Focused Feasibility Study Report

Cosden Chemical Coatings Corporation Superfund Site
City of Beverly, Burlington County, New Jersey

Prepared for:

U.S. Environmental Protection Agency
Region II

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ABBREVIATIONS

CEA	Classification Exception Area
CERCLA	Comprehensive Environmental, Response, Compensation, and Liability Act
COC	Contaminant of Concern
EPA	Environmental Protection Agency
FFS	Focused Feasibility Study
GWQS	Groundwater Quality Standard
ISCO	In-Situ Chemical Oxidation
LNAPL	Light Non-Aqueous Phase Liquid
LTRA	Long-Term Remedial Action
MCL	Maximum Contaminant Levels
MIP/HPI	Membrane Interface Probe/Hydraulic Profile Investigation
NCP	National Contingency Plan
NJDEP	New Jersey Department of Environmental Protection
NPL	National Priorities List
PFAS	Per- and Polyfluoroalkyl Substances (PFAS)
PRG	Preliminary Remediation Goals
ROD	Record of Decision
SCADA	Supervisory Control and Data Acquisition
SVE	Soil Vapor Extraction
TBC	To Be Considered (as in, criteria)
TCE	Trichloroethylene
TCL	Target Compound List
TEX	Toluene, Ethylbenzene, and Xylene
USACE	U.S. Army Corps of Engineers
VOCS	Volatile Organic Compounds
ZVI	Zero Valent Iron

EXECUTIVE SUMMARY

The United States Environmental Protection Agency (EPA) requested that the United States Army Corps of Engineers (USACE) perform a Focused Feasibility Study (FFS) to evaluate three remedial alternatives to address contaminated groundwater at the Cosden Chemical Coatings Corporation Superfund Site (Cosden or Site) located in Beverly, New Jersey.

The Cosden Chemical Coatings Corporation was a paint formulation and manufacturing facility that produced coatings for industrial applications. The facility operated from 1945 until its closure in 1989. The Site first came to the attention of the New Jersey Department of Environmental Protection (NJDEP) following a grass fire at the facility in 1980. An inspection by NJDEP in 1980 revealed surface spills and several hundred unsecured drums stored on-site. Despite various court actions and a judicial consent order, Cosden Chemical Coatings failed to clean up the surface spills and remove the drums. In 1987, the Site was added to the National Priorities List (NPL) and the EPA undertook a removal action to secure the Site and address the imminent and substantial endangerment posed by the conditions at the Site.

In 1992, EPA initiated remedial action when it issued the September 30, 1992 Record of Decision (ROD) at the Site to address contamination that existed in and around aboveground structures, in soils, and in groundwater. The 1992 ROD was later modified in 1998 by an Explanation of Significant Differences.

The Remedial Action Objectives of the 1992 ROD are:

- Prevent exposure to contaminant sources that present a significant human health risk and;
- Restore contaminated groundwater to drinking water standards.

The remedial action for aboveground structures included the decontamination, demolition, and disposal of all on-site structures, equipment, and debris, and was completed in 1996. Soil cleanup was completed in 2002 by removing 10,711 tons of soil, 1,800 tons of debris, and 3,000 gallons of liquid wastes. After the work was completed, the area was backfilled with clean fill, graded, and revegetated, to give the Site a park-like appearance.

EPA's environmental investigations at the Site revealed that groundwater beneath the Site is contaminated with volatile organic compounds (VOCs), including; toluene, ethylbenzene, xylene, and trichloroethene (TCE) as well as chromium and lead. EPA selected a groundwater extraction and treatment system remedy in the 1992 ROD, which was constructed and operated at the Site from 2009 until 2018. Subsequently, EPA performed an In-Situ Chemical Oxidation (ISCO) Pilot Study to determine whether this technology would more effectively remediate the residual groundwater contamination. The ISCO Pilot Study was completed in 2021, and EPA is now considering remedial alternatives that would address the residual groundwater contamination.

The remedial alternatives identified by EPA for evaluation in this FFS are:

- Alternative 1 (current remedy) – Groundwater Extraction and Treatment
- Alternative 2 – In-Situ Treatment

Alternatives 1 and 2 would both include the following common elements:

- Institutional controls, including establishing an NJDEP Classification Exception Area (CEA)
- Long-term monitoring program to assess the concentrations of COCs over time
- Five-year reviews

This FFS has been prepared to screen and evaluate remedial alternatives to address groundwater contamination at the Site. The remedial alternatives were evaluated against the NCP's nine evaluation criteria and compared against one another.

Alternative 1 was found to be generally effective and suitable for treating metals in addition to VOCs, but has a higher cost than Alternative 2, and a longer time to cleanup. Alternative 2 was found to be generally effective at treating Site VOCs, with a moderate cost and over a timeframe of five years. Under Alternative 2, metal concentration increases due to in-situ chemical oxidation treatments are typically transitory and will re-equilibrate so that the metal concentrations will return to the pre-injection state (USACE, 2017 and Kaur and Crimi, 2013).

This evaluation provides a basis for the EPA to select a preferred remedial alternative to address the contamination at the Site.

1.0 INTRODUCTION

In November 2021, the EPA requested that USACE perform an FFS at the Site, located in the City of Beverly, Burlington County, New Jersey, to assess remedial alternatives to address groundwater contamination at the Site.

1.1 PURPOSE AND ORGANIZATION OF THE REPORT

The purpose of this FFS is to identify, screen, and evaluate remedial alternatives to address groundwater contamination at the Site. The remedial alternatives were evaluated against s nine evaluation criteria in the NCP and compared against one another in accordance with the U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response Directive 9355.3-01, *Guidance for Conducting Remedial Investigations and Feasibility Studies under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*, Interim Final (EPA 1988). This evaluation provides a basis for the EPA to select the preferred remedial alternative. Specifically, the FFS objectives are:

- Identification of feasible remedial technologies for containment, removal, or treatment and disposal of contaminated groundwater;

- Screening and assembly of the feasible technologies into remedial alternatives for detailed analysis; and

- Detailed evaluation and comparison of the remedial alternatives to provide the basis for EPA's selection of the preferred remedial alternative.

This FFS is organized as follows:

Section 1 presents introductory information including: Site description, environmental history, nature and extent of groundwater contamination, contaminant fate and transport, and a summary of the baseline risk assessment.

Section 2 identifies the remedial technologies considered for this FFS, summarizes remedial action objectives, and identifies applicable remediation standards.

Section 3 presents details on the remedial alternatives and screens the candidate alternatives. This section also describes the screening process.

Section 4 presents the detailed evaluation of the remedial alternatives and describes the screening criteria utilized during the evaluation, along with a comparative analysis and description of elements common to all alternatives.

Section 5 summarizes the FFS analysis and presents recommendations.

1.2 BACKGROUND INFORMATION

1.2.1 Site Description

The Site is located in the southeastern corner of the City of Beverly, Burlington County, New Jersey, approximately one-half mile southeast of the Delaware River (Figure 1). The Site address is 1023 Cherry Street, and the property encompasses approximately 6.7 acres. Two buildings, a Soil Vapor Extraction (SVE) system building and the groundwater extraction and treatment system building, are currently located on the property. The Site is bounded on the north by Cherry Street, on the east by Manor Road, on the south by railroad tracks, and on the west by undeveloped land. The neighboring area is suburban residential with some light industry.

1.2.2 Site History and Response Activities

Cosden Chemical Coatings Corporation was a paint formulation and manufacturing facility that produced coatings for industrial applications. The facility operated from 1945 until its closure in 1989. The manufacturing process involved mixing pigments with resins and solvents in both ball and sand mills. The material was then placed into a mixing tank where other ingredients were added to produce the final coating products. Mixing tanks were then washed out with solvents, and the rinsate was transferred to drums. Organic solvents used in the manufacturing process were recycled until 1974. After 1974, drums containing spent solvents were stored on-site; some of these drums leaked onto the ground causing soil and groundwater contamination. Fresh solvents were stored in underground tanks, which may have leaked.

The Site first came to the attention of the NJDEP following a grass fire at the facility in 1980. An inspection by NJDEP in 1980 revealed surface spills and several hundred unsecured drums stored on-site. Despite various court actions and a judicial consent order, Cosden failed to clean up the surface spills and remove the drums. In February 1985, the NJDEP initiated emergency removal of the drums and cleanup of the surface spills. By January 1986 most of drums had been removed; however, 41 drums and two large soil piles remained. Additional environmental remediation activities were necessary.

In 1987, the Site was added to the National Priorities List (NPL) and the EPA undertook a removal action. The removal action consisted of the construction of a fence to secure the Site and the off-site disposal of 75 lab pack drums, 300 fifty-five gallon drums, 2,000 gallons of bulk liquids, and 350 empty containers ranging in size from 5-gallon pails to fifty-five gallon drums.

The 1992 ROD addressed contamination that existed in and around above-ground structures, in soils, and in groundwater. The remedial action for above-ground structures included the decontamination, demolition, and disposal of all on-Site structures, equipment, and debris, and was completed by EPA in 1996. EPA updated the site's soil remedy to excavation with off-site treatment and disposal in a September 1998 Explanation of Significant Differences. Soil cleanup was completed in 2002 by removing 10,711 tons of soil, 1,800 tons of debris, and 3,000 gallons of liquid wastes. After the work was completed, the area was backfilled with clean fill, graded, and revegetated to give the Site a park-like appearance.

EPA tasked the USACE to design and build a groundwater extraction and treatment system that included a treatment plant, two groundwater extraction wells, an array of soil vapor extraction wells, and a treatment plant to treat soil vapor. The construction of the groundwater and soil vapor extraction (SVE) systems was completed in 2009 and was followed by long-term response action (LTRA). LTRA activities consisted of operating the groundwater extraction and treatment system to remove volatile organic compounds (VOCs). The operating system consisted of two groundwater recovery wells with reinjection of treated effluent through two infiltration galleries. Extracted water was treated using oxidation, filtration, and carbon adsorption and was then discharged back into the aquifer on the eastern and western edges of the Site. This system was shut down in June 2018 due to aging equipment and the performance of the ISCO Pilot Study. The groundwater extraction and treatment system is estimated to have treated 282,311,828 gallons of water since 2009 and removed approximately 13,000 pounds of total VOCs.

The SVE system was shut down in June 2010 because soil vapor contaminants in the vadose zone were reported at concentrations below levels requiring treatment.

Recovery wells and monitoring wells are shown on Figure 2.

1.2.3 Nature and Extent of Contamination

The nature and extent of contamination at the Site presented in this section is based on data presented in the Final Interim Remedial Investigation Report (Ebasco, September 1990) and Draft Phase II Results Report (Ebasco, April 1992) as summarized in the Draft Final Feasibility Study Report (Ebasco, July 1992), as well as the Cosden Membrane Interface Probe/Hydraulic Profile Investigation (MIP/HPI) report (USACE, June 2016), the Summary Report for In-Situ Chemical Oxidation Pilot Study (Tetra Tech, July 2021), and the EPA Draft Third Five-Year Review Report for Cosden Chemical Coatings Superfund Site. The Site contamination discussed in this FFS is for the groundwater and limited soil media. Recent groundwater analytical data from May 2021 is shown on Figure 3.

Groundwater beneath the Site is contaminated with VOCs including toluene, ethylbenzene, and xylene (TEX), and trichloroethene (TCE), as well as chromium and lead. Previous investigations found that nearly all of the groundwater contaminants were also present above local background levels in overlying on-site soils at various locations. This indicates that the source of the groundwater contamination beneath the Site included contaminated on-site soil. As noted above, soil remediation later targeted much of the shallow contamination, particularly metals.

The MIP/HPI report concluded that a relatively shallow elongated two- to four-foot-thick layer of source material that encompasses approximately 0.7 acres exists at the Site. The upper two feet of that source material contains high concentrations of VOCs and possibly limited immobile light non-aqueous phase liquid (LNAPL) that is contributing to local groundwater contamination at the Site.

The MIP/HPI report identified portions of the site where VOC contamination concentrations remain above NJDEP Groundwater Quality Standards (GWQS). In 2017, EPA contracted USACE to implement a pilot study to determine if ISCO would be an effective treatment option to address the remaining TEX and TCE concentrations in groundwater.

With the exception of total chromium in a single well (MW-9S), total lead and total chromium concentrations remained below NJDEP GWQS in groundwater before the ISCO pilot study. Total lead and total chromium concentrations are now above NJDEP GWQS primarily in portions of the site where ISCO injections were concentrated due to the oxidizing conditions created by the chemical that was injected, persulfate. There has been only one exceedance of NJDEP GWQS for metals (chromium) in April 2021 in a series of four sentinel wells located at the edge of the Cosden property. There have been no exceedances, for metals or VOCs, in the off-property wells during the ISCO pilot study, indicating there is not a migration of metals off of the Cosden property (EPA, 2022). According to USACE's "Cosden Bench-Scale In Situ Oxidation Test Summary" (2017), these metal concentration increases due to ISCO are typically transitory and will re-equilibrate so that the metal concentrations will return to the pre-injection state. This is further supported in the article "Release of Chromium from Soils with Persulfate Chemical Oxidation" (Kaur and Crimi, 2013) which concludes that releases of chromium from soils due to persulfate treatments are expected to be "transient and localized to the treatment area where extremely high oxidizing conditions exist during ISCO treatment. Downgradient of the treatment area where concentration of persulfate and amendment decreases because of dilution and degradation, the effect on chromium release will be minimal."

1.2.4 Contaminant Fate and Transport

The revised conceptual Site model for soil and groundwater includes a fairly uniform layer of soil impacted largely by xylenes. This layer ranges from 20-24 feet deep and two to four feet thick; however, most of the contamination is located in the interval of 20-22 feet below ground surface (bgs). In addition, there does not appear to be a significant zone of contaminated soil above or below the static water level commonly known as the "smear zone". The contaminated layer is thought to have resulted from a spill or spills of solvent waste composed mostly of xylenes with some toluene and ethylbenzene.

Some evidence suggests that a shallow lower permeability unit could be present, resulting in a shallow perched water-bearing unit in some portions of the Site, but well and soil boring logs have not shown a continuous lower permeability unit. It appears that in limited areas, high concentrations of VOCs or limited immobile solvent material could be sorbed to soil particles beneath the water table particularly in the area where the Cosden production plant underground storage tanks existed.

One explanation for the location (depth) of the residual contamination is that during a period(s) of low groundwater table, such as that seen on 9/25/2002 (URS, 2005), residual contamination migrated downward perhaps through a gap in a thin confining unit into a more permeable lens of silty sand. The contamination then spread laterally, moving mostly in a northwest/southeast direction. A subsequent rise in groundwater elevation has left the contamination trapped in this thin layer, where it now impacts groundwater.

In December 2021 and January 2022, and as part of this FFS effort, USACE completed TEX contaminant plume modeling to evaluate the impact of source treatment (ISCO) on plume stability. Modeling results are included as Appendix A. The modeling approach used the reactive transport code RT3D (Clement, 1997), with Site data and simplifying assumptions to model how TEX concentrations in groundwater would change with reductions in source area TEX concentrations. Model results showed that a reduction in source area concentrations resulted in a smaller dissolved-phase plume (see Appendix A: Figures 1-11). Conclusions of the modeling include:

- Model results in terms of stabilized plume extent were shown to be sensitive to assumptions of hydraulic conductivity and recharge (via dissolved oxygen [DO] and recharge rate).
- Lower DO concentrations in both the ambient, upgradient groundwater, and recharge water could result in a more extensive stabilized plume.
- Variations in porosity and reaction parameters over the ranges tested did not have an appreciable impact on the extent of the stabilized plume.
- Remediation technologies that are designed to reduce source area concentrations may result in a smaller and more stable dissolved-phase plume.

The uncertainties of the model results include:

- How subsurface heterogeneities affect the fine-scale contact between ISCO oxidant and contaminants, and therefore the effectiveness of such a remedy at treating the source area.
- How many ISCO injections, or how long a treatment plant would need to run, in order to achieve source reductions like those in the model.
- The possibility of an additional source area near monitoring well MW-110 (see Figures 2 and 3), west of the main source area. High concentrations (~35,000 µg/L in October 2020) have been observed at MW-110 (Figure 3, Area C). This model was designed for a single source area and was not used to model a source near MW-110.

Figures showing these modeling results are also included in Appendix A.

Risk Assessment – The 1992 Human Health Risk Assessment conducted as part of the remedial investigation indicated that ingestion of contaminated groundwater in a future residential use scenario posed an elevated risk to human health. The hazard indices calculated in the risk assessment were 16 for children and 11 for adults which exceed the EPA’s noncancer hazard index (HI) of 1. Residential adult ingestion of groundwater as drinking water yielded a cancer risk of $3x10^{-4}$, exceeding EPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$ as well. Additionally, concentrations of toluene, ethylbenzene, xylene, trichloroethene, chromium, and lead in groundwater were reported in excess of promulgated federal and/or state Maximum Contaminant Levels (MCLs) and the New Jersey GWQS.

2.0 IDENTIFICATION OF SCREENING TECHNOLOGIES

2.1 INTRODUCTION

The purpose of this section is to present the development of remedial action objectives and to identify, screen, and present the most appropriate technologies to address contamination at the Site. Candidate technologies are specific remedial processes, systems, or methods that, either alone or in combination with other technologies, may potentially comprise a remedial action. Candidate technologies considered in this FFS include processes that have been demonstrated to be capable of mitigating impacts to human health and the environment from contaminants in groundwater.

2.2 REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) are site-specific statements that convey the goals for minimizing or eliminating risks to public health and/or the environment posed by contamination at the Site.

RAOs provide the basis for the development of remedial action alternatives and specify what the cleanup action will accomplish. The process of identifying the RAOs follows the identification of affected media and contaminant characteristics and evaluation of exposure pathways, contaminant migration pathways, and exposure limits to receptors.

To achieve RAOs, preliminary remediation goals (PRGs) are developed as the quantitative goals used for the technology screening process and the development and detailed evaluation of alternatives as described below.

The following additional RAO identified for the Site is:

- Reduce contaminant mass in the source area such that the maximum dissolved-phase concentration of xylene is lowered between 97-98 percent.

Preliminary Remediation Goals

To achieve RAOs, PRGs are developed based on federal-or state-promulgated ARARs, human health risk-based levels, ecological risk-based levels, and comparison to the background concentrations, with consideration given to other factors such as analytical detection limits, guidance values, and other pertinent information.

The 1992 feasibility study included a comparison of the average contaminant concentrations in groundwater against ARARs and risk-based cleanup levels. The ARARs used in that comparison were the federal Safe Drinking Water MCLs and the NJDEP GWQS.

For the purposes of this FFS the following PRGs have been identified for groundwater at the Cosden Site:

Groundwater Preliminary Remediation Goals

Contaminant of Concern	Remediation Goal (µg/L)
Toluene	600
Ethylbenzene	700
Xylenes, (Total)	1,000
Trichloroethylene (TCE)	1
Chromium, (Total)	70
Lead (Total)	5

Potential Applicable or Relevant and Appropriate Requirements (ARARs)

CERCLA and the NCP require that on-site remedial actions attain or waive federal and state ARARs. The potential ARARs for this site are shown in Appendix B. Along with the protection of human health, attainment of ARARs is one of the threshold criteria in the NCP.

Definition of ARARs Under CERCLA

A federal- or state-promulgated requirement may be either “applicable” or “relevant and appropriate” to a site-specific remedial action but not both. If a federal- or state-promulgated requirement is determined to be either “applicable” or “relevant and appropriate,” compliance with the substantive requirements of that ARAR must be attained unless a waiver is justified. Only state standards that are promulgated, identified by the state in a timely manner, and more stringent than federal requirements may be applicable or relevant and appropriate. For purposes of identification and notification of promulgated state standards, the term promulgated means that the standards are of general applicability and are legally enforceable.

“Applicable” and “relevant and appropriate” requirements are defined in the NCP at 40 CFR §300.5.

Applicable Requirements - Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site.

Relevant and Appropriate Requirements - Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site.

Determining whether a requirement is relevant and appropriate is a two-step process that includes: (1) the determination that the requirement is relevant and (2) the determination that the requirement is appropriate. In general, this involves a comparison of a number of site-specific factors, including an examination of the purpose of the requirement and the purpose of the proposed CERCLA action, the medium and substances regulated by the requirement and those involved in the proposed remedial action, and the potential use of resources addressed in the requirement and the remedial action. When the analysis results in a determination that a requirement is both relevant and appropriate, such a requirement must be compiled with to the same degree as if it were applicable (EPA 1988).

Advisories, criteria, or guidance "to be considered" ("TBCs" or "TBC Criteria") - TBCs are federal and state criteria, advisories or guidance that are not generally enforceable but that may be useful in developing CERCLA remedies. TBCs may be used to determine the necessary level of remediation to be protective of human health and/or the environment where no specific ARARs exist for a chemical or situation or where such ARARs are not sufficient to be protective. There is more agency discretion in identifying TBCs as there are no prescribed factors in the NCP for evaluating such materials. If a TBC is utilized as the basis for development of a remedial goal, once incorporated into the remedy selection, it becomes an enforceable part of the remedy and must be attained.

Classification of ARARs-Three classifications of requirements are defined by EPA in the ARAR determination process: chemical-, location-, and action-specific. Additionally, TBC criteria are also evaluated. TBC criteria are not federally enforceable standards but may be technically or otherwise appropriate to consider in developing site- or media-specific PRGs.

Chemical-specific ARARs and TBCs are usually health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. They may also define acceptable exposure levels for a specific contaminant in an environmental medium. They may be actual concentration-based cleanup levels, or they may provide the basis for calculating such levels. Examples of chemical-specific ARARs are PCB cleanup values for soils under the Toxic Substances Control Act (TSCA) or MCLs specified for public drinking water that are relevant and appropriate to groundwater aquifers used for drinking water.

Appendix B, Table B-1 summarizes the chemical-specific ARARs and TBC criteria for this Site and their considerations for this FFS.

Location-Specific ARARs

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in certain locations. Examples include restrictions or requirements for response activities performed in a floodplain, a wetland, or a historic site. Location-specific criteria can generally be established early in the RI/FS process. As presented in Table B-2 in Appendix B, the only Location-Specific ARAR identified for the Site is its location in the Coastal Plain Sole Source Aquifer.

Action-Specific ARARs and TBC Criteria

Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous substances and may include performance, design, or other similar action-specific controls and restrictions for particular remedial actions. Potential action-specific ARARs are considered in the screening and evaluation of various technologies and process options in subsequent sections of this report. Examples include requirements for construction of extraction, monitoring and injection wells.

Remedial activities typically generate at least a small amount of solid waste which is identified as an ARAR and will be disposed in accordance with the regulations. While it is not anticipated that conducting any of the remedial alternatives will generate hazardous waste, the safe handling, storage, treatment, and/or transportation of hazardous waste are listed as ARARs with the prerequisite as Relevant and Appropriate. However, the relevant and appropriate sited regulations are not applicable unless the waste generated is analytically characterized as hazardous. Table B-3 in Appendix B summarizes the potential ARARs and one TBC (noise) for the remedial alternatives identified in this FFS.

Under CERCLA Section 121(d), the remedial action alternatives developed in subsequent sections of this FFS are required to attain applicable federal and state ARARs unless a waiver can be justified. CERCLA Section 121(d)(4) identifies six circumstances under which ARARs may be waived:

- The remedial action is an interim measure where the final remedy will attain the ARAR upon completion.
- Compliance with the ARAR will result in greater risk to human health and the environment than other options.
- Compliance with the ARAR is technically impracticable.

- An alternative remedial action will attain an equivalent standard of performance using another method or approach.
- The ARAR is a state requirement that the state has not consistently applied (or demonstrated the intent to apply consistently) in similar circumstances.
- For Superfund-financed remedial actions, compliance with the ARAR will not provide a balance between protecting human health and the environment and the availability of Superfund money for response at other facilities.

2.3 GENERAL RESPONSE ACTIONS

CERCLA and the NCP require that each selected site remedy be protective of human health and the environment, be cost effective, comply with other statutory laws, and utilize permanent solutions, alternative treatment technologies, and resource recovery alternatives to the maximum extent practicable. In addition, the NCP includes a preference for the use of treatment as a principal element for the reduction of toxicity, mobility, or volume of the hazardous substances.

General Response Actions that are considered to be applicable and capable of achieving the site-specific RAOs include:

- Removal/Treatment; and
- In Situ Treatment

2.4 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

This Section presents the identification and screening of technology types and process options. For the purposes of this FFS, the technology types have been limited to and focused on the General Response Actions presented in Section 2.3.

2.4.1 Identification and Screening of Technologies

Since this is a focused feasibility study, it is focused on three specific candidate remedial technologies based on the Site history, impacted media, and contaminants. The three candidate remedial technologies associated with the General Response Actions are presented in the table below:

General Response Action	Candidate Remedial Technologies
Removal/Treatment	Groundwater Extraction and Treatment
In Situ Treatment	In Situ Chemical Treatment

Groundwater Extraction and Treatment:

Groundwater extraction and treatment is a common remedial technology for cleaning up groundwater contaminated with volatile organic compounds (VOCs), metals, fuel oil, and/or other industrial chemicals. Groundwater extraction and treatment systems involve pumping groundwater through extraction wells into a treatment system or a holding tank. If the groundwater contains different types of contaminants or high concentrations of a single contaminant, the treatment system may include several different remedial processes. Examples of remedial processes used in groundwater extraction and treatment systems include granular activated carbon, air stripping, and bioreactors.

In Situ Chemical Treatment:

In-situ chemical treatment options use various processes to degrade or breakdown contaminants in groundwater or soil. These physical and chemical treatment technologies are described below.

In Situ Chemical Oxidation (ISCO) chemically converts contaminants to less toxic compounds that are more stable, less mobile, and/or inert. It involves injecting a solution of oxidizing agent into the subsurface via an injection well or direct injection into the soil to treat dissolved-phased contaminants. The oxidizing agents most commonly used are ozone, hydrogen peroxide, potassium permanganate, hypochlorites, zero valent iron (ZVI), chlorine, and chlorine dioxide activated persulfate. ISCO can be a viable remediation technology as it is effective for mass reduction of organic compounds in groundwater, has a relatively rapid treatment time, and is implementable with commercially available equipment. There are safety requirements for handling and administering large quantities of hazardous oxidizing chemicals, a need to monitor the fate and transport of the chemicals in the aquifer, and naturally occurring organic material in the formation that can consume large quantities of oxidant. The effective distribution of reagents in the treatment zone and the reactivity of a particular oxidant also needs to be monitored.

ISCO is an effective technology that involves delivering chemical oxidants into the contaminated medium such as subsurface soil and/or groundwater to destroy organic contaminants. ISCO can be applied in a variety of ways including through perforated metal rods hammered into the ground by direct push drilling methods or through injection wells. Oxidants are delivered as water-based solutions. These solutions are injected into the aquifer and then allowed to propagate by gravity and groundwater flow via advection, diffusion, and dispersion. As contaminants are encountered, the solutions oxidize the contaminants, breaking them down into non-toxic byproducts.

In Situ Chemical Reduction (ISCR) uses chemicals called “reducing agents” to help change contaminants into less toxic or less mobile forms. Similar to ISCO, it is described as “in situ” because it is conducted in place, without having to excavate soil or pump groundwater above ground for cleanup. ISCR can clean up several types of contaminants dissolved in groundwater. ISCR is most often used to clean up the metal chromium and the industrial solvent trichloroethene (TCE).

Other in-situ treatment technologies exist, such as biological remediation (bioremediation, bioventing, phytoremediation), thermal treatment, and additional physical and chemical treatments (SVE, soil flushing, and additional chemical oxidants) (EPA, 2006).

2.4.2 Evaluation of Technologies and Selection of Representative Technologies

Groundwater Extraction and Treatment:

Groundwater extraction and treatment systems involve the extraction of contaminated groundwater for subsequent treatment and prevention of contaminant migration.

The remedial action at the Site includes a groundwater treatment system. The system is still present, but not operating. In July 2006, construction of the treatment facility was initiated, and construction was completed in July 2007. The system was certified in 2009, and the LTRA period began in July 2009. Contaminated groundwater was pumped from the subsurface through two extraction wells, identified as RW-1 and RW-2, and conveyed to the treatment system, which is located within a dedicated building on the Site. The treatment system includes a pretreatment system for metals (and some VOCs), removal by addition of hydrogen peroxide, and multi-media filtration. The water then passes through two granular activated carbon (GAC) vessels, in series, to remove VOC contamination. The treated water then is routed to a tank for filter and GAC vessel backwashing or discharged to the reinjection trenches. The reinjection trenches consist of two banks and each bank contains two trenches, for a total of four possible reinjection trenches. Solids from the treatment process are sent through an inclined plate clarifier and sludge thickening tank and then go through a filter press for off-site disposal.

In addition to the groundwater extraction and treatment system, three banks of SVE wells and collection lines were installed to collect contaminated vapors from the vadose zone. In June 2010, the SVE system was shut down because soil vapor contaminants in the vadose zone were reported at concentrations below levels requiring treatment. The SVE system and the groundwater extraction and treatment system were operated separately. The SVE equipment is housed in a separate building on-site, and the wells and collection lines of the SVE system are not mechanically connected to the groundwater extraction and treatment system.

The groundwater extraction and treatment system technology is retained for evaluation in this FFS since it has been an effective remediation technology at the Site.

In Situ Chemical Oxidation- In August 2017, an ISCO Pilot Study was initiated to determine whether the existing groundwater remedy could be optimized to remove remaining hydrocarbon contamination consisting of TEX and TCE from the subsurface. The Pilot Study was conducted in two phases. Each phase included two rounds of injections (locations provided in Appendix C). The first round of Phase I injections was performed between January and March 2018. Phase 1 involved the injection of sodium persulfate oxidant and sodium hydroxide activator into 63 injection points covering an area approximately 50% of the estimated groundwater plume. The second round of Phase 1 injections included 63 injection points and was performed between November and December 2018 and January 2019.

The first round of Phase 2 (Phase 2A) injections was performed between November 2019 and January 2020 and included 76 injection points. The second round of Phase 2 (Phase 2B) injections was performed in October/November 2020 and included 40 injection points. After each injection in both Phases, EPA evaluated the performance and determined improvements that resulted in an optimization of the next injection.

During the ISCO Pilot Study, multiple rounds of soil and groundwater sampling were performed. The results of the Pilot Study indicate that the four rounds of ISCO injections were successful in eliminating or reducing TEX and TCE groundwater concentrations within the target treatment areas.

Prior to the ISCO pilot study, groundwater results indicated the shallow plume contained elevated TEX concentrations at three areas of concern. The first and largest source area (Area A) was south of the groundwater treatment plant and included five wells (MW-100, MW-103, MW-104, MW-105, and MW-109). Total xylene and ethylbenzene detections in all of these wells were greater than 1,000 µg/L at the end of the pilot study, and Area A contained the highest total xylene concentration in well MW-103 (37,400 µg/L). During baseline sampling in November 2017, the highest total xylene concentration in Area A was reported for well MW-103 at 87,000*J* µg/L. In general, toluene concentrations in all wells were much lower than ethylbenzene and total xylene concentrations and were often non-detect. The highest toluene result was reported at MW-110 and the second highest at MW-103.

The second source area of concern (Area B) was near wells MW-3 and MW-111, southwest and south of the SVE building, respectively. Total xylenes were detected up to 1,800*J* µg/L in MW-3. during the pilot study. Total xylenes at MW-111 were less than 1 µg/L in May 2021, as compared to the February 2019 xylenes concentration of 15,800 µg/L and ethylbenzene concentration of 3,000 µg/L.

The third source area (Area C) was west of the SVE building and centered on well MW-110. During baseline November 2018 monitoring, total xylenes were detected at 114,000 µg/L, ethylbenzene at 25,200 µg/L, and toluene at 3,220 µg/L. at MW-110. The November 2018 toluene concentration for MW-110 was the highest result among all groundwater samples collected during the study. At the end of the pilot study, total xylenes were detected at 23,800 µg/L in March 2021. Wells located downgradient of MW-110 did not reveal elevated TEX concentrations and many values were non-detect.

TEX groundwater concentrations decreased during the study at nearly all wells. Notably, total xylenes decreased at well MW-103 from 87,000*J* µg/L to 37,400 µg/L and ethylbenzene decreased from 20,000 µg/L to 6,500 µg/L from November 2017 to May 2021. During the same period, total xylenes for MW-105 decreased from 59,000 µg/L to 5,160*J* µg/L and ethylbenzene showed a similar decrease. In addition, concentrations of TEX at wells MW-106, MW-107, and

MW-110 exhibited a greater than 50% decline. There were exceptions to the overall TEX concentration decreases for two wells (MW-104 and MW-112). The TEX increases for these two wells may be due to the ISCO-related dislodged pockets of highly contaminated groundwater migrating toward these wells, or due to the proximity of TEX contaminated groundwater in nearby wells that were unaffected by ISCO treatment (i.e., low permeability of soils at the wells), or both.

The estimated areal extent of the contaminated source plume was reduced by roughly 73% as a result of ISCO treatments. This area was determined using the change in average total xylene concentrations and the total xylene plume area greater than the New Jersey Groundwater Quality Standard of 1,000 µg/L. The plume was estimated to be 33,500 ft^2 prior to injections and about 9,000 ft^2 post-injection.

Based on the success of the Pilot Study, ISCO is retained as a remedial technology for further evaluation in this FFS. However, while ISCO is a known effective remedial technology for the TEX contaminants on-site, ISCO will not treat metals. In fact, ISCO commonly oxidizes metals such as chromium. As reported in Section 1.2.3, groundwater data collected at the site has indicated increased concentrations of chromium and lead since the ISCO pilot study was initiated. Recent sampling has confirmed the presence of hexavalent chromium as well. Despite this occurrence, the oxidized state of the soils is expected to be transitory. Once the soils revert to reducing conditions, oxidized metals such as hexavalent chromium can become reduced and in the case of hexavalent chromium it will revert to trivalent chromium. If the metal concentrations remain elevated once the ISCO injections are completed, EPA may consider additional injection treatments to address them.

3.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

The purpose of the Development and Screening of Alternatives step is to identify the remedial technologies worthy of undergoing detailed evaluation. For the purposes of this FFS, this step will be abbreviated and focused only on those remedial technologies identified in Section 2 of this report.

3.1 DEVELOPMENT OF ALTERNATIVES

Remedial alternatives have been assembled from the remedial technology/process options retained in Section 2.4. They include:

- Alternative 1 - Groundwater Extraction and Treatment
- Alternative 2 – In Situ Chemical Treatment

Alternatives 1 and 2 would include the following common elements:

- Institutional controls, including establishing an NJDEP Classification Exception Area (CEA)
- Long-term monitoring program to assess the concentrations of COCs over time
- Five-year reviews

3.2 SCREENING OF ALTERNATIVES

3.2.1 Introduction

The purpose of this section is to screen the remedial alternatives presented in Section 3.1. In this step, each of the alternatives is evaluated for the criteria of effectiveness, implementability, and cost. Later in the detailed analysis, alternatives are evaluated using additional criteria.

- Effectiveness: An important aspect of the screening process is to evaluate the effectiveness of each remedial alternative. Each alternative is evaluated to determine whether or not it will be effective in providing reduction in toxicity, mobility, or volume. Reduction of toxicity, mobility, or volume refers to changes in one or more characteristic of the contaminant or contaminated medium through the use of treatment that decreases the threat or risk associated with the contaminant. In some cases, the effectiveness criterion may outweigh the implementability and relative cost criteria.

- Implementability: Implementability refers to the ability to construct, operate, and maintain a remedial action alternative. This criterion considers both the technical and administrative feasibility of the technology or process option and includes evaluation of pretreatment requirements and residual management. Process options that are ineffective or unworkable at the Site are eliminated by this criterion. It also includes the ability to replace and monitor technical components of the remedial alternative. Administrative implementability refers to the ability to obtain approvals from other offices and agencies, the availability of treatment, storage, and disposal services, and the availability of specific equipment and technical specialists.

- Cost: At this stage of the screening process, the remedial alternatives may or may not be defined well enough to prepare detailed cost estimates. Therefore, the focus of cost estimates prepared at this stage are made for the purposes of comparative analysis and screening of the alternatives against one another.

3.2.2 Alternative #1 – Groundwater Extraction and Treatment

Description:

A Groundwater Extraction and Treatment system is currently located on the Site and was previously operated for approximately 8 years. The groundwater extraction and treatment system consists of two extraction wells, identified as RW-1 and RW-2 (Figure 2), that are connected to the treatment system that utilizes oxidation, filtration, and carbon adsorption to remediate the contaminated groundwater followed by reinjection of the treated groundwater through two infiltration galleries. Under this remedial alternative, a groundwater extraction and treatment system similar to the one previously operated at the Site would be used to reduce contaminant mass at the Site and maintain hydraulic control of impacted groundwater.

In addition to the groundwater extraction and treatment system, a separate Soil Vapor Extraction (SVE) was installed at the Site in 2009 and operated to extract contaminated vapors from the vadose zone. In June 2010, the SVE system was shut down because soil vapor contaminants in the vadose zone were reported at concentrations below levels requiring treatment. SVE is not included in the remedial alternative.

Evaluation:

Effectiveness – Groundwater data collected during the period of time that the groundwater extraction and treatment system was operated indicates that the groundwater extraction and treatment system effectively removed contaminants from the groundwater. As indicated earlier, the ground water extraction and treatment system is estimated to have treated 282,311,828 gallons of water since 2009 and removed approximately 13,000 pounds of total VOCs, demonstrating its effectiveness. Groundwater extraction and treatment systems can also help contain the plume by pumping contaminated water towards the wells. This pumping helps prevent contaminants from migrating off-site, reaching drinking water wells, wetlands, streams, and/or other natural resources.

Although this technology has proven to be effective, the length of time expected to meet the remediation goal using this technology would be significant. The effectiveness may be limited for the remaining contaminant mass since this remedy does not address the residual unsaturated subsurface soil contamination contributing VOCs to groundwater.

Implementability – The groundwater extraction and treatment system is located on the Site and could be restarted. Note that important changes in the Site conceptual model occurred after the extraction wells were installed. Therefore, studies and an updated design would be needed to replace/optimize the extraction wells. The existing equipment has been idle for four years and much may still be usable, but a detailed evaluation of the current state of the equipment would be required to determine how much new equipment would need to be purchased and installed.

The system was designed to treat the Site's known COCs, and additional studies and upgrades would be required to treat other contaminants.

Cost – Alternative 1 has a present value of $10.3 million ($10.3M). Detailed costs are provided in the next section, and in Appendix D. Capital and operational costs for this alternative are based on historical operations of the existing groundwater treatment system.

3.2.3 Alternative 2 – In Situ Chemical Treatment

Description:

As discussed in Section 2.4.2, an ISCO Pilot Study was performed to determine whether the existing groundwater remedy could be optimized to remove remaining TEX contamination. Under this remedial alternative, additional ISCO injections would be performed to further degrade the COCs. This technology is evaluated using ISCO Pilot Study data and information under the In-situ Chemical Treatment alternative since there is ample data to evaluate its overall characteristics with regard to the evaluation criteria. If necessary, ISCR injections would be conducted to reduce metals contamination to below PRGs. However, metal concentration increases due to ISCO are typically transitory and will re-equilibrate so that the metal concentrations will return to the pre-injection state (USACE, 2017 and Kaur and Crimi, 2013).

Evaluation:

Effectiveness – The results of the Pilot Study conducted at the Site indicate that the ISCO injections were generally successful in eliminating or reducing TEX concentrations in groundwater within the target treatment zones. The source area of the contaminated groundwater plume was reduced by approximately 73% by the four rounds of injections. Post-injection TEX analysis performed in October 2020 and May 2021 reported decreased concentrations in nearly all wells as compared to pre-injection (baseline) monitoring results reported in November 2017 (or compared to initial results for newly installed wells in November 2018). It is noted that increased concentrations of TEX were reported in three monitoring wells, MW-3, MW-104, and MW-112. However, metal concentration increases due to ISCO are typically transitory and will re-equilibrate so that the metal concentrations will return to the pre-injection state (USACE, 2017 and Kaur and Crimi, 2013).

Implementability – ISCO treatment is generally considered to be easy to implement utilizing readily available technologies. The success of the treatment is dependent upon the degree to which the oxidant solution comes in contact with the contaminants. Based on the success of the Pilot Study, it is believed that ISCO would be easy to implement at the Site based on the extensive ISCO Pilot Study that was completed at the site.

Cost – Alternative 2 has a present value of $1.4M. Detailed costs are provided in the next section, and in Appendix D. Costs to perform ISCO are based on information developed during the ISCO Pilot Study.

4.0 DETAILED ANALYSIS OF ALTERNATIVES

4.1 INTRODUCTION

This section presents a detailed evaluation of each remedial alternative presented in Section 3.0. The evaluation of the remedial alternatives is conducted with respect to the requirements identified in the NCP and EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA", October 1988 (RI/FS Guidance).

4.2 INDIVIDUAL ANALYSIS OF ALTERNATIVES

EPA's nine evaluation criteria address statutory and regulatory requirements and considerations for remedial actions in accordance with the NCP and additional technical and policy considerations that are important for selecting among remedial alternatives (EPA 1988). The following subsections describe the nine evaluation criteria used in the detailed analysis of remedial alternatives. remedial alternatives. Each of the proposed remedial alternative are screened against the nine evaluation criteria that have been developed to address the requirements of CERCLA and the NCP. The nine criteria are described below.

The first two criteria are referred to as Threshold Criteria. Any alternative that does not satisfy these criteria is no longer considered in the detailed analysis.

<u>Threshold Criteria</u>:

1. <u>Overall Protection of Human Health and the Environment</u>
   This criterion evaluates how well each remedial alternative protects human health and the environment and how well risks are eliminated, reduced, or controlled through treatment, engineering controls, and/or institutional controls.

2. <u>Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)</u>
   This criterion is used to determine whether or not each remedial alternative complies with ARARs.

The next five criteria are referred to as Balancing Criteria. These criteria are technical in nature and are used to make comparisons between the remedial alternatives.

<u>Balancing Criteria</u>:

3. <u>Long-Term Effectiveness and Permanence</u>
   This criterion addresses the results of the remedial action in terms of the risk remaining at a site after the remedial action objectives have been met. This criterion consists of two components including the magnitude of risk remaining at the end of the remedial activities and the adequacy and reliability of controls used to manage remaining waste

over the long term. Remaining waste may include untreated waste and/or treatment residuals.

4. Reduction in Toxicity, Mobility, or Volume of Contaminants Through Treatment
   This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the contamination. This preference is satisfied when treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media. This criterion evaluates several factors associated with each remedial alternative. These include the remediation process employed; the amount of contamination destroyed or treated; the degree of reduction expected in toxicity, mobility, or volume; and the type and quantities of residuals.

5. Short-Term Effectiveness
   This criterion addresses the effects of the remedial alternative during the construction and implementation phase until remedial action objectives are met. The components of this criterion include its effect on the community and on-site workers in terms of short-term risks, environmental impacts from implementation, and the time required to achieve protection.

6. Implementability
   This criterion addresses the technical and administrative feasibility of implementing a remedial alternative and the availability of various services and materials required during its implementation. Technical implementability considers construction and operational conditions and unknowns, reliability of the technology, ease of undertaking additional remedial action, and monitoring considerations. Administrative implementability considers activities necessary to coordinate with other offices and agencies for items such as obtaining permits or approvals for implementing remedial actions. Availability of services and materials refers to the availability of treatment, storage capacity, and disposal services, as well as the availability of necessary equipment and specialists and the availability of prospective technologies.

7. Cost
   This criterion considers costs associated with each remedial alternative. The types of costs to be considered include capital cost, annual operation and maintenance cost, cost of Five-Year Reviews, and potential future remedial action costs. Capital costs consist of direct and indirect costs. Direct costs include expenses for labor, equipment, and material necessary to install remedial actions. Indirect costs include expenses for engineering, financial, and other services necessary to complete the installation of the remedial action. Annual operation and maintenance costs include operating labor, maintenance materials, auxiliary materials, energy, disposal of residues, administrative, purchased services, insurance, taxes, licensing, rehabilitation, and periodic reviews.

This assessment evaluates cost on a present worth basis. Present worth analysis allows remedial alternatives to be compared on the basis of a single cost considering expenditures that occur over different time periods. The discount rate used to calculate the present worth estimate is 7%.

The final two criteria, for a total of nine criteria, are referred to as Modifying Criteria. These criteria are formally evaluated after the public comment period. Therefore, these two criteria are not discussed in the FFS.

Modifying Criteria:

8. State Acceptance
   State (support agency) acceptance is a modifying criterion under the NCP. Assessment of state acceptance will not be completed until comments on the final FFS report are submitted to EPA by the state. Thus, state acceptance is not considered in the detailed analysis of alternatives presented in the FFS.

9. Community Acceptance
   Community acceptance is also a modifying criterion under the NCP. Assessment of community acceptance will include responses to questions that any interested person in the community may have regarding any component of the remedial alternatives presented in the final FFS report. This assessment will be completed after EPA receives public comments on the proposed plan during the public comment period. Thus, community acceptance is not considered in the detailed analysis of alternatives presented in the FFS.

4.2.2 Alternative 1 – Groundwater Extraction and Treatment

4.2.1.1 Description:

The Groundwater Extraction and Treatment remedial alternative consists of groundwater collection, treatment, and reinjection of the treated groundwater. This alternative also includes a performance monitoring program. A groundwater extraction and treatment system was constructed at the Site and began operating in July 2009. Contaminated groundwater is pumped from the subsurface through two extraction wells, identified as RW-1 and RW-2, and conveyed to the treatment system, which is located within a dedicated building on the Site. The treatment system includes a pretreatment system for metals removal by addition of hydrogen peroxide and multi-media filtration. The water then passes through two GAC vessels, in series, to remove VOC contamination. The treated water then is routed to a tank for filter and GAC vessel backwashing or discharged to the reinjection trenches. The reinjection trenches consist of two banks and each bank contains two trenches for a total of four possible reinjection trenches. The system was shut down in June 2018 due to aging equipment and the performance of the ISCO Pilot Study.

4.2.1.2 Assessment

Overall Protection of Human Health and the Environment

Alternative 1 has successfully removed COCs from the groundwater and could likely control and/or eliminate off-site migration of contaminated groundwater. The treatment system is capable of removing COCs from the groundwater to meet ARARs and be reinjected into the aquifer. Ultimately, this Alternative would result in protection of human health and the environment.

Compliance with ARARs

The technologies associated with Alternative 1 are industry and regulatory recognized methods for removing COCs from groundwater. The pretreatment system has proven to be effective at removing metals from the groundwater and the GAC treatment has been shown to be effective at removing VOCs from the groundwater to below federal and state groundwater quality standards, which are the ARARs for this Site. This remedial alternative, which includes groundwater extraction and treatment, is considered to be able to achieve compliance with ARARs.

Long-Term Effectiveness and Permanence

The effects of Alternative 1 include the incremental removal of the COCs from the aquifer and long-term minimization of contaminant migration. The extracted groundwater would be treated to concentrations below groundwater cleanup standards prior to reinjection. Although the groundwater extraction and treatment system was shut down in 2018, it is expected that continued operation would achieve long-term effectiveness. It is estimated that groundwater extraction and treatment would take 30 years or more to address the remaining contamination; historical data at other sites show that treatment of this type typically require this timeframe to reach cleanup goals. Site conditions, including the likely presence of residual LNAPL and contamination trapped in lower hydraulic conductivity areas, may limit the treatment plant's ability to reach contaminants. However, new extraction wells designed with optimal horizontal and vertical placement targeting the high-concentration area and depth would increase the effectiveness of this alternative. Additionally, natural degradation in the subsurface would occur simultaneously with treatment, adding to the overall destruction of COCs.

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

Alternative 1 offers significant reduction of toxicity, mobility, and volume of COCs by removing and treating contaminated groundwater from the aquifer. During the treatment process, contaminants are removed from the groundwater by chemical precipitation and filtration in the pretreatment stage and carbon adsorption in the treatment stage. Although wastes, in the form of sludge and spent carbon, are generated in the groundwater extraction and treatment process, this remedial alternative is considered to be effective at reducing toxicity, mobility, or volume of contaminants in the subsurface.

As described in Section 1.2.4 and Appendix A, modeling showed that reducing source area TEX concentrations resulted in reduced groundwater concentrations. Groundwater extraction and treatment focused in the source area is one feasible alternative for reducing source area concentrations in order to reduce dissolved phase concentrations and reduce the size of the dissolved phase plume.

The system was designed to treat the Site's known TEX COCs, with pre-treatment for metals. Additional studies and upgrades would be required to treat other compounds such as emerging contaminants if such contaminants were found to be present at the Site.

Short-Term Effectiveness

Alternative 1 is considered moderately effective in the short-term at reducing COCs to below the Site ARARs, as It is estimated that groundwater extraction and treatment would take 30 years or more to address the remaining contamination. Alternative 1 poses limited short-term risks during the implementation of this remedy since the groundwater extraction and treatment system already exists on the Site. Potential short-term risks to the system operators would be from direct contact with contaminated groundwater or inhalation of vapors from leaks or accidental discharges from the groundwater treatment system. Other risks to the operators would be from improper handling of reagent chemicals. However, these short-term risks can be mitigated by training and review of the existing site treatment plant operations and maintenance manual, as well as the use of appropriate process control such as automatic alarms and shutdown switches. Risks to the community are expected to be minimal and limited to traffic during construction upgrades and transportation of treatment residuals. No adverse environmental impacts are expected from this Alternative.

Implementability

Technical Implementability - The groundwater extraction and treatment system was shut down in 2018. However, the building, tanks, treatment equipment, extraction wells, and reinjection trenches are still located on the Site and could be used again. However, a previous evaluation by USACE indicated the following significant upgrades would be needed to continue operations:

- SCADA upgrades (software and hardware)
- Multi-media filtration system replacement
- Additional extraction wells

An updated assessment would be required prior to implementing this remedy to account for any changes or degradations to the system during the inoperable period.

Administrative Implementability – Alternative 1 requires administrative management including permit and permit equivalencies, monitoring, reporting, and preparation of administrative documentation. Frequent reviews to assess the effectiveness of this Alternative regarding contaminant concentration reduction and to assess whether alterations in the treatment process are necessary. Although these administrative duties may be significant, they are implementable.

Cost

This Alternative 1 has a total present value of $10,322,320 (Appendix D).

Capital costs are estimated at $555,650. These costs include document and plan updates, SCADA upgrades, replacement of media in both the multi-media and carbon filters, 2 new extraction wells, start-up costs, and $75,000 for general repairs.

Annual operation and maintenance costs are estimated at $787,000, including costs for utilities, materials, operator labor, and USACE labor (oversight and contracting). Annual monitoring costs are estimated at $40,000, including two rounds of groundwater sampling and one annual report.

The present value of the total annual operations and monitoring costs over a 30-year period were calculated using a 7% discount rate (calculations shown in Appendix D). The present value of operations cost is $9,270,270, and the present value of monitoring cost is $496,400, for a total of $9,766,670. With capital costs, this yields a total of $10,322,320.

Additional costs are anticipated if upgrades were desired to enable treatment of other compounds, such as emerging contaminants like Per- and Polyfluoroalkyl Substances (PFAS).

4.2.2 Alternative 2 – In Situ Treatment

4.2.2.1 Description

In-situ chemical treatment includes ISCO which utilizes oxidants to transform harmful contaminants into less toxic byproducts. At the Site, the ISCO Pilot Study involved the injection of sodium persulfate oxidant and sodium hydroxide activator into the subsurface to determine whether the existing groundwater remedy could be optimized to remove remaining hydrocarbon contamination consisting of TEX and other TCL organic constituents from the subsurface. This remedial alternative would involve several rounds of additional ISCO injections followed by sampling following each injection event. Additional studies would need to be performed to evaluate if additional injection treatment, such as ISCR, could be used to address the metals at the Site. However, metal concentration increases due to ISCO are typically transitory and will re-equilibrate so that the metal concentrations will return to the pre-injection state (USACE, 2017 and Kaur and Crimi, 2013).

4.2.2.2 Assessment

Overall Protection of Human Health and the Environment

The ISCO Pilot Study concluded that the ISCO injections were generally successful at eliminating or reducing TEX concentrations within the targeted treatment zones. Alternative 2 will remove COCs from the groundwater and the pilot study indicates that the alternative will control and/or eliminate off-site migration of contaminated groundwater. Thus, the pilot study indicates that ISCO will be able to remove COCs from the groundwater to meet federal and state standards. Ultimately, this Alternative would result in protection of human health and the environment.

Compliance with ARARs

Alternative 2 provides recognized technology that has been successful at eliminating or reducing primary COCs (TEX) concentrations in source areas of the Site below their respective PRGs at the Cosden Site though contamination still remains above PRGs in some areas. The objective of the ISCO Pilot Study conducted at the Site was to determine whether injections of sodium persulfate oxidant and sodium hydroxide activator could eliminate or reduce TEX concentrations in groundwater by destroying source material.

Groundwater monitoring will be conducted following future in-situ injections, and it is anticipated that injections and injectants can be optimized to eliminate or reduce TEX to below PRGs which would result in compliance with TEX-related ARARs.

However, metal concentration increases due to ISCO are typically transitory and will re-equilibrate so that the metal concentrations will return to the pre-injection state (USACE, 2017 and Kaur and Crimi, 2013).

Long-Term Effectiveness and Permanence

The effects of Alternative 2 include the degradation/destruction of source material and removal of the primary COCs from the aquifer along with long-term minimization of contaminant migration. The remediation would be conducted until concentrations of COCs are equal to or below PRGs.

As described in Section 1.2.4 and Appendix A, modeling showed that reducing source area TEX concentrations resulted in reduced groundwater concentrations. ISCO injections focused in the source area are a feasible alternative for permanently reducing source area concentrations in order to reduce dissolved phase concentrations and reduce the size of the dissolved phase plume.

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

Alternative 2 offers significant reduction of toxicity, mobility, and volume of TEX COCs by treating contaminated groundwater, as well as subsurface soil, in-situ. The injected oxidant will contact subsurface soil that are acting as a source of the contamination and will also alter the chemical composition of the contaminants resulting in a reduction of toxicity, mobility, and volume of the COCs. This is substantiated by the data obtained during the ISCO Pilot Study which indicated that TEX concentrations in groundwater decreased during the study at nearly all wells.

Notably, total xylenes decreased at well MW-103 from 87,000*J* µg/L to 37,400 µg/L and ethylbenzene decreased from 20,000 µg/L to 6,500 µg/L from November 2017 to May 2021. During the same period, total xylenes for MW-105 decreased from 59,000 µg/L to 5,160*J* µg/L and ethylbenzene showed a similar decrease. In addition, concentrations of TEX at wells MW-106, MW-107, and MW-110 exhibited a greater than 50% decline.

This alternative alone, without ISCR or other remedies, does not treat metals. However, metal concentration increases due to ISCO are typically transitory and will re-equilibrate so that the metal concentrations will return to the pre-injection state (USACE, 2017 and Kaur and Crimi, 2013). Thus, this alternative is predicted to result in metal concentrations that comply with ARARs.

Short-Term Effectiveness

Alternative 2 is effective in the short term at reducing COCs below the Site ARARs. Results of the 2018-2020 ISCO pilot study were used to estimate the number of injections needed to reduce concentrations of total xylenes to below 1,000 µg/L. The pilot study report (TetraTech, 2021) presented that the areal extent of contamination was reduced by approximately 75% after four rounds of injections.

For this time to cleanup analysis, it was assumed that current concentrations of total xylenes (as reported in May 2021) will be reduced by 75% after every four injections. This analysis yielded an initial estimate of 11 injections to reduce total xylenes concentration of 37,400 µg/L to 1,000 µg/L. However, only a small portion (~0.07 acres) of the plume has concentrations of total xylenes at this high level. This estimate was therefore reduced to three full-scale injection rounds (25 injection locations over .75 acres, as in the pilot study injection rounds), followed by two reduced-area injection rounds (10 injection locations over 0.13 acres) targeting the remaining high-xylene areas of the plume. The below table shows the data used in this analysis:

May 2021 Total Xylenes (C_0, µg/L)	Source Area (acres)	Injections
>1,000	0.75	3
> 2,500	0.13	5
> 5,000	0.071	7
> 20,000	0.035	9
> 35,000	0.013	11

Alternative 2's active ISCO remediation would take approximately five years, assuming one ISCO round per year.

All residents in the Site vicinity are currently connected to a municipal supply thus interrupting potential exposure.

Groundwater monitoring during and after injection rounds would determine if additional treatment of the highest-xylene areas was necessary following these five ISCO injection rounds. Institutional controls, such as groundwater use restrictions, could also be implemented to mitigate any risk of exposure to remaining contaminated groundwater.
In addition, monitoring should be used to assess the potential for re-bound in VOC concentrations after the ISCO injections have been completed and to determine if the metals concentrations have re-equilibrated. If the VOC concentrations have re-bounded or the metal concentrations have not re-equilibrated, additional injection treatment remedies could be considered. Downgradient, sentinel wells are present at the edge of the property and can be monitored to determine if there is a migration of metals off of the property, which would be consistent with the recommendations in "Guidance Document: Assessing the Potential for Metals Mobilization During the Application of In Situ Chemical Oxidation Technologies" (Gardner et al., 2015) for including a metals mobilization contingency plan as a component of the ISCO design.

There are limited short-term risks associated with Alternative 2. Potential short-term risks to the ISCO technicians would be from direct contact with contaminated groundwater or from improper handling of injectants which are initially in powder and liquid form. However, these short-term risks can be mitigated by training, the use of engineering controls, and the use of personal protective equipment. Risks to the community are expected to be minimal to non-existent. No adverse environmental impacts are expected from this Alternative.

Implementability

Technical Implementability – Alternative 2 technologies are easy to implement and can be directed to specific target zones within the contaminated area. There are no significant implementability issues associated with ISCO.

Administrative Implementability – Alternative 2 will involve administrative management tasks, obtaining permit equivalencies, monitoring, reporting, and preparation of administrative documentation. Monitoring to assess the effectiveness of this Alternative regarding contaminant concentration reduction and to assess whether alterations in the treatment/injection process are necessary. The administrative duties are implementable.

Cost

This Alternative 2 has a total present value of $1,409,900 (Appendix D).

Capital costs are estimated at $913,500. These costs include document and plan updates, 2 additional monitoring wells, mobilization and injection costs for 5 rounds of injections, monitoring during injections, reporting, and USACE labor (oversight and contracting).

Annual long-term monitoring costs after the conclusion of injections are estimated at $40,000, including two rounds of groundwater sampling and one annual report. The present value of monitoring costs over a 30-year period were calculated using a 7% discount rate (calculations shown in Appendix D), for a total of $496,400. With capital costs, this yields a total of $1,409,900.

If the total monitoring cost of Alternative 2 over 30 years was calculated linearly (i.e., annual cost*number of years=total cost), the total monitoring cost would be $1.2M. This added to the capital costs yields a total cost of $2.1M.

4.3 COMPARATIVE ANALYSIS

The results of the detailed evaluation were used in this subsection to conduct a comparative analysis of Alternatives. Comparisons are presented in a qualitative manner and attempts to identify substantive differences between the Alternatives.

Overall Protection of Human Health and the Environment

Both Remedial Alternatives 1 and 2 would provide equal protection of human health. The exposure pathways to human receptors would be eliminated by restrictions placed on the use of groundwater within the area of groundwater contamination.

Compliance with ARARs

Both Remedial Alternatives 1 and 2 can achieve compliance with ARARs.

Alternative 2, in-situ treatment involving ISCO, would achieve compliance with TEX-related ARARs significantly sooner than Alternative 1, groundwater extraction and treatment. The time period to attain ARARs for Alternative 2 is estimated at 5 years, and the time period to attain ARARs for Alternative 1 is estimated at 30 or more years.

For metals, Alternative 1 is a suitable treatment for metals in order to comply with ARARs. Though Alternative 2 will not treat metal concentrations, metal concentration increases due to ISCO are typically transitory and will re-equilibrate so that the metal concentrations will return to the pre-injection state (USACE, 2017 and Kaur and Crimi, 2013). Thus, Alternative 2 is expected to comply with ARARs.

Long-Term Effectiveness and Permanence

Alternatives 1 and 2 both have the potential for long-term effectiveness and permanence. However, Alternative 2 is estimated to attain ARARS in a significantly shorter time period than Alternative 1 (5 years compared to 30 or more years).

Remedial Alternative 1 achieves long-term effectiveness primarily by preventing off-site migration by pumping. The time it takes for Alternative 1 to remove contaminants from the groundwater and reduce risk is limited by the extraction rates from the aquifer and diffusion of contaminants from the source material into the groundwater. This alternative is expected to take a considerable amount of time to achieve long-term effectiveness.

The technology utilized in Alternative 2, direct injection, will treat groundwater in-situ and will achieve long-term effectiveness in a shorter amount of time, 5 years, as compared to Alternative 1.

For metals, Alternative 1 is a suitable treatment for metals in order to comply with ARARs. Though Alternative 2 will not treat metals concentrations, metal concentration increases due to ISCO are typically transitory and will re-equilibrate so that the metal concentrations will return to the pre-injection state (USACE, 2017 and Kaur and Crimi, 2013). Thus, Alternative 2 is expected to comply with ARARs.

Although residents in the Site vicinity are currently connected to a municipal drinking water supply, institutional controls, such as groundwater use restrictions, could be used to prevent the installation of any private wells during the implementation of both Alternatives 1 and 2.

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

Both Remedial Alternatives 1 and 2 reduce toxicity, mobility, and volume of the TEX contaminants in groundwater. For metals, Alternative 1 is a suitable treatment for metals in order to comply with ARARs. However, metal concentration increases due to ISCO are typically transitory and will re-equilibrate so that the metal concentrations will return to the pre-injection state (USACE, 2017 and Kaur and Crimi, 2013). Thus, Alternative 2 is expected to comply with ARARs as well.

Alternative 1 treats less contaminant mass than Alternative 2 since direct injection can be targeted to the primary source areas. Historical data from previous groundwater treatment plant operations showed that total xylenes decreased on a relatively shallow slope, resulting in less destruction of COCs over time. In contrast, according to the ISCO Pilot Study Report, the ISCO injections were successful in destroying or reducing TEX groundwater concentrations. TEX groundwater concentrations decreased during the study at nearly all wells. The areal extent was reduced by approximately 73% by four rounds of injections.

Short-Term Effectiveness

Alternative 2 is effective for TEX COCs in the short-term, with a time period to attain ARARs of approximately 5 years. Alternative 1 is somewhat effective in the short-term, since the time to attain ARARs is longer at 30 or more years.

There are no significant short-term risks to the community or the environment associated with Alternatives 1 and 2.

Workers operating the treatment plant have the potential for longer term exposure to contaminated groundwater, vapors, and chemicals associated with the implementation of Alternative 1. Note that for worker safety, the oxidant hydrogen peroxide is required for Alternative 1 which is similar in terms of exposure risk to the oxidant sodium persulfate present in Alternative 2. Workers performing ISCO injections and groundwater sampling/monitoring have the potential to be temporarily exposed to contaminants, but this risk is minimized by the use of personal protective equipment, and implementation of a Health and Safety Plan.

Implementability

Alternatives 1 and 2 are implementable on-site.

There are no significant technical implementability issues associated with Alternatives 1 and 2. However, Alternative 1 has greater implementability challenges associated with start-up and long-term operation of the groundwater extraction and treatment system.

Cost

Alternative 2 has a lower cost than Alternative 1. Alternative 1 has a total present value over 30 years of $10.3M, compared to Alternative 2 with a total present value over 30 years of $1.4M.

Costs to perform additional studies and upgrades for either Alternative 1 or 2, such as to address metals via alternative injections and emerging contaminants in groundwater, are not included in these cost estimates.

4.4 COMMON ELEMENTS

Additional elements pertaining to Site remediation are important for protecting human health and the environment and are recommended or required regardless of which alternative is selected. Common elements identified during this FFS include:

- Long-Term Monitoring: Groundwater sampling to determine effectiveness of any applied remedy is recommended. At the conclusion of remediation, long-term monitoring is necessary to establish stability of reduced contaminant concentrations and inform permanence of the remedy.

- Investigation of and monitoring for emerging contaminants (e.g., PFAS): In general, PFAS chemicals are widespread and chemically persistent and may be linked to harmful health effects. Whether PFAS are substantially present at the Site, and whether contamination is connected with on-site or off-site sources, have not yet been determined. Groundwater extraction and treatment could address potential site-related emerging contaminants, but ISCO may not.

- Institutional Controls - Evaluation of administrative controls, including a Classification Exception Area (CEA) and deed notice is recommended. These controls could be used to mitigate the risk of groundwater exposure by preventing the installation of any potable wells for remaining contaminated groundwater.

- Five-Year Reviews - Five-Year reviews for all alternatives is required by CERCLA. The reviews would assess any ongoing risks to human health and the environment and the effectiveness of remediation and institutional controls. The data collected during the long-term monitoring program would be used in the reviews. Based on each review, a decision would be made for future management of the Site.

5. SUMMARY

This FFS identified, screened, and compared three remedial alternatives using EPA's nine evaluation criteria.

Both Alternatives 1 (Groundwater Extraction and Treatment) and 2 (In-Situ Treatment) would be protective of human health and the environment since they would actively treat the groundwater appropriately to reduce groundwater contaminant concentrations. Both Alternative 1 and 2 can achieve compliance with ARARs.

It is anticipated that Alternative 2 – In-Situ Treatment has a significantly shorter timeframe to achieve ARARs and a significantly lower cost than Alternative 1 – Groundwater Extraction and Treatment.

The technology utilized in Alternative 2 will treat groundwater TEX COCs in-situ and is anticipated to achieve long-term effectiveness in a shorter amount of time as compared to Alternative 1. Both Remedial Alternatives 1 and 2 reduce toxicity, mobility, and volume of the TEX contaminants in groundwater.

There are no significant short-term risks to the community or the environment associated with Remedial Alternatives 1 and 2. Workers performing remediation associated with either Alternatives 1 and 2 and groundwater sampling/monitoring have the potential to be exposed to contaminants, but this risk is minimized by the use of personal protective equipment and other protective measures.

There are no significant technical implementability issues associated with Alternatives 1 and 2. However, Alternative 1 has greater implementability challenges associated with start-up and long-term operation of the groundwater extraction and treatment system and significantly higher cost to implement.

This FFS determined both groundwater extraction and treatment and in-situ treatment to be feasible alternatives for Site remediation. This evaluation provides a basis for the EPA to select a preferred remedial alternative.

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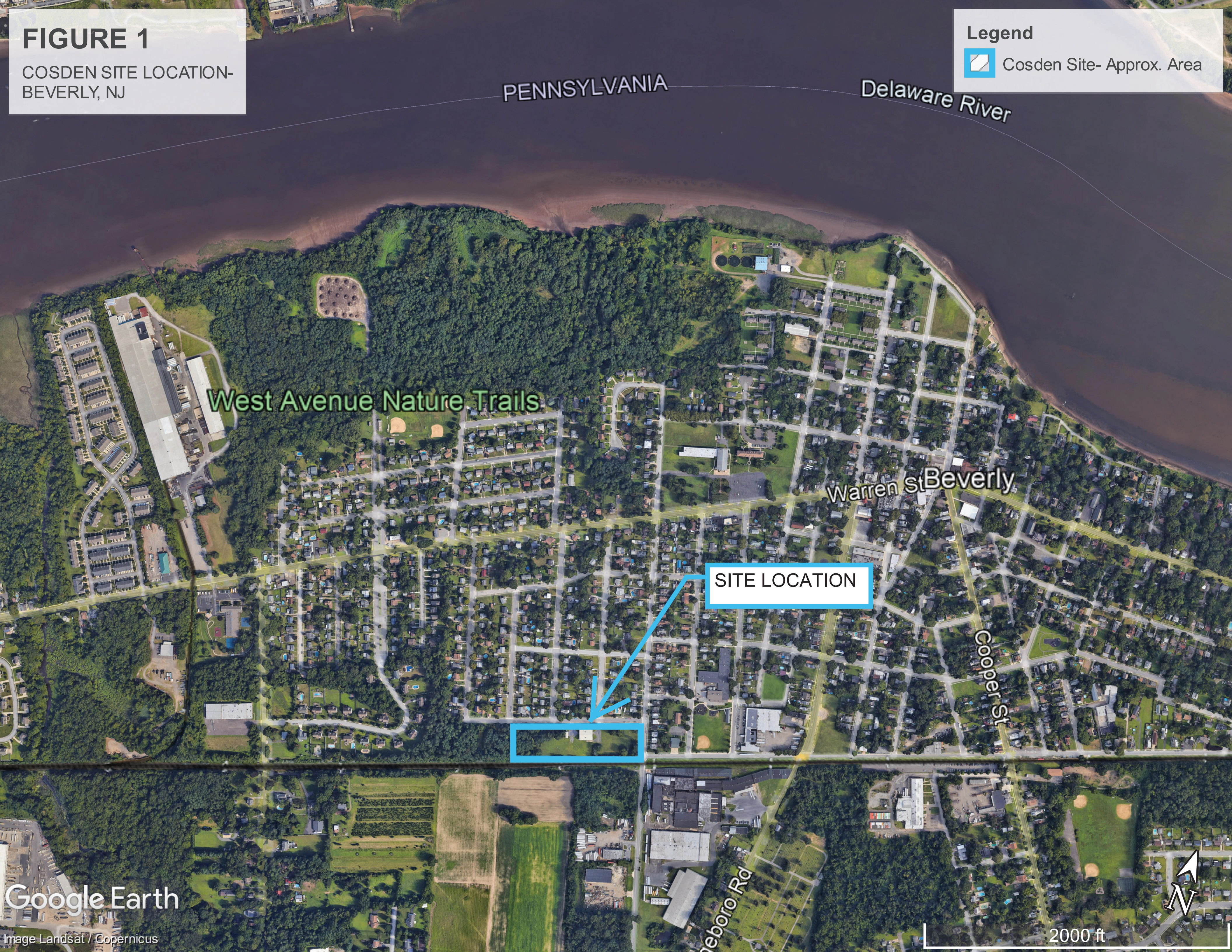
FIGURES

FIGURE 1

COSDEN SITE LOCATION-
BEVERLY, NJ



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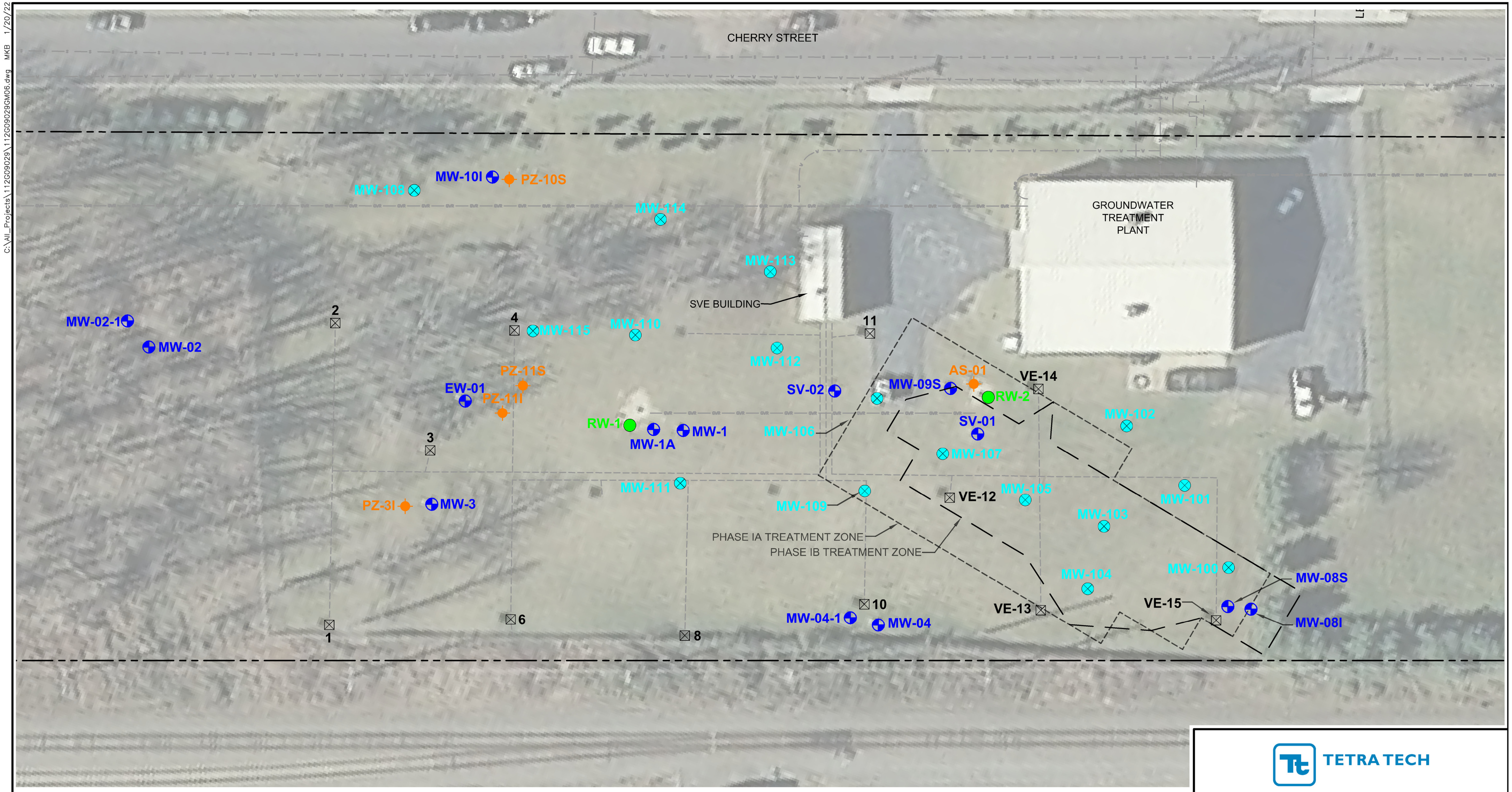

LEGEND

☒ SVE WELL

---- SVE PIPING

⊕ PRE-EXISTING MONITORING WELL

⊗ NEW ISCO PILOT STUDY MONITORING WELL

● INACTIVE RECOVERYWELL

✦ PIEZOMETER WELL

0 40 80

SCALE IN FEET

TETRA TECH

WELL LOCATIONS
COSDEN CHEMICAL SUPERFUND SITE
BEVERLY, NEW JERSEY

FILE 112G09029GM06	SCALE AS NOTED	
FIGURE NUMBER FIGURE 2	REV 0	DATE 1/20/22

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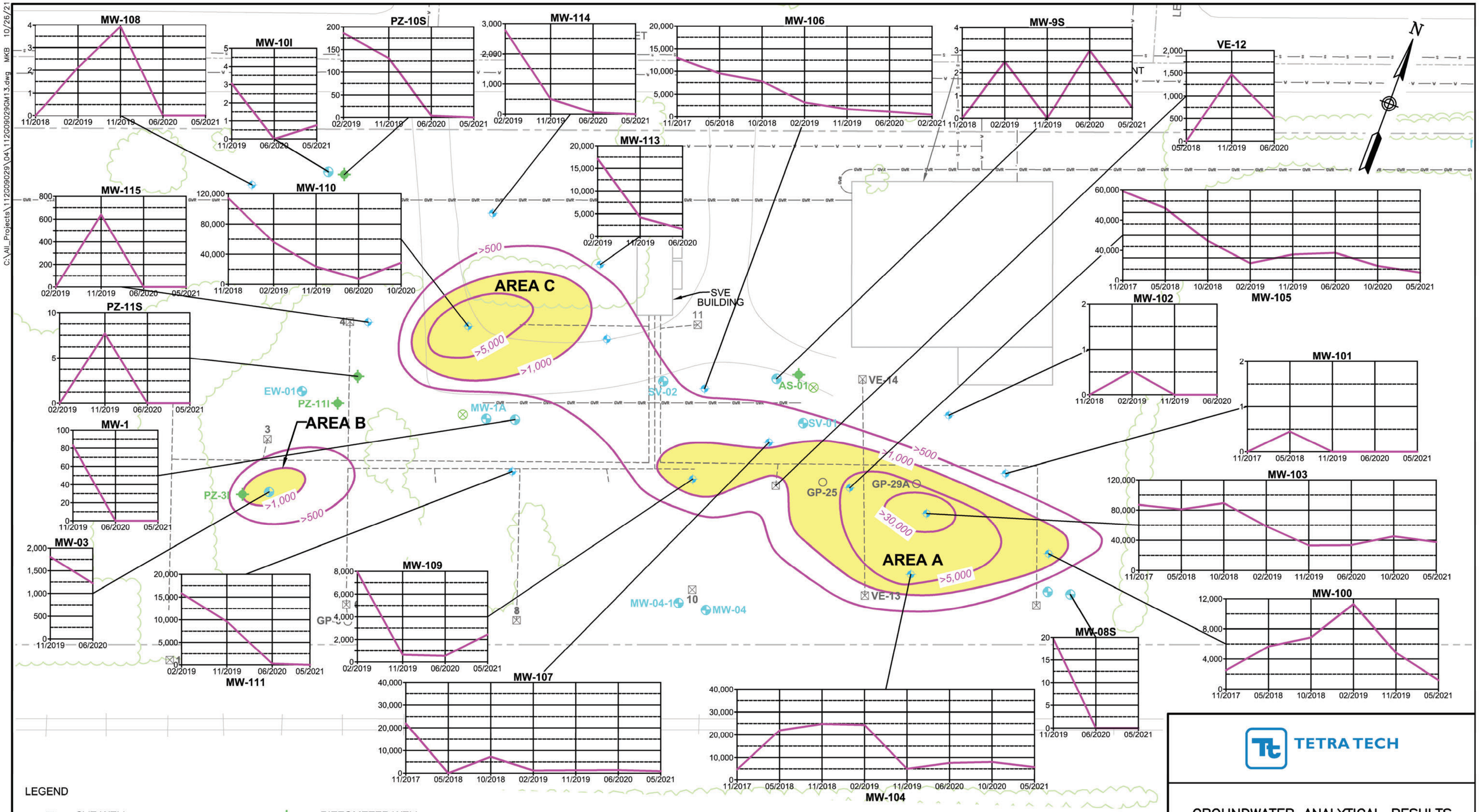

LEGEND

⊠	SVE WELL
- - - -	SVE PIPING
●	EXISTING MONITORING WELL
●	NEW MONITORING WELL
⊗	EXTRACTION WELL
○	SOIL BORING
✦	PIEZOMETER WELL
260	RESULT IN µg/L
🟨	AREA OF CONCERN
>1,000	ELEVATED TOTAL XYLENE CONCENTRATIONS, (MAY 2021)

0 40 80
SCALE IN FEET

TETRA TECH

GROUNDWATER ANALYTICAL RESULTS
(AS OF MAY 2021)
COSDEN CHEMICAL SUPERFUND SITE
BEVERLY, NEW JERSEY

FILE	SCALE
112G09029GM13	AS NOTED

FIGURE NUMBER	REV	DATE
10–1	0	8/17/20

FFS: FIGURE 3- GROUNDWATER RESULTS (MAY 2021)

APPENDIX A

CONTAMINANT MODELING MEMO

Evaluation of Toluene, Ethylbenzene, Xylene (TEX) Plume Stability using RT3D

Cosden Chemical Coatings Superfund Site, Beverly, NJ
Prepared by U.S. Army Corps of Engineers, Philadelphia District
Revised April 2022

1 Introduction

Recent in-situ chemical oxidation (ISCO) treatment of hydrocarbon contamination at the Cosden Chemical Coatings Superfund site successfully reduced contaminant concentrations at the site. The U.S. Army Corps of Engineers (USACE), Philadelphia District has been tasked with assessing the impact of source treatment on the stability of the plume and the ability to contain the plume on the site via natural attenuation. To accomplish this task, the USACE used Multi-Species Reactive Transport Simulation Software for Groundwater Systems, or RT3D, along with simplifying assumptions to model potential future behavior of the dissolved-phase plume under various conditions.

2 Modeling Approach and Assumptions

The reactive transport code RT3D (Clement, 1997) was selected to model the dissolved-phase plume (Toluene, Ethylbenzene, and Xylenes, or TEX) using the Kinetic-Limited Degradation of BTEX with Multiple Electron Acceptors reaction package available within RT3D. This reaction package assumes that all BTEX species degrade at similar rates and can therefore be modeled as a single electron donor species, BTEX (or TEX for the Cosden site). The RT3D simulation also included transport by advection and dispersion. MODFLOW (Harbaugh, et al., 2000) is used to generate the flow field for the transport simulations. Model simulations were run within GMS version 10.5 developed by Aquaveo, LLC.

Since the goal of the model is to evaluate the long-term, average behavior of the dissolved-phase plume, the model was run under steady state conditions (i.e. inputs were not varied over the duration of the model simulation) until the plume stabilized. The extent of the plume was then compared to the site boundaries to assess the ability of source treatment to contain the plume on site without pumping.

In-lieu of model calibration, several assumptions were made regarding model input parameters. The assumptions were based on knowledge of the site from previous site investigations as well as information obtained from literature. Selected parameters were varied over reasonable ranges in order to demonstrate the model's sensitivity to the parameters and provide a range of potential outcomes. However, the suite of model simulations performed does not constitute a comprehensive sensitivity analysis and other reasonable sets of parameters may produce results outside of the results shown in this memorandum. Additionally, there is a higher level of uncertainty in the predicted outcomes when no model calibration is performed even though all input parameters are reasonable for the site. Model assumptions are summarized in the subsections below.

2.1 Site hydraulic and hydrologic conditions

The groundwater gradient across the site was assumed to be a constant 0.002 ft/ft based on observed water levels during recent gaging events (TetraTech, 2021). The direction of groundwater flow was assumed to be approximately 3 degrees north of west. The average groundwater recharge rate was varied between 9 in/yr and 11 in/yr (NJGS, 2005). No pumping was simulated.

2.2 Aquifer Characteristics

The aquifer was assumed to be homogeneous and isotropic. The average hydraulic conductivity (K) for the contaminated zone has been reported to range between 25 ft/day and 35 ft/day with 35 ft/day being selected for most model simulations (TetraTech, 2021). The effective porosity (n) of the aquifer was also assumed to be 25% for most model simulations but was varied between 10% and 35% to test the effect of this assumption.

2.3 Initial Concentrations

The initial water quality at the site was assumed to be consistent with samples collected in May 2021. Initial concentrations of TEX and sulfate were assigned to the model by interpolating the May 2021 sample data to the grid. Concentrations of TEX outside of the monitoring well network were assumed to be 0 mg/l. Concentrations of sulfate outside of the monitoring well network were assumed to be 20 mg/l, which is consistent with ambient water quality obtained from offsite wells. Dissolved oxygen (DO) was assumed to be 0 mg/l within the TEX plume and 4 mg/l outside of the plume, which is consistent with ambient water quality obtained from offsite wells. Concentrations of all other electron acceptors (nitrate, iron, and methane) were assumed to be negligible.

2.4 Source Area

The extent of the TEX source area was assumed to coincide with borings AB-1 through AB-5 where elevated levels of total xylenes and ethylbenzene were measured (see TetraTech, 2021 for locations of borings and soil sample results). The source area was also extended over the highest aqueous phase TEX concentrations, within the area of the 5 mg/l total xylenes contour delineated by TetraTech (2021). Three wells fall within this area: MW-103, MW-104, and MW-105. An additional well with high concentrations, MW-110, was not considered in this model since it is outside the source area as determined by the soil borings. Discussion of MW-110 is provided below in Section 4, and in the body of the FFS. The table below summarizes the concentrations of Toluene, Ethylbenzene, and Total Xylenes from May 2021 at these wells.

Concentration, May 2021, mg/l			
Well ID	Toluene	Ethylbenzene	Xylenes, Total
MW-103	ND	6.5	37.4
MW-104	0.098 J	2.3	11.6
MW-105	0.035	1.2 J	5.05

ND = non-detect

J = estimated value below reporting limit

The contaminant source was modeled by assigning a constant concentration to the source area for the duration of the model simulation. In reality, some natural degradation of the source will likely occur over time, but this is not accounted for in the RT3D simulation.

Three source strengths were compared to demonstrate the possible impact of that a reduction in source area concentration might have on the stabilized plume: 30 mg/l, 21 mg/l and 10 mg/l. A source concentration of 30 mg/l was used as an approximate average of the two wells with the highest concentrations (MW-103 and MW-104); 21 mg/l was used to represent the average of all wells within the assumed source area; and 10 mg/l was used to demonstrate a reduction in source area concentration by approximately half of the existing average concentration.

2.5 Ambient and Recharge Water Quality

Water enters the model through both the upgradient boundary and the surface of the model via recharge. The water quality for these sources of water must be specified. Water quality samples collected from offsite wells MW-OS1 through MW-OS7 in March 2017 were assumed to be representative of the ambient water quality entering the upgradient boundary of the model. These wells were formerly downgradient of the contaminant plume based on historical groundwater flow, and currently are side-gradient to the plume. The average sulfate concentration at these wells was approximately 20 mg/l while the average DO was about 4 mg/l. Water upgradient of the site was assumed to contain no TEX, nitrate, iron, or methane.

For most simulations, the DO of the recharge water was also assumed to be 4 mg/l in order to maintain levels of 4 mg/l once the waters (upgradient and recharge) had mixed. DO of the recharge water was increased to 8 mg/l in one simulation to reflect the DO that might be expected with “healthy” recharge water. Sulfate concentrations of the recharge water were assumed to be 5 mg/l in most model simulations and were increased to 20 mg/l for a sensitivity simulation. The recharge water was assumed to contain no TEX, nitrate, iron, or methane.

2.6 Dispersion

Longitudinal dispersivity was assumed to be 10 ft for most model simulations. The sensitivity of the model to this parameter was explored by reducing this value to 1 ft in one model simulation.

2.7 Reaction Parameters

Decay of the TEX plume was modeled in RT3D using the Kinetic-Limited Degradation of BTEX with Multiple Electron Acceptors reaction package. The user can input decay rates for aerobic respiration, denitrification, iron reduction, sulfate reduction, and methanogenesis in this package. The GMS default values for these decay rates were used for the baseline scenarios. Literature values for the decay rates from Suarez and Rifai (1999) were also used in sensitivity simulations. Suarez and Rifai reported a range of first order decay rates for individual BTEX compounds by electron acceptor. Since the contamination at the Cosden site is primarily Xylenes, the mean rates reported for *m*-, *o*-, and *p*-Xylene were compared, and the minimum and maximum of the mean rates were used in the sensitivity runs. The table below compares the degradation rates used in the model simulations. Although all redox processes are listed, aerobic respiration and sulfate reduction control the degradation of TEX at the Cosden site since concentrations of the other electron acceptors (nitrate, iron, and methane) are assumed to be negligible.

Decay Rates (day^{-1})			
Redox Process	**GMS Default**	**Suarez and Rifai Min**	**Suarez and Rifai Max**
Aerobic Respiration	0.05	0.086	0.207
Nitrate Reduction	0.03	0.012	0.089
Iron Reduction	0.005	0.003	0.01
Sulfate Reduction	0.003	0.011	0.81
Methanogenesis	0.001	0.018	0.19

3 Model Results

The attached figures show the extent of the stabilized TEX plume for the suite of model simulations that was run. The assumptions for each model simulation are listed on each figure. Parameters highlighted on Figures 2 through 11 are those that differ from the parameters used in the simulation shown on Figure 1. Only concentrations above 1 mg/l are contoured on the figures, which represents concentrations above the MCL for Xylenes.

Figures 1 through 3 demonstrate that a reduction in source area concentration results in a smaller dissolved-phase plume.

Changes in hydraulic conductivity and recharge (DO and recharge rate) also had a noticeable impact to the overall extent of the stabilized plume. Although the range of values modeled for these parameters is reasonable for the site, only a limited sensitivity was conducted. There could be other reasonable values outside of the range used in this modeling exercise that produce different outcomes. In particular, lower DO concentrations in both the ambient, upgradient groundwater and recharge water could result in a more extensive stabilized plume.

Variations in porosity and reaction parameters over the ranges tested did not have an appreciable impact on the extent of the stabilized plume.

4 Discussion

The model results show the effect on the groundwater plume of any reduction in source area concentrations, regardless of how that source area reduction is achieved. The FFS evaluates three alternatives: no action, groundwater extraction and treatment, and in-situ chemical oxidation (ISCO). The no action alternative would not reduce source area concentrations, and therefore this model does not apply to that alternative. Groundwater extraction and treatment does not directly treat the source area, but over a long period of operation could indirectly reduce source concentrations as contaminated groundwater is extracted and the source continues to contribute contaminants to the dissolved plume as groundwater flows through the system. Finally, the ISCO alternative is the only of the three alternatives that does directly treat source areas. An ISCO remedy would be effective in reducing source area concentrations; these model conditions could be replicated by ISCO treatment at the Site.

Limitations of this model alone, without the context of the FFS, include:

- What type of remedial alternative, and over what timeframe, would need to be implemented in order to achieve source reductions like those in the model.
- If ISCO were used,
  - How subsurface heterogeneities affect the fine-scale contact between ISCO oxidant and contaminants, and therefore the effectiveness of such a remedy at treating the source area.
  - How many injection rounds and over what areas would be needed.
- The possibility of an additional source area near monitoring well MW-110 (see Figures 2 and 3), west of the main source area. High concentrations (~35,000 ug/L in October 2020) have been observed at MW-110 (Figure 3, Area C). This model was designed for a single source area and was not used to model a source near MW-110.

The FFS provides additional information regarding the treatment alternatives and their effectiveness in treating Site contaminants.

5 References

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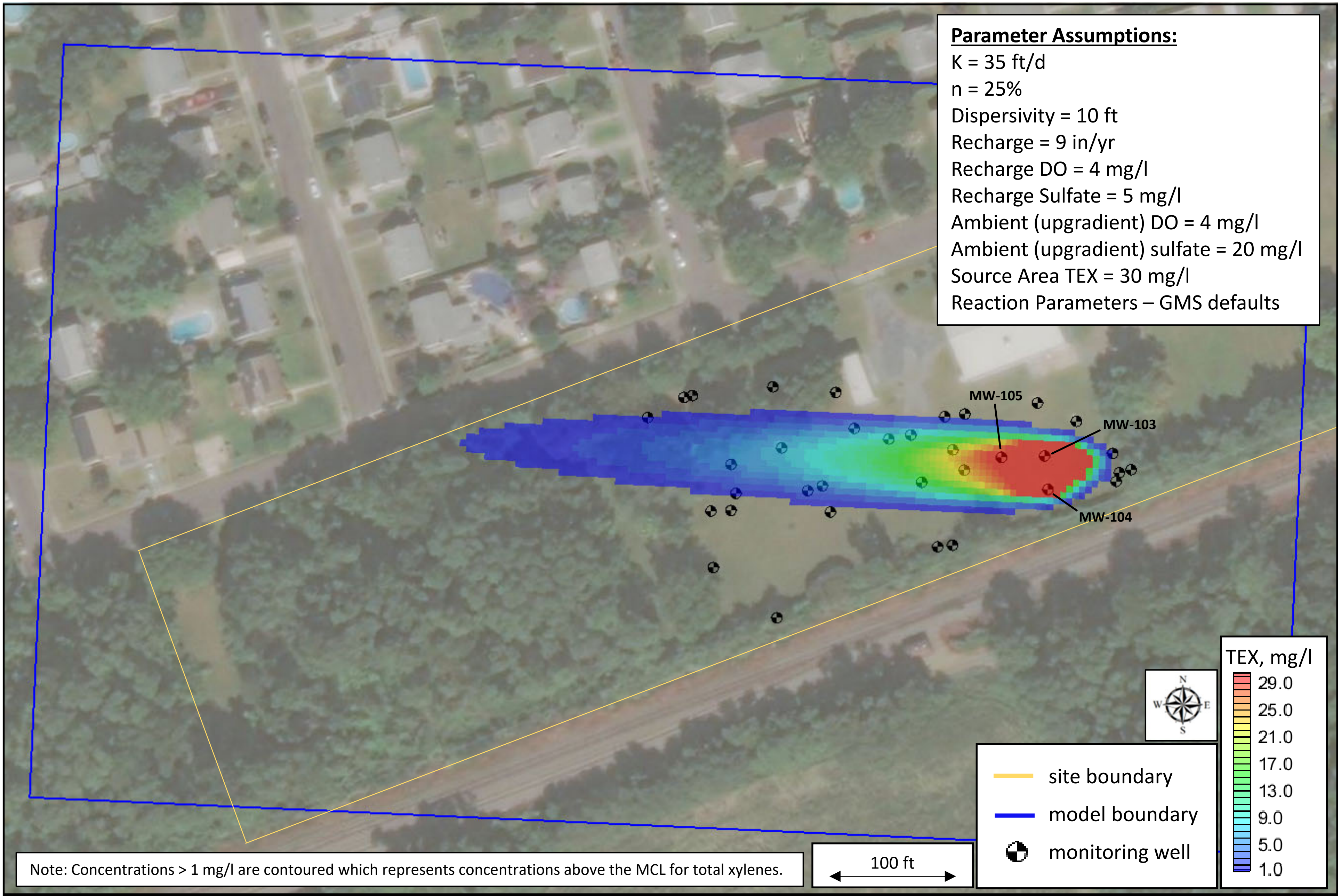


Parameter Assumptions:
K = 35 ft/d
n = 25%
Dispersivity = 10 ft
Recharge = 9 in/yr
Recharge DO = 4 mg/l
Recharge Sulfate = 5 mg/l
Ambient (upgradient) DO = 4 mg/l
Ambient (upgradient) sulfate = 20 mg/l
Source Area TEX = 30 mg/l
Reaction Parameters – GMS defaults

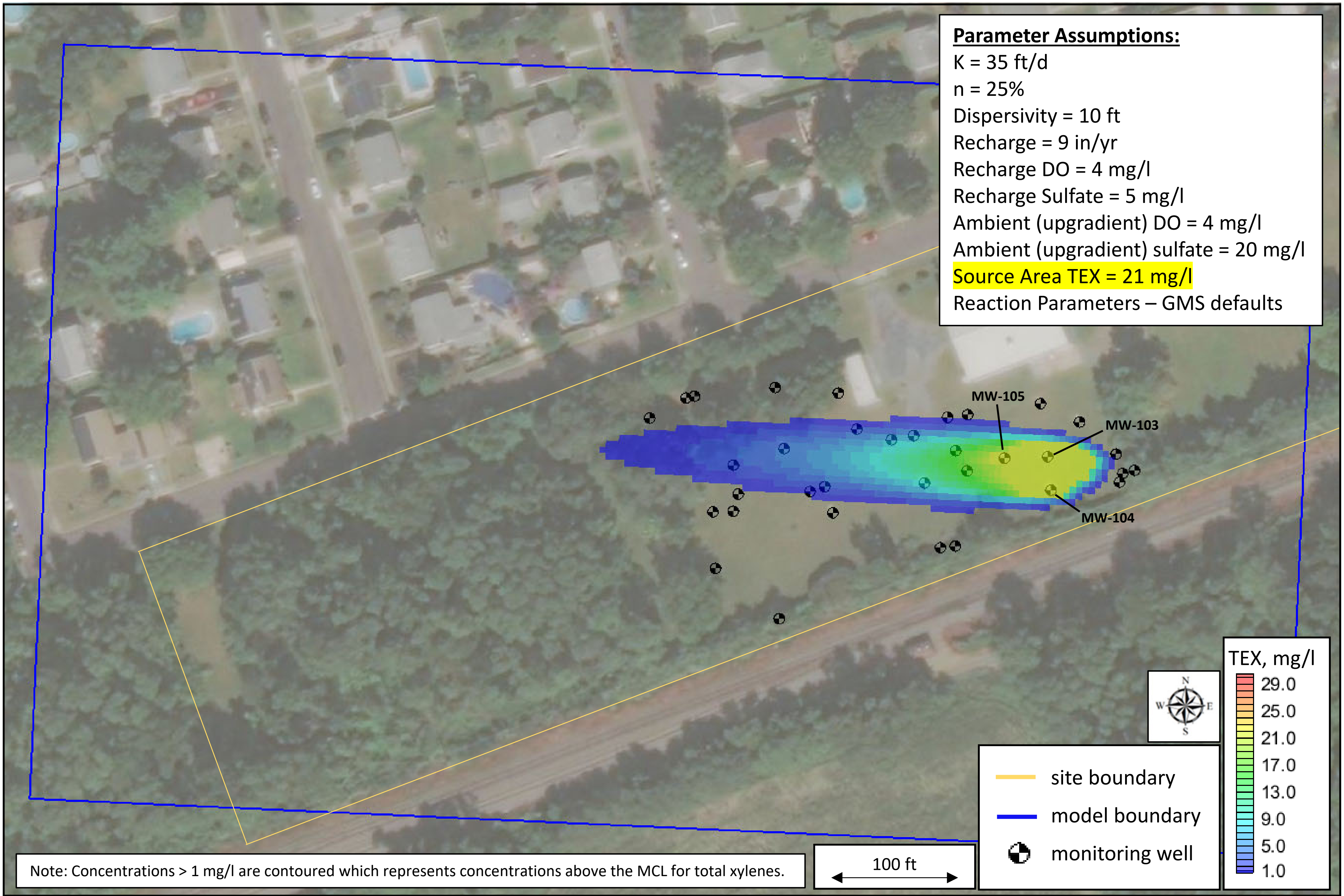
Note: Concentrations > 1 mg/l are contoured which represents concentrations above the MCL for total xylenes.

Evaluation of TEX Plume Stability using RT3D

Cosden Chemical Coatings Superfund Site
Beverly, NJ

Figure 1

February 2022



Parameter Assumptions:

K = 35 ft/d

n = 25%

Dispersivity = 10 ft

Recharge = 9 in/yr

Recharge DO = 4 mg/l

Recharge Sulfate = 5 mg/l

Ambient (upgradient) DO = 4 mg/l

Ambient (upgradient) sulfate = 20 mg/l

Source Area TEX = 21 mg/l

Reaction Parameters – GMS defaults

Note: Concentrations > 1 mg/l are contoured which represents concentrations above the MCL for total xylenes.

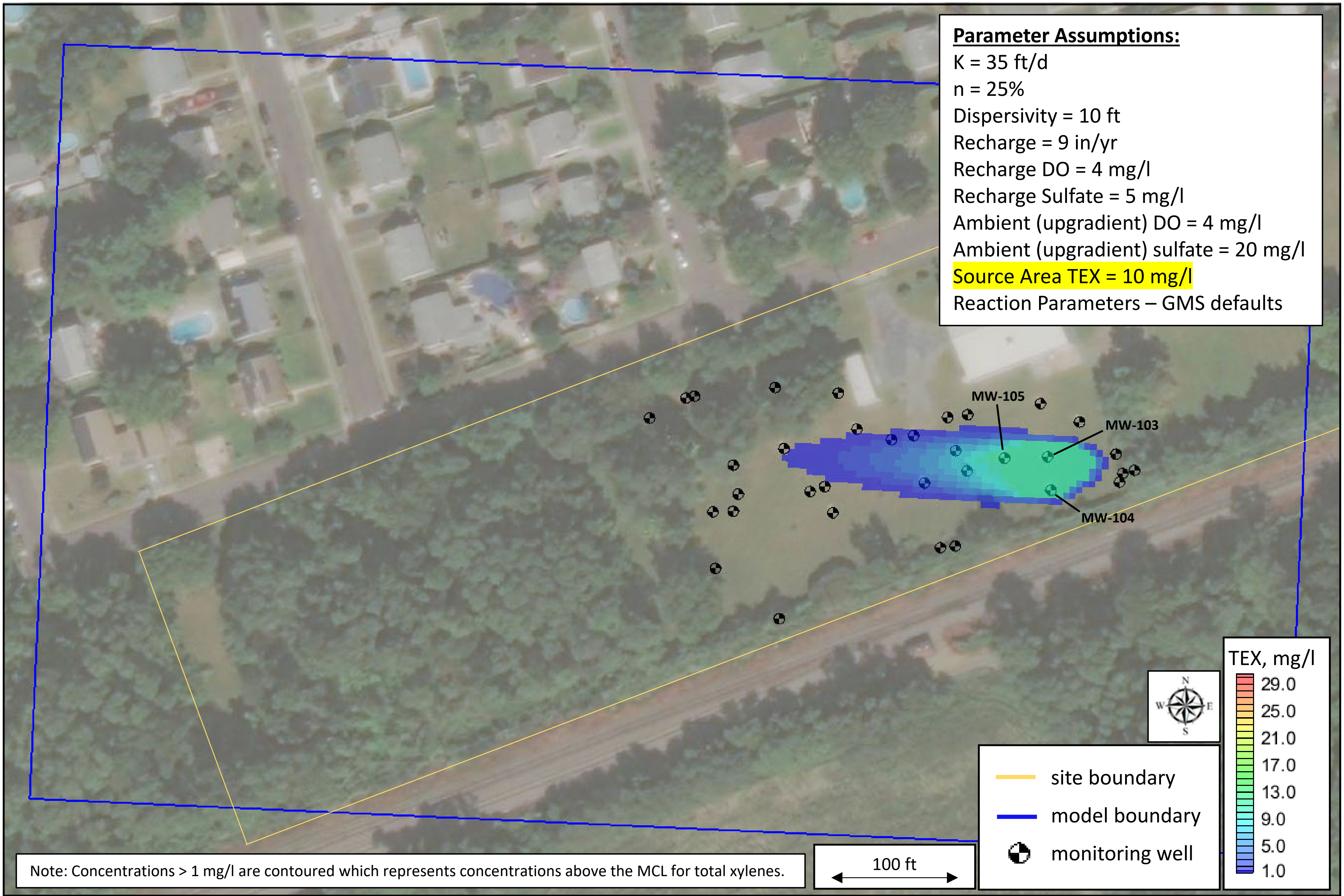
Evaluation of TEX Plume Stability using RT3D

Cosden Chemical Coatings Superfund Site

Beverly, NJ

FIGURE 2

FEBRUARY 2022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n = 25%
Dispersivity = 10 ft
Recharge = 9 in/yr
Recharge DO = 4 mg/l
Recharge Sulfate = 5 mg/l
Ambient (upgradient) DO = 4 mg/l
Ambient (upgradient) sulfate = 20 mg/l
Source Area TEX = 10 mg/l
Reaction Parameters – GMS defaults

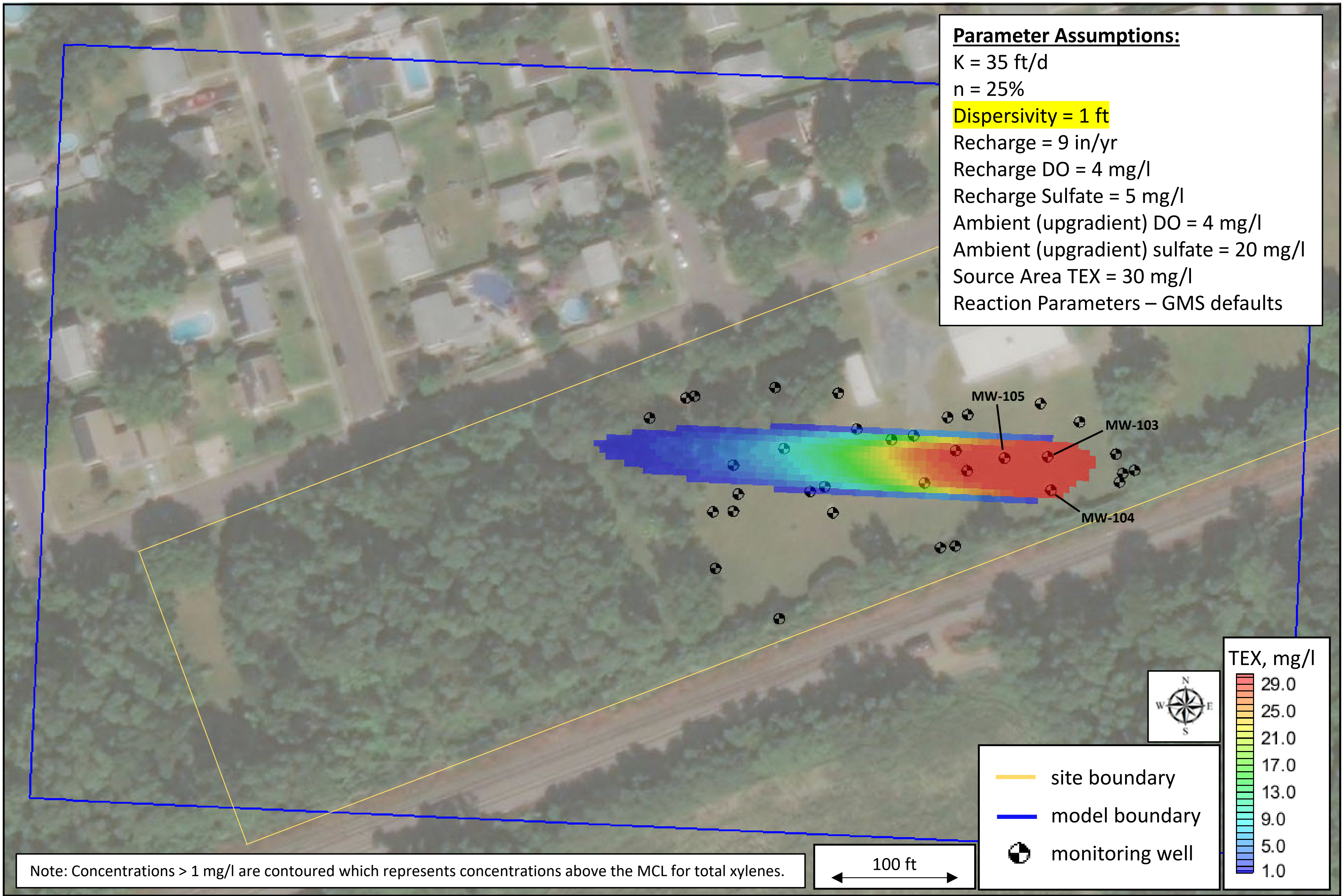
Note: Concentrations > 1 mg/l are contoured which represents concentrations above the MCL for total xylenes.

Evaluation of TEX Plume Stability using RT3D

Cosden Chemical Coatings Superfund Site
Beverly, NJ

FIGURE 3

FEBRUARY 2022



Parameter Assumptions:
K = 35 ft/d
n = 25%
Dispersivity = 1 ft
Recharge = 9 in/yr
Recharge DO = 4 mg/l
Recharge Sulfate = 5 mg/l
Ambient (upgradient) DO = 4 mg/l
Ambient (upgradient) sulfate = 20 mg/l
Source Area TEX = 30 mg/l
Reaction Parameters – GMS defaults

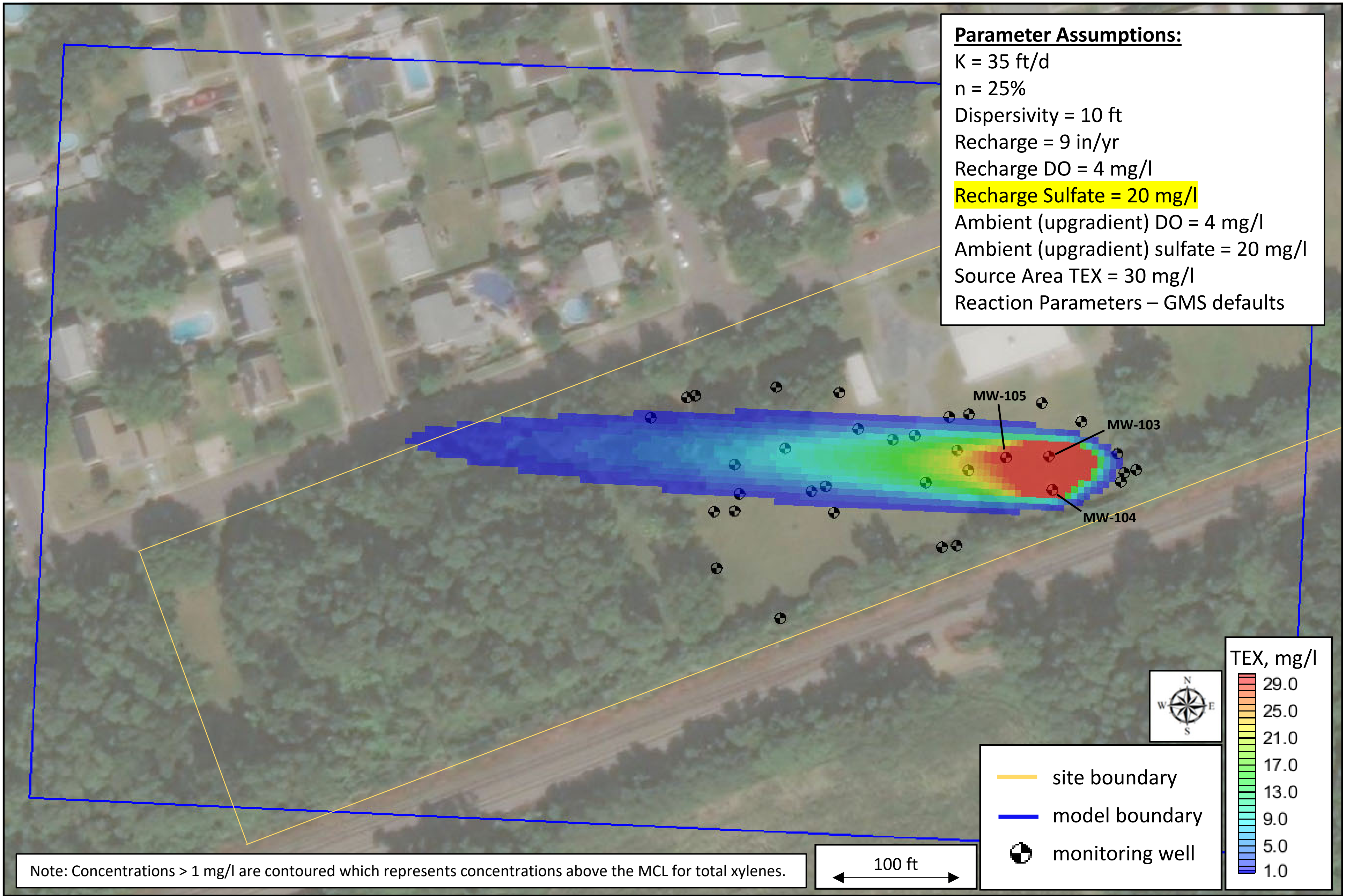
Note: Concentrations > 1 mg/l are contoured which represents concentrations above the MCL for total xylenes.

Evaluation of TEX Plume Stability using RT3D

Cosden Chemical Coatings Superfund Site
Beverly, NJ

FIGURE 4

FEBRUARY 2022



Parameter Assumptions:

K = 35 ft/d

n = 25%

Dispersivity = 10 ft

Recharge = 9 in/yr

Recharge DO = 4 mg/l

Recharge Sulfate = 20 mg/l

Ambient (upgradient) DO = 4 mg/l

Ambient (upgradient) sulfate = 20 mg/l

Source Area TEX = 30 mg/l

Reaction Parameters – GMS defaults

Note: Concentrations > 1 mg/l are contoured which represents concentrations above the MCL for total xylenes.

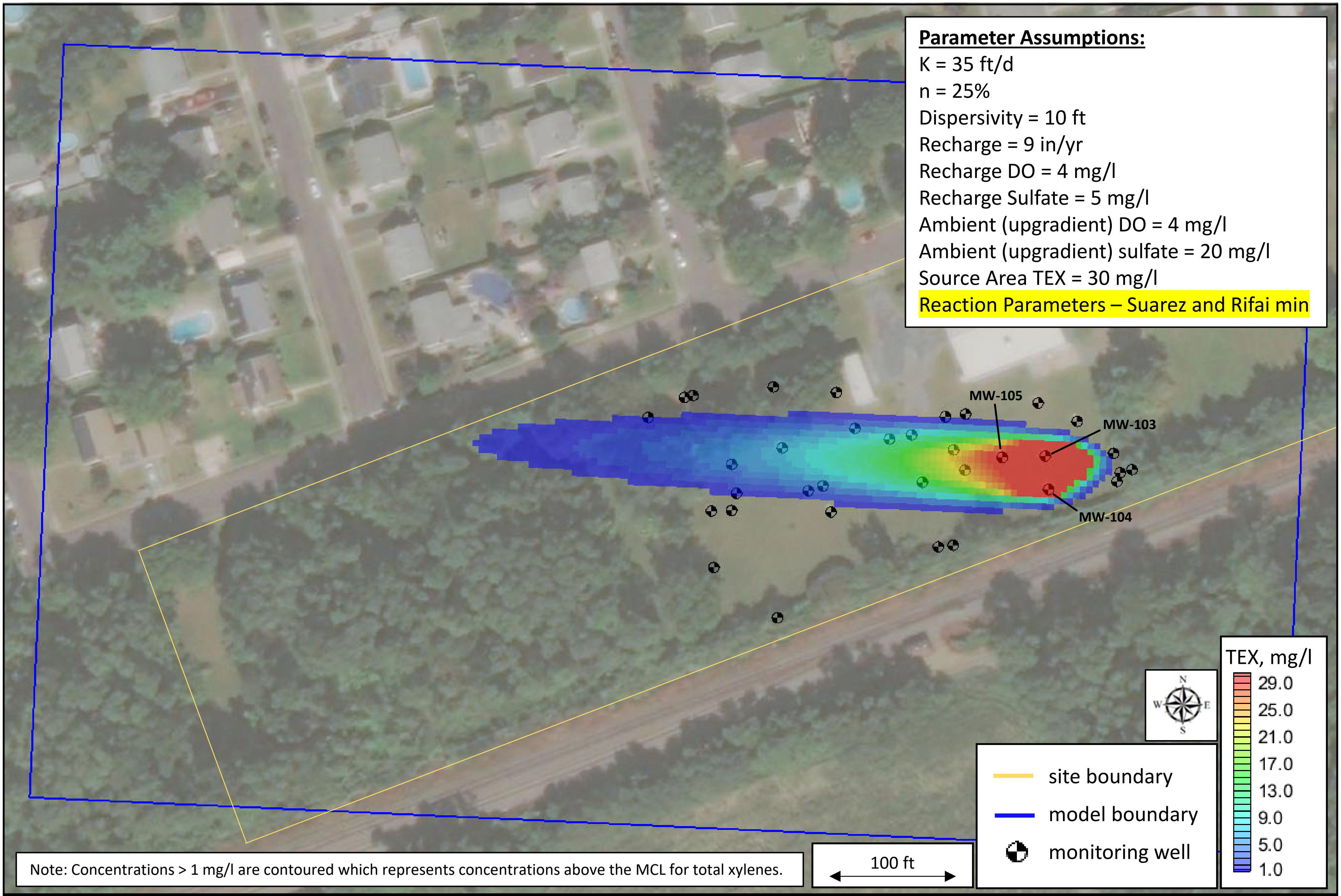
Evaluation of TEX Plume Stability using RT3D

Cosden Chemical Coatings Superfund Site

Beverly, NJ

FIGURE 5

FEBRUARY 2022



Parameter Assumptions:

K = 35 ft/d
n = 25%
Dispersivity = 10 ft
Recharge = 9 in/yr
Recharge DO = 4 mg/l
Recharge Sulfate = 5 mg/l
Ambient (upgradient) DO = 4 mg/l
Ambient (upgradient) sulfate = 20 mg/l
Source Area TEX = 30 mg/l
Reaction Parameters – Suarez and Rifai min

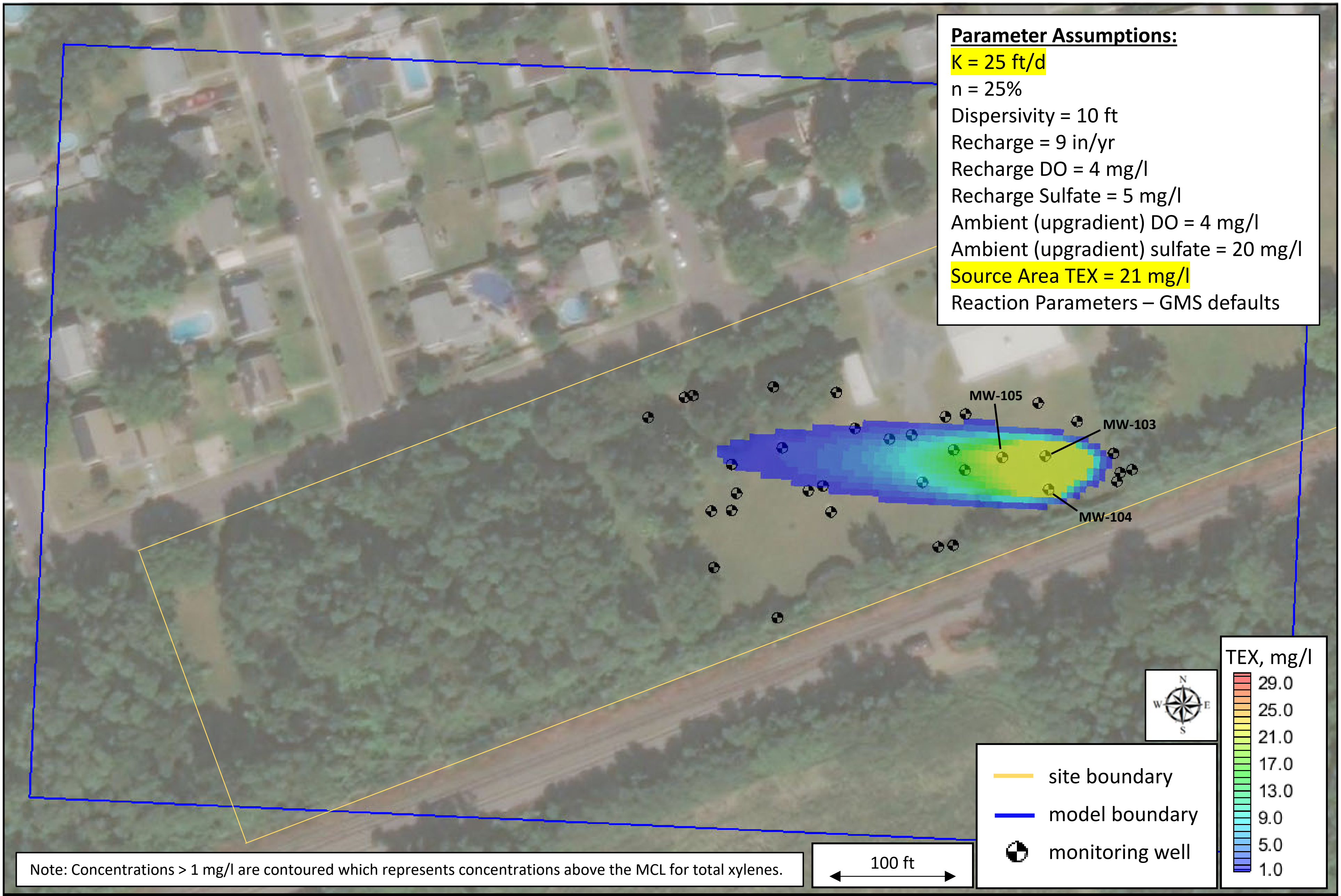
Note: Concentrations > 1 mg/l are contoured which represents concentrations above the MCL for total xylenes.

Evaluation of TEX Plume Stability using RT3D

Cosden Chemical Coatings Superfund Site
Beverly, NJ

FIGURE 6

FEBRUARY 2022



Parameter Assumptions:

K = 25 ft/d
n = 25%
Dispersivity = 10 ft
Recharge = 9 in/yr
Recharge DO = 4 mg/l
Recharge Sulfate = 5 mg/l
Ambient (upgradient) DO = 4 mg/l
Ambient (upgradient) sulfate = 20 mg/l
Source Area TEX = 21 mg/l
Reaction Parameters – GMS defaults

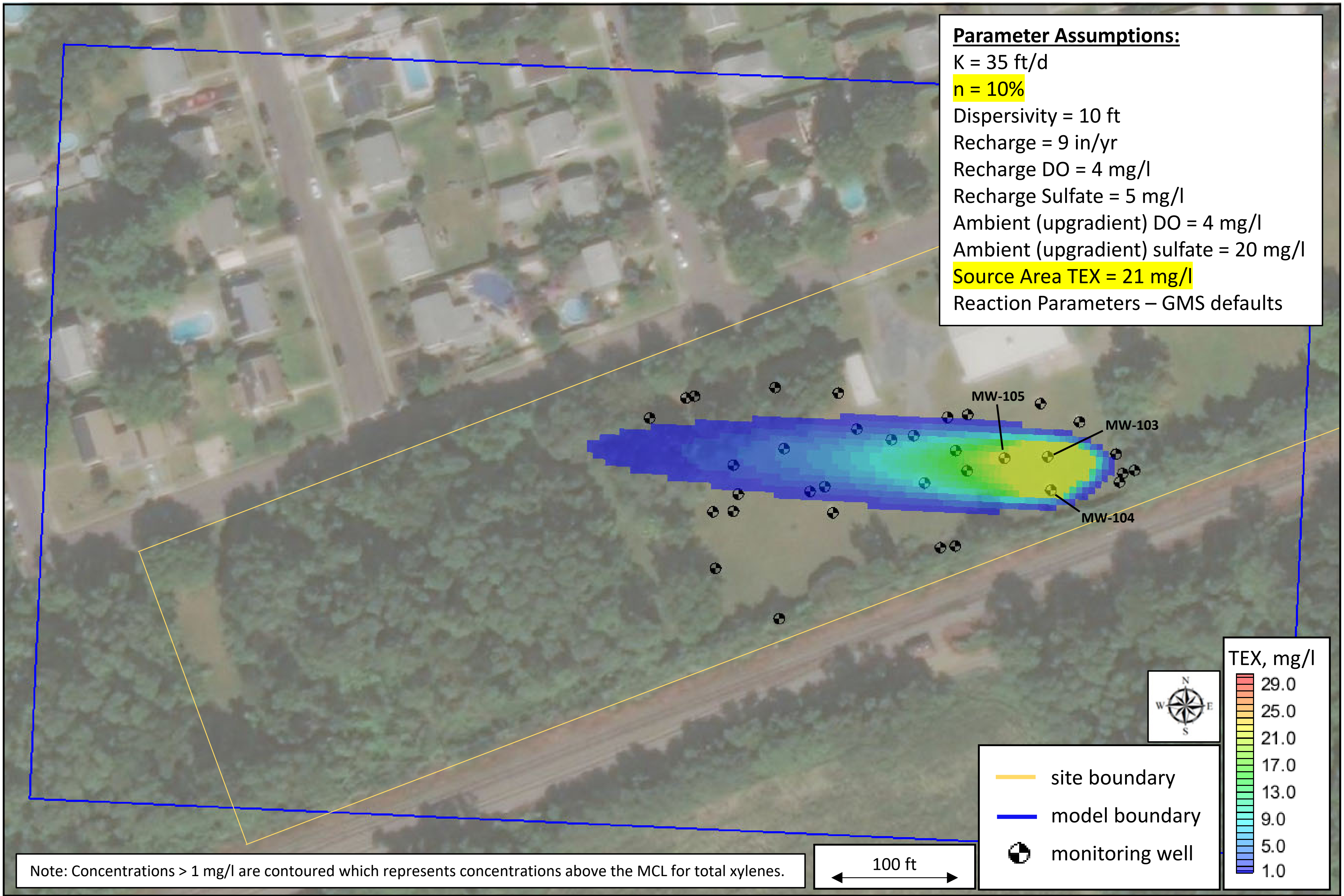
Note: Concentrations > 1 mg/l are contoured which represents concentrations above the MCL for total xylenes.

Evaluation of TEX Plume Stability using RT3D

Cosden Chemical Coatings Superfund Site
Beverly, NJ

FIGURE 7

FEBRUARY 2022



Parameter Assumptions:
K = 35 ft/d
n = 10%
Dispersivity = 10 ft
Recharge = 9 in/yr
Recharge DO = 4 mg/l
Recharge Sulfate = 5 mg/l
Ambient (upgradient) DO = 4 mg/l
Ambient (upgradient) sulfate = 20 mg/l
Source Area TEX = 21 mg/l
Reaction Parameters – GMS defaults

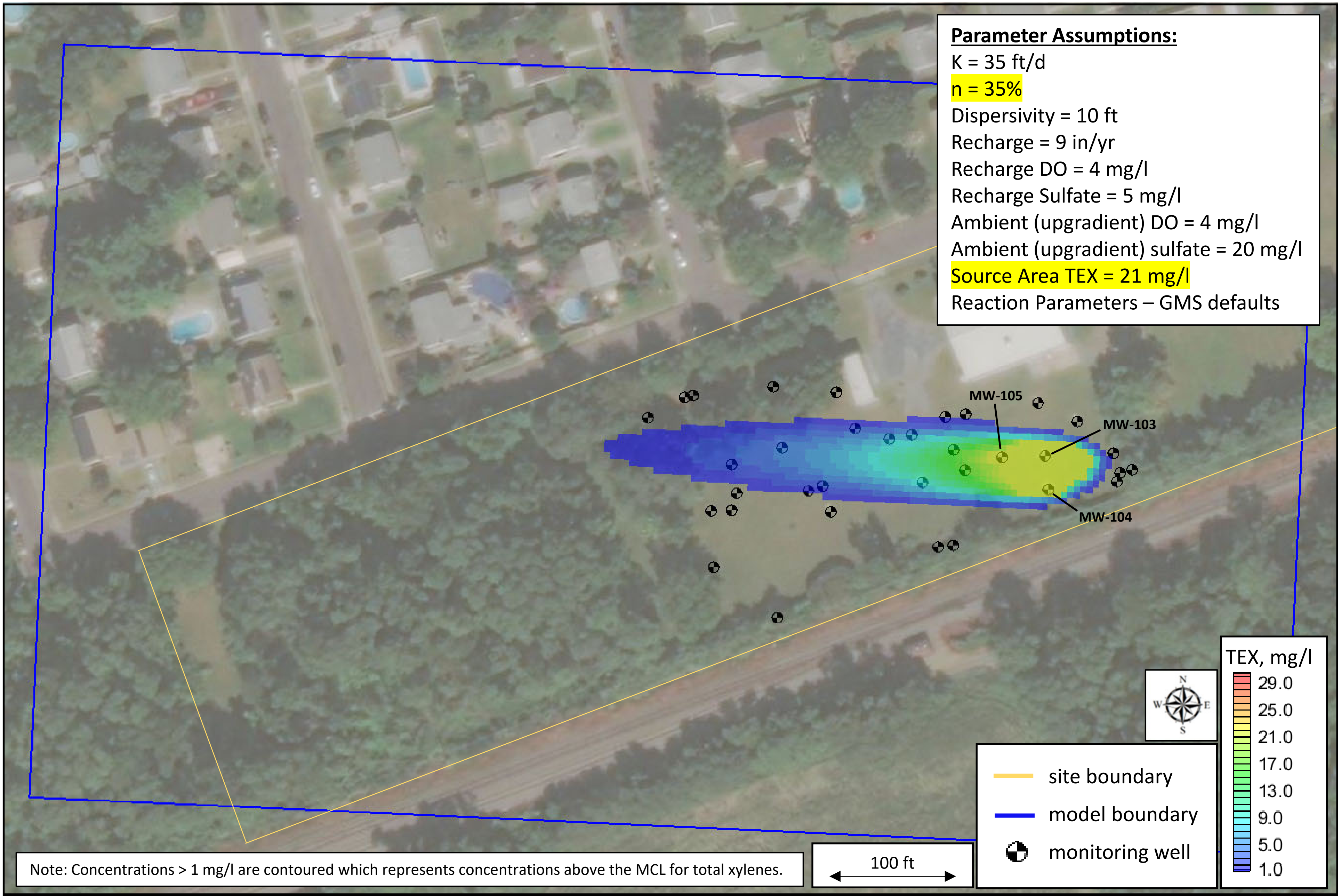
Note: Concentrations > 1 mg/l are contoured which represents concentrations above the MCL for total xylenes.

Evaluation of TEX Plume Stability using RT3D

Cosden Chemical Coatings Superfund Site
Beverly, NJ

FIGURE 8

FEBRUARY 2022



Parameter Assumptions:

K = 35 ft/d
n = 35%
Dispersivity = 10 ft
Recharge = 9 in/yr
Recharge DO = 4 mg/l
Recharge Sulfate = 5 mg/l
Ambient (upgradient) DO = 4 mg/l
Ambient (upgradient) sulfate = 20 mg/l
Source Area TEX = 21 mg/l
Reaction Parameters – GMS defaults

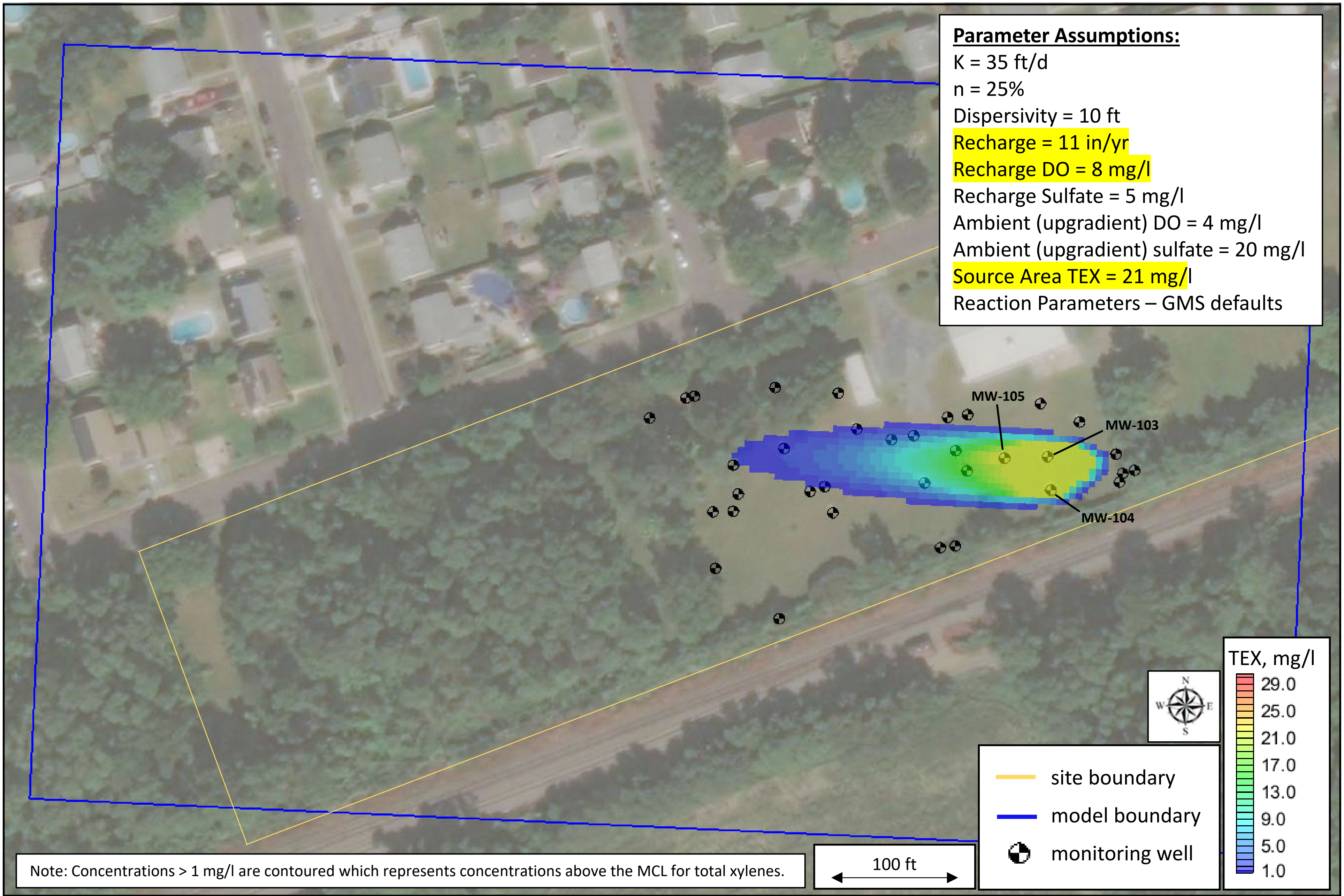
Note: Concentrations > 1 mg/l are contoured which represents concentrations above the MCL for total xylenes.

Evaluation of TEX Plume Stability using RT3D

Cosden Chemical Coatings Superfund Site
Beverly, NJ

FIGURE 9

FEBRUARY 2022



Parameter Assumptions:
K = 35 ft/d
n = 25%
Dispersivity = 10 ft
Recharge = 11 in/yr
Recharge DO = 8 mg/l
Recharge Sulfate = 5 mg/l
Ambient (upgradient) DO = 4 mg/l
Ambient (upgradient) sulfate = 20 mg/l
Source Area TEX = 21 mg/l
Reaction Parameters – GMS defaults

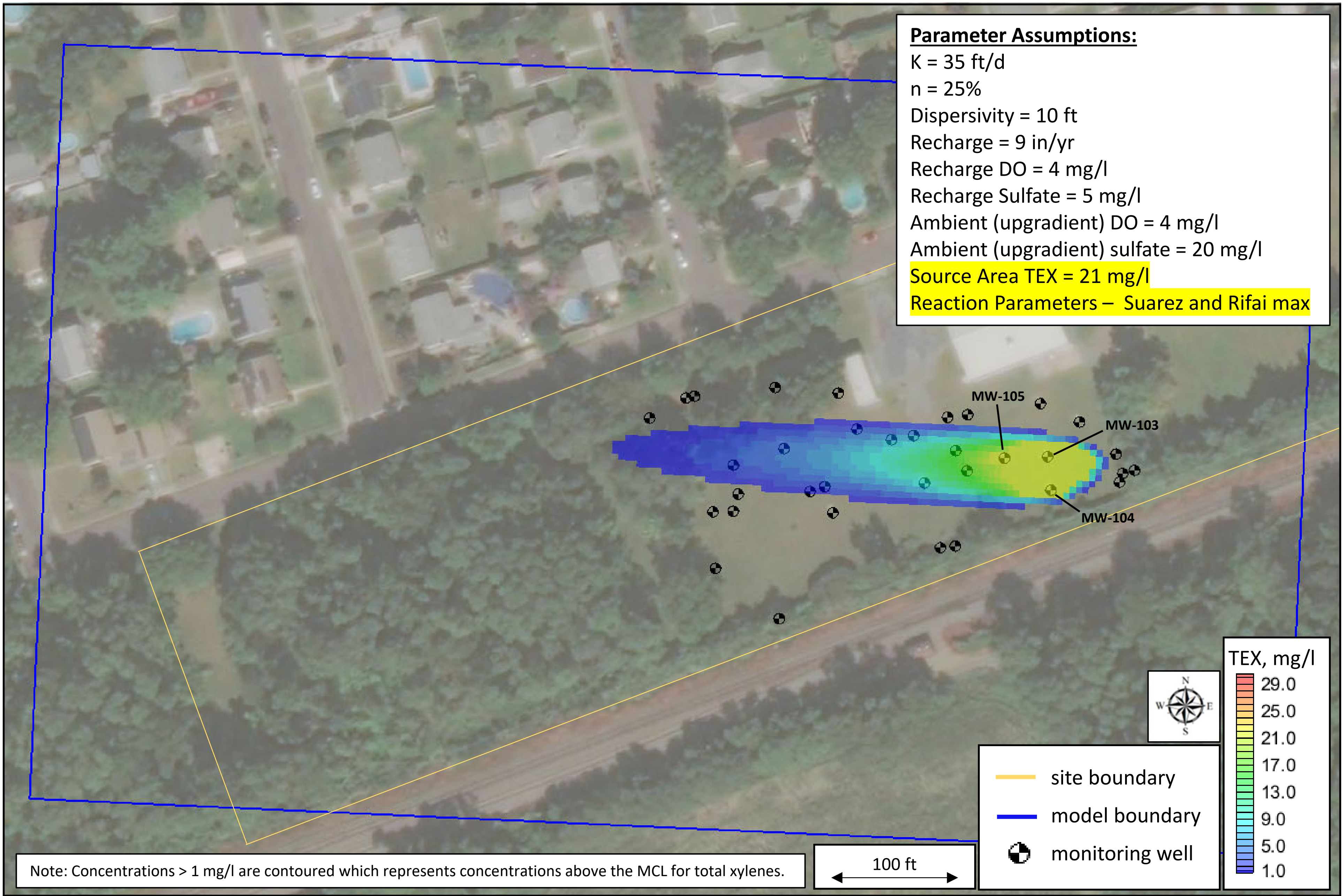
Note: Concentrations > 1 mg/l are contoured which represents concentrations above the MCL for total xylenes.

Evaluation of TEX Plume Stability using RT3D

Cosden Chemical Coatings Superfund Site
Beverly, NJ

FIGURE 10

FEBRUARY 2022



Parameter Assumptions:

K = 35 ft/d
n = 25%
Dispersivity = 10 ft
Recharge = 9 in/yr
Recharge DO = 4 mg/l
Recharge Sulfate = 5 mg/l
Ambient (upgradient) DO = 4 mg/l
Ambient (upgradient) sulfate = 20 mg/l
Source Area TEX = 21 mg/l
Reaction Parameters – Suarez and Rifai max

Note: Concentrations > 1 mg/l are contoured which represents concentrations above the MCL for total xylenes.

Evaluation of TEX Plume Stability using RT3D

Cosden Chemical Coatings Superfund Site
Beverly, NJ

FIGURE 11

FEBRUARY 2022

APPENDIX B

ARAR Summary Tables

Appendix B
Table B - 1
Chemical-Specific ARARs and TBCs
Cosden Chemical Coatings Corporation Superfund Site
Beverly, Burlington County, New Jersey

Title	Requirement	Prerequisite	Consideration in this FFS	Citation	Website
USEPA National Primary Drinking Water Regulations – Safe Drinking Water Act (SDWA)	Established federal primary standards (maximum permissible levels of contaminants in water) for the protection of human health via drinking water exposure.	Applies to public water systems or water associated with sources of drinking water. **Relevant and Appropriate**	USEPA Maximum Contaminant Level for drinking water quality and remediation	40 CFR Parts 141-142; 40 CFR Part 141.61(a) and (c) 42 USC 300f et seq.	https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations https://www.epa.gov/sdwa https://www.epa.gov/emergency-response/national-oil-and-hazardous-substances-pollution-contingency-plan-ncp-overview
NJDEP Ground Water Quality Standards (GWQS)	Established to protect the quality of New Jersey's ground waters and their designated uses.	Applies to ground water of special ecological significance, ground water for potable water supply and ground water with other uses. **Applicable**	GWQS for groundwater quality and remediation	N.J.A.C. 7:9C	https://www.nj.gov/dep/rules/rules/njac7_26d.pdf https://www.nj.gov/dep/wms/bears/Appendix_Table_1.htm
NJDEP Drinking Water Standards - Safe Drinking Water Act	Established state primary standards (maximum permissible levels of contaminants in water) for the protection of human health via drinking water exposure.	Applies to public water systems or water associated with sources of drinking water. **Applicable**	NJDEP Maximum Contaminant Level for drinking water quality and remediation	N.J.A.C. 7:10-1 et seq.	https://www.state.nj.us/dep/watersupply/pdf/dw-standards.pdf

Abbreviations:

ARAR = Applicable or Relevant and Appropriate Requirement
CFR = Code of Federal Regulations
NJDEP = New Jersey Department of Environmental Protection
USEPA = United States Environmental Protection Agency
TBC = To Be Considered

Appendix B
Table B - 2
Location-Specific ARARs and TBCs
Cosden Chemical Coatings Corporation Superfund Site
Beverly, Burlington County, New Jersey

Location	Requirement	Prerequisite	Consideration in this FFS	Citation	Website
Sole Source Aquifer – Safe Drinking Water Act of 1974 (SDWA)	Consider the remedial alternatives in the project review area which is designated a sole-source aquifer.	Remedial Activities that involve potential impact(s) to sole source aquifer beneath the Site. **Applicable**	The aquifer beneath the Cosden Superfund Site is designated as the Coastal Plain Sole Source aquifer.	Safe Drinking Water Act of 1974, Section 1424(e) 42 USC 300 et seq., 40 CFR 149 NJ Sole Source Aquifers on NJ Geo-Web NJ Well Head Protection Program	https://www.epa.gov/dwssa https://www.nj.gov/dep/gis/geowebsplash.htm https://www.state.nj.us/dep/njgs/whpaguide.pdf

Abbreviations:

ARAR = Applicable or Relevant and Appropriate Requirement
CFR = Code of Federal Regulations
NJDEP = New Jersey Department of Environmental Protection
TBC= To Be Considered

Appendix B
Table B -3
Action-Specific ARARs and TBCs
Cosden Chemical Coatings Corporation Superfund Site
Beverly, Burlington County, New Jersey

Action	Requirements	Prerequisite	Consideration in this FFS	Citation	Website
General Site Remediation					
NJ Technical Requirements for Site Remediation	Established to provide requirements for remedial activities under NJ cleanup programs.	**Substantive elements may be Relevant and Appropriate**	Overall state requirements for remedial investigation and action	N.J.A.C. 7:26E	https://www.nj.gov/dep/rules/rules/njac7_26e.pdf
General					
Activities causing stormwater runoff (e.g., clearing, grading)	The National Pollutant Discharge Elimination System (NPDES) requires the development of a Stormwater Pollution Prevention Plan (SWPPP) and submission of permits.	Point source discharges of stormwater to the waters of the State of New Jersey from construction activities. **Not Applicable**	As presented in this FFS, no significant land disturbance is anticipated as part of the proposed remedial alternatives that could cause stormwater runoff	40 CFR Part 122, 33 USC 1251 et seq.; NJ Stormwater Management(N.J.A.C. 7:8)	https://www.epa.gov/npdes https://www.epa.gov/npdes/developing-stormwater-pollution-prevention-plan-swppp https://www.nj.gov/dep/stormwater/
Land disturbance	Consider the requirements for obtaining a permit prior to any land disturbance. A plan must be developed prior to any land disturbance.	Actions that involve potential impacts to the land. **Not Applicable**	The remedial alternatives presented in this FFS apply to groundwater remedial activities and as such significant land disturbance is not planned or anticipated	NJ Soil Erosion and Sediment Control Act (N.J.S.A. 4:24-39 et seq.)	https://www.nj.gov/agriculture/divisions/anr/nrc/njerosion.html
Monitoring, Extraction and Injection Wells – Installation, Operation and Abandonment					
Construction of extraction, injection and monitoring wells	Provides state standards for the siting, construction, operation, maintenance, and abandonment of wells and boreholes to protect public health and water resources of the State and requires certain permits and licenses.	Activities related to construction, operation, maintenance and abandonment of wells. **Applicable**	Activities related to wells necessary for the remedy, to comply with substantive requirements.	NJ Well Construction and Maintenance; Sealing of Abandoned Wells (N.J.A.C.7:9D) NJ Water Pollution Control Act (N.J.A.C. 7:14)	https://www.nj.gov/dep/rules/rules/njac7_9d.pdf https://www.nj.gov/dep/rules/rules/njac7_14.pdf
Operation & Maintenance of extraction, injection and monitoring wells					
Abandonment of extraction, injection and monitoring wells and boreholes					
Activity associated with Class V injection wells (e.g., remediation injections)	Federal and state standards for injection activity to prevent the movement of fluid containing any contaminant into drinking water, if the presence of that contaminant may cause a violation of the primary drinking water standards under 40 CFR Part141, other health-based standards, or may otherwise adversely affect the health of persons.	Construction, operation, maintenance, conversion, plugging and closure of Class V injection wells associated with remedial activity. **Applicable**	Activities related to wells necessary for the remedy, to comply with substantive requirements.	40 CFR 144; Underground Injection Control, NJPDES, N.J.A.C.7:14A-1.9	https://www.law.cornell.edu/cfr/text/40/part-144/subpart-A https://www.state.nj.us/dep/dwq/714a.htm
Waste Characterization – Primary Waste (e.g., drill cuttings, purge water) and Secondary Waste (e.g., contaminated equipment or treatment residuals)					
Characterization of solid waste (all primary and secondary wastes)	Must determine if solid waste is a hazardous waste: - First determine if waste is excluded from regulation under 40 CFR 261.4; - Then determine if waste is listed as a hazardous waste under subpart D 40 CFR Part 261.	Generation of solid waste as defined in 40 CFR 261.2. **Relevant and Appropriate,** However, applicable only if waste characterization results show RCRA Hazardous Waste was generated during remedial activities	Hazardous waste characterization	40 CFR 262.11(a) and (b)	https://www.law.cornell.edu/cfr/text/40/part-262
	Must determine whether the waste is characteristic waste identified in Subpart C of 40 CFR part 261 by either: (1) Testing the waste according to the methods set forth in subpart C of 40 CFR part 261, or according to an equivalent method approved by the Administrator under 40 CFR 260.21; or (2) Applying knowledge of the hazard characteristic of the waste considering the materials or the processes used.	Generation of solid waste which is not excluded under 40 CFR 261.4(a). **Relevant and Appropriate,** However, applicable only if waste characterization results show RCRA Hazardous Waste was generated during remedial activities	Hazardous waste characterization	40 CFR 262.11(c)	https://www.law.cornell.edu/cfr/text/40/part-262
	Refer to Parts 261, 262, 264, 265, 266, 268, and 273 of Chapter 40 for possible exclusions or restrictions pertaining to management of the specific waste.	Generation of solid waste which is determined to be hazardous waste. **Relevant and Appropriate,** However, applicable only if waste characterization results show RCRA Hazardous Waste was generated during remedial activities	Hazardous waste characterization and management	40 CFR 262.11(d)	https://www.law.cornell.edu/cfr/text/40/part-262
	Must obtain a detailed chemical and physical analysis on a representative sample of the waste(s), which at a minimum contains all the information that must be known to treat, store, or dispose of the waste in accordance with pertinent sections of 40 CFR 264 and 268.	Generation of RCRA hazardous waste for storage, treatment or disposal. **Applicable**	Hazardous waste characterization and management	40 CFR 264.13(a)(1)	https://www.law.cornell.edu/cfr/text/40/part-264

Appendix B
Table B -3
Action-Specific ARARs and TBCs
Cosden Chemical Coatings Corporation Superfund Site
Beverly, Burlington County, New Jersey

Action	Requirements	Prerequisite	Consideration in this FFS	Citation	Website
Determination of waste code for management of hazardous waste	Must determine each EPA Hazardous Waste Number (waste code) is applicable to determine the applicable treatment standards under 40 CFR268 et seq. This determination may be made concurrently with the hazardous waste determination required in Sec. 262.11. Must comply with the special requirements of 40 CFR 268.9 in addition to any applicable requirements in CFR 268.7.	As necessary, accumulation of RCRA hazardous waste on site as defined in 40 CFR 260.10. **Relevant and Appropriate,** However, applicable only if the waste generated during remedial activities is characterized as RCRA hazardous waste for storage, treatment or disposal.	Hazardous waste treatment	40 CFR 268.9(a), 40 CFR 268.7(a)	https://www.law.cornell.edu/cfr/text/40/part-268
Hazardous waste regulations	Established to manage the discovery, storage, treatment or disposal of hazardous waste.	As necessary, accumulation of 55 gal. or less of RCRA hazardous waste or one quart of acutely hazardous waste listed in 261.33(e) at or near any point of generation. **Relevant and Appropriate,** However, applicable only if the waste generated during remedial activities is characterized as a RCRA hazardous waste	Hazardous waste management during remediation	NJ Waste Regulations (N.J.A.C. 7:26G)	https://www.state.nj.us/dep/dshw/resource/njac726g.pdf
Solid waste management	Established to manage the storage, treatment or disposal of solid waste.	Applies to Solid waste generated during remedial activities. **Applicable**	Solid waste management during remediation	NJ Solid Waste Regulations (N.J.A.C. 7:26, N.J.S.A. 13:1E-1 et seq.)	https://www.nj.gov/dep/dshw/resource/26sch01.pdf
Hazardous Waste Storage – Primary Waste (e.g., drill cuttings, purge water) and Secondary Waste (e.g., contaminated equipment or treatment residuals)					
Temporary on–site storage of hazardous waste in containers	A generator may accumulate hazardous waste at the facility provided that:	As necessary, accumulation of RCRA hazardous waste on site as defined in 40 CFR 260.10. **Relevant and Appropriate,** However, applicable only if RCRA Hazardous Waste is generated during remedial activities	Hazardous waste storage during remediation	40 CFR 262.34(a);	https://www.law.cornell.edu/cfr/text/40/part-262
	Waste is placed in containers that comply with 40 CFR 265.171 – 180 (USDOT Hazardous Materials Transportation Regulations) and		Hazardous waste storage during remediation	40 CFR 262.34(a)(1)(i);	
	The date upon which accumulation begins is clearly marked and visible for inspection on each container; Container is marked with the words "hazardous waste"; or waste pending analysis which is update appropriately following the receipt of results.		Hazardous waste storage during remediation	40 CFR 262.34(a)(2) and (3)	
	Container may be marked with other words that identify the contents.	As necessary, accumulation is 55 gal. or less of RCRA hazardous waste or one quart of acutely hazardous waste listed in 261.33(e) at or near any point of generation. **Relevant and Appropriate,** However, applicable only if RCRA Hazardous Waste is generated during remedial activities	Hazardous waste storage during remediation	40 CFR 262.34(c)(1)	
Use and management of hazardous waste in containers	If container is not in good condition (e.g. severe rusting, structural defects) or if it begins to leak, must transfer waste from this container to a container that is in good condition.	If Hazardous Waste is generated, applies to the storage of RCRA hazardous waste in containers. **Relevant and Appropriate,** However, applicable only if RCRA Hazardous Waste is generated during remedial activities	Hazardous waste storage during remediation	40 CFR 265.171	https://www.law.cornell.edu/cfr/text/40/part-265
	Must use container made or lined with materials compatible with waste to be stored so that the ability of the container to contain is not impaired.		Hazardous waste storage during remediation	40 CFR 265.172	
	Containers must be closed during storage, except when necessary to add/remove waste.		Hazardous waste storage during remediation	40 CFR 265.173(a)	
	Container must not opened, handled and stored in a manner that may rupture the container or cause it to leak.		Hazardous waste storage during remediation	40 CFR 265.173(b)	
Storage of hazardous waste in container area	Area must have a containment system designed and operated in accordance with 40 CFR 264.175(b)	As necessary, applies to the storage of RCRA hazardous waste in containers with free liquids. **Relevant and Appropriate,** However, applicable only if RCRA Hazardous Waste is generated during remedial activities	Hazardous waste storage during remediation	40 CFR 264.175(a)	https://www.law.cornell.edu/cfr/text/40/part-264
	Area must be sloped or otherwise designed and operated to drain liquid resulting from precipitation, or Containers must be elevated or otherwise protected from contact With accumulated liquid.	As necessary, applies to the storage of RCRA hazardous waste in containers that do not contain free liquids (other than F020, F021, F022, F023, F026 and F027). **Relevant and Appropriate,** However, applicable only if RCRA Hazardous Waste is generated during remedial activities.	Hazardous waste storage during remediation	40 CFR 264.175(c)(1) and (2)	
Closure of RCRA container storage unit	At closure, all hazardous waste and hazardous waste residues must be removed from the containment system. Remaining containers, liners, bases, and soils containing or contaminated with hazardous waste and hazardous waste residues must be decontaminated or removed.	If Hazardous waste is generated, applies to the storage of RCRA hazardous waste in containers in a unit with a containment system. **Relevant and Appropriate,** However, applicable only if RCRA Hazardous Waste is generated during remedial activities.	Hazardous waste storage During remediation	40 CFR 264.178	

Appendix B
Table B -3
Action-Specific ARARs and TBCs
Cosden Chemical Coatings Corporation Superfund Site
Beverly, Burlington County, New Jersey

Action	Requirements	Prerequisite	Consideration in this RI/FS	Citation	Website
Waste Treatment and Disposal – Primary Waste (e.g., treated groundwater, drill cuttings, purge water) and Secondary Waste (e.g., contaminated equipment or treatment residuals)					
Discharge of treated groundwater to POTW	Requirements for discharging pollutants into Publicly Owned Treatment Works (POTW) or privately-owned treatment facility operated by a person other than the indirect discharger.	Discharge to POTW. **Applicable only under FFS Alternative #2 – restart of the groundwater treatment system.**	Discharge of treated groundwater to POTW, to comply with substantive requirements.	40 CFR 122; 40 CFR 403; 40 CFR 9 NJ Water Pollution Control Act Rules (N.J.A.C. 7:14, N.J.S.A. 58:10A-a et seq.)	https.//www.federalregister.gov/documents/2005/10/14/05- 20001/streamlining-the-general- pretreatment-regulations-for-existing-and-new-sources-of-pollution https://www.nj.gov/dep/rules/rules/njac7_14.pdf
National Pollutant Discharge Elimination System / State Disposal System (NPDES/SDS) permits	Surface water quality requirements for discharges of pollutants to waters of the United States and to the waters of the State of NJ.	Point source discharge to Waters of the United States (WOTUS). **Applicable**	Discharge of treated groundwater to surface water / WOTUS, to comply with substantive requirements.	40 CFR 122; 40 CFR 131; NJDEP Pollutant Discharge Elimination System Rules (N.J.A.C. 7:14A)	https://www.law.cornell.edu/cfr/text/40/part-122 https://www.law.cornell.edu/cfr/text/40/part-131 https://www.nj.gov/dep/dwq/njpdes.htm
	Use of best available technology (BAT) economically achievable is required to control toxic and nonconventional pollutants. Use of best conventional pollutant control technology (BCT) is required to control conventional pollutants. Technology-based limitations may be determined on a case-by-case basis.		Discharge of treated groundwater to surface water / WOTUS, to comply with substantive requirements.	40 CFR 122.44(a)	https://www.law.cornell.edu/cfr/text/40/part-122
	Develop and implement a Best Management Practices program to prevent the release of toxic constituents to surface waters.		Discharge of treated groundwater to surface water / WOTUS, to comply with substantive requirements.	40 CFR 125.100	https://www.law.cornell.edu/cfr/text/40/part-125
Waste Transportation – Primary Waste (e.g., treated groundwater, drill cuttings, purge water) and Secondary Waste (e.g., contaminated equipment or treatment residuals)					
Transportation of hazardous waste on-site	The generator manifesting requirements of 40 CFR 262.20-262.32(b) do not apply. Generator or transporter must comply with the requirements set forth in 40 CFR 263.30 and 263.31 in the event of a discharge of hazardous waste on a private or public right-of-way.	Transportation of hazardous wastes on a public or private right-of-way within or along the border of contiguous property under the control of the same person, even if such contiguous property is divided by a public or private right-of-way. **Relevant and Appropriate,** However, applicable only if RCRA Hazardous Waste is generated during remedial activities	Hazardous waste transport on-site	40 CFR 262.20(f)	https://www.law.cornell.edu/cfr/text/40/part-262
Transportation of hazardous waste off-site	Must comply with the generator standards of Part 262 including 40 CFR 262.20-23 for manifesting, Sect. 262.30 for packaging, Sect. 262.31 for labeling, Sect. 262.32 for marking, Sect. 262.33 for placarding,	Preparation and initiation of shipment of hazardous waste off-site. **Relevant and Appropriate,** However, applicable only if RCRA Hazardous Waste is generated during remedial activities	Hazardous waste transport off-site	40 CFR 262.10(h); 40 CFR 262, Subpart B and C	https://www.law.cornell.edu/cfr/text/40/part-262
Transportation of hazardous materials	Shall be subject to and must comply with all applicable provisions of the Hazardous Materials Transportation Act and Hazardous Materials Regulations at 49 CFR 171-180 related to marking, labeling, placarding, packaging, emergency response, etc.	Any person who, under contract with a department or agency of the federal government, transports “in commerce,” or causes to be transported or shipped, a hazardous material. **Relevant and Appropriate,** However, applicable only if RCRA Hazardous Waste is generated during remedial activities	Hazardous waste transport off-site	49 CFR 171.(c); 40 CFR 262, Subpart B and C	https://www.law.cornell.edu/cfr/text/49/part-171
Transportation of samples (i.e.,contaminated soil and wastewaters)	Are not subject to any requirements of 40 CFR Parts 261 through 268 or 270 when: - The sample is being transported to a laboratory for the purpose of testing; or - The sample is being transported back to the sample collector after testing - The sample is being stored by sample collector before transport to a lab for testing	Samples of solid waste or a sample of water, soil for purpose of conducting testing to determine its characteristics or composition. **Applicable**	Hazardous waste transport off-site	40 CFR 261.4(d)(1)(i)-(iii)	https://www.law.cornell.edu/cfr/text/40/part-261

Appendix B
Table B -3
Action-Specific ARARs and TBCs
Cosden Chemical Coatings Corporation Superfund Site
Beverly, Burlington County, New Jersey

Action	Requirements	Prerequisite	Consideration in this RI/FS	Citation	Website
Air Quality					
Air quality control	Establishes air quality standards for discharge of pollutants to air for the protection of public health and preservation of ambient air quality.	**Applicable for FFS Alternative #2 (Groundwater Treatment)**	Under Alt. #2 (Groundwater Treatment) The proper air quality control measures will be taken prior to treatment system start-up	Clean Air Act (42 USC 7401); National Ambient Air Quality Standards (40 CFR 50); National Emission Standards for Hazardous Air Pollutants (40 CFR Part 61, 63); 40 CFR Part 52 New Source Review and Prevention of Significant Deterioration Requirements NJ Air Pollution Rules (N J A C 7:27)	https://www.epa.gov/laws-regulations/summary-clean-air-act https://www.epa.gov/naaqs https://www.epa.gov/compliance/national-emission-standards-hazardous-air-pollutants-compliance-monitoring https://www.epa.gov/nsr/prevention-significant-deterioration-basic-information https://www.nj.gov/dep/aqm/
Miscellaneous					
Noise Pollution	Established to set maximum limits of sound from any industrial, commercial, public service, or community service facility.	**To Be Considered for FFS Alternatives #2 (Groundwater Treatment) and #3 (ISCO Injection)**	Under Alt. #2, Any noise generated during system overhaul, and start-up will occur only on weekdays during normal business hours or as specified by local ordinance. Under Alt. #3, Any noise generated during advancing injection points to target depths and ISCO injection will occur only on weekdays during normal business hours or as specified by local ordinance.	NJ Restrictions of Noise (N.J.A.C. 7:29)	https://www.nj.gov/dep/rules/rules/njac7_29.pdf

Abbreviations:

ARAR = applicable or relevant and appropriate requirement
CFR = Code of Federal Regulations
USC = United States Code
FFS= Focused Feasibility Study
TBC= To Be Considered

APPENDIX C

ISCO PILOT STUDY INJECTION LOCATIONS

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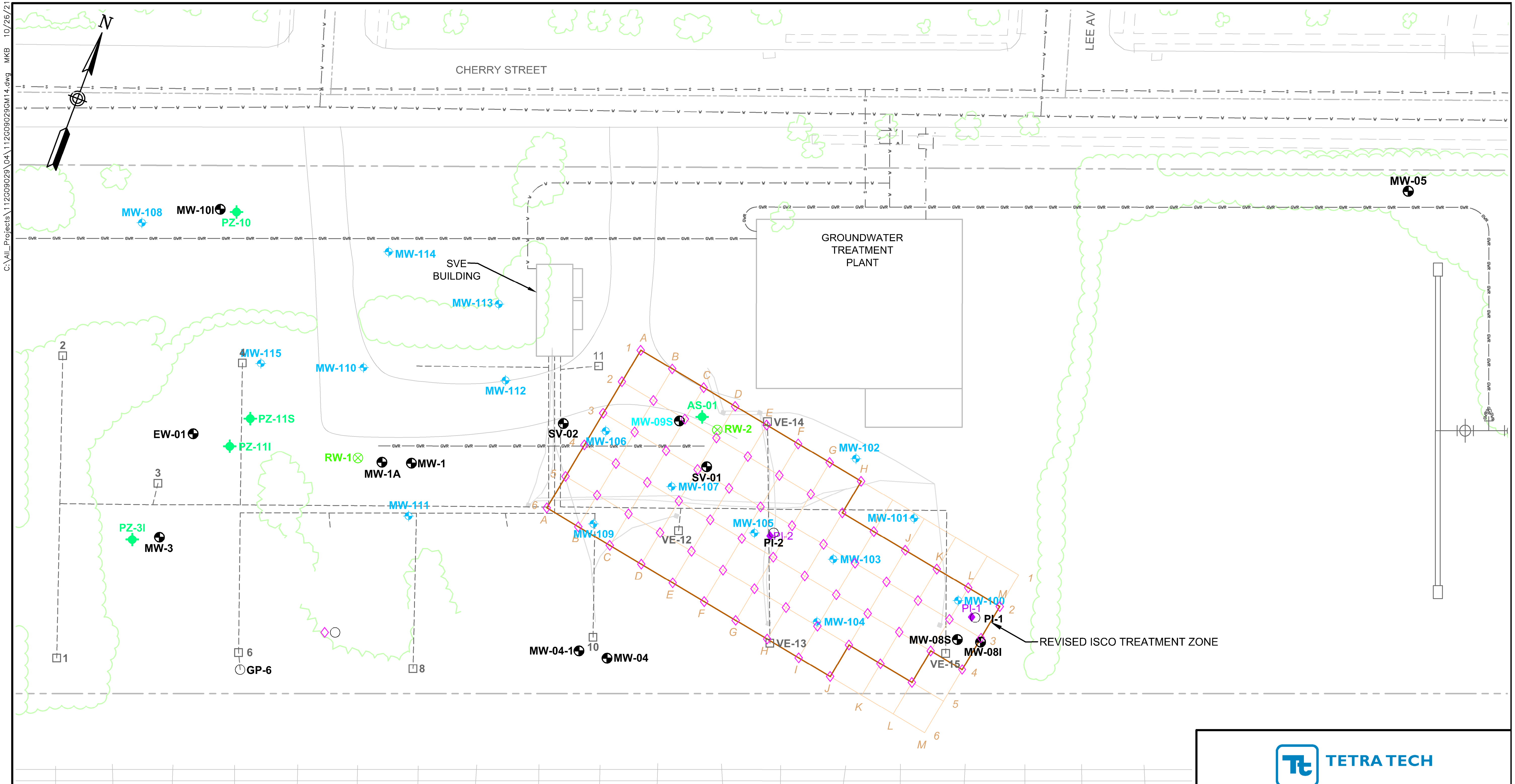

LEGEND

□	VE WELL
------	VE PIPING
◐	EXISTING MONITORING WELL
⊕	NEW MONITORING WELL
⊗	EXTRACTION WELL
✦	PIEZOMETER WELL
✦	PIEZOMETER
○	PHASE II SOIL BORING LOCATION
◇	REVISED INJECTION POINT
◆	PRE-INJECTION POINT
——	AGS UTILITY

0 40 80

SCALE IN FEET

TETRA TECH

PHASE 1 PART 1
INJECTION POINTS AND WELL LOCATIONS
COSDEN CHEMICAL SUPERFUND SITE
BEVERLY, NEW JERSEY

FILE 112G09029GM14-3	SCALE AS NOTED
NUMBER 2-1	REV 0 DATE 10/26/21

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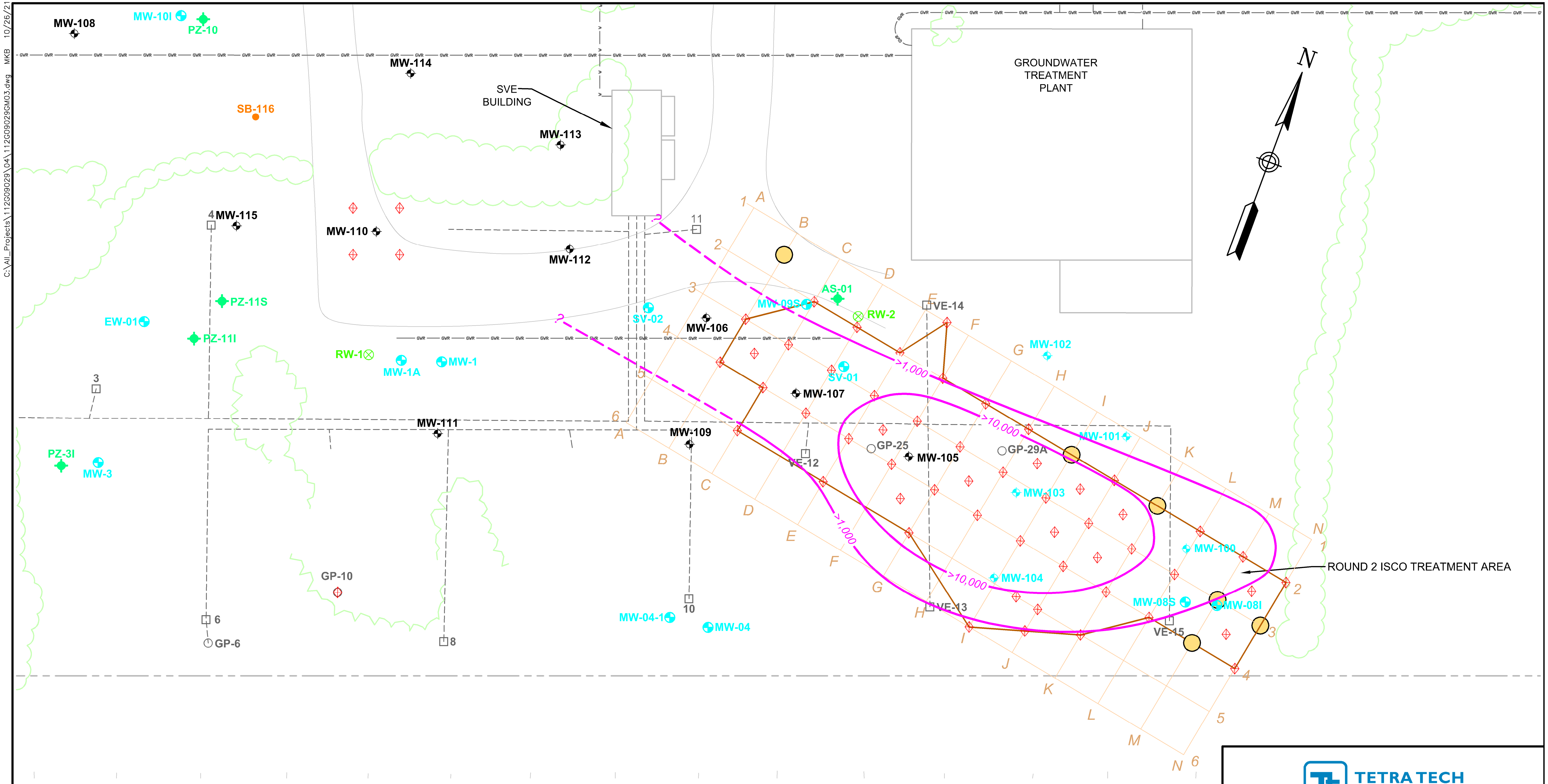

LEGEND

□ SVE WELL

- - - - - - SVE PIPING

● EXISTING MONITORING WELL

◆ NEW 2018 MONITORING WELL

⊗ EXTRACTION WELL

○ SOIL BORING

● NEW 2018 SOIL BORING LOCATION

◆ PIEZOMETER WELL

—>1,000— ELEVATED TOTAL XYLENE GROUNDWATER CONCENTRATIONS (NOVEMBER 2018) (DASHED WHERE INFERRED) (RESULT IN µg/L)

◇ PHASE 1 PART 2 INJECTION POINT

● NOT COMPLETED OR UNSUCCESSFUL

0 30 60
SCALE IN FEET

TETRA TECH

PHASE 1 PART 2
INJECTION POINTS AND WELL LOCATIONS
COSDEN CHEMICAL SUPERFUND SITE
BEVERLY, NEW JERSEY

FILE	SCALE
112G09029GM03	AS NOTED

FIGURE NUMBER	REV	DATE
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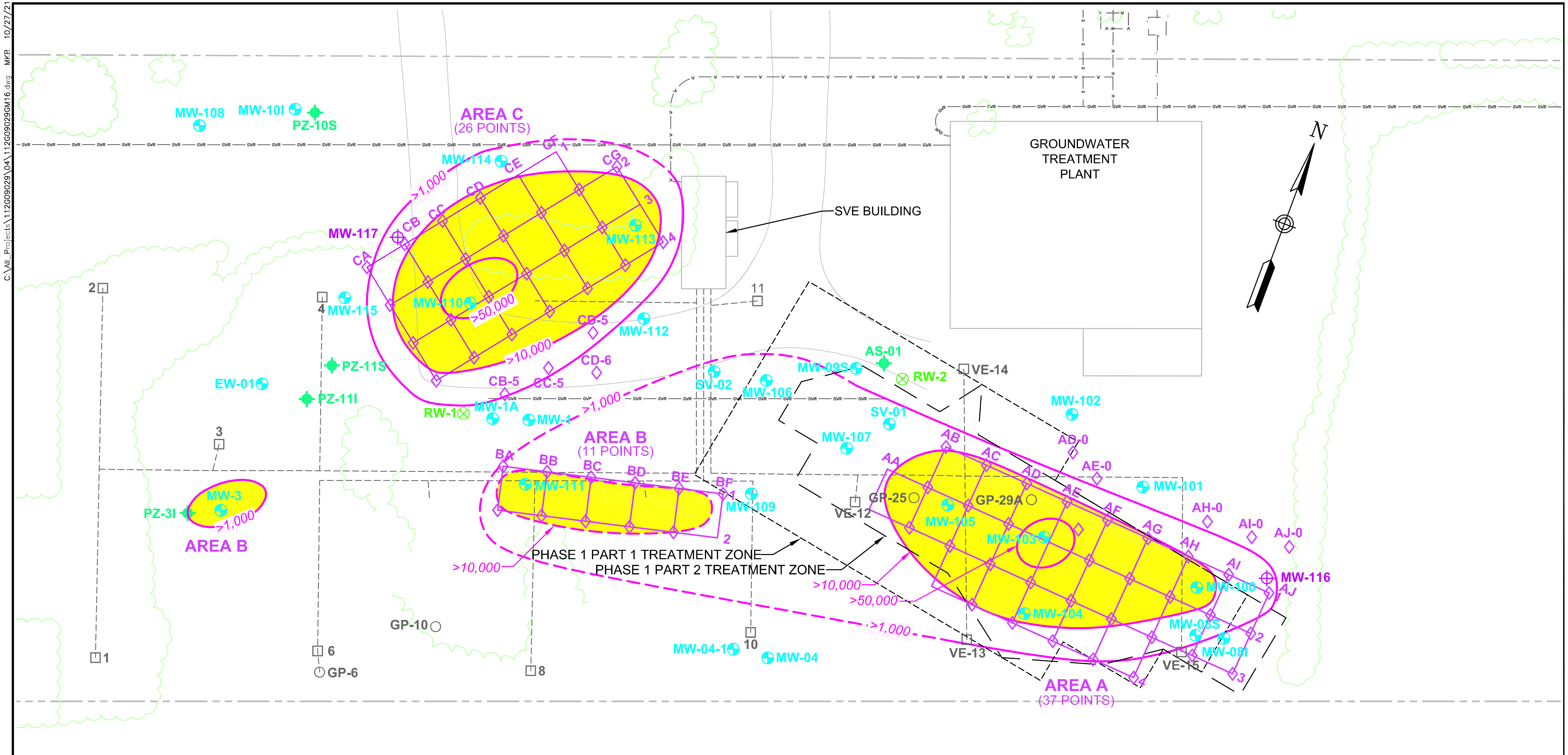

LEGEND

□ SVE WELL

- - - - SVE PIPING

⊕ EXISTING MONITORING WELL

⊗ EXTRACTION WELL

○ SOIL BORING

⊕ PIEZOMETER WELL

⊕ PROPOSED PHASE II MONITORING WELL

◇ PHASE 2A INJECTION POINT

—>1,000— ELEVATED TOTAL XYLENE CONCENTRATIONS (FEBRUARY 2019) (DASHED WHERE INFERRED)

● PHASE 2A TARGET TREATMENT AREAS

PHASE 1 PART 1 TREATMENT ZONE

PHASE 1 PART 2 TREATMENT ZONE

0 40 80
SCALE IN FEET

TETRA TECH

PHASE 2A
TARGET TREATMENT AREAS
AND INJECTION POINTS
COSDEN CHEMICAL SUPERFUND SITE
BEVERLY, NEW JERSEY

FILE 112G09029GM16	SCALE AS NOTED	
FIGURE NUMBER 6–1	REV 0	DATE 10/27/21

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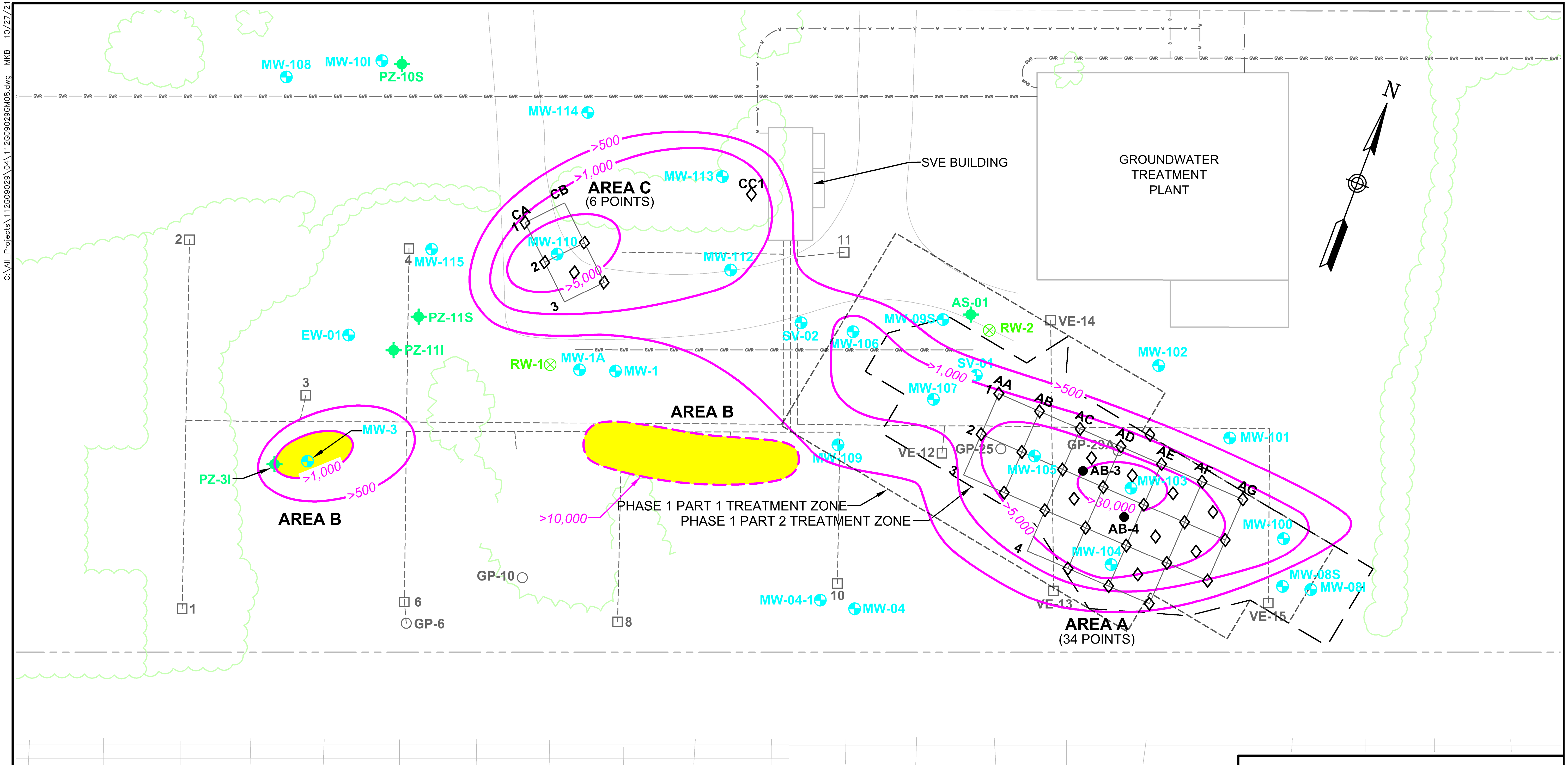

LEGEND

□	SVE WELL	●	TEMPORARY WELL LOCATION (INSTALLED BY USACE)
- - - -	SVE PIPING	◇	PHASE 2B INJECTION POINT
●	EXISTING MONITORING WELL	—>1,000—	ELEVATED TOTAL XYLENE CONCENTRATIONS (JUNE 2020) (DASHED WHERE INFERRED)
⊗	EXTRACTION WELL	●	PHASE 2A TARGET TREATMENT AREAS
○	SOIL BORING	⬚	PHASE 1 PART 1 TREATMENT ZONE
✦	PIEZOMETER WELL	⌐ ¬	PHASE 1 PART 2 TREATMENT ZONE

0 40 80

SCALE IN FEET

TETRA TECH

PHASE 2B
TARGET TREATMENT AREAS
AND INJECTION POINTS
COSDEN CHEMICAL SUPERFUND SITE
BEVERLY, NEW JERSEY

FILE	SCALE
112G09029GM08	AS NOTED

FIGURE NUMBER	REV	DATE
6–2	1	10/27/21

APPENDIX D

Cost Calculations

APPENDIX D: FOCUSED FEASIBILITY STUDY COST ESTIMATE

PROJECT

Cosden Chemical Coatings Corporation Superfund Site
Cost Estimate - Groundwater Treatment and Extraction

	DESCRIPTION	ESTIMATED AMOUNT
	GROUNDWATER EXTRACTION AND TREATMENT	
	Groundwater Extraction and Treatment Capital Cost	**$555,650.00**
	Groundwater Extraction and Treatment Annual O&M Cost	$747,000.00
	Groundwater Extraction and Treatment Present Value of O&M Costs over 30 years	**$9,270,270.00**
	Groundwater Extraction and Treatment Present Value of Monitoring Costs over 30 years	**$496,400.00**
	TOTAL: GROUNDWATER	**$10,322,320.00**
	IN SITU CHEMICAL OXIDATION (ISCO)	
	ISCO Capital Cost (New Monitoring Wells)	**$30,000.00**
	ISCO Injection Cost	**$883,500.00**
	Groundwater Extraction and Treatment Present Value of Monitoring Costs over 30 years	**$496,400.00**
	TOTAL: ISCO	**$1,409,900.00**

Cosden Chemical Coatings Corporation Superfund Site
Cost Estimate - Groundwater Extraction and Treatment

Capital Cost

Cost Item	Unit Price	Units	Estimate Cost
Work Plan, APP, QAPP, OM Plan Updates	$20,000.00	1.00	$20,000.00
SCADA Upgrades	$200,000.00	1.00	$200,000.00
Multi-Media Filtration System	$150,000.00	1.00	$150,000.00
New Extraction Wells	$80,000.00	1.00	$80,000.00
Equipment Replacement (as necessary)	$75,000.00	1.00	$75,000.00
Start-Up Transition	$30,650.00	1.00	$30,650.00
			$555,650.00
Total Capital Cost			**$555,650.00**

Annual Operation and Maintenance (O&M) Cost

Cost Item	Unit Price	Units	Estimate Cost
Utilities Account	$40,000.00	1.00	$40,000.00
Treatment System Operation	$454,000.00	1.00	$454,000.00
Maintenance and Spare Parts	$25,000.00	1.00	$25,000.00
USACE Labor (Oversight and Contracting)	$228,000.00	1.00	$228,000.00
			$747,000.00
Total Annual O&M Cost			**$747,000.00**

Present Value of O&M Cost

Estimate

Present Worth Calculation for O&M

This is a recurring annual cost

The discount factor is (P/A,I,n)

P = Present Worth

A = Annual amount

I = interest rate 7%

n - number of years 30

$$P = A \times \frac{(1+i)^n-1}{i(1+i)^n}$$

For n=30 years, the multiplier for (P/A) = 12.41

Annual O&M Cost	$747,000.00	12.41	$9,270,270.00
			$9,270,270.00
Total Present Value of O&M Cost (30 Years)			**$9,270,270.00**

Present Value of Long Term Monitoring

For n=30 years, the multiplier for (P/A) = 12.41

Annual Monitoring Cost	$30,000.00	12.41	$372,300.00
Annual Reporting Cost	$10,000.00		$124,100.00
			$496,400.00
Total Present Value of Monitoring Cost (30 Years)			**$496,400.00**
Total Present Value, All Costs (30 Years)			**$10,322,320.00**

Cosden Chemical Coatings Corporation Superfund Site
Cost Estimate -ISCO Injections

Capital Cost

Cost Item	Unit Price	Estimate Units	Cost
Monitoring Well Install- 2 New Wells	$30,000.00	1.00	$30,000.00
Total Capital Cost			**$30,000.00**

Injection Cost

Cost Item	Unit Price	Estimate Units	Cost
Work Plan, APP, QAPP Updates	$4,000.00	1.00	$4,000.00
Mobe/Demobe- Per Event	$16,000.00	5.00	$80,000.00
Injection Rounds 1-3 (25 points)	$115,000.00	3.00	$345,000.00
Injection Rounds 4-5 (10 points)	$46,000.00	2.00	$92,000.00
Monitoring- 2 Sampling Rounds Per Injection F	$60,000.00	5.00	$300,000.00
Reporting (5 memos + 1 summary rpt)	$30,000.00	1.00	$30,000.00
USACE Labor (Oversight + Contracting)	$32,500.00	1.00	$32,500.00
Total Injection Cost			**$883,500.00**

Present Value of Long Term Monitoring

Estimate

Present Worth Calculation for O&M

This is a recurring annual cost
The discount factor is (P/A,I,n)
P = Present Worth
A = Annual amount
I = interest rate 7%
n - number of years 30

$$P = A \times \frac{(1+i)^n-1}{i(1+i)^n}$$

For n=30 years, the multiplier for (P/A) = 12.41

	Unit Price	Units	Cost
Annual Monitoring Cost	$30,000.00	12.41	$372,300.00
Annual Reporting Cost	$10,000.00		$124,100.00
			$496,400.00
Total Present Value of Monitoring Cost (30 Years)			**$496,400.00**

Total Present Value, All Costs (30 Years)	**$1,409,900.00**