964773

Record of Decision

Pike and Mulberry Streets PCE Plume
Superfund Site
Martinsville, Morgan County, Indiana

U.S. Environmental Protection Agency
Region 5
Chicago, Illinois

March 11, 2021

Table of Contents

LIST OF ACRONYMS/ABBREVIATIONS

ADT	Active Depressurization Technology
AR	Administrative Record
ARAR	Applicable or Relevant and Appropriate Requirement
AS	Air Sparging
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	Below Ground Surface
BHHRA	Baseline Human Health Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
C.F.R.	Code of Federal Regulations
The City	City of Martinsville, Indiana
cis-1,2-DCE	cis-1,2-dichloroethene
cm/s	Centimeters Per Second
COC	Contaminant of Concern
CSM	Conceptual Site Model
DPT	Direct-Push Technology
ELCR	Excess Lifetime Risk of Cancer
EPA	United States Environmental Protection Agency
^{0}F	Degrees Fahrenheit
FS	Feasibility Study
ft/yr	Feet Per Year
GAC	Granular Activated Carbon
HHRA	Human Health Risk Assessment
HI	Hazard Index
HVAC	Heating, Venting, and Air Conditioning
IC	Institutional Control
IDEM	Indiana Department of Environmental Management
ISCO	In-Situ Chemical Oxidation
ISCR	In-Situ Chemical Reduction
LTM	Long-term Monitoring
MCL	Maximum Contaminant Level
MNA	Monitored Natural Attenuation
NAPL	Non-Aqueous Phase Liquid
NCP	National Oil and Hazardous Substances Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OM&M	Operation, Maintenance, and Monitoring
ORP	Oxidative, Reductive Potential
P&M Site	Pike and Mulberry Streets PCE Plume Site
PCA	Pre-Closure Assessment
PCE	Tetrachloroethene
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
RI	Remedial Investigation

ROD	Record of Decision
SDWA	Safe Drinking Water Act
Site	Pike and Mulberry PCE Plume Site
SL	Screening Level
SLERA	Screening Level Ecological Risk Assessment
SMD	Submembrane Depressurization
SSD	Sub-Slab Depressurization
SVE	Soil Vapor Extraction
SVP	Soil Vapor Point
TCE	Trichloroethene
TCRA	Time-Critical Removal Action
UU/UE	Unlimited use and Unrestricted Exposure
µg/l	Micrograms Per Liter
µg/kg	Micrograms Per Kilogram
$\mu g/m^3$	Micrograms Per Cubic Meter
VI	Vapor Intrusion
VIMS	Vapor Intrusion Mitigation System
VISL	Vapor Intrusion Screening Level
VOC	Volatile Organic Compound
WTP	Water Treatment Plant
ZVI	Zero-Valent Iron

This Record of Decision (ROD) documents the selected site-wide remedy for the Pike and Mulberry Streets PCE Plume Superfund Site (P&M Site or Site) in Martinsville, Morgan County, Indiana (the City). The ROD is organized in three sections: Part I contains the Declaration for the ROD, Part II contains the Decision Summary and Part III contains the Responsiveness Summary.

Part I: Declaration

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

Site Name and Location

Pike and Mulberry Streets PCE Plume Superfund Site
Martinsville, Morgan County, Indiana
National Superfund Identification Number: INN000508678

Statement of Basis and Purpose

This decision document presents the selected site-wide remedy for the P&M Site, which was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended, 42 U.S.C. § 9601 *et seq.*, and, to the extent practicable, the National Oil and Hazardous Substances Contingency Plan (NCP), 40 C.F.R. Part 300. This decision is based on the Administrative Record (AR) file for this Site. The AR Index, included as Appendix A, identifies each of the items comprising the AR upon which the selection of the remedial action is based.

In a February 11, 2021 letter, the Indiana Department of Environmental Management (IDEM) indicated that it concurs with the selected remedy in this ROD. This letter is included as Appendix B.

Assessment of Site

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

Description of the Selected Remedy

This ROD sets forth the final site remedy for volatile organic compound (VOC) contamination in groundwater and soil vapors at the Pike and Mulberry Site (*see* Figure 1, Site Location Map). The selected remedy includes groundwater alternatives GW2 (Option GW2A) and GW5 and soil vapor alternative SV5. This remedy will address potential exposure to VOCs in groundwater exceeding drinking water standards by treating the contaminated groundwater at the Site, both in the aquifer and from the City's water treatment plant (WTP) before the water is provided to residents, and implementing institutional controls to prevent consumption of untreated water.

This remedy will address potential exposure to unhealthy concentrations of soil vapors in indoor air through a combination of treatment of the soil vapors, installation of systems to prevent the soil vapors from entering occupied structures, and implementation of institutional controls. Implementation of this remedy will continue as necessary to assure protection of human health and the environment.

The selected Site remedy includes soil vapor source removal using soil vapor extraction (SVE). EPA may also implement limited soil excavation to assist with soil vapor source removal if appreciable amounts of Site-related soil contamination are identified during subsequent investigations or other actions at the Site.

In summary, the selected Site remedy includes the following components:

- Groundwater Alternative GW-2A (Granular Activated Carbon) at the City's WTP;
- Groundwater Alternative GW-5 (In Situ Chemical Reduction) with a contingency to implement Groundwater Alternative GW-6 (In Situ Chemical Oxidation);
- Soil Vapor Alternative SV-5 (Pathway Sealing, Vapor Intrusion Mitigation, and Soil Vapor Source Removal); and
- Institutional Controls.

Statutory Determinations

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

The Site remedy is consistent with the statutory mandate for permanence and treatment to the maximum extent practicable. This selected remedy action does utilize groundwater treatment as a principal element of the remedy that will permanently and significantly reduce the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants.

The statutory preference for treatment of principal threat waste does not apply because there is no known principal threat waste at the Site.

Until remedial action objectives are achieved, hazardous substances will remain at the Site in the groundwater above levels that allow for UU/UE. As a result, statutory reviews will be conducted every five years after commencement of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment until the RAOs are achieved.

ROD Data Certification Checklist

The following information is included in the Decision Summary section (Part II) of this ROD. Additional information can be found in the AR file for the Site.

- Contaminants of concern (COCs) and their respective concentrations (Section 5.3);

- Baseline risk represented by the COCs (Section 7.0);
- Cleanup levels established for COCs and the basis for the levels (Sections 7.1 and 8.0);
- Assumptions in the baseline risk assessment and the ROD (Sections 7.0);
- Current and reasonably anticipated future land use assumptions used in the baseline risk assessment and ROD (Section 7.0);
- Potential land use that will be available as a result of the selected remedy (Section 6.0);
- Estimated capital, operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected (Section 9.0); and
- Key factor(s) that led to selecting the remedy (Section 10.0).

Support Agency Acceptance

IDEM supports the selected remedy. EPA received a February 11, 2011, letter from the Assistant Commissioner in the Office of Land Quality in IDEM expressing concurrence with the selected remedy (see Appendix B).

Authorizing Signature

3/11/2021

X 

Douglas Ballotti, Director
Superfund & Emergency Management Division
Signed by: DOUGLAS BALLOTTI

Part II: Decision Summary

1.0 Site Name, Location and Description

Name: Pike and Mulberry Streets PCE Plume (P&M) Site
Location: Martinsville, Morgan County, Indiana
National Superfund Identification Number: INN000508678
Lead Agency: EPA
Support Agency: IDEM

The Site is primarily a tetrachloroethylene (PCE)[1] groundwater plume that is centered near the intersection of Pike and Mulberry Streets in Martinsville. The groundwater plume extends downgradient to the northwest to the City's municipal wellfield and upgradient to the southeast just beyond the intersection of Jackson and Sycamore Streets, with a lobe extending to the west past the intersection of Morgan Street and Shirley Drive. (*See* Figure 2).

The Site also includes soil vapor contamination resulting from contaminants volatilizing from soil and groundwater. Figures 3 and 4 depict the area of soil vapor contamination, which is similar in aerial extent to the shallow groundwater contaminant plume with a few exceptions. One notable exception is an area of soil vapor contamination that extends to the east on Washington Street outside of the groundwater plume area. This area of soil vapor contamination may be intersecting with another area of contamination being investigated by IDEM (O'Neal's Cleaning Depot).

The contaminants of concern (COC) at the Site[2], which are CERCLA hazardous substances, consist of PCE in groundwater and PCE and trichloroethene (TCE) in soil vapor.

2.0 Site History and Enforcement Actions

2.1 Site History

The initially identified source of PCE contamination at the Site is the former Master Wear facility (the Facility), which is located on the west side of the courthouse square in downtown Martinsville. The Facility was constructed in 1956 and operated as a furniture store until 1985. Master Wear, Inc. (Master Wear), also known as American Glove, operated in the Facility from January 1986 to November 1991. Master Wear was an industrial dry cleaner that used PCE to perform laundering and dry cleaning for commercial and institutional organizations. Between 1987 and 1991, multiple complaints of illegal dumping and mishandling of waste drums at the Facility were reported to IDEM. Several spills and releases were also reported. The warehouse portion of the Facility was vacated in 1991, but since then, miscellaneous household items have been stored there. The western portion of the Facility periodically housed miscellaneous shops,

[1] Other synonyms for tetrachloroethylene include "perchloroethylene" or "perc."
[2] PCE and TCE are currently the only COCs; however, EPA may address additional related COCs (including PCE and TCE degradation products) during the implementation of the remedial action.

such as a hair-styling business, an antiques shop, a curios shop, a manicure service, and an insurance office.

In August of 1992, IDEM removed drums from the Facility and oversaw investigations at or near the Facility between 1996 and 1999.

In November 2002, the PCE concentration in City well PW-1, downgradient from the Facility, exceeded the federal Safe Drinking Water Act (SDWA) maximum contaminant level (MCL) of 5 micrograms per liter (µg/L). The IDEM Office of Water Quality ordered the well temporarily closed, and the City diverted its drinking water supply to the other two wells in the municipal wellfield until it implemented granular activated carbon (GAC) treatment of the drinking water supply in 2005.

The IDEM Site Investigation Program began investigating the presence of PCE in the municipal wellfield in late 2002. The Facility was entered into the Comprehensive Environmental Response, Compensation, and Liability Information System database in January 2003. IDEM staff conducted a preliminary assessment (PA)/site inspection (SI) in 2003 and 2004 in four phases. In the first phase, IDEM confirmed the presence of PCE in Municipal Well #3 (at a concentration of 4.2 µg/L) and identified Master Wear, Inc. as a possible PCE source. However, contamination also was found in samples that were cross-gradient to the former Master Wear facility. The second phase of the PA/SI involved the use of a direct-push technology (DPT) rig to collect soil and groundwater samples at and near the former Master Wear facility. IDEM detected PCE in subsurface soil at levels as high as 270 milligrams per kilogram (mg/kg) and in groundwater as high as 20,000 µg/L at the former Master Wear facility. In the third phase, IDEM collected indoor air samples and confirmed the presence of indoor air contamination at various businesses and residences in the immediate vicinity of the groundwater plume. In the fourth phase, IDEM advanced an additional 14 borings using a DPT rig to collect groundwater samples. At this time, IDEM referred the matter to EPA's Superfund Removal Program.

2.2 Removal Action

A time-critical removal action (TCRA), overseen by EPA, was conducted from 2005 through 2008 at the Facility. The TCRA was implemented by Master Wear under an Administrative Order issued by EPA. The action was conducted to address PCE contamination in soil, groundwater, and indoor air on or near the Facility property. The treatment of the identified source area included installing a combination air sparging (AS) and soil vapor extraction (SVE) system over a limited area of the source zone, including the parking lot just north of the Facility and along portions of Mulberry Street up to Morgan Street. The SVE/AS system, along with individual sub-slab depressurization (SSD) vapor intrusion (VI) mitigation systems (VIMS) and passive venting in nearby structures, began operation on January 7, 2005 to address VI. The TCRA did not include removal of impacted soils except from piping trenches and SVE/AS well locations when the remedial system was installed.

The SVE/AS system operated until November 9, 2006, when the closure criteria were met, and the system was shut down. Two pre-closure assessments (PCAs) were conducted in 2006 (one in April and one in November) to evaluate the efficiency of the system at addressing soil and soil

vapor contamination near the Facility. Ten direct-push borings were advanced during the first PCA adjacent to soil borings demonstrating the highest PCE concentrations in soil during previous investigations, and an additional five borings were advanced during the November PCA.

Figure 5 provides the soil sampling results from the PCAs for the Master Wear removal action. It shows a comparison of PCE concentrations in subsurface soil from the original investigations to the PCE concentrations from the PCAs. The borings advanced during the April PCA are denoted with an "A" suffix after the original boring name, and the borings advanced during the November PCA are denoted with a "B" suffix. The PCE concentrations that exceeded IDEM's targeted soil clean-up level (640 micrograms per kilogram or µg/kg) are shown in red, and PCE concentrations less than IDEM's targeted clean-up level are shown in blue. PCE concentrations in soil samples collected from the April PCA range from 16 to 1,600 µg/kg, and PCE concentrations in soil samples collected from the November PCA range from below the quantitation limit to 750 µg/kg at soil boring location SB-4B, which was the only remaining soil boring location after the November PCA with a PCE concentration in soil exceeding the IDEM's targeted clean-up level. This sample was collected from the 18- to 20-foot depth interval and the boring was located within the Facility parking lot towards the northwest corner of the building, approximately 30 feet to the northwest of the MW-1 well cluster and 15 feet southeast of the SVE-1 extraction well. Although the system included one SVE well and two air sparge wells beneath the building at the Facility, the PCAs did not include results for soil samples from beneath this building nor did it assess the effectiveness of the SVE/AS under this building.

The SVE/AS system was restarted in August 2007 after indoor air samples from two of three spaces sampled within the Facility exceeded the sub-chronic action levels. The system was turned off again on March 31, 2008, at which time indoor air, soil, and groundwater sample results indicated that the closure criteria had been met. The SVE/AS system and individual SSD systems were later removed. Analyses of soil and groundwater samples collected after the TCRA, to evaluate the performance of the SVE/AS system, detected residual levels of PCE but all sample points were below IDEM's targeted clean-up level.

2.3 Post-removal Investigation

After completion of removal activities, groundwater in and around the facility was monitored. Also, the City continued to monitor PCE in groundwater from its municipal wellfield and has continued to operate its GAC unit to comply with the MCL for PCE.

After IDEM had obtained sufficient data to determine that a groundwater plume remained that would continue to threaten the municipal wellfield for some time and that the Facility was not likely the only source of groundwater contamination in the area, IDEM requested that EPA assess the Site to determine its eligibility for the Superfund National Priorities List.

EPA added the Pike and Mulberry Streets PCE Plume Site to the NPL in May 2013. The Site is so named as preliminary investigation data indicated that this intersection was in the approximate center of the plume and is not named "Master Wear" because preliminary data

included elevated concentrations of groundwater contamination upgradient of the Master Wear facility, indicating other contributing sources to the groundwater contamination.

2.4 Remedial Investigation Activities

After the Site was listed on the NPL, EPA initiated an investigation to identify potential historical sources and associated responsible parties (potentially responsible parties or PRPs) capable of leading the remedial investigation (RI). EPA was unable to identify any liable and viable PRPs to conduct the RI so it initiated a federally-funded RI in 2014. The RI included seven sampling phases conducted from April 2015 through January 2017. The RI activities, data collection methodologies, resulting data, physical characteristics of the Site, nature and extent of contamination, contaminant fate and transport, and conceptual site model (CSM) are documented in detail in the RI Report.

A human health risk assessment (HHRA) and a screening-level ecological risk assessment (SLERA) were also completed as part of the RI. The HHRA is presented as Appendix M in the RI and the SLERA is presented as Appendix O in the RI report.

2.5 Concurrent Investigations

A third-party VI investigation was performed in August 2015 for three noncontiguous buildings located within the footprint of the PCE groundwater plume. The findings of this investigation indicated the presence of VOCs within and underneath these three buildings.

Additional VI sampling was conducted by EPA's Superfund Technical Assessment and Response Team in January 2016, after the preliminary findings of the first four phases of the RI were evaluated. Nine residential properties were sampled based on the Agency for Toxic Substances and Disease Registry (ATSDR) recommendation and proximity to the PCE groundwater plume.[3]

IDEM is also conducting investigative and cleanup activities for PCE, including VI, related to O'Neal's Clothes Depot (currently Vista Cleaners), which is located approximately 0.5 mile to the east of the Facility (see Figures 3 and 4).

3.0 Community Participation

EPA conducted community interviews in 2015 and in 2019 to better understand the community and its needs regarding the Site. These interviews were conducted with residents and business owners in the community as well as local and county officials. EPA completed a community involvement plan for the Site in August 2019 (https://semspub.epa.gov/work/05/949417.pdf).

[3] EPA conducted its more extensive VI investigation as part of Phases 6 and 7 of the RI after reviewing this initial investigation and receiving a recommendation to do so by ATSDR.

4.0 Scope and Role of Operable Unit

This site-wide remedy addresses all the contaminant areas of concern for the P&M Site in one operable unit. The selected remedy will address treatment of contaminated groundwater at the Site; continued treatment of the City's drinking water at the WTP to remove Site contaminants; connecting to municipal water any residential properties with wells located in the groundwater contaminant plume; removal of soil vapor sources; VI monitoring and, if necessary, mitigation; and placement of institutional controls (ICs) on affected land and groundwater to prevent exposures until Site clean-up goals are met.

5.0 Site Characteristics

5.1 Physical Characteristics

The Site is in Martinsville, Indiana, which is located in south central Indiana and is approximately 30 miles southwest of Indianapolis, Indiana. Martinsville is surrounded by unincorporated areas of Morgan County, and the nearby towns include Paragon (6.5 miles to the west) and Morgantown (9.4 miles to the southeast). The major routes through Martinsville are State Routes 37, 44, and 252. The north-to-south-flowing White River is located 1.5 miles to the west/northwest of Martinsville.

During the RI, EPA did not identify any subsurface features in the area (natural or manmade) other than City of Martinsville water, storm, and sanitary sewer lines and private company utilities. However, after RI activities were completed, EPA was made aware of possible subsurface structures such as a tunnel underneath or in the vicinity of the Facility. If found during pre-design investigations, subsurface structures in this area may have some relevancy in the design of the remedial action for soil vapor.

5.1.1 Climate

The climate of Morgan County is humid and temperate, with warm, humid summers and moderately cold winters. According to the National Oceanic and Atmospheric Administration, average daily temperatures for Morgan County ranges from 72.1 degrees Fahrenheit (°F) in the summer to 29.5 °F in the winter. For the period of record (1971–2000), annual average precipitation is approximately 43.1 inches, ranging from 40 inches in the northern part of the basin to 48 inches in the south-central part of the basin, and usually is distributed evenly throughout the year. Rainfall in the winter and early spring is generally of long duration, steady, and of mild intensity, whereas late spring and summer rainfall tends to be of short duration and high intensity.

5.1.2 Topography

Martinsville is approximately 607 feet above mean sea level. The Site is located in the Norman Upland physiographic unit of the White River Basin in south-central Indiana. The Norman Upland is characterized by narrow, flat-topped divides and deep V-shaped valleys. Local relief is

typically 125 to 250 feet. The Norman Upland is well-drained by a strongly dendritic stream pattern.

5.1.3 Regional Soils

The predominant surficial soil types mapped for the Site and surrounding area are dominated by Martinsville loam, Princeton fine sandy loam, Rensselaer clay loam, and Whitaker loam. These account for approximately 92 percent of the surficial soil types within the City of Martinsville.

The Martinsville loam occurs in outwash plains and terraces and is well-drained and moderately permeable. Surface soil to a depth of about 8 inches is usually a brown to grayish brown, very friable, dry fine sandy loam. The subsurface to 43 inches is typically a firm, brown to dark yellowish-brown clay to sandy clay loam.

The Princeton fine sandy loam consists of well-drained soils that are typically formed on dunes and less commonly, on stream terraces. Slope variation can range from 2 to 25 percent. Surface characteristics are brown to grayish brown, very friable, dry fine sandy loam to a depth of 8 inches. Subsurface layering consists of brown to yellowish red sandy or sandy clay loam or loamy sand that is friable and approximately 52 inches thick.

Rensselaer clay loam occurs within the depressions on outwash plains and is poorly drained. Slope variation can range from 0 to 2 percent. Surficial material, to a depth of 11 inches, is typically a gray to very dark gray, friable, dry clay loam. Material underlying the above layer, to a depth of 60 inches, is gray to dark gray, friable to firm, clay or silt loam.

Whitaker loam consists of very deep, somewhat poorly drained soils formed in stratified silty and loamy outwash on outwash, lake, or till plains. Slope variation can range from 0 to 6 percent. The soil is generally dark grayish brown to light brownish gray, dry, friable loam to a depth of 9 inches. Subsurface soil is typically brown to grayish brown, friable to firm, clay or sandy clay loam down to 39 inches.

5.1.4 Regional Geology

The City of Martinsville is located in a glacial outwash (sands and gravel) area, ranging from less than 50 to over 150 feet thick, of Wisconsinan, Illinoian, and pre-Illinoian glaciation events and overlies bedrock composed of mainly siltstones and shales (with minor sandstone and limestone) of the Mississippian-age Borden Group. A topsoil layer less than 10 feet thick overlies the glacial deposits in the study area. The Borden Group ranges from 485 to 800 feet thick.

5.1.5 Regional Surface Water Hydrology

Surface water hydrology is dominated by the West Fork of the White River, located approximately 1.17 miles from the Master Wear facility. The White River Basin is part of the Mississippi River system and drains 11,350 square miles of central and southern Indiana. Long-term average streamflow is about 12,300 cubic feet per second near the White River's

confluence with the Wabash River in southwestern Indiana. Variations in streamflow are generally moderate and seasonal. Streamflow is typically highest in April and May and lowest in late summer and fall. There is a levee northwest of the City to control the flow of the West Fork of the White River.

5.1.6 Regional Hydrogeology and Groundwater Use

The regional aquifer is in the fluvial and glaciofluvial (glacial outwash) sand and gravel unit found near the surface to the bedrock along the floodplain of the White River. Although not necessarily a continuous, single geologic deposit, these unconsolidated sands and gravels are a single stratigraphic unit with hydraulic connectivity throughout. Hydraulic conductivities for sand and gravel aquifers within the White River Basin, similar to the one in this study area, range from 24 to 1,500 feet per day and produce well yields from 10 to 2,000 gallons per minute. The City of Martinsville's municipal wells use groundwater from the unconsolidated sand and gravel aquifer located within this unit.

Bedrock aquifers are developed in an upper weathered zone of the Mississippian Borden group. The upper weathered zone is a zone of enhanced permeability produced by weathering before, during, and after glaciation. The availability of water in this weathered zone is highly variable and is dependent on the degree of enhanced permeability, the type and thickness of overlying deposits, and the bedrock topography. The shale siltstone upper weathered bedrock aquifer is used primarily for domestic and stock water supplies in areas where no other aquifers are available.

5.1.7 Site Geology

Generally, the geology at the Site consists of approximately 5 to 8 inches of topsoil (when present) composed of silt or clay with variable amounts of sand. Topsoil thicknesses of 9 to 12 inches are present in a few locations. Locations without topsoil are usually paved with fine sand below asphalt/concrete and gravel. Below topsoil and pavement with fine sand is predominately fine to medium, coarse to rounded gravel and fine to coarse sand with no to some silt and clay. The underlying bedrock is encountered at between approximately 53 to 98.5 feet below ground surface (bgs), with the bedrock's high elevation being located toward the middle of the Site (near monitoring wells MW-01, MW-02, MW-16, and MW-07). No local or regional fine-grained layers appear to be present beneath the Site based on review of previously installed boring logs and geologic material observed during the RI.

5.1.8 Site Surface Water Hydrogeology

Since the Site is located in urban commercial and residential areas, the surface drainage pattern has been altered by roadway, driveway, and building construction. Surface water runoff from buildings, developments, and streets is directed into the City of Martinsville stormwater sewer system. A local topographic high is located to the northeast of the Site, designated on topographic maps as Lincoln Hill, with a maximum elevation of approximately 830 feet above mean sea level.

5.1.9 Site Hydrogeology

The groundwater contamination at the Site is in the surficial aquifer. During the RI, EPA found the depth to groundwater to range from 5 to 17 ft bgs. For purposes of investigation, EPA divided this aquifer into shallow (17-27 ft bgs), intermediate (43-60 ft bgs), and top of bedrock (67-99 ft bgs) water-bearing zones. Based on data gathered during the RI and historical data, EPA found that groundwater elevation in each zone of the aquifer was highest in the southeast corner of the Site and lowest in the northwest corner and groundwater migrates to the northwest, towards the municipal supply wells. The northwest migration pattern is likely influenced by the municipal supply wells. A more western or southwestern groundwater migration pattern toward the White River to the west would be expected without the hydraulic influence of the municipal supply wells. EPA observed seasonal variations in water levels between the spring, summer, and fall. Water levels were on average approximately 4 feet higher in the summer than the fall and approximately 2 to 3 feet higher in the summer than the spring; however, EPA observed that the gradients are consistently in a southeast to northwest direction with groundwater flow.

During the RI, EPA also determined that the hydraulic conductivity of the aquifer ranged from 1.2×10^{-3} to 4.1×10^{-2} centimeters per second (cm/s) in the shallow zone of the aquifer, 9.0×10^{-4} to 3.6×10^{-2} cm/s in the intermediate zone of the aquifer, and 3.7×10^{-2} to 4.2×10^{-2} cm/s in the top of bedrock zone of the aquifer. EPA calculated the average groundwater velocities ranging from 34.4 feet per year (ft/yr) to 89.3 ft/yr in the shallow zone, 137 ft/yr to 233 ft/yr in the intermediate zone, and 605 ft/yr to 982 ft/yr in the top of bedrock zone. Although the vertical gradients showed some variability between each phase of the groundwater investigation, the average gradients were typically downward (from shallow to intermediate or to deep portions of the aquifer) and relatively low (less than 0.001 foot per foot). The low vertical gradients indicate that the groundwater flow is predominantly in the horizontal direction. However, EPA observed anomalously high and upward vertical gradients in the MW-4 well nest, likely due to the bedrock high that is directly downgradient of the nest.

5.2 Nature and Extent of Contamination

EPA determined the nature and extent of Site contamination during the RI, and it conducted the RI between April 2015 and February 2017 using a phased approach. The significant findings and conclusions from the site characterization activities completed during the RI are summarized below. The April 2018 Final RI Report provides additional detail about site investigations and can be found at: (https://semspub.epa.gov/src/document/05/941790).

5.2.1 Groundwater

The only groundwater contaminant that EPA identified above its screening level (SL) is PCE. The SL for PCE is the SDWA MCL of 5 µg/l. The highest PCE detection that EPA found during the RI (240 µg/l) is in a monitoring well (MW-1S) located near the Facility. EPA identified PCE degradation products, including TCE and cis-1,2-dichloroethylene (cis-1,2-DCE), in groundwater but not above their respective SLs (MCLs of 5 µg/l and 70 µg/l, respectively). The groundwater plume is well-defined horizontally and vertically and is limited to the upper, surficial aquifer. The groundwater plume consists of two "lobes" radiating from the Facility. A

third "lobe" extends towards the Facility from a potential upgradient source. The plume is most extensive in the shallow zone of this aquifer with some contamination extending to the intermediate depth. At the municipal wellfield, the plume is drawn into the lower portion of the aquifer by the pumping action of the production wells. The concentrations are highest in the center of the plume near the Facility with lower concentrations on the periphery, including the portion of the plume that is being drawn into the municipal wells.

5.2.2 Soil

EPA performed soil sampling at 66 locations and found a single exceedance of the residential, risk-based SLs. Specifically, EPA detected TCE at 3,600 micrograms per kilogram (µg/kg) in a single, shallow soil sample from just north of the Facility. The residential SL for TCE is 410 µg/kg. Although EPA identified PCE in 27 of the 66 soil samples, all detections were below the residential SL of 8,100 µg/kg.

The extent of impacted soils appears to be limited to the area immediately adjacent to the Facility and the uppermost soil interval. This is likely due to the efforts of the previous removal action EPA oversaw at that Facility that treated the soils using SVE/AS. EPA notes that there may be impacted soils under the building at the former Master Wear facility and that these soils have not been sampled. Additional investigation of this area may be required during design or at a later time when these soils become more accessible (e.g. during or after future construction and/or demolition work at the building).

5.2.3 Soil Vapor

Figures 3 and 4 are maps presenting the PCE and TCE, respectively, in soil vapor data collected during the RI.

EPA conducted soil vapor sampling over four phases. In the first two phases, EPA sampled soil vapor in 18 and 17[4] soil vapor points (SVPs) located above the center (highest concentration area) of the groundwater plume. In the third and fourth phases, EPA conducted an expanded soil vapor investigation using 77 (third phase) and 52 (fourth phase) temporary soil vapor probes and an instrument that analyzes samples and provides results in real time. EPA arranged the temporary SVPs around the circumference of the initial (first and second phase) soil vapor exceedances and installed additional SVPs in expanding concentric circles to delineate the extent of the soil vapor plume. EPA then compared these results of the analyses of these soil vapor samples to its most protective risk-based residential SL for soil vapors below the slab (sub-slab) of a home or other dwelling.

During each of the first and second phases of its soil vapor investigation, EPA identified 15 PCE exceedances and 3 TCE exceedances of EPA's risk-based, residential sub-slab VI screening levels (VISLs), 360 micrograms per cubic meter (µg/m^3) for PCE and 16 µg/m^3 for TCE. In both phases, EPA found the highest concentrations of PCE and TCE in soil vapor (180,000 µg/m^3 and 16,000 µg/m^3, respectively) in a soil vapor well (SG-1) located just north of the Facility[5]. EPA

[4] During the second phase of soil vapor sampling, one of the SVPs did not pass a leak test and was not re-sampled.
[5] EPA notes that this soil vapor well is in close proximity to the single soil sample exceedance.

also found particularly elevated soil vapor concentrations at several other SVPs in the vicinity of SG-1.

In the third and fourth phases, EPA identified 40 additional PCE exceedances and 11 additional TCE exceedances of EPA's risk-based, residential sub-slab VISLs, as well as two additional areas with notably elevated soil vapor concentrations, though none were similar in magnitude to the concentrations detected in the vicinity of SG-1. One of these additional areas is located to the southeast of the Facility, in the vicinity of the intersection of Jackson and Sycamore Streets. The other is located to the northwest of the Facility, in the vicinity of the intersection of Harrison and Cherry Streets.

EPA was able to use the data from the four phases of soil vapor sampling to nearly fully delineate the extent of the soil vapor plume above the most conservative risk-based residential SLs for sub-slab vapors, with one notable exception. EPA was not able to delineate the eastern extent of the soil vapor plume on Washington Street. EPA believes that soil vapor from the Site plume in this area may comingle with soil vapors from an adjacent site with PCE contamination in groundwater that IDEM is overseeing, O'Neal's Dry Cleaners. The scope of the O'Neal's Dry Cleaners investigation has included VI investigation.

5.3 Conceptual Site Model

EPA developed the CSM by integrating technical information from a variety of sources, including the physical characteristics, the nature and extent of contamination, and contaminant fate and transport pathways. Figure 6 presents the CSM of PCE in groundwater and soil vapor, Figure 7 presents the CSM of TCE in soil vapor, and Figure 8 presents the CSM of COCs in soil.

Although TCRA clean-up activities were implemented to address the potential source area at the former Master Wear facility, some residual source contamination may exist at or near the Facility. Soil exceeds its SL for TCE in one surface sample collected near the former Master Wear facility. No soil samples were taken from below the building at the Facility. The sources of potential contamination at the Site are likely historical discharges of waste material and solvents from the former Master Wear facility and possibly other sources, as discussed in the RI report. Recent sampling indicates that PCE concentrations in groundwater downgradient (and upgradient) of the Facility exceed the MCL. Soil vapor exceeds the PCE and TCE SLs at multiple locations upgradient and downgradient of the Facility.

COCs could have been released to the environment as dissolved-phase constituents in water or as free-phase product (nonaqueous phase liquid or NAPL)[6]. Dissolved-phase COCs would migrate downward and be subject to soil sorption and volatilization. Likewise, free-phase NAPL would migrate downward and be subject to soil sorption and volatilization, as well as dissolution into soil moisture and retention of discontinuous droplets in soil pores. Precipitation and infiltration will continue to leach sorbed-phase COCs (and trapped NAPL, if any) downward to the saturated zone over time, constituting a continuing source of contaminants to groundwater.

[6] Note that EPA did not identify any NAPL at the Site.

Based on previous investigations conducted at the Site and the data gathered during the RI, EPA determined that the vadose zone is not currently a continuing source of groundwater contamination sitewide. However, EPA determined that vadose zone contamination may be an ongoing source of soil vapor contamination, particularly at soil sample point SG-01 (near the former Master Wear facility). EPA identified an exceedance of TCE in surface soil (1 to 2 feet bgs) at this location and detected PCE and TCE in shallow soils in the multiple other locations within this vicinity (though below SLs). An AS/SVE system was operated in this area as part of the Master Wear removal action, and it achieved the treatment objectives and substantially reduced VOC concentrations in soil. EPA believes that residual PCE and TCE may still be present in vadose zone soil in this area.

PCE, the primary groundwater COC, is not expected to adsorb to the sandy matrix present beneath the Site. For this reason, the plume is expected to continue to migrate with the groundwater flow, primarily by advection and dispersion. Groundwater flow in the shallow, intermediate, and top of bedrock water-bearing zones of the aquifer is to the northwest, towards the municipal supply wells, and is likely influenced by the pumping rates of the municipal supply wells. A more western or southwestern groundwater flow direction toward the White River to the west would be expected without the hydraulic influence of the municipal supply wells.

PCE and TCE are the principal contaminants within soil vapor at the Site. These and other VOCs located in subsurface soils or in groundwater can volatilize, migrate through soil as vapor, and transport into and accumulate in indoor spaces, where inhalation exposures can occur. Generally, EPA observed PCE and TCE vapors in soil to follow exceedances in groundwater and along preferential pathways (e.g., utility corridors).

Based on soil vapor concentrations detected during Phases 2 through 5, three areas were identified where PCE soil vapor concentrations are greater than 15,000 $\mu g/m^3$, as shown in Figure 3. The first high PCE soil vapor concentration area is located around the former Master Wear facility and the former Manitorium Cleaners. Contamination released from these facilities may be acting as potential soil vapor sources. The second high PCE soil vapor concentration area is located within the northwest portion of the study area approximately 1,200 feet downgradient of the former Master Wear facility. However, this area is not located near an identified potential past PCE user nor are there high concentrations of PCE in groundwater in this area. There may be an unidentified source of PCE in soil vapor in this area, or PCE may be migrating to this area through preferential pathways from another source area. Preferential pathways, such as the sanitary line, storm line, or other utility conduits, may transport VOC vapors between a potential source and building over greater distances than what is typically observed due to vadose zone diffusion and advection. The third high PCE soil vapor concentration area is located to the southeast (and upgradient) of the former Master Wear facility and just to the west of the former Central Dry Cleaners. Contamination released from this facility may be acting as a source of the soil vapor in this area.

EPA also observed elevated PCE concentrations in soil vapor samples to the east of the Site along Washington Street. EPA did not identify any past potential PCE users in this area and believes that these contaminants could have potentially migrated along a utility corridor. In particular, the pipe bedding for the water main that runs along Washington Street could

potentially serve as a preferential pathway for vapor migration. Sanitary and/or storm lines may also be present along portions of Washington Street and serve as soil vapor conduits. In addition, PCE in soil vapor from the potential source at the O'Neal's Clothing Depot site may also be migrating from the east along the utility corridor.

EPA only identified three locations with TCE concentrations in soil vapor exceeding the SL (16 µg/m3), and each is generally located near identified potential past PCE users, as shown in Figure 4. The TCE result from one of these locations, near the former Master Wear facility, was 160,000 µg/m3.

Soil vapor can migrate across a building slab and/or basement or foundation walls through two mechanisms: (1) advection through cracks, seams, or other openings, and (2) diffusion directly through the concrete, brick, or concrete blocks. Advection across the slab has been the predominant mechanism discussed in the literature and guidance. Building characteristics such as age, condition, construction type, heating, venting, and air conditioning (HVAC) type, and the presence of preferential pathways can also influence the VI pathway. Advection can be affected by barometric pressure changes, wind load, thermal currents, depressurization caused by HVAC systems, exhaust fans, or the stack effect, which is caused by the difference in pressure between the less-dense interior heated air and denser cold outdoor air. This pressure differential can result in infiltration of air and soil vapor into the lower part of the building. The gas permeability of the slab affects the rate at which vapor enters a structure.

Building slabs at the properties where VI assessments were conducted were in varying degrees of condition ranging from good with no observed cracks, to significant cracking or even missing sections with exposed dirt. These observed openings can generally be presumed to be routes for potential VI.

Once VOCs have entered the indoor air of a building, concentrations can be attenuated through a number of dilution processes, including both natural and mechanical building ventilation and adsorption to building materials. The building envelope leakage (walls and roof) and the mechanical ventilation rate affect the dilution of VOCs that have entered the building.

VOCs do not persist in indoor air without an ongoing source, as typical residential air exchange rates are on the order of 0.25 air exchanges per hour. If the source is discontinued, concentrations rapidly decrease within a few days. In addition, VOCs are subject to sorption and desorption processes from building materials. Therefore, observed persistence in indoor air is evidence for the presence of an ongoing source, which can be either ongoing VI or a product containing VOCs in use or stored within the structure.

At this site, the presence and operation of a heating system within a building appears to be a major consideration for VI due to the stack effect. There does not seem to be a strong geographic pattern between VI results and property location; however, there are multiple properties where access was not granted for VI sampling, so EPA is basing this observation on limited data.

6.0 Current and Potential Future Land Use

Martinsville is the county seat of Morgan County, and the town's residential population is approximately 11,800 people (2010 Census), with 5,100 housing units. In the RI, EPA estimated that up to 4,748 people live within ¼ mile of the Site.

Figure 9 presents Site features and land use for the Site. The buildings that overlay the Site are a mix of residential, commercial, and industrial uses. The economy of the area consists of agricultural and industrial concerns. The latter includes brick manufacturing, manufacturing of aircraft and missile components, and several large-scale goldfish hatcheries. Martinsville is surrounded by rural farmland, and the City is a suburban setting with a town square.

EPA expects that the future use of land at the Site will not change significantly. However, the state highway that runs through the town is being converted into an interstate connecting Evansville, Indiana with Indianapolis, Indiana. Representatives from the City of Martinsville informed EPA that it expects additional development as a result.

Martinsville operates its only municipal wellfield in the northwest terminus of the groundwater plume and draws its water from the surficial aquifer where the Site plume is located. The City currently treats the groundwater with GAC before providing the water to its customers, and it is in the process of replacing these wells with new wells in the same location from the same aquifer. The only change to groundwater usage that EPA expects is a potential increase in pumping rate if the City's population and/or municipal water customers grow.

7.0 Summary of Site Risks

EPA used data from the RI to conduct a baseline HHRA (BHHRA) and a SLERA. To conduct these risk assessments, EPA assumed that the current land use at the Site will remain the same in the future, which consists of mostly residential and small commercial operations but also includes some government buildings and light industry. EPA also assumed that properties at the Site will continue to have access to municipal water, while recognizing some properties in the vicinity of the Site have private wells. EPA issued both of these risk assessments in April 2018 as appendices to the RI report.

7.1 Human Health Risk

EPA performed a BHHRA to assess risks posed by the Site in the absence of any future remedial or other clean-up actions. Because this ROD addresses only groundwater and soil vapor contamination, this section is limited to the risks posed by VI and exposure to contaminated groundwater.

To evaluate the potentially complete exposure pathways further, EPA estimated and quantified the magnitude, frequency, and duration of exposures as well as the concentrations of the contaminants at the point of exposure. In the BHHRA, EPA followed its guidance in using upper-bound parameter values (as opposed to average values) for exposure frequency and

exposure duration. EPA also followed its guidance in selecting intake variable values for a given pathway such that the combination of values from all variables results in a reasonable estimate of the maximum exposure for each exposure pathway.

7.1.1 Contaminants of Concern

In the BHHRA, EPA evaluated the potential COCs in both groundwater and soil vapor. In groundwater, EPA determined PCE and TCE in groundwater as posing potential risks but only detected PCE above its MCL. In soil vapor, EPA determined that both PCE and TCE posed potential risks via the VI pathway and identified both of these contaminants above their respective soil vapor SLs. Therefore, EPA identified PCE as a COC for groundwater and both PCE and TCE as COCs for soil vapor.

7.1.2 Groundwater

The BHHRA presents the potential current and future risks to human health posed by exposure to contaminated groundwater via ingestion, inhalation, or dermal contact (described as "potable use" in the BHHRA report) for both residents and commercial or industrial workers. EPA evaluated the potential potable use of untreated, contaminated groundwater for the purposes of the BHHRA. These exposure scenarios are only theoretical as the groundwater from the City's municipal wells is being effectively treated using activated carbon, and EPA did not identify any private, residential wells with contamination above SLs. However, it is possible that residential wells exist (or could be installed) within the Site groundwater contaminant plume.

In the BHHRA, EPA also evaluated the potential exposure of construction workers to contaminated groundwater via dermal contact or inhalation of contaminant vapors. For this exposure scenario, EPA evaluated potential exposure from construction activities involving digging to shallow groundwater contamination using data from monitoring wells screened at 10 ft bgs or less.

Based on monitoring well and municipal wellfield (pre-treatment) data gathered during the RI, EPA found that the range of concentrations of Site contaminants in groundwater do not present an unacceptable cancer risk to adult or child residents but may pose an unacceptable non-cancer risk to residents. Specifically, EPA determined that the highest concentrations of Site contaminants in groundwater increase a resident's excess lifetime risk of cancer (ELCR) by 2 in 100,000 (2×10^{-5}), which is less risk that EPA's maximum acceptable ELCR of 1×10^{-4}. However, EPA did determine that the Site contaminants in groundwater pose an unacceptable potential non-cancer health risk to adult and child residents, with a measured hazard index (HI) as high as 3. EPA considers an HI of greater than 1 an unacceptable risk.

In the BHHRA, EPA determined that groundwater contaminants at the Site do not pose an unacceptable cancer or non-cancer health risk to industrial, commercial, or construction workers (non-potable uses).

7.1.3 Soil Vapor

In the BHHRA, EPA considered current and future potential soil vapor exposure scenarios to residents, industrial/commercial workers, and construction workers. For each of these receptor groups, EPA considered exposure scenarios involving inhalation of indoor air after soil vapor contaminants from the Site had accumulated within a structure. For the construction worker scenario, EPA evaluated exposure to soil vapor from the Site released to the ambient air during digging activities.

Based on sampling data gathered during the RI, EPA found that the range of indoor air concentrations of Site contaminants do not present an unacceptable cancer risk to adult or child residents but may pose an unacceptable non-cancer risk to these residents. Specifically, EPA determined that the highest indoor air concentration of Site contaminants measured in residential properties at the Site have the potential to increase a resident's ELCR by 2 in 100,000 (2×10^{-5}), which is less risk than EPA's acceptable maximum ELCR of 1 in 10,000 (1×10^{-4}). However, EPA also determined that the indoor air concentrations of Site contaminants pose unacceptable potential non-cancer risks at two of the 50 properties sampled, with a measured HI as high as 6.

Based on sampling data gathered during the RI, EPA found that the range of indoor air concentrations of Site contaminants do not present an unacceptable cancer risk to industrial/commercial workers but may pose an unacceptable non-cancer risk to these workers. Specifically, EPA determined that the highest indoor air concentration of Site contaminants measured in commercial properties at the Site have the potential to increase a worker's excess lifetime cancer risk (ELCR) by 8 in one million (8×10^{-6}), which is less risk than EPA's acceptable maximum ELCR of 1 in 10,000 (1×10^{-4}). However, EPA also determined that the indoor air concentration of one Site contaminant (TCE) at one of the 50 sampled properties poses an unacceptable potential non-cancer risk to workers (i.e. an HI of greater than 1).

EPA notes that it was only able to sample 50 of the more than 200 occupied structures within the soil vapor plume and that it is unclear how many additional properties may have unacceptable risks from Site-related exposures to COCs via the VI pathway. EPA will attempt to obtain access to sample more of these properties during subsequent VI investigations.

7.2 Ecological Risk

EPA conducted a SLERA and determined that Site contaminants do not pose actual or potential unacceptable risks to ecological receptors. Specifically, EPA used the surface soil and groundwater data generated during the RI to assess risk for both aquatic and terrestrial invertebrates, fish, and wildlife (i.e., ecological receptors) by comparing measured concentrations of Site contaminants in soil and groundwater with ecological SLs established for soil and surface water, respectively. Because the Site is located in a heavily developed urban area, potential ecological receptors are limited, and EPA did not identify any special habitats or endangered species threatened by Site contaminants. However, the maximum concentration of two Site contaminants exceeded their respective screening values in at least one sample of soil or groundwater.

In soil, cis-1,2-Dichloroethene (cis-1,2-DCE), exceeded its screening value in the 1- to 2-foot depth interval of a single sample taken in the vicinity of the former Masterwear facility. Due to the low frequency of detection of cis-1,2-DCE in soil, the absence of suitable wildlife habitat in the vicinity of the location where the sample exceedance was identified, and the fact that this was the only Site contaminant to exceed its respective SL, EPA concluded that Site contaminants in soil do not require further evaluation relative to ecological risk.

In groundwater, PCE exceeded the surface water screening value in shallow groundwater in 3 of 45, 5 of 63, and 5 of 62 samples in the three phases of sampling, respectively. However, contaminants confined to groundwater do not present ecological risk because there is no exposure pathway through which ecological receptors could be exposed to contaminants in groundwater.

Therefore, EPA concluded in the SLERA that COC concentrations in soil and groundwater do not present significant risk to ecological receptors and that no further evaluation relative to ecological risk at the Site is necessary.

7.3 Basis for Taking Action

The response action selected in this ROD is necessary to protect the public health or welfare or the environment. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by a remedial action.

8.0 Remedial Action Objectives

RAOs are specific goals developed to protect human health and the environment based on unacceptable risks calculated in the Site-specific risk assessment, anticipated current and future land use, objectives and expectations of the action, and statutory requirements. The RAOs provide the basis for developing cleanup options that will be protective of human health and the environment. The RAOs address Site-related receptor and pathway risks and hazard exceedances based on the results of the risk assessment. Preliminary remediation goals (PRGs) were identified by using established cleanup criteria such as MCLs, Regional SLs, and VISLs.

EPA developed the following RAOs specific to this remedial action:

- Protect human health by reducing or eliminating exposure (via ingestion, inhalation, or direct contact) to groundwater COCs at concentrations that could pose an unacceptable risk to human health for current and future groundwater use.

- Reduce COC concentrations in groundwater to restore the aquifer to its beneficial use as a drinking water aquifer within a reasonable timeframe[7].

[7]Currently the City of Martinsville is effectively using this aquifer as a drinking water source because it treats the groundwater before providing it to customers. This RAO is more specifically intended to restore the groundwater in the aquifer to drinking water standards before treatment.

- Protect human health by reducing or eliminating the potential for COCs in soil, soil vapor, or groundwater to volatilize and migrate into buildings through the VI pathway.

- Protect human health by reducing or eliminating exposure (via inhalation) to COCs in indoor air, resulting from the intrusion of soil vapors, at concentrations that could pose an unacceptable risk to human health for current and future use of affected properties.

To meet these RAOs, EPA is proposing the following PRGs:

- Groundwater[8]:
    - SDWA MCL for PCE = 5 µg/L
    - SDWA MCL for TCE = 5 µg/L
    - SDWA MCL for cis-1,2-DCE = 70 µg/L
    - SDWA MCL for vinyl chloride = 2 µg/L

- Soil Vapor[9]:
    - Residential:
        - 70 µg/m^3 for TCE
        - 1,390 µg/m^3 for PCE
    - Commercial/industrial:
        - 292 µg/m^3 for TCE
        - 5,840 µg/m^3 for PCE

9.0 Description of Alternatives

CERCLA Section 121(b)(1), 42 U.S.C. § 9621(b)(1), mandates that remedial actions must be protective of human health and the environment, be cost-effective, comply with applicable or relevant and appropriate requirements, and utilize permanent solutions, alternative treatment technologies, and resource recovery alternatives to the maximum extent practicable.

In the feasibility study (FS), EPA developed and evaluated cleanup alternatives for groundwater and soil vapor to address the current and potential risks to human health or the environment at the Site. EPA initially developed eight cleanup alternatives for groundwater and five cleanup alternatives for soil vapor. After an initial analysis, EPA rejected three of the groundwater treatment alternatives and one of the soil vapor treatment alternatives and conducted a more

[8] PRGs are included for PCE breakdown products as EPA anticipates it may detect these during the course of the response action.

[9] A discussion of how these values were determined can be found in Section 2.3 of the FS Report. The need for VIMS will be determined first by sub-slab soil vapor concentrations. EPA, in consultation with IDEM, will determine the need to include an additional evaluation for indoor air concentrations and, if it is deemed necessary, will establish target indoor air concentrations based on the most recent health protective data available at that time.

detailed evaluation of the remaining five groundwater treatment alternatives and four soil vapor treatment alternatives.

The eight groundwater treatment alternatives that EPA initially analyzed included:

- GW1 = The "no action" alternative, which is included as a baseline of comparison.
- GW2 = Options for treatment at the City's WTP.
- GW3 = Monitored natural attenuation (MNA) and ICs.
- GW4 = Enhanced in-situ bioremediation, long-term monitoring (LTM), and ICs.
- GW5 = In-situ chemical reduction (ISCR), LTM, and ICs.
- GW6 = In-situ chemical oxidation (ISCO), LTM, and ICs.
- GW7 = In-situ sorptive-reactive media, LTM, and ICs
- GW8 = In-well air stripping, LTM, and ICs.

The five soil vapor alternatives that EPA initially analyzed included:

- SV1 = The no action alternative.
- SV2 = Pathway sealing, LTM, and ICs.
- SV3 = Pathway sealing, VIMS, LTM, and ICs.
- SV4 = Soil vapor source removal, LTM, and ICs.
- SV5 = Pathway sealing, soil vapor source removal, VIMS, LTM, and ICs.

In its initial analysis, EPA rejected GW4, GW7, GW8, and SV2. EPA's initial analysis of these alternatives and reasoning for rejecting alternatives for further evaluation can be found in Section 3 of the FS report for the Site[10].

A summary of the cleanup alternatives for which EPA conducted a detailed analysis to consider for this response action is provided below.

To calculate the present value of future costs, EPA used the discount factor identified by the Office of Management and Budget when EPA drafted the FS, 2.6%.

9.1 Common Elements

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

- Access to private properties and public rights-of-way as necessary to conduct monitoring and implement response actions;

- Treatment of the groundwater at the City's WTP before it is provided to the City's customers (provided the wellfield remains at or near the same location);

[10] EPA conducted a subsequent evaluation of GW7 after receiving comments which it summarized in a technical memorandum that can be found in the AR for the Site with document ID number 958369.

- Connection of private residences to the City's public drinking water supply if needed[11]; and

- Groundwater and VI sampling.

As needed to address residual risk remaining until the clean-up alternatives meet PRGs, EPA may implement the following ICs:

- Recording the Site contamination in the land record to provide notice of the issue to prospective landowners and the public.

- Recording contaminated aquifers on the state registry to maintain institutional tracking.

- Working with State and/or local regulators to develop ordinances or other regulations that would achieve the following IC objectives:

    - Prohibit the installation of potable wells in groundwater at the Site that is above SDWA MCLs;

    - Close potable wells and/or reduce the use of potable wells in groundwater at the Site above SDWA MCLs; and/or

    - Require construction of new, occupiable structures at the Site overlying groundwater or soil vapor concentrations greater than VISLs to include protective measures, such as vapor barriers or sub-slab depressurization systems.

9.2 Groundwater Alternatives

For the two active groundwater alternatives presented below, GW5 and GW6, EPA evaluated active treatment in only the core of the groundwater plume. For these evaluations, EPA defined the "core of the groundwater plume" as that portion of the groundwater plume with PCE concentrations greater than 46 µg/l.

Alternative GW1—*No Action*

EPA is required to evaluate a "no action" alternative when considering potential remedial actions for a site to provide a baseline for comparison to the other potential response actions. The no-action alternative means that no remedial action would be undertaken and that no institutional controls, containment, removal, treatment, or other mitigating actions would be implemented to

[11] EPA is proposing to provide for private residences to connect to the city's municipal water supply if said residence is dependent on a private well for drinking water and the private well is within the plume and screened at a depth that has been impacted by site contamination. EPA estimates the cost for a single installation to be $4,000 and that the number of residences needing this connection are very low since previous efforts revealed none. Therefore, EPA estimates that the potential cost from these connections are insignificant in comparison to the cost of the active groundwater remedies.

control exposure to COCs. For the purpose of conducting the evaluation of this alternative, EPA assumed that the City would no longer continue to treat water from its municipal wellfield. Therefore, the potential human health and environmental risks associated with exposure to the COCs which EPA identified in its risk assessments would not be mitigated. In addition, contamination from the Site would not be contained and could spread and expand the Site boundaries.

Estimated Costs for Alternative GW1

Direct Capital Costs:	$0
O&M Costs:	$0
Total Periodic Costs:	$0
WTP Costs:	$0
Total Present Value:	$0

Alternative GW2—*WTP Options*

Alternative GW2 is a group of options that EPA considered for treating the water at the City's WTP. The City is currently using GAC for treating the drinking water from its WTP, and EPA evaluated this in comparison to two other viable options. This alternative would continue to treat the groundwater extracted from the City's WTP before the water is provided to its customers and protect those customers, the residents of the City of Martinsville, from exposure to groundwater contamination via the drinking water pathway.

EPA assumed the treatment option selected as part of this alternative would be implemented concurrently with any of the other groundwater treatment alternatives selected. Because the WTP treatment would be a part of a more comprehensive groundwater treatment alternative, the City is already effectively treating the drinking water at its WTP, and continued treatment at the WTP is imperative to continued protection of the drinking water pathway, EPA did not conduct a full detailed analysis of these options. Instead, EPA compared GAC treatment to other effective treatment options to determine if GAC would continue to be the most effective and cost-efficient option.

For its evaluation of the Alternative GW2 options, EPA assumed that the City will continue pumping from the three existing municipal extraction wells at a similar rate and that treatment will continue until the groundwater at the Site meets the PRGs.

EPA evaluated three different treatment technologies to reduce PCE concentrations to meet drinking water standards in groundwater that is already being pumped for municipal use. The three GW2 treatment technologies are:

- *Option GW2A.* Option GW2A would continue operations of the City WTP using GAC treatment to reduce PCE concentrations to below the MCL.

- *Option GW2B.* Option GW2B would replace the existing GAC treatment system with an air stripper. Air strippers remove COCs from liquid (water) by providing contact between

the liquid and air. The air is then released to the atmosphere or potentially treated to remove the COCs and subsequently released to the atmosphere.

- *Option GW2C*. Option GW2C would replace the existing GAC treatment system with an advanced oxidation process treatment system. Advanced oxidation process treatment combines ultraviolet light or ozone with hydrogen peroxide to form hydroxyl radicals, which are powerful oxidants that effectively oxidize recalcitrant organic compounds (like PCE).

EPA estimated that the O&M and total periodic[12] costs presented would be incurred annually for Options GW2B and GW2C and every 2 years for Option GW2A. Though the number of years that these WTP options would need to be operated varies depending on the overall groundwater remedy selected, the total present value presented below for each of the three WTP options is based on 17 years of operation, which represents the longest estimate for the selected remedy to achieve PRGs and makes the costs directly comparable.

Estimated Costs for WTP Options

	Estimated Costs for Option GW2A	***Estimated Costs for Option GW2B***	***Estimated Costs for Option GW2C***
Direct Capital Cost	$0	$627,484	$2,384,051
O&M Costs	$61,500	$62,143	$272,345
Total Periodic Costs	$87,514	$0	$0
Total Present Value	$1,119,113	$1,472,648	$6,088,050

After evaluating these three WTP options, EPA has determined that continued use of GAC for treatment at the City's WTP is the best option. In each of the subsequent evaluations of groundwater treatment alternatives, EPA assumes continued use of GAC at the City's WTP.

Alternative GW3—*MNA and ICs*

Alternative GW3 addresses the risk to current and potential future receptors by relying on natural attenuation to decrease COC concentrations in groundwater and using institutional controls to prevent COC exposure while natural attenuation is ongoing. The following are the main components of Alternative GW3:

- MNA, including the following:
    - Sampling and analyzing groundwater samples to assess natural attenuation of COCs in groundwater; and
    - Modeling groundwater and natural attenuation processes.

[12] Periodic costs are costs that are expected to be encountered while the treatment alternative is being implemented that do not fit in the O&M or direct capital costs categories.

- Implementing institutional controls to prevent domestic use of untreated groundwater within or nearby the plume.

Each of the main components of this alternative is discussed in the following paragraphs.

EPA defines MNA as "the reliance on natural attenuation processes (within the context of a carefully controlled and monitored clean-up approach) to achieve site-specific remedial objectives within a timeframe that is reasonable compared to other methods." Natural attenuation processes include a variety of physical, chemical, or biological processes that act without human intervention to reduce the contaminant mass, toxicity, mobility, volume, or concentrations in soil and groundwater. Biodegradation is the most important destructive attenuation mechanism, although abiotic destruction of some compounds does occur. Nondestructive attenuation mechanisms include sorption, dispersion, dilution from recharge, and volatilization.

MNA is appropriate as a remedial approach only when it can be demonstrated to be capable of achieving the RAOs within a timeframe that is reasonable compared to that offered by other methods. MNA is typically applied in conjunction with active remediation measures (e.g., source control[13]) or as a follow-up to active remediation measures that have already occurred.

Evaluating natural attenuation usually involves both determining what natural attenuation processes are occurring and estimating future results of these processes. Therefore, if EPA were to select this remedy, it would include continued monitoring and data evaluation over time to document and verify the effectiveness of these processes. The evaluation may consist of groundwater or fate-and-transport modeling to predict the effects of natural attenuation. The evaluation method may also be updated periodically to verify progress and compare groundwater analysis results to the predictions.

In addition to modeling, the use of natural attenuation as part of the remedial plan would require that an LTM program be instituted. The monitoring data would provide information to allow EPA to decide if natural attenuation is meeting Site objectives and to verify that changes in Site conditions do not reduce the effectiveness of natural attenuation. Groundwater would be monitored to determine if COC concentrations within the plume decrease as the result of existing natural attenuation processes or if additional remedial action would be required. The existing monitoring well network would be used to monitor groundwater COC concentrations, breakdown products, geochemical conditions, and natural attenuation parameters, including dissolved oxygen, oxidative-reductive potential (ORP), turbidity, pH, and conductivity. A detection plan for early warning of potential impacts to sensitive receptors, such as users of residential wells, would be provided. Plans could also be developed for contingent remedial efforts that could be executed if natural attenuation processes do not fulfill expectations.

ICs implemented as part of this remedy would protect human health and the environment until natural attenuation processes (or a contingent remedy) reduce COC concentrations in groundwater to below PRGs. The specific ICs EPA would implement would prevent exposure to and use of contaminated groundwater at the Site. EPA may also require access agreements and

[13] EPA previously oversaw the operation of an SVE/AS system that was designed to remediate the primary contaminated soil and groundwater source at the Site and does not expect source control to be necessary at the Site.

property restrictions to install and protect groundwater monitoring wells and other response infrastructure.

For the estimated total present value for Alternative GW3 presented below, EPA assumed 35 years of groundwater monitoring and operation of the carbon treatment on the WTP (Option GW2A). EPA estimates that it will take 34 years for natural attenuation to achieve groundwater PRGs and has included an extra year of monitoring to confirm groundwater concentrations remain below PRGs. The periodic costs presented below would be incurred every 5 years.

Estimated Costs for Alternative GW3:

Direct Capital Costs:	$158,933
Annual O&M Costs:	$84,050
Total Periodic Costs:	$42,081
WTP Costs:	$1,934,435
Total Present Value:	$3,285,377

Estimated Time for Alternative GW3 to reach PRGs: 34 years

Alternative GW5—*ISCR, LTM, and ICs*

Alternative GW5 addresses the risk to current and potential future receptors using ISCR and institutional controls to prevent COC exposure until ISCR and natural attenuation reduce groundwater COCs to below PRGs. ISCR involves injecting an insoluble chemical amendment, such as zero-valent iron (ZVI), with or without carbon sources, in solid or slurry form into the groundwater plume to create a zone with strongly reducing conditions, triggering and accelerating reductive dechlorination of the COC contaminants.

The following are the main components of Alternative GW5:

- In situ chemical reduction, including the following:
    - Injecting ISCR amendments into the subsurface within the core of the shallow groundwater plume to stimulate abiotic and biotic processes; and
    - Relying on MNA to achieve the PRGs for the areas of the plume with lower COC concentrations.
- LTM, including sampling and analyzing groundwater samples for COCs and daughter products.
- ICs to prevent domestic use of untreated groundwater within or nearby the plume.

Both ICs and LTM would be implemented for Alternative GW5 in the same manner as for Alternative GW3.

Alternative GW5 would primarily consist of injecting ISCR amendments into the shallow aquifer to promote ISCR. Injecting an ISCR reagent consisting of a combined ZVI and carbon source has proven to be highly effective in treating chlorinated compounds based on oxidation-reduction processes where the contaminant serves as an electron acceptor and the ISCR reagent as the electron donor. Chlorinated compounds can accept electrons from ZVI and be chemically reduced to nontoxic end products, such as ethene and ethane. In addition to the chemical component of ISCR, the reduced conditions in groundwater created by the ZVI are also favorable for stimulating the growth of microorganisms capable of degrading compounds. Bacterial cultures that facilitate this degradation may need to be including in the ISCR amendments. These would be injected after a reducing environment has been established, as these bacteria that thrive under reducing conditions are often not present in aerobic aquifers. In addition, if ZVI is combined with nutrients and an electron acceptor or energy source, several physical, chemical, and microbiological processes combine to create strong reducing conditions that stimulate rapid and complete dechlorination of organic solvents. These biogeochemical reductions minimize the generation of daughter products, such as vinyl chloride, and result in end products of ethene and ethane.

Injections would be accomplished using a permanent network of wells or by temporary injection wells through DPT and associated screened injection tools. Injection points could be spaced on a grid pattern at the Facility or in off-set rows to create a reactive zone to intercept contaminated groundwater.

The geochemical conditions induced by ISCR could also induce biotic processes in downgradient portions of the groundwater plume and could help to reduce COC concentrations to below the PRGs within the remainder of the groundwater plume.

Predesign investigations may be conducted to refine estimates of contaminant mass and depth intervals or to collect remedy-specific parameters. During and after treatment, performance monitoring would be conducted to establish baseline conditions at the Site prior to remediation, determine the degree of contaminant reduction, and monitor contaminant migration. The potential for methane generation and need for methane control during remediation would also be evaluated before and during treatment. Parameters specific to the performance of ISCR would also be monitored during treatment, such as ISCR amendments, microorganisms, pH, ORP, dissolved oxygen, methane, ethane, ethene, and general chemistry. EPA would use this performance monitoring to evaluate if additional injections are necessary and, if so, whether it is more technically and economically effective to continue with the same ISCR amendment or to focus on promoting the biotic processes leading to reductive dehalogenation.

For the estimated total present value for Alternative GW5 presented below, EPA assumed two injection events would be conducted and that LTM and WTP operation (Option GW2A) would continue for 17 years. This is the amount of time EPA estimates will be required for natural processes to reduce COC concentrations in groundwater to below PRGs after the initial injection of ISCR amendments decrease concentrations in the core of the plume, using the most conservative assumption scenario in the FS (see Appendix E of the FS). The annual O&M costs

are presented as a range because EPA estimates this cost to vary by year, as detailed in the FS report. The periodic costs presented below would be incurred every 5 years.

Estimated Costs for Alternative GW5:

Direct Capital Costs:	$1,337,696
Annual O&M Costs:	$82,027 - $404,907
Total Periodic Costs:	$42,081
WTP Costs:	$1,119,113
Total Present Value:	$4,382,898

Estimated Time for Alternative GW5 to reach PRGs: 9 to 17 years[14]

Alternative GW6—*ISCO, LTM, and ICs*

Alternative GW6 consists of injecting a liquid chemical oxidant (persulfate, permanganate, or peroxide) into the shallow groundwater. The following are the main components of Alternative GW6:

- ISCO, including the following:
    - Injecting an oxidant into the subsurface to oxidize COCs within the core of the shallow groundwater plume; and
    - Relying on MNA to achieve the PRGs for the areas of the plume with lower COC concentrations.
- LTM, including sampling and analyzing groundwater samples for COCs and daughter products
- ICs to prevent domestic use of untreated groundwater within or nearby the plume.

ICs and LTM would be implemented for Alternative GW6 as discussed for Alternatives GW3 and GW5.

ISCO involves oxidation, a chemical process that can convert hazardous contaminants, such as PCE, to nonhazardous or less toxic compounds that are inert, more stable, or less mobile. Alternative GW6 would primarily consist of injecting a chemical oxidant into the core of the groundwater plume within the shallow aquifer to treat the COCs present in the core of the groundwater plume. The COCs would be converted into innocuous compounds commonly found in nature, such as carbon dioxide, water, and inorganic chloride.

[14] In the FS, EPA used two different sets of assumptions for estimating the amount of time active treatment using Alternative GW5 followed by natural attenuation would reduce site groundwater contaminants to below PRGs. The differences in the assumptions are specific to the assumed effectiveness of active treatment. As such, EPA is reporting this estimated timeframe as a range. More details can be found in Appendix E of the FS Report.

The oxidants that may be applicable to the Site include permanganate and persulfate, which have been used for the remediation of chlorinated solvents like PCE. Permanganate is commonly available in two forms: potassium permanganate, a crystalline solid that is typically mixed with water onsite to form a solution; and a liquid sodium permanganate. Compared to other oxidants, permanganate is relatively stable and persistent in the subsurface; as a result, it can migrate by diffusive processes, allowing it to treat more of the groundwater plume. Persulfate typically must be activated in the field by applying iron ethylenediaminetetraacetate or a base, such as sodium hydroxide, to increase pH. For persulfate to be effective in field applications, the activator must be distributed and transported with the persulfate. Natural mineral activated persulfate using ambient groundwater minerals would also be considered.

As discussed for Alternative GW5, injections would be accomplished using a permanent network of injection wells or temporary injection wells using DPT and screen tools. The oxidant would be injected into the subsurface, exit the well screens (if applicable), and spread laterally into the aquifer formation. The oxidant would mix and react with the COCs in the surrounding groundwater. Recirculation wells or injection and extraction well combinations may be employed to improve mixing and oxidant distribution in the subsurface. Fewer injection wells would be required using these delivery approaches. This could be an advantage as the groundwater plume is located below a highly developed area.

The injection points could be arranged in rows to create a reactive zone to intercept contaminated groundwater. If necessary, injection points could also be spaced on a grid pattern within the parking lot of the Facility. As with Alternative GW5, the injections would be focused on treating the core of the groundwater plume with the highest PCE concentrations. After the initial injection period, an evaluation would be conducted to determine if additional injections are necessary.

Predesign investigations would be performed to refine the COC mass estimate and vertical intervals for injections. During and after treatment, performance monitoring would be conducted to establish baseline conditions at the Site prior to remediation, determine the degree of contaminant reduction, and monitor contaminant migration. Parameters specific to the performance of ISCO would also be monitored, such as oxidant concentrations, metals that may be solubilized due to highly oxidative conditions (e.g., arsenic, barium, cadmium, chromium, lead, or selenium), pH, ORP, dissolved oxygen, and general chemistry.

For the estimated total present value for Alternative GW6 presented below, EPA assumed two injection events would be conducted and that LTM and WTP operation (Option GW2A) would continue for 15 years. This is the amount of time EPA estimates will be required for natural processes to reduce COC concentrations in groundwater to below PRGs after the initial injection of ISCO amendments decrease concentrations in the core of the plume, using the most conservative assumption scenario in the FS (see Appendix E of the FS). The annual O&M costs are presented as a range because EPA estimates this cost to vary by year, as detailed in the FS report. The periodic costs presented below would be incurred every 5 years.

Estimated Costs for Alternative GW6:

Direct Capital Costs:	$1,913,970
Annual O&M Costs:	$82,027 - 346,058
Total Periodic Costs:	$42,081
WTP Costs:	$1,003,034
Total Present Value:	$4,266,387

Estimated Time for Alternative GW6 to reach PRGs: 11 to 15 years[15]

9.3 Soil Vapor Alternatives

In the FS, EPA conducted an initial analysis of 5 soil vapor alternatives but conducted a detailed evaluation of 4 of these soil vapor alternatives. In this ROD, EPA is only presenting the 4 soil vapor alternatives for which it conducted a detailed analysis. EPA presents its rationale for screening out 1 of the initial 5 soil vapor alternatives in the FS report.

Alternative SV1—*No Action*

EPA is required to evaluate a "no action" alternative when considering potential remedial actions for a site to provide a baseline for comparison to the other potential response actions. The no-action alternative means that no remedial action would be undertaken and affected soil vapor would remain at the Site without implementing any institutional controls, containment, removal, treatment, or other mitigating actions to control exposure to COCs. Therefore, the potential human health and environmental risks associated with exposure to the COCs would not be mitigated.

Direct Capital Costs:	$0
O&M Costs:	$0
Total Periodic Costs:	$0
Total Present Value:	$0

Alternative SV3—Pathway Sealing, VIMS, LTM, and ICs

Alternative SV3 consists of installing active or passive VIMS for existing buildings to reduce COCs in indoor air. The following are the main components of Alternative SV3:

- Pathway sealing to close the preferential routes of VI into buildings.
- VIMS, including the following:
    - Performing predesign diagnostic testing for design of a VIMS;

[15] In the FS, EPA used two different sets of assumptions for estimating the amount of time active treatment using Alternative GW6 followed by natural attenuation would reduce site groundwater contaminants to below PRGs. The differences in the assumptions are specific to the assumed effectiveness of active treatment. As such, EPA is reporting this estimated timeframe as a range. More details can be found in Appendix E of the FS Report.

    - Installing a VIMS for each building where COCs in indoor or crawlspace air pose an unacceptable risk to human health due to the VI pathway;

    - Operating active VIMS in buildings where selected as the appropriate mitigation measure; and

    - Performing O&M activities and monitoring the performance of the VIMS.

- LTM, including the following:

    - Sampling and analyzing indoor, outdoor, and crawlspace air samples for COCs and daughter products; and

    - Sampling and analyzing sub-slab soil vapor samples for COCs and daughter products, if warranted.

- Coordination with the City to identify any ICs that could be utilized to encourage new construction to include measures to prevent soil vapors from accumulating in indoor air.

- ICs as needed to ensure the integrity of the VIMS.

Pathway Sealing: Cracks and openings in the building foundation are the preferential routes of vapor entry, rather than diffusion through the concrete slab itself. Thus, an important first step in preventing VI is to seal preferential vapor entry points, which can include the following:

- Cracks or holes in the building walls, floors, slabs, and foundation;
- Gaps in and around fieldstone walls, utilities, floor drains, dry utilities, and pipes;
- Construction joints between walls and slabs;
- Floor and utility penetrations, such as those for plumbing, sewer drainage, heating ducts, and electrical conduit; and
- Floor drains and open sumps.

As part of Alternative SV3, each building to be sealed would be thoroughly inspected to identify preferential vapor entry points prior to initiating further remedial action. The base of the building envelope would be visually inspected to identify cracks, building joints, and other building features that could be potential soil vapor entry points. In addition, potential entry points could be surveyed with a portable photoionization detector or a portable gas chromatograph/mass spectrometer. It is often possible to find elevated concentrations of COCs at particular points (that is, preferential pathways) where VI is occurring. The sealing technique would be selected to be appropriate for each type of vapor entry point. Periodic maintenance and visual inspections of the seal could be performed, and appropriate repairs would be made as needed.

Long-term Monitoring: LTM would be conducted to identify areas where VI from the Site remains a threat and, where appropriate, to assess potential VI in occupied structures. LTM could include sampling for COC concentrations in soil vapor in exterior soil vapor probes or wells in

addition to sampling for COC concentrations in indoor air, crawlspace air, and/or sub-slab soil vapor. Samples (particularly those in and under occupied structures) would be collected during multiple seasons, including during both heating and cooling seasons. Outdoor ambient air would be concurrently sampled for COCs to determine if contaminants are likely to be attributable to VI rather than ambient sources. Though the frequency of LTM may vary, it would continue as long as the VI pathway continues to present an unacceptable risk to human health.

VI Mitigation: An appropriate mitigation measure would be designed and implemented for each occupied structure where COCs in indoor or crawlspace air from VI pose an unacceptable risk to human health. EPA may also elect to implement mitigation measures at occupied structures where there is the potential for COCs from VI to pose a future risk to human health. Future risk may be assessed by COC concentrations in soil vapor or sub-slab soil vapor. Mitigation measures can generally be classified as active or passive technologies. Active VIM technologies would be implemented in occupied structures where there is current unacceptable risk to human health. EPA could elect to implement passive or active VIM technologies for occupied structures with no current but a potential future unacceptable risk from VI.

A common active mitigation measure is active depressurization technology (ADT), which has been used successfully to mitigate the VI pathway into residential, commercial, and school buildings. ADT systems are widely considered the most practical VIM strategy for most existing buildings, including those with basement slabs or slab-on-grade foundations. ADT systems are generally recommended for consideration for VIM because of their moderate cost and their demonstrated capability to achieve significant concentration reductions in a wide variety of buildings. SSD systems, a common type of ADT system, function by creating a pressure difference across the building slab to prevent soil vapor from entering the building, thus overcoming the building's natural under-pressurization, which is the driving force for VI. Alternative SV3 would include installing SSD systems in occupied structures with a basement slab or slab-on-grade and where ADT is warranted. The SSD system would be constructed by coring one or more holes through the existing slab, removing soil from beneath the slab to create a suction pit, placing vertical suction pipes into the holes, and sealing the openings around the pipes. These pipes would be manifolded and connected to powered mitigation fans or blowers. The fans would extract soil vapor collected from the targeted sub-slab area, creating a negative pressure field between the sub-slab and indoor spaces. The extracted air would be discharged to the atmosphere outside the structure at a height above the outdoor breathing zone and away from windows and air supply intakes. As part of the design process, pre-mitigation diagnostic testing may be required to optimize the VIMS design.

In buildings with a crawlspace or basement with an earthen floor, a vapor-resistant membrane would be placed over the ground to retard the flow of vapor into the building. The membrane would be sealed to the walls of the building, and one or more suction points would be fitted through the membrane using a gasket. This type of system is referred to as submembrane depressurization (SMD) and is like an SSD, except that the membrane is used as a surrogate for a slab to depressurize the soil.

Before or shortly after VIMs are installed, an operation, maintenance, and monitoring (OM&M) plan would be prepared to identify activities that should be performed following start-up of the

system and a schedule for conducting these activities, including an exit strategy for discontinuing SSD/SMD system operation. The SSD/SMD systems would be inspected periodically which could include measuring field parameters and conducting visual inspections. Routine inspections would also include evaluating significant changes made to the building that would impact the design of the mitigation system or the environment in which it is operated. Routine maintenance of the systems may include periodic fan replacement.

Passive venting relies on natural diffusion, natural pressure gradients, the stack effect, or wind-driven ventilation fans to cause soil vapor to migrate to collection pipes and exhaust to the atmosphere. Passive systems generally have the same components as active systems, except that they do not include electric-powered fans. As a contingency measure, the passive system could be converted to an active system if needed.

For future construction, VIM technology may include barriers, such as geomembranes or spray-applied membranes. Other technologies for new buildings that could be considered include passive venting layers and aerated floor systems.

ICs: ICs could be a necessary part of this remedy to protect human health. For example, land-use controls could be implemented at the Site in areas where VI sampling indicates that the VI pathway potentially presents an unacceptable risk. Prior to remediation of the groundwater plume, ICs may be needed for future construction at the Site to allow for VI sampling and/or mitigation. EPA expects that such ICs would be in effect on an interim basis until the cleanup goals are met and unacceptable risk to human health is no longer present.

For the estimated total present value for Alternative SV3 presented below, EPA assumed that the indoor air action level triggering the need for a VIMs based on an HI of 1 (or an ELCR 10^{-5}) and that 34 residential and 21 commercial buildings would need VIMS. EPA estimated that the VIMS would need to be operated for 30 years, which assumes that contaminant levels will no longer pose a VI risk at that time. EPA expects that the needed timeframe for operation of VIMS will be primarily dependent on the performance on the groundwater cleanup activities and that 30 years is a conservatively long estimate.

EPA estimated two sets of periodic costs as detailed below, one cost to be incurred every 5 years and another cost to be incurred every 10 years.

Direct Capital Costs:	$4,961,904
Annual O&M Costs:	$91,632
Total Periodic Costs (every 5 years):	$36,101
Total Periodic Costs (every 10 years):	$275,573
Total Present Value:	$7,430,653

Alternative SV4—Soil Vapor Source Removal, LTM, and ICs

Alternative SV4 primarily relies on removing sources of soil vapor contamination to decrease COC concentrations in soil vapor that act as the driving force for VI. The following are the main components of Alternative SV4:

- Soil vapor source removal, including the following:

    - Installing and operating an SVE system or multiple SVE systems to address high-concentration soil vapor areas; and

    - If needed, excavating shallow soil within the Facility parking lot that may be acting as a source of COCs in soil vapor.

- LTM.

- ICs as needed to allow for installation and protection of response action infrastructure.

This alternative would include LTM and ICs as described for Alternative SV3. The remaining component of this alternative is discussed in the following paragraphs.

Soil Vapor Source Removal: Alternative SV4 would reduce a significant source of soil vapor contamination via SVE and would be supplemented by excavation, if sufficient soil contamination is found to warrant direct removal.

Residual soil contamination may be contributing to COCs in soil vapor. The highest PCE and TCE concentrations were detected within the 1- to 2-feet depth interval of SG-1, which is in the Facility parking lot. The soil within the immediate vicinity of this sample location could be excavated and transported offsite for disposal. The goal of soil excavation would be to remove contaminated soil acting as a continuing source of soil vapor contamination from an area near the Facility that is readily accessible. Waste characterization sampling would determine whether the soil would be disposed of as hazardous or nonhazardous waste. Following excavation, the excavated area would be backfilled with clean fill material from an offsite source, and site restoration would be performed.

EPA identified 3 main areas with particularly elevated PCE concentrations in soil vapor (greater than 15,000 $\mu g/m^3$ – See Figure 3). In addition to soil excavation, Alternative SV4 would also include installing SVE systems within one or more of the high-concentration PCE soil vapor areas. At a minimum, an SVE system would be installed in the area surrounding the Facility. The goal of an SVE system would be to treat the source of soil vapor contamination that cannot be readily addressed by excavation. The most elevated TCE concentrations in soil vapor (greater than 1,000 $\mu g/m^3$) are near the Facility and would be among the areas addressed by this system. SVE wells could be installed beneath the Facility using directional drilling to address residual soil contamination. Secondary systems could also be installed to address the two additional areas with elevated PCE concentrations in soil vapor, one to the northwest of the Facility (near HAP-023 and HAP-084) and one to the southeast of the Facility (near the former location of Central Dry Cleaners). The need for these secondary systems would be determined as part of predesign investigations. The extracted soil vapor would be treated to remove COCs prior to discharge to the atmosphere if required by state and federal air discharge regulations.

Predesign activities would be required for the design of the SVE system(s). Soil samples may also be collected in targeted areas as part of a predesign investigation to optimize the SVE design

and to determine the need for secondary systems. If possible, soil samples would be collected to assess if soil contamination is present beneath the Facility. A field pilot study would also be conducted, if necessary, to establish the radius-of-influence and other design parameters for the SVE system. Based on the results of the predesign activities, the SVE system could also be thermally enhanced, if warranted.

OM&M would also be required for the SVE system(s), including periodic inspections, field measurements, and performance verification. Maintenance of the SVE system(s) would include periodic carbon replacement, if off-gas treatment is implemented, and system component replacement, as needed.

For the estimated total present value for Alternative SV4 presented below, EPA assumed that the SVE systems would be operated for 5 years. EPA estimates that the periodic costs presented below would be incurred every 5 years.

Direct Capital Costs:	$2,273,931
Annual O&M Costs:	$224,372
Total Periodic Costs:	$36,101
Total Present Value:	$3,338,829

Alternative SV5—*Pathway Sealing, Soil Vapor Source Removal, VIMs, LTM, and ICs*

Alternative SV5 is a combination of Alternative SV3 and SV4 in that it includes VIM for individual buildings, as well as soil vapor source removal to address residual soil contamination and high concentration soil vapor areas. The following are the main components of Alternative SV5:

- Pathway sealing to close the preferential routes of VI into buildings.
- Soil vapor source removal, including the following:
    - Installing and operating an SVE system or multiple SVE systems to address high-concentration soil vapor areas; and
    - If needed, excavating shallow soil within the Facility parking lot that may be acting as a source of COCs in soil vapor.
- VIM, including the following:
    - Performing predesign diagnostic testing for design of the VIMS;
    - Installing a VIMS for each building where COCs in indoor or crawlspace air pose an unacceptable risk to human health due to the VI pathway; and
    - Performing OM&M activities and monitoring the performance of the VIMS.

- LTM, including the following:

    - Sampling and analyzing indoor, outdoor, and crawlspace air samples for COCs and daughter products; and

    - Sampling and analyzing sub-slab soil vapor samples for COCs and daughter products, if warranted.

- ICs as needed to allow for installation and protection of response action infrastructure.

The components for Alternative SV5 have been previously discussed as part of Alternatives SV3 and SV4.

For the estimated total present value for Alternative SV5 presented below, EPA assumed the indoor air action level triggering the need for a VIMs based on an HI of 1 (or an ELCR of 10^{-5}) and that 34 residential and 21 commercial buildings would need VIMs. EPA also assumed that the VIMS would be operated for 30 years. EPA estimates that the periodic costs presented below would be incurred every 5 years.

Direct Capital Costs:	$6,075,915
Annual O&M Costs:	$304,150
Total Periodic Costs:	$72,202
Total Present Value:	$7,539,713

10.0 Comparative Analysis of Alternatives

Section 121(b)(1) of CERCLA identifies several factors that EPA is required to consider in its assessment of remedial alternatives. Building on these specific statutory mandates, the NCP articulates nine evaluation criteria to be used in assessing the individual remedial alternatives. The purpose of this evaluation is to promote consistent identification of the relative advantages and disadvantages of each alternative, thereby guiding selection of remedies offering the most effective and efficient means of achieving site remediation goals. While all of the nine criteria are important, they are weighed differently in the decision making process depending on whether they evaluate protection of human health and the environment or compliance with federal and State requirements, standards, and criteria (threshold); consider technical or economic merits (balancing criteria); or involve evaluation from the State and the public that may influence the final remedy selection (modifying criteria). Each of these nine criteria is described below.

Threshold Criteria

1. **Overall Protection of Human Health and the Environment** focuses on how an alternative achieves protection over time and indicates how each source of contamination would be minimized, reduced, or controlled through treatment, engineering, or institutional controls. The evaluation of the degree of overall protection associated with each alternative is based largely on the exposure pathways and scenarios set forth in the baseline human health risk assessment.

2. **Compliance with ARARs** addresses whether alternatives meet applicable or relevant and appropriate federal and State requirements.

Balancing Criteria

3. **Long Term Effectiveness and Permanence** addresses the results of a remedial action in terms of the risk remaining at the Site after response objectives have been met.

4. **Reduction of Toxicity, Mobility or Volume through Treatment** addresses the statutory requirement for selecting remedial actions that employ treatment technologies that reduce the toxicity, mobility or volume of the hazardous constituents present in the impacted media to the maximum extent practicable.

5. **Short-Term Effectiveness** addresses the effects of the alternatives during the construction and implementation phases (i.e. remediation risks) until the remedial action objectives are met.

6. **Implementability** considers the technical and administrative feasibility of implementing the remedial alternative, including factors such as the relative availability of goods and services.

7. **Cost** includes estimated capital, annual O&M costs, and net present value of capital and O&M costs including long term monitoring.

Modifying Criteria

8. **State Agency Acceptance** considers whether the State support Agency concurs with the selected remedy for the Site.

9. **Community Acceptance** addresses the public's general response to the remedial alternatives and the preferred alternative presented in the Proposed Plan.

Each of the nine evaluation criteria are discussed below with respect to the alternatives under consideration for this P&M Site remedial action. The relative performance of each alternative for remediating the groundwater plume and soil vapor contamination is evaluated against the nine criteria, noting how it compares to the other options under consideration. A more detailed analysis of each of the remedial alternatives can be found in Section 4.4 and Tables 4-9 and 4-10 of the FS report for the Site.

10.1 Comparative Analysis of Groundwater Alternatives

All groundwater alternatives except the no action alternative (Alternative GW1) include continued operation of treatment operations at the WTP. For purposes of conducting the evaluations of these groundwater alternatives in the FS, EPA assumed that WTP Option GW2A (GAC treatment) would be used. GAC treatment has proven to be effective, requires no upfront

capital costs, and is the most cost-efficient option in present value, even after an assumed 35-year operating period, which represents the longest amount of time EPA estimates it would take to achieve groundwater PRGs plus an extra year of monitoring.

1. *Overall Protection of Human Health and the Environment*

Alternative GW1 (No Action) is not protective because it allows for groundwater COC concentrations exceeding PRGs to remain in place and potentially exposes current and future receptors to COCs above acceptable levels, and it does not prevent or minimize plume migration.

Alternative GW3 is protective of human health and the environment, even though no active treatment process is used, because it prevents access to contaminated groundwater through the use of ICs and continued GAC treatment at the WTP. Modeling provided in the FS estimates that PCE concentrations would decrease below the PRG in about 34 years.

Alternatives GW5 and GW6 include active in situ groundwater treatment in addition to ICs and continued GAC treatment at the WTP. As such, these alternatives offer greater protection than the other alternatives considered.

2. *Compliance with ARARs*

Alternative GW1 (No Action) does not comply with ARARs. Alternative GW3 would meet chemical specific ARARs once natural attenuation processes have reduced PCE concentrations within the plume to below the PRG. Alternatives GW5 and GW6 would comply with ARARs. The primary ARARs to be met relate to reducing PCE concentrations in groundwater to below their PRGs, treating off-gas if required, and proper management and disposal of waste generated during the remedial action. Specific ARARs are listed in Table 2-1 of the FS report.

3. *Long-term Effectiveness and Permanence*

The long-term effectiveness and permanence of the alternatives are evaluated in terms of the magnitude of residual risk, adequacy and reliability of controls, and potential environmental impacts of the remedial actions.

The residual risk of Alternative GW1 (No Action) would remain unchanged until natural attenuation processes reduced groundwater concentrations to levels no longer posing a risk. EPA estimates this would take 34 years; however, this alternative proposes no monitoring to track or confirm that. No active treatment processes would be used to reduce COC concentrations in groundwater in Alternative GW3; however, EPA estimates that, after 34 years, the groundwater would achieve PRGs through natural attenuation in conjunction with treatment at the City's WTP (Alternative GW2), eliminating residual risk. No residual risks would be anticipated with Alternatives GW5 and GW6 because both active treatment methods would be expected to reduce COC concentrations to below a performance standard[16], and then, natural attenuation processes

[16] EPA will establish the initial performance standard for the active groundwater treatment during the remedial design. For estimating purposes, EPA used two options for performance standards, 46 µg/l and 16 µg/l. However,

would eventually reduce COC concentrations to below their respective PRGs. However, if any COC adsorbed on the aquifer matrix was to back-diffuse into the groundwater over time, it is anticipated that the more persistent carbon substrate would make Alternative GW5 better able to address this newly released PCE. Treatment chemicals used for Alternative GW5 and GW6 are not expected to result in residual risks because of their short lifespan, ranging from 2 to 5 years, and exposures not addressed by institutional controls are not expected to occur over this period.

Implementation of Alternative GW5 includes residual risks associated with methane generation and/or formation and accumulation of more harmful daughter products, such as vinyl chloride. EPA believes these residual risks can be managed with careful monitoring and the addition of methane-inhibiting supplements. Similarly, implementation of Alternatives GW5 and GW6 both include residual risks with increased dissolution of naturally occurring minerals into groundwater, but this risk can be managed with careful design and monitoring.

Alternatives GW3, GW5, and GW6 include institutional controls that would be adequate and reliable in preventing direct contact with and ingestion of untreated contaminated groundwater. Additionally, Alternatives GW3, GW5, and GW6 would require LTM of COC concentrations and natural attenuation parameters to monitor the progress of natural attenuation processes. Alternatives GW5 and GW6 would also include monitoring to evaluate performance of the remedy and to ensure that residual risks are being managed.

4. *Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment*

No treatment processes are used for Alternative GW1 and GW3; therefore, no reduction of toxicity, mobility, or volume through treatment is anticipated. However, natural attenuation processes would be expected to reduce concentrations of PCE to below its PRG in approximately 34 years. Alternatives GW5 and GW6 include in situ treatment via injection of a chemical reductant and chemical oxidant, respectively; therefore, both alternatives would meet the NCP preference for treatment. Alternative GW6 would be expected to treat more contaminant mass than Alternative GW5 over the shorter timeframe, accelerating a decrease in toxicity, mobility, and volume of PCE during the initial phase of implementation. However, EPA expects the overall reduction in toxicity, mobility, and volume for GW5 and GW6 to be the same.

5. *Short-term Effectiveness*

No additional risks are associated with Alternative GW1 because no remedial action would be taken, and no construction would be performed. The remedial option, other than No Action, that would pose the least amount of risk in the short-term is Alternative GW3 because this option contains the least amount of construction and work required as it is ongoing. Alternatives GW5 and GW6 would pose the most risk in the short-term because of the number of surface penetrations required, the timeframe for injections, and the use of chemicals and potential exposure to the community during implementation of the remedy. The overall difference in risk between Alternatives GW5 and GW6 would be nominal, except for the type and quantity of chemical used and the timeframe required for injection. The treatment chemicals used for

EPA expects the actual performance standard to be based on the ultimate goal of reducing concentrations with active treatment to as close to PRGs as practicable.

Alternative GW5 would pose less of a risk than the strong oxidants involved with Alternative GW6. However, the potential exposures would be controlled through standard best management practices, such as appropriate decontamination protocols, careful dosing, air monitoring, and appropriate traffic control measures.

6. *Implementability*

Alternative GW1 requires no construction or treatment and would be the easiest to implement. For costing purposes, Alternative GW3 assumes installation of three monitoring wells with materials that are readily available. Alternatives GW5 and GW6 would have the greatest implementability challenges because both alternatives are active treatment options requiring the use of chemicals and injections. Alternative GW5 would be more difficult to implement than Alternative GW6 because Alternative GW5 would involve injection of a viscous slurry into the aquifer.

7. *Cost*

An overview of the cost analysis performed for this evaluation and the detailed breakdowns for each of the alternatives are presented in Appendix D of the FS report. Total costs are summarized below and include costs for the City WTP to continue to operate in its current configuration (Option GW2A):

Alternative GW1:	$0
Alternative GW3:	$3.29 million
Alternative GW6:	$4.27 million
Alternative GW5:	$4.38 million

8. *State Agency Acceptance*

IDEM supports the selected remedy: Groundwater Alternative GW5 in conjunction with Groundwater Alternative GW2 (Option GW2A) and with the contingency that Groundwater Alternative GW6 be used if EPA, in consultation with IDEM, determines that Groundwater Alternative GW5 is ineffective or risks cannot be adequately managed. EPA received a February 11, 2021, letter from the Assistant Commissioner of IDEM expressing concurrence with the selected remedy (Appendix B).

9. *Community Acceptance*

During the virtual public meeting and public comment period, the community expressed support for Groundwater Alternative GW5 (ISCR). A number of commenters also expressed support for the use of a second technology, sorbent reactive media, in addition to ISCR. EPA rejected this analysis in its initial evaluation of alternatives in the FS. EPA revisited this evaluation after receiving these comments but has determined that the use of this technology is not warranted or appropriate at this time. No commenters expressed support for the implementation of a different treatment technology than EPA's selection of continued use of GAC to treat the City's municipal drinking water supply. Further details on the comments from the community and EPA's

responses to those comments can be found in the Responsiveness Summary which is Part III of this ROD.

10.2 Comparative Analysis of Soil Vapor Alternatives

1. Overall Protection of Human Health and the Environment

Alternative SV1 (No Action) would not be protective because there would be no remediation of soil vapor, and exposures to current and future receptors would continue. Alternatives SV3 and SV5 would be protective of human health because sub-slab soil vapors would be mitigated through active SSD or SMD. Alternative SV4 would not be protective of human health in the short-term because no VIMS are installed to address risk to current receptors. However, Alternative SV4 would become protective of human health once soil vapor source removal occurs and concentrations in soil vapor and indoor air are confirmed to be below remedial goals.

2. *Compliance with ARARs*

Alternative SV1 (No Action) would not comply with ARARs because no remedial actions would be taken to address unacceptable risk. Alternatives SV3 and SV5 would comply with ARARs because VIMSs would remove unacceptable risk to current and future receptors. Alternative SV4 would not comply with chemical-specific ARARs despite remedial actions being taken because no VIMS would be installed to address risk to current receptors. Specific ARARs are listed in Table 2-1 of the FS report.

3. *Long-term Effectiveness and Permanence*

The residual risk of Alternative SV1 (No Action) would remain unchanged. Alternative SV3 would address exposures leading to residual risks by implementation of VIMS, pathway sealing, and ICs. However, because no soil vapor source removal would occur, residual risk would remain until natural attenuation processes reduce concentrations in soil vapor to below PRGs. Though EPA does not have enough data to estimate the rate of natural attenuation in soil vapor, it expects this to be similar to the 34 years estimated for groundwater to achieve PRGs. VIMS monitoring would be required to verify that COC concentrations in indoor air do not exceed target levels.

Alternative SV4 would address soil vapor source material but would not provide protection from residual risks until all source material is removed or has attenuated, which could continue to provide a source for soil vapor migrating into indoor air at concentrations greater than PRGs. Off-gas treatment would be included, if required to reduce the rate of COCs venting to the atmosphere.

Alternative SV5 would address residual risk by implementing VIMS after soil vapor source removal occurs. Residual COC concentrations remaining in the subsurface would be addressed by natural attenuation. VIMS monitoring would be required to verify that COC concentrations do not exceed target levels. Off-gas treatment from SVE would be included, if required to reduce environmental impacts of COCs venting to the atmosphere.

4. *Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment*

No active treatment processes would be used for Alternative SV1 and SV3; therefore, no reduction of toxicity, mobility, or volume through treatment is anticipated. However, natural attenuation processes and extraction from VIMS are expected to reduce COC concentrations in indoor air, though not from treatment.

Alternatives SV4 and SV5 would include physical treatment using an SVE system to remove contaminated soil vapors from the subsurface (potentially with off-gas treatment) and soil excavation to remove contaminated soil. Therefore, both alternatives would meet the NCP preference for treatment if the SVE includes off-gas treatment.

Alternatives SV4 and SV5 would both increase mobility of soil vapors during SVE, though the mobile vapors would be directed towards the extraction wells and removed from the environment. There would be the potential for residual contamination to remain in the subsurface in areas where the radius of influence of vapor extraction wells is insufficient to remove all contaminated soil vapors.

5. *Short-term Effectiveness*

There are no additional risks associated with Alternative SV1 because no remedial action would be taken, and no construction would be performed. The remedial option with the greatest short-term effectiveness is Alternative SV3. This option would have the least amount of construction and work required. Alternatives SV4 and SV5 would provide the least degree of short-term effectiveness because of the installation of the SVE system (vertical or horizontal extraction points and potentially off-gas treatment) and soil excavation and offsite disposal activities. The overall difference between Alternatives SV4 and SV5 would be that only Alternative SV5 would require the installation of individual VIMS in multiple buildings so Alternative SV5 would be effective in controlling exposures in the short term; whereas, SV4 would not. Exposure to contaminated soil and soil vapor during construction would be controlled through standard best management practices such as appropriate decontamination protocols, air monitoring, and appropriate traffic control measures.

6. *Implementability*

Alternative SV1 would require no construction or treatment and would be the easiest to implement. Alternative SV3 would only require the installation of VIMS with materials that are readily available. Alternative SV4 would require the installation of an SVE system, soil excavation, and offsite disposal of contaminated soil. Alternative SV5 would have the greatest implementability challenges as it requires the most activities, including VIM and SVE system installation, soil excavation, and offsite disposal of contaminated soils.

7. *Cost*

An overview of the cost analysis performed for this evaluation and the detailed breakdowns for each of the alternatives are presented in Appendix D of the FS report. Although the initial capital cost for Alternative SV5 is significantly greater than Alternative SV3, Alternatives SV3 and SV5 have a similar overall present-values due to the longer timeframe required for O&M for Alternative SV3 (30 years versus 5 years for Alternative SV5). Total costs are summarized as follows:

Alternative SV1:	$0
Alternative SV4:	$3.34 million
Alternative SV3:	$7.43 million
Alternative SV5:	$7.54 million

8. *State Agency Acceptance*

IDEM supports the selected soil vapor remedy, Alternative SV5. EPA received a February 11, 2021 letter from the Assistant Commissioner of IDEM expressing concurrence with the selected remedy (Appendix B).

9. *Community Acceptance*

During the virtual public meeting and public comment period, the community expressed support for EPA's preferred soil vapor remedy, Alternative SV5. Further details can be found in the Responsiveness Summary which is Part III of this ROD.

11.0 Principal Threat Waste

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a Site, wherever practical. The principal threat concept is applied to the characterization of "source material" at a Superfund Site. Source material includes or contains hazardous substances, pollutants or contaminants that act as a source for migration of contaminants to groundwater, surface water or air, or acts as a source for direct exposure. EPA has defined principal threat wastes as those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.

During the RI, EPA did not identify any principal threat waste on the Site. From 2005 through 2008, EPA oversaw a removal action at the former Master Wear facility on the Site, which involved the cleanup of highly contaminated groundwater at concentrations indicative of the presence of source material. Though EPA believes most, if not all, source material has been depleted and that the groundwater and soil vapor contamination is residual contamination from former source material, EPA will continue to investigate for the presence of source material, particularly in this area, during the remedial design and possibly during the implementation of the soil vapor remedy. The selected soil vapor alternative includes the potential for the removal

and/or treatment of such source material through the use of soil excavations and/or soil vapor extraction.

12.0 Selected Remedy

EPA has selected as the Site remedy the combination of Groundwater Alternative GW-2A (GAC) to continue to protect the municipal drinking water supply; Groundwater Alternative GW-5 (ISCR) to reduce concentrations in the central (greater than 46 µg/L of PCE) portion of the groundwater plume followed by MNA, and Soil Vapor Alternative SV-5 (Pathway Sealing, VIMS, and Soil Vapor Source Removal) to both reduce soil vapor concentrations and protect receptors from exposure to these vapors. EPA is also including as part of this remedy LTM of groundwater and soil vapor, the implementation of ICs to protect from exposures to Site contaminants until groundwater and soil vapor reach PRGs, and the connection of residential properties to the municipal drinking water supply if EPA identifies any such properties relying on private wells drawing from the Site groundwater plume for drinking water.

If EPA, in consultation with IDEM, determines during the design of the remedy that it is not confident the risks posed by implementing ISCR can be sufficiently managed, EPA will instead select ISCO. These risks are described in Section 10 above and include methanogenesis, daughter product formation, as well as any other risks posed by converting a largely aerobic aquifer to anaerobic conditions. Additionally, EPA may also change its groundwater remedy selection to ISCO rather than ISCR if EPA and IDEM find ISCR to be insufficiently effective after implementation. If EPA chooses to implement the contingent remedy, EPA will issue a decision document to record this change in the remedial approach. IDEM will be given an opportunity to comment on and concur with any potential change in remedy.

12.1 Summary of the Rationale for the Selected Remedy

The groundwater portion of the Selected Remedial Cleanup Alternative for the P&M Site is a combination of Groundwater Alternatives GW2 (Option GW2A - GAC treatment at the City's WTP) and GW5 (ISCR). EPA estimates that the total present value cost of the groundwater portion of the remedy will be $4.38 million and that it will take between 9 and 17 years for the Site groundwater to reach RAOs. This will include an initial period of active treatment followed by a period of MNA.

The City, IDEM, and EPA are in agreement that continued use of GAC is the preferred treatment option for the City's WTP (Option GW2A). The infrastructure is already in place and this technology has proven to be effective at removing PCE from the City's drinking water supply. Based on concerns raised by the City that some residential properties could be relying on a private well located in the Site groundwater plume for drinking, EPA is also including in the Selected Remedial Cleanup Alternative the option to connect residential properties to the City's municipal drinking water supply.

In the FS, EPA determined that both ISCO (Groundwater Alternative GW6) and ISCR (Groundwater Alternative GW5) have the potential to effectively reduce PCE in groundwater at the Site but that ISCR has the potential to more effectively treat the groundwater plume because

the reducing conditions produced by the ISCR treatment reagents could persist longer than the ISCO reagent and stimulate continued biological reductive dechlorination of PCE. The ISCR treatment reagents also pose less of a risk than the strong oxidants used for ISCO. However, EPA also found that there are risks in converting a largely aerobic aquifer to reducing conditions. EPA expects ISCR to include the addition of significant amounts of ZVI and a carbon source to create and sustain anaerobic conditions by consuming oxygen and other electron acceptors during biodegradation. In some situations, this can result in the unintended production of subsurface methane (methanogenesis). Also, after the short-term chemically destructive treatment of PCE by ZVI, longer-term anaerobic biodegradation of PCE can sometimes result in an accumulation of daughter products, possibly with higher toxicity. For these reasons, EPA identified in the proposed plan ISCO as its preferred remedial alternative for addressing groundwater contamination.

After receiving numerous comments from the public, including the City of Martinsville, supporting ISCR over ISCO, reviewing the current status of technologies available to control for the unintended side effects of implementing ISCR in an aerobic aquifer (specifically, methanogenesis and daughter product formation), and consulting with IDEM, EPA changed its preference and is instead selecting ISCR as the groundwater treatment alternative for this Site. However, EPA is making this selection contingent on a determination during the remedial design that it can sufficiently mitigate the potential for methanogenesis and daughter product formation. If EPA determines that it cannot sufficiently manage for the potential risks with ISCR implementation or that ISCR is otherwise ineffective, EPA will instead implement ISCO for treating groundwater. If EPA determines that such contingency needs to be implemented, it will reflect this change in a decision document.

The soil vapor portion of the Selected Remedial Cleanup Alternative for the P&M Site is Soil Vapor Alternative SV5 (Pathway Sealing, Soil Vapor Source Removal, VIMs). EPA estimates that the total present value cost of this portion of the remedy will be $7.54 million; however, this estimate required a number of assumptions regarding the number of houses to be sampled, the number needing mitigation, and the results of design investigations. Also, this estimate included the assumption that the VIMS would need to be operated for 30 years. The VIMS will need to be operated until the groundwater and soil vapor concentrations are reduced to a level that no longer pose a threat to human health via indoor air. EPA expects that it will take longer for groundwater concentrations to reach RAOs than soil vapor concentrations to reach RAOs so EPA believes 30 years is a conservatively high assumption.

Based on the comments received during the public comment period, the public and the City concur with IDEM and EPA that soil vapor alternative SV5 is the preferred alternative for the soil vapor portion of the remedy. This alternative is a combination of the other active soil vapor treatment alternatives and represents the most aggressive treatment option evaluated. Soil vapor concentrations will be reduced using SVE and, if necessary, soil excavation, and the human health exposure pathway will be protected using a combination of pathway sealing and VIMs.

Based on the information available, the Selected Remedial Cleanup Alternative satisfies the following statutory requirements of CERCLA 121(b): it is protective of human health and the environment, complies with ARARs, is cost-effective, and utilizes permanent solutions and

alternative treatment technologies to the maximum extent practicable. The Selected Remedial Cleanup Alternative complies with the statutory preference for selecting a remedy that involves treatment as a principal element.

12.2 Description of Remedial Components

The groundwater component of the Selected Remedial Cleanup Alternative includes ISCR in the central portion (greater than 46 µg/l of PCE) of the groundwater plume and MNA in the remaining portions of the plume as well as in the central portion of the plume after active treatment decreases concentrations to below 46 µg/l[17]. ISCR involves injecting an insoluble chemical amendment, such as ZVI with or without a carbon source, in solid or slurry form into the groundwater plume. Under strongly reducing conditions ZVI chemically destroys PCE to non-toxic end products while a carbon source will cause the PCE contamination in the groundwater to breakdown through reductive dechlorination. EPA may utilize more than one injection event to reduce concentrations in the central portion of the groundwater plume to a level that will allow natural attenuation to achieve PRGs in a reasonable amount of time.

If EPA determines that the risks associated with ISCR cannot be adequately managed or ISCR proves to be insufficiently effective, EPA will instead utilize ISCO for actively treating the central portion of the groundwater plume. ISCO is similar to ISCR except that strongly oxidizing conditions are created through the injection of oxidants such as potassium permanganate. PCE would then be fully oxidized to CO_2, water, and inorganic chloride without producing more toxic intermediate daughter products.

To protect human health from exposure to the Site's groundwater contamination via the drinking water pathway, the Selected Remedial Cleanup Alternative also includes continued treatment of the City's municipal drinking water with GAC and, if necessary, connection of residential properties at the Site to the City's municipal drinking water supply. The GAC treatment of the City's municipal drinking water will continue until Site groundwater contamination is reduced to below the PRG (the drinking water MCL for PCE of 5 µg/L).

The soil vapor components of the Selected Remedial Cleanup Alternative include SVE in one or more areas of relatively high soil vapor concentrations at the Site and will include soil excavation if EPA identifies any soil contamination during the RD or RA that merits excavation. To protect human health from exposures to PCE contamination in indoor air via the VI pathway, the Selected Remedial Cleanup Alternative will also include a combination of monitoring and, where necessary, mitigation using pathway sealing and VIMs.

The Selected Remedial Cleanup Alternative will also include implementation of ICs aimed at preventing exposures to Site soil vapor and/or groundwater contamination until such contamination is reduced to below the PRGs.

[17] EPA expects to set the performance standard during the remedial design, but it will be no greater than 46 µg/l.

The Selected Remedial Cleanup Alternative also includes LTM of groundwater and soil vapor to track the progress of active treatment and natural attenuation and to determine where ICs need to be implemented. Long-term monitoring will continue until Site contaminants are reduced to below PRGs.

12.3 Summary of the Estimated Remedy Costs

EPA estimates the present worth cost for the selected remedy is $11.92 million. The principal elements of the remedy costs for each component of the remedy include capital cost, periodic costs, and O&M, except that there are no capital costs associated with the GAC treatment at the City's WTP. EPA estimates that the groundwater treatment component (ISCR followed by MNA) will have a capital cost of $1.34 million, recurring O&M costs between $82,027 and $404,907, and recurring periodic costs of $42,081. EPA estimates the treatment at the City's WTP with GAC will have recurring O&M costs of $61,500 and recurring periodic costs of $87,514. EPA estimates the soil vapor component (pathway sealing, soil vapor source removal, and VIMs installation) will have a capital cost of $6.08 million, recurring O&M costs of $304,150, and recurring periodic costs of $72,202.

Appendix D of the FS report for the Site contains more details supporting these cost estimates. EPA further notes that these estimates are based on assumed findings during the RD and RA that will affect the extent to which the remedial components will be implemented. In particular, the number of structures requiring VIMs is largely unknown at this time, and the extent to which EPA will implement soil vapor source removal could change upon further investigation.

12.4 Expected Outcomes of the Selected Remedy

The selected remedy will protect human health and the environment under current and reasonably anticipated future property uses at the Site by continuing to treat groundwater at the Site used for drinking water, providing access to treated groundwater, treating the groundwater contaminant plume, identifying and preventing exposures to soil vapor contamination, treating soil vapor contamination, and implementing ICs on affected land and groundwater use until RAOs are achieved. Site monitoring combined with ICs will provide the ongoing data needed to assess the progress of the selected remedy and ensure that new exposure pathways do not arise. EPA estimates that RAOs for the groundwater will be achieved in 9 to 17 years and that RAOs for soil vapor will be achieved upon successful implementation of vapor intrusion mitigation. Installation of VIMs could typically be accomplished within the first year of construction, which would achieve the soil vapor RAO initially by eliminating exposure to COCs in indoor air. Long-term, the soil vapor RAO would be met by depleting the source through operation of an SVE system (estimated to be 5 years) and through treatment of groundwater.

13.0 Statutory Determinations

Under CERCLA Section 121 and the NCP, the lead Agency must select remedies that are protective of human health and the environment, attain federal and state requirements that are applicable or relevant and appropriate for this remedial action (or invoke an appropriate waiver), are cost effective, and utilize permanent solutions to the maximum extent practicable. In

addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduce the toxicity, mobility, or volume of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the selected remedy addresses these statutory requirements.

13.1 Protection of Human Health and the Environment

The selected remedy will be protective of human health and the environment for the risks associated with the Site. ISCR, GAC treatment of the municipal water supply, ICs, and monitoring will be protective of human health and the environment for groundwater risks. Pathway sealing, VIMs, soil vapor source removal, and monitoring will be protective of human health and the environment for soil vapor risks. ISCR will provide an initial reduction in the portion of the groundwater plume with the highest contaminant concentrations, and MNA will provide the opportunity to reach groundwater RAOs over the long-term. Soil vapor source removal and groundwater treatment will provide the opportunity to reach soil vapor RAOs. Implementation of ICs will provide restrictions to protect human health, the environment, and the remedy, as needed. Monitoring will track the remedy so EPA can ensure that the remedy achieves the RAOs.

13.2 Compliance with ARARs

The selected remedy is expected to comply with the state and federal ARARs that are specific to the scope of this remedy action. The ARARs for this remedial action are discussed in Sections 10.1 and 10.2 above.

13.3 Cost-effectiveness

EPA has determined that the selected remedy is cost effective, will be protective and represents a reasonable level of protectiveness for the money to be spent. In making this determination, the following definition was used: "[a] remedy shall be cost effective if its costs are proportional to the overall effectiveness." (40 C.F.R. 300.430(f)(1)(ii)(D)). "Overall effectiveness" was evaluated by assessing three of the five balancing criteria (long term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, and short-term effectiveness). Overall effectiveness was then compared to cost to determine cost-effectiveness. The relationship to the overall effectiveness of this remedial action was determined to be proportional to its costs; therefore, the remedy represents a reasonable level of protectiveness for the money spent. The estimated present worth of the selected remedy is $11.92 million.

13.4 Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable

EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that the selected remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the preference for treatment as

a principal element, the bias against off-site treatment and disposal, and state and community acceptance.

The selected remedy, Groundwater Alternatives GW2A and GW5 and Soil Vapor Alternative SV5, achieves substantial risk and mass reduction. In-situ treatment of the central portion of the groundwater plume as well as natural attenuation will permanently reduce the mass of Site groundwater contamination and, thus, reduce risk. The end goal of the chemical reduction process is to convert PCE into non-toxic end products. Continued treatment at the City's WTP using GAC as well as connection to the municipal drinking water system of any residential properties at the Site currently dependent on private wells will substantially reduce risk from exposure to contaminated groundwater at the Site. Soil vapor source removal and groundwater treatment will permanently reduce the mass of Site soil vapor contamination and, thus, reduce risk. Pathway sealing and the installation of VIMs will substantially reduce risk from exposure to Site soil vapor contamination.

13.5 Preference for Treatment as a Principal Element

By treating the highest concentrations of Site groundwater contamination with ISCR and reducing soil vapor contamination with source removal involving soil vapor extraction, the selected remedy satisfies the statutory preference for remedies that employ treatment as a principal element.

13.6 Five-Year Review Requirements

CERCLA § 121(c) and the NCP § 300.430(f)(5)(iii)(C) provide the statutory and legal bases for conducting Five-Year Reviews. Until RAOs are achieved, hazardous substances will remain at the Site in the groundwater above levels that allow for UU/UE. As a result, statutory reviews will be conducted every five years after commencement of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment until the RAOs are achieved.

14.0 Documentation of Significant Changes

The Proposed Plan for this Site identified a combination of Groundwater Alternative GW-2A (GAC), Groundwater Alternative GW-6 (ISCO), and Soil Vapor Alternative SV-5 (Pathway Sealing, Vapor Intrusion Mitigation, and Soil Vapor Source Removal) as the preferred remedial action. In this ROD, EPA has selected Groundwater Alternative GW-5 (ISCR) instead of Groundwater Alternative GW-6 (ISCO), while retaining Groundwater Alternative GW-6 (ISCO) as a contingent alternative to Groundwater Alternative GW-5 (ISCR).

The Proposed Plan comment period ran from August 3, 2020 to October 3, 2020. CERCLA Section 117(b) and the NCP at 300.430(f)(5)(iii) requires an explanation of significant changes from the remedy presented in the Proposed Plan that was published for public comment. After receipt of numerous comments supporting the selection of Groundwater Alternative GW-5 (ISCR) instead of Groundwater Alternative GW-6 (ISCO), EPA reconsidered its proposal to select Groundwater Alternative GW-6 (ISCO).

EPA proposed Groundwater Alternative GW-6 (ISCO) instead of Groundwater Alternative GW-5 because of the potential risks posed by the implementation of ISCR. However, EPA recognizes that ISCR may be a more effective than ISCO for treating the Site's groundwater contamination and options may be available to adequately manage the risks posed by ISCR. As such, EPA is making this significant change from the proposed plan but is retaining as a contingency the option to implement ISCO instead of ISCR if EPA determines these risks cannot be sufficiently managed. EPA is also retaining the option of implementing ISCO if the initial implementation of ISCR proves to be insufficiently effective. If EPA chooses to implement this contingency, EPA will issue a decision document to record this change in the remedial approach.

Part III: Responsiveness Summary

This Responsiveness Summary documents public participation in the remedy selection process for the P&M Site. A summary of comments received during the 60-day public comment period and during the August 12, 2020 virtual public meeting are included in this section of the ROD, along with EPA's responses to these comments. The public comment period for this response action ran from August 3, 2020 to October 3, 2020.

1) Several commenters pointed out that the FS report used the term "highly effective" when describing the potential effectiveness of ISCR and "moderately effective" when describing ISCO and expressed support for the use of ISCR versus ISCO.

   EPA response: EPA notes that the use of these terms could be misleading. The difference in terminology is based on the fact that ISCR treatment materials are expected to persist in the aquifer longer than ISCO. The overall effectiveness of the treatment can also be affected by how well the injected materials can be distributed through the aquifer and the number of injection events. Either of these in situ treatments could effectively treat the groundwater contamination.

   EPA proposed ISCO versus ISCR because there is less chance of unintended consequences when adding oxidants to an already aerobic (oxidizing) aquifer. ISCR requires a change in the fundamental chemistry of the aquifer to anaerobic (reducing) conditions. As such, EPA predicts that there is a greater risk in using ISCR, though these risks may indeed be manageable.

   In this ROD, EPA is selecting ISCR with the option of using ISCO instead. Specifically, EPA plans to evaluate the potential risks posed by ISCR and determine if these risks can be adequately managed. If EPA does not feel these risks can be adequately managed, EPA will instead use ISCO. If EPA opts to use ISCO, the change will be documented in a subsequent decision document.

2) One commenter asked what the vapor intrusion sampling and installation of a mitigation system costs a property owner. Another commenter asked if owners of properties equipped with VIMS would be compensated for the cost to operate the fans that are part of these systems.

   EPA Response: There is no cost to property owners to have EPA sample their home or business for vapor intrusion. Similarly, there is no cost to property owners for the installation of a mitigation system where these may be needed. However, EPA cannot reimburse property owners for the added energy costs to operate these fans as these are operation and maintenance costs - which EPA is statutorily limited from paying. The wattage of the fans used for VIMs varies, depending on the size of the structure, and are typically in the range of 150 Watts so the electricity costs to run this system are equivalent to the costs to leave on two 75 Watt incandescent lightbulbs.

3) One commenter expressed concern about depressed property values as a result of the site being included on the National Priority's List (i.e. making it a "Superfund" site).

EPA Response: EPA is unable to control real estate market conditions as a result of a site becoming a Superfund site. However, EPA can work to improve site conditions, and provide property owners with data to demonstrate the site is not impacting their property or that the impacts have been mitigated.

EPA evaluated the issue of the impact of Superfund Sites on property values in the following publication:

https://semspub.epa.gov/work/05/927384.pdf

In addition, EPA further evaluated the economic impacts of its clean-up work in the following handbook:

https://www.epa.gov/environmental-economics/handbook-benefits-costs-and-impacts-land-cleanup-and-reuse

4) One commenter representing a local environmental group asked how many properties were above the plume and if those properties could be identified.

EPA Response: During the investigation, EPA identified approximately 230 properties above the soil vapor plumes associated with the Site. The soil vapor plumes are delineated on maps located in the RI Report (Figures 5-7 and 5-8) and the FS Report (Figures 1-12 and 1-13).

5) One or more commenters asked when EPA would be conducting additional vapor intrusion sampling.

EPA Response: EPA expects that it will begin collecting additional vapor intrusion samples within approximately one year of issuing this ROD. After issuing the ROD, EPA will need to procure a contractor, approve the necessary sampling and quality assurance plans, and obtain written access from property owners before it can begin taking additional vapor intrusion samples.

6) One or more commenters have asked about the operation and or disposition of equipment leftover from previous EPA response activities at the site.

EPA Response: Any property owners with leftover equipment at their property should contact EPA. EPA does not recommend discontinuing the operation of any equipment (such as a vapor intrusion mitigation system, as one commenter alluded to) until more information can be obtained.

7) One or more commenters asked about what vapor intrusion sampling is and how long it takes.

EPA Response: Vapor intrusion sampling at a building typically involves performing a building survey, collecting sub-slab vapor or crawlspace air and indoor air samples. Sub-slab vapor is the "air" in the soil beneath the building slab, and crawlspace air is the air within the crawlspace beneath the building. Vapor intrusion sampling is typically performed over two or three days, but the work only takes an hour or two each day. The sampling requires little-to-no involvement from the property owner or resident, aside from setting up appointments allowing the sampling team inside the property. The following description reflects what EPA expects to be the VI sampling procedures to be conducted in the future at the Site:

The building survey and sub-slab probe installation are performed on the first day (approximately two hours of work). The sampling team will take notes on the building construction and occupancy conditions. They will ask the property owner/occupant questions to gather this information. The sampling team will also use a hand-held detector to identify any potential indoor sources of volatile organic compounds (VOCs) (such as solvents, cleaning products or craft glues) that may interfere with the samples. Any indoor VOC sources identified, such as certain cleaning or degreasing products, will be placed outside of the building in a storage bin for the next two days while the samples are collected. If the building is constructed on a slab, then one or more sub-slab probes (depending on the building size) will be installed by drilling a small hole (approximately 1.5-inch diameter) through the slab with a hammer drill.

Collection of the indoor air samples will begin on the second day (approximately 1 hour of work). Also, if the building is constructed on a full or partial crawlspace, then crawlspace air samples will also be collected. The indoor and crawlspace air samples are collected in stainless-steel canisters (approximately the size and shape of a basketball) equipped with flow controllers so that the samples will collect over an 8- or 24-hour period (depending on building occupancy - 8 hours for commercial buildings and 24 hours for residential buildings). The canisters should not be touched or moved around the property. The indoor and crawlspace air samples will be collected the same day at commercial buildings.

The indoor and crawlspace air (for residential buildings) and sub-slab vapor samples will be collected on the third day (approximately 2 hours of work). The indoor and crawlspace air canisters will be collected from the building, and then the sub-slab probes will be sampled. The sampling team will connect tubing and a smaller stainless-steel canister to the sub-slab probes and collect the sample. The sub-slab probes will be covered with a small metal plate (size of a half dollar coin) and left in place so that they can be sampled again in the future if necessary.

8) A number of commenters expressed support for the use of sorptive-reactive media, citing a specific product used at a neighboring state-led site.

EPA Response: EPA evaluated the use of sorptive-reactive media in the FS (Alternative GW-7) and screened this clean-up option out due to its limited history of use and the limited data demonstrating its effectiveness. Because it received numerous comments supporting the use of this technology, EPA conducted a supplemental evaluation of this technology for consideration at this site.

Sorptive-reactive media by itself only adsorbs the contamination; however, typical applications will include treatment additives designed to break down or otherwise destroy the contamination. These additives, such as those that might be used for ISCR or ISCO, could be added without the sorbent materials. The primary benefit of the sorbent materials is it reduces the mobility of the contamination. At this site, EPA does not see mobility reduction as a primary concern for treatment as it will take many years for the elevated groundwater contamination in the treatment area to reach the City's municipal wellfield.

In addition, EPA remains concerned that data demonstrating that the contaminants are broken down by the intended mechanism is still limited. Data demonstrating that groundwater contaminant concentrations are lower downgradient of the sorbent material are not an indicator that the contamination has been fully degraded, only that the contaminants have been adsorbed to the sorbent material.

EPA is also concerned about the practicality of applying this technology throughout the entire portion of the plume it intends to treat.

9) One or more commenters asked about private drinking water wells located within the groundwater plume.

EPA Response: EPA made efforts to identify any private drinking water wells within the vicinity of the groundwater plume. EPA identified three private drinking water wells near the plume and was able to sample each well. None of the wells were found to have contaminants above EPA's drinking water standard.

Regardless, EPA has included an option in the ROD to connect to municipal water any existing residential properties dependent on a private drinking water well drawing water from the Site groundwater plume.

EPA encourages any owners of property in the vicinity of the plume using a private drinking water well to contact EPA or IDEM as soon as possible. Furthermore, EPA strongly discourages the use of these wells for potable purposes, unless the well is outside of the plume. However, even then, EPA encourages property owners to arrange to have their wells tested for VOCs. The Site plume is not the only known groundwater contamination in Martinsville.

10) One commenter asked about institutional controls that EPA would look to the City to implement.

EPA Response: Institutional controls are legal controls EPA puts in place or arranges to have put in place to prevent exposures to Site contaminants until clean-up levels can be met. One type of institutional control that EPA may try to utilize is referred to as "governmental controls." This includes legal restrictions, such as a local ordinance, that would prevent exposure to Site contaminants. At this stage, it is too early to determine the specific institutional controls that EPA may utilize to prevent exposures. However, it is conceivable that EPA might request that the City implement a local ordinance restricting the use of drinking water wells in the vicinity of the groundwater plume.

11) One commenter asked about where EPA expects to remove contaminated soils.

EPA Response: During the RI, EPA only identified a small area of soil contamination (near the former Master Wear facility). EPA plans to conduct pre-design investigations to determine if limited removal of soil contamination is warranted. EPA expects that, if needed, soil removal activities will be very small in scale.

12) One commenter asked about remedial activities and redevelopment activities in the area interfering with each other.

EPA Response: EPA doesn't expect to begin remedial activities for at least a year. At that time, EPA will work with city officials and others to minimize disruption from remedial activities. EPA recommends that developers be made aware of Site contamination and take proper precautions in the design and implementation of development activities to prevent exposures from Site contaminants at depth.

13) One commenter asked about the use of monitored natural attenuation as part of the proposed remedy.

EPA Response: EPA proposed and is now selecting an active groundwater treatment remedy in the central portion of the groundwater plume with PCE concentrations greater than 46 ppb while depending on natural attenuation to reduce the other, lower concentration portions of the plume to below clean-up levels. EPA will monitor the rate at which these natural processes attenuate contaminant concentrations and may choose to actively treat these areas at a later time if deemed necessary to meet clean-up levels in a reasonable amount of time.

14) One commenter asked about the area in which EPA expects to conduct future investigations on individual properties.

EPA Response: EPA has provided maps in both the RI and FS reports that show the total area of groundwater contamination as well as the total area of soil vapor contamination as assessed during the RI. EPA typically extends its vapor intrusion

investigations to homes and businesses inside of or within 100 feet of the soil vapor contamination area. EPA will consider sampling or otherwise addressing any private drinking water wells within or in close proximity to the groundwater plume.

EPA notes that the delineation of the groundwater and soil vapor plumes might change as it gathers additional data going forward.

15) Several commenters discussed the expected timeframe for the cleanup.

EPA Response: In the proposed plan, EPA discussed one estimate developed during the FS that showed that treating the central portion of the plume with ISCO combined with MNA for the lower-concentration periphery of the plume would take fifteen years before the groundwater meets clean-up levels (i.e. the Federal drinking water standard for PCE of 5 parts per billion). This estimate was generated using models but required some assumptions that over-simplify the number of potential variables that could affect this rate. In comparison, for this particular scenario, EPA estimated that ISCR and MNA would take 17 years to achieve MCLs throughout the plume.

Regardless of the set of assumptions used for preparing these estimates, the actual rate at which the groundwater will be cleaned up to the Federal drinking water standard is less affected by the use of ISCR versus ISCO and more affected by how quickly treatment can begin and how well the remediation reagent can be distributed in the subsurface.

An assumption in the model is for active treatment using ISCO or ISCR to take an estimated 4 and 6 years, respectively. This time period allows for an initial treatment event followed by an evaluation period of groundwater monitoring and a second injection event, if warranted. The model assumes that after 4 or 6 years, contaminant concentrations in groundwater would decrease from a maximum PCE concentration of 210 parts per billion to below the proposed treatment goal of 46 parts per billion. The full duration of 15 to 17 years to achieve the Federal drinking water standard for PCE of 5 parts per billion is based on natural processes that passively occur after active treatment, periodically monitored by sampling groundwater. Depending on the actual performance results of the active groundwater treatment, which can be influenced by many factors, the overall duration to achieve the Federal drinking water standard may be shorter. For example, assuming active treatment decreases PCE concentrations to 16 parts per billion results in overall durations of 11 and 9 years for ISCR and ISCO, respectively[18].

16) One commenter asked about whether a number of contaminants were found at Site.

EPA Response: EPA only identified PCE as a contaminant of concern in groundwater at the Site. However, EPA identified both PCE and TCE as contaminants of concern in soil vapor at the Site. EPA did not identify any other contaminants of concern at the Site.

[18] Note that an error was made in the FS report reversing these duration estimates. This error has been corrected and the corrected version of the FS report for the Site is available on the website for the Site.

17) One commenter asked about several other potential sources of contamination in the Martinsville area.

EPA Response: EPA's Superfund Program is specifically tasked with investigating and cleaning up the Pike and Mulberry Streets PCE Plume Site, which is defined as a chlorinated solvent groundwater plume and associated areas of soil vapor contamination generally centralized near the intersection of Pike and Mulberry Streets and extending to the City's municipal wellfield. Concerns with other sources of contamination outside of this area can be brought to the attention of the Indiana Department of Environmental Management. In addition, EPA and IDEM welcome any information regarding parties that are potentially responsible for the contamination.

18) One commenter asked: "Regarding the proposed potassium permanganate wax cylinders, how will lateral distribution, perpendicular to groundwater flow be controlled to ensure complete coverage across the treatment area?"

EPA Response: Though EPA is selecting ISCR in this ROD, EPA would determine details such as this during the remedial design. Over time, technologies offered by various suppliers and manufacturers may change. During the design phase, the best available technologies at that time for chemical distribution will be reviewed and considered. In the Proposed Plan, EPA had not proposed a specific type of oxidant nor a vehicle for distributing an oxidant.

19) One commenter asked what the rationale is behind a 17-year post injection treatment period of ISCR versus a 15-yr treatment period for ISCO. ISCR is generally known to last longer within the subsurface.

EPA Response: Details about the modeling EPA completed for the estimates of treatment times to reach RAOs can be found in Appendix E of the FS Report. The commenter is referring to the Scenario 2 set of assumptions, which included a presumed 4-year treatment period for ISCO and a 6-year treatment period for ISCR. Scenario 2 assumes that concentrations are reduced through active treatment to below the treatment goal of 46 parts per billion. While it is generally true that ISCR may last longer in the subsurface, some long-lasting oxidants are also available. Additionally, ISCO typically relies on faster reactions, which may reduce concentrations more quickly, compared to ISCR.

EPA notes that under the Scenario 3 set of assumptions, which assumes that active treatment is able to reduce concentrations by 90 percent, the overall timeframes decrease to 11 and 9 years for ISCR and ISCO, respectively. EPA notes that these estimates are based on a number of assumptions and cautions against placing too much emphasis on these relatively small differences in time estimates.

20) One commenter asked why the estimated combined costs for GW-5 were less than those for GW-6 but that estimated total present value for GW-5 is higher than that for GW-6?

EPA Response: Details about these cost estimates can be found in Appendix D of the FS Report. The differences between total combined costs and the total present value had to do with the timing of when the costs are expected to occur and the discount rate (e.g. costs incurred 10 years from now are of less value than if they were incurred today). Additionally, the estimated timeframe for remediation for GW-5 is 17 years, while the estimated timeframe for remediation of GW-6 is 15 years. This means that GW-5 includes two additional years of sampling and monitoring costs.

21) One commenter asked why more aggressive measures aren't being proposed to be taken downgradient of "the source" now to address potential exposure of the residents and businesses in the area. The commenter went on further to recommend the use of a specific product that is a type of sorptive-reactive media and is being used for another groundwater cleanup in the City of Martinsville.

EPA Response: First, EPA notes that it has not identified an ongoing "source" of groundwater contamination. EPA oversaw remediation of what was known to be the source as part of a time-critical removal action (TCRA) between 2003 and 2008. Prior to the initiation of the TCRA, the PCE groundwater concentrations were as high as 31,000 parts per billion. During the TCRA, active remediation of the source was conducted using a treatment system (details are provided in Appendix A of the FS report). The maximum PCE concentration observed in groundwater during the remedial investigation activities (2015 through 2017) was 210 parts per billion. A large portion of the remaining plume is fairly diffuse (5 to 25 parts per billion) and spread over a large area (the total plume length is over ½ mile long). Active treatment of these low concentrations over this entire area is impractical.

EPA's proposed treatment plan includes active treatment in the most concentrated portion of the remaining groundwater plume, followed by natural attenuation, as well as natural attenuation in the remaining, lower concentration portions of the plume. EPA notes that the ongoing GAC treatment of the municipal drinking water is preventing exposure to the groundwater contamination from the use of the City's municipal water.

Regarding the use of sorptive-reactive media, see response to Comment 8 above.

22) One commenter, a vendor for a type of sorptive-reactive media, asked how quickly ISCO will clean up a long, diffused plume and what is the expected longevity of the ISCO reagent. The commenter went on to suggest the use of sorptive-reactive media.

EPA Response: The estimates for achieving Remedial Action Objectives (RAOs) can be found in the FS Report, with specific details about how these estimates were generated provided in Appendix E of the FS Report. EPA notes that it is now selecting ISCR in this ROD, though it may invoke a contingency to use ISCO instead. EPA will select the specific reagent(s) to be used during the remedial design. The low total oxidant demand (TOD) results for the site (Table 3-4 of the FS) reflect low quantities of organic matter in the sandy aquifer. As a result, an appropriate oxidant dose could remain reactive for 6 months to over a year, which is typical for applications in sandy aquifers. The oxidant

longevity is site-specific and dose-specific and will not be known until applied in the field.

Regarding the use of sorptive-reactive media, see response to Comment 8 above.

23) One commenter asked if EPA looked for 1,4-dioxane during its investigation noting that it can be found as a comingled contaminant at chlorinated sites (most often with TCA, but PCE/TCE as well).

EPA Response: EPA sampled for 1,4-dioxane during the RI but did not detect any. The relevant data can be found in the groundwater data in Appendix A of the RI report.

24) One commenter, a vendor of ISCO technologies, stated support for EPA not specifying an ISCO chemical and further encouraged including flexibility in the ROD as several oxidants can effectively treat TCE/PCE and the final decision often comes down to cost.

EPA Response: This comment is noted, particularly if EPA uses the contingency to employ ISCO technology as opposed to its selected remedy (ISCR). Also see response to Comment 18 above.

25) One commenter, a vendor of ISCO technologies, suggested that we consider lower solubility oxidants such as potassium persulfate as they would have the ability to persist longer in the treatment area.

EPA Response: This comment is noted, particularly if EPA uses the contingency to employ ISCO technology as opposed to its selected remedy (ISCR).

26) One commenter asked how decisions on the preferred clean-up method will be affected by new information received during the clean-up period.

EPA Response: EPA will continue to evaluate the remedy during the remedial design and throughout implementation of the remedial action. Furthermore, EPA will continue to evaluate the remedy until the RAOs are achieved. This will include a comprehensive review of the Site every 5 years until the Site is cleaned up.

27) One commenter asked how EPA will work with local government to ensure that no one puts a well in the affected area or builds a day care or pre-school in the affected area.

EPA Response: EPA was recently made aware of an ordinance implemented by the City to prevent installation of new wells within the groundwater plume. Provided that a day care or pre-school is not using a private well and that the structure is monitored for indoor air impacts from VI (and mitigated if necessary), there is no additional risk to these types of facilities being operated in the vicinity of the Site.

EPA may also work with local government to implement requirements for new construction in the vicinity of the Site, or portions of the Site, to be equipped with vapor mitigation, barriers, or the like.

28) One commenter asked how future residents, property owners, or business owners will be made aware of the Site and further asked if this information is required during real estate transactions.

EPA Response: EPA will continue community engagement activities throughout design and implementation of the remedy. A copy of the Administrative Record will be added to the repository at the Morgan County Library and on EPA's web site for the Site. Though EPA may use informational devices such as deed notices at specific properties, EPA does not have a mechanism for identifying and notifying all prospective purchasers of properties within the vicinity of the Site.

EPA also notes that some states have disclosure laws that require owners to report pollution problems to buyers when they sell a property, but these laws are outside of EPA's jurisdiction. For further information, EPA recommends contacting a real estate representative, state and/or local government agencies, or an attorney.

29) Several commenters inquired about past exposures leading to health issues.

EPA Response: The federal Agency for Toxic Substances and Disease Registry issued a report in 2020 concluding that people's health is not likely to be harmed by Site contaminants in the municipal drinking water supply, both in the past and currently. The document is available here:

https://www.atsdr.cdc.gov/HAC/pha/PikeMulberryStreetsPCEPlume/Pike_MulberryStrts_PCE_Plume_HC-508.pdf

If you have any questions about this report or other health concerns, you may contact the author, Dr. Motria Caudill, at 312-886-0267 or mcaudill@cdc.gov.

30) One commenter pointed out that EPA's fact sheet for the proposed plan described breaking down site contaminants into "less toxic" constituents and stated that EPA's goal should be to break down contaminants into non-toxic constituents.

EPA Response: EPA notes that, while true, referring to the breakdown products as less toxic could lead a reader to believe that these products still pose a risk. To be clear, EPA's goal for this remedial action is to remove contamination, in the case of soil vapor, and to break down contamination into non-toxic constituents, in the case of groundwater.

31) One commenter asked whether the PRG for PCE in groundwater (the MCL of 5 µg/l) is meant for the groundwater before it is treated at the City's municipal drinking water plant or after.

EPA Response: EPA's Remedial Action Objective to restore to beneficial use the aquifer in which the Site's groundwater plume is located requires EPA to clean up the groundwater in the aquifer to below the MCL (i.e. before treatment). Treatment of the City's drinking water with GAC is necessary to meet EPA's RAO to prevent exposures to contaminated groundwater through the drinking water pathway before the aquifer achieves cleanup to the MCL.

32) One commenter asked about the timeframe for long-term monitoring of groundwater and soil vapor.

EPA Response: EPA will continue monitoring groundwater and soil vapor until contaminant levels are below PRGs. Furthermore, EPA will only discontinue monitoring after it has determined, in consultation with IDEM, that contaminant levels have consistently remained below PRGs that there is no concern for rebound or other changing conditions causing concentrations to exceed PRGs.

33) One commenter asked which properties would receive ICs and about compensation for ICs placed on deeds for these properties.

EPA Response: There is no list of properties for which EPA anticipates pursuing ICs, particularly of the proprietary nature. Were EPA to acquire a property interest via a proprietary IC, compensation may be necessary. There are hundreds of residences and businesses located in the footprint of the groundwater plume and VI plume. Additionally, there have been hazardous substances releases in other parts of Martinsville. EPA does not believe proprietary controls are the most efficient means to prevent use of the aquifer for potable purposes (i.e., by way of a private well) and to prevent harm from vapor intrusion. EPA's preference is that ICs of a governmental nature be enacted.

34) One commenter asked about who would be responsible for the operation, maintenance, and monitoring of the VIMS.

EPA Response: IDEM will primarily be responsible for maintaining the VIMS until Site contamination has been reduced such that VI no longer poses a threat to human health at the Site (or, in some cases, for that specific property).

35) One commenter asked if the City would be reimbursed for its costs to replace the GAC filters at its drinking water plant while EPA has conducted its investigation and prepared its decision and who would be paying to maintain the GAC filters in the future.

EPA Response: EPA is not a responsible party but is tasked with cleaning up and preventing exposures to the contamination at the Site. As such, EPA will not be reimbursing the City for past costs incurred to operate its GAC filter. EPA is incorporating the GAC treatment into the remedial action selected by this ROD because it finds that the GAC is necessary to prevent exposures to the Site's contaminated groundwater until the groundwater can be cleaned up to below PRGs. Please see the

response to question 40n. below for further information regarding costs associated with the GAC systems.

36) One commenter asked what PRG applies to indoor air.

EPA Response: EPA assesses the need for a VIMS based on the concentrations of Site contaminants in the soil vapor underneath (sub-slab) an occupied structure as well as the concentrations of Site contaminants in indoor air.

A VIMS is installed to prevent soil vapors from accumulating in the indoor air, not to treat the contamination or otherwise meet a clean-up goal. EPA is selecting soil vapor source removal to reduce Site soil vapor concentrations to below PRGs. The PRGs for soil vapor are based on levels which, when found in sub-slab vapors, do not pose a potential health risk through inhalation of indoor air. These PRGs are listed in Section 8.0 of the ROD.

37) One commenter asked about any sort of guarantee of future funding for the cleanup of the Site.

EPA Response: EPA cannot provide a funding guarantee; however, funding for performance of the remedial action, operations and maintenance, and long-term monitoring requirements will be planned to provide continuity of work. In addition, the State of Indiana will also have cost-share responsibilities for long-term response actions.

38) One commenter asked whom at IDEM would EPA be working with to finalize this decision.

EPA Response: EPA received concurrence on the remedy selected in the ROD from the Assistant Commissioner of IDEM on February 11, 2021.

39) The City of Martinsville submitted comments to the proposed plan expressing support for the selection of Soil Vapor Alternative SV5 and Groundwater Alternatives GW2A, GW5 (ISCR), and GW7 (sorptive-reactive media).

EPA Response: See EPA's Response to Comment #8 above regarding sorptive-reactive media. Though EPA may elect to include some sorbent material with the mixture of reagents injected as part of the ISCR treatment, EPA does not believe that the use of a sorptive-reactive media is necessary to reduce exposures to contamination. Additionally, EPA has concerns regarding solely relying on sorptive-reactive media to achieve PRGs based on its limited history of use and the limited data demonstrating its effectiveness. Data are still limited that demonstrate that the contaminants are broken down by the intended mechanism, rather than just adsorbed to the medium.

In fact, the addition of sorbent material into the aquifer may make it more difficult for EPA to sufficiently monitor the progress of the clean-up as it would be difficult to sample and quantify the amount of sorbed contamination remaining in the aquifer. Data

demonstrating that groundwater contaminant concentrations are lower downgradient of the sorbent material are not an indicator of the ultimate fate of the contaminants, only that the contaminants have been adsorbed to the sorbent material. The sorbed contaminants, if not adequately degraded over time, may then later desorb back into the aquifer as the sorptive-reactive media weathers or disintegrates in situ.

40) In its comments submitted during the public comment period, the City of Martinsville asked the questions detailed below and followed by EPA responses:

a) When will the final ROD be issued?

EPA response: This responsiveness summary is part of the final ROD. EPA has been in communication with the City of Martinsville throughout this process, including discussions of the expected timeframes.

b) Will there be any more opportunity for input prior to or after release of the ROD?

EPA Response: EPA will continue to inform the City and its residents and workers of any significant progress updates. EPA is also assisting in the formation of a Community Advisory Group to facilitate the distribution and understanding of these updates and to otherwise facilitate communication between these groups and EPA.

In addition, EPA seeks comment from the community when it conducts five-year reviews, every five years after the remedial action begins. These reviews continue until clean-up goals are met and the contamination no longer restricts any activities at the Site.

c) When will the remedial design start?

EPA response: Because EPA has not identified any liable and viable responsible parties for this Site, EPA assumes it will continue to lead the work. After the ROD is finalized, EPA will procure a contractor to conduct the remedial design. Currently, EPA expects that remedial design activities will begin in the fall of 2021.

d) When will pre-design investigations/testing start?

EPA response: Any pre-design investigations or testing will be part of the remedial design contract.

e) When is the actual remedial action estimated to start?

EPA response: Assuming it continues to lead the work, EPA will seek to procure a contractor to conduct the remedial action after it has finalized a remedial design. The remedial design could take a year or more and some of the work may be limited to particular seasons. EPA currently estimates that the groundwater and soil vapor remedial activities will start after the remedial design is completed and funding is

available for this remedial action, anticipated to be no sooner than 2023. EPA will keep the City and the community up to date on the project schedule.

f) When will VI testing start?

EPA response: EPA hopes to re-start VI sampling early in the remedial design. The specific timing depends on contract acquisition.

g) Will there be other properties sampled for VI beyond the initial approximately 230 EPA identified during the remedial design?

EPA response: While EPA expects to utilize the soil vapor investigation from the RI in determining where to sample for potential VI exposures, EPA may supplement or otherwise modify this list based on pre-design findings or other data generated throughout the remedial design and/or remedial action.

h) Can people within the Pike and Mulberry Plume footprint request VI testing, even if their property is not one of the buildings targeted for testing?

EPA response: While EPA may make some property-specific decisions about whether to sample for VI or not, EPA generally expects to use the delineation of the soil vapor plume in the RI for determining what properties to sample for VI.

i) How quickly will respective parties be notified of VI results?

EPA response: EPA endeavors to provide actual sampling data to property owners as expeditiously as possible. Typically, results can be expected within one to two months of the sampling.

j) What additional efforts will be made to identify private wells?

EPA response: EPA conducted efforts to identify private wells during the RI. While EPA encourages property owners with private wells to discuss this with the City, EPA, and/or IDEM; EPA does not have a specific plan for identifying additional wells beyond community outreach activities.

k) Will these private wells be tested and will the (three) tested wells be retested?

EPA response: EPA may, in the future, elect to test private wells in or near the Site's groundwater plume. However, to date, EPA identified only three private wells in or near the Site's groundwater plume, and each of these wells were found to have not been impacted by the Site's groundwater contamination.

l) Will the groundwater preliminary remedial goal of 5 µg/l be in the ROD?

EPA Response: Yes, EPA is selecting 5 µg/l, which is the MCL for PCE, as the a PRG for PCE in groundwater.

m) Will ambient air be tested in the highly concentrated area of the plume?

EPA Response: While ambient air samples are typically part of EPA's VI sampling protocol, these samples are conducted to determine the impact of background air from non-Site related sources on Site sampling data. While EPA is concerned that soil vapor contamination from the Site may be accumulating at harmful concentrations in indoor air, EPA is not concerned about exposures in ambient (outside) air from soil vapor or groundwater contamination. The concentrations in these contaminated media are such that, any releases to ambient air would be immediately diluted to concentrations well below those of potential concern.

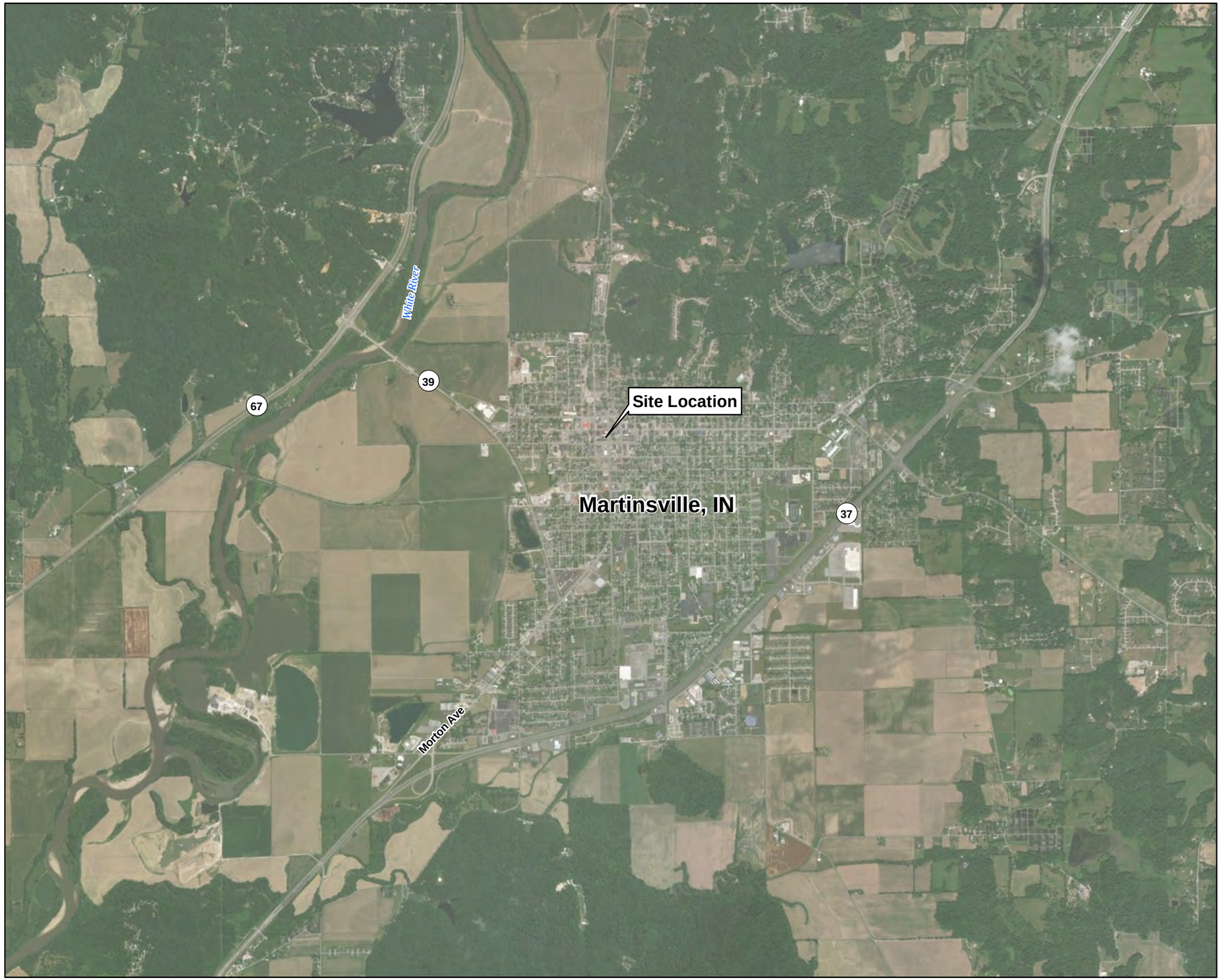
n) When will the cost coverage of the water treatment plant carbon filtration (GAC) unit exchanges start?

EPA Response: EPA will evaluate the performance of the GAC system as the Remedial Design is conducted after the ROD is signed. When the Remedial Action begins (after RD is complete), EPA will fund any modifications to the GAC system that are deemed necessary and then fund operation of the system for up to one year to assure needed modifications are operational. After that, the system will transition to Operation & Maintenance (O&M). EPA will then turn O&M responsibility over to the state of Indiana.

o) What will be the relationship between EPA/contractors and the City Water Treatment Plant personnel once EPA takes over GAC exchange responsibilities (GW2A)?

EPA Response: EPA, along with its contractor(s), will maintain communication with IDEM and the City as it evaluates the performance of the GAC system during RD and optimizes the system during RA. EPA will work collaboratively with all parties to ensure the system is meeting the remedial action objectives of the ROD.

Figures

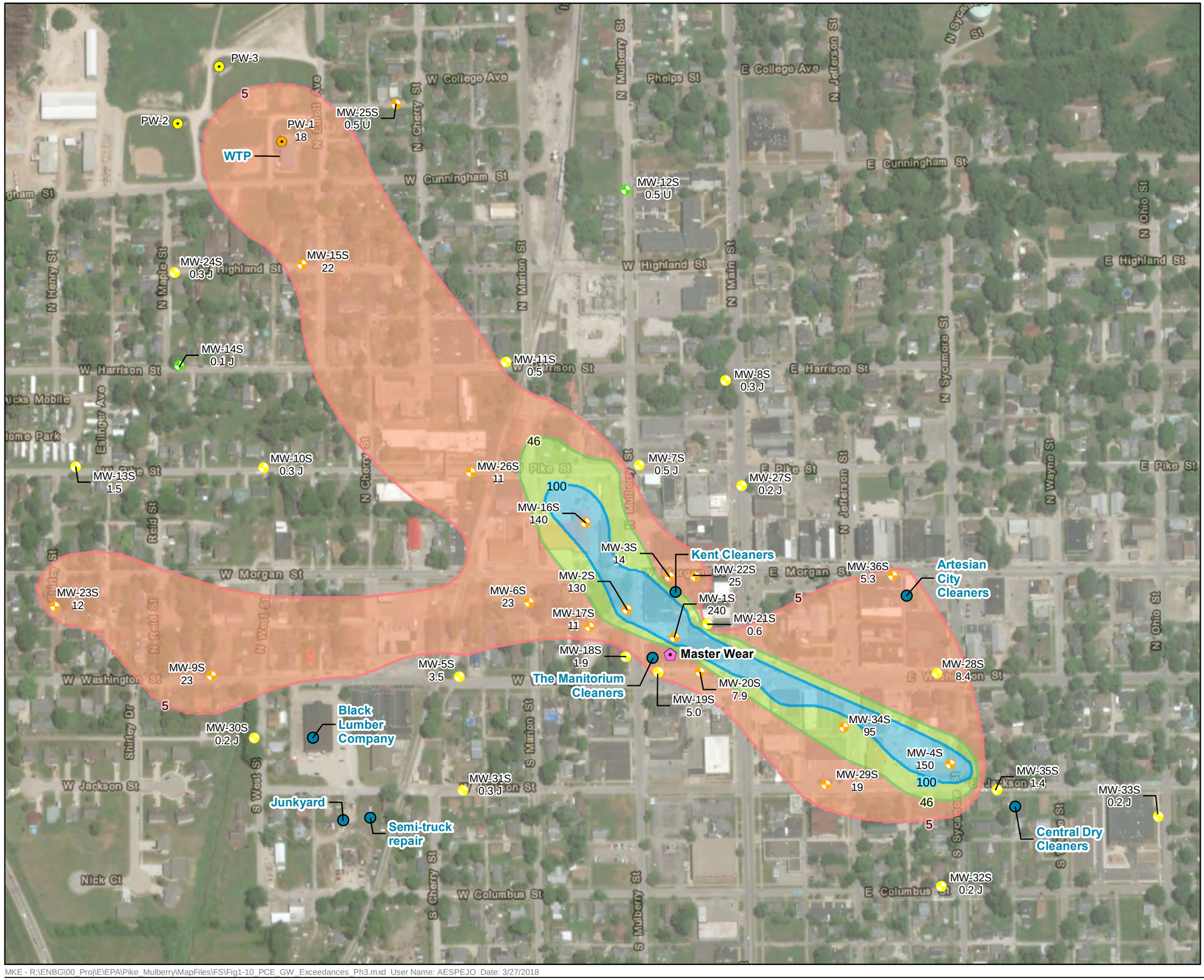


N

0 0.25 0.5
Miles

Figure 1
Site Location Map
Pike and Mulberry Streets PCE Plume Site
Martinsville, Indiana

ch2m



LEGEND

- Potential Past PCE User
- Former Master Wear Facility

Monitoring Well

- Detected Above MCL
- Detected Below MCL
- Not Detected

Municipal Wells (PW)

- Detected Above MCL
- Detected Below MCL
- Not Detected

Groundwater Contour Concentrations (µg/L)

- 100
- 46
- 5

Notes:

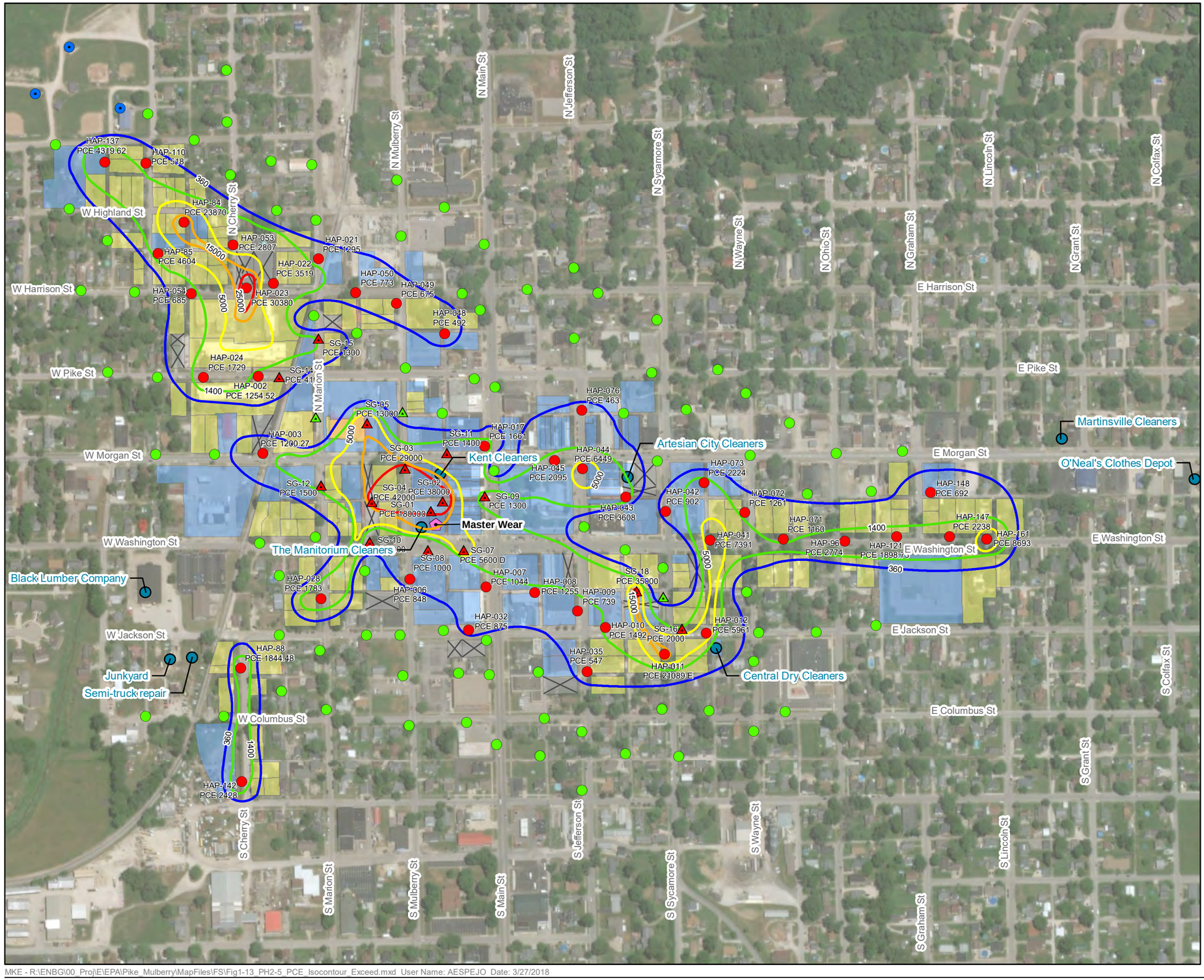
1. EPA = U.S. Environmental Protection Agency
2. G = indicates groundwater grab sample collected from soil boring at approximately 10 ft. below ground surface
3. J = Estimated detection
4. MCL = Maximum Contaminant Level
5. PCE = tetrachloroethene
6. U = Result not detected
7. UJ = Estimated result not detected
8. µg/L = micrograms per liter
9. Dashed lines indicate where plume is inferred or estimated
10. PCE screening level (SL) = 5 µg/L
11. PCE in intermediate well MW-7M was 24 µg/L

N

0 162.5 325

Feet

Figure 2
PCE Exceedances in Shallow Groundwater - Phase 3
Pike and Mulberry Streets PCE Plume Site
Martinsville, Indiana



LEGEND

- Potential Past PCE User
- Former Master Wear Facility
- Municipal Well
- Residential (129.5)
- Commercial/Industrial (90.5)
- No Sampling (park or parking lot) (18)

PCE Isocontours

Value

- 360
- 1400
- 5000
- 15000
- 25000

PCE Concentrations

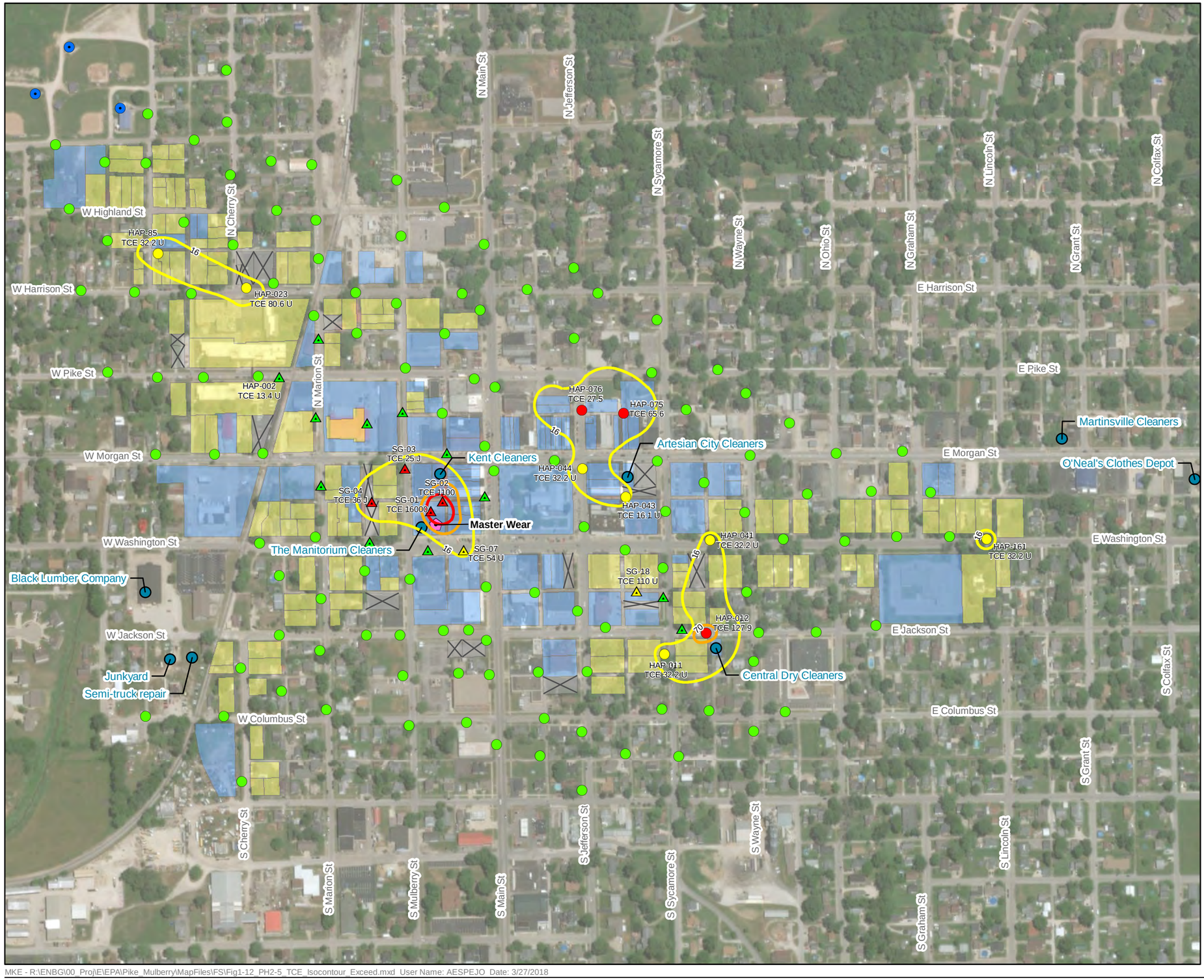
- Permanent Soil Vapor Probe with results of PCE greater than the VISL
- Permanent Soil Vapor Probe with results of PCE below the VISL
- Temporary Soil Vapor Point with HAPSITE results of PCE greater than the VISL
- Temporary Soil Vapor Point with HAPSITE results of PCE below the VISL

Notes:
1. All units are in µg/m³
2. PCE VISL is 360 µg/m³
3. VISLs are based on EPA VISL Calculator Version 3.5.1 (EPA 2016) with May 2016 RSLs, a residential exposure scenario, target Excess Lifetime Cancer Risk (ELCR) of 1x10-6, and a Hazard Index of 1
4. The 1400 contour line represents the ELCR of 1x10-5
5. U = HAPSITE result is non-detect
6. E = HAPSITE result exceeds calibration range and result is Estimated
7. PCE = tetrachloroethene
8. VISL = Vapor Intrusion Screening Level

All permanent soil vapor probe locations had soil vapor results that exceeded the PCE VISLs in August and October 2015 except for SG-6, SG-13, and SG-17.

Figure 3
PCE Soil Vapor Results (Phases 2 through 5) and Property Type Designations
Pike and Mulberry Streets PCE Plume Site
Martinsville, Indiana

ch2m



LEGEND

- Potential Past PCE User
- Former Master Wear Facility
- Municipal Well
- Residential (129.5)
- Commercial/Industrial (90.5)
- No Sampling (park or parking lot) (18)

TCE Isocontours

- 16
- 70
- 1000

TCE Concentrations

- Permanent Soil Vapor Probe with results of TCE greater than the VISL
- Permanent Soil Vapor Probe with Detection Limit greater than the VISL
- Permanent Soil Vapor Probe with results of TCE below the VISL
- Temporary Soil Vapor Point with HAPSITE results of TCE greater than the VISL
- Temporary Soil Vapor Probe with Detection Limit greater than the VISL
- Temporary Soil Vapor Point with HAPSITE results of TCE below the VISL

Notes:
1. All units are in µg/m³
2. TCE VISL is 16 µg/m³
3. VISLs are based on EPA VISL Calculator Version 3.5.1 (EPA 2016) with May 2016 RSLs, a residential exposure scenario, target Excess Lifetime Cancer Risk (ELCR) of 1x10-6, and a Hazard Index of 1
4. The 70 contour line represents the ELCR of 1x10-5
5. U = HAPSITE result is non-detect
6. E = HAPSITE result exceeds calibration range and result is Estimated
7. TCE = trichloroethene
8. VISL = Vapor Intrusion Screening Level

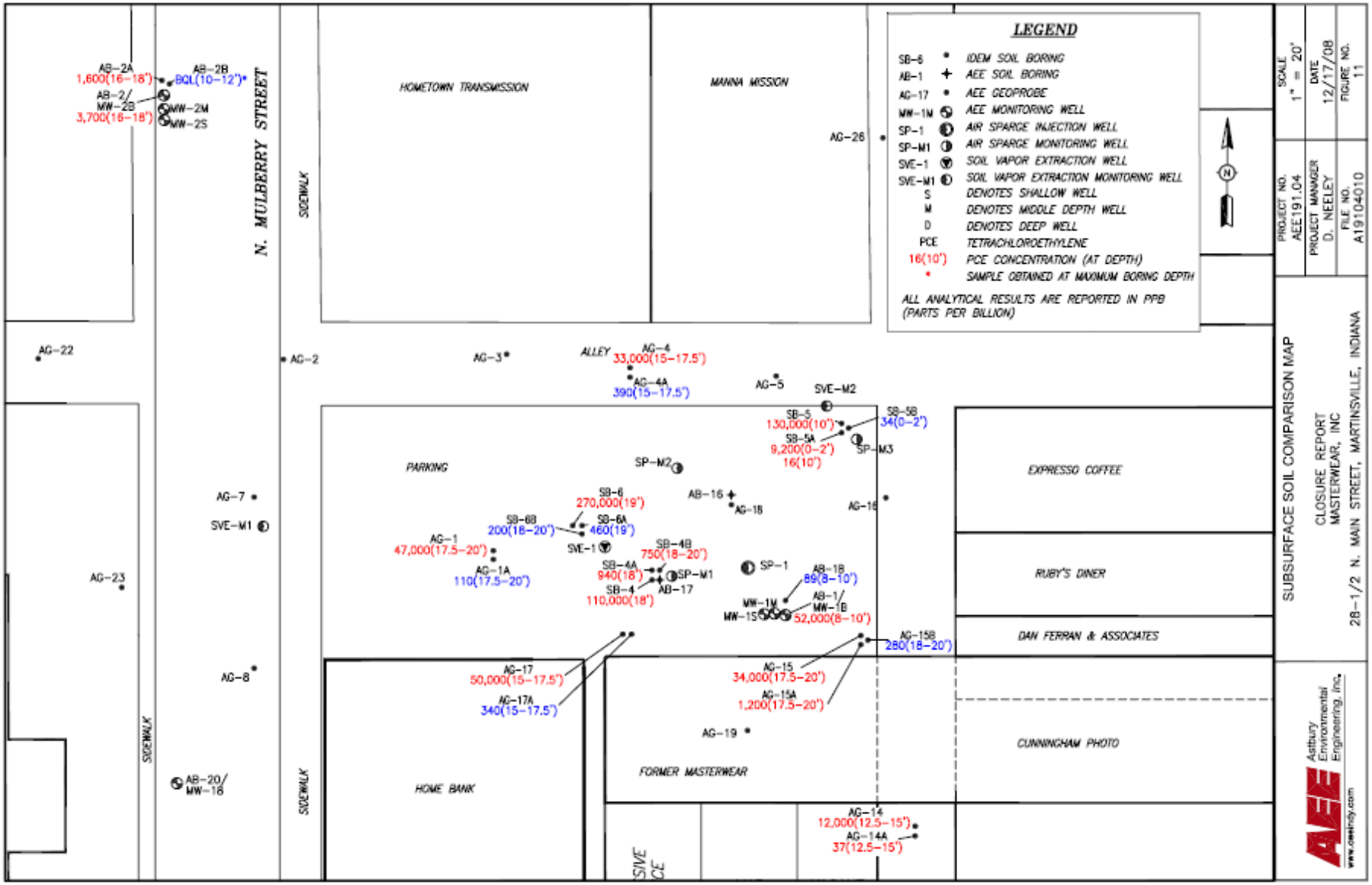
All permanent soil vapor probe locations had soil vapor results that exceeded the TCE VISLs in August and October 2015 except for SG-6, SG-13, and SG-17.

N

0 200 400
Feet

Figure 4
TCE Soil Vapor Results (Phases 2 through 5) and Property Type Designations
Pike and Mulberry Streets PCE Plume Site
Martinsville, Indiana

Figure 5 – Soil Sample Results from PCA for Master Wear Removal Action



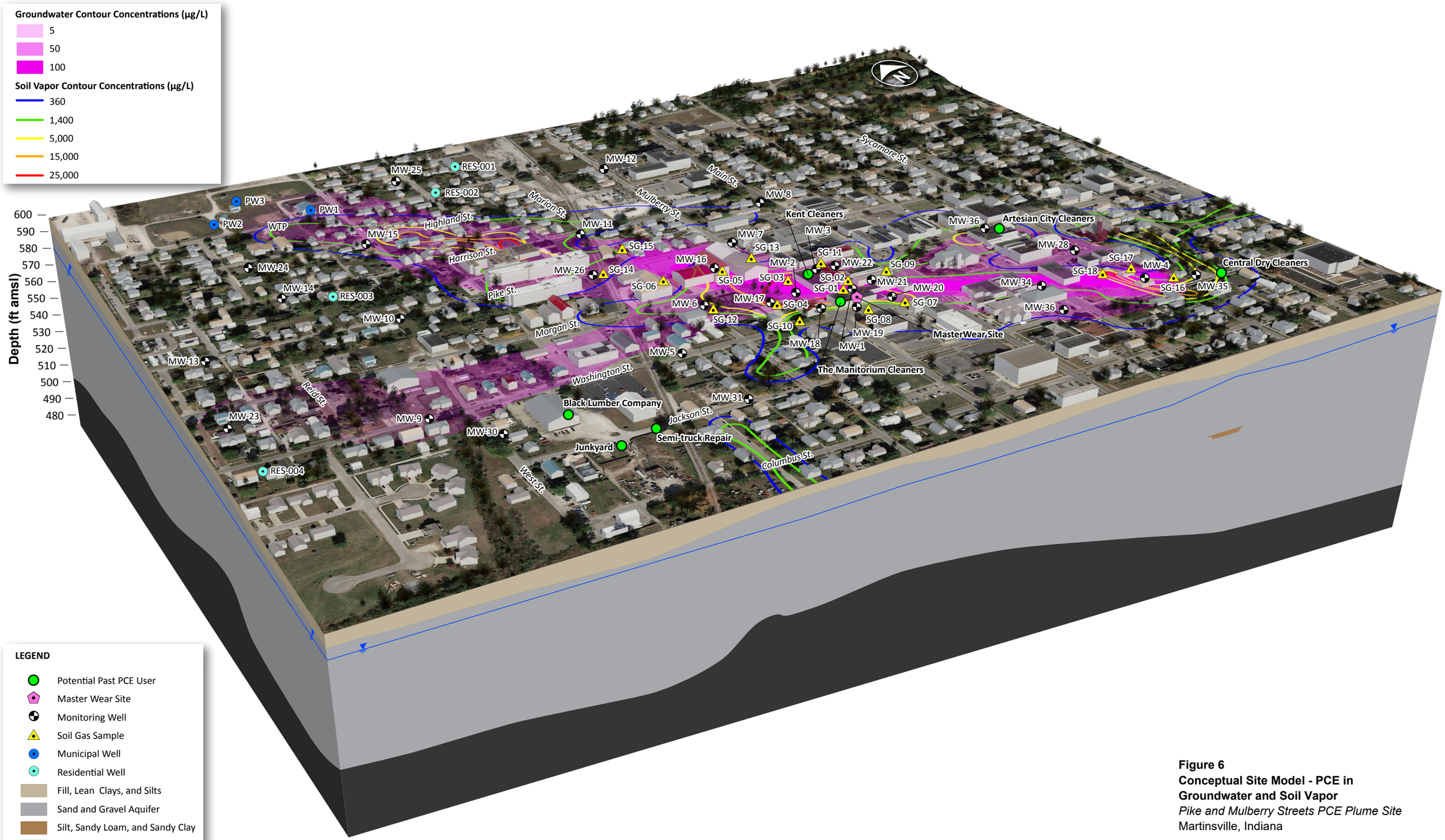


Figure 6
Conceptual Site Model - PCE in Groundwater and Soil Vapor
Pike and Mulberry Streets PCE Plume Site
Martinsville, Indiana

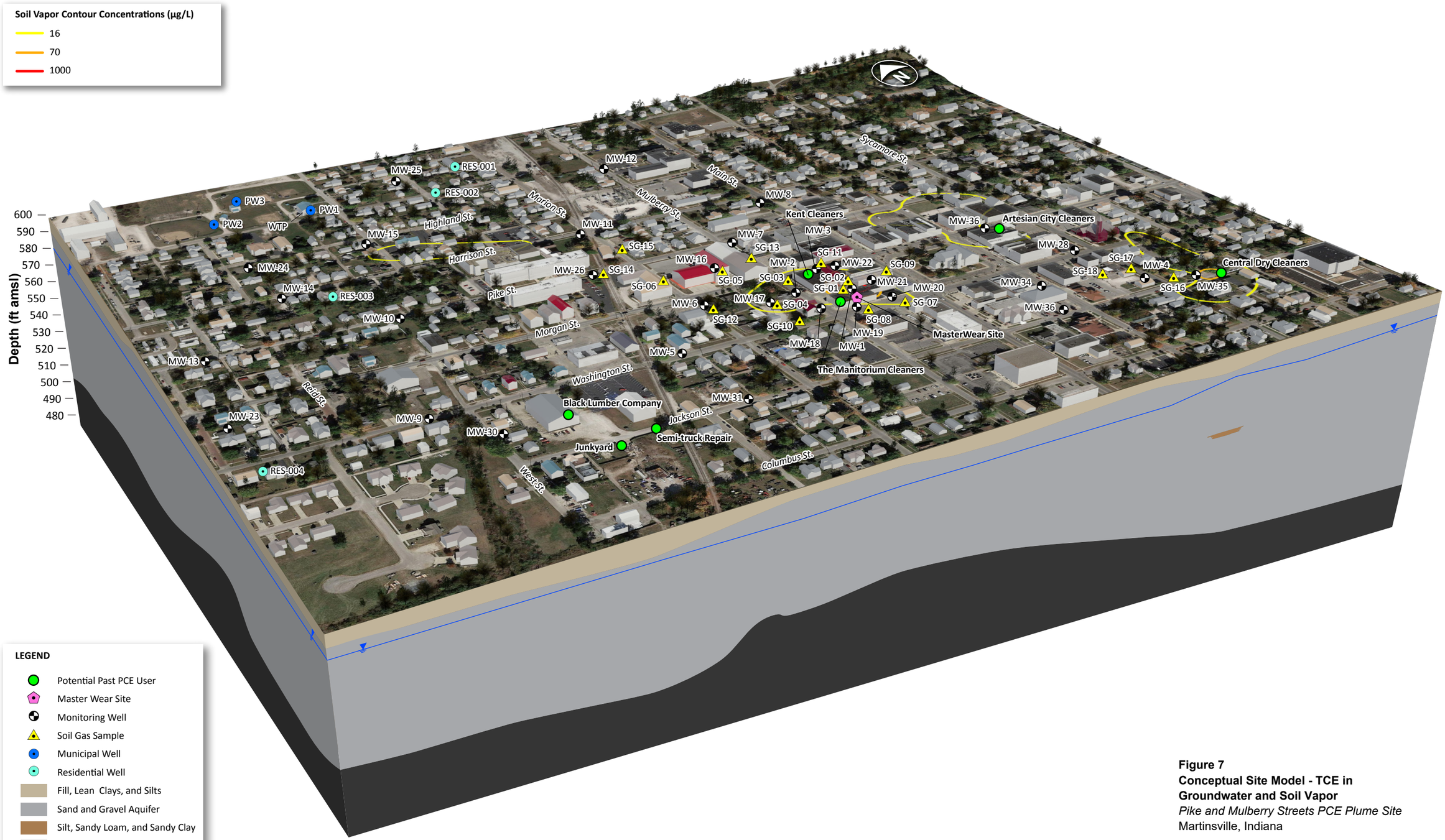


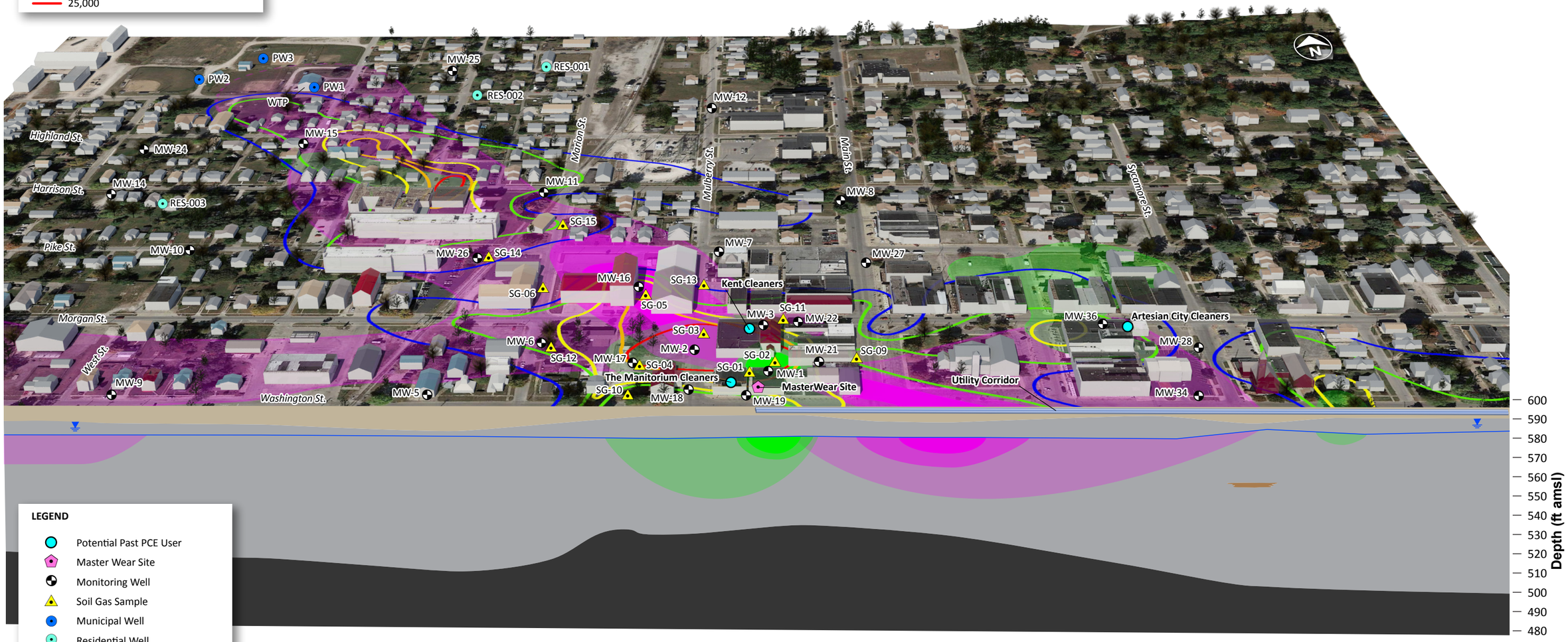
Figure 7
Conceptual Site Model - TCE in Groundwater and Soil Vapor
Pike and Mulberry Streets PCE Plume Site
Martinsville, Indiana

PCE Groundwater Contour Concentrations (µg/L)
- 5
- 50
- 100

PCE Soil Vapor Contour Concentrations (µg/L)
- 360
- 1,400
- 5,000
- 15,000
- 25,000

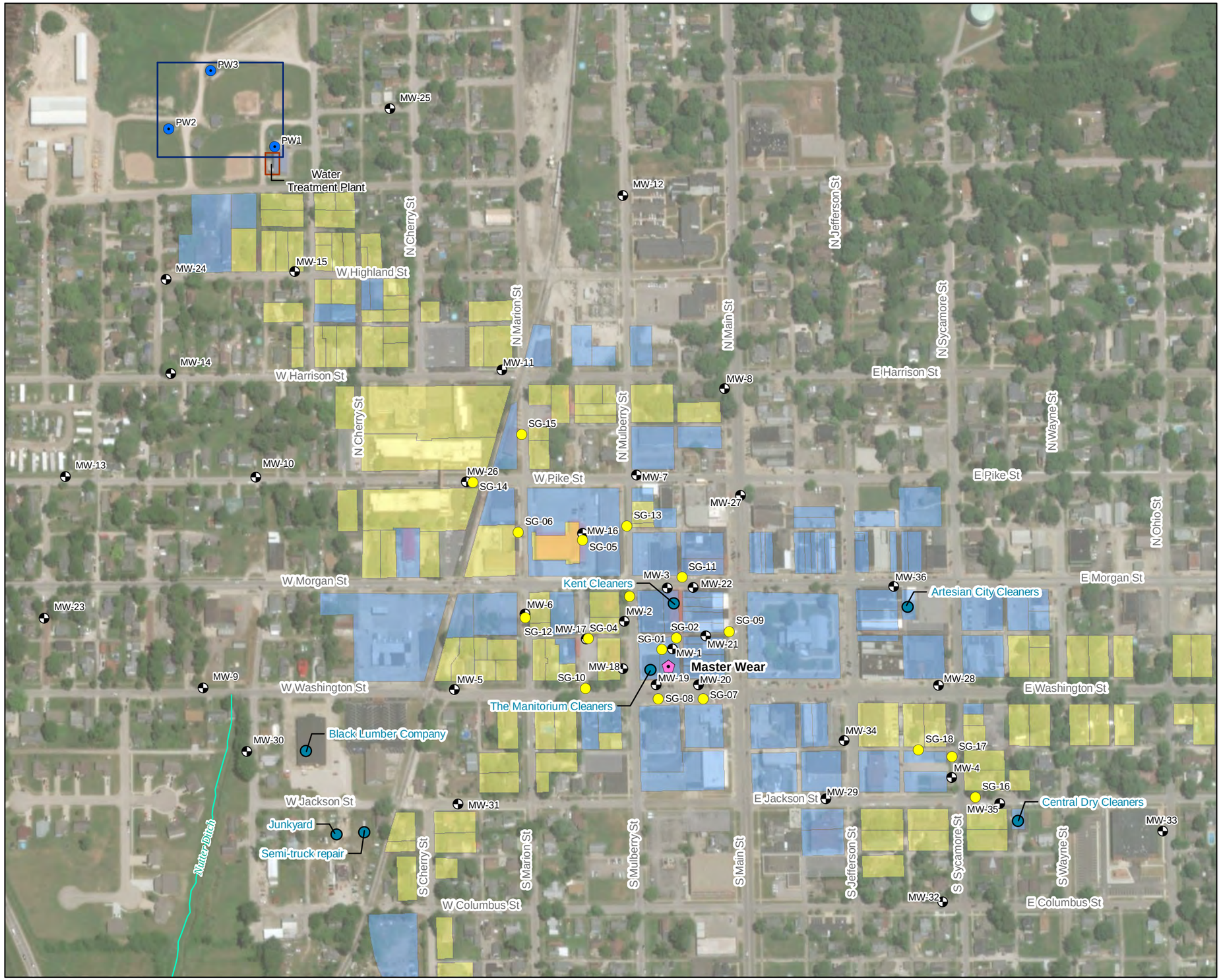
TCE Groundwater Contour Concentrations (µg/L)
- 16
- 70
- 1000

Screening Levels
- PCE – 8,100 µg/kg
- TCE – 410 µg/kg



LEGEND
- Potential Past PCE User
- Master Wear Site
- Monitoring Well
- Soil Gas Sample
- Municipal Well
- Residential Well
- Fill, Lean Clays, and Silts
- Sand and Gravel Aquifer
- Silt, Sandy Loam, and Sandy Clay
- Bedrock
- Groundwater Level

Figure 8
Conceptual Site Model - PCE and TCE in Soil
Pike and Mulberry Streets PCE Plume Site
Martinsville, Indiana



Note:
Location of Nutter Ditch is approximate.

Figure 9
Site Features and Land Use
Pike and Mulberry Streets PCE Plume Site
Martinsville, Indiana

Appendix A

Administrative Record Index

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR THE
PIKE AND MULBERRY STREETS PCE PLUME SITE
MARTINSVILLE, MORGAN COUNTY, INDIANA

UPDATE 1
FEBRUARY 25, 2021
SEMS ID: 956347

NO.	SEMS ID	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	237819	8/12/05	U.S. EPA	U.S. EPA File	Administrative Record Site Index Masterwear Update #1 Removal Action (This Document is Included for Informational Purposes Only)	2
2	313351	11/20/08	U.S. EPA	U.S. EPA File	Administrative Record Site Index Masterwear Update #2 Removal Action (This Document is Included for Informational Purposes Only)	2
3	353222	12/22/08	Astbury Environmental Engineering	U.S. EPA	Former Masterwear Closure Report (This Document is Included for Informational Purposes Only)	68
4	956308	7/1/10	IDEM	U.S. EPA	Map: Re: Masterwear Site Re-assessment July-August 2010 Groundwater and Soil	1
5	956325	12/11/11	City of Martinsville Water Utility	U.S. EPA	Table Re: Water Utility Service Cost	1

6	956342	12/16/13	Hardin, E., U.S. EPA	U.S. EPA File	Confidential Enforcement - Draft of Potentially Responsible Parties (This Document is Included for Informational Purposes Only)	29
7	956323	6/1/15	CH2M	U.S. EPA	Map Re: Soil Gas Impacted Area - Soil Vapor Probe VOC	1
8	956346	2/11/16	Olsson, D., CH2M	Hardin, E., U.S. EPA	Report on Work Plan Revision Request #1 - Remedial Investigation/Feasibility Study (This Document is Included for Informational Purposes Only)	42
9	956338	5/31/16	Knoepfle, J., CH2M	Hardin, E., U.S. EPA	Email Re: VI Sample Results that exceed RML's - Analysis (This Document is Included for Informational Purposes Only)	40
10	956317	6/1/16	CH2M	U.S. EPA	Final Quality Assurance Project Plan Addendum 3 on Pike & Mulberry Street PCE Plume Site	74
11	956312	9/13/16	Jones, K., Pace Analytical	Manley, S., City of Martinsville	Potentiometric Surface - Shallow Water Bearing	1
12	940584	9/13/16	Walterman, D., IDEM	Hardin, E., U.S. EPA	Letter: Re: Applicable or Relevant and Appropriate Requirements (ARARs) for Pike & Mulberry Street PCE Plume Site	3
13	956322	12/22/16	Gahala, A., U.S. Geological Survey	Hardin, E., U.S. EPA	Hydrologist Memo Re: Potential for Co-Mingling Plume with O'Neal Investigation	3
14	956320	1/1/17	CH2M	Hardin, E., U.S. EPA	Remedial Alternatives Screening Report	210
15	956319	2/10/17	Walter, D., IDEM	Hardin, E., U.S. EPA	Letter Re: Remedial Alternatives Screening	3

16	956324	3/15/17	Knoepfle, J., CH2M	Hardin, E., U.S. EPA	Email Re: VI Sample Results that Exceeds RML's - Analysis (This Document is Included for Informational Purposes Only)	3
17	956344	3/23/17	Knoepfle, J., CH2M	Hardin, E., U.S. EPA	Email Re: VI Sample Results that Exceeds RML's - Analysis (This Document is Included for Informational Purposes Only)	4
18	956314	4/1/18	CH2M	U.S. EPA	[Redacted] Final Remedial Investigation Report of Pike & Mulberry Street PCE Plume Site	1664
19	237819	7/16/18	U.S. EPA	U.S. EPA File	Administrative Record Site Index Pike and Mulberry Streets PCE Plume Site - Original Removal Action	1
20	956309	10/18/18	Jones, K., Pace Analytical	Manley, S., City of Martinsville	Certifications, Sample Summary, Summary of Detection, Analytical Results and Chain of Custody Report	19
21	956310	10/30/18	Jones, K., National Environmental Testing Inc.	Manley, S., City of Martinsville	Analytical Sample Results Applicable to TNI/NELAC Standards	15
22	949417	8/1/19	Safakas, K., U.S. EPA	Hardin, E., U.S. EPA	Pike & Mulberry Streets PCE Plume Site Community Involvement Plan	46
23	951485	12/11/19	CH2M	U.S. EPA	[Redacted] Final Feasibility Study	377
24	956321	4/16/20	U.S. Dept. of Human Health	Hardin, E., U.S. EPA	Report Re: Analysis of Contaminants in Drinking Water and Indoor Air	59

25	956318	5/12/20	Hardin, E., U.S. EPA	U.S. EPA File	Memo Re: Technical Memorandum of Supplemental Evaluation of In Situ Sorbent Reactive Media (SRM) for Groundwater Remediation	2
26	956339	7/1/20	City of Martinsville Water and Utility	Hardin, E., U.S. EPA	Planning and Engineering Work Estimate Per Residence for Replacing City Water Line (This Document is Included for Informational Purposes Only)	1
27	956316	8/1/20	Hardin, E., U.S. EPA	U.S. EPA File	Superfund Proposed Plan of Pike & Mulberry Street PCE Plume Site	51
28	956313	8/4/20	Hardin, E., U.S. EPA	U.S. EPA File	Map Re: Pike & Mulberry Street PCE Plume Site Exceedances in Shallow Groundwater	1
29	956345	8/5/20	Hardin, E., U.S. EPA	U.S. EPA File	Private Residential Well Summary (This Document is Included for Informational Purposes Only)	1
30	956340	8/5/20	Hardin, E., U.S. EPA	U.S. EPA File	Confidential Map of Phase 2 Private Residential Groundwater Sampling (This Document is Included for Informational Purposes Only)	1
31	956341	8/5/20	Hardin, E., U.S. EPA	U.S. EPA File	Confidential Map Re: First Round of Removal VI Results (This Document is Included for Informational Purposes Only)	1
32	956336	8/12/20	Hardin, E., U.S. EPA	U.S. EPA File	[Redacted] Transcript of Virtual Public Comment Meeting on Pike & Mulberry Street PCE Plume Site	35

33	956335	8/18/20	Smith, B., Proxychem	Safakis, K., U.S. EPA	Letter Re: Proxychem Comment on Pike & Mulberry Street PCE Plume Site	2
34	956337	8/31/20	Safakas, K., U.S. EPA	Hardin, E., U.S. EPA	[Redacted] Re: Public Comments on Pike & Mulberry Street PCE Plume Site	40
35	956331	8/31/20	Safakas, K., U.S. EPA	Hardin, E., U.S. EPA	[Redacted] Re: Public Comment of Concerned Citizen on Pike & Mulberry Street PCE Plume Site	1
36	956326	9/3/20	Safakas, K., U.S. EPA	U.S. EPA File	[Redacted] Written Comment Form - From Concerned Citizen on Pike & Mulberry Street PCE Plume Site	1
37	956333	9/9/20	Safakas, K., U.S. EPA	U.S. EPA File	[Redacted} Concerned Citizen Comment on Pike & Mulberry Street PCE Plume Site Via Email	1
38	956332	9/14/20	Mayor Costin, K., City of Martinsville	U.S. EPA File	Letter Re: Mayor's Comments With Fifteen Questions on Pike & Mulberry Street PCE Plume Site	13
39	956334	9/22/20	Safakas, K., U.S. EPA	U.S. EPA File	[Redacted] Concerned Citizen Comment From Concerned Citizen - With Eleven Questions on Pike & Mulberry Street PCE Plume Site	1
40	956327	10/2/20	Safakas, K., U.S. EPA	U.S. EPA File	[Redacted] Public Notice Form - Comment and Four Questions From Concerned Citizen on Pike & Mulberry Street PCE Plume Site Via Email	1
41	956328	10/2/20	Safakas, K., U.S. EPA	U.S. EPA File	[Redacted] Form Comment From Concerned Citizen on Pike & Mulberry Street PCE Plume Site Via Email	1

42	956329	10/2/20	Safakas, K., U.S. EPA	U.S. EPA File	[Redacted] Form Comment From Concerned Citizen on Pike & Mulberry Street PCE Plume Site Via Email	1
43	956330	10/2/20	Safakas, K., U.S. EPA	U.S. EPA File	[Redacted] Form Comment From Concerned Citizen on Pike & Mulberry Street PCE Plume Site Via Email	1
44	956315	2/11/21	Dorsey, P., IDEM	U.S. EPA File	Letter Re: Concurrence of Record of Decision	1

Appendix B

IDEM Concurrence Letter on ROD

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
We Protect Hoosiers and Our Environment.
100 N. Senate Avenue • Indianapolis, IN 46204
(800) 451-6027 • (317) 232-8603 • www.idem.IN.gov

Eric J. Holcomb
Governor

Bruno L. Pigott
Commissioner

February 11, 2021

Doug Ballotti, Superfund Division Director
U.S. EPA, Region 5
77 West Jackson Boulevard, Mail Code SR-6J
Chicago, IL 60604

Dear Mr. Ballotti:

Re: Record of Decision for the Pike and Mulberry Groundwater Plume Superfund Site, Martinsville, IN

The Indiana Department of Environmental Management (IDEM) has reviewed the U.S. Environmental Protection Agency's Record of Decision (ROD) document for the Pike and Mulberry Groundwater Plume Superfund site located in Martinsville, Indiana. IDEM is in full concurrence with the selected remedy outlined in the document, which includes:

- Groundwater Alternative GW-2A (Granular Activated Carbon) at the City's WTP;
- Groundwater Alternative GW-5 (In Situ Chemical Reduction) with a contingency to implement Groundwater Alternative GW-6 (In Situ Chemical Oxidation); and
- Soil Vapor Alternative SV-5 (Pathway Sealing, Vapor Intrusion Mitigation, and Soil Vapor Source Removal).

IDEM staff have been working closely with Region 5 staff in the selection of the appropriate remedy and are satisfied with the chosen alternative. Please be assured that IDEM is committed to accomplish cleanup at all Indiana sites on the NPL and intends to fulfill all obligations required by law to achieve that goal. We look forward to beginning work on this next phase of the project.

Sincerely,

Peggy Dorsey
Assistant Commissioner
Office of Land Quality

PD:JHF:jhf
cc:Rex Osborn, IDEM
Erik Hardin, EPA