THIRD FIVE-YEAR REVIEW REPORT FOR PARKER LANDFILL SUPERFUND SITE TOWN OF LYNDON CALEDONIA COUNTY, VERMONT

Prepared by

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Region 1
Boston, Massachusetts

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9/24/14

Date

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LIST OF ACRONYMS

ADAF	Age-Dependent Adjustment Factor
ARAR	Applicable or Relevant and Appropriate Requirement
BNA	Bio-Enhanced Natural Attenuation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIC	Community Involvement Coordinator
Cis-1,2-DCE	cis-1,2-Dichloroethene
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
CV	Coefficient of Variation
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
EVO	Emulsified Vegetable Oil
FYR	Five-Year Review
ICs	Institutional Controls
IGCL	Interim Groundwater Cleanup Levels
IRIS	Integrated Risk Information System
IWS	Industrial Waste Site
LEL	Lower Explosive Limit
LTMP	Long-Term Monitoring Plan
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MEK	2-Butanone
MNA	Monitored Natural Attenuation
MOM	Management of Migration
NCP	National Contingency Plan
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PCE	Tetrachloroethene
PRB	Permeable Reactive Barrier
PRP	Potentially Responsible Party
PVC	Polyvinyl Chloride
RAO	Remedial Action Objectives
RCRA	Resource Conservation & Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
RSL	Regional Screening Level
SMCL	Secondary Maximum Contaminant Levels
SVOC	Semi-Volatile Organic Compound
SWDA	Solid Waste Disposal Area
TAL	Target Analyte List
1,1,1-TCA	1,1,1-Trichloroethane

LIST OF ACRONYMS (cont.)

TCE	Trichloroethene
Trans-1,2-DCE	Trans-1,2-Dichloroethene
UIC	Underground Injection Control
VFA	Volatile Fatty Acid
VI	Vapor Intrusion
VISL	Vapor Intrusion Screening Level
VOC	Volatile Organic Compound
VPGQS	Vermont Primary Groundwater Quality Standards
VTAEC	Vermont Agency of Environmental Conservation
VTDEC	Vermont Department of Environmental Conservation

EXECUTIVE SUMMARY

This is the third Five-Year Review (FYR) for the Parker Landfill Superfund Site, located in the Town of Lyndon, Caledonia County, Vermont. The purpose of this FYR is to review information to determine if the remedy is and will continue to be protective of human health and the environment. The triggering action for this statutory FYR was the signing of the previous FYR on September 30, 2009.

The remedy selected to address contamination at the Parker Landfill Superfund Site includes a multi-layer cap over the Solid Waste Disposal Area (SWDA) and Industrial Waste Site (IWS) areas, active gas collection on the SWDA and IWS-1, a Permeable Reactive Barrier (PRB) downgradient of IWS-3, bio-enhanced natural attenuation (BNA) of the downgradient aquifer, and institutional controls.

Section X of the April 7, 1995 Record of Decision (ROD) describes the original remedy for the Site, which included the following components:

- Construction of multi-layer (RCRA subtitle C) caps over the SWDA and three IWS areas to minimize the potential for transfer of contaminants from the soil and waste into the groundwater, surface water and sediments;
- Installation and operation of a gas collection system in the SWDA and IWS-1 area to reduce landfill gas accumulation and lateral migration below the solid waste landfill cap;
- Installation of a source control groundwater treatment system to address overburden and bedrock contamination, the configuration of which was to be determined during pre-design studies of Site groundwater;
- Conduct long-term sampling and analysis of groundwater, surface water and sediments to assess compliance with the groundwater cleanup levels through natural attenuation and to ensure surface water and sediments in nearby brooks/river have not been adversely impacted;
- Institutional controls to protect the cap, and to restrict groundwater use, including the extension of municipal water service to all homes potentially affected by contamination; and
- Review of the Site every five years to evaluate the effectiveness of the remedy.

An Explanation of Significant Differences (ESD) was issued in July 2004 detailing a change in the original groundwater remedy. As stated above, the original groundwater remedy specified in the ROD included a source control groundwater treatment system (extraction and ex-situ treatment) and natural attenuation of the downgradient groundwater contamination plume. The ESD specified that a PRB system would be designed and installed to treat source area groundwater and BNA would be used to treat downgradient groundwater contamination.

The capping of the landfill was initiated in April 1999. The PRB and BNA systems were completed in September 2005.

A new wetland area was created during 2000 as a mitigation measure to compensate for wetlands destroyed during the capping of the landfill. In 2005 and 2006, the compensatory wetland was expanded to mitigate for wetlands destroyed during installation of the PRB and BNA systems.

The remedy at the Parker Landfill Superfund Site currently protects human health and the environment because there is no current use of or exposure to Site media containing contaminant concentrations exceeding applicable criteria. However, in order for the remedy to be protective in the long-term, the following actions need to be taken:

- Expand the institutional control area to ensure that the boundary encompasses the current contaminant plume pursuant to the ROD;
- Monitor VOC concentration trends in groundwater, surface water and sediments.. Install groundwater monitoring wells to ensure the plume is within IC control areas as well as to determine the nature and extent of the contamination.;
- Evaluate, monitor and define the extent of 1,4-dioxane in the groundwater;
- Evaluate VOCs in groundwater in the vicinity of occupied buildings against appropriate vapor intrusion screening criteria; and
- Evaluate and repair landfill cap settlement in the vicinity of GW-4.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Parker Landfill Superfund Site		
EPA ID: VTD981062441		
Region: 1	**State:** VT	**City/County:** Lyndon / Caledonia

SITE STATUS	
NPL Status: Final	
Multiple OUs? No	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: EPA ***[If "Other Federal Agency", enter Agency name]*:** Not Applicable
Author name (Federal or State Project Manager): Leslie McVickar
Author affiliation: US Environmental Protection Agency
Review period: 1/08/14 – 9/30/2014
Date of site inspection: 5/8/2014
Type of review: Statutory
Review number: 3
Triggering action date: 9/30/2009
Due date *(five years after triggering action date)*: 9/30/2014

Issues/Recommendations

Issues and Recommendations Identified in the Five-Year Review:				
OU1	**Issue Category:** Institutional Controls			
	Issue: Institutional controls need to be expanded to ensure the Site boundary encompasses the current contaminant plume.			
	Recommendation: Finalize institutional controls for the Site.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA / VTDEC	12/31/2016
OU1	**Issue Category:** Monitoring			
	Issue: Recent data indicates that conditions have changed in the groundwater west of the SWDA.			
	Recommendation: Implement an investigation to evaluate and determine the current nature and extent of the VOC plume.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA / VTDEC	12/31/2015
OU1	**Issue Category:** Monitoring			
	Issue: Extent of 1,4-dioxane plume needs to be determined and further monitored.			
	Recommendation: Continue to monitor and define the extent of 1,4-dioxane in groundwater to ensure the plume is within the areas of established institutional control areas.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA / VTDEC	12/31/15
OU1	**Issue Category: Monitoring**			
	Issue: Annual vapor intrusion evaluations must be performed.			
	Recommendation: Annually evaluate all groundwater VOC data, particularly in the vicinity of occupied buildings, against appropriate vapor intrusion screening criteria.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA / VTDEC	Ongoing

OU1	**Issue Category: Operations and Maintenance**			
	Issue: Localized landfill cap settlement.			
	Recommendation: Evaluate and repair settlement in the vicinity of GW-4.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA / VTDEC	12/31/2014

Sitewide Protectiveness Statement
Protectiveness Determination: Short-term Protective
Protectiveness Statement: The remedy at the Parker Landfill Superfund Site currently protects human health and the environment because there is no current use of or exposure to site media containing contaminant concentrations exceeding applicable criteria. However, in order for the remedy to be protective in the long-term, institutional controls must be expanded and contaminant concentrations and trends (i.e., VOCs and 1,4-dioxane) must continue to be monitored and evaluated. Groundwater plume migration west of the landfill needs to be investigated and evaluated to determine the current nature and extent of groundwater contamination at the Site. Landfill repairs are necessary to address an area of settlement at location GW-4. All groundwater data must be evaluated for future potential vapor intrusion issues.

I. INTRODUCTION

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) prepares FYRs pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121 and the National Contingency Plan (NCP). CERCLA Section 121 states:

> "*If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*"

EPA interpreted this requirement further in the NCP; 40 Code of Federal Regulations (CFR) Section 300.430(f)(4)(ii), which states:

> "*If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such actions no less often than every five years after the initiation of the selected remedial action*."

EPA conducted this FYR on the remedy implemented at the Parker Landfill Superfund Site (Site) in the Town of Lyndon, Caledonia County, Vermont. Figure 1 shows the location of the Parker Landfill Superfund Site. EPA is the lead agency for developing and implementing the remedy for the Site. Vermont Department of Environmental Conservation (VTDEC), as the support agency representing the State of Vermont, has reviewed all supporting documentation and provided input to EPA during the FYR process.

This is the third FYR for the Site. The triggering action for this statutory review is signature of the last FYR on September 30, 2009. This FYR is required due to the fact that hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure.

II. PROGRESS SINCE THE LAST REVIEW

The following provides the protectiveness determination and a list of the recommendations presented in the 2009 FYR for the Site.

Table 1 Protectiveness Determinations/Statements from the 2009 FYR		
OU #	**Protectiveness Determination**	**Protectiveness Statement**
Sitewide	Short-term Protective	The remedy at the Parker Landfill Site currently protects human health and the environment because there is no current use of or exposure to Site media containing contaminant concentrations exceeding applicable criteria. However, in order for the remedy to be protective in the long-term, institutional controls must be finalized.

Table 2 Status of Recommendations from the 2009 FYR							
OU #	**Issue**	**Recommendations Follow-up Actions**	**Party Responsible**	**Oversight Party**	**Original Milestone Date**	**Current Status**	**Completion Date (if applicable)**
OU1	Institutional Controls	Finalization of institutional controls for the Site, ensuring that the institutional control boundary encompasses wells with IGCL exceedances.	Other	EPA/State	September 2010	Ongoing	Institutional controls have been established consistent with the August 2003 Groundwater Reclassification ; however current Site conditions may warrant expansion of the Institutional Control area.
OU1	Updated VPGQS and/or MCL for Acetone and Arsenic	Evaluate need to update IGCL and consider effects on treatment technologies.	PRP	EPA/State	September 2011	Completed	Though IGCLs have not been formally changed by EPA, the updated VPGQS and MCLs were incorporated as comparison criteria in the 2009 long-term monitoring plan report.
OU1	1,4-Dioxane	Continue to monitor and define the extent of 1,4-dioxane to ensure the plume is within the groundwater.	PRP	EPA/State	September 2013	Ongoing	N/A
OU1	Vapor Intrusion	Continue to evaluate VOCs in	PRP	EPA/State	September 2013	Ongoing	N/A

Table 2 Status of Recommendations from the 2009 FYR							
OU #	**Issue**	**Recommendations Follow-up Actions**	**Party Responsible**	**Oversight Party**	**Original Milestone Date**	**Current Status**	**Completion Date (if applicable)**
		groundwater against appropriate federal and state vapor intrusion guidance and criteria.					
IGCL – Interim Groundwater Cleanup Level MCL – Maximum Contaminant Level PRP – Potentially Responsible Party VOCs – Volatile Organic Compounds VPGQS – Vermont Primary Groundwater Quality Standards							

Further explanation regarding the status/completion date of Recommendation #1 from the 2009 FYR is provided below and in the following sections.

<u>*Recommendation 1*</u>

- The Town of Lyndon updated their zoning bylaws to establish an Institutional Control Area that mirrors the Groundwater Reclassification Area as shown in Attachment B of the *Findings of Fact and Reclassification Order, Proposed Groundwater Reclassification at the Parker Landfill, Lyndon, Vermont* dated August 21, 2003 (see Appendix B). The Groundwater Reclassification Area was delineated based on data collected in 2000; however downgradient Interim Groundwater Cleanup Level (IGCL) exceedances and increasing VOC concentration trends, including 1,4-dioxane and particularly in the "top-of-rock" groundwater system, continue to be evident west-southwest of the Solid Waste Disposal Area (SWDA), including near Lily Pond Road and potentially beyond (i.e., toward the Passumpsic River). The current data suggest a need for additional monitoring locations and/or installation of additional wells downgradient of the Site. As a result, the limits of the current institutional controls do not encompass the area of recent IGCL exceedances as required by the Record of Decision (ROD).

A. Remedy Implementation Activities

No remedial implementation activities, other than the institutional controls (ICs) noted above by the Town of Lyndon, have occurred since the previous FYR. A summary of remedial implementation activities previously completed at the Site is included in Appendix A.

B. System Operation/Operation and Maintenance Activities

Operation and maintenance (O&M), including monitoring of select media, are conducted for both the landfill cap and groundwater remedies, as further described below. Monitoring activities are currently conducted in accordance with the Updated Draft Final Long-Term Monitoring Plan and associated Addenda #1 and #2, Permeable Reactive Barrier (PRB) Remedial Design Report and Revised Draft Bio-Enhanced Natural Attenuation (BNA) O&M Plan.

Landfill Cap Remedy O&M

O&M for the cap remedy primarily consists of operating the flare system to burn collected methane gas and maintenance of the cap. Maintenance of the cap includes mowing, cleaning out drainage swales, repairing erosion damage, replanting grass (as needed) and removing animals that burrowed in the cap.

Periodic gas probe monitoring is also conducted to monitor the migration of methane gas from areas outside of the cap.

Groundwater Remedy O&M

O&M for the groundwater remedies primarily consists of groundwater, surface water, and sediment monitoring. Groundwater monitoring wells are grouped into the Management of Migration (MOM), PRB and BNA monitoring well groups. Annual groundwater monitoring of 32 MOM wells, 29 PRB wells, and eight BNA wells is currently conducted.[1] Every five years, as part of the FYR, an additional 28 MOM wells are also monitored.

Surface water sampling is conducted on an annual basis. Three surface water samples are collected from the unnamed stream extending along the eastern portion of the SWDA. In addition, sediment sampling is currently conducted every five years, as part of the FYR, with samples collected from three locations from the unnamed stream.

III. FIVE-YEAR REVIEW PROCESS

Administrative Components

The Parker Landfill Superfund Site FYR was led by Leslie McVickar of the EPA, Remedial Project Manager for the Site and Emily Zimmerman, the Community Involvement Coordinator (CIC). John Schmeltzer, Project Manager for the VTDEC, assisted in the review as the representative for the support agency.

The review, which began on 1/8/2014, consisted of the following components: review of Site-related background documents, review of Site monitoring data, review of Applicable or Relevant and Appropriate Requirements (ARARs) and other standards, inspection of the Site, interviews with key stakeholders and development of this FYR report.

Community Notification and Involvement

Activities to involve the community in the FYR process were initiated with a news release dated February 13, 2014 from EPA stating that a FYR of the Site would be conducted. The results of this FYR report will be made available at the Site information repository located at the Cobleigh Public Library in Lyndon and at EPA's Records Center located in Boston, Massachusetts.

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[1] Per the findings of the Five-Year Review Long-Term Monitoring Plan report issued in 2008, four wells (B119C, B126S, B144A and B201OW) that were previously sampled every five years have been added to the annual monitoring events.

Review of Site-Related Background Documents

This FYR consisted of a review of documents relevant to the history and status of the Site. The document review including the following: decision documents including the ROD and Explanation of Significant Differences (ESD), the previous (2009) FYR report, an updated long-term monitoring plan, long-term monitoring plan reports (2009 through 2013), the Town of Lyndon's zoning ordinances, institutional controls documentation, Site inspection reports, and O&M documents and records during the past five years. Applicable groundwater and sediment cleanup standards, as listed in the April 1995 ROD, were also reviewed.

Review of Site Monitoring Data

Figure 2 shows the locations of sediment samples, surface water samples, and groundwater monitoring wells included in the LTMP. A long-term monitoring program is being implemented as required by the ROD and ESD. Based on the results of the Remedial Investigation (RI), contaminants associated with the Site were present in soil (mainly below the waste areas), landfill gas, sediment, surface water and groundwater. The ROD (dated April 1995), original LTMP (dated August 2000) and the Updated Draft Final LTMP (dated September 8, 2006) specified on-going monitoring requirements for sediment, surface water, and groundwater at the Site.

The results of a review of available data from the past five years are presented below. These data were used to determine if any significant changes in Site conditions have occurred within the past five years.

Sediments

As part of long-term monitoring activities required by the ROD, sampling and analysis of sediments was performed once in the past five years at three locations (SD01, SD02, and SD03) in the unnamed stream (Figure 2). Sediment samples were collected on October 4, 2013. Samples at each location were analyzed for VOCs and target analyte list (TAL) metals.

Historically, long-term sediment monitoring data indicate that the concentrations of VOCs and metals were generally highest in the "upstream" samples collected from SD01 and decreased with distance downstream. Although no VOCs were detected in the sediment samples collected in October 2013, this trend generally held true during the most recent monitoring event for metals. Table 3 presents a comparison of maximum concentrations detected in the long-term monitoring samples collected in the unnamed stream to the project-specific sediment quality guidelines for Contaminants of Concern (COCs) established for the Site in the 1993 Final Risk Assessment.

Table 3
Comparison of Unnamed Stream Sediment COC Results from 2009-2013 To Sediment Results from 2001-2004, 2005-2008 and Remedial Investigation
Parker Landfill Superfund Site

Parameter (COC)	*Sediment Quality Criteria*	Unnamed Stream			
		RI Maximum Concentration	2001-2004 Maximum Concentration	2005-2008 Maximum Concentration	2009-2013 Maximum Concentration
VOCs (mg/kg)					
Acetone	*0.17*	0.24	**0.91 J**	0.31	ND
2-Butanone	*0.91*	0.0815	**0.16**	0.0177 J	ND
Chloroethane	*0.59*	0.01	ND	ND	ND
Chloroform	*0.08*	0.0054	ND	ND	ND
Trichloroethene	*5.8*	0.0054	**0.12**	0.00144 J	ND
SVOCs (mg/kg)					
Bis(2-ethylhexyl)phthalate	*6.2*	0.3279	NA	ND	NA
Inorganics (mg/kg) (1)					
Arsenic	*33*	962.3	4.2	2.48 J	ND
Barium	*20*	809.5	125	110	28.2
Cadmium	*5*	10.5	1.4	0.462 J	ND
Copper	*70*	20.7	14.2	13	4.22
Cyanide	*0.1*	22.6	NA	NA	NA
Iron	*17,000*	383,000	29,000	25,000	10,800
Manganese	*300*	2,425	**10,400**	2,390	220
Nickel	*30*	24.8	22.4	17.9	3.92

(1) Only COCs with established Sediment Quality Criteria listed. Additional ROD-specified inorganic COCs associated with the unnamed stream include: aluminum, calcium, chromium, cobalt, lead, magnesium, potassium, vanadium and zinc.
Concentrations in milligrams per kilogram (mg/kg).
Sediment Quality Criteria (mg/kg) are from 1993 Final Risk Assessment by TRC.
RI - 1990-1994 Remedial Investigation by ESE. (Maximum concentration is taken from results for 11 sediment samples on unnamed stream or 4 sediment samples on Passumpsic River.)
LTM - Long-Term Monitoring activities; conducted semi-annually from October 2001 to April 2004
NA - Not analyzed for given parameter.
ND - Not detected in excess of laboratory reporting limit.
Black shading indicates result exceeds given sediment quality criteria.
Bold type indicates maximum concentration has increased since the previous reporting period.
J - Estimated

Table 3 indicates an overall decrease in the concentrations of VOCs within the sediments relative to concentrations detected during the RI. The reduction in VOC concentrations indicates that the remedy is successfully minimizing the transfer of VOC contamination from the SWDA and IWS area soil and waste materials into the sediments.

In October 2013, barium at the SD01 location was the only metal detected in excess of the sediment quality criteria. This represents a decrease, particularly for iron and manganese, in the number of metal exceedances of the sediment quality criteria since the September 2008 sampling event.

Surface Water

Surface water sampling along the unnamed stream was performed at three locations on an annual basis from April 2004 to the present. The locations of stream surface water samples (SW01, SW02, and SW03) were co-located with the sediment sample locations (SD01, SD02, and SD03).

Table 4 presents the comparison of maximum concentrations detected in the long-term monitoring samples collected within the unnamed stream to benchmark criteria and maximum concentrations of COCs detected during the RI. The benchmark criteria are not cleanup goals but were established using available criteria and guidelines for evaluating chemical toxicity to ecological receptors According to the ROD, all risk values for exposure to surface water were within or below EPA’s acceptable risk range.

As shown in Table 4, there was an increase in the maximum concentrations of TCE, vinyl chloride, 1,2-dichloroethene, aluminum, chromium, iron, magnesium, manganese and thallium in the 2001-2004 data from the ROD levels. However, the 2005-2008 and 2009-2013 maximum concentrations are similar to, and in most cases lower than, the maximum RI concentrations and therefore, surface water concentrations are not considered to present an adverse impact.

Table 4
Comparison of Unnamed Stream Surface Water COC Results from 2009-2013
To
Surface Water Results from 2001-2004, 2005-2008 and Remedial Investigation
Parker Landfill Superfund Site

		Unnamed Stream			
Parameter (COC)	***Surface Water Criteria or Guidelines***	**RI Maximum Concentration**	**2001-2004 Maximum Concentration**	**2005-2008 Maximum Concentration**	**2009-2013 Maximum Concentration**
VOCs (ug/L)					
Acetone	*61,000*	15	10	ND	**7.03 J**
Trichloroethene	*21,900*	21	**920**	50	30.6 J
Vinyl Chloride	*17,800*	1	**5.2**	0.513 J	0.359 J
cis-1,2-Dichloroethene	*11,600*	42	**350**	17.8	**25.3 J**
trans-1,2-Dichloroethene	*11,600*	42	2.4	ND	**0.277 J**
Inorganics (ug/L)					
Aluminum	87	116	**34,100**	199	**3,320**
Antimony	80	56.5	7.9	ND	ND
Barium	220	291.5	258	31.7	**112**
Cadmium (1)	0.24	NS	0.8	NA/ND	ND
Calcium	NP	79,400	36,700	**59,700**	**73,200**
Chromium	75.4	11.2	**52.3**	ND	ND
Cobalt (1)	24	NS	19.9	13.4	3.22 J

Table 4 Comparison of Unnamed Stream Surface Water COC Results from 2009-2013 To Surface Water Results from 2001-2004, 2005-2008 and Remedial Investigation Parker Landfill Superfund Site					
		Unnamed Stream			
Parameter (COC)	***Surface Water Criteria or Guidelines***	**RI Maximum Concentration**	**2001-2004 Maximum Concentration**	**2005-2008 Maximum Concentration**	**2009-2013 Maximum Concentration**
Iron	1,000	33,750	**51,400**	945	**16,100**
Lead (1)	2.69	NS	61.4	13.4	13.3
Magnesium	NP	9,375	**11,300**	6,050	**7,060**
Manganese	NP	3,350	**6,990**	249	**2,060**
Nickel	45.5	38.8	32.3	ND	ND
Potassium	NP	10,040	4,780	3,060	**3,920**
Selenium (1)	5	NS	8.3	ND	ND
Silver	2.86	14.4	4.7	ND	ND
Sodium	NP	23,550	15,100	15,100	ND
Thallium	10	1.6	**18**	ND	ND
Zinc (1)	104	NS	238	9.77 J	**64.7**

NS - Not summarized in ROD.
NP - Not Published
NA – Not analyzed for given parameter.
(1) Not a COC identified in the ROD; however metal is listed due to previous and/or current exceedances of Surface Water Quality Criteria (ug/L)
Concentrations in micrograms per liter (ug/L).
Surface Water Quality Criteria (ug/L) for VOCs are from 1993 Final Risk Assessment by TRC.
Surface Water Quality Criteria shown for hardness-dependent metals are calculated from average water hardness during RI (85,000 ug/L). Sources of metal criteria/guidelines are EPA National Recommended Water Quality Criteria (2013) and EPA Region V Ecological Screening Levels (2003).
RI - 1990-1994 Remedial Investigation by ESE. (Maximum concentration is taken from results for 11 surface water samples on unnamed stream)
ND - Not detected.
Black shading indicates result exceeds given surface water quality criteria.
Bold type indicates maximum concentration has increased since the previous reporting period.
J – Estimated,

In October 2013, all VOC detections in surface water were below National Recommended Water Quality Criteria identified in the Final Risk Assessment completed in 1993. Acetone, chloromethane, styrene, 1,1,1-trichloroethane (1,1,1-TCA), TCE, tetrachloroethene (PCE), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE) and vinyl chloride were the only VOCs detected during the previous five years. Concentrations of VOCs remained relatively consistent from April 2004 to the present, with TCE and vinyl chloride showing decreasing trends.

October 2013 data show only three exceedances of National Recommended Water Quality Criteria in surface water (SW01); as noted in Table 4. The remaining metals analyzed for were below this criteria. Consistent with historic surface water results, fewer metals were detected at lower concentrations, from upstream (SW01) to downstream (SW03) on the unnamed stream.

Since the 1993 Risk Assessment, there have been increased/decreased concentrations of iron and silver, respectively (silver to ND levels, though the detection limit for silver (10 ug/L) is slightly above the guideline (2.86 ug/L)) in the unnamed stream; the two metals of concern at that time. To address this potential analytical issue for silver, use of a more sensitive analytical method should be considered prior to the next round of surface water sampling. Data collected since that time show that both metals remain below the maximum RI concentrations and impacts to human health and the environment are considered nominal; with further protection through IC's and access controls

Groundwater Flow

Groundwater contour and potentiometric surface maps for the shallow (overburden), top-of-rock and bedrock aquifers, as provided in annual Long-Term Monitoring (LTM) Reports by URS, were compared to evaluate historic changes in groundwater flow. In addition, equipotential contours for PRB Zone A (shallow), Zone B (intermediate) and Zone C (deep) are presented on an annual basis. Review of the groundwater flow patterns during the previous (2009) FYR indicated no significant changes in the groundwater levels or groundwater flow direction within the study area.

The groundwater contour and potentiometric surface contours as shown in Figures 8 and 10 and presented in the 2009, 2010, 2011, 2012 and 2013 annual LTM Reports (based on quarterly water level measurements) show some features of note including:

- A westward extending component of groundwater flow within the shallow overburden in the vicinity of monitoring well MW-6A (located approximately 450 feet west of IWS-2; see Figure 2) was distinctive in 2009 and evident in 2010, but was not evident during subsequent monitoring events;
- Historically, a primarily westward shallow overburden groundwater flow direction was evident south of IWS-3. Based on recent monitoring data, an apparent southwest trending component of shallow overburden groundwater flow is now evident in the area southwest of IWS-3;
- Although some mild variability in the top-of-rock potentiometric surface is evident in the vicinity of the BNA Well Group, the water level elevations and flow directions have remained relatively stable over the last five years; and
- Although relatively minor fluctuations in the water level elevations have been evident, the groundwater flow patterns in the vicinity of the PRB have been relatively consistent over the last five years. As noted in the LTMP reports, localized northward flow, along the alignment of the PRB, in the northern end of the PRB should continue to be monitored to ensure movement of impacted groundwater flow through the PRB.

No significant changes in overall groundwater levels or groundwater flow direction within shallow overburden, top-of-rock or bedrock portions of the study area are apparent during the post-cap period of October 2000 to the present. Therefore, groundwater flow direction is considered to be consistent with the last FYR period and groundwater flow patterns appear to be stable.

Groundwater Quality Monitoring

Monitoring of groundwater quality at the Site has been conducted on a regular basis since 1994, prior to the construction of the cap. A Long-Term Monitoring Plan (LTMP) was prepared for the Site in August 2000. This LTMP established a project timeline for the post-cap sampling of groundwater, surface water, and sediment samples for laboratory analysis. The long-term groundwater monitoring program was initiated in October 2000. An Updated Draft LTMP was issued by URS in September 2006, which included monitoring procedures associated with the PRB and BNA systems. Results of long-term monitoring activities are subsequently documented in biannual reports (with presentation of data only) by URS, and in annual LTM Reports submitted to EPA by URS. During this FYR period (April 30, 2009 to April 30, 2014), groundwater was sampled on an annual basis for a total of five monitoring events. Additional wells and analyses are performed once every five years in conjunction with the routine annual sampling event.

While as many as 100 groundwater monitoring wells were once present in the vicinity of the Site, the original LTMP (dated 2000) reduced the number of wells subjected to periodic groundwater sampling and analysis to 40 of the wells present prior to cap construction, plus an additional eight wells that were installed during/after cap construction and subsequently added to the LTMP. The updated LTMP (dated 2006) included the sampling of new wells installed to monitor the PRB and BNA systems, specifying the sampling and analysis of 89 monitoring wells.

The groundwater monitoring well network being utilized for groundwater monitoring includes wells screened within three distinct subsurface "zones of interest". Shallow overburden (SO) monitoring wells are those with screened intervals intercepting the groundwater table.. Monitoring wells with screens completed in the overburden, but resting on the top of the bedrock interface (i.e., deeper overburden), are termed "top-of-rock" wells (TOR). Monitoring wells installed in the bedrock are referred to as bedrock. Bedrock monitoring wells are those with screened intervals below the bedrock.

Laboratory testing of samples collected in LTMP wells have included analyses for VOCs, semi-volatile organic compounds (SVOCs), and TAL metals. Analyses for VOCs are performed annually, while SVOC and metals analyses are performed every five years. In addition, geochemistry parameters (e.g., temperature, pH, dissolved oxygen, specific conductance, and turbidity) are measured and recorded annually at each LTMP groundwater sampling point.

Table 5 summarizes the maximum concentrations of the analytes that exceeded IGCLs during the October 2013 sampling event only. An expanded table, including maximum concentrations of analytes exceeding IGCLs, by well location, for the previous five years is included as Appendix C. Of the groundwater monitoring wells sampled as part of the LTMP to date, nearly all have contained contaminant concentrations exceeding applicable IGCLs for metals and/or VOCs at some point.

Table 5
Maximum Concentrations of Groundwater Contaminants that Exceeded IGCLs in October 2013
Parker Landfill Superfund Site

Parameter (COC)	Screened Zone	IGCL (µg/L)	2013 Maximum Concentration Exceeding IGCLs (µg/L)	Location of Maximum Concentration Exceedance
VOCs				
1,1-Dichloroethane [(1)]*	TOR	*70*	88.7 J	B138B
1,1-Dichloroethene	TOR	*7*	16.0 J	B138B

Table 5 Maximum Concentrations of Groundwater Contaminants that Exceeded IGCLs in October 2013 Parker Landfill Superfund Site				
Parameter (COC)	**Screened Zone**	**IGCL (µg/L)**	**2013 Maximum Concentration Exceeding IGCLs (µg/L)**	**Location of Maximum Concentration Exceedance**
1,2-Dichloropropane (1)*	TOR	*5*	8.9	B138B
Cis-1,2-Dichloroethene	TOR	*70*	2,690 J	B138B
1,4-Dioxane (1)*	TOR	*3*	980 J	B138B
Benzene	TOR	*5*	5.58	B137B
Methylene Chloride	TOR	*5*	5.40 J	B136B
Trans-1,2-Dichloroethene	TOR	*100*	122 J	B138B
Tetrachloroethene	SO	*5*	71.8	B170B
Trichloroethene	SO	*5*	2,860	B170B
Vinyl Chloride	TOR	*2*	998	B138B
SVOCs				
3-Methylphenol/4-Methylphenol	TOR	*200*	524	B113BB
Inorganics				
Lead (1)*	SO	*15*	28.4	B174A
Manganese	TOR	*300*	2,380	B125A
Vanadium	SO	*0.2*	24.5	B174A

Concentrations in micrograms per liter (ug/L).
(1) Not a COC identified in the ROD; however compound is listed due to previous and/or current exceedances of IGCLs (ug/L).
J – Estimated.
* - Non-COC contaminants with no ROD assigned IGCLs, but still tracked for risk purposes
.SO – Shallow Overburden.
TOR – “Top -of -Rock.” wells
BRB – Bedrock. wells
SO – Shallow bedrock wells
BR – Bedrock wells

Routine reporting limits for vanadium, benzo(a)pyrene, pentachlorophenol and trans-1,3-dichloropropene exceed IGCLs. Though vanadium reporting limits exceed the risk-based IGCL established in the ROD (0.2 ug/L), an appropriately sensitive analytical method is being used that can achieve a current risk-based screening level for this compound (86 ug/L). Benzo(a)pyrene and trans-1,3-dichloropropene analytical methods being utilized are appropriate; however, it is possible to achieve lower reporting limits (below the IGCLs) using these methods. A more sensitive analytical method, such as that being used for benzo(a)pyrene, may be necessary to achieve the pentachlorophenol IGCL. Further coordination with the analytical laboratory and/or use of a more sensitive analytical method should be considered to address these issues prior to the next round of groundwater sampling.

Metals Trends

The ROD identified arsenic, antimony, beryllium, chromium, manganese, nickel, and vanadium as COCs. Recent 2013 monitoring data indicate that only lead, manganese and vanadium currently exceed their IGCLs. Arsenic and selenium exceed their applicable IGCLs as of the previous FYR, but were detected below laboratory reporting limits in 2013. The data indicate that one or more metals exceeded the corresponding IGCL at 28 of the 51 groundwater monitoring wells sampled in October 2013, consisting of 12 shallow overburden wells, 10 top-of-rock wells, and six bedrock wells. These data indicate a prevalence of elevated concentrations of vanadium and manganese (above IGCLs) versus other metals among overburden, top-of-rock, and bedrock wells.

The recent distribution of elevated manganese concentrations in the shallow overburden and top-of-rock groundwater, and to a lesser degree in the bedrock groundwater, appears to be somewhat concentrated downgradient of IWS-1 and IWS-2 (see Figure 2). The concentrations of vanadium appear to be more widely distributed within the shallow overburden, top-of-rock and bedrock groundwater. Concentrations of vanadium in excess of the IGCL are generally present downgradient of IWS-1 and IWS-2, as well as in the vicinity of IWS-3. In addition, the only elevated lead concentration above the IGCL in recent groundwater monitoring data is in the shallow overburden groundwater at B174A, located in the vicinity of the Passumpsic River.

Data collected during the first FYR period (April 2003, October 2003, and April 2004) indicated concentrations of chromium, lead, manganese, nickel, thallium and vanadium above IGCLs in no more than 10 well locations. Therefore, although there have recently been fewer individual metals exceeding IGCLs, exceedances continue to be present at more well locations.

<u>SVOC Trends</u>

Consistent with previous monitoring events in which groundwater samples from select monitoring wells are analyzed for SVOCs, only one SVOC (i.e., 3-methylphenol/4-methylphenol) was detected at a concentration above its IGCL (200 ug/l) in October 2013. Historically, since 2000, 3-methylphenol/4-methylphenol was detected in two wells located to the southwest of the landfill (i.e., B113BB and B138B – see Figure 2). In October 2013, 3-methylphenol/4-methylphenol was only detected in monitoring well B113BB at a concentration (524 ug/L) in excess of the IGCL.[2]

The COC list for SVOCs includes both 4-methylphenol and bis(2-ethylhexyl)phthalate; however, bis(2-ethylhexyl)phthalate has not been detected in any of the monitoring wells during the routine sampling events conducted since February 2000.

<u>VOC Trends</u>

VOCs are the primary constituents of concern at the Site, due to their prevalence and mobility over other contaminants in groundwater. Up to 12 different VOCs have been detected at concentrations exceeding IGCLs during the last five LTM events (2009 through 2013). These VOCs consist of acetone, benzene, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-DCE, 1,2-dichloroethane, 1,2-dichloropropane, 1,4-dioxane, methylene chloride, PCE, TCE and vinyl chloride. Historically, 2-butanone (MEK) was detected in excess of the IGCL of 4,200 ug/l, but no exceedances were detected during LTM events within the last five years. In general, the chlorinated VOCs, cis-1,2-DCE, PCE, TCE and vinyl chloride, have had the highest incidence of detection in groundwater during recent monitoring events.

[2] 3-methylphenol/4-methylphenol was detected in excess of the IGCL in the duplicate sample collected from B113BB in October 2013. The original sample exhibited a significantly lower concentration of 10.9 ug/L.

Specifically, a higher incidence of chlorinated VOCs exceeding IGCLs have recently (October 2013) been detected in shallow overburden groundwater in the vicinity of the PRB, in top-of-rock wells located near the BNA and to a lesser degree bedrock wells that are located downgradient of the SWDA and IWS-1.

At the request of EPA, monitoring for 1,4-dioxane in groundwater was initiated in 2004 and incorporated into the LTMP at MOM wells starting in 2006. In general, 1,4-dioxane also exhibited a high incidence of detection in groundwater in excess of the IGCL (3 ug/l) during the previous five years. Based on the October 2013 sampling results, 1,4-dioxane is primarily present in excess of the IGCL in top-of-rock groundwater (seven of the 15 wells exhibiting IGCL exceedances in October 2013), and to a lesser degree the shallow overburden and bedrock groundwater. All exceedances are found downgradient of the IWS-1 and IWS-2 areas.

The Draft 2013 Annual LTM Report submitted by URS includes an evaluation of groundwater quality trends, consisting of data plots and non-parametric Mann-Kendall Test analysis of VOCs and SVOCs detected in excess of IGCLs.[3] Historic data plots for wells B138A, B131C and B145B are included in Appendix D for reference. The Mann-Kendall analysis includes monitoring data collected from 2009 through 2013, as well as prior analytical data if insufficient data were available from the past five years, for purposes of evaluating changes in concentrations over time. The Mann-Kendall evaluation identified increasing VOC trends at the 95% confidence level in several wells as follows.

- B136B (vinyl chloride)
- B137B (benzene)
- B138B (1,1-dichloroethane, 1,1-dichoroethene and vinyl chloride)

An increasing trend for 1,2-dichloropropane was also identified at the 80% confidence level in B138B.

In addition, stable conditions which can be in an indication of the effectiveness of the remedy in reducing concentrations below IGCLs were evaluated. Based on a finding of no trend being identified at the 80% confidence level, the Coefficient of Variation (CV) Test identified the following stable conditions.

- B113BB (3-methylphenol/4-methylphenol)
- B126A (TCE)
- B131C (TCE)
- B136C (cis-1,2-DCE and PCE)
- B138B (benzene, trans-1,2-DCE and TCE)
- B145B (vinyl chloride)

Based on key indicator compound (e.g., TCE and cis-1,2-DCE) trend plots and other data presented in the Draft 2013 Annual LTM Report submitted by URS, there is an indication of some progress toward

[3] 1,4-dioxane is not included in this VOC trend discussion because it is discussed in more detail later in this five-year review report.

the remedy meeting IGCLs. The following historical trends were observed based on the information provided in the Draft 2013 Annual LTM Report:

Wells Near Source Areas (Landfill, IWS3, IWS2

- No VOCs were detected in the B101 and B102 well clusters.
- Prior to the previous FYR, well B103A demonstrated an increase in TCE concentrations from approximately 200 ug/L in 2005 to 1,360 ug/L in 2008, which is higher than TCE concentrations in 2000. Since November 2008, a reversal of this trend was observed, with both TCE and vinyl chloride exhibiting a decreasing trend.
- Downgradient of the SWDA, well B113BB showed significant decreases in TCE and cis-1,2-DCE prior to June 2005, with relatively low concentrations evident following completion of the groundwater remedial action (installation of PRB and BNA systems) in September 2005. TCE continued to be detected at well B113BB above the IGCL in October 2013 and a seemingly isolated spike of TCE was detected in 2012.
- No VOCs were detected in excess of IGCLs in the B118 well cluster, located cross-gradient to IWS-1 and the SWDA, in October 2013.
- TCE and cis-1,2-DCE are generally decreasing in concentration within B132 and stable within B132B; however TCE continues to be consistently detected in excess of the IGCL. Concentrations of cis-1,2-DCE, as well other VOCs including 1,4-dioxane and PCE, have been more sporadically detected in B132 and/or B132B over the last five years.
- No VOCs were detected in excess of the applicable IGCLs in B137A in October 2013. TCE and cis-1,2-DCE appear to exhibit a recent increasing trend in B137B. In addition, the Mann-Kendall evaluation noted an increasing benzene trend in B137B.
- No VOCs were detected in shallow overburden well B138A in October 2013. Top-of-rock well B138B, located downgradient of the SWDA, has shown a significant increasing trend in the concentrations of TCE, cis-1,2-DCE and vinyl chloride since November 2007, with the highest concentrations of these VOCs detected to date in October 2013. In addition, other VOCs (i.e., 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloropropane, 1,4-dioxane, benzene and trans-1,2-DCE) continue to be detected in excess of their respective IGCLs. The Draft 2013 Annual LTM Report suggests leaching waste materials in the SWDA and/or IWS-1, as well as impacted soil and waste relocated to the SWDA from IWS-2, or periodic settling and compaction of waste materials within the SWDA as possible causes of the increasing contaminant concentrations; however further evaluation and monitoring is required.
- TCE and cis-1,2-DCE concentrations have decreased within B139A, located downgradient of the SWDA. Wells B139B and B139C have not exhibited VOCs in excess of IGCLs in the last five years.
- Bedrock well B143, located downgradient of the PRB, did not exhibit VOCs in excess of IGCLs in October 2013.
- No VOCs were detected at levels above IGCLs in the B159 well cluster in October 2013.
- TCE was detected in excess of the IGCL at wells B160A and B160B during the previous five years.

Wells Downgradient of the Landfill, IWS3 and IWS2 Areas

- No VOCs were detected above the IGCLs in well MW4A in the previous five years.
- No VOCs were detected above the IGCLs in wells B125A and B125B in the previous five years. Data plots generally indicate significant decreases in the concentrations of indicator VOCs since 2000, although within B125B, TCE and cis-1,2-DCE concentrations fluctuated between 2001 and 2005.
- No VOCs were detected above IGCLs in B131B in October 2013. Although the Mann-Kendall analysis indicates that TCE concentrations are stable in B131C, the data plots are potentially indicative of an increasing trend in the concentrations of TCE and cis-1,2-DCE. TCE has been detected relatively consistently above the IGCL over the last five years.
- TCE and cis-1,2-DCE concentrations within B136A have decreased to levels below IGCLs. Concentrations of TCE and cis-1,2-DCE within B136B have fluctuated over time, but have generally exhibited decreasing concentrations prior to the last FYR. A spike in the concentrations of TCE and cis-1,2-DCE was detected in 2011 and a potential increasing concentration trend is evident in the data plots for B136B. Well B136C had a peak in TCE and cis-1,2-DCE concentrations in 2005, which temporarily decreased to concentrations below the IGCLs; however spikes in the concentrations of these VOCs were detected in 2009 and 2012.

Wells Near Downgradient Property Lines

- Indicator VOCs were not detected above IGCLs during the last five years in B119C; however, as discussed below, 1,4-dioxane was detected in B119B and B119C in excess of the IGCL. Well B119C has generally exhibited a decreasing TCE trend since a peak in 2004.
- No VOCs were detected in well B120A in October 2013. TCE and cis-1,2-DCE concentrations are decreasing at B120C. However, concentrations of TCE remain at a significantly higher concentration (maximum of 2,220 ug/L during the last five years) than the IGCL. Well B120D exhibited a peak in TCE concentrations in 2005 followed by a peak in cis-1,2-DCE concentrations in 2006, which are now followed by decreasing or stable trends through October 2013 when vinyl chloride was the only indicator VOC detected above the IGCL.
- With exception of 1,4-dioxane, no VOCs were detected above applicable IGCLs in well B121B during the past five years. Data plots indicated a decreasing trend in indicator VOCs in B121B. No VOCs were detected in B121OW in October 2013.
- No VOCs were detected in B122 during the October 2013 sampling event.
- B126A exhibited a peak in both TCE and cis-1,2-DCE concentrations in 2005 with TCE concentrations up to 5,000 ug/L, which have been followed by decreasing trends since 2005. Concentrations of TCE and cis-1,2-DCE were relatively stable in B126B until an increase (up to approximately 1,000 ug/L for TCE) occurred in 2006. Since 2006, TCE and cis-1,2-DCE concentrations have decreased, but remain somewhat elevated, with concentrations of TCE consistently detected in excess of the IGCL.
- No VOCs were detected at levels above IGCLs in well B201OW during the past five years.

- Well B145B has exhibited an increasing trend in the concentrations of TCE, cis-1,2-DCE and vinyl chloride over the last five years, with the highest concentrations of TCE and vinyl chloride detected to date in October 2013. In addition, benzene and 1,4-dioxane were detected in excess of IGCLs in B145B during the past five years. Indicator VOCs were not detected in excess of IGCLs during the past five years in B145C; however 1,4-dioxane (2009 through 2013) and benzene (2009) have been detected in this well above IGCLs.

BNA Monitoring Wells

- BNA monitoring wells have generally exhibited a decrease in TCE concentrations with an initial increase in cis-1,2-DCE concentrations, followed by a decrease in cis-1,2-DCE, and an increase in vinyl chloride concentrations. Wells B147B, B149B, and B150B exhibit this trend. This trend is not as apparent in B172B, although the concentration of TCE within this well has decreased since 2006.
- The TCE concentration within B173B appears to be either stable or increasing slightly since 2006.
- Several wells (i.e., B147B, B148B, B149B/B149B-R and B172B) appear to exhibit a slight increase in indicator VOC concentrations in October 2013; however this may be related to the diminishing effectiveness of the most recent BNA application in September 2011.
-

PRB Monitoring Wells

- Concentrations of VOCs downgradient of the PRB (well clusters B162, B167 and B168) are lower than VOC concentrations in corresponding upgradient wells (well clusters B164, B165 and B170), indicating that the PRB continues to be effective in reducing VOC contamination in groundwater immediately downgradient of the in-situ wall.

Extent of VOCs in Groundwater

Delineating the extent of the VOC plume in groundwater is important for evaluating the effectiveness of the remedies and implementation of institutional controls. The VOC contaminant plume is defined as where VOCs exceed IGCLs in groundwater.

Figure 3 presents the IGCL exceedances in MOM and BNA monitoring well groups for VOCs and SVOCs by flow zone in 2013. All wells shown on the figure were sampled during October 2013 and only wells that had one or more compounds exceed its IGCL have results shown. The following observations are based on the depiction in Figure 3:

- Shallow overburden IGCL exceedances include 1,4-dioxane, TCE and PCE. With the exception of 1,4-dioxane in B119B, the shallow overburden exceedances are present in the vicinity and downgradient of IWS-3;
- IGCL exceedances are most prevalent in top-of-rock groundwater, with exceedances of VOCs and SVOCs downgradient of the SWDA and IWS-1, IWS-2 and IWS-3; and
- Bedrock exceedances of IGCLs in B120D, B126B, B136C and B145C include 1,4-dioxane, cis-1,2-DCE, TCE and vinyl chloride. These wells are generally located downgradient of the southern portion of the SWDA and IWS-2.

In October 2013, concentrations of 1,4-dioxane exceeding the IGCL of 3 ug/L were detected in shallow overburden well B119B (3.6 ug/L) located along Lily Pond Road (Lot 32-131). The IGCL exceedance at this location is outside of the current Institutional Control Area (see Figure 4). However, public water is supplied to residences along this road.

In November 2003, groundwater at the Site was reclassified from Class III to Class IV, and a Groundwater Reclassification Area was delineated based on the area of IGCL exceedances defined from October 2000 data. As noted in the prior FYR report, exceedances were noted for 1,2-dichloropropane in the B145B and B145C monitoring wells, which appeared to extend into the 200-foot buffer zone of the Groundwater Reclassification Area. Exceedances of 1,2-dichloropropane, as well as several more compounds, including benzene, 1,2-dichloroethane, vinyl chloride, and vanadium were subsequently detected in the B145B and/or B145C monitoring wells. Exceedances of IGCLs continue to be present in the B145 well cluster during the past five years. Furthermore, VOC concentrations appear to be increasing in top-of-rock well B138B, located upgradient to the B145 well cluster, and the highest concentrations of TCE and vinyl chloride detected to date in top-of-rock well B145B were detected in October 2013.

Based on an interview with the Zoning Administrator, the Town of Lyndon has updated their zoning bylaws to establish an Institutional Control Area that mirrors the Groundwater Reclassification Area as shown in Attachment B of the *Findings of Fact and Reclassification Order, Proposed Groundwater Reclassification at the Parker Landfill, Lyndon, Vermont* dated August 23, 2003 (see Appendix B). As noted above, the Groundwater Reclassification Area was delineated based on data collected in 2000; however downgradient IGCL exceedances and increasing VOC concentration trends, including 1,4-dioxane and particularly in the top-of-rock groundwater system, continue to be evident west-southwest of the SWDA. These data suggest a need for additional monitoring locations and/or installation of additional wells downgradient of the Site. This information also indicates that the limits of the current institutional controls that have been established do not encompass the area of recent IGCL exceedances as required by the ROD. However, public water is supplied to the households within the IGCL exceedance area.

In addition, several VOCs including 1,1-dichloroethane, 1,4-dioxane, cis-1,2-DCE and/or TCE were detected in shallow groundwater monitoring wells located near occupied residences (e.g., B118A, B119B, B120A, B121OW, B126S, B131B, B136A, B137A, B144A, B174A, B201OW, and MW-4A) in October 2013. Although a risk screening concluded that the vapor intrusion pathway was not significant at this time, as further described in Section IV, the groundwater trends analysis indicates that concentrations of several VOCs are increasing. Therefore, groundwater monitoring should continue in the vicinity of occupied buildings to ensure that concentrations do not increase to levels exceeding the vapor intrusion screening criteria.

<u>1,4-Dioxane</u>

Groundwater samples have been collected from the MOM monitoring wells for 1,4-dioxane analysis since the last FYR reporting period. During the October 2013 monitoring event, groundwater samples from 55 monitoring wells were analyzed for 1,4-dioxane, a solvent additive typically associated with 1,1,1-TCA. The mobility of 1,4-dioxane in the environment is greater than most chlorinated VOCs, including 1,1,1-TCA, and therefore, the 1,4-dioxane plume is potentially larger than the plume of other VOCs.

The Draft 2013 Annual LTM Report includes an evaluation of 1,4-dioxane trends, consisting of data plots and non-parametric Mann-Kendall Tests combined with the CV test. The Mann-Kendall analysis includes monitoring data collected from 2009 through 2013, as well as prior analytical data if insufficient data were available from the past five years, for purposes of evaluating changes in 1,4-dioxane concentrations over time.[4] The Mann-Kendall evaluation identified increasing 1,4-dioxane trends in several wells B131C, B137B, B138B and B145B (see Figure 3). Each of these wells is located downgradient of the SWDA and IWS-1.

As shown on Figure 3, there are multiple 1,4-dioxane exceedances of the IGCL within the shallow overburden, top-of-rock, and bedrock wells downgradient of the Site, near Lily Pond and Red Village Roads. The highest concentrations of 1,4-dioxane were detected in top-of-rock wells B138B (980 ug/L), B131C (160 ug/L) and B113BB (89 ug/L), located immediately southwest (B138B and B131C) and south of the SWDA (B113BB). The trend evaluation presented in the Draft 2013 Annual LTM Report indicates increasing 1,4-dioxane trends in top-of-rock wells B131C, B137B, B138B and B145B. Concentrations of 1,4-dioxane in these wells have generally been increasing since monitoring was initiated at the request of EPA in 2004. The concentrations of 1,4-dioxane detected in October 2013 represent the highest detections to-date in top-of-rock wells B131C, B137B, B138B and B145B. Concentrations of 1,4-dioxane in B119B, located downgradient of the B137 and B138 well clusters and outside the current Institutional Control Area, have also recently (2011 through 2013) shown an increase in 1,4-dioxane concentrations. Concentrations of 1,4-dioxane in monitoring well B113BB, located downgradient of the southwestern limit of the SWDA, appear to relatively stable since June 2004.

The highest concentration of 1,4-dioxane detected in the shallow overburden groundwater was downgradient of IWS-3 in well B160C (8.8 ug/L). 1,4-dioxane was also detected in shallow overburden well B119B, located downgradient of the Site in the vicinity of Lily Pond Road.

Elevated 1,4-dioxane concentrations present in the bedrock wells (e.g., B120D at 27 ug/L and B126B at 11 ug/L) indicate a potential for the 1,4-dioxane plume to extend beyond the boundary of the Groundwater Reclassification Area. Continued monitoring of groundwater for 1,4-dioxane is necessary, and may require the monitoring of additional existing monitoring wells and/or the installation and monitoring of new groundwater wells.

<u>*Landfill Gas*</u>

The concentration of landfill gas is monitored at gas extraction wells within the SWDA landfill and off-cap gas monitoring probes. The landfill gas system, including gas extraction system, flare system, compressed gases, management and safety equipment, undergoes monthly inspections by the PRP. No problems were noted during the monthly inspections conducted during the last five years.

The gas extraction wells are also monitored monthly (output only) for flow rate, temperature, vacuum, and the concentrations of methane, carbon dioxide and oxygen. The data are intended to be used to

[4] No trend evaluation was performed on monitoring wells where 1,4-dioxane was not detected or detected fewer than four times during the monitoring period. This includes a total of 37 monitoring well locations.

balance the landfill gas management system by optimizing methane gas collection and minimizing the rate at which oxygen is pulled into the waste from the atmosphere. Monitoring data indicate the landfill gas management system is properly balanced.

The crawl spaces beneath the mobile homes to the northwest of the landfill were also monitored in the past for the presence of landfill gas. Subsurface gas monitoring probes were installed mainly in the northwest portion of the Site to define the extent of landfill gas beyond the boundary of the SWDA landfill. The subsurface investigations conducted during the installation of the probes indicated there are two separate zones beneath the mobile home park, shallow and deep, where landfill gas has been shown to migrate. The zones are separated by a fine-grained silt layer that appears to act as a barrier to retard the upward vertical migration of landfill gas from the deep zone into the shallow zone.

Probe monitoring data have historically indicated higher and more sustained concentrations of methane in the deep zone, while the detections in the shallow zone have generally been lower and intermittent. During previous FYRs, it was noted that there was a strong correlation between periods of low barometric pressure and the presence of landfill gas in both zones and that the low barometric pressure was creating a pressure differential between the landfill waste and the surrounding soils causing gas to migrate from the high pressure (landfill waste) to low pressure (surrounding soils). The rise and fall of the barometric pressure resulted in a pulsing of landfill gas into the soils below the mobile homes. It was not clear whether the gas in the shallow zone was the result of vertical migration from the deep zone or lateral migration directly from the landfill. In either case, gas in the shallow zone has the most potential to migrate upward into the crawl spaces beneath the mobile homes, or the interior of the mobile homes where the gas would be cause for concern.

The PRP is currently conducting monitoring of landfill gas probes at a minimum of once per month. Two levels of contingency are currently in place to protect the safety of the mobile home residents. A concentration above 20% of the Lower Explosive Limit (LEL) within a shallow probe triggers expanded monitoring to define the extent of the gas plume until concentrations subside. A concentration of 50% of the LEL within a shallow probe triggers expanded monitoring of the mobile homes to determine if explosive concentrations are present. LEL measurements during the last five years did not trigger any contingency activities.

In general, the methane concentrations in landfill gas probes declined since balancing and optimization of the landfill gas management system started in January 2003. From October 2002 through January 2005, gas probes were monitored on a daily basis. Beginning in February 2005, following approval of the Gas Probe Monitoring Program and Contingency Plan in January 2005, barometric-based monitoring was conducted, which included monitoring on a monthly basis at a minimum, but more frequently if the barometric pressure fell below the benchmarks.

During the 2001 to 2004 FYR period, data were presented for gas probes GP-21B (shallow) and GP-21A (deep), showing a significant decrease over that period from the highest methane concentrations (as percent LEL) of 250 and 74 for the deep and shallow zones, respectively. In response to the 2004 FYR report recommendations for further monitoring and delineation of the elevated methane concentrations, additional probes were installed in October 2004 and August 2006, including GP-34A, GP-34B and GP-35 located downgradient of the GP-21 cluster.

Building upon the previous FYR, Figure 5 shows the results of the monitoring for GP-34B (shallow) and GP-34A (deep) from November 2006 to December 2013. This graph indicates that methane has not been detected in the shallow probe (GP-34B), methane concentrations have decreased in GP-34A (the deep probe) and have generally been non-detect during the past five years. Over this timeframe, methane was not detected in either of the GP-21 probes or at GP-35. The methane concentration (as percent LEL) trends within the GP-34 well cluster continue to indicate that the methane gas collection system is being properly balanced.

To date methane has not been detected in the crawl spaces below the mobile homes, even when the concentration of methane in the shallow gas probes exceeded 50% LEL (prior to the current FYR period). Therefore, the performance standard for the landfill to maintain gas concentrations to 25% of the LEL in the shallow soil below the mobile homes and 100% LEL at the landfill boundary is protective. The 25% LEL standard represents a factor of safety of 4 against explosion in subsurface structures. The factor of safety should be higher for the crawl spaces due to the dispersion of the gas when it enters the atmosphere. Continued monitoring is critical to ensuring the remedy is protective in the future.

Review of ARARs and Other Standards

ARARs for the Parker Landfill Superfund Site were identified in the ROD (April 1995) and include the following:

- Federal Safe Drinking Water Act MCLs and Maximum Contaminant Level Goals (MCLGs)
- Vermont Hazardous Waste Regulations
- Vermont Groundwater Protection Rule and Strategy (VT Primary Groundwater Quality Standards)
- Vermont Water Quality Standards
- Vermont Solid Waste Regulations
- Vermont Hazardous Waste Regulations
- Vermont Land Use and Development Law
- Vermont Air Pollution Control Regulations
- Federal National Emission Standards for Hazardous Air Pollutants (NESHAP) for Vinyl Chloride
- Federal NESHAP for Benzene Waste Operations
- Federal Noise Control Regulations
- Vermont Wetland Rules
- Vermont National Pollutant Discharge Elimination System (NPDES) Permit
- Resource Conservation & Recovery Act (RCRA)

Additionally, the ROD identifies the following as “To Be Considered” criteria:

- Federal Safe Drinking Water Act Secondary Maximum Contaminant Levels (SMCLs)
- Federal Safe Drinking Water Act Proposed MCLs
- Federal Drinking Water Health Advisories
- Federal Groundwater Protection Strategy

- Federal Interim Sediment Quality Criteria

Most of the ARARs cited in the ROD related to the design and construction of the landfill cap remedy have been met. Landfill cap ARARs that apply to ongoing landfill O&M activities include Vermont Air Pollution Control Regulations (adopted through September 2011 with proposed amendments currently under review), Federal NESHAP for Vinyl Chloride; Federal NESHAP for Benzene Waste Operations; and ARARs related to landfill post-closure maintenance and monitoring. These ARARs will be met with continued operation and maintenance of the landfill gas management system and landfill caps.

The primary ARARs cited in the ROD related to the groundwater remedy include the Federal Safe Drinking Water Act MCLs, MCLGs and the Vermont Groundwater Protection Rule and Strategy. The MCLs, MCLGs and Vermont Primary Groundwater Quality Standards (VPGQS) have not been revised since the signing of the previous FYR in September 2009.[5] These ARARs are being complied with or will be complied with upon remedy completion. The remedy will be operated and groundwater quality will be monitored until groundwater cleanup goals are attained.

Construction of the PRB component of the groundwater remedy required that wetlands be created on Site to compensate for those destroyed to construct the PRB. The compensatory wetland was constructed and is inspected as part of routine O&M activities for the remedy. The principal ARAR for this portion of the groundwater remedy is the Vermont Wetland Rules. In May 2012, rulemaking authority concerning Vermont Water Quality Standards, Wetland Rules, Public Water Rules, Surface Level Rules and Rules Determining Mean Water Levels was transferred from the Vermont Natural Resources Board to the Agency of Natural Resources. The Vermont Wetland Rules were subsequently amended (adopted July 16, 2010), becoming effective on August 1, 2010.

ARARs cited in the ROD to address protection of surface water bodies include the Vermont Water Quality Standards and NPDES provisions of the Clean Water Act. As noted below, the NPDES rules do not currently apply to the groundwater remedy. The existing Vermont Water Quality Standards became effective December 20, 2011. Proposed amendments to Water Quality Standards have been filed with the Vermont Secretary of State on May 23, 2014. The proposed amendments include modifying the Water Quality Criteria for the Protection of Health and Aquatic Biota (Appendix C of the Water Quality Standards), including some COCs at the Site (e.g., proposed criteria for iron).

The Vermont NPDES Permit rules do not apply to the groundwater remedy as currently constructed, because the groundwater remedy does not include a discharge to surface water, as was envisioned in the ROD-specified groundwater remedy (a pump-and-treat system).

The Vermont Underground Injection Control (UIC) Rule is relevant and appropriate to the groundwater remedy as currently constructed, because bio-enhancing reagents are injected to support the BNA component of the remedy. This rule requires that owners of injection wells apply for a permit. However, because the remedial action is being performed on a Superfund Site, it is not required that a permit be obtained. However, the substantive requirements of the UIC permit process should be met.

[5] As indicated in Appendix C interview record, the VTDEC anticipates adopting a new Groundwater Protection Rule and Strategy prior to the next FYR due date in 2019.

Table 6 lists those COCs for which the current MCL or VPGQS is different from the ROD-based IGCL, or those contaminants that are present in Site groundwater that do not have a ROD-based IGCL but do have a MCL or VPGQS that is exceeded at some locations. Table 7 presents the ROD-based IGCLs and their basis, along with the current MCL or VPGQS. IGCLs were established in the ROD for groundwater COCs. The ROD established IGCLs as MCLs, MCLGs, or VPGQS, as available. For chemicals lacking regulatory limits, risk-based values were used as IGCLs.

Table 6
Water Quality Standards Revised or Developed since 1995 ROD

Analyte	IGCL in ROD (ug/L)	Current Standard (MCL and/or VPGQS) (ug/L)	Type of Current Standard	Basis of IGCL
Tetrachloroethylene	0.7	5	MCL and VPGQS	VPGQS, 1994
2-Butanone	170	4.2	VPGQS	VPGQS, 1994
1,4-Dioxane	NA	3	VPGQS	NA
Arsenic	50	10	MCL and VPGQS	MCL, 1994
Acetone	3,700	700	VPGQS	Risk based
Chromium	50	100	MCL and VPGQS	VPGQS, 1994
Manganese	180	300	VPGQS	Risk based

Table 7
Comparison of IGCLs with Current MCLs and/or VPGQS

Carcinogenic Constituents	ROD-Based IGCL (ug/L)	ROD Basis for IGCL	Current MCL/VPGQS (ug/L)	Source of Current MCL/VPGQS (ug/L)
1,1-Dichloroethene	7	MCLG	7	MCL [a]
Benzene	5	MCL	5	MCL [a]
Methylene Chloride	5	MCL	5	MCL [a]
Tetrachloroethene	0.7	VPGQS	5	MCL [a]
Trichloroethene	5	MCL	5	MCL [a]
Vinyl Chloride	2	MCL	2	MCL [a]
1,4-Dioxane	NA	NA	**3**	**VPGQS [b]**
Bis(2-ethylhexyl)phthalate	6	MCL	6	MCL [a]
Arsenic	***50***	***MCL***	***10***	***MCL [a]***
Beryllium	4	MCL	4	MCL [a]
1,2-Dichloroethene	70	MCL	70	MCL [a, e]
Acetone	***3,700***	***RB***	***700***	***VPGQS [c]***
2-Butanone	170	VPGQS	4,200	VPGQS [c]
1,1,1-Trichloroethane	200	MCLG	200	MCL [a]
4-Methylphenol	200	RB	1,920*	Risk-based*
Antimony	6	MCL	6	MCL [a]
Chromium	50	VPGQS	100	VPGQS [c]
Manganese	180	RB	**300**	**VPGQS [d]**

Table 7 Comparison of IGCLs with Current MCLs and/or VPGQS				
Carcinogenic Constituents	**ROD-Based IGCL (ug/L)**	**ROD Basis for IGCL**	**Current MCL/VPGQS (ug/L)**	**Source of Current MCL/VPGQS (ug/L)**
Nickel	100	MCL	100	VPGQS [c]
Vanadium	0.2	RB	86*	Risk-based*

Bold and Italicized = IGCL in the ROD is higher than the Current MCL/VPGQS for this analyte.
IGCL = Interim Groundwater Cleanup Level from the ROD
MCL = Safe Drinking Water Act Maximum Contaminant Level
MCLG = Safe Drinking Water Act Maximum Contaminant Level Goal
NA = Not Applicable (no IGCL for this analyte included in ROD)
* = Risk-based screening levels established at a cancer risk of 1 x 10^{-6} or non-cancer hazard of 1.
RB = Risk-Based
VPGQS = Vermont Primary Groundwater Quality Standard
[a] = National Primary Drinking Water Regulations, 40 CFR Ch. I Part 141, 7-1-02 Edition.
[b] = New interim enforcement standard for 1,4-dioxane, VT Water Supply Division, March 6, 2009.
[c] = Vermont Primary Groundwater Quality Standards, Ch. 12: Groundwater Protection Rule and Strategy, February 14, 2005.
[d] New interim enforcement standard for manganese, VT Water Supply Division, March 6, 2009.
[e] The MCL listed for 1,2-dichloroethene is specific to the cis isomer.

The currently applicable standards for acetone and arsenic are lower (i.e., more stringent) than those applicable at the time of the ROD. The VPGQS standards for tetrachloroethylene, 2-butanone, and chromium have increased (i.e., are less stringent) from those applicable at the time of the ROD. The VPGQS for manganese was reduced from what it was in 2004 (reduced from 840 ug/L to 300 ug/L), but it remains greater than the ROD IGCL of 180 ug/L.

Vermont also previously revised its enforcement standard for 1,4-dioxane from 20 ug/L to 3 ug/L. It may be necessary to update the ROD IGCL in the future to accommodate these changes in standards, both more stringent and less stringent than those applied in the ROD, depending on review of groundwater quality data as the remedy progresses.

Inspection of the Site

The inspection of the Site was conducted on 5/8/2014. In attendance were Leslie McVickar of EPA, John Schmeltzer of the VTDEC, David Pettit (project engineer) and Scott Heim (senior ecologist) from TRC on behalf of EPA, Eric Chadburn of Fairbanks Scales, Incorporated and Frederik Schuele of URS.

The Site inspection included visual inspection of the surfaces of the SWDA and IWS-3 caps, the landfill gas management system, storm water controls, fencing, the wetland compensation areas, the PRB, and BNA injection wells. The Site inspection generally included the following.

- Walking inspection of the perimeter and top of the SWDA landfill cap was conducted to look for evidence of erosion, cap disturbance, excessive settlement, and poor growth of vegetation (e.g., bare spots, presence of stressed grass cover, abnormal growth of weeds/woody vegetation));
- On and off-cap storm water control structures were inspected for damage, settlement, sedimentation, vegetation and blockage;

- The above-ground portions of structures that penetrate the cap (i.e., gas vents and utility poles) were inspected for damage;
- The landfill gas flare was observed to confirm that the flare was operating at the time of the inspection; and
- The wetland mitigation area was inspected.

Overall, the Site appears in good condition. The findings of the Site inspection are summarized below.

- The surfaces of the SWDA landfill cap and the IWS-3 were generally in good condition with no signs of erosion, holes, cracks or bulging. The cover system appeared to be firm and stable and the vegetative cover was in excellent condition. Several areas of settlement were observed including the following:
    - The area in the western portion of the landfill, in the vicinity of GW-4, appears to have a fairly significant degree of settlement. The settlement appears to be approximately one foot below the previous year's elevation and GW-4 has shifted on a noticeable angle. Since settlement could cause the cap liner to separate from the well and allow infiltration of precipitation, Fairbanks Scales, Inc. is conducting an examination of the well to evaluate the need for repairs.
    - A minor area (1-foot by 1-foot) of settlement may be occurring at the interface between the grassed cap and the stone collection area near the inlet to Culvert #2.
    - The slope benches and other drainage ditches were in good condition with no signs of erosion, undermining or bypass.
    - The two gabion-lined downcomers, or letdown channels, on the SWDA cap were in good condition with no evidence of material degradation, erosion, undercutting, or obstructions, with the following exceptions:
        - Vegetation was observed at the bottom of Downcomer No. 1, along with standing water. The vegetation should be removed.
        - An area of settlement at the top of Downcomer No. 2 was observed. Settlement at this location has historically been observed. It was monitored since the last FYR inspection through surveying of five points in the area. Representatives from Fairbanks Scales, Inc. reported that the survey monitoring was expanded to include portions of the surrounding cap. It was recently determined that this settlement area needed investigation and repairs, as the settlement was retaining water above the geotextile liner and preventing proper drainage. Those repairs are anticipated to be completed in 2014. However, to ensure the future integrity of the cap all preventative repairs need to be made and an updated survey performed annually by a VT licensed surveyor to both monitor over time and to warn of future necessary repairs.
    - No obstructions were observed at the ends of the drainage layer outlet pipes. The crushed stone layer along the edge of the cover system appeared to be in place and did not appear to be clogged.
    - The sedimentation basin was in good condition and appeared to be functioning properly. Two riprap-lined drainage structures located on the southern and western sidewall of the

basin, the inlet culvert and the riprap/gabion erosion control apron, were in good condition. Sedimentation was observed on the southeastern floor of the basin, and should be removed. Apparent tire ruts are evident on the southern sidewall. The ruts may contribute to future erosion and should be repaired.

  - The landfill gas flare was operating at the time of the inspection. No obvious damage or changed condition was apparent. However to fully evaluate the gas management system at the Site, input gas sampling should be conducted; as this has not been done in many years.

- The perimeter and access roads of the SWDA were in good condition with no signs of erosion, sedimentation or significant blockage.
- The PRB and source area monitoring wells appeared to be in good condition, based on visual observation. No wells were opened during the Site visit.
- The BNA system wells appeared to be in good condition, based on visual observation. Well #14 was observed to be unlocked during the Site visit and should be locked.
- The wetland compensation areas appear to be functioning as intended. Surface water appears to have been impounded at the northern wetland compensatory areas from past beaver activity, which also may have adversely affected the subsurface hydrology to the southern wetland compensation area by limiting wetland recharge. Surface water was not present in this wetland compensation area, though the ground detritus did exhibit staining which is associated with periodic inundation. Vegetation did not appear stressed, though this inspection occurred prior to the start of the growing season. Overall, both compensatory wetlands currently contain characteristics of wetland hydrology and predominantly hydrophytic vegetation.

Interviews with Key Stakeholders

During the FYR process, interviews were conducted with parties impacted by the Site, including the PRP, local authorities and regulatory agencies involved in Site activities or aware of the Site. The purpose of the interviews was to document any perceived problems or successes with the remedy that has been implemented to date. Interviews were conducted between May 30, 2014 and June 10, 2014. Interviews are summarized below and complete interviews are included in Appendix E.

Interviews were conducted with representatives of the VTDEC, Town of Lyndon, Vermont and the PRPs. The interviews were conducted via telephone or email following the Site inspection. The following provides a summary of each interview.

John Schmeltzer, Hazardous Waste Manager, VTDEC - Mr. Schmeltzer was interviewed via email on May 30, 2014. Mr. Schmeltzer feels that the management of the Site is going well and the remedial actions have been effective in mitigating contamination. He said that he has not had any complaints, violations or other incidents related to the Site that have required a response from VTDEC and is not aware of any community groups that are actively involved with the project. Although Mr. Schmeltzer has a good impression of the Site and communication between the VTDEC, EPA and PRPs is good, he noted two outstanding issues:

- An apparent upward trend in COCs and 1,4-dioxane; and

- Localized settlement in the vicinity of extraction Well GW-4.

Mr. Schmeltzer indicated that EPA and VTDEC have directed the PRPs to evaluate the apparent upward contaminant trend and provide recommended further steps (as necessary) to be undertaken. Further evaluation of the localized settlement is also currently being evaluated by the PRPs.

Eric Chadburn, Facilities Manager, Fairbanks Scales, Incorporated - Mr. Chadburn was interviewed by telephone on June 4, 2014. Mr. Chadburn, representing the PRP responsible for landfill O&M, reported that overall the landfill portion of the Site is in good order and that he has a good overall impression of the project. Mr. Chadburn stated that since the last FYR, there have not been any significant changes to the O&M of the landfill. Although no unexpected difficulties with the O&M of the landfill have developed, Mr. Chadburn noted that further evaluation of the settlement in the vicinity of extraction Well GW-4 will be conducted and repairs implemented with EPA approval. Mr. Chadburn also noted that animal burrows are an ongoing concern, but that mitigation measures have been successful. Mr. Chadburn stated that he had no recommendations for reducing or increasing activities at the Site, but that they are planning to prepare for when the time comes that there is insufficient methane to burn, so that they can have a plan in place to deal with it effectively and efficiently.

Frederik Schuele, Project Manager/Hydrogeologist, URS Corporation – Mr. Schuele was interviewed via email on June 10, 2014. URS Corporation is the consultant representing Vermont American, the PRP responsible for the groundwater remedies. URS designed and is operating the groundwater remedies. Mr. Schuele stated that the PRB and BNA groundwater remedies are functioning as expected and are performing well, without any unexpected difficulties. Mr. Schuele indicated that the PRB continues to intercept impacted shallow overburden groundwater from IWS-3, as designed, and that a significant overall reduction in the mass of VOCs is being achieved downgradient. Similarly, Mr. Schuele stated that BNA monitoring indicates effective reduction in the concentrations and mass of VOCs in groundwater downgradient of the landfill, with an overall reduction in TCE concentrations within the BNA treatment zone since 2005 and the continued presence of chlorinated ethenes, ethene, volatile fatty acids (VFAs) and nutrients in downgradient monitoring wells indicating active dechlorination throughout the treatment zone and downgradient aquifer.

Mr. Schuele stated that significant changes to the monitoring of the PRB included an addendum to the LTMP in July 2010 that modified the sampling program to eliminate analysis of ethene, ethane and chloride. Performance monitoring of the BNA remedial activity continues to be conducted in accordance with the approved O&M Plan, but the plan was revised in 2011 to accommodate the use of emulsified vegetable oil (EVO) as an amendment compound, which resulted in an expanded analytical suite and additional monitoring of additional wells (both monitoring wells and extraction wells).

Mr. Schuele anticipates continued reductions in the concentrations of VOCs downgradient of the PRB and BNA areas, with an eventual shift to monitored natural attenuation (MNA), but no detailed projections for achieving cleanup goals have been established. Given that the BNA remedial activity is not intended to continue indefinitely, BNA O&M modifications were recently proposed to allow for continued operation of the BNA remedial activity until concentrations of total chlorinated ethenes are reduced to the point where MNA is feasible and effective. The proposed BNA O&M modifications will be implemented pending regulatory approval.

With regard to increasing VOC and 1,4-dioxane trends within the top-of-rock groundwater within the western-southwestern portion of the Site, Mr. Schuele indicated monitoring and trend evaluations will continue to better understand the groundwater conditions and conceptual site model (CSM). The CSM will be revised (as needed) to identify data gaps for the top-of-rock groundwater flow system, recommend additional sampling locations and propose installation of addition monitoring wells to further define the impact extents.

Justin Smith, Zoning Administrator, Town of Lyndon, Vermont – Mr. Smith was contacted via email on June 10, 2014 regarding the Town's efforts to expand the "Institutional Control Area" and any new areas/roads/housing developments in the vicinity of the Site. According to Mr. Smith, no new areas/roads have been included in the zoning ordinance within the last five years and no new construction is proposed/planned in the vicinity of the Site. Mr. Smith stated that the Town has completed expansion of the "Institutional Control Area" and that the area is identified in the Town's zoning bylaws.

IV. TECHNICAL ASSESSMENT

Question A: *Is the remedy functioning as intended by the decision documents?*

Yes. The review of documents, ARARs, and the results of the Site inspection indicate that the landfill cap and groundwater remedy are functioning as intended by the ROD and ESD. The major components of the selected remedy in the ROD included:

- Multi-layer caps on the SWDA and three IWS areas with gas collection systems at the three IWS areas;
- Source control groundwater extraction and treatment, which was revised in the July 2004 ESD in favor of the PRB and BNA technologies with pump-and- treat retained as a contingency;
- Wetland restoration;
- Institutional controls; and
- Long-term monitoring to evaluate the performance and protectiveness of the remedy.

The following provides a summary of how the primary components of the remedy are functioning.

Capping and Landfill Gas Management

The capping of the SWDA and IWS-3 area has achieved the remedial objectives of minimizing, to the extent practicable, the potential for transfer of hazardous substances from the soil and solid waste into the groundwater, surface water and sediment; and to prevent direct contact/ingestion of soil or solid waste posing a potential total cancer risk greater than 10^{-4} to 10^{-6}, or a potential hazard index greater than one. Construction of the groundwater remedy was completed in September 2005, and the groundwater was reclassified to Class IV (not potable; suitable for some industrial and agricultural use). A municipal water line was constructed to service the residences within the proposed institutional control boundary, preventing current exposures through household water use. However, due to the fact that institutional controls will need to be expanded to include current IGCL exceedances, the remedy, as prescribed in the ROD, has not yet been fully implemented. This does not impact the remedy's protectiveness at this time since no one is currently using the Site or associated contaminated water. Should the institutional controls not be finalized, this could impact the remedy's protectiveness in the future.

Although currently protective, the area in the vicinity of GW-4 on the SWDA has a fairly significant degree of settlement which requires evaluation and repairs. As noted in Section III, further evaluation has been initiated by the PRPs.

The landfill gas management system was designed and constructed in accordance with the Landfill Cap Remedial Design Statement of Work dated November 1996 and standard engineering practice. While the performance standard for the gas management system is to protect the potentially exposed individuals and comply with federal and state regulation, there was some concern in the past with the ability of the landfill gas system to achieve the ROD objective of preventing lateral migration of landfill gas. The point of compliance for air, consistent with the NCP, shall be the point(s) of the maximum exposed individual, considering reasonable expected used of the Site and surrounding area. The maximum exposed individuals include: (1) adjacent residents; (2) O&M personnel; and (3) individuals working at the facility. The gas collection system is successful in preventing an unacceptable risk of exposure to the maximum exposed individuals by controlling the release of landfill gas and treating collected landfill gas. The gas collection and treatment system also complies with federal and state air regulations.

To date methane has not been detected in the crawl spaces below the mobile homes and monitoring data indicate that the frequency of detection and concentration of methane in the subsurface has declined over time to the point where it is currently non-detect in most gas probes. Current monitoring of the shallow gas probes provides sufficient warning to allow evacuation of the mobile home residents prior to the development of explosive conditions.

O&M of the caps and landfill gas management system is effective. Minor issues as identified in the Site inspection continue to be addressed adequately. The landfill gas management system is the only component of the cap remedy that offers the possibility of optimization.

Groundwater Restoration, PRB and BNA

Several VOCs (i.e., 1,1-dichloroethane, 1,4-dioxane, cis-1,2-DCE and/or TCE) have been detected in shallow groundwater monitoring wells located near occupied residences as recently as October 2013. Although risk screening concluded that the vapor intrusion pathway was not significant at this time, the groundwater trends analysis indicates that concentrations of some VOCs are increasing in a few locations. Therefore, groundwater monitoring should continue in the vicinity of occupied buildings to ensure that concentrations do not increase to levels exceeding the vapor intrusion screening criteria.

In addition, there are multiple 1,4-dioxane exceedances of the IGCL within the shallow overburden, top-of-rock, and bedrock wells downgradient of the Site, near Lily Pond and Red Village Roads. The highest concentrations of 1,4-dioxane were detected in top-of-rock wells located immediately southwest and south of the SWDA. The trend evaluation presented in the Draft 2013 Annual LTM Report indicates increasing 1,4-dioxane trends in top-of-rock wells within these portions of the Site (i.e., B131C, B137B, B138B and B145B). Elevated 1,4-dioxane concentrations present in the bedrock wells (e.g., B120D and

B126B) indicate a potential for the 1,4-dioxane plume to extend beyond the boundary of the Groundwater Reclassification Area. As a result, continued monitoring of groundwater for 1,4-dioxane is necessary, and may require the monitoring of additional existing monitoring wells and/or the installation and monitoring of new groundwater wells.

The modified remedy described in the ESD included construction of a PRB within the source area using a treatment cell with granular zero-valent iron. The PRB continues to successfully intercept the flow path of impacted groundwater within the shallow overburden moving downgradient from the IWS-3 source area. Monitoring data collected during the last five years continues to indicate favorable geochemical conditions for dechlorination of VOCs. As a result, the mass of VOCs in the groundwater continues to be reduced by the PRB as indicated by concentrations of VOCs downgradient of the PRB (well clusters B162, B167 and B168) exhibiting lower VOC concentrations than in corresponding upgradient wells (well clusters B164, B165 and B170). However, monitoring should continue in accordance with the LTMP to evaluate limited detections of VOCs in excess of the IGCLs downgradient of the PRB (e.g., TCE in B167B and B168B).

The ESD also included BNA treatment of the downgradient portion of the contaminated aquifer. BNA amendment applications were successfully implemented in November 2005, September 2007 and September 2009. Although initial applications were successful, the Draft BNA O&M Plan was amended in September 2011 to include the use of Slow Release Substrate (SRS®). Several BNA monitoring wells have generally exhibited a decrease in TCE concentrations with an initial increase in cis-1,2-DCE concentrations, followed by a decrease in cis-1,2-DCE, and an increase in vinyl chloride concentrations. The observation of these trends, in combination with other indicator data (e.g., presence of ethene, VFAs, etc.), suggests that the BNA portion of the remedy is promoting favorable conditions for natural attenuation and is functioning as designed.

Ongoing BNA evaluation and monitoring in accordance with the LTMP is required, as concentrations of select VOCs continue to exceed IGCLs within and downgradient of the BNA well group and some increasing trends appear to be evident. For example, the TCE concentration within B173B appears to be either stable or increasing slightly since 2006. In addition, several wells appear to exhibit a slight increase in indicator VOC concentrations in October 2013, which suggests the potential for rebound to be occurring following the previous BNA application in September 2011.

Wetland Restoration

Based on Site inspections conducted during that last five years, the wetland compensation areas appear to be functioning as intended. Surface water appears to have been impounded at the northern wetland compensatory areas from past beaver activity, which also may have adversely affected the subsurface hydrology to the southern wetland compensation area. Although surface water was not present in the southern wetland compensation area in October 2013, the vegetation does not appear stressed. Overall, both compensatory wetlands currently contain characteristics of wetland hydrology and predominantly hydrophytic vegetation indicating that this portion of the remedy is functioning as designed.

Question B: ***Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy section still valid?***

No. Although there have been changes in toxicity values, exposure assumptions and risk assessment methods since the 1993 risk assessment, the changes do not affect remedy protectiveness as long as the landfill cap remains intact, the property is not used for residential purposes, municipal water is supplied to residences within the groundwater plume, and ongoing monitoring and evaluation of groundwater, sediment and surface water contaminant concentrations relative to current risk-based concentrations continues.

Question B is addressed by reviewing the human health and ecological risk assessments that formed the basis for the selected remedies, describing any significant differences as compared to current risk assessment practice, and qualitatively evaluating the impact of any such differences on remedy protectiveness.

Human Health Risk Review

The 1993 risk assessment evaluated the risks and hazards associated with current and future ingestion of groundwater in the entire vicinity of the Site and on the Site, direct contact with and incidental ingestion of soil and sediment at the Site, and inhalation of VOCs in air emitted from the landfill and the unnamed stream.

The primary risks and hazards observed in this analysis were those associated with the ingestion of contaminated groundwater. The primary risk contributors for the groundwater ingestion pathway were 1,2-dichloroethene, TCE, vinyl chloride, 4-methylphenol, arsenic, and manganese. The risks and hazards associated with incidental ingestion of and dermal contact with soil were less significant than those estimated for groundwater ingestion. However, elevated risks and hazards for soil exposures in the IWS-2 and IWS-3 areas were attributable to TCE, barium, chromium, and vanadium for a future residential scenario. Risks and hazards above EPA's risk management guidelines were also estimated for future recreational sediment exposure in the unnamed stream, due to arsenic. Potential risks associated with current trespasser exposure to surface soil, surface water, and sediment and exposure to VOCs in ambient air were below EPA's risk management guidelines. The risk assessment did not evaluate the potential for vapor intrusion (VI) from groundwater contaminants into structures overlying the groundwater, current or future exposures to surface water, or direct contact with soil or shallow groundwater by excavation workers.

There were no cleanup levels established for the landfill cap remedy as the landfill cap prevents exposures to contaminated soil and solid wastes. The ROD established IGCLs as MCLs, MCLGs, or VPGQS, as available. For chemicals lacking regulatory limits, risk-based values were used as IGCLs. Sediment and surface water are monitored periodically to determine landfill impacts to the unnamed brook.

In this FYR report, the toxicity values that served as the basis for the cleanup levels, as contained in the ROD, were re-evaluated to determine whether any changes in toxicity impact the protectiveness of the remedy. Any changes in current or potential future exposure pathways or exposure assumptions that may impact remedy protectiveness are also noted. In addition, environmental data, available since the last FYR, have been qualitatively evaluated to determine whether exposure levels existing at the Site present a risk to current human receptors.

Changes in Toxicity Criteria

Tables 1 and 2 in Appendix F present the changes in toxicity values (oral reference doses and oral cancer slope factors) for compounds selected as compounds of potential concern (COPCs) in the 1993 Risk Assessment. Updated toxicity information was obtained from the EPA's 2014 Integrated Risk Information System (IRIS) and other current EPA sources (e.g., the Superfund Technical Support Center). For most contaminants, changes to toxicity values have been minimal and primarily reflect decreases in toxicity (e.g., acetone, 2-butanone, 1,1-dichloroethene, 1,1,1-TCA, 4-methylphenol, barium and manganese), though some compounds are now believed to have greater toxicity than thought in 1993 (PCE, TCE, hexavalent chromium and benzene).

Changes in toxicity values for groundwater COCs would not affect remedy protectiveness since municipal water has been supplied to residences within the groundwater plume. Until IGCLs are achieved, an evaluation should be performed to demonstrate that the risk and hazard associated with potable groundwater do not exceed EPA's risk management guidelines. Until IGCLs are achieved and groundwater use is demonstrated to pose no risk to human health, the installation of private wells and associated groundwater exposure pathways should be prevented. The Groundwater Reclassification Area was delineated based on data collected in 2000; however downgradient IGCL exceedances and increasing VOC concentration trends, including 1,4-dioxane, continue to be evident west-southwest of the SWDA. As a result, the established institutional controls do not encompass the area of recent IGCL exceedances as required by the ROD and institutional controls should be expanded to assure future protectiveness for groundwater exposures.

One compound not identified as a groundwater COPC in the 1993 Risk Assessment is 1,4-dioxane, a common solvent stabilizer used with 1,1,1- TCA-based degreasers. Recent (2013) groundwater sampling for 1,4-dioxane resulted in detected concentrations up to 980 µg/L. Monitoring of 1,4-dioxane should be continued and a potential exposure to this compound considered in future risk evaluations as warranted.

Changes in toxicity do not affect the soil remedy since the SWDA and IWS areas have been consolidated and capped. The risk assessment identified a future risk associated with residential use of these areas. Therefore, as long as the cap remains intact and the property is not used for residential purposes in the future, the remedy remains protective for soil exposure pathways.

Changes in toxicity values have the potential to affect remedy protectiveness for sediment and surface water. However, recent sediment and surface water monitoring data are compared to risk-based concentrations, developed using the most up-to-date toxicity and exposure information available to confirm remedy protectiveness. This comparison is presented in the *Human Health Risk Evaluation of Recent Sampling Data* section (below).

Changes in Exposure Pathways, Assumptions and Methods

There have been no changes in land use since the last FYR. The landfill property is undeveloped and fenced, with only the occasional trespasser accessing the property. With respect to groundwater use, exposures to contaminants in groundwater used as household water or for other purposes are controlled. Municipal water has been supplied to residences within the groundwater plume. However, additional enforceable controls may be needed to assure future protectiveness until IGCLs are achieved.

A new method to evaluate compounds with mutagenic modes of action is now recommended by EPA. The currently recommended method was not used as part of the 1993 evaluation since the EPA carcinogen risk assessment guidance was published subsequent to the completion of the Site-specific risk assessment. Vinyl chloride, methylene chloride, TCE and total chromium (evaluated as hexavalent chromium) are COCs which have been determined to be carcinogenic through a mutagenic mode of action. In the 2005 Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens, EPA recommends evaluating chemicals with mutagenic modes of action using either chemical-specific data on susceptibility from early-life exposures or an age-dependent adjustment factor (ADAF) applied to the cancer slope factor. Because chemical-specific data on susceptibility from early-life exposures were available for the derivation of vinyl chloride's updated cancer slope factor, the updated slope factor is used for risk characterization and an ADAF is not applied. ADAFs are applied when assessing risk for methylene chloride, TCE and hexavalent chromium. None of the other COCs were determined to be carcinogenic by a mutagenic mode of action. However, because no complete exposure pathway exists for groundwater and soil exposures are prevented by the landfill cap remedy, this change in methodology does not affect the protectiveness of the remedy. In addition, continued evaluation of sediment and surface water monitoring data compared to risk-based concentrations developed using the most current methodology will assure that these media do not pose a risk to human health (see *Human Health Risk Evaluation of Recent Sampling Data* section below)

In February 2014, EPA published updated standard default exposure assumptions for Superfund sites, based on exposure studies considered and evaluated in the 2011 Exposure Factors Handbook. Some of the recommended exposure assumptions are more conservative than those used previously, while some are less conservative. However, these changes in exposure assumptions do not affect remedy protectiveness due to the presence of the landfill cap preventing exposure, the availability of public water, and the ongoing monitoring and evaluation of sediment and surface water contaminant concentrations relative to current risk-based concentrations.

The 1993 Risk Assessment did not specifically assess the risk to excavation workers exposed to soil or shallow groundwater contamination during intrusive activities. Because this receptor population has not been evaluated, excavations into areas of the Site with soil and shallow groundwater contamination should be prevented, or an evaluation should be performed to determine the potential risk to workers prior to initiating intrusive activities as part of Site re-development.

An additional pathway of potential concern that was not evaluated in the 1993 Risk Assessment is the VI pathway. This pathway may be of concern at sites where shallow groundwater contaminated with VOCs exists in close proximity to occupied buildings. The VI pathway from groundwater to indoor air was evaluated by EPA in 2003. This evaluation determined this pathway to be associated with negligible risk due to the presence of clean groundwater between the deep groundwater plume and the vadose zone.

A VI risk analysis was subsequently prepared by URS as part of the 2013 Annual LTM Report. The evaluation concluded that cancer risks and noncancer hazards associated with the VI pathway are minimal for residential properties adjacent to the Site. However, because groundwater concentrations within the landfill property would be associated with risks and hazards above EPA criteria due to TCE and vinyl chloride, the report recommends the use of land use controls to prohibit redevelopment on the landfill property.

Due to the February 2014 update in the standard default exposure assumptions and recent updates to toxicity values, the vapor intrusion pathway screening evaluation for the current residences was updated and is presented in the following section.

Human Health Risk Evaluation of Recent Sampling Data

Sediment

Table 8 summarizes the maximum detected concentrations observed in sediment over the last 5 years at the three locations. As part of long-term monitoring activities required by the ROD, sampling and analysis of sediments was performed once in the past 5 years at three locations (SD01, SD02, and SD03) in the unnamed stream, in October 2013.

To conservatively evaluate whether the maximum detected sediment concentrations would pose a risk to trespassers or recreational users, a comparison to EPA's May 2014 residential soil Regional Screening Levels (RSLs) was performed. The residential soil RSLs are developed based on current toxicity and exposure information and correspond to a carcinogenic risk of 1×10^{-6} and a noncarcinogenic hazard of 0.1, to account for the detection of more than one compound in sediment. Because the screening levels are based on exposures assumed to occur in a residential yard at a frequency, duration, and intensity greater than sediment exposures within the unnamed brook, comparison directly to residential soil RSLs would be highly conservative. Therefore, sediment screening levels were developed assuming the frequency of contact with soil is approximately 7-fold less (up to 52 days per year as assumed in the ROD) than residential exposures which are assumed to occur daily. The sediment screening levels presented in Table 8 below are the residential soil RSLs multiplied by the 7-fold adjustment factor.

Table 8
Comparison of 2009-2013 Maximum Sediment Concentrations to Human Health Screening Levels

Pollutant	2009-2013 Maximum Sediment Concentration (mg/kg)	Sediment Screening Level (mg/kg)
Aluminum	4,090	53,900
Barium	28.2	10,500
Chromium	7.58	2.1
Cobalt	2.52	16.1
Copper	4.22	2,170
Iron	10,800	38,500
Lead (1)	8.33	400
Manganese	220	1,260
Mercury	0.0341	5.46
Nickel	3.92	1,050
Vanadium	8.74	273

Table 8 Comparison of 2009-2013 Maximum Sediment Concentrations to Human Health Screening Levels		
Pollutant	**2009-2013 Maximum Sediment Concentration (mg/kg)**	**Sediment Screening Level (mg/kg)**
Zinc	37.4	16,100

(1) Screening Level listed is the residential lead screening level developed using the Integrated Exposure Uptake Biokinetic Model.

Maximum detected sediment concentrations are below the RSLs except for chromium (assuming chromium is present in the hexavalent form). The sediment chromium concentration exceeds the sediment screening level set at a cancer risk of 1×10^{-6} by less than 4-fold, indicating an incremental cancer risk of less than 4×10^{-6}. Factoring in the risk and hazard of all chemicals combined, this comparison of maximum sediment concentrations to sediment screening levels indicates that exposure to sediment in the unnamed brook would not be associated with a cumulative cancer risk and noncarcinogenic hazard greater than EPA's risk management criteria and consequently, would not pose an unacceptable risk to human health.

Routine reporting limits for thallium in sediment (approximately 20 mg/kg to 40 mg/kg) exceed its sediment screening levels of 0.55 mg/kg set at a noncarcinogenic hazard of 0.1. In addition, two of the four sediment sample results for thallium were rejected during the data validation process. To address these potential analytical issue, use of a more sensitive analytical method should be considered prior to the next round of sediment sampling.

Surface Water

Table 9 summarizes the maximum detected concentrations observed in surface water over the last 5 years at the three locations. Surface water sampling along the unnamed stream was also performed at three locations on an annual basis from September 2009 to October 2013. The locations of stream surface water samples (SW01, SW02, and SW03) were co-located with the sediment sample locations (SD01, SD02, and SD03).

To conservatively evaluate whether the maximum detected surface water concentrations would pose a risk to trespassers or recreational users, a comparison to the dermal component of the EPA's May 2014 tap water RSLs was performed. Use of the dermal component of the tap water screening levels is appropriate since depth of surface water in the unnamed brook is less than two feet, making swimming (and subsequent ingestion exposures) highly unlikely. The tap water RSLs are developed based on current toxicity and exposure information and correspond to a carcinogenic risk of 1×10^{-6} and a noncarcinogenic hazard of 0.1, to account for the detection of more than one compound in surface water. Because the dermal component of the tap water RSL is based on exposures assumed to occur to household water at a frequency, duration and intensity greater than surface water exposures within the unnamed brook, comparison directly to the tap water RSL would be highly conservative. Therefore, surface water screening levels were developed assuming the frequency of contact with surface water within the unnamed brook is approximately 52 days per year (as assumed in the ROD) compared to daily dermal contact with household water (i.e., a difference of approximately 7-fold). The surface water screening levels presented in Table 9 below are the tap water RSLs multiplied by the 7-fold adjustment factor.

Table 9 Comparison of 2009-2013 Maximum Surface Water Concentrations to Human Health Screening Levels		
Pollutant	**2009-2013 Maximum Surface Water Concentration (ug/L)**	**Surface Water Screening Level (ug/L)**
1,1,1-Trichloroethane	1.3	175,000
Acetone	7.03	3,080,000
Styrene	0.733	7,000
Tetrachloroethene	0.749	161
Trichloroethene	30.6	48.3
Vinyl chloride	0.359	1.89
cis-1,2-Dichloroethene	25.3	252
Trans-1,2-Dichloroethene	0.277	2,520
Aluminum	3,320	3,150,000
Barium	112	44,800
Cobalt	3.22	2,380
Iron	16,100	2,240,000
Lead (1)	13.3	15
Manganese	2,060	3,080
Vanadium	6.47	420
Zinc	64.7	1,610,000

(1) Screening Level listed is the Maximum Contaminant Level (MCL) for lead, protective of residential exposures to water including ingestion and dermal contact.

Maximum detected surface water concentrations are below the surface water screening levels. Therefore, exposure to surface water in the unnamed brook would not be associated with a cumulative cancer risk and noncarcinogenic hazard greater than EPA's risk management criteria and consequently, would not pose an unacceptable risk to human health.

Groundwater

The current VI pathway for residences in the vicinity of the landfill is evaluated using groundwater data collected between 2009 and 2013. Shallow overburden wells included in the analysis are: B118A, B119B, B120A, B121OW, B126S, B131B, B136A, B137A, B144A, B174A, B201OW, and MW-4A. This VI screening consists of a comparison of maximum detected shallow groundwater VOC concentrations from the vicinity of the occupied residences to groundwater vapor intrusion screening levels (VISLs) protective of groundwater to indoor air impacts. The VISLs were calculated using formulas obtained from EPA's 2014 VISL calculator (version 3.2.1) and the EPA's May 2014 residential indoor air RSLs, as presented in Appendix F, Table 3. The VISLs correspond to a cancer risk of 1 x 10^{-6} for carcinogens or a hazard quotient of 0.1 for noncarcinogens, to account for the detection of more than one compound in groundwater.

VOC concentrations are below VISLs presented in Table 10, except for benzene and TCE. For these two compounds, the maximum detected concentration exceeds the VISL based on a cancer risk of 1 x 10^{-6} by less than 2-fold, indicating the cancer risk is less than 2 x 10^{-6} for each of the compounds. In addition, the maximum detected TCE concentration exceeds its VISL based on a non-carcinogenic hazard quotient of 0.1 by approximately 3-fold. Factoring in the risk and hazard of all chemicals combined, the VI pathway would not be associated with a cumulative cancer risk and noncarcinogenic hazard greater than EPA's risk management criteria, confirming that the remedy is currently protective of VI.

Table 10
Comparison of Shallow Overburden Groundwater Concentrations to Vapor Intrusion Screening Levels

VOC	Maximum 2009-2013 Shallow Overburden Groundwater Concentration (ug/L)	Vapor Intrusion Screening Level (ug/L) [(a)]
1,1-Dichloroethane	0.455	7.83
Acetone	3.16	2,240,000
Benzene	3.05	1.59
Methylene chloride	0.338	474
Trichloroethene	1.62	0.521

(a) Values taken from Appendix F. The screening concentrations corresponding to a cancer risk of 10^{-6} and noncancer hazard of 0.1.

Routine reporting limits for benzene (5 ug/L), TCE (5 ug/L) and VC (1 ug/L) in groundwater samples are slightly greater than their corresponding VISLs. Because benzene and TCE were detected in monitoring wells included in the VI screening at estimated concentration less than the reporting limit, the slightly elevated reporting limits do not compromise the conclusions of the VI screening. For VC, VISLs are 0.15 ug/L for a cancer risk of 1 x 10^{-6} and 8.8 ug/L for a HQ of 0.1. The 1 ug/L VC reporting limit is less than the non-cancer based VISL, but exceeds the cancer-based VISL and would be associated with approximately a 7 x 10^{-6} cancer risk. Therefore, the elevated reporting limits for VC in groundwater would not change the conclusions of this VI screening.

However, the groundwater trends analysis indicates that concentrations of several VOCs are increasing indicating that groundwater monitoring should continue in the vicinity of occupied buildings to ensure that concentrations do not increase to levels exceeding the VISLs. In addition, should further Site development include the construction of occupied buildings above areas where shallow groundwater VOC contamination is present, the indoor air pathway should be further evaluated to determine the potential risk to individuals using those buildings. It should be noted that 1,4-dioxane was detected in a number of the shallow overburden wells. However, because 1,4-dioxane does not readily volatilize from groundwater and does not meet EPA's definition of a volatile compound, it is unlikely to contribute significantly to VI risk.

Ecological Risk Review

EPA's ecological risk assessment evaluated potential risks associated with stream and river surface water, stream sediment, and surface soil within the IWS areas. EPA ambient water quality criteria and available sediment screening benchmarks were used to evaluate chemical toxicity to ecological receptors. Surface soils were evaluated by estimating exposure doses received by various indicator species representing different foraging guilds. These doses were then compared to toxicity data obtained from the scientific literature.

The ecological risk assessment concluded that surface water quality in the unnamed stream may be impacted by elevated concentrations of iron and silver. Sediment concentrations of barium, cyanide and manganese were elevated above screening benchmarks but the results of macrobenthic invertebrate community sampling concluded that surface water and sediment contamination within the stream are unlikely to have resulted in adverse impacts to resident aquatic biota.

Risks to terrestrial receptors exposed to contaminants in surface soil were assessed by modeling exposures to three indicator species. Based on the modeling, the ecological risk assessment concluded that concentrations of metals in the IWS area surface soils may impact shrew (insectivores), while herbivores (e.g., meadow voles) and higher trophic levels (e.g., red fox) are unlikely to be affected.

Because surface soils within the SWDA and IWS areas have been consolidated and capped, there is no longer a complete ecological exposure pathway between receptors and surface soils. As long as the caps are maintained, this exposure pathway will remain incomplete.

As part of long-term monitoring activities required by the ROD, sampling and analysis of sediments was performed once in the past 5 years at three locations (SD01, SD02, and SD03) in the unnamed stream, in October 2013. Section III (Review of Site Monitoring Data) discussed the comparison of maximum concentrations detected in the long-term monitoring samples collected in the unnamed stream to the project-specific sediment quality guidelines established for the Site in the risk assessment. The 1993 ecological risk assessment concluded that barium, cyanide, and manganese concentrations were elevated above benchmarks but were unlikely to result in adverse effects to resident aquatic organisms. Cyanide was removed from the long-term monitoring program because the one sample location where an elevated concentration was detected had been disturbed during the construction of the cap. Maximum barium and manganese concentrations are lower than detected during the RI. Therefore, the potential for ecological impacts has decreased and the remedy remains protective with respect to sediment exposure to aquatic receptors.

Surface water sampling along the unnamed stream was performed at three locations on an annual basis from September 2009 to the present. The locations of stream surface water samples (SW01, SW02, and SW03) were co-located with the sediment sample locations (SD01, SD02, and SD03). Section III (Review of Site Monitoring Data) discusses the comparison of maximum concentrations detected in the long-term monitoring samples collected in the unnamed stream to National Recommended Water Quality Criteria. The 1993 ecological risk assessment concluded that aquatic biota in the unnamed stream may be impacted by elevated concentrations of iron and silver. However, surface water concentrations of silver have decreased in the unnamed stream to non-detectable levels and the maximum 2009-2013 iron concentration is approximately 2-fold lower than the maximum RI iron concentration. Therefore, the potential for ecological impacts has decreased and the remedy remains protective with respect to surface water exposures.

Question C: ***Has any other information come to light that could call into question the protectiveness of the remedy?***

Yes. Although the remedy continues to be protective in the short-term, future protectiveness could be affected by downgradient plume migration. Specifically, top-of-rock wells B131C, B138B and B145B located downgradient of the SWDA, have shown a significant increasing trend in the concentrations of TCE, cis-1,2-DCE and vinyl chloride in recent years, with the highest concentrations of these VOCs detected to-date in October 2013. In addition, other VOCs (i.e., 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloropropane, 1,4-dioxane, benzene and trans-1,2-DCE) have been detected in excess of their respective IGCLs in B138B. The increasing VOC concentration trends indicate a potential for the contaminant plume to extend beyond the boundary of the Groundwater Reclassification Area (mirrored by the current Institutional Control Area). However, public water is supplied to residences within the plume area.

Increasing 1,4-dioxane trends in are evident in top-of-rock wells B131C, B137B, B138B and B145B, which are located downgradient of the SWDA and IWS-1. The B145 well cluster is located in the downgradient portion of the current Institutional Control Area buffer. Concentrations of 1,4-dioxane in these wells have generally been increasing since monitoring was initiated at the request of EPA in 2004. The concentrations of 1,4-dioxane detected in October 2013 represent the highest detections to-date in top-of-rock wells B131C, B137B, B138B and B145B. Concentrations of 1,4-dioxane in B119C, located downgradient of the B137 and B138 well clusters and outside the current Institutional Control Area, have also recently (2011 through 2013) shown an increase in 1,4-dioxane concentrations.

The Draft 2013 Annual LTM Report suggests leaching waste materials in the SWDA and/or IWS-1, as well as impacted soil and waste relocated to the SWDA from IWS-2, or periodic settling and compaction of waste materials within the SWDA as possible causes of the increasing VOC concentrations; however further evaluation and monitoring is required to determine source(s) and long-term protectiveness of the remedy. Bosch has proposed updating the CSM for the Site to identify and define data gaps prior to submittal of the September 2015 LTM Report and anticipates installation and monitoring of additional monitoring wells.

Based on all of the activities conducted as part of this FYR, no additional information has come to light which would call into question the current protectiveness of the landfill cap or groundwater remedies.

Technical Assessment Summary

The review of documents, ARARs, and the results of the Site inspection indicate that the landfill cap and groundwater remedy are functioning as intended by the ROD and ESD. The capping of the SWDA and IWS-3 area has achieved the remedial objectives of minimizing, to the extent practicable, the potential for transfer of hazardous substances from the soil and solid waste into the groundwater, surface water and sediment and to prevent direct contact/ingestion of soil or solid waste posing potential risks to human health and the environment. The PRB and BNA remedial activities have been successful in reducing the contaminant concentrations and mass within and downgradient of the treatment areas. In addition the wetland restoration areas are functioning as designed. Although the remedies are functioning as designed and are currently protective, some issues requiring further evaluation have been identified, as described in Section V.

Exposure assumptions, toxicity data, cleanup levels and RAOs were addressed by reviewing the human health and ecological risk assessments that formed the basis for the selected remedies, describing any significant differences as compared to current risk assessment practice, and qualitatively evaluating the impact of any such differences on remedy protectiveness.

There have been no changes in land use since the last FYR. Though there have been changes in toxicity values, exposure assumptions and risk assessment methods since the 1993 risk assessment, the changes do not affect remedy protectiveness as long as the landfill cap remains intact, the property is not used for residential purposes, municipal water is supplied to residences within the groundwater plume, and ongoing monitoring and evaluation of groundwater, sediment and surface water contaminant concentrations relative to current risk-based concentrations continues.

An additional pathway of potential concern that was not evaluated in the 1993 risk assessment is the VI pathway. The VI pathway from groundwater to indoor air was evaluated by EPA in 2003. This evaluation determined this pathway to be associated with negligible risk due to the presence of clean groundwater between the deep groundwater plume and the vadose zone. A VI risk analysis was subsequently prepared by URS as part of the 2013 Annual LTM Report and updated as part of this FYR. The evaluations concluded that cancer risks and noncancer hazards associated with the VI pathway are minimal for residential properties adjacent to the Site. However, because groundwater concentrations within the landfill property would be associated with risks and hazards above EPA criteria due to TCE and vinyl chloride, land use controls to prohibit redevelopment on the landfill property may be warranted.

EPA's ecological risk assessment evaluated potential risks associated with stream and river surface water, stream sediment, and surface soil within the IWS areas. The potential for ecological impacts in sediments and surface water has decreased and the remedy remains protective with respect to sediment and surface water exposures to aquatic receptors. Because surface soils within the SWDA and IWS areas have been consolidated and capped, there is no longer a complete ecological exposure pathway between receptors and surface soils. As long as the caps are maintained, this exposure pathway will remain incomplete.

From all of the activities conducted as part of this FYR, no new information has come to light which would call into question the protectiveness of the landfill cap or groundwater remedies.

V. ISSUES / RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Table 11
Issues and Recommendations/Follow-up Actions

OU #	Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
						Current	Future
OU1	Institutional controls need to be expanded to ensure that the boundary encompasses the current contaminant plume.	Finalize Institutional controls for the Site.	PRP	EPA / VTDEC	12/31/2016	No	Yes
OU1	Recent data indicates that conditions have changed in the groundwater west of the SWDA.	Implement an investigation to evaluate and determine the current nature and extent of the VOC plume.	PRP	EPA / VTDEC	12/31/2015	No	Yes
OU1	Extent of 1,4-dioxane plume needs to be determined and further monitored.	Continue to monitor and define the extent of 1,4-dioxane in groundwater to ensure the plume is within the areas of established institutional control areas.	PRP	EPA / VTDEC	12/31/2015	No	Yes
OU1	Annual vapor intrusion evaluations must be performed.	Annually evaluate all groundwater VOC data, particularly in the vicinity of occupied buildings, against appropriate vapor intrusion screening criteria.	PRP	EPA / VTDEC	Ongoing	No	Yes
OU1	Localized landfill cap settlement.	Evaluate and repair settlement in the vicinity of extraction well GW-4.	PRP	EPA / VTDEC	12/31/2014	No	Yes

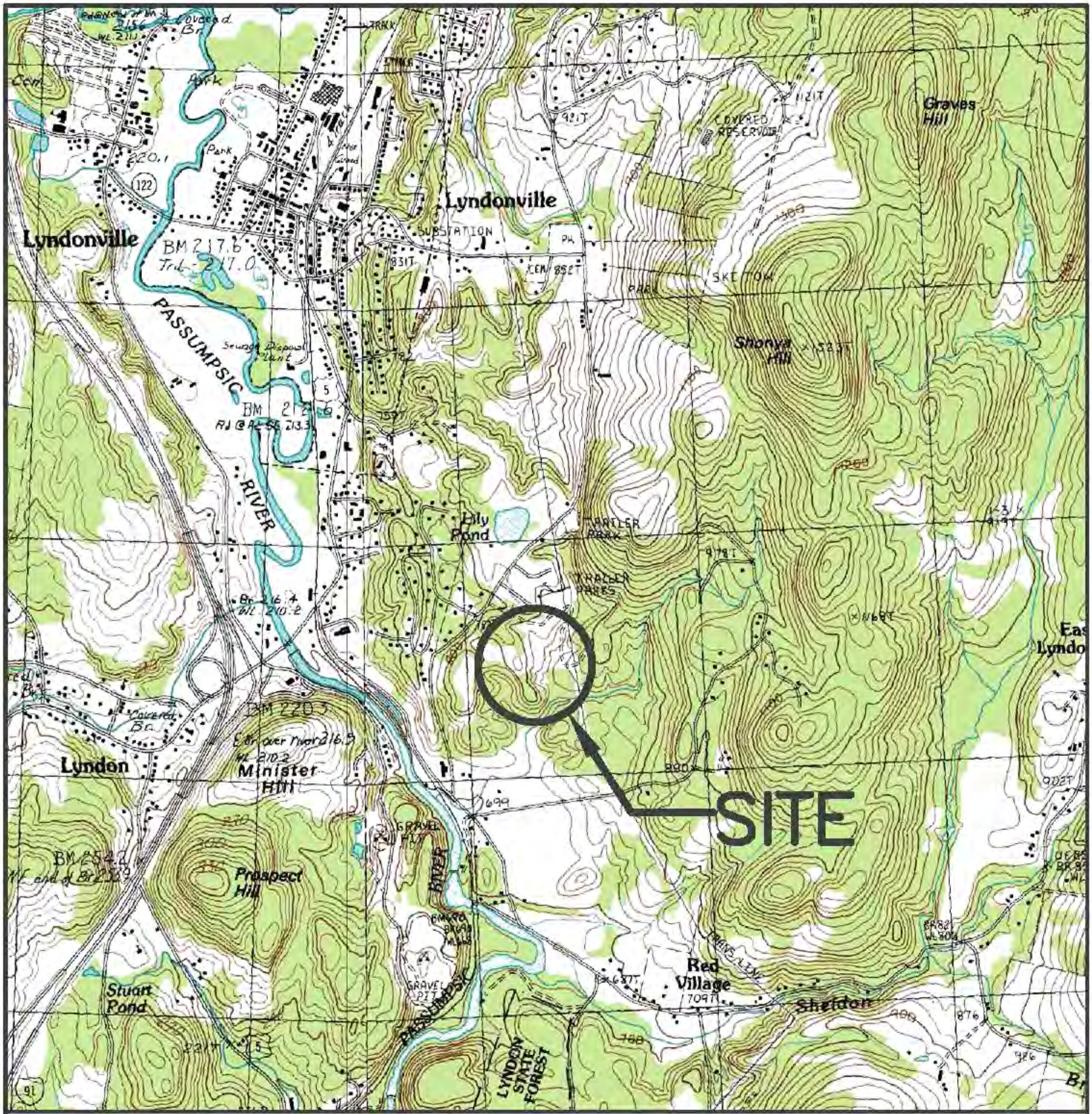
VI. PROTECTIVENESS STATEMENT

Site wide Protectiveness Statement
Protectiveness Determination: Short-term Protective
Protectiveness Statement: The remedy at the Parker Landfill Superfund Site currently protects human health and the environment because there is no current use of or exposure to site media containing contaminant concentrations exceeding applicable criteria. However, in order for the remedy to be protective in the long-term, institutional controls must be expanded and contaminant concentrations and trends (i.e., VOCs and 1,4-dioxane) must continue to be monitored and evaluated. Groundwater plume migration west of the landfill needs to be investigated and evaluated to determine the current nature and extent of groundwater contamination at the Site. Landfill repairs are necessary to address an area of settlement at location GW-4. All groundwater data must be evaluated for future potential vapor intrusion issues.

VII. NEXT REVIEW

The next FYR report for the Parker Landfill Superfund Site is required five years from the completion date of this review. Therefore, the next five-year review should be completed by September 30, 2019.

FIGURES



VERMONT

0 2000 4000

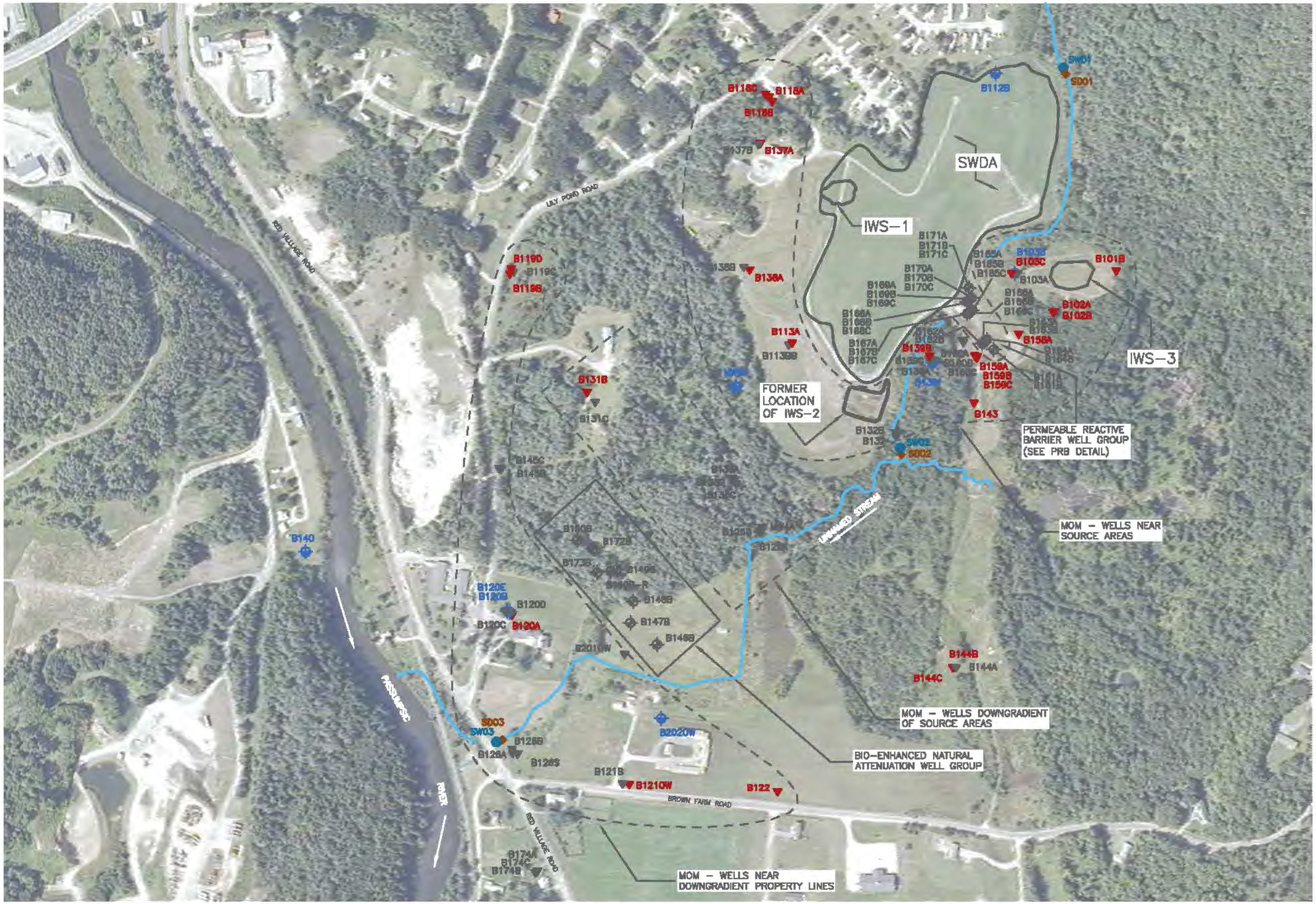
SCALE IN FEET

SOURCE:

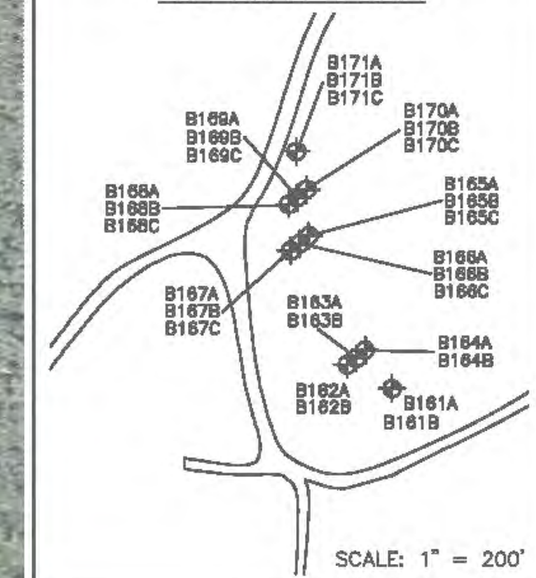
VERMONT TOPOGRAPHIC MAPS, 1:24000 EDITION, 2003 REVISION, VERMONT CENTER FOR GEOGRAPHIC INFORMATION

DRAFT

URS Corporation 477 Congress St Portland, ME 04101 Tel: 207.879.7686 Fax: 207.879.7685 www.urscorp.com	SCALE: 1" = 2000' DATE: DEC 2013 FILE NO: LTMP_2013 DESIGN: CAM APPROVED: MW DRAWN: FS	CLIENT: VERMONT AMERICAN CORPORATION PROJ: PARKER LANDFILL PROJECT NO: 38460777	TITLE: SITE LOCUS	FIGURE: 1



PRB AREA DETAIL



SCALE: 1" = 200'

LEGEND

- B120C ▼ MANAGEMENT OF MIGRATION WELL GROUP (ANNUAL SAMPLING)
- B120A ▼ MANAGEMENT OF MIGRATION WELL GROUP (5-YEAR SAMPLING)
- SW03 ● SURFACE WATER SAMPLE LOCATION (ANNUAL SAMPLING)
- SD03 ◆ SEDIMENT SAMPLE LOCATION (5-YEAR SAMPLING)
- B161B PERMEABLE REACTIVE BARRIER/ BIO-ENHANCED NATURAL ATTENUATION MONITORING WELL GROUP
- B120B HYDRAULIC ELEVATION MONITORING WELL GROUP

DRAFT

SOURCES:

WELL LOCATIONS SURVEYED BY URS CORPORATION BETWEEN MARCH 2000 AND OCTOBER 2005.

COLOR ORTHOPHOTO FROM NATIONAL AGRICULTURAL IMAGERY PROGRAM, VERMONT CENTER FOR GEOGRAPHIC INFORMATION, INC. 1:40000 (1 METER RESOLUTION) TRUE COLOR, COLLECTED IN 2009.

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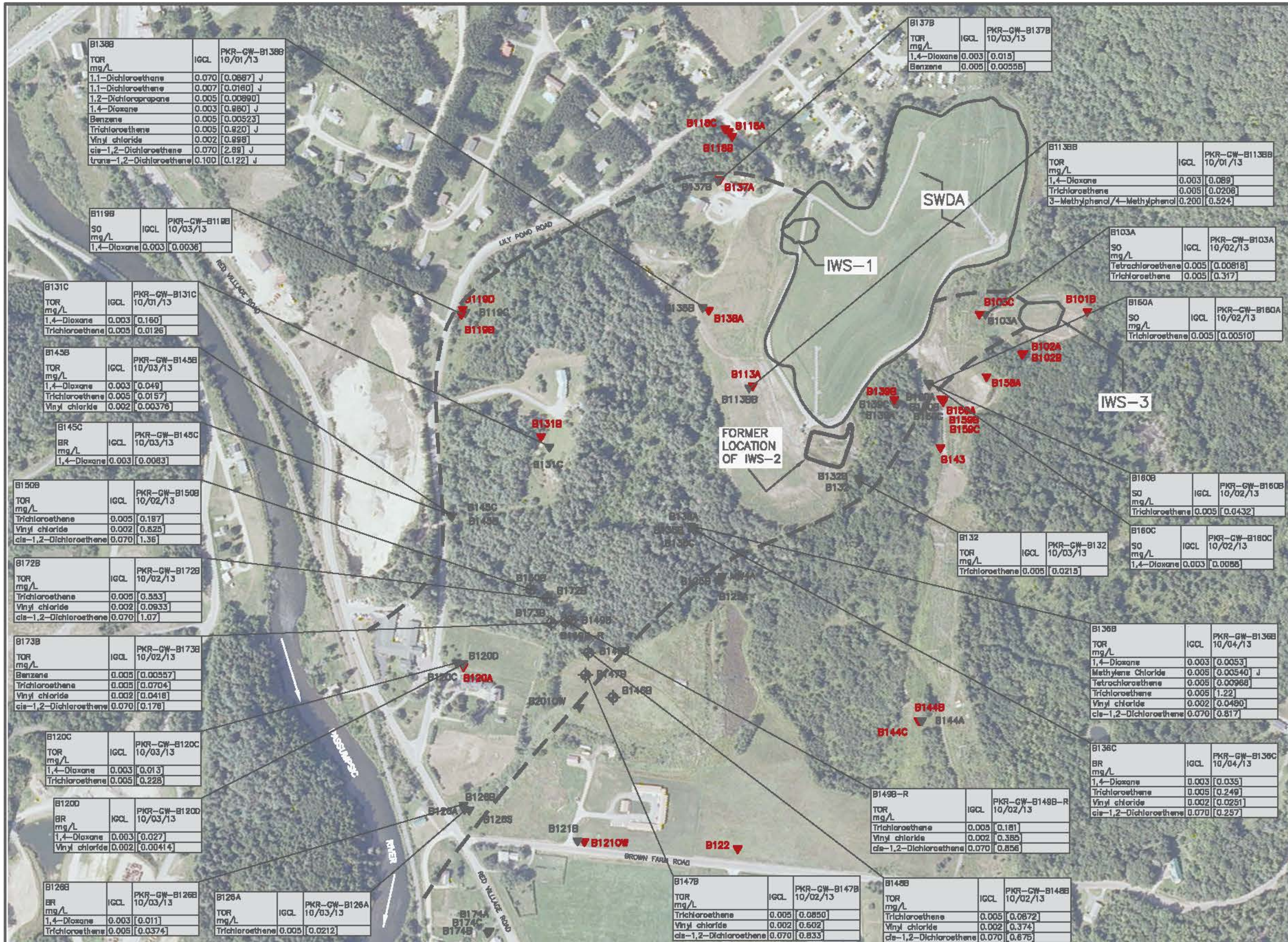
0 400 800
SCALE IN FEET

PROJECT NO:	39460936
DESIGN:	FS
SCALE:	1" = 400'
APPROVED:	MW
DATE:	DEC 2013
DRAWN:	FS
FILE NO:	LTMP_2013
CLIENT:	VERMONT AMERICAN CORPORATION
PROJECT:	PARKER LANDFILL LYNDONVILLE, VERMONT
TITLE:	SITE PLAN AND MONITORING LOCATIONS
FIGURE NO.:	2

P:\...\Parker Landfill\dwg\LTMP_2013.DWG, FIG 2 - SITE PLAN, 1/2/2014 10:00:26 AM



B138B TOR mg/L	IGCL	PKR-GW-B138B 10/01/13
1,1-Dichloroethane	0.070	[0.0687] J
1,1-Dichloroethene	0.007	[0.0160] J
1,2-Dichloropropane	0.005	[0.00890]
1,4-Dioxane	0.003	[0.960] J
Benzene	0.005	[0.00523]
Trichloroethene	0.005	[0.920] J
Vinyl chloride	0.002	[0.898]
cis-1,2-Dichloroethene	0.070	[2.69] J
trans-1,2-Dichloroethene	0.100	[0.122] J

B119B SO mg/L	IGCL	PKR-GW-B119B 10/03/13
1,4-Dioxane	0.003	[0.0036]

B131C TOR mg/L	IGCL	PKR-GW-B131C 10/01/13
1,4-Dioxane	0.003	[0.160]
Trichloroethene	0.005	[0.0126]

B145B TOR mg/L	IGCL	PKR-GW-B145B 10/03/13
1,4-Dioxane	0.003	[0.049]
Trichloroethene	0.005	[0.0157]
Vinyl chloride	0.002	[0.00376]

B145C BR mg/L	IGCL	PKR-GW-B145C 10/03/13
1,4-Dioxane	0.003	[0.0063]

B150B TOR mg/L	IGCL	PKR-GW-B150B 10/02/13
Trichloroethene	0.005	[0.197]
Vinyl chloride	0.002	[0.825]
cis-1,2-Dichloroethene	0.070	[1.36]

B172B TOR mg/L	IGCL	PKR-GW-B172B 10/02/13
Trichloroethene	0.005	[0.553]
Vinyl chloride	0.002	[0.0933]
cis-1,2-Dichloroethene	0.070	[1.07]

B173B TOR mg/L	IGCL	PKR-GW-B173B 10/02/13
Benzene	0.005	[0.00557]
Trichloroethene	0.005	[0.0704]
Vinyl chloride	0.002	[0.0416]
cis-1,2-Dichloroethene	0.070	[0.176]

B120C TOR mg/L	IGCL	PKR-GW-B120C 10/03/13
1,4-Dioxane	0.003	[0.013]
Trichloroethene	0.005	[0.228]

B120D BR mg/L	IGCL	PKR-GW-B120D 10/03/13
1,4-Dioxane	0.003	[0.027]
Vinyl chloride	0.002	[0.00414]

B126B BR mg/L	IGCL	PKR-GW-B126B 10/03/13
1,4-Dioxane	0.003	[0.011]
Trichloroethene	0.005	[0.0374]

B126A TOR mg/L	IGCL	PKR-GW-B126A 10/03/13
Trichloroethene	0.005	[0.0212]

B137B TOR mg/L	IGCL	PKR-GW-B137B 10/03/13
1,4-Dioxane	0.003	[0.015]
Benzene	0.005	[0.00558]

B113BB TOR mg/L	IGCL	PKR-GW-B113BB 10/01/13
1,4-Dioxane	0.003	[0.089]
Trichloroethene	0.005	[0.0206]
3-Methylphenol/4-Methylphenol	0.200	[0.524]

B103A SO mg/L	IGCL	PKR-GW-B103A 10/02/13
Tetrachloroethene	0.005	[0.00818]
Trichloroethene	0.005	[0.317]

B160A SO mg/L	IGCL	PKR-GW-B160A 10/02/13
Trichloroethene	0.005	[0.00510]

B160B SO mg/L	IGCL	PKR-GW-B160B 10/02/13
Trichloroethene	0.005	[0.0432]

B160C SO mg/L	IGCL	PKR-GW-B160C 10/02/13
1,4-Dioxane	0.003	[0.0066]

B132 TOR mg/L	IGCL	PKR-GW-B132 10/03/13
Trichloroethene	0.005	[0.0215]

B136B TOR mg/L	IGCL	PKR-GW-B136B 10/04/13
1,4-Dioxane	0.003	[0.0053]
Methylene Chloride	0.005	[0.00540] J
Tetrachloroethene	0.005	[0.00968]
Trichloroethene	0.005	[1.22]
Vinyl chloride	0.002	[0.0480]
cis-1,2-Dichloroethene	0.070	[0.817]

B136C BR mg/L	IGCL	PKR-GW-B136C 10/04/13
1,4-Dioxane	0.003	[0.035]
Trichloroethene	0.005	[0.249]
Vinyl chloride	0.002	[0.0251]
cis-1,2-Dichloroethene	0.070	[0.257]

B149B-R TOR mg/L	IGCL	PKR-GW-B149B-R 10/02/13
Trichloroethene	0.005	[0.181]
Vinyl chloride	0.002	[0.385]
cis-1,2-Dichloroethene	0.070	[0.856]

B147B TOR mg/L	IGCL	PKR-GW-B147B 10/02/13
Trichloroethene	0.005	[0.0850]
Vinyl chloride	0.002	[0.602]
cis-1,2-Dichloroethene	0.070	[0.833]

B148B TOR mg/L	IGCL	PKR-GW-B148B 10/02/13
Trichloroethene	0.005	[0.0672]
Vinyl chloride	0.002	[0.374]
cis-1,2-Dichloroethene	0.070	[0.675]

LEGEND

▼	MANAGEMENT OF MIGRATION WELL GROUP (ANNUAL SAMPLING)
▼ (red)	MANAGEMENT OF MIGRATION WELL GROUP (5-YEAR SAMPLING)
⌖	BNA MONITORING WELL GROUP
(mg/L)	MILLIGRAMS PER LITER
IGCL	INTERIM GROUNDWATER CLEANUP LEVEL
[ ]	CONCENTRATION EXCEEDS IGCL
J	ESTIMATED CONCENTRATION
— —	APPROXIMATE EXTENT OF IGCL EXCEEDANCES, ALL DEPTH ZONES

WELL SCREEN ZONE

SO	SHALLOW OVERBURDEN
TOR	TOP-OF-ROCK
BR	BEDROCK

SOURCES:

WELL LOCATIONS SURVEYED BY URS CORPORATION BETWEEN MARCH 2000 AND OCTOBER 2005.

COLOR ORTHOPHOTO FROM NATIONAL AGRICULTURAL IMAGERY PROGRAM, VERMONT CENTER FOR GEOGRAPHIC INFORMATION, INC. 1:40000 (1 METER RESOLUTION) TRUE COLOR, COLLECTED IN 2009.

IGCLs LISTED ARE BASED ON VALUES PRESENTED IN THE RECORD OF DECISION (EPA, 1995), MAXIMUM CONTAMINANT LEVELS (EPA, 2009), AND VERMONT PRIMARY GROUNDWATER QUALITY STANDARDS (VTANR, 2005).

DRAFT

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SCALE IN FEET

PROJECT NO:	39460936		
DESIGN:	FS	SCALE:	1" = 400'
APPROVED:	MW	DATE:	DEC 2013
DRAWN:	FS	FILE NO:	LTMP_2013

CLIENT: VERMONT AMERICAN CORPORATION

PROJECT: PARKER LANDFILL LYNDONVILLE, VERMONT

TITLE: EXCEEDANCES OF IGCLs FOR VOCs AND SVOCs IN GROUNDWATER 2013

FIGURE NO.: 3

B138B TOR mg/L	IGCL	PKR–GW–B138B 10/01/13
1,1–Dichloroethane	0.070	[0.0687] J
1,1–Dichloroethene	0.007	[0.0160] J
1,2–Dichloropropane	0.005	[0.00890]
1,4–Dioxane	0.003	[0.980] J
Benzene	0.005	[0.00523]
Trichloroethene	0.005	[0.920] J
Vinyl chloride	0.002	[0.898]
cis–1,2–Dichloroethene	0.070	[2.69] J
trans–1,2–Dichloroethene	0.100	[0.122] J

B119B SO mg/L	IGCL	PKR–GW–B119B 10/03/13
1,4–Dioxane	0.003	[0.0036]

B131C TOR mg/L	IGCL	PKR–GW–B131C 10/01/13
1,4–Dioxane	0.003	[0.160]
Trichloroethene	0.005	[0.0126]

B145B TOR mg/L	IGCL	PKR–GW–B145B 10/03/13
1,4–Dioxane	0.003	[0.049]
Trichloroethene	0.005	[0.0157]
Vinyl chloride	0.002	[0.00376]

B145C BR mg/L	IGCL	PKR–GW–B145C 10/03/13
1,4–Dioxane	0.003	[0.0063]

B150B TOR mg/L	IGCL	PKR–GW–B150B 10/02/13
Trichloroethene	0.005	[0.197]
Vinyl chloride	0.002	[0.825]
cis–1,2–Dichloroethene	0.070	[1.36]

B172B TOR mg/L	IGCL	PKR–GW–B172B 10/02/13
Trichloroethene	0.005	[0.553]
Vinyl chloride	0.002	[0.0933]
cis–1,2–Dichloroethene	0.070	[1.07]

B173B TOR mg/L	IGCL	PKR–GW–B173B 10/02/13
Benzene	0.005	[0.00557]
Trichloroethene	0.005	[0.0704]
Vinyl chloride	0.002	[0.0418]
cis–1,2–Dichloroethene	0.070	[0.176]

B120C TOR mg/L	IGCL	PKR–GW–B120C 10/03/13
1,4–Dioxane	0.003	[0.013]
Trichloroethene	0.005	[0.228]

B120D BR mg/L	IGCL	PKR–GW–B120D 10/03/13
1,4–Dioxane	0.003	[0.027]
Vinyl chloride	0.002	[0.00414]

B126B BR mg/L	IGCL	PKR–GW–B126B 10/03/13
1,4–Dioxane	0.003	[0.011]
Trichloroethene	0.005	[0.0374]

B126A TOR mg/L	IGCL	PKR–GW–B126A 10/03/13
Trichloroethene	0.005	[0.0212]

B137B TOR mg/L	IGCL	PKR–GW–B137B 10/03/13
1,4–Dioxane	0.003	[0.015]
Benzene	0.005	[0.00558]

B113BB TOR mg/L	IGCL	PKR–GW–B113BB 10/01/13
1,4–Dioxane	0.003	[0.089]
Trichloroethene	0.005	[0.0206]
3–Methylphenol/4–Methylphenol	0.200	[0.524]

B103A SO mg/L	IGCL	PKR–GW–B103A 10/02/13
Tetrachloroethene	0.005	[0.00818]
Trichloroethene	0.005	[0.317]

B160A SO mg/L	IGCL	PKR–GW–B160A 10/02/13
Trichloroethene	0.005	[0.00510]

B160B SO mg/L	IGCL	PKR–GW–B160B 10/02/13
Trichloroethene	0.005	[0.0432]

B132 TOR mg/L	IGCL	PKR–GW–B132 10/03/13
Trichloroethene	0.005	[0.0215]

B160C SO mg/L	IGCL	PKR–GW–B160C 10/02/13
1,4–Dioxane	0.003	[0.0088]

B136B TOR mg/L	IGCL	PKR–GW–B136B 10/04/13
1,4–Dioxane	0.003	[0.0053]
Methylene Chloride	0.005	[0.00540] J
Tetrachloroethene	0.005	[0.00968]
Trichloroethene	0.005	[1.22]
Vinyl chloride	0.002	[0.0480]
cis–1,2–Dichloroethene	0.070	[0.817]

B136C BR mg/L	IGCL	PKR–GW–B136C 10/04/13
1,4–Dioxane	0.003	[0.035]
Trichloroethene	0.005	[0.249]
Vinyl chloride	0.002	[0.0251]
cis–1,2–Dichloroethene	0.070	[0.257]

B149B–R TOR mg/L	IGCL	PKR–GW–B149B–R 10/02/13
Trichloroethene	0.005	[0.181]
Vinyl chloride	0.002	[0.385]
cis–1,2–Dichloroethene	0.070	[0.856]

B147B TOR mg/L	IGCL	PKR–GW–B147B 10/02/13
Trichloroethene	0.005	[0.0850]
Vinyl chloride	0.002	[0.602]
cis–1,2–Dichloroethene	0.070	[0.833]

B148B TOR mg/L	IGCL	PKR–GW–B148B 10/02/13
Trichloroethene	0.005	[0.0872]
Vinyl chloride	0.002	[0.374]
cis–1,2–Dichloroethene	0.070	[0.675]

LEGEND

- ▼ MANAGEMENT OF MIGRATION WELL GROUP (ANNUAL SAMPLING)
- ▼ MANAGEMENT OF MIGRATION WELL GROUP (5–YEAR SAMPLING)
- BNA MONITORING WELL GROUP
- (mg/L) MILLIGRAMS PER LITER
- IGCL INTERIM GROUNDWATER CLEANUP LEVEL
- [ ] CONCENTRATION EXCEEDS IGCL
- J ESTIMATED CONCENTRATION
- APPROXIMATE EXTENT OF IGCL EXCEEDANCES, ALL DEPTH ZONES
- Approximate IC Buffer Zone

WELL SCREEN ZONE

- SO SHALLOW OVERBURDEN
- TOR TOP–OF–ROCK
- BR BEDROCK

SOURCES:

WELL LOCATIONS SURVEYED BY URS CORPORATION BETWEEN MARCH 2000 AND OCTOBER 2005.

COLOR ORTHOPHOTO FROM NATIONAL AGRICULTURAL IMAGERY PROGRAM, VERMONT CENTER FOR GEOGRAPHIC INFORMATION, INC. 1:40000 (1 METER RESOLUTION) TRUE COLOR, COLLECTED IN 2009.

IGCLs LISTED ARE BASED ON VALUES PRESENTED IN THE RECORD OF DECISION (EPA, 1995), MAXIMUM CONTAMINANT LEVELS (EPA, 2009), AND VERMONT PRIMARY GROUNDWATER QUALITY STANDARDS (VTANR, 2005).

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SCALE IN FEET

PROJECT NO:	39460936
DESIGN: FS	SCALE: 1" = 400'
APPROVED: MW	DATE: DEC 2013
DRAWN: FS	FILE NO: LTMP_2013
CLIENT:	VERMONT AMERICAN CORPORATION
PROJECT:	PARKER LANDFILL LYNDONVILLE, VERMONT
TITLE:	Approximate Buffer Zone of Institutional Controls based on Groundwater Reclassification
FIGURE NO.:	4

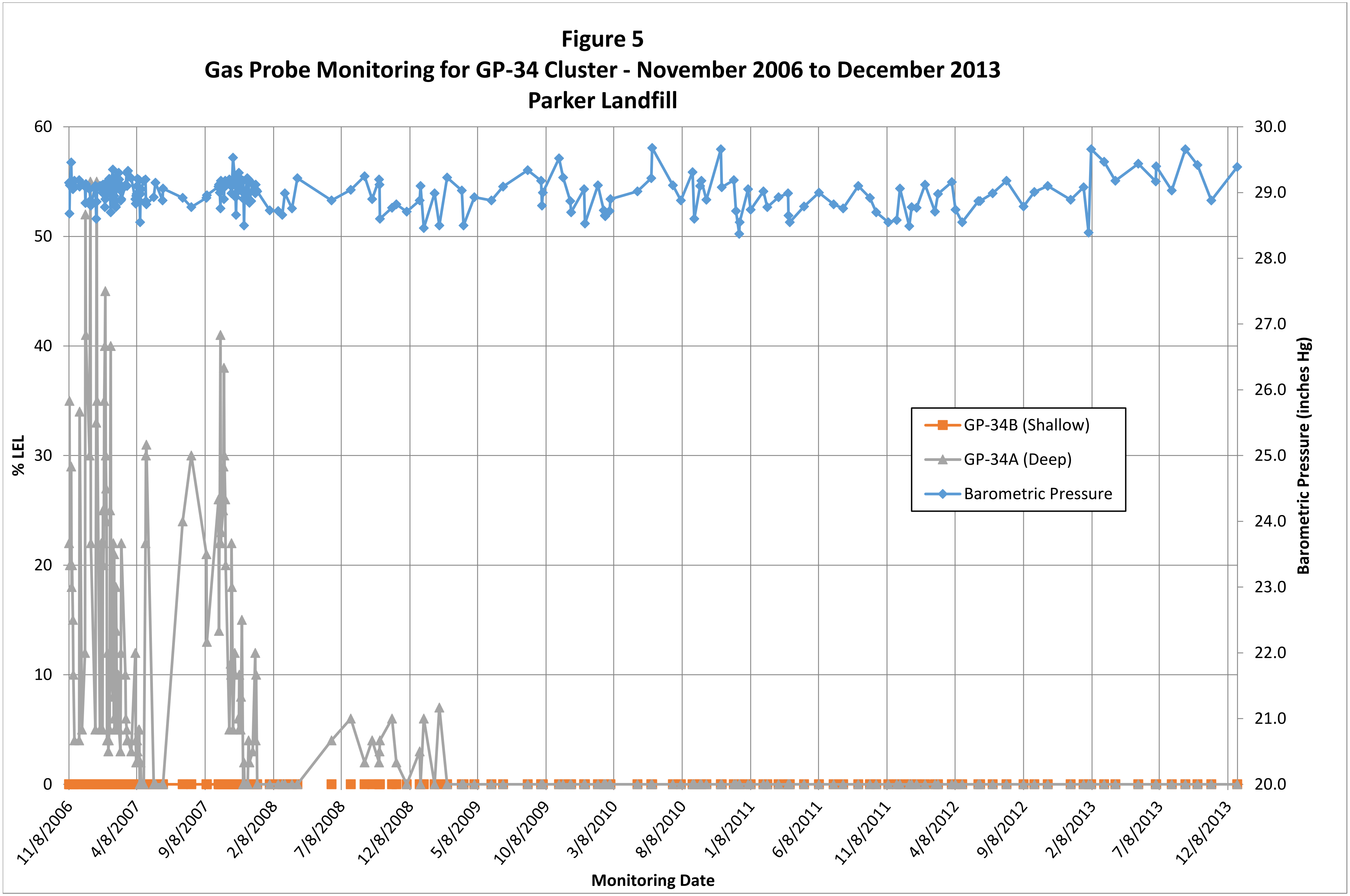


Figure 5
Gas Probe Monitoring for GP-34 Cluster - November 2006 to December 2013
Parker Landfill
% LEL
Barometric Pressure (inches Hg)
Monitoring Date
60
50
40
30
20
10
0
30.0
29.0
28.0
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
11/8/2006
4/8/2007
9/8/2007
2/8/2008
7/8/2008
12/8/2008
5/8/2009
10/8/2009
3/8/2010
8/8/2010
1/8/2011
6/8/2011
11/8/2011
4/8/2012
9/8/2012
2/8/2013
7/8/2013
12/8/2013
GP-34B (Shallow)
GP-34A (Deep)
Barometric Pressure

APPENDIX A – EXISTING SITE INFORMATION

A. SITE CHRONOLOGY

The chronology of all significant Site events and dates is included in Table A-1.

Table A-1 Site Chronology	
Event	**Date**
Permitted Solid Waste Disposal at Site	October 1971 through 1992
Monitoring wells installed by landfill operator	1979
Preliminary Assessment/Uncontrolled Hazardous Waste Site Evaluation by VTAEC	1984-1985
Proposed NPL listing date	June 21, 1988
NPL listing date	February 16, 1990
Consent Order for RI/FS	August 1990
Initial Site Characterization activities by ESE, Inc.	Aug. 1990 – July 1991
Initial Site Characterization Report by ESE, Inc.	February 10, 1992
RI/FS	July 1990-June 1991
RI report complete	May 2, 1994
FS report complete	June 1, 1994
ROD Signature	April 4, 1995
Quarterly Groundwater Monitoring	1999-2007
First Five-Year Review Report	September 2004
Annual Groundwater Monitoring and Reporting	2007-present
Second Five-Year Review Report	September 2009
Landfill Cap	
AOC for Remedial Design	December 1996
Cap design start	1997
Cap design complete	1999
CD for Remedial Action (cap)	April 1999
Cap Construction start	April 1999
Cap Construction end	November 2000
Cap Remedy complete	December 2001
Groundwater Treatment Remedy	
Unilateral Administrative Order for Remedial Design and Remedial Action	April 26, 1999
Class IV Groundwater Reclassification Petition	May 31, 2001
Draft Institutional Control Report	December 13, 2002
VTDEC Reclassification of Groundwater to Class IV	November 6, 2003
Downgradient Pre-Design Technical Report by URS	November 7, 2003
Draft Source Area Pre-Design Technical Report by URS	January 9, 2004

Table A-1 Site Chronology	
Event	**Date**
Alternative Technology Analysis and Evaluation by URS	July 14, 2004
Declaration for the ESD	July 2004
EPA Approval of the Remedial Design	September 22, 2004
PRB and BNA groundwater remediation system construction begins	September 2004
PRB and BNA system construction complete	September 2005
Overall Remedy	
Preliminary Construction Completion Report signed	September 2005
First full-scale BNA groundwater remediation system injection event	November 2005
Final Inspection performed and Site is determined to be Operational and Functional	May 2006
Second full-scale BNA groundwater remediation system injection event	September 2007
Third full-scale BNA groundwater remediation system injection event	September 2009
Lyndon Amendment to draft BNA Operation and Maintenance Plan	September 2011
Fourth full-scale BNA groundwater remediation system injection event (initial event employing Slow Release Substrate [SRS®])	September 2011

B. BACKGROUND

Physical Characteristics

Figure 1 in the FYR shows the location of the Parker Landfill Superfund Site on the southern side of Lily Pond Road in the Town of Lyndon, Caledonia County, Vermont. The current Site configuration is shown on Figure 2 in the FYR. The Site consists of 25 acres located in an area of hilly terrain in the southeast portion of Lyndon, approximately 0.2 miles southeast of Lily Pond. An unnamed stream traverses the Site from northeast to southwest, joining a larger unnamed stream immediately southwest of the Site that flows to the Passumpsic River approximately ¼-mile southwest of the Site. The Site is accessed via four roads: three that begin at Lily Pond Road and intersect the southwest and west sides of the Site, and one entering the Site from the east.

The Site is surrounded by residential areas to the north, wooded, hilly areas to the east, wooded areas and agricultural land to the south, and residential areas to the west. Pastures and cropland are located to the south of the Site, beyond Brown Farm Road. A nursing home and a private school are located approximately ½-mile southwest of the Site, on Red Village Road. Residential properties located in the vicinity of the Site include three mobile home parks located immediately northwest of the Site and assisted living homes located downgradient of the Site.

Land, Resource, Operational and Regulatory History

Historical records reviewed by ESE as part of a 1992 Initial Site Characterization indicate that prior to permitted landfilling of the Site, the Site area consisted of a borrow pit for the mining of sands, and was used as a Town disposal area starting in the late 1950s.

A Land Use Permit to operate a solid waste disposal facility at the Site was granted by the Vermont District No. 7 Environmental Commission on July 17, 1971. Approval to operate as a sanitary landfill was granted under the authority of the Vermont Health Regulations on October 20, 1971. Operation of the landfill began in 1972, and continued through 1992. There were four distinct waste disposal areas at the Site; all were unlined. The largest waste disposal area is the solid waste disposal area (SWDA), comprising approximately 14 acres. Adjacent to the SWDA are three smaller industrial waste areas (IWS-1, IWS, 2 and IWS-3), located on the west, south, and east sides of the SWDA, respectively.

During a Preliminary Assessment completed in 1985, the Vermont Agency of Environmental Conservation (VTAEC; currently VTDEC) discovered that prior to 1983, uncontrolled disposal of industrial wastes occurred at the Site, resulting in the landfill receiving approximately 1,330,300 gallons of liquid industrial wastes and 688,900 kilograms of solid, semi-liquid and liquid industrial wastes. These wastes included waste oils, plating solutions, degreasers, paint sludge, coolant oils, sodium hydroxide, and TCE or 1,1,1-TCA sludge.

As a result of the findings of the VTAEC during the 1985 Preliminary Assessment and Uncontrolled Hazardous Waste Site Evaluation, the Site was referred to EPA for inclusion in the National Priorities List (NPL) under CERCLA. EPA added the Site to the NPL as a Superfund Site on February 16, 1990. An Administrative Order by Consent for the Remedial Investigation/Feasibility Study (RI/FS) was issued by EPA to the Respondents/PRPs on August 8, 1990. The August 1990 Consent Order for the RI/FS included an order that operations at the landfill must cease on or before July 1, 1992.

The Village of Lyndonville operates a municipal water system that supplies water to the residences north and west of the Site, including the nearby mobile homes. In the Fall of 1991, this municipal water supply line was extended to properties located along Red Village Road, less than ½-mile southwest of the Site. Prior to this, these properties utilized private wells.

Based on the results of RI groundwater studies, it was predicted that groundwater contamination could be adequately addressed by a combination of source control (i.e., capping of the waste areas), groundwater source controls (i.e., pump and treat system to address contaminants from source area), and natural attenuation. Cap construction began in 1999, approximately five years after the completion of the RI and four years after the signing of the ROD.

According to Site reports from the early 1990s, the private drinking water wells located within a three-mile radius of the Site served a population of approximately 525. However, due to the implementation of institutional controls near the Site and the expansion of the Village of Lyndonville's municipal water supply infrastructure, this number is expected to be much lower now. The municipal water supply wells that serve as a source of drinking water for the Village of Lyndonville are located 1.75 miles north of the Site, and provide water for a population of over 3,200.

Potential human and ecological receptors to Site contamination include users of private wells up to 0.5 mile downgradient from the Site, recreational users of the Passumpsic River and the unnamed tributaries flowing from the Site, and biota inhabiting the Passumpsic River and related tributaries.

Geology and Hydrology

Based on the results of the RI/FS, the Site area is underlain by four major surficial geologic deposits. An esker (a linear landform resulting from deposition by glacial meltwater) located to the west of the

Landfill, consists of coarse to medium sand, gravel, and cobbles in graded and cross-bedded deposits. An esker delta deposit, consisting of cross-bedded coarse to fine sand and gravel, trends west to east just south of the Landfill. A Proximal Unit, consisting of medium to fine sand and silty fine sand, extends in an easterly direction from the esker. This Proximal Unit is extensive throughout the area under investigation and underlies the SWDA and IWS areas. A Distal Unit, consisting of very fine sand, silt, and clay overlies the lower Proximal Unit and is overlain by an upper Proximal Unit in the immediate vicinity of the SWDA, IWS 1, and IWS 2. Both the Proximal and Distal Units pinch out against the steeply rising bedrock just east of the Landfill.

The surficial deposits are underlain by two fractured bedrock formations. The Waits River Formation, to the west, consists of a calcarious phyllite. The Gile Mountain Formation, to the east, consists of a siliceous phyllite. The contact of these two formations is gradational and is located immediately east of the SWDA.

The Site contains three groundwater flow paths. The upper portion (upper Proximal) of the aquifer underlying the Site has a southwesterly groundwater flow direction. The lower portion (Proximal) of the aquifer exhibits a regional groundwater flow in a westerly direction. The fractured bedrock aquifer exhibits groundwater flowing in a south/southwesterly direction. Shallow groundwater flow in the upper Proximal portion of the aquifer at IWS 3 is southwest toward IWS 2. Flow in the lower Proximal unit, the principal water-bearing unit underlying much of the Site, is to the west-southwest. It is believed that groundwater flow in the fractured bedrock is generally south/southwest and could be related to a fracture zone along the eastern margin of the SWDA.

History of Contamination

Between 1979 and 1984, routine groundwater monitoring conducted by the VTDEC indicated the presence of chlorinated VOCs in the groundwater and in the unnamed stream adjacent to the landfill. In 1984, VOCs were detected at concentrations exceeding federal MCLs in groundwater in five private wells approximately 0.5 miles southwest of the Site.

In 1985, VTDEC informed four PRPs of their responsibility for performing investigative work and remediation at the Site. Following EPA's placement of the Site on the NPL, between 1990 and 1994, the PRP consultant, ESE, completed and performed the RI/FS at the Site. The RI/FS report summarized the field investigations, described the nature and extent of wastes and related contaminant source areas, and described subsurface hydrogeology at the Site assessed as part of the field investigation. The SWDA was estimated to contain approximately 2 million cubic yards of waste, and based on field studies, was estimated to be about 55 feet deep on average. Based on observations during the RI/FS, the SWDA was considered a diffuse source of leachate and contaminants to soil and groundwater. RI/FS assessment results indicated that the IWS areas, due to their history of accepting industrial wastes, were serving as additional, discrete source areas from which the VOCs were leaching into Site soils and groundwater.

Basis for Taking Action

According to the ROD, COCs for Site groundwater were designated as those constituents detected during the RI at concentrations exceeding cleanup goals based on ARARs. COCs include PCE, TCE, cis-1,2-DCE, 1,2-dichloropropane, 1,2-dichloroethane, benzene, vinyl chloride, and 2-butanone (all

VOCs), as well as, 3-methylphenol, 4-methylphenol, chromium, nickel, manganese, and vanadium. During the RI, these contaminants were detected at the highest concentrations at the source area, and were thought to be decreasing in concentration with distance from the landfill as a result of diffusion and natural degradation processes.

Based on the results of RI groundwater studies, it was predicted that groundwater contamination could be adequately addressed by a combination of source control (i.e., capping of the waste areas), groundwater source controls (i.e., pump and treat system to address contaminants from source area), and natural attenuation. Cap construction began in 1999, approximately five years after the RI and four years after the signing of the ROD. The ROD specified that the groundwater treatment was to be selected based on pre-design studies conducted subsequent to the RI. Post-cap groundwater monitoring confirmed the effectiveness of the cap in reducing the mass loading of contaminants to groundwater in the source area. However, monitoring data suggested there had not been a significant reduction in contaminant concentrations in the downgradient plume due to natural attenuation. Chlorinated VOCs such as TCE and cis-1,2-DCE were detected at significantly higher concentrations than previously detected in the area between the landfill and the Passumpsic River.

C. REMEDIAL ACTIONS

Remedy Selection

The ROD for the Parker Landfill Site was signed on April 4, 1995. The original remedies selected within the ROD to address contamination at the Parker Landfill Superfund Site consisted of (1) multi-layer caps (including gas management) over the SWDA and IWS areas, and (2) source control groundwater extraction and treatment. The ROD also required the installation of additional groundwater monitoring wells, long-term monitoring of groundwater, surface water and sediment in the vicinity of the Site, and five-year Site reviews.

The 1995 ROD describes the remedy required for the Site as follows:

- Construction of multi-layer (RCRA subtitle C) caps over the SWDA and IWS areas;

- Installation and operation of a gas collection system to reduce landfill gas accumulation and lateral migration below the SWDA and IWS areas that were capped;

- Installation of a source control groundwater treatment system to address overburden and bedrock contamination, of which the configuration was to be determined during a pre-design phase;

- Conducting long-term sampling and analysis of groundwater, surface water and sediment to assess compliance with the groundwater cleanup levels through natural attenuation and to ensure surface water and sediments in nearby brooks/river have not been adversely impacted;

- Institutional controls to protect the cap and to restrict groundwater use, including the extension of municipal water service to all homes potentially affected by contamination; and

- Review of the Site every five years to evaluate the effectiveness of the remedy in ensuring the protection of human health and the environment.

Although the ROD specified that groundwater extraction wells would be placed in both the overburden and bedrock aquifers at the source area as part of the groundwater remedy, specific treatment technologies to treat the extracted groundwater and methods for discharge of treated water were to be determined during the design phase, in order to ensure that the most effective and least costly alternative is used. Under a 1999 unilateral order, pre-design studies and groundwater monitoring were conducted.

A revised Feasibility Study was completed under this order in July 2004, to both address current conditions at the Site and to evaluate the most contemporary technologies available to best meet the objectives identified in the ROD. In July 2004, EPA issued an ESD for the groundwater component of the ROD remedy. The adjustment in the groundwater remedy was due to changes in the extent of the downgradient groundwater plume and the emergence of more effective treatment technologies to address source area groundwater contamination. The ESD called for active treatment of the source area groundwater plume using a permeable reactive barrier wall, and active in-situ treatment of the downgradient plume using enhanced bioremediation.

Cap Remedy

The RAOs for the cap remedy (i.e., capping SWDA and IWS areas) are as follows:

- Minimize, to the extent practicable, the potential for transfer of hazardous substances from the soil and solid waste into the groundwater, surface water and sediment;

- Prevent direct contact/ingestion of soil or solid waste posing a potential total cancer risk greater than 10^{-4} to 10^{-6}, or a potential hazard index greater than one; and

- Comply with federal and state ARARs.

Groundwater Remedy

The RAOs for the groundwater remedy (i.e., source control groundwater treatment) are as follows:

- Prevent ingestion of groundwater containing COCs in excess of federal or state standards, or posing a potential total cancer risk greater than 10^{-4} to 10^{-6}, or a potential hazard index greater than one; and

- Comply with federal and state ARARs.

Although EPA issued an ESD for the groundwater component of the ROD remedy in July 2004, the RAOs for the groundwater remedy remained unchanged.

The cleanup levels selected, as identified in the ROD, are summarized in the following table:

Table A-2
ROD-Specified Cleanup Levels

Contaminant of Concern	Interim Cleanup Level (µg/L)	Basis
1,1-Dichloroethene	7	MCLG

Table A-2 ROD-Specified Cleanup Levels		
Contaminant of Concern	**Interim Cleanup Level (µg/L)**	**Basis**
1,2-Dichloroethene	70	MCL
1,1,1-Trichloroethane	200	MCLG
2-Butanone (MEK)	170	VPGQS
4-Methylphenol	200	Risk-Based
Acetone	3,700	Risk-Based
Benzene	5	MCL
Methylene Chloride	5	MCL
Tetrachloroethene	0.7	VPGQS
Trichloroethene`	5	MCL
Vinyl Chloride	2	MCL
Bis (2-Ethylhexyl) Phthalate	6	MCL
Antimony	6	MCL
Arsenic	50	MCL
Beryllium	4	MCL
Chromium (Hexavalent)	50	VPGQS
Manganese	180	Risk-Based
Nickel	100	MCL
Vanadium	0.2	Risk-Based

MCL – Maximum Contaminant Level
MCLG – Maximum Contaminant Level Goal
VPGQS – Vermont Primary Groundwater Quality Standard

Remedy Implementation

Landfill Cap Remedy Implementation

Construction of the cap began in April 1999 and was completed in December 2001. The design components of the cap were set forth in the Landfill Cap Remedial Design Statement of Work dated November 1996. Industrial wastes and contaminated soils were excavated from IWS-2 in June 1999 and placed into the SWDA area prior to capping, eliminating the need for a separate cap over IWS-2. A continuous multi-layer cap was constructed over SWDA and IWS-1 between May 1999 and October 2000. A separate multi-layer cap was constructed over IWS-3. The landfill gas management system was constructed to control gas generated in the SWDA and IWS-1 areas (no gas recovery in IWS-3). The active gas management system consists of 17 gas extraction wells, piping and blowers, and an enclosed flare to destroy VOCs and methane. A compensatory wetland was constructed to mitigate wetlands lost during construction of the cap. Institutional controls associated with the landfill cap remedy have been defined and have been implemented; however expansion of the institutional controls is required based on current IGCL exceedances and VOC trends.

Groundwater Remedy Implementation

Source Area Groundwater – Permeable Reactive Barrier

The PRB technology uses a reactive media of granular zero-valent iron to treat chlorinated VOCs in groundwater by permanently reducing the volume and toxicity of the contaminants through reductive de-halogenation, as electrons transfer from the iron to halogenated VOCs at the iron surface contact point. The result is halogen ions being replaced by hydrogen species that yield the non-halogenated compounds ethene or ethane. These, in turn, are mineralized by bio-degradation in the groundwater downgradient of the PRB treatment cell.

The "Draft Source Area Pre-Design Technical Report" dated January 9, 2004, evaluated the feasibility of a zero-valent iron PRB wall to passively intercept the upgradient portion of the VOC-contaminated plume, and to effectively reduce concentrations of chlorinated VOCs in groundwater at the source area. This report concluded, based on column testing and bench-scale studies, that a zero-valent iron PRB would be effective in reducing concentrations of chlorinated VOCs to below the groundwater cleanup goals at the Site.

The PRB was installed using an open trench technique with excavation by an extended-arm backhoe, using a bio-polymer slurry for support (guar gum). The trench is approximately 2.5 feet in width and approximately 235 feet in length. The trench depth is approximately 62 feet deep, decreasing linearly to an approximate 30-foot depth at the eastern end. The trench was backfilled with a granular iron/sand blend.

The PRB is comprised of four sections containing different iron/sand blends. Iron percentages by weight of 34.5 percent, 61.2 percent, 100 percent, and 51.3 percent correspond to different VOC contaminant zones. This material was placed in the trench continuously using a tremie pipe to an elevation of two feet above the high groundwater table, and was backfilled with sand. In order to adequately monitor the performance of the PRB and to reduce contaminant concentrations in the groundwater, additional monitoring well clusters were installed.

A total of eight monitoring wells, in three well clusters were installed within the trench during construction. Each cluster was bound together with nylon ties surrounding a section of reinforced steel bar and suspended in the excavation as the trench was backfilled with the iron/sand blend. These wells are 1-inch diameter and constructed using a 10-foot polyvinyl chloride (PVC) screen and riser. In addition, 21 monitoring wells in eight clusters were installed at strategic locations around the PRB perimeter. All wells were tested during construction to assess groundwater quality and geochemistry. The initial testing indicates that VOC concentrations have reduced and that there is an elevated concentration of ethene/ethane. As designed, a reactive zone was established and de-chlorination is occurring. O&M is currently being performed by the PRPs.

The physical extent of the PRB cell constructed to intercept contaminated groundwater is noted above. The cell was constructed adjacent to the south-eastern edge of the landfill. In order to construct the PRB, the following activities occurred: 1) relocation of a power line; 2) up-grade of an access road; 3) abandonment of select groundwater monitoring wells; 4) extension of an existing stream culvert; 5) re-grading of the area where the PRB was located (including erosion and sediment control measures and seeding); and 6) construction of a gravel work pad and guide wall.

Downgradient Groundwater – Bio-Enhanced Natural Attenuation

Construction of the bio-enhanced natural attenuation technology included limited modification of the terrain in the downgradient area to improve access to install a series of injection/extraction wells. Area preparation included limited clearing of trees and brush, construction of an access road, and the extension of an electrical power line from Lily Pond Road. The wells installed span a distance of approximately 500 feet and are located approximately 40 feet apart. To meet the cleanup objectives, groundwater is periodically withdrawn from the extraction wells and amended using a sodium lactate/nutrient solution and re-injected back into the overburden groundwater via injection wells. Based on the pre-design test results this solution contains: 60% sodium lactate; ammonium bromide; ammonium carbonate; and ammonium phosphate. Full scale applications have been conducted in November 2005, September 2007 and September 2009.

Although initial applications were successful, due to the technological advancements in the effectiveness of biodegradation compounds, a review of alternative organic carbon sources was conducted in 2011. As a result, the Draft BNA O&M Plan was amended in September 2011 to include the use of Slow Release Substrate (SRS®). The application of SRS, which contains sodium lactate, yeast extract, nutrients, 60-percent by weight emulsified soybean oil and surfactants, was conducted for the first time in September 2011.

As with the PRB technology, a post implementation monitoring program is ongoing to track the induced effects within the groundwater system. This includes quantifying geochemical field parameters that contribute to, or are indicators of, the degradation of the chlorinated organic contaminants.

Compensatory Wetland

The PRB work pad construction required removing approximately 0.26 acres of wetland, as characterized in a Wetland Investigation Summary letter submitted to EPA on October 29, 2004. A compensatory wetland was constructed along the west side of the unnamed stream approximately 1,550 feet downstream from the PRB. This location is within the 50-foot-wide conservation easement located adjacent to the unnamed stream and was selected based on guidance from EPA, the U.S. Fish and Wildlife Service and the VTDEC.

A design plan for the compensatory wetland was prepared by URS and submitted for review and comment by EPA and the VTDEC on August 17, 2005. Based on both federal and state comments, URS revised the plan and resubmitted it on August 18, 2005. EPA approved the design on August 19, 2005. The compensatory wetland is 0.44 acres in size. This ratio was approved by EPA and the VTDEC based on the designated space available within the conservation easement area. With this approval, the wetland requirements are achieved.

Wetland construction commenced on August 23, 2005. An existing log pile was relocated to an area located beyond the conservation easement area. This work was completed on August 29, 2005.

Institutional Controls

Institutional controls have been partially implemented. Institutional controls consist of easements and enforceable local or state regulations to restrict groundwater use. The area of restricted groundwater use was specified in the ROD to extend from the upgradient perimeter of the landfill to all downgradient boundaries of the contaminant plume (both in overburden and bedrock aquifers). The restricted groundwater use area includes a buffer zone around the contaminated area, to prevent potential spreading of the plume caused by drawdown in active private wells outside the area.

In 2002, a municipal water line was constructed to service the residences within the proposed institutional control boundary. The reclassification of groundwater from a Class III (all groundwater) to Class IV (not potable; suitable for some industrial and agricultural use) category was established for the 119-acre area including the landfill and downgradient plume in November 2003. The Town of Lyndon has updated their zoning bylaws to establish an Institutional Control Area that mirrors the Groundwater Reclassification Area as shown in Attachment B of the *Findings of Fact and Reclassification Order, Proposed Groundwater Reclassification at the Parker Landfill, Lyndon, Vermont* dated August 23, 2003 (see Appendix B). However, the Groundwater Reclassification Area was delineated based on data collected in 2000 and downgradient IGCL exceedances and increasing VOC concentration trends, including 1,4-dioxane and particularly in the top-of-rock groundwater system, continue to be evident west-southwest of the SWDA. These data suggest a need for additional monitoring locations and/or installation of additional wells downgradient of the Site. As a result, the current institutional controls that have been established do not encompass the area of recent IGCL exceedances as required by the ROD.

System Operation/Operation and Maintenance

Operations and maintenance, including monitoring are conducted for both the landfill cap and groundwater remedies, as further described below.

Cap Remedy O&M

O&M for the cap remedy primarily consists of operating the flare system to burn collected methane gas and maintenance of the cap. Maintenance of the cap includes mowing, cleaning out drainage swales, repairing erosion damage, replanting grass (as needed) and removing animals that burrowed in the cap.

Periodic gas probe monitoring is also conducted to monitor the migration of methane gas from areas outside of the cap.

Groundwater Remedy O&M

O&M for the groundwater remedies primarily consists of groundwater, surface water, and sediment monitoring. Groundwater monitoring wells are grouped into the MOM, PRB, and BNA monitoring well groups. Annual groundwater monitoring of 32 MOM wells, 29 PRB wells, and eight BNA wells is currently conducted. Every five years, as part of the FYR, an additional 28 MOM wells are also monitored.

Surface water sampling is conducted on an annual basis and sediment sampling is currently conducted every five years, as part of the FYR.

APPENDIX B

Copy of Findings of Fact & Reclassification Order

State of Vermont

Department of Fish and Wildlife
Department of Forests, Parks and Recreation
Department of Environmental Conservation
State Geologist
RELAY SERVICE FOR THE HEARING IMPAIRED
1-800-253-0191 TDD>Voice
1-800-253-0195 Voice>TDD

AGENCY OF NATURAL RESOURCES
Department of Environmental Conservation
WATER SUPPLY DIVISION
103 South Main Street
Old Pantry Building
Waterbury, VT 05671-0403

TEL 802-241-3400
TOLL Free 800 823-6500
FAX 802-241-3284

November 24, 2003

Re: Groundwater Reclassification of the Parker Landfill Site in Lyndon, Vermont

Dear Interested Parties:

The groundwater at the Parker Landfill Site in Lyndon, Vermont has been reclassified by the Agency of Natural Resources from Class III to Class IV. According to Vermont Statute (10 VSA §1394), Class IV groundwater is defined as "Not suitable as a source of potable water but suitable for some agricultural, industrial and commercial use." The Secretary of the Agency of Natural Resources, Elizabeth McLain, signed the Findings of Fact and Reclassification Order on November 6, 2003.

Please see the enclosed Findings of Fact and Reclassification Order for details on the site and issues associated with this decision. Prior to reclassifying the groundwater, the Agency of Natural Resources held a public meeting on the proposed reclassification. A response to comments received at the public meeting is also enclosed. Please note that the boundary of the Class IV area was modified from the original proposal to accommodate concerns expressed at the public meeting.

Any questions regarding the Groundwater Reclassification at the Parker Landfill or groundwater reclassification in general can be directed to me at (802) 241-1412 or toll-free in Vermont at (800) 823-6500. If you have more specific questions on the status of the site, please contact John Schmeltzer of the Waste Management Division at (802) 241-3886.

Sincerely,
Tina Hubbard

Tina Hubbard
Drinking Water Source Protection Specialist

c: Groundwater Coordinating Committee

Findings of Fact & Reclassification Order

Proposed Groundwater Reclassification at the Parker Landfill
Lyndon, Vermont

August 21, 2003

Prepared by:

The Vermont Agency of Natural Resources
and the
Vermont Groundwater Coordinating Committee

Findings of Fact & Reclassification Order
Parker Landfill, Lyndon, Vermont

INTRODUCTION

This document represents the Vermont Agency of Natural Resources' findings and determination to reclassify groundwater from Class III to Class IV at the Parker Landfill, located in Lyndon, Vermont (see map, Attachment A). The 250-acre reclassification area is shown in map view in Attachment B. The findings are based on the considerations outlined in Section 12-403 of the Vermont Groundwater Protection Rule and Strategy, effective January 20, 2000. A copy of the rule is available online at www.vermontdrinkingwater.org or by contacting the Department of Environmental Conservation, Water Supply Division, 103 South Main Street, Waterbury, Vermont 05671-0403 or at (802) 241-3400.

Copies of the petition to reclassify and other supporting documents are available at the Waterbury Office of the Department of Environmental Conservation, Waste Management Division. Much of the information contained here was obtained from the petition to reclassify groundwater, prepared by URS Corporation (March 25, 2002).

BACKGROUND

The Parker Landfill is located on approximately 25 acres situated on the east side of Lily Pond Road in the southeast portion of the Town of Lyndon, Caledonia County, Vermont in vegetated, hilly terrain. Residences border the north and northwest portions of the property. The land slopes westward toward the Passumpsic River. Portions of the Parker Property are currently used by the owner as a storage and maintenance garage for heavy equipment. Part of the property is also planted in hay.

The Parker Landfill was approved as a disposal facility for solid waste in 1971. Ray O. Parker & Sons, Inc. began operating the facility in 1972. Prior to 1972, the disposal area was used as a sand pit and a town disposal area. The industrial wastes disposed at the site included trichoroethylene, sodium hydroxide, 1,1,1- trichloroethane, acetone, lacquer and stain sludge, paint sludge, tetrachloroethane, barium chloride, chromium, nickel plating rinse waters, polyester resin, mercury, electroplating sludge and water soluble coolants. Approximately 1,330,300 gallons of liquid industrial wastes and 688,900 kilograms of liquid, semi-solid, and solid industrial wastes were disposed of at the site between 1972 and 1983. [Source: EPA Record of Decision, 1995]

In February 1990, Parker Landfill was placed on the National Priorities List. In 1999, EPA signed a Unilateral Administrative Order (UAO) with a potentially responsible party, Vermont American Corporation, requiring groundwater clean-up. Under a Consent Decree with other potentially responsible parties, the waste was covered with a multi-layered cap. The cap was completed in the summer of 2001.

The overburden at the site consists of glacio-fluvial and glacio-lacustrine materials. The waste units are situated on top of a thin sandy unit that has a perched water table. Directly beneath the waste units, the thin sandy zone is underlain by a much thicker silty layer that appears to have acted as a barrier to downward contaminant migration. Downgradient from the landfill, near the Passumpsic River, the silty layer pinches out and a thick, transmissive, sandy formation comprises the overburden. Bedrock in the area is metamorphic, and includes the Waits River and Gile Mountain formations.

Surface water runoff from the site generally flows west toward the Passumpsic River. An unnamed stream flows in a southwesterly direction along the east side of the landfill before joining two other unnamed streams south of the landfill. These streams discharge to the Passumpsic River. The groundwater flow system from the landfill also converges on the Passumpsic River. Upward hydraulic gradients from nested wells near the river indicate that the river is a groundwater discharge location.

During a site inspection in 1984, the State detected contaminants in a stream bordering the landfill, in groundwater at the landfill, and in four private wells located less than a mile from the landfill. Subsequent investigations have shown that soil, soil gas, surface water and groundwater at the site are contaminated with a wide range of chemicals. As part of groundwater investigations, about 120 monitoring wells have been drilled and tested. The main contaminants of concern in the groundwater are trichloroethylene (TCE) and its daughter products.

Concentrations greater than 10,000 ug/L of TCE have been seen in shallow wells near the waste units, suggesting that TCE has likely reached the subsurface in non-aqueous form. Near the waste units, the highest contaminant concentrations are found in the perched water above the silt layer. Further down gradient, near the Passumpsic River, contamination is minimal in the shallow sandy overburden, but wells screened in sand at the top of the bedrock and in upper portions of the bedrock itself show elevated TCE concentrations. Samples from one top-of-rock well (B120C) near the river have contained nearly 5,000 ug/L of TCE. The presence of TCE in this well cannot be explained entirely by the prevailing groundwater flow pattern, suggesting dense-nonaqueous-phase liquids may be present in the subsurface.

The reclassification area encompasses 250 acres. It includes a zone where 95% confidence-level statistics indicate that groundwater is contaminated above the Vermont Groundwater Enforcement Standards (VGES), and a 200-foot buffer around the upgradient and crossgradient boundaries of the contamination zone. The downgradient boundary of the reclassification area is the Passumpsic River.

The UAO between Vermont American and EPA requires groundwater extraction and treatment as the groundwater clean-up technology, but site investigators are now looking at other treatment options. Long-term monitoring of groundwater and institutional controls to prevent inappropriate uses of contaminated land and water at the site are also required by the UAO. More than forty wells are currently included in the long-term monitoring program.

All homes and businesses within the reclassification area have been connected to the municipal water supply. Under the institutional control plan for the site, all private wells identified within the reclassification area have been either converted to monitoring wells or abandoned in accordance with state regulations.

AGENCY REVIEW

Below is the Agency of Natural Resources' review of the Parker Landfill site with respect to the Groundwater Protection Rule and Strategy Section 12-403 Class I, II, III and IV Groundwater Reclassification Process. This information is based on the following document:

> *Petition for Groundwater Reclassification, Parker Landfill, Inc., Lyndon, Vermont.* URS Corporation, March 25, 2002.

In determining whether or not to reclassify groundwater as Class I, II, III, or IV, the Secretary shall consider the following:

(1) The use or potential future use of the groundwater as a public water supply source

Municipal water is available to the properties within the Class IV Groundwater Area and easements are or will be in place to restrict groundwater use. However, the overburden aquifer is transmissive and could represent an enticing water supply opportunity to individuals unaware of contaminant risks. A Class IV designation for the groundwater in the area would provide another institutional control to prohibit future public water supply development.

(2) The extent of activity which poses a risk to the groundwater

Disposal of industrial wastes, the high-risk land use which led to the present contamination, was discontinued in 1983. Solid waste disposal was discontinued in 1992. Residual contamination in the subsurface from past disposal practices may be serving as a continuing source of groundwater contamination.

(3) The current water quality of the groundwater

Numerous rounds of groundwater sampling have been performed at the Parker Landfill between October 1984 and October 2000. About 120 wells have been drilled and tested. The contaminant zone boundaries have been defined using a 95% confidence level statistic for monitoring points which exceed the Vermont Groundwater Enforcement Standards (VGES).

Dissolved TCE concentrations in groundwater have been detected at levels as high as 5,000 ug/L in a deep monitoring well near the Passumpsic River (# B120C). TCE concentrations near the center of the contamination zone range up to 10,000 ug/L. Over the approximately 125-acre areal extent of the plume, groundwater quality consistently exceeds the VGES for TCE.

Due to elevated contaminant levels, the groundwater is unsuitable for use as drinking water. The groundwater should not be used for agricultural, industrial, or commercial uses in situations where it may cause health risks.

(4) The availability of groundwater in quantities needed for beneficial use

According to the Vermont Groundwater Protection Rule and Strategy, beneficial use refers to specific groundwater uses deemed appropriate for a designated groundwater class. Class IV groundwater is not considered to be a potable water source but may be suitable for some agricultural, commercial, or industrial uses.

As noted above, the groundwater in the Class IV Groundwater Area has no beneficial uses at present. Although the subsurface water resource is capable of yielding a plentiful supply, the on-site groundwater will be unsuitable for any beneficial use unless it receives treatment or until present levels of contamination are substantially reduced.

Reclassification of the groundwater to Class IV is necessary to protect future users from inappropriate use of the groundwater for potable supplies. Other protections, such as deed restrictions or landowner agreements, will prevent other inappropriate beneficial uses of the on-site groundwater. The Secretary will not issue permits for drinking water supplies within the Class IV boundary.

(5) The consequences of potential groundwater contamination and the availability of alternate sources of water

Use of any onsite water source must be avoided until contaminant concentrations are reduced by the site remediation system to be constructed and by natural attenuation. A Class IV designation will prevent development of any water supply requiring a permit from the Secretary. Municipal water is available as an alternative water source within the Class IV Groundwater Area.

(6) The classification of adjacent surface waters

Groundwater from the site discharges to an unnamed stream and to the Passumpsic River. The State of Vermont has classified these waters as Class B. Class B waters are considered suitable for the following uses: water supply with filtration and disinfection; irrigation and other agricultural uses; swimming, and recreation.

The surface water data indicates that the groundwater contamination is not adversely affecting the water quality of the Passumpsic River. However, TCE has been detected at low concentrations in the samples taken from the unnamed stream near the landfill.

(7) The probability for use as a public water supply source

Although the site could potentially provide high-yield water supplies, it is both unsuitable for use as a potable supply and unlikely to be needed for such use in the future. The town of Lyndon gets its water supply from a sand and gravel aquifer on the opposite end of the town. The municipal water system was expanded this past spring with the addition of one more well at the well field. In the case of an unanticipated need for an additional public water supply source in the area, a Class IV designation will prevent the inappropriate development of a public water supply at the Parker landfill.

(8) <u>Other factors relevant to determining the maximum beneficial use of the groundwater</u>

Under the Unilateral Administrative Order (UAO) between Vermont American Corporation and EPA, the properties in the groundwater reclassification area will be subject to other institutional controls to prevent inappropriate uses of contaminated land and water at the site, including an easement that prohibits groundwater use.

RECLASSIFICATION AREA

The 250-acre reclassification area has been delineated in accordance with the DEC guidance document entitled "Procedure for Class IV Groundwater Reclassification," dated November 12, 2000. Supporting documentation outlining the basis for the delineation is available in the Petition for Groundwater Reclassification, Parker Landfill, Lyndon, Vermont. URS Corporation, March 25, 2002.

The Class IV Groundwater Area is shown on the map, Attachment B, and a legal description of the reclassification area boundary is file at the DEC Water Supply Division Waterbury, VT. Attachment C provides a list of current property owners within the Class IV Groundwater Area boundaries.

MONITORING AND MANAGEMENT REQUIREMENTS

Restrictions on groundwater use and additional monitoring requirements for the Parker Landfill may be applicable under Sections 12-401(7), which states:

> *Any classification or reclassification decision issued by the Secretary may include special conditions for the management of the classified groundwater area which shall apply to activities regulated by the Secretary.*

Long-term monitoring of groundwater at the site is required by the U.S. Environmental Protection Agency. More than forty wells are currently included in the long-term monitoring program. The Class IV boundary delineation shall be evaluated if contaminant levels in the sentinel wells along the eastern and western boundaries of the Class IV Groundwater Area equal or exceed Vermont Preventive Action Levels.

Rationale for Reclassifying Groundwater at the Parker Landfill, Lyndon, Vermont

The following is a listing of reasons for reclassifying the groundwater at the Parker Landfill located in Lyndon, Vermont from Class III to Class IV.

1. The groundwater beneath the site is not used and is not likely to be used as a public water supply source.

2. The groundwater is contaminated by a number of organic contaminants and metals as summarized in the *Petition for Groundwater Reclassification*.

3. The groundwater quality does not meet the Vermont Groundwater Enforcement Standards set forth in the Groundwater Protection Rule and Strategy.

4. The groundwater is degraded to the point that it is not suitable as a source of potable water but may be suitable for some agricultural, industrial, or commercial uses.

5. Local surface waters that receive groundwater discharges are classified by the State of Vermont as Class B.

6. The current activities at the site are intended to prevent the further degradation of groundwater quality.

Findings of Fact

1. Since 1984, environmental investigations at the Parker landfill have identified a zone of groundwater contamination stemming from the disposal of industrial wastes.

2. In 1999, EPA signed a Unilateral Administrative Order (UAO) with Vermont American which outlined the steps by which groundwater contamination originating from the Parker Landfill would be investigated, remediated, and monitored over the long term.

3. Based on information prepared by URS Corporation, the environmental consultant for Vermont American, the DEC Waste Management Division submitted a reclassification petition on March 25, 2002.

4. The Agency of Natural Resources reviewed the application and determined that the groundwater beneath an 250-acre area at the Parker Landfill meets the criteria for reclassification from Class III to Class IV in accordance with the Groundwater Protection Rule & Strategy and 10 V.S.A. Chapter 48.

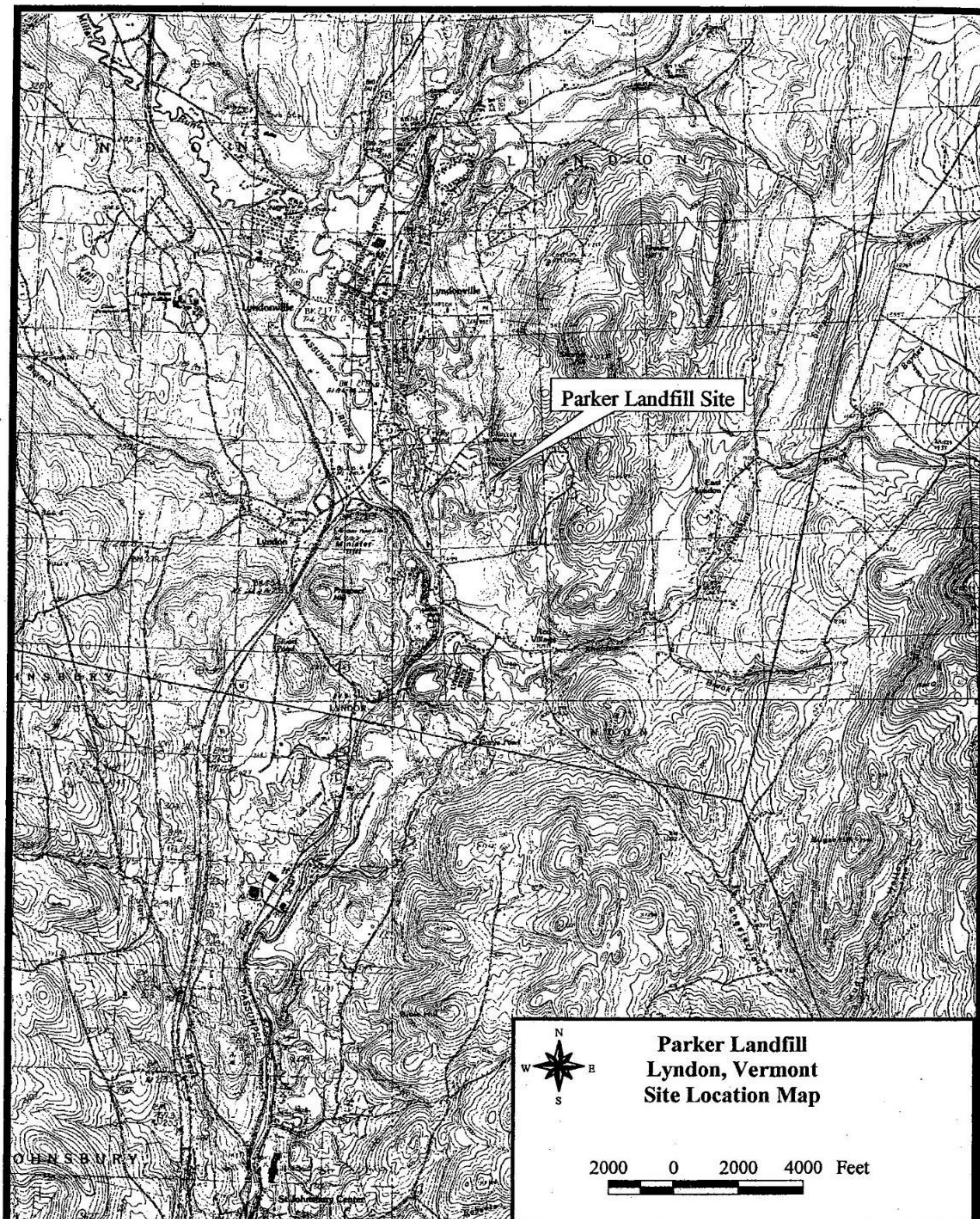
I hereby make the Findings of Fact identified above and reclassify the groundwater to Class IV under the Parker Landfill and adjoining property identified in this document.

Elizabeth McLain

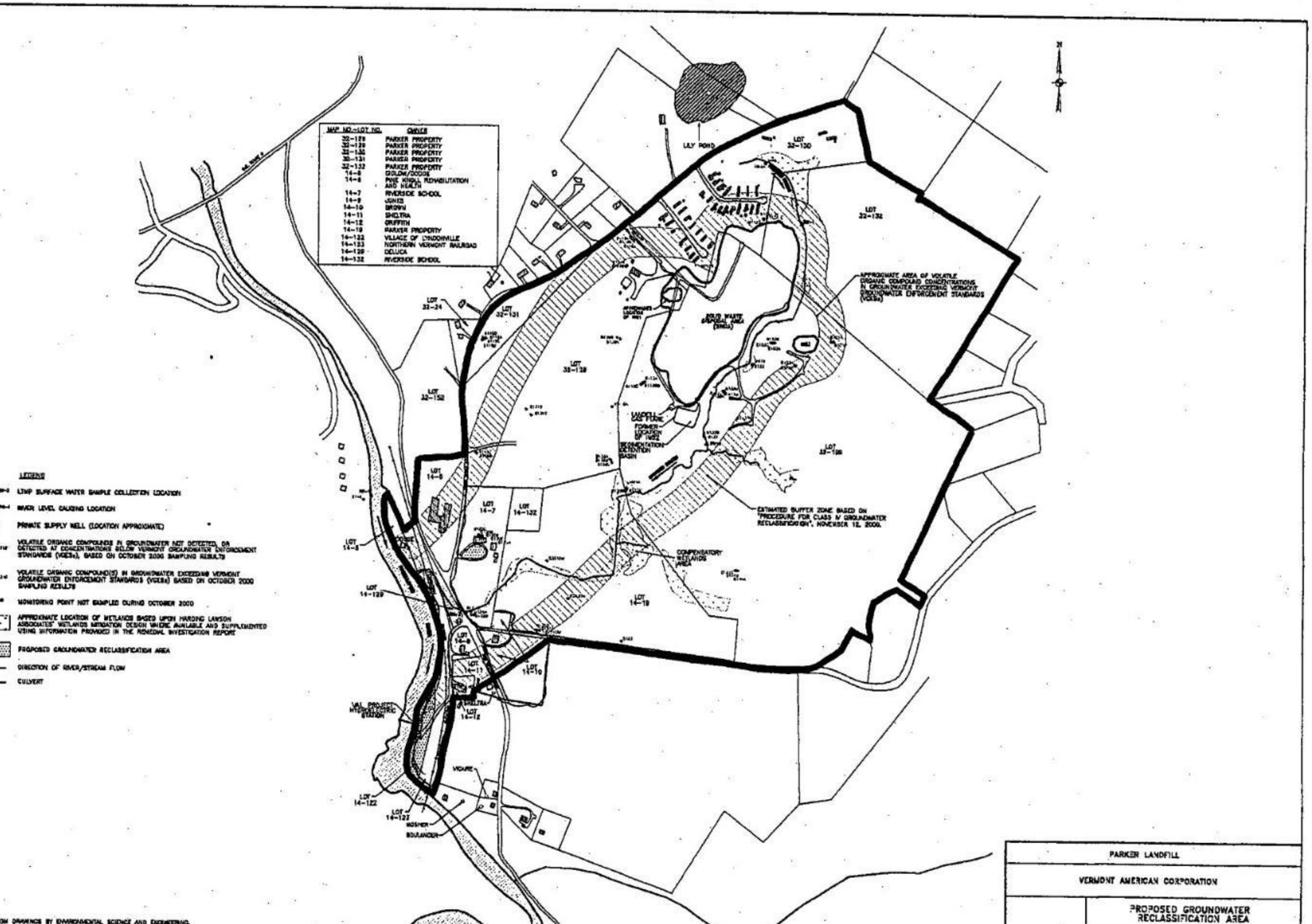
Elizabeth McLain, Secretary
Agency of Natural Resources

Date 11-6-03

Attachment A



Attachment B



Findings of Fact & Reclassification Order
Parker Landfill, Lyndon, Vermont

Attachment C
List of Property Owners within the Reclassification Area

<table>
<tr><th>Map Lot</th><th>Owner</th><th>Property Mailing Address</th></tr>
<tr><td>32-128</td><td>Parker</td><td rowspan="6">D&A Enterprises, Inc
P.O. Box 25
Lyndonville, VT 05851

Anne H. Parker
P.O. Box 25
Lyndonville, VT 05851

Ray O. Parker and Sons, Inc.
P.O. Box 25
Lyndonville, VT 05851</td></tr>
<tr><td>32-129</td><td>Parker</td></tr>
<tr><td>32-130</td><td>Parker</td></tr>
<tr><td>32-131</td><td>Parker</td></tr>
<tr><td>32-132</td><td>Parker</td></tr>
<tr><td>14-19</td><td>Parker</td></tr>
<tr><td>14-129</td><td>Mark DeLuca</td><td>10 Light Plant Drive
Lyndonville, VT 05851</td></tr>
<tr><td>14-5</td><td>Rolf Gidlow/Sylvia Dodge</td><td>580 Red Village Road
Lyndonville, VT 05851</td></tr>
<tr><td>14-6</td><td>Pine Knoll Rehabilitation & Health</td><td>601 Red Village Road
Lyndonville, VT 05851</td></tr>
<tr><td>14-7</td><td>Riverside School</td><td>30 Lily Pond Road
Lyndonville, VT 05851</td></tr>
<tr><td>14-132</td><td>Riverside School</td><td>30 Lily Pond Road
Lyndonville, VT 05851</td></tr>
<tr><td>14-9</td><td>Joyce Jones</td><td>49 Light Plant Drive
Lyndonville, VT 05851</td></tr>
<tr><td>14-10</td><td>Denise Brown</td><td>737 Red Village Road
Lyndonville, VT 05851</td></tr>
<tr><td>14-11</td><td>Blanche Sheltr</td><td>794 Red Village Road
Lyndonville, VT 05851</td></tr>
<tr><td>14-12</td><td>Erven Griffith</td><td>P.O. Box 232
Lyndonville, VT 05851</td></tr>
<tr><td>14-122</td><td>Village of Lyndonville</td><td>P.O. Box 167
Lyndonville, VT 05851</td></tr>
<tr><td>14-123</td><td>Northern Vermont Railroad</td><td>P.O Box 39
Newport, VT 05855</td></tr>
</table>

Parker Landfill Class IV Reclassification
Response to Questions and Comments from Interested Parties
August 21, 2003

What is the Groundwater Coordinating Committee and who are its members?

The Groundwater Coordinating Committee is a multi-agency group established by the Secretary of the Agency of Natural Resources (ANR) under the authority of 10 VSA Chapter 48 §1392. The official members of the Committee include representatives from the following organizations:

- *Agency of Agriculture, Food, and Markets*
- *Department of Forests, Parks, and Recreation*
- *Department of Health*
- *Department of Environmental Conservation*
  - *Water Supply Division*
  - *Wastewater Management Division*
  - *Waste Management Division*
  - *Water Quality Division*
  - *Geology Division*

Currently, the Committee also includes a representative from the Agency of Transportation, an EPA representative, an industry representative from a hydrogeological consulting firm, and 47 other interested parties from both government and the private sector. The group advises the ANR Secretary on matters concerning groundwater, including groundwater classification.

What is the purpose of the 200 ft buffer around the contamination zone at the Parker Landfill site?

The zone of contamination is defined by assessing the existing groundwater quality data to determine where groundwater quality exceeds Vermont Groundwater Enforcement Standards (VGES) at a 95% statistical confidence level. Since monitoring wells can be sparse at many sites, hydrogeologists must use their best judgment to interpolate between monitoring points in order to draw a continuous line. There is uncertainty associated with this process. The buffer provides some leeway for error.

The 200 ft buffer also provides protection from inadvertent withdrawal of contaminated water into a residential well placed outside the contaminant zone boundary. In creating the Class IV boundary, petitioners are required to calculate the radius of influence for a hypothetical 1 gallon-per minute (gpm) well – a yield that could serve a large single family home. If the calculated radius of influence is greater than 200 feet, then the buffer is enlarged to equal that radius. If smaller, the 200 ft buffer is maintained.

For the Parker Landfill reclassification, the petitioner took a more conservative approach and calculated the radius of influence for a 3 gpm well (large enough to serve a small subdivision). In this geological setting, even the radius for the 3 gpm well was calculated to be less than 200 feet, so the buffer width was set at 200 ft.

The 200 ft minimum buffer width is consistent with general regulatory setback requirements for residential water supply wells. According to the Water Supply Rule, no such well may be constructed within 200 feet of any hazardous waste site. Public and small-scale water system wells are subject to more stringent installation criteria.

Why does the reclassification boundary follow property boundaries and not the outer margin of the 200 ft buffer around the contamination zone?

Once a zone of contamination and its buffer are determined, the state's procedure for reclassification allows for adjustments to the boundary to improve future administration of the Class IV area. In order to protect public health, is especially important to make sure the Class IV boundary is recognizable on the ground and not just on maps. In most cases, the boundary is adjusted to follow property lines or transportation corridors. In the Parker Landfill case, the Class IV boundaries were adjusted to match the outer boundaries of the properties in which easements prohibiting groundwater use are being obtained. The attainment of these easements is required as part of the institutional control plan. As part of their obligations under a Unilateral Administrative Order (UAO) with the USEPA, Vermont American must obtain these easements.

The reclassification reduces the value of property in that people are less likely to want to buy land that they can't install a well on. Why shouldn't I be allowed to install a well on the portion of my property outside the buffer zone?

The Groundwater Coordinating Committee prefers to follow property boundaries or transportation corridors in outlining a Class IV area to make the boundary easier to administrate. However, the Committee is willing to reconsider this practice on a case-by-case basis. In this case, the Committee has elected to alter the proposed Class IV boundary to bisect, rather than encompass, Lot 14-10 in response to a request from the property owner, Denise Brown.

What happens to the reclassification area if the contamination is cleaned up?

If site data provide conclusive evidence that groundwater within all or part of the Class IV Area has been rendered potable, all or part of the area may be reclassified as Class III. At present, there are no cases in the State of Vermont where a Class IV designation has been altered to reflect improvements in groundwater quality.

APPENDIX C

Table of Maximum Concentrations of Groundwater Contaminants that Exceeded IGCLs (2009 through 2014)

Appendix C
Maximum Concentrations of Groundwater Contaminants that Exceeded IGCLs by Well Location (2009 through 2013)
Parker Landfill Superfund Site

Well Location	Screened Zone	Parameter (COC) [1]	IGCL (ug/L)	Maximum Concentration Exceeding IGCLs (ug/L)	Date of Detected Exceedance
B101B [2]	TOR	Vanadium	0.2	3.33	10/1/2013
B102A [2]	SO	Vanadium	0.2	4.2	10/2/2013
B103A	SO	Cis-1,2-Dichloroethene	70.0	79.5	9/30/2009
		Tetrachloroethene	5.0	27.6	9/28/2011
		Trichloroethene	5.0	1160	9/30/2009
		Vanadium	0.2	4.83	10/2/2013
B103C [2]	TOR	Vanadium	0.2	3.56	10/2/2013
B113A [2]	SO	Manganese	300.0	470	10/4/2013
		Vanadium	0.2	28.5	10/4/2013
B113BB	TOR	1,4-Dioxane [3]	3.0	138 J	9/22/2010
		Acetone	700.0	1110	9/30/2009
		Methylene Chloride	5.0	5.51 J	9/30/2009
		Trichloroethene	5.0	187	9/26/2012
		Vinyl Chloride	2.0	30.7	9/26/2012
		3-Methylphenol/4-Methylphenol	200.0	524	10/1/2013
B118C [2]	BR	Vanadium	0.2	2.18	10/3/2013
B119B [2]	SO	1,4-Dioxane [3]	3.0	3.60	10/3/2013
		Vanadium	0.2	3.37	10/3/2013
B119C	TOR	1,4-Dioxane [3]	3.0	4.64	9/30/2009
		Manganese	300.0	321	10/3/2013
B120A [2]	SO	Manganese	300.0	1510	10/15/2013
		Vanadium	0.2	4.21	10/15/2013
B120C	TOR	1,4-Dioxane [3]	3.0	30.1 J	9/23/2010
		Benzene	5.0	5.59	9/23/2010
		Cis-1,2-Dichloroethene	70.0	910 J	9/23/2010
		Methylene Chloride	5.0	48.8 J	9/27/2009
		Tetrachloroethene	5.0	13.7 J	9/23/2010
		Trichloroethene	5.0	2220 J	9/27/2009
		Vinyl Chloride	2.0	40.2 J	9/23/2010
B120D	BR	1,4-Dioxane [3]	3.0	27	10/3/2013 & 9/26/2012
		Cis-1,2-Dichloroethene	70.0	160	9/27/2009
		Trichloroethene	5.0	40.7	9/27/2009
		Vinyl Chloride	2.0	159	10/5/2011
		Vanadium	0.2	1.3	10/3/2013
B121B	TOR	1,4-Dioxane [3]	3.0	3.22	9/22/2010
		Vanadium	0.2	1.64	10/3/2013

Well Location	Screened Zone	Parameter (COC) (1)	IGCL (ug/L)	Maximum Concentration Exceeding IGCLs (ug/L)	Date of Detected Exceedance
B121OW (2)	SO	Vanadium	0.2	13.6	10/3/2013
B122 (2)	TOR	Vanadium	0.2	1.37	10/3/2013
B125A	TOR	Manganese	300.0	2380	10/4/2013
B126A	TOR	1,4-Dioxane (3)	3.0	5.53	9/22/2010
		Trichloroethene	5.0	25.1	9/26/2012

Well Location	Screened Zone	Parameter (COC) (1)	IGCL (ug/L)	Maximum Concentration Exceeding IGCLs (ug/L)	Date of Detected Exceedance
B126B	BR	1,4-Dioxane (3)	3.0	24.00	9/26/2012
		Cis-1,2-Dichloroethene	70.0	249 J	9/22/2010
		Trichloroethene	5.0	379 J	9/22/2010
		Vinyl Chloride	2.0	12 J	9/22/2010
		Vanadium	0.2	3.97	10/3/2013
B131C	TOR	1,4-Dioxane (3)	3.0	160	10/1/2013
		Trichloroethene	5.0	12.6	10/1/2013
B132	TOR	1,4-Dioxane (3)	3.0	8.4 J	9/25/2012
		Cis-1,2-Dichloroethene	70.0	101	9/22/2010
		Tetrachloroethene	5.0	8.96	9/22/2010
		Trichloroethene	5.0	154	9/22/2010
		Vanadium	0.2	4.29	10/3/2013
B132B	BR	1,4-Dioxane (3)	3.0	3.67	9/30/2009
		Manganese	300.0	1130	10/3/2013
		Vanadium	0.2	1.42	10/3/2013
B136A	SO	1,4-Dioxane (3)	3.0	31.3 J	9/22/2010
		Vanadium	0.2	1.67	10/4/2013
B136B	TOR	1,4-Dioxane (3)	3.0	12.2 J	9/22/2010
		Cis-1,2-Dichloroethene	70.0	2080	9/29/2011
		Methylene Chloride	5.0	6.11 J	9/24/2009
		Tetrachloroethene	5.0	13.8	9/29/2011
		Trichloroethene	5.0	4070	9/29/2011
		Vinyl Chloride	2.0	50.8	9/26/2012
		Manganese	300.0	1310	10/4/2013
		Vanadium	0.2	1.54	10/4/2013
B136C	BR	1,4-Dioxane (3)	3.0	52.6	9/24/2009
		Cis-1,2-Dichloroethene	70.0	1460 J	9/24/2009
		Methylene Chloride	5.0	13.5 J	9/24/2009
		Trichloroethene	5.0	587	9/26/2012
		Vinyl Chloride	2.0	556 J	9/24/2009
B137A (2)	SO	Manganese	300.0	327	10/3/2013
		Vanadium	0.2	10.6	10/3/2013

B137B	TOR	1,2-Dichloroethane	5.0	8.09	9/22/2010
		1,4-Dioxane (3)	3.0	15	10/3/2013
		Benzene	5.0	5.58	10/3/2013
B138A (2)	SO	Vanadium	0.2	4.74	10/4/2013
B138B	TOR	1,1-Dichloroethane	70.0	88.7 J	10/1/2013
		1,1-Dichloroethene	7.0	16 J	10/1/2013
		1,2-Dichloropropane (3)	5.0	9.53	10/3/2011
		1,4-Dioxane (3)	3.0	980 J	10/1/2013
		Benzene	5.0	6.15	9/30/2009
		Cis-1,2-Dichloroethene	70.0	2690 J	10/1/2013
		trans-1,2-Dichloroethene	100.0	122 J	10/1/2013
		Trichloroethene	5.0	920 J	10/1/2013
		Vinyl Chloride	2.0	998	10/1/2013

Well Location	Screened Zone	Parameter (COC) (1)	IGCL (ug/L)	Maximum Concentration Exceeding IGCLs (ug/L)	Date of Detected Exceedance
B139A	SO	Trichloroethene	5.0	46.3	9/22/2010
B139C	BR	Vanadium	0.2	4.24	10/2/2013
B144A	SO	Vanadium	0.2	1.72	10/3/2013
B144B (2)	TOR	Manganese	300.0	428	10/3/2013
		Vanadium	0.2	4.09	10/3/2013
B145B	TOR	1,4-Dioxane (3)	3.0	49	10/3/2013
		Trichloroethene	5.0	157	10/3/2013
		Vinyl Chloride	2.0	3.76	10/3/2013
B145C	BR	1,4-Dioxane (3)	3.0	8.3	10/3/2013
		Benzene	5.0	14.9	9/30/2009
B147B	TOR	Cis-1,2-Dichloroethene	70.0	928	9/21/2010
		Methylene Chloride	5.0	8.87 J	9/24/2009
		Trichloroethene	5.0	255	9/21/2010
		Vinyl Chloride	2.0	1370 J	9/24/2009
B148B (4)	TOR	Cis-1,2-Dichloroethene	70.0	675	10/2/2013
		Trichloroethene	5.0	105	9/21/2010
		Vinyl Chloride	2.0	450	9/25/2012
B149B-R	TOR	Cis-1,2-Dichloroethene	70.0	856	10/2/2013
		Trichloroethene	5.0	181	10/2/2013
		Vinyl Chloride	2.0	385	10/2/2013
B150B	TOR	Benzene	5.0	5.67 J	9/26/2011
		Cis-1,2-Dichloroethene	70.0	4980	9/24/2009
		Methylene Chloride	5.0	8.94 J	9/24/2009
		Trichloroethene	5.0	291	9/24/2009
		Vinyl Chloride	2.0	825	10/2/2013

Appendix C

Maximum Concentrations of Groundwater Contaminants that Exceeded IGCLs by Well Location (2009 through 2013) Parker Landfill Superfund Site

B160A	SO	Tetrachloroethene	5.0	5.23	9/27/2009
		Trichloroethene	5.0	66.7	9/27/2009
B160B	SO	1,4-Dioxane (3)	3.0	4.09	9/27/2009
		Trichloroethene	5.0	68.7	9/27/2009
B160C	SO	1,4-Dioxane (3)	3.0	12.1	9/28/2009
		Trichloroethene	5.0	6.02	9/28/2009
B163A	SO	Tetrachloroethene	5.0	4.01	9/29/2009
		Trichloroethene	5.0	44.4	9/27/2012
B164A	SO	Trichloroethene	5.0	5.1	9/27/2012
B164B (4)	SO	Trichloroethene	5.0	22.7	9/25/2009
B165B	SO	Cis-1,2-Dichloroethene	70.0	1640	9/25/2009
		Tetrachloroethene	5.0	73.1	10/3/2011
		Trichloroethene	5.0	2440 J	9/25/2009
B165C	SO	Cis-1,2-Dichloroethene	70.0	1060	9/22/2010
		Tetrachloroethene	5.0	19.8	10/2/2013
		Trichloroethene	5.0	729	10/2/2013
		Vinyl Chloride	2.0	5.05 J	9/22/2010
B166C	SO	Cis-1,2-Dichloroethene	70.0	119	9/23/2010
		Vinyl Chloride	2.0	2.68	10/4/2011
B167C	SO	Trichloroethene	5.0	8.61	9/25/2009
B168B	SO	Trichloroethene	5.0	8.82	10/3/2013
Well Location	**Screened Zone**	**Parameter (COC) (1)**	**IGCL (ug/L)**	**Maximum Concentration Exceeding IGCLs (ug/L)**	**Date of Detected Exceedance**
B168C	SO	Cis-1,2-Dichloroethene	70.0	143	9/26/2009
		Vinyl Chloride	2.0	4.5	9/26/2009
B169B	SO	Cis-1,2-Dichloroethene	70.0	365	9/27/2012
		Tetrachloroethene	5.0	8.12	9/27/2012
		Trichloroethene	5.0	183	9/27/2012
		Vinyl Chloride	2.0	3.42	9/23/2010
B169C (4)	SO	Cis-1,2-Dichloroethene	70.0	247 J	9/29/2009
		Vinyl Chloride	2.0	8.1	9/29/2009
B170B	SO	Cis-1,2-Dichloroethene	70.0	1570	9/26/2009
		Tetrachloroethene	5.0	82.3	10/3/2011
		Trichloroethene	5.0	4060 J	9/26/2009
B170C	SO	Cis-1,2-Dichloroethene	70.0	290	9/26/2009
		Vinyl Chloride	2.0	9.36	9/26/2009
B171B	SO	Trichloroethene	5.0	5.24	9/26/2009
B171C	SO	Trichloroethene	5.0	8.22	10/3/2013
B172B	TOR	Benzene	5.0	12 J	9/21/2010
		Cis-1,2-Dichloroethene	70.0	1400	9/26/2011
		Tetrachloroethene	5.0	6.45	9/21/2010

Appendix C
Maximum Concentrations of Groundwater Contaminants that Exceeded IGCLs by Well Location (2009 through 2013)
Parker Landfill Superfund Site

		Trichloroethene	5.0	975	9/21/2010
		Vinyl Chloride	2.0	93.3	10/2/2013
B173B	TOR	Benzene	5.0	8.17 J	9/21/2010
		Cis-1,2-Dichloroethene	70.0	341	9/21/2010
		Trichloroethene	5.0	143	9/21/2010
		Vinyl Chloride	2.0	112	9/21/2010
B174A	SO	Lead (3)	15.0	28.4	10/4/2013
		Manganese	300.0	1040	10/4/2013
		Vanadium	0.2	24.5	10/4/2013
B174B	TOR	Vanadium	0.2	4.63	10/4/2013
B174C	BR	Vanadium	0.2	1.30	10/4/2013
MW4A	SO	1,4-Dioxane (3)	3.0	7.55 J	9/22/2010
		Vanadium	0.2	2.18	10/4/2013

Notes

ug/L - micrograms per liter

(1) Groundwater samples only analyzed for metals and SVOCs during the October 2013 sampling event.

(2) Well location only sampled in during this FYR period.

(3) Not a COC identified in the ROD; however compound is listed due to previous and/or current exceedances of IGCLs (mg/L) for risk purposes.

(4) - 1,2-dichloroethane, 1,2-dichloropropane and/or tetrachloroethene listed in Table 3 of 2009 annual report as exceeding the applicable IGCL;however the listed concentration is below the IGCL.

J – Estimated.

SO – Shallow Overburden.

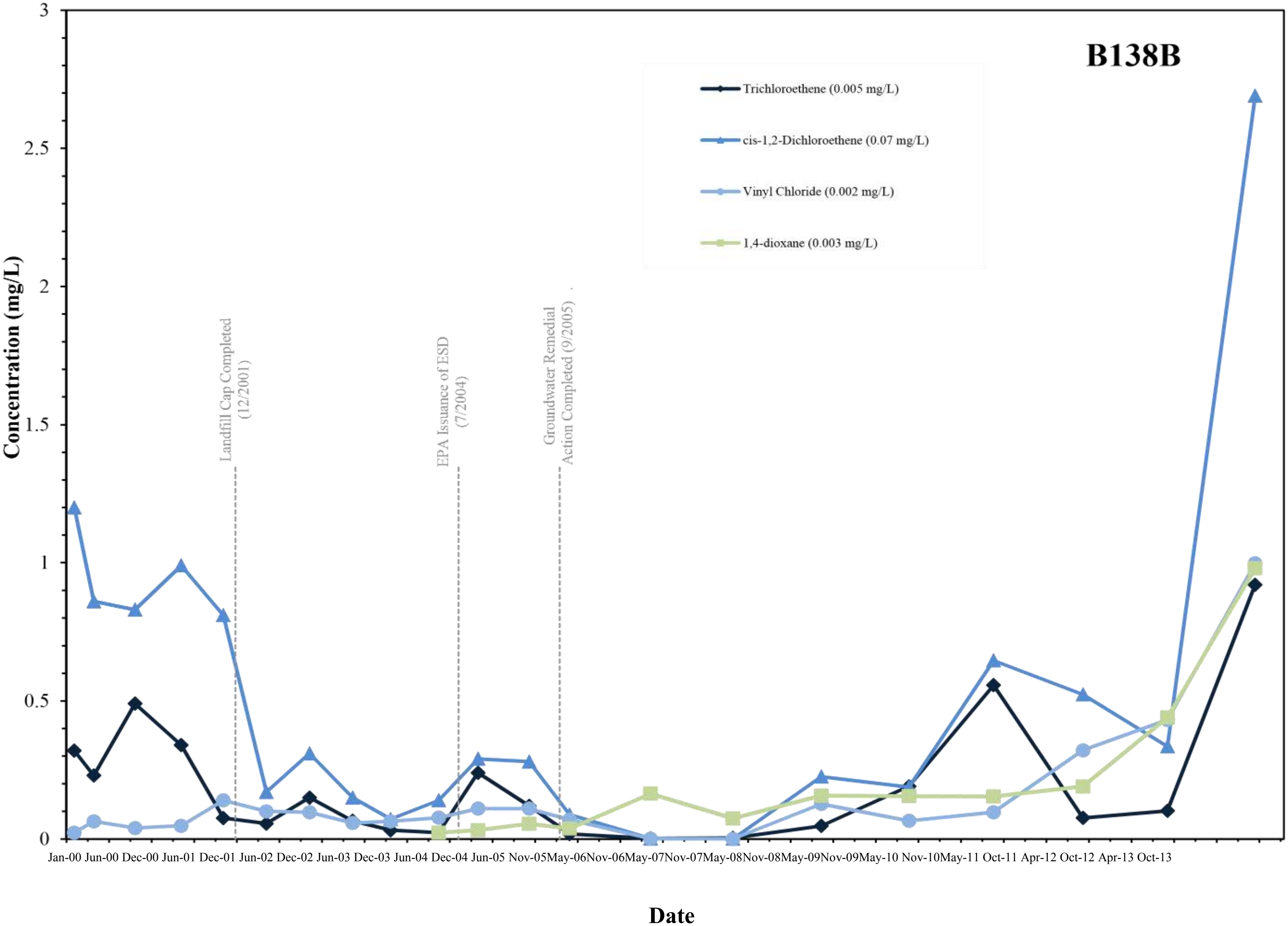
TOR – Top of Rock.

BR – Bedrock.

APPENDIX D

Representative Data Plots

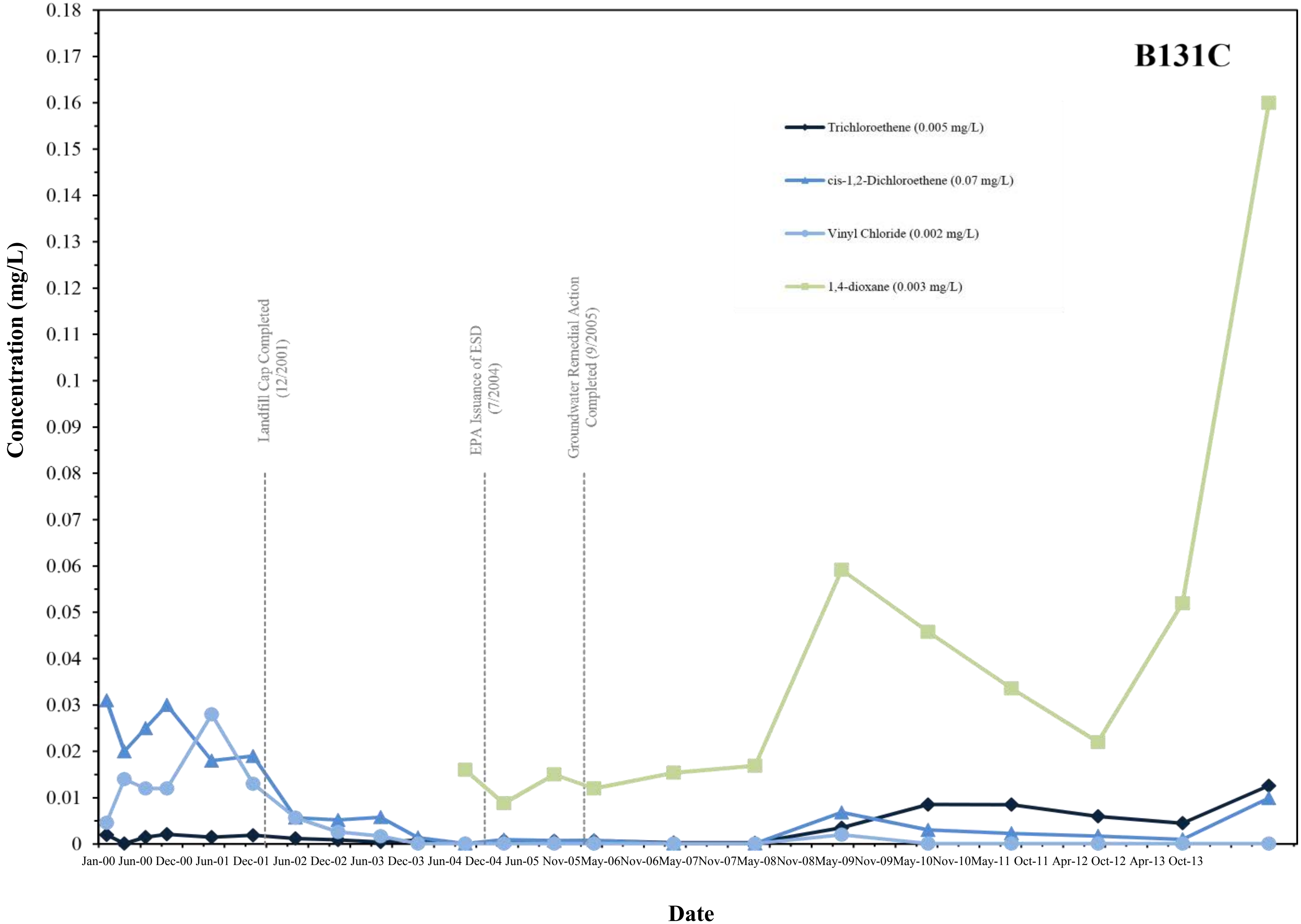
Near source areas



Non-detected results were assigned a value of 0.0001 mg/L for charting purposes

IGCL is listed in parentheses after constituent name

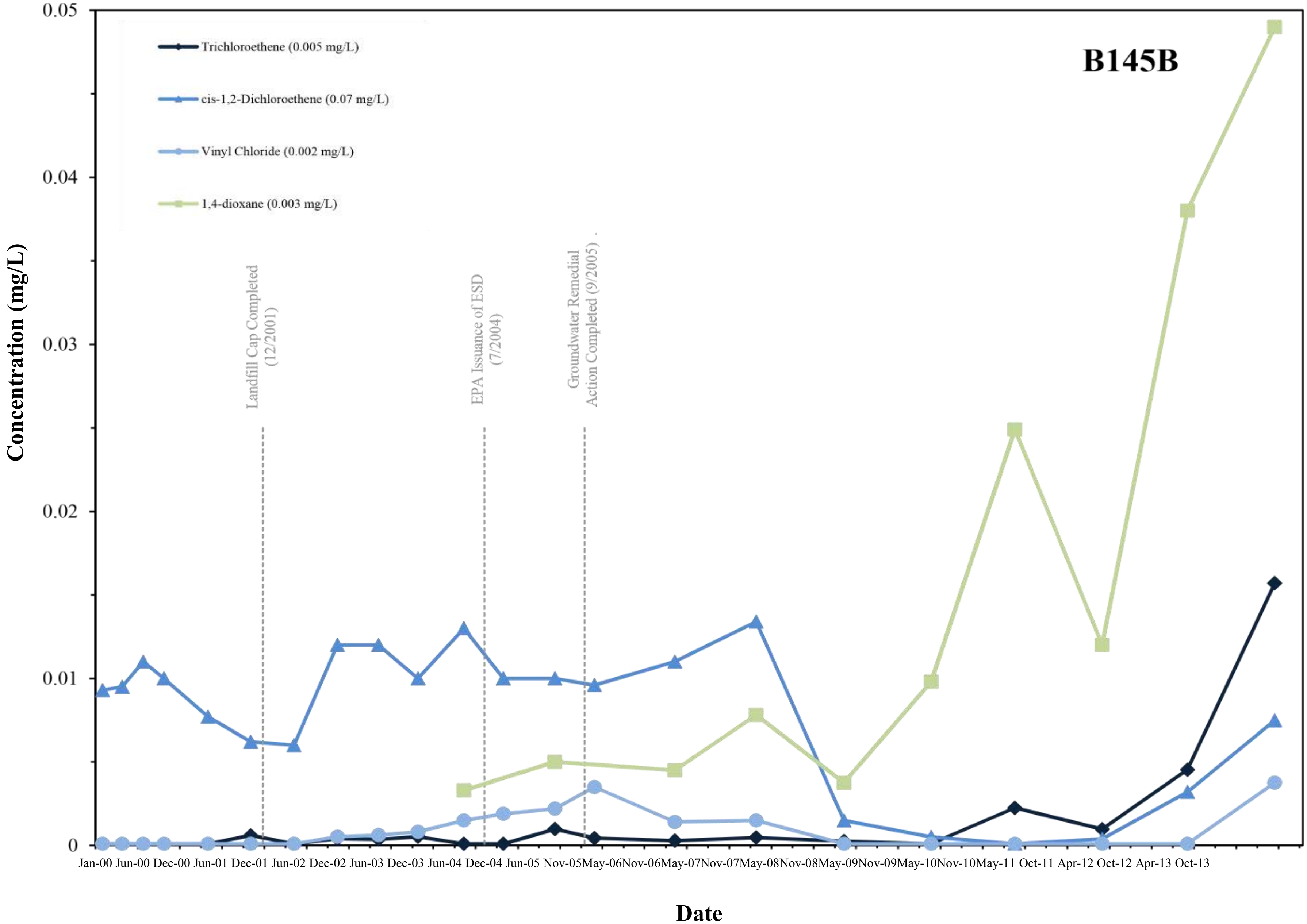
Downgradient of source area



Non-detected results were assigned a value of 0.0001 mg/L for charting purposes

IGCL is listed in parentheses after constituent name

Near downgradient property line



Non-detected results were assigned a value of 0.0001 mg/L for charting purposes

IGCL is listed in parentheses after constituent name

APPENDIX E

Interview Documentation

INTERVIEW RECORD

Site Name: Parker Landfill	**EPA ID No.:** VTD981062441
Subject: Five Year Review	**Time:** 2:28 pm / **Date:** 5/28/2014
Type: Telephone Visit Other: Email **Location of Visit:** N/A	Incoming Outgoing

Contact Made By:

Name: Jeff Saunders	**Title:** Project Manager/Geologist	**Organization:** TRC Environmental

Individual Contacted:

Name: John Schmeltzer	**Title:** Hazardous Site Manager	**Organization:** VTDEC

Telephone No: 802-241-3886 **Street Address:** 103 **Fax No:** **City, State, Zip:** Waterbury, Vermont **E-Mail Address:** john.schmeltzer@state.vt.us	South Main Street, West Building 05671-0404

Summary Of Conversation

Q1. What is your overall impression of the project?
A1. I have a good impression. VT DEC believes that the remedies at this site have been effective to mitigate the contamination. Recently, it appears that there may be an increase in groundwater contamination in monitoring wells approximately southwest of the covered landfill. EPA and the state has directed one of the responsible parties to take a closer look at this apparent upward trend and recommend next steps (if any). They are in the process of doing so.

Q2 Have there been any complaints, violations, or other incidents related to the site requiring a response by your office?
A2. No

Q3 Are there any community groups that are active or involved in the project? A3. No

Q4 Do you feel well informed about the site's activities and progress?
A4. Yes…The responsible parties and EPA have kept me informed of the site's activities and progress.

Q5 Are you aware of anyone using groundwater near the site?
A5. No, given that properties downgradient of the landfill are connected to municipal water and there are institutional controls (groundwater use restrictions and town zoning restrictions) prohibiting groundwater use.

Q6 Are there any new state regulations (since 2009) that are applicable to the site?
A6. No,,,It is anticipated that a new groundwater and protection rule will be adopted prior to the next 5-year review in 2019.

Q7 Are there any outstanding issues at the Parker Landfill?
A7. The two outstanding issues are the apparent upward trend in contaminants of concerns and dioxane and localized settlement on the landfill. Both of these issues are currently being addressed by the responsible parties.

INTERVIEW RECORD

Site Name: Parker Landfill		**EPA ID No.:** VTD981062441
Subject: Five Year Review	**Time:** 11:20 am	**Date:** 6/4/2014
Type: Telephone X Visit Other **Location of Visit:** NA		Incoming X Outgoing

Contact Made By:		
Name: Jeff Saunders	**Title:** Project Manager / Geologist	**Organization:** TRC Environmental
Individual Contacted:		
Name: Eric Chadburn	**Title:** Facilities Manager	**Organization:** Fairbanks Scales, Inc.

Telephone No: 802-748-5111 **Fax No:** **E-Mail Address:**	**Street Address:** 2176 Portland Street **City, State, Zip:** St. Johnsbury, VT 05824

Summary Of Conversation
Q1 What is your overall impression of the project? A1 Great. The site conditions, gas management and working relationship with interested parties, including the US EPA and VTDEC, are all very good. Q2 Have there been any significant changes to the O&M of the landfill within the past 5 years? A2 No, current O&M practices have been and continue to be successful. Q3 Have there been any unexpected difficulties with continued O&M of the landfill? A3 There have been no unexpected difficulties with the O&M in the past five years. The settlement in the vicinity of extraction Well #4 is currently being address collectively with the US EPA and VTDEC, but this type of issue is not uncommon following landfill closure. Pending approval, further evaluation of the settlement, including potentially temporarily exposing a limited portion of the liner, will be conducted and repairs will be implemented (as needed). Woodchuck burrows are an ongoing concern, but this is not an unexpected challenge and, although time consuming, the current management strategy has successful. Q4 Do you have any recommendations for reducing or increasing activities at the Site? A4 No, O&M activities will continue as currently approved/scheduled with mitigation measures (e.g., settlement, burrows, etc.) implemented on an as needed basis. Looking forward, preparing for the time when there is not enough methane to burn to effectively and efficiently manage the associated changes will become an area of focus.

INTERVIEW RECORD

Site Name: Parker Landfill		**EPA ID No.:** VTD981062441
Subject: Five Year Review	**Time:** 11:17 am	**Date:** 6/10/2014
Type: Telephone Visit Other: Email **Location of Visit:**		Incoming Outgoing

Contact Made By:		
Name: Jeff Saunders	**Title:** Project Manager/Geologist	**Organization:** TRC Environmental

Individual Contacted:		
Name: Frederik Schuele	**Title:** Hydrogeologist, Project Manager	**Organization:** URS Corporation

Telephone No: 207-879-7686 ext. 224 **Fax No:** **E-Mail Address:** Frederik.Schuele@urs.com	**Street Address:** 477 Congress Street, Suite 900 **City, State, Zip:** Portland, ME 04101

Summary Of Conversation

Q1 What is your overall impression of the project? A1
Positive.

Q2 Are the groundwater remedies functioning as expected?
A2 Yes both the BNA and the PRB groundwater remedies are functioning as expected and performing well.

Q3 How well is the remedy performing?
A3 The PRB continues to intercept impacted shallow overburden groundwater from the IWS-3 source area. Using conservative assumptions, and based on volumetric mass flux estimates derived from 2013 performance monitoring data, the PRB remedial activity results in a significant overall reduction in the mass of total CVOCs in downgradient groundwater. PRB performance monitoring data from 2013 are consistent with conditions observed during previous year (i.e., 2008 through 2012). BNA monitoring data collected in 2013 indicate that the BNA Remedial Activity is effectively reducing the concentration and mass of CVOCs in groundwater downgradient of the landfill. Overall, trichloroethene concentrations within the BNA Treatment Zone have been substantially reduced since the start of the BNA Remedial Activity in 2005. The presence of chlorinated ethenes, ethene, VFAs, and nutrients in monitoring wells situated downgradient of the BNA Treatment Zone indicates that active dechlorination of chlorinated ethenes extends from the BNA injection wells through the BNA Treatment Zone and into the downgradient aquifer.

Q4 Have there been any significant changes to the monitoring for either of the PRB or BNA system in the last five years?
A4 Monitoring of the PRB remedial activity for CVOCs has been performed annually since 2008, in accordance with the 2006 Long-Term Monitoring Plan (LTMP) for the Parker Landfill. An addendum to the LTMP in July 2010 modified the sampling program for the PRB by eliminating analysis for ethene, ethane, and chloride. Performance monitoring of the BNA remedial activity is conducted in accordance with the BNA Operation and Maintenance (O&M) Plan, and has historically entailed monitoring of the 14 BNA injection wells. The BNA O&M plan was substantially revised in 2011 to include the use of emulsified vegetable oil (EVO) as an amendment compound. As a result, performance monitoring for the BNA remedial activity was

revised to include an expanded analytical suite, as well as the downgradient BNA monitoring wells, and the BNA extraction wells.

Q6 Have there been any unexpected difficulties with respect to continued operation/implementation of the groundwater remedies?
A6 No, there have not been any unexpected difficulties with the remedies.

Q7 What is your projection for achieving the cleanup goals in either of the treatment areas?
A7 Remedial activity monitoring data show marked reductions in the concentrations of CVOCs immediately downgradient of the PRB and downgradient of the BNA. These conditions are expected to continue into the future, and eventually allow for the ROD-selected remedy of monitored natural attenuation to prevail in the areas downgradient of the landfill. However, actual cleanup projections have not been revisited since they were provided in the design documents.

Q8 Do you have any recommendations for reducing or increasing activities at the Site?
A8 BNA performance monitoring data collected to date demonstrate that the BNA is fulfilling its designated role of enhancing conditions favorable for groundwater remediation through natural attenuation. However, the BNA remedial activity is not intended to continue indefinitely. The function of the BNA is to enhance the monitored natural attenuation remedial activity in achieving IGCLs in groundwater downgradient of the Parker landfill. Recently proposed BNA O&M plan modifications are intended to allow for continued operation of the BNA Remedial Activity until concentrations of total chlorinated ethenes in the vicinity of the BNA area are reduced to where monitored natural attenuation processes (e.g., advection, diffusion, and natural biodegradation) will effectively continue groundwater remediation downgradient of the landfill. The proposed performance monitoring program is designed to evaluate the continued enhancement of natural attenuation processes that extend from the BNA extraction wells, through the BNA Treatment Zone, and into and beyond the downgradient BNA Monitoring wells. If the proposed BNA O&M Plan modifications are approved by the EPA, the revised BNA performance monitoring program will be implemented as of the next scheduled performance monitoring event, and future re-applications of BNA amendments will be scheduled when the proposed re-application criteria are met.

Long-term groundwater monitoring data collected from monitoring well clusters B119, B131, B137, B138, and B145 indicate that levels of CVOCs and 1,4-dioxane are increasing within the top-of rock groundwater flow system in the western/southwestern portion of the Study Area. Potential source materials and conditions for the increases were identified in the 2013 Draft Annual Monitoring Report. Monitoring and analyses will continue to be conducted to evaluate constituent trends at these monitoring locations, and the data obtained will be analyzed to develop a better understanding of groundwater conditions in the vicinity of these wells. In addition, the Conceptual Site Model for the Parker Landfill will be updated by incorporating information generated from investigations, monitoring, and remedial activities performed at the Parker Landfill from 2005 through 2013. The updated CSM will identify data gaps for the top-of-rock groundwater flow system in the western/southwestern portion of the Study Area, and is expected to recommend proposed locations for the installation of additional monitoring wells to better define the extent of CVOCs and 1,4-dioxane in groundwater west/southwest of the landfill.

INTERVIEW RECORD

Site Name: Parker Landfill	**EPA ID No.:** VTD981062441	
Subject: Five Year Review	**Time:** 4:03 pm	**Date:** 6/10/2014
Type: Telephone Visit Other: Email **Location of Visit:**	Incoming Outgoing	

Contact Made By:

Name: Jeff Saunders	**Title:** Project Manager/Geologist	**Organization:** TRC Environmental

Individual Contacted:

Name: Justin Smith	**Title:** Zoning Administrator	**Organization:** Town of Lyndon, Vermont

Telephone No: 802-626-1269 **Fax No:** **E-Mail Address:** justin@lyndonvt.org	**Street Address:** Zoning Department **City, State, Zip:** Town of Lyndon, Vermont

Summary Of Conversation

Q1: Are you familiar with the activities at the site in the last five years and the institutional controls (IC) being implemented to restrict use of groundwater? A1. Yes.

Q2: Have any new areas/roads been included in the zoning ordinance within the last five years? A2. No.

Q3: In 2003, the State of Vermont reclassified groundwater from Class III to Class IV. Has the Town of Lyndonville completed expansion of the "Institutional Control Area"? A3. To the best of my knowledge yes.

Q4: Will a Town ordinance continue to be sought to fulfill the ROD institutional control requirements and is there an anticipated completion date?
A4. I am unaware of there being any intention of adding anything to the ordinances, we already have the Institutional Control area identified in our zoning by-laws.

Q5: What, if any, new construction is proposed/planned in the vicinity of the site**?**
A5. None at the moment within the IC District.

APPENDIX F

Current Toxicity Criteria and Vapor Intrusion Screening Levels for Groundwater

Table 1
Current Toxicity Criteria for Carcinogens

Constituent	Current Weight of Evidence Classification	1993 Oral Slope Factor (mg/kg-d)-1	2014 Oral Slope Factor (mg/kg-d)-1
Acetone	Inadequate (b)		
Benzene	A (b)	2.9E-02 (a)	5.5E-02 (b)
Butanone, 2-	Inadequate (b)		
Chloroform	B2 (b)	6.1E-03 (a)	3.1E-02 (g)
Chloroethane	Likely (d)	2.9E-02 [c]	None (b)
Dichlorodifluoromethane	- - (b)		
Dichloroethane, 1,1-	C (b)		5.7E-03 (g)
Dichloroethene, 1,1-	Suggestive (b)	6E-01 (a)	None (b)
Dichloroethene, 1,2- (total)	Inadequate (b)		
Dichloropropane, 1,2-	B2 (f)	6.8E-02 (e)	3.6E-02 (g)
Dioxane, 1, 4-	Likely (b)		1.0E-01 (b)
Ethyl Benzene	D (a)		1.1E-02 (g)
Methylene Chloride	Likely (b)	7.05E-03 (a)	2.0E-03 (b)
Methyl-2-Pentanone, 4- (MIBK)	Inadequate (b)		
Tetrachloroethene	Likely (d)	5.2E-02 [c]	2.1E-03 (b)
Toluene	Inadequate (b)		
Trichloroethane, 1,1,1-	Inadequate (b)		
Trichloroethene	Carcinogenic to Humans (b)	1.1E-02 [c]	4.6E-02 (b)
Vinyl Chloride	A (b)	1.9E+00 [c]	7.2E-1 adult (b)
Vinyl Chloride (cont'd)			1.4E+00 from birth (b)
Xylenes, Total	Inadequate (b)		
Bis(2-ethylhexyl) Phthalate	B2 (b)	1.4E-02 (a)	Same (b)
Dibenzofuran	D (b)		
Diethyl phthalate	D (b)		
Di-n-butylphthalate	D (b)		
Fluoranthene	D (b)		
Fluorene	D (b)		
Methylnaphthalene, 2-	Inadequate (b)		
Methylphenol, 4- (p-cresol)	C (b)		
Naphthalene	C (b)		
Phenanthrene	D (b)		
Pyrene	D (b)		
Aluminum	Inadequate (d)		
Antimony	Inadequate (d)		
Arsenic	A (b)	1.75E+00 (a)	1.5E+00 (b)
Barium	D (b)		
Beryllium	B1 (b)	4.3E+00 (a)	None (b)
Cadmium	B1 (b)		
Chromium (total)	D oral, A inh. (b)	None	5.0E-01 (h,i)
Cobalt	Likely (d)		
Copper	D (b)		
Cyanide	Inadequate (b)		
Iron	C (d)		
Lead	B2 (b)		
Manganese	D (b)		
Nickel	- - (b)		

Selenium	D (b)		
Vanadium	Inadequate (d)		
Zinc	Inadequate (b)		

(a) IRIS, Integrated Risk Information System, 1993
(b) IRIS, Integrated Risk Information System, 2014 (http://www.epa.gov/iris/)
[c] Interim value from ECAO, 1992
(d) PPRTV value from STSC, 2014
(e) Health Effects Assessment Summary Tables (HEAST), FY 1992
(f) Health Effects Assessment Summary Tables (HEAST), FY 1997
(g) California OEHHA value, 2014
(h) New Jersey Department of Environmental Protection, 2014
(i) Value is for hexavalent chomium
A = Known human carcinogen
B1 or B2 = Probably human carcinogen

Table 2
Current Toxicity Criteria for Non- Carcinogens

Constituent	1993 Oral RfD mg/kg-d	2014 Oral RfD mg/kg-d
Acetone	1E-01 (a)	9E-01 (b)
Benzene		4E-03 (b)
Butanone, 2-	5E-02 (a)	6E-01 (b)
Chloroform	1E-02 (a)	Same (b)
Chloroethane	4E-01 [c]	None (b)
Dichlorodifluoromethane	2E-01 (a)	Same (b)
Dichloroethane, 1,1-	1E-01 (e)	2E-01 (d)
Dichloroethene, 1,1-	9E-03 (a)	5E-02 (b)
Dichloroethene, 1,2- (total)	9E-03 (e)	2E-03 (b,n)
Dichloropropane, 1,2-		9E-02 (k)
Dioxane, 1, 4-		3E-02 (b)
Ethyl Benzene	1E-01 (a)	Same (b)
Methylene Chloride	6E-02 (a)	6E-03 (b)
Methyl-2-Pentanone, 4- (MIBK)	5E-02 (a)	8E-02 (f)
Tetrachloroethene	1E-02 (a)	6E-03 (b)
Toluene	2E-01 (a)	8E-02 (b)
Trichloroethane, 1,1,1-	9E-02 (e)	2E+00 (b)
Trichloroethene	6E-03 [c]	5E-04 (b)
Vinyl Chloride	None	3E-03 (b)
Xylenes, Total	2E+00 (a)	2E-01 (b)
Bis (2-ethylhexyl) Phthalate	2E-02 (a)	Same (b)
Dibenzofuran	4E-03 [c]	1E-03 (d)
Diethyl phthalate	8E-01 (a)	Same (b)
Di-n-butylphthalate	1E-01 (a)	Same (b)
Fluoranthene	4E-02 (e)	Same (b)
Fluorene	4E-02 (e)	Same (b)
Methylnaphthalene, 2-	None	4E-03 (b)
Methylphenol, 4- (p-cresol)	5E-03 (e)	1E-01 (k)
Naphthalene	4E-02 (e)	2E-02 (b)
Phenanthrene	4E-02 (e,g)	2E-02 (b,g)
Pyrene	3E-02 (a)	Same (b)
Aluminum	1E+00 [c]	Same (d)
Antimony	4E-04 (a)	Same (b)
Arsenic	3E-04 (a)	Same (b)
Barium	7E-02 (a)	2E-01 (b)
Beryllium	5E-03 (a)	2E-03 (b)
Cadmium	5E-04 (a,h)	Same (b,h)

Chromium (total)	5E-03 (a,i)	3E-03 (b,i)
Cobalt		3E-04 (d)
Copper		4E-02 (f)
Cyanide	2E-02 (a)	6E-04 (b,m)
Iron	None	7E-01 (d)
Lead		
Manganese	5E-03 (a)	2.4E-02 (b,l)
Nickel	2E-02 (a,j)	Same (b,j)
Selenium	5E-03 (a)	Same (b)
Vanadium	7E-03 (e,k)	5E-03 (b)
Zinc	2E-01 (a)	3E-01 (b)

(a) IRIS, Integrated Risk Information System, 1993

(b) IRIS, Integrated Risk Information System, 2014 (http://www.epa.g

(c)Interim value from ECAO, 1992

(d) PPRTV value from STSC, 2014

(e) Health Effects Assessment Summary Tables (HEAST), FY 1992

(f) Health Effects Assessment Summary Tables (HEAST), FY 1997

(g) Value is cross-assigned from Naphthalene

(h) Cadmium RfD is for water, 1E-03 mg/kg-d is the RfD for food

(i) Value is for hexavalent chromium

(j) Value is for nickel, soluble salts

(k)ATSDR, 2014

(l) Value is for manganese (non-diet)

Table 3

Vapor Intrusion Screening Levels for Groundwater[1]

Chemical	Basis of Target Concentration C=Cancer Risk; N/C=Non cancer Risk	InhalationUnit Risk ($\mu g/m^3$)$^{-1}$	Reference Concentration ($\mu g/m^3$)	Residential Target Indoor Air Concentration (ILCR=1E-06) $\mu g/m^3$	Residential Target Indoor Air Concentration (HQ=0.1) $\mu g/m^3$	Dimensionless Henry's Law Constant (unitless)	Target Groundwater Concentration (ILCR=1E-06) $\mu g/L$	Target Groundwater Concentration (HI=0.1) $\mu g/L$
Acetone	NC	NA	3.10E+04 A	NA	3.20E+03	1.43E-03	NA	2.24E+06
Benzene	C	7.80E-06 I	3.00E+01	3.60E-01	3.10E+00	2.27E-01	1.59E+00	1.37E+01
1,1-Dichloroethane	C	1.60E-06 C	I NA	1.80E+00	NA	2.30E-01	7.83E+00	NA
Methylene chloride	C	1.00E-08 I	6.00E+02 I	1.00E+02	6.30E+01	1.33E-01	7.53E+02	4.74E+02
Trichloroethene	C	4.10E-06 I	2.00E+00 I	4.80E-01	2.10E-01	4.03E-01	1.19E+00	5.21E-01
cis-1,2-Dichloroethene	NC	NA	NA	NA	NA	1.67E-01	No value available	No value available

[1] Table Footnotes:

Toxicity Values used as basis of Target Indoor Air and Groundwater Concentrations are available on the Regional Screening Levels Table at http://www.epa.gov/reg3hwmd/risk/human/index.htm (May 2014)

Toxicity Value References: C = CalEPA; I = IRIS; ATSDR = Agency for Toxic Substances and Disease Registry

Henry's Law Constants from Regional Screening Levels Table (May 2014)

Screening value is based on 1×10^{-6} cancer risk or HI = 0.1.

Residential Target Indoor Air values are found in Regional Screening Levels table (http://www.epa.gov/reg3hwmd/risk/human/index.htm).

The equation for the target groundwater concentration (Cgw) is:

$$Cgw = \frac{Cia,target}{AFgw \times (1000\ L/m^3) \times HLC}$$

where Cia is the target indoor air concentration, AFgw is the generic attenuation factor for groundwater (default value = 0.001) and HLC is Henry's Law Constant.

The lower of the target groundwater concentration based on an ILCR of 1E-06 or a HQ = 0.1 is selected as the groundwater Vapor Intrusion Screening Level (VISL).