United States
Environmental Protection
Agency

EPA 542-R-11-011
August 2012
Office of Solid Waste and Emergency Response
Office of Superfund Remediation and
Technology Innovation

Optimization Review
Sidney and Richardson Hill Road Landfills

Delaware County, New York

Optimization Evaluation

Sidney and Richardson Hill Road Landfills
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Report of the Optimization Evaluation
Site Visit Conducted at the Sidney and Richardson Hill Road Landfill Superfund Sites
August 23, 2011

Final Report
April 4, 2012

EXECUTIVE SUMMARY

Optimization Background

For more than a decade, the U.S. Environmental Protection Agency (EPA) Office of Superfund Remediation and Technology Innovation (OSRTI) has provided technical support to EPA Regional offices through third-party optimization evaluations. OSRTI has conducted more than 100 optimization studies at Superfund sites nationwide via Independent Design, Remediation System Evaluation (RSE), and Long-Term Monitoring Optimization (LTMO) reviews.

OSRTI is now implementing its National Strategy to Expand Superfund Optimization from Remedial Investigation to Site Completion. The strategy unifies previously independent optimization efforts (RSE, LTMO, Triad Approach, and Green Remediation) under the single activity and term "optimization," which can be applied at any stage of the Superfund project life cycle. EPA's working definition of optimization as of June 2011 is as follows:

> *"A systematic site review by a team of independent technical experts, at any phase of a cleanup process, to identify opportunities to improve remedy protectiveness, effectiveness, and cost efficiency, and to facilitate progress toward site completion."*

An optimization review at the remedy stage therefore considers the goals of the remedy, available site data, the 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 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 before the recommendation can be implemented. Note that the recommendations are based on an independent evaluation and represent the opinions of the evaluation team. These recommendations do not constitute requirements for future action, but rather are provided for consideration by the Region and other site stakeholders.

Site-Specific Background

The Sidney Landfill site is located on Richardson Hill Road approximately 10 miles southeast of Sidney, New York. In March 1989, the site was added to the National Priorities List (NPL) based on investigations completed by the New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH). The Richardson Hill Road Landfill (RHRL) site, which is also on the NPL, is located immediately south of the Sidney Landfill site. Historical waste disposal resulted in polychlorinated biphenyl (PCB) and volatile organic compound (VOC) contamination of soil and groundwater at the Sidney Landfill site and of soil, groundwater, and sediments at the RHRL site. Soil and sediment remedies have been implemented and completed at both sites. Groundwater remediation with a pump and treat system is ongoing at the RHRL, and pumping from the North Area of the RHRL site is included in the groundwater remedy for Sidney Landfill site. The respondents at the two sites are Amphenol Corporation and Honeywell, Inc., which is the successor to Bendix Corporation and Allied Signal, Inc.

Summary of Conceptual Site Model (CSM)

Groundwater contamination at both sites is present in the overburden and bedrock. The soil remedies have likely reduced the potential for additional contamination from soil. However, groundwater concentrations at the Sidney Landfill remain relatively stable, or potentially increasing (for example, at MW-6D), since the soil remedy was completed. The Sidney Landfill is located on a groundwater flow divide, and groundwater flow and groundwater contamination to the north are not well understood. Seeps at the bottom of the hill to the north are impacted with chlorinated volatile organic compound (CVOC) contamination above standards, suggesting that at least part of the plume is migrating to the north. The North Area recovery system that is part of the RHRL site may address contamination that migrates to the west or south from the Sidney Landfill site. However, the hydraulic gradient in the northern portion of the North Area recovery system trends away from Sidney Landfill, and the hydraulic gradient at the southern end trends from RW-4 to the south. This observed pattern suggests that the wells do not provide capture of contamination migrating from the Sidney Landfill in the direction of these wells.

For the RHRL site, no groundwater quality data are available from beneath the landfills since the landfill cap was constructed or up gradient of the extraction trench. It is therefore difficult to determine the effect the RHRL site soil remedy has had on groundwater quality. Contaminant concentrations in groundwater downgradient of the RHRL extraction trench are generally decreasing; with the exception of samples from well TMW-02. These concentration decreases are likely the result of operating the groundwater extraction trench. Hydraulic data are insufficient to confirm capture, and it is too early to determine from groundwater sampling if capture is sufficient to allow downgradient concentrations to decrease to cleanup standards. Gaps in capture, if present, would likely be around the northern end of the trench, through shallow bedrock under the trench, and or through deeper bedrock, given that the contamination in the shallow bedrock beneath the trench does not appear to have been vertically delineated. No recent water quality data are available from the RHRL North Area to evaluate water quality trends in that area.

Summary of Findings

- Groundwater flow and contaminant migration pathways at the Sidney Landfill site do not appear to be well understood, especially to the north.
- Insufficient information is available to evaluate plume capture in both areas of pumping.
- Contaminant concentrations at the Sidney Landfill have decreased since the Remedial Investigation (RI) but have not continued to decrease since implementation of the groundwater remedy at the RHRL North Area. Concentrations may be increasing in some localized areas at the Sidney Landfill site.
- Contamination downgradient of the RHRL extraction trench was likely present before the remedy was in place and is likely contributing to limited recontamination of the sediments at South Pond. Decreasing contaminant concentrations in locations downgradient of the trench suggest some degree of plume capture, but insufficient information is available to determine if capture is complete.

- The 2008 fish tissue sampling results raise the concern about ongoing exposure of fish to significant levels of PCBs. The 2010 surface water and sediment sampling indicated some recontamination of the South Pond sediments by PCBs and undetectable PCBs in surface water. The 2011 fish sampling may help evaluate whether conditions are improving.
- The groundwater treatment plant is well maintained and routinely meets compliance standards.

Summary of Recommendations

Recommendations are provided to improve remedy effectiveness, reduce cost, and provide technical improvement. The recommendations in these areas are as follows:

Improving effectiveness – conduct comprehensive water level measurement events and additional groundwater sampling to better understand contaminant transport at the Sidney Landfill site, update the groundwater flow model for use in evaluating plume capture, and potentially evaluate the discharge of PCBs to South Pond.

Reducing cost – consider potential reductions in operator labor, use of passive diffusion bags (PDB) for groundwater sampling of VOCs, discontinuation of laboratory analysis for natural attenuation parameters, and use of greens and filtration for metals removal.

Technical improvement – track leachate levels and leachate quality in the on-site toxic substances waste unit, and improve operation of extraction and treatment plant flow meters.

No considerations were identified at this time for accelerating site closure, and no opportunities were identified at this time for meaningful reduction of the remedy environmental footprint.

NOTICE

Work described herein was performed by Tetra Tech GEO (TtGEO) for the U.S. Environmental Protection Agency (EPA). Work conducted by TtGEO, including preparation of this report, was performed under Work Assignment #58 of EPA contract EP-W-07-078 with Tetra Tech EM Inc., Chicago, Illinois. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

PREFACE

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

Organization	Key Contact	Contact Information
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LIST OF ACRONYMS

µg/kg	Micrograms Per Kilogram
µg/L	Micrograms Per Liter
AMSL	Above Mean Sea Level
AOC	Administrative Order on Consent
bgs	Below Ground Surface
cfm	Cubic Feet Per Minute
COC	Constituent of Concern
CSM	Conceptual Site Model
CVOC	Chlorinated Volatile Organic Compound
DCA	Dichloroethane
DCE	Dichloroethene
DI	Deionized
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
GAC	Granular Activated Carbon
gpd	Gallons Per Day
gpm	Gallons Per Minute
GWTP	Groundwater Treatment Plant
HDPE	High Density Polyethylene
HRC	Hydrogen Release Compound
IC	Institutional Control
LNAPL	Light Non-Aqueous Phase Liquids
LTMO	Long-Term Monitoring Optimization
mg/kg	Milligrams Per Kilogram
mg/L	Milligrams Per Liter
MNA	Monitored Natural Attenuation
NPL	National Priorities List
NYCRR	New York Codes, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	Operations and Maintenance
ORP	Oxidation Reduction Potential
OSRTI	Office of Superfund Remediation and Technology Innovation
P&T	Pump and Treat
PAC	Polyaluminum Chloride
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
PDBs	Passive Diffusion Bags
PISCES	Passive In Situ Concentration-Extraction Samplers
PPM	Parts Per Million

PRP	Potential Responsible Party
PSI	Pounds Per Square Inch
PVC	Polyvinyl Casing
QAPP	Quality Assurance Project Plan
RAO	Remedial Action Objective
RCRA	Resources Conservation and Recovery Act
RD	Remedial Design
RHRL	Richardson Hill Road Landfill
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
ROD	Record of Decision
RSE	Remedial System Evaluation
RTU	Reaction Treatment Unit
SPDES	State Pollutant Discharge Elimination System
SVOCs	Semi-Volatile Organic Compound
TCA	Trichloroethane
TCE	Trichloroethene
TSCA	Toxic Substances Control Act
VC	Vinyl Chloride
VI	Vapor Intrusion
VOC	Volatile Organic Compound

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1.0 INTRODUCTION

1.1 PURPOSE

During fiscal years 2000 and 2001, independent reviews called Remediation System Evaluations (RSEs) were conducted at 20 operating Fund-lead pump and treat (P&T) sites (those sites with P&T systems funded and managed by Superfund and the states). In light of the opportunities for system optimization that arose from those RSEs, the U.S. Environmental Protection Agency (EPA) Office of Superfund Remediation and Technology Innovation (OSRTI) has incorporated RSEs into a larger post-construction complete strategy for Fund-lead remedies as documented in *OSWER Directive No. 9283.1-25, Action Plan for Ground Water Remedy Optimization*. Concurrently, EPA developed and applied the Triad approach to optimize site characterization and development of a conceptual site model (CSM). EPA has since expanded the definition of optimization to encompass investigation stage optimization using the Triad approach, optimization during design, and RSEs. EPA's working definition of optimization as of June 2011 is as follows:

> *"A systematic site review by a team of independent technical experts, at any phase of a cleanup process, to identify opportunities to improve remedy protectiveness, effectiveness, and cost efficiency, and to facilitate progress toward site completion."*

As stated in the definition, optimization refers to a "systematic site review," indicating that the site as a whole is often considered in the review. Optimization can be applied to a specific aspect of the remedy (for example, focus on long-term monitoring optimization [LTMO] or focus on one particular operable unit), but other site or remedy components are still considered to the degree that they affect the focus of the optimization. An optimization evaluation considers the goals of the remedy, available site data, the 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, OSRTI has developed a Green Remediation Primer (http://cluin.org/greenremediation/) and now routinely considers green remediation and environmental footprint reduction during optimization evaluations. The evaluation includes reviewing site documents, 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 before the recommendation can be implemented. Note that the recommendations are based on an independent evaluation and represent the opinions of the evaluation team. These recommendations do not constitute requirements for future action, but rather are provided for consideration by the Region and other site stakeholders.

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

The 72-acre Sidney Landfill site is located on Richardson Hill Road, approximately 2 miles south of the Village of Sidney Center in Delaware County, New York. The Richardson Hill Road Landfill (RHRL) site is located immediately to the south of the Sidney Landfill site. The remedies at both National Priorities List (NPL) sites have been implemented by the responsible parties, Amphenol Corporation and Honeywell, Inc., which are the successors to Bendix Corporation and Allied Signal, Inc. These parties are collectively referred to as the Potentially Responsible Parties (PRP) for this report.

The capture zone associated with extraction wells at the northern end of the RHRL site is considered part of the Sidney Landfill remedy. The identification of new seeps downhill to the north from the Sidney Landfill, the presence of an apparent hydraulic connection between the two landfills, as well as the persistence of groundwater and sediment contamination at the RHRL site led the EPA to request a study of optimization opportunities for the remedies at these two sites. This optimization review focuses on the groundwater components of the remedies for the two sites and considers soil and sediment contamination only as it may be related to groundwater contamination.

1.2 TEAM COMPOSITION

The optimization review team consisted of the following individuals:

Name	Affiliation	Phone	Email
Doug Sutton	Tetra Tech GEO	732-409-0344	doug.sutton@tetratech.com
Mike Noel*	Tetra Tech GEO	262-792-1282	mike.noel@tetratech.com
Scott Shaw*	Tetra Tech GEO	703-444-7000	scott.shaw@tetratech.com

** Present for the site visit*

In addition, the following individual from EPA OSRTI participated in the site visit.

- Kathy Yager, EPA OSRTI

1.3 DOCUMENTS REVIEWED

The following documents were reviewed. The reader is directed to these documents for additional site information that is not provided in this report.

Sidney Landfill Record of Decision (EPA Region 2, September 1995)

Sidney Landfill Explanation of Significant Differences (EPA Region 2, September 2004)

Sidney Landfill Site Environmental Data Review Report (JTM Assoc., 2006)

Sidney Landfill Second 5-yr Review Report (EPA Region 2, June 2009)

Sidney Landfill Site Draft Enhanced Biodegradation Report, MW-2S Area Groundwater "Hotspot" (MACTEC, May 2003)

Sidney Landfill Inspection and Monitoring Program, 2007 Annual Report (JTM Associates, August 2008)

Sidney Landfill Inspection and Monitoring Program, 2010 Annual Report (JTM Associates, April 2011)

Sidney Landfill Inspection and Monitoring Program, 2008 Annual Report (JTM Associates, March 2009)

Richardson Hill Road Landfill Record of Decision (US EPA Region 2, September 1997)

Richardson Hill Road Landfill Supplemental Hydrogeologic Investigation (O'Brian & Gere, September 2008)

Richardson Hill Road Landfill First 5-yr Review Report (US EPA Region 2, September 2007)

Richardson Hill Road Landfill Groundwater Treatment Plant Effluent Discharge Criteria (NYSDEC, December 1, 2005)

NYSDEC Sec. 703.5 Water Quality Standards for Surface Water and Groundwater (Current)

National Primary Drinking Water Regulations (Current)

Richardson Hill Road Landfill Site Final Interim Remedial Action Report, Remedial Work Element I, Remedial Excavations and Capping (Parsons, August 2007)

Richardson Hill Road Landfill Site Final Interim Remedial Action Report, Remedial Work Element I, Groundwater Extraction and Treatment (Parsons, August 2007)

Richardson Hill Road Landfill Site Operations and Maintenance Manual for Post Construction Activities (Parsons, August 2007)

Richardson Hill Road Landfill Site 2008 Fish Tissue Sampling Results

Richardson Hill Road Landfill Site Explanation of Significant Differences (EPA Region 2, September 2008)

Richardson Hill Road Landfill Site Final Remedial Action Report for Herrick Hollow Creek Restoration (Barton & Loguidice, March 2009)

Richardson Hill Road Landfill Site Operations and Maintenance 2009 Annual Summary Report (JTM Associates, April 2010)

Richardson Hill Road Landfill Site Operations and Maintenance 2010 Annual Summary Report (JTM Associates, April 2011)

Richardson Hill Road Landfill Site Operations and Maintenance Report 1st Quarter 2011 (JTM Associates, June 2011)

Richardson Hill Road Landfill Site 2008 - 2011 process data

1.4 QUALITY ASSURANCE

This optimization evaluation uses existing environmental data to interpret the CSM, evaluate remedy performance, and make recommendations to improve the remedies at two focus sites. The optimization team evaluates the quality of the existing data before data are used for these purposes. The evaluation for data quality includes a brief review of how the data were collected and managed (where practical, the site Quality Assurance Project Plan [QAPP] is considered), the consistency of the data with other site data, and the use of the data in the optimization evaluation. Data that are of suspect quality are either not used as part of the optimization evaluation or are used with the quality concerns noted. Where appropriate, this report provides recommendations made to improve data quality.

1.5 PERSONS CONTACTED

The site visit and stakeholders meeting were held on August 23, 2011, at the Amphenol Plant (office of one of the PRPs) in Sidney, New York. In addition to Mike Noel, Scott Shaw, and Kathy Yager, the following persons were present for the stakeholders meeting:

Name	Affiliation	Phone	Email
Young Chang	EPA Region 2	212-637-4253	chang.young@epa.gov
Edward Modica	EPA Region 2		
Samuel Waldo	Amphenol		
Joe Bianchi	Amphenol		
David Carnevale	O'Brien & Gere		
Deborah Wright	O'Brien & Gere		
Richard Galloway	Honeywell		
James Drumm	NYSDEC		

2.0 SITE BACKGROUND

2.1 LOCATION

The Sidney Landfill is located on the eastern side of Richardson Hill Road, approximately 2 miles south of the village of Sidney Center in Delaware County, New York. The closest large town is Sidney, New York, which is located approximately 10 miles northwest. The RHRL site is located south of the Sidney Landfill, on the western side of Richardson Hill Road, and on the western side of Herrick Hollow Creek, a north/south stream valley. The RHRL site consists of two sections designated as the "North Area" and the "South Area." The South Area is composed of an 8-acre landfill (which contained a former waste oil disposal pit), South Pond, and a portion of Herrick Hollow Creek. Both sites are located on the boundary between the Susquehanna (north) and Delaware River (south) drainage divides. Figure 1-1 (see Attachment A) illustrates the locations of these two sites with respect to each other and Richardson Hill Road.

2.2 SITE HISTORY

2.2.1 HISTORICAL LAND USE AND FACILITY OPERATIONS

The RHRL property was purchased in 1964 to operate a landfill. In 1968, the operator agreed with the New York State Department of Environmental Conservation (NYSDEC) to cease landfilling as a result of a number of operational violations. The site continued to accept waste until 1969. Two areas at the site have historically been used for landfilling: (1) the North Area, which consisted of a pair of waste trenches; and (2) the South Area, which included approximately 8 acres used for conventional landfill operations and a waste oil pit.

According to the Record of Decision (ROD) (EPA, 1995) the Sidney Landfill property was purchased in 1967 with the intent of operating a landfill. Landfill operations ceased in 1972. Six distinct areas of the Sidney Landfill were used for landfill operations: (1) the North Disposal Area; (2) the Southeast Disposal Area; (3) the Southwest Disposal Area; (4) the Alleged Liquid Disposal Area; (5) the White Goods Disposal Area; and (6) the Can and Bottle Dump.

2.2.2 CHRONOLOGY OF ENFORCEMENT AND REMEDIAL ACTIVITIES

Sidney Landfill

The following is the chronological sequence of site investigation and remedial activities associated with the Sidney Landfill.

- Landfill operations at the site began in 1967 and ended in 1972.

- From 1985 to 1987, NYSDEC conducted a Phase II site investigation of the site. Groundwater samples collected in September 1985 and October 1986 had concentrations of several constituents of concern (COC) that were above state and federal drinking water standards. As a result of the investigation, the site was proposed to be included on the NPL on June 24, 1988.

- On March 31, 1989, the site was added to the NPL.

- The EPA conducted a Remedial Investigation and Feasibility Study (RI/FS) at the site from 1991 to 1995.

- On September 28, 1995, the EPA issued a ROD for the site, selecting a remedy that included landfill capping, groundwater extraction, institutional controls (IC), and monitoring.

- An Administrative Order was issued to the PRPs in 1996 to design and install the remedy.

- The Remedial Design (RD) began in 1997.

- In 1998, during a pre-design investigation, a pilot test of a blasted-bedrock trench was attempted. During the initial installation of the trench as part of the pilot test, detonation of blasting materials created a hydraulic inter-connection between the shallow and deep bedrock zones that effectively dewatered the aquifer near MW-2S, a contamination "hot spot." As a result, the MW-2S hot spot was no longer in existence and, therefore, extraction of contaminated groundwater was no longer possible in this area.

- Disposal area capping started in June 1999 and was completed by November 2000.

- The site operations and maintenance (O&M) manual was approved by the EPA in 1999.

- As part of an assessment of site-wide natural attenuation, quarterly groundwater sampling was initiated in November 2001. Quarterly groundwater sampling was conducted for eight quarters. The samples were analyzed for natural attenuation parameters and volatile organic compounds (VOC).

- In an attempt to address groundwater contamination near MW-2S, injection of Hydrogen Release Compound (HRC®) to enhance contaminant biodegradation was tested at the pilot scale between 2001 and 2002. Although there was some evidence of minor reducing conditions and contaminant degradation, it was determined that the enhanced biodegradation technology would not be a suitable alternative at the site.

- In September 2004, EPA issued an Explanation of Significant Differences (ESD) that formalized eliminating groundwater extraction in the area of MW-2S and specified that the radius of influence of pumping from the RHRL site is sufficient to meet the remedial action objectives (RAO) for the Sidney Landfill remedy. In addition, as a result of the location of the main site access road, the White Goods Disposal Area and the Alleged Liquid Waste Disposal Area were capped and fenced off separately, rather than combining them into a single unit.

- The initial Five-Year Review of the site was completed in 2004 and the second Five-Year Review was completed in 2009.

RHRL

The following is the chronological sequence of site investigation and remedial activities associated with the RHRL site.

- Landfill operations began in 1964 and ended in 1969. Based on the results of a Phase II site investigation conducted by NYSDEC, the site was placed on the NPL on July 1, 1987.

- On July 22, 1987, EPA entered into an Administrative Order on Consent (AOC) with the PRPs, requiring them to complete an RI/FS and delineate the nature and extent of the contamination at, and emanating from, the site and to identify and evaluate remedial alternatives.

- From 1988 to 1996, the initial RI was conducted.

- In 1993, EPA entered into an AOC with the PRPs, requiring them to investigate potential contamination of nearby residential water supplies and install and operate whole-house supply water treatment systems.

- In 1993, a Unilateral Administrative Order was issued to the PRPs to control light non-aqueous phase liquids (LNAPL) and excavate sediment in the hot spot of the South Pond.

- In 1997, EPA signed a ROD that included excavation of contaminated waste from selected areas, removal of contaminated sediments and soils from selected areas, installation of outlet controls on South Pond, groundwater extraction and treatment from an extraction trench, ICs, long-term monitoring, and installation and maintenance of water treatment systems on the contaminated wells at two nearby residences.

- The RD started and a Consent Decree for the remedy design and implementation was approved in 1999.

- In 2003 and 2004, contaminated soil from outside of the landfill, polychlorinated biphenyl (PCB)-contaminated soils from the waste oil pit, and PCB-contaminated sediments from the South Pond area were excavated, and the groundwater extraction trench was installed.

- Landfill cap installation was initiated in 2004 and completed in 2006.

- A Supplemental Hydrogeologic Investigation was completed between 2006 and 2008 to (1) assess the extent of contaminants in the shallow bedrock east of the RHRL site and South Pond and south of South Pond; (2) define the extent of hydraulic influence of the groundwater collection trench; and (3) identify appropriate trench monitoring and operational modifications.

- The initial Five-Year Review was completed in 2007.

- In 2008, EPA issued an ESD to formalize the consolidation of sediment removal into a single event and to include additional limited groundwater extraction from downgradient of the groundwater extraction trench to address contamination but limit dewatering of wetlands.

2.3 POTENTIAL HUMAN AND ECOLOGICAL RECEPTORS

According to the Sidney Landfill second Five-Year Review, approximately 50 property owners live within one mile of the sites, all of which obtain drinking water from either water wells or active springs. The September 2008 Preliminary Site Close-Out Report states that there are three residences located between the entrances of the two NPL sites. Two of the residences are located on the eastern side of Richardson Hill Road, and the third is located on the western side. Despite the implementation of ICs

(Environmental Restriction Easement and Declaration of Restrictive Covenants) at both of the properties on the eastern side of the Richardson Hill Road that run with the land, it was determined in 2011 that the property owner had installed two household supply wells immediately south of the Sidney Landfill and east of the RHRL.

The seeps (springs), wetlands, ponds, and streams that are present at the toe of both landfills serve as discharge points for site groundwater. Downslope property owners, wildlife, and recreational users of surface water features are potential receptors of site contaminants.

2.4 EXISTING DATA AND INFORMATION

The information provided in this section is intended to represent data already available from existing site documents. Interpretation included in this section is generally from the document that supplied the information. The optimization review team's subsequent interpretation of these data is presented in Sections 4.0 and 5.0 of this report.

2.4.1 SOURCES OF CONTAMINATION

Sidney Landfill

The primary COCs at the site are PCBs and chlorinated volatile organic compounds (CVOC) that result from previous disposal practices. According to the second Five-Year Review, the area where waste was deposited is not well-documented; however, several discrete areas in different parts of the site were filled. According to the second Five-Year Review, the following disposal areas had shown the presence of hazardous constituents prior to remediation:

- North Disposal Area (10.8 acres)
- Southeast Disposal Area (6.4 acres)
- Southwest Disposal Area (1.9 acres)
- Alleged Liquid Waste Disposal Area (3,125 square feet)
- White Goods Disposal Area (8,516 square feet)
- Can and Bottle Dump Area (19,032 square feet)

Soils near the Southeast Disposal Area in an area described as the "eastern stained soil area" contained detectable concentrations of cadmium (14.8 milligrams per kilogram [mg/kg]) and thallium (0.4 mg/kg).

Based on their presence in soil and groundwater, CVOCs were most likely part of the waste stream in one or more parts of the site.

According to the second Five-Year Review, 1,200 cubic yards of waste was excavated from the Can and Bottle Dump Area during remedy construction and consolidated onto the North Disposal Area, and caps consistent with Title 6 of the New York Codes, Rules and Regulations Part 360 ("Part 360 caps") were installed over the North Disposal Area, Southeast Disposal Area, Southwest Disposal Area, Alleged Liquid Waste Disposal Area, and White Goods Disposal Area. The caps consisted of a 12-inch gas venting layer, a textured 60-mil high density polyethylene (HDPE) geomembrane liner, a 24-inch barrier protection layer, and a 6-inch topsoil layer. Each cap was enclosed by a chain-link fence. The cap construction was completed in November 1999. The capped areas are indicated on Figure 2-1 (see Attachment A).

RHRL Site

The sources of contamination in the South Area include an 8-acre landfill, part of which is a former waste oil disposal pit. The primary COCs for the RHRL site are the same as at the Sidney Landfill site, and the highest concentrations in surface and subsurface soils were detected in the vicinity of the former waste oil disposal pit (see Figure 2-2, Attachment A). According to the ROD, the maximum PCB concentration detected in the original Remedial Investigation (RI) samples collected in 1990 in the subsurface soil was 14,000 mg/kg, located southwest of the former waste oil disposal pit. In the former waste oil disposal pit itself, PCB concentrations ranged up to 7,000 mg/kg. Soil samples collected in the former waste oil disposal pit showed a substantial reduction in contaminant levels over time. The ROD suggests that the significant reduction in PCB concentrations in the former waste oil disposal pit and the surrounding soils, in conjunction with the presence of high levels of PCB-contaminated sediments in South Pond before they were excavated, appears to indicate that much of the contamination in the former waste oil disposal pit migrated to the South Pond and caused significant sediment contamination. Based on their more extensive presence in soil and groundwater, CVOCs were most likely part of the waste stream in the waste oil pit and other parts of the landfill.

The North Area is located about 1,000 feet northeast of the landfill and included two disposal trenches (approximately 70 feet by 70 feet) and a man-made surface water body called North Pond (shown on Figure 1-1 north of the treatment plant). PCBs were also detected in surface and subsurface soils in the North Area (field screening concentrations ranged up to 42.2 mg/kg and 0.14 mg/kg, respectively).

Elevated levels of inorganic contaminants were detected in subsurface soil samples in an area south-southwest of the former waste oil disposal pit, the former waste oil disposal pit itself, and the North Area. Iron, nickel, lead, and zinc were detected, with highest concentrations of 53,100 mg/kg, 37.6 mg/kg, 136 mg/kg, and 413 mg/kg, respectively. The concentrations of the remaining inorganic constituents were within the New York State background levels.

According to the Five-Year Review, approximately 7,300 cubic yards of contaminated waste materials and soils were excavated from the North and South Areas of the site and from the waste oil disposal pit in the landfill.

2.4.2 GEOLOGY SETTING AND HYDROGEOLOGY

The geology, hydrogeology, and hydrology of the two sites are similar and are therefore discussed together.

Geology

According to several of the site reports reviewed, the unconsolidated overburden at the two sites consists of dense reddish brown to gray glacial till. For the most part, the overburden is unsaturated except near the valley center in proximity to discharge points near the North and South Ponds. Bedrock beneath the landfills is part of the Sonyea Group of the lower Walton Formation, consisting of non-marine, massive gray sandstones interbedded with siltstones and shales that dip gently (2 to 3 degrees) to the east. The depth to bedrock at the RHRL site varies from 18 feet to 39 feet below ground surface (bgs). According to the Sidney Landfill Five-Year Review, the dominant fracture orientation is from northeast to southwest with a secondary fracture orientation from east to west.

Hydrogeology

Groundwater is encountered in the overburden, shallow bedrock (18 to 70 feet bgs), and the deeper bedrock (greater than 70 feet bgs). According to the 2007 final O&M plan for the RHRL remedy, the overburden and shallow bedrock flow regimes appear to be hydraulically connected and isolated from the deeper bedrock groundwater flow system. Overburden groundwater flow in the vicinity of the landfills is topographically controlled in the coarser-grained sediments within the till. Groundwater flow in the bedrock is predominantly along bedding planes and fractures toward the center of the valley, where it discharges to the overburden and emerges as wetlands, ponds, and streams.

There is a 0.15 feet/foot hydraulic gradient in the overburden at the RHRL site, and overburden groundwater at the RHRL site discharges to the South Pond. Groundwater in the North Area flows to the north toward North Pond. Bedrock at the RHRL site flows from the eastern and western uplands toward Herrick Hollow. Water level data collected from bedrock monitoring wells at the Sidney Landfill indicate that the hydraulic gradient in the bedrock ranges from 0.10 to 0.20 feet/foot in an east-to-west direction. Supplemental information from the Sidney Landfill indicates that while groundwater flow is predominantly to the west, a southwesterly flow component associated with the primary fracture orientation is also present and contributing to the distribution of contaminated groundwater.

Water budget data collected during well installation at both sites show that little, if any, drilling fluid was lost during drilling in the overburden, indicating that the till is relatively impermeable.

Overburden hydraulic conductivity measured during the RI varied from 0.01 to 15 feet/day. With a hydraulic gradient of 0.15 feet/foot and porosity of 0.3, the overburden seepage velocity ranges from 0.007 to 7.5 feet/day. In bedrock, the hydraulic conductivity ranges from 2.7E-4 to 6.6 feet/day, with groundwater primarily flowing through bedding plane fractures and not through the bedrock matrix.

Surface Water Hydrology

Surface water primarily drains from the sites into wetlands and eventually into either the North Pond or the South Pond. The Sidney Landfill and RHRL are located on the drainage divide between the Susquehanna and Delaware Rivers (see Figure 2-3, Attachment A). South Pond drains to Herrick Hollow Creek. Approximately 1.5 miles south of the site, Herrick Hollow Creek discharges to Trout Creek, a tributary of Cannonsville Reservoir. The Cannonsville Reservoir is part of the Delaware River watershed and serves as a source of drinking water for New York City. North Pond drains to a northerly flowing unnamed tributary of Carrs Creek that discharges to the Susquehanna River approximately 2 miles east of Sidney, New York.

2.4.3 SOIL CONTAMINATION

Soil contamination is briefly discussed in Section 2.4.1 during the discussion of source areas. Soil remedies have been implemented at the site and soils are not a primary focus of this optimization evaluation. Further information regarding the soil remedies, however, can be found in the site documents referenced by this report. It is noted that excavated soil contamination with PCB concentrations in excess of 500 mg/kg were disposed of off-site at a Toxic Substances Control Act (TSCA)-compliant facility. Excavated soil contaminated with PCB concentrations between 50 and 500 mg/kg at RHRL has been consolidated in a constructed landfill on site that meets the majority of the TSCA requirements (including double composite liner and a Resource Conservation and Recovery Act [RCRA] cap); PCBs are not expected to migrate from this management unit. Excavated soil contaminated with PCBs less than 50 mg/kg were consolidated on top of the landfill and included under a Part 360 cap. Therefore, contaminated soils remain on site as part of the final remedy.

2.4.4 SOIL VAPOR CONTAMINATION

There is only one permanent structure not associated with the site that would potentially be affected by vapor intrusion. A trailer associated with the house is used as a temporary vacation home. Both residences are located between the two sites. EPA reports that soil vapor intrusion was evaluated at both residences and determined not to pose a risk for the occupants.

Each of the capped solid waste units constructed as part of the remedy has passive landfill gas vents whose emissions are monitored on a frequent basis.

2.4.5 GROUNDWATER CONTAMINATION

Sidney Landfill

The following CVOCs have been detected in site monitoring wells since the initial phase II site investigation conducted by the NYSDEC in the 1980s.

- Trichloroethene (TCE)
- cis 1,2-dichloroethene (cis 1,2-DCE)
- vinyl chloride (VC)
- 1,1,1-trichloroethane (TCA)
- 1,1-dichloroethane (1,1-DCA)

PCBs have also been detected in groundwater.

CVOCs in the Sidney Landfill monitoring wells are primarily TCE and cis 1,2-DCE. Figure 2-4 (see Attachment A) illustrates the CVOC distribution as of 2010. Attachment B provides trends of CVOC monitoring from the fourth quarter of 2003 through 2010. Maximum CVOC concentrations during this period were detected in MW-6D (more than 1,000 micrograms per liter [µg/L]), which is located on the downgradient side of the North Disposal Area. PCB sampling is now currently limited to MW-2S, MW-6S, and MW-16S, and PCB concentrations were as high as 13 µg/L in 2010 (MW-6S).

RHRL

At the time of the initial RI (1988 to 1996), groundwater contamination at the RHRL site was dominated by high overburden concentrations of TCE (8,400 µg/L) and its daughter product cis 1,2-DCE (26,000 µg/L). As with the Sidney Landfill, TCA (1,300 µg/L) and its daughter compound 1,1-DCA were also detected at the RHRL site. In general, total CVOC concentrations in groundwater were greatest in the overburden downgradient from the waste oil disposal pit. PCB concentrations were encountered in shallow overburden at concentrations up to 1,400 µg/L. RI data indicated that the contaminant plume was 1,200 feet wide and 400 feet long from the RHRL to the South Pond. According to the RHRL RI, VOCs and PCBs were not detected in deeper bedrock monitoring wells.

CVOCs and PCBs continue to be monitored in site monitoring wells. Figure 2-5 (see Attachment A) illustrates the CVOC distribution as of 2010. All of the monitoring points are located downgradient of the landfill or downstream along Herrick Hollow Creek and are used for evaluating remedy performance. Attachment C provides trends of CVOC monitoring from the third quarter of 2007 through 2010.

Water quality sampling data from the RHRL North Area extraction wells have decreased slightly over time (on the order of 10 percent to 20 percent) and ranged from approximately 30 µg/L at RW-1 to more than 400 µg/L at RW-4.

2.4.6 SURFACE WATER AND SEDIMENT CONTAMINATION

Sidney Landfill

Contaminated seeps in the vicinity of the North Disposal Area were evident during the RI. NYSDEC sampled seeps associated with the Sidney Landfill in 2010 and identified a seep along the unnamed tributary north of North Pond with cis 1,2-DCE concentrations of approximately 15 µg/L.

The maximum concentration of COCs detected in sediment during the Sidney Landfill RI were 80 micrograms per kilogram (µg/kg) of PCBs, 420 µg/kg of benzo[a]pyrene, and lower concentrations of various VOCs in North Pond. The ROD reported that, based on the average concentrations found in North Pond, there was no potential risk to benthic organisms in North Pond.

RHRL

At the time of the RIs in the early- to mid-1990s, concentrations of TCE (4 µg/L) and cis 1,2-DCE (1 to 4 µg/L) were present in the surface water of South Pond. PCBs were detected in the stream draining the South Pond during the RI at concentrations ranging from 0.15 to 0.42 µg/L. Surface water is no longer sampled for CVOCs. PCBs were not detected (at a presumed detection limit of 0.05 µg/L) in 2010 surface water samples.

According to the ROD, concentrations of PCBs as high as 1,300 mg/kg were detected in sediments collected from the South Pond before the initial pond excavation. Other COCs detected in South Pond sediments included toluene (1.4 mg/kg) and cis 1,2-DCE (3.5 mg/kg). After the initial South Pond excavation event in 1993, concentrations of these compounds had decreased below relevant standards for all compounds.

During the RHRL RI, it was determined that PCBs were the dominant COC, with maximum concentrations of 24 mg/kg in flood plain sediments just to the south of the pond and up to 180 mg/kg in Herrick Hollow Creek. According to the 2008 Preliminary Closeout Report, all of the remaining PCB-contaminated sediments exceeding 1 mg/kg from South Pond and Herrick Hollow Creek (a total of 28,520 cubic yards) were dry excavated in 2004 and consolidated on the landfill before it was capped. Confirmatory sampling presented in the 2007 Remedial Action Report demonstrated compliance with the 1 mg/kg criterion.

Long-term sediment and surface water monitoring will be conducted to confirm that upland remediation (landfill cap and groundwater collection and treatment) are functioning as designed and are not re-contaminating South Pond and Herrick Hollow Creek. Although excavated sediment was replaced with clean soil, sediment sampling in 2010 indicates detectable levels of PCBs below the sediment remedy cleanup criterion of 1 mg/kg.

2.4.7 FISH TISSUE CONTAMINATION

One fish sampling event was conducted in 2008 and another one was conducted in fall 2011. Fish tissue samples were collected at multiple segments of Herrick Hollow Creek. The 2008 fish tissue results were reviewed by the optimization review team. Wet weight PCB concentrations in creek chub and pumpkinseed (sun fish) ranged from 720 µg/kg to 8,000 µg/kg for fish tissue samples collected from South Pond (segment 21) and the upper reaches of Herrick Hollow Creek (segments 15 to 20). Fish tissue samples collected farther downstream were generally lower than 500 µg/kg for creek chub, but as high as 3,800 µg/kg for brook trout.

3.0 DESCRIPTION OF PLANNED OR EXISTING REMEDIES

This section presents information available from existing site documents. Interpretations included are generally from the documents that supplied the information. The optimization review team's interpretation of this information and evaluation of remedy components are discussed in Sections 4.0 and 5.0.

3.1 REMEDY AND REMEDY COMPONENTS

Sidney Landfill

The remedy outlined in the Sidney Landfill ROD included the following elements:

- Waste in the Can and Bottle Dump was to be excavated and relocated to the North Disposal Area.
- Four closure cap areas with Part 360 caps were to be created, as follows:
    - The North Disposal Area,
    - Combine the White Goods Disposal Area and the Alleged Liquid Disposal Area,
    - The Southeast Disposal Area, and
    - The Southwest Disposal Area.
- Groundwater contamination associated with the MW-2S "hot spot" was to be extracted from a blasted bedrock trench, treated, and discharged to surface water.
- A series of ICs were to be implemented to limit potential exposure pathways.
- A long-term monitoring program was to be instituted to ensure that the RAOs are being met. Monitoring was to include a groundwater monitoring program and a site inspection program that included landfill caps and other physical controls such as fences.

With the exception of the groundwater remediation at MW-2S, the above remedies were implemented according to the ROD. The groundwater remedy at MW-2S was addressed by a 2004 ESD based on changes during pre-design activities. A pilot-scale blasted bedrock trench was constructed in May 1998 as part of the pre-design investigation for the MW-2S hot spot. Based on the results of subsequent testing, it was determined that the blasting caused the shallow bedrock zone to become hydraulically connected with the deeper zone, thereby dewatering the hydraulic zone monitored by monitoring well MW-2S. After the bedrock trench had been blasted, with the exception of the sampling event in February 2000, monitoring well MW-2S could not be sampled because the well was dry or contained an insufficient amount of water for sampling. (The February 2000 sample results showed the presence of only TCE at 1.4 µg/L.) As a result of these conditions, it was concluded that extraction of groundwater from the hot spot could not effectively remove contaminants from this area. Therefore, the remedy selected in the ROD for the MW-2S hot spot was considered no longer necessary. Additional studies suggested that groundwater contamination at Sidney Landfill could be remediated within 22 years by the RHRL North Area recovery system compared with 17 years with on-site pumping at the Sidney Landfill. Given the similarity in timeframes and the significant costs associated with on-site pumping at Sidney Landfill, the 2004 ESD specified that Sidney Landfill groundwater contamination would be addressed by the RHRL North Area recovery system and monitored natural attenuation (MNA).

RHRL

The 1997 ROD selected a remedy consisting of the following components:

- Soil and sediment excavation/dredging,
- Disposal of contaminated soil exceeding 500 mg/kg PCBs at a TSCA-compliant facility,
- Consolidation of contaminated soil with PCB concentrations between 50 mg/kg and 500 mg/kg in a TSCA cell with a landfill cap consistent with 6 NYCRR Part 360,
- Groundwater extraction from both the North Area via extraction wells and South Area via an interceptor trench, and
- Treatment of extracted groundwater with discharge to surface water.

According to the Five-Year Review, approximately 7,300 cubic yards of contaminated waste materials and soils have been excavated from the North and South Areas of the site and from the waste oil disposal pit in the landfill. In addition, a total of 28,520 cubic yards of sediments from South Pond and Herrick Hollow Creek were dry excavated and consolidated on the landfill before it was capped. The soil and sediment remedies have been completed, and the primary focus at the site is on landfill maintenance and groundwater remediation.

The groundwater remedy consists of an extraction trench at the toe of the RHRL, a North Area recovery system, and a groundwater treatment plant (GWTP). Each of these components is described in the following sections.

3.1.1 EXTRACTION TRENCH

The extraction trench is located between monitoring wells TMW-01/TMW-02 and TMW-07/TMW-08, as illustrated on Figure 2-2 (see Attachment A). The trench is approximately 1,150 feet long, 3 feet wide, and extends to bedrock at an elevation ranging from 1728.5 to 1742.4 feet above mean sea level (amsl). The northern half of the trench is an average of 10 feet deeper than the southern half. The trench is keyed a minimum of 2 feet into dense till and bedrock. An 80-mil HDPE barrier wall was installed on the downgradient side of the trench before it was backfilled with clean stone. Three sumps (S1 through S3) consisting of vertical 24-inch perforated pipe with submersible pumps are installed to pump groundwater to the GWTP. Each pump is turned on or off depending upon the water surface elevation in the corresponding sump. (Each pump is controlled independently by a separate level measuring system in the sump.) Each sump also includes a dilute acid feed line intended to limit iron precipitation. A single underground pipeline carries the combined flow from the three sumps to the GWTP. A flow meter at the GWTP measures combined flow and reports it to the system computer. Figure 3-1 (see Attachment A) depicts the trench construction and the anticipated capture zone.

There are six in-trench monitoring wells. The inner four of these in-trench wells (SSC-1 through SSC-4) have 8-inch stainless steel casing with screened intervals within the trench and in the bedrock below the trench. The two outer trench monitoring wells (TMW-01 and TMW-08) have 4-inch polyvinyl chloride (PVC) casing and also are screened in the trench and in the bedrock below the trench. Monitoring wells TMW-2 through TMW-7 are 2-inch PVC wells that are installed in the overburden approximately 4 feet downgradient of the trench.

Conditions encountered during early operation of the collection trench resulted in the addition of a groundwater extraction well near the southern end of the trench. Discharge from this well is pumped to the nearest trench sump, and the discharge is then piped to the treatment system.

3.1.2 NORTH AREA RECOVERY SYSTEM

Four groundwater recovery wells are installed in the bedrock on an approximately north-south alignment at the downgradient edge of the VOC plume identified during the RI. The extraction wells were spaced between 62 and 67 feet apart and installed at depths ranging from 71 to 77 feet bgs. The wells were constructed of 6-inch-diameter stainless steel risers and a 25-foot-long, 0.30-inch slot, continuous wire-wound screen. A 3-inch diameter Grundfos submersible pump (Model Redi-Flo3-250) is installed in each well to pump groundwater to the GWTP. Each well is equipped with a pressure transducer to measure the water level in the well.

3.1.3 TREATMENT PLANT

According to the Final O&M Manual, the GWTP is designed to remove oils (if present), suspended solids, iron and other dissolved metals, VOCs, and PCBs through a series of physical-chemical treatment processes to meet the limits specified in the site's State Pollutant Discharge Elimination System (SPDES) discharge permit. The system design capacity is 100 gallons per minute (gpm). The following are details of the GWTP design components:

- 82-foot by 60-foot pre-engineered building with an eave height of approximately 20 feet
- Propane heat and a ventilation system that provides four air exchanges per hour
- Permanent emergency diesel generator
- One 26,000-gallon equalization tank with a mixer and heat tracing
- A multi-compartment oil/water separator that includes pH adjustment to "crack" emulsified oils
- pH adjustment with 50 percent sodium hydroxide to 8.5 to 9.0
- Reaction treatment unit (RTU) consisting of a polyaluminum chloride (PAC) addition and mixing, polymer addition and mixing, and flocculation tank
- Inclined plate clarifier for settling of precipitated solids
- Two bag filter units arranged in parallel for solids removal prior to the air stripper
- One 4-tray air stripper rated for 100 gpm with a 900 cubic feet per minute (cfm) blower
- Two bag filter units arranged in parallel for solids removal before the air stripper
- Two 5,000-pound granular activated carbon (GAC) units arranged in a lead-lag orientation
- One bag filter unit for solids removal prior to discharge
- One 6,000-gallon effluent tank, which is also used to store water for backwashing the GAC
- Chemical feed pumps
- Process pumps
- Solids pumps and holding tanks
- 18 cubic foot filter press
- Air compressor rated for 120 pounds per square inch (psi) with a 50-gallon tank to operate the solids and chemical feed pumps
- 5 parts per million (ppm) for polymer

A process flow diagram is provided in Figure 3-2 (see Attachment A).

3.2 REMEDIAL ACTION OBJECTIVES AND STANDARDS

3.2.1 REMEDIAL ACTION OBJECTIVES

Sidney Landfill

The RAOs established for the Sidney Landfill and specified in the site ROD are as follows:

- The selected remedy must minimize infiltration of surface water.
- The remedy must control surface water runoff.
- The remedy must be completed in a manner that mitigates off-site migration of contaminated groundwater.
- Measures must be put in place that restore groundwater quality to levels that do not exceed state and federal drinking water standards.
- Subsurface landfill gas generation and migration must be controlled through appropriate means.
- Appropriate remedial efforts should be put in place to prevent contact with contamination in groundwater.

RHRL

The RAOs established for the RHRL site and specified in the site ROD are as follows:

- Reduce or eliminate contaminant leaching to groundwater.
- Control surface water runoff and erosion.
- Mitigate the off-site migration of contaminated groundwater.
- Restore groundwater quality to levels that meet state and federal drinking water standards.
- Prevent human contact with contaminated soils, sediments, and groundwater.
- Minimize exposure of fish and wildlife to contaminants in surface water sediments and soil.

3.2.2 CLEANUP STANDARDS

Table 1 is a summary of the maximum allowable drinking water concentrations that apply to both sites.

Table 3-1 Groundwater COCs and the applicable cleanup standards

Compound	**Federal Drinking Water Maximum Contaminant Levels (µg/L)**	**New York Water Quality Standards for Surface Waters and Groundwater (µg/L)**
Trichloroethene	5	5
cis-1,2-Dichloroethene	70	5
trans-1,2-Dichloroethene	100	5
Vinyl Chloride	2	2
1,1,1-Trichloroethane	200	5
Tetrachloroethene	5	5
PCBs	0.5	0.09

3.2.3 TREATMENT PLANT OPERATION STANDARDS

Treatment plant effluent standards for the RHRL system were established for the site in a letter from the NYSDEC Division of Environmental Remediation on December 1, 2005. Table 2 is a summary of many of these parameters and includes the frequency at which they must be evaluated.

Table 3-2 RHRL treatment plant effluent standards (NYSDEC, May 2011).

Parameter	Discharge Limitation	Units	Frequency of Measurement
Flow	60,000 – 145,000	gpd	Continuous
Ph	6.5 – 8.5	Standard Units	Daily
Oil and Grease	15	mg/L	Weekly
Iron	300	µg/L	Monthly
Magnesium	94,000	µg/L	Quarterly
Manganese	800	µg/L	Quarterly
Lead, Total	4	µg/L	Monthly
1,1-Dichloroethane	10	µg/L	Monthly
1,1,1-Trichloroethane	10	µg/L	Monthly
1,2-Dichloroethene	10	µg/L	Monthly
Trichloroethene	10	µg/L	Monthly
Vinyl Chloride	0.8	µg/L	Monthly
PCBs (all Aroclors)	0.2	µg/L	Weekly

gpd = gallons per day
mg/L = milligrams per liter
µg/L = milligrams per liter

3.3 PERFORMANCE MONITORING PROGRAMS

Sidney Landfill

Inspection and maintenance are carried out on a quarterly basis to ensure that the site fence system, the landfill covers, the drainage system, and the site monitoring wells are in good condition and operating as planned. Quarterly environmental monitoring includes inspection of the passive landfill gas venting system and collection and analysis of groundwater samples from site monitoring wells. Groundwater is sampled as follows:

- 20 wells sampled and analyzed for VOCs
- Two wells sampled for natural attenuation parameters (MW-6S and MW-6D)
- Three wells sampled for PCBs (MW-2S, MW-6S, and MW-16S)
- Six wells sampled for routine Part 360 parameters

RHRL

Inspection and maintenance are conducted on a quarterly basis and after major rainfall events for the landfill cap, TSCA cell, storm water control features, access structures, and other features. Environmental sampling includes the following:

- Groundwater monitoring includes sampling of 27 monitoring wells on a quarterly basis
    - Samples from all 27 wells are analyzed for VOCs quarterly
    - Samples from 12 monitoring wells are analyzed for natural attenuation parameters annually
    - Samples from 6 wells are analyzed for PCBs quarterly
    - Samples from 10 additional wells are analyzed for PCBs annually
- The four North Area extraction wells are sampled quarterly for VOCs
- Monthly sampling of the treatment plant influent for metals, VOCs, PCBs, and other parameters
- Two residential wells are sampled annually and samples are analyzed for VOCs
- Three sediment samples are collected annually and analyzed for PCBs and total organic carbon
- Three surface water samples are collected annually and analyzed for PCBs
- Groundwater elevations are measured weekly at 43 monitoring or extraction system points
- LNAPL monitoring in Sump 1 of the extraction trench
- Fish tissue sampling in South Pond and Herrick Hollow Creek (2008 and 2011 only)

4.0 CONCEPTUAL SITE MODEL (CSM)

This section discusses the optimization review team's interpretation of existing characterization and remedy operation data and site visit observations to explain how historical events and site characteristics have led to current conditions. This CSM may differ from that described in other site documents. CSM elements discussed are based on data obtained from EPA Region 2 and described in the preceding sections of this report. This section is intended to include interpretation of the CSM only. It is not intended to provide findings related to remedy performance or recommendations for improvement. Findings and recommendations are provided in Sections 5.0 and 6.0, respectively.

4.1 CSM OVERVIEW

Historical waste disposal resulted in PCB and VOC contamination of soil and groundwater at the Sidney Landfill and soil, groundwater, and sediments at the RHRL site. Soil and sediment remedies have been implemented and completed. Contaminated soil remains on site in capped disposal areas. Sediment with PCB contamination exceeding 1 mg/kg was removed from South Pond and Herrick Hollow Creek by excavating contaminated sediments and replacing them with clean soil. PCB-contaminated groundwater continued to discharge to South Pond for 4 years after the sediment remedy was completed and before the groundwater remedy was operational. The 2008 fish tissue sampling was likely influenced by the contaminated groundwater that continued to discharge to South Pond. From 2008 until present, the groundwater extraction trench has captured some of the groundwater contamination migrating from the source areas, as is evidenced by decreasing concentration trends in monitoring wells downgradient of the extraction trench. The contaminated groundwater that had previously migrated downgradient of the groundwater extraction trench continues to discharge to South Pond and may continue to contribute to the PCB contamination detected in sediments and fish tissue.

Groundwater contamination at both sites is present in the overburden and bedrock. Historically, contaminated groundwater likely migrated downgradient (downhill) and vertically downward in the vicinity of the source areas and then transitioned to an upward gradient at the bottom of the valley where it discharged to North Pond, South Pond, and Herrick Hollow Creek. Some contaminated groundwater (presumably the deepest contaminated groundwater) remains below the stream bed for several thousand feet in a horizontal direction before it discharges to the stream. Generally, the highest groundwater contaminant concentrations at the RHRL site are in the overburden, and the highest groundwater contaminant concentration at the Sidney Landfill is in a bedrock well.

Concentrations in groundwater at the Sidney Landfill remain relatively stable, or potentially increasing (for example, at well MW-6D), since the soil remedy was completed. The Sidney Landfill is located on a groundwater flow divide, and groundwater flow and contaminant migration to the north are not well understood. Seeps at the bottom of the hill to the north are impacted with CVOC contamination above regulatory standards, suggesting that at least part of the plume is migrating to the north. The North Area recovery system that is part of the RHRL site might address some of the contamination that migrates from Sidney Landfill to the west or south. However, the hydraulic gradient in the north portion of the North Area recovery system is directed away from Sidney Landfill and the hydraulic gradient at the southern end is directed away from well RW-4 to the south. This observed pattern suggests that the wells do not capture contamination migrating from the Sidney Landfill in the direction of these wells. Water quality data from the recovery wells in the RHRL North Area show that concentrations are not significantly increasing or decreasing.

With the exception of groundwater concentrations in samples collected from well TMW-02, concentrations detected downgradient of the RHRL extraction trench are generally decreasing. These concentration decreases are likely the result of capture provided by the operating groundwater extraction trench. Hydraulic data are insufficient to confirm capture, and it is too early to use water quality sampling to determine if capture is sufficient to allow downgradient concentrations to decrease to cleanup standards. Section 5.0 of this report further discusses interpretations of hydraulic data and water quality data.

4.2 DATA GAPS

Data gaps in the CSM that are relevant to groundwater remedy performance are discussed in Section 5.0 Findings.

4.3 IMPLICATIONS FOR REMEDIAL STRATEGY

Implications of the CSM and data gaps in the CSM that are relevant to groundwater remedy performance are discussed in Section 5.0 (Findings) and Section 6.0 (Recommendations).

5.0 FINDINGS

The observations provided below are the interpretations of the optimization review team. No observations are intended to imply a deficiency in the work of the system designers, system operators, or site managers, but are offered as constructive suggestions in the best interest of the EPA and the public. These observations have the benefit of being formulated based on operational data unavailable to the original designers. Furthermore, it is likely that site conditions and general knowledge of groundwater remediation have changed over time.

5.1 SUBSURFACE PERFORMANCE AND RESPONSE

5.1.1 GROUNDWATER FLOW AND PLUME CAPTURE

Sidney Landfill

The shallow bedrock potentiometric surface slopes generally from east to west toward the regional topographic valley and the North Area groundwater extraction wells. During a 2003 pump test of the North Area extraction wells, a positive drawdown response was observed at Sidney Landfill wells MW-8D and MW-9D located 900 and 550 feet from the extraction wells, indicating good hydraulic connection. No response or inconclusive results were observed at well nests MW-6S/D, MW-10S/D, and MW-23, located 900, 750 and 400 feet from the extraction wells, respectively. It is important to note, however, that drawdown is not synonymous with hydraulic plume capture. Hydraulic plume capture is provided only if groundwater is flowing to the extraction wells, which is typically indicated by a potentiometric surface that is directed toward extraction wells. The hydraulic gradient in the northern portion of the North Area recovery system (near wells RW-1 and RW-2) is trending away from the Sidney Landfill, and the hydraulic gradient in the south of well RW-4 is trending to the south away from RW-4. From the data reviewed, the optimization review team believes there is weak evidence for concluding that the North Area recovery system is capturing the southern portion of the Sidney Landfill.

A groundwater flow divide occurs toward the north end of the Sidney Landfill site, but there are not enough data in the information reviewed by the optimization review team to clearly identify the location of the divide. NYSDEC identified and sampled a seep located north of the MW-7 cluster that had CVOC concentrations above cleanup criteria, suggesting that a portion of the plume is migrating to the north and is not addressed by active remediation.

RHRL – Trench and RW-05

Hydraulic Responses

Groundwater flow in unconsolidated deposits converges from the east and west toward South Pond and Herrick Hollow Creek and continues south. Groundwater elevations inside and directly downgradient (east) of the extraction trench are generally lowest to the north (between Sumps 1 and 2) in the vicinity of wells SSC-1/TMW-3, SSC-2/TMW-4 and RH-6S because the trench is deeper in this area and the pumps can lower the water table to depths below the trench depth and sump in the southern portion of the trench will allow. The northern section is also the area where South Pond is closest to the extraction trench.

The table in Attachment D compares weekly water level elevations between pairs of wells inside and downgradient of the extraction trench for the fourth quarter 2009, fourth quarter 2010, and first quarter 2011 time periods. This comparison shows generally inward gradients, indicating groundwater flows toward the trench at TMW-1, SSC-2 and SCC-3 and outward gradients indicating groundwater flows away from the trench at SSC-1, SSC-4, and TMW-8. Additionally, there are outward gradients from TMW-5 to the RH-5 cluster and outward gradients from the TMW-6 cluster to the RH-8 cluster. The trench design, which is based on the groundwater model, indicated that 10 percent of the water would come from downgradient (east) of the trench. Based on these water elevations, it seems that this is not the case for over half the trench length where an inward gradient is not present.

The hydraulic response of the in-trench wells to packer testing also differs depending on the location in the trench. Packers were installed in the in-trench wells during the 2008 Supplemental Hydrogeological Investigation to cut off flow from the bedrock screen interval. TMW-1 (northern end) showed a strong response to the installed packer. TMW-8 (southern end) showed a significantly smaller response, and SSC-4 (southern end) showed no response. The trench and sump are deeper in the northern end, which allows for more drawdown in the trench and more induced flow from the bedrock wells. The lack of a response in SSC-4 may be caused by one of two reasons: (1) contributions to the southern end of the trench are substantially higher from overburden than the contributions through SSC-4 from bedrock, or (2) the southern end of the trench has a reasonably strong connection to bedrock even in the absence of the contribution from SSC-4.

The drawdown caused by restarting extraction after a system shutdown is also different between the northern and southern portions of the trench (Figure 24 of the 2008 Supplemental Hydrogeological Investigation). For most in-trench wells, there is approximately 8 feet of drawdown, and the drawdown curve ends abruptly at what appears to be the low-level control set point for the pump. A pattern consistent with pump cycling is then observed. The drawdown response is more typical in wells SSC-4 and TMW-8 (southern portion) and transitions smoothly from a steep drawdown decline to a steady level. This pattern seems to suggest that extraction in the northern portion is limited to what the trench and wells can provide and that extraction in the southern portion might be limited by the pump capacity. There is more drawdown in the overburden for wells downgradient of the trench than in bedrock near the northern portion of the trench (RH-6 cluster), and there is more drawdown in the bedrock than in the overburden near the southern end of the trench (RH-8 cluster). In addition, decreases in contaminant concentration at RH-8D and stable contaminant concentrations at RH-8S suggest more complete hydraulic capture in bedrock than in overburden and that groundwater extraction is occurring from bedrock from the southern end of the trench.

It is apparent from the above hydraulic data that the northern and southern portions of the trench respond differently to pumping and that hydraulic communication between the northern and southern portions of the trench is somewhat obstructed.

Concentration Trends

Concentration trends are decreasing in most downgradient wells, indicating that some degree of capture is provided. Concentrations should decline to cleanup standards in the next several years if plume capture is complete. If plume capture is not complete, the observed decreases will asymptotically approach concentrations above the cleanup standards. Two exceptions to these observed decreases are at wells TMW-2, which is located in the overburden downgradient of the northern end of the trench, and RH-08S, which is located downgradient of the southern portion of the trench. Concentrations in these wells have been stable or potentially increasing, suggesting that contamination may not be captured in these locations.

RW-05 was installed to address contamination observed at RH-03 and the RH-4 cluster, and RW-05 probably is providing capture of the contamination observed in these wells, but the contamination in groundwater at these wells is not delineated farther to the south. Therefore, contaminated groundwater may be migrating around the southern end of the extraction system.

Model Results

The groundwater modeling study conducted in 2000 to preliminarily evaluate an extraction trench design suggested that 30 gpm would be required along a 950-foot trench to provide capture 25 feet into bedrock and that a drawdown of 5 feet would provide that amount of flow during typical conditions. The actual trench is 1,150 feet long, a drawdown of more than 5 feet is achieved in the in-trench monitoring wells, but extraction rates averaged approximately 20 gpm during 2010. Therefore, overall actual flow is lower than the modeled flow.

RHRL North Area

Groundwater elevation and cone of depression maps for the North Area groundwater extraction wells are shown in Figures 5-1 and 5-2 (see Attachment A). The performance objective is at least 1 foot of drawdown in the North Area monitoring wells compared with the non-pumping conditions noted in the O&M plan. This is generally being achieved (NMW-9 is the only exception); however, it should be noted that the "target levels" reported in Table 2 of the 2009 RHRL Annual Report and Table 10 of the 2010 RHRL Annual Report are the non-pumping conditions based on the table on page 3-8 of the O&M plan. The actual "target levels" are 1 foot lower than the non-pumping conditions specified on page 3-8 of the O&M plan. Even with this adjustment or correction, the criteria are being met. As discussed in the section on plume capture for Sidney Landfill, it is unclear whether these wells are providing the level of capture anticipated despite meeting performance criteria. The 2000 modeling study suggested that the four wells would pump a total of 10 gpm. During 2010, the average total pumping rate was approximately 2.5 gpm.

5.1.2 GROUNDWATER CONTAMINANT CONCENTRATIONS

Sidney Landfill

The Sidney Landfill VOC plume has relatively low to moderate contaminant concentrations across an area 2,500 feet long and 1,700 feet wide. The highest contaminant concentrations occur at the downgradient edge of the North Disposal Area at monitoring well MW-6S. The time-concentration trend plots (Attachment B) show nearly all the wells with no long-term trend except MW-6D and MW-8S, which show an increasing trend. These data suggest the plume will require a relatively long time to attenuate and meet groundwater standards. The undulating spikes in concentrations appear to coincide with fluctuations in water levels. Higher water levels caused by precipitation generally result in dilution, which lowers concentrations. Conversely, concentrations generally increase when water levels decline.

RHRL

The groundwater plume in the upper bedrock unit from the RHRL has migrated to the southeast and then trends more southerly along the Herrick Hollow Creek valley, extending approximately 6,000 feet south of South Pond (Figure 5-3, Attachment A). The core of the plume passes through monitoring wells RH-05D and RH-02. Given the age of the landfill and the relatively slow groundwater velocities, this plume was established before the extraction trench was installed.

Time concentration charts for groundwater monitoring wells are provided in Attachment C. All of the upper bedrock wells show a decreasing trend in VOC concentrations (TCE, DCE, and VC). As discussed in the section on plume capture at the RHRL site, these trends suggest a degree of capture, but the degree of capture cannot be ascertained until concentrations stabilize. If concentrations stabilize below cleanup standards, then plume capture is adequate and this and other downgradient portions of the aquifer should eventually exhibit decreases in concentrations to below cleanup standards. If concentrations stabilize above cleanup standards, then capture is incomplete. Even if capture is complete, the current downward trend in concentrations suggests it will require a relatively long time for the downgradient plume to attenuate and meet groundwater standards.

The extent of the plume is much more limited in the unconsolidated deposits (Figure 5-4, Attachment A). The highest contaminant concentrations occur adjacent to the South Pond in wells TMW-03, TMW-04, and RH-06S. These three shallow wells have also historically had frequent detections of PCBs above groundwater standards. This downgradient overburden groundwater appears beyond the capture of the trench and will ultimately discharge to South Pond. Given this scenario, it is possible that PCB concentrations in groundwater that discharge to South Pond may be the cause of observed PCB concentrations in the sediment along the west edge of the pond. The degree of capture provided by the trench in this area is uncertain because outward gradients are observed at SSC-1/TM-3 and inward gradients are observed at SSC-2/TM-4. RH-6S is between these two locations.

RHRL North Area

Water quality data from the recovery wells in the RHRL North Area show that CVOC concentrations in groundwater have decreased by approximately 10 percent to 20 percent. They also show that TCE and cis 1,2-DCE are the CVOCs with the highest detected concentrations. Blended influent CVOC concentrations to the treatment plant are lower than the CVOC concentrations detected at RHRL North Area wells and also show a general decrease. These results suggest that the CVOC concentrations in the blended groundwater extracted from the trench are lower than the CVOC concentrations in the RHRL North Area wells.

5.1.3 SURFACE WATER AND SEDIMENT CONTAMINATION

Sediment sampling was conducted in 2010 at three locations, and the PCB concentrations in all three locations were below the original cleanup criterion of 1 mg/kg. Surface water sampling was also conducted in 2010 at three locations, and the PCB concentrations in all three locations were below the detection limit of Method 8082A of (presumed to be 0.05 µg/L). Both sediment and surface water samples reflect substantial improvement over pre-remediation conditions and do not suggest a decline in water quality since remediation. It is noted, however, that a more extensive sampling program for sediment or surface water could result in different findings. In addition, PCB concentrations lower than the 0.05 µg/L detection limit may be present and could continue to pose a risk to wildlife.

5.1.4 FISH TISSUE CONTAMINATION

The 2008 fish tissue sampling results include PCB concentrations that indicate exposure of fish to high levels of PCB contamination (wet weight fish tissue PCB concentrations up to 8,000 µg/kg). The optimization review team only reviewed the results and not the field sampling notes, field sampling protocols, or QAPP. In addition, a complete report discussing the sampling effort was not prepared. Therefore, analysis by the optimization review team is subject to some uncertainty. Although the sediment remedy was completed in 2004 and the groundwater remedy began operating in late 2004, PCB-contaminated groundwater between the trench and South Pond continued to discharge to South Pond. The PCBs in the discharging groundwater likely impacted the fish tissue and resulted in detectable concentrations of PCBs in the soil that had been placed in the pond during the sediment remedy. The 2008 fish tissue sampling results may, therefore, be explained by PCB-contaminated groundwater that continued to discharge to the pond and possibly to PCB levels already present in fish from pre-remedy conditions. The 2011 and other future fish tissue sampling results will help determine if the PCB concentrations in fish tissue continue to decline as a result of remediation or remain elevated through continued exposure to PCBs.

5.2 COMPONENT PERFORMANCE

5.2.1 EXTRACTION NETWORK

Subsurface performance of the extraction network is discussed above. According to the RHRL treatment plant operator, it is necessary from time to time to clean conveyance lines and trench sump pumps because of biological fouling and mineral accumulation (Figure 5-5). It may be possible that similar fouling conditions exist in the collection trench gravel and may be further reducing the ability of the trench to intercept the RHRL contaminant plume.

The extraction pumps in the extraction trench sumps are Grundfos Redi-Flo 4 pumps rated for 25 gpm each. The extraction pumps in the North Area are Grundfos Redi-Flo 3 pumps rated for 5 gpm each. The pumps in both systems are controlled by high and low controls set to prevent dewatering of the sumps and so to prevent damaging the pumps.

5.2.2 GROUNDWATER TREATMENT PLANT

The GWTP routinely meets the compliance monitoring requirements. The pH adjustment for oil recovery is not used. The only observable oil is in Sump 1, and it is addressed manually with adsorbent socks. Chemical usage varies on a monthly basis, but typical usages are as follows:

- 50 to 70 gallons per month of 50 percent caustic for pH adjustment
- 150 to 250 gallons per month of PAC
- 50 pounds per month of diatomaceous earth
- 2.5 gallons per month of polymer

All of the above chemical usage is for metals removal, primarily manganese.

GAC usage was not documented in the files provided to the optimization review team.

The GWTP is staffed by two full-time operators during the week. Responsibilities include changing bag filters approximately three times per week, routine maintenance of items, operating the filter press (approximately two to three times per month), and collecting weekly water level measurements at recovery system monitoring points.

The optimization review team believes that:

- The air stripper is an appropriate treatment technology to treat the CVOCs,
- GAC is an appropriate treatment technology treat PCBs,

- PAC is an effective technology for metals removal, and
- Bag filters are an appropriate technology for filtration given the solids loading and bag filter use.

The GWTP is likely overstaffed with two full-time operators, but the operators noted that two operators are used to address healthy and safety concerns given the relative remoteness of the site.

5.3 REGULATORY COMPLIANCE

The GWTP routinely meets the compliance monitoring requirements.

5.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF ANNUAL COSTS

A breakdown of costs was not provided to the optimization review team. The EPA Preliminary Close Out Report states that operating costs were estimated to be approximately $500,000 per year in 2006. The optimization review team estimates that the costs are likely significantly higher when the following are included for both sites:

- Project management, consulting, and report preparation
- Operator labor
- Electricity usage
- Chemical usage
- Propane for heating
- Waste disposal
- Quarterly groundwater sampling at both sites
- Laboratory analysis

5.5 APPROXIMATE ENVIRONMENTAL FOOTPRINTS ASSOCIATED WITH REMEDY

The optimization review team estimates based on professional judgment and experience at other sites that the primary contributors to the remedy footprints associated each of the EPA green remediation core elements are as follows:

- Energy usage – electricity use and propane for building heat,
- Greenhouse gas emissions – electricity use and propane for building heat,
- Nitrogen oxide, sulfur oxide, and particulate matter emissions – electricity use and propane for building heat,
- Hazardous air pollutant emissions – air stripper off-gas,
- On-site water usage – no significant footprint because extracted and treated water is discharged to the same creek where it would naturally discharge,
- Materials usage – treatment chemicals, and

- Waste generation – dewatered solids from metals removal.

5.6 Safety Record

The site team did not report any safety concerns or incidents.

6.0 RECOMMENDATIONS

Cost estimates provided herein have levels of certainty comparable to those done for CERCLA Feasibility Studies (-30 percent/+50 percent), and these cost estimates have been prepared in a manner generally consistent with EPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, July, 2000. The costs presented do not include potential costs associated with community involvement that may be conducted before field activities. The costs impacts of these recommendations are summarized in Table 6-1.

6.1 RECOMMENDATIONS TO IMPROVE EFFECTIVENESS

6.1.1 DELINEATE CONTAMINANT MIGRATION PATHWAYS

A review of topography and groundwater elevations across the two sites confirms the presence of a drainage divide between the Susquehanna and Delaware River watersheds. The degree to which the divide affects the distribution of contaminants between the sites is poorly understood. Given that the primary regional bedrock fracture orientation is from northeast to southwest, it is possible that groundwater coming from the southern and southeastern portions of the Sidney Landfill is flowing toward the RHRL site. However, potentiometric surface maps also suggest groundwater flow paths to the north, and NYSDEC identified a seep with contamination above cleanup standards more than 200 feet north of the MW-7 cluster. The highest contaminant concentrations are from groundwater sampling at monitoring wells MW-6S (PCBs) and MW-6D (CVOCs, but analysis is not conducted for PCBs). Similar concentrations are not identified downgradient of this location despite potentially decades of transport. It is unclear if this contamination discharges to North Pond, migrates north in the subsurface, migrates south around the North Area extraction, or migrates and is at least partially captured by the North Area extraction trench.

The first step in clarifying flow paths is to use water levels from all existing wells at both sites plus water levels in North Pond and South Pond to develop potentiometric surface maps for the area. This should be used as the routine approach to quarterly water level measurements at the two sites. In addition, groundwater sampling should be conducted for those wells that are near or could bracket the potential migration pathways, including MW-7S, MW-7D, MW-23, MW-26, MW-8DD, MW-9D, MW-10S, MW-10D, several of the North Area monitoring wells, and various observed seeps. The contaminated seep discovered by NYSDEC is along the unnamed tributary to Carr Creek where the topography steepens significantly. A search for seeps and sampling for contamination should be conducted farther downstream. Sampling at the monitoring wells and seeps should include analysis of PCBs. Existing sampling data from the RI should also be revisited to provide additional input.

Based on the results, the site team may identify potential locations for monitoring wells or piezometers. If discharge to North Pond is suspected, resampling sediment or pore water beneath the pond should be revisited.

Conducting comprehensive water level events should not significantly increase the cost because the majority of water levels are already collected. Upfront costs of approximately $10,000 would be needed to install and survey staff gauges in North Pond and South Pond. Slightly increased costs would be associated with collecting measurements at several new locations and interpreting the more complex results. The seep search should likely require approximately $10,000 to conduct and summarize. The sampling (assuming four quarterly events based on fluctuations observed concentrations at other wells) would likely cost an additional $15,000 per event. The need for continued sampling at these locations or a change in frequency can be evaluated after the first four events. Sampling of representative North Area wells for VOCs and PCBs should become part of the routine monitoring program.

6.1.2 UPDATE GROUNDWATER FLOW MODEL AND EVALUATE CAPTURE

A reasonably constructed groundwater flow model was developed for the site and was used in designing the remedy. Now that the remedy is installed and data are available from routine operation and from the 2008 Supplemental Hydrogeologic Investigation, the model should be updated and recalibrated to better evaluate contaminant transport at the Sidney Landfill and plume capture by the North Area recovery system, the extraction trench, and RW-05. The model would benefit from the comprehensive water levels discussed in Section 6.1.1. Before the modeling is conducted, the site team should consider relocation of one or more of the pumps from the sumps to the SSC wells, especially for the southern portion of the trench. Operating the trench in this manner will allow for higher pumping rates that will better influence the aquifer. It will also provide a different pumping scenario to model, which is helpful for improving model calibration. Conducting the pumping tests from the SSC wells should cost approximately $35,000, including preparation and reporting. Updating the model and recalibrating it should cost approximately $50,000. The model should be calibrated to transient data from the 2008 investigation and the SSC pumping and to two different comprehensive water level events. Once capture is evaluated, the site team will have the information to determine if pumping should continue from the SSC wells or if pumping from the sumps provides a sufficient degree of plume capture.

6.1.3 POTENTIALLY EVALUATE PCB SEDIMENT CONTAMINATION IN SOUTH POND

The capture zone of the extraction trench does not extend into South Pond. As a result, existing PCB groundwater contamination between the downgradient boundary of the trench capture zone and South Pond will continue to discharge to South Pond for some period after trench operation began. This period of time may be several years, despite the short distance, for two reasons: (1) the operation of the extraction trench has flattened the hydraulic gradient between the trench and the pond and the groundwater flow that will flush the contamination may be relatively slow; and (2) PCBs adsorb strongly to organic material on soils and will desorb slowly into groundwater over time. Additionally, some level of PCB flux could continue indefinitely if capture of PCBs up gradient of the trench is incomplete (see Section 6.1.2). The continued flux of PCB contamination via groundwater to South Pond since 2004 may have been sufficient to cause the low-level PCB contamination of the sediments and to influence the 2008 fish tissue results. If PCBs from up gradient of the trench are captured, the flux of PCBs to South Pond should decrease slowly over time.

The optimization review team suggests comparing the 2011 and 2008 fish tissue sampling results to determine if there has been a measureable improvement 3 years after remediation. If there is a noticeable improvement and sediment and surface water sampling in future events continues to meet post-remediation expectations, then more extensive sampling of South Pond is likely not merited. Continued sediment, surface water, and fish tissue sampling would likely be sufficient to monitor continued improvements over time. However, if the 2011 and 2008 fish tissue sampling results are comparable, then it would appear that PCBs are continuing to be exposed to relatively high levels of PCBs from groundwater. The optimization review team would not expect PCB concentrations in wet weight fish tissue to be as high as several mg/kg in short-lived fish such as creek chub and pumpkinseeds 7 years after remediation if the only PCB exposure is to less than 1 mg/kg in sediments. Therefore, if the 2011 fish tissue sampling results are comparable to the 2008 results, then additional attention is merited to determine if the PCB flux is generally decreasing over time or is remaining constant because of a lack of plume control. A monitoring program that could evaluate that flux over time would be helpful. The current sediment and surface water monitoring program alone would not likely provide this information. There are several options for evaluating the PCB contributions from groundwater over time. For example, the site team could consider one of the following:

- Collect pore water samples in several locations to evaluate the concentration and estimated flux of PCBs from groundwater to sediments and surface water. This approach might be implemented by installing sampling points through the sediments of South Pond and obtaining both filtered and unfiltered samples via low-flow sampling. This approach would help minimize the bias from PCB-contaminated suspended solids. The sampling points could be left in place and monitored over time until a discernible trend is identified.

- Use passive, *in situ* concentration-extraction samplers (PISCES) at multiple locations and near the bottom of South Pond to sample for low levels of PCBs at the interface of groundwater and surface water. This sampling approach involves PCBs passing through a semi-permeable membrane and partitioning into a hexane sampling medium. Temperature is also monitored, and PCB concentrations in surface water are back-calculated based on known relationships of the sampling rate to temperature and sampler membrane area. The method yields time-integrated samples over a 14-day period and is effective at detecting low concentrations in water. The samplers, therefore, have a higher likelihood of identifying PCBs at the groundwater surface water interface than surface water grab sampling. The samplers have been reported to preferentially sample the lower weight PCBs because the heavier PCBs are typically adsorbed to suspended solids that cannot pass through the membrane. Therefore, the samplers may preferentially sample the lower weight PCBs detected in groundwater (which is primarily reported as Aroclor 1242 at this site) and not the higher-weight PCBs detected in fish (which is primarily reported as Aroclor 1254 at this site). The approach would likely be effective at identifying areas impacted by contaminated groundwater, but the signature of the PISCES results may not directly overlap with the fish tissue results. There is overlap in the molecular weight of PCBs in Aroclor 1242 and Aroclor 1254 (for example, PCBs with five chlorine molecules comprise a significant percentage of both Aroclors), so the difference in signatures should not suggest that the PCB results are unrelated. This sampling approach could also be repeated over time until a discernible trend is identified.

The optimization review team suggests using one of the two sampling methods above in up to five locations in areas of South Pond or Herrick Hollow Creek where discharge of PCB-contaminated groundwater would be expected (such as near RH-06S). This sampling could be done on an annual basis in place of the surface water sampling in the current O&M plan. Sediment sampling as conducted in 2010 could also occur on an annual basis. Fish tissue sampling might be done once every 5 years. Several years of this sampling program should provide sufficient information to see if conditions are improving, staying the same, or getting worse. If conditions get worse during the next 5 years, the site team could consider additional studies to identify the extent of contamination and a potential means of removing or controlling that contamination.

If after the 2011 results have been evaluated, the site team decides to implement the above changes to the sampling program, the optimization review team estimates that up to $15,000 might be needed to document and plan the program, an additional $15,000 might be needed to install the sampling points (Option 1 only), and annual costs may be $1,000 to $5,000 higher than the current sediment and surface water sampling.

6.1.4 REPORTING NORTH AREA WATER LEVELS

When the water levels in the North Area are reported, the target levels that are provided for comparison should be 1 foot lower than the non-pumping conditions presented in the O&M plan.

6.1.5 MONITOR INSTITUTIONAL CONTROLS

In light of the recent residential well that was installed within the plume area, the site stakeholders should develop a plan to routinely check that the ICs in place are enforced so that future potential violations of the ICs are identified early or prevented.

6.1.6 MONITOR EXTRACTION TRENCH FOR POTENTIAL FOULING

According to the RHRL treatment plant operator, it is necessary from time to time to clean conveyance lines and trench sump pumps because of biological fouling and mineral accumulation. It may be possible that similar fouling conditions exist in the collection trench gravel and may be further reducing the ability of the trench to intercept the RHRL contaminant plume. Trench flow rates have been decreasing over time, but this observed decrease has not been correlated to precipitation, which could be the cause, or partial cause. The site team should continue to monitor trench extraction rates for given in-trench water level set points to determine if the specific capacity of the trench is decreasing, and if so, develop a rehabilitation plan. There should be negligible cost for including the data analysis for trench evaluation in routine reporting. The costs for a rehabilitation plan, if needed, are not estimated here.

6.2 RECOMMENDATIONS TO REDUCE COSTS

6.2.1 EVALUATE POTENTIAL FOR REDUCING OPERATOR LABOR

Labor associated with day-to-day site operations appears to be in excess of what should be required for the GWTP. Treatment systems with these treatment components can typically be operated by 1 to 1.5 full-time equivalent operators. One example is the EPA-lead site Pentawood Products in Daniels, Wisconsin, which as with treatment plants at many other Superfund sites, is relatively isolated, but is operated efficiently, effectively, and safely by one operator. Safety protocols can be established, such as routine check-in calls, security cameras to monitor on-site staff, and additional alarms. Emergency first responders should be contacted and introduced to the site so that emergency response can be timely. It is possible that these measures at this site would provide an adequate response time to emergencies comparable to many other Superfund sites that are similarly safely operated. Alternatively, if an appropriate working area is available at the site, the treatment plant could serve as a base of operations for other staff who are working on other projects. Staff who are at the plant doing office work for other projects or a company overhead function could be present as a health and safety contact without charging to the RHRL GTWP operations. Staff can be scheduled as appropriate to assist with those tasks that require two individuals to be conducted safely.

To facilitate this change, the site team can discontinue the weekly water level measurements. These measurements are no longer used or interpreted, and changing to a monthly frequency will provide an operator with more time to address more critical, necessary items.

The optimization review team estimates that reducing operator labor by 0.5 to 1 full-time equivalent operator could lead to savings of $65,000 to $130,000 per year. Implementing some procedures and protocols to improve safety as described above would cost approximately $25,000.

6.2.2 CONSIDER USING PDBS FOR VOC SAMPLING

The site team should consider the use of passive diffusion bags (PDB) for most of the groundwater sampling events completed at both sites. PDBs are low-density polyethylene bags filled with deionized (DI) water that are suspended in the water column in each well between sampling events. In time and as a result of the low-density nature of the material that makes up the samplers, the DI water reaches chemical equilibrium with surrounding groundwater. The cost savings associated with the use of PDBs includes elimination of the need to purge monitoring wells, elimination of the need to return numerous times to collect samples from low producing wells, and elimination of trips to the GWTP to dispose of purge water. Wells that are sampled for other parameters (for example, some natural attenuation parameters, metals, and PCBs) will not be suitable for PDBs. Assuming PDBs can be used at a total of 40 wells between the two sites, sampling costs might be reduced by $32,000 per year. Cost savings during the initial year may be lower because multiple PDBs may need to be placed in monitoring wells with long screened intervals to determine which portion of the screened interval is appropriate for sampling.

6.2.3 ELIMINATE LABORATORY ANALYSIS FOR NATURAL ATTENUATION

Natural attenuation of chlorinated solvent compounds occurs through processes broadly referred to as reductive dechlorination. Significantly reducing conditions ([Oxidation Reduction Potential [ORP] less than approximately -100 millivolts) must be present in groundwater for these processes to take place. Under the current groundwater monitoring plan, parameters like ORP and dissolved oxygen (DO) as wells as tests for various electron acceptors are routinely included in groundwater monitoring efforts. Data from the RHRL Supplemental Hydrogeologic Investigation and the Sidney Landfill Environmental Data Monitoring Review indicate that while conditions that support natural attenuation of chlorinated solvents exist in some locations, the distribution of reducing conditions is not wide-spread. Time series plots of TCE and TCA as well as their degradation products indicate that the attenuation processes taking place are probably dominated by diffusion, dispersion, and adsorption rather than reductive dechlorination. Reductive dechlorination under historical conditions may have been responsible for converting TCE to cis 1,2-DCE and some VC, but sequential decreases from TCE to cis 1,2-DCE to VC are generally not present. Eliminating this analysis should reduce costs by approximately $8,000 per year. Sampling for these parameters could continue in select locations where evidence for natural attenuation is strong and contamination is not addressed by pumping.

6.2.4 CONSIDER POTENTIAL MODIFICATIONS TO THE GWTP TO HELP REDUCE LABOR COSTS

The optimization review team reviewed in the influent water quality data since 2008 and identified that iron and manganese are the only metals that require treatment. Influent concentrations for these two metals are approximately 0.5 mg/L for iron and 2 mg/L for manganese. A single exception is one monthly influent sample out of more than 30 samples that had an anomalously high copper concentration of 11.3 µg/L compared with a discharge standard of 4.1 µg/L. Although the current treatment process of metals removal is effective at meeting discharge criteria, it requires more operator attention and may not be as cost-effective as using greensand filtration. An appropriately designed greensand filtration system with an automated sodium permanganate feed and automated backwash can operate with minimal operator attention. One example is the treatment system at the Westside Industries site that is part of the North

Penn Area 6 site in Lansdale, Pennsylvania. The system includes bag filters, greensand filtration, air stripping, vapor phase treatment for the air stripper off-gas, and GAC polishing for the air stripper effluent. The system is able to operate continuously with less than 16 hours of operator attention per week. The system flow rate and iron and manganese loading are comparable to those at RHRL, and the treatment system operates for under $100,000, excluding analytical costs, project management, and reporting. Thus, a substantial reduction in operator labor can be realized. The site team might evaluate the use of greensand filtration in place of the current metals removal system, especially if efforts to implement recommendation 6.2.1 are not successful. The costs for designing and implementing this system might be approximately $150,000. The materials and disposal costs for operating the system are likely comparable to those of the existing system, but the operator labor would be significantly lower, perhaps saving more than $150,000 per year.

6.3 Recommendations for Technical Improvement

6.3.1 Track and Analyze TSCA Cell Leachate

In 2010, 9,550 gallons of leachate was removed from the TSCA cell. The site team should compare this amount with cap performance expectations and track the leachate quantity quarterly to evaluate whether the cap is performing as expected. The optimization review team expects that leachate quantities would decrease if the cap is working appropriately. If leachate quantities continue to be present or increase, the site team should consider if the water is coming through the cap or side wall and if the leachate is continuing to impact groundwater. Leachate quality should also be analyzed quarterly for VOCs and PCBs so that quality can be tracked over time. This additional tracking and sampling should likely cost approximately $1,000 per year.

6.3.2 Evaluate Flow Meters

During the site visit, it became apparent that a discrepancy may exist between the volume of water extracted from the North Area wells and the South Area trench and the volume of water discharged at the plant outfall. The discrepancy itself is not a significant concern to the optimization review team. For quantifying overall flow, however, the site team can confirm the effluent flow meter is working and calibrated and use the values for that flow meter. The optimization review team does not see the need to revisit old data or identify the cause of the discrepancy; rather, the recovery well and sump flow meters should be evaluated so that flows from individual extraction points can be tracked and considered during capture zone evaluations. Maintenance and calibration of individual flow meters should be included in the routine plant operator scope of work.

6.4 Considerations for Gaining Site Closeout

No considerations for gaining site closeout are offered at this time.

6.5 Recommendations Related to Green Remediation

No green remediation recommendations are provided, but recommendations in Section 6.2 may result in reducing aspects of the remedy footprint.

6.6 SUGGESTED APPROACH TO IMPLEMENTING RECOMMENDATIONS

The optimization review team believes that the recommendations in Section 6.1 should be emphasized. All other items can be considered at any time, with the exception of 6.2.4, would be somewhat contingent on what is learned from implementing the 6.1 recommendations and recommendations 6.2.1 and 6.3.1.

Table 6-1 Cost Summary Table

Recommendation	Reason	Additional Capital costs ($)	Estimated Change in Annual Costs ($/yr)	Estimated Change in Life-Cycle Costs $*	Discounted Estimated Change in Life-Cycle Costs $**
6.1.1 DELINEATE CONTAMINANT MIGRATION PATHWAYS	Effectiveness	$80,000	$0	$80,000	$80,000
6.1.2 UPDATE GROUNDWATER FLOW MODEL AND EVALUATE CAPTURE	Effectiveness	$85,000	$0	$85,000	$85,000
6.1.3 POTENTIALLY EVALUATE PCB SEDIMENT CONTAMINATION IN SOUTH POND	Effectiveness	$15,000 to $30,000	$1,000 to $5,000	$45,000 to $180,000	$35,000 to $128,000
6.1.4 REVIEW DATA QUALITY	Effectiveness	$0	$0	$0	$0
6.1.5 MONITOR INSTITUTIONAL CONTROLS	Effectiveness	Not estimated			
6.1.6 MONITOR EXTRACTION TRENCH FOR POTENTIAL FOULING	Effectiveness	$0	$0	$0	$0
6.2.1 EVALUATE POTENTIAL FOR REDUCING OPERATOR LABOR	Cost reduction	$25,000	($65,000) to ($130,000)	($1,925,000) to ($3,875,000)	($1,249,000) To ($2,523,000)
6.2.2 CONSIDER USING PDBS FOR VOC SAMPLING	Cost reduction	$0	($32,000)	($960,000)	($627,000)
6.2.3 ELIMINATE LABORATORY ANALYSIS FOR NATURAL ATTENUATION	Cost reduction	$0	($8,000)	($240,000)	($157,000)
6.2.4 CONSIDER POTENTIAL MODIFICATIONS TO THE TREATMENT PLANT TO HELP REDUCE LABOR COSTS	Cost reduction	$150,000	($150,000)***	($4,350,000)	($2,790,000)
6.3.1 TRACK AND ANALYZE TSCA CELL LEACHATE	Technical improvement	$0	$1,000	$30,000	$20,000
6.3.2 EVALUATE FLOW METERS	Technical improvement	$0	$0	$0	$0

* Assumes additional 30 years of system operation
** Assumes a discount rate of 3%
*** Project cost savings are not in addition to those from Recommendation 6.2.1.

ATTACHMENT A

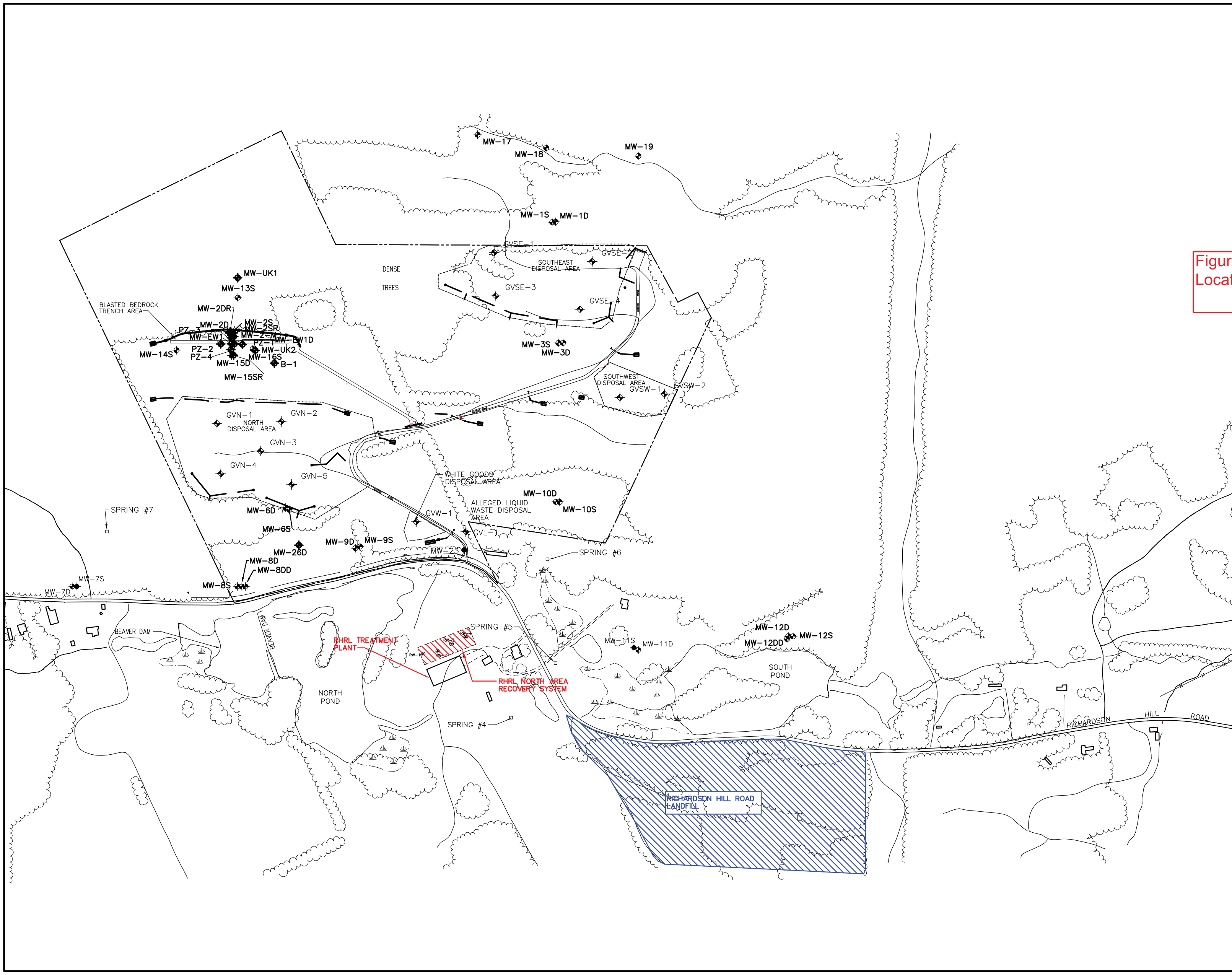
The figures presented in this attachment are from existing site documents with a figure number specific to this report added to facilitate reference to them. In some cases, annotations may have been added to illustrate a specific site feature.

FIGURE 1

SIDNEY LANDFILL ENVIRONMENTAL MONITORING PROGRAM

SITE MAP

Figure 1-1 - Sidney Landfill and RHRL Locations and Surrounding Features



LEGEND

- BEDROCK MONITORING WELL
- GLACIAL TILL MONITORING WELL
- GAS VENT LOCATION
- RECOVERY WELL
- SPRING
- TREE LINE
- SIDNEY LANDFILL PROPERTY BOUNDARY
- FENCE LINE

NOTES:

1. TOPOGRAPHIC SURVEY FROM MALCOLM PIRNIE; JANUARY 1995.
2. ADAPTED FROM MAPS AND ILLUSTRATIONS PREPARED BY HARDING ESE.
3. WELL LOCATIONS ARE CURRENT AS OF JUNE 2008 FOLLOWING THE DECOMMISSIONING OF SEVERAL GROUND WATER MONITORING WELLS.

200 0 200 400

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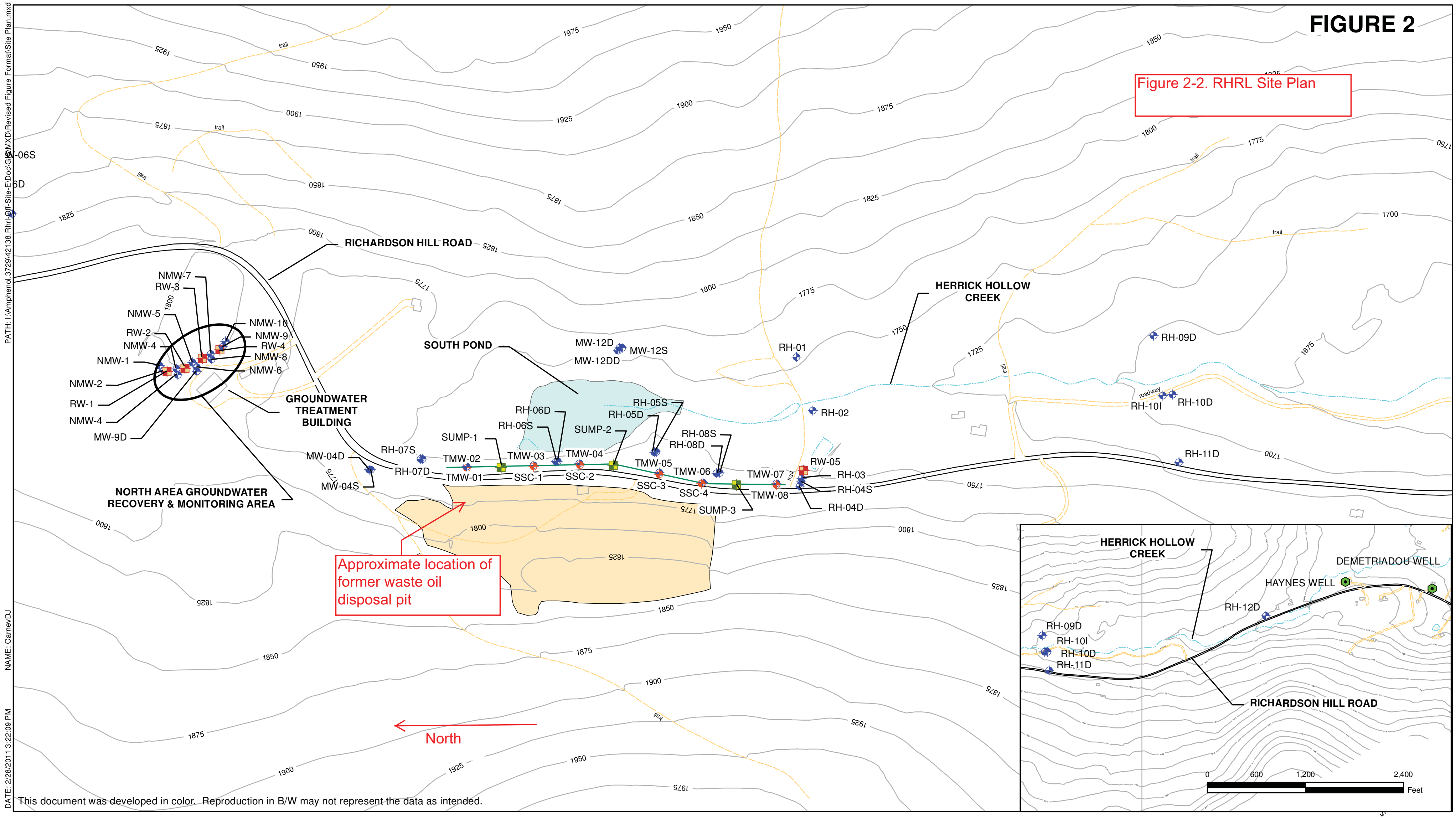
DWG PATH:C:\dwgs\JTM-Associates\Sidney Landfill\031.dwg

PLOT DATE: 3/22/09



LEGEND

- DUAL-ZONE TRENCH MONITORING WELL
- HOMEOWNER WELL
- MONITORING WELL
- RECOVERY WELL
- SUMP
- GROUNDWATER RECOVERY TRENCH
- CAPPED LANDFILL

RICHARDSON HILL ROAD LANDFILL SITE
SIDNEY CENTER, NEW YORK

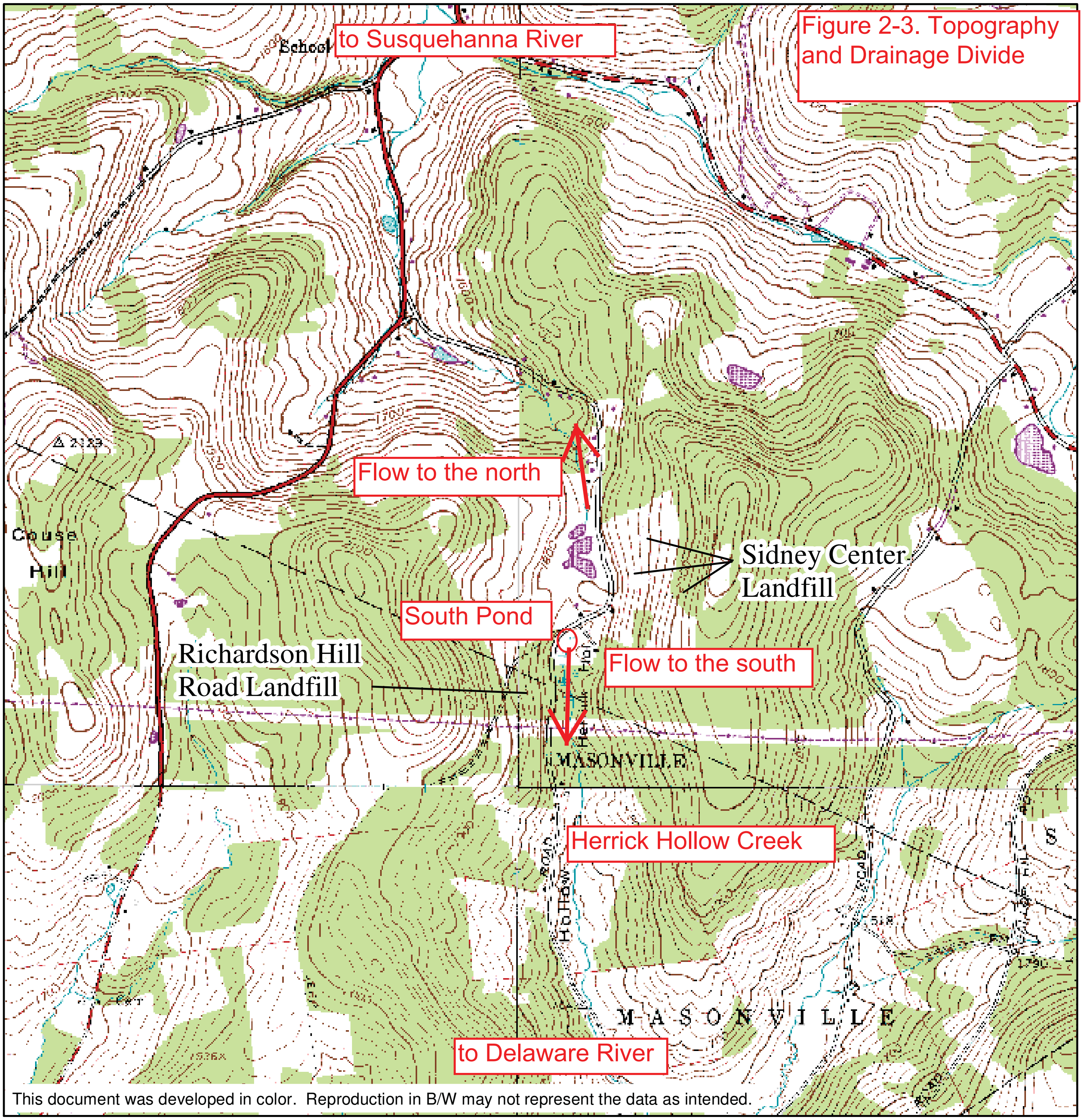
0 150 300 600 900 1,200
Feet

SITE PLAN

FEBRUARY 2010
3729/42138

O'BRIEN & GERE

PATH: I:\DIV71\Projects\3729.Amphenol\42138.RHRLS Offsite\Doc\GIS\MXD\SITE_LOCATION.MXD



ADAPTED FROM: TROUT CREEK, WALTON WEST, UNADILLA, AND FRANKLIN USGS QUADRANGLES

PLOT DATE: MAY 09, 2008 DIV 071 SMT

RICHARDSON HILL ROAD LANDFILL SITE
SIDNEY, NEW YORK

QUADRANGLE LOCATION

SITE LOCATION

0 1,000 2,000 4,000 6,000 8,000
Feet

1:24,000

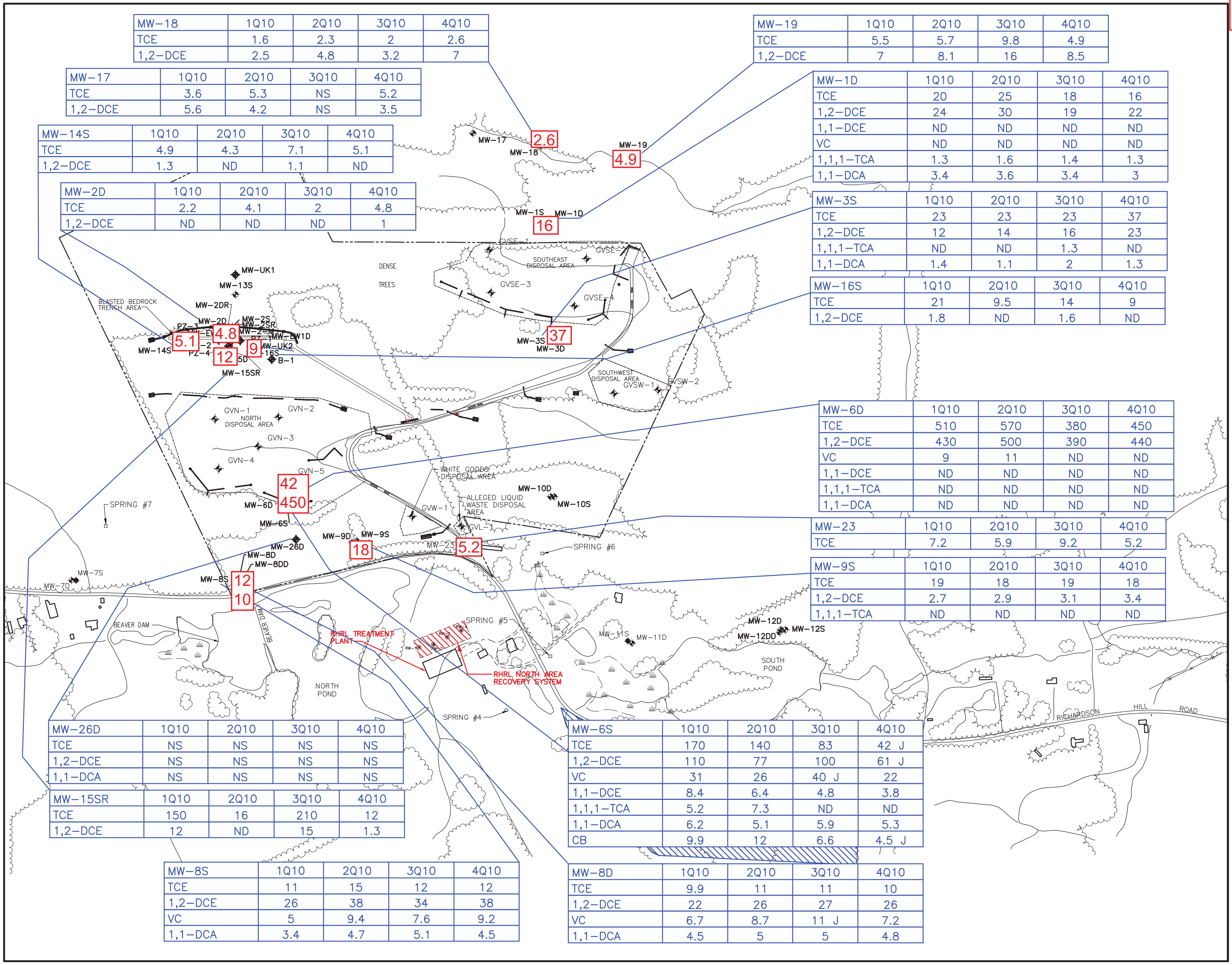
O'BRIEN & GERE

FILE NO. 3729/42138
AUGUST 2008

Figure 2-4.
TCE Plume Sidney Landfill Site

SIDNEY LANDFILL ENVIRONMENTAL MONITORING PROGRAM

GROUND WATER SITE INDICATOR VOC MAP 2010



MW-18	1Q10	2Q10	3Q10	4Q10
TCE	1.6	2.3	2	2.6
1,2-DCE	2.5	4.8	3.2	7

MW-17	1Q10	2Q10	3Q10	4Q10
TCE	3.6	5.3	NS	5.2
1,2-DCE	5.6	4.2	NS	3.5

MW-14S	1Q10	2Q10	3Q10	4Q10
TCE	4.9	4.3	7.1	5.1
1,2-DCE	1.3	ND	1.1	ND

MW-2D	1Q10	2Q10	3Q10	4Q10
TCE	2.2	4.1	2	4.8
1,2-DCE	ND	ND	ND	1

MW-19	1Q10	2Q10	3Q10	4Q10
TCE	5.5	5.7	9.8	4.9
1,2-DCE	7	8.1	16	8.5

MW-1D	1Q10	2Q10	3Q10	4Q10
TCE	20	25	18	16
1,2-DCE	24	30	19	22
1,1-DCE	ND	ND	ND	ND
VC	ND	ND	ND	ND
1,1,1-TCA	1.3	1.6	1.4	1.3
1,1-DCA	3.4	3.6	3.4	3

MW-3S	1Q10	2Q10	3Q10	4Q10
TCE	23	23	23	37
1,2-DCE	12	14	16	23
1,1,1-TCA	ND	ND	1.3	ND
1,1-DCA	1.4	1.1	2	1.3

MW-16S	1Q10	2Q10	3Q10	4Q10
TCE	21	9.5	14	9
1,2-DCE	1.8	ND	1.6	ND

MW-6D	1Q10	2Q10	3Q10	4Q10
TCE	510	570	380	450
1,2-DCE	430	500	390	440
VC	9	11	ND	ND
1,1-DCE	ND	ND	ND	ND
1,1,1-TCA	ND	ND	ND	ND
1,1-DCA	ND	ND	ND	ND

MW-23	1Q10	2Q10	3Q10	4Q10
TCE	7.2	5.9	9.2	5.2

MW-9S	1Q10	2Q10	3Q10	4Q10
TCE	19	18	19	18
1,2-DCE	2.7	2.9	3.1	3.4
1,1,1-TCA	ND	ND	ND	ND

MW-26D	1Q10	2Q10	3Q10	4Q10
TCE	NS	NS	NS	NS
1,2-DCE	NS	NS	NS	NS
1,1-DCA	NS	NS	NS	NS

MW-15SR	1Q10	2Q10	3Q10	4Q10
TCE	150	16	210	12
1,2-DCE	12	ND	15	1.3

MW-6S	1Q10	2Q10	3Q10	4Q10
TCE	170	140	83	42 J
1,2-DCE	110	77	100	61 J
VC	31	26	40 J	22
1,1-DCE	8.4	6.4	4.8	3.8
1,1,1-TCA	5.2	7.3	ND	ND
1,1-DCA	6.2	5.1	5.9	5.3
CB	9.9	12	6.6	4.5 J

MW-8S	1Q10	2Q10	3Q10	4Q10
TCE	11	15	12	12
1,2-DCE	26	38	34	38
VC	5	9.4	7.6	9.2
1,1-DCA	3.4	4.7	5.1	4.5

MW-8D	1Q10	2Q10	3Q10	4Q10
TCE	9.9	11	11	10
1,2-DCE	22	26	27	26
VC	6.7	8.7	11 J	7.2
1,1-DCA	4.5	5	5	4.8

LEGEND

- BEDROCK MONITORING WELL
- GLACIAL TILL MONITORING WELL
- GAS VENT LOCATION
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- FENCE LINE

NS = NOT SAMPLED
ND = NOT DETECTED
1,1,1-TCA = 1,1,1-TRICHLOROETHANE
1,1-DCA = 1,1-DICHLOROETHANE
1,2-DCE = 1,2-DICHLOROTHENE (TOTAL)
1,1-DCE = 1,1-DICHLOROETHENE
1,2-DCA = 1,2-DICHLOROETHANE
PCE = TETRACHLOROETHENE
TCE = TRICHLOROETHENE
VC = VINYL CHLORIDE

NOTE: ALL UNITS ARE ug/L (ppb)

NOTES:

1. TOPOGRAPHIC SURVEY FROM MALCOLM PIRNIE; JANUARY 1995.
2. ADAPTED FROM MAPS AND ILLUSTRATIONS PREPARED BY HARDING ESE.
3. WELL LOCATIONS ARE CURRENT AS OF JUNE 2008 FOLLOWING THE DECOMMISSIONING OF SEVERAL GROUND WATER MONITORING WELLS.

200 0 200 400

JTM ASSOCIATES, LLC
environmental consulting

PLOT DATE: 3/20/2011

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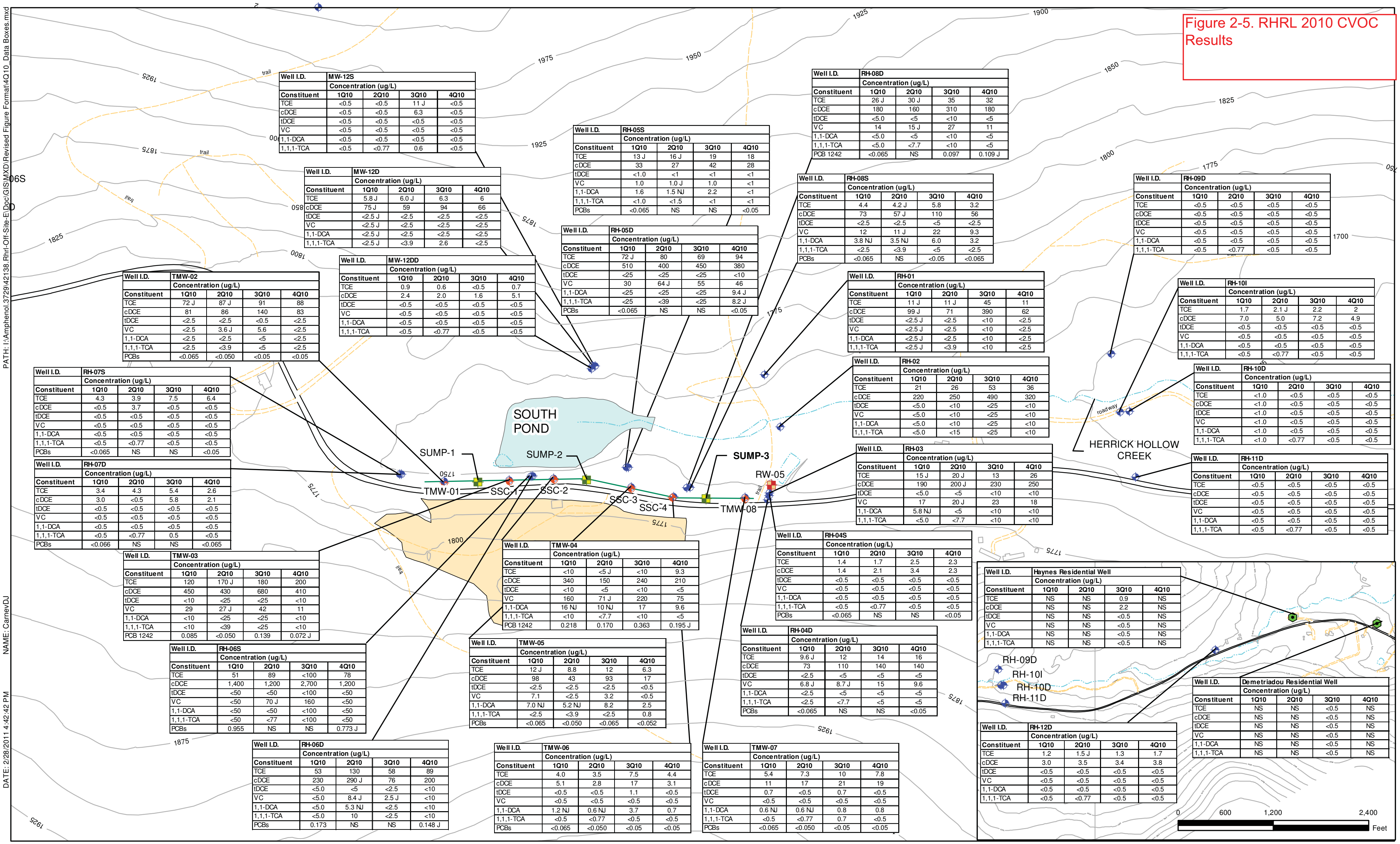

Well I.D. MW-12S — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	<0.5	<0.5	11 J	<0.5
cDCE	<0.5	<0.5	6.3	<0.5
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	0.6	<0.5

Well I.D. MW-12D — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	5.8 J	6.0 J	6.3	6
cDCE	75 J	59	94	66
tDCE	<2.5 J	<2.5	<2.5	<2.5
VC	<2.5 J	<2.5	<2.5	<2.5
1,1-DCA	<2.5 J	<2.5	<2.5	<2.5
1,1,1-TCA	<2.5 J	<3.9	2.6	<2.5

Well I.D. MW-12DD — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	0.9	0.6	<0.5	0.7
cDCE	2.4	2.0	1.6	5.1
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5

Well I.D. TMW-02 — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	72 J	87 J	91	88
cDCE	81	86	140	83
tDCE	<2.5	<2.5	<0.5	<2.5
VC	<2.5	3.6 J	5.6	<2.5
1,1-DCA	<2.5	<2.5	<5	<2.5
1,1,1-TCA	<2.5	<3.9	<5	<2.5
PCBs	<0.065	<0.050	<0.05	<0.05

Well I.D. RH-07S — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	4.3	3.9	7.5	6.4
cDCE	<0.5	3.7	<0.5	<0.5
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5
PCBs	<0.065	NS	NS	<0.05

Well I.D. RH-07D — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	3.4	4.3	5.4	2.6
cDCE	3.0	<0.5	5.8	2.1
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	0.5	<0.5
PCBs	<0.066	NS	NS	<0.065

Well I.D. TMW-03 — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	120	170 J	180	200
cDCE	450	430	680	410
tDCE	<10	<25	<25	<10
VC	29	27 J	42	11
1,1-DCA	<10	<25	<25	<10
1,1,1-TCA	<10	<39	<25	<10
PCB 1242	0.085	<0.050	0.139	0.072 J

Well I.D. RH-06S — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	51	89	<100	78
cDCE	1,400	1,200	2,700	1,200
tDCE	<50	<50	<100	<50
VC	<50	70 J	160	<50
1,1-DCA	<50	<50	<100	<50
1,1,1-TCA	<50	<77	<100	<50
PCBs	0.955	NS	NS	0.773 J

Well I.D. RH-06D — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	53	130	58	89
cDCE	230	290 J	76	200
tDCE	<5.0	<5	<2.5	<10
VC	<5.0	8.4 J	2.5 J	<10
1,1-DCA	<5.0	5.3 NJ	<2.5	<10
1,1,1-TCA	<5.0	10	<2.5	<10
PCBs	0.173	NS	NS	0.148 J

Well I.D. RH-05S — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	13 J	16 J	19	18
cDCE	33	27	42	28
tDCE	<1.0	<1	<1	<1
VC	1.0	1.0 J	1.0	<1
1,1-DCA	1.6	1.5 NJ	2.2	<1
1,1,1-TCA	<1.0	<1.5	<1	<1
PCBs	<0.065	NS	NS	<0.05

Well I.D. RH-05D — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	72 J	80	69	94
cDCE	510	400	450	380
tDCE	<25	<25	<25	<10
VC	30	64 J	55	46
1,1-DCA	<25	<25	<25	9.4 J
1,1,1-TCA	<25	<39	<25	8.2 J
PCBs	<0.065	NS	NS	<0.05

Well I.D. RH-08D — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	26 J	30 J	35	32
cDCE	180	160	310	180
tDCE	<5.0	<5	<10	<5
VC	14	15 J	27	11
1,1-DCA	<5.0	<5	<10	<5
1,1,1-TCA	<5.0	<7.7	<10	<5
PCB 1242	<0.065	NS	0.097	0.109 J

Well I.D. RH-08S — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	4.4	4.2 J	5.8	3.2
cDCE	73	57 J	110	56
tDCE	<2.5	<2.5	<5	<2.5
VC	12	11 J	22	9.3
1,1-DCA	3.8 NJ	3.5 NJ	6.0	3.2
1,1,1-TCA	<2.5	<3.9	<5	<2.5
PCBs	<0.065	NS	<0.05	<0.065

Well I.D. RH-01 — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	11 J	11 J	45	11
cDCE	99 J	71	390	62
tDCE	<2.5 J	<2.5	<10	<2.5
VC	<2.5 J	<2.5	<10	<2.5
1,1-DCA	<2.5 J	<2.5	<10	<2.5
1,1,1-TCA	<2.5 J	<3.9	<10	<2.5

Well I.D. RH-02 — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	21	26	53	36
cDCE	220	250	490	320
tDCE	<5.0	<10	<25	<10
VC	<5.0	<10	<25	<10
1,1-DCA	<5.0	<10	<25	<10
1,1,1-TCA	<5.0	<15	<25	<10

Well I.D. RH-03 — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	15 J	20 J	13	26
cDCE	190	200 J	230	250
tDCE	<5.0	<5	<10	<10
VC	17	20 J	23	18
1,1-DCA	5.8 NJ	<5	<10	<10
1,1,1-TCA	<5.0	<7.7	<10	<10

Well I.D. RH-09D — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	<0.5	<0.5	<0.5	<0.5
cDCE	<0.5	<0.5	<0.5	<0.5
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5

Well I.D. RH-10I — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	1.7	2.1 J	2.2	2
cDCE	7.0	5.0	7.2	4.9
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5

Well I.D. RH-10D — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	<1.0	<0.5	<0.5	<0.5
cDCE	<1.0	<0.5	<0.5	<0.5
tDCE	<1.0	<0.5	<0.5	<0.5
VC	<1.0	<0.5	<0.5	<0.5
1,1-DCA	<1.0	<0.5	<0.5	<0.5
1,1,1-TCA	<1.0	<0.77	<0.5	<0.5

Well I.D. RH-11D — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	<0.5	<0.5	<0.5	<0.5
cDCE	<0.5	<0.5	<0.5	<0.5
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5

Well I.D. RH-04S — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	1.4	1.7	2.5	2.3
cDCE	1.4	2.1	3.4	2.3
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5
PCBs	<0.065	NS	NS	<0.05

Well I.D. RH-04D — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	9.6 J	12	14	16
cDCE	73	110	140	140
tDCE	<2.5	<5	<5	<5
VC	6.8 J	8.7 J	15	9.6
1,1-DCA	<2.5	<5	<5	<5
1,1,1-TCA	<2.5	<7.7	<5	<5
PCBs	<0.065	NS	NS	<0.05

Well I.D. TMW-04 — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	<10	<5 J	<10	9.3
cDCE	340	150	240	210
tDCE	<10	<5	<10	<5
VC	160	71 J	220	75
1,1-DCA	16 NJ	10 NJ	17	9.6
1,1,1-TCA	<10	<7.7	<10	<5
PCB 1242	0.218	0.170	0.363	0.195 J

Well I.D. TMW-05 — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	12 J	8.8	12	6.3
cDCE	98	43	93	17
tDCE	<2.5	<2.5	<2.5	<0.5
VC	7.1	<2.5	3.2	<0.5
1,1-DCA	7.0 NJ	5.2 NJ	8.2	2.5
1,1,1-TCA	<2.5	<3.9	<2.5	0.8
PCBs	<0.065	<0.050	<0.065	<0.052

Well I.D. TMW-06 — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	4.0	3.5	7.5	4.4
cDCE	5.1	2.8	17	3.1
tDCE	<0.5	<0.5	1.1	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	1.2 NJ	0.6 NJ	3.7	0.7
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5
PCBs	<0.065	<0.050	<0.05	<0.05

Well I.D. TMW-07 — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	5.4	7.3	10	7.8
cDCE	11	17	21	19
tDCE	0.7	<0.5	0.7	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	0.6 NJ	0.6 NJ	0.8	0.8
1,1,1-TCA	<0.5	<0.77	0.7	<0.5
PCBs	<0.065	<0.050	<0.05	<0.05

Well I.D. Haynes Residential Well — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	NS	NS	0.9	NS
cDCE	NS	NS	2.2	NS
tDCE	NS	NS	<0.5	NS
VC	NS	NS	<0.5	NS
1,1-DCA	NS	NS	<0.5	NS
1,1,1-TCA	NS	NS	<0.5	NS

Well I.D. Demetriadou Residential Well — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	NS	NS	<0.5	NS
cDCE	NS	NS	<0.5	NS
tDCE	NS	NS	<0.5	NS
VC	NS	NS	<0.5	NS
1,1-DCA	NS	NS	<0.5	NS
1,1,1-TCA	NS	NS	<0.5	NS

Well I.D. RH-12D — Concentration (ug/L)

Constituent	1Q10	2Q10	3Q10	4Q10
TCE	1.2	1.5 J	1.3	1.7
cDCE	3.0	3.5	3.4	3.8
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5

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LEGEND

- DUAL-ZONE TRENCH MONITORING WELL
- HOMEOWNER WELL
- MONITORING WELL
- RECOVERY WELL
- SUMP
- GROUNDWATER RECOVERY TRENCH
- CAPPED LANDFILL

RICHARDSON HILL ROAD LANDFILL SITE
SIDNEY CENTER, NEW YORK

0 150 300 600 900 1,200
Feet

2010 SITE-RELATED VOLATILE ORGANIC COMPOUNDS

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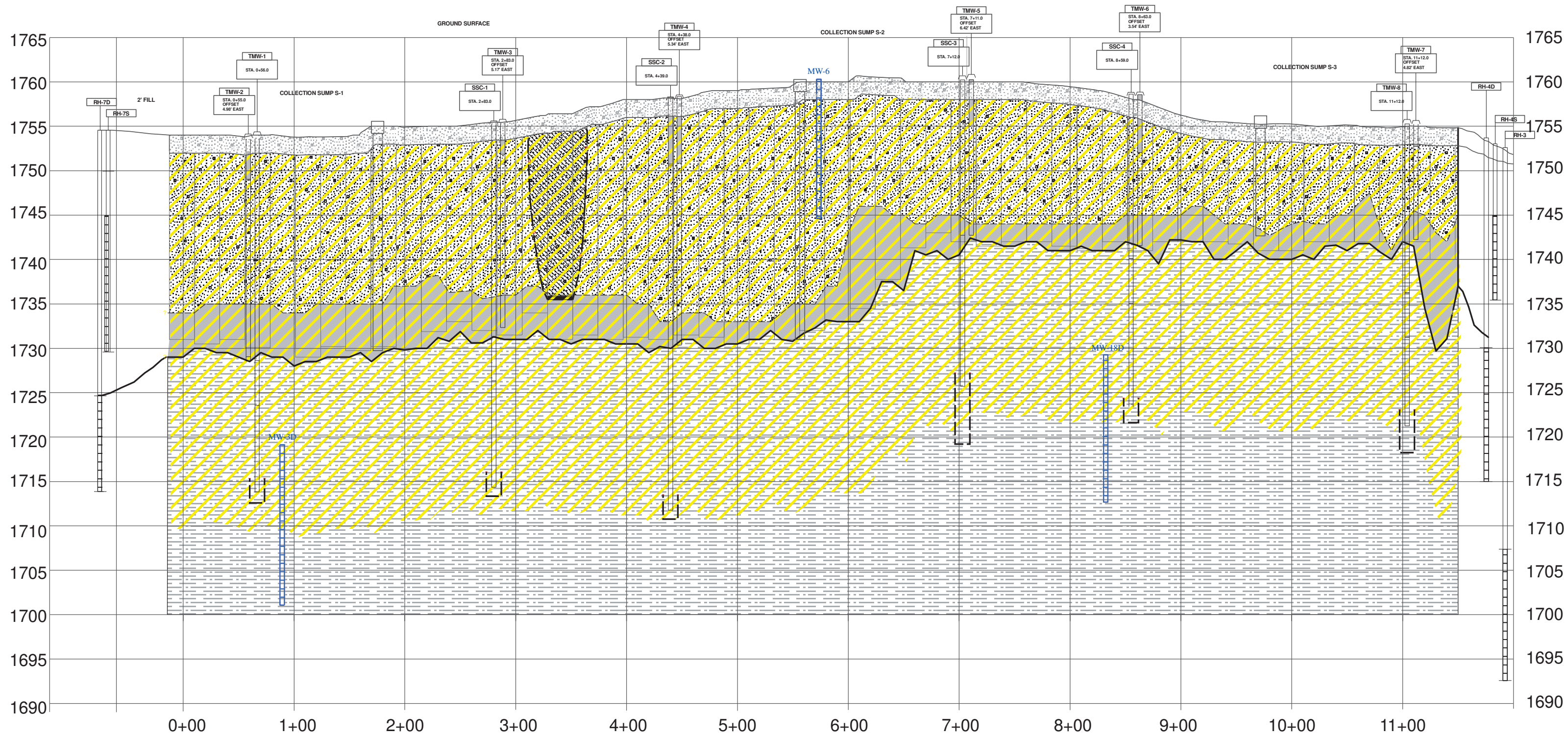
FIGURE 16



LEGEND

- Design Capture Zone
- HDPE Pipe
- Filter Fabric
- Bedrock
- Fill
- Riser
- Till/Bedrock
- Trench Backfill
- Upgradient Abandoned Well Screen

RICHARDSON HILL ROAD LANDFILL SITE
SIDNEY, NEW YORK

EXTRACTION TRENCH CAPTURE ZONE

Figure 3.1 - Richardson Hill Road Landfill extraction trench and expected capture zone.

Note: This drawing is adapted from Drawing C-9: The Ground Water Extraction Trench/Profile, in the Record Drawings Richardson Hill Road Landfill Site Remedial Work Element II Ground Water Extraction and Treatment.

SEPTEMBER 2008
3729.42138

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Figure 3-2. Process Flow Diagram for RHRL Treatment System

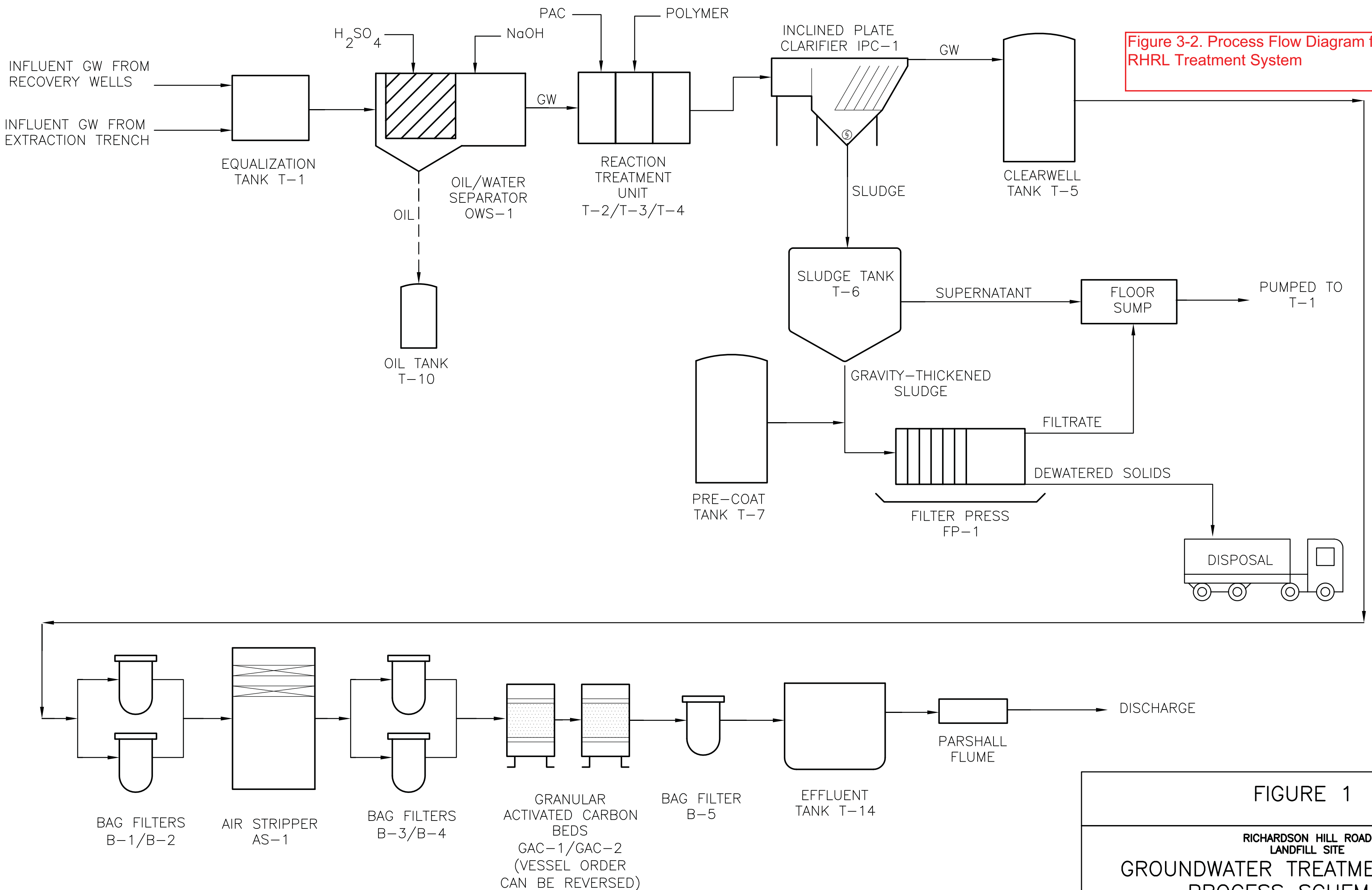


FIGURE 1

RICHARDSON HILL ROAD LANDFILL SITE

GROUNDWATER TREATMENT PLANT PROCESS SCHEMATIC

PARSONS

290 ELWOOD DAVIS ROAD, SUITE 312, LIVERPOOL, N.Y. 13088, PHONE: 315-451-9560

P:\742577\CAD\O&M\742577C005.DWG

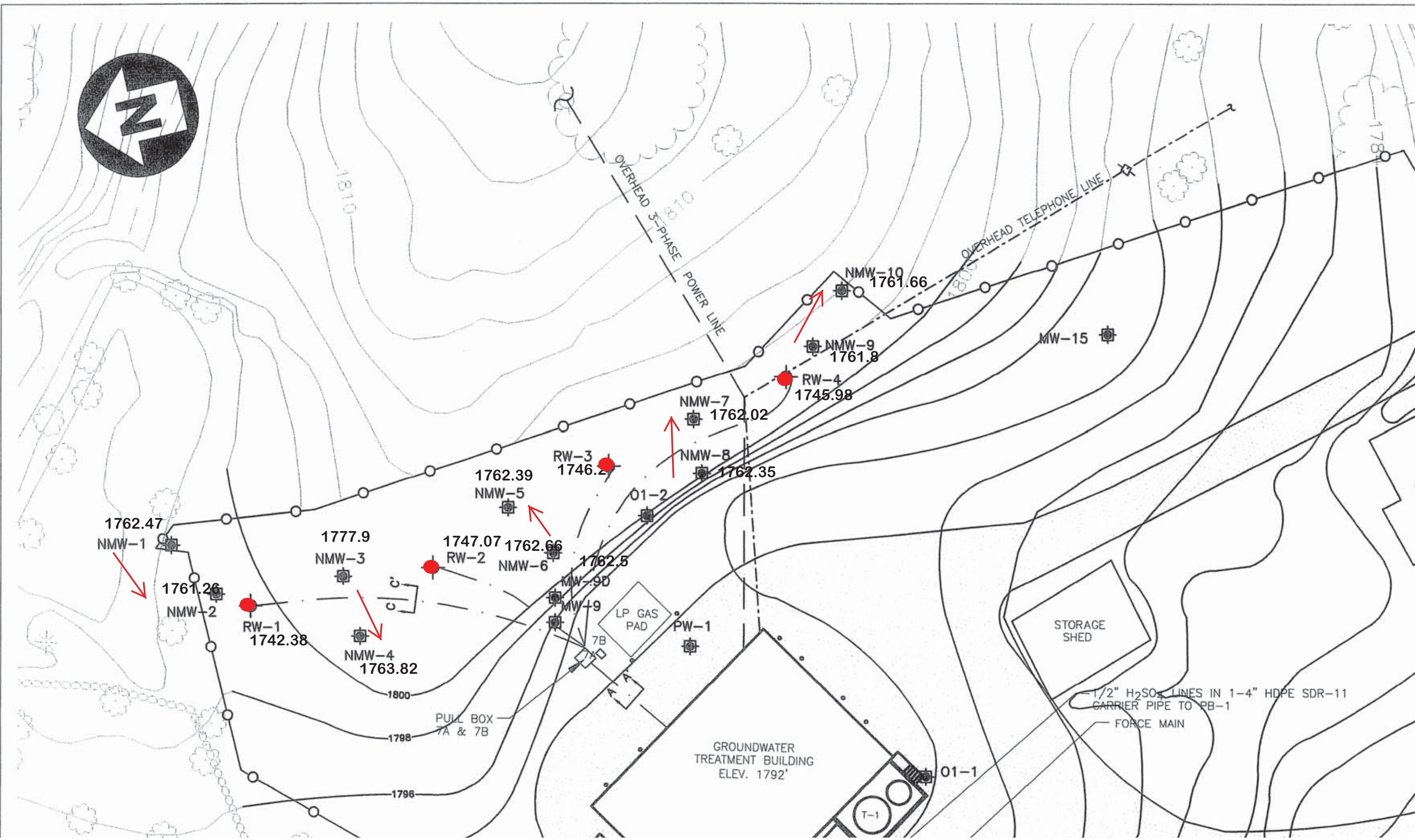


Figure 5-1. Groundwater Elevations Richardson Hill North Area (Arrows indicate direction of gradient)

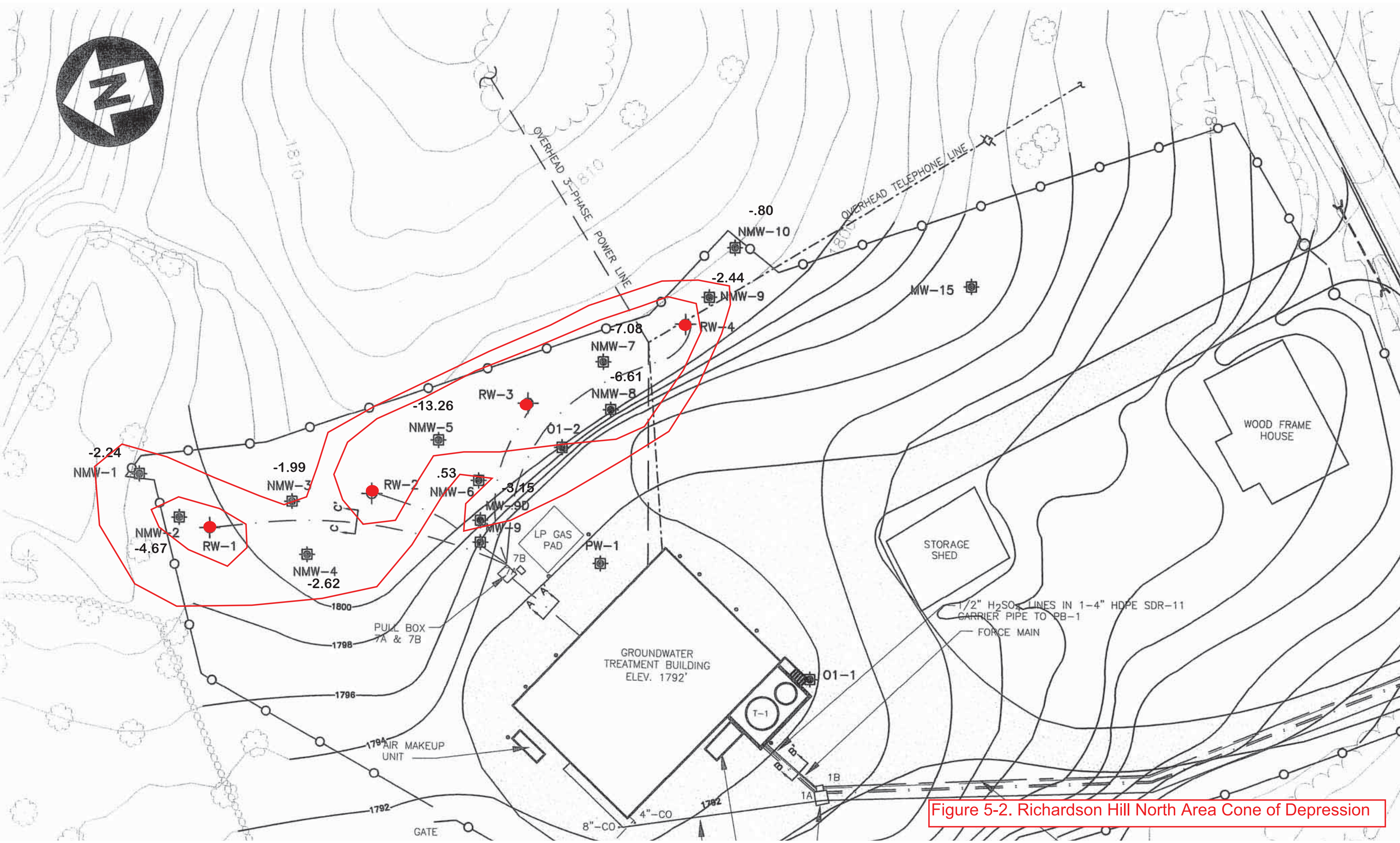
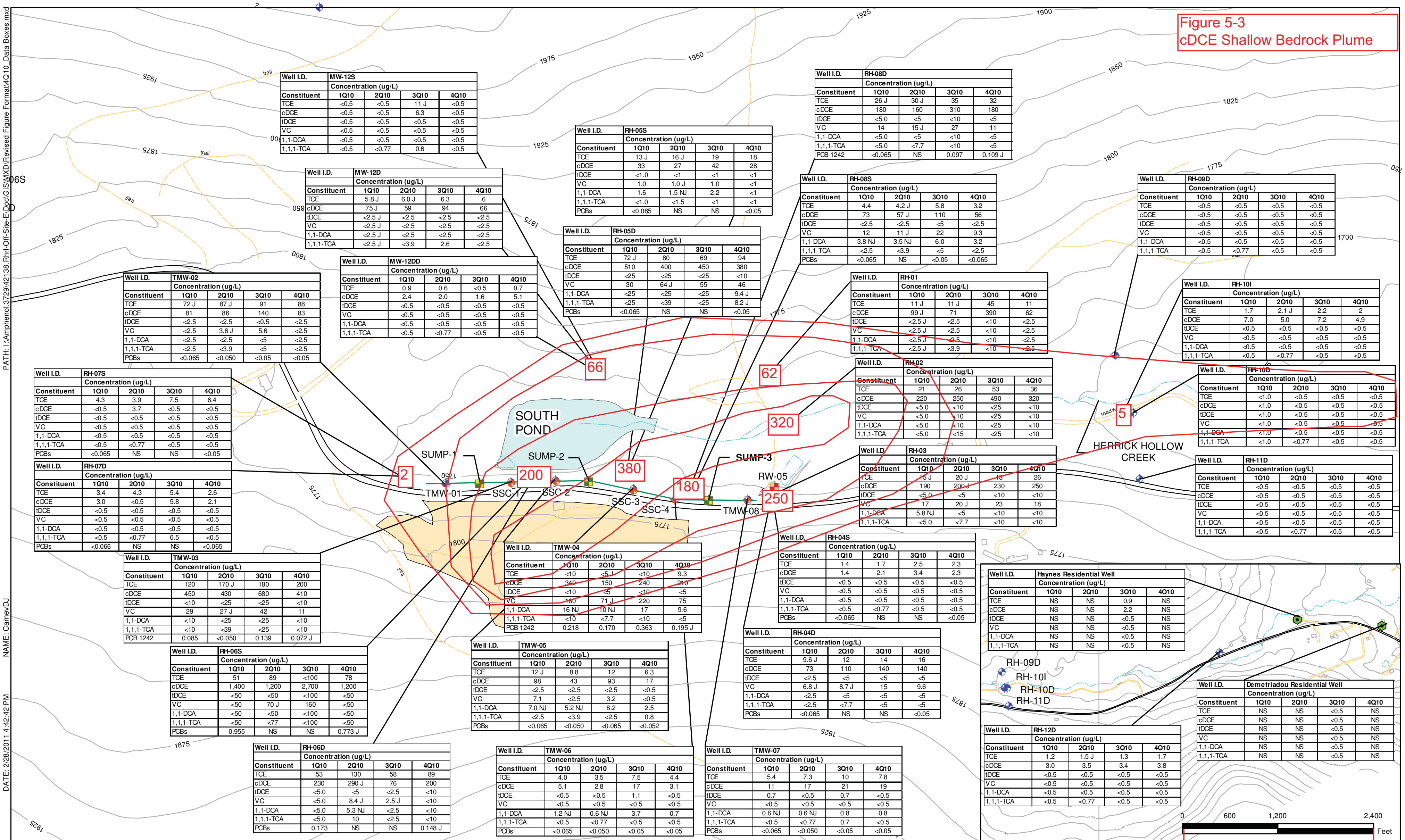


Figure 5-2. Richardson Hill North Area Cone of Depression



Well I.D.	MW-12S			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	<0.5	<0.5	11 J	<0.5
cDCE	<0.5	<0.5	6.3	<0.5
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	0.6	<0.5

Well I.D.	MW-12D			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	5.8 J	6.0 J	6.3	6
cDCE	75 J	59	94	66
tDCE	<2.5 J	<2.5	<2.5	<2.5
VC	<2.5 J	<2.5	<2.5	<2.5
1,1-DCA	<2.5 J	<2.5	<2.5	<2.5
1,1,1-TCA	<2.5 J	<3.9	2.6	<2.5

Well I.D.	MW-12DD			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	0.9	0.6	<0.5	0.7
cDCE	2.4	2.0	1.6	5.1
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5

Well I.D.	TMW-02			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	72 J	87 J	91	88
cDCE	81	86	140	83
tDCE	<2.5	<2.5	<0.5	<2.5
VC	<2.5	3.6 J	5.6	<2.5
1,1-DCA	<2.5	<2.5	<5	<2.5
1,1,1-TCA	<2.5	<3.9	<5	<2.5
PCBs	<0.065	<0.050	<0.05	<0.05

Well I.D.	RH-05S			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	13 J	16 J	19	18
cDCE	33	27	42	28
tDCE	<1.0	<1	<1	<1
VC	1.0	1.0 J	1.0	<1
1,1-DCA	1.6	1.5 NJ	2.2	<1
1,1,1-TCA	<1.0	<1.5	<1	<1
PCBs	<0.065	NS	NS	<0.05

Well I.D.	RH-05D			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	72 J	80	69	94
cDCE	510	400	450	380
tDCE	<25	<25	<25	<10
VC	30	64 J	55	46
1,1-DCA	<25	<25	<25	9.4 J
1,1,1-TCA	<25	<39	<25	8.2 J
PCBs	<0.065	NS	NS	<0.05

Well I.D.	RH-08D			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	26 J	30 J	35	32
cDCE	180	160	310	180
tDCE	<5.0	<5	<10	<5
VC	14	15 J	27	11
1,1-DCA	<5.0	<5	<10	<5
1,1,1-TCA	<5.0	<7.7	<10	<5
PCB 1242	<0.065	NS	0.097	0.109 J

Well I.D.	RH-08S			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	4.4	4.2 J	5.8	3.2
cDCE	73	57 J	110	56
tDCE	<2.5	<2.5	<5	<2.5
VC	12	11 J	22	9.3
1,1-DCA	3.8 NJ	3.5 NJ	6.0	3.2
1,1,1-TCA	<2.5	<3.9	<5	<2.5
PCBs	<0.065	NS	<0.05	<0.065

Well I.D.	RH-09D			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	<0.5	<0.5	<0.5	<0.5
cDCE	<0.5	<0.5	<0.5	<0.5
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5

Well I.D.	RH-01			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	11 J	11 J	45	11
cDCE	99 J	71	390	62
tDCE	<2.5 J	<2.5	<10	<2.5
VC	<2.5 J	<2.5	<10	<2.5
1,1-DCA	<2.5 J	<2.5	<10	<2.5
1,1,1-TCA	<2.5 J	<3.9	<10	<2.5

Well I.D.	RH-10I			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	1.7	2.1 J	2.2	2
cDCE	7.0	5.0	7.2	4.9
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5

Well I.D.	RH-02			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	21	26	53	36
cDCE	220	250	490	320
tDCE	<5.0	<10	<25	<10
VC	<5.0	<10	<25	<10
1,1-DCA	<5.0	<10	<25	<10
1,1,1-TCA	<5.0	<15	<25	<10

Well I.D.	RH-10D			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	<1.0	<0.5	<0.5	<0.5
cDCE	<1.0	<0.5	<0.5	<0.5
tDCE	<1.0	<0.5	<0.5	<0.5
VC	<1.0	<0.5	<0.5	<0.5
1,1-DCA	<1.0	<0.5	<0.5	<0.5
1,1,1-TCA	<1.0	<0.77	<0.5	<0.5

Well I.D.	RH-07S			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	4.3	3.9	7.5	6.4
cDCE	<0.5	3.7	<0.5	<0.5
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5
PCBs	<0.065	NS	NS	<0.05

Well I.D.	RH-07D			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	3.4	4.3	5.4	2.6
cDCE	3.0	<0.5	5.8	2.1
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	0.5	<0.5
PCBs	<0.066	NS	NS	<0.065

Well I.D.	RH-03			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	15 J	20 J	13	26
cDCE	190	200 J	230	250
tDCE	<5.0	<5	<10	<10
VC	17	20 J	23	18
1,1-DCA	5.8 NJ	<5	<10	<10
1,1,1-TCA	<5.0	<7.7	<10	<10

Well I.D.	RH-11D			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	<0.5	<0.5	<0.5	<0.5
cDCE	<0.5	<0.5	<0.5	<0.5
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5

Well I.D.	TMW-03			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	120	170 J	180	200
cDCE	450	430	680	410
tDCE	<10	<25	<25	<10
VC	29	27 J	42	11
1,1-DCA	<10	<25	<25	<10
1,1,1-TCA	<10	<39	<25	<10
PCB 1242	0.085	<0.050	0.139	0.072 J

Well I.D.	TMW-04			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	<10	<5 J	<10	9.3
cDCE	340	150	240	210
tDCE	<10	<5	<10	<5
VC	180	71 J	220	75
1,1-DCA	16 NJ	10 NJ	17	9.6
1,1,1-TCA	<10	<7.7	<10	<5
PCB 1242	0.218	0.170	0.363	0.195 J

Well I.D.	RH-04S			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	1.4	1.7	2.5	2.3
cDCE	1.4	2.1	3.4	2.3
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5
PCBs	<0.065	NS	NS	<0.05

Well I.D.	Haynes Residential Well			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	NS	NS	0.9	NS
cDCE	NS	NS	2.2	NS
tDCE	NS	NS	<0.5	NS
VC	NS	NS	<0.5	NS
1,1-DCA	NS	NS	<0.5	NS
1,1,1-TCA	NS	NS	<0.5	NS

Well I.D.	RH-06S			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	51	89	<100	78
cDCE	1,400	1,200	2,700	1,200
tDCE	<50	<50	<100	<50
VC	<50	70 J	160	<50
1,1-DCA	<50	<50	<100	<50
1,1,1-TCA	<50	<77	<100	<50
PCBs	0.955	NS	NS	0.773 J

Well I.D.	TMW-05			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	12 J	8.8	12	6.3
cDCE	98	43	93	17
tDCE	<2.5	<2.5	<2.5	<0.5
VC	7.1	<2.5	3.2	<0.5
1,1-DCA	7.0 NJ	5.2 NJ	8.2	2.5
1,1,1-TCA	<2.5	<3.9	<2.5	0.8
PCBs	<0.065	<0.050	<0.065	<0.052

Well I.D.	RH-04D			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	9.6 J	12	14	16
cDCE	73	110	140	140
tDCE	<2.5	<5	<5	<5
VC	6.8 J	8.7 J	15	9.6
1,1-DCA	<2.5	<5	<5	<5
1,1,1-TCA	<2.5	<7.7	<5	<5
PCBs	<0.065	NS	NS	<0.05

Well I.D.	Demetriadou Residential Well			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	NS	NS	<0.5	NS
cDCE	NS	NS	<0.5	NS
tDCE	NS	NS	<0.5	NS
VC	NS	NS	<0.5	NS
1,1-DCA	NS	NS	<0.5	NS
1,1,1-TCA	NS	NS	<0.5	NS

Well I.D.	RH-12D			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	1.2	1.5 J	1.3	1.7
cDCE	3.0	3.5	3.4	3.8
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5

Well I.D.	RH-06D			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	53	130	58	89
cDCE	230	290 J	76	200
tDCE	<5.0	<5	<2.5	<10
VC	<5.0	8.4 J	2.5 J	<10
1,1-DCA	<5.0	5.3 NJ	<2.5	<10
1,1,1-TCA	<5.0	10	<2.5	<10
PCBs	0.173	NS	NS	0.148 J

Well I.D.	TMW-06			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	4.0	3.5	7.5	4.4
cDCE	5.1	2.8	17	3.1
tDCE	<0.5	<0.5	1.1	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	1.2 NJ	0.6 NJ	3.7	0.7
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5
PCBs	<0.065	<0.050	<0.05	<0.05

Well I.D.	TMW-07			
Concentration (ug/L)				
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	5.4	7.3	10	7.8
cDCE	11	17	21	19
tDCE	0.7	<0.5	0.7	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	0.6 NJ	0.6 NJ	0.8	0.8
1,1,1-TCA	<0.5	<0.77	0.7	<0.5
PCBs	<0.065	<0.050	<0.05	<0.05

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LEGEND

- DUAL-ZONE TRENCH MONITORING WELL
- HOMEOWNER WELL
- MONITORING WELL
- RECOVERY WELL
- SUMP
- GROUNDWATER RECOVERY TRENCH
- CAPPED LANDFILL

RICHARDSON HILL ROAD LANDFILL SITE
SIDNEY CENTER, NEW YORK

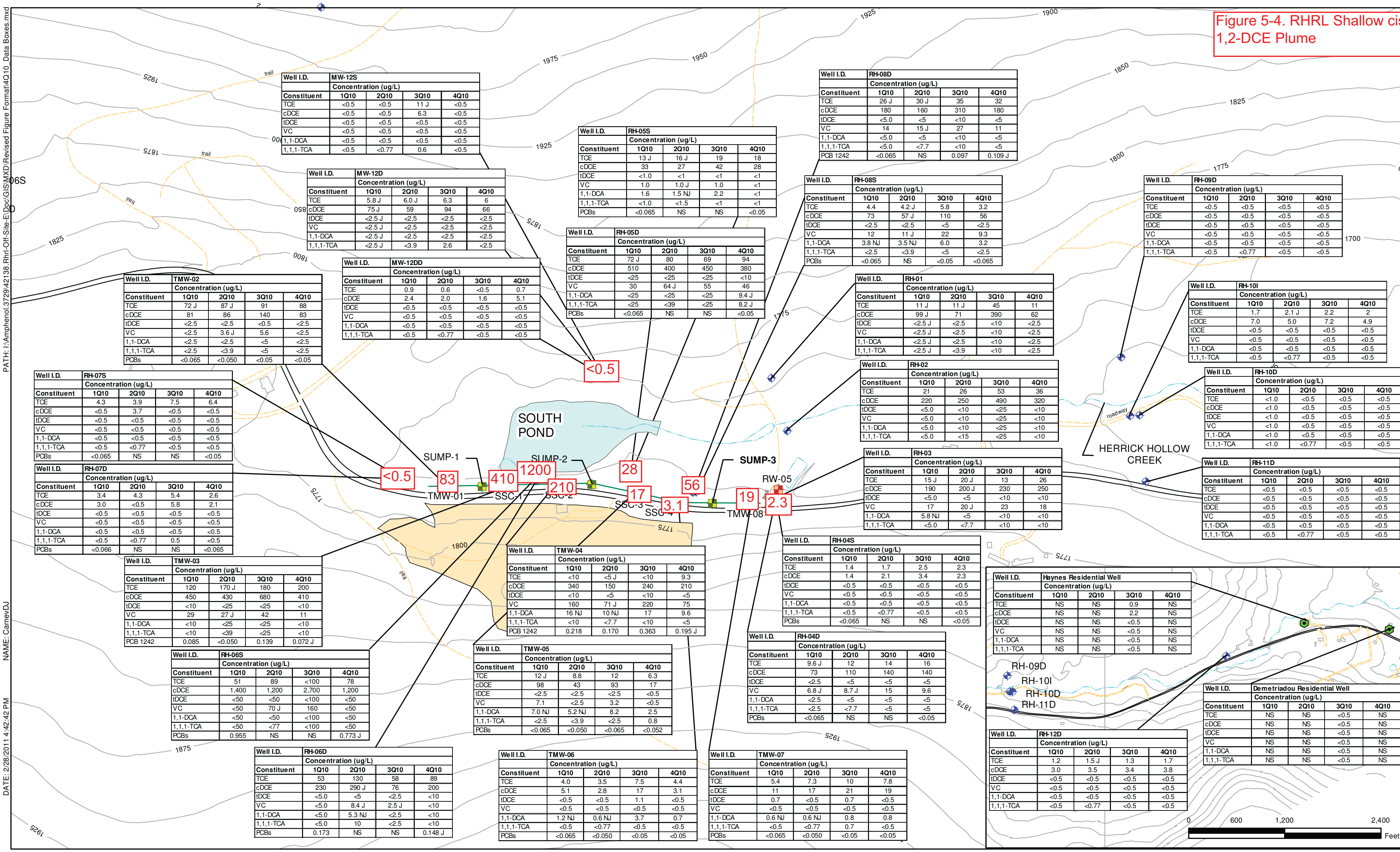
0 150 300 600 900 1,200
Feet

2010 SITE-RELATED VOLATILE ORGANIC COMPOUNDS

FEBRUARY 2010
3729/42138

O'BRIEN & GERE

Figure 5-4. RHRL Shallow cis 1,2-DCE Plume



Well I.D.	MW-12S			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	<0.5	<0.5	11 J	<0.5
cDCE	<0.5	<0.5	6.3	<0.5
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	0.6	<0.5

Well I.D.	MW-12D			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	5.8 J	6.0 J	6.3	6
cDCE	75 J	59	94	66
tDCE	<2.5 J	<2.5	<2.5	<2.5
VC	<2.5 J	<2.5	<2.5	<2.5
1,1-DCA	<2.5 J	<2.5	<2.5	<2.5
1,1,1-TCA	<2.5 J	<3.9	2.6	<2.5

Well I.D.	MW-12DD			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	0.9	0.6	<0.5	0.7
cDCE	2.4	2.0	1.6	5.1
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5

Well I.D.	TMW-02			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	72 J	87 J	91	88
cDCE	81	86	140	83
tDCE	<2.5	<2.5	<0.5	<2.5
VC	<2.5	3.6 J	5.6	<2.5
1,1-DCA	<2.5	<2.5	<5	<2.5
1,1,1-TCA	<2.5	<3.9	<5	<2.5
PCBs	<0.065	<0.050	<0.05	<0.05

Well I.D.	RH-05S			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	13 J	16 J	19	18
cDCE	33	27	42	28
tDCE	<1.0	<1	<1	<1
VC	1.0	1.0 J	1.0	<1
1,1-DCA	1.6	1.5 NJ	2.2	<1
1,1,1-TCA	<1.0	<1.5	<1	<1
PCBs	<0.065	NS	NS	<0.05

Well I.D.	RH-05D			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	72 J	80	69	94
cDCE	510	400	450	380
tDCE	<25	<25	<25	<10
VC	30	64 J	55	46
1,1-DCA	<25	<25	<25	9.4 J
1,1,1-TCA	<25	<39	<25	8.2 J
PCBs	<0.065	NS	NS	<0.05

Well I.D.	RH-08D			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	26 J	30 J	35	32
cDCE	180	160	310	180
tDCE	<5.0	<5	<10	<5
VC	14	15 J	27	11
1,1-DCA	<5.0	<5	<10	<5
1,1,1-TCA	<5.0	<7.7	<10	<5
PCB 1242	<0.065	NS	0.097	0.109 J

Well I.D.	RH-08S			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	4.4	4.2 J	5.8	3.2
cDCE	73	57 J	110	56
tDCE	<2.5	<2.5	<5	<2.5
VC	12	11 J	22	9.3
1,1-DCA	3.8 NJ	3.5 NJ	6.0	3.2
1,1,1-TCA	<2.5	<3.9	<5	<2.5
PCBs	<0.065	NS	<0.05	<0.065

Well I.D.	RH-09D			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	<0.5	<0.5	<0.5	<0.5
cDCE	<0.5	<0.5	<0.5	<0.5
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5

Well I.D.	RH-01			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	11 J	11 J	45	11
cDCE	99 J	71	390	62
tDCE	<2.5 J	<2.5	<10	<2.5
VC	<2.5 J	<2.5	<10	<2.5
1,1-DCA	<2.5 J	<2.5	<10	<2.5
1,1,1-TCA	<2.5 J	<3.9	<10	<2.5

Well I.D.	RH-10I			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	1.7	2.1 J	2.2	2
cDCE	7.0	5.0	7.2	4.9
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5

Well I.D.	RH-07S			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	4.3	3.9	7.5	6.4
cDCE	<0.5	3.7	<0.5	<0.5
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5
PCBs	<0.065	NS	NS	<0.05

Well I.D.	RH-02			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	21	26	53	36
cDCE	220	250	490	320
tDCE	<5.0	<10	<25	<10
VC	<5.0	<10	<25	<10
1,1-DCA	<5.0	<10	<25	<10
1,1,1-TCA	<5.0	<15	<25	<10

Well I.D.	RH-10D			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	<1.0	<0.5	<0.5	<0.5
cDCE	<1.0	<0.5	<0.5	<0.5
tDCE	<1.0	<0.5	<0.5	<0.5
VC	<1.0	<0.5	<0.5	<0.5
1,1-DCA	<1.0	<0.5	<0.5	<0.5
1,1,1-TCA	<1.0	<0.77	<0.5	<0.5

Well I.D.	RH-07D			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	3.4	4.3	5.4	2.6
cDCE	3.0	<0.5	5.8	2.1
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	0.5	<0.5
PCBs	<0.066	NS	NS	<0.065

Well I.D.	RH-03			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	15 J	20 J	13	26
cDCE	190	200 J	230	250
tDCE	<5.0	<5	<10	<10
VC	17	20 J	23	18
1,1-DCA	5.8 NJ	<5	<10	<10
1,1,1-TCA	<5.0	<7.7	<10	<10

Well I.D.	RH-11D			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	<0.5	<0.5	<0.5	<0.5
cDCE	<0.5	<0.5	<0.5	<0.5
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5

Well I.D.	TMW-03			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	120	170 J	180	200
cDCE	450	430	680	410
tDCE	<10	<25	<25	<10
VC	29	27 J	42	11
1,1-DCA	<10	<25	<25	<10
1,1,1-TCA	<10	<39	<25	<10
PCB 1242	0.085	<0.050	0.139	0.072 J

Well I.D.	TMW-04			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	<10	<5 J	<10	9.3
cDCE	340	150	240	210
tDCE	<10	<5	<10	<5
VC	160	71 J	220	75
1,1-DCA	16 NJ	10 NJ	17	9.6
1,1,1-TCA	<10	<7.7	<10	<5
PCB 1242	0.218	0.170	0.363	0.195 J

Well I.D.	RH-04S			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	1.4	1.7	2.5	2.3
cDCE	1.4	2.1	3.4	2.3
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5
PCBs	<0.065	NS	NS	<0.05

Well I.D.	Haynes Residential Well			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	NS	NS	0.9	NS
cDCE	NS	NS	2.2	NS
tDCE	NS	NS	<0.5	NS
VC	NS	NS	<0.5	NS
1,1-DCA	NS	NS	<0.5	NS
1,1,1-TCA	NS	NS	<0.5	NS

Well I.D.	RH-06S			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	51	89	<100	78
cDCE	1,400	1,200	2,700	1,200
tDCE	<50	<50	<100	<50
VC	<50	70 J	160	<50
1,1-DCA	<50	<50	<100	<50
1,1,1-TCA	<50	<77	<100	<50
PCBs	0.955	NS	NS	0.773 J

Well I.D.	TMW-05			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	12 J	8.8	12	6.3
cDCE	98	43	93	17
tDCE	<2.5	<2.5	<2.5	<0.5
VC	7.1	<2.5	3.2	<0.5
1,1-DCA	7.0 NJ	5.2 NJ	8.2	2.5
1,1,1-TCA	<2.5	<3.9	<2.5	0.8
PCBs	<0.065	<0.050	<0.065	<0.052

Well I.D.	RH-04D			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	9.6 J	12	14	16
cDCE	73	110	140	140
tDCE	<2.5	<5	<5	<5
VC	6.8 J	8.7 J	15	9.6
1,1-DCA	<2.5	<5	<5	<5
1,1,1-TCA	<2.5	<7.7	<5	<5
PCBs	<0.065	NS	NS	<0.05

Well I.D.	Demetriadou Residential Well			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	NS	NS	<0.5	NS
cDCE	NS	NS	<0.5	NS
tDCE	NS	NS	<0.5	NS
VC	NS	NS	<0.5	NS
1,1-DCA	NS	NS	<0.5	NS
1,1,1-TCA	NS	NS	<0.5	NS

Well I.D.	RH-12D			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	1.2	1.5 J	1.3	1.7
cDCE	3.0	3.5	3.4	3.8
tDCE	<0.5	<0.5	<0.5	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	<0.5	<0.5	<0.5	<0.5
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5

Well I.D.	RH-06D			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	53	130	58	89
cDCE	230	290 J	76	200
tDCE	<5.0	<5	<2.5	<10
VC	<5.0	8.4 J	2.5 J	<10
1,1-DCA	<5.0	5.3 NJ	<2.5	<10
1,1,1-TCA	<5.0	10	<2.5	<10
PCBs	0.173	NS	NS	0.148 J

Well I.D.	TMW-06			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	4.0	3.5	7.5	4.4
cDCE	5.1	2.8	17	3.1
tDCE	<0.5	<0.5	1.1	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	1.2 NJ	0.6 NJ	3.7	0.7
1,1,1-TCA	<0.5	<0.77	<0.5	<0.5
PCBs	<0.065	<0.050	<0.05	<0.05

Well I.D.	TMW-07			
	Concentration (ug/L)			
Constituent	1Q10	2Q10	3Q10	4Q10
TCE	5.4	7.3	10	7.8
cDCE	11	17	21	19
tDCE	0.7	<0.5	0.7	<0.5
VC	<0.5	<0.5	<0.5	<0.5
1,1-DCA	0.6 NJ	0.6 NJ	0.8	0.8
1,1,1-TCA	<0.5	<0.77	0.7	<0.5
PCBs	<0.065	<0.050	<0.05	<0.05

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NAME: CarnevDJ

DATE: 2/28/2011 4:42:42 PM

This document was developed in color. Reproduction in B/W may not represent the data as intended.

LEGEND

- DUAL-ZONE TRENCH MONITORING WELL
- HOMEOWNER WELL
- MONITORING WELL
- RECOVERY WELL
- SUMP
- GROUNDWATER RECOVERY TRENCH
- CAPPED LANDFILL

RICHARDSON HILL ROAD LANDFILL SITE
SIDNEY CENTER, NEW YORK

0 150 300 600 900 1,200
Feet

2010 SITE-RELATED VOLATILE ORGANIC COMPOUNDS

FEBRUARY 2010
3729/42138

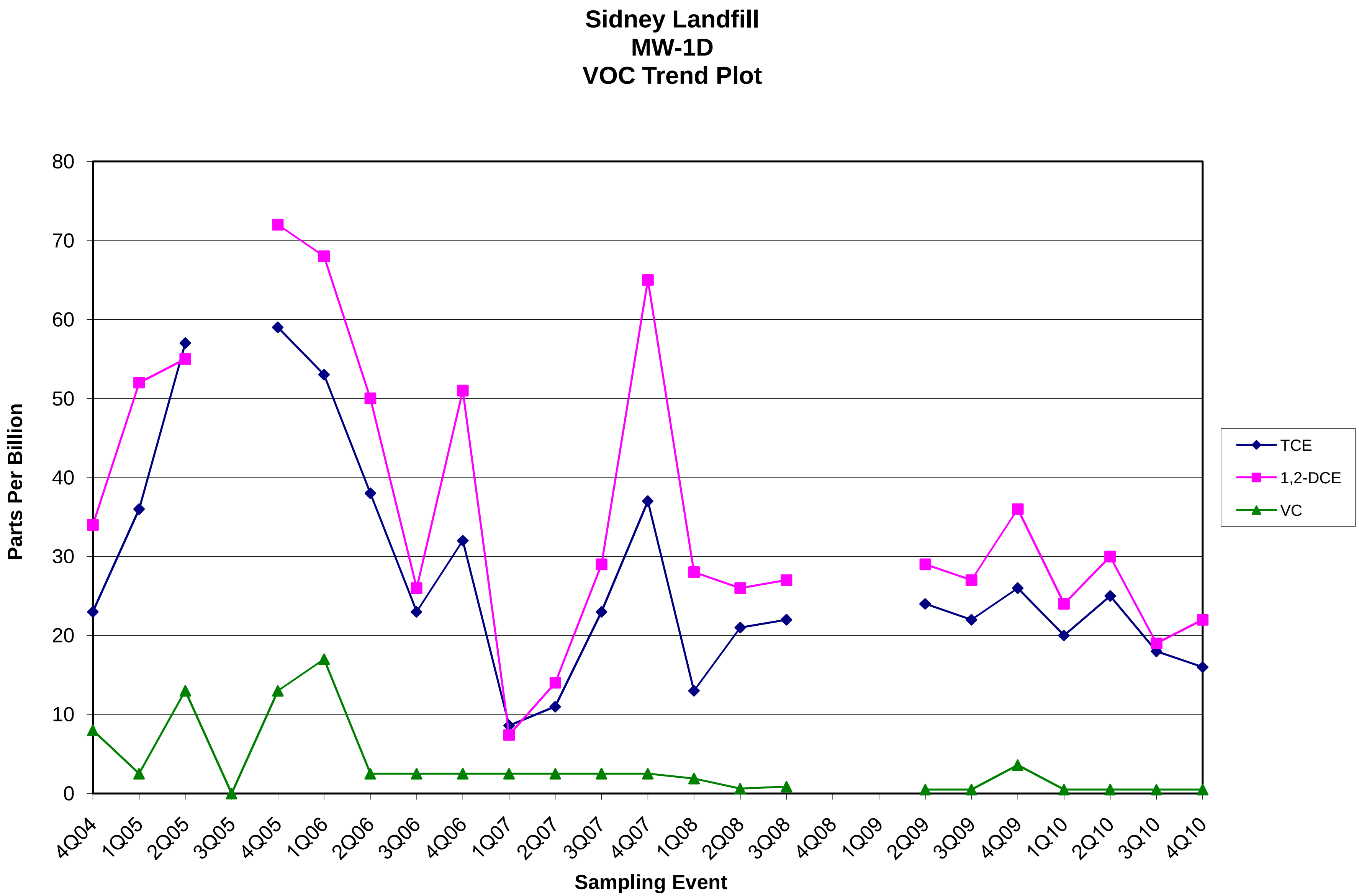
O'BRIEN & GERE

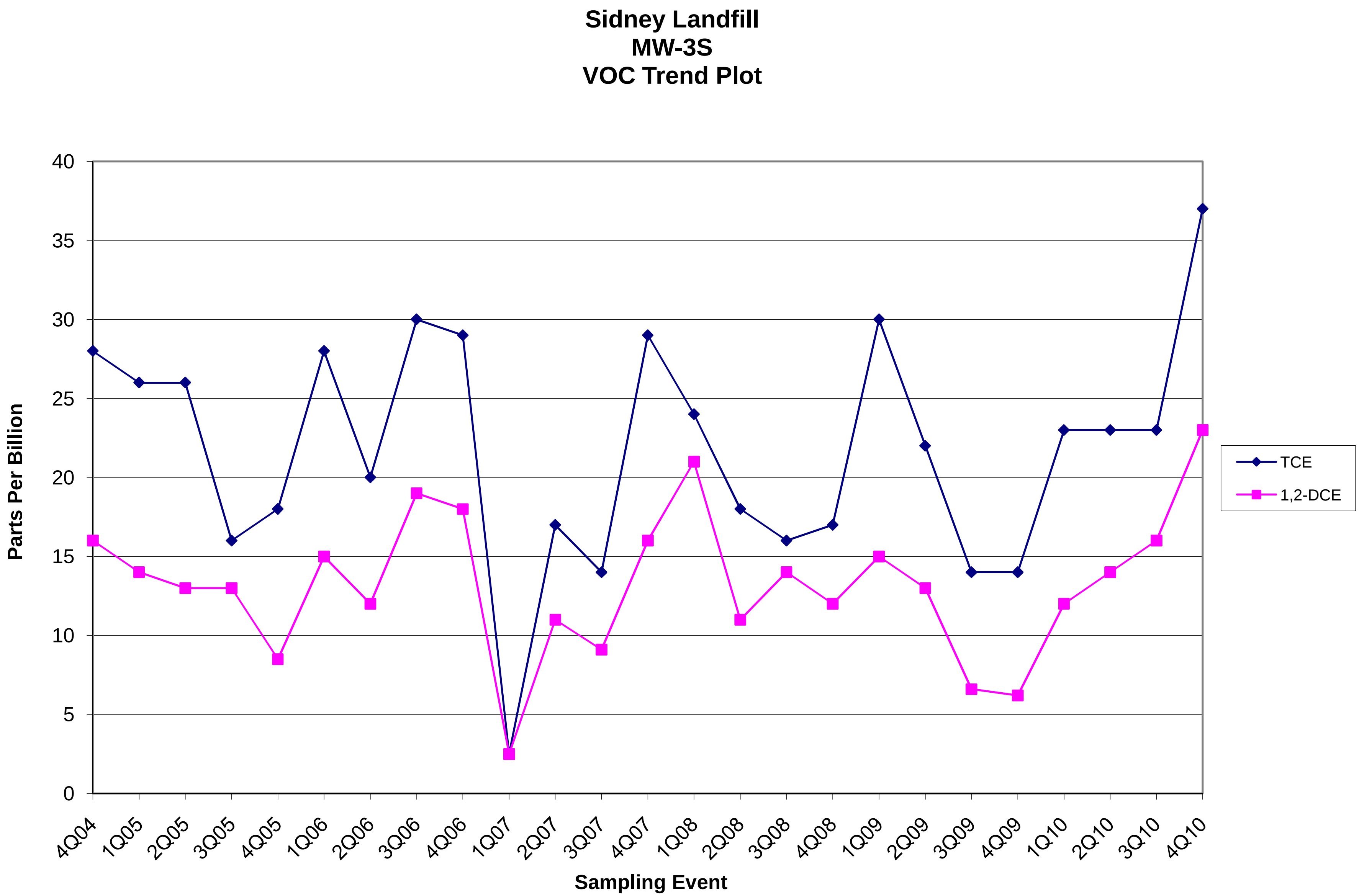
Treatment System Concretion

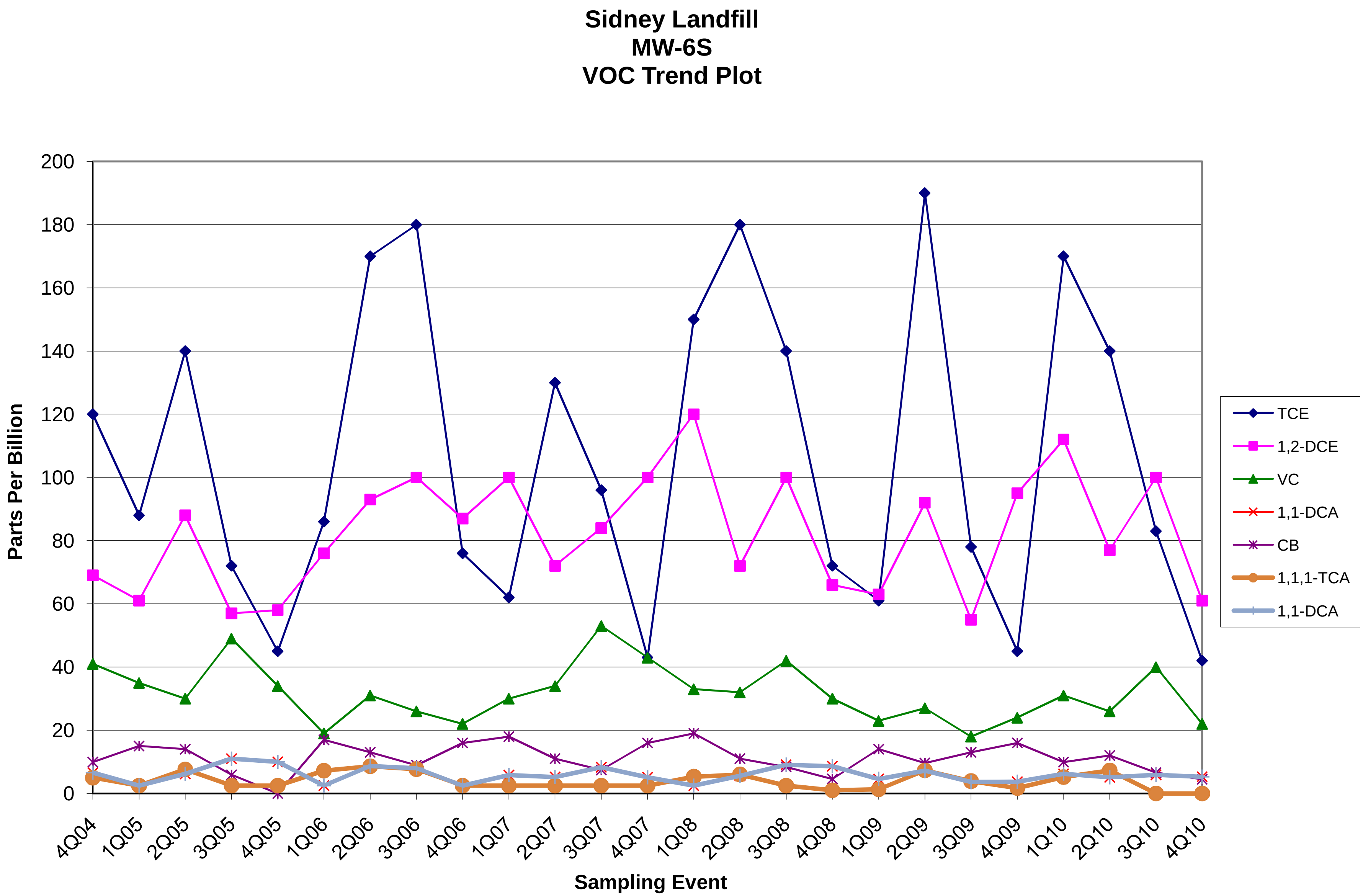
Figure 5-5. Treatment system concretion.

ATTACHMENT B

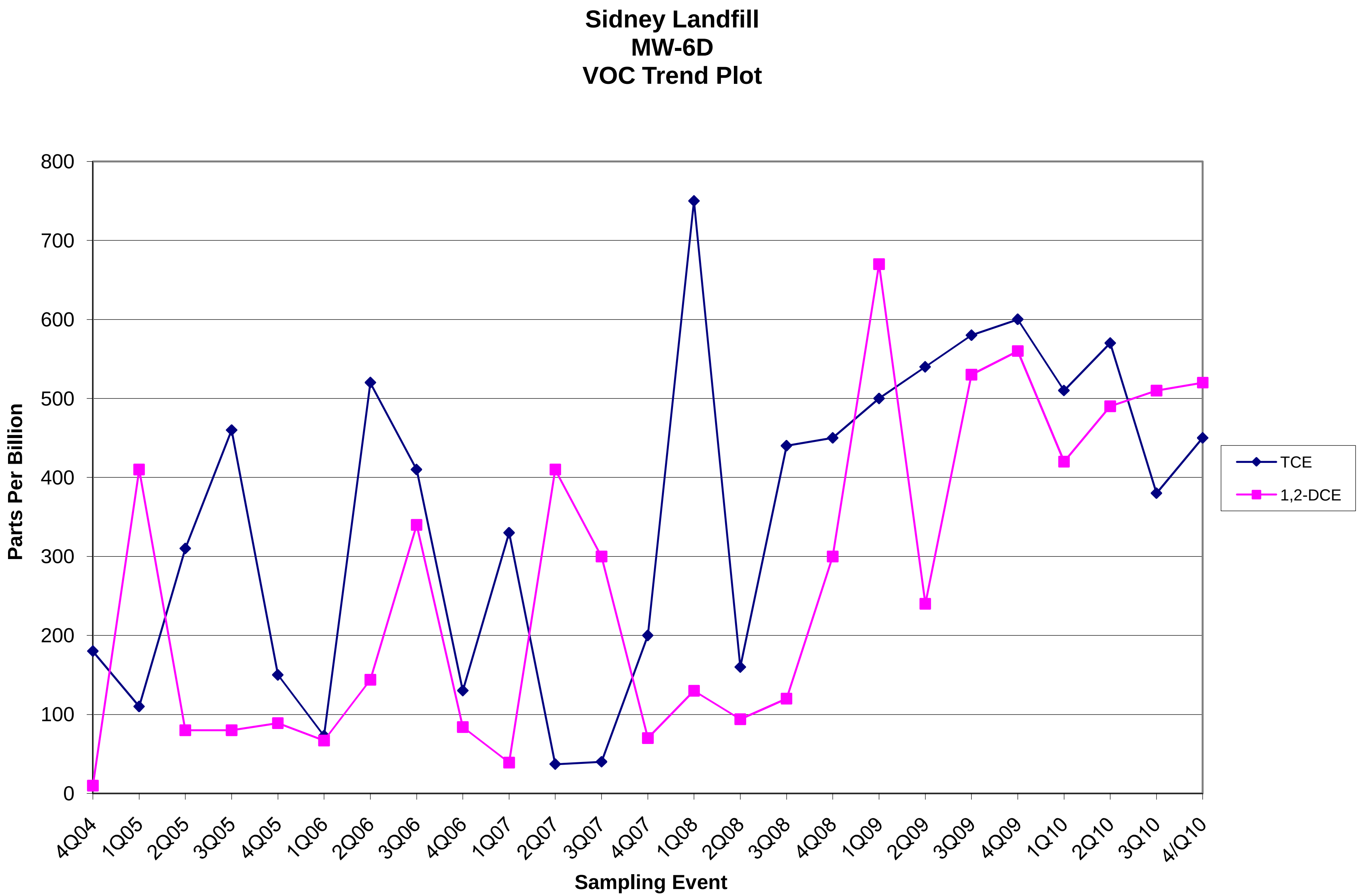
CVOC Trends in Sidney Landfill Monitoring Wells

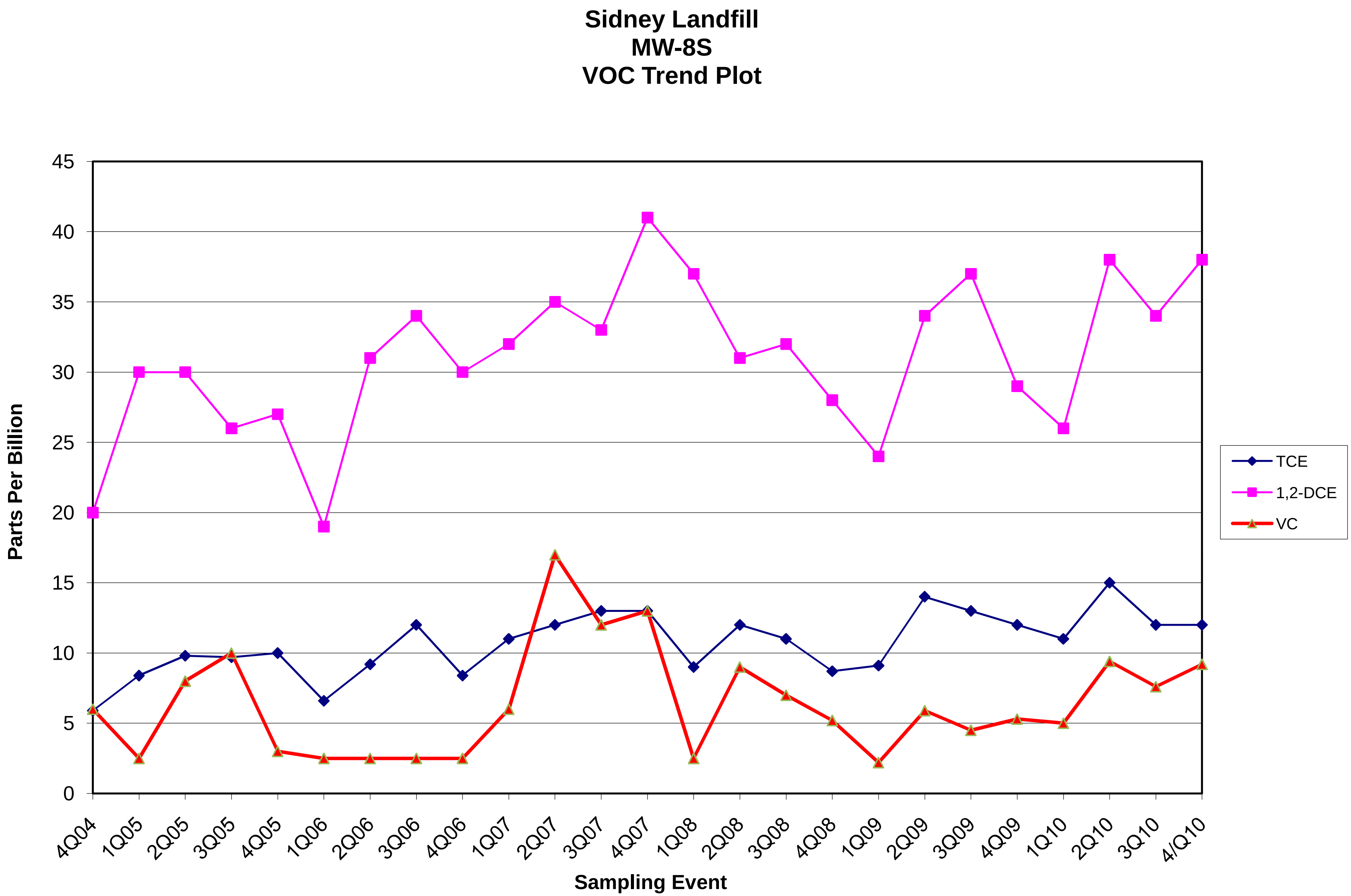

Sidney Landfill
MW-1D
VOC Trend Plot
Parts Per Billion
80
70
60
50
40
30
20
10
0
4Q04
1Q05
2Q05
3Q05
4Q05
1Q06
2Q06
3Q06
4Q06
1Q07
2Q07
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
Sampling Event
TCE
1,2-DCE
VC

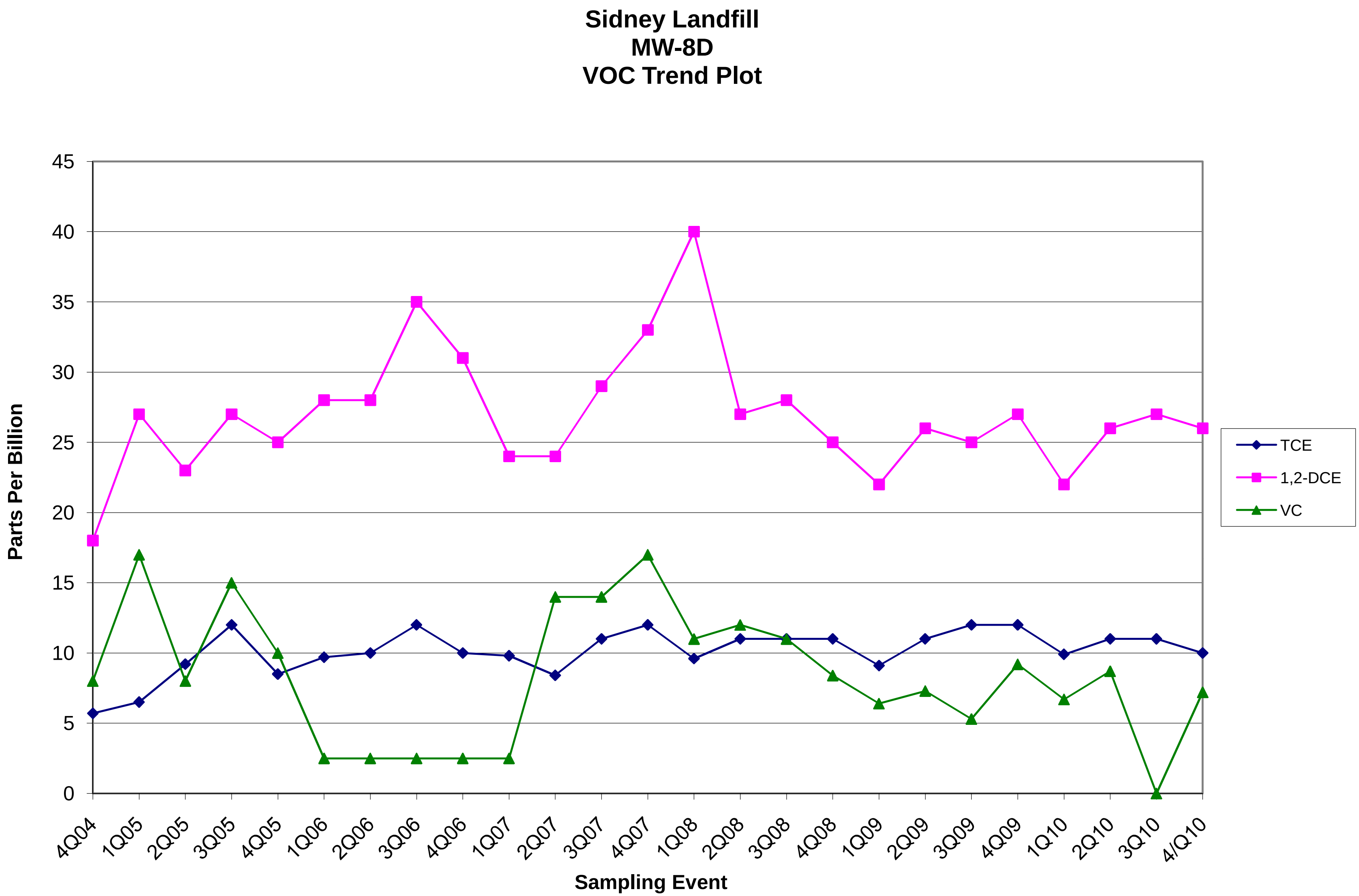

Sidney Landfill
MW-3S
VOC Trend Plot
Parts Per Billion
0
5
10
15
20
25
30
35
40
4Q04
1Q05
2Q05
3Q05
4Q05
1Q06
2Q06
3Q06
4Q06
1Q07
2Q07
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
Sampling Event
TCE
1,2-DCE



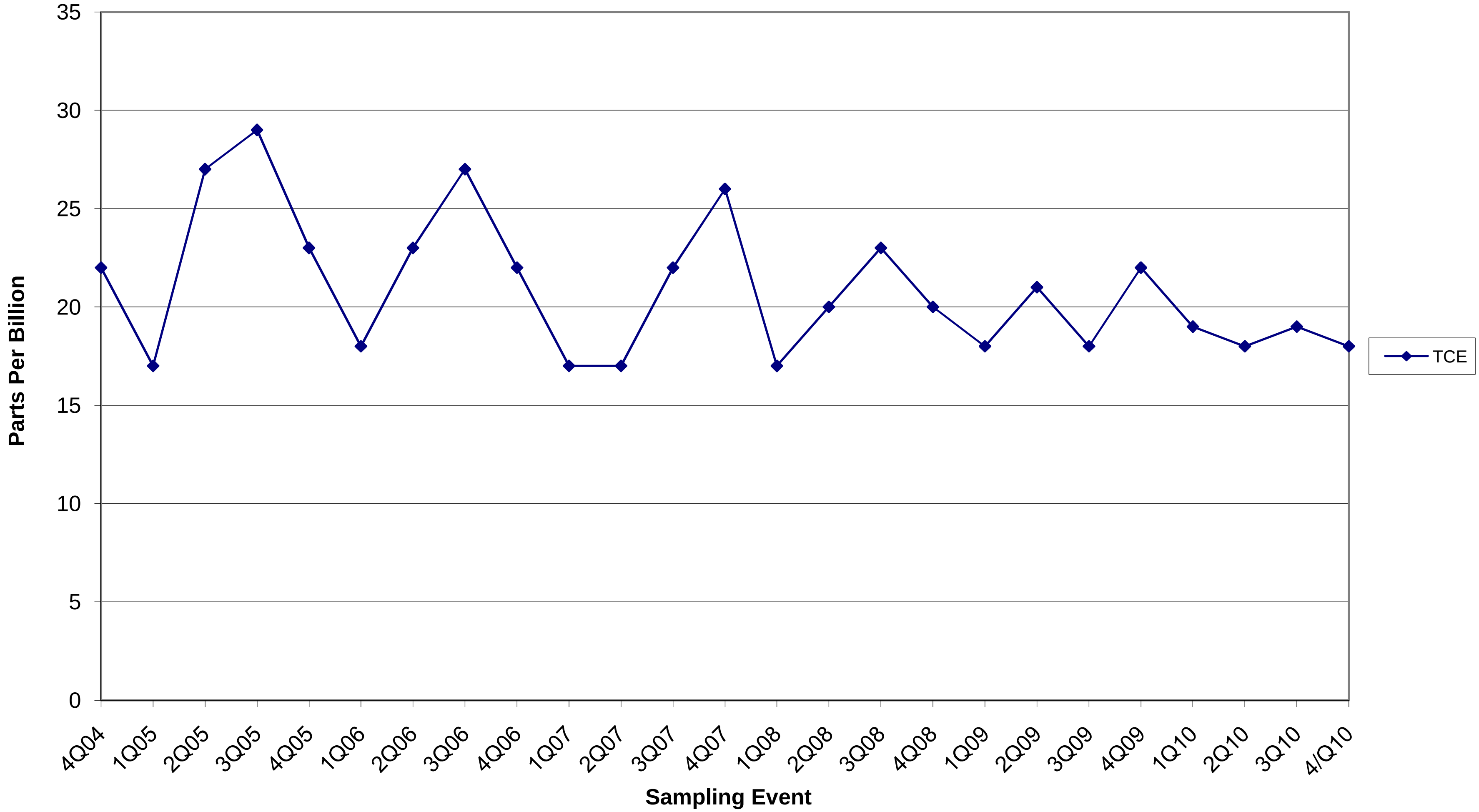
Sidney Landfill
MW-6S
VOC Trend Plot
Parts Per Billion
200
180
160
140
120
100
80
60
40
20
0
4Q04
1Q05
2Q05
3Q05
4Q05
1Q06
2Q06
3Q06
4Q06
1Q07
2Q07
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
Sampling Event
TCE
1,2-DCE
VC
1,1-DCA
CB
1,1,1-TCA
1,1-DCA

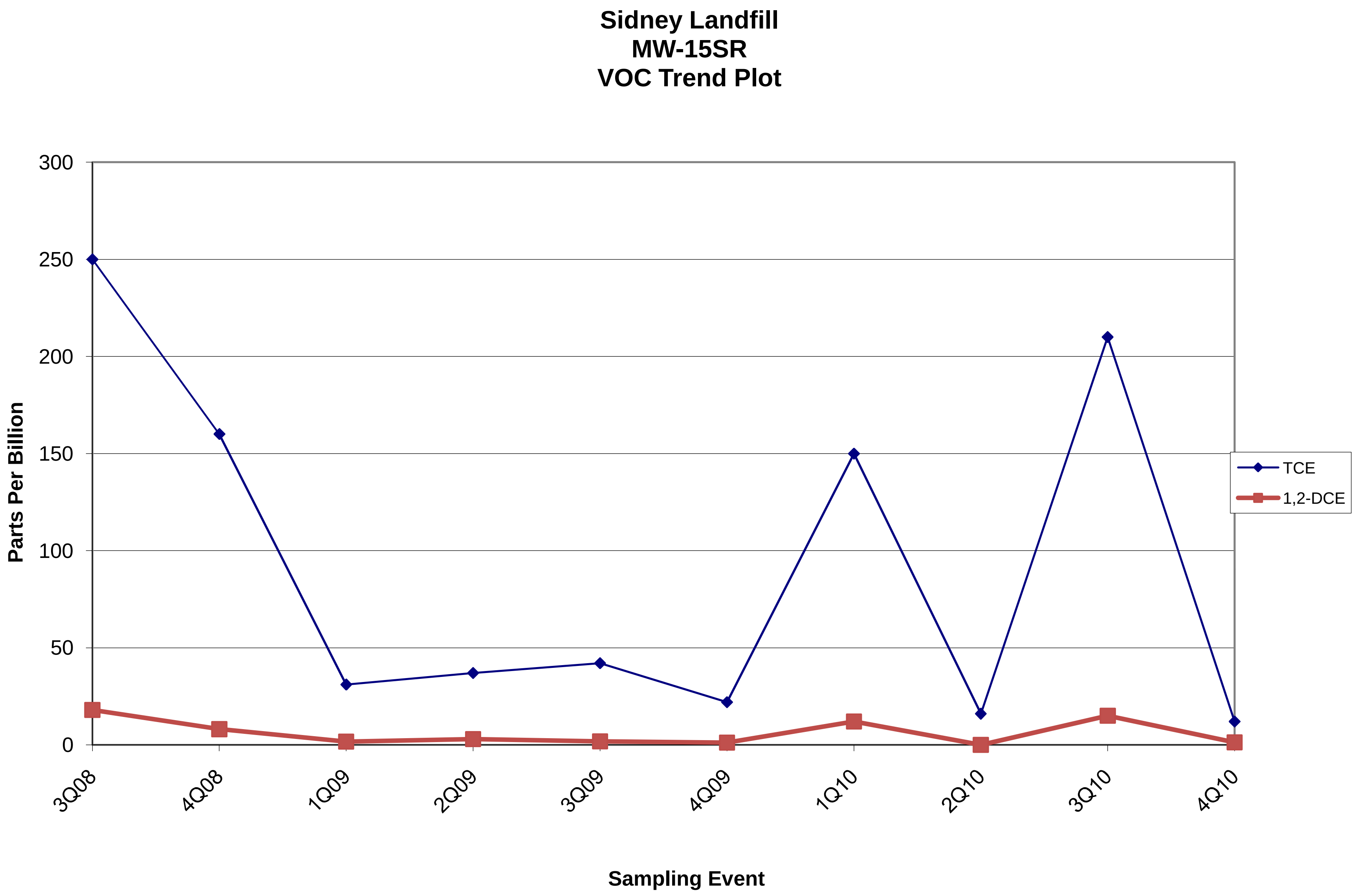

Sidney Landfill
MW-6D
VOC Trend Plot
Parts Per Billion
0
100
200
300
400
500
600
700
800
4Q04
1Q05
2Q05
3Q05
4Q05
1Q06
2Q06
3Q06
4Q06
1Q07
2Q07
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4/Q10
Sampling Event
TCE
1,2-DCE

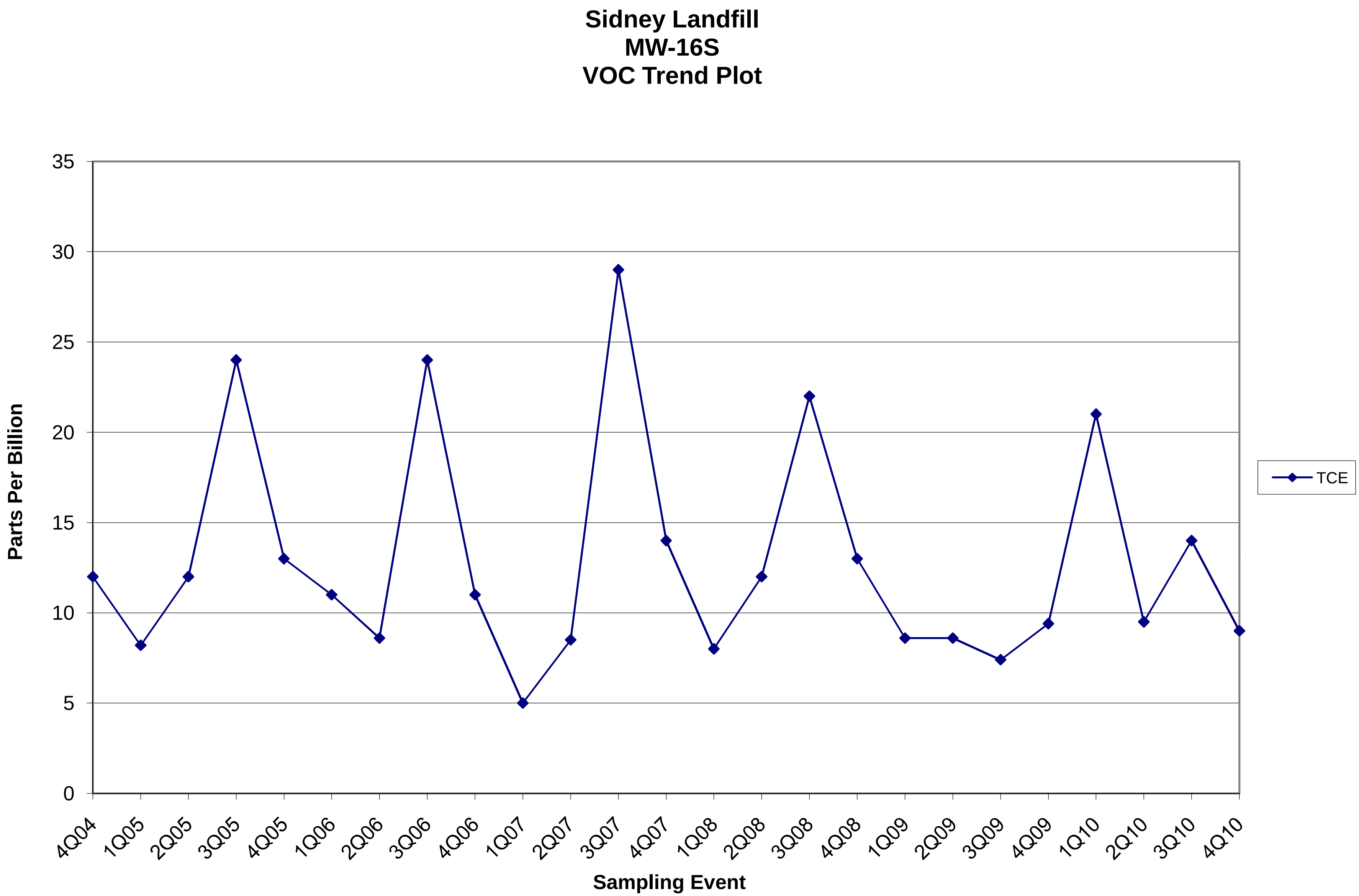

Sidney Landfill
MW-8S
VOC Trend Plot
Parts Per Billion
0
5
10
15
20
25
30
35
40
45
4Q04
1Q05
2Q05
3Q05
4Q05
1Q06
2Q06
3Q06
4Q06
1Q07
2Q07
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4/Q10
Sampling Event
TCE
1,2-DCE
VC

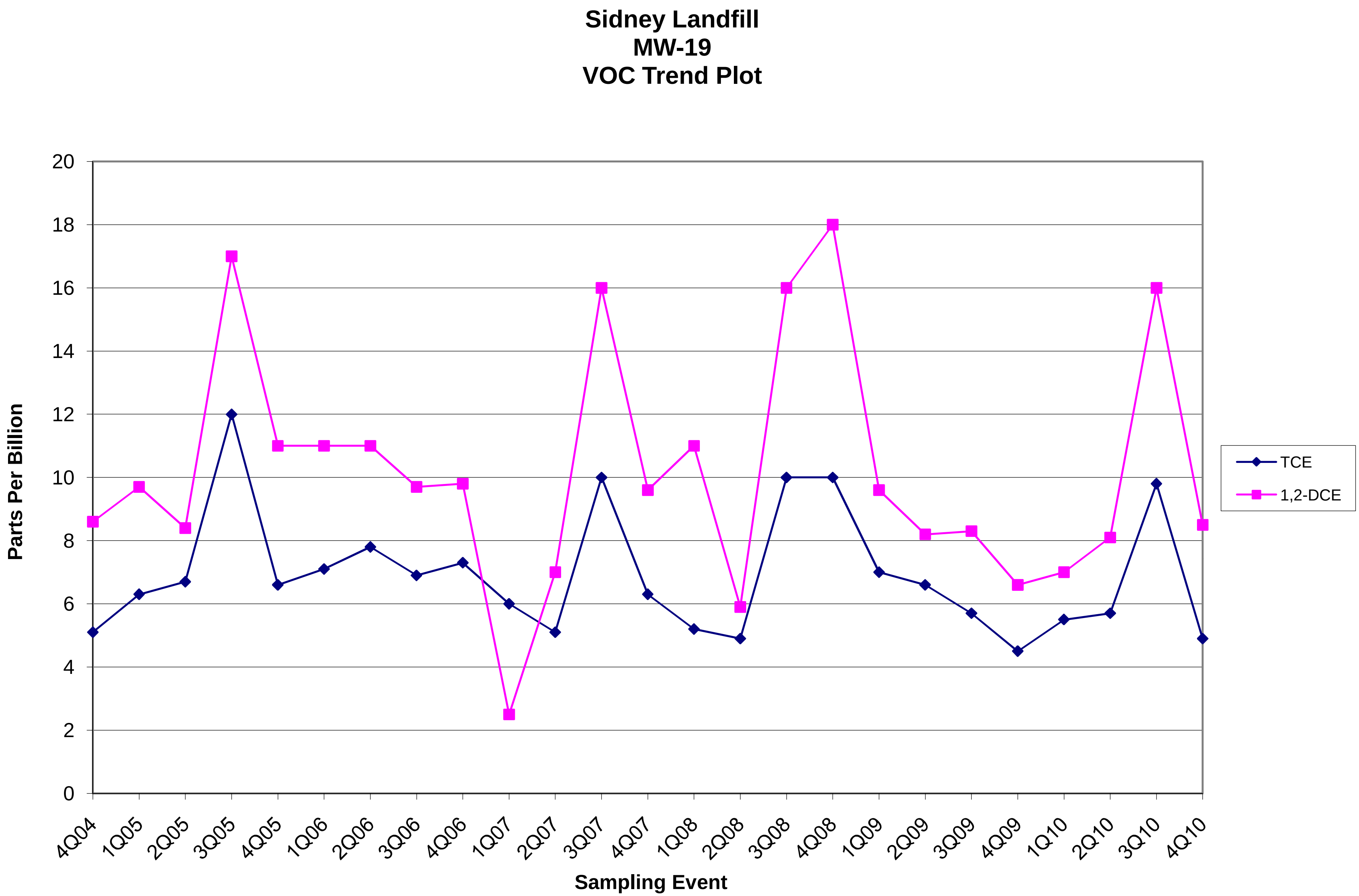

Sidney Landfill
MW-8D
VOC Trend Plot
Parts Per Billion
45
40
35
30
25
20
15
10
5
0
4Q04
1Q05
2Q05
3Q05
4Q05
1Q06
2Q06
3Q06
4Q06
1Q07
2Q07
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4/Q10
Sampling Event
TCE
1,2-DCE
VC

Sidney Landfill
MW-9S
VOC Trend Plot



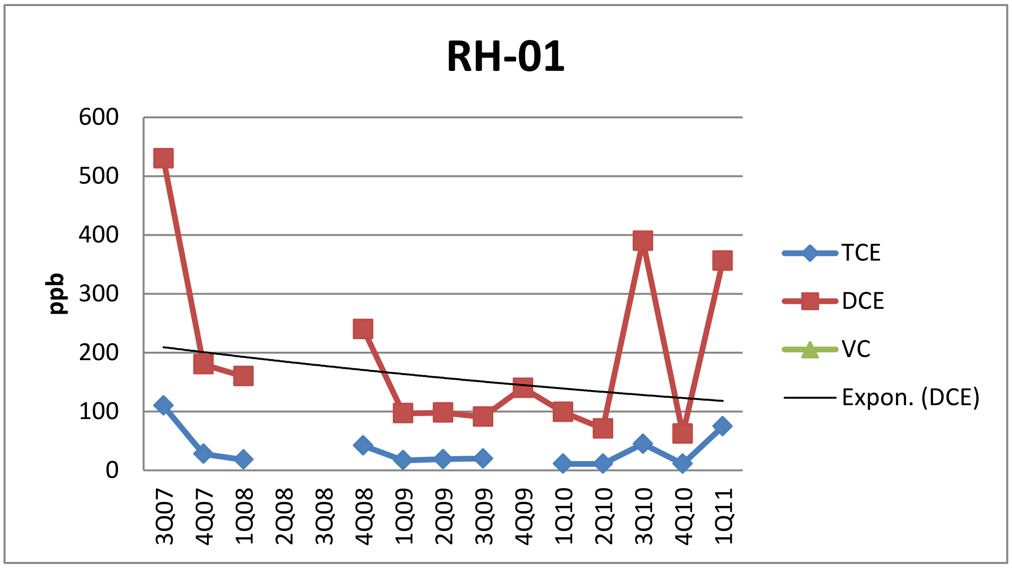

Sidney Landfill
MW-15SR
VOC Trend Plot
300
250
200
150
100
50
0
Parts Per Billion
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
Sampling Event
TCE
1,2-DCE

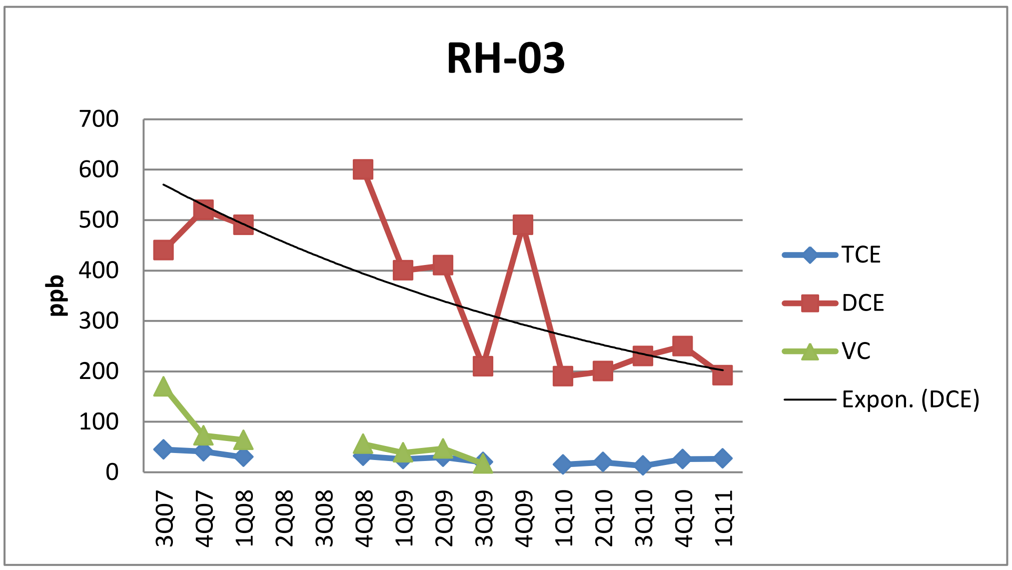

Sidney Landfill
MW-16S
VOC Trend Plot
Parts Per Billion
35
30
25
20
15
10
5
0
4Q04
1Q05
2Q05
3Q05
4Q05
1Q06
2Q06
3Q06
4Q06
1Q07
2Q07
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
Sampling Event
TCE

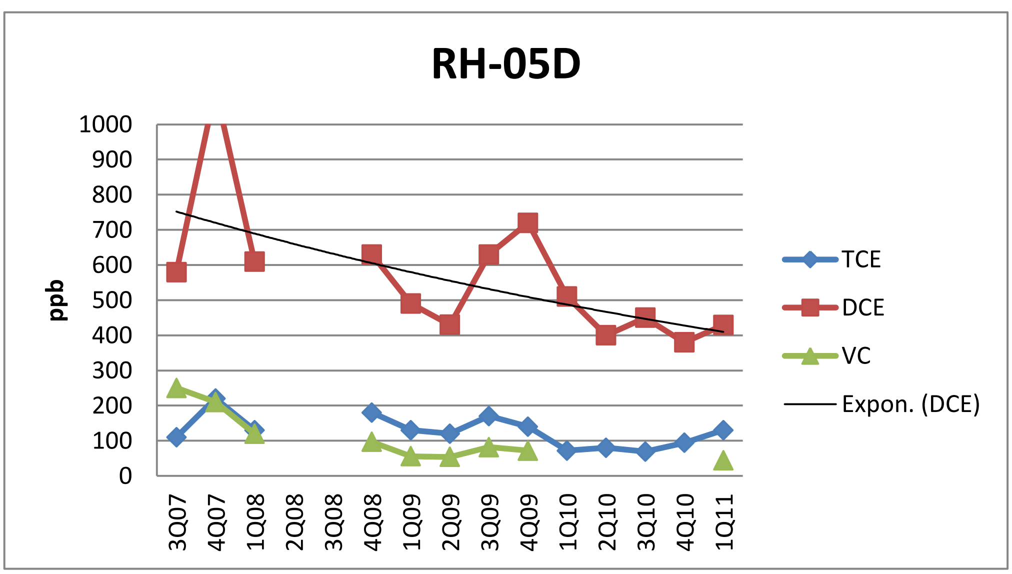

Sidney Landfill
MW-19
VOC Trend Plot
Parts Per Billion
0
2
4
6
8
10
12
14
16
18
20
4Q04
1Q05
2Q05
3Q05
4Q05
1Q06
2Q06
3Q06
4Q06
1Q07
2Q07
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
Sampling Event
TCE
1,2-DCE

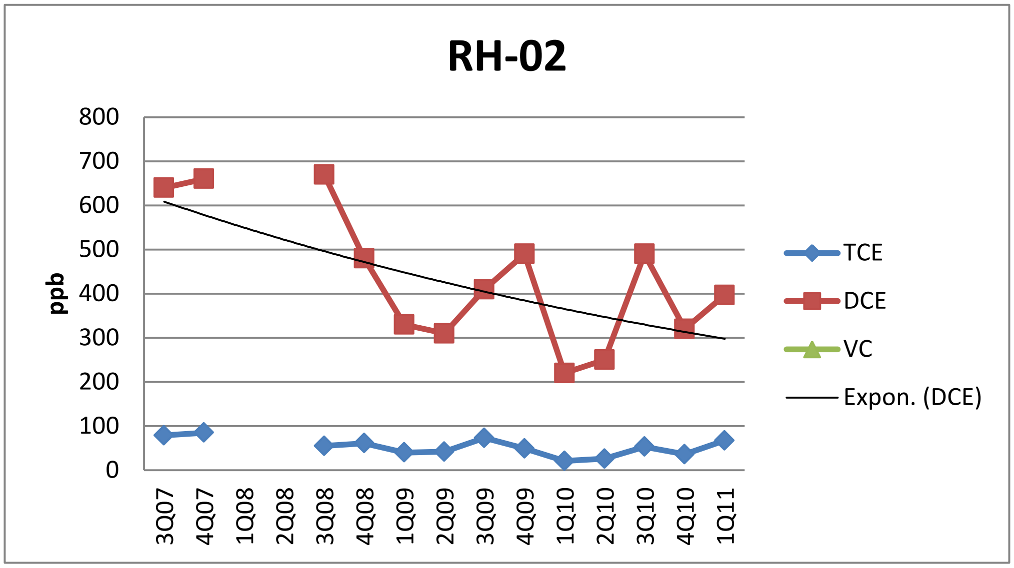
ATTACHMENT C

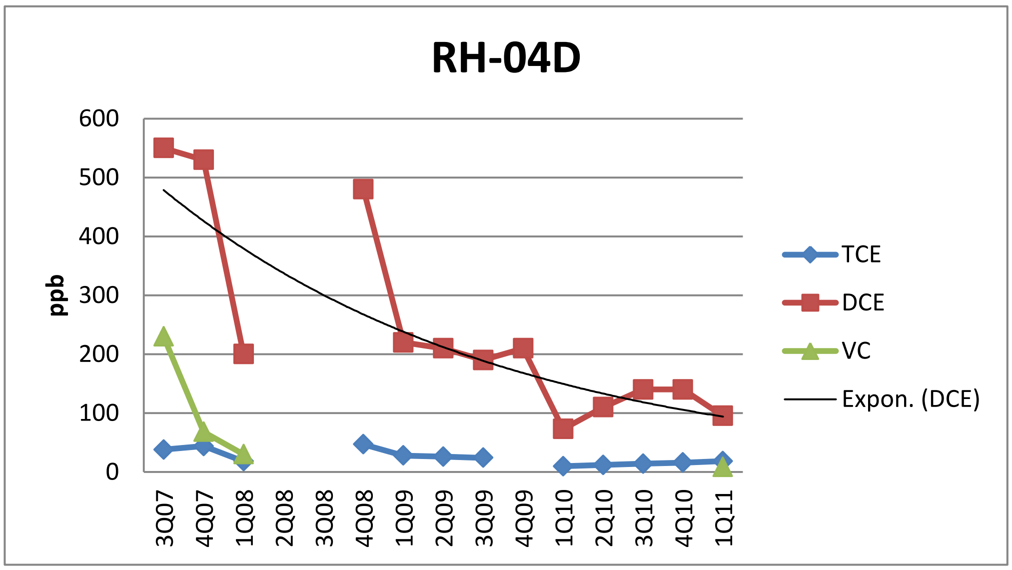
CVOC Trends in RHRL Monitoring Wells

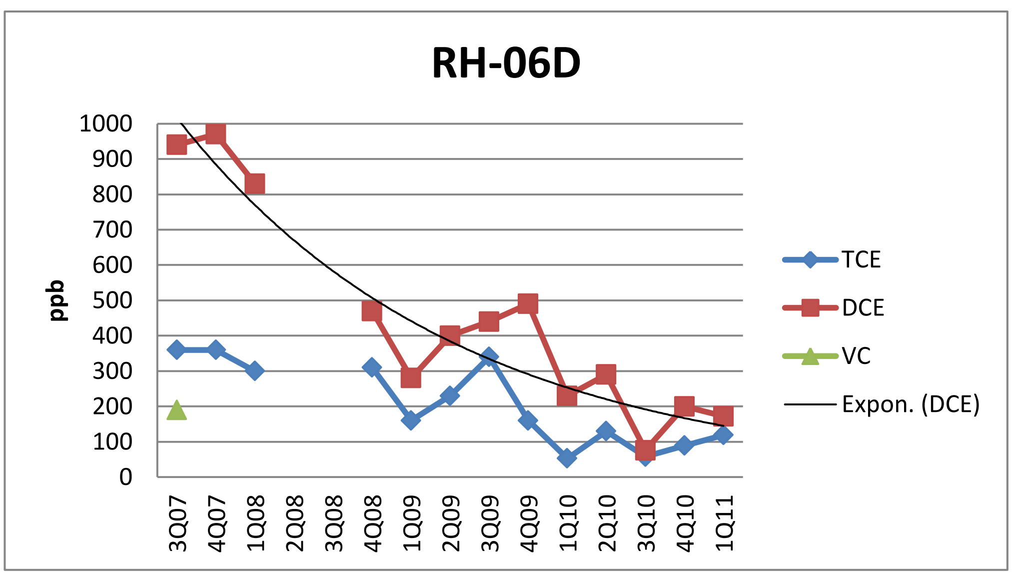

RH-01
600
500
400
300
200
100
0
ppb
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


RH-03
700
600
500
400
300
200
100
0
ppb
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


RH-05D
1000
900
800
700
600
500
400
300
200
100
0
ppb
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


RH-02
ppb
800
700
600
500
400
300
200
100
0
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


RH-04D
ppb
600
500
400
300
200
100
0
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


RH-06D
ppb
1000
900
800
700
600
500
400
300
200
100
0
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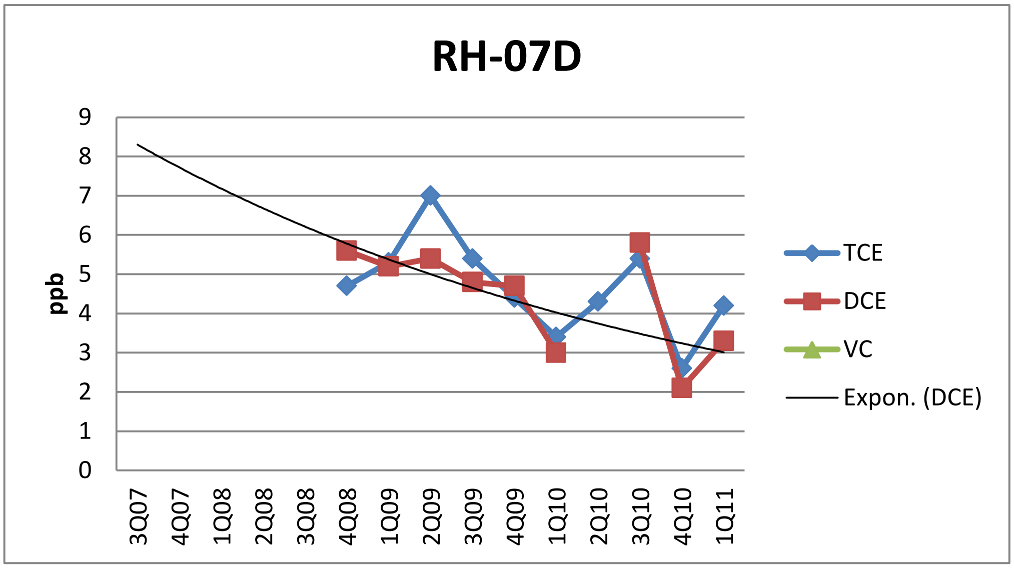
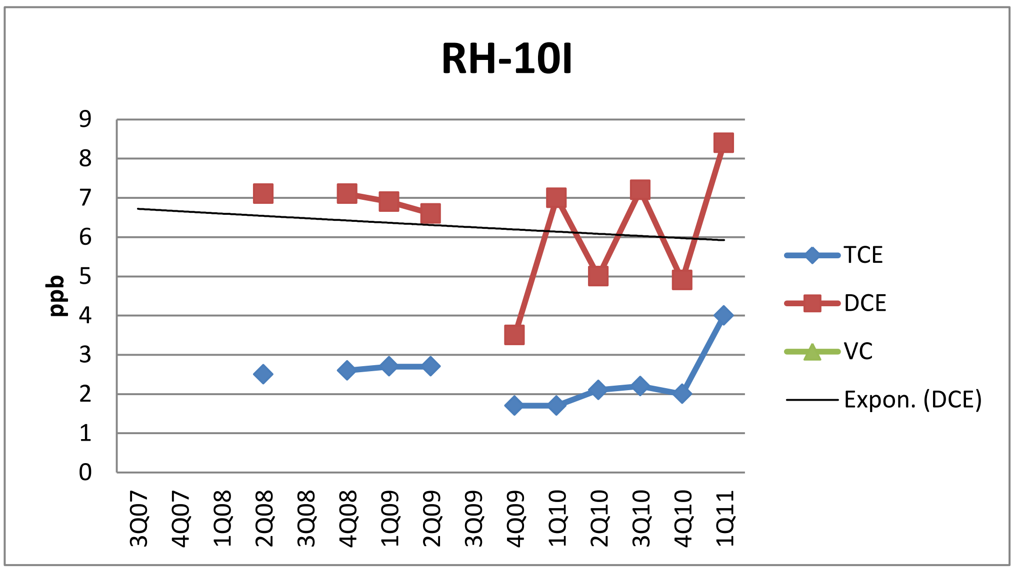
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


RH-07D
ppb
9
8
7
6
5
4
3
2
1
0
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


RH-10I
ppb
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8
7
6
5
4
3
2
1
0
3Q07
4Q07
1Q08
2Q08
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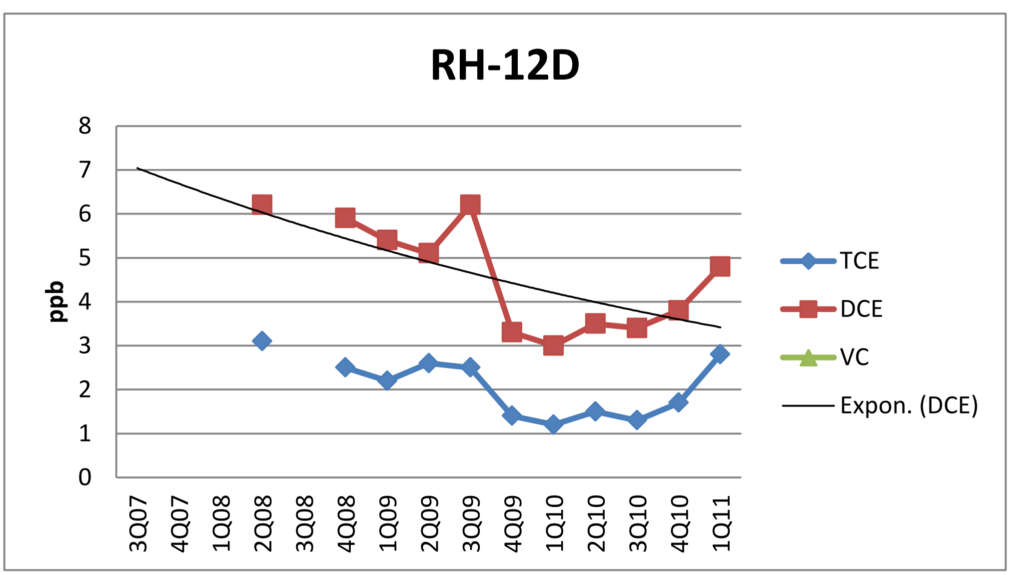
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


RH-12D
ppb
8
7
6
5
4
3
2
1
0
3Q07
4Q07
1Q08
2Q08
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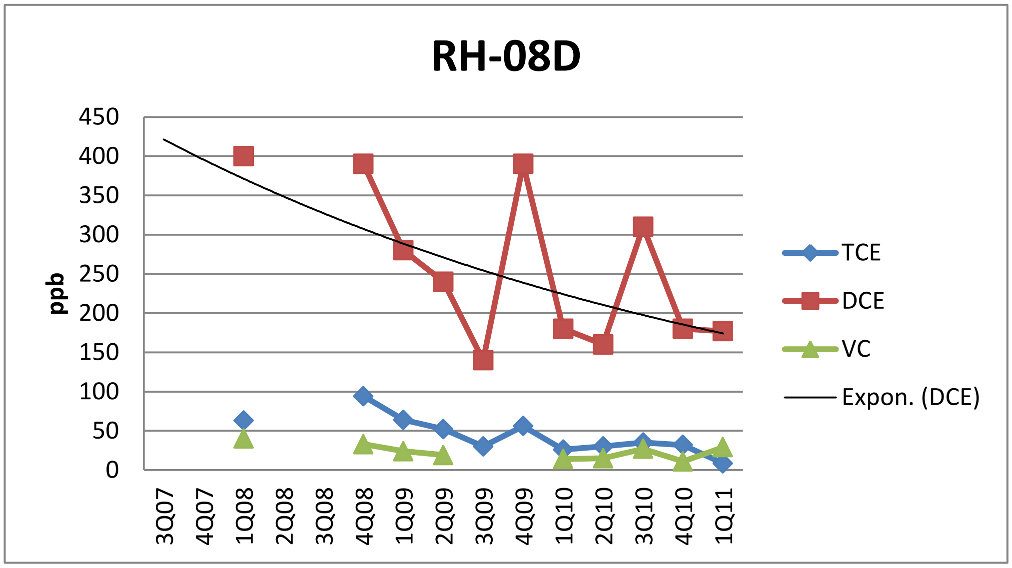
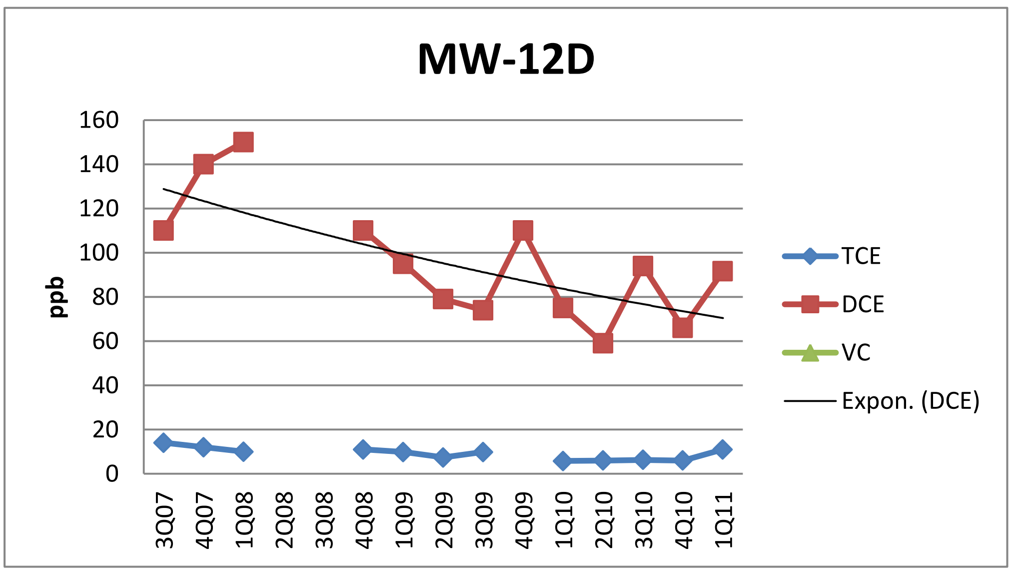
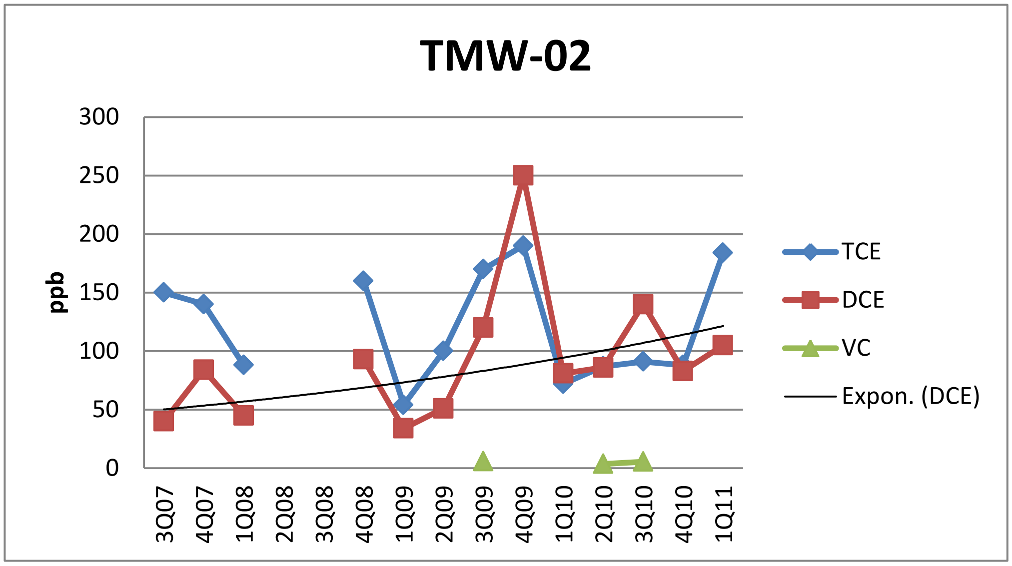
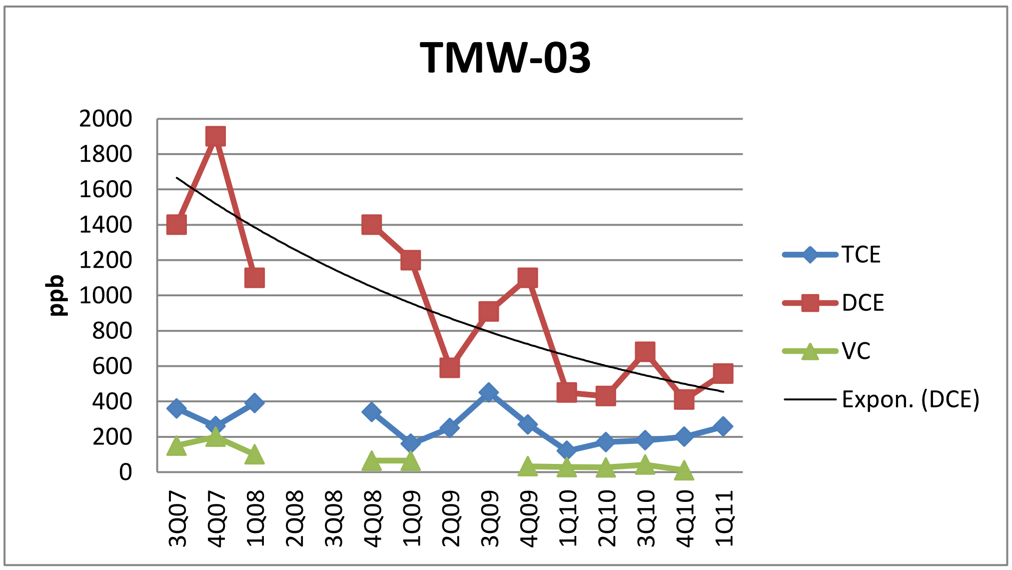
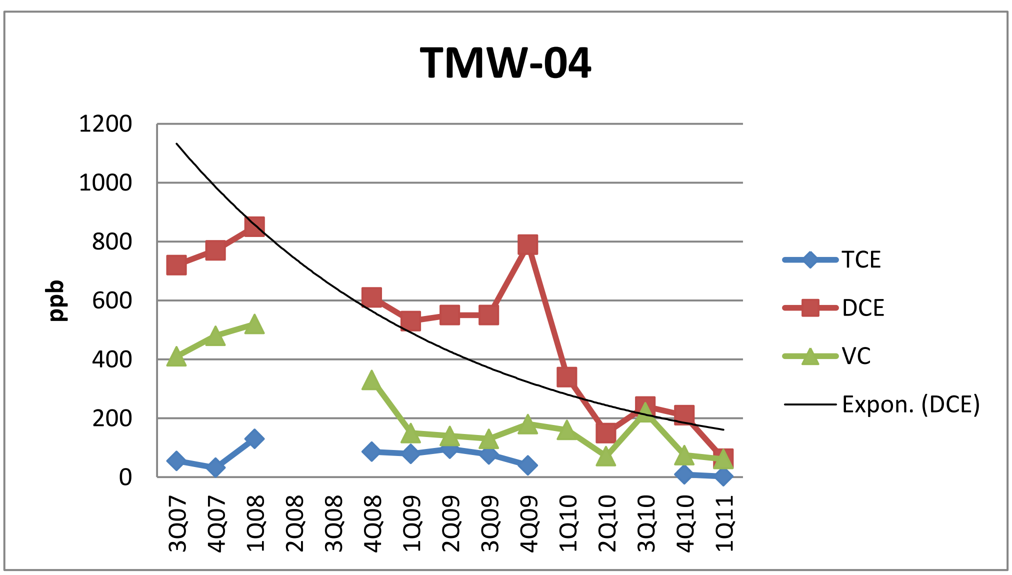
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)

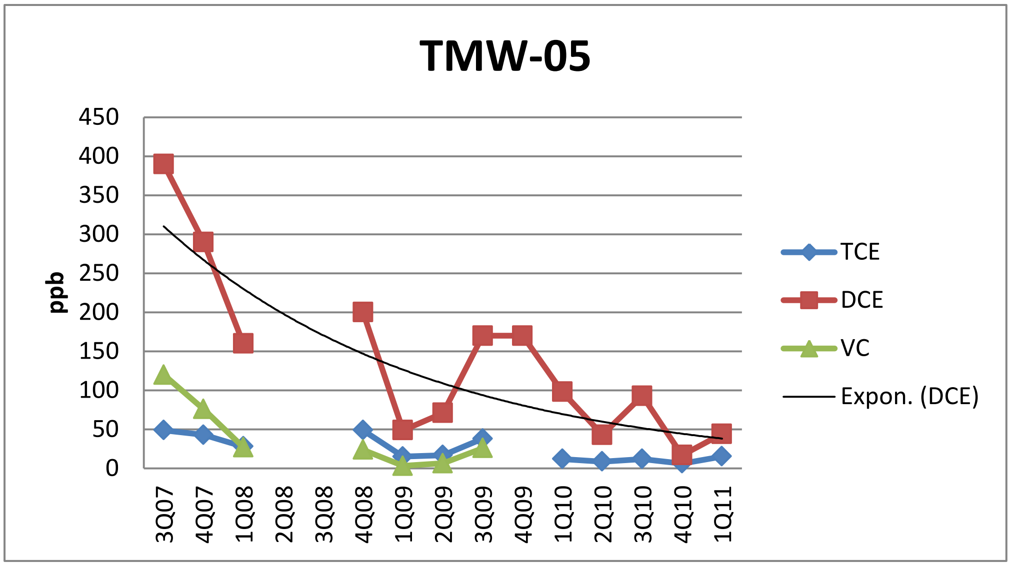

RH-08D
ppb
450
400
350
300
250
200
150
100
50
0
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)

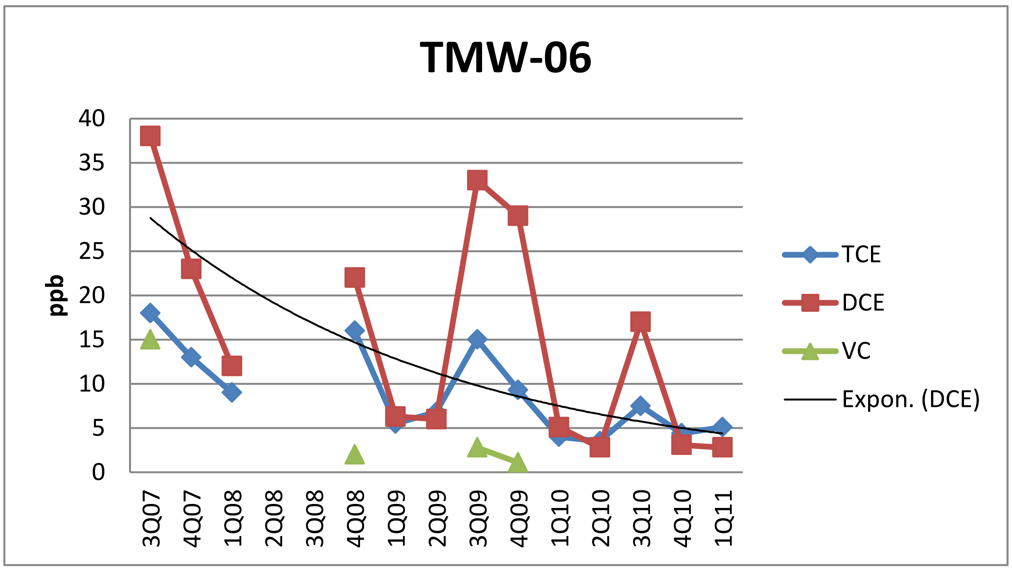

MW-12D
ppb
160
140
120
100
80
60
40
20
0
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


TMW-02
ppb
300
250
200
150
100
50
0
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


TMW-03
ppb
2000
1800
1600
1400
1200
1000
800
600
400
200
0
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


TMW-04
ppb
1200
1000
800
600
400
200
0
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


TMW-05
ppb
450
400
350
300
250
200
150
100
50
0
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


TMW-06
ppb
40
35
30
25
20
15
10
5
0
3Q07
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1Q08
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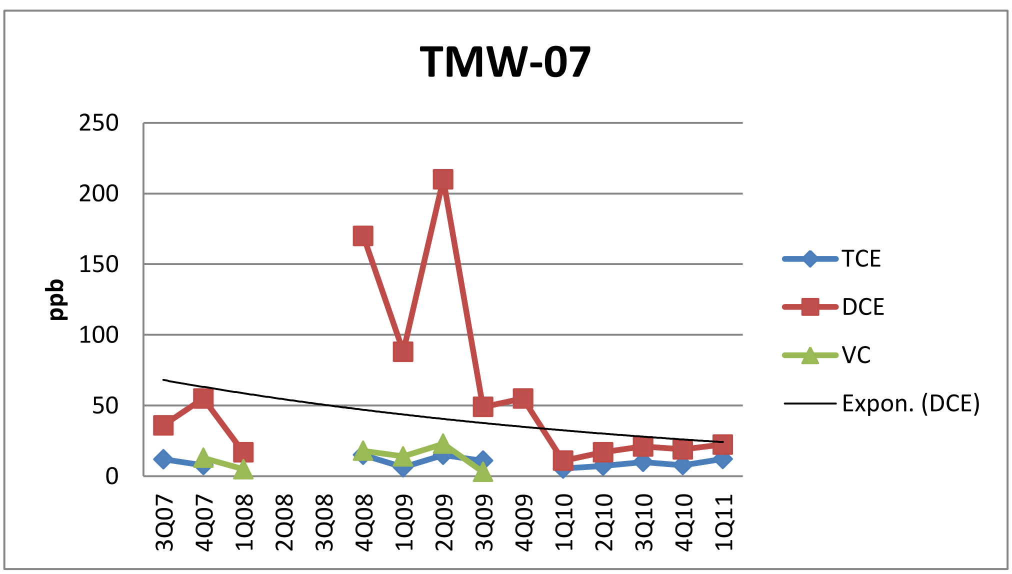
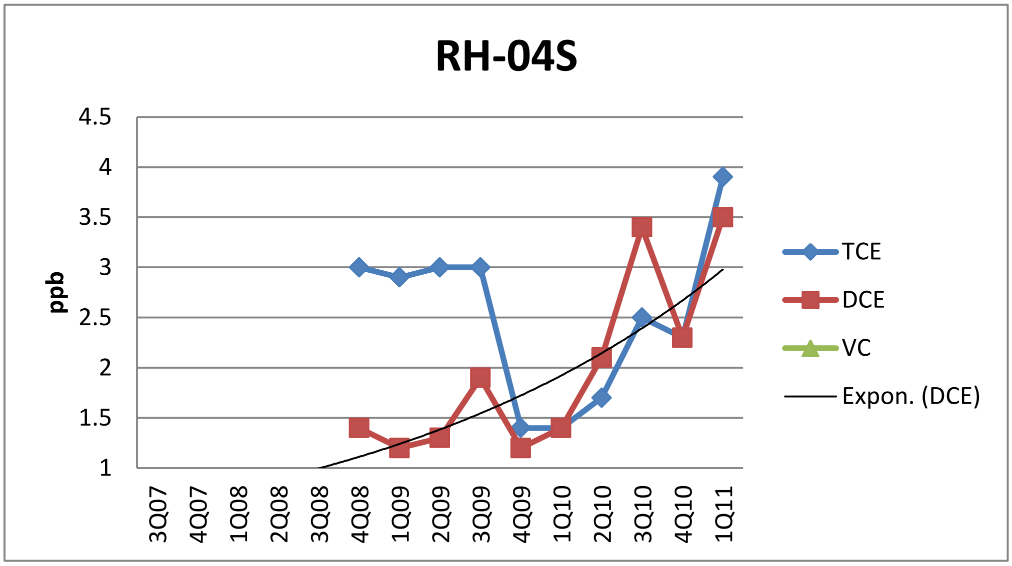
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


TMW-07
ppb
250
200
150
100
50
0
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


RH-04S
ppb
4.5
4
3.5
3
2.5
2
1.5
1
3Q07
4Q07
1Q08
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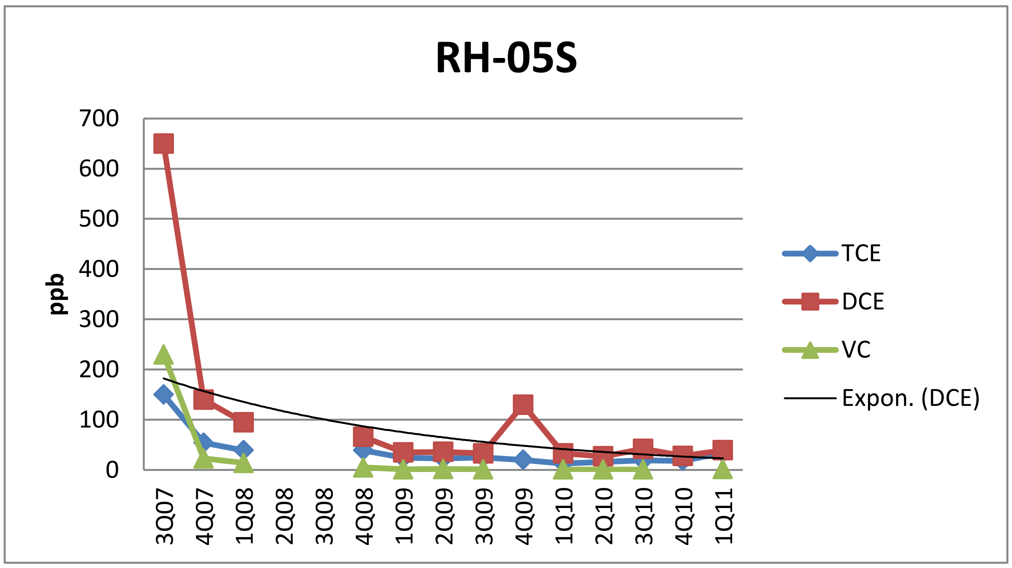
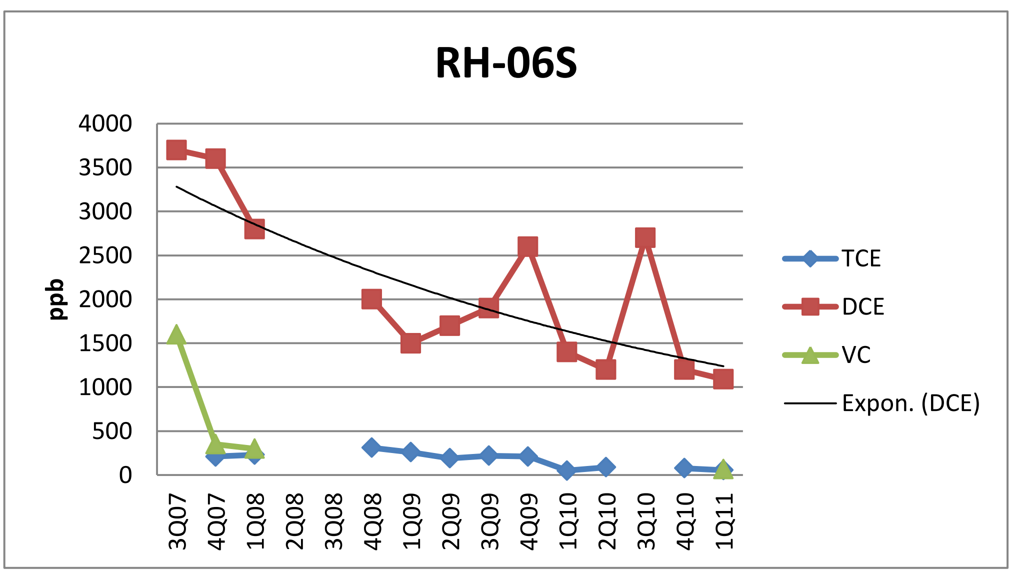
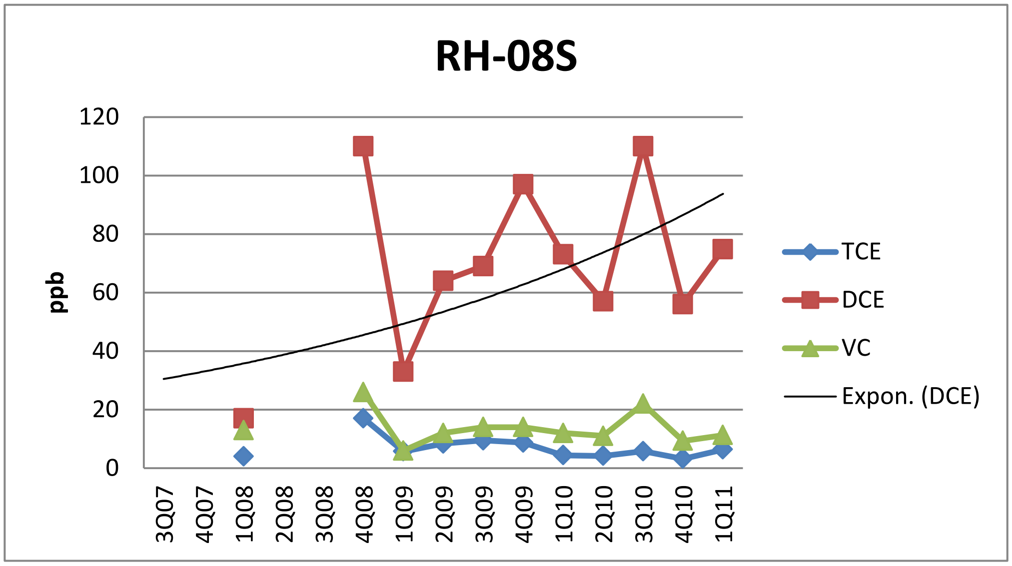
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


RH-05S
ppb
700
600
500
400
300
200
100
0
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


RH-06S
ppb
4000
3500
3000
2500
2000
1500
1000
500
0
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)


RH-08S
120
100
80
60
40
20
0
ppb
3Q07
4Q07
1Q08
2Q08
3Q08
4Q08
1Q09
2Q09
3Q09
4Q09
1Q10
2Q10
3Q10
4Q10
1Q11
TCE
DCE
VC
Expon. (DCE)

ATTACHMENT D

Extraction trench gradients

		IN	DG		IN	DG		IN	DG		IN	DG		IN	DG		IN	DG	
		TMW-01	TMW-02	Δ	SSC-01	TMW-03	Δ	SSC-02	TMW-04	Δ	SSC-03	TMW-05	Δ	SSC-04	TMW-06	Δ	TMW-08	TMW-07	Δ
4th Q 2009	10/5/09	1741.40	1741.89	-0.49	1740.81	1740.69	0.12	1740.79	1740.88	-0.09	1745.09	1745.09	0.00	1746.19	1745.87	0.32	1746.08	1746.12	-0.04
	10/12/09	1741.38	1741.89	-0.51	1740.74	1740.95	-0.21	1740.79	1740.86	-0.07	1745.09	1745.03	0.06	1746.19	1745.84	0.35	1746.16	1746.12	0.04
	10/19/09	1741.34	1741.84	-0.50	1740.75	1740.66	0.09	1740.75	1740.83	-0.08	1745.09	1744.98	0.11	1746.19	1745.83	0.36	1746.21	1746.14	0.07
	10/27/09	1742.90	1743.40	-0.50	1741.32	1741.46	-0.14	1741.57	1741.92	-0.35	1745.20	1745.45	-0.25	1746.23	1746.13	0.10	1746.17	1746.12	0.05
	11/3/09	1743.79	1744.39	-0.60	1742.61	1742.71	-0.10	1742.77	1742.95	-0.18	1745.29	1745.65	-0.36	1746.28	1746.19	0.09	1746.23	1746.15	0.08
	11/9/09	1742.59	1743.19	-0.60	1741.90	1741.82	0.08	1742.04	1742.23	-0.19	1745.24	1745.53	-0.29	1746.25	1746.02	0.23	1746.20	1746.12	0.08
	11/16/09	1741.50	1742.07	-0.57	1740.97	1740.76	0.21	1740.96	1741.23	-0.27	1745.19	1745.14	0.05	1746.18	1745.87	0.31	1746.05	1746.03	0.02
	11/25/09	1741.66	1742.28	-0.62	1741.07	1740.86	0.21	1741.09	1741.40	-0.31	1745.19	1745.44	-0.25	1746.20	1745.96	0.24	1746.15	1746.08	0.07
	11/30/09	1741.61	1742.19	-0.58	1741.00	1740.86	0.14	1740.95	1741.25	-0.30	1745.19	1745.38	-0.19	1746.19	1746.00	0.19	1746.14	1746.08	0.06
	12/7/09	1743.45	1743.99	-0.54	1742.50	1742.64	-0.14	1742.76	1742.88	-0.12	1745.22	1745.57	-0.35	1746.23	1745.98	0.25	1746.06	1746.02	0.04
	12/17/09	1743.96	1744.58	-0.62	1742.97	1742.91	0.06	1742.50	1742.88	-0.38	1745.25	1745.79	-0.54	1746.19	1746.27	-0.08	1746.06	1745.99	0.07
	12/21/09	1743.56	1744.09	-0.53	1742.97	1742.88	0.09	1743.02	1743.12	-0.10	1745.26	1745.73	-0.47	1746.24	1746.06	0.18	1746.16	1746.07	0.09
	12/28/09	1743.81	1744.34	-0.53	1742.95	1742.90	0.05	1742.90	1743.02	-0.12	1745.33	1745.68	-0.35	1746.29	1746.22	0.07	1746.17	1746.13	0.04
4th Q 2010	10/4/10	1744.42	1745.01	-0.59	1742.96	1743.09	-0.13	1742.84	1743.14	-0.30	1745.19	1746.68	-1.49	1746.37	1746.40	-0.03	1746.17	1746.13	0.04
	10/12/10	1743.96	1744.56	-0.60	1742.80	1742.71	0.09	1742.69	1742.93	-0.24	1745.29	1746.12	-0.83	1746.35	1746.28	0.07	1746.21	1746.13	0.08
	10/18/10	1743.88	1744.49	-0.61	1742.85	1742.73	0.12	1742.54	1742.92	-0.38	1745.30	1745.97	-0.67	1746.37	1746.32	0.05	1746.20	1746.07	0.13
	10/25/10	1743.62	1744.26	-0.64	1742.85	1742.76	0.09	1742.54	1742.93	-0.39	1745.31	1745.76	-0.45	1746.33	1746.14	0.19	1746.16	1746.12	0.04
	11/2/10	1744.16	1744.79	-0.63	1743.05	1742.99	0.06	1742.69	1742.93	-0.24	1745.34	1746.13	-0.79	1746.35	1746.21	0.14	1746.21	1746.12	0.09
	11/9/10	1744.06	1744.67	-0.61	1743.11	1743.01	0.10	1742.79	1743.02	-0.23	1745.39	1745.88	-0.49	1746.34	1746.27	0.07	1746.20	1746.12	0.08
	11/15/10	1743.60	1744.15	-0.55	1742.81	1742.68	0.13	1742.56	1742.79	-0.23	1745.34	1745.88	-0.54	1746.30	1746.09	0.21	1746.17	1746.12	0.05
	11/22/10	1743.71	1744.28	-0.57	1742.91	1742.82	0.09	1742.79	1742.93	-0.14	1745.69	1746.13	-0.44	1747.39	1747.12	0.27	1747.56	1747.52	0.04
	11/29/10	1744.01	1744.57	-0.56	1743.05	1742.96	0.09	1742.58	1742.93	-0.35	1745.29	1745.98	-0.69	1746.34	1746.30	0.04	1746.21	1746.13	0.08
	12/6/10	1744.86	1745.44	-0.58	1743.63	1743.51	0.12	1742.68	1743.13	-0.45	1745.38	1746.38	-1.00	1746.39	1746.42	-0.03	1746.21	1746.14	0.07
	12/13/10	1744.76	1745.38	-0.62	1743.60	1743.51	0.09	1742.93	1743.23	-0.30	1745.40	1746.31	-0.91	1746.47	1746.61	-0.14	1746.26	1746.23	0.03
	12/20/10	1744.17	1744.79	-0.62	1743.24	1743.16	0.08	1742.65	1743.03	-0.38	1745.34	1746.14	-0.80	1746.40	1746.27	0.13	1746.16	1746.12	0.04
	12/28/10	1743.60	1744.09	-0.49	1742.90	1742.80	0.10	1742.79	1742.88	-0.09	1745.28	1745.98	-0.70	1746.35	1746.02	0.33	1746.21	1746.12	0.09
1st Q 2011	1/3/11	1744.06	1744.54	-0.48	1743.15	1743.00	0.15	1742.69	1742.92	-0.23	1745.36	1745.78	-0.42	1746.44	1746.32	0.12	1746.24	1746.18	0.06
	1/10/11	1743.63	1744.09	-0.46	1742.96	1742.86	0.10	1742.85	1742.93	-0.08	1745.28	1745.68	-0.40	1746.31	1746.07	0.24	1746.16	1746.12	0.04
	1/17/11	1743.52	1743.94	-0.42	1742.94	1742.81	0.13	1742.84	1742.83	0.01	1745.29	1745.62	-0.33	1746.30	1745.97	0.33	1746.16	1746.12	0.04
	1/25/11	1743.69	1744.09	-0.40	1743.00	1742.90	0.10	1742.89	1742.83	0.06	1745.29	1745.57	-0.28	1746.37	1746.12	0.25	1746.25	1746.22	0.03
	1/31/11	1743.58	1743.98	-0.40	1743.00	1742.89	0.11	1742.93	1742.83	0.10	1745.29	1745.48	-0.19	1746.25	1745.93	0.32	1746.07	1746.04	0.03
	2/7/11	1743.90	1744.34	-0.44	1743.17	1743.06	0.11	1743.03	1742.90	0.13	1745.37	1745.54	-0.17	1746.39	1746.27	0.12	1746.26	1746.23	0.03
	2/14/11	1743.81	1744.24	-0.43	1743.15	1743.01	0.14	1742.86	1742.90	-0.04	1745.35	1745.76	-0.41	1746.39	1746.24	0.15	1746.26	1746.16	0.10
	2/23/11	1744.71	1745.27	-0.56	1743.76	1743.71	0.05	1743.15	1743.28	-0.13	1745.38	1746.18	-0.80	1746.41	1746.47	-0.06	1746.18	1746.15	0.03
	3/1/11	1745.02	1745.58	-0.56	1743.92	1743.81	0.11	1742.99	1743.40	-0.41	1745.46	1746.13	-0.67	1746.49	1746.63	-0.14	1746.23	1746.15	0.08
	3/8/11	1747.25	1747.67	-0.42	1746.14	1746.02	0.12	1744.89	1745.14	-0.25	1745.54	1746.78	-1.24	1746.59	1747.03	-0.44	1746.26	1746.17	0.09
	3/14/11	1748.43	1748.79	-0.36	1747.50	1747.29	0.21	1746.35	1746.41	-0.06	1746.10	1747.38	-1.28	1746.68	1747.12	-0.44	1746.27	1746.22	0.05
	3/21/11	1748.79	1749.06	-0.27	1747.92	1747.69	0.23	1746.83	1746.83	0.00	1746.56	1747.68	-1.12	1746.79	1747.13	-0.34	1746.42	1746.36	0.06
	3/28/11	1746.56	1747.07	-0.51	1745.89	1745.76	0.13	1744.94	1745.13	-0.19	1745.51	1747.28	-1.77	1746.60	1746.66	-0.06	1746.21	1746.17	0.04

-0.56	Indicates inward gradient toward trench
0.21	Indicates outward gradient away from trench