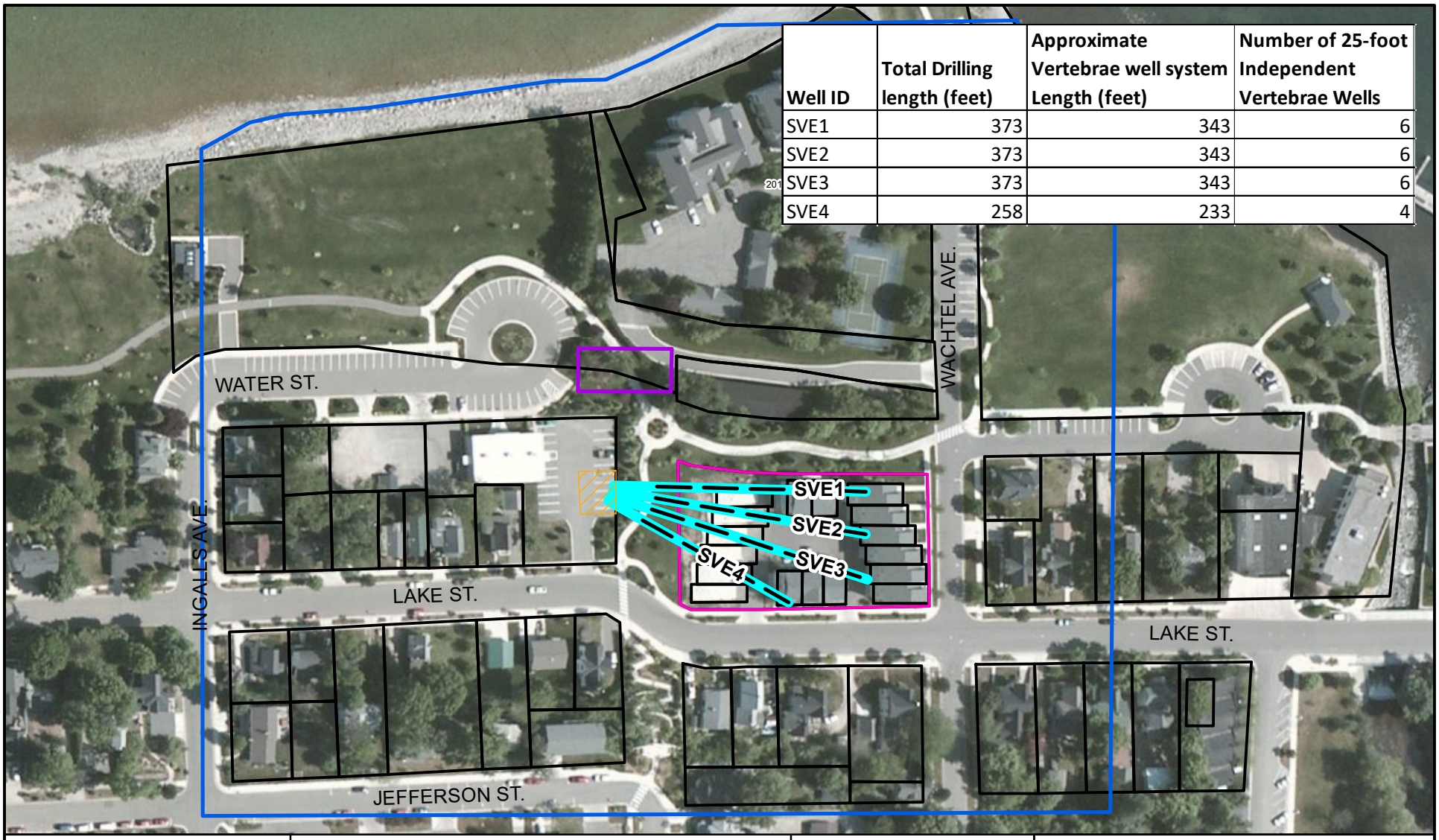
TETRA TECH

Prepared For: EPA | Prepared By: Tetra Tech Inc.

File Path: C:\Users\andrew.prestridge\Desktop\Chicago\PMC GW\Fig4-2.mxd

Date Saved: 9/15/2021 EPA Contract No.: 68-HE-0519-D0005 TO-TOLIN: F0072-0001CC103

Coordinate System: NAD 1983 StatePlane Michigan North FIPS 2111 Feet Projection: Lambert Conformal Conic Datum:North American 1983 Units: Foot US



Well ID	Total Drilling length (feet)	Approximate Vertebrae well system Length (feet)	Number of 25-foot Independent Vertebrae Wells
SVE1	373	343	6
SVE2	373	343	6
SVE3	373	343	6
SVE4	258	233	4

Legend

- Approximate location of AS/SVE Equipment Building
- Laydown Area
- HDD Bore Path
- Vertebrae Well Segment
- Study Area
- Parcel Boundary
- Parcel Boundary/Target Treatment Zone

Notes:
SVE - soil vapor extraction
AS - air sparging

N

100 0 100

Feet

PMC Groundwater Site
Petoskey, Emmet County, MI

Figure 11

SVE Layout

TETRA TECH

Prepared For: EPA | Prepared By: Tetra Tech Inc.

File Path: C:\Users\andrew.prestridge\Desktop\Chicago\PMC GW\Fig4-3.mxd

Date Saved: 9/15/2021 | EPA Contract No.: 68-HE-0519-D0005 | TO-TOLIN: F0072-0001CC103

Coordinate System: NAD 1983 StatePlane Michigan North FIPS 2111 Feet Projection: Lambert Conformal Conic Datum:North American 1983 Units: Foot US

ATTACHMENT 2:
TABLES

Table 1 - Summary of Media/Receptor COCs
PMC Groundwater Site, Petoskey, MI

Future Resident - Indoor Air Exposure (from Subslab Soil Vapor)

Location[1]	ELCR COCs	Adult Target-Organ-Specific HI COCs	Child Target-Organ-Specific HI COCs
WSC Z	None	TCE (HIs = 6)	TCE (HIs = 6)
WSC Y	None	TCE (HIs = 4)	TCE (HIs = 4)
WSC X	None	TCE (HIs = 2)	TCE (HIs = 2)
Property 40	None	TCE (HIs = 4)	TCE (HIs = 4)

Notes

[1] Exact location is hidden to protect privacy

COCs = contaminants of concern

ELCR = excess lifetime cancer risk

HIs = hazard indices

TCE = trichloroethylene

WSC = Water Street Condominium

Table 2 - Remedy Selection Criteria Evaluation
PMC Groundwater Site, Petoskey, MI

Criteria		Alternative 2 AS/SVE	Alternative 3 ISCO/SVE
Threshold Criterion *Overall Protection of Human Health and the Environment*	Description of Ability to meet criterion	- Protects human health and environment by stripping VOCs from groundwater and capturing them with an SVE system. The captured air would be treated before discharge to the atmosphere - Additional mitigation systems would be installed throughout the Study Area - Existing SSDs would operate until cleanup levels are met - SVE should help mitigate VI issues.	- Protects human health and environment by treating VOCs in groundwater in situ and does not generate off-gas - Existing SSDs would operate until cleanup levels are met - SVE should help mitigate VI issues.
	Score (Pass or Fail)	Pass	Pass
Threshold Criterion *Compliance with ARARs*	Description of Ability to meet criterion	- Complies with chemical-specific ARARs by reducing the concentrations through airstripping/volatilization, SVE, and treatment of extracted vapors. - Location-specific and action-specific ARARs, including but not limited to well installation, subsurface injections, potential air emissions, and waste handling, would be complied with throughout implementation.	- Complies with chemical-specific ARARs by reducing the concentrations through chemical oxidation and SVE. Potential risks associated with handling oxidants would be mitigated. - Location-specific ARARs and action-specific ARARs, including well installation, subsurface injections, and waste handling, would be complied with throughout implementation.
	Score (Pass or Fail)	Pass	Pass
Balancing Criterion *Long-Term Reliability and Effectiveness*	Description of Ability to meet criterion	- Proven and reliable technology for treating VOCs. VOCs stripped and volatized from the groundwater by AS would be permanently removed from the subsurface through SVE wells. - Existing SSDs would continue to operate until cleanup levels are met. - SVE may mitigate VI issues and potentially reach RAOs sooner, which would reduce the required timeframe for continuing to operate mitigation systems. - There is potential risk to the community associated with the SVE wells not adequately capturing the stripped VOCs and the possibility that VI issues could worsen.	- Proven and reliable technology for treating VOCs. - VOCs captured through SVE would be permanently removed from the subsurface. - No rebound from groundwater would be expected once goals are achieved. - Existing SSDs would continue to operate until cleanup goals are met. - SVE may mitigate VI issues and potentially reach RAOs sooner, which would reduce the required timeframe for continuing to operate mitigation systems. - Due to the lack of net advective groundwater flow, there is uncertainty in the volume of the groundwater plume that can be treated, making this alternative less reliable than Alternative 2. Additional extraction wells or recirculation wells are needed to optimize this Alternative.
	Score (0 low, 4 high)	4	3
Balancing Criterion *Reduction of Toxicity, Mobility, or Volume through Treatment*	Description of Ability to meet criterion	- Would reduce toxicity and volume of the plume at the source through AS processes. - Would treat soil vapor and vadose zone mass similar to Alternative 3.	- Due to the lack of net advective groundwater flow, additional extraction wells or recirculation wells would need to be installed to optimize Alternative 3. If the oxidance is not able to make contact with contaimantion, diffusion over time will be required to meet RAO. - Treatment of soil vapors and vadose zone mass is similar to Alternative 2.
	Score (0 low, 4 high)	4	3
Balancing Criterion *Short-Term Effectiveness*	Description of Ability to meet criterion	- Would involve impacts to residences but same amount as Alternatives 3. - Once the AS/SVE system is operational, noise associated with equipment operation may persist. All methods to reduce the noise level will be explored and implemented to the extent practical. - Existing SSDs and any new VIMS would continue to operate until cleanup levels are achieved, requiring annual monitoring to verify operation and correct any issues that are observed, therefore disturbing homeowners. - The SVE component may help mitigate VI issues and potentially meet RAOs quicker, thereby reducing the required timeframe for continuing to operate the SSD. - There is potential risk to the community associated with SVE wells not adequately capturing the stripped VOCs and possibly increasing VI issues, resulting in the need to install additional mitigation systems within the Study Area.	- Would involve impacts to residences but same amount as Alternative 2. - Once the SVE system is operational, noise associated with equipment operation may persist. All methods to reduce the noise level will be explored and implemented to the extent practical. - Due to the lack of net advective groundwater flow, extraction wells or recirculation wells are necessary to move the oxidant through the contaminated groundwater. - Existing SSDs and any new VIMS would continue to operate until cleanup levels are achieved, requiring annual monitoring to verify operation and correct any issues that are observed, therefore disturbing homeowners. - The SVE component may help mitigate VI issues and potentially meet RAOs quicker, thereby reducing the required timeframe for continuing to operate the VIMS. - There is potential risk to the community associated with SVE wells not adequately capturing the stripped VOCs and possibly increasing VI issues, resulting in the need to install additional mitigation systems within the Study Area.
	Score (0 low, 4 high)	4	4
Balancing Criterion *Implementability*	Description of Ability to meet criterion	- AS/SVE systems are reliable technologies and use conventional, well-understood processes. The segmented well system is more novel but has been proven to be effective at similar sites. The segmented well systems will allow for change in technology in the future if remedy changes are necessary	- ISCO and SVE systems are reliable technologies and use conventional, well-understood processes. The segmented well system is more novel but has been proven to be effective at similar sites. The segmented well systems will allow for change in technology in the future if remedy changes are necessary
	Score (0 low, 4 high)	4	4

Table 2 - Remedy Selection Criteria Evaluation
PMC Groundwater Site, Petoskey, MI

Criteria		Alternative 2 AS/SVE	Alternative 3 ISCO/SVE
Balancing Criterion *Cost* *(Class 4 Feasibility Range -30/+50%)*	Description of Ability to meet criterion	NPV: $3.8 to $8.2M Costs are comparable with Alternative 3.	NPV: $3.6M to $7.7M Costs are comparable with Alternative 2.
	Score (0 low, 4 high)	3	4
Modifying Criterion *State and Community Acceptance*	Description of Ability to meet criterion	-EPA received formal comments from seven citizens who all but one supported Alternative 2 -State of Michigan concurrs with EPA's preferred remedy, Alterntive 2	-EPA did not receive any support from the community for Alternative 3 during the public coment period -State of Michigan concurrs with EPA's preferred remedy, Alternative 2, but is not opposed to Alternative 3
	Score (0 low, 4 high)	4	1
	TOTAL SCORE	**23**	**19**

Notes:

Alternative 1, No Action, was identified and carried through the evaluation process as a point of comparison. As this Interim ROD is directed towards selection of appropriate remedial responses that can reasonably be expected to achieve the stated RAOs, Alternative 1 was not included in this table.

Threshold Criteria 1 and 2, Overall Protection of Human Health and the Environment and Compliance with ARARs, were rated as pass or fail and not assigned a numerical value.

ARARs = applicable or relevant and appropriate requirement
AS = air sparging
GAC = granular activated carbon
O&M = operations and maintenance
SSD = subslab depressurization system
SVE = soil vapor extraction
TTZ = target treatment zone
VI = vapor intrusion
VIMS = vapor intrusion mitigation system
VOC = volatile organic compound

Table 3 - Applicable or Relevant and Appropriate Requirements
PMC Groundwater Site, Petoskey, MI

Act/Authority	Requirement	ARAR Status	Media	Analysis
Chemical Specific ARARs				
Federal				
Vapor Intrusion Screening Level (VISL) (https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator)	The EPA developed a spreadsheet calculator that lists chemicals considered to be volatile and sufficiently toxic through the inhalation pathway; and provides VISLs for indoor air, which are generally recommended, media-specific, risk-based screening-level concentrations.	To Be Considered	Groundwater, Soil Vapor, and Indoor Air	VISLs are not promulgated, but are a reference for use in determining COPCs, delineating the nature and extent of contamination, and developing PRGs.
EPA Regional Screening Levels (RSLs) - May 2018 (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables)	The EPA has developed generic screening level tables. The RSL tables provide comparison values for residential and commercial/industrial exposures to soil, air, and tap water (drinking water). The unified use of the RSLs to screen chemicals at Superfund sites promotes national consistency.	To Be Considered	Groundwater and Soil Vapor	RSLs are not promulgated, but are a reference for use in determining COPCs, delineating the nature and extent of contamination, and developing PRGs. Actual level will be the most recent at the time of the risk assessment.
State - Michigan				
Part 201 Environmental Remediation of the NREPA[1] (1994 PA 451, as amended) MCL 324.20120a, MCL 324.20120b, MCL 324.20120e, MCL 324.20120f MAC: R 299.1-299.50	Response actions shall be protective of human health, safety, welfare, and the environment of the State. Identifies risk levels to be used in the development of those response actions. Describes methods to evaluate and manage indoor air, for protection of human health, safety, welfare and the environment of the State, and identifies methods to develop acceptable risk levels. Such methods include regional screening levels published by the USEPA that are applicable to residential or nonresidential land use, as appropriate.	Applicable	Groundwater, Soil, and, Soil Vapor	Establishes screening levels and generic cleanup criteria for sites of environmental contamination based on current and future land use. Site-specific cleanup criteria can be developed if such criteria, in comparison to generic criteria, better reflect best available information concerning the toxicity or exposure risk posed by the hazardous substance or other factors. Provides a choice of methods to determine acceptable risk levels and a choice of investigation methods for vapor intrusion sites.
Michigan Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, March 2021	Table summarizing screening levels for soil, shallow groundwater and groundwater under residential and non-residential scenarios.	To Be Considered	Soil and Groundwater	Provides recommended screening levels for remedial actions.
[1] NREPA - National Resources and Environmental Protection Act, 1994 PA 451				
Location-Specific ARARs				
Federal				
Native American Graves Protection and Repatriation Act Regulations 43 CFR 10.4 (b), (c), and (d)	Requires notification to Indian tribe official(s) upon inadvertent discovery of human remains, funerary objects, sacred objects, or objecs of clutural partimony on Federal or tribal lands, and steps to secure and protect excavated or inadvertently discovered remains/ objects.	Potentially Applicable	--	Applicable if the Native American Tribe(s) can show a relationship of lineal descent or cultural affiliation. Though on-site actions are not required to meet administrative/procedural requirements (e.g., notification), notification will be completed as needed to verify compliance with substantive requirements. If human remains, funerary objects, sacred objects, or objects of cultural patrimony are found, notification will be made to the tribe, items secured and protected and proper disposition coordinated.
National Historic Preservation Act - Section 106 16 USC 470 36 CFR 800.3(f)(2) and 800.4(a)(4)	Requires Federal agencies to take into account the effects of their undertakings on historic properties included on or eligible for inclusion on the National Register of Historic Places and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on such undertakings.	Potentially Applicable	--	No listed National Register Historic Places are on the site. The closest property is a structure located across the street from the site. The Michigan Historic Preservation Office (MHPO) will be contacted to identify eligible or listed archeological sites. Though on-site actions are not required to meet administrative/procedural requirements (e.g., notification and consultation), the MHPO and the Odawa Tribe would be consulted if the site is determined to lie within the Odawa Tribe reservation boundary, to verify compliance with substantive requirements.
Protection of Archaeological Resources Protection Act Regulations 43 CFR 7.4(a) and 7.5(b)(1)	Requires protection of archaeological resources if discovered on public lands or Indian lands. Archaeological resource means any material remains of human life or activities which are at least 100 years of age, and which are of archaeological interest.	Potentially Applicable	--	Applicable if the Little Traverse Bay Bands of Odawa Indians reservation boundary is determined to encompass the site and if archeological resources are discovered.
Archeological and Historic Preservation Act 16 USC 469-469c	Requires Federal agencies to provide for the preservation of historical and archeological data (including artifacts and specimens) that might otherwise be irreparably lost or destroyed through federally licensed activities or programs.	Potentially Applicable	--	Applicable if the project is expected to result in the loss or destruction of significant archeological data.
16 United States Code 703 – Migratory Bird Treaty Act	Protects almost all species of native migratory birds in the United States from unregulated taking.	Applicable	--	Migratory birds, or their active nests or eggs, may be identified at the site and may be disturbed during implementation of the selected alternative. Design will address measures to avoid or minimize disturbance to birds, active nests, and eggs. Consultation with USFWS may occur.
Endangered Species Act (16 USC 1531 et. seq.); 50 CFR 17, and 50 CFR Part 402 – Threatened and Endangered Species Protection	Requires that federal agencies ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat.	Potentially Applicable	--	Alternatives that include removal of trees or habitat may jeopardize wildlife, or plant species or destroy or adversely modify critical habitat. A data search will be performed to identify whether threatened and endangered species or their habitat are present.

Table 3 - Applicable or Relevant and Appropriate Requirements
PMC Groundwater Site, Petoskey, MI

Act/Authority	Requirement	ARAR Status	Media	Analysis
Executive Order 11988 Floodplains Management	Avoid long and short-term adverse impacts to floodplains and to avoid direct and indirect support of floodplain development.	To Be Considered	--	Executive Orders are TBC. PMC is located within a floodplain; refer to the cited statefloodplain regulation.
Coastal Zone Management (16 USC, Ch. 33)	Preserve and protect during development;, restore and enhance the coastal zone.	Applicable.	--	PMC is located along coastal management zone of Lake Michigan. Would also need to comply with State Coastal Zone Management Program.
State - Michigan				
Part 365, Endangered Species Protection, of the NREPA (1994 PA 451, as amended), and Michigan Compiled Laws (MCL) 324.36501-36507), and Michigan Administrative Code (MAC): R 299.1021-1028	Establishes requirements for conservation, management, enhancement, and protection of species either endangered or threatened with extinction	Relevant and appropriate	--	Alternatives that include removal of trees or habitat may jeopardize wildlife, or plant species or destroy or adversely modify critical habitat. Would be considered applicable if more stringent than the Federal endangered species law.
Part 411, Protection and Preservation of Fish, Game, and Birds of the NREPA (1994 PA 451, as amended and MCL 324.41101-41105	Regulates the protection and preservation of fish, game, and birds	Potentially Applicable	--	Alternatives that disturb habitat may trigger Part 411. Substantive requirements of Orders issued by the Natural Resources Commission of the Department of Natural Resources would apply to the taking or killing of regulated game, or birds.
Part 413, Invasive Species, NREPA (1994 PA 451, as amended and MCL 324.41301-324.41325.	Lists nonnative species that are prohibited or restricted in Michigan;	Applicable	--	For any planting, the requirements of Part 413 will apply to the selection or introduction of plant species.
Part 31, (Section 3108) Water Resource Protection (Floodplain Regulatory Authority), of the NREPA (1994 PA 451, as amended) and MAC R323.1312 to 1316	Requirements for any occupation, construction, filling, or grade change within the 100-year floodplain.	Applicable	--	The PMC site is within a floodplain; substantive requirements triggered by the alternatives would be addressed.
Part 303, Wetlands Protection, of the NREPA (1994 PA 451, as amended) and MAC R281.925 Mitigation	Regulates construction activities in wetlands and describes mitigation requirements.	Not Likely Applicable	--	National Wetlands Inventory (NWI) mapping does not indicate presence of wetlands on site; however, should be confirmed as the remedial alterntatives evaluation progresses.
Action-Specific ARARs				
Federal				
Safe Drinking Water Act (42 USC, 300); Underground Injection Control (UIC) Progam (40 CFR, Part 144 Subparts A, B, C, and G)	Regulates the subsurface emplacement of fluids (including air) with standards for the design and operation of five classes of injection wells.	Applicable	Groundwater	Triggered by alternatives that include underground injection of liquids or air. EPA regulates underground injection contol wells in Michigan. Underground injection would be through Class V wells.
USEPA *Vapor Intrusion Technical Guide for CERCLA* (2015)	Provides guidance for mitigation systems, termination of building mitigation, and termination of institutional controls	To Be Considered	Groundwater, Soil, and Soil Vapor.	Evaluation and response action guidance where vapor intrusion is a pathway of concern.
State - Michigan				
Part 31, Water Resources Protection, NREPA (1994 PA 451, as amended), Rule 2190 and Part 91 (Soil Erosion and Sediment Control) of the NREPA (1994 PA 451, as amended) and MAC R 323.1709 – Erosion and Sediment Control	Sets requirements for onsite discharges of construction stormwater to both surface waters and groundwater of the State.Establishes requirements for the control of erosion and sedimentation during earth-change operations amnd prohibits direct or indirect discharge to ground or surface waters of the state that are or may become injurious to the environment or public health. Requires development and implementation of a soil erosion and sediment control plan per Part 91 of the NREPA.	Applicable	Stormwater	Applicable to any earth disturbance that exceeds 1 acre, or for any disturbance within 500 feet of the water's edge of a lake or stream, if storm water that has not contacted contaminated media is discharged during remedial operations at the site. Distrubance activities may include excavation in paved areas, construction of groundwater injection or treatment systems, and related piping. The current remedial design includes containerization and offsite disposal of all water that contacts contaminated media during the execution of the remedial action. The alternatives do not include extracting, treating, or discharging contaminated groundwater to surface water or to a publically owned treatment works.

Table 3 - Applicable or Relevant and Appropriate Requirements
PMC Groundwater Site, Petoskey, MI

Act/Authority	Requirement	ARAR Status	Media	Analysis
Part 55, Air Pollution Control, NREPA and MAC R 336.1372(8)(b) – Control of Fugitive Dust	Establishes rules for prohibiting the emission of fugitive dust from certain activities in quantities which cause injurious effects to human health, animal life, plant life, or significant economic value, and/or property. Establishes common measures to mitigate the generation of fugitive dust during small-construction work.	Relevant and appropriate	Air	Contaminated soil may become airborne and generate fugitive dust and air emissions at trigger levels during certain alternatives . For certain remedial alternatives, air emissions must comply with substantive requirements and monitoring may be required.
Part 121, Liquid Industrial Wastes, NREPA and MCL 324.12101-12118	Regulates liquid industrial waste generators, transporters and designated facilities. Transporters are required to be registered in accordance with the hazardous materials transportation act. Liquid industrial waste is defined as “any liquid waste, other than unpolluted water.”	Applicable	Wastewater	Remedial action may require the onsite storage and subsequent transportation of liquid industrial wastes. Relevant and appropriate for the on-site management of liquid industrial wastes. Note that All aspects of the regulation must be adhered to for offsite transportation and disposal.
Part 115, Solid Waste Management, NREPA MCL 324.11512(1) only	Requires that persons dispose of solid waste at a permitted facility	Potentially Applicable	Contaminated soil if determined to be solid waste	Contaminated soil may be generated and would be disposed at a permitted Subtitle D commerical landfill. Generator requirements of the rules are ARARs; full compliance is required once the waste leaves the site boundary.
Part 111, Hazardous Waste, NREPA (1994 PA 451, as amended) MCL 324.11138 Generator Requirements only	Requirements for generators of hazardous waste, including proper labeling, packaging for transport, and initiation of manifest.	Potentially Applicable	Soil that is determined to be hazardous	Soil that is tested to be characteristically hazardous may be disposed offsite. Generator requirements of the rules are ARARs; full compliance is required once the waste leaves the site boundary.
Part 201, Environmental Remediation, NREPA (1994 PA 451, as amended) MCL 324.20120c: Relocation of Contaminated Soil	Provides conditions for re-location of contaminated soil offsite, or allowing re-located soil to remain onsite.	Potentially Applicable	Soil	Applicable if contaminated soil is relocated and triggers the conditions in the regulation.
The MDEQ *Guidance Document for the Vapor Intrusion Pathway* (May 2013) as amended. https://www.michigan.gov/documents/deq/deq-rrd-VIGuidanceDoc-May2013_422550_7.pdf	Outlines an approach to demonstrate compliance when the generic criteria under Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA), and Part 213, Leaking Underground Storage Tanks, of the NREPA, do not apply. This reference document is not a mandatory requirement.	To Be Considered	Groundwater, Soil, and Soil Vapor.	Investigation, evaluation and response action guidance where vapor intrusion is a pathway of concern.
Section 20121 of Part 201, Environmental Remediation, NREPA, 1994 PA 451, as amended, MCL 324.20101 Part 201 and 2013 of NREPA (1994 PA 451, as amended)	Outlines land use or resource use restrictions to manage risk by reducing or restricting exposure to environmental contamination left in-place at a property.	Applicable	Groundwater and Soil	Legal document that is signed by a property owner and is recorded with the register of deeds to impose activity- or use-limitations at a property that reduce or restrict exposure to environmental contamination left in-place.

Table 4 - Alternative 2 Cost Estimate
PMC Groundwater Site, Petoskey, MI

Alternative 2 — **COST ESTIMATE SUMMARY**

Site: PMC **Description:** Horizontal SVE with AS (AS/SVE)
Location: Petoskey, MI
Phase:
Base Year: 2021
Date:

CAPITAL COSTS:

	DESCRIPTION		QTY	UNIT	UNIT COST	TOTAL	NOTES
1A	Premobilization						
		Contractor Submittals	1	LS	$20,000	$20,000	H&S Plan, Work Plan
		SUBTOTAL				**$20,000**	
1B	Predesign Investigation						
		Investigation	1	LS	$250,000	$250,000	
		SUBTOTAL				**$250,000**	
2	Mobilization/Demobilization						
		Mobilization - Driller	1	LS	$25,000	$25,000	
		Mobilization - Mechanical	1	LS	$10,000	$10,000	
		Mobilization - Electrical	1	LS	$5,000	$5,000	
		Utility Locate	**1**	DY	$2,500	$2,500	1 day, just a condo area and FOE
		Surveying	2	DY	$2,200	$4,400	
		SUBTOTAL				**$46,900**	
3A	Horizontal SVE Well Installation						4 horizontal wells at varying lengths - includes pipe and screened interval
		Horizontal Well	1	LS	$185,000	$185,000	
		Vertibrae Well system	1	LS	$114,000	$114,000	
		Analytical - Waste Profiling	30	EA	$1,500	$45,000	296 cy = 30 rolloffs (10y) 1 sample
		IDW 10 yd rolloff transport	450	TON	$20	$9,000	~1.5ton/cy (crushed limestone)
		IDW - Non Haz	450	TON	$20	$9,000	
		SUBTOTAL				**$362,000**	
3B	Horizontal AS Well Installation						3 horizontal wells at varying lengths - includes pipe and screened interval
		Horizontal Well	1	LS	$155,000	$155,000	
		Vertibrae Well System	1	LS	$82,000	$82,000	
		Analytical - Waste Profiling	10	EA	$1,500	$15,000	96 cy = 10 rolloffs (10y) 1 sample
		IDW 10 yd rolloff transport	150	TON	$20	$3,000	~1.5ton/cy (crushed limestone)
		IDW - Non Haz	150	TON	$20	$3,000	
		SUBTOTAL				**$258,000**	
4	Electrical/Mechanical						
		Power Drop	1	LS	$30,000	$30,000	
		Service Connection	1	LS	$12,500	$12,500	
		Electrical Conduit/Conductor to Wells	3,000	LF	$10	$30,000	
		2-4" HDPE Conveyance Piping	3,000	LF	$45	$135,000	Includes trenching - 4 SVE wells at 150 feet, assumes all areas unpaved (AS wells are installed at system location)
		SUBTOTAL				**$207,500**	
5	Install AS/SVE System						
		System Enclosure/System (Vacuum Blower, Air Compressor, Ar/water separator, Control Panel, PLC, Instrumentation, Telemetry, shipping)	1	LS	$400,000	$400,000	Quote from Seneca
		System Foundation and Crane Placement	1	LS	$70,000	$70,000	
		Fencing/noise control	100	LF	$30	$3,000	
		VGAC (includes shipping)	1	LS	$54,500	$54,500	Budgetary estimate - Evoqua Water Technologies - 01/2021
		SUBTOTAL				**$527,500**	
6	Drilling Oversight						Assume 180-ft per day plus 3-day mobilization & setup, 1-day between drilling locations, 3 days for HAS development
		Geologist	14	day	$1,200	$16,800	
		Travel Roundtrip	48	HR	$110	$5,280	3 10-day shifts
		Per Diem - Lodging	14	DY	$101	$1,414	
		Per Diem - Meals	14	DY	$56	$784	
		Vehicle	14	DY	$100	$1,400	
		SUBTOTAL				**$25,678**	
6	System Installation Oversight and Start-Up						4-weeks
		Engineer	20	day	$1,200	$24,000	
		Travel Roundtrip	32	HR	$110	$3,520	2 trips
		Per Diem - Lodging	28	DY	$101	$2,828	
		Per Diem - Meals	28	DY	$56	$1,568	
		Vehicle	28	DY	$100	$2,800	
		SUBTOTAL				**$34,716**	
7	Interim Mitigation						
		Mitigation systems (where not currently present)	6	EA	$50,000	$300,000	
		SUBTOTAL				**$300,000**	
8	Allowances						
		Restoration Allowance	1	LS	$25,000	$25,000	Repair/Replace sidewalk, parking lot, landscape due to trenching
		SUBTOTAL				**$25,000**	
9	Construction Completion Report						
		Final Construction Completion Report	1	LS	$50,000	$50,000	
		SUBTOTAL				**$50,000**	
		TOTAL				**$2,107,294**	
		Contingency	15%		$2,107,294	$316,100	Scope and bid contingency
		TOTAL				**$2,423,394**	
		Project Management	6%		$2,423,394	$145,400	USEPA 2000, p. 5-13, $500K - $2M
		Remedial Design	12%		$2,423,394	$290,800	USEPA 2000, p. 5-13, $500K - $2M
		Construction Management	8%		$2,423,394	$193,900	USEPA 2000, p. 5-13, $500K - $2M

Table 4 - Alternative 2 Cost Estimate
PMC Groundwater Site, Petoskey, MI

Alternative 2 — **COST ESTIMATE SUMMARY**

Site:	PMC	**Description:**	Horizontal SVE with AS (AS/SVE)
Location:	Petoskey, MI		
Phase:			
Base Year:	2021		
Date:			

Total Capital Costs					**$3,053,494**	
OPERATIONS AND MAINTENANCE COSTS (Years 1 to 5)						
	DESCRIPTION	**QTY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES**
	Long Term Monitoring (LTM)					15 soil gas probes + GAC influent/effluent
	Technician	80	HR	$110	$8,800	1 person x 8 days (quarterly [2 day per])
	Travel Roundtrip	16	HR	$110	$1,760	
	Per Diem - Lodging	8	DY	$101	$808	
	Per Diem - Meals	8	DY	$56	$448	
	Vehicle	8	DY	$100	$800	
	Sampling Supplies	8	DY	$125	$1,000	
	Analytical					
	SW-846 8260	15	EA	$130	$1,950	
	TO-15	17	EA	$125	$2,125	
	Canister plus Flow Controller	17	EA	$90	$1,530	
	Shipping Samples	5	EA	$150	$750	4 per cooler
	Annual Monitoring Report	1	EA	$20,000	$20,000	
	SUBTOTAL				**$39,971**	One Year
	O&M					
	Senior Engineer	48	HR	$175.00	$8,400	4 hours per month
	Technician	120	HR	$110	$13,200	1 person x 1 dy/mth - 12 events per year
	Travel Roundtrip	192	HR	$110	$21,120	
	Per Diem - Lodging	12	DY	$101	$1,212	
	Per Diem - Meals	12	DY	$56	$672	
	Vehicle	24	DY	$100	$2,400	
	Electrical Use	1	Year	$100,000	$100,000	
	VGAC Replacement	20000	LB	$3	$60,000	changeouts 2 times per year
	Misc Consumables	1	LS	$1,000	$1,000	
	SUBTOTAL				**$208,004**	Per Year
	Total LTM and O&M				**$247,975**	
	Project Management	8%		$247,975	$19,800	USEPA 2000, p. 5-13, $100K - $500K
Total Operating O&M Costs (Years 1 to 5)					**$267,775**	
MITIGATION MONITORING COSTS (Years 1 to 3)						
	Mitigation Monitoring					
	Monitoring of each property within the TTZ	25	EA	$10,000	$250,000	Per year
	Per property letter Report	25	EA	$1,000	$25,000	annual
	SUBTOTAL				**$275,000**	
	Project Management	8%		$275,000	$22,000	USEPA 2000, p. 5-13, $100K - $500K
Total Mitigation Monitoring Costs (Years 1 to 3)					**$297,000**	
MITIGATION MONITORING COSTS (Years 4 to 10)						
	Mitigation Monitoring					
	Monitoring of each property within the TTZ	25	EA	$3,000	$75,000	Per year
	Per property letter Report	25	EA	$1,000	$25,000	annual
	SUBTOTAL				**$100,000**	
	Project Management	8%		$100,000	$8,000	USEPA 2000, p. 5-13, $100K - $500K
Total Mitigation Monitoring Costs (Years 4 to 10)					**$108,000**	
PERIODIC COSTS (Year 5 and 10)						
DESCRIPTION		**QTY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES**
	5 Year Review	1	EA	$20,000	$20,000	
Total Periodic Costs					**$20,000**	

Present Value **Discount Factor** **7%**

Year	**Capital**	**Annual**	**Disc. Factor**	**Total Costs**
0	$ 3,053,494		1.00	$ 3,053,494
1		$564,775	0.93	$ 527,827
2		$564,775	0.87	$ 493,296
3		$564,775	0.82	$ 461,025
4		$375,775	0.76	$ 286,677
5		$395,775	0.71	$ 282,182
6		$108,000	0.67	$ 71,965
7		$108,000	0.62	$ 67,257
8		$108,000	0.58	$ 62,857
9		$108,000	0.54	$ 58,745
10		$128,000	0.51	$ 65,069
			NPV Total	**$5,430,394**
			NPV: - 30%	$3,801,276
			NPV: + 50%	$8,145,590

ATTACHMENT 3:
ADMINISTRATIVE RECORD INDEX

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMOVAL ACTION

ADMINISTRATIVE RECORD
FOR THE
PMC GROUNDWATER SITE
PETOSKEY, EMMET COUNTY, MICHIGAN
UPDATE #4
JUNE 22, 2022
SEMS ID: 975823

NO.	SEMS ID	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	939555	12/10/14	Fusinski, K., U.S. EPA	Thompson, O., U.S. EPA	Memorandum: Review of Potential Vapor Intrusion Scenarios at the PMC Site, Petoskey MI	4
2	483167	12/19/14	U.S. EPA	General Public	Third Five-Year Review Report, PMC Groundwater Superfund Site, Emmet County, Michigan	105
3	932601	06/01/15	U.S. EPA	General Public	EPA - OSWER Technical Guide For Assessing And Monitoring Mitigating The Vapor Intrusion Pathway From Subsurface Vapor Sources To Indoor Air	267
4	939559	01/26/16	CH2M	U.S. EPA	Revised Sampling Approach Technical Memorandum- PMC Groundwater Superfund Site, Petoskey, Michigan	5
5	939568	07/01/16	CH2M	U.S. EPA	Draft Final Quality Assurance Project Plan	523
6	933414	08/01/16	U.S. EPA	General Public	EPA Fact Sheet - EPA To Begin Sampling This Fall	4
7	932595	03/13/17	Thompson, O., U.S. EPA	Kapuscinski, R., U.S. EPA; Mankowski, M., U.S. EPA; Dollhopf, R. U.S. EPA	EPA Email RE: PMC Groundwater Site - Sub Slab Sampling Results	1
8	932598	04/28/17	CH2M	U.S. EPA	Technical Memorandum - Long-Term Groundwater Monitoring Activities	149

9	932596	05/01/17	U.S. EPA	Various Agencies and Personnel	Pollution Report (POLREP) - #1 PMC Groundwater Site	3
10	933529	05/01/17	U.S. EPA	General Public	EPA Fact Sheet - EPA To Test For Vapors; Access Agreements Needed	4
11	940174	05/01/17	U.S. EPA	General Public	EPA Fact Sheet - EPA Expanding Investigation; Seeks Community Input	2
12	935146	07/13/17	U.S. EPA	General Public	US EPA Action Memorandum RE: Request For Approval And Funding And Waiver Of 12-Month Statutory Limit For A Time-Critical Removal Action At The PMC Groundwater Site (Redacted)	41
13	939569	08/07/17	CH2M	U.S. EPA	Technical Memorandum - Proposed Approach to Complete Nature and Extent Delineation of the PMC Groundwater Site	6
14	957840	08/13/17	CH2M	U.S. EPA	Memorandum - Discussion Of Non-Site Related Volatile Organic Compound Exceedances	2
15	939570	08/24/17	CH2M	U.S. EPA	Long-Term Groundwater Monitoring Activities - October 2016	161
16	941369	05/01/18	U.S. EPA	General Public	EPA Fact Sheet - EPA Expanding Investigation; Seeks Community Input	2
17	944972	01/01/19	U.S. EPA	General Public	Community Involvement Plan	28
18	2003329	07/31/19	CH2M	U.S. EPA	Remedial Investigation Report - Operable Unit 2 PMC Groundwater Site, Petoskey, Michigan (Redacted)	6464
19	2003330	07/31/19	CH2M	U.S. EPA	RI Report Appendix B - Technical Memorandum - Individual Property Vapor Intrusion Investigations (Redacted)	6214

20	950416	09/10/19	Quadri, S., U.S. EPA	Dollhopf, R., U.S. EPA	Memorandum: Recommendation for Pre-Emptive Mitigation at the Petoskey Manufacturing Company (PMC) Superfund Site, Petoskey, Michigan [Redacted]	22
21	950426	09/27/19	Dollhopf, R., U.S. EPA	Ballotti, D., U.S. EPA	EPA Action Memo - Request For Time Critical Removal Action At The PMC Groundwater Site [Redacted]	39
22	955047	03/05/20	U.S. EPA	General Public	Fourth Five Year Review Report - PMC Groundwater	57
23	2004363	09/21/21	CH2M & U.S. EPA	U.S. EPA	Focused Feasibility Study - Petoskey Manufacturing Company Groundwater Superfund Site, Petoskey, Emmet County, Michigan	430
24	2004385	11/23/21	Mead-O'Brien, B.; MEGLE	Kondreck, C., U.S. EPA	Review of the September 21, 2021 Draft Focused Feasibility Study (FFS) to Support an Interim Record of Decision (ROD), Petoskey Manufacturing Company (PMC) Groundwater Superfund Site, Petoskey, Emmet County, Michigan	79
25	976052	06/01/22	U.S. EPA	Public	EPA Fact Sheet - EPA Proposes Cleanup Plan For Groundwater, Soil & Vapors	8
26	2004386	06/22/22	U.S. EPA	Public	Interim Action Proposed Plan, PMC Groundwater Superfund Site, Petoskey, Michigan	49

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR THE
PMC GROUNDWATER SITE
PETOSKEY, EMMET COUNTY, MICHIGAN
UPDATE #5
SEPTEMBER 23, 2022
SEMS ID: 977570

NO.	SEMS ID	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	2004646	10/01/16	CH2M	U.S. EPA	Final Quality Assurance Project Plan, PMC Groundwater Site, Petoskey, Michigan, WA No. 243-RICO-0554	502
2	2004647	06/04/18	CH2M	U.S. EPA	Final Quality Assurance Project Plan, PMC Groundwater Site	898
3	2004551	06/29/22	Montour, B., Court Reporter	U.S. EPA	U.S. EPA Public Hearing Transcript	26
4	977962	06/22/22	U.S. EPA	Public	Interim Action Proposed Plan, PMC Groundwater Superfund Site Petoskey, Michigan [Redacted}	46
5	2004556	06/30/22	Johnson, N.,	Kondreck, C., U.S. EPA	Public Comment Email RE: PMC Groundwater Site/Proposed Plan Comment	1
6	2004554	07/01/22	Friske, H.	Kondreck, C., U.S. EPA	Public Comment Mailed For PMC Groundwater Proposed Plan	1
7	2004555	07/01/22	Tomey, P. & I.	Kondreck, C., U.S. EPA	Public Comment Mailed For PMC Groundwater Proposed Plan	1
8	2004558	07/08/22	Nasif, A.	Kondreck, C., U.S. EPA	Public Comment on PMC Groundwater Proposed Plan	1
9	2004552	07/21/22	Haggerty, C.	Kondreck, C., U.S. EPA	Public Comment Email RE: PMC Groundwater Site/Proposed Plan Comment	1

10	2004643	08/30/22	Mead-O'Brien, B., EGLE	Kondreck, C., U.S. EPA	Review of the Draft Interim Record of Decision (ROD) for the Petoskey Manufacturing Company (PMC) Groundwater Superfund Site, Petoskey, Emmet County, Michigan	10
11	2004708	09/19/22	Eichler Clark, L., EGLE	Ballotti, D., U.S. EPA	Letter of Concurrence with the Proposed Remedy in the Interim Record of Decision (ROD) for the Petoskey Manufacturing Company (PMC) Groundwater Superfund Site	2

ATTACHMENT 4:
MICHIGAN DEPARMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY
LETTER OF CONCURRENCE

STATE OF MICHIGAN
DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY
LANSING

GRETCHEN WHITMER
GOVERNOR

LIESL EICHLER CLARK
DIRECTOR

September 19, 2022

VIA EMAIL

Douglas E. Ballotti, Director
Superfund & Emergency Management Division
United States Environmental Protection Agency
Region 5
77 West Jackson Boulevard (S-6J)
Chicago, Illinois 60604-3507

Dear Douglas Ballotti:

SUBJECT: Concurrence with the Proposed Remedy in the Interim Record of Decision (ROD) for the Petoskey Manufacturing Company (PMC) Groundwater Superfund Site; Petoskey, Emmet County, Michigan

The Michigan Department of Environment, Great Lakes, and Energy (EGLE) has received a copy of the Interim ROD for the PMC Groundwater Superfund Site located in Petoskey, Emmet County, Michigan. The objective of the Interim ROD is to address sources of contaminant vapors at the source of the PMC Groundwater Superfund Site. The United States Environmental Protection Agency (USEPA) has requested concurrence from the State of Michigan with the Interim ROD.

With regard to the USEPA's Interim ROD cleanup goals, EGLE's September 3, 2020, and December 15, 2020, comments on the USEPA's Preliminary Remediation Goals (PRGs) still apply to the USEPA's PRGs and Interim ROD cleanup goals. Given the PRGs/cleanup goals do not vary substantially from EGLE's December 2019 site specific volatilization to indoor air criteria and, in the interest of moving this interim action remedy forward, EGLE does not oppose the use of the USEPA's soil vapor and groundwater cleanup goals identified in the Interim ROD at the site. EGLE will rely on the USEPA's justification for the appropriateness of the use of these USEPA-generated PRGs/cleanup goals.

EGLE concurs with the remedial actions that are proposed in the Interim ROD to address sources of contaminant vapors at the source of the PMC Groundwater Superfund Site with the understanding that (1) the USEPA will conduct a detailed evaluation of the effect of the new system on the existing sub-slab depressurization systems (SSDSs)/vapor intrusion mitigation systems (VIMS) installed by the USEPA and the USEPA will make any adjustments as necessary to the SSDSs/VIMS to ensure the SSDSs/VIMS are protective in the event the interim remedy affects these systems; and (2) the USEPA will monitor the soil gas and groundwater in the downgradient area near the Sunset Shores Condos and take any necessary actions to ensure the residents are protected.

EGLE also understands that the USEPA will issue a future final site-wide ROD that more fully addresses the contamination at the site.

If you need further information, please contact Mike Neller, Director, Remediation and Redevelopment Division, at 517-512-5859; NellerM@Michigan.gov; or EGLE, P.O. Box 30426, Lansing, Michigan 48909-7926; or you may contact me.

Sincerely,

Liesl Eichler Clark
Director
517-284-6700

cc: Cheryl Kondreck, USEPA, Region 5
Aaron B. Keatley, Chief Deputy Director, EGLE
Mike Neller, EGLE
David Kline, EGLE
Robert Franks, EGLE
Beth Mead-O'Brien, EGLE