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Office of Solid Waste and Emergency Response
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Technology Innovation

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Remedial Design Optimization Review Report

East 67th Street Ground Water Plume NPL Site
Odessa, Ector County, Texas
EPA Region 6

OPTIMIZATION REVIEW

EAST 67TH STREET GROUND WATER PLUME NPL SITE
ODESSA, ECTOR COUNTY, TEXAS
EPA REGION 6

FINAL REPORT

January 10, 2014

EXECUTIVE SUMMARY

NATIONAL OPTIMIZATION STRATEGY BACKGROUND

The U.S. Environmental Protection Agency's definition of optimization is as follows:

> "*Efforts at any phase of the removal or remedial response to identify and implement specific actions that improve the effectiveness and cost-efficiency of that phase. Such actions may also improve the remedy's protectiveness and long-term implementation which may facilitate progress towards site completion. To identify these opportunities, Regions may use a systematic site review by a team of independent technical experts, apply techniques or principles from Green Remediation or Triad, or apply some other approaches to identify opportunities for greater efficiency and effectiveness*."[1]

An optimization review considers the goals of the remedy, available site data, conceptual site model (CSM), remedy performance, protectiveness, cost-effectiveness and closure strategy. A strong interest in sustainability has also developed in the private sector and within Federal, state and municipal governments. Consistent with this interest, optimization now routinely considers green remediation and environmental footprint reduction during optimization reviews.

An optimization review includes reviewing site documents, interviewing site stakeholders, potentially visiting the site for one day and compiling a report that includes recommendations in the following categories:

- Protectiveness
- Cost-effectiveness
- Technical improvement
- Site closure
- Environmental footprint reduction

The recommendations are intended to help the site team identify opportunities for improvements in these areas. In many cases, further analysis of a recommendation, beyond that provided in this report, may be needed prior to implementation of the recommendation. Note that the recommendations are based on an independent review and represent the opinions of the optimization review team. These recommendations do not constitute requirements for future action, but rather are provided for consideration by the EPA Region and other site stakeholders. Also note that while the recommendations may provide some details to consider during implementation, the recommendations are not meant to replace other, more comprehensive, planning documents such as work plans, sampling plans and quality assurance project plans (QAPP).

The national optimization strategy includes a system for tracking consideration and implementation of the optimization recommendations and includes a provision for follow-up technical assistance from the optimization review team as mutually agreed upon by the site management team and EPA OSRTI.

[1] EPA. 2012. Memorandum: Transmittal of the National Strategy to Expand Superfund Optimization Practices from Site Assessment to Site Completion. From: James. E. Woolford, Director Office of Superfund Remediation and Technology Innovation. To: Superfund National Policy Managers (Regions 1 – 10). Office of Solid Waste and Emergency Response (OSWER) 9200.3-75. September 28.

SITE-SPECIFIC BACKGROUND

The East 67th Street Ground Water Plume Superfund Site (East 67th Street Site) is located in Odessa, Ector County, Texas in EPA Region 6. The site was added to the National Priorities List (NPL) on March 7, 2007, and is managed as a fund-lead site. A Remedial Investigation (RI) and report were finalized in May 2010 and a Record of Decision (ROD) was signed in September 2011. The site is currently in the Remedial Design (RD) phase. The site was nominated for an optimization review at the request of the Region 6 Remedial Project Manager (RPM) in January 2013.

The site consists of a contaminated groundwater plume originating from a 1985 release of alcohols, naphtha-based solvents and tetrachloroethene (PCE) from above ground tanks. The plume encompasses an area of at least 60 acres in the Trinity Aquifer, which is the only source for drinking water in the area outside of the Odessa city limits. The primary contaminants of concern (COCs) are PCE, trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2 DCE). The current CSM is detailed in documents including the ROD, RI reports, and data evaluation summaries. A summary of the CSM components relevant to RD is provided below.

SUMMARY OF CONCEPTUAL SITE MODEL AND KEY FINDINGS

The source of Site contamination was a single release of 15,000 gallons of chemicals, including 635 gallons of PCE, caused by an act of vandalism at the former Delta Solvents Company facility in March of 1985. The original spill was remediated at the time of release, but a resulting groundwater plume was identified by the Texas Commission on Environmental Quality (TCEQ) during routine monitoring of public water supplies in 2004. The plume is located in a rural residential area with some light industry. Area groundwater is also affected by elevated nitrate concentrations, most likely resulting from septic releases.

Site stratigraphy consists of unconsolidated overburden deposits overlying shale bedrock of the Dockum Group at a depth of approximately 145 feet (ft) below ground surface (bgs). Overburden deposits consist of:

- Quaternary Alluvium - eolian sand, unsaturated
- Ogallala Formation - differentiated as follows:
    - Caprock consisting of fractured caliche, unsaturated
    - Upper sand number 1 (US1), unsaturated
    - Upper clay number 1 (UC1), unsaturated
    - Upper sand number 2 (US2), saturated or unsaturated depending on rainfall
    - Upper clay number 2 (UC2), saturated or unsaturated depending on rainfall
- Trinity Sands, differentiated as follows:
    - Lower sand number 1 (LS1), saturated
    - Lower clay number 1 (LC1), saturated
    - Lower sand number 2 (LS2), saturated

The dissolved-phase plume is present in US2 (saturated at the time of the optimization review) and LS1. Contaminants are transported in the subsurface in both the dissolved phase and vapor phase. Existing private water supply wells are not typically grouted above the screened interval, or have long screen intervals, that allow contamination from US2 to migrate vertically past the UC2 and into the LS1. The TCEQ has installed granular activated charcoal (GAC) water filtration systems on 14 private wells located within the plume in LS1 and is presently providing operation and maintenance on the systems.

The optimization review team identified the following data gaps in the current CSM relevant to RD:

- The quantity of mass remaining in vadose zone soils that is capable of causing long-term contamination and its potential response to soil vapor extraction (SVE) treatment;
- Extent of dissolved groundwater contamination in US2;
- Potential effect of active in situ bioremediation (ISB) on secondary water quality issues such as mobilization of arsenic, manganese and iron;
- Potential mechanisms for vertical migration of contamination;
- Extent of contaminant migration and time frame for aquifer restoration once relevant supply wells are plugged and abandoned.

SUMMARY OF RECOMMENDATIONS

The optimization review team identified the following priorities for RD and implementation:

- Eliminate exposure pathways and vertical migration by replacing specific private water supply wells that may function as conduits to LS1.
- Improve plume monitoring by installing new groundwater monitoring wells.
- Increase priority of implementing US2 ISB groundwater remedy, rather than the proposed extraction and treatment remedy. Use extracted groundwater for ISB substrate blending and delivery.
- Conduct small-scale soil vapor extraction (SVE) pilot test in source area. SVE pilot will improve characterization of contaminant mass remaining in the vadose.
- Evaluate the need for active remediation in LS1 after plugging supply wells that appear to be contaminant transport conduits to the lower unit. If remediation is required in LS1, ISB is recommended.
- Implement remedy performance monitoring.
- Establish exit criteria for each active remedy component.
- No recommendations were identified for improvements in data management or green remediation goals.

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NOTICE AND DISCLAIMER

Work described herein, including preparation of this report, was performed by Tetra Tech for the U.S. Environmental Protection Agency under Work Assignment 2-58 of EPA contract EP-W-07-078 with Tetra Tech EM, Inc., Chicago, Illinois. The report was approved for release as an EPA document, following the Agency's administrative and expert review process.

This optimization review is an independent study funded by the EPA that focuses on protectiveness, cost-effectiveness, site closure, technical improvements and green remediation. Detailed consideration of EPA policy was not part of the scope of work for this review. This report does not impose legally binding requirements, confer legal rights, impose legal obligations, implement any statutory or regulatory provisions or change or substitute for any statutory or regulatory provisions. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Recommendations are based on an independent evaluation of existing site information, represent the technical views of the optimization review team and are intended to help the site team identify opportunities for improvements in the current site remediation strategy. These recommendations do not constitute requirements for future action, rather they are provided for consideration by the EPA Region and other site stakeholders.

While certain recommendations may provide specific details to consider during implementation, these are not meant to supersede other, more comprehensive planning documents such as work plans, sampling plans and quality assurance project plans (QAPP), nor are they intended to override Applicable or Relevant and Appropriate Requirements (ARAR). Further analysis of recommendations, including review of EPA policy may be needed prior to implementation.

PREFACE

This report was prepared as part of a national strategy to expand Superfund optimization practices from site assessment to site completion implemented by the U.S. Environmental Protection Agency Office of Superfund Remediation and Technology Innovation (OSRTI)[2]. The project contacts are as follows:

ORGANIZATION	KEY CONTACT	CONTACT INFORMATION
EPA OSRTI	Kirby Biggs	EPA OSRTI Technology Innovation and Field Services Division 2777 Crystal Dr. Arlington, VA 22202 biggs.kirby@epa.gov phone: 703-823-3081
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GSI Environmental (Contractor to Tetra Tech)	Mindy Vanderford, Ph.D	GSI Environmental, Inc. 2211 Norfolk, Suite 1000 Houston, TX 77098 mvanderford@gsi-net.com phone: 713-522-6300 x 186

[2] EPA. 2012. Memorandum: Transmittal of the National Strategy to Expand Superfund Optimization Practices from Site Assessment to Site Completion. From: James. E. Woolford, Director Office of Superfund Remediation and Technology Innovation. To: Superfund National Policy Managers (Regions 1 – 10). Office of Solid Waste and Emergency Response (OSWER) 9200.3-75. September 28.

LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	Micrograms per Liter
ARAR	Applicable or Relevant and Appropriate Requirements
bgs	Below Ground Surface
CSM	Conceptual Site Model
COC	Contaminant of Concern
cis-1,2 DCE	*cis*-1,2-Dichloroethene
EPA	U.S. Environmental Protection Agency
ERT	Emergency Response Team
ft	Feet
GAC	Granular Activated Carbon
HQ	Headquarters
ISB	*In Situ* Bioremediation
LC	Lower Clay
LS	Lower Sand
MAROS	Monitoring and Remediation Optimization Systems
MCL	Maximum Contaminant Level
NPL	National Priorities List
ORP	Oxidation Reduction Potential
OSRTI	Office of Superfund Remediation and Technology Innovation
PCE	Tetrachloroethene (aka Perchloroethylene)
QAPP	Quality Assurance Project Plans
RAC	Remedial Action Contractor
RAO	Remedial Action Objective
RD	Remedial Design
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
SVE	Soil Vapor Extraction
TCE	Trichloroethene
TCEQ	Texas Commission on Environmental Quality
TOC	Total Organic Carbon
UC	Upper Clay
US	Upper Sand
VOC	Volatile Organic Compound

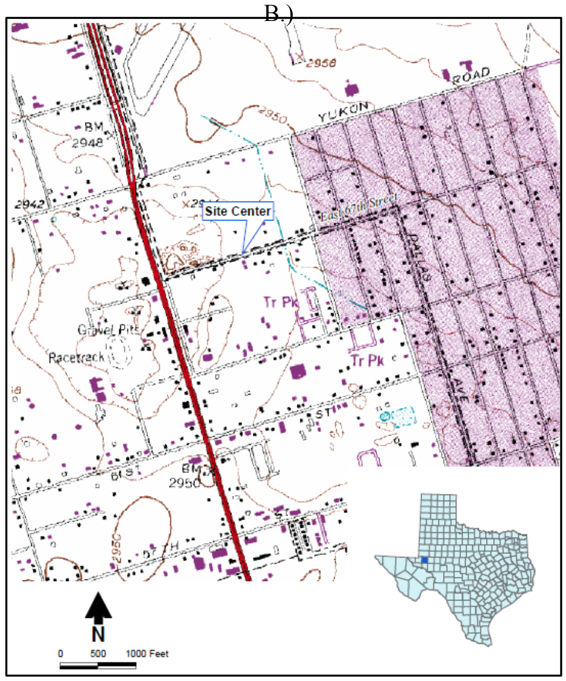
1.0 OBJECTIVES OF THE OPTIMIZATION REVIEW

For more than a decade, the Office of Superfund Remediation and Technology Innovation (OSRTI) has provided technical support to the EPA regional offices through the use of independent (third party) optimization reviews at Superfund sites. The East 67th Street Ground Water Plume Superfund Site (East 67th Street Site) was nominated for an optimization review at the request of the Region 6 Remedial Project Manager (RPM) in January 2013. The current optimization review of the site is intended to improve protectiveness, reduce cost and reduce the time required to attain cleanup goals.

To this end, an optimization review team (described below) was assembled and met with regulatory stakeholders and consultants in Dallas, Texas to review site data, remediation goals, potential funding and time frames to implement the remedy. This report is a summary of the recommendations of the optimization review team based on a review of Site documents and meeting with stakeholders.

FIGURE 1. Site location

(Excerpt from Figure 1 of the September 2011 ROD. A full size version of this figure is provided in Appendix B.)



The site is located in Odessa, Ector County, Texas in EPA Region 6 (Figure 1). The site was added to the National Priorities List (NPL) on March 7, 2007. A Remedial Investigation (RI) and report was finalized in May 2010 and a Record of Decision (ROD) was signed in September 2011. The site is currently in the Remedial Design (RD) phase.

Objectives of the RD optimization review included:

- Review of conceptual site model (CSM)
- Review of Remedial Action Objectives (RAO)
- Review of proposed remedies and associated costs
- Provide recommendations for:
    - CSM improvements
    - Remedy improvements
    - Prioritization and sequencing of the remedy components
    - Performance monitoring metrics in support of exit criteria for each remedy component

2.0 OPTIMIZATION REVIEW TEAM

The RD optimization review team consisted of the independent, third-party participants listed below. The optimization review team collaborated with representatives of EPA Headquarters and EPA Region 6, the Texas Commission on Environmental Quality (TCEQ) and representatives of EA Engineering, Science and Technology, Inc. (EA), the Remedial Action Contractor (RAC) for EPA.

The independent (third-party) optimization review team consisted of the following individuals:

TABLE 1. Optimization Review Team

NAME	ORGANIZATION	PHONE	EMAIL
Doug Sutton	Tetra Tech	732-409-0344	doug.sutton@tetratech.com
Mindy Vanderford	GSI Environmental, Inc.	713-522-6300	mvanderford@gsi-net.com

The following individuals contributed to the optimization review process, including being present for the onsite review meeting:

TABLE 2. Other Optimization Review Contributors

NAME	ORGANIZATION	TITLE/PARTY
Kirby Biggs	EPA HQ	Optimization Review Lead
Tom Kady	EPA HQ ERT	Optimization Review Team
Vincent Malott	EPA Region 6	RPM and Region 6 Optimization Liaison
Marilyn Czimer Long	TCEQ	Project Technical Support
Buddy Henderson	TCEQ	Project Manager
Jay Snyder	EA	RAC Consultant
Luis Vega	EA	RAC Consultant

EA = EA Engineering, Science and Technology, Inc.
ERT = Environmental Response Team
HQ = Headquarters
RAC = Remedial Action Contract
TCEQ = Texas Commission on Environmental Quality

A meeting to discuss the site was held at Region 6 Headquarters in Dallas, Texas on April 25, 2013. Documents reviewed for the optimization review effort are listed in Appendix A.

This optimization review used existing environmental data to interpret the CSM, evaluate potential future remedy performance and make recommendations to improve the remedy. The quality of the existing data was evaluated by the optimization review team prior to using the data for these purposes. The evaluation for data quality included a brief review of how the data were collected and managed (where practical, the site quality assurance project plan is considered), the consistency of the data with other site data and the use of the data in the optimization review. Data that were of suspect quality were either not used as part of the optimization review or were used with the quality concerns noted. Where appropriate, this report provides recommendations made to improve data quality.

3.0 REMEDIAL ACTION OBJECTIVES AND PROPOSED REMEDIES

The site includes a contaminated groundwater plume originating from a 1985 release of alcohols, naphtha-based solvents and tetrachloroethene (PCE) from above ground tanks. The plume encompasses an area of at least 60 acres in the Trinity Aquifer, which is the only source for drinking water in the area outside of the Odessa city limits. The primary contaminants of concern (COCs) are PCE, trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2 DCE). The current CSM is detailed in documents including the ROD, RI reports and data evaluation summaries. A summary of the CSM components relevant to RD is provided below.

3.1 REMEDIAL ACTION OBJECTIVES AND AFFECTED MEDIA

Remedial Action Objectives (RAOs) for the site have been developed to address COCs associated with the release of 15,000 gallons of chemicals, including 635 gallons of PCE released by an act of vandalism at the former Delta Solvents Company facility in March of 1985 (Figure 2). The former Delta Solvents Company facility is currently occupied by Brenntag Facilities. The site was identified by the TCEQ during routine monitoring of public water supplies in 2004. The plume is located in a rural residential area with some light industry (Figure 3).

FIGURE 2. Location of source area as indicated by passive soil gas sampling.
(Figure is an excerpt of Figure 8 from the September 2011 ROD. A full size version of the figure is provided in Appendix B.)

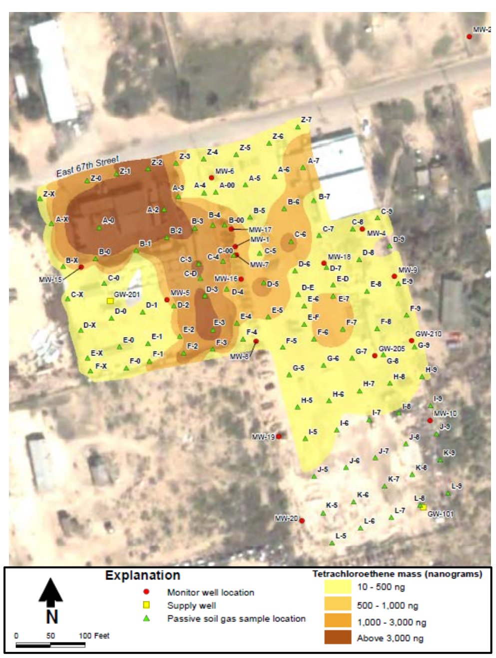
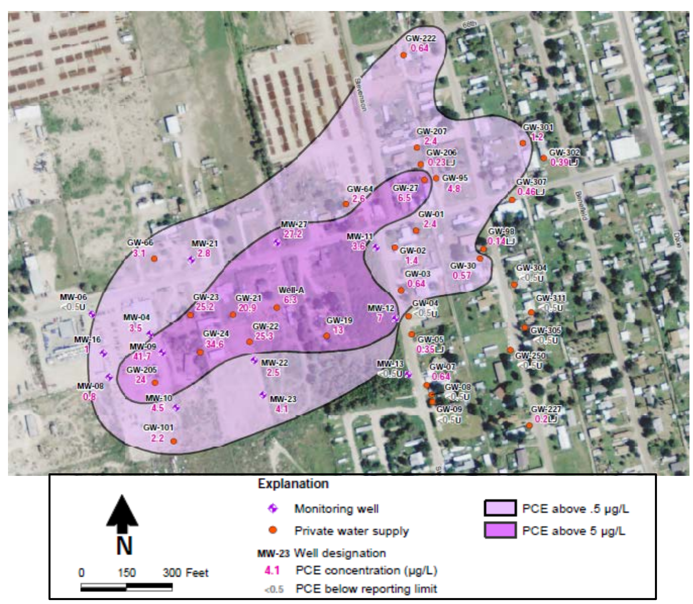


FIGURE 3. 2013 Distribution of PCE contamination in the LS1.
(Figure is an excerpt of a figure prepared by EA Engineering, Science and Technology. A full size version of the figure is provided in Appendix B.)

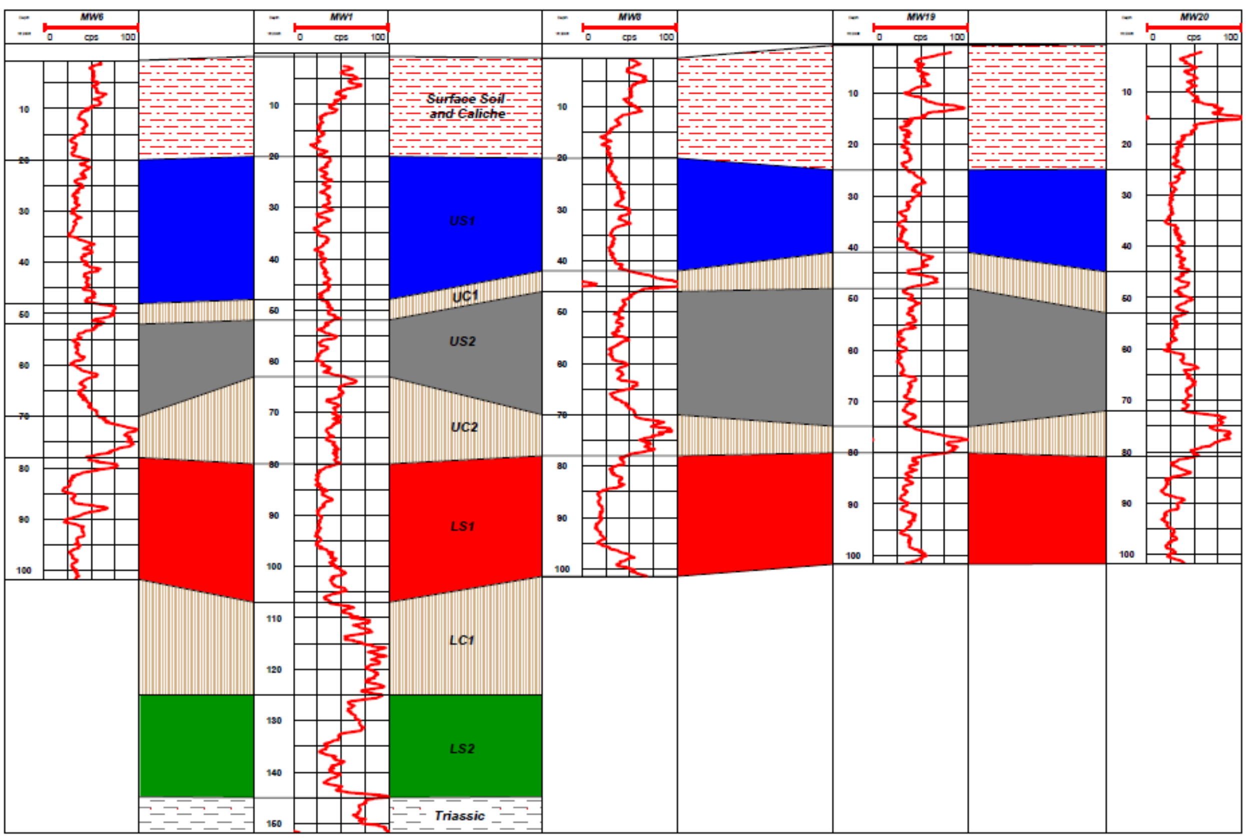


Site stratigraphy (Figure 4) consists of unconsolidated overburden deposits overlying the shale bedrock of the Dockum Group. The Docum Group begins at a depth of approximately 145 feet (ft) below ground surface (bgs). Overburden deposits consist of:

- Quaternary Alluvium, eolian sand, unsaturated
- Ogallala Formation, differentiated as follows:
  - Caprock consisting of fractured caliche, unsaturated
  - Upper sand number 1 (US1), unsaturated
  - Upper clay number 1 (UC1), unsaturated
  - Upper sand number 2 (US2), saturated or unsaturated depending on rainfall
  - Upper clay number 2 (UC2), saturated or unsaturated depending on rainfall
- Trinity Sands, differentiated as follows:
  - Lower sand number 1 (LS1), saturated
  - Lower clay number 1 (LC1), saturated
  - Lower sand number 2 (LS2), saturated

FIGURE 4. Geologic cross-section illustrating the various sand and clay layers at the East 67th Street Site.

US2 and LS1 are contaminated. US2 is sometimes saturated. LS1 is always saturated and is the interval screened by most existing water supply wells in the area. Most existing water supply wells in the LS1 are not grouted above the screen interval and serve as preferential vertical pathways for contamination to migrate from US2 to LS1. New water supply wells can be installed in LS2. (Figure is an excerpt of a Figure 3 from the September 2011 ROD. A full size version of the figure is provided in Appendix B.)



The dissolved-phase plume is present in US2 (saturated at the time of the optimization review) and LS1. Contaminants are transported in the subsurface in both the dissolved phase and vapor phase. Existing private water supply wells are not typically grouted above the screened interval, or have long screen intervals, that allow contamination from US2 to migrate vertically past the UC2 and into the LS1. The TCEQ has installed granular activated charcoal (GAC) water filtration systems on 14 private wells located within the plume in LS1 and is presently providing operation and maintenance on the systems.

Site COCs and cleanup levels based on federal Maximum Contaminant Levels (MCLs) are shown in Table 3. Affected and potentially affected media along with potential exposure/migration pathways are summarized in Table 4. Table 5 lists RAOs for the source area and downgradient groundwater.

TABLE 3: COCs and Cleanup goals

CONSTITUENT NAME	AFFECTED MEDIA	CLEANUP GOAL
PCE	Trinity Aquifer	5 µg/L
TCE		5 µg/L
cis-1,2 DCE		70 µg/L
Benzene		5 µg/L
Vinyl chloride		2 µg/L

µg/L = micrograms per liter

TABLE 4: Affected or Potentially Affected Media on Site

MEDIUM	LOCATION	COMPOSITION	POTENTIAL EXPOSURE/MIGRATION PATHWAYS
Vadose Zone Soils	Quaternary eolian sands and Ogallala Formation (US1 and US2) in source area around Brenntag Facilities building	Sands, silts, fine sands and gravels separated by layers of clay (UC1 and UC2)	Infiltration to groundwater/direct exposure by excavation
Occasionally saturated lower Ogallala Formation (US2)	Approximately 50 to 70 feet (ft) below ground surface (bgs)	Highly transmissive, unconsolidated fine- to medium- grained sands	Migration to LS1 through unsealed wells or UC2 clay
Trinity Sands aquifer (LS1 and LS2)	65 ft or less of saturated thickness between 80 and 145 ft bgs	Highly transmissive, unconsolidated fine- to medium- grained sands	Primary local water supply
Indoor air	Commercial businesses and residences	Vapor intrusion study not completed	

TABLE 5: Remedial Action Objectives

REMEDIAL ACTION	REMEDIAL ACTION OBJECTIVE
Prevent Exposure	Prevent human exposure to COCs from water supply wells at concentrations above MCLs or concentration standards identified in Applicable or Relevant and Appropriate Requirements (ARARs)
Plume Containment	Prevent or minimize further migration of COCs in groundwater at concentrations exceeding the MCLs or identified by ARARs
Aquifer Restoration	Restore the groundwater to its expected beneficial uses, wherever practicable, so that concentrations of COCs are less than the applicable MCLs or concentrations identified in ARARs
Source Control	Prevent or minimize further migration of COCs in the vadose zone soils that would cause concentrations of COCs in groundwater to exceed MCLs or identified in ARARs and mitigate potential vapor intrusion

3.2 Proposed Remedies

Table 6 lists the remedies proposed in the ROD.

TABLE 6: Remedies Proposed in the ROD

REMEDY	TARGET MEDIUM	DESCRIPTION
Install Water Supply Line	Drinking water	Install water supply line from City of Odessa to homes and businesses with private water supply wells impacted by the site contamination or that may be impacted in the near future. Connection to the water supply line is voluntary. This alternative does not include continued maintenance of the filtration systems. Continued maintenance and or plugging and abandonment of existing supply wells will be responsibility of the property owner.
Ground Water Extraction and Treatment	Ground Water (Trinity Aquifer)	Install extraction wells to pump groundwater from the contaminated interval of the Ogallala and Trinity aquifers to provide hydraulic containment of the plume. Transfer the extracted water to central treatment plant remove volatile organic compounds (VOCs) via an air stripper with off-gas treatment. Install additional monitoring wells and conduct additional groundwater sampling to update and monitor the extent of the VOC plume.
In Situ Biodegradation Treatment Zones	Ground Water (Trinity Aquifer)	Utilize *in situ* biostimulation and/or bioaugmentation to treat the plume interior through reductive dechlorination.
Soil Vapor Extraction and Well Abandonment	Source Area	Extract contaminated soil vapors from the target zone over 3 years. Abandon an estimated ten private water supply wells suspected of serving as vertical conduits between US2 and LS1. Replace abandoned wells with new supply wells in LS2 with cement casing constructed to prevent vertical migration of contaminants.
Institutional Controls	Residential properties and area groundwater	Implement restrictive covenants, deed notices, and/or other area-wide restrictions of groundwater use.
Five-Year Reviews	All site media	Prepare reports to document remedy performance and protectiveness.

Subsequent to the ROD, the site team identified the following potential deviations from the remedies described in the ROD:

- Plug, abandon and replace existing impacted supply wells and postpone construction of a water line pending the results of the other remedy components in reducing the dissolved plume concentrations.
- Focus on the in situ bioremediation (ISB) component of the remedy and avoid use of the pump and treat system due to the more expensive treatment requirements for removal of nitrate (from suspected septic tank or agricultural releases) that is present in the groundwater.
- Pilot test soil vapor extraction (SVE) to determine if it is needed or will be effective in meeting RAOs.

3.3 CURRENT EXIT STRATEGY

The ROD identifies short-term expectations that the exposure to contaminated groundwater will be prevented, that plume migration will be controlled and that source area soil will be remediated. Subsequent to the ROD, the focus of the site team has been on addressing the higher concentration portions of the plume in an attempt to close the site without the need for a water line or long-term groundwater extraction and treatment.

4.0 FINDINGS

Discussions during the optimization meeting and the optimization review team's document review resulted in the key findings identified in this section.

4.1 DATA GAPS AND CHARACTERIZATION

Table 7 presents identified data gaps identified by the optimization review team that may influence RD.

TABLE 7. Identified data gaps

MEDIUM	DATA GAP	POTENTIAL RECOMMENDATION
Vadose zone	Remaining mass in vadose zone that is capable of causing human exposure or groundwater contamination above cleanup goals and can be removed by SVE	Concur with Site team to pilot test a small-scale SVE system to evaluate potential mass removal and if a full-scale Soil vapor extraction (SVE) system is merited. See Recommendation 5.3.
US2 groundwater	Extent of dissolved contamination in US2	Install additional monitoring wells to delineate contamination and serve as potential injection wells for an in situ bioremediation (ISB) remedy. See Recommendation 5.2.
US2 and LS1 groundwater	Effect of ISB on secondary water quality issues such as mobilization of arsenic, manganese and iron	Pilot test ISB to determine extent of secondary water quality issues resulting from ISB. See Recommendation 5.2.
US2, UC2 and LS1 groundwater	Mechanism for vertical migration of contamination	With GW-205 and GW-210 already plugged, evaluate concentrations at MW-9 to determine if plugging GW-205 and GW-210 prevents further impacts to the LS1 in the vicinity of MW-9. See Recommendation 5.1.
LS1 groundwater	Extent of contaminant migration and time frame for aquifer restoration once relevant supply wells are plugged and abandoned.	Develop targets for limiting contaminant migration and for aquifer restoration timeframe. Develop a contingency remedy to implement if targets are not achieved. See Recommendation 5.4.

4.2 REMEDIAL STRATEGY

The optimization review team identified the following priorities for RD and implementation.

1. Plug and abandon unsealed wells that are allowing contamination to migrate vertically from the US2 to the LS1.
2. Provide permanent alternative water supply to those properties where water supply wells currently have filtration systems.

3. Provide permanent alternative water supply to those properties where water supply wells are likely to be impacted by site-related contamination within the next 5 years or that are likely to be significantly affected by secondary water quality effects caused by remediation
4. Remediate contamination in US2.
5. Determine if SVE will provide a meaningful benefit.
6. Evaluate LS1 concentrations to determine if active remediation is merited in the LS1.
7. Implement active remediation in LS1, if needed.

5.0 RECOMMENDATIONS

The optimization review team recognizes there are logistical constraints that may prevent timely implementation of all remedy components. Consequently, the optimization recommendations reflect a suggested prioritization of activities consistent with the remedial strategy presented in Section 4.2.

5.1 ELIMINATE EXPOSURE PATHWAY AND VERTICAL MIGRATION BY REPLACING SPECIFIC PRIVATE WATER SUPPLY WELLS AND INSTALLING NEW MONITORING POINTS

5.1.1 *Recommendation 5.1.1: Plug, Abandon and Replace Key Water Supply Wells*

With respect to limiting vertical migration from the US2 to the LS1, the site team and optimization review team identified water supply wells (GW-19, GW-21, GW-22, GW-24, GW-67 and Well-A) as private wells that should be plugged, abandoned and replaced with wells screened in LS2. In addition, the site team and optimization review team agreed that private water supply well GW-23 should be plugged and abandoned; this well does not need to be replaced because water would be available to the GW-23 property owner from the replacement well for GW-24A. Instead of installing a water line, well replacement would also be conducted for the water supply wells that are currently on filtration systems maintained by TCEQ.

Benefits of Implementing Section 5.1 Recommendations

- Eliminate exposure pathway over the long term for three residences not connected to public water supply.
- Significantly reduce or prevent vertical migration of contamination to the LS1.
- Provide key monitoring locations to characterize the plume and monitor and implement the ISB remedy.

5.1.2 *Recommendation 5.1.2: Install Additional Monitoring Wells in US2 and LS1*

Water supply wells recommended for plugging and replacement represent areas of the plume with some of the highest contaminant concentrations. The area between GW-24 and MW-27 represents up to 60 percent of the calculated dissolved contaminant mass in the LS1 plume (see Appendix C – Monitoring and Remediation Optimization Systems (MAROS) reports). The optimization review team cautions that plugging and abandoning these wells could alter the groundwater flow direction in the US2 because plugging and abandoning these wells will remove US2 groundwater “sinks” that are currently controlling US2 groundwater flow. The optimization review team, therefore, recommends that the site team install new US2 and LS1 monitoring wells adjacent to water supply wells GW-21, GW-23, GW-24A and additional LS1 wells at GW-19 and GW-27 when those wells are plugged, abandoned and replaced. (The optimization review team recommends installation of 4-inch wells.) The new US2 wells can be monitored to determine the extent of US2 contaminant migration after the water supply wells are plugged and can help determine the extent of contamination to be addressed by ISB. Monitoring wells MW-4, MW-9, MW-10, and the three new LS1 monitoring wells can be monitored to determine if plugging and abandoning water supply wells GW-205 and GW-210 prevents further contaminant migration from the US2 to the LS1. The new LS1 monitoring wells should be 4-inch diameter wells so that they can be converted to groundwater extraction wells for the US2 ISB remedy, if necessary. If concentrations in three noted existing LS1 wells persist and are identified in the three new LS1 wells, it may suggest continued vertical migration from the US2 through the UC2 to the LS1. If this is the case, greater urgency should be placed on remediating the US2 in a timely manner. Monitoring of other LS1 water supply wells should also continue to determine if additional wells should be plugged, abandoned and replaced.

The optimization review team agrees with the site team's estimated cost of approximately $40,000 to plug, abandon and replace each water supply well and $10,000 to plug and abandon each monitoring well. Based on the plugging, abandonment and replacement of up to 16 wells, installation of five additional US2 wells and installation of three new LS1 wells, the optimization review team estimates a cost of approximately $750,000. The costs for monitoring of the wells discussed in this section are presented in Section 5.5.

5.2 INCREASE PRIORITY OF IMPLEMENTING US2 ISB

5.2.1 *Recommendation 5.2.1: Increase Priority of US2 ISB Remedy*

The optimization review team places a high priority on remediating the contaminant plume in US2 and agrees with the site team that ISB is an appropriate remedial approach. Prior to conducting the ISB remedy, the target area for treatment needs to be identified. This might be achieved by monitoring results from existing and proposed US2 wells recommended in Section 5.1. An analysis of existing data from 2013 indicates that the majority of dissolved mass is found in the vicinity of water supply wells GW-21A, GW-22A, GW-23, GW-24A and MW-27 (see Appendix C; Percent of Mass by Well Report). Historically, water supply well GW-205 and monitoring wells MW-09 and MW-27 have exhibited the highest concentrations of PCE. Monitoring well MW-09 and water supply well GW-205 show decreasing trends, while monitoring well MW-27 has a fairly stable concentration trend.

Benefits of Implementing Section 5.2 Recommendations

- Prioritizing source remediation over plume containment expedites the aquifer restoration process and provides the potential opportunity to avoid a long-term costly containment remedy.
- The approach significantly reduces or prevents vertical migration of contamination to the LS1.
- Key monitoring locations are provided to characterize the plume and to implement and monitor the ISB remedy.

5.2.2 *Recommendation 5.2.2: Use Extracted Groundwater for ISB Substrate Blending and Delivery*

The optimization review team suggests using permanent injection wells and extracted groundwater for ISB reagent blending and injection. Impacted water from the three new LS1, 4-inch wells noted in Section 5.1 should be used if possible. Extracting the impacted water from the LS1 aquifer for remediation purposes should provide sufficient water for remediation and would provide some degree of LS1 mass removal, which should help mitigate contaminant migration and speed remedial progress. LS1 wells that are installed for this purpose also can be used to monitor the LS1 after the water supply wells identified in Section 5.1 are plugged and abandoned.

The optimization review team suggests that areas with contaminant concentrations more than four times the cleanup goals be targeted for remediation. Assuming this area is less than 10,000 ft^2, the remedy would likely involve five injection wells, under 40,000 pounds of ISB substrate (based on use of emulsified vegetable oil) and approximately 225,000 gallons of water. The injections could likely be conducted within a 2-week period. Based on the installation of five US2 injection wells, 40,000 pounds of ISB substrate, 2 weeks for injections and additional resources for planning and reporting, the optimization review team estimates that ISB remedy implementation should cost under $300,000. A larger target treatment zone would require additional cost or a different configuration of injections. Continued monitoring on a quarterly basis for 2 years for VOCs, oxidation reduction potential (ORP), total organic carbon (TOC), arsenic, manganese and iron in the five injection wells and US2 monitoring wells would be appropriate. A second round of ISB injections may be appropriate based on the results from the analysis of 2 years of quarterly performance monitoring. The costs of performance monitoring are discussed in Section 5.5.

5.3 SVE PILOT TEST

5.3.1 *Recommendation 5.3.1: Conduct Small-Scale SVE Pilot Test in Source Area Vadose Zone*

Benefits of Implementing Section 5.3 Recommendations

- Determine the need for SVE and obtain data to support a decision to retain or eliminate SVE from the final remedy.

The amount of mass in the source area, the potential for that mass to be removed via SVE and the potential for that mass to cause ongoing groundwater contamination is uncertain. The optimization review team supports conducting a small-scale SVE pilot test in the shallow unsaturated zone of the source area to evaluate the mass removal and to determine if broader-scale SVE is merited. If the pilot test suggests that significant mass removal is possible, then it should be assumed that the mass can cause continued groundwater contamination and broader-scale SVE should be applied. The pilot can involve vacuum testing several existing vapor monitoring wells to determine the flow rate that can be obtained from each well and the PCE and cis-1,2 DCE concentrations in the extracted vapors. Assuming three wells are tested over the course of 2 to 3 days, the cost for the pilot test might be on the order of $15,000, excluding planning and reporting.

5.4 DETERMINE NEED FOR ACTIVE REMEDIATION OF LS1

5.4.1 *Recommendation 5.4.1: Evaluate LS1 after Well Plugging and US2 Remediation to Determine Need for Active Remediation of LS1*

Benefits of Implementing Section 5.4 Recommendations

- Evaluation of the LS1 water quality over time following source remediation and before an LS1 remedy provides the potential opportunity to avoid complications and cost associated with a LS1 remedy.

Plugging and abandonment of the wells, as described in Section 5.1, and remediation of US2 may be successful at preventing further contaminant migration into the LS1, and the absence of a continuing source to LS1 may allow LS1 to reach cleanup goals without active remediation. Continued monitoring of existing LS1 wells, the new LS1 wells noted in Section 5.1 and some of the remaining LS1 water supply wells will help the site team monitor the progress toward aquifer restoration. Based on this information, the site team can determine if active remediation is needed in the LS1 to help control contaminant migration, shorten the time frame for aquifer restoration or both. The determination can be made based on the number of LS1 wells that would require replacement if remediation was not conducted compared to the number of LS1 wells that would require replacement if remediation was conducted.

The optimization review team and the site team discussed ISB and *in situ* chemical oxidation with ozone as potential practical, remedial options. Both technologies cause temporary water quality issues. ISB could result in increased dissolved arsenic, iron and manganese in groundwater. Odor may also be an issue in some locations. Ozone could form hexavalent chromium or bromate. The optimization review team favors ISB because of the larger radius of influence of each well and because less infrastructure is needed than for ozone injections associated with chemical oxidation. In addition, degradation will occur for several months after a single ISB injection. Depending on the extent of the secondary water quality issues, the site team may need to replace additional LS1 water supply wells that might be impacted by the ISB treatment.

5.4.2 *Recommendation 5.4.2: Actively Remediate LS1 Using ISB*

If active remediation in LS1 is deemed necessary, the optimization review team would favor a target treatment zone focusing on areas with PCE concentrations that are more than four times higher than the cleanup goal. Assuming this volume of water could be treated with three ISB biobarriers installed at various distances along the plume axis, this remedy might involve the installation of 15 dual-purpose injection/extraction wells in the LS1, 200,000 pounds of emulsified vegetable oil (or equivalent amounts of another substrate) and 1.5 million gallons of extracted water to blend and inject the substrate. Based on these parameters and over a month in the field to conduct the injections, the optimization review team estimates a cost of approximately $1 million for one round of ISB injection. Replacement of up to 10 additional LS1 wells could cost another $400,000. An additional injection event would not likely be needed. The costs for potential performance monitoring activities are discussed in Section 5.5.

Given the cost of this effort and the potential adverse effects on water quality, the optimization review team encourages the site team to carefully determine if remediation is necessary for LS1 before pursuing remediation (that is, implement Recommendations 5.1, 5.2 and 5.3 first).

5.5 REMEDY PERFORMANCE MONITORING

5.5.1 *Recommendation 5.5.1: Implement Remedy Performance Monitoring*

The performance monitoring recommendations for the site, including the monitoring described above, are provided in Appendix D. The specified performance monitoring is expected to cost approximately $250,000 over a two year period.

Benefits of Implementing Section 5.5 Recommendations

- Cost-effective monitoring program and performance metrics will optimize remedy operation and allow shutdown of remedy components in a timely manner.

Recommended remedy performance metrics include:

Well plugging, abandonment and replacement – These activities should significantly decrease the mass discharge from the US2 to the LS1. Potential performance metrics should include the following:

Groundwater contaminant concentrations in wells (or replacement wells near) MW-04, MW-09, GW-24, GW-22, GW-19, GW-67, MW-27 and the new LS1 wells over time relative to baseline groundwater contaminant concentrations at the same wells.

Groundwater contaminant concentrations and statistical trends in wells listed above over time relative to cleanup goals.

US2 ISB – The US2 ISB remedy should significantly reduce the PCE and other VOC concentrations in the US2 and reduce mass discharge to the LS1. A potential performance metric in addition to those noted for well plugging (above) includes the following:

Reduction of PCE and VOC plume mass based on total dissolved mass calculations using VP-01 through VP-05 and the new US2 wells.

LS1 Aquifer Restoration – Signs of LS1 restoration should become apparent after well plugging and US2 ISB. A potential performance metric in addition to those noted above includes the following:

Changes in groundwater contaminant concentrations in other LS1 wells relative to baseline (current) groundwater contaminant concentrations in LS1 wells and relative to cleanup goals. Significant contaminant concentration increases in some wells could indicate the potential for plume expansion and the need for the LS1 ISB remedy to achieve aquifer restoration without affecting additional water supply wells.

Additional performance monitoring evaluations can include calculations of dissolved plume mass and mass flux through monitoring transects.

5.6 DATA MANAGEMENT

Data management activities for the site appear to have captured the majority of the data necessary to support site decision making. Site data can be transferred between groups analyzing data fairly easily and historic data are easy to interpret and visualize. No changes in site data management are recommended.

5.7 CONSIDERATIONS FOR ESTABLISHING EXIT CRITERIA

5.7.1 *Recommendation 5.7.1: Establish Exit Criteria for Each Remedy Component*

The optimization review team has the following suggestions for consideration by the site team in developing exit criteria.

Benefits of Implementing Section 5.7 Recommendations

- Criteria established to help avoid operating long-term remedies longer than necessary.

One potential exit criterion for the SVE system is attainment of a PCE mass removal rate that is some given fraction of the initial PCE mass removal rate. The fraction should be calculated at the point where further operation of the SVE system would result in negligible mass removal relative to mass removal at startup. At this point, further SVE implementation would no longer be technically effective or cost effective.

Another potential exit criterion for the SVE system can be based on a mass removal rate relative to the current mass flux from the source area to the dissolved plume. For example, there is a given flux of PCE mass from the source area to the dissolved plume that could be represented by the estimated groundwater volume flow rate through an assumed cross-sectional area around VP-01 and multiplied by the PCE concentration at VP-01. The exit criterion could be to shut down the SVE system when the rate of mass removal from the SVE system is some multiple lower than the current mass flux rate through this cross-sectional area.

The exit criterion for ISB of US2 should be to discontinue injections after the first round. One injection should be enough to sufficiently reduce the plume mass to facilitate aquifer restoration; therefore, additional injections should not be needed. If one injection is not effective in reducing average PCE (or total VOC) concentration (or plume mass) in the target treatment area below the criteria used to select the target treatment area, then it is unlikely that subsequent injections will be effective (unless the site team gains information during the first injection that suggests another injection would be successful).

Additional study by the site team would be needed to help refine the above exit criteria for the various remedy components to help avoid unnecessary operation of these remedies.

5.8 RECOMMENDATIONS RELATED TO ENVIRONMENTAL FOOTPRINT REDUCTION

No specific recommendations have been provided for environmental footprint reduction. However, several of the above recommendations have the potential to reduce the remedy footprint by (1) carefully evaluating the need for remediation before implementation and (2) developing an exit strategy for remediation before implementing a remedy.

TABLE 8: Recommendation Summary

RECOMMENDATION	EFFECTIVENESS	COST REDUCTION	TECHNICAL IMPROVEMENT	SITE CLOSURE	ENVIRONMENTAL FOOTPRINT REDUCTION	CAPITAL COST	CHANGE IN ANNUAL COST
5.1.1 Plug, abandon and replace (16) key water supply wells	X			X		$670K	
5.1.2 Install additional monitoring wells in US2 and LS1	X			X		$80K	
5.2.1 Increase priority of US2 ISB remedy	X			X	X	$300K	
5.2.2 Use extracted groundwater for ISB substrate blending and delivery	X	X			X	N/A	
5.3.1 Conduct small-scale SVE pilot test in source area	X	X		X	X	$15 – 20K	
5.4.1. Evaluate LS1 after well plugging and US2 remediation to determine need for active remediation of LS1	X			X	X	N/A	
5.4.2 Install LS1 ISB remedy, if 5.4.1 evaluation indicates remedy is required			X			$1.4M	
5.5.1 Implement remedy performance monitoring	X	X	X	X		$250K	
5.7.1 Establish exit criteria for each remedy component		X			X	N/A	

N/A = Not applicable; cost for recommendation is not significantly greater than existing reporting and management activities.

APPENDIX A
REFERENCES

EA (2010a). *Remedial Investigation, East 67th Street Ground Water Plume Superfund Site. Lewisville, Texas*, EA Engineering, Science and Technology, Inc for US Environmental Protection Agency Region 6.

EA (2010b). *Feasibility Study Report, East 67th Street Ground Water Plume Superfund Site. Lewisville, Texas*, EA Engineering, Science and Technology, Inc for US Environmental Protection Agency Region 6.

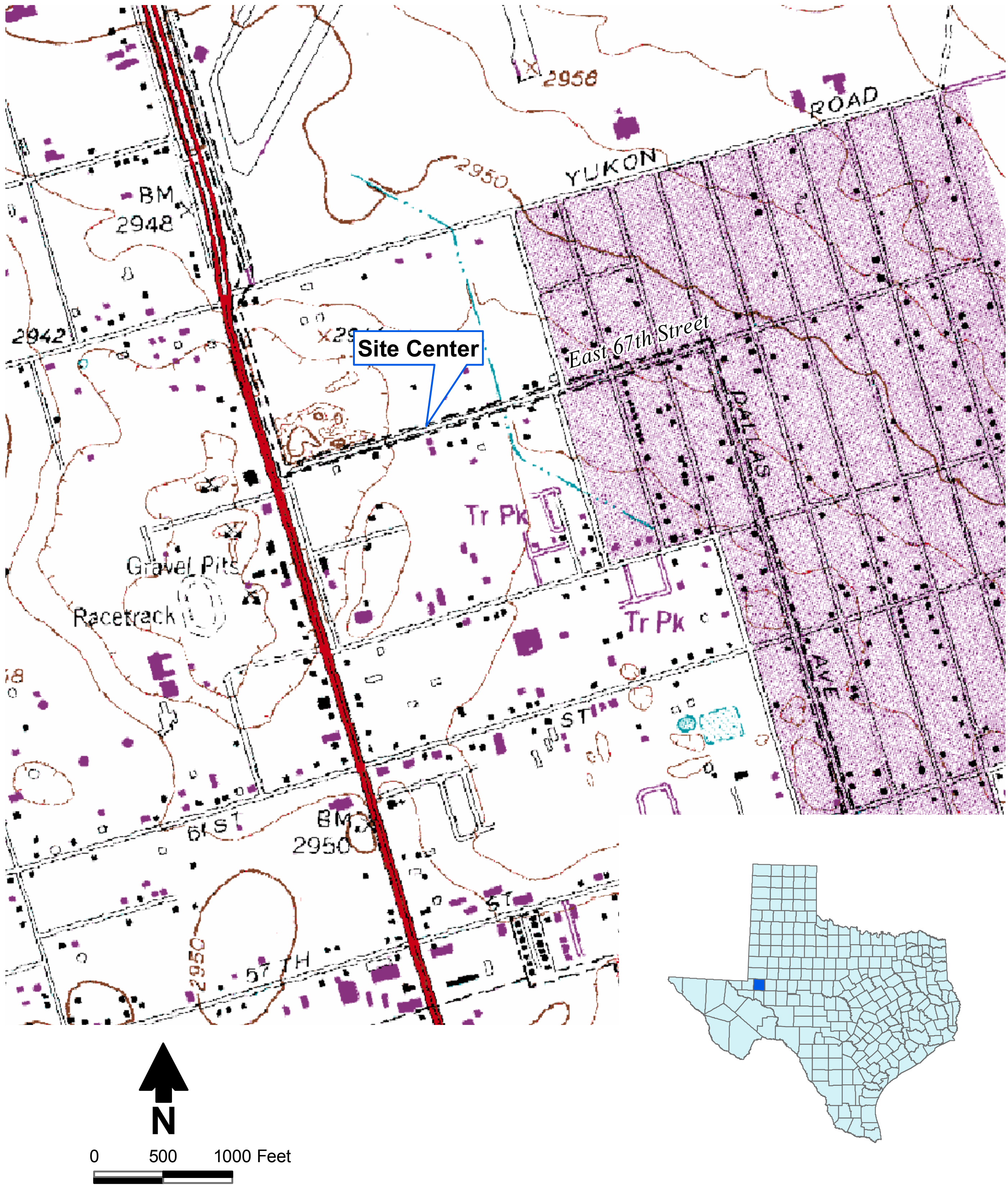
EA (2011). *Technical Memorandum, qPCR and CSIA Data Evaluation. Lewisville, Texas*, EA Engineering, Science and Technology, Inc for US Environmental Protection Agency Region 6.

EA (2013). *Data and Maps for January 2013 Groundwater Data. Dallas, Lewisville*, Texas, EA Engineering, Science and Technology, Inc. for US Environmental Protection Agency Region 6.

EPA (2011). *Record of Decision East 67th Street Ground Water Plume Superfund Site. Dallas, TX*, U.S. Environmental Protection Agency Region 6.

EPA (2012). *Transmittal of the National Strategy to Expand Superfund Optimization Practices from Site Assessment to Site Completion. Washington, D.C.*, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response.

APPENDIX B
SUPPORTING FIGURES FROM EXISTING DOCUMENTS



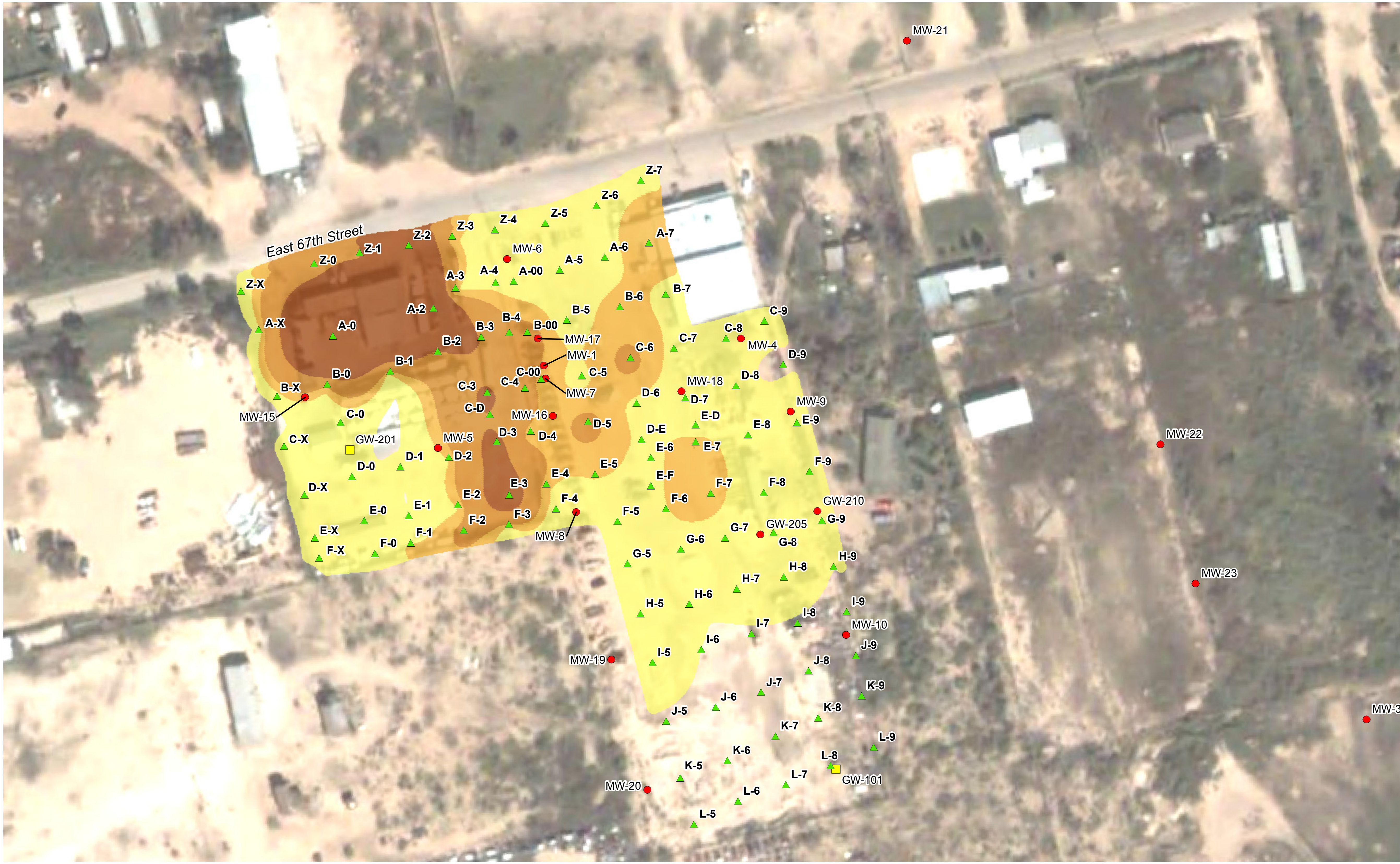
EA ENGINEERING, SCIENCE, AND TECHNOLOGY

EAST 67TH STREET
GROUND WATER PLUME
SUPERFUND SITE

Site Location

DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
CRF	CRF	DWR	1:12,000	11/28/06	EPA6.0000.06	1

M:/PROJECTS/EPA_RAC/EPA6.06_EAST_67TH_STREET/GIS/MXDS/FIGURES FOR RI REPORT/SITE_LOCATION.MXD 010210



Explanation

- Monitor well location
- Supply well
- Passive soil gas sample location

N

0 50 100 Feet

Tetrachloroethene mass (nanograms)

- 10 - 500 ng
- 500 - 1,000 ng
- 1,000 - 3,000 ng
- Above 3,000 ng

Source:

2007 Aerial photograph provided by Google Earth

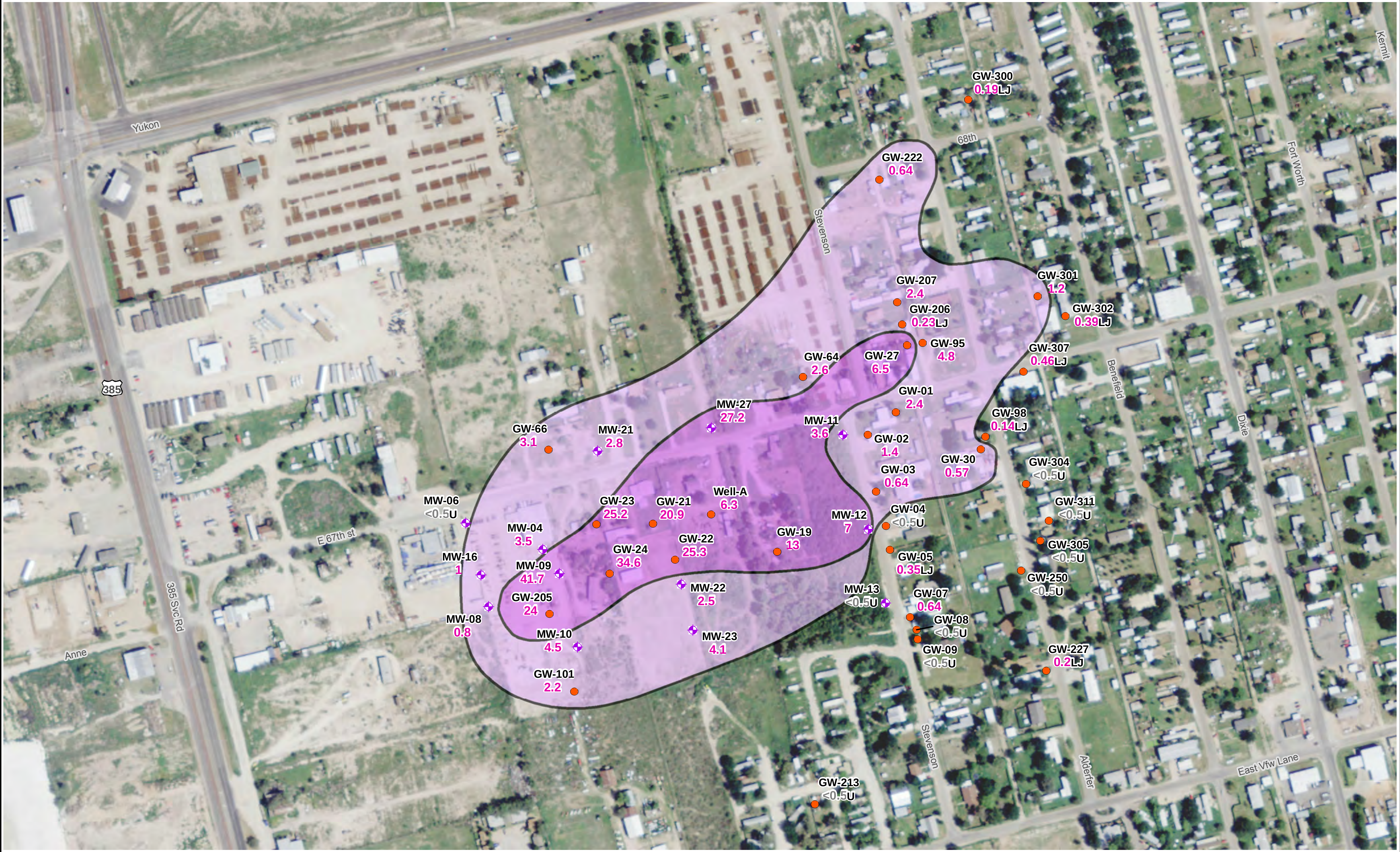
Distribution of PCE in Soil Gas

EAST 67TH STREET GROUND WATER PLUME
ECTOR COUNTY, TEXAS

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

FIGURE	5
PROJECT NO	EPA6.06RI.04
DATE	01/20/2010
SCALE	1:1,200
CHECKED BY	DWR
DRAWN BY	CRF
DESIGNED BY	CRF

M:/PROJECTS/EPA_RAC/EPA6.06_EAST_67TH_STREET/GIS/MXDS/APRIL 2008/PCE_GRID.MXD 805060



Base Map Source: 2008/2009 NAIP aerial photograph provided by TNRIS.

N

0 150 300 Feet

Explanation

- Monitoring well
- Private water supply
- **MW-23** Well designation
- 4.1 PCE concentration (µg/L)
- <0.5 PCE below reporting limit
- PCE above .5 µg/L
- PCE above 5 µg/L

Notes:
1. PCE = Tetrachloroethene
2. MCL = 5 µg/L
3. Qualifier:
   U = Not detected at reported quatitation limit
   L = Reported concentration is below the CRQL
   J = Estimated value

Distribution of PCE in the Shallow Zone January 2013

EAST 67TH STREET GROUND WATER PLUME ECTOR COUNTY, TEXAS

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

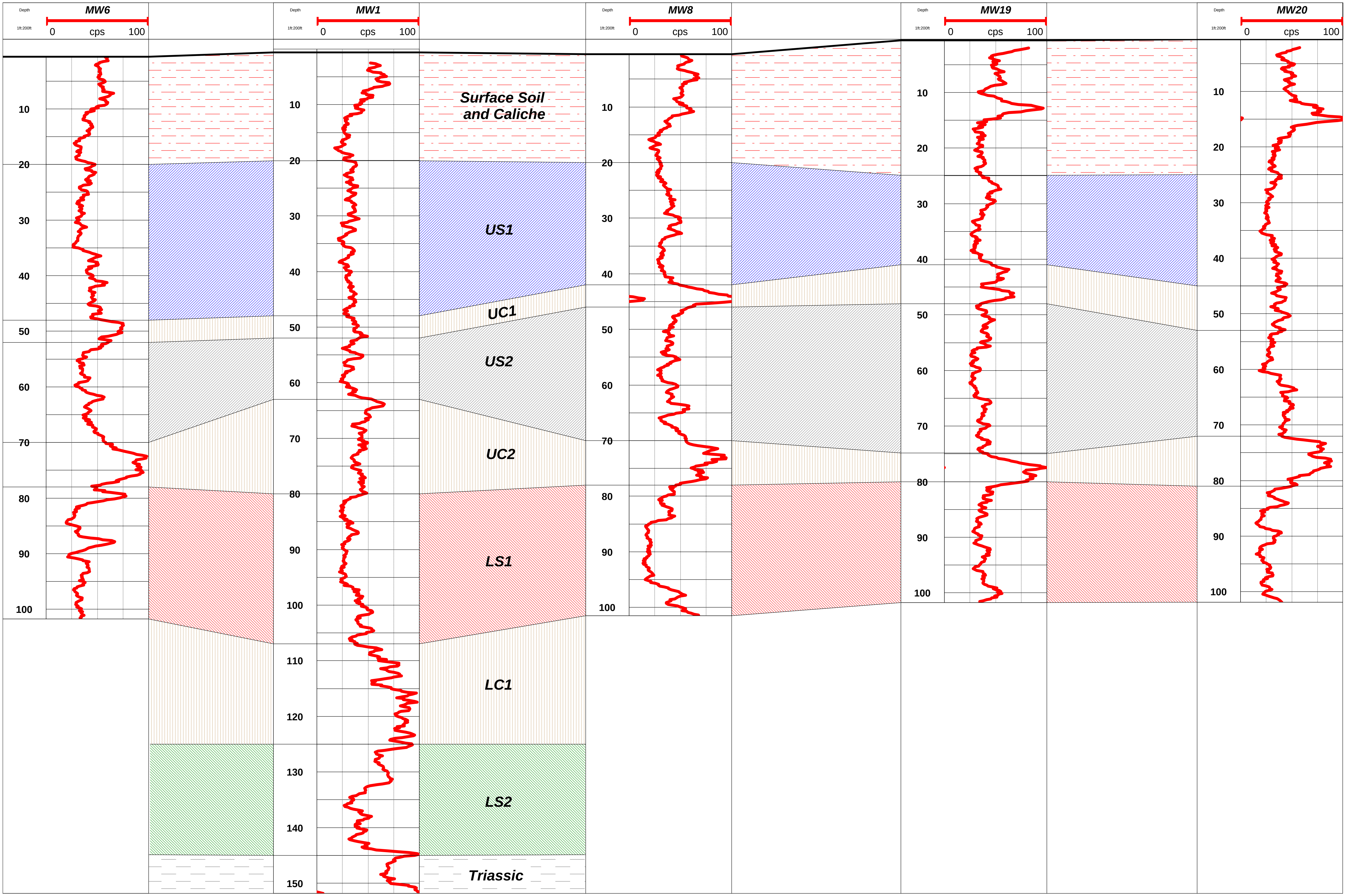
FIGURE	2
PROJECT NO	1434266
DATE	3/8/2013
SCALE	1:3,600
CHECKED BY	DWR
DRAWN BY	CRS
DESIGNED BY	DWR

M:/PROJECTS/EPA_RAC/EPA6.06_EAST_67TH_STREET/GIS/MXDS/WELL_LOCATION_MAP.MXD 019140

Company	EPA	Country	UNITED STATES	Name	NORTH-SOUTH1
		County	ECTOR	State	TX

Boreholes in Section MW6, MW1, MW8, MW19, MW20

Figure 3. Geophysical Cross-Section



APPENDIX C
MONITORING AND REMEDIATION OPTIMIZATION SYSTEM ANALYSIS REPORTS

MAROS Statistical Trend Analysis Summary

Project: East 67th Street **User Name:** MV

Location: Odessa **State:** Texas

Time Period: 1/31/2007 **to** 1/25/2013
Consolidation Period: No Time Consolidation
Consolidation Type: Median
Duplicate Consolidation: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value

Well	Source / Tail	Number of Samples	Number of Detects	Average Conc. (mg/L)	Median Conc. (mg/L)	All Samples "ND" ?	Mann-Kendall Trend	Linear Regression Trend
GW-01A	T	7	6	1.3E-03	9.7E-04	No	NT	NT
GW-02	T	7	4	5.2E-04	5.0E-04	No	S	S
GW-03	T	7	4	2.6E-04	2.0E-04	No	NT	NT
GW-04	T	4	0	3.1E-04	2.5E-04	Yes	ND	ND
GW-05	T	2	0	2.5E-04	2.5E-04	Yes	ND	ND
GW-07A	T	7	6	1.7E-03	1.2E-03	No	D	D
GW-08A	T	7	2	1.0E-03	5.0E-04	No	S	PD
GW-101	T	7	0	3.9E-04	5.0E-04	Yes	ND	ND
GW-19A	T	5	4	3.7E-03	4.6E-03	No	S	PI
GW-205	S	7	7	5.7E-02	3.9E-02	No	D	D
GW-206	T	5	0	3.0E-04	2.5E-04	Yes	ND	ND
GW-207	T	6	3	5.1E-04	5.0E-04	No	NT	I
GW-213	T	6	1	4.6E-04	3.8E-04	No	S	S
GW-21A	S	6	5	2.5E-02	6.4E-03	No	PI	I
GW-222	T	2	0	2.5E-04	2.5E-04	Yes	ND	ND
GW-227	T	3	0	2.5E-04	2.5E-04	Yes	ND	ND
GW-22A	T	5	4	6.7E-02	9.0E-02	No	NT	PI
GW-23	S	1	1	1.9E-02	1.9E-02	No	N/A	N/A
GW-24A	S	5	5	6.3E-02	5.5E-02	No	S	S
GW-27	T	5	2	8.1E-04	5.0E-04	No	I	PI
GW-30	T	6	2	3.6E-04	3.4E-04	No	S	S
GW-301	T	2	1	2.2E-04	2.2E-04	No	N/A	N/A
GW-302	T	2	0	2.5E-04	2.5E-04	Yes	ND	ND
GW-304	T	2	0	2.5E-04	2.5E-04	Yes	ND	ND
GW-307	T	2	1	2.1E-04	2.1E-04	No	N/A	N/A
GW-66A	T	6	6	9.7E-03	1.0E-02	No	NT	I

Wednesday, June 19, 2013

MAROS Statistical Trend Analysis Summary

Project: East 67th Street **User Name:** MV

Location: Odessa **State:** Texas

Well Name	Source / Tail	Number of Samples	Number of Detects	Average Conc. (mg/L)	Median Conc. (mg/L)	All Samples "ND" ?	Mann-Kendall Trend	Linear Regression Trend
cis-1,2-DICHLOROETHYLENE								
MW-02	T	3	3	1.1E-02	1.1E-02	No	N/A	N/A
MW-04	S	6	3	1.3E-03	1.1E-03	No	NT	NT
MW-07	T	3	1	5.5E-04	5.0E-04	No	N/A	N/A
MW-08	T	5	0	4.0E-04	5.0E-04	Yes	ND	ND
MW-09	S	6	6	6.3E-02	6.3E-02	No	S	D
MW-10	S	6	4	7.0E-04	6.2E-04	No	NT	NT
MW-11	T	7	6	2.5E-03	2.7E-03	No	PI	I
MW-12	T	7	4	8.3E-04	6.5E-04	No	PD	D
MW-13	T	7	1	7.4E-04	5.0E-04	No	NT	NT
MW-14	T	3	0	4.2E-04	5.0E-04	Yes	ND	ND
MW-16	T	6	6	3.0E-03	2.9E-03	No	NT	NT
MW-18	T	3	1	4.0E-03	5.0E-04	No	N/A	N/A
MW-21	T	5	5	1.6E-02	1.7E-02	No	S	PD
MW-22	S	5	4	3.9E-03	2.9E-03	No	D	D
MW-23	S	5	4	1.6E-03	1.1E-03	No	D	D
MW-24	T	6	0	7.5E-04	5.0E-04	Yes	ND	ND
MW-27	T	4	4	4.7E-02	4.6E-02	No	NT	PI
GW-01A	T	7	7	2.9E-03	2.5E-03	No	NT	NT
GW-02	T	7	7	1.7E-03	1.8E-03	No	S	I
GW-03	T	7	5	5.4E-04	5.3E-04	No	PI	I
GW-04	T	4	1	3.0E-04	2.5E-04	No	NT	NT
GW-05	T	2	2	2.4E-04	2.4E-04	No	N/A	N/A
GW-07A	T	7	7	4.8E-03	3.0E-03	No	D	D
GW-08A	T	7	4	1.2E-03	5.0E-04	No	PD	D
GW-101	T	7	7	2.9E-03	2.8E-03	No	PD	D
GW-19A	T	5	4	8.8E-03	1.2E-02	No	NT	PI
GW-205	S	7	7	6.5E-02	7.0E-02	No	PD	D
GW-206	T	5	4	2.8E-04	2.3E-04	No	NT	NT
GW-207	T	6	6	2.1E-03	1.9E-03	No	I	PI
GW-213	T	6	2	9.2E-04	3.8E-04	No	NT	NT
GW-21A	S	6	6	9.9E-03	7.7E-03	No	PI	PI

MAROS Statistical Trend Analysis Summary

Project: East 67th Street **User Name:** MV

Location: Odessa **State:** Texas

Well Name	Source / Tail	Number of Samples	Number of Detects	Average Conc. (mg/L)	Median Conc. (mg/L)	All Samples "ND" ?	Mann-Kendall Trend	Linear Regression Trend
TETRACHLOROETHYLENE(PCE)								
GW-222	T	2	2	6.9E-04	6.9E-04	No	N/A	N/A
GW-227	T	3	3	2.6E-04	2.1E-04	No	N/A	N/A
GW-22A	T	5	5	2.0E-02	2.5E-02	No	NT	PI
GW-23	S	1	1	2.5E-02	2.5E-02	No	N/A	N/A
GW-24A	S	5	5	3.4E-02	3.5E-02	No	NT	NT
GW-27	T	5	5	5.3E-03	5.2E-03	No	NT	I
GW-30	T	6	6	1.1E-03	1.1E-03	No	S	S
GW-301	T	2	2	1.0E-03	1.0E-03	No	N/A	N/A
GW-302	T	2	2	3.4E-04	3.4E-04	No	N/A	N/A
GW-304	T	2	1	2.2E-04	2.2E-04	No	N/A	N/A
GW-307	T	2	2	6.0E-04	6.0E-04	No	N/A	N/A
GW-66A	T	6	6	3.7E-03	3.4E-03	No	S	I
MW-02	T	3	3	2.5E-03	2.0E-03	No	N/A	N/A
MW-04	S	6	6	9.4E-03	6.4E-03	No	NT	NT
MW-07	T	3	0	4.2E-04	5.0E-04	Yes	ND	ND
MW-08	T	5	1	5.1E-04	5.0E-04	No	NT	PI
MW-09	S	6	6	7.3E-02	8.0E-02	No	S	PD
MW-10	S	6	6	9.9E-03	7.9E-03	No	D	D
MW-11	T	7	7	4.3E-03	4.4E-03	No	NT	PI
MW-12	T	7	7	7.2E-03	6.8E-03	No	NT	NT
MW-13	T	7	1	7.3E-04	5.0E-04	No	NT	NT
MW-14	T	3	0	4.2E-04	5.0E-04	Yes	ND	ND
MW-16	T	6	4	9.0E-04	9.6E-04	No	NT	PI
MW-18	T	3	0	4.2E-04	5.0E-04	Yes	ND	ND
MW-21	T	5	5	4.9E-03	5.3E-03	No	D	PD
MW-22	S	5	5	1.4E-02	1.9E-02	No	D	D
MW-23	S	5	5	1.0E-02	1.0E-02	No	D	D
MW-24	T	6	0	7.5E-04	5.0E-04	Yes	ND	ND
MW-27	T	4	4	4.2E-02	3.9E-02	No	S	S
GW-01A	T	7	4	8.6E-04	5.0E-04	No	NT	NT
GW-02	T	7	3	3.6E-04	4.1E-04	No	S	S

MAROS Statistical Trend Analysis Summary

Project: East 67th Street **User Name:** MV

Location: Odessa **State:** Texas

Well Name	Source / Tail	Number of Samples	Number of Detects	Average Conc. (mg/L)	Median Conc. (mg/L)	All Samples "ND" ?	Mann-Kendall Trend	Linear Regression Trend
TRICHLOROETHYLENE (TCE)								
GW-03	T	7	2	2.7E-04	2.5E-04	No	NT	NT
GW-04	T	4	0	3.1E-04	2.5E-04	Yes	ND	ND
GW-05	T	2	0	2.5E-04	2.5E-04	Yes	ND	ND
GW-07A	T	7	4	6.9E-04	5.0E-04	No	D	D
GW-08A	T	7	2	6.7E-04	5.0E-04	No	NT	NT
GW-101	T	7	0	3.9E-04	5.0E-04	Yes	ND	ND
GW-19A	T	5	4	1.0E-03	1.3E-03	No	NT	PI
GW-205	S	7	7	7.5E-03	6.7E-03	No	D	D
GW-206	T	5	1	2.6E-04	2.5E-04	No	NT	PI
GW-207	T	6	4	4.6E-04	4.9E-04	No	NT	I
GW-213	T	6	1	3.5E-04	3.8E-04	No	S	S
GW-21A	S	6	3	1.2E-03	5.4E-04	No	NT	I
GW-222	T	2	0	2.5E-04	2.5E-04	Yes	ND	ND
GW-227	T	3	1	2.0E-04	2.5E-04	No	N/A	N/A
GW-22A	T	5	4	3.1E-03	4.0E-03	No	NT	PI
GW-23	S	1	1	2.8E-03	2.8E-03	No	N/A	N/A
GW-24A	S	5	5	3.9E-03	4.2E-03	No	NT	PI
GW-27	T	5	3	9.8E-04	5.0E-04	No	I	I
GW-30	T	6	2	3.2E-04	2.7E-04	No	S	S
GW-301	T	2	2	2.5E-04	2.5E-04	No	N/A	N/A
GW-302	T	2	0	2.5E-04	2.5E-04	Yes	ND	ND
GW-304	T	2	0	2.5E-04	2.5E-04	Yes	ND	ND
GW-307	T	2	1	1.9E-04	1.9E-04	No	N/A	N/A
GW-66A	T	6	3	1.1E-03	7.6E-04	No	NT	NT
MW-02	T	3	1	4.8E-04	5.0E-04	No	N/A	N/A
MW-04	S	6	3	9.3E-04	5.0E-04	No	NT	NT
MW-07	T	3	0	4.2E-04	5.0E-04	Yes	ND	ND
MW-08	T	5	0	4.0E-04	5.0E-04	Yes	ND	ND
MW-09	S	6	6	8.2E-03	8.6E-03	No	S	D
MW-10	S	6	4	5.7E-04	5.0E-04	No	D	D
MW-11	T	7	5	1.1E-03	1.1E-03	No	NT	I
MW-12	T	7	6	9.7E-04	9.2E-04	No	NT	NT
MW-13	T	7	0	6.8E-04	5.0E-04	Yes	ND	ND

MAROS Statistical Trend Analysis Summary

Project: East 67th Street **User Name:** MV

Location: Odessa **State:** Texas

Well Name	Source / Tail	Number of Samples	Number of Detects	Average Conc. (mg/L)	Median Conc. (mg/L)	All Samples "ND" ?	Mann-Kendall Trend	Linear Regression Trend
TRICHLOROETHYLENE (TCE)								
MW-14	T	3	1	4.2E-04	5.0E-04	No	N/A	N/A
MW-16	T	6	2	3.7E-04	3.8E-04	No	S	S
MW-18	T	3	0	4.2E-04	5.0E-04	Yes	ND	ND
MW-21	T	5	4	1.5E-03	1.4E-03	No	S	PD
MW-22	S	5	5	1.5E-03	1.8E-03	No	D	D
MW-23	S	5	4	1.0E-03	8.7E-04	No	S	D
MW-24	T	6	1	7.2E-04	5.0E-04	No	NT	NT
MW-27	T	4	4	5.3E-03	5.0E-03	No	S	S

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); No Detectable Concentration (ND)

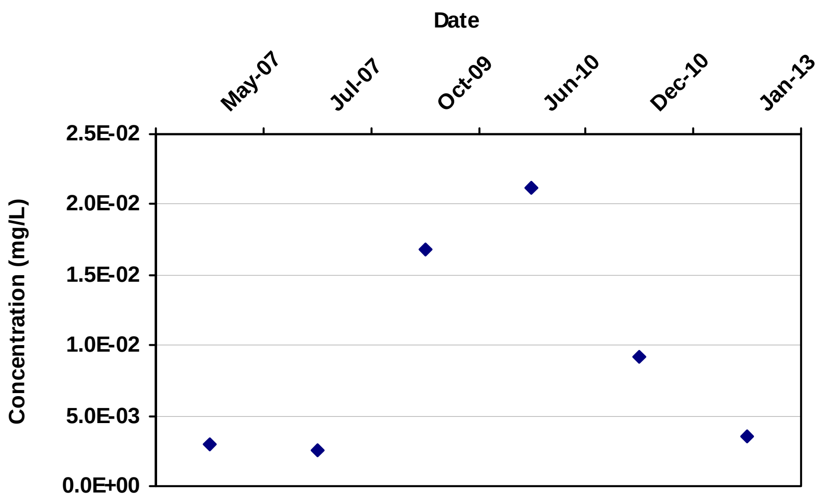
The Number of Samples and Number of Detects shown above are post-consolidation values.

MAROS Mann-Kendall Statistics Summary

Project: East 67th Street
User Name: MV
Location: Odessa
State: Texas

Well: MW-04
Well Type: S
COC: TETRACHLOROETHYLENE(PCE)

Time Period: 1/31/2007 **to** 1/25/2013
Consolidation Period: No Time Consolidation
Duplicate Consolidation: Median
Consolidation Type: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic:

3

Confidence in Trend:

64.0%

Coefficient of Variation:

0.85

Mann Kendall Concentration Trend: (See Note)

NT

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
MW-04	S	5/22/2007	TETRACHLOROETHY	3.0E-03		1	1
MW-04	S	7/19/2007	TETRACHLOROETHY	2.5E-03		1	1
MW-04	S	10/28/2009	TETRACHLOROETHY	1.7E-02		1	1
MW-04	S	6/16/2010	TETRACHLOROETHY	2.1E-02		1	1
MW-04	S	12/15/2010	TETRACHLOROETHY	9.2E-03		1	1
MW-04	S	1/25/2013	TETRACHLOROETHY	3.5E-03		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

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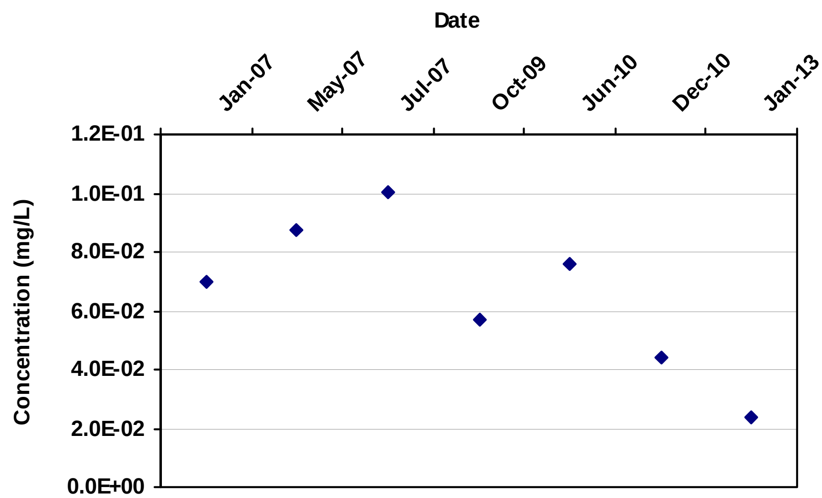
MAROS Mann-Kendall Statistics Summary

Project: East 67th Street | **User Name:** MV
Location: Odessa | **State:** Texas

Well:	GW-205	**Time Period:**	1/31/2007 **to** 1/25/2013
Well Type:	S	**Consolidation Period:**	No Time Consolidation
COC:	TETRACHLOROETHYLENE(PCE)	**Duplicate Consolidation:**	Median
		Consolidation Type:	Average
		ND Values:	1/2 Detection Limit
		J Flag Values :	Actual Value



Mann Kendall S Statistic:

-11

Confidence in Trend:

93.2%

Coefficient of Variation:

0.40

Mann Kendall Concentration Trend: (See Note)

PD

Data Table:

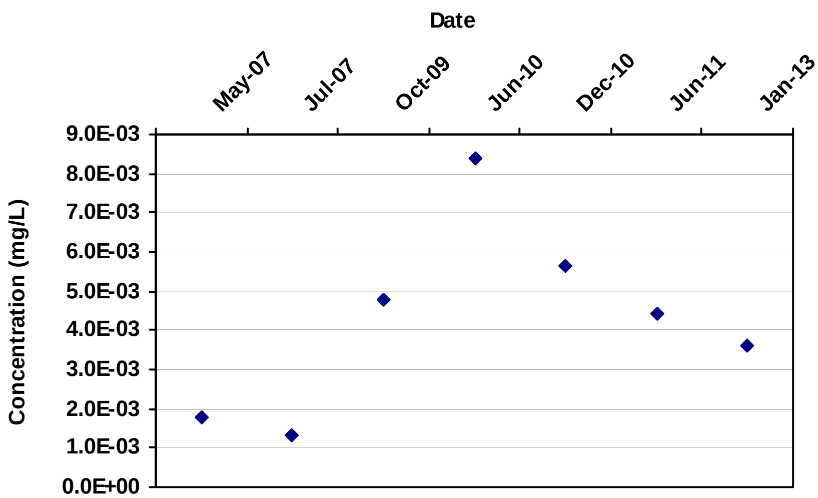
Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
GW-205	S	1/31/2007	TETRACHLOROETHY	7.0E-02		1	1
GW-205	S	5/22/2007	TETRACHLOROETHY	8.7E-02		2	2
GW-205	S	7/19/2007	TETRACHLOROETHY	1.0E-01		1	1
GW-205	S	10/28/2009	TETRACHLOROETHY	5.7E-02		1	1
GW-205	S	6/16/2010	TETRACHLOROETHY	7.6E-02		1	1
GW-205	S	12/15/2010	TETRACHLOROETHY	4.4E-02		1	1
GW-205	S	1/25/2013	TETRACHLOROETHY	2.4E-02		1	1

MAROS Mann-Kendall Statistics Summary

Project: East 67th Street **User Name:** MV

Location: Odessa **State:** Texas

Well:	MW-11	**Time Period:**	1/31/2007 **to** 1/25/2013
Well Type:	T	**Consolidation Period:**	No Time Consolidation
COC:	TETRACHLOROETHYLENE(PCE)	**Duplicate Consolidation:**	Median
		Consolidation Type:	Average
		ND Values:	1/2 Detection Limit
		J Flag Values :	Actual Value



Mann Kendall S Statistic:

3

Confidence in Trend:

61.4%

Coefficient of Variation:

0.56

Mann Kendall Concentration Trend: (See Note)

NT

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
MW-11	T	5/22/2007	TETRACHLOROETHY	1.8E-03		1	1
MW-11	T	7/19/2007	TETRACHLOROETHY	1.3E-03		2	2
MW-11	T	10/28/2009	TETRACHLOROETHY	4.8E-03		1	1
MW-11	T	6/16/2010	TETRACHLOROETHY	8.4E-03		1	1
MW-11	T	12/15/2010	TETRACHLOROETHY	5.7E-03		2	2
MW-11	T	6/29/2011	TETRACHLOROETHY	4.4E-03		1	1
MW-11	T	1/25/2013	TETRACHLOROETHY	3.6E-03		1	1

MAROS Mann-Kendall Statistics Summary

Project: East 67th Street

User Name: MV

Location: Odessa

State: Texas

Well: GW-22A

Well Type: T

COC: TETRACHLOROETHYLENE(PCE)

Time Period: 1/31/2007 **to** 1/25/2013

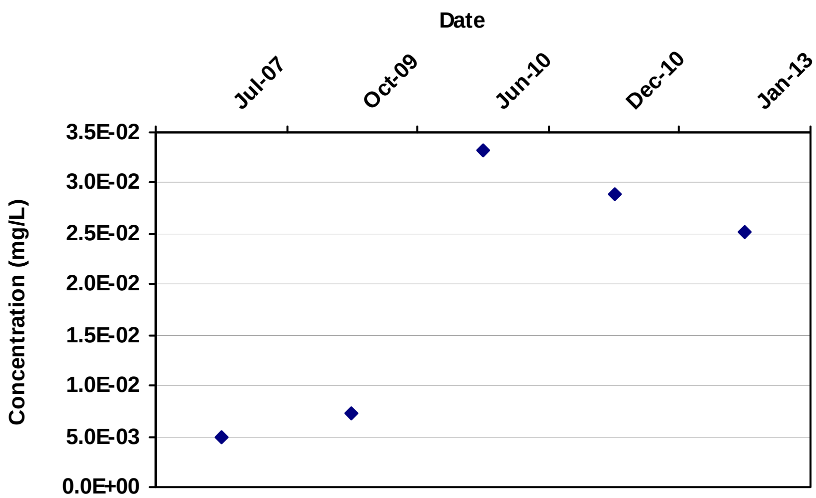
Consolidation Period: No Time Consolidation

Duplicate Consolidation: Median

Consolidation Type: Average

ND Values: 1/2 Detection Limit

J Flag Values : Actual Value



Mann Kendall S Statistic:

4

Confidence in Trend:

75.8%

Coefficient of Variation:

0.65

Mann Kendall Concentration Trend: (See Note)

NT

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
GW-22A	T	7/19/2007	TETRACHLOROETHY	5.0E-03		1	1
GW-22A	T	10/28/2009	TETRACHLOROETHY	7.3E-03		1	1
GW-22A	T	6/16/2010	TETRACHLOROETHY	3.3E-02		1	1
GW-22A	T	12/15/2010	TETRACHLOROETHY	2.9E-02		1	1
GW-22A	T	1/25/2013	TETRACHLOROETHY	2.5E-02		2	2

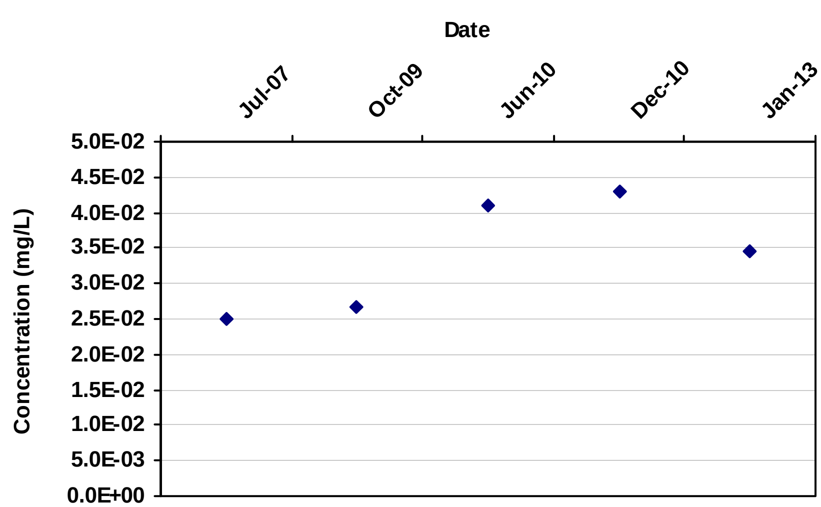
Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Mann-Kendall Statistics Summary

Project: East 67th Street | **User Name:** MV
Location: Odessa | **State:** Texas

Well: GW-24A
Well Type: S
COC: TETRACHLOROETHYLENE(PCE)

Time Period: 1/31/2007 **to** 1/25/2013
Consolidation Period: No Time Consolidation
Duplicate Consolidation: Median
Consolidation Type: Average
ND Values: 1/2 Detection Limit
J Flag Values : Actual Value



Mann Kendall S Statistic:

6

Confidence in Trend:

88.3%

Coefficient of Variation:

0.24

Mann Kendall Concentration Trend: (See Note)

NT

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
GW-24A	S	7/19/2007	TETRACHLOROETHY	2.5E-02		1	1
GW-24A	S	10/28/2009	TETRACHLOROETHY	2.7E-02		1	1
GW-24A	S	6/16/2010	TETRACHLOROETHY	4.1E-02		1	1
GW-24A	S	12/15/2010	TETRACHLOROETHY	4.3E-02		1	1
GW-24A	S	1/25/2013	TETRACHLOROETHY	3.5E-02		1	1

Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

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MAROS Mann-Kendall Statistics Summary

Project: East 67th Street **User Name:** MV

Location: Odessa **State:** Texas

Well: MW-27

Well Type: T

COC: TETRACHLOROETHYLENE(PCE)

Time Period: 1/31/2007 **to** 1/25/2013

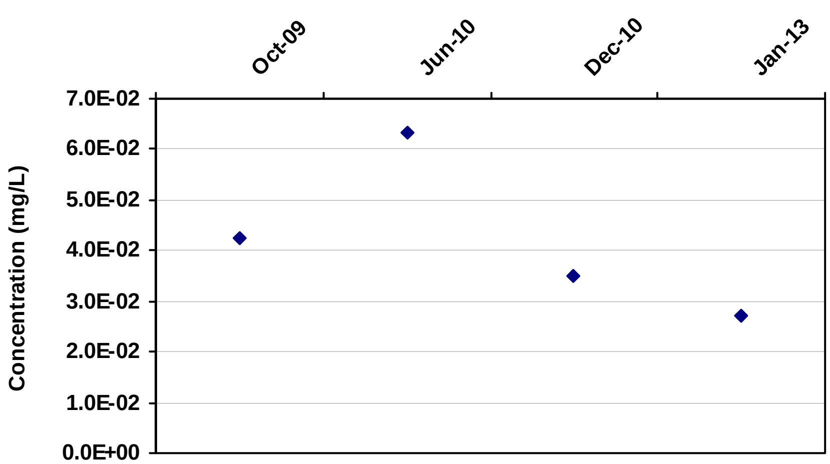
Consolidation Period: No Time Consolidation

Duplicate Consolidation: Median

Consolidation Type: Average

ND Values: 1/2 Detection Limit

J Flag Values : Actual Value



Mann Kendall S Statistic:

-4

Confidence in Trend:

83.3%

Coefficient of Variation:

0.37

Mann Kendall Concentration Trend: (See Note)

S

Data Table:

Well	Well Type	Effective Date	Constituent	Result (mg/L)	Flag	Number of Samples	Number of Detects
MW-27	T	10/28/2009	TETRACHLOROETHY	4.3E-02		1	1
MW-27	T	6/16/2010	TETRACHLOROETHY	6.4E-02		1	1
MW-27	T	12/15/2010	TETRACHLOROETHY	3.5E-02		1	1
MW-27	T	1/25/2013	TETRACHLOROETHY	2.7E-02		1	1

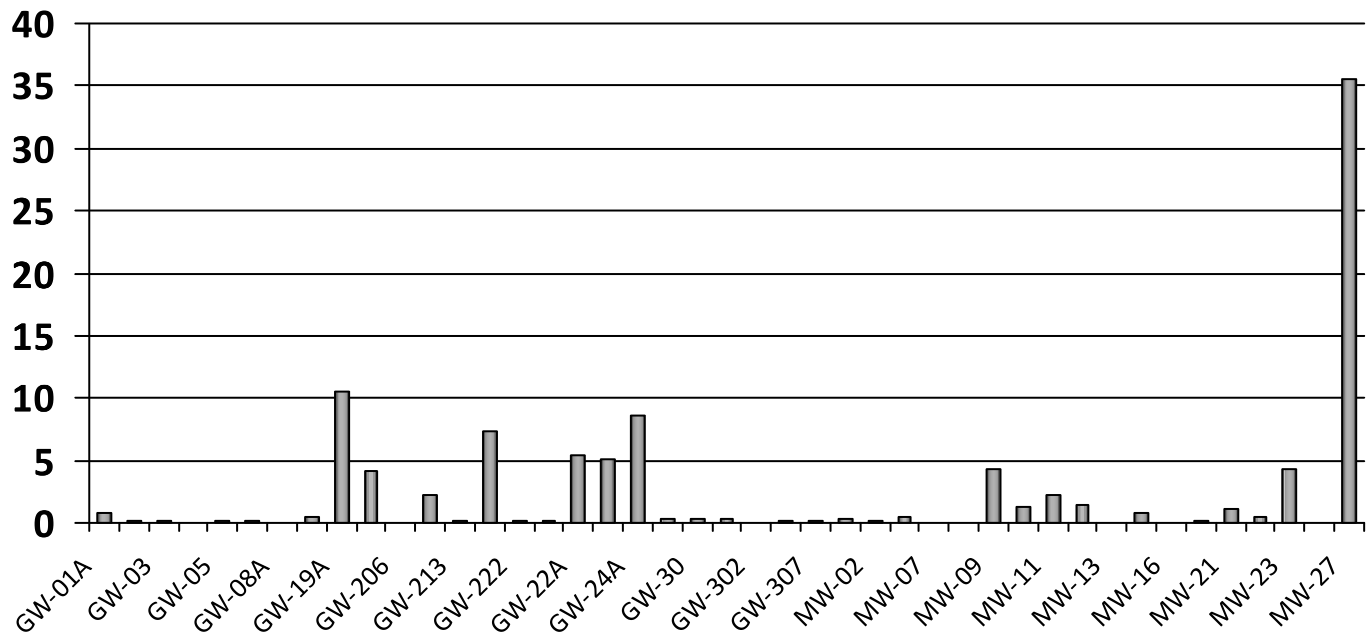
Note: Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A) - Due to insufficient Data (< 4 sampling events); ND = Non-detect

MAROS Percent of Mass by Well

Project: East 67th Street **User Name:** MV

Location: Odessa **State:** Texas

TETRACHLOROETHYLENE(PCE) 7/1/2013



Well	Area (ft2)	Mass (mg)	Percent of Mass	Percent of Area
GW-01A	47,811.89	30.12	0.79	2.23
GW-02	18,491.10	6.80	0.18	0.86
GW-03	39,463.59	6.63	0.17	1.84
GW-04	23,102.51	1.52	0.04	1.08
GW-05	39,932.90	3.67	0.10	1.86
GW-07A	29,962.05	5.03	0.13	1.40
GW-08A	43,463.68	2.85	0.08	2.03
GW-101	27,709.30	16.00	0.42	1.29
GW-19A	117,751.36	401.83	10.58	5.49
GW-205	25,201.02	158.77	4.18	1.17
GW-206	33,562.12	2.03	0.05	1.56
GW-207	137,362.71	86.54	2.28	6.40
GW-213	94,632.98	6.21	0.16	4.41
GW-21A	49,333.64	275.84	7.26	2.30

MAROS Percent of Mass by Well

Project: East 67th Street **User Name:** MV

Location: Odessa **State:** Texas

Well	Area (ft2)	Mass (mg)	Percent of Mass	Percent of Area
GW-222	47,110.08	7.91	0.21	2.20
GW-227	64,490.01	3.56	0.09	3.01
GW-22A	30,585.59	202.73	5.34	1.43
GW-23	29,005.26	191.87	5.05	1.35
GW-24A	36,302.66	329.72	8.68	1.69
GW-27	51,441.48	13.50	0.36	2.40
GW-30	69,535.56	10.40	0.27	3.24
GW-301	39,322.03	12.39	0.33	1.83
GW-302	9,092.82	0.93	0.02	0.42
GW-304	91,022.56	5.97	0.16	4.24
GW-307	70,818.01	8.55	0.23	3.30
GW-66A	14,603.64	11.88	0.31	0.68
MW-02	18,241.13	4.79	0.13	0.85
MW-04	16,677.10	15.32	0.40	0.78
MW-07	5,584.30	1.47	0.04	0.26
MW-08	7,894.68	1.66	0.04	0.37
MW-09	14,735.64	161.30	4.25	0.69
MW-10	40,409.69	47.73	1.26	1.88
MW-11	90,667.04	85.68	2.26	4.23
MW-12	29,959.11	54.66	1.44	1.40
MW-13	40,732.26	2.67	0.07	1.90
MW-14	106,982.39	28.08	0.74	4.99
MW-16	2,200.84	0.58	0.02	0.10
MW-18	16,270.02	4.27	0.11	0.76
MW-21	61,188.63	44.97	1.18	2.85
MW-22	30,972.97	20.33	0.54	1.44
MW-23	154,329.53	166.10	4.37	7.19
MW-24	37,671.84	2.47	0.07	1.76
MW-27	189,349.23	1,351.95	35.60	8.83
	2,144,977.0	3,797.3	100	100

MAROS Spatial Moment Analysis Summary

Project: East 67th Street **User Name:** MV

Location: Odessa **State:** Texas

Effective Date	0th Moment Estimated Mass (Kg)	1st Moment (Center of Mass) Xc (ft)	Yc (ft)	Source Distance	2nd Moment (Spread) Sigma XX (sq ft)	Sigma YY (sq ft)	Number of Wells
cis-1,2-DICHLOROETHYLENE							
7/1/2007	9.9E-01	1,658,974	10,663,300	522	101,906	44,826	36
7/1/2009	8.8E-01	1,659,064	10,663,470	642	93,157	65,921	31
7/1/2010	1.4E+00	1,659,021	10,663,489	607	73,137	46,296	29
7/1/2011	5.2E-02	1,659,877	10,663,523	1,446	23,972	86,657	18
7/1/2013	8.9E-01	1,659,077	10,663,520	670	93,449	58,664	35
TETRACHLOROETHYLENE(PCE)							
7/1/2007	1.6E+00	1,659,099	10,663,270	647	101,490	64,664	36
7/1/2009	2.1E+00	1,659,160	10,663,418	722	79,853	60,912	33
7/1/2010	2.2E+00	1,659,154	10,663,439	720	86,295	57,725	31
7/1/2011	4.6E-01	1,659,476	10,663,570	1,064	73,391	52,091	22
7/1/2013	1.4E+00	1,659,152	10,663,461	723	107,497	71,264	39
TRICHLOROETHYLENE (TCE)							
7/1/2007	2.6E-01	1,659,165	10,663,273	713	128,376	74,021	36
7/1/2009	2.9E-01	1,659,203	10,663,418	764	98,252	77,920	31
7/1/2010	3.7E-01	1,659,167	10,663,458	737	102,916	72,140	29
7/1/2011	5.4E-02	1,659,876	10,663,531	1,446	22,143	85,402	18
7/1/2013	2.6E-01	1,659,252	10,663,461	821	143,904	83,574	35

MAROS Spatial Moment Analysis Summary

Project: East 67th Street **User Name:** MV

Location: Odessa **State:** Texas

Spatial Moment Analysis Summary:

Moment Type	Constituent	Coefficient of Variation	Mann-Kendall S Statistic	Confidence in Trend	Moment Trend
0th Moment	cis-1,2-DICHLOROETHYLENE	0.59	-2	59.2%	S
0th Moment	TETRACHLOROETHYLENE(P	0.44	-2	59.2%	S
0th Moment	TRICHLOROETHYLENE (TCE)	0.48	-2	59.2%	S
First Moment	cis-1,2-DICHLOROETHYLENE	0.49	6	88.3%	NT
First Moment	TETRACHLOROETHYLENE(P	0.21	6	88.3%	NT
First Moment	TRICHLOROETHYLENE (TCE)	0.35	6	88.3%	NT
Second Moment X	cis-1,2-DICHLOROETHYLENE	0.41	-4	75.8%	S
Second Moment X	TETRACHLOROETHYLENE(P	0.16	0	40.8%	S
Second Moment X	TRICHLOROETHYLENE (TCE)	0.47	0	40.8%	S
Second Moment Y	cis-1,2-DICHLOROETHYLENE	0.28	4	75.8%	NT
Second Moment Y	TETRACHLOROETHYLENE(P	0.12	-2	59.2%	S
Second Moment Y	TRICHLOROETHYLENE (TCE)	0.07	4	75.8%	NT

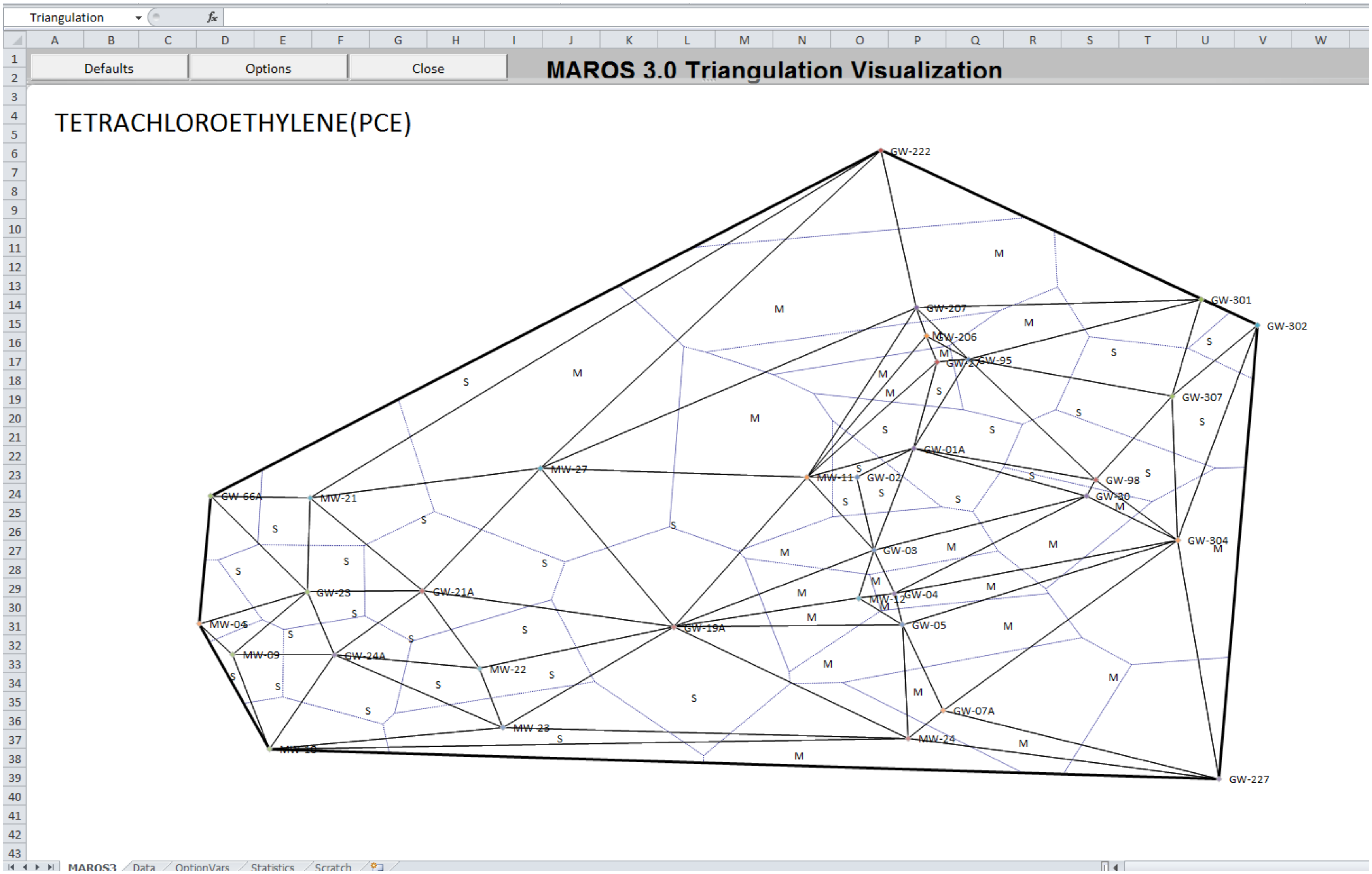
Note: The following assumptions were applied for the calculation of the Zeroth Moment:

Porosity: 0.25 **Saturated Thickness:** Uniform: 30 ft

Mann-Kendall Trend test performed on all sample events for each constituent. Increasing (I); Probably Increasing (PI); Stable (S); Probably Decreasing (PD); Decreasing (D); No Trend (NT); Not Applicable (N/A)-Due to insufficient Data (< 4 sampling events); (ND) Non Detect.

Note: The Sigma XX and Sigma YY components are estimated using the given field coordinate system and then rotated to align with the estimated groundwater flow direction. Moments are not calculated for sample events with less than 6 wells.

MAROS Well Network Uncertainty: PCE in LS1 Unit. Uncertainty is evaluated by Slope Factor within Delaunay Triangles. S = Small uncertainty, M = Medium, L = Large. The monitoring well network recommended for East 67th Street remedy performance monitoring does not show excess uncertainty.



APPENDIX D
RECOMMENDED GROUNDWATER PERFORMANCE MONITORING

WELL NAME	UNIT	OBJECTIVE	PARAMETERS AND FREQUENCY*	ANALYSES
MW-4 MW-9 MW-10	LS1	Evaluate effect of plugging GW-205 and GW-210 on contaminant migration from US2 to LS1	VOCs quarterly for 2 years	Trend evaluation, mass discharge downgradient
VP-01 VP-02 VP-03 VP-04 VP-05 VP-06	US2	Evaluate US2 source extent and US2 ISB performance	VOCs, arsenic, iron, manganese, TOC, and ORP prior to ISB and quarterly for 2 years after injection	Compare concentrations to cleanup goals, mass removal vs. cost of remedy
3 New US2 Monitoring Wells (Near GW-21, GW-23, GW-24)	US2	Evaluate US2 plume extent and US2 ISB performance	VOCs, arsenic, iron, manganese, TOC, and ORP prior to ISB and quarterly for two years after injection	Mass discharge downgradient, delineation of plume in US2, metals concentrations versus standards
5 New US2 Injection Wells	US2	Evaluate US2 plume extent and US2 ISB performance	VOCs, arsenic, iron, manganese, TOC, and ORP prior to ISB and quarterly for 2 years after injection	Confirm reducing conditions, monitor metals mobilization
5 New LS1 Monitoring Wells* (near GW-21, GW-23, GW-67, GW-24, GW-19, GW-27)	LS1	Evaluate effect of plugging GW-205 and GW-210 on LS1 water quality and evaluate need for active remediation in LS1	VOCs quarterly for 2 years	Trend evaluation, mass discharge downgradient
MW-11 MW-12 MW-21 MW-22 MW-23 MW-24 MW-27	LS1	Evaluate need for active remediation in LS1	VOCs quarterly for 2 years after recommended well plugging and abandonment has been conducted	Trend evaluation, compare concentrations to cleanup goals, delineate plume footprint

WELL NAME	UNIT	OBJECTIVE	PARAMETERS AND FREQUENCY*	ANALYSES
GW-01 GW-02 GW-03 GW-04 GW-05 GW-07 GW-27 GW-30 GW-64	LS1	Evaluate LS1 plume migration, need for active remediation in LS1, and need to replace specific water supply wells to eliminate exposure pathways	VOCs quarterly for 2 years after recommended well plugging and abandonment has been conducted	Compare to MCLs, delineate plume to below MCLs
GW-66 GW-95 GW-206 GW-207 GW-222 GW-227 GW-301 GW-302 GW-304 GW-307	LS1	Evaluate LS1 plume migration, need for active remediation in LS1, and need to replace specific water supply wells to eliminate exposure pathways	VOCs quarterly for 2 years after recommended well plugging and abandonment has been conducted	Compare to MCLs, delineate plume to below MCLs
MW-06	LS1	Background location	VOCs, arsenic, iron, manganese, TOC, and ORP prior to ISB and annually	Establish background concentrations of metals, confirm delineation of plume

* Frequency and parameters to be revisited after specified time frame
** Sample GW-21, GW-22 and GW-24 until new LS1 wells are available

The monitoring network can be reduced in both well number and frequency after the 2 year remedy performance monitoring period. If remedy installation/activation is delayed, annual monitoring is recommended until active remedies are initiated.