Ohio Environmental Protection Agency

PREFERRED PLAN

FOR THE REMEDIATION OF THE FORMER PHTHALCHEM SITE
266 West Mitchell Avenue
Cincinnati, Hamilton County, Ohio

Division of Environmental Response and Revitalization
Southwest District Office

March 2019

Ohio EPA's Division of Environmental Response and Revitalization (DERR) - Remedial Response Program			Preferred Plan For the Remediation of the Former Phthalchem Site Cincinnati, Hamilton County, Ohio		
THE REMEDIAL RESPONSE PROCESS					
(1) Preliminary Assessment & Site Inspection	**(2)** Remedial Investigation & Feasibility Study	**(3)** Remedy Selection (Preferred Plan & Decision Document)	**(4)** Remedial Design	**(5)** Remedial Action	**(6)** Remedy Operation, Maintenance & Monitoring

This Preferred Plan is subject to public comment. Ohio EPA may modify the preferred remedial alternative or select another alternative presented in this Preferred Plan based on new information or public comments that are received. Therefore, the public is encouraged to review and comment on the remedial alternatives presented in this Preferred Plan. Once the final remedial alternative is selected, it will be presented in a Decision Document, defining the final remedy decision. All documents referenced herein can be found in the repository located at Ohio EPA's Southwest District Office, 401 East Fifth Street, Dayton, OH 45402-2911.

Written public comments on this preferred plan will be accepted during the comment period that runs from April 23, 2019 – June 14, 2019. Ohio EPA will hold a public meeting to explain this preferred plan. Oral and written comments will be accepted at this meeting, which will be held on June 4, 2019 at 6:00 pm at the St. Bernard City Hall in the lower level conference room, located at 110 Washington Avenue, St. Bernard, Ohio 45217. Additional information on the former Phthalchem Site (Site) is available from Ohio EPA's Southwest District Office, located at 401 East Fifth Street, Dayton, Ohio 45402, or by contacting Charles Mellon at 937-285-6056, or via e-mail at Charles.Mellon@epa.ohio.gov.

SUMMARY

On February 19, 1987, Phthalchem, Inc. signed Director's Final Findings and Orders (DFFOs) with Ohio EPA to investigate the extent of contamination and, if appropriate, develop remedial alternatives to address the problem. The Remedial Investigation (RI) documented the existence of contamination (e.g., trichlorobenzene [TCB], dichlorobenzene [DCB], ammonia, copper, naphthalene, phthalate, di-n-butyl phthalate, arsenic, phenols, and diethyl phthalate) on the Site. An evaluation of the risk to human health and environment was performed.

In the process of scoping and conducting the RI, generic preliminary remediation goals (PRGs) were established. These PRGs were converted to site-specific remediation goals (RGs) following completion of the RI and Feasibility Study (FS) phase of the project. The FS includes a list of RGs for protection of human health, established using the acceptable excess lifetime cancer risk and non-cancer hazard goals identified in the DERR Technical Decision Compendium (TDC) document titled "Human Health Cumulative Carcinogenic Risk

and Non-Carcinogenic Hazard Goals for DERR Remedial Response and Federal Facility Oversight," dated August 21, 2009. These goals are given as a cumulative excess lifetime cancer risk of 1×10^{-5} (i.e., 1 in 100,000) and a cumulative non-cancer hazard goal equal to a Hazard Index (HI) of 1, and were established using the default exposure parameters provided by U.S. EPA or site-specific information. This TDC can be found at http://www.epa.ohio.gov/portals/30/rules/riskgoal.pdf

The Site poses unacceptable human health and environmental risks based on direct contact with contaminated subsurface soil and ground water, and inhalation of vapors from contaminated ground water. Additional details concerning the primary contaminants of concern (COCs) and the RGs, now considered to be final remediation levels (RLs), and the health risks associated with them are presented in **Table 1.**

TABLE 1: CONTAMINANTS OF CONCERN (COCs) / REMEDIATION LEVELS (RLs)

Medium	COC	RL	RL Basis
Soils: Human Direct Contact- Industrial Exposure Scenario	Acenaphthene	4.5E+04 mg/kg	Non-Carcinogenic
	Aluminum, Total	1.1E+06 mg/kg	Non-Carcinogenic
	Anthracene	2.3E+05 mg/kg	Non-Carcinogenic
	Aroclor 1248	9.5E+00 mg/kg	Carcinogenic
	Arsenic, Total	3.00E+01 mg/kg	Carcinogenic
	Benzo(a)anthracene	2.1E+02 mg/kg	Carcinogenic
	Benzo(b)fluoranthene	2.1E+02 mg/kg	Carcinogenic
	Benzo(k)fluoranthene	2.1E+03 mg/kg	Carcinogenic
	Benzo(a)pyrene	2.1E+01 mg/kg	Carcinogenic
	Beryllium, Total	2.3E+03 mg/kg	Non-Carcinogenic
	Bis(2-ethylhexyl)phthalate	1.60E+03 mg/kg	Carcinogenic
	Calcium, Total	9.8E+02 mg/kg	Non-Carcinogenic
	Carbon Disulfide	3.5E+03 mg/kg	Non-Carcinogenic
	Chlorobenzene	1.3E+03 mg/kg	Non-Carcinogenic
	Chromium, Total	6.3E+01 mg/kg	Carcinogenic, based on Cr(VI)
	Chrysene	2.1E+04 mg/kg	Carcinogenic
	Cobalt, Total	3.5E+02 mg/kg	Non-Carcinogenic
	Copper, Total	4.70E+04 mg/kg	Non-Carcinogenic

TABLE 1: CONTAMINANTS OF CONCERN (COCs) / REMEDIATION LEVELS (RLs)			
Medium	**COC**	**RL**	**RL Basis**
	Cyanide, Total	1.5E+02 mg/kg	Non-Carcinogenic, based on CN-
	Dibenzo(a,h)anthracene	2.1E+01 mg/kg	Carcinogenic
	Dibenzofuran	1.0E+03 mg/kg	Non-Carcinogenic
	1,2-Dichlorobenzene	9.30E+03 mg/kg	Non-Carcinogenic
	1,4-Dichlorobenzene	1.10E+02 mg/kg	Carcinogenic
	2,4-Dichlorophenol	2.5E+03 mg/kg	Non-Carcinogenic
	Di-n-butyl phthalate	8.20E+04 mg/kg	Non-Carcinogenic
	Di-n-octyl phthalate	8.2E+03 mg/kg	Non-Carcinogenic
	Fluoranthene	3.0E+04 mg/kg	Non-Carcinogenic
	Fluorene	3.0E+04 mg/kg	Non-Carcinogenic
	Hexachlorobenzene	9.6E+00 mg/kg	Carcinogenic
	Iron, Total	8.2E+05 mg/kg	Non-Carcinogenic
	Lead, Total	8.0E+02 mg/kg	Industrial Lead Standard
	Mercury, Total	3.5E+02 mg/kg	Non-Carcinogenic, based on mercury salts
	2-Methylnaphthalene	3.0E+03 mg/kg	Non-Carcinogenic
	Naphthalene	1.70E+02 mg/kg	Carcinogenic
	Nickel, Total	2.2E+04 mg/kg	Non-Carcinogenic, based on nickel soluble salts
	Phenol	2.50E+05 mg/kg	Non-Carcinogenic
	Phthalic Acid	8.2E+05 mg/kg	Non-Carcinogenic
	Pyrene	2.3E+04 mg/kg	Non-Carcinogenic
	Silver, Total	5.8E+03 mg/kg	Non-Carcinogenic
	1,2,3-Trichlorobenzene	9.30E+02 mg/kg	Non-Carcinogenic
	1,2,4-Trichlorobenzene	1.10E+02 mg/kg	Non-Carcinogenic
	Vanadium, Total	5.8E+03 mg/kg	Non-Carcinogenic
	Zinc, Total	3.5E+05 mg/kg	Non-Carcinogenic
Ground Water Potable Use	Acetophenone	1.9E+03 µg/l	Non-Carcinogenic
	4-Chloroaniline	3.7E+00 µg/l	Carcinogenic
	2-Chlorophenol	9.1E+01 µg/l	Non-Carcinogenic
	1,2-Dichlorobenzene	3.0+02 µg/l	Non-Carcinogenic
	1,4-Dichlorobenzene	4.8E+00 µg/l	Carcinogenic
	2,4-Dichlorophenol	4.6E+01 µg/l	Non-Carcinogenic
	Naphthalene	1.7E+00 µg/l	Carcinogenic
	Phenol	5.8E+03 µg/l	Non-Carcinogenic
	o-Toluidine	4.7E+01 µg/l	Carcinogenic
	1,2,4-Trichlorobenzene	1.2E+01 µg/l	Carcinogenic
	2,4,5-Trichlorophenol	1.2E+03 µg/l	Non-Carcinogenic
	2,4,6-Trichlorophenol	4.1E+01 µg/l	Carcinogenic
Ground Water: Vapor Intrusion to Indoor Air-Industrial Exposure Scenario	Free Product	Remove to the Extent Practicable	
	Ammonia	3.30E+06 µg/l	Non-Carcinogenic
	1,2-Dichlorobenzene	1.10E+04 ug/l	Non-Carcinogenic
	1,4-Dichlorobenzene	1.10E+02 ug/l	Carcinogenic
	Naphthalene	2.00E+02 ug/l	Carcinogenic

TABLE 1: CONTAMINANTS OF CONCERN (COCs) / REMEDIATION LEVELS (RLs)

Medium	COC	RL	RL Basis
	1,2,4-Trichlorobenzene	1.50E+02 ug/l	Non-Carcinogenic
Ground Water: Ground Water to Surface Water Exposure Human Health (non-drinking water)	2-Chlorophenol	4.00E+02 µg/l	
	1,2-Dichlorobenzene	1.7E+04 µg/l	
	1,3-Dichlorobenzene	2.6E+03 µg/l	
	1,4-Dichlorobenzene	2.6E+03 µg/l	
	2,4-Dichlorophenol	7.9E+02 µg/l	
	Phenol	4.6E+06 µg/l	
	1,2,4-Trichlorobenzene	9.4E+02 µg/l	
	2,4,5-Trichlorophenol	9.8E+03 µg/l	
	2,4,6-Trichlorophenol	6.5E+01 µg/l	
	Free Product	Remove to the Extent Practicable	
Ground Water: Ground Water to Surface Water Exposure Aquatic Life (Outside Mixing Zone Average)	Ammonia	3.4E+03 µg/l	
	2-Chlorophenol	3.2E+01 µg/l	
	1,2-Dichlorobenzene	2.3E+01 µg/l	
	1,3-Dichlorobenzene	2.2E+01 µg/l	
	1,4-Dichlorobenzene	9.4E+00 µg/l	
	2,4-Dichlorophenol	1.1E+01 µg/l	
	Naphthalene	2.1E+01 µg/l	
	Phenol	4.0E+02 µg/l	
	2,4,6-Trichlorophenol	4.9E+00 µg/l	
	Free Product	Remove to the Extent Practicable	

Based on this information, remedial alternatives were developed to address human health and environmental risks posed by the Site. The FS documents the remedial alternatives developed for the Site, and the Remedial Action Objectives (RAOs) to ensure protectiveness of human health and the environment. This Preferred Plan summarizes the range of remedial alternatives evaluated, identifies Ohio EPA's preferred remedial alternative, and explains the reasons for selection of the preferred remedial alternative. The preferred remedial alternative is designed to reduce human health risks to within acceptable limits, and to protect human health and the environment from exposure to soil, ground water, and indoor air contamination.

The expectations for the preferred remedial alternative include:

1. Reduction of risks to human health and the environment from exposure to COCs in soil, ground water, and indoor air, to applicable remediation levels.
2. Compliance with applicable or relevant and appropriate requirements (ARARs).
3. Cost-effectiveness and limitation of expenses to what is necessary to achieve the remedial action objectives.
4. Continued operation and maintenance of the existing remedial action and monitoring systems.

The major elements of the preferred remedial alternative include:

1. Institutional controls limiting the property to commercial/industrial use.
2. Utilizing the current parking lot and building slabs and foundations as an asphalt/concrete cap.
3. A maintenance and repair program for the asphalt/concrete cap.
4. A ground water management program.
5. Ground water monitoring.

SITE HISTORY

The former Phthalchem facility is located at 266 West Mitchell Avenue in Cincinnati, Hamilton County, Ohio and is approximately 3 acres in size (see Figure 1). The Site is located north of the interchange of Mitchell Avenue and Interstate 75 between Mill Creek and the B&O Railroad in the Northwest Quarter of Section 16, Range 2 East, Township 3 North, on the Cincinnati West United States Geological Survey (USGS) 7.5-minute quadrangle. It is within an industrial corridor along Mill Creek at the Cincinnati-St. Bernard corporation boundary. The current layout of the Site is shown on Figure 2. The Site has been divided into two operable units (OUs). OU1 consists of the on-property area of contamination which includes the former production area. OU2 consists of the off-property area of contamination, which includes Mill Creek.

The Site, which is currently owned by Sun Chemical, is vacant. Prior to development, the Site was reportedly vacant of structures for at least 80 years. The northern section of the property was backfilled in the early 1970s. Phthalchem began operations at the facility in 1977 and ceased operations in 1996. During that time, Phthalchem manufactured phthalocyanine chemicals. The methodology for the manufacturing of the phthalocyanine blue chemical consisted of reacting urea and phthalic anhydride with a copper salt in the presence of catalysts. TCB was used as a non-reactive solvent in the process. A wastewater treatment system, including solvent separation and recovery was, and currently is, present at the Site. During plant operations, wastewater containing ammonia and copper was treated prior to discharge to the Metropolitan Sewer District. The wastewater treatment system is currently used to treat ground water pumped from the on-site recovery wells.

During the early years of the plant's operation, Phthalchem reported having significant losses of TCB and aqueous ammonia as a result of leaks, spills, and scrubber system discharges. Plant modifications and system improvements were made in 1980 and 1981 that curtailed these loses. Only one incident has been recorded that resulted in a sudden release. Reportedly, 7,000 gallons of TCB were accidentally released in 1978 when a tanker truck carrying TCB overturned at the Site. In 1981, Environmental Enterprises Incorporated conducted chemical analyses of soil samples from an abandoned lagoon (a low-lying area located to the east of the plant) that indicated the presence of ammonia, copper, and TCB.

In 1983, the Army Corps of Engineers channelized Mill Creek and constructed a concrete structure in the portion of the creek adjacent to the Site. The channel structure has a 10-inch thick concrete floor overlying a 12-inch-thick sand and gravel base with sloped concrete sides. The channel is over 18 feet deep from the top edge of the walls to the surface of the concrete floor. Four-inch diameter weep holes were drilled through the concrete in rows

across the structure. During channelization of the creek, the area of the old lagoon on the Site was covered with approximately 5 to 10 feet of fill material and the area to the northeast of the Site was regraded.

SITE CONDITIONS

In 1985, OEPA personnel observed pools of TCB on the bottom of Mill Creek during a low flow period. It was determined that the TCB was migrating from weep holes on the channel bottom adjacent to the Site. Shortly thereafter, remedial actions were initiated to mitigate the release. An ongoing monitoring program for ammonia and TCB through analysis of samples taken from weep holes in Mill Creek augmented the initial remedial efforts. Also, in 1985, a system was installed for product recovery from the subbase of Mill Creek. Between 1985 and 1989, over 5,300 gallons of TCB had been removed from below Mill Creek.

In 1987, Phthalchem entered into an Administrative Order of Consent (AOC) with Ohio EPA. The objective of the AOC was to investigate the entire Site, and to develop appropriate response measures. In 1989, Phthalchem agreed to undertake immediate ground water removal actions that were requested by Ohio EPA, as outlined in a Consent Order for Preliminary Injunctive Relief. Westinghouse Environmental and Geotechnical Services, Inc. (Westinghouse) was retained by Phthalchem to design and install a ground water recovery and treatment system for the removal of free-phase TCB and DCB. In addition, the recovery system was intended to prevent the migration and release of contaminants from the Site. A series of 11 ground water recovery wells were installed in the shallow ground water-bearing unit on the Site and the system began operation in 1990.

In 1992, Phthalchem entered into a Consent Order with the state of Ohio and the City of St. Bernard (the "1992 Consent Order"). Under this Consent Order, Phthalchem is enjoined to remove free-phase DCB and TCB from the ground water, as well as prevent the off-site migration of DCB, TCB, ammonia, copper, and any potential breakdown products. SCS Engineers, Inc. (SCS) assumed responsibility for the operation and maintenance of the ground water recovery and treatment system in 1992.

All manufacturing operations at the Site ceased in May and June 1996. Thereafter, all manufacturing equipment was removed from the Site, and the manufacturing building was razed. The only structures remaining at the Site are an office building, a warehouse building, an office trailer, the former boiler building, and a metal building that houses the wastewater treatment system.

In 1996, David E. Estes Engineering, Inc. (Estes Engineering) assumed responsibility for operation and maintenance of the ground water and product recovery systems. In 1997, Ohio EPA approved the most recent work plan, Work Plan for Additional Free Product Removal/Ground-water Control (Revision 4) (the "1997 Work Plan"). In 1998, ENVIRON was retained by Phthalchem to provide additional engineering consulting services associated with the 1992 Consent Order. In 1999, PSARA Technologies (PSARA) took over the operation and maintenance of the Phthalchem product and ground water recovery systems from Estes Engineering.

In the fall of 2001, the well recovery system was upgraded with the construction of a slurry wall and ground water interception trench along the south edge of the Site. By December

2001, ground water was being collected via wells in the interception trench. The ground water recovery system is currently operating as it was in 2001. The slurry wall is providing containment for the Site ground water, which is pumped out of the interception trench to the wastewater treatment area. After treatment, the wastewater is discharged to the Metropolitan Sewer District. In addition, monthly product checks are performed on the drive points in the concrete base of Mill Creek. Any recoverable product is removed from these drive points on a monthly basis.

The Site is underlain by four distinctive unconsolidated stratigraphic units followed by bedrock, as detailed below:

- Surficial fill and soil material (7.5 to 18 feet thick),
- Upper sand and gravel unit (up to 17 feet thick) – uppermost ground water bearing zone at the Site,
- Lacustrine unit (83 to 87 feet thick) – low permeability silt and clay layer,
- Lower sand and gravel unit (1 to 10 feet thick) – confined aquifer, and
- Bedrock (several hundred feet thick) – interbedded shale and limestone.

Shallow ground water flows toward the southwest toward Mill Creek. During the operation of the ground water/product recovery wells, the saturated thickness of the shallow sand and gravel unit decreased across the Site from north (where it was approximately 8 feet) to south (where there was no saturated thickness).

The downgradient and vertical extent of the ground water impact were evaluated as part of the Phase II RI. The ground water contamination does not extend beyond Mill Creek in the downgradient direction or into the deep ground water bearing unit in the vertical direction.

The ground water ingestion pathway is not considered complete at the Site based on the following information:

- There is no ground water use or planned ground water use at the Site. Ground water is not used as drinking water within a 2-mile radius of the Site.

- Drinking water for the city of Cincinnati is provided by Greater Cincinnati Water Works, with potable water being sourced from surface water from the Ohio River (~88% of the drinking water) and ground water from the Great Miami Aquifer (~12% of the drinking water). The closest Cincinnati ground water well used for potable water is approximately 14 miles northwest of the Phthalchem Site, which is upgradient of the Site.

- In the 1930s and 1940s, industrial companies in the Mill Creek Valley realized that the ground water resources in the industrialized region of southwestern Ohio were being depleted by substantial industrial use of the aquifer. Eleven industries joined together to form the Southwestern Ohio Water Company to supply the water needs of the industrial companies. The Southwestern Ohio Water Company currently draws water from two production wells near the Great Miami River in Ross, Ohio. These two production wells are located approximately 11 to 12 miles northwest of the Phthalchem Site, which is upgradient of the Site.

Free product is currently located in two areas: (1) below the lacustrine interface with the upper sand and gravel unit in the former manufacturing area, and (2) in the sub-base of Mill Creek. The free product in the former manufacturing area is controlled by the ground water interception trench system. Product has only been recovered from 3 of the 11 wells that have been monitored on a routine basis from 2002 through the present, with a total of only 24.5 gallons of product/water mixture being collected from the monitoring wells over the past 14 years of monitoring. The free product currently located in the sub-base of Mill Creek is being controlled by regularly pumping the free product out of the drive points (installed 1997), preventing accumulation of free product. The free product area in the Mill Creek sub-base is bounded by upstream and downstream drive points, in which free product has not been detected. Since 1997, several of the drive points have "silted in," preventing monitoring of these locations for free product. Rehabilitation of these drive points will be considered as part of an appropriate long-term monitoring program that will be determined as part of the active remedy completion evaluation. The extent of free product in 1997 in OU1 and OU2 (prior to the installation of the ground water interceptor system) is shown on Figure 3. The extent of free product detected in OU1 after 11 to 15 years of operation of the ground water interceptor system is shown on Figure 4. The extent of free product under the channelized portion of Mill Creek (OU2) is shown on Figure 5.

The 2018 FS has taken into consideration that ground water may become surface water and that this water resource represents an important hydrologic pathway. The ground water at the Site does not appear to be significantly impacting Mill Creek. In 2011, the Metropolitan Sewer District of Greater Cincinnati (MSD) conducted a biological, chemical, and physical monitoring study of Mill Creek from the border of Butler and Hamilton counties to the Ohio River, the West Fork of the Mill Creek, the East Fork of the Mill Creek, and tributaries to each. Both the upstream (MC07) and downstream (MC75) monitoring stations of the Phthalchem facility were in "Full" attainment status for aquatic life use. Copper, bis(2-ethylhexyl)phthalate, and ammonia were not detected in surface water above their respective reference target limits in either location.

SITE RISKS

The conceptual site model (CSM) and baseline risk assessment (BRA) for OU1 (On-Site) and OU2 (Mill Creek) were presented in the 2005 RI/FS Addendum. The BRA was performed for the Site as it currently exists, i.e., zoned for industrial/commercial use, with most of the surface covered with pavement, and an operating ground water interception system. The CSM was updated, and the risk assessment was performed in accordance with U.S. EPA's Risk Assessment Guidance for Superfund (RAGS). The BRA indicated that the Site does not pose any unacceptable exposure under current site zoning, pavement covering, and the ground water interception system.

Potential receptors evaluated in the BRA included trespasser/visitor, site worker, construction worker, and ecological receptors. Completed pathways evaluated in the BRA included exposure to surface soils (construction worker at OU1), subsurface soils (construction worker at OU1), sediments (construction worker and trespasser/visitor at OU2), ground water (construction worker at OU1), and ground water to surface water (human and ecological receptors). For the purposes of the BRA reported in this RI/FS Addendum Report, the

potential COCs were assumed to be only the chemicals that have been detected. Risks associated with potential COCs were evaluated based on the potential exposure routes.

Exposure of trespasser/visitor and site worker to surface soils at OU1 was not considered as the soils at the Site are covered by pavement or building foundations. However, this may be a potential future risk if the pavement or building foundations are compromised. Exposure to surface water for construction worker and trespasser/visitor at OU2 was not considered as there were no COCs detected in Mill Creek. The construction worker also has the potential to encounter free product in OU2. Exposure to air contamination and inhalation risks were considered in the evaluation of the various exposure sources (surface soils, subsurface soils, surface water, ground water, and free product).

The calculated risks for OU1 and OU2 under current site conditions (ground-water interceptor operating, asphalt and concrete pavement in place and no occupied structures) were less than the acceptable cancer risk level of $1x10^{-5}$ and the acceptable hazard index (HI) of 1. The calculated risks for OU1 were cancer risk equal to $2x10^{-7}$ and HI equal to 0.3. For OU2, the highest calculated cancer risk was $2x10^{-9}$ and HI equal to 0.03.

REMEDIAL ACTION OBJECTIVES

RAOs were developed for the Site to identify goals that a remedy should achieve in order to ensure protection of human health and the environment. The RAOs for the Site are listed in **Table 2.**

TABLE 2: REMEDIAL ACTION OBJECTIVES	
Ground Water	
Human Health Risk	Prevent ingestion/direct contact of ground water at the site having a COC in excess of its MCL or having carcinogens in excess of a total excess lifetime cancer risk (for all contaminants) greater than $1x10^{-5}$.
Human Health Risk	Prevent ingestion/direct contact of ground water at the site having non-carcinogens in excess of MCLs or having non-carcinogens in excess of a HQ or HI greater than 1.
Human Health Risk	Prevent inhalation in future site structures of carcinogens 1,4-dichlorobenzene (1,4-DCB) and naphthalene in vapors emanating from ground water in excess of a $1x10^{-5}$ excess lifetime cancer risk.
Human Health Risk	Prevent inhalation in future site structures of non-carcinogens ammonia; 1,2-DCB; and 1,2,4-trichlorobenzene (1,2,4-TCB) in vapors emanating from ground water in excess of a hazard quotient (HQ) or HI of 1.
Human Health Risk	Reduce migration of potential contaminants of concern (PCOCs) from ground water to surface water to levels that are protective of human health.
Environmental Risk	Reduce migration of PCOCs from ground water to surface water to levels that are protective of biota.

Soil	
Human Health Risk	Prevent ingestion/direct contact with Site soils having carcinogenic COCs in excess of a total excess lifetime cancer risk greater than $1x10^{-5}$.
Human Health Risk	Prevent ingestion/direct contact of Site soils having non-carcinogenic COCs in excess of a HI greater than 1.
Note: Ecological evaluations of Mill Creek adjacent to the Site have been conducted. These evaluations indicate that the Site does not pose any unacceptable aquatic risks to Mill Creek (2005 Remedial Investigation/Feasibility Study Addendum Report, Phthalchem Facility). Also, given the highly urbanized/industrial conditions of the Site and surrounding areas, and the channelization of Mill Creek, there is a lack of habitat that would support ecological receptors.	

SUMMARY OF REMEDIAL ALTERNATIVES

A total of 7 remedial alternatives were considered in the FS. A brief description of the major features of each follows:

RA-1: No Action

The National Contingency Plan (NCP) requires that a No Action alternative be incorporated into the evaluation and selection of an RA. The No Action alternative serves as a point of comparison to the other alternatives under consideration at the Site. This alternative assumes that no remedial technologies or controls would be implemented and the exposures at the Site would remain unchanged in the near and long-term.

RA-2: Institutional Controls and Long-Term Monitoring

Institutional controls for the Site would consist of the limitation of land/resource use to prevent exposure to on-site contamination in OU1. This alternative would be implemented using an environmental covenant (EC). The property where OU1 is located would be limited to industrial/commercial land use. The EC would also require the property owner to submit a risk mitigation plan (RMP) to Ohio EPA for approval prior to any construction or excavation activities at the site. Long-term monitoring of the site ground water would also be performed as part of this alternative.

RA-3: Ground-water Interception Trench and Slurry Wall

This alternative consists of an interception trench that contains a perforated pipe to transfer captured ground water for ex-situ treatment and a slurry wall down-gradient adjacent to Mill Creek.

This alternative would capture and contain contaminated ground water at the Site using a trench and perforated pipe, and would include the following components:

- Simultaneous trenching and wall construction utilizing guar gum bio-slurry (trench construction will include installation/submersion of collection system piping).
- Installation of collection system pumps.
- Installation of on-site treatment system or modification of the existing treatment system.
- Periodic monitoring of downgradient monitoring wells.
- Periodic collection system and on-site treatment system maintenance and sampling.

Perforated ground water collection piping and any necessary pumping equipment would be laid in the excavation during the trenching operations. The pipe would be designed to ensure that the maximum ground water flow through the Site would be captured. Through gravity flow and/or pumping, the captured ground water would be transported via the pipe to a treatment system, with discharge of the treated ground water to MSD. The system described in this alternative was installed at the Site in 2001 and continues to operate. The work was performed in accordance with the 2001 Design Report, which was approved by Ohio EPA in May 2001, and the subsequent construction modifications approved by the OEPA. In August 2014, the MSD approved direct discharge of the extracted ground water without pretreatment to the MSD sewer system.

RA-4: In-Situ Chemical Oxidation (ISCO)

This RA would attempt to chemically degrade contaminants using Fenton's chemistry (generation of hydroxyl radicals with iron and peroxide). COCs, in theory, would be degraded to carbon dioxide and water, in addition to possible degradation products if the reactions are incomplete. The most commonly used oxidants are hydrogen peroxide, permanganate, ozone, and persulfate. The two most critical factors in ISCO implementation are the effective distribution of oxidants to the treatment zone and the reactivity of the oxidant with the contaminants present. There are several options for delivery, including: vertical wells, well points, horizontal or inclined wells, infiltration galleries, and treatment fences. Other techniques such as deep soil mixing and hydraulic fracturing have been used for media with low permeability. The application of chemical oxidation to the former production area of the Facility would include the following activities:

- Installation of injection points.
- Injection (and possible re-injection) of Fenton's reagent.
- Collection and treatment of vapors generated during the process.
- Pre- and post-injection monitoring.

The effectiveness of in-situ chemical oxidation of chlorinated benzenes in contaminated soils has been reviewed by others. In a critical analysis of field-scale applications of chemical oxidation assessing a range of case studies (242 overall, 5 involving chlorinated benzenes), the mean and median % reductions of chlorinated benzenes in ground water were only 16% and 23%, respectively. In addition, USEPA's CLU-IN database and the Interstate Technical and Regulatory Council (ITRC) databases were both reviewed, but there were no reported studies on the removal effectiveness for chlorinated benzenes. Peer reviewed literature was also searched for Fenton's reagent and chlorinated benzenes, but no reported studies were found.

A chemical oxidation pilot test was conducted by GCI on a small portion of the Site in August 1998. As reported by Estes Engineering in their pilot-scale test report, ground water samples collected prior to and following the injection of chemicals indicated an approximately 85 percent reduction in TCB within the test area. In-situ technologies rely heavily on various delivery mechanisms to contact the oxidant with the impacted medium. As depth increases, the delivery methods inherently become more problematic and costlier. Contact with contaminants and diffusion of the injected chemical oxidant is typically a limiting factor for effective ISCO. Delivery via injection is generally limited to a relatively small radius of influence. Thus, for a site with relatively large treatment areas, a very large number of oxidant injection points are required.

Natural minerals and organic matter in the target soil will consume the oxidant and consequently less oxidant will be available to oxidize the Site COCs. A complete understanding of the native oxidant demand is necessary to determine the amount of oxidant necessary to treat the Site COCs. If there is a large amount of natural organic matter, a large amount of oxidant will need to be injected in order to treat the COCs to levels below the RAOs. There has been limited success in applying ISCO to remediate chlorinated benzenes in vadose zone soils. However, ISCO was retained as a remedial alternative for addressing source area impacts. Long-term monitoring of the site ground water would also be conducted as part of this alternative.

RA-5: Free Product Removal

Continued removal of free product is consistent with the 1992 Consent Order and would continue until removal volumes approach asymptotic levels. Long-term monitoring of ground water would also be conducted as part of this alternative. However, this remedial alternative does not, by itself, meet the RAOs and would likely need to be paired with another remedial alternative. It is assumed that free product removal activities may be required for up to 30 years.

RA-6: Soil/Free Product Excavation and Off-Site Disposal

This alternative consists of excavation of pooled free product and soils with COC concentrations greater than the soil saturation concentration (Csat) for specific COCs. Long-term monitoring of the site ground water would also be conducted as part of this alternative.

Based on soil borings conducted during previous investigations, an area of approximately 47,350 square feet is estimated to be impacted by either free product ganglia or free-phase

product in the former manufacturing area (not including the concrete-lined Mill Creek area). The impacted zones are near the interface of the fill/shallow sand unit with the lacustrine unit. The lacustrine unit is generally 15 to 20 feet below the current ground surface in the former manufacturing area of the Site. Removal of the soils above the lacustrine interface would be required for this excavation and off-site disposal alternative. The cost and safety concerns for removal of 15 to 20 feet of soil to gain access to the impacted materials and pooled free product makes this alternative impractical. Excavation to remove free product beneath the concrete-lined Mill Creek area is not considered a part of this alternative.

An alternative to excavate and dispose of impacted soils and free product from the Site would include the following components:

- Excavation of the approximately 47,350 square-foot area in sections to a depth of 15 to 20 feet and stockpiling on-site. This clean overburden will be used to backfill the excavation.

- Excavation of approximately 5 feet thickness of soils at the lacustrine interface (the contaminated soils). These soils will be containerized on-site pending waste characterization activities.

- Transportation of waste soils and disposal at a local landfill. It is assumed that the contaminated soils would be characterized as non-hazardous wastes.

- Backfilling of excavation with stockpiled shallow soils and imported fill as needed.

- Surface restoration.

RA-7: Institutional Controls with Long-Term Monitoring, Ground-water Interception Trench and Slurry Wall, and Free Product Removal

This alternative consists of a combination of Alternatives RA-2, RA-3, and RA-5 as described above. It includes a method to capture the ground water at the Site, a mechanism to control site access through means of enforcement tools, permitting tools, and information tools and continued removal of the source contamination.

COMPARISON CRITERIA

Eight (8) criteria have been established to evaluate the various remedial alternatives individually and compare them with each other to select a preferred remedy. Consisting of threshold, balancing, and modifying criteria, they include:

Threshold Criteria

1. Overall protection of public health and the environment which evaluates whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, treatment, etc.
2. Compliance with ARARs which evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver is justified.

Any acceptable remedy must minimally comply with both criteria.

Balancing Criteria

1. Long-Term Effectiveness and Permanence, which evaluates the ability of an alternative to maintain protection of human health and the environment over time.
2. Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment, which evaluates the amount of contamination present, the ability of the contamination to migrate, and the use of treatment to reduce harmful effects.
3. Short-Term Effectiveness, which evaluates the length of time needed to implement an alternative and the risks the alternative poses during implementation.
4. Implementability, which evaluates the technical and administrative feasibility of implementing the alternative.
5. Cost, which is an estimate of the capital and annual operation and maintenance costs. Evaluation of the Balancing Criteria are used to select the most appropriate remedial alternative.

Modifying Criterion

The Modifying Criterion is Community Acceptance, which considers whether the local community agrees with the analyses and preferred alternative as proposed. This criterion is evaluated through comments on the alternatives that are received during the comment period.

EVALUATION OF ALTERNATIVES

A summary of the evaluation of the Site remedial alternatives and the costs associated with each is included in **Table 3.**

TABLE 3: EVALUATION OF SITE REMEDIAL ALTERNATIVES								
Remedial Alternatives	**Threshold Criteria**		**Balancing Criteria**					**Modifying Criteria**
	1. Protects Human Health and Environment	2. Complies with ARARs	3. Long-Term Effectiveness	4. Reduces T, M, or V through Treatment	5. Short-Term Effectiveness	6. Implementability	7. Cost	8. Community Acceptance
RA-1	☐	☐	☐	☐	☐	■	$0	TBD
RA-2	◘	☐	☐	☐	☐	■	$594,000	TBD
RA-3	◘	◘	◘	◘	◘	■	$3,304,500	TBD
RA-4	◘	◘	◘	◘	◘	◘	$5,634,000	TBD
RA-5	◘	◘	◘	◘	◘	■	$465,000	TBD
RA-6	■	◘	◘	◘	☐	☐	$8,460,000	TBD
RA-7	◘	◘	◘	◘	◘	■	$3,983,000	TBD
■ = Fully Meets Criteria ◘ = Partially Meets Criteria ☐ = Does Not Meet Criteria								

PREFERRED REMEDIAL ALTERNATIVE

Ohio EPA's preferred remedial alternative for the former Phthalchem Site is RA-7, which is a combination of RA-2, RA-3 and RA-5. This alternative relies on various institutional controls to restrict the use of the Site, and engineering controls to prevent direct contact with contamination remaining at the Site. The engineering and institutional controls on which the preferred alternative relies are commonly used strategies and have been widely applied at other sites with soil and ground water impacts. This preferred remedial alternative, as detailed below, may change in response to Ohio EPA's consideration of public comment or new information.

The preferred alternative for OU1 includes the following components:

- An environmental covenant that would limit the use of the Site to industrial/commercial; prohibit the use of ground water for any purpose other than sampling to monitor contamination; maintenance of the existing asphalt cap to prevent direct contact with soil; a risk mitigation plan and pre-approval from Ohio EPA for any construction or excavation activities at the Site, and evaluation of the vapor intrusion pathway, if any structures are constructed at the Site.

- Continued operation and maintenance of the ground water interceptor system and slurry wall, with long term ground water monitoring and free product removal to maximum extent practicable.

The preferred alternative for OU2 is to continue to monitor selected weep holes in Mill Creek with removal of free product to the maximum extent practicable.

Ohio EPA encourages the public to review and comment on this document, and other documents contained in the administrative record file for the Site, to gain a better understanding of the Site, and the activities that have been conducted there.

CONTOUR INTERVAL 10 FEET

0 — 1/2 — 1 MILE

0 — 2000 — 4000 FEET

LEGEND:

PROPERTY BOUNDARY (APPROXIMATE)

QUADRANGLE LOCATION

SOURCE:
2013 USGS 7.5 Minute Series Cincinnati West and Cincinnati East, Ohio Topographic Quadrangles.
Site Location; N: 39.168176° W: 84.506885° WGS84

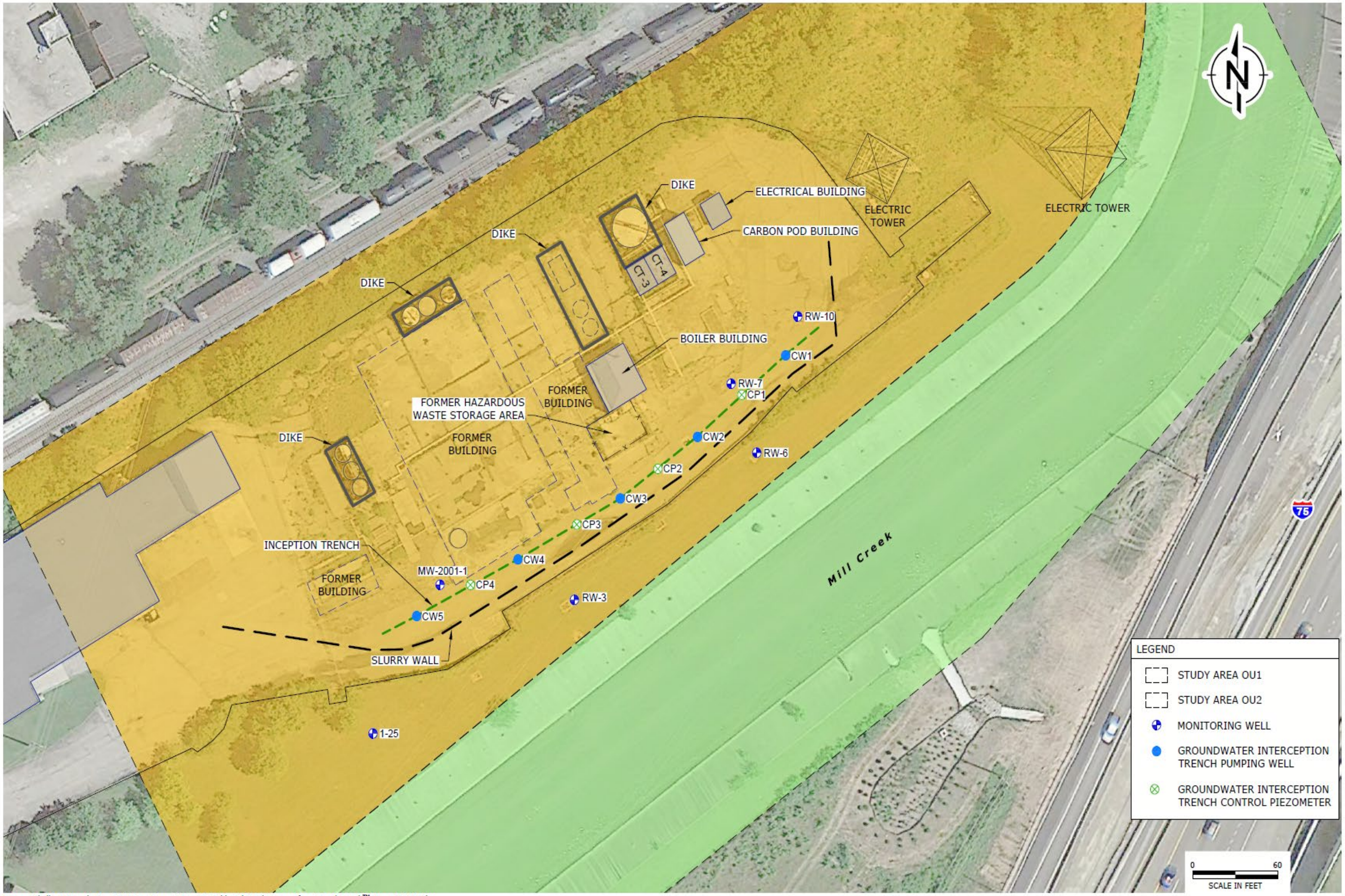
RAMBOLL ENVIRON

SITE LOCATION MAP
PHTHALCHEM, INC.
266 WEST MITCHELL AVENUE
CINCINNATI, OHIO

FIGURE
1

DRAFTED BY: ELS | DATE: 2/15/17 | 216772A

L:\Loop Project Files\00_CAD FILES\21\Sun Chemical_Phthalchem 216772A\01_Site Location Map (Cincinnati OH).dwg



Source: Shallow Groundwater Monitoring Report, Event 4, Table 5 (Aerial imagery from Google Earth™, June 10, 2016).

RAMBOLL ENVIRON	**SITE LAYOUT** PHTHALCHEM, INC. 266 WEST MITCHELL AVENUE CINCINNATI, OHIO	FIGURE **2**
DRAFTED BY: ELS — DATE: 2/15/17		216772A

Source: David E. Estes Engineering, Inc., October 1997 (Aerial imagery from Google Earth™, June 10, 2016.

RAMBOLL ENVIRON

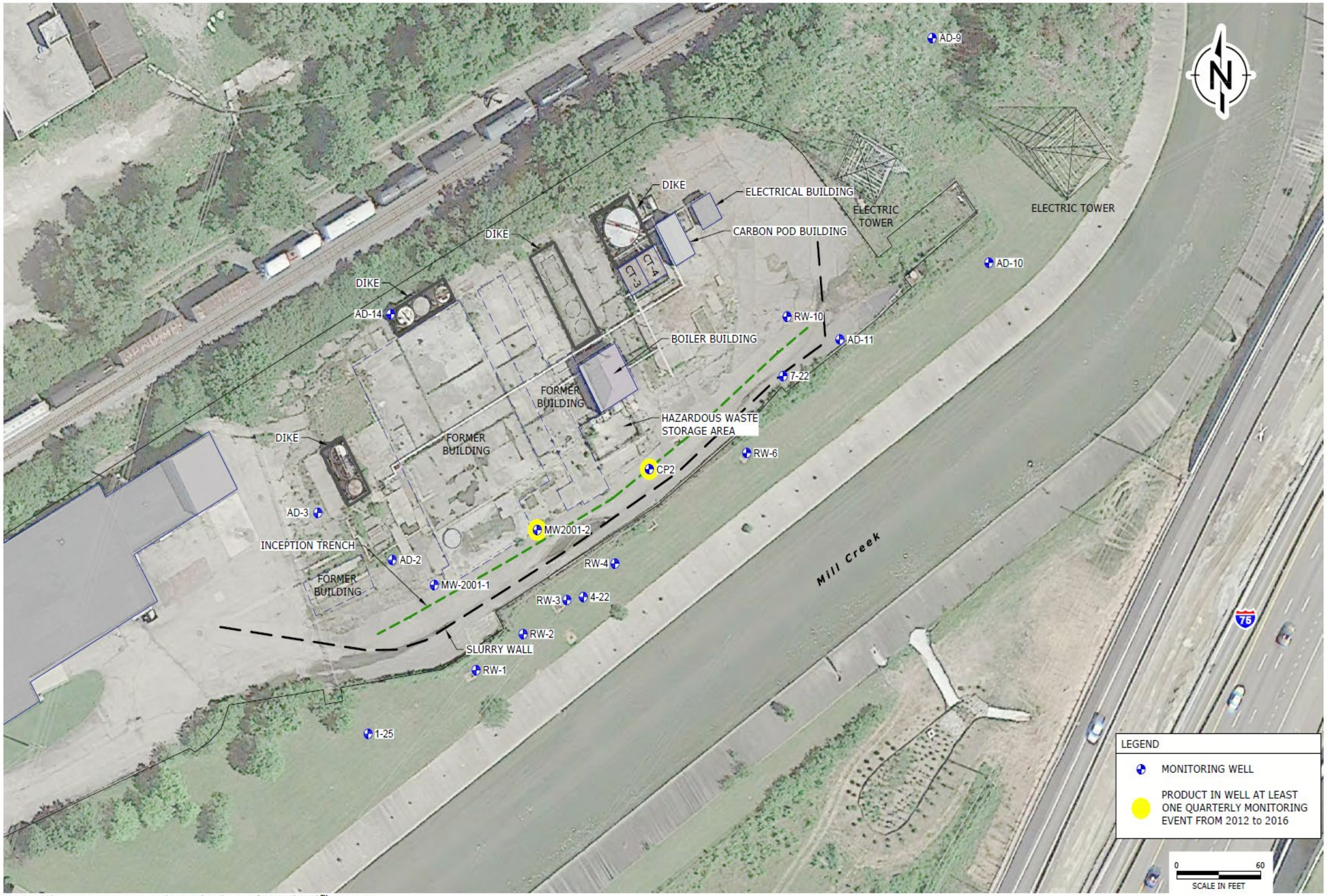
DRAFTED BY: ELS | DATE: 2/15/17

DISTRIBUTION OF PRODUCT ON TOP OF LACUSTRINE UNIT AS OF SEPTEMBER 22, 1997
PHTHALCHEM, INC.
266 WEST MITCHELL AVENUE
CINCINNATI, OHIO

FIGURE
3

216772A

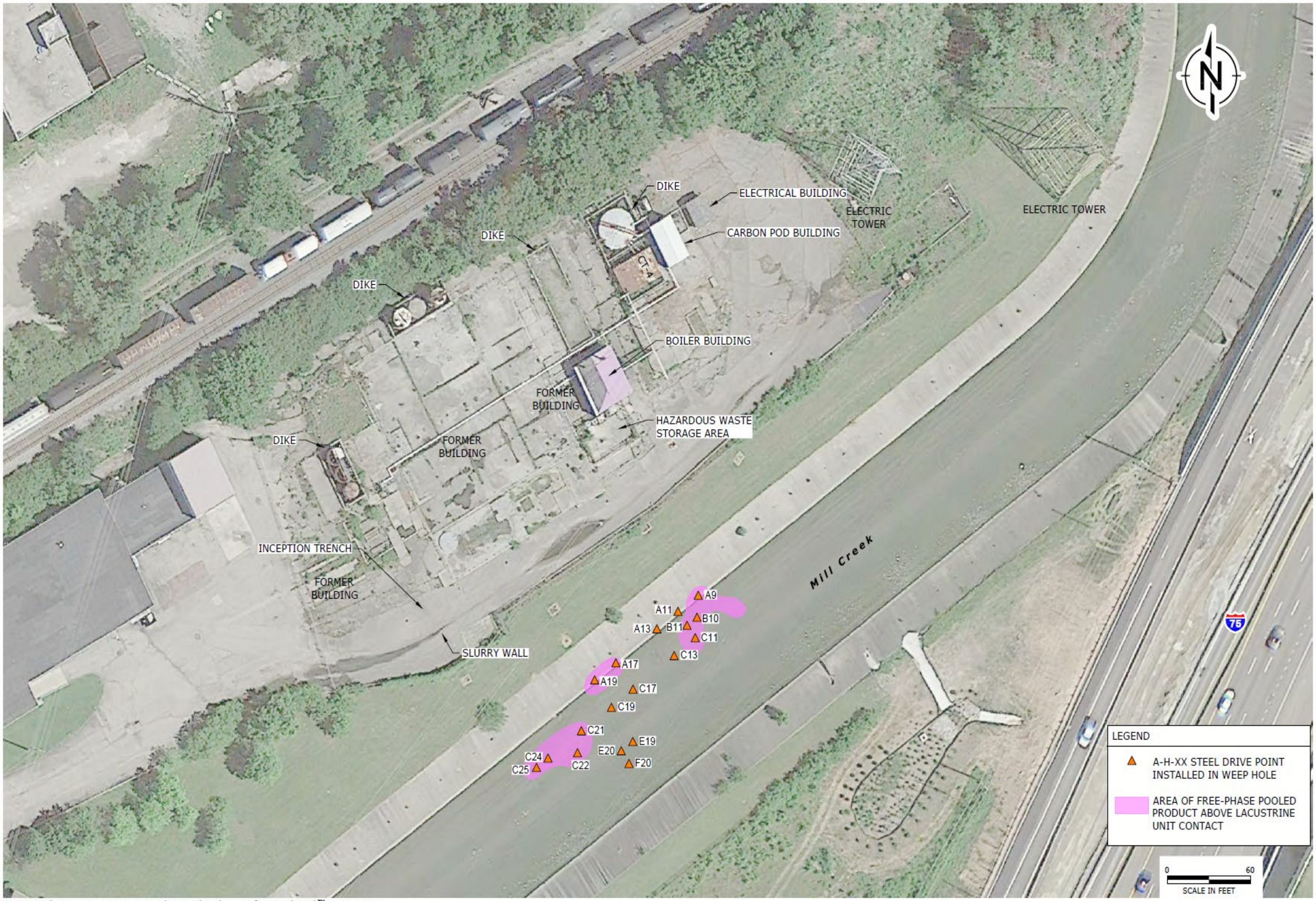
L:\Loop Project Files\00_CAD FILES\21\Sun Chemical_Phthalchem 216772A\03_Dist of Product on Top of Lacustrine Unit.dwg



Source: David E. Estes Engineering, Inc., October 1997 (Aerial imagery from Google Earth™, June 10, 2016.

RAMBOLL ENVIRON	DISTRIBUTION OF FREE PRODUCT IN QUARTERLY / SEMI-ANNUAL MONITORING WELLS - 2012 to 2016 PHTHALCHEM, INC. 266 WEST MITCHELL AVENUE CINCINNATI, OHIO	FIGURE 4
DRAFTED BY: ELS / DATE: 2/15/17		216772A

L:\Loop Project Files\00_CAD FILES\21\Sun Chemical_Phthalchem 216772A\04_Dist of Free Product in Qtrly-Semi Ann MWs.dwg



Source: David E. Estes Engineering, Inc., October 1997 (Aerial imagery from Google Earth™, June 10, 2016.

RAMBOLL ENVIRON

DRAFTED BY: ELS | DATE: 2/15/17

DISTRIBUTION OF FREE PRODUCT IN DRIVE POINTS - 2012 to 2016
PHTHALCHEM, INC.
266 WEST MITCHELL AVENUE
CINCINNATI, OHIO

FIGURE
5

216772A