

**FOURTH FIVE-YEAR REVIEW REPORT FOR
PMC GROUNDWATER SUPERFUND SITE
EMMET COUNTY, MICHIGAN**



Prepared by

**U.S. Environmental Protection Agency
Region 5
CHICAGO, ILLINOIS**

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LIST OF ABBREVIATIONS & ACRONYMS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µg/m ³	micrograms per cubic meter
AOC	Administrative Order by Consent
ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
DCE	Dichloroethylene
EGLE	Michigan Department of Environment, Great Lakes and Energy
EPA	United States Environmental Protection Agency
FFS	Focused Feasibility Study
FS	Feasibility Study
FYR	Five-Year Review
GSI	Groundwater-Surface Water Interface
HHRA	Human Health Risk Assessment
ICIAP	Institutional Control Implementation and Assurance Plan
IC	Institutional Control
LTS	Long-Term Sampling
MCL	Maximum Contaminant Level (federal drinking water criteria)
MDEQ	Michigan Department of Environmental Quality
NCP	National Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PFAS	Per- and Polyfluoroalkyl Substances
PMC	Petoskey Manufacturing Company
RAO	Remedial Action Objective
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
Site	PMC Groundwater Superfund Site
SL	Screening Level
SSD	Subslab Depressurization System
SVE	Soil Vapor Extraction
TCE	Trichloroethylene
UU/UE	Unlimited Use and Unrestricted Exposure
VI	Vapor Intrusion
VIMS	Vapor Intrusion Mitigation Systems
VISL	Vapor Intrusion Screening Level
VOC	Volatile Organic Compound

I. INTRODUCTION

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The United States Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP) (40 *Code of Federal Regulations* [CFR] Section 300.430(f)(4)(ii)) and considering EPA policy.

This is the fourth FYR for the PMC Groundwater Superfund Site (Site). The triggering action for this statutory FYR was the signing of the previous FYR on December 19, 2014. The FYR has been prepared due to the fact that hazardous substances, pollutants, or contaminants remain at the site exceeding levels that allow for unlimited use and unrestricted exposure (UU/UE).

The PMC Site consists of one sitewide operable unit (OU) addressing soil and groundwater.

The PMC Site FYR was led by Syed Quadri, Remedial Project Manager (RPM) for EPA. Participants included Beth Mead-O'Brien and Barb Vetort of the Michigan Department of Environment, Great Lakes, and Energy (EGLE), formerly known as the Michigan Department of Environmental Quality (MDEQ). EGLE was notified of the initiation of the FYR on February 14, 2019. The review began on February 14, 2019.

Site Background

The former Petoskey Manufacturing Company (PMC) facility was located at 200 West Lake Street, Petoskey, Emmet County, Michigan, and contained a die-casting plant from the 1940s and a painting operation from the mid- to late-1960s. The Site has been redeveloped as a condominium complex (Water Street Condominiums) 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 Bay Front Park access easement and a parking lot associated with a commercial structure. Additional single-family residential structures lie to the west and south. Bear River, which drains into Little Traverse Bay, is located approximately 500 feet east of the Site. Immediately south of Lake Street (behind a row of homes) is a steep bluff running approximately parallel to the shoreline.

Contamination at the Site was first discovered in September 1981 when drinking water samples were collected from the Ingalls Municipal Well. The samples from the Ingalls Municipal Well, when tested, showed high levels of trichloroethylene (TCE), cis-1,2-dichloroethylene (DCE), and trihalomethanes, and it was determined that the PMC facility was responsible for the contamination at the Ingalls Municipal Well. Bad housekeeping and inappropriate disposal of spent solvents and/or paint sludge resulted in soil and groundwater contamination in the vicinity of the PMC facility.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: PMC Groundwater		
EPA ID: MID006013049		
Region: 5	State: MI	City/County: Petoskey/Emmet
SITE STATUS		
NPL Status: Final		
Multiple OUs? No	Has the site achieved construction completion? Yes	
REVIEW STATUS		
Lead agency: EPA		
Author name (Federal or State Project Manager): Syed M. Quadri		
Author affiliation: EPA Region 5		
Review period: 2/14/2019 - 11/4/2019		
Date of site inspection: 6/11/2019		
Type of review: Statutory		
Review number: 4		
Triggering action date: 12/19/2014		
Due date (five years after triggering action date): 12/19/2019		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

Previous waste disposal practices were identified as the cause of soil and groundwater contamination at the Site and the basis for acting at the Site.

The primary contaminants of concern (COCs) in groundwater as stated in the Record of Decision (ROD) are: TCE, DCE, and trihalomethanes. The soil COCs are TCE and zinc. TCE accounts for the majority of volatile organic compound (VOC) mass in the Site's groundwater. Groundwater at the Site generally flows to the northwest towards Lake Michigan. However, due to flat groundwater elevations and gradient reversals caused by level fluctuations at Lake Michigan, there is virtually no net advective flow to Lake Michigan. The two primary exposure pathways identified by risk assessment are TCE in potential drinking water and vapor intrusion (VI) by TCE. The cleanup goals for the contaminants of concern are provided in Table 1. No ecological risks were identified at the Site.

Response Actions

In 1982, under the direction of the State, PMC excavated contaminated soils at the Site, and the area was backfilled with clean compacted soil and graded to provide drainage. The soil was next covered with a synthetic liner and 6 inches of gravel. In July 1983, EPA evaluated the Site using the Hazard Ranking System. The Site was added to the National Priorities List on September 8, 1983.

In 1984, EPA negotiated a removal administrative order by consent with PMC to conduct further hydrogeological studies, and in 1987, EPA and PMC signed another administrative order by consent for PMC to conduct a full remedial investigation (RI)/feasibility study (FS). However, due to delays and financial uncertainty, EPA took over the RI/FS work from PMC.

In 1995, EPA signed an Interim Record of Decision (ROD) to provide treatment (air stripping) of groundwater at the Ingalls Municipal Well. However, in place of the air stripper on Ingalls Municipal Well, the State requested that the City's construction of a new drinking water source be considered an enhancement of the selected remedy under 40 CFR 300.515(f). In late 1997, the City of Petoskey completed construction of its replacement municipal wells; use of the Ingalls Municipal Well ceased, and it was abandoned (removed) in 2006.

On September 30, 1998, EPA issued a final ROD to select the remedies for soil and groundwater at the Site. Table 1 summarizes the remedial action objectives (RAOs) and remedy decisions for the 1998 ROD.

Table 1: Summary of PMC RAOs and Remedy Selected in the September 30, 1998 ROD

RAOs	Remedy Requirements
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)	<ul style="list-style-type: none"> • Deed restrictions in accordance with Michigan Natural Resources and Environmental Protection Act Part 201 due care requirements for the landowner’s responsibilities if the current structure of PMC property is partially or totally removed. The deed restriction will also require (if soils under the building are uncovered) the property owner to determine if there is a threat to human health and the environment and/or exceedances of the State’s chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs), conduct any follow-up action (i.e., additional investigation and disposal) necessary for any development of the property, and not to exacerbate an existing condition. • Excavation and offsite disposal of approximately 15 cubic yards of contaminated soil that exceed EGLE’s residential direct contact criteria
Protect future exposure to groundwater containing site-related contamination at concentrations exceeding Maximum Contamination Levels	<ul style="list-style-type: none"> • Deed restrictions to prohibit the future use of the groundwater for private property because the current municipal ordinance may be insufficient to prohibit the construction of wells and use of groundwater.
Restore the aquifer to its highest beneficial use (i.e., drinking water)	<ul style="list-style-type: none"> • Excavation and offsite disposal of approximately 15 cubic yards of contaminated soil that exceed MDEQ’s residential direct contact criteria and groundwater/surface water interface (GSI) protection criteria for protection of surface water. • Operation of a soil vapor extraction (SVE) system to remove TCE from deep, unsaturated soils. • Use of a natural attenuation and monitoring program to address groundwater contamination to restore the most beneficial use of the aquifer. Installation of additional groundwater monitoring wells in the area between the former PMC facility and Lake Michigan and monitoring of groundwater contaminant levels until compliance with Maximum Contaminant Levels (federal drinking water criteria) (MCLs) and EGLE’s GSI criteria are achieved. • A Contingency Plan would be implemented in the event that natural attenuation is not occurring sufficiently or at an acceptable rate.

<p>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, 1994 PA 451, as amended, and Part 31 and associated rules.</p>	<ul style="list-style-type: none"> • Use of a natural attenuation and monitoring program for groundwater contamination for the most beneficial use of the aquifer. Installation of additional groundwater monitoring wells in the area between the former PMC facility and Lake Michigan, and monitoring of groundwater contaminant levels until compliance with MCLs and EGLE’s GSI criteria is achieved. • Deed restrictions in accordance with Michigan Natural Resources and Environmental Protection Act Part 201 due care requirements for the landowner’s responsibilities if the current structure of PMC property is partially or totally removed. The deed restriction will also require (if soils under the building are uncovered) the property owner to determine if there is a threat to human health and the environment and/or exceedances of Michigan’s chemical-specific ARARs, conduct any follow-up action (i.e., additional investigation and disposal) necessary for any development of the property, and not to exacerbate an existing condition.
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Status of Implementation

The remedial action construction activities began after EPA approval of the remedial design work plan in October 1999. The construction work was separated into a soil excavation unit and SVE unit:

- **Soil Excavation:** Excavation of approximately 2,500 cubic yards contaminated soil began on November 1, 1999. Soil was excavated from the northern portion of the Site to a depth of up to 15 feet below ground surface (bgs); deeper contaminated soil was left in place. The excavated soil was transported and disposed in a nonhazardous waste landfill. All disturbed areas were backfilled with clean soil and seeded or covered with gravel consistent with the original conditions.
- **Soil Vapor Extraction:** The SVE system was installed in November 1999 by EPA’s contractor and was operated over three time periods until discontinued and dismantled on December 27, 2000. As specified in the construction quality assurance plan, the SVE system was operated until the organic vapor concentrations were less than 0.1 part per million by volume for three consecutive weeks in soil vapor samples collected from all soil vapor probes. Approximately 753 grams of TCE were removed from the subsurface by the SVE system during the three treatment periods.
- **Monitored Natural Attenuation of the Groundwater:** This included the development of a groundwater monitoring plan followed by long-term monitoring, which is ongoing.
- **Establishment of Deed Restrictions:** As shown in Table 2 below, multiple institutional controls (ICs) have been implemented on and around the site.

On February 18, 2000, a Preliminary Close-Out Report was signed. This document indicated that the remedial construction activities had been completed at the Site.

In 2000, the State awarded the City of Petoskey \$600,000 to acquire and demolish the former PMC facility. In April 2003, the former PMC facility was sold through Chapter 7 Bankruptcy Trustee to Perazza Products, LLC, a Michigan corporation (the developer). The site was redeveloped under a City Brownfields Redevelopment Authority and a Small Business Tax Credit from the Michigan Economic Development Corporation. In July 2004, the developer completely demolished the existing building, including its foundation, and removed contaminated soils that exceeded EGLE Residential Cleanup Criteria for Direct Contact, Volatilization to Indoor Air, and some soils that exceeded GSI protection. The demolished building material and contaminated soils were sent offsite for disposal. The construction of the new residential apartment building started in September 2004

and continued until 2008. Ten units of the Water Street Condominiums were completed by 2008 before the property went into foreclosure in the fall of 2009. The remaining six units were completed by a new developer in 2014.

Based on indoor air and subslab samples collected by EPA, as recommended in the previous FYR, EPA found high levels of contamination. Subsequently, the EPA’s Removal Program installed vapor mitigation devices, over 2016-2017. These temporary household air purifier systems and subslab depressurization systems (SSDs) were installed in 11 homes and one commercial building to prevent TCE from entering into these buildings. These initial response activities were completed in April 2018. Nine additional homes, which were not included in the initial Removal Action because the indoor air of these units did not exceed EPA’s standard for TCE in indoor air, are recommended for mitigation. A Phase II Removal Action was initiated on September 27, 2019, to pre-emptively mitigate these homes. The Removal Action is expected to be completed by the end of March 2020.

Institutional Controls

Institutional controls are required by the 1998 ROD. They serve as a protectiveness measure to be used in concert with the containment and active treatment methods to restrict property use, maintain the integrity of the remedy, and assure the long-term protectiveness for areas that do not allow for UU/UE. Table 2 summarizes the implemented ICs for the Site.

Table 2: Institutional Controls Summary

Media, Engineered Controls, & Areas that Do Not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called For in the Decision Documents	Impacted Parcels	IC Objective	Title of IC Instrument Implemented and Date (or planned)
<i>Former PMC Property</i> – Area of soil treated to industrial cleanup standards identified in Restrictive Covenants.	Yes	Yes	52-19-06-202-001, 52-19-06-206-101 through 52-19-06-206-117 (See Figure 4)	Prohibit contact with soil.	Restrictive Covenant recorded at Emmet county recorder’s office on May 15, 2005
<i>Former PMC Property</i> – Area of TCE contaminated soil	Yes	No	52-19-06-206-101 through 52-19-06-206-117 (See Figure 4)	Prevent inhalation of vapors in indoor air inhalation in excess of NCP and State risk Management criteria.	Amend 2005 Restrictive Covenant to address VI (planned)
<i>Groundwater</i> – current area that exceeds groundwater cleanup standards.	Yes	Yes	52-19-06-202-011, 52-19-06-200-017,	Prohibit groundwater use until cleanup	City of Petoskey Code (Div. 2; Sec. 22-68), and also by consequence of

			52-19-06-200-013, 52-19-06-200-002, 52-19-06-200-014, 52-19-06-202-012, 52-19-06-202-010, 52-19-06-202-009, 52-19-06-202-008, 52-19-06-202-007, 52-19-06-202-008, 52-19-06-202-009, 52-19-06-202-010, 52-19-06-201-002, 52-19-06-201-003, 52-19-06-201-004, 52-19-06-127-006, 52-19-06-127-012, 52-19-06-127-021, 52-19-06-127-007, 52-19-06-127-013, 52-19-06-127-014, 52-19-06-127-008, 52-19-06-127-015, 52-19-06-127-016, 52-19-06-127-020, 52-19-06-127-017, 52-19-06-127-009,	standards are achieved. Prevent inhalation of vapors in indoor air inhalation in excess of NCP and State EPA risk management criteria. Prevent tampering and removal of any existing VI mitigation systems.	municipal ownership of most of the Site. Restrictive Covenants for all impacted parcels will be recorded at Emmet County Recorder's Office by 12/23/2020 (planned)
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			52-19-06-127-030, 52-19-06-127-031, 52-19-06-127-032, 52-19-06-127-129, 52-19-06-127-035, 52-19-06-127-036, 52-19-06-127-037 (See Figure 4)		
<i>Bayfront Park and Neighboring City Property North and Northwest of the PMC Footprint (properties over the plume not yet developed)</i>	Yes	No	52-19-06-201-003, 52-19-06-201-002, 52-19-06-201-004	Prohibit groundwater use until cleanup standards are achieved. VI mitigation systems will be required if commercial buildings are developed. Prohibit future residential development.	City of Petoskey Code (Div. 2; Sec. 22-68), and also by consequence of municipal ownership of most of the Site. Restrictive Covenants (planned)
<i>Vapor Intrusion – properties with VI mitigation systems</i>	Yes	No	52-19-06-206-109, 52-19-06-206-110, 52-19-06-206-111, 52-19-06-206-112, 52-19-06-206-113, 52-19-06-206-114, 52-19-06-206-115, 52-19-06-206-116, 52-19-06-206-117, 52-19-06-206-107, 52-19-06-206-108, 52-19-06-206-106,	To ensure continued operation of vapor intrusion mitigation systems installed preemptively by EPA until soil gas concentrations reach target levels.	Restrictive Covenants (planned)

			52-19-06-206-105, 52-19-06-206-104, 52-19-06-206-103, 52-19-06-206-102, 52-19-06-206-101, 52-19-06-127-009		
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Notes: Figure 4 contains a map showing the area in which the ICs apply.

Status of ICs: All institutional or other controls required in the RODs are in place and effective. Additional ICs are needed to address the VI pathway, as shown in Table 2.

Current Compliance: Based on the Site inspection and interviews, EPA is not aware of Site or media uses that are inconsistent with the stated objectives to be achieved by the ICs.

IC Follow-up Actions Required: In summary, the required follow-up actions are:

- Finalize and implement the IC Implementation and Assurance Plan (ICIAP).
- Develop and implement long-term stewardship (LTS) procedures in an appropriate plan.
- Amend the Restrictive Covenant on the PMC property to address the VI pathway.
- Implement Restrictive Covenants on properties over the plume not yet developed where residential use should be restricted due to VI potential and where VI mitigation systems (VIMS) would be required if commercial buildings were developed.
- The City of Petoskey should update its current groundwater ordinance.
- Implement Restrictive Covenants at the specified properties to ensure continued operation of the VIMS.
- Implement Restrictive Covenants for properties overlying the 5 micrograms per liter (µg/L) groundwater plume exceeding the MCL for TCE, to provide a more specific prohibition on drinking-water well installation.
- Include the additional ICs needed as part of the selected remedy in an upcoming decision document.

Long-Term Stewardship: Since compliance with ICs is necessary to assure the protectiveness of the remedy, planning for LTS is required to ensure that the ICs are maintained, monitored, and enforced so that the remedy continues to function as intended. As noted above, a plan incorporating LTS procedures will be prepared. The plan will include the mechanisms and procedures for inspecting and monitoring compliance with the ICs, as well as communication procedures to ensure that no inconsistent uses have occurred; that ICs remain in place and are effective; and that any necessary contingency actions have been executed. IC reviews will be conducted by EPA to ensure that the ICs remain in place and are effective. Once the site is transferred to the State for operation and maintenance (O&M), the IC reviews will be part of the State responsibility.

Systems Operations/Operation & Maintenance

Eleven residential units and one commercial building with existing operational SSDs or other VIMS require regular O&M. The SSDs and other VIMS components are currently operated and maintained by the State in accordance with the VIMS O&M Plan. The systems are expected to remain in place and operational until complete Site remediation is achieved.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the last FYR, as well as the recommendations from the last FYR and the current status of those recommendations.

Table 4: Protectiveness Determinations/Statements from the 2014 FYR

OU #	Protectiveness Determination	Protectiveness Statement
1 Sitewide	Short-term Protective	The remedy is currently protective of human health and the environment in the short-term. The contaminated Ingalls Municipal Well was removed from service in 1995 and completely demolished in 2006. Redevelopment of the former PMC facility in accordance with restrictive deed covenants has eliminated the possibility of human contact with contaminated soil. ICs are in place to restrict the use of contaminated groundwater. However, in order for the remedy to be protective in the long-term, EPA needs to evaluate the potential for a VI pathway, design and implement a site-specific long-term stewardship plan, and evaluate contingency remedial technologies for groundwater.

Table 5: Status of Recommendations from the 2014 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
01	There is no site-specific plan to address long-term stewardship of institutional controls	Revise the Long-Term Monitoring Plan to add an Institutional Control Implementation and Assurance Plan Section	Ongoing	Not completed yet. An ICIAP will be completed to address the long-term stewardship of ICs; the anticipated completion date is 6/15/2020.	NA
01	There is residential property above the plume; VI has not been evaluated per the new	Evaluate VI to confirm it is not a potential route of exposure to VOCs in groundwater	Completed	A VI evaluation was conducted in 2016 and 2017 by conducting sub-slab and indoor air testing. Results showed that TCE concentrations exceeded the EPA VISL criteria (2.1 ug/m ³) in	April 30, 2018

	guidance/screening levels.			subslab soil samples from 9 of the 11 units sampled, which triggered a time-critical removal action. (See Data Review for a discussion of the results.) Subslab soil probes were installed in the garages of 11 condominium units located at 200 West Lake Street. Based on additional indoor air and subslab samples collected by the EPA Removal Program, temporary household air purifier systems and SSDs were installed in 12 homes and buildings (11 PMC Water Street Condominium Units and one commercial building) to prevent TCE from entering into these buildings.	
01	Contamination concentrations in groundwater do not appear to be decreasing over time.	Evaluate a contingency remedy in a Contingency Remedy Technical Evaluation Memorandum	Considered But Not Implemented	On November 25, 2019, EPA decided that a Contingency Remedy Technical Evaluation Memorandum will not be prepared. It was decided that in lieu of this memorandum, EPA will rely on the supplemental Remedial Investigation and Focused Feasibility Study (FFS) to address the groundwater concentrations.	11/25/2019

In addition, the following recommendations were identified during the 2014 FYR as noted in the following table. The 2014 FYR stated that these recommendations would improve management of the Long-Term Remedial Action but did not affect current or future protectiveness of the Site.

OU #	Recommendation	Current Implementation Status Description	Completion Date (if applicable)
01	Current data indicates that GSI [groundwater-surface water interface] is not an issue at this Site. However, MDEQ suggests additional water level sampling would be helpful to support this conclusion.	Based on the 2019 Supplemental RI Report (the data collected for vapor intrusion), it was determined that there were no exceedances of the MDEQ groundwater/surface water interface criteria in the collected groundwater samples.	July 2019
01	Although sufficiently protective in regard to CERCLA requirements, the City of Petoskey Groundwater Protection Ordinance could be revised to maintain consistency with Michigan regulations and guidance.	EPA's position is that the existing city ordinance "does not threaten the protectiveness of EPA's selected remedy." EPA cannot force the City to amend its ordinance. EPA believes that Michigan should work directly with the City to modify the ordinance to bring the City into compliance with State	March 2020

		regulations. EPA will send a written request to the City requesting to know (1) whether anyone in the previous five years within the Site's area of concern has requested a permit from the City to install a private well, and (2) whether the City ever granted such a request.	
01	1,4-Dioxane is an emerging contaminant found in association with TCE plumes. 1,4 Dioxane has not been analyzed for at the PMC Site in the past, and EPA recently updated its analytical methods for this contaminant. 1,4-Dioxane may need to be added to the analyte list when additional groundwater monitoring is done at the Site.	As part of the Supplemental RI, groundwater samples were also analyzed for 1,4-dioxane from 21 monitoring wells. 1,4-Dioxane was not detected in any of the groundwater samples collected in October 2016. EPA has concluded that 1,4-dioxane is not an issue of concern based on the data collected.	July 2019

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

A public notice was published in the *Petoskey News Review* on March 29, 2019, stating that there was a FYR and inviting the public to submit any comments to EPA (see Attachment 1). However, no comments were received. The results of the review, completed fourth FYR Report, and background data will be available at the Site information repository located at Petoskey Public Library, 500 E. Mitchell Street, Petoskey, Michigan, and at the EPA website (www.epa.gov/superfund/pmc-groundwater) for public viewing.

During the FYR process, interviews were conducted with parties impacted by the Site, including the Petoskey Mayor, City Engineer, Water Street Condominium Association Board of Directors, and representatives from Little Traverse Bay Bands of Odawa. The purpose of the interviews was to document any perceived problems or successes with the remedy that has been implemented to date. The interviews were conducted on June 11, 2019.

During the interviews, the Community Involvement Coordinator (Ruth Muthsen), RPM (Syed Quadri), and State representatives provided a briefing on the Site and plan for the FYR. The interviews revealed a strong community interest in the upcoming soil and groundwater cleanup at the Site. The community is concerned about the contamination located near their houses and would like EPA to perform remediation as soon as practicable.

Data Review

Since the last FYR, two rounds of groundwater samples have been collected by EPA from the Site monitoring wells (Figure 3). One round was conducted in 2016 to support long-term monitoring and the other in 2018 to support the RI. In October 2016, 22 wells were analyzed for VOCs, general chemistry, dissolved gases, total and dissolved metals, and 1,4-dioxane. 1,4-Dioxane analysis was added because of

its status as an emerging contaminant found in association with TCE that had not been previously analyzed at the PMC Site (as documented in the 2014 FYR Report). Table 11 presents the concentrations of chemicals that exceeded one or more screening levels (SLs) in groundwater, except sodium, which is a nutrient. Six total and dissolved metals (manganese, nickel, iron, lead, zinc, and sodium) and one dissolved metal (chromium) were detected at concentrations that exceeded the MDEQ Residential Screening Criteria. Exceedances were limited to 10 of the wells at concentrations within an order of magnitude of respective SLs. 1,4-Dioxane was not detected in any of the groundwater samples collected in October 2016. Of the VOCs, only chloroform (in one sample at 1.8 µg/L below the drinking water standard of 80 µg/L), TCE (at a maximum concentration of 55 µg/L compared to the MCL of 5 µg/L), and vinyl chloride (in one sample at an estimated concentration of 0.24 µg/L, which is below the MCL of 2 µg/L) exceeded one or more SLs.

To support the 2019 Supplementary RI, two wells were installed in the source area (CMW-01 and CMW-02). Vertical profiling of TCE was conducted at CMW-01 by collecting grab groundwater samples from multiple depths prior to installation. Samples from four intervals indicate that concentrations decrease with depth in the former source area. Downgradient of the source area, two shallow/deep well pairs, PS-4/PS-104 and PS-CS/PS-CD, also show 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 from a supply well, which was relocated in 1997. TCE concentrations were highest in well PS-4 (36 µg/L), the same well where the highest concentrations were reported in 2016, indicating a 35 percent decrease in concentrations. Figure 9 shows the distribution of TCE in 2016 and 2018. With one exception, MW-401D, concentrations in 2018 were less than in 2016.

Because the selected remedy for groundwater based on the 1998 ROD is monitored natural attenuation, TCE time-series trend charts were prepared for selected wells with a minimum of four sampling events to evaluate whether natural attenuation is acting to reduce plume concentrations (Figures 4 through 6). A review of the trend charts indicates that concentrations of TCE in the source area wells are stable to decreasing. The last two samples collected from PS-104 (deep well) did not detect TCE. TCE concentrations in this well historically have been less than 10 µg/L, indicating a lack of vertical migration near the source area. Trends at near-source wells PS-CD and MW-402S are generally decreasing, but PS-CS and COP-5R are generally stable. Trends in downgradient well PS-106 initially increased but have been stable since approximately 2008 and trends in PS-11 are decreasing. The stable concentrations in multiple wells indicate that natural attenuation of the plume is limited. In addition, cis-1,2-dichloroethene and vinyl chloride – breakdown products of TCE that might indicate that attenuation through degradation is occurring – were seen in only a few wells historically and were not detected in 2018. The aquifer is generally aerobic; therefore, intrinsic bioremediation via reductive dechlorination is limited. The plume generally appears to be at quasi-equilibrium. The presence of TCE in both the vadose and saturated zones is acting as an ongoing source to groundwater, contributing to the slow attenuation and persistence of the plume.

In 2018, six wells were also sampled for per- and polyfluoroalkyl substances (PFAS) analysis at the request of MDEQ because of the potential for these chemicals to have been used at the site historically but not have been investigated previously. PFAS were detected but not in concentrations greater than the applicable EPA drinking water health advisory levels or MDEQ Residential Shallow Groundwater screening levels.

As part of the Supplementary RI investigation in 2018, 15 soil sampling locations were advanced to collect soil samples and/or deploy multi-depth soil vapor sampling screens (Figure 8). Soil samples were collected from 10 of the 15 borings for VOCs, percent moisture, permanganate natural oxidant demand, and total organic carbon. However, due to refusal from what is interpreted as large boulders or blocks of weathered bedrock, direct-push drilling methods could not be used. The alternate method, rotosonic drilling, heated the cores such that some samples could not be collected, and others may have had VOC loss during drilling biasing sample results low.

Concentrations of TCE in soil found above the residential SL of 940 micrograms per kilogram ($\mu\text{g}/\text{kg}$) fall primarily within the western portion of the former PMC property as shown on Figure 8. In particular, the highest concentration of 2,700 $\mu\text{g}/\text{kg}$ was noted below the water table at SVB-10, indicating that mass is likely present due to groundwater. The highest concentration above the water table is 1,100 $\mu\text{g}/\text{kg}$ at SVB-12 (Figure 8). The data indicate that mass is present in both the vadose and saturated zones. One metal, arsenic, was detected above the residential SL, but these exceedances are not considered site-related contamination and have not impacted groundwater.

The VI investigation began onsite in fall 2016 and was expanded from May 2017 to November 2018 to include surrounding properties. Indoor, crawlspace, outdoor air, and subslab or near-slab soil vapor samples were collected from 25 properties, including 2 properties with multiple condominiums, 1 commercial property, and 22 residential properties with single-family or duplex houses. In addition, 31 exterior multi-depth soil vapor samples were collected from 16 locations across the study area (Figure 9). Samples were analyzed for VOCs. The distribution of TCE in exterior soil vapor is identified north of Lake Street and west of the former PMC property (Figure 8), generally consistent with the distribution of TCE in groundwater (Figure 9). In particular, the highest concentrations of TCE in exterior soil vapor are noted in the western portion of the former PMC property. Samples collected within the footprint of the former PMC site range from 7.4 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) to 5,800 $\mu\text{g}/\text{m}^3$ compared to the EPA VISL of 16 $\mu\text{g}/\text{m}^3$ (Figure 11). Outside of the former PMC Site footprint, concentrations were at least an order of magnitude lower than those observed onsite with the maximum concentration of 390 $\mu\text{g}/\text{m}^3$ detected at SVB-05 downgradient of the former site, along the groundwater flow path.

The VI investigation was conducted at the former PMC site (Water Street Condominiums) and adjacent properties as shown on Figure 8. Table 6 summarizes the concentrations of TCE detected in collected samples. At the Water Street Condominiums, TCE was detected beneath 9 of 11 units, with the highest concentrations at 15,400 $\mu\text{g}/\text{m}^3$ compared to the EPA VISL of 16 $\mu\text{g}/\text{m}^3$ (Table 7). No exceedances were noted in samples collected at the nearby Sunset Shores Condominiums (to the north of the former PMC Site). Of the 22 private properties investigated near the PMC site, only 4 reported concentrations above EPA residential VISLs. These properties (shown on Figure 8) are located downgradient or adjacent to the former PMC Site. Of these four properties, only one reported an exceedance in the building (Property 39). To mitigate the potential for VI at properties where exceedances were noted, EPA installed SSDs as described previously.

TCE vapor sources were identified both in the vadose zone and groundwater at the historical source area, although TCE source strength appears to be greater from groundwater. This conclusion is supported by the mass partitioning analysis conducted and documented in the RI. Remedial alternatives to address TCE in soil vapor and sources of the TCE are being evaluated by EPA.

Site Inspection

The inspection of the Site was conducted on June 11, 2019. In attendance were Syed Quadri and Ruth Muthsun of EPA; Beth Mead-O'Brien and Barb Vetort of EGLE; Rachel Grand of Jacobs Engineering, and Traven Michaels of Little Traverse Bay Band of Odawa Indians. The purpose of the inspection was to assess the protectiveness of the remedy. The remedy is monitored natural attenuation of groundwater to address TCE concentrations in groundwater. However, the current remedy is not adequately addressing the VI issues at the site and the plume is not attenuating rapidly; thus a supplemental RI/FFS is being prepared to address these issues. The monitoring wells were found to be intact, and Site conditions had not changed since the 2014 FYR.

IV. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents? No.

Question A Summary:

The soil and groundwater remedy defined in the 1998 ROD continues to provide benefits to human health and the environment through implementation of effective ICs and the residual benefits of the previous excavation of contaminated soil and SVE. However, natural attenuation of the groundwater TCE plume is not occurring at a rapid enough rate and VI has been found to be an exposure pathway of concern. EPA plans to select a new remedy to address contaminated soil and groundwater, the source of VI, which currently poses the greatest risk to human health. VIMS installed by EPA are preventing VI exposure in the buildings with the highest potential risk. A Supplemental RI and Human Health Risk Assessment (HHRA) were completed; a FFS identifying potential remedial alternatives to address contaminated groundwater and soil (source area for VI) has been drafted and is expected to be completed by March 31, 2020.

Remedial Action Performance

An evaluation of the time-series trends of TCE indicate that TCE concentrations are generally stable, although some wells show decreasing trends. Attenuation is primarily occurring through volatilization and dispersion, but intrinsic bioremediation via reductive dechlorination is very limited. As a result, the plume is generally at quasi-equilibrium. The presence of TCE in the vadose and saturated zones is acting as an ongoing source to groundwater, contributing to the slow attenuation and persistence of the plume. The lack of plume attenuation, combined with the presence of TCE in soil gas above screening levels, has resulted in the need for implementation of pre-emptive mitigation at properties with identified risk, completion of the 2018 Supplemental RI, and a remedy evaluation (to be presented in the FFS) to further address TCE in source area soil, groundwater, and soil gas.

Implementation of Institutional Controls and Other Measures

ICs on the former PMC property (now the Water Street Condominiums) were implemented when a restrictive covenant was recorded in May 2005. The existing ICs on the former PMC property remain protective because they prohibit contact with soil and prevent groundwater use. No groundwater usage was observed during the FYR site visit. However, the existing restrictive covenant needs to be amended to address the VI pathway. Restrictive covenants are needed on properties over the plume where development has not yet taken place to restrict residential use due to VI potential and where VIMS would be required if commercial buildings were developed. ICs are also needed on other specific

properties to ensure continued operation of VIMS installed preemptively by EPA until soil gas concentrations reach target levels.

The municipal ordinance (i.e., the groundwater use restriction ordinance contained in the Petoskey City Code Section 22-68) has successfully prevented the installation of any drinking water wells on the rest of the Site. The ordinance is in place, protective, and enforceable. However, it is not consistent with certain State administrative requirements; for example, exceptions to the ordinance are permitted with regulatory approval and the ordinance does not contain State required model language. EPA plans to pursue restrictive covenants for properties overlying the 5 µg/l groundwater plume to provide a more specific prohibition on drinking water well installation to supplement the existing City of Petoskey code.

An ICIAP has been drafted and needs to be finalized and implemented. A plan incorporating LTS procedures needs to be developed and implemented to include the mechanisms and procedures for inspecting and monitoring compliance with the ICs as well as communications procedures.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid? No.

Question B Summary:

The MDEQ Part 201 generic Cleanup Criteria and Screening Level Tables were updated in 2018. The contaminants 1,4-dioxane and PFAS were identified as emerging contaminants at some sites. As discussed above, neither has been detected above relevant screening levels at this site. In addition, EPA conducted a VI HHRA as part of the July 2019 RI. The 2019 VI HHRA has changed risk conclusions pertaining to the future residential indoor air pathway and provided additional information pertaining to the current/future direct contact pathway with soil.

Changes in Standards and TBCs

The EGLE Part 201 generic Cleanup Criteria and Screening Level Tables were updated in 2018.

Updated groundwater volatilization to indoor air criteria were provided by EGLE via email on May 9, 2018. The criteria are defined as the “PMC Groundwater Site-Specific Volatilization to Indoor Air Criteria” promulgated under Part 201 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, which represent State’s determination of values that reflect best available information regarding the toxicity and exposure risks posed by the hazardous substances present at the PMC Groundwater Superfund Site.

Changes in Risk Assessment Methods

At the time of the 1998 ROD, VI screening criteria were higher and resulted in the conclusion that VI was not a concern. Since that time, new VI methodology and screening criteria (please see Table 7 for State and EPA VI screening criteria) from EPA and the State have been promulgated. Concentrations of TCE below the former PMC building (redeveloped as the Water Street Condominiums) exceed (please see Table 7 for TCE concentrations detected at the PMC Site) the updated VI screening criteria.

The 2019 HHRA concluded current residential and commercial/industrial receptors were not exposed to unacceptable risk because mitigation systems had been installed in units where concentrations outside

the risk management range had been observed. However, some of the areas that may be developed in the future for residential use may have unacceptable risk if SSDs or VIMS were not applied in the construction process. Furthermore, EPA VI guidance states that mitigation systems should only be an interim protection and remediation of source material should be pursued.

Changes in Exposure Pathways

The HHRA conducted as part of the July 2019 RI assessed pathways, including:

- Residential adults and children living in residential properties who could contact chemicals of potential concern in indoor air and crawl space air, and
- Industrial/commercial workers who could contact soil beneath the site after it was demolished in 2004.

Both current and potential future exposures were considered for these exposure scenarios. In the VI portion of the HHRA, condominium units and buildings with existing SSDs or other VIMS were not evaluated because they were being mitigated.

The HHRA concluded that one pathway has changed (the future scenario for currently undeveloped residential property) and further information on direct contact with soil has been refined, as follows:

- TCE is a potential COC for the residential VI pathway if future residences were to be developed without using SSDs or VIMS within specific portions of the site.

Migration of groundwater to surface water is a recognized exposure pathway in the 1998 ROD as part of the remedy/monitored natural attenuation process. Quantitative data has not been collected at the interface of groundwater to surface water although the groundwater data was compared to groundwater to surface water interface screening levels and there are wells located very close to Lake Michigan.

Expected Progress Towards Meeting RAOs

The remedy is progressing more slowly than expected and is not likely to meet RAOs in a reasonable timeframe; therefore, EPA prepared a Supplemental RI and draft FFS in July 2019 to further investigate the sources areas and evaluate remedial alternatives that address TCE in soil, groundwater, and soil gas.

The Supplemental RI report shows that both vadose-zone soil and groundwater have been identified as sources that contribute to the VI potential. For the draft FFS, the elements of the groundwater remedy selected in the 1998 ROD essentially form a baseline for the remedial actions evaluated in the draft FFS. This includes existing ICs and monitored natural attenuation.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy? Yes.

The groundwater level at the Site is influenced by the stage of Lake Michigan. Predicted rising lake water levels will likely enhance dispersion and volatilization of the plume. Rising groundwater levels may also increase the potential for VI.

VI. ISSUES/RECOMMENDATIONS

Issues and Recommendations Identified in the Five-Year Review:

OU(s): 1/Sitewide	Issue Category: Institutional Controls			
	Issue: Documents and procedures should be developed and implemented to ensure that implemented ICs are effective and properly maintained, monitored, and enforced.			
	Recommendation: Complete and implement the ICIAP.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	EPA/State	6/15/2020

OU(s): 1/Sitewide	Issue Category: Institutional Controls			
	Issue: Procedures are not in place to ensure LTS of ICs at the Site.			
	Recommendation: Develop and implement a plan for LTS of ICs.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	EPA/State	12/30/2020

OU(s): 1/Sitewide	Issue Category: Institutional Controls			
	Issue: VI has been identified as a new exposure pathway of concern.			
	Recommendation: Amend the 2005 restrictive covenant for the PMC property to address the VI pathway.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	EPA/State	12/30/2020

OU(s): 1/Sitewide	Issue Category: Institutional Controls			
	Issue: VI has been identified as a new exposure pathway of concern.			

	Recommendation: Implement additional ICs on properties to ensure continued operation of vapor intrusion mitigation systems installed preemptively by EPA until soil gas concentrations reach target levels.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	EPA/State	12/30/2020

OU(s): 1/Sitewide	Issue Category: Institutional Controls			
	Issue: VI has been identified as a new exposure pathway of concern.			
	Recommendation: Implement additional ICs on properties over the TCE plume to prevent residential use and require VI mitigation systems installed on the property being developed.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	EPA/State	12/30/2020

OU(s): 1/Sitewide	Issue Category: Institutional Controls			
	Issue: Additional ICs to restrict use of TCE contaminated groundwater.			
	Recommendation: Implement restrictive covenants for properties overlying the 5 µg/l TCE groundwater plume to provide a more specific prohibition on drinking water well installation and to supplement the existing City of Petoskey code.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	EPA/State	12/30/2020

OU(s): 1/Sitewide	Issue Category: Changed Site Conditions			
	Issue: The existing remedy does not address VI and does not include all necessary ICs for the site, and attenuation of groundwater concentrations is not occurring rapidly enough.			
	Recommendation: Issue a new decision document addressing groundwater and soils as sources of VI and requiring additional ICs.			

Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	EPA	EPA/State	12/30/2020

OTHER FINDINGS

In addition, the following recommendations were identified during the FYR, but do not affect current or future protectiveness:

- Prepare an updated map showing all areas where ICs are needed.
- Prepare an updated O&M Plan to specify routine maintenance activities for the upgraded groundwater plume and to include information about long-term groundwater monitoring.
- Conduct an evaluation of the existing monitoring well network to see if any additional wells are required.
- Prepare a monitoring well abandonment plan for the PMC Site.
- Collect another round of monitoring wells samples (to include some deeper wells and address seasonal variations) to confirm that PFOA and PFOS are not contaminants of concern for the PMC Site.
- Although sufficiently protective in regard to CERCLA requirements, the City of Petoskey Groundwater Protection Ordinance should be revised to maintain consistency with EGLE regulations and guidance.

VII. PROTECTIVENESS STATEMENT

OU1 and Sitewide Protectiveness Statement(s)
<p><i>Protectiveness Determination:</i> Short-term Protective</p>
<p><i>Protectiveness Statement:</i> The remedy is currently protective of human health and the environment. The contaminated Ingalls municipal well was removed from service in 1995 and completely demolished in 2006. Redevelopment of the former PMC property in accordance with restrictive deed covenants has eliminated the possibility of human contact with contaminated soil. ICs are also in place to restrict the use of contaminated groundwater. A long-term groundwater monitoring program monitors the progress of concentrations toward regulatory thresholds. However, in order for the remedy to be protective in the long term, the following actions need to be taken to ensure protectiveness:</p> <ul style="list-style-type: none"> • Complete and implement the ICIAP. • Develop and implement a plan for LTS of ICs. • Amend existing ICs. • Implement additional ICs.

- Issue a new decision document addressing groundwater and soils as sources of VI and requiring additional ICs.

VIII. NEXT REVIEW

The next FYR report for the PMC Groundwater Superfund Site is required 5 years from the completion date of this review.

APPENDIX A – REFERENCE LIST

CH2M HILL, Inc. (CH2M). 2013. Memorandum Technical Impracticability of Groundwater Restoration, Petoskey Manufacturing Company Superfund Site, Petoskey, Michigan.

CH2M HILL, Inc. (CH2M). 2016a. Uniform Federal Policy–Quality Assurance Project Plan, PMC Groundwater Site, Emmet County, MI.

CH2M HILL, Inc. (CH2M). 2016b. Revised Sampling Approach Technical Memorandum-PMC Groundwater Superfund Site, Petoskey, Michigan.

CH2M HILL, Inc. (CH2M). 2017. Technical Memorandum-Proposed Approach to Complete Nature and Extent Delineation of the PMC Groundwater Site, Emmet County, Michigan.

CH2M HILL, Inc. (CH2M). 2018a. Technical Memorandum Vapor Intrusion Investigation – PMC Groundwater Site, Emmet County, Michigan.

CH2M HILL, Inc. (CH2M). 2018b. Quality Assurance Project Plan, PMC Groundwater Superfund Site, Operable Unit 2.

CH2M HILL, Inc. (CH2M). 2019a. Remedial Investigation Report, Operable Unit 2, Petoskey Manufacturing Company Groundwater Superfund Site. July.

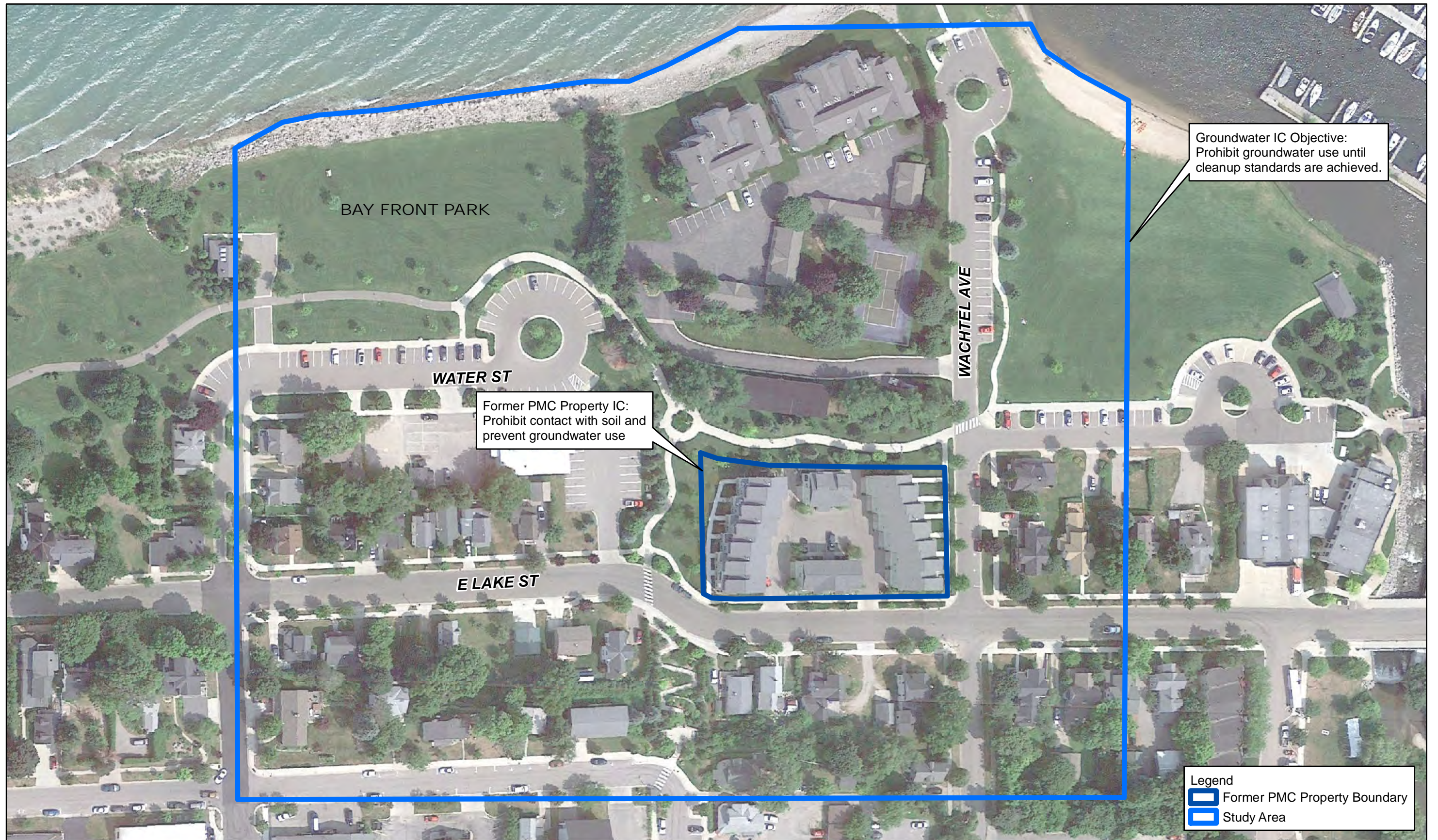
CH2M HILL, Inc. (CH2M). 2019b. Focused Feasibility Study, Operable Unit 2, Petoskey Manufacturing Company Groundwater Superfund Site. July.

APPENDIX B – FIGURES



Figure 1
 Site Location Map
 Five-Year Review
 PMC Groundwater Superfund Site
 Petoskey, Michigan





Groundwater IC Objective:
Prohibit groundwater use until
cleanup standards are achieved.

Former PMC Property IC:
Prohibit contact with soil and
prevent groundwater use

Legend
 [Blue Outline] Former PMC Property Boundary
 [Blue Box] Study Area

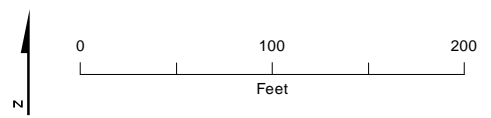
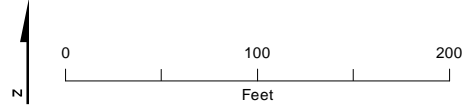


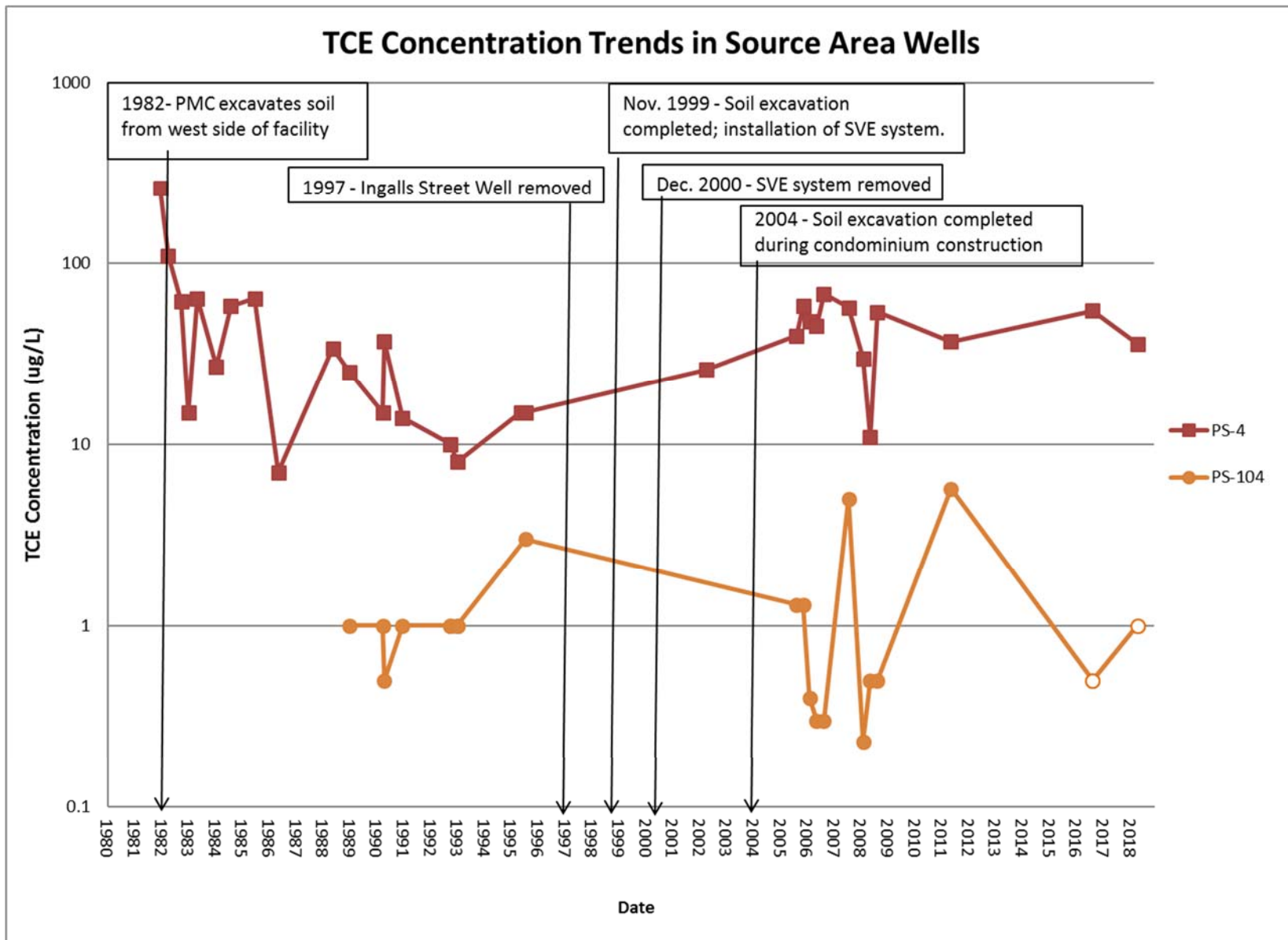
Figure 2
 Site Institutional Controls
 Five-Year Review
 PMC Groundwater Superfund Site
 Petoskey, Michigan



Note:
 1. Soil and/or groundwater grab samples were taken at all SVB- and CMW- locations except for SVB-01, SVB-03, and SVB-04 (where only exterior soil vapor samples were collected).

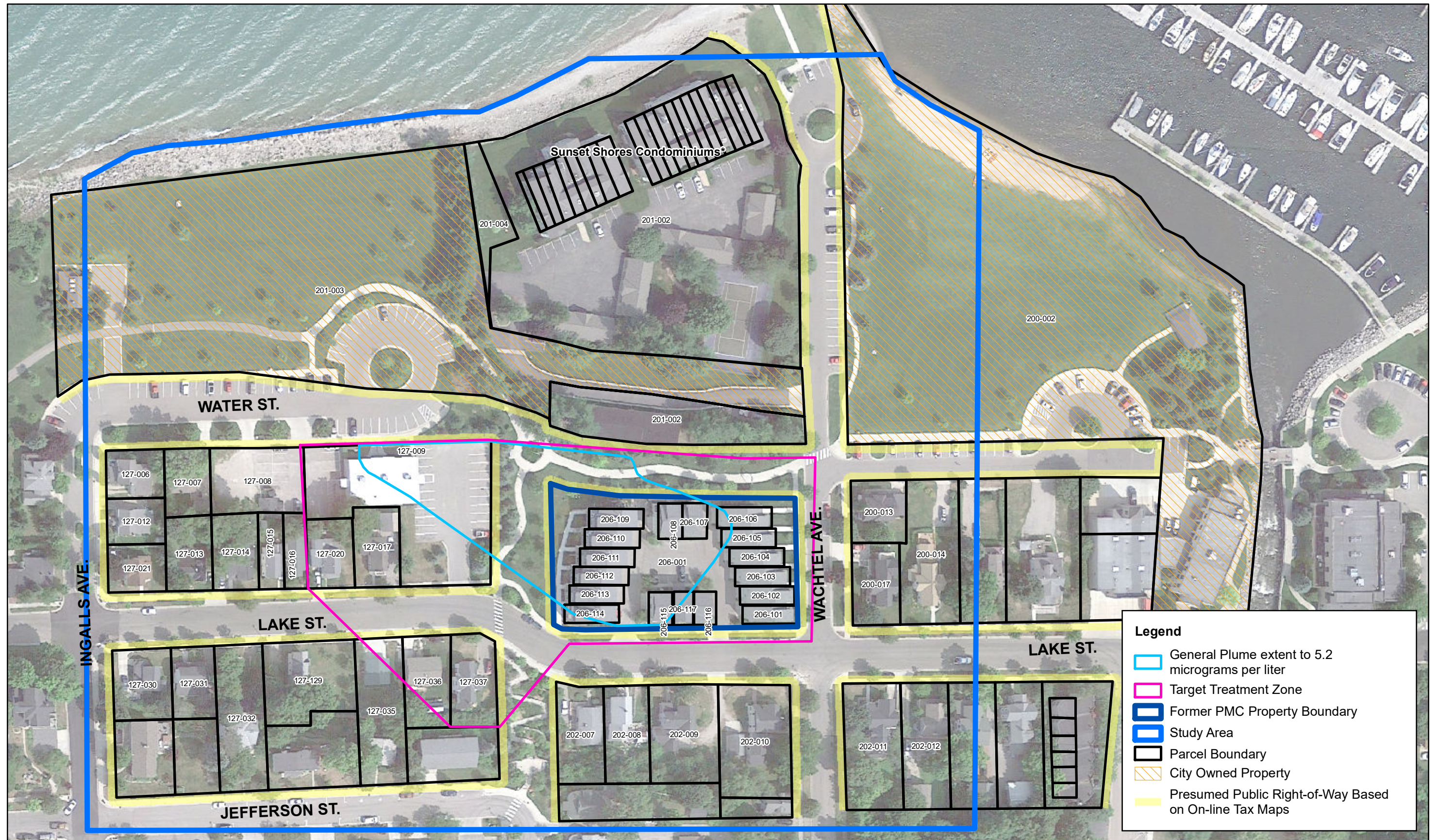
Figure 3
 Sample Location Map
 Five-Year Review
 PMC Groundwater Superfund Site
 Petoskey, Michigan





Note:
White filled circles indicate TCE was not detected.

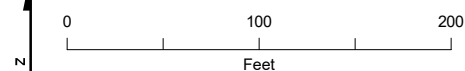
Figure 4
Source Area Well Trends
Five-Year Review
PMC Groundwater Superfund
Site Petoskey, Michigan



Legend

- General Plume extent to 5.2 micrograms per liter
- Target Treatment Zone
- Former PMC Property Boundary
- Study Area
- Parcel Boundary
- City Owned Property
- Presumed Public Right-of-Way Based on On-line Tax Maps

Imagery Date: 8/14/2014
Google Earth.



NOTES:
 * = Parcel boundaries for Sunset Shores Condominiums shown as depicted on Emmet county GIS site, which do not reflect the actual shape of the condominium units which are single story units in a building three stories high.
 Parcel ID's start with: 52-19-06-XXX-XXX
 Parcels not labeled are not of interest

SOURCE: Emmet County, GIS

Figure 5
 Target Treatment Zones
 Focused Feasibility Study
 PMC Groundwater Superfund Site
 Petoskey, Michigan



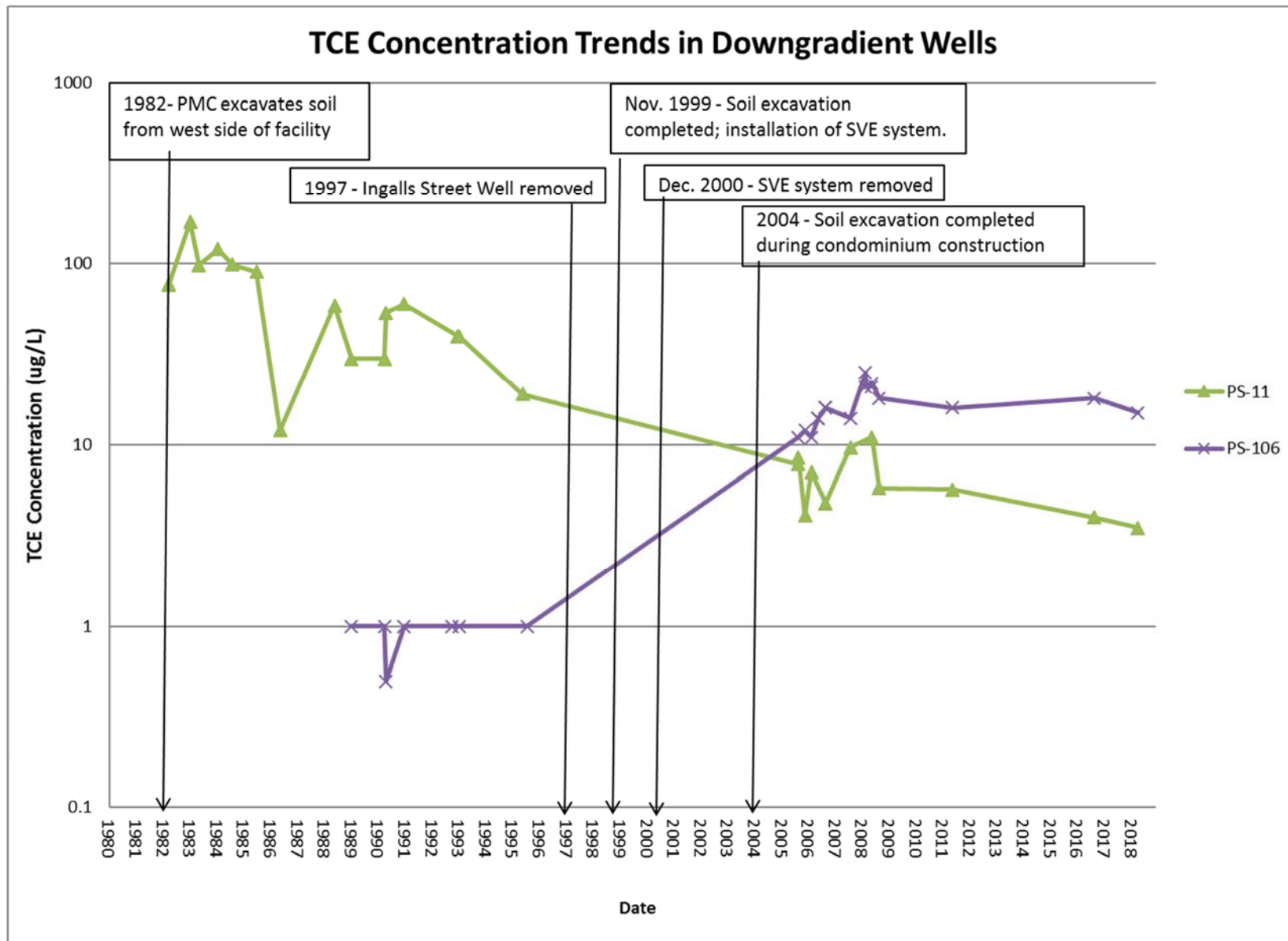
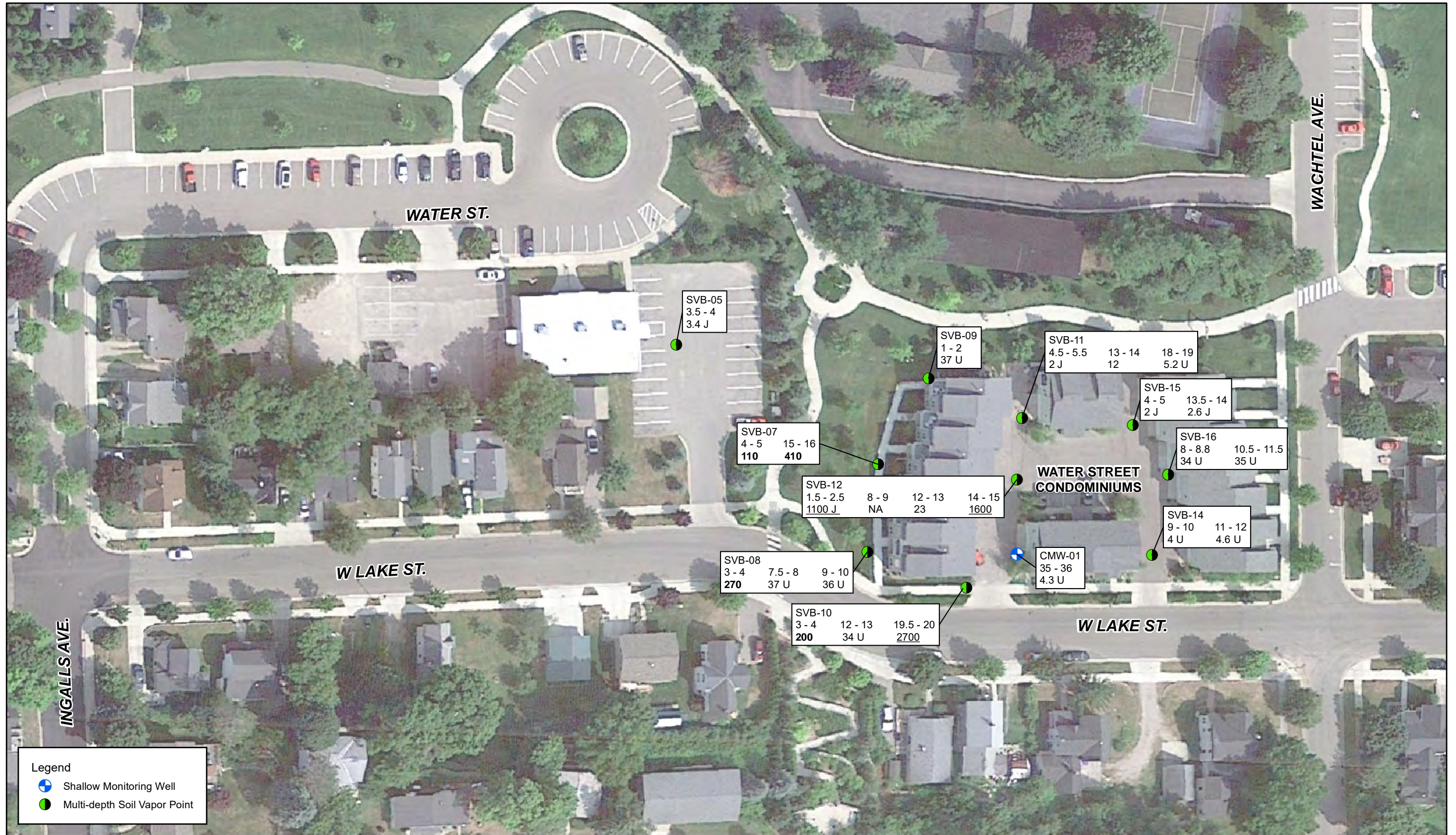


Figure 6
 Downgradient Well Trends
 Five-Year Review
 PMC Groundwater Superfund
 Site Petoskey, Michigan



EPA Residential Soil RSL	¹ (µg/kg)
Trichloroethylene (TCE)	940

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

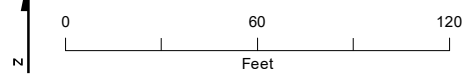
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
 U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

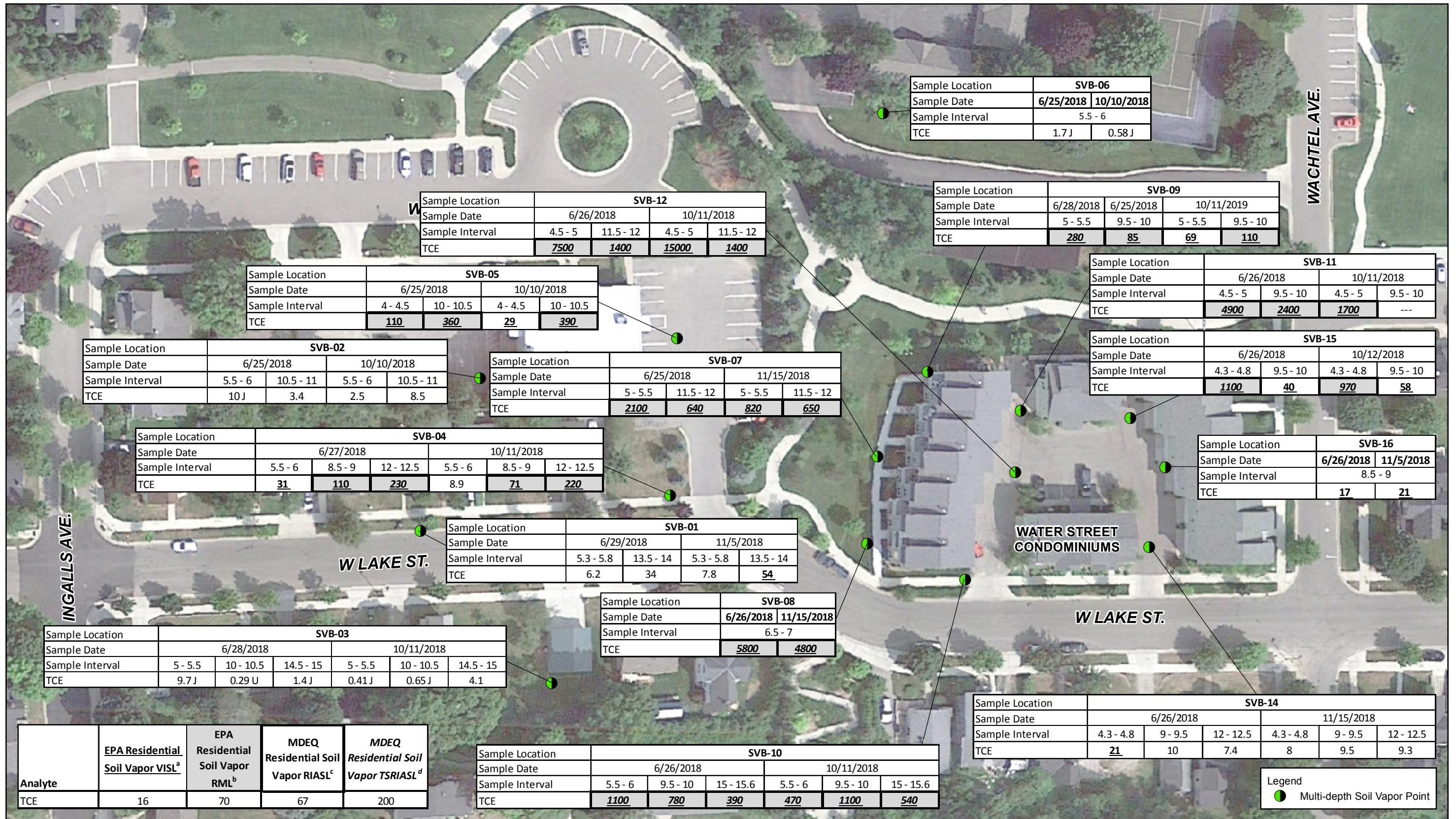
- The EPA Residential Soil Regional Screening Levels (RSLs; EPA, November 2017) are based on a TCR of 1×10^{-6} and a THQ of 1. Exceedances of this criterion are underlined.
- The MDEQ Residential Volatilization to Indoor Air Criteria are unrestricted site-specific criteria that apply to a residential 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.

- At this site, the soil samples were frequently hot (> 212° F) due the difficult drilling and thus are expected to underestimate actual VOC concentrations. The hottest samples were those collected from the vadose zone below the first encounter with the crushed rock/rock fragments which is noted as "hard drilling" or "hot, hard drilling" on some of the boring logs. Samples collected below the water table were somewhat cooler than those in the "hard drilling" portions of the vadose zone.

Figure 7
 Soil Sample Results
 Five-Year Review
 PMC Groundwater Superfund Site
 Petoskey, Michigan





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 detection 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 10⁻⁶ 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
 Five-Year Review
 PMC Groundwater Superfund Site
 Petoskey, Michigan





Notes:
 µg/L = Micrograms per Liter
 MCL = Maximum contaminant limit
 RSL = Regional Screening Level
 2016 Screening Criteria:
 a Maximum Contaminant Limits (MCLs) for Drinking Water (EPA, May 2009) and MDEQ criteria for Residential Drinking Water (MDEQ 2013). Selection Basis: The lower value of the EPA MCL and MDEQ Part 201 Residential Criteria was selected as the final screening level for that chemical.
 b VISL Calculator, Version 3.4, Target Groundwater Concentration (EPA, May 2016). The VISLs are based on a carcinogenic risk of 1 × 10⁻⁶ and a non-carcinogenic hazard quotient of 1.
 c MDEQ Residential Vapor Intrusion Groundwater Screening levels (MDEQ, May 2013).
 d MDEQ Groundwater Surface Water Interface (GSI) Criteria (MDEQ, May 2013).
 2018 Screening Criteria:
 e 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.
 f 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.
 g The MDEQ residential shallow groundwater media-specific volatilization to indoor air recommended interim action screening levels (RIASLs; MDEQ, August 2017).

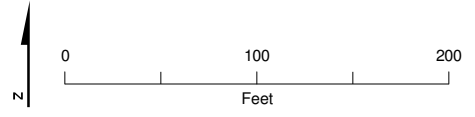
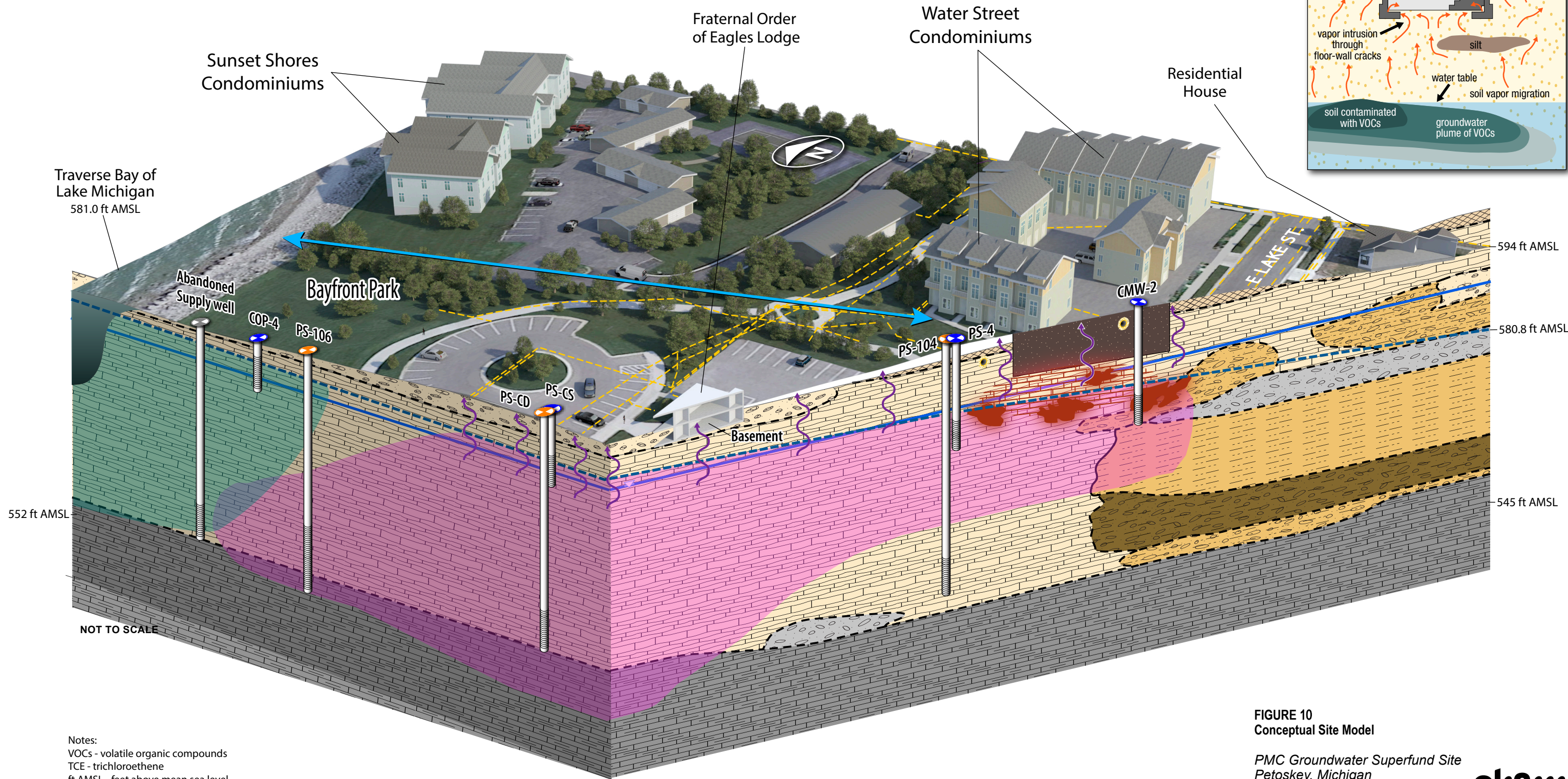
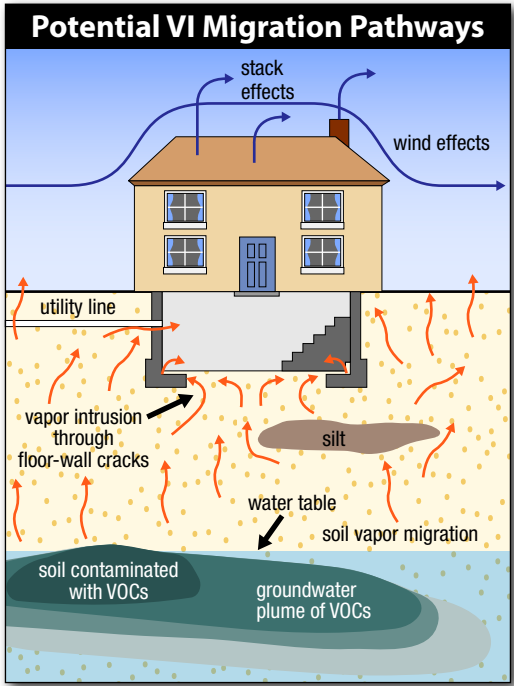
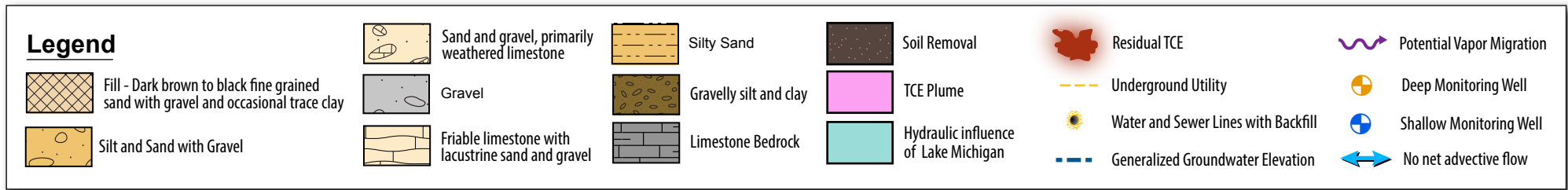


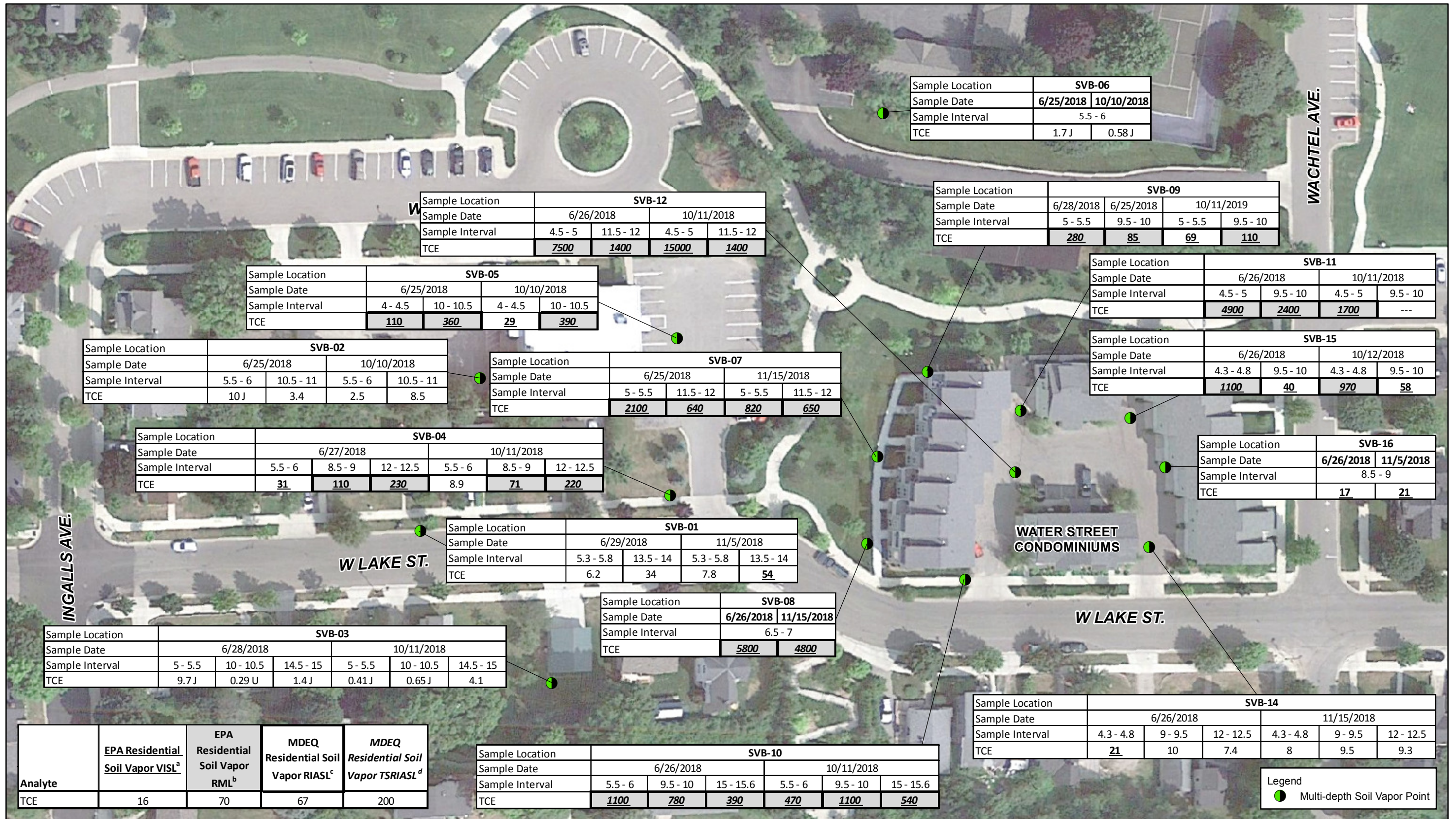
Figure 9
 Results in Groundwater - 2016 and 2018
 Five-Year Review
 PMC Groundwater Superfund Site
 Petoskey, Michigan





Notes:
 VOCs - volatile organic compounds
 TCE - trichloroethene
 ft AMSL - feet above mean sea level

FIGURE 10
Conceptual Site Model
 PMC Groundwater Superfund Site
 Petoskey, Michigan

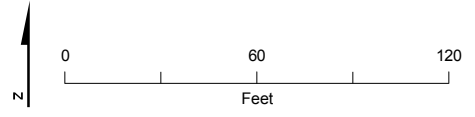


Notes:
 J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
 MDEQ = Michigan Department of Environmental Quality
 MDL = method detection limit
 RL = reporting limit
 Sample Intervals are in feet below ground surface
 TCE = 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 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 10⁻⁶ 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 11
 TCE Results in Exterior Soil Vapor Remedial Investigation
 PMC Groundwater Superfund Site
 Petoskey, Michigan





Imagery Date: 8/14/2014
 Google Earth.



Figure 12
 Properties Included in the Vapor Intrusion Investigation
 PMC Groundwater Site
 Petoskey, Michigan



EPA Begins Review of PMC Groundwater Superfund Site Petoskey, Michigan

U.S. Environmental Protection Agency is conducting a five-year review of the PMC Groundwater Superfund site – formerly the Petoskey Municipal Well Field - at 200 W. Lake St. in Petoskey. The Superfund law requires regular checkups of sites that have been cleaned up – with waste managed on-site – to make sure the cleanup continues to protect people and the environment. This is the fourth review of the site.

EPA's cleanup included removal and off-site disposal of contaminated soil, installation and operation of a soil vapor extraction system, monitored natural attenuation of the groundwater, long-term monitoring, and limits on use of the site and site access. Long-term monitoring and groundwater cleanup continues in an area under Water Street and Bayfront Park.

More information is available at the Petoskey Public Library, 500 E. Mitchell St., and at www.epa.gov/superfund/pmc-groundwater. The review should be completed by the end of December 2019.

The five-year review is an opportunity for you to tell EPA about site conditions and any concerns you have. Contact:

Heriberto Leon
Community Involvement
Coordinator
312-353-1325
leon.heriberto@epa.gov

Syed Quadri
Remedial Project Manager
312-886-5736
quadri.syed@epa.gov

Call EPA toll-free at 800-621-8431, 9:30 a.m. weekdays.

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Attachment 2
Site Photographs



Attachment 2
Site Photographs



Attachment 2
Site Photographs



Attachment 3

Five-Year Review Site Inspection Checklist

(Working document for site inspection. Information may be completed by hand and attached to the Five-Year Review report as supporting documentation of site status. "N/A" refers to "not applicable.")

I. SITE INFORMATION			
Site name: PMC Groundwater Superfund Site	Date of inspection: 6/11/2019		
Location and Region: Petoskey, MI Region 5	EPA ID: 0554		
Agency, office, or company leading the five-year review: USEPA	Weather/temperature: Sunny and clear, 72 °F		
Remedy Includes: (Check all that apply) <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <input type="checkbox"/> Landfill cover/containment <input type="checkbox"/> Access controls <input type="checkbox"/> Institutional controls <input type="checkbox"/> Groundwater pump and treatment <input type="checkbox"/> Surface water collection and treatment <input type="checkbox"/> Other _____ _____ </td> <td style="width: 50%; vertical-align: top;"> <input checked="" type="checkbox"/> Monitored natural attenuation <input type="checkbox"/> Groundwater containment <input type="checkbox"/> Vertical barrier walls </td> </tr> </table>		<input type="checkbox"/> Landfill cover/containment <input type="checkbox"/> Access controls <input type="checkbox"/> Institutional controls <input type="checkbox"/> Groundwater pump and treatment <input type="checkbox"/> Surface water collection and treatment <input type="checkbox"/> Other _____ _____	<input checked="" type="checkbox"/> Monitored natural attenuation <input type="checkbox"/> Groundwater containment <input type="checkbox"/> Vertical barrier walls
<input type="checkbox"/> Landfill cover/containment <input type="checkbox"/> Access controls <input type="checkbox"/> Institutional controls <input type="checkbox"/> Groundwater pump and treatment <input type="checkbox"/> Surface water collection and treatment <input type="checkbox"/> Other _____ _____	<input checked="" type="checkbox"/> Monitored natural attenuation <input type="checkbox"/> Groundwater containment <input type="checkbox"/> Vertical barrier walls		
Attachments: <input type="checkbox"/> Inspection team roster attached <input type="checkbox"/> Site map attached			
II. INTERVIEWS (Check all that apply)			
1. O&M site manager _____ N/A _____ <div style="display: flex; justify-content: space-between; margin-left: 100px;"> Name Title Date </div> Interviewed <input type="checkbox"/> at site <input type="checkbox"/> at office <input type="checkbox"/> by phone Phone no. _____ Problems, suggestions; <input type="checkbox"/> Report attached _____ _____			
2. O&M staff _____ <div style="display: flex; justify-content: space-between; margin-left: 100px;"> Name Title Date </div> Interviewed <input type="checkbox"/> at site <input type="checkbox"/> at office <input type="checkbox"/> by phone Phone no. _____ Problems, suggestions; <input type="checkbox"/> Report attached _____ _____			

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency: Michigan Department of Environment, Great Lakes and Energy (EGLE)
 Contact Beth Mead-O'Brien Project Manager 6/11/19
 Name Title Date

Problems; suggestions; Report attached EPA needs to incorporate the entire site in remedy selection. Aquifer restoration needs to be a remedy consideration. Need to look at the groundwater surface water interface and update the ordinances. The restrictive covenant needs to be updated to include vapor intrusion.

Agency: Little Traverse Band Bay of Odawa Indians
 Contact Traven Michaels Environmental Response Specialist 6/11/19
 Name Title Date

Problems; suggestions; Report attached: The tribe requests more engagement from EPA. Also requesting a site visit/tour from EPA.

Agency City of Petoskey
 Contact John Murphy Mayor 6/11/19
 Name Title Date

Problems; suggestions; Report attached. Suggests public meetings be held in the spring, summer or early fall. Many residents leave in the winter.

Agency Water Street Condominium Board
 Contact Dave Domann Board president 6/11/19
 Name Title Date

Problems; suggestions; Report attached _____

4. **Other interviews** (optional) Report attached.



III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	O&M Documents	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	<input type="checkbox"/> O&M manual			
	<input type="checkbox"/> As-built drawings	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input type="checkbox"/> N/A
	<input type="checkbox"/> Maintenance logs	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input type="checkbox"/> N/A
	Remarks _____			
2.	Site-Specific Health and Safety Plan	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	<input type="checkbox"/> Contingency plan/emergency response plan	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	Remarks _____			
3.	O&M and OSHA Training Records	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	Remarks _____			
4.	Permits and Service Agreements	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	<input type="checkbox"/> Air discharge permit	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	<input type="checkbox"/> Effluent discharge	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	<input type="checkbox"/> Waste disposal, POTW	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input type="checkbox"/> N/A
	<input type="checkbox"/> Other permits _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	Remarks _____			
5.	Gas Generation Records	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	Remarks _____			
6.	Settlement Monument Records	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	Remarks _____			
7.	Groundwater Monitoring Records	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	Remarks _____			
8.	Leachate Extraction Records	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	Remarks _____			
9.	Discharge Compliance Records	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	<input type="checkbox"/> Air	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	<input type="checkbox"/> Water (effluent)	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	Remarks _____			
10.	Daily Access/Security Logs	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
	Remarks _____			

IV. O&M COSTS																																									
1.	<p>O&M Organization</p> <p> <input type="checkbox"/> State in-house <input type="checkbox"/> Contractor for State <input type="checkbox"/> PRP in-house <input type="checkbox"/> Contractor for PRP <input type="checkbox"/> Federal Facility in-house <input type="checkbox"/> Contractor for Federal Facility <input type="checkbox"/> Other <u>Not Applicable</u> </p> <hr/>																																								
2.	<p>O&M Cost Records</p> <p> <input type="checkbox"/> Readily available <input type="checkbox"/> Up to date <input type="checkbox"/> Funding mechanism/agreement in place Original O&M cost estimate <u>N/A</u> <input type="checkbox"/> Breakdown attached </p> <p style="text-align: center;">Total annual cost by year for review period if available</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%;">From _____</td> <td style="width: 10%;">To _____</td> <td style="width: 40%;"></td> <td style="width: 20%; text-align: right;"><input type="checkbox"/> Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">Total cost</td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td></td> <td style="text-align: right;"><input type="checkbox"/> Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">Total cost</td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td></td> <td style="text-align: right;"><input type="checkbox"/> Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">Total cost</td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td></td> <td style="text-align: right;"><input type="checkbox"/> Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">Total cost</td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td></td> <td style="text-align: right;"><input type="checkbox"/> Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">Total cost</td> <td></td> </tr> </table>	From _____	To _____		<input type="checkbox"/> Breakdown attached	Date	Date	Total cost		From _____	To _____		<input type="checkbox"/> Breakdown attached	Date	Date	Total cost		From _____	To _____		<input type="checkbox"/> Breakdown attached	Date	Date	Total cost		From _____	To _____		<input type="checkbox"/> Breakdown attached	Date	Date	Total cost		From _____	To _____		<input type="checkbox"/> Breakdown attached	Date	Date	Total cost	
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3.	<p>Unanticipated or Unusually High O&M Costs During Review Period</p> <p>Describe costs and reasons: <u>N/A</u></p> <hr/> <hr/> <hr/> <hr/>																																								
V. ACCESS AND INSTITUTIONAL CONTROLS <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A																																									
A. Fencing																																									
1.	<p>Fencing damaged <input type="checkbox"/> Location shown on site map <input type="checkbox"/> Gates secured <input checked="" type="checkbox"/> N/A</p> <p>Remarks _____</p> <hr/>																																								
B. Other Access Restrictions																																									
1.	<p>Signs and other security measures <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> N/A</p> <p>Remarks _____</p> <hr/>																																								

C. Institutional Controls (ICs)			
1. Implementation and enforcement			
Site conditions imply ICs not properly implemented	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A
Site conditions imply ICs not being fully enforced	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A
Type of monitoring (e.g., self-reporting, drive by)	_____		
Frequency	_____		
Responsible party/agency	_____		
Contact	_____	_____	_____
	Name	Title	Date Phone no.
Reporting is up-to-date	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A
Reports are verified by the lead agency	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A
Specific requirements in deed or decision documents have been met	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A
Violations have been reported	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> N/A
Other problems or suggestions:	<input type="checkbox"/> Report attached		

2. Adequacy			
	<input type="checkbox"/> ICs are adequate	<input type="checkbox"/> ICs are inadequate	<input checked="" type="checkbox"/> N/A
Remarks	_____		

D. General			
1. Vandalism/trespassing			
	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> No vandalism evident	
Remarks	_____		

2. Land use changes on site			
	<input checked="" type="checkbox"/> N/A		
Remarks	_____		

3. Land use changes off site			
	<input type="checkbox"/> N/A		
Remarks	_____		

VI. GENERAL SITE CONDITIONS			
A. Roads			
	<input type="checkbox"/> Applicable	<input type="checkbox"/> N/A	
1. Roads damaged			
	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Roads adequate <input checked="" type="checkbox"/> N/A	
Remarks	_____		

B. Other Site Conditions			
Remarks _____ _____ _____ _____ _____			
VII. LANDFILL COVERS <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A			
A. Landfill Surface-Not Applicable			
1.	Settlement (Low spots) Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map Depth _____	<input type="checkbox"/> Settlement not evident
2.	Cracks Lengths _____ Widths _____ Depths _____ Remarks _____	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Cracking not evident
3.	Erosion Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map Depth _____	<input type="checkbox"/> Erosion not evident
4.	Holes Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map Depth _____	<input type="checkbox"/> Holes not evident
5.	Vegetative Cover <input type="checkbox"/> Trees/Shrubs (indicate size and locations on a diagram) Remarks _____	<input type="checkbox"/> Grass <input type="checkbox"/> Cover properly established	<input type="checkbox"/> No signs of stress
6.	Alternative Cover (armored rock, concrete, etc.) Remarks _____	<input type="checkbox"/> N/A	
7.	Bulges Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map Height _____	<input type="checkbox"/> Bulges not evident

8.	Wet Areas/Water Damage <input type="checkbox"/> Wet areas <input type="checkbox"/> Ponding <input type="checkbox"/> Seeps <input type="checkbox"/> Soft subgrade Remarks _____ _____	<input type="checkbox"/> Wet areas/water damage not evident <input type="checkbox"/> Location shown on site map Areal extent _____ <input type="checkbox"/> Location shown on site map Areal extent _____ <input type="checkbox"/> Location shown on site map Areal extent _____ <input type="checkbox"/> Location shown on site map Areal extent _____	
9.	Slope Instability <input type="checkbox"/> Slides <input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of slope instability Areal extent _____ Remarks _____ _____		
B. Benches <input type="checkbox"/> Applicable <input type="checkbox"/> N/A (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)			
1.	Flows Bypass Bench Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A or okay	
2.	Bench Breached Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A or okay	
3.	Bench Overtopped Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> N/A or okay	
C. Letdown Channels <input type="checkbox"/> Applicable <input type="checkbox"/> N/A (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)			
1.	Settlement Areal extent _____ Depth _____ Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of settlement	
2.	Material Degradation <input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of degradation Material type _____ Areal extent _____ Remarks _____ _____		
3.	Erosion Areal extent _____ Depth _____ Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of erosion	

4.	Undercutting	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> No evidence of undercutting
	Areal extent _____	Depth _____	
	Remarks _____ _____		
5.	Obstructions	Type _____	<input type="checkbox"/> No obstructions
	<input type="checkbox"/> Location shown on site map	Areal extent _____	
	Size _____		
	Remarks _____ _____		
6.	Excessive Vegetative Growth	Type _____	
	<input type="checkbox"/> No evidence of excessive growth		
	<input type="checkbox"/> Vegetation in channels does not obstruct flow		
	<input type="checkbox"/> Location shown on site map	Areal extent _____	
	Remarks _____ _____		
D. Cover Penetrations <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A			
1.	Gas Vents	<input type="checkbox"/> Active	<input type="checkbox"/> Passive
	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition
	<input type="checkbox"/> Evidence of leakage at penetration	<input type="checkbox"/> Needs Maintenance	
	<input type="checkbox"/> N/A		
	Remarks _____ _____		
2.	Gas Monitoring Probes	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition
	<input type="checkbox"/> Evidence of leakage at penetration	<input type="checkbox"/> Needs Maintenance	<input checked="" type="checkbox"/> N/A
	Remarks _____ _____		
3.	Monitoring Wells (within surface area of landfill)	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition
	<input type="checkbox"/> Evidence of leakage at penetration	<input type="checkbox"/> Needs Maintenance	<input checked="" type="checkbox"/> N/A
	Remarks _____ _____		
4.	Leachate Extraction Wells	<input type="checkbox"/> Properly secured/locked	<input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition
	<input type="checkbox"/> Evidence of leakage at penetration	<input type="checkbox"/> Needs Maintenance	<input checked="" type="checkbox"/> N/A
	Remarks _____ _____		
5.	Settlement Monuments	<input type="checkbox"/> Located	<input type="checkbox"/> Routinely surveyed <input checked="" type="checkbox"/> N/A
	Remarks _____ _____		

E. Gas Collection and Treatment <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A		
1.	Gas Treatment Facilities <input type="checkbox"/> Flaring <input type="checkbox"/> Thermal destruction <input type="checkbox"/> Collection for reuse <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____	
2.	Gas Collection Wells, Manifolds and Piping <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____	
3.	Gas Monitoring Facilities (e.g., gas monitoring of adjacent homes or buildings) <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance <input checked="" type="checkbox"/> N/A Remarks _____ _____	
F. Cover Drainage Layer <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A		
1.	Outlet Pipes Inspected <input type="checkbox"/> Functioning <input checked="" type="checkbox"/> N/A Remarks _____ _____	
2.	Outlet Rock Inspected <input type="checkbox"/> Functioning <input checked="" type="checkbox"/> N/A Remarks _____ _____	
G. Detention/Sedimentation Ponds <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A		
1.	Siltation Areal extent _____ Depth _____ <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Siltation not evident Remarks _____ _____	
2.	Erosion Areal extent _____ Depth _____ <input type="checkbox"/> Erosion not evident Remarks _____ _____	
3.	Outlet Works <input type="checkbox"/> Functioning <input type="checkbox"/> N/A Remarks _____ _____	
4.	Dam <input type="checkbox"/> Functioning <input type="checkbox"/> N/A Remarks _____ _____	

H. Retaining Walls		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	Deformations	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Deformation not evident
	Horizontal displacement_____	Vertical displacement_____	
	Rotational displacement_____		
	Remarks_____		

2.	Degradation	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Degradation not evident
	Remarks_____		

I. Perimeter Ditches/Off-Site Discharge		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	Siltation	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Siltation not evident
	Areal extent_____	Depth_____	
	Remarks_____		

2.	Vegetative Growth	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> N/A
	<input type="checkbox"/> Vegetation does not impede flow		
	Areal extent_____	Type_____	
	Remarks_____		

3.	Erosion	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Erosion not evident
	Areal extent_____	Depth_____	
	Remarks_____		

4.	Discharge Structure	<input type="checkbox"/> Functioning	<input checked="" type="checkbox"/> N/A
	Remarks_____		

VIII. VERTICAL BARRIER WALLS		<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	Settlement	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Settlement not evident
	Areal extent_____	Depth_____	
	Remarks_____		

2.	Performance Monitoring	Type of monitoring_____	
	<input type="checkbox"/> Performance not monitored		
	Frequency_____	<input type="checkbox"/> Evidence of breaching	
	Head differential_____		
	Remarks_____		

IX. GROUNDWATER/SURFACE WATER REMEDIES <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
A. Groundwater Extraction Wells, Pumps, and Pipelines <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
1.	Pumps, Wellhead Plumbing, and Electrical <input type="checkbox"/> Good condition <input type="checkbox"/> All required wells properly operating <input type="checkbox"/> Needs Maintenance <input checked="" type="checkbox"/> N/A Remarks _____ _____ _____
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
3.	Spare Parts and Equipment <input type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided Remarks _____ _____
B. Surface Water Collection Structures, Pumps, and Pipelines <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
1.	Collection Structures, Pumps, and Electrical <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
2.	Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
3.	Spare Parts and Equipment <input type="checkbox"/> Readily available <input type="checkbox"/> Good condition <input type="checkbox"/> Requires upgrade <input type="checkbox"/> Needs to be provided Remarks _____ _____

C. Treatment System <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A	
1.	Treatment Train (Check components that apply) <input type="checkbox"/> Metals removal <input type="checkbox"/> Oil/water separation <input type="checkbox"/> Bioremediation <input type="checkbox"/> Air stripping <input type="checkbox"/> Carbon adsorbers <input type="checkbox"/> Filters _____ <input type="checkbox"/> Additive (e.g., chelation agent, flocculent) _____ <input type="checkbox"/> Others _____ <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> Sampling ports properly marked and functional <input type="checkbox"/> Sampling/maintenance log displayed and up to date <input type="checkbox"/> Equipment properly identified <input type="checkbox"/> Quantity of groundwater treated annually _____ <input type="checkbox"/> Quantity of surface water treated annually _____ Remarks _____ _____
2.	Electrical Enclosures and Panels (properly rated and functional) <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
3.	Tanks, Vaults, Storage Vessels <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Good condition <input type="checkbox"/> Proper secondary containment <input type="checkbox"/> Needs Maintenance Remarks _____ _____
4.	Discharge Structure and Appurtenances <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____
5.	Treatment Building(s) <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Good condition (esp. roof and doorways) <input type="checkbox"/> Needs repair <input type="checkbox"/> Chemicals and equipment properly stored Remarks _____ _____
6.	Monitoring Wells (pump and treatment remedy) <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> All required wells located <input type="checkbox"/> Needs Maintenance <input checked="" type="checkbox"/> N/A Remarks _____ _____
D. Monitoring Data	
1.	Monitoring Data <input checked="" type="checkbox"/> Is routinely submitted on time <input checked="" type="checkbox"/> Is of acceptable quality
2.	Monitoring data suggests: <input checked="" type="checkbox"/> Groundwater plume is effectively contained <input checked="" type="checkbox"/> Contaminant concentrations are declining

D. Monitored Natural Attenuation			
1.	Monitoring Wells (natural attenuation remedy)		
	<input checked="" type="checkbox"/> Properly secured/locked	<input checked="" type="checkbox"/> Functioning	<input type="checkbox"/> Routinely sampled
	<input type="checkbox"/> All required wells located	<input type="checkbox"/> Needs Maintenance	<input type="checkbox"/> Good condition
	Remarks _____		<input type="checkbox"/> N/A
X. OTHER REMEDIES			
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.			
XI. OVERALL OBSERVATIONS			
A. Implementation of the Remedy			
Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).			
<u>The remedy is designed to address TCE concentrations in groundwater. The remedy is monitored natural attenuation of groundwater. The current remedy is not adequately addressing the vapor intrusion issues at the site, thus a RI/FS is being prepared to address these issues.</u>			

B. Adequacy of O&M			
Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.			
<u>None noted.</u>			

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

The current remedy is not reducing groundwater concentrations in a timely manner and does not fully address the vapor intrusion issues at the site.

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. The new remedy selected to address vapor intrusion should also address groundwater impacts at the site.
