Final

First Five Year Review Report

Rose Hill Landfill Superfund Site
Town of South Kingstown, Washington County, Rhode Island

August 2010

Prepared by

USEPA Region 1, Boston, MA

with support from

Rhode Island Department of Environmental Management

and

The Louis Berger Group, Inc

Providence, RI

First Five-Year Review Report

for

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Landfill Superfund Site

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Approved by:

James T Owens III, Director
Office of Site Remediation and Restoration

Date: 8/25/10

EXECUTIVE SUMMARY

This is the first five-year review for the Rose Hill Landfill Superfund Site (the Site) in South Kingstown, RI as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and in accordance with EPA Office of Solid Waste and Emergency Response (OSWER) Guidance No. 9355.7-03B-P, which also identifies this review as Statutory. This statutory five-year review is required since hazardous contamination remains at the Site above levels that allow for unlimited use and unrestricted exposure. A public announcement initiating this five-year review process was published in the Narragansett Times on July 3, 2009. The triggering action for this statutory five-year review is based on the starting date of Remedial Action construction activities, May 26, 2005. The purpose of the five-year review is to assess whether the remedy selected for the Site is or will be protective of human health and the environment.

The Record of Decision (ROD) for the Site was signed on December 20, 1999. The ROD describes the first operable unit (OU-1) of a phased approach to remediate contamination caused by the Site, consisting of a source control remedy that will prevent or minimize the continued release of hazardous substances, pollutants or contaminants to the environment. An Explanation of Significant Differences (ESD) was issued on September 2008 documenting modifications to the remedy principally for modification to the gas collection and thermal destruction system proposed in the ROD.

The ROD called for consolidation of the Bulky Waste Area onto the Solid Waste Area, containment, leachate collection and treatment (during consolidation), and landfill gas treatment (Solid Waste Area).

A Consent Decree (CD) requiring the design, construction, operation and maintenance of the remedy was entered by the Court on March 13, 2003.

The Site Cooperative Agreement (CA) was initiated on May 28, 2004 and the State of Rhode Island Department of Environmental Management, Office of Waste Management (RIDEM/OWM) took the lead for site design and construction. Notice to Proceed for Phase I project construction was issued on April 27, 2005. The consolidation phase (Phase I) was completed in March 29, 2006, and the capping phase (Phase II), which began on September 25, 2006, was completed on September 25, 2007.

Since the Spring of 2008, continued monitoring of landfill gas has been performed on a quarterly basis; monitoring of groundwater and surface water on a bi-annual basis; and habitat assessment and biomonitoring on an annual basis. The data from this monitoring point to the need for continued monitoring of these media at the same frequency due to the continued exceedances of ambient standards and to assess the need for taking any further response actions after the Site is determined to be operational and functional.

The review of Site-related documents, data, operation and maintenance (O&M) procedures, applicable or relevant and appropriate requirements (ARARs), status concerning Institutional Controls (ICs), and Site inspection notes and review of documents generally indicate that the remedy is functioning as intended by the ROD in advance of implementation of the ICs. Additional environmental monitoring is required to determine trends in contaminant levels.

During this five year review period, the vapor intrusion pathway from landfill gas migration was evaluated. At this time, the vapor intrusion pathway does not pose an unacceptable risk based on the information collected and evaluated. Further assessment is recommended annually while the gas flare

pilot study is underway or until it is known that gas migration and/or the potential for vapor intrusion is diminished to a level which no longer constitutes a concern.

FIVE-YEAR REVIEW SUMMARY FORMNOTIFICATION		
Site name *(from WasteLAN)*: Rose Hill Regional Landfill		
EPA ID *(from WasteLAN)*: RID980521025		
Region: 1	**State:** RI	**City/County:** South Kingstown/ Washington County
SITE STATUS		
NPL status: ☑ Final ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): ☐ Under Construction ☐ Operating ☑ Complete		
Multiple OUs?* ☐ YES ☑ NO	**Construction completion date:** September 25, 2007	
Has site been put into reuse? ☐ YES ☑ NO		
REVIEW STATUS		
Lead agency: ☑ EPA ☐ State ☐Tribe ☐Other Federal Agency_____		
Author name: David J. Newton; Gary Jablonski (Support)		
Author title: Remedial Project Manager (Lead), RIDEM Project Manager (Support)	**Author affiliation:** U.S. EPA Region I (Lead); Rhode Island Department of Environmental Management, Office of Waste Management (Support) with technical support from The Louis Berger Group, Inc.	
Review period:** 7/3/09 to 8/31/10		
Date(s) of site inspection: 3/29/10		

Type of review:

☑Post-SARA ☐ Pre-SARA ☐NPL-Removal only ☐Non-NPL Remedial Action Site

☐ NPL State/Tribe-lead ☐ Regional Discretion

Review number: ☑ 1 (first) ☐ 2 (second) ☐ 3 (third) ☐ Other (specify) _____

Triggering action:

☑ Actual RA Onsite Construction at OU #1 ☐ Actual RA Start at OU#____

☐ Construction Completion ☐ Previous Five-Year Review Report

☐ Other (specify)

Triggering action date *(from WasteLAN)*: 5/26/2005

Due date *(five years after triggering action date)*: 5/26/2010

Five-Year Review Summary Form, cont'd.

Issues:

1) Institutional Controls (ICs) are planned but are not in place. However, IC documents have been prepared by the Town of South Kingstown and progress is being made to implement these in accordance with the current IC program.

2) Sporadic methane concentrations above the LEL have been detected at monitoring points on the western side of Rose Hill Road outside of the Site property limits. Potential for vapor intrusion, while not an immediate concern, remains as a potential threat.

3) Management of the migration of contaminants from the Site continues to be based upon data obtained from the first operable unit and any additional studies that are deemed necessary in order to further assess Site impacts.

Recommendations and Follow-up Actions:

1) ICs are to be completed by the Town of South Kingstown in accordance with the current plan and schedule as outlined in section 6.6 of this document.

2) Continue active landfill gas pilot study and make a decision within one year concerning active versus passive landfill gas management based on ongoing flare pilot studies, continued monitoring, and modeling data. Implementation of the landfill gas pilot study has demonstrated that the active gas collection system can essentially eliminate westward landfill gas migration off-site. If the passive gas venting system is reinstituted, the gas probes and the passive venting system must continue to be monitored at the current frequency, at a minimum, until it is known that the threat of gas migration and/or the potential for vapor intrusion is diminished to a level which no longer constitutes a concern.

3) The Long-Term Monitoring Work Plan should continue in its present form, with continued quarterly landfill gas monitoring, bi-annual groundwater and surface water monitoring, and annual habitat assessment and bio-monitoring. Modifications to the long term monitoring program for the Site may be made in the future based upon monitoring results and analyses.

Five-Year Review Summary Form, cont'd.

Protectiveness Statement(s):

The remedy for OU-1 currently protects human health and the environment in the short term because: 1) access to the Site is restricted to prevent direct exposures to the waste; 2) the vegetative cover and the drainage system are constructed and maintained to prevent erosion of soil and deposition into the surrounding detention ponds, wetlands and surface water bodies; and 3) the landfill cap, gas extraction system, and the pilot flare is capturing and treating landfill gases to prevent exposures beyond the Site boundary.

However, in order for the remedy to be protective in the long-term, the following actions need to be taken: 1) institutional controls are fully implemented; 2) a decision is rendered concerning active vs. passive landfill gas management based on the ongoing pilot study, continued monitoring and modeling data. If passive gas venting system is reinstituted, the gas probes and the passive venting system must continue to be monitored at the current frequency, at a minimum, in order for the remedy to be deemed protective in the long-term; and 3) management of the migration of contaminants from the Site continues to be based upon data obtained from the first operable unit and any additional studies that are deemed necessary in order to further assess Site impacts. Thus the Long-Term Monitoring Work Plan should continue to be implemented to continue to evaluate contaminant trends.

The following actions need to be taken:

Institutional control tasks need to be completed and all ICs fully implemented following the IC program and schedule. Once the pilot study is complete, a decision will be made regarding continued operation of the active landfill gas control or return to passive treatment of landfill gas. If passive gas venting system is reinstituted, the gas probes and the passive venting system must continue to be monitored at the current frequency, at a minimum, and the environmental monitoring as established in the Long-Term Monitoring Plan should be continued to assure protectiveness.

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TABLES

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APPENDICES

Note: Only Appendix A is provided within this printed document. Appendices A through H are provided on the attached computer disk.

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LIST OF ACRONYMS AND ABBREVIATIONS

AGQS	Ambient Groundwater Quality Standard
ARAR	Applicable or Relevant and Appropriate Requirement
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
Berger	The Louis Berger Group, Inc.
bgs	below ground surface
BWA	Bulky Waste Area
CA	Cooperative Agreement
CDN	composite drainage net
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
CRP	Community Relations Plan
CRSP	Community Relations Support Plan
1,1-DCA	1,1-dichloroethane
1,1,1-DCE	1,1,1-dichloroethylene
DNAPL	dense non-aqueous phase liquid
DQO	Data Quality Objectives
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FS	Feasibility Study
GCL	geosynthetic clay liner
gpm	gallons per minute
IC	Institutional Controls

IDL	Instrument Detection Limit
LEL	Lower Explosive Limit
LLDPE	low linear density polyethylene
LTM	Long Term Monitoring Plan
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDL	Method Detection Limit
mg/kg	milligrams per kilogram
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
NA	Not Applicable
NPL	National Priorities List
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU1	Operable Unit 1
PAH	polyaromatic hydrocarbon
PAL	Project Action Limit
PCBs	polychlorinated biphenyl
PCE	tetrachloroethene
PEL	Permissible Exposure Limit
ppb	parts per billion
PQL	Project Quantitation Limit
PQO	Project Quality Objective
PRG	Preliminary Remediation Goal

PRP	Potentially Responsible Party
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QL	Quantitation Limit
RA	Remedial Action
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RIDEM	Rhode Island Department of Environmental Management
RIDOH	Rhode Island Department of Health
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
Site	Rose Hill Landfill Superfund site
SSA	Sewage Sludge Area
SVOCs	semi-volatile organic compounds
SWA	Solid Waste Area
1,1,1-TCA	1,1,1-trichloroethane
TCE	trichloroethene
TMDL	Total Maximum Daily Load
TPH	total petroleum hydrocarbons
VI	vapor intrusion
VOCs	volatile organic compounds
WQC	National Recommended Water Quality Criteria

SECTION 1.0 INTRODUCTION

The purpose of this five-year review is to determine whether the remedy selected for the Rose Hill Regional Landfill Superfund Site (Site) is or will be protective of human health and the environment. This report summarizes the five-year review processes, investigations, and remedial actions undertaken at the Site. The report evaluates the monitoring data collected since the Record of Decision (ROD), with emphasis on measuring the success of the actions taken to control the source of contamination from the Site; reviews Applicable or Relevant and Appropriate Requirement (ARARs) specified in the ROD for changes which may call into question the protectiveness of the remedy; describes the current Site status, and assesses the need for further response.

With technical assistance and support from the State of Rhode Island acting under a Cooperative Agreement for the cleanup, the United States Environmental Protection Agency, Region 1 (EPA) prepared this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan. CERCLA §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."*

The EPA interpreted this requirement further in the National Contingency Plan; 40 Code of Federal Regulations (CFR) §300.430(f)(4)(ii) 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 action no less often than every five years after the initiation of the selected remedial action."*

This is the first five-year review for the Site. This statutory five-year review is required because hazardous substances, pollutants, or contaminants remain at a portion of the Site above levels that would allow for unrestricted use and unlimited exposure. The selected remedy was a landfill cap as a source control remedy response action. The formal review process was conducted in accordance with EPA Office of Solid Waste and Emergency Response (OSWER) Comprehensive Five-Year Review Guidance (EPA, 2001). This report documents the results of this review and presents the results in accordance with the EPA OSWER Guidance.

EPA conducted this five-year review of the remedial action selected for the Site with RIDEM participation. The Louis Berger Group Inc. (Berger) supported RIDEM and EPA in completion of the review under a State Cooperative Agreement No. RID980521025.

SECTION 2.0 SITE CHRONOLOGY

Event	Date
Discovery of the problem / Preliminary Assessment Report for the Rose Hill Regional Landfill Site issued	January, 1983
Site Inspection Report issued	September, 1985
Final listing on National Priorities List (NPL)	October 4, 1989
Negotiations to conduct Remedial Investigation/Feasibility Study initiated	June 19, 1990
Initiate Remedial Investigation/Feasibility Study (Fund Lead)	September 30, 1990
Removal Action for lateral migration of Landfill Gas (LFG) (Start and Complete – See Site POLREPS: Initiated November 8, 1991, After Action Report May 1996, Final POLREP May 28, 1996)	November 8, 1991
Unilateral Order to Town of South Kingston taking action concerning LFG (alarms and venting)	March 26, 1993
Remedial Investigation/Feasibility Study complete	November, 1998
Record Of Decision signature	December 12, 1999
Negotiations to conduct Remedial Design and Remedial Action initiated	September 28, 2000
Cooperative Agreement for Remedial Design	July 12, 2001
Consent Decree to implement remedy entered	March 13, 2003
Beneficial Reuse Study completed	November, 2003
Cooperative Agreement for Remedial Action	May 28, 2004
Remedial Design #1 approved	January 5, 2005
Construction Start (Phase I) – Notice to Proceed (contractural)	April 27, 2005
Initiate Construction (Phase I) – first day in field	May 26, 2005

Construction Completion – Phase I (Waste Consolidation) – Substantially Complete	March 29, 2006
Remedial Design #2 approved	May 30, 2006
Construction Start (Phase II) – Notice to Proceed (contractural)	September 25, 2006
Initiate Construction (Phase II) – first day in field	September 25, 2006
Construction Completion – Phase II (Landfill Capping) – Substantially Complete	September 25, 2007
Explanation of Significant Differences (ESD)	September 19, 2008
Preliminary Close-out Report complete	September 26, 2008
Pilot Study for Landfill Gas- System Start-up	February 10, 2010

SECTION 3.0 BACKGROUND INFORMATION

The Site is located within the Town of South Kingstown, Rhode Island in the village of Peace Dale, all of which are part of Washington County. It lies approximately five miles inland from Narragansett Bay and two miles north of Wakefield, Rhode Island. The Site is bordered by Rose Hill Road to the west, the Saugatucket River to the east and residential private property to the north and south. The Site location is shown on Figures 1 and 2 in Appendix A. Figure 1 illustrates the Site location with reference to the Town of South Kingstown and the abutting Towns.

The Site encompasses approximately 70 acres, and includes an active solid waste transfer facility zoned as public land; a small area of land zoned for commercial use along Transfer Station Road; and privately owned land which was either formerly used for sand and gravel mining and/or waste disposal, or has remained undeveloped. Land use within one mile of the Site is predominantly agricultural and residential.

Several environmental investigations have been conducted at the Site since 1975 and were summarized in Metcalf & Eddy's 1994 Remedial Investigation (RI) and Feasibility Study (FS) Reports and 1991 RI/FS Work Plan. The RI investigated the extent of contamination and impact of the Site to public health and the environment. The FS analyzed source control and management of migration alternatives for the Site. A Record of Decision (ROD) was signed by EPA in December 1999. Following negotiations for the Remedial Design/Remedial Action (RD/RA), a Consent Decree (CD) to conduct the remedy was entered into by the settling defendants. In May 2003, Berger (working for the State of Rhode Island under a cooperative agreement between EPA and RIDEM) began the quarterly monitoring program as part of the Remedial Design (RD) for Rose Hill Landfill. The results of the 2003-2004 sampling events were presented in Berger's Field Investigation Summary Report (August 2004). In 2008, Berger began quarterly post-closure monitoring; results were presented in Berger's Landfill Closure – Rose Hill Landfill Superfund Site Quarterly Monitoring Reports (2008-2009). Also in 2008, the ESS Group of East Providence, Rhode Island began annual stream habitat assessment and macroinvertebrate biomonitoring at the site.

3.1 Physical Characteristics and Land and Resource Use

The Site previously consisted of three distinct areas formerly used for waste disposal: a Solid Waste Area (SWA), a Bulky Waste Area (BWA), and a Sewage Sludge Area (SSA). The locations of these three separate and inactive disposal areas are shown in Figure 2 of Appendix A. The SWA is a 27.7-acre area located immediately east of Rose Hill Road between an unnamed tributary to the Saugatucket River and Mitchell Brook. The BWA is a 9.4-acre area located east of the SWA and southwest of the SSA. The SSA is a 9-acre area located in the northeast section of the Site, between Mitchell Brook and the Saugatucket River. The waste materials within these areas were consolidated within the SWA as part of the landfill remedial action conducted between 2004 and 2007.

Two primary surface water bodies, the Saugatucket River and Mitchell Brook, flow through the Site. An unnamed brook, west of the Site, flows into the Saugatucket River and an unnamed tributary, in the northern portion of the Site, flows into Mitchell Brook. Both Mitchell Brook and the Saugatucket River are classified by the State of Rhode Island as Class B waterbodies, designated for fish consumption, aquatic life, and recreational contact (swimming and boating) uses. Wetland and flood plain habitats are also found adjacent to the disposal areas and are subject to runoff and contamination from the disposal

areas. An open excavated area approximately 400 feet north of the disposal areas is currently used for target and skeet shooting. A former sand and gravel bank exists approximately 200 feet west of the disposal areas.

Efforts related to re-use of the Site have been limited to preliminary studies. In August 2003, CDM was engaged by the Town of South Kingstown to prepare a beneficial reuse study. The CDM report, Rose Hill Landfill Beneficial Reuse Study (November 2003), identified potential future uses of the Site following completion of Site remediation activities. The report noted that any anticipated reuse options at the Site would need to factor in the inherent limitations that arise from land use restrictions placed on the property in order to protect the constructed remedy. The CDM report indicated possible uses for the Site including a golf range (SWA), nature trails, and a dog park, with the BWA potentially envisioned as recreational fields, but no efforts have been made by the Town to pursue any Site re-use to date. The SSA is privately owned and has returned back to its previous use as part of a shooting range operation. Any future development opportunities for the Site would be included under the Town's capital improvement program (CIP) budget process. EPA and RIDEM remain open to discussions with the Town concerning reasonably anticipated reuse opportunities which are not inconsistent with the identified land use restrictions, maintain the integrity of the constructed cap, and do not otherwise interfere with the operation and maintenance (O&M) of the remedy over the long term.

3.2 History of Contamination

Prior to 1941, the Site was used for agricultural purposes. Sand and gravel operations were conducted at the Site from at least 1948 through 1963. The Site began landfill operations in 1967 and was operated by the Town of South Kingstown under State permit from RIDEM which was renewed annually. For approximately 16 years, the Site received domestic and industrial wastes from residents and industries in the Towns of South Kingstown and Narragansett. In October 1983, the Site reached its State permitted maximum capacity and active landfilling operations ceased.

Landfills in the three disposal areas (SWA, BWA and SSA) began operations in 1967, 1978 and 1977, respectively. The SWA landfill was closed in 1982 and the BWA and SSA landfills were closed in 1983. In 1983, a transfer station for municipal waste was constructed south of the BWA and the municipality began waste transfer operations that have been continuous since that time. Municipal solid waste is unloaded from collection trucks and private vehicles and transferred to vehicles that transport it off site to the Central Landfill in Johnston, RI for final disposal.

In 1967, when activity at the Site officially commenced, a court order prohibited the disposal of combustibles at the Site. In 1978, the order was amended to allow the disposal of combustibles in the BWA. In 1979, the State of Rhode Island ordered cities and towns to establish facilities for the collection of waste oil. There is evidence that a waste oil collection facility at the Site was established during this time.

A known waste handling problem at the Site concerns the disposal of liquid waste from the Peacedale Processing Company, specifically in the form of a urethane adhesive. A letter from the State Division of Solid Waste Management dated January 8, 1970 to the Town of South Kingstown Director of Public Works identified the agreed upon disposal method for liquid waste from the Peacedale Processing Company, whereby drummed waste would be disposed of daily by dumping it onto other wastes

deposited at the landfill each day. This method was intended to utilize the absorptive characteristics of the waste material as the urethane adhesive was disposed.

Correspondence dated March 16, 1971 from the State Division of Solid Waste Management to the Town of South Kingstown Town Manager notified the Town that the liquid waste from the Peacedale Processing Company was being improperly disposed of at the landfill and reiterated that the agreed upon method of spreading the liquid waste over the surface of the landfill must be followed.

In 1979, a resident observed and reported to RIDEM that a number of barrels, with lids intact, were being dumped on the SWA landfill slope within a few feet of Rose Hill Road. The truck transporting these drums was reported to be from the Peacedale Processing Company. The resident further reported that at least one barrel was labeled "slop glue", with all drums being buried intact with the exception of one. RIDEM investigated this report and found a drum labeled "DALTOSLEX 535" and "DRANO 21". Daltoslex is a polyurethane fabric coating dissolved in trichloroethylene (TCE), dimethyl formamide (N, N-DMF), and cellosolve solvent. Cellosolve is the trademark for mono- and dialkyl ethers of ethylene glycol and their derivates. Analysis of samples collected from these drums identified hexane, 2-butanone (MEK), trichloroethylene (TCE), and toluene as components of the liquid. All of these chemicals are widely used industrial solvents. Dimethyl formamide and cellosolve cannot be detected by the common methods used to analyze for volatile organic compounds.

The State Division of Solid Waste Management wrote a letter to Kenyon Piece Dyeworks (a subsidiary of Peacedale Processing) on December 6, 1979, to confirm an analysis of the waste adhesive procured from the Peacedale plant on November 19, 1979. The analysis indicated that the sample contained TCE at 29,000 parts per billion (ppb), toluene at 400 ppb, and tetrachloroethylene at 4 ppb. An analysis of the waste itself revealed that it contained TCE in the amount of 0.35%. Based upon the analyses, the waste adhesive produced at the plant was deemed not hazardous (as a solid), as defined by Rhode Island regulations, and could be disposed of at any licensed solid waste management facility. The State added that the waste adhesive was to be in a solid form when taken to the landfill and exposed to the air for at least a week prior to its disposal. Within the same time frame, Kenyon Piece Dyeworks notified the State that the company had suspended shipment of the above-mentioned waste adhesive to the Site pending further investigation of its environmental reactivity.

In 1981, Peacedale Processing notified EPA, Region 1 that the company had disposed of laminating adhesive at the Site from 1971 to 1979. Although other volatile organics, inorganics and phthalate compounds have been detected at the Site, little is known about the disposal practices associated with these contaminants.

The SWA operated from 1967 through 1982 covering approximately 27.7 acres. The exact depth of deposited solid waste materials varies, but has been identified as to be to bedrock in some locations. Refuse has also been deposited in areas above, below and at the water table. Review of historical aerial photographs has indicated that the sand and gravel pit was filled in with solid waste material starting in the southernmost portion and progressing in a northerly direction. By 1988, waste materials were present throughout the pit, with all remnants of the sand and gravel pit no longer existing. Several possible leachate seeps were observed in the review of 1988 aerial photographs, particularly in the northern, eastern and southern portions of the disposal area. The SWA was closed with a cover of 0.5 to 2 feet of sandy soil and subsoil in 1982.

The SSA is located in the northeast corner of the Site, between Mitchell Brook and the Saugatucket River and north of the BWA. This area, approximately 9 acres in size, was operated from 1977 to 1983, for the disposal of sewage sludge generated by the Town of South Kingstown wastewater treatment plant. The sludge was deposited in trenches and backfilled. Review of 1981 aerial photographs show a series of trenches running the entire length of the area in a north-south direction, as well as two small trenches in the northern section. Reported problems with high moisture content of the sludge prompted the Town of South Kingstown to initiate the hauling of sludge to the Central Landfill in Johnston, RI. In a July 15, 1993 letter to the Utilities Director of the Town of South Kingstown, RIDEM, Division of Water Resources confirmed that the SSA has been properly closed, poses no threat to public heath as long as the area is not excavated and a closed Order of Approval No. 490 was issued for the sludge disposal area.

The BWA is a 9.9 acre area which was used by the Town of South Kingstown primarily for the disposal of large bulky materials, such as appliances, tree stumps and other debris. The BWA is located east of the SWA and southwest of the SSA, approximately 200 feet east of Mitchell Brook and 250 feet west of the Saugatucket River. The BWA was operated from 1978 to 1983. During Remedial Action (RA) activities, complete excavation of the BWA revealed that the area was filled primarily with textile remnants deposited by local industries, with very little conventional bulky waste materials.

The original property owners of the Site were Edward L. Frisella, Sr. and Pearl F. Frisella, who are now both deceased. In 1967, the Town of South Kingstown entered into a lease with Edward Frisella, Sr. for the operation of a solid waste landfill. After the establishment of the landfill, in February 1973, the Town of Narragansett entered into an agreement with the Town of South Kingstown for joint use and operation of the landfill. In 1977, Edward Frisella, Sr. and the Town of South Kingstown reached an agreement regarding the continued use of the property as a landfill facility. This amendment to the lease provided additional landfill areas for expansion of the landfill facility to utilize the SSA and BWA. In 1982, the Town of South Kingstown purchased 15 acres from Edward Frisella, Sr. for the location of the Town's new transfer station. The Town of South Kingstown is now the owner of the parcels containing the SWA and BWA portions of the Site, with the SSA parcel remaining in the Frisella family under the ownership of Richard Frisella.

3.3 Initial Response

The Preliminary Assessment Report for the Site was completed in January 1983, followed by a Site Inspection Report completed in September 1985. The Site was proposed for inclusion on the National Priority List (NPL) on June 24, 1988. On October 4, 1989, the Site qualified for final listing on the NPL.

Historical sampling data gathered in support of the Preliminary Assessment Report and Site Investigation Report indicated the presence of contaminants in groundwater, landfill leachate, surface water, and sediments within the vicinity of the Site. This information was summarized in the Preliminary Health Assessment (ATSDR, 1990).

1975: Town of South Kingstown hired a consultant to perform a groundwater study, due to the discovery of contamination in an off-site private well.

1971-1979: laminating adhesive containing TCE disposed of at the Site.

1978-1981: High concentrations of copper and zinc detected in sludge.

1982: High concentrations of VOCs detected; 1,2-dichloroethene has the highest concentration level. The VOCs 1,1,-trichloroethane, methylene chloride, 1,2-dichloroethylene, 1,1-dichloroethane, and toluene were detected in samples collected from Mitchell Brook.

1983: Sampling indicates contamination in the Saugatucket River, below the confluence with Mitchell Brook.

1987-1988: Volatile and extractable organic compounds detected in soil and surface water samples.

1990: Preliminary Health Assessment (ATSDR, 1990)

1992-1993 Remedial Investigation (May 1994): Gas migration from landfill to nearby residences detected.

Feasibility Study (November 1998): Feasibility Study issued and presenting findings.

Residences from South Kingstown obtain water from both public and private wells. Private wells within a 3-mile radius of the Site consist of overburden or bedrock wells. Three supply wells for the University of Rhode Island are located approximately 2.7 miles northwest of the Site. Two municipal supply wells for the Kingston District are located approximately 3-miles northwest of the Site. The University and the District use each other's water systems as backup water supply sources. Due to well contamination issues, in 1985, the Town of South Kingstown extended the municipal water line to adjacent residences located on Rose Hill Road and those dwellings abutting the immediate northern portion of the Site. By 1989, water service was provided by the Town to residences on Broad Rock Road. Residences that abut the Site along Rose Hill Road and Pearl's Way north, west, east and south of the Site are all connected to municipal water.

EPA investigations during the winter and spring of 1993 indicated gas migration from the landfill to nearby residences, with initial sampling results indicating the presence of explosive levels of combustible and hazardous gases in the vicinity of specific residential dwellings abutting the Site. In response to this information, the Town of South Kingstown installed gas alarms in two of the residences (278 and 349 Rose Hill Road), and, in June 1993, razed a third problematic dwelling (220 Rose Hill Road). A new single story structure (Rose Hill golf course clubhouse) utilizing a slab on-grade design with an underground methane interception system was constructed on the lot where the razed building was once located.

In 1994, the Town installed a bentonite clay dam around the municipal water service supply line before the pipe entered the residence at 278 Rose Hill Road to prevent landfill gases from seeping into the house. The Town also relocated the methane sensor from the outside basement wall to inside the basement to record methane concentrations inside the dwelling. Since that time, the Town has continued to maintain the methane monitoring equipment and submit data reports to EPA and RIDEM.

EPA began an investigation into the nature and extent of contamination in the three separate disposal areas in 1990. The scope of the investigation included sampling of groundwater, surface water, soils, and sediments. Expanded studies included an ecological impact assessment, a landfill gas migration evaluation, and a revised assessment of alternatives that included the feasibility of using several innovative cleanup technologies. EPA evaluated several cleanup alternatives through 1999, and following

a public comment period, selected a final cleanup remedy for the Site and issued a Record of Decision on December 12, 1999.

3.4 Basis for Taking Action

Groundwater: The analytes trans-1,2-dichloroethylene, TCE, di-n-butyl phthalate, and diethyl phthalate were detected in off-site residential wells in sampling performed in November 1984.

Surface Water: The analytes 1,1,1,-trichloroethane, methylene chloride, 1,2-dichloroethylene, 1,1-dichloroethane, and toluene were detected in samples collected from Mitchell Brook in September 1982. Various volatile and extractable organic compounds were also detected in surface water samples collected from Mitchell Brook in the period from November 1987 – March 1988.

Soil: Various volatile and extractable organic compounds were detected in soil samples collected in the period November 1987 - March 1988 at several locations at the Site. The 1990 Preliminary Health Assessment document was not specific as to the actual soil sampling locations.

Leachate: The analytes 1,1-dichloroethylene, trans-1,2-dichloroethylene, cis-1,2 TCE, benzene, toluene, ethylbenzene, and m-xylene were detected in leachate sampled primarily from the SWA in the period from November 1987 - March 1988.

Landfill Gas: The presence of landfill gas was detected in soil gas wells in the vicinity of residential dwellings abutting the landfill. Elevated levels of vinyl chloride were also detected in soil gas wells.

Table 3-1: Operable Unit 1 Contaminants of Concern

Groundwater	Leachate	Surface Water	Soil	Landfill Gas
Contaminants of Concern identified in RI Final Report, Volume II, May 1994				
Benzene	Chloroethane	Acrylamide	Acetone	Acetone
Chloroethane	cis-1,2-Dichloroethene	NN dimethylformamide	Vinyl chloride	Benzene
1,1 Dichloroethane	Bis (2-ethylhexyl) pthlalate	Aluminum	Benzo(a) anthracene	Carbon Disulfide
cis-1,2-Dichloroethene	cis-1,2-Dichloroethene	Antimony	Benzo(a) pyrene	1,1 Dichloroethane
Vinyl chloride	Aluminum	Barium	Benzo(b) fluoranthene	1,1 Dichloroethene
2-Methylnapthalene	Arsenic	Manganese	Benzo(k) fluoranthene	cis-1,2-Dichloroethene

Bis (2-ethylhexyl) pthlalate	Barium	Ammonia	Chrysene	trans-1,2-Dichloroethene
4-Chloro-3-methylphenol	Beryllium	Sulfide	Indeno (1,2,3-c,d) pyrene	Dichlorodifluoromethane
Pentachlorophenol	Chromium		Aluminum	Ethylbenzene
Acrylamide	Cobalt		Arsenic	4-Methyl-2-pentanone
NN dimethylformamide	Copper		Barium	Methylene Chloride
Aluminum	Lead		Beryllium	Toluene
Antimony	Manganese		Chromium	1,2,4-Trichlorobenzene
Arsenic	Vanadium		Cobalt	Trichloroethene
Barium	Zinc		Copper	1,2,4-Trimethylbenzene
Beryllium	Ammonia		Lead	1,3,5-Trimethylbenzene
Cadmium			Manganese	Vinyl chloride
Chromium			Mercury	m,p-Xylene
Cobalt			Nickel	
Copper			Selenium	
Lead			Thallium	
Manganese			Vanadium	
Nickel			Zinc	
Vanadium			Ammonia	
Zinc			Sulfide	
Ammonia				
Sulfide				
Additional Contaminants of Concern identified subsequent to RI Final Report, Volume II, May 1994				
Iron				Methane
				Vinyl chloride

SECTION 4.0 REMEDIAL ACTIONS

4.1 Remedy Selection

The ROD for the Site was signed on December 12, 1999. The remedial action objectives (RAOs) listed in the ROD are:

- To reduce the potential exposure of area residents and those at the landfill to landfill gases (i.e., vinyl chloride, benzene, 1,1-dichloroethene, and 1,1,2,2-tetrachloroethane) in ambient and indoor air via inhalation that may present a human health risk in excess of the EPA target risk range of 10^{-6} to 10^{-4} for carcinogenic compounds or with a total HI>1 for non-carcinogenic compounds with similar toxic endpoints.

- To reduce the potential exposure of area residents to organic and inorganic contaminants of concern (.e., vinyl chloride, 1,2-dichloroethene, acrylamide, benzene, pentachlorophenol, bis (2-ethylhexyl)phthalate, antimony, arsenic, cadmium, manganese, beryllium, chromium, and lead) in groundwater via ingestion that may present a human health risk in excess of the EPA target risk range of 10^{-6} to 10^{-4} for carcinogenic compounds or with a total HI>1 for non-carcinogenic compounds with similar toxic endpoints through institutional controls.

- To reduce contaminant migration via leachate to surface waters and sediments of Mitchell Brook in order to improve water quality and designated use, including aquatic life support.

- To reduce contaminant migration via leachate to surface waters and sediments of the Saugatucket River in order to improve water quality and designated uses, including aquatic life support.

The source control remedy selected in the ROD for the Site was Alternative 4B, which would control the sources of contamination at the Site by limiting the extent to which precipitation would percolate and infiltrate through waste materials and minimizing further migration of the contaminated groundwater and landfill gas plume. The components of the landfill capping remedy consisted of the following:

- Excavate and consolidate the BWA landfill materials onto the SWA landfill;

- Collect and effectively manage leachate and waters collected from runoff and dewatering operations during the excavation of the BWA;

- Construct a multi-layer hazardous waste cap using innovative and cost efficient cover materials, as may be appropriate and as further defined in design, over the extent of the SWA landfill and consolidated BWA materials;

- Inspect and monitor the integrity and performance of the landfill cap over time;

- Assess, control, collect and treat landfill gas emissions by an active internal and perimeter gas collection system and thermal treatment of such gases through the use of an enclosed flare and continue monitoring landfill gas concentrations to assess the need to modify the landfill gas collection treatment system as necessary;

- Implement access restrictions and Institutional Controls (land title restrictions including, but not limited to, easements and restrictive covenants) on land use and the use of, or hydraulic alteration of, groundwater where Preliminary Remediation Goals (PRGs) (based on MCLs, MCLGs) and/or other health based standards are exceeded.

- Install a chain link fence and/or other physical barriers where necessary to prevent Site access, injury, and/or exposure;

- Long-Term monitoring of surface water, groundwater, air and leachate emergence;

- Perform operation and maintenance activities throughout the life of the remedy;

- Conduct statutory five year reviews as required.

Following the ROD and after approximately two years of negotiation, a Consent Decree (CD) effectuating a successful settlement to perform the Remedial Design/Remedial Action (RD/RA) for OU-1 was entered by the District Court in March 2003. The settlement required the potentially responsible parties, the Towns of South Kingstown and Narragansett, RI to pay $4,000,000, plus interest from March 31, 2002, to a Superfund special account in settlement of past costs incurred by the United States and future costs by the United States relating to the OU-1 source control remedy. The CD also provides that the State, with RIDEM as the lead agency, will implement the OU-1 remedy and be responsible for 50% of the cost of construction and 100% of the cost of O&M of the remedy. Under the CD, the Towns are to eventually reimburse the State for 30% of the State's OU1 remedy costs and O&M through a combination of cash payments and in-kind services. The CD also resolves the Towns' liability to the United States for natural resource damages relating to the Site. The Towns will also repair or replace the Indian Run Reservoir Dam and the Asa Pond Dam, both in the Town of South Kingstown, R.I., in settlement of the State's claims for natural resource damages.

4.2 Remedy Implementation

The RD/RA was conducted by the State in conformance with the ROD. The selected remedy in the ROD is the first operable unit of a phased approach to remediate the environmental contamination caused by the Site. This first operable unit is a source control remedy which is intended to prevent or minimize the continued release of hazardous substances, pollutants or contaminants to the environment. Upon completion of the source control remedy, site monitoring will furnish data to assess the effectiveness of the remedy and assist the State with TMDL predictions for site-related contaminant concentrations affecting local water bodies.

RD activities began with the development of a Final RD Work Plan (April 2003), prepared by Berger. The Final RD Work Plan described the tasks and investigations to be used to develop a RD. From May 2003 to April 2004, Berger conducted four quarters of groundwater, sediment, surface water, leachate, and landfill gas monitoring and sampling, with results from these activities summarized in the Field Investigation Report (August 2004). The Final Cap Design Report (December 2004) issued by Berger presented the design basis for the selected remedy.

Following review of the Final Cap Design Report by RIDEM, EPA and the Towns of South Kingstown and Narragansett, the decision was made to split the RA work into two phases: Phase I, Waste

Consolidation and Landfill Cap Preparation, and Phase II, Landfill Closure. Contract documents (plans and specifications) for Phase I were completed by Berger in January 2005. Following completion of Phase I construction activities, contract documents for Phase II were completed by MACTEC, Inc. in May 2006.

The SSA met minimal State requirements for sewage sludge landfill closure, and did not pose any significant direct contact health threat as originally closed. However, the composted sludge in the SSA held some potential for use as a vegetative support layer for the SWA. The RA included the excavation and removal of buried sewage sludge material from the SSA as part of the project, with clean fill material used to backfill the excavated areas in the SSA. The sludge material was placed on the landfill as an 8-inch thick layer above the 18-inch vegetative support soil layer and topped with 4-inches of plantable soil material. This solution allowed for modest project cost efficiencies while also helping to gain some further environmental and local water quality improvements over time. Additionally, incorporating the SSA material enhanced the OU-1 remedy by serving as a fertile soil amendment to the landfill capping system.

The RA for Phase I, Waste Consolidation and Landfill Cap Preparation consisted of:

- Excavation and consolidation of approximately 167,500 cubic yards (cy) of waste/soil material from the BWA to be transported, placed and compacted at the SWA;
- Excavation and consolidation of approximately 58,500 cy of waste/soil material from the SWA to be placed and compacted within limits of the capped area in the SWA;
- Construction of stormwater management controls, including drainage swales, downchute, diversion benches and constructed wetlands;
- Construction of a culvert crossing at Mitchell Brook;
- Surface restoration of disturbed areas as indicated in grading plans specified in Contract Drawings;
- Utility relocation, fences, security, health and safety, erosion control, odor abatement, sedimentation ponds, dewatering and temporary transfer station access road; and
- Other miscellaneous tasks contained in the Contract Documents.

The RA for Phase II, Landfill Closure consisted of:

- Excavation and consolidation of approximately 41,800 cy of sewage sludge/soil material from the SSA to be transported and placed as part of the multi-layer cap in the SWA and incorporated as part of the plantable soil layer in the restoration and finish grading of the BWA;
- Placement of approximately 8,000 cy of controlled fill as part of the base layer construction within limits of the capped area in the SWA;
- Construct a multi-layer hazardous waste cap over the limits of the SWA and consolidated BWA materials;

- Construction of stormwater management controls, including drainage swales, downchute, diversion benches and constructed wetlands;
- Construction of landfill and BWA access roads;
- Surface restoration of disturbed areas as indicated in grading plans specified in Contract Documents;
- Construction of a landfill gas collection system in the SWA;
- Fence and access gate installation, erosion control, odor abatement, completion of sedimentation ponds, landscape plantings; and
- Other miscellaneous tasks contained in the Contract Documents.

The design for the RA included landfill components such as the landfill cover system, articulating concrete block downchute, landfill access road, riprap and earthen swale encircling the base of the landfill, landfill gas vents and landfill gas collection system. The landfill cover system was composed of base layer fill, low hydraulic conductivity soil or geosynthetic clay liner (GCL) layer, 60 mil textured Low Linear Density Polyethylene (LLDPE) liner, composite drainage net (CDN), vegetative soil layer, sludge layer and topsoil layer. Ancillary components associated with the operation of the landfill include the landfill fence system, including culverts, forebays and two retention ponds.

The landfill cap was designed to the performance standards outlined in the ROD CA and in accordance with the requirements of RCRA Subtitle C, including 40 CFR 264.19, 264.17, 264.310, and 264.111, and the Rhode Island Rules and Regulations for hazardous waste management. The Statement of Work performance standards required that the multi-layer RCRA C cap achieve minimum requirements, which are identified in the Remedial Action Report, Phase II Landfill Closure, January, 2008,

The selected remedy of Alternative 4B – Horizontal Containment (capping) of the SWA, Landfill Mining of the BWA, Leachate Collection and On-Site Treatment During Construction, combined with Gas Collection and Treatment, was revised during the RD/RA phases and an Explanation of Significant Differences (ESD) was issued by the Region in September 2008. Changes were made based upon value engineering opportunities arising from the availability of innovative materials, as well as Site monitoring results. The design for the landfill gas collection and treatment systems was expanded to include a passive landfill gas venting system. The system includes the installation of twenty-nine gas vents on the capped SWA landfill, with each vent directly connected to a landfill gas well and the landfill gas collection system installed under the cap. The vents are located ten (10) feet above the finish grade surface with each vent manually controlled by a butterfly valve. In addition, each vent is connected to an active landfill gas extraction system buried in the cap above the LLDPE liner. A second butterfly valve was installed between each gas vent and the landfill gas extraction system. Landfill gas sampling ports and temperature gauges were installed at each gas vent as well.

The landfill gas extraction system is designated as the active component of the landfill gas system. It is connected to every gas vent and terminates at two locations outside the landfill perimeter. The termination points for the landfill gas extraction system are located outside of the capped limits near the northeast and southeast corners of the SWA. The two piping system termination locations will be utilized, if needed, for installation of a blower system and landfill gas emissions flare. The need for

utilizing the active landfill gas system would be assessed during post-closure landfill gas monitoring. By installing both active and passive gas systems, the option to operate either type of system could remain open after completion of the Phase II construction.

The RD/RA determined that the decision to convert the operation of the landfill gas system from passive to active could be made during the post-closure phase and would be based upon results obtained during post-closure landfill gas monitoring and subsequent dispersion modeling.

4.3 System Operation/Operation and Maintenance

The Post-Closure Operation and Maintenance Plan (O&M Plan) was prepared as a component of the Remedial Action Project Operations Plan (RA POP) in accordance with the Remedial Action Statement of Work (RA SOW) in the May 2004 CA. The overall objective of the O&M Plan is to provide RIDEM and EPA with a written understanding and commitment of how various post-closure aspects such as operations and anticipated use of areas, access, security, contingency procedures, maintenance responsibilities, evaluation and assessment of landfill components, monitoring and inspection programs, record keeping and reporting and well maintenance program are being managed by the Town of South Kingstown and the Supervising Contractor responsible for Environmental Engineering Services to RIDEM.

The operation and maintenance costs as identified in the 1999 ROD were estimated at $6,680,000 (net present worth). A cost estimate for the annual operation and maintenance for the Site with a passive landfill gas system is approximately $166,000 per year. However, use of an active landfill gas system is under consideration, pending further evaluation. A cost estimate for the annual operation and maintenance budget for the Site using an active landfill gas system is estimated at $466,000 per year. (see: Post - Closure Operation and Maintenance Plan, LBG, Inc., February 2008)

4.3.1 Evaluation of Landfill Components

The landfill components, as constructed during the Phase II Landfill Closure, include the landfill cover system, downchute, landfill access road, riprap and earthen swale encircling the base of the landfill, landfill gas vents and landfill gas collection system. The landfill cover system is composed of base layer fill, GCL, 60 mil textured LLDPE liner, CDN, vegetative soil layer, sludge layer and topsoil layer. Ancillary components associated with the operation of the landfill include the landfill fence system, and drainage system, including culverts, sediment forebays and two retention ponds.

Periodic evaluation of landfill components includes a quarterly inspection of components to ascertain the stability and integrity of the cover system, drainage system, and security controls. Any changes to the landfill components or potential changes based upon physical inspection are reported and addressed as part of the maintenance program. Possible integrity issues related to the landfill components could include erosion damage to the cover system or landfill access road, vandalism, wind or flying object damage to the landfill gas venting system and groundwater wells, or other unanticipated circumstances. Possible integrity issues to the ancillary landfill components could include vandalism damage to the fencing system, sediment buildup in the forebay or retention ponds, erosion damage to the pond sides or animal damage to the vegetation or soil components of the landfill cover system established as part of the landfill closure. Copies of the quarterly Site inspection reports are included in Appendix D.

The stability and integrity of the monitoring network is evaluated as part of the Site monitoring program. Issues regarding the status of the monitoring wells are identified during the Site monitoring program and any repairs or adjustments needed to ensure that the wells are operating as designed are made under the monitoring program contract.

During a quarterly post-construction inspection in February 2008, differential settlement of the earthen layer between the LLDPE liner and the original articulating block revetment system installed in the downchute was observed. This settlement, caused by freeze/thaw erosive effects, resulted in washout conditions in the earthen layer, with the loss of soil causing buckling of the articulating block system. As a result, in August 2008, the articulating block was removed from the downchute and replaced with a gabion basket construction. No other alterations have been needed in the downchute since this replacement was completed.

4.3.2 Assessment of Landfill Gas Emissions

Periodic assessments of the emissions from the landfill gas collection system and combustion system are made in order to ascertain landfill gas creation, emission or lateral migration.

The selected remedy in the 1999 ROD includes assessment, control, collection and treatment of landfill gas emissions by an active internal and perimeter gas collection system and thermal destruction system to meet State and Federal regulatory standards. During the RD/RA, additional Site landfill gas data was collected by EPA (2003) and Berger (2004).

The landfill gas analytical sampling conducted in 2004 showed results below the State and Federal regulatory standards. Both EPA and Berger took their individual landfill gas sampling results and ran these Site-specific data through Landfill Gas Generation Models (LANDGEM) approved by RIDEM, with EPA concurrence. LANDGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste landfills. The program provides a relatively simple approach to estimating landfill gas emission and is frequently used as a screening tool in the planning and design stages. Input to the program includes the waste acceptance rate, start and completion dates for landfilling activities, and other methane generation parameters.

The evaluation of the landfill gas collection and combustions system, required by the ROD, was completed in 2004 as part of the RD. Both EPA and Berger modeling efforts resulted in concentrations that were less than the Human Health Preliminary Remediation Goals (PRGs) for Ambient Air set by the ROD. Also, the maximum methane concentration detected from the Berger 2004 landfill gas data collection activities was 0.035%, which is well below the methane Lower Explosive Limit (LEL) of 5%. RIDEM and EPA concluded that landfill gas generation could be handled using a phased management approach. Accordingly, the design decision was made to build the landfill gas collection system such that it could be operated in either a passive (venting) or active (combustion) mode. This alternative landfill gas collection system was designed to be in compliance with State and Federal regulations and the air risk assessment performed by EPA.

Landfill Gas Collection System: The objective of the air monitoring is to assess the performance of the passive landfill gas collection system. The air monitoring program is divided into ambient monitoring, perimeter monitoring, and dispersion modeling. The purpose of sampling the gas vents is to provide data for exposure assessment and to support a dispersion model of the passive system. The samples collected are analyzed for pollutants of concern and entered into a Screen3 dispersion model. The purpose of the

perimeter sampling is to determine the effectiveness of the barrier in controlling off-site migration of landfill gas. The purpose of ambient air monitoring is to determine if any long-term restrictions are required on the landfill to protect future users of the Site.

The landfill gas collection system is monitored as set forth in the Long Term Monitoring (LTM) Work Plan (September 2008). Landfill gas emissions are sampled quarterly in accordance with the RI Solid Waste Regulations Rules 2.1.09 and 2.3.08. Each of the gas vents and gas monitoring probes are sampled utilizing a landfill gas meter for the following field parameters: Methane LEL, CO_2, oxygen, methane, hydrogen sulfide, and temperature. Summa canisters are used to collect landfill gas samples at two locations around the perimeter of the landfill and on top of the landfill.

Landfill Gas Combustion System: As described above, the active landfill gas collection and combustion system was not initially installed as part of the landfill post-closure program. The landfill gas monitoring data collected in 2008 indicated that the passive landfill gas management system, as an alternative construction and operating approach to that which was described in the ROD, would provide protection from the ambient air risks identified in the ROD. Landfill gas sampling would continue, based upon the LTM Work Plan, to monitor the on-site landfill gas vents and off-landfill gas probes. The landfill gas sampling results would be compared to ambient air criteria as outlined in the RIDEM Air Pollution Control Regulation Number 22 for Air Toxics. If the landfill gas results exceed the RIDEM ambient air criteria, then the landfill gas results would be used as input values for the Screen3 model.

The phased gas management approach provided that if ambient air monitoring or modeling identified a risk to the nearby residents, the constructed remedy could be converted from the current passive landfill gas venting system to an active landfill gas combustion system. Results from quarterly and monthly testing of landfill gas vents and probes installed as part of the RA and probes installed post construction again have indicated the presence of methane both on the Site and across the western property boundary of Rose Hill Road. Methane was detected off-site in concentrations above the LEL in the probes. Figure 3, Post-Closure Monitoring Program, Landfill Gas, depicts the Site and indicates the locations of landfill gas vents and probes installed as part of the Phase II Landfill Closure remedial work completed in 2007. An additional twenty soil-gas vapor probes were installed in April 2009 as part of a more specific landfill gas investigation focusing on the westernmost portion of the Site and selected off-site areas along Rose Hill Road. Results from these efforts are found in the Landfill Gas Investigation Report, May 2009, prepared by Berger.

As part of an effort to address these landfill gas concerns, Berger prepared the Landfill Gas Management Report (June 2009) to identify potential means of reducing methane concentrations detected off-site on Rose Hill Road and on private properties on the west side of Rose Hill Road. The Report considered a variety of means to reduce off-site methane concentrations, including installation of localized gas flares at specific gas vents, installation of a skid mounted gas blower system with attached gas flare, and construction of a slurry wall or geomembrane liner cut-off trench. After review of the report by EPA, RIDEM and the Towns of South Kingstown and Narragansett, it was determined that the best approach would be the installation of the landfill gas destruction option, using a skid mounted gas blower system with an attached gas flare. The system would be located at the north flare pad location, approximately 50’ beyond the northeast corner of the SWA. This active gas collection system operation would be conducted as a pilot study to evaluate the success and identify shortcomings of the gas extraction process.

The implementation of the active gas collection pilot study began in September 2009 with installation of a skid-mounted gas extraction blower with an attached 22-foot tall gas flare. The blower is sized to deliver

landfill gas flow ranging between 35 – 350 standard cubic feet per minute (scfm). An underground knockout tank was installed to remove condensate from the underground gas piping header system and the above-ground gas piping to the flare. Landfill gas is combusted after being pulled through the gas piping system under vacuum by the electrically powered blower and delivered to the 4-inch diameter flare. The valves installed on the gas vents which allowed for passive gas venting were closed shut, and the landfill gas collection valves were opened to switch the piping system over to active collection. Frequent monitoring of the gas vents is needed to properly balance the system during its initial operation, while gas probes are monitored to determine the effectiveness of the active collection system operation.

The SCREEN3 modeling is utilized to predict the maximum concentration of pollutants after landfill gas is combusted. The landfill gas emissions predictions generated by LANDGEM are input into the SCREEN3 model. The SCREEN3 model receives operator input assumptions including the location of the gas flare, the amount of landfill gas sent to the flare and the concentrations of pollutants contained within the landfill gas.

The SCREEN3 modeling was performed for the Landfill Gas Management Report, June 2009, prepared by Berger. The model utilized actual composition of landfill gas constituents as measured in the field by Berger in the 4th Quarter, Year 1 sampling round. SCREEN3 input assumptions included single flare source, unity emission rate of 1 g/s to provide maximum 1 hour concentrations, 15-foot flare stack height, total heat release rate of 31,000 BTU/min (approximately double the recommended EPA guideline) and simple terrain.

Results from SCREEN3 modeling for each Chemical of Potential Concern (COPC) component of landfill gas are compared to the Project Action Limit (PALs) for those COPCs. Based upon the SCREEN3 model results, predicted concentrations are not exceeded for the COPCs for a single flare installed at the north flare pad. The SCREEN3 results presented in the report demonstrated that if landfill gas delivered to the flare is insufficient for combustion, the COPCs in the landfill gas do not require combustion to remain below PALs. This conclusion eliminated the need for on-site storage of propane as an additional source of combustion to supplement the methane component of landfill gas in order to destroy COPCs. Under normal flare operations, sufficient quantities of methane can be expected to be delivered to the flare for continuous and complete combustion, which will destroy COPCs and methane in the process.

Landfill gas monitoring during the pilot study will demonstrate the effectiveness of the active gas management system, both in terms of quantity of landfill gas collected and combusted, as well as potentially reversing the apparent flux of landfill gas below grade from the western side of the capped landfill by capturing landfill gas within the landfill using a vacuum pressure gradient from the gas blower system.

Landfill Gas Flare Pilot Study: The skid-mounted gas flare system was delivered to the site from Shaw LFG on January 21, 2010. Electrical installation of three-phase power from National Grid to the project site was completed by National Grid on January 29, 2010. Underground electrical connections from the flare skid were made to the utility service termination at a utility pole located on the north flare access road within the Site property boundary. Installation of the landfill header piping connections to the gas flare, insulation and heat trace on the drain lines from the knockout pot to the condensate storage tank were completed in early February 2010.

Initial startup of the flare took place on February 10, 2010, with the assistance of a Shaw LFG field service technician, who also provided flare training to the flare operating personnel from Berger. System

debugging and initial balancing was performed by Shaw LFG over that same two day period. The flare has essentially been in continuous operation since the February 10, 2010 startup.

Since February 10, 2010, field personnel have been providing field services to oversee the operation of the gas flare. Field work has included monitoring the flare operation, adjustments to the landfill gas field in the form of partially or fully closing gas vent operating valves, and adjustment of gas flare inlet header valve. Field adjustments are based upon landfill gas monitoring work which identifies the gas vents which are producing landfill gas of sufficient methane quality for flaring. In general, it has been observed that the lower gas header along the east side of the landfill provides poor quality gas and this header has been throttled back frequently over the past month, and is now closed. The flare does go out occasionally, but has always restarted using the automatic restart sequence. In these cases, the flare shutdowns have been coincident with high wind events.

Although dropping from values achieved during initial operation, gas quality has remained within acceptable levels. Initial readings were in upper 40% to lower 50% range, while more recent readings have been in the lower 40% range. These readings are taken at the gas flare inlet header. Both headers coming from the landfill are monitored before combining into the 4" flare inlet header. The landfill gas flow rate has also dropped from the initial 90 scfm range to approximately 50 scfm. The lower flow rate can be attributed to the need for maintaining sufficient blower vacuum pressure as well as maintaining methane quality. These types of adjustments are made as a result of gas monitoring efforts at the flare.

Weekly methane monitoring of the gas probes began with the initial operation of the flare. Results of the gas probe monitoring through the first four months of gas flare operation in 2010 have demonstrated a significant reduction in the methane concentration in the gas probes throughout the site, and particularly on the west side of the landfill and beyond the Site property boundary.

After seven weeks of weekly gas monitoring, landfill gas probe monitoring was switched to a monthly basis based upon observations of continuously low off-site methane levels. TO-15 analysis will be conducted at the gas flare inlet header for use in determining the composition of the landfill gas being drawn out of the landfill by the flare blower. The results of the TO-15 analysis will assist in determining the future active gas collection options related to the gas flare pilot study.

Residential Gas Monitoring Points: There are two residential gas monitoring devices previously installed as part of the RI. These monitoring points utilize a 4100-30 sensor which is connected to an alarm and data collector installed in the basements at 278 and 349 Rose Hill Road. The Town of South Kingstown currently inspects and calibrates each sensor at both residences monthly. The digital recorder from each resident is downloaded during each monthly calibration event. During the monthly calibration events, the Town downloads information that contains the maximum, minimum, and average readings for each sensor at both residences. According to the CD, the Town is required to send a report to the EPA and the State for any monthly detection exceedence of 100 ppm of methane from any of the two sensors. At the end of each calendar year, the Town submits a yearly report to EPA and the State containing all the calibration events and results for each residential sensor.

According to the Town, over the course of operating the methane meters, there have been periodic false alarms, typically due to condensation or power failures. For example, in 2009 there were three power failures to the system at 278 Rose Hill Road, with an associated methane spike with the system powering back up. There were also four non-power failure-related methane detection spikes between January and June 2009. However, these were observed to be sharp peaked events with a very steep detection curve,

which are likely to be associated with power supply surges and thus considered to be false detection readings. There were no methane detections at 349 Rose Hill Road.

4.3.3 Post-Closure Monitoring Program

The Post-Closure Monitoring Program for the Rose Hill Landfill is performed as described in the LTM Work Plan. The LTM Work Plan was prepared in accordance with the CA SOW, dated May 28, 2004. The LTM Work Plan describes the components and decision points approved during the RD to determine the post-closure environmental monitoring program. The LTM Work Plan summarizes the required monitoring to demonstrate conformance and compliance with the goals of the ROD for the source control remedy.

In general terms, environmental monitoring includes groundwater monitoring, surface water monitoring, landfill gas monitoring, and inspection of institutional controls. The LTM Work Plan provides in more detail the sample techniques, sample locations, and analytical parameters.

Surface water and groundwater monitoring is performed twice per year. Habitat and Macroinvertebrate assessments are conducted annually. The groundwater monitoring locations are presented in Figure 4, Post-Closure Monitoring Program, Groundwater and the surface water monitoring locations are presented in Figure 5, Post-Closure Monitoring Program, Surface Water.

The landfill gas monitoring locations are presented in Figure 3, Post-Closure Monitoring Program, Landfill Gas. Landfill gas monitoring is performed quarterly. Inspection of institutional controls is also performed quarterly, when the full landfill gas monitoring program takes place. In March 2009, the frequency of methane gas monitoring at gas vents and probes was increased to a monthly basis as a result of high methane readings observed off-site. During the first two months of active gas flare operation in 2010, methane gas monitoring was conducted weekly to identify the cause and effect relationship over time of the active gas collection system and off-site methane concentrations.

A data management system (DMS) is utilized for organizing, manipulating, and presenting the field and laboratory data generated during the LTM program following Phase II RA activities, and verifying its quality for the RA work. The DMS facilitates analyzing and verifying data obtained during the LTM monitoring program and encompasses overall management of field and laboratory data from the time it is first generated, through entry into, and use within a computer database system, and presentation as tables, charts, graphs, maps and cross-sections. Currently, the system is maintained using an Excel spreadsheet data base.

For data obtained during the post-closure monitoring, the QA/QC procedures include a review of all data points in field and laboratory reports for completeness, indications of aberrations, adherence to and interference with specified procedures, and reasonability. Edits are made, where needed, to transform the working files into record files which are considered complete and correct. Examples of such edits are correcting a mis-typed well identification number on a laboratory report, or "flagging" a data point because of an aberration (e.g., intended detection limit not achieved due to high matrix interference). Electronic backup files are periodically made of the database.

4.3.4 Post-Closure Inspection Schedule

The landfill cap system for the Site requires periodic inspection and maintenance during its post-closure period. The landfill is inspected for general Site conditions quarterly, coincident with quarterly monitoring program. Inspection includes noting general Site conditions, such as growth of vegetative cover, condition of landfill gas wells, areas of observed erosion, areas of accumulated siltation and travel road surface condition.

Post-closure inspections have been made on January 8, 2008; February 14, 2008; February 24, 2008; April 29, 2008; August 19, 2008; September 12, 2008; December 15, 2008; March 12, 2009; June 11, 2009; September 24, 2009; January 14, 2010 and April 1, 2010. Post-closure inspection reports are included in Appendix D.

4.4 Institutional Controls and Access Requirements

Institutional controls (IC) are required as a component of the remedy for OU-1. ICs are binding land use agreements placed on real estate in order to protect human health. For OU-1, ICs include prohibitions on the future use or hydrologic alteration of contaminated groundwater throughout OU-1 and prevent the direct contact or exposure to contaminated soil (within the BWA and SWA sections). To the extent that ICs in the form of deed restrictions are required on any property for the implementation of the CD, the Towns are in the process of securing and implementing the ICs in accordance with the guidance provided by EPA. Also, for OU-1, the CD requires that EPA and RIDEM and their representatives are provided access to the Site at all reasonable times to OU-1 properties within control of the Town of South Kingstown. In addition, the CD requires that the State and the Towns of South Kingstown and Narragansett use best efforts to obtain recorded deed restrictions (IC) barring activities on OU-1 properties that could interfere with the performance of the remedy.

A list identifying OU-1 and surrounding properties where ICs and access agreements have been recorded or anticipated and their status are presented in Appendix E of this report. EPA's review of the progress in securing ICs and maintaining access is further discussed in Section 6.6 of this report.

SECTION 5.0 PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

This section is not applicable as this is the First Five-Year Review Report for the Site.

SECTION 6.0 FIVE-YEAR REVIEW PROCESS

This five-year review was conducted in accordance with EPA's five-year review guidance (USEPA, 2001). Tasks completed as part of this five-year review included a review of pertinent Site-related documents, conducting interviews with parties associated or familiar with the Site, performing inspections of the Site, and a review of the current status of regulator or other relevant standards.

6.1 Document Review

The documents which are applicable for review in the preparation of this report are listed below. These documents can be found in the Administrative Record maintained by RIDEM.

Remedial Investigation/Feasibility Study

GZA GeoEnvironmental Inc., Field Investigation Report, Rose Hill Landfill Superfund Site, South Kingstown, Rhode Island, February 1999.

GZA GeoEnvironmental Inc., Feasibility Study, Rose Hill Landfill Superfund Site, South Kingstown, Rhode Island, April 1999.

Metcalf & Eddy, Remedial Investigation – Final Report, Volumes I-IV, May 1994.

Metcalf & Eddy, Feasibility Study – Final Report, Volumes I-III, November 1998.

U.S. Environmental Protection Agency, Record of Decision, First Operable Unit – Source Control, Rose Hill Regional Landfill Superfund Site, South Kingstown, Rhode Island, December 1999.

Remedial Design

CDM, Rose Hill Landfill Beneficial Reuse Study, November 2003.

Louis Berger Group, Inc., Remedial Design - Community Relations Support Plan, April 2003.

Louis Berger Group, Inc., Remedial Design Project Operation Plan, Health and Safety Project Plan, April 2003.

Louis Berger Group, Inc., Remedial Design Project Operation Plan, Site Management Plan, April 2003.

Louis Berger Group, Inc., Remedial Design – Quality Assurance Project Plan, Volumes I-II, April 2003.

Louis Berger Group, Inc., Remedial Design – Work Plan, April 2003.

Louis Berger Group, Inc., Field Investigation Summary Report, August 2004.

Louis Berger Group, Inc., Remedial Design - Data Assessment Report, November 2004.

Louis Berger Group, Inc., Final Cap Design Report, Volumes I-II, December 2004.

MACTEC Environmental Sampling Round Report, November, 2006.

Remedial Action

Louis Berger Group, Inc., Contract Documents, Phase I, Waste Consolidation and Landfill Cap Preparation, Rose Hill Landfill, January 2005.

Louis Berger Group, Inc., Remedial Action Project Operation Plan, Health and Safety Plan, September 2006.

Louis Berger Group, Inc., Remedial Action Project Operation Plan, Volumes I-II, September 2006.

Louis Berger Group, Inc., Community Relations Support Plan, November 2006.

Louis Berger Group, Inc., Remedial Action Project Operation Plan, Site Management Plan, November 2006.

Louis Berger Group, Inc., Remedial Action Report, Phase II Landfill Closure, January 2008.

Louis Berger Group, Inc., Remedial Action Quality Assurance Project Plan, Volumes I-II, September 2008.

MACTEC Engineering and Consulting, Inc., Phase I Remedial Action Report, Rose Hill Landfill Superfund Site, April 2007.

MACTEC Engineering and Consulting, Inc., Project Manual, Phase II Landfill Closure, Rose Hill Landfill Superfund Site, April 2007.

Post-Closure Monitoring

ESS Group, Inc. Rose Hill Stream Habitat Assessment and Biomonitoring Data Report, 2008.

ESS Group, Inc. Rose Hill Stream Habitat Assessment and Biomonitoring Data Report, 2009.

Louis Berger Group, Inc., Post-Closure Operation and Maintenance Plan, February 2008.

Louis Berger Group, Inc., Demonstration of Compliance Plan , September 2008.

Louis Berger Group, Inc., Long Term Monitoring Work Plan , September 2008.

Louis Berger Group, Inc., Quality Assurance Project Plan , Volumes I-II, September 2008.

Louis Berger Group, Inc., Landfill Gas Management Report, June 2009.

Louis Berger Group, Inc., Post-Closure Site Monitoring Reports, 2008 – 2009.

U.S. Environmental Protection Agency, Explanation of Significant Differences, Rose Hill Regional Landfill Superfund Site, South Kingstown, Rhode Island, September 2008.

U.S. Environmental Protection Agency, Preliminary Closeout Report, Rose Hill Regional Landfill Superfund Site, South Kingstown, Rhode Island, September 2008.

Relevant findings from the document reviews are contained in the Section 6.3.

6.2 Community Notification and Involvement

Throughout the Site's history, community concern and involvement has been moderate. EPA and RIDEM have kept the community and other interested parties apprised of the progression of Site activities through informational meetings, fact sheets, press releases and public meetings. The Administrative Record (AR) is presently maintained for public access by RIDEM. The AR can be reviewed by the public at RIDEM/OWM, 235 Promenade Street, Providence, RI or at the Peace Dale Library, 1057 Kingstown Road, Peace Dale, RI.

In June 1991, EPA released the Community Relations Plan (CRP) which outlined a program to address community concerns and keep citizens informed and involved in activities during remediation. The CRP program was designed to inform interested citizens and officials about the progress of RI and RA activities at the Site and to provide an opportunity for public involvement in the Superfund process. On June 18, 1991, EPA held an informational meeting in South Kingstown to describe the plans for the RI and FS. During the RI activities, meetings were held by EPA with the residents of Rose Hill Road on January 20 and April 29, 1993 to inform the residents of monitoring results, on-going work and proposed actions. On June 23, 1994, EPA held a public meeting in South Kingstown to discuss the results of the RI.

EPA published a notice and brief analysis of the FS and Proposed Plan in the Providence Journal on January 29, 1999 and made the plan available for review by the public at the South Kingstown Public Library. On February 1, 1999, EPA made the Administrative Record available for public review at EPA's offices in Boston and at the South Kingstown Public Library. The Administrative Record has remained available for public review since that time and is continually updated as information, reports and press releases are issued for the project.

On February 2, 1999, EPA held an informational meeting to discuss the results of the RI and the cleanup alternatives presented in the FS and to present EPA's Proposed Plan. The public participated in the meeting, asking questions with responses provided by EPA at the meeting. A joint letter from the Towns of South Kingstown and Narragansett was received on January 27, 1999 containing a formal request to extend the 30 day public comment period by sixty days. In response to this request, EPA held a 90-day public comment period from February 3 and May 3, 1999 to accept public comment on the alternatives presented in the FS and the Proposed Plan, as well as any other documentation previously released to the public. On February 18, 1999, EPA held a public hearing to discuss the Proposed Plan and accept oral comments.

Throughout the time period in which the RI/FS was conducted, EPA solicited views from the Site owner, neighboring property owners, the State, the Towns and local citizen groups on the present and reasonably anticipated future land uses. EPA also sought information and local perspectives of the present and potential future groundwater use and value within the Site boundary and in adjacent areas. Based upon public input during the 1999 public comment period, the EPA's original proposed remedy (Alternative 3A) originally selected for the RA was not chosen, and EPA modified its Selected Remedy to Alternative 4B. Alternative 4B included excavation of BWA materials to be consolidated with existing waste within the SWA, and construction of a multi-layer cap over the SWA. Alternative 3A included the capping in place of the BWA with no consolidation of BWA material in the SWA.

In April 2003, the Community Relations Project Plan was issued during the RD phase of the project to identify issues of community concern and outline site-specific community relations activities to be conducted by EPA and RIDEM. On April 24, 2003, a press release was issued by RIDEM announcing the start of field activities to support the RD phase of the project. The announcement indicated that the information gathered during the Site Investigation (SI) was required to complete the engineering design plans and would also aid in identifying any potential future re-use of the Site.

On May 10, 2004, a press release was issued by RIDEM to announce a public meeting to present the landfill cap design for the project. The public hearing was held on May 20, 2004 at the South Kingstown Town Council Chambers to present the results of the RD phase of the work, including the proposed RD and findings from field activities conducted during the RD. Field activities conducted during the RD included test pits, monitoring, leachate sampling, residential well sampling, survey work, surface water and sediment sampling.

RIDEM announced the start of RA construction activities aimed at capping the Site in a press release issued May 13, 2005. The announcement indicated that the construction activities would be split into two phases, with all construction to be completed by 2007. Phase I activities would include clearing and grubbing, consolidating waste, maintaining soil and sediment erosion controls, demolishing an on-site building, installing fencing, reinstalling a culvert at Mitchell Brook, relocating the transfer station water line, restoring the transfer station road and preparing the landfill cap. Phase II activities would include restoring the BWA, removing and blending soil from the SSA, restoring impacted wetlands adjacent to Mitchell Brook, installing a landfill gas collection system and constructing a multi-layer landfill cap.

RIDEM announced the start of Phase II RA landfill cap construction activities in a press release issued October 19, 2006. In November 2006, the Community Relations Support Plan (CRSP) was issued as a component of the Remedial Action Project Operations Plan (RA POP). The CRSP was prepared to provide the public with an update to the existing Community Relations Project Plan and identify issues of community concern and outline site-specific community relations activities to be conducted by EPA, RIDEM and the Towns of South Kingstown and Narragansett during Phase II RA construction and the post-closure LTM program. Just over a year later, on November 6, 2007, the completion of Phase II RA landfill cap construction activities was announced in a joint press release issued by RIDEM, EPA and the Towns of South Kingstown and Narragansett.

In July 2009, EPA issued a press release, published on July 3, 2009 in The Narragansett Times announcing the start of the Five Year Review of the remedy for the Site. EPA will continue to take the lead role in public notification related to the Five Year Review.

RIDEM is responsible for generating future press releases relative to other issues and progress at the Site. EPA and the Towns of South Kingstown and Narragansett will receive the press releases for review and to provide input. All future press releases will be prepared and sent out to the public only by RIDEM. Key Remedial Action press releases are provided in Appendix C.

6.3 Data Review

EPA's ROD defined the selected remedy as a source control remedy which is intended to prevent or minimize the continued release of hazardous substances, pollutants or contaminants to the environment. This decision is also the first operable unit remedy of a phased clean up approach. As such, no cleanup levels were established under this remedy; instead the remedy will meet the performance standards set out in the 1999 ROD. This (first operable unit) remedy will meet all ARARs including those for Site air emissions, landfill closure, and process water discharge or reinjection. Management of the migration of contaminants from the Site will be addressed in a future decision document, based upon data obtained from monitoring conducted under the first operable unit, and any additional studies that are deemed necessary to further assess Site impacts, characterize the extent of contamination, and to assess the need to develop and evaluate alternatives for future actions.

Data collected during the RI/FS, pre-design investigation, and post-closure were reviewed for this initial five year review period. A discussion of analytical results for groundwater, surface water, landfill gas, soil, sediment, and leachate is presented below.

6.3.1 Applicable or Relevant and Appropriate Requirements

Berger reviewed Applicable or Relevant and Appropriate Requirements (ARARs) for the Site. The Federal and State ARARs were first identified in the ROD in 1999 and were detailed in the Demonstration of Compliance Plan (2007). Environmental laws from which ARARs for the selected remedial action were derived can be found in Table 76, in Appendix B of the ROD. The table provides a brief synopsis of the ARARs and an explanation of the actions necessary to meet the ARARs. These tables also indicate whether the ARARs are applicable or relevant and appropriate to the actions to be taken at the Site. In addition to ARARs, the tables describe standards that are To-Be-Considered (TBC) with respect to remedial actions. A full description of the ARARs is also located in the 1998 Feasibility Study.

The surface water ARARs consist of the Clean Water Act (CWA) Ambient Water Quality Criteria (AWQC), 40 CFR 122.44; RIDEM Water Quality Regulations; and Proposed CWA AWQC, 40 CFR Part 120, with the point of compliance being where discharge from the Site enters receiving waters. Point source discharges of pollutants to a Water of the State are required to comply with the Rhode Island Water Quality Regulations and the Regulations for the Rhode Island Pollutant Discharge Elimination System (RIPDES).

The purpose of the remedy selected in the 1999 ROD was to control the sources of contamination; therefore, no groundwater cleanup levels were established in the ROD. Since no cleanup levels were established, no chemical specific ARARs for groundwater have been identified.

The action specific ARARs for source control include groundwater requirements set out in the Rhode Island Rules and Regulations for Groundwater Quality, and the more stringent of the Rhode Island Rules

and Regulations for Hazardous Waste, or the federal hazardous waste rules at 40 CFR 264 Subtitle F, and 40 CFR 258 Subtitle E. Because groundwater cleanup levels were not established in the 1999 ROD, only those provisions related to implementing a groundwater monitoring program will be complied with. In addition, maximum contaminant levels and non-zero maximum contaminant level goals (MCLs/non-zero MCLGs) in the Safe Drinking Water Act have been identified as action specific ARARs solely for the purpose of measuring the performance of the source control remedy.

The ARARs for air consist of Rhode Island Air Pollution Control Regulations and Guidance for Air Quality/Air Toxics Substances, and Clean Air Act (CAA) National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61) and CAA Standards of Performance for Municipal Solid Waste Landfills. These ARARs apply to air emissions during construction and/or landfill gas emissions. Monitoring of landfill gas probes is to be used to demonstrate compliance. With the inclusion of the landfill gas flare pilot study, the gas flare is also monitored for compliance. Permanent use of the gas flare would require registration with RIDEM Office of Air Resources and compliance with applicable RIDEM Air Pollution Regulations after meeting certain emissions thresholds. In the event that the gas flare pilot program is discontinued, the Site will revert back to a passive gas venting system and the gas vents will be monitored to demonstrate compliance.

The ARARs that apply to solid waste include Rhode Island Solid Waste Regulation No. 2, Solid Waste Landfills, Section 2.1.09 (b) and (c). These ARARs are met through quarterly landfill inspections and maintenance of the landfill cap.

6.3.2 Project Action Limits

In complying with ARARs and other requirements, Project Action Limits (PALs) were established for environmental monitoring of the various media sampled at the Site as described in various documents including:

- Berger's 2003 Quality Assurance Project Plan (QAPP) for the Remedial Design;
- A 2005 QAPP prepared by MACTEC Engineering and Consulting, Inc. (MACTEC) for the Remedial Action; and
- Berger's 2008 QAPP prepared for the LTM Work Plan, as appropriately amended.

As stated in these QAPPs, the intent of the PALs is not to supersede the risk assessment or remedial action objective processes which are integral parts of developing cleanup standards for the Site, but to provide a check that the data produced will meet Project Quality Objectives for contaminants of concern (COCs), which include those listed in Section 3.4 and Table 3-1.

The PALs for groundwater were based on EPA drinking water standards (e.g., Maximum Contaminant Levels (MCLs) for drinking water) and EPA Regional Screening Levels. In 2001 EPA adopted a new standard for arsenic in drinking water of 10 parts per billion (ppb), replacing the old standard of 50 ppb. Public water systems were required to comply with the updated standard by January 23, 2006. The PAL for arsenic in groundwater at the Site is 10 micrograms per liter (µg/l), equivalent to 10 ppb by volume.

Following its review of Berger's vapor intrusion analysis (see section 7.2.1) the EPA recommended that the laboratory detection limit for vinyl chloride be lowered so that the data can be evaluated at the appropriate risk-based screening concentration. A 0.145 ug/l detection limit corresponds with the 10^{-6}

cancer risk used by EPA Region 1 as described in its 2002 *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils*.

The QAPP states that PALs for surface water were based on RIDEM Ambient Water Quality Criteria (AWQC) and EPA National Recommended Water Quality Criteria (NRWQC, 1999). The Rhode Island Water Quality Regulations include all the federal aquatic life and human health water quality criteria and those criteria are to be used when evaluating waters of the state.

Since NRWQC and AWQC were not available for all analytes and since other more rigorous criteria for some COCs have been established, some PALs were based on other standards including the following:

- Manganese: EPA Drinking Water Advisory 2008;
- Silver and zinc PALs had been based on National Secondary Drinking Water Regulations (no NRWQC applicable), but a change is proposed based on RIDEM AWQC using equations provided in the Rhode Island Water Quality Regulations and a hardness value of 15 µg/l.

During a recent review of a Draft Quarterly Monitoring Reports by RIDEM's Office of Water Resources, questions were raised about some of the PALs being used for metals in surface water, and their protectiveness with respect to RIDEM's chronic and acute freshwater criteria. As such, Berger has prepared proposed new PALs for some surface water metals (cadmium, chromium, copper, lead, nickel, silver, and zinc) and recommends an update to the QAPP following completion of the Five Year Review to reflect the new PALs and identify the source of each PAL.

Table 6-1 provides the previous and proposed new PALs for metals in surface water. No other PALs for surface water or other environmental media have changed since the 2008 QAPP. The data review in this Five-Year Review Report compares surface water metals data to the new, proposed PALs.

Further, the following laboratory Quantitation Limits described in the QAPPs would have to be made more stringent to meet RIDEM guidance as described in its Summary Guidance for Reviewing Environmental Monitoring Data (2007):

- Cadmium (from 5 to 1.0 µg/l);
- Copper (from 10 to 1.0 µg/l);
- Lead (from 10 to 1.0 µg/l);
- Zinc (from 10 to 2.5 µg/l)

PALs for landfill gas are based on RIDEM Air Pollution Control Regulation No. 22 for Air Toxics. This regulation was enacted in 1988, amended in 2004, and again amended in 2008. The 2008 amendment, published after the QAPP, included the addition of one chemical, n-propyl bromide, to the list of regulated substances. N-propyl bromide is not one of the COCs monitored in landfill gas at the Site, and it is not recommended that it be added to the list of analytes at the site as its primary uses are not consistent with wastes disposed of at the Site.

Table 6-1: Revised Project Action Limits (PALs) for Metals in Surface Water

Analyte	2003 QAPP (µg/l)	2008 QAPP (µg/l)	2010 Proposed (µg/l)
Aluminum	87	87	87
Arsenic	50	150	150
Dissolved Cadmium	18	18	**0.07**
Dissolved Chromium III	10	11	**16**
Dissolved Copper	1,300	1,300	**1.77**
Total Iron	50	1,000	1,000
Dissolved Lead	15	15	**0.3**
Manganese	500	300	300
Dissolved Mercury	0.0122	0.77	0.77
Dissolved Nickel	4,600	4,600	**10.4**
Dissolved Silver	100	100	**0.13**
Dissolved Zinc	5,000	5,000	**24**

Notes:
Bold Text indicates recommended change in PAL
mg/l – milligrams per liter
NE – none established

6.3.3 Summary of Environmental Monitoring

As part of work conducted in advance of the RD, Berger conducted four quarterly rounds of environmental sampling in 2003-2004. The purpose of the sampling was to provide an updated baseline of environmental sampling prior to initiating the source control remedy, as described in Phases I and II of the RA Report (Berger, 2008). In addition to the environmental sampling conducted by Berger during the RA, MACTEC conducted one round of sampling in 2006 between Phases I and II of the RA. The purpose of the sampling was to document any potential impact (positive or negative) associated with Phase I construction activities.

During the RD, Berger completed a Field Investigation Summary Report (August 2004) that summarized the results of the 2003-2004 quarterly monitoring and made recommendations for future monitoring. The MACTEC sampling round subsequent to the RD obtained results generally consistent with the findings of the quarterly monitoring program performed by Berger. Therefore, the conclusions reached in the Field Investigation Summary Report remained valid.

Based on the results of these environmental monitoring programs, the sampling strategy for the Site has changed since the 1999 ROD. Changes in the sampling regimen were accepted by both EPA and RIDEM and the current sampling regimen for the Site based on these changes is described in the Final LTM Work

Plan (Berger, 2008). Changes in the monitoring locations and analytical parameters are described for each medium sampled in Sections 6.3.4 through 6.3.9.

Based on examination of the EPA Integrated Risk Information System (www.epa.gov/iris) and related sources, during the last five years no changes have occurred to the toxicity values of the Site COCs that might affect the protectiveness of the remedy. The COCs reviewed included the metals manganese, cadmium, chromium, iron, lead, and aluminum; the volatile organic compounds (VOCs) benzene, vinyl chloride, trichloroethene, tetrahydrofuran, bis-(2-ethylhexyl)phthalate, 1,4-dichlorobenzene, acrylamide and 1,1-dichloroethane. Upon attainment of the cleanup goals an updated risk assessment will be conducted to confirm that residual conditions are protective of human health and environment.

The most current validated analytical data used for the 5-year review was collected during April 2010. The following is a summary of environmental media (groundwater, surface water, landfill gas, soil, sediment, and leachate) sampling data from the 2003 RD to present and a description of and rationale for any sampling modifications. Based on the performance data collected to date (both during and after implementation of the source control remedy), contamination at the Site has diminished. Limited data collected to date indicate that further monitoring is required to assess the effectiveness of the source control remedy and assist the state with TMDL predictions for site-related contaminant concentrations affecting local waterbodies.

References are made to Method Quantitation Limit (MQL) in the evaluation of monitoring data. The MQL is defined as the value at which an instrument can accurately measure an analyte at a specific concentration. The MQL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

6.3.4 Groundwater

Groundwater monitoring was conducted in 45 locations during the RI/FS, 20 locations during the pre-design investigation, and 17 locations post-closure. Groundwater monitoring wells sampled were installed in shallow overburden, deep overburden, and bedrock. Groundwater monitoring locations are shown on Figure 4, Post-Closure Monitoring Program, Groundwater.

The RI involved groundwater sampling at 36 monitoring wells and nine residential wells conducted in 1991 and 1992. Analysis of these samples indicated the presence of several organic compounds in groundwater, including VOCs, semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and water-soluble organics.

According to the RI, numerous organic compounds were detected in groundwater from shallow and deep overburden and bedrock monitoring wells. Of the three disposal areas, the most elevated concentrations of VOCs were measured in the SWA and the lowest concentrations were found in the SSA. VOC contamination had migrated through groundwater north and northeast of the SWA. The predominant metals detected in groundwater were aluminum, iron, barium, and manganese. Concentrations of metals in bedrock groundwater were significantly lower than in overburden groundwater.

Quarterly groundwater monitoring was performed from 2003 to 2004, during the pre-design investigation. Groundwater samples were analyzed for VOCs, SVOCs, total metals, polycyclic aromatic hydrocarbons (PAHs), and PCBs. Groundwater samples were analyzed for the water-soluble organic (W-SO) acrylamide during the first quarter only, as acrylamide had not been detected historically in groundwater,

and was not detected during the first quarter of monitoring. Analytical results indicated that PALs for several parameters were exceeded in one or more monitoring wells. PALs exceeded were those for aluminum, manganese, benzene, vinyl chloride, trichloroethene, tetrahydrofuran, bis(2-ethylhexyl)phthalate, and 1,4-dichlorobenzene. In general, the wells at which concentrations were detected above the PALs in groundwater were downgradient of the SWA and BWA.

No concentrations of analytical parameters for groundwater exceeded the PALs in monitoring wells MW-03-DO, MW-04-BR, MW-05-S, MW-05-DO, and MW-13-DO, and residential wells Res #7, Res #10, and Res #11 during the pre-design and it was therefore recommended that the monitoring wells be eliminated from future groundwater monitoring programs, with the exception of monitoring well MW-05-S, which was retained as a downgradient monitoring location. Recommended groundwater monitoring locations included MW-03-S, MW-03-BR, MW-04-S, MW-04-DO, MW-05-S, MW-06-DO, MW-07-DO, MW 07-BR, MW-11-S, MW-11-DO, MW-11-BR, MW-12-S, MW-12-DO, W-13-S, and residential wells Res #7, Res #10, and Res #11.

Polychlorinated biphenyls were not detected in groundwater above the laboratory detection limits or PALs during the pre-design or subsequent sampling. Therefore, PCBs analysis of groundwater was eliminated from future monitoring programs.

Post-closure groundwater monitoring was conducted in April and July of 2008 and 2009, and April 2010. Samples were analyzed for VOCs, SVOCs, and total metals as described in the LTM Work Plan (Berger, 2008). The only analytes detected at concentrations above the PAL were cadmium, which was detected in a single sample, manganese, which was detected at concentrations exceeding the PAL in the majority of samples collected and the SVOC bis-(2-ethylhexyl)phthalate, which exceeded the PAL only once, during the most recent (April 2010) quarterly monitoring, in deep bedrock well MW-11-BR.. Overall, the concentration of analytes in groundwater remained fairly stable during post-closure monitoring; with some fluctuation, including both increasing and downward trends in concentration of analytes at various monitoring wells long-term trends are described below and trend graphs for some COCs are provided in Appendix H.

Table 6-2 summarizes groundwater sampling at the Site since 1991. Groundwater analytical data from the 2003-2004 (RD) and the 2008-2010 post closure sampling is provided in Tables 6-3 through 6-5.

Table 6-2: Groundwater Sampling Summary

Phase	**RI/FS**				**RD**					**Post-Closure**			
Date	June 1991	Sept/Oct 1991	Jan/Feb 1992	April 1992	June 2003	August 2003	December 2003	April 2004	April 2008	July 2008	April 2009	July 2009	April 2010
Samples (#)	17	45	45	45	21	21	21	21	18	18	18	18	17
Monitoring	8	36	36	36	18	18	18	18	15	15	15	15	14
Residential	9	9	9	9	3	3	3	3	3	3	3	3	3
Analysis													
VOC	•	•	•	•	•	•	•	•	•	•	•	•	•
SVOC	•	•	•	•	•	•	•	•	•	•	•	•	•
W-SO		•	•	•	•								
Pesticides	•	•	•	•									
PCBs	•	•	•	•	•	•	•	•					
Metals (Total)	•	•	•	•	•	•	•	•	•	•	•	•	•
Metals (Dissolved)	•	•	•	•									
Cyanide	•	•	•	•									
Sulfide	•	•	•										
Ammonia				•									
TOC	•	•	•	•									
BOD	•	•	•	•									
PAHs					•	•	•	•					

Table 6-3: Groundwater Laboratory Analytical Results, Metals in Groundwater

ANALYTE	PAL (mg/l)	MEAN CONCENTRATION[1] (mg/l)							
		RD		Post-Closure					
				Year 1		Year 2		Year 3	
		Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)	Mean	(#)
Aluminum	3.7	0.259	(7)	0.269	(13)	0.296	(19)	0.11	(1)
Antimony	0.006	<MQL	(0)	0.0014	(1)	0.0013	(3)	0.0003	(8)
Arsenic	0.01	<MQL	(0)	0.0025	(14)	0.0010	(15)	0.0005	(19)
Beryllium	0.004	<MQL	(0)	<MQL	(0)	<MQL	(0)	<MQL	(0)
Cadmium	0.005	<MQL	(0)	**0.0127**	(1)	0.0009	(7)	<MQL	(0)
Chromium	0.11	0.**200**	(1)	0.0022	(5)	0.0027	(4)	0.0004	(20)
Lead	0.15	<MQL	(0)	0.0034	(5)	0.0041	(5)	0.0007	(20)
Manganese	0.30	**2.03**	(24)	**2.46**	(16)	**1.62**	(31)	**0.92**	(3)
Sodium	NE	21	(32)	22	(32)	21	(34)	20	(20)
Thallium	0.002	<MQL	(0)	<MQL	(0)	<MQL	(0)	<MQL	(0)
Vanadium	0.26	0.0055	(2)	0.0031	(6)	0.0022	(8)	0.0006	(5)
Zinc	11	0.06	(3)	0.03	(11)	0.04	(15)	0.007	(7)

Notes:
[1] Mean concentration calculated from positive results only
[2]Four rounds of sampling were conducted and additional monitoring wells were sampled during the pre-design investigation;
data from first and second quarters only for wells sampled during post-closure.
(#) Number of positive analytical results
Bold Text indicates exceeds PAL
mg/l – milligrams per liter
<MQL – Less than Method Quantitation Limit (MQL), which is value at which an instrument can accurately measure an analyte at a specific concentration, including any adjustments from dilutions, concentrations or moisture content
NE- None Established
PAL – Project Action Limit, based on U.S. Environmental Protection Agency (EPA) drinking water standards (e.g., Maximum Contaminant Levels (MCLs) for drinking water) and EPA Regional Screening Levels

Table 6-4: Laboratory Analytical Results, VOCs in Groundwater

ANALYTE	PAL (µg/l)	MEAN CONCENTRATION[1] (µg/l)							
		RD		Year 1		Year 2		Year 3	
		Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)
VOC		(µg/l)		(µg/l)		(µg/l)		(µg/l)	
1,1-Dichloroethane	800	3.18	(15)	1.27	(3)	1.42	(7)	1.8	(4)
1,2-Dichlorobenzene	600	2.50	(1)	<MQL	(0)	<MQL	(0)	<MQL	(0)
1,4-Dichlorobenzene	75	5.00	(4)	<MQL	(0)	<MQL	(0)	<MQL	(0)
2-Butanone	1,900	6.10	(1)	<MQL	(0)	<MQL	(0)	<MQL	(0)
Benzene	5	3.34	(15)	1.45	(11)	1.31	(9)	1.1	(4)
Chlorobenzene	100	4.99	(14)	2.11	(10)	3.48	(7)	1.8	(4)
Chloroethane	21,000	38.8	(11)	8.73	(10)	9.01	(7)	5.5	(5)
Cis-1,2-Dichloroethene	70	5.87	(10)	0.61	(2)	3.30	(2)	0.94	(2)
Ethyl ether	1,200	11.55	(16)	4.34	(8)	4.62	(6)	3.1	(3)
Isopropylbenzene	660	0.91	(10)	0.62	(4)	0.59	(1)	1.3	(3)
Methyl tert-butyl ether	12	1.57	(6)	2.50	(2)	2.30	(1)	2.2	(1)
n-Propylbenzene	NE	0.58	(5)	<MQL	(0)	<MQL	(0)	<MQL	(0)
o-Xylene	1,400	1.20	(5)	<MQL	(0)	<MQL	(0)	<MQL	(0)
p/m-Xylene	1,400	2.10	(2)	<MQL	(0)	2.00	(1)	<MQL	(0)
Tetrahydrofuran	8.8	**36.50**	(2)	<MQL	(0)	0.60	(2)	<MQL	(0)
Toluene	1,000	1.42	(3)	<MQL	(0)	<MQL	(0)	<MQL	(0)
Trans-1,2-Dichloroethane	100	0.77	(1)	<MQL	(0)	<MQL	(0)	<MQL	(0)
Trichloroethene	5	0.74	(5)	<MQL	(0)	<MQL	(0)	<MQL	(0)
Vinyl Chloride	2	**13.46**	(8)	<MQL	(0)	**2.90**	(2)	<MQL	(0)

Notes:
[1] Mean concentration calculated from positive results only
[2]Four rounds of sampling were conducted and additional monitoring wells were sampled during the pre-design investigation; data from first and second quarters only for wells sampled during of post-closure.
(#) Number of positive analytical results
Bold Text indicates exceeds PAL
<MQL – Less than Method Quantitation Limit (MQL), which is value at which an instrument can accurately measure an analyte at a specific concentration, including any adjustments from dilutions, concentrations or moisture content
NE- None Established
µg/l – micrograms per liter

Table 6-5: Project Action Limit (PAL) Exceedances, Groundwater

Analyte	PAL (mg/l)	Number of PAL Exceedances								
		Pre-Design				Post-Closure				
						Year 1		Year 2		Year 3
		June 2003	August 2003	Nov 2003	April 2004	April 2008	July 2008	April 2009	July 2009	April 2010
Metal (Total)		9	-	11	10	8	10	9	7	9
Cadmium	0.005	-	-	-	-	-	1	-	-	-
Chromium	0.11	-	-	-	-	-	1	-	-	-
Manganese	0.3	9	10	11	10	8	8	9	7	9
VOC		6	4	-	6	-	-	-	-	-
Benzene	0.005	1	-	-	-	-	-	-	-	-
Vinyl chloride	0.002	5	3	-	4	-	-	-	-	-
Tetrahydrofuran	0.088	1	1	-	2	-	-	-	-	-

The groundwater data post-closure indicate a general decrease in concentrations of VOCs and metals. Mean concentrations of the VOCs benzene, tetrahydrofuran, trichloroethene, p/m-xylene, and vinyl chloride exceeded the PAL during the pre-design. The mean concentration of these VOCs dropped below the PALs during post-closure monitoring.

The metal manganese was detected above the PAL by two orders of magnitude during the RD at an average concentration of 2.03 mg/l. The mean concentrations of manganese during years 1 through 3 of the post-closure monitoring were 2.46 mg/l, 1.62 mg/l, and 0.92 mg/l respectively. The mean concentration of chromium was above the PAL during the pre-design and below the PAL during the post-closure. The mean concentration of cadmium was above the PAL during Year 1 (0.127 mg/l) of the post-closure and below the PAL during Year 2 (0.009 mg/l), and below the MQL during Year 3. Cadmium did not exceed the PAL during the pre-design.

During the fourth quarter of post-closure monitoring in 2009, one groundwater sample was collected from an off-site monitoring well and analyzed for alkanes. The purpose of this analysis was to determine whether methane might be migrating off-site in groundwater. Both methane and ethane were detected in the groundwater sample; however, these analytes were detected at low levels, below their solubility. Therefore, it was determined unlikely that that the source of elevated concentrations of methane detected in some of the off-site gas probes was due to groundwater migration.

Berger has prepared trend analysis graphs for the following COCs in groundwater: manganese (wells MW-04-S, MW-04-DO, MW-06-DO, MW-07-DO, MW-11-S, MW-11-DO, MW-12-S, and MW-12-DO); the VOCs benzene, tetrahydrofuran, vinyl chloride, trichloroethene, and 1,4–dichlorobenzene (wells MW-03-S, MW-03-BR, MW-04-S, MW-04-DO, MW-05-S, MW-06-DO, MW-07-DO, MW 07-BR, MW-11-S, MW-11-DO, MW-11-BR, MW-12-S, MW-12-DO, W-13-S, Res #7, Res #10, and Res #11). These chemicals and sampling stations were selected as representative of chemicals and locations where elevated contaminant concentrations have been detected.

Graphs showing these trends are provided in Appendix H. Concentrations of the VOCs benzene, trichloroethene, 1,4-dichlorobenzene, and tetrahydrofuran showed a declining trend in all wells from 2003-2010, ultimately to levels below the PALs and/or MQLs.

Concentrations of the VOC vinyl chloride show a declining trend from 2003-2010 in all wells except well MW-04-DO, located immediately east of the SWA and west of Mitchell Brook. One sample only from this well contained a concentration of vinyl chloride above the PAL during the June 2009 quarterly monitoring round.

Concentrations of the metal manganese have been generally stable across the site from 2003-2010, with a spike in manganese concentrations observed around the commencement of post-closure monitoring in 2008. With two exceptions all manganese concentrations ranged from 0 to 5 mg/l, slightly above the PAL of 0.3 mg/l,

Based on the results of post-closure monitoring, continued semi-annual groundwater monitoring is recommended, and monitoring of additional wells, and/or sampling for additional analytes, throughout the Site are likely to be necessary prior to the next Five Year Review, or in support of any well abandonment procedure.

6.3.5 Surface Water

Surface water was sampled at 18 locations during the RI, 12 locations during the RD investigation, and 8 locations during the 2008 – 2009 post-closure monitoring activities. Samples were collected from Mitchell Brook (MB), an unnamed tributary to Mitchell's Brook (UT), the Saugatucket River (SR), and an unnamed brook (UB) west of the Site that flows into the Saugatucket River. Table 6-6 below summarizes the samples collected and analyses performed. Surface water monitoring locations are shown on Figure 5, Post-Closure Monitoring Program, Surface Water.

During the RI/FS, surface water samples were analyzed for VOCs, SVOC, the water-soluble organic (W-SO) acrylamide, pesticides, PCBs, total and dissolved metals, cyanide, sulfide, ammonia, total organic carbon (TOC), and biological oxygen demand (BOD). A few organic compounds were infrequently detected in the three surface water bodies on the Site (Saugatucket River, Mitchell Brook, and the unnamed tributary brook located west of the Site that flows into Mitchell Brook (UT)). VOCs were the primary contaminant detected. Semi-volatile organic compounds (SVOCs), acrylamide, and pesticides were also detected in surface water. Organic compounds detected included VOCs, SVOCs, pesticides, and acrylamide. Metals detected included aluminum, iron, barium, manganese, zinc, antimony, copper, and lead, and basic cations (calcium, magnesium, sodium, and potassium).

Surface water samples were collected quarterly during the pre-design, in 2003 and 2004. Samples were analyzed for total and dissolved metals, VOCs, SVOCs, ammonia, BOD, sulfide, nitrate, cyanide, PCBs, pesticides, acrylamide, and TOC. A number of total and dissolved metals, including aluminum, copper, iron, lead, and manganese, were detected at concentrations exceeding the PALs. The detection of metal concentrations above PALs at upgradient surface water monitoring locations suggests some upstream source of these parameters.

Three VOCs were detected at concentrations below the PALs: methylene chloride, chlorobenzene, and cis-,2-dichloroethene. Ammonia, nitrate, cyanide, and TOC were also detected in samples, at mean concentrations below the PALs. Concentrations of VOCs, SVOCs, PCBs, pesticides, acrylamide, and BOD were not detected in surface water samples above the PALs during any of the four quarterly monitoring rounds. It was therefore recommended that these analytes be eliminated from future surface water monitoring programs.

Following completion of the 2003-2004 RD sampling, it was recommended that sample locations SW-03 and SW-05 be eliminated from future monitoring programs as sample stations SW-02, SW-04, SW-06, and SW-17 provided adequate coverage of the Saugatucket River. It is was also recommended that sample stations SW-07 and SW-15 be eliminated from future monitoring programs as sample stations SW-09, SW-12, SW-01, and SW-13 provided adequate coverage of Mitchell Brook. Recommended surface water monitoring locations included SW-01, SW-02, SW-04, SW-06, SW-09, SW-12, SW-13, and SW-17. Following discussions with RIDEM and EPA, the post-closure sampling frequency for surface water and groundwater was reduced from four times per year to twice per year.

Post-closure surface water monitoring was conducted in April and July of 2008 and 2009, and April 2010. Samples were analyzed for total and dissolved metals, TOC, cyanide, sulfide, nitrate, ammonia, phosphorus, and hardness as described in the LTM Work Plan (Berger, 2008) and Quarterly Monitoring Reports. Samples were analyzed for TKN in April 2008 only. Macroinvertebrate and habitat sampling and analyses were conducted annually in September 2008 and August 2009.

Results were similar in Year 1 and Year 2 of post-closure monitoring. Several metals were detected in both the total and dissolved metals analysis, including metals that had not been detected during the RD. Aluminum, cadmium, copper, iron, lead, manganese, nickel, and zinc were detected at concentrations exceeding the PAL in the total metals analysis, and all of these metals except manganese were also detected at a concentration exceeding the PAL in the dissolved metals analysis. In the RD, lead was only detected in samples from SW-01 and SW-13; two of the four samples from SW-01 exceeded the PAL. Station SW-01 is located upstream from the Site and adjacent to a firing range.

Overall, the concentration of analytes detected in surface water remained fairly stable during post-closure monitoring; long-term trends are described below and trend graphs for some metals in surface water are provided in Appendix H.

Table 6-6 summarizes surface water sampling at the Site since 1991. Surface water analytical data since 2003 is provided in Tables 6-7 through 6-9.

Table 6-6: Surface Water Sampling

Phase	**RI/FS**				**RD**				**Post-Closure**				
Date	June 1991	Sept/Oct 1991	Jan/Feb 1992	April/May 1992	June 2003	August 2003	December 2003	April 2004	April 2003	July 2008*	April 2009	July 2009*	April 2010
Samples (#)	15	16	15	17	12	12	12	12	8	8	8	8	8
MB	7	7	7	7	5	5	5	5	3	3	3	3	3
SR	6	7	7	9	6	6	6	6	4	4	4	4	4
UB	1	1	-	-	-	-	-	-	-	-	-	-	-
UT	1	1	1	1	1	1	1	1	1	1	1	1	1
Analysis													
VOC	•	•	•	•	•	•	•	•	•	•	•	•	•
SVOC	•	•	•	•	•	•	•	•	•	•	•	•	•
W-SO		•	•	•									
Pesticides	•	•	•	•									
PCBs	•	•	•	•	•	•	•	•					
Metals (Total)	•	•	•	•	•	•	•	•	•	•	•	•	•
Metals (Dissolved)	•	•	•	•	•	•	•	•	•	•	•	•	•
Cyanide	•	•	•	•	•	•	•	•	•	•	•	•	•
Sulfide	•	•	•		•	•	•	•	•	•	•	•	•
Ammonia				•	•	•	•	•	•	•	•	•	•
TOC	•	•	•	•	•	•	•	•	•	•	•	•	•
BOD	•	•	•	•									
Nitrate					•	•	•	•	•	•	•	•	•
Phosphorus									•	•	•	•	•
Macroinvertebrate sampling										•		•	
Habitat assessment										•		•	
Hardness									•	•	•	•	•

* - macroinvertebrate sampling and habitat assessment were conducted in September 2008 and August 2009.
MB – Mitchell Brook
SR – Saugatucket River
UB – unnamed brook
UT – unnamed tributary to Mitchell's Brook

Table 6-7: Laboratory Analytical Results, Metals in Surface Water

ANALYTE	PAL (µg/l)	MEAN CONCENTRATION[1] (µg/l)							
		RD		Year 1		Year 2		Year 2	
		Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)
Total Metals									
Aluminum	**87**	**231**	**(14)**	**231**	**(16)**	**251**	**(16)**	**193**	**(8)**
Arsenic	150	<MQL	(0)	1.9	(2)	<MQL	(0)	2	(1)
Cadmium	0.07	<MQL	(0)	<MQL	(0)	**2.3**	(4)	<MQL	(0)
Chromium	16	<MQL	(0)	0.8	(1)	0.8	(7)	0.6	(2)
Copper	1.77	<MQL	(0)	1.0	(10)	**2.0**	(9)	1.6	(8)
Iron	1,000	**1,390**	(15)	**1,560**	(16)	984	(16)	**1,400**	(8)
Lead	0.3	**18**	(2)	**11**	(9)	**8.4**	(15)	**5.6**	(8)
Manganese	300	181	(15)	250	(16)	137	(16)	121	(8)
Nickel	10.4	<MQL	(0)	0.8	(5)	1.8	(12)	0.9	(4)
Zinc	2.4	**15**	(2)	**39**	(10)	**53**	(15)	**112**	(4)
Dissolved Metals									
Aluminum	87	**148**	(10)	**122**	(15)	**138**	(16)	**93**	(7)
Arsenic	150	<MQL	(0)	1.8	(1)	0.7	(2))	<MQL	(0)
Cadmium	0.07	<MQL	(0)	<MQL	(0)	1.0	(3)	<MQL	(0)
Chromium	16	<MQL	(0)	1.3	(3)	0.7	(13)	0.9	(1)
Copper	1.77	10	(2)	1.2	(9)	**2.7**	(16)	1.1	(8)
Iron	1,000	401	(13)	483	(15)	396	(11)	189	(8)
Lead	0.3	**243**	(3)	**6.6**	(7)	**2.3**	(16)	**0.6**	(4)
Manganese	300	149	(15)	202	(16)	81	(9)	78	(8)
Nickel	10.4	<MQL	(0)	2.0	(6)	1.4	(16)	0.75	(2)
Zinc	5,000	12.5	(4)	24	(8)	124	(16)	81	(7)

Notes:
[1] Mean concentration calculated from positive results only.
[2]Four rounds of sampling were conducted and surface water locations were sampled during the pre-design investigation; data from first and second quarters only for wells sampled during post-closure.
(#) Number of positive analytical results
Bold Text indicates exceeds PAL
mg/l – milligrams per liter
<MQL – Less than Method Quantitation Limit (MQL), which is value at which an instrument can accurately measure an analyte at a specific concentration, including any adjustments from dilutions, concentrations or moisture content
NE- None Established

Table 6-8: Laboratory Analytical Results, Other Analytes in Surface Water

ANALYTE	PAL (mg/l)	MEAN CONCENTRATION[1] (mg/l)							
		RD		Year 1		Year 2		Year 3	
		Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)
Total Organic Carbon	NE	5.8	(15)	5.62	(16)	7.01	(16)	4.75	(7)
Ammonia	NE	0.81	(7)	1.31	(2)	0.19	(11)	0.14	(6)
Nitrate	10	0.34	(9)	0.39	(15)	0.36	(12)	0.49	(5)
Total Kjehal Nitrogen	NE	<MQL	(0)	0.56	(2)	<MQL	(0)	<MQL	(0)
Phosphorus	NE	<MQL	(0)	0.30	(14)	0.35	(13)	0.04	(5)
Hardness	NE	<MQL	(0)	16.79	(16)	14.40	(16)	12.68	(8)
Cyanide	0.0052	<MQL	(0)	<MQL	(0)	**0.0060**	(1)	<MQL	(0)
Sulfide	0.11	<MQL	(0)	<MQL	(0)	<MQL	(0)	<MQL	(0)

Notes:
[1] Mean concentration calculated from positive results only
(#) Number of positive analytical results
Bold Text indicates exceeds PAL
mg/l – milligrams per liter
<MQL – Less than Method Quantitation Limit (MQL), which is value at which an instrument can accurately measure an analyte at a specific concentration, including any adjustments from dilutions, concentrations or moisture content
NA – not analyzed
NE- none established

Table 6-9: Project Action Limit (PAL) Number of Exceedances, Surface Water

Analyte	Remedial Design				Post-Closure				
					Year 1		Year 2		Year 3
	June 2003	August 2003	Nov. 2003	April 2004	April 2008	July 2008	April 2009	July 2009	April 2010
Total Metals									
Aluminum	8	6	6	8	8	5	8	7	9
Cadmium	-	-	-	-	-	-	1	3	-
Copper	-	-	-	-	-	-	3	2	3
Iron	1	5	2	-	1	6	3	4	2
Lead	2	1	-	-	2	7	7	8	9
Manganese	1	4	-	-	-	3	1	-	1
Zinc	-	-	-	-	1	3	3	4	3
Dissolved Metals									
Aluminum	6	-	4	7	8	3	5	6	5
Cadmium	-	-	-	-	-	-	-	3	-
Copper	2	-	-	2	1	1	3	5	1
Iron	-	7	1	-	-	2	-	1	-
Lead	2	1	-	-	2	5	5	6	4
Manganese	1	3	-	-	-	3	-	-	1
Zinc	-	-	-	-	2	6	4	1	2

The post-closure surface water data shows relatively similar concentrations of metals and other analytes to the pre-design data. Mean concentrations of both total and dissolved metals remained similar or increased from 2003–2004 to 2008-2009. Aluminum, copper, iron, lead, and manganese concentrations had exceeded the PALs during the pre-design. These same metals and cadmium and zinc had mean concentrations in excess of the PALs during post-closure monitoring. Several of the surface water sampling locations (e.g. SW-01 and SW-13 on Mitchell Brook) are upstream or cross-gradient from the site and the presence of metals at these locations may be attributed to other sources other than site discharges.

Berger has prepared trend analysis graphs for the following COCs (metals) in surface water: aluminum (sample locations SW-01, SW-02, SW-04, SW-06, SW-09, SW-12, SW-13, SW-17), lead (sample locations SW-01, SW-02, SW-09, SW-12); copper (sample locations SW-01, SW-13, SW-17), zinc (sample locations SW-04, SW-09, SW-13, SW-17), iron (sample locations SW-01, SW-02, SW-06, SW-09, SW-12), and manganese (sample locations SW-01, SW-06, SW-09, SW-12). These chemicals and sampling stations were selected as representative of chemicals and locations where elevated contaminant concentrations have been detected.

Graphs showing these trends are provided in Appendix H. The trend analysis graphs are presented for both dissolved metals and total metals. All of these metals showed some increase in concentration at the beginning of the post-closure monitoring period, followed by a decline to near the concentrations during

the remedial design. The reason for this temporary spike in metals concentration across the site is unclear; however, metals concentrations in surface water have decreased on average from 2003-2010.

Based on the results of post-closure monitoring, continued biannual surface water monitoring is recommended.

Habitat assessment and biomonitoring is also conducted annually at five upstream/downstream locations on Mitchell Brook and the Saugatucket River. Sampling is performed to assess basic water quality, and habitat and biological conditions. Results are used to identify trends and evaluate the quality of conditions at the sampling locations by assessing the macroinvertebrate community and other biological metrics including habitat. Annual habitat assessment and biomonitoring is presently scheduled to continue.

6.3.6 Landfill Gas

Landfill gas was monitored and sampled during the RI/FS, RD, and post-closure investigations. Samples were monitored in the field for percent carbon dioxide, (CO_2), methane (CH_4), oxygen (O_2), percent lower explosive limit (LEL), VOCs, and in some cases, flow and temperature. Samples were also laboratory analyzed for VOCs. Sampling locations differed among the three sampling events. Table 6-10 summarizes samples collected.

During the RI, samples were collected from on-site and off-site monitoring points in June and July 1991; and off-site points were monitored in September 1991, as shown in Table 6-10. During the RI, methane was detected at one off-site location (LFG-LHR), the location of the building which was demolished and replaced by the new slab on-grade clubhouse at the golf course property at 220 Rose Hill Road. A single VOC, acetone, was detected above the sample quantitation limit in this location. Several other VOCs were detected in another sample collected from this location in May 1992. Across the three disposal areas, landfill gas was shown to have elevated concentrations of methane, carbon dioxide, and VOCs. Concentrations and types of VOCs varied among the disposal areas.

During the 2003-2004 RD, landfill gas samples were collected from the permanent landfill gas sampling locations installed around the perimeter of the SWA. The landfill gas monitoring stations sampled were identified as LFGF-2 through LFGF-4 (located along Pearls Way on the north side of the SWA), LFGF-8 (northeast side of the SWA); LFGT-3 (south of the SWA along the transfer station road), LFGT-5 (south of the SWA along the transfer station road), LFGT-6 (south of the SWA and transfer station road), and LFGT-8 (south of the SWA and transfer station road). The RD Work Plan had called for a larger number of landfill gas monitoring points; however, only the above-listed wells were located and determined to be functional during sampling activities. SUMMA canisters were used to collect samples from four locations for laboratory analysis of samples for VOCs.

Concentrations of the VOCs 1,1-dichloroethane, vinyl chloride, and trichloroethene exceeded the PALs during all four quarterly monitoring rounds of the pre-design. The concentration of benzene exceeded the PAL in sample LFGF-3 during the fourth quarterly monitoring round only. Average concentrations of the following VOCs exceeded the PALs during the pre-design: 1,1-dichloroethane, 1,1-dichloroethene, benzene, cis-1,2-dichloroethene, dichlorodifluoromethane, trans-1,2-dichloroethene, trichloroethene, 1,2,4-trimethylbenzene, and vinyl chloride.

The landfill gas samples collected during the RD were to establish baseline conditions for comparison with post-closure quarterly perimeter monitoring and to evaluate landfill gas generation for design of the gas collection system. However, the stations sampled during the RD are no longer active due to cap construction activities. During the RA, the Contractor installed several new landfill gas monitoring probes and gas vents (see Figure 3). The gas vents are part of the passive landfill gas collection and venting system. The landfill gas system was expected to behave differently under capped conditions with numerous gas collection wells.

Post-closure landfill gas monitoring was conducted quarterly beginning in April 2008 and scheduled through April 2010. Landfill gas samples were monitored in the field for methane, carbon dioxide, oxygen, hydrogen sulfide, and percent LEL as described in the LTM Work Plan (Berger, 2008) and Quarterly Monitoring Report (Berger, August 2009). A subset of five sample locations, GV-03, GV-09, GP-11, GP-18, and GP-21, were also selected for laboratory analysis for VOCs. The landfill gas monitoring locations are presented in Figure 3, Post-Closure Monitoring Program, Landfill Gas.

The average concentrations of several VOCs detected in landfill gas samples within the capped area were above the PALs during post-closure monitoring. These VOCs included 1,1-dichloroethane, 1,1-dichloroethene, benzene, chloroform, cis-1,2-dichloroethene, dichlorodifluoromethane, ethylbenzene, methylene chloride, n-hexane, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride. These are the same compounds that exceeded the PALs in average concentration during the RD, except chloroform and tetrachloroethene did not exceed PALs in average concentration during the RD and 1,2,4-trimethylbenzene did not exceed PAL in average concentration during the post-closure monitoring. The samples collected during the RD were not analyzed for n-hexane, cyclohexane and 2-butanone, so it is unknown whether these VOCs were present in the RD samples. In some cases the laboratory detection limit for VOCs was set above the PAL, and therefore additional exceedances of the PALs may have occurred.

Table 6-10 summarizes landfill gas sampling at the Site since 1991. Landfill gas analytical data since 2003 is provided in Table 6-11.

Due to updated landfill gas sampling results and landfill gas modeling, a change was made as described in the Explanation of Significant Differences (EPA, 2008). The Explanation of Significant Differences documents the basis for a design decision to build the landfill gas collection system such that it could be operated in either a passive (venting) or active (combustion) mode. The ROD had initially specified an active landfill gas collection system. Landfill gas monitoring during 2003-2004 indicated that this system can operate passively while providing adequate protection from the ambient air risks identified in the ROD.

Subsequent to the landfill closure and capping, the landfill was initially operated using the passive venting system. Post-closure monitoring of gas probes indicated the presence of methane in concentrations above the LEL off-site at certain locations, particularly along Rose Hill Road. The landfill gas flare pilot study was designed in 2009 to determine if active gas collection would lower the off-site methane concentration levels. Since the initial gas flare startup in February 2010, preliminary indications are that the gas flare operation is able to reduce the off-site methane concentrations below the LEL. It has also been observed that the quantity of landfill gas being delivered to the gas flare has been slowly trending downward since the startup. The landfill gas flare pilot study remains on-going and any future decisions to remove the gas flare or establish it permanently at the site have yet to be made.

In addition, due to some of the laboratory air sampling results still being above the PALs, and in accordance with the LTM Work Plan, Screen3 Dispersion Modeling was conducted based on the analytical results from the 2008-2009 post-closure monitoring. Results of the Screen3 Model concluded that none of the pollutants exceeded the PALs established for the Site for dispersion modeling. These modeling results were provided in Berger's Year 1 Annual Monitoring Report (2009). The following steps were taken to develop the maximum 1-hour concentration, emission rates for each pollutant, and maximum annual concentration:

- Calculated 90th percentile values for three sampling events for the two points sampled (GV-03, GV-09). Values below the Method Detection Limit (MDL) were established at 50% of the MDL for purposes of calculating the 90th percentile.

- LandGem Model was run based on the input of the new values into the pollutant tab. The model was run using assumptions used during the RD.

- Screen3 Dispersion Model was run to obtain the maximum 1-hour emission concentration.

- Maximum annual concentrations for the pollutants were calculated based on the results of the Screen3 dispersion model and emission rate from LandGem.

- Maximum concentrations were then compared to the established PALs for each of the contaminants of concern.

None of the VOCs exceeded the PALs based upon dispersion modeling. As there were no PAL exceedances during Year 3 of post-closure monitoring at the gas flare, which is the only sampling location venting to ambient air, Screen3 Dispersion Modeling was not conducted on the Year 3 data.

Table 6-10: Landfill Gas Sampling

Phase	RI/FS				RD				Post-Closure							
Date	June/July 1991	Sept 1991	Dec 1991	May 1992	June 2003	August 2003	December 2003	April 2004	April 2008	July 2008	October 2008	January 2009	April 2009	July 2009	October 2009	April 2010
Samples (#)	168	32	16	30	4	4	4	4	4	4	4	4	4	5	6	6
BWA	29	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
SSA	22	-	-	1		-	-	-	-	-	-	-	-	-	-	-
SWA	85	-	-	3	-	-	-	-	2	2	2	-	2	2	2	3
PSWA	32	32	16	24	4	4	4	4	2	2	2	4	2	3	4	3
Analysis																
[1]VOC (GC)	•	•	•	•												
[2]VOC (S)				•	•	•	•	•	•	•	•	•	•	•	•	•
[3]Reduced Sulfur				•												

NOTES
BWA – Bulky Waste Area
PSWA – Perimeter of Solid Waste Area
SSA – Sewage Sludge Area
SWA – Solid Waste Area
VOC – Volatile Organic Carbon
1 – Sampled with portable gas chromatograph
2 – Sampled with SUMMA canister
3 – Sampled with impinger

Table 6-11: Laboratory Analytical Results, Volatile Organic Compounds in Landfill Gas

ANALYTE	PAL (ppbv)	Risk-Based Vapor Intrusion Target Concen-trations[2]	MEAN CONCENTRATION[1] (ppbv)							
			RD		Year 1		Year 2		Year 3	
			Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)
1,1,1-Trichloroethane	700	400	9.80	(2)	53.5	(4)	47.3	(8)	<MQL	(0)
1,1-Dichloroethane	0.1	120	**45.6**	(3)	**87.1**	(9)	**55.8**	(9)	<MQL	(0)
1,1-Dichloroethene	0.57	50	**179**	(1)	**117.3**	(3)	**25.3**	(5)	<MQL	(0)
1,2,4-Trimethylbenzene	60	1.2	**8.84**	(3)	<MQL	(0)	<MQL	(0)	<MQL	(0)
1,3,5-Trimethylbenzene	60	1.2	**7.22**	(3)	<MQL	(0)	<MQL	(0)	<MQL	(0)
2-Butanone	1,000	NE	NA		94.9	(13)	27.5	(14)	44.2	(5)
Benzene	9	0.098	**71.58**	(3)	**26.1**	(11)	**19.8**	(12)	0.46	(5)
Carbon disulfide	200	220	NA		2.5	(7)	8.93	(12)	6.5	(5)
Chloroethane	4,000	3,800	94.5	(3)	476	(12)	299	(10)	0.5	(1)
Chloroform	0.04	0.022	<MQL	(0)	**4.64**	(3)	**3.82**	(6)	**0.59**	(1)
Chloromethane	200	NE	13.6	(7)	3.0	(7)	2.32	(12)	1.7	(5)
cis-1,2-Dichloroethene	200	8.8	**258**	(3)	**2,139**	(11)	**3,794**	(7)	<MQL	(0)
Cyclohexane	2,000	NE	NA		75.1	(14)	93.4	(11)	<MQL	(0)
Dichlorodifluoromethane	100	40	**148**	(9)	**282**	(13)	**64.4**	(15)	0.66	(5)
Ethylbenzene	200	0.51	**36.1**	(3)	<MQL	(0)	**2.61**	(3)	<MQL	(0)
Freon-113	NE	NE	<MQL	(0)	<MQL	(0)	2.41	(4)	0.28	(1)
Freon-114	NE	NE	<MQL	(0)	223	(9)	52.7	(12)	0.41	(1)
Methylene Chloride	300	1.5	<MQL	(0)	**9.5**	(4)	**3.28**	(4)	<MQL	(0)
p/m-Xylene	700	1,600	14.7	(4)	3.2	(1)	1.49	(2)	<MQL	(0)
o-Xylene	700	1,600	19.3	(4)	1.5	(2)	0.52	(2)	<MQL	(0)
n-hexane	50	57	NA		**152**	(16)	**160**	(13)	0.63	(5)
Propylene	2,000	NE	NA		17.6	(2)	89.4	(15)	11.3	(5)
Styrene	200	230	<MQL	(0)	<MQL	(0)	0.06	(1)	<MQL	(0)
Tetrachloroethene	0.03	0.12	<MQL	(0)	**114**	(2)	**0.47**	(1)	<MQL	(0)
Toluene	100	110	75.6	(8)	52.1	(13)	18.7	(14)	0.77	
trans-1,2-Dichloroethene	20	NE	**51.2**	(3)	10.0	(14)	**28.3**	(6)	<MQL	(0)
Trichloroethene	90	.0041	**238**	(4)	**208**	(11)	**1,194**	(9)	**0.3**	(3)
Trichlorofluoromethane	200	120	<MQL	(0)	2.4	(2)	3.35	(5)	0.27	(5)
Vinyl chloride	40	0.11	**2,369**	(8)	**1,712**	(15)	**1,654**	(12)	**0.22**	(1)

Notes:
[1] Mean concentration calculated from positive results only
[2] Using shallow soil gas concentrations corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor = 0.1 (from EPA Guidance, 2002).
Bold Text indicates exceeds PAL and/or Risk-Based Target Concentration
(#) Number of positive analytical results
<MQL – Less than Method Quantitation Limit (MQL), which is value at which an instrument can accurately measure an analyte at a specific concentration, including any adjustments from dilutions, concentrations or moisture content
NA – not analyzed
ppbv – parts per billion by volume

In addition to the dispersion modeling, Berger conducted an assessment of the potential for vapor intrusion in nearby residences from groundwater and landfill gas. This assessment was performed using EPA Region 1 Guidance for indoor air intrusion calculations and the results of that assessment were provided in a separate memorandum (June 9, 2010) from Berger to EPA. Further review of this issue at the Site was performed by EPA regarding screening of the vapor intrusion pathway, with results reported in an internal EPA memorandum (June 22, 2010). Both memoranda are presented in Appendix G. Based on the vapor intrusion analysis, EPA has concluded that vapor intrusion does not pose an unacceptable risk at this time.

Berger has prepared trend analysis graphs for the following COCs (VOCs) in landfill gas: chloroform (GF, GP-11, GP-16, GP-18, GP-21, GV-3), benzene (GF, GP-11, GP-12, GP-14, GV-3), dichlorodifluoromethane (GF, GP-11, GP-12, GP-14, GV-3), n-hexane (GF, GP-11, GP-12, GP-14, GV-3), toluene (GF, GP-11, GP-12, GP-14), trichloroethene (GF, GV-3), vinyl chloride (GF, GP-11, GP-12, GP-14, GP-21, GV-3, GV-9), 1,1-dichloroethane (GF, GP-11, GP-12, GP-14, GP-21, GV-3, GV-9), 1,1-dichloroethene (GF, GP-11, GV-3), cis-1,2-dichloroethene (GF, GV-3, GV-9), tetrachloroethene (GF, GV-3, GV-9), and trans-1,2-dichloroethene (GF, GV-3). These chemicals and sampling stations were selected as representative of chemicals and locations where elevated contaminant concentrations have been detected.

Berger has also prepared a trend analysis graph for methane concentration in landfill gas (GP-5, GP-7, GP-10, GP-12, GP-16). The methane concentration at gas probe locations was monitored quarterly following post-closure, with the monitoring frequency changed to monthly in March 2009 due to concerns of off-site methane migration.

Graphs showing these trends are provided in Appendix H. All of these VOCs showed an overall general decreasing trend, with some periods of increasing concentrations, since before the post-closure monitoring (2006). More importantly, nearly all concentrations of these VOCs decreased to zero during the first quarterly monitoring round of 2010, following start-up of the gas flare. A similar result for reduction in methane concentrations is also observed, with all off-site measurements of methane concentrations at or below 1% following start-up of the gas flare.

Quarterly landfill gas sampling is presently scheduled to continue. Sampling of VOCs at the landfill gas vents has been replaced with sampling at the gas flare since the system was switched from passive to active. Continued sampling of VOCs at specific gas probe locations remains unchanged. Monthly monitoring of methane at the Site remains unchanged.

6.3.7 Soil

During the RI/FS, 13 surface soil samples were collected in September/October 1991. Eleven additional samples were collected in April 1992. All samples were analyzed for VOCs, SVOCs, pesticides, PCBs, metals, and cyanide. Samples collected in September 1991 were also analyzed for total combustible organics (TCO) and grain size. VOCs, including chlorinated and aromatic compounds and ketones, metals, and PAHs were detected in surface soil samples.

During the 1994 RI, more than 132 compounds were detected in soil at the Site. Contaminants of concern in surface soil were VOCs and metals. Chlorinated and aromatic compounds and ketones were detected most frequently and at highest concentrations in the soil. Elevated iron concentrations were detected throughout the Site. Compounds detected in subsurface soils included ketones, toluene, PAHs,

phthalates, phenols, pesticides, and dicholorobenzenes. Of the metals detected in subsurface soils, only copper in the SSA was significantly elevated compared to background concentrations.

No additional soils were sampled and analyzed during this 5-year review period because soils were fully addressed earlier in the investigation phase and remedial actions for soil have been undertaken as described in the RI/FS Reports (Metcalf & Eddy, 1994 and 1998).

6.3.8 Sediment

Sediment was sampled at the same locations as surface water samples. Sediment was sampled at 18 locations during the RI, of which 12 locations were sampled during the pre-design investigation, and reduced down to 8 sampling locations during post-closure monitoring. Samples were collected from Mitchell Brook (MB), the unnamed tributary to Mitchell Brook (UT), the Saugatucket River (SR), and the unnamed brook (UB) west of the site. Table 6-12 summarizes the samples collected and analyses performed. Sediment monitoring locations are shown on Figure 5, Post-Closure Monitoring Program, Surface Water (and identified as "SW" rather than "SE").

During the RI, sediment samples were analyzed for VOCs, SVOCs, pesticides, PCBs, metals, cyanide, sulfide, ammonia, TCO, and grain size. Pesticides, VOCs, SVOCs, metals, PAHs, ammonia, and sulfide were detected in Mitchell Brook and UT sediment. Metals, VOCs, PAHs, sulfide, and ammonia were detected in Saugatucket River sediment. Pesticides, VOCs, metals, and sulfide were detected in sediments of the unnamed brook.

During the pre-design investigation, sediment samples were analyzed for total metals, TOC, cyanide, sulfide, nitrate, ammonia, BOD, VOCs, SVOCs, PAHs, PCBs, and pesticides. Analytes detected included cyanide, ammonia, nitrate, sulfide, metals, VOCs, and SVOCs. The metals arsenic, iron, and lead were detected above the PAL in one or more samples. The SVOCs benzo(a)anthracene, benzo(a)pyrene, chrysene, benzo(ghi)perylene, and dibenzo(a,h)anthracene were each detected at concentrations exceeding PALs in one sample. No other analytes were detected at concentrations above PALs.

No contaminants in sediment exceeded the PALs at sample locations SE-02, SE-03, SE-05, SE-07, SE-09, SE-12, SE-13, SE-15, and SE-17 during the pre-design. Although elevated concentrations (above the PALs) had been detected in surface water samples at these same locations, it was apparent that contaminants were not affecting sediments at these locations at levels of concern. It was recommended that sediment sampling at these locations be eliminated from future monitoring programs.

Volatile organic compounds and cyanide were not detected in sediment at concentrations above the PALs during any of the pre-design quarterly sampling rounds. No sediment sampling has been conducted during post-closure monitoring.

Table 6-12 summarizes sediment sampling at the site since 1991. Sediment analytical data for the four rounds of testing since 2003 is provided in Tables 6-13 through 6-14.

Table 6-12: Sediment Sampling

Phase	**RI/FS**				**RD**			
Date	June/July 1991	Sept /Oct 1991	December 1991	May 1992	June 2003	August 2003	December 2003	April 2004
Samples (#)	17	17	17	17	12	12	12	12
MB	6	6	6	7	5	5	5	5
SR	9	9	9	9	6	6	6	6
UB	1	1	1	1	0	0	0	0
UT	1	1	1	0	1	1	1	1
Analysis								
VOC	•	•	•	•	•	•	•	•
SVOC	•	•	•	•	•	•	•	•
Pesticides	•	•	•	•	•	•	•	•
PCB	•	•	•	•	•	•	•	•
Total metals	•	•	•	•	•	•	•	•
Cyanide	•	•	•	•	•	•	•	•
Sulfide	•	•			•	•	•	•
Ammonia				•				
TCO	•	•	•	•				
Grain Size	•	•	•	•				
TOC					•	•	•	•
Nitrate					•	•	•	•
BOD					•	•	•	•
PAH					•	•	•	•

Table 6-13: Laboratory Analytical Results, Metals and Other Analytes in Sediment

ANALYTE	PAL	MEAN CONCENTRATION[1] (µg/kg)							
		Mitchell Brook		Saugatucket River		Unnamed Tributary to Mitchell Brook[2]			
		Mean	(#)	Mean	(#)	Mean	(#)		
Total Solids (%)	NE	78	(19)	62	(24)	52	(4)		
Cyanide, Total (mg/kg)	200	<MQL	(0)	0.40	(1)	<MQL	(0)		
Nitrogen, Ammonia	NE	26.6	(6)	34.2	(15)	50.0	(1)		
Nitrogen, Nitrate (mg/kg)	NE	1.95	(2)	1.73	(1)	<MQL	(0)		
Sulfide (mg/kg)	NE	9.10	(7)	137.7	(19)	49.5	(2)		
TOC (mg/kg)	NE	0.52	(17)	4.74	(24)	7.00	(3)		
Total Metals (mg/kg)									
Aluminum	76,000	1,895	(19)	1,760	(24)	7,750	(4)		
Arsenic	2	0.65	(18)	1.52	(19)	**25.85**	(4)		
Cadmium	39	NA	(0)	0.27	(2)	NA	(0)		
Chromium	390	1.90	(19)	2.86	(24)	6.18	(4)		
Copper	3,100	1.68	(19)	1.83	(20)	9.03	(4)		
Iron	23,000	3,953	(19)	5,401	(24)	7,450	(4)		
Lead	150	5.48	(19)	5.90	(24)	**2,453**	(4)		
Mercury	23	NA	(0)	0.00	(0)	0.05	(1)		
Nickel	1,000	1.92	(19)	5.02	(20)	5.08	(4)		
Silver	200	NA	(0)	<MQL	(0)	1.90	(1)		
Zinc	6,000	11.8	(19)	8.78	(22)	21.8	(4)		

Notes:
[1] Mean concentration calculated from positive results only
[2] Includes sample locations SE-01 and SE-13, PAL exceedances occurred at SE-01 only.
(#) Number of positive analytical results
Bold Text indicates exceeds PAL
<MQL – Less than Method Quantitation Limit (MQL), which is value at which an instrument can accurately measure an analyte at a specific concentration, including any adjustments from dilutions, concentrations or moisture content
NA – not analyzed
µg/kg – micrograms per kilogram

Table 6-14: Laboratory Analytical Results, Volatile Organic Compounds and Semivolatile Organic Compounds in Sediment

ANALYTE	PAL	MEAN CONCENTRATION[1] (µg/kg)					
		Mitchell Brook		Saugatucket River		Unnamed Tributary to Mitchell Brook	
		Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)
VOCs (ug/kg)							
1,2-Dichlorobenzene	510,000	<MQL	(0)	20.3	(3)	<MQL	(0)
1,4 – Dichlorobenzene	27,000	<MQL	(0)	36.7	(4)	<MQL	(0)
2-Butanone	NE	<MQL	(0)	10.2	(2)	40.0	(1)
Acetone	7,800,000	20.0	(2)	80.8	(11)	395	(2)
Benzene	2,500	<MQL	(0)	2.90	(3)	<MQL	(0)
Carbon disulfide	7,800,000	<MQL	(0)	10.8	(1)	<MQL	(0)
Chlorobenzene	210,000	6.95	(2)	35.6	(6)	<MQL	(0)
Chloroethane	220,000	<MQL	(0)	3.10	(3)	<MQL	(0)
Ethyl ether	NE	<MQL	(0)	5.20	(2)	<MQL	(0)
Isopropylbenzene	27,000	<MQL	(0)	5.88	(3)	<MQL	(0)
Naphthalene	54,000	<MQL	(0)	4.00	(1)	<MQL	(0)
n-Butylbenzene	3,100,000	<MQL	(0)	2.33	(1)	<MQL	(0)
n-Propylbenzene	3,100,000	<MQL	(0)	1.70	(2)	<MQL	(0)
Sec-Butylbenzene	3,100,000	<MQL	(0)	2.60	(2)	<MQL	(0)
Tetrachloroethene	12	<MQL	(0)	**34.4**	(2)	<MQL	(0)
Toluene	190,000	<MQL	(0)	11.3	(1)	20.0	(1)
SVOCs (ug/kg)							
Bis-2(ethylhexyl)phthalate	46,000	390	(1)	1,120	(2)	<MQL	(0)
Di-n-butylphthalate	NE	<MQL	(0)	110	(2)	<MQL	(0)
Benzo(a)anthracene	900	19.7	(3)	<MQL	(0)	626	(4)
Benzo(a)pyrene	400	17.3	(3)	<MQL	(0)	**786**	(4)
Benzo(b)fluoranthene	900	20.3	(3)	<MQL	(0)	74.3	(3)
Benzo(k)fluoranthene	900	22.7	(3)	<MQL	(0)	33.9	(3)
Chrysene	400	26.0	(3)	<MQL	(0)	**775**	(4)
Benzo(ghi)perylene	800	16.5	(2)	<MQL	(0)	521	(4)
Dibenzo(a,h)anthracene	400	34.0	(1)	<MQL	(0)	**794**	(3)
Indeno(1,2,3-cd)pyrene	900,000	23.5	(2)	<MQL	(0)	557	(3)

Notes:
[1] Mean concentration calculated from positive results only
[2] Includes sample locations SE-01 and SE-13, PAL exceedances occurred at SE-01 only.
(#) Number of positive analytical results
Bold Text indicates exceeds PAL
<MQL – Less than Method Quantitation Limit (MQL), which is value at which an instrument can accurately measure an analyte at a specific concentration, including any adjustments from dilutions, concentrations or moisture content
NE - none established

6.3.9 Leachate

During the RI, leachate was collected from six leachate seeps (see Figure 5), five along the Saugatucket River (LE-02 – LE-06) and one near Mitchell Brook (LE-01). The Saugatucket River locations and the Mitchell Brook location were sampled in June 1991 and April 1992. Samples were analyzed for VOCs, SVOCs, pesticides, PCBs, total and dissolved metals, cyanide, sulfide, TOC, and BOD. Chlorinated and aromatic VOCs, metals, and cyanide were detected in leachate samples. Three composite samples were collected from one of the leachate seeps (LE-05) in April 1992 to supplement ecological toxicity testing; these samples were analyzed for the same analytes as the June 1991, except for sulfide; these samples were also analyzed for water-soluble organics and ammonia. VOCs, metals, ammonia, and TOC were detected in these composite samples.

In the pre-design investigation, leachate was collected from four seeps, collected at locations generally to the east and southeast of the BWA: LE-02, LE-03, LE-05, and LE-06. Leachate samples were analyzed for total metals, dissolved metals, TOC, cyanide, sulfide, nitrate, ammonia, BOD, VOCs, SVOCs, PCBs, and pesticides. Analytes detected included total and dissolved metals, cyanide, TOC, ammonia, nitrate, sulfide, BOD, and VOCS. The metals aluminum, arsenic, cadmium, chromium, iron, lead, manganese, and mercury were detected above the PAL in the total metals analysis. In the dissolved metals analysis, the analytes aluminum, iron, and zinc were detected above the PAL. Ammonia, cyanide, and sulfide concentrations also exceeded the PALs in some samples. The only VOC detected above the PAL was naphthalene during one quarter of sampling.

In addition to the quarterly analysis of leachate samples, a one-time leachate toxicity test was conducted during the RD in June 2003. The results of the toxicity test indicated a significant reduction in daphnid (planktonic crustacean indicator species) survival was observed in one of five leachate samples (sample LE-04). No survival reduction was observed in diluted leachate samples, indicating that reduced concentrations of leachate (e.g. through contamination source removal and dilution via percolating precipitation) would represent reduced toxicity.

Concentrations of SVOCs, PCBs, and pesticides were not detected in leachate above the laboratory detection limits or PALs during any of the quarterly RD monitoring rounds. It was therefore recommended that SVOCs, PCBs, and pesticides analysis of leachate be eliminated from future monitoring programs.

Leachate sampling was not performed during the post-closure investigation as the SWA was capped as a measure intended to eliminate/minimize leachate seepage. Visual examination for the presence of leachate seeps are conducted as part of the post-closure inspections. Table 6-15 summarizes leachate sampling at the site since 1991. No leachate analysis has been conducted during the past five years under the post-closure monitoring program.

Table 6-15: Leachate Sampling

ANALYTE	RI/FS		RD			
	June/July 1991	April/May 1992	June 2003	August 2003	December 2003	April 2004
Samples (#)	6	3	4	4	3	4
SR	5	3	4	4	3	4
MB	1	-	-	-	-	-
Analysis						
VOC	•	•	•	•	•	•
SVOC	•	•	•	•	•	•
WS-O		•				
Pesticides	•	•	•	•	•	•
PCB	•	•	•	•	•	•
Total metals	•	•	•	•	•	•
Dissolved metals	•	•				
Cyanide	•	•	•	•	•	•
Sulfide	•		•	•	•	•
Ammonia		•				
TOC	•	•				
BOD	•	•				

6.4 Site Inspection

EPA, RIDEM, the Towns of South Kingstown and Narragansett, and Berger inspected the Site on March 29, 2010. The attendees at the Site Inspection included:

- David Newton EPA Remedial Project Manager
- Gary Jablonski RIDEM Remediation Project Manager
- Jon Schock Town of South Kingstown, Director of Public Services
- Jeffry Ceasrine Town of Narragansett, Town Engineer
- Christopher Feeney The Louis Berger Group, Inc.
- Clayton CarlisleThe Louis Berger Group, Inc.

The attendees inspected the Site, including the SWA and BWA as well as the retention ponds and Mitchell Brook. Issues raised at the site inspection included the following:

Landfill Cap

- Identified sloughing of sideslope near the top of the downchute on the southern side. The slight concave section can easily be repaired by placing filter fabric on the soil surface and covering with additional riprap material.

- Observed critter holes or burrows occasionally around the SWA soil surface, particularly on the top of the landfill. When kept in check to a minimum number, animal holes are a minor issue and do not impact the functionality of the capping remedy or compromise the integrity of the cap.

Drainage Structures

- A slight gap or crack between sections of the downchute culvert crossing under the landfill road has been previously detected based on observation of water flowing into the culvert on the upstream side, but not flowing out through the downstream side. The gap has been repaired by parging the inner seams at the section interfaces. This will prevent further drainage flow travelling through the seam and potentially causing settlement of the culvert section through movement of sub-surface soils and differential settling.

Site Plantings

- Some of the vegetation (primarily the various species of berry bushes) planted around the sides of South Pond during Phase II was inadvertently mowed down during the fall 2009 mowing conducted by the Town. It was determined that this area will be watched during the 2010 growing season to see if the bushes make a comeback from being cut down. If the bushes do not sufficiently recover, the Town will enact plans to replace the damaged plants.

No other issues were identified.

During the Site Inspection, the operation of the gas flare pilot program was reviewed. Berger reported that the flare began operating on February 10, 2010. Since that time, the flare has been running in a continuous operating mode, except for occasional outage due to high winds blowing the flare out. The flare continues to draw landfill gas from the capped landfill and is continuously monitored for methane quality and blower vacuum. The flare operates on a vacuum in the range of 0.5" to 1.5" water column, with a methane quality around 40% and greater. The flare initially drew a landfill gas flow rate around 90 scfm in the first few weeks of operation, but has been operating in the 50 scfm range since mid-March 2010. The monitoring of landfill gas probes throughout the Site has demonstrated a significant reduction in methane concentrations in the soil since the start of the gas flare operation, particularly on the west side of the landfill and beyond the Site property boundary.

In general, it was observed that the drainage swales and the downchute in the SWA are working properly.

6.5 Interviews

Representatives of EPA, RIDEM, the Towns of South Kingstown and Narragansett were interviewed on February 10, 2010 in a meeting held at RIDEM headquarters, 235 Promenade Street, Providence, RI. The attendees at the interview meeting included:

- David Newton EPA Remedial Project Manager
- Gary Jablonski RIDEM Remediation Project Manager
- Jon Schock Town of South Kingstown, Director of Public Services
- Jeffry Ceasrine Town of Narragansett, Town Engineer

Issues discussed at the interview include the following:

Operation and Maintenance (O & M) activities performed by the Town (South Kingstown) to date have included, the cutting of vegetation in SWA; removal of woody growth (October 2009); repair and backfilling of critter burrow holes in top of landfill cap (October 2009); and maintenance/reporting of methane meters at two homes (on-going). Potential future O&M activities over the long term may include fence and gate repair (as needed); access road rut repair (as needed); occasional maintenance of the downchute, swales, culverts, and pond spillway; cutting of vegetation in SWA in the fall; and maintenance/reporting of methane meters at two homes. The Town does not see any changes pertaining to this list of activities to be performed except for the methane meters. The Town would like to see the meters removed from the homes in the future, pending results of the flare gas operation. Cutting vegetation in the SWA annually in the fall was discussed as being appropriate, as long as any woody growth is continually eliminated. The Town may also cut along the fence line to prevent vegetative growth from damaging the fence.

The Town has not encountered any difficulties or issues conducting current O&M efforts.

In general, the Towns do not have any municipal concerns, observations, or suggestions concerning the OU-1 remedy as presently implemented.

Jon Schock indicated his concern that the gas flare skid, installed as part of the gas flare pilot study, does not have a remote alarm system. He also expressed concern with the exposure of the equipment to potential acts of vandalism. Discussion was held that the system as presently installed is a pilot system and may not be utilized for long-term. The Town's concerns were acknowledged and would be addressed in the future if a gas flare system is desired for long-term use, specific to controls and vandal resistant enclosures.

The Towns were asked if there are any municipal concerns with the OU-1 remedy as presently implemented which could affect the residents of the Town (including those who live near the Site and those who do not). The Town hopes that the implementation of active gas collection would eliminate the need for the methane meters which are presently installed in residential homes. Over the course of operating the methane meters, there have been some false alarms possibly due to condensation. Methane data is digitally recorded and downloaded monthly by Town staff. The downloaded data is provided to a

sub-contractor for the Town who is tasked with annual environmental reporting and maintenance of the technical equipment.

Jon Schock also indicated that some residents had concerns over the amount of tree-cutting involved in implementing the remedy. He said very few complaints were received during the construction of both Phases I and II. Since the project completion, there have been only been two complaints related to the tree removal performed by National Grid on Rose Hill Road, but those types of complaints were received throughout the town for other areas as well.

Jon Schock reported that there have been no complaints or comments for or against the implementation of the pilot gas flare program.

Presently, the Town has no future re-use plans for the Site due to lack of local funding. Future use of the BWA may include development of multi-purpose fields for recreation. For short term, the BWA is targeted as a potential debris management site for emergency cleanup activities after hurricane destruction.

The Town is planning future improvements to the transfer station and will be working with the private operator to increase the recycling and waste diversion rates for the Towns of South Kingstown and Narragansett. These improvements may include changes to existing buildings at the transfer station for municipal waste and recycling operations. The buildings and/or operations may expand further to the north into the treed area behind the waste station and recycling building. There are no anticipated changes to the roadway or site fencing.

The Town was asked if there have been any changes in the use of the land at or near the Site, in terms of the use of groundwater, target populations or potential exposure routes. Jon Schock said that there are no changes in the groundwater use. The Town continues to encourage residents in the vicinity of the Site to use potable water not to be drawn from a well potentially affected by the Site. No residential developments are presently under review in the vicinity of the Site. No potential exposure routes have resulted based upon changes in the use of the land at or near the Site.

The Town indicated that there is not any new information that might call into question the protectiveness of the remedy.

The Towns were asked about the status of Institutional Control (IC) implementation and schedule for the Site. Completion target dates for IC implementation were discussed with the Towns.

No other issues were identified in the interview meeting.

In addition, local residents were interviewed by Berger via telephone.

- Ms. Patricia Gagne, 349 Rose Hill Road, stated that she has never been in favor of the cap project and is still opposed to it due to its visual impact and its impact to wildlife. She is in favor of future uses which only involve natural uses for wildlife and open space. The Gagne residence (Plat 33, Lot 36) is adjacent to the northwest corner of the Site. Gas probe GP-19 is located on the north side of Pearls Way next to the Gagne property line. The Gagne residence also has a methane detector inside the house.

- Mr. Myron Duffin, 278 Rose Hill Road, stated that he does not have any issues with the capped landfill. He would like to see trees replanted along the west side of the Site next to Rose Hill Road to replace trees that were either removed or have died. The Duffin residence (Plat 33, Lot 42) is on the west side of Rose Hill Road across from GV-18. Gas probes GP-40C, GP-40D and GP-40E are located on the Duffin property and GP-12 is located on the west side of Rose Hill Road next to the Duffin property line. The Duffin residence also has a methane detector inside the house.

- Ms. Cynthia Knight, 75 Pearls Way, stated that she likes the way that the capped landfill looks and that the site does look better now that it is capped. She is satisfied with the on-going monitoring, but is not pleased with the location of the gas flare in relation to her property and its potential effect on her property value. The Knight residence (Plat 33, Lot 33) is northeast of the SWA and is adjacent to the gas flare location and North Pond.

- Mr. Richard Frisella, 130 Pearls Way, stated that he does not have any issues with the capped landfill, but had questions about the gas flare, its location and how long it would stay in place. He suggested that trees should be planted on the west side of the Site along Rose Hill Road to replace tree that were either removed or died. The Frisella residence (Plat 33, Lot 30) is northeast of the SWA and directly west of the SSA. The SSA is located on the Frisella parcel.

- Mr. David Webster, 938 Broad Rock Road, stated that he did not have any issues with the capped landfill. His property is closer to the BWA and he stated that he would be concerned with any development taking place or future usage in the BWA which may impact his property or use of it. He would want to see what was proposed before taking any position on the future use of the BWA. The Webster property (Plat 33, Lot 21) is located on the eastern side of the Saugatucket River, east of the BWA.

Interview records for all interviews conducted for this Five Year Review are found in Appendix B.

6.6 Review of Current Access Agreements and Institutional Controls

As a component of the First Five Year Review for the Site, the access agreements and institutional controls (IC) were reviewed. Institutional Control determinations are part of the ROD and are critical to the implementation of the remedy. The Town of South Kingstown is the lead agent for implementing the IC mechanisms and tracking the IC determinations.

Aside from properties owned and/or controlled by the Town, there are presently three access agreements in place regarding the Site. The purpose of these access agreements is to provide access to sampling points for the implementation of the long term monitoring program. The current monitoring program utilizes soil gas probes and indoor methane monitors at two locations and monitoring a groundwater well at a third location. Table 6-16 below presents the parcel ID and address of the existing access agreements and the type of monitoring performed at the properties.

Table 6-16: Existing Access Agreements

Location (Plat/Lot)	Name and Address	Reason for access agreement
Plat 33 Lot 42	278 Rose Hill Road	Methane monitoring inside dwelling. Soil gas vapor probe monitoring on property.
Plat 33 Lot 36	349 Rose Hill Road	Methane monitoring inside dwelling.
Plat 33 Lot 21	938 Broad Rock Road	Groundwater monitoring of private well on property.

The Town has prepared the templates for the IC instruments for both public and private properties. The IC will reference the Rose Hill Landfill Superfund Site Phase II – Landfill Closure Record Drawings prepared by The Louis Berger Group, Inc. dated September 2008 (As-Built plans). Mylar copies of the drawings were submitted to the Town in February 2010 and will be filed with the Town Clerk as references for the ICs. The Town will implement the ICs in coordination with EPA. The Town mailed the proposed ICs to affected property owners in May 2010. Title examination services were contracted out by the Town in June 2010 and the title reports for the affected properties are expected to be completed in August 2010. Once the title documents are reviewed and approved, final IC documents will sent to property owners for signature, with a target date of on or before December 31, 2010. Completion and recording of ICs are expected to occur by July 31, 2011, subject to property owner willingness to sign and/or other unforeseen procedural recordation issues.

The Town does not foresee any obstacles that might prevent implementation of the Institutional Controls within an acceptable time frame for overall protectiveness.

The ICs that are to be implemented are set forth in the Rose Hill Regional Landfill Institutional Control Tracking Chart included in Appendix E. The IC Tracking Chart was developed to identify the parcels, parcel owners, deed restrictions, site issues, and legal recordings related to each parcel and is updated by the Town of South Kingstown on an ongoing basis, as appropriate. Presently, the Town is in the process of conducing title examinations on all affected properties.

The Town also prepared a plan showing the IC boundaries, which is included in Appendix E together with any executed Institutional Controls and property access agreements.

SECTION 7.0 TECHNICAL ASSESSMENT

As previously stated, the purpose of this five-year review is to determine whether the remedy selected for the Rose Hill Regional Landfill Superfund Site (Site) remains protective of human health and the environment. This section provides a technical assessment of the RA that is being implemented at the Site. In accordance with EPA's Comprehensive Five-Year Review Guidance (EPA, 2001), protectiveness is largely determined through analysis of three questions:

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

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

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

Sections 7.1 through 7.3 provide an analysis of these questions for OU-1. Section 7.4 provides the protectiveness statement for OU-1.

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

NO. All aspects of the Site remedy, except the ICs, have been implemented or are being conducted on an on-going basis, in accordance with the 1999 ROD, and are operating and functioning as designed. Once the ICs are implemented, the answer to Question A will be yes.

The source control remedy selected in the ROD for the Site (Alternative 4B) was intended to control the sources of contamination at the Site by limiting the extent to which precipitation would percolate and infiltrate through waste materials and minimizing further migration of the contaminated groundwater and landfill gas plume. The remedy does appear to be controlling the source of contamination; contaminant concentrations in groundwater and surface water have decreased or stabilized since implementation of the remedy and contaminant concentrations in landfill gas have decreased significantly since start-up of the active landfill gas collection system (gas flare pilot study).

The components of the landfill capping remedy which have been completed consist of the following:

- Excavate and consolidate the BWA landfill materials onto the SWA landfill;
- Collect and effectively manage leachate and waters collected from runoff and dewatering operations during the excavation of the BWA;
- Construct a multi-layer hazardous waste cap using innovative and cost efficient cover materials, as may be appropriate and as further defined in design, over the extent of the SWA landfill and consolidated BWA materials;
- Assess, control, collect and treat landfill gas emissions by an active internal and perimeter gas collation system and thermal treatment of such gases through the use of an enclosed flare and

continue monitoring landfill gas concentrations to assess the need to modify the landfill gas collection treatment system as necessary; and

- Install a chain link fence and/or other physical barriers where necessary to prevent Site access, injury, and/or exposure.

The active landfill gas collection and combustion system, although originally included in the ROD, was later revised to a combination active and passive gas collection system design and was initially operated as a passive gas venting system. The basis for this revision is presented in the September 2008 ESD. The ESD also indicated that, if ambient air monitoring or modeling identifies a potential risk to the nearby residents, the constructed remedy could be converted from the passive landfill gas migration system to an active landfill gas migration system. Landfill gas monitoring after completion of Phase II construction indicated methane was in fact detected off-site in concentrations above the LEL. Accordingly, the decision was made to implement a Landfill Gas Flare Pilot Study, as detailed in Section 4.3.2 of this report. Within days of flare operations startup on February 10, 2010, methane concentrations were found to be below 1.0% methane at all gas probes located off-site and have consistently remained at or below that level through the current Spring 2010 testing.

The on-going components of the remedy include the following:

- Inspect, maintain, and monitor the integrity and performance of the landfill cap over time;
- Long-Term monitoring of surface water, groundwater, and air;
- Perform operation and maintenance activities throughout the life of the remedy; and
- Conduct statutory five year reviews as required.

These components will continue to be implemented at the Site. Modifications to the long term monitoring program for the Site may be made in the future based upon monitoring results and analysis. Operation and maintenance activities at the Site continue to be performed. The conducting of the five year reviews, of which this document is the first, is expected to continue in the future.

The implementation of ICs, as described in the selected remedy, consists of the following:

- Implement access restrictions and Institutional Controls (land title restrictions including, but not limited to, easements and restrictive covenants) on land use and the use of, or hydraulic alteration of, groundwater where Preliminary Remediation Goals (PRGs) (based on MCLs, MCLGs) and/or other health based standards are exceeded.

As indicated in Section 6.6 of this document, there are only three current access agreements in place regarding the Site at the present time. Institutional Control determinations continue to be a critical component in the implementation of the remedy. As the lead agent for initiating the IC mechanisms and tracking the development of the IC determinations, the Town of South Kingstown is currently in the process of ICs implementation. The Town will continue to update the IC Tracking Chart presented in Appendix E, as information regarding the parcels, parcel owners, deed restrictions, site issues, and legal recordings becomes available. Despite the fact that ICs are not currently in place at the Site, fences are in place around the perimeter of the capped area and public water supply is available to all area residents.

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

YES. With few exceptions, the assumptions and conclusions used at the time of remedy selection are valid. There have been no remarkable changes in physical conditions of the OU1 (other than the implemented remedy) that would affect the protectiveness of the remedy.

ARARs

The Federal and State ARARs were first identified in the ROD (EPA, 1999) and were detailed in the Demonstration of Compliance Plan (2007), and are described in detail in Section 6.3.1. The purpose of the source control remedy was to control sources of contamination; therefore, no numeric clean-up levels were established in the ROD. The changes in standards which have been made to the ARARs since the ROD was signed do not affect the remedy protectiveness. Relevant changes to PALs are described in Section 6.3.2.

Standards and Standards Changes To Be Considered

The PALs were established for environmental media on the Site as described in Berger's 2008 Quality Assurance Project Plan (QAPP); a 2005 QAPP prepared by MACTEC Engineering and Consulting, Inc. (MACTEC) for the Remedial Action; and a 2003 QAPP prepared by Berger for the Remedial Design. As stated in these QAPPs, the intent of the PALs is not to supersede the risk assessment or remedial action objective processes which are integral parts of developing cleanup standards for the Site, but to provide a check that the data produced will meet Project Quality Objectives for COCs.

The changes in standards which have been made to the PALs since the 1999 ROD are the following:

Groundwater PALs

- Adoption of a new standard for arsenic in drinking water of 10 parts per billion (ppb), replacing the old standard of 50 ppb (EPA, 2001).

Surface water PALs

- Changes to EPA National Recommended Water Quality Criteria (NRWQC) based upon recalculation of human health criteria based on EPA's Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000) (EPA-822-B-00-004), (NRWQC, 2002).

- Additional revised human health criteria for fifteen chemicals (EPA, 2003).

Since NRWQC and AWQC were not available for all analytes and since other more rigorous criteria for some contaminants of concern (COCs) have been established, some PALs were based on other standards including the following:

- Manganese: EPA Drinking Water Advisory 2008;

- Silver and Zinc: National Secondary Drinking Water Regulations (no NRWQC applicable);

- Cadmium: The source of the 18 µg/l PAL for cadmium is unclear following review of project documents and water quality standards.

Berger has prepared proposed new PALs for some metals (cadmium, chromium, copper, lead, nickel, silver, and zinc) in surface water and recommends an update to the QAPP following completion of the Five Year Review to reflect the new PALs and clarify the source of each PAL.

Landfill gas PALs

- Addition of one chemical, n-propyl bromide, to the list of regulated substances under RIDEM Air Pollution Control Regulation No. 22 for Air Toxics (RIDEM APC No. 22 amendment, 2008)

N-propyl bromide is not one of the COCs monitored in landfill gas at the Site and it is not recommended that it be added to the list of analytes at the site as its primary uses are not consistent with wastes disposed of at the site.

During the RD, Berger completed a Field Investigation Summary Report (August 2004) that summarized the results of the 2003-2004 quarterly monitoring and made recommendations for future monitoring. The MACTEC sampling round subsequent to the RD obtained results generally consistent with the findings of the quarterly monitoring program. Therefore, the conclusions reached in the Field Investigation Summary Report remained valid.

Based on the results of the environmental monitoring programs conducted in 2003-2004, the sampling strategy for the Site has changed since the 1999 ROD. Changes in the sampling regimen were accepted by both EPA and RIDEM and the current sampling regiment for the Site based on these changes is described in the Final LTM Work Plan (Berger, 2008). Changes in the monitoring locations and analytical parameters are described for each media sampled in Sections 6.3.4 through 6.3.9.

Based on examination of the EPA Integrated Risk Information System (www.epa.gov/iris) and related sources, during the last five years no changes have occurred to the toxicity values of the Site COCs that might affect the protectiveness of the remedy.

7.2.1 Vapor Intrusion Analysis

Vapor Intrusion analysis was conducted as part of the Five Year Review. Memoranda regarding vapor intrusion from Berger and EPA of vapor intrusion findings are provided in Appendix G – Vapor Intrusion. EPA reviewed the groundwater data that are applicable for screening the vapor intrusion exposure pathway. A comparison of groundwater data to the screening values provided in the 2002 OSWER Draft Guidance for Evaluating the Vapor Intrusion Pathway and the Region 1 Risk-Based Vapor Intrusion Target Concentrations in Groundwater for Chemicals with MCLs (March 11, 2010) showed that vapor intrusion does not pose an unacceptable risk at this time. However, EPA recommended that groundwater samples continue to be collected and depth to groundwater measurements be taken at least annually to the northwest and west of the site (including in the vicinity of Resident -11) along with other site wells; and that these data be evaluated as they relate to abutting property uses and the potential for vapor intrusion into indoor air. EPA also recommended that, under the site-specific Quality Assurance Plan, the method detection limit for vinyl chloride be lowered so that there is greater assurance that data can be evaluated at the appropriate screening concentration.

7.2.2 Remedial Action Performance

The Remedial Action was performed between April 2005 and September 2007. Documentation of the performance of the work is provided in the Final Remedial Action Report, Phase II Landfill Closure (Berger, September 2008).

The RA Report indicates that the RA was completed according to the Design Documents, which were prepared in accordance with the remedy selected in the ROD.

Based on the performance data collected to date (both during and after implementation of the source control remedy), contamination at the Site has diminished. Analyses of chemical concentration trends are provided in Sections 6.3.4 through 6.3.6.

7.2.3 System Operations/O&M

The Post-Closure Operation and Maintenance Plan (O&M Plan) was prepared as a component of the Remedial Action Project Operations Plan (RA POP) in accordance with the Remedial Action Statement of Work (RA SOW) in the May 28, 2004 CA. The O&M Plan provides a written understanding and commitment of how various post-closure aspects such as operations and anticipated use of areas, access, security, contingency procedures, maintenance responsibilities, evaluation and assessment of landfill components, monitoring and inspection programs, record keeping and reporting and well maintenance program are being managed by the Town of South Kingstown and the Supervising Contractor responsible for Environmental Engineering Services to RIDEM.

The post-closure programs related to maintenance, monitoring and inspection of the Site have been and will continue to be performed in accordance with the remedy selected in the ROD.

7.2.4 Opportunities for Optimization

There is no information available which indicates or suggests opportunities for optimization.

7.2.5 Early Indicators of Potential Remedy Problems

There are no early indicators of potential remedy problems.

The detection of methane in gas probes beyond the Site property boundaries resulted in the implementation of the Landfill Gas Flare Pilot Study. As operation of the gas flare and gas probe monitoring continues, a program will be developed to determine the effect on off-site methane concentrations related to shutting off the active gas collection system and gas flare and switching back to passive venting. This program will study the potential time delay from when methane concentrations go from negligible (presently found when operating the gas flare) to tangible or potentially approaching LEL levels and at which locations this occurs. The results of this cause and effect relationship will assist in deciding whether long-term active gas collection and gas flare operation are necessary at the Site or if the landfill can revert back to passive gas venting operation.

7.2.6 Implementation of Institutional Controls

The implementation of ICs in the selected remedy are discussed in Section 7.1 above and include access restrictions and Institutional Controls (land title restrictions including, but not limited to, easements and

restrictive covenants) on land use and the use of, or hydraulic alteration of, groundwater where Preliminary Remediation Goals (PRGs) (based on MCLs, MCLGs) and/or other health based standards are exceeded.

As indicated in Section 7.1, there are only three access agreements in place regarding the Site at the present time. The Town of South Kingstown has granted access for the State and EPA to town-owned parcels of the Site and is currently in the process of the ICs implementation. The Town will continue to update the IC Tracking Chart presented in Appendix E, as information regarding the parcels, parcel owners, deed restrictions, site issues, and legal recordings becomes available.

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

NO. There is no other information that calls into question the protectiveness of the remedy.

7.4 Technical Assessment Summary

According to the data reviewed, the site inspection, and the interviews, the remedy is generally functioning as intended by the ROD. There have been no changes in the physical conditions of the Site that would affect the protectiveness of the remedy. Except as noted previously, most of the ARARs identified in the ROD remain applicable or relevant and appropriate and either have been met or are being complied with.

Gas probe monitoring has detected the presence of methane beyond the Site property boundaries, but not on a consistent basis at any one location. The Landfill Gas Flare Pilot Study has been implemented and remains on-going in order to determine the ability of the active gas collection system to lower the off-site methane concentrations to below LEL levels and if active gas collection and gas flare operation is needed permanently at the Site.

Initial monitoring results following implementation of the landfill gas flare have indicated that the gas flare has lowered off-site methane concentration to well below LEL levels at all off-site monitoring locations, with mean methane concentrations below 1.0%. All but two on-site monitoring locations report methane concentrations at or about zero. All results indicate that the pilot system is performing as intended and within expected specifications. The gas flare continues to operate at a steady state condition and the gas collection system is continually monitored to ensure proper operation of the landfill gas management system.

Although vapor intrusion pathway does not currently pose an unacceptable risk based on available information, it is recommended that groundwater concentrations and depth to groundwater continue to be monitored so that vapor intrusion pathway can be reassessed annually in residential areas and in the future should structures be built in other areas or until it is known that the threat of gas migration and/or the potential for vapor intrusion is diminished to a level which no longer constitutes a concern. The Long-Term Monitoring Work Plan should continue to be implemented to further assess or characterize the management of migration, or site impacts from, landfill gas, contaminated groundwater and surface water at the Site. Modifications to the site–specific monitoring program may be needed over time based upon the results of the monitoring completed and the trends observed.

SECTION 8.0 ISSUES

This Five-Year Review has identified three issues which affect the protectiveness of the remedy, which are listed in Table 8-1 below. These are the basis of the recommendations subsequently made in Section 9.

Table 8-1: Issues

Issues	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness(Y/N)
Institutional Controls are planned but are not in place, IC documents need to be prepared, reviewed and finalized according to the IC program presently underway by the Town of South Kingstown.	N	Y
Sporadic methane concentrations above the LEL have been detected at monitoring points on the western side of Rose Hill Road outside of the Site property limits. Potential for vapor intrusion, while not posing an unacceptable risk based on available information, remains as a potential threat.	N	Y
Management of the migration of contaminants from the Site continues to be based upon data obtained from the first operable unit and any additional studies that are deemed necessary in order to further assess Site impacts.	N	Y

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SECTION 9.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

In response to the issues noted in Section 8 above, recommended action items for each of the issued raised are listed in Table 9-1. Further recommendations (with no specific issue) are:

Table 9-1: Recommendations/Follow-up Actions

Recommendations/Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
				Current	Future
1. Institutional Controls (ICs) are planned but are not in place. However, IC documents have been prepared by the Town of South Kingstown and progress is being made to implement these in accordance with the current IC program. ICs are to be completed by the Town of South Kingstown in accordance with the current plan and schedule as outlined in section 6.6 of this document.	Town of South Kingstown	EPA	Final ICs sent to property owners for signature by December 31, 2010. Completion and recording of ICs by July 31, 2011.	N	Y

Recommendations/Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
				Current	Future
2. Sporadic methane concentrations above the LEL have been detected at monitoring points on the western side of Rose Hill Road outside of the Site property limits. Potential for vapor intrusion, while not posing an unacceptable risk based on currently available information, remains as a potential threat and requires further assessment. Continue with the active landfill gas pilot study and make a decision within one year concerning active vs. passive landfill gas management based on ongoing flare pilot studies, continued monitoring, and modeling data. Implementation of the landfill gas pilot study has demonstrated that the active gas collection system can essentially eliminate westward landfill gas migration off-site. If the passive gas venting system is reinstituted, the gas probes and the passive venting system must continue to be monitored at the current frequency, at a minimum, until it is known that the threat of gas migration and the potential for vapor intrusion is diminished to a level which no longer constitutes a concern.	RIDEM and Towns	EPA	Landfill gas pilot study to be completed on or before February 2011. Decision to continue active gas collection system or revert back to passive gas venting made on or before March 2011. Continue groundwater monitoring and reassess vapor intrusion pathway annually and lower method detection limit in the site-specific QAPP for vinyl chloride for next sampling round.	N	Y

Recommendations/Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
				Current	Future
3) Management of the migration of contaminants from the Site continues to be based upon data obtained from the first operable unit and any additional studies that are deemed necessary in order to further assess Site impacts. The Long-Term Monitoring Work Plan should continue in its present form, with continued landfill gas monitoring, bi-annual groundwater and surface water monitoring, and annual habitat assessment and biomonitoring. Modifications to the long term monitoring program for the Site may be made in the future based upon monitoring results and analyses.	RIDEM and Towns	EPA	Continued assessment for a 2 to 5 year period as prescribed under the Long-Term Monitoring Work Plan.	N	Y

SECTION 10.0 PROTECTIVENESS STATEMENT

The remedy for OU-1 currently protects human health and the environment in the short term because: 1) access to the Site is restricted to prevent direct exposures to the waste; 2) the vegetative cover and the drainage system are constructed and maintained to prevent erosion of soil and deposition into the surrounding detention ponds, wetlands and surface water bodies; and 3) the landfill cap, gas extraction system, and the pilot flare is capturing and treating landfill gases to prevent exposures beyond the Site boundary.

However, in order for the remedy to be protective in the long-term, the following actions need to be taken: 1) institutional controls are fully implemented; 2) a decision is rendered concerning active versus passive landfill gas management based on the ongoing pilot study, continued monitoring and modeling data. If passive gas venting system is reinstituted, the gas probes and the passive venting system must continue to be monitored at the current frequency, at a minimum, in order for the remedy to be deemed protective in the long-term. 3) Additionally, management of the migration of contaminants from the Site continues to be based upon data obtained from the first operable unit and any additional studies that are

deemed necessary in order to further assess Site impacts. Thus the Long-Term Monitoring Work Plan should continue to be implemented to continue to evaluate contaminant trends.

SECTION 11.0 NEXT REVIEW

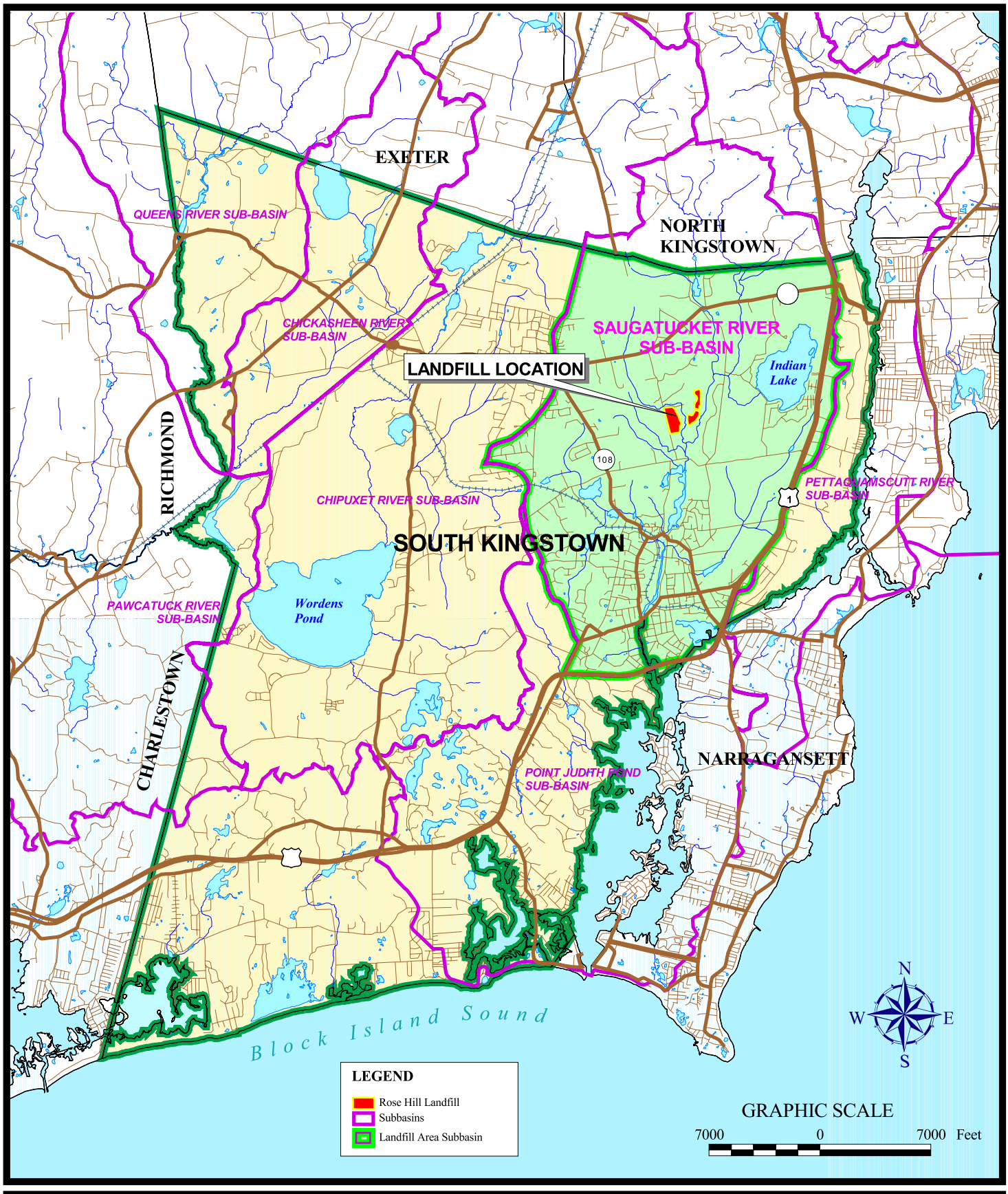
The second five-year review for the Site will be completed in 2015, either on or prior to five years from the date of signature of this report. Statutory five-year reviews are required for this Site since hazardous contamination remains above levels that allow for unlimited use and unrestricted exposure.

APPENDICES A through H
(on Disc)

APPENDIX A

SITE FIGURES

LIST OF FIGURES



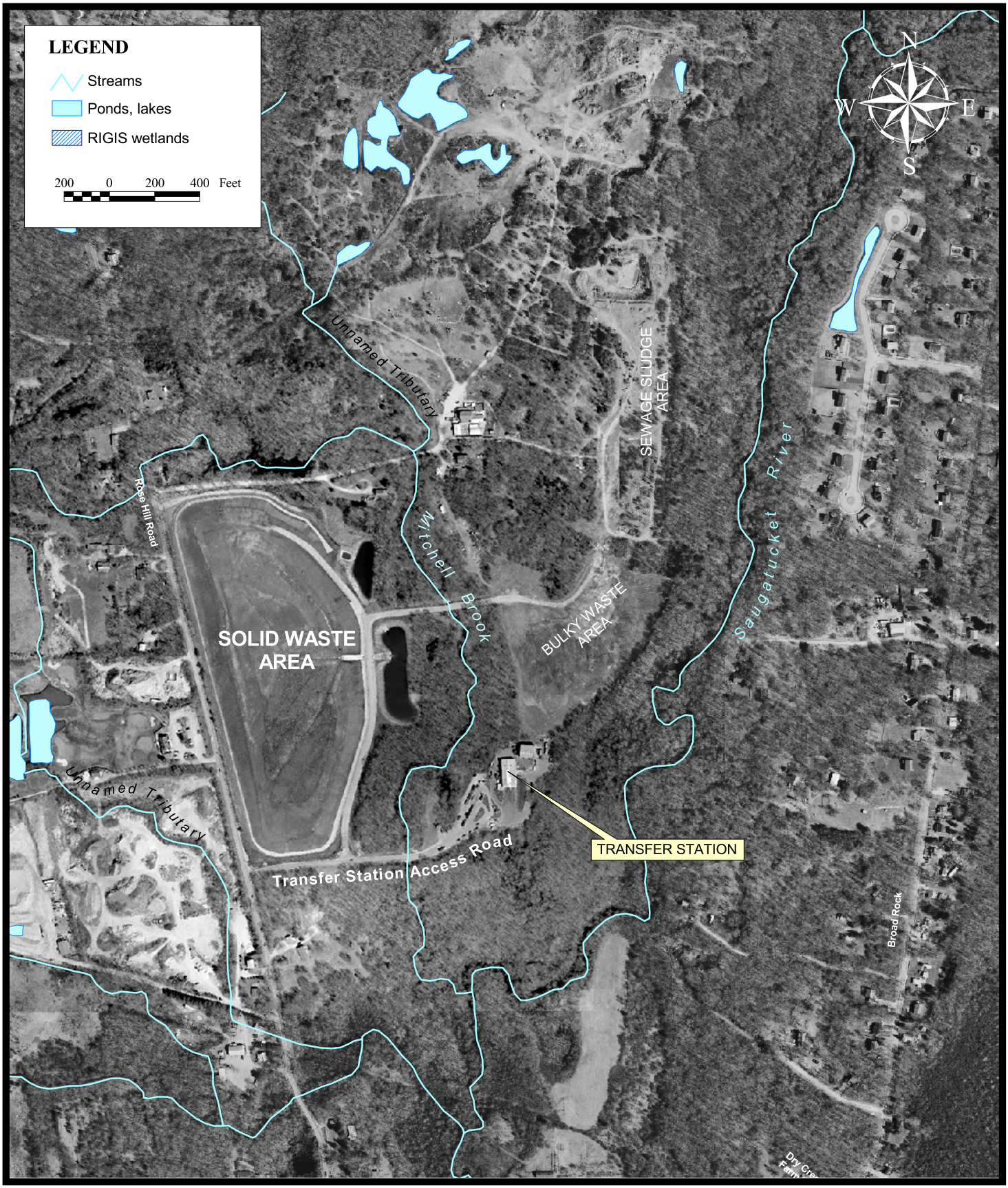
RI Department of Environmental Management

The Louis Berger Group, Inc.

Remedial Action - Rose Hill Landfill

Figure 1: SITE LOCATION MAP

Source: RIGIS, RIDEM, M&E | *5-y_Review.apr* | January 2010



RI Department of Environmental Management

The Louis Berger Group, Inc.

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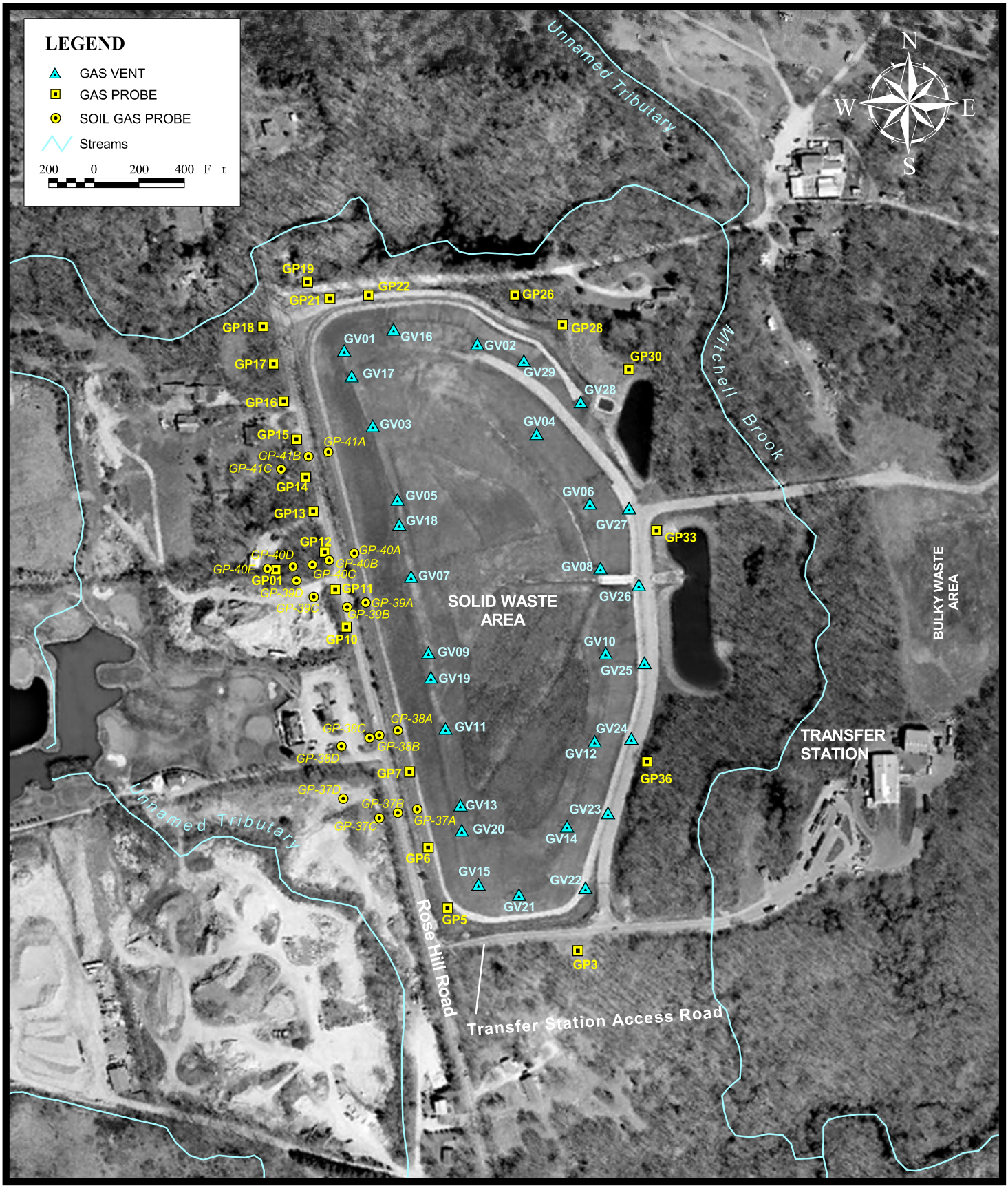
Figure 2: SITE AERIAL EXISTING FEATURES MAP

Source: RIGIS, RIDEM, M&E | 5 r | January 2010



RI Department of Environmental Management

The Louis Berger Group, Inc.

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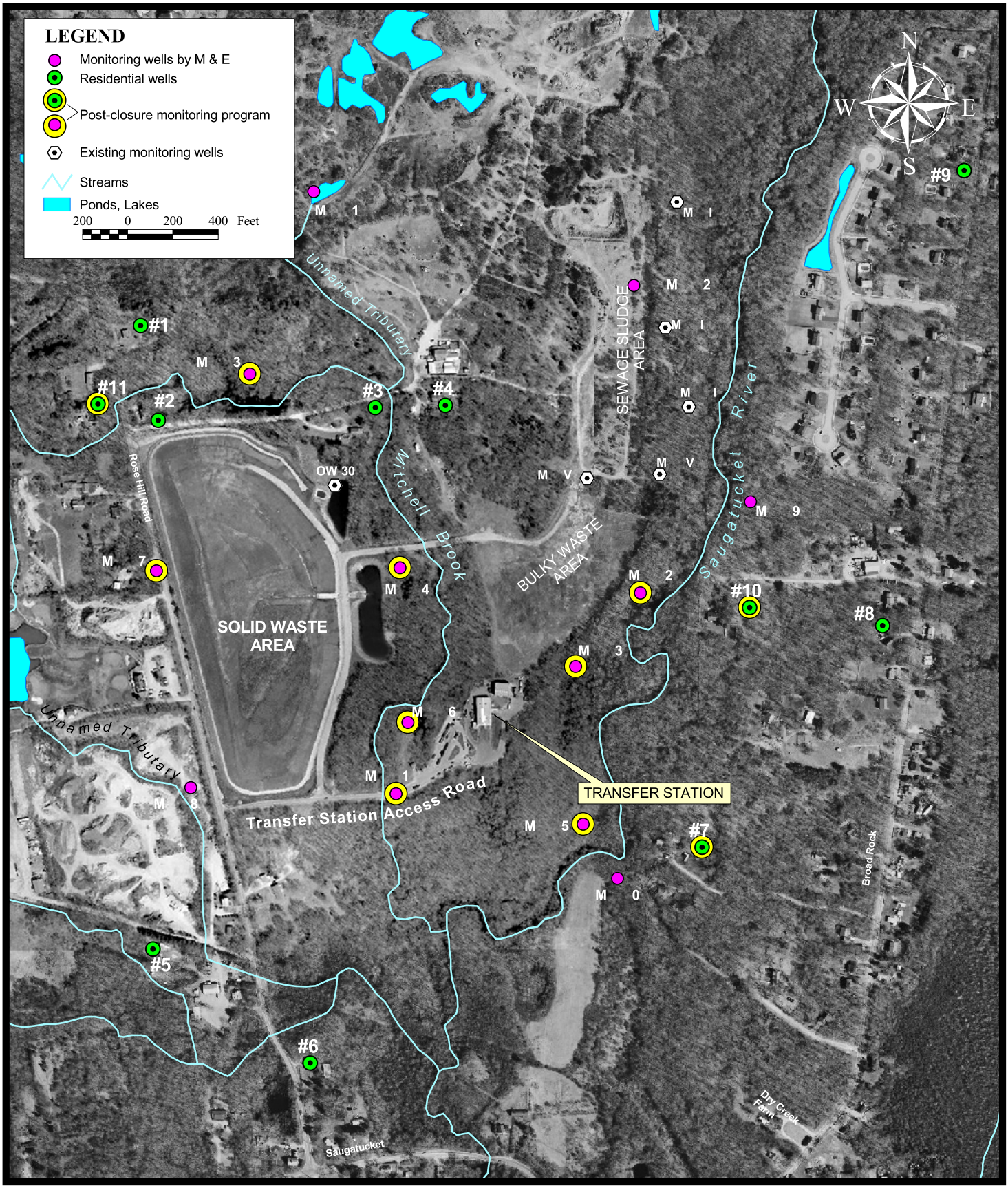
Figure 3: POST CLOSURE MONITORING PROGRAM LANDFILL GAS

Source: RIGIS, RIDEM, M&E | 5 r | January 2010



RI Department of Environmental Management

The Louis Berger Group, Inc.

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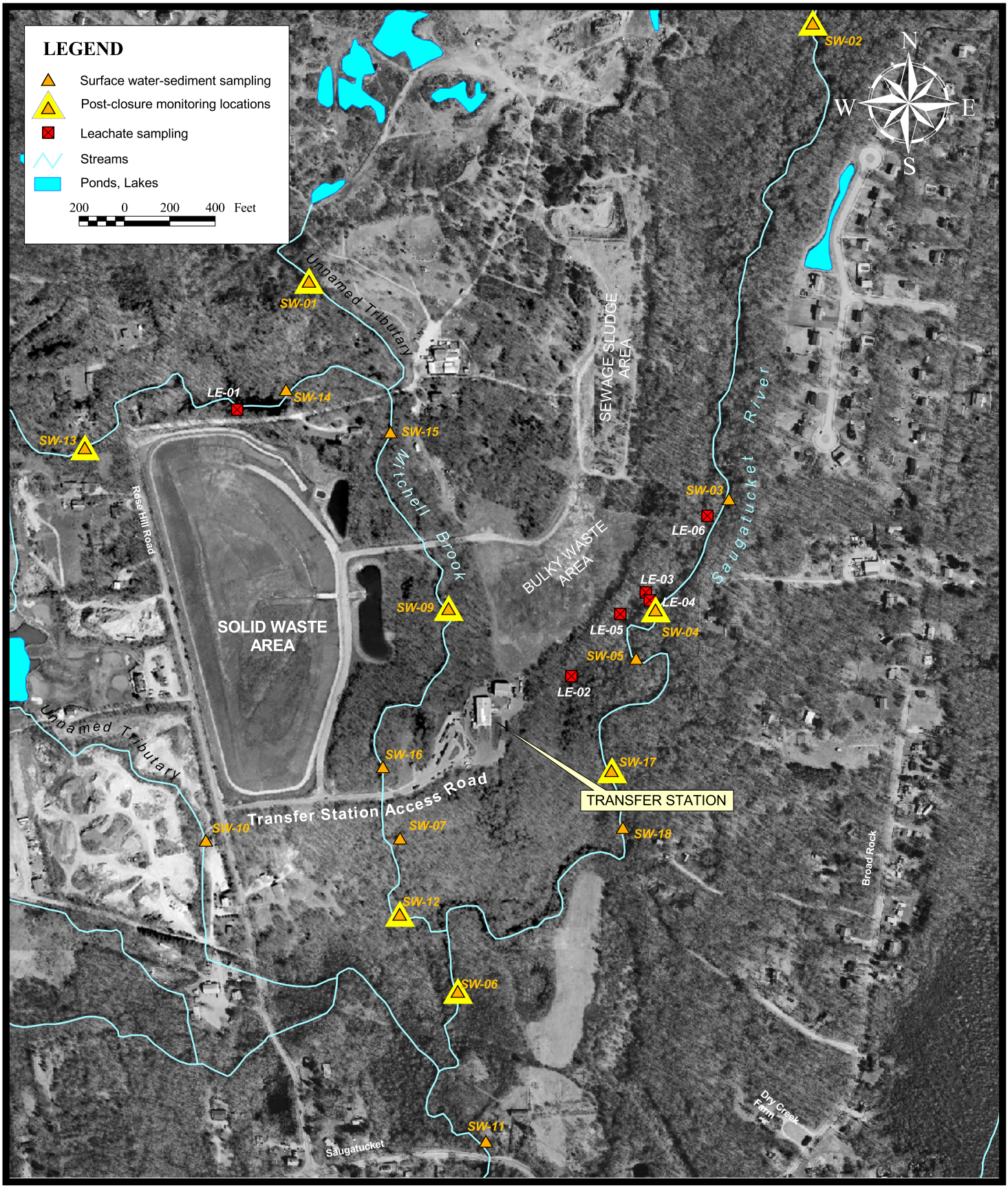
Figure 4: POST-CLOSURE MONITORING PROGRAM GROUNDWATER

Source: RIGIS, RIDEM, M&E | 5 r | January 2010



RI Department of Environmental Management

The Louis Berger Group, Inc.

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Figure 5: POST-CLOSURE MONITORING PROGRAM SURFACE WATER

Source: RIGIS, RIDEM, M&E | 5 r | January 2010

APPENDIX B

INTERVIEW LIST

LIST OF INTERVIEWS

Interview Record #1	**Interview with Towns of South Kingstown and Narragansett**
Interview Record #2	**Interview with Patricia Gagne, 349 Rose Hill Road**
Interview Record #3	**Interview with Cynthia Knight, 75 Pearls Way**
Interview Record #4	**Interview with Richard Frisella, 130 Pearls Way**
Interview Record #5	**Interview with Myron Duffin, 278 Rose Hill Road**
Interview Record #6	**Interview with David Webster, 938 Broad Rock Road**

INTERVIEW RECORD #1

Site Name: Rose Hill Landfill Superfund Site South Kingstown, RI	**EPA ID Number:** RID980521025
Type: Meeting	**Date:** February 10, 2010
Location of Visit: RIDEM Conference Room RIDEM/ OWM, Providence, RI	

CONTACT MADE BY:

See below.

INDIVIDUAL CONTACTED:

See below.

SUMMARY OF CONVERSATION:

Interview with representatives from the Towns of South Kingstown and Narragansett, RI
February 10, 2010

Attendees:

- Jon Schock, Public Services Director, Town of South Kingstown, RI
- Jeffry Ceasrine, Town Engineer, Town of Narragansett, RI
- Gary Jablonski, Principal Environmental Engineer, RIDEM
- David Newton, EPA Remedial Project Manager
- Christopher Feeney, Director of Environmental Engineering, Louis Berger Group, Inc.
- Clayton Carlisle, Senior Environmental Engineer, Louis Berger Group, Inc.

Notes:

Interview was held at RIDEM/OWM conference room.

1. Operations and Maintenance activities

Operation and Maintenance (O & M) activities performed by the Town to date include:

- cutting of vegetation in SWA (October 2009)
- removal of woody growth (October 2009)
- repair and backfilling of critter burrow holes in top of landfill cap (October 2009).
- maintenance/reporting of methane meters at two homes (on-going)

Potential future O&M activities over the long term may include:

- fence and Gate repair (as needed)
- access road rut repair (as needed)
- Occasional maintenance of downchute, swales, culverts, and pond spillway
- cutting of vegetation in SWA in the fall
- maintenance/reporting of methane meters at two homes (on-going)

The Town of South Kingstown does not see any changes pertaining to this list of activities to be performed except for the methane meters. The Town would like to see the meters removed from the homes in the future, pending results of the flare gas operation. Cutting vegetation in the SWA annually in the fall was discussed as being appropriate, as long as any woody growth is continually eliminated. The Town may also cut along the fence line to prevent vegetative growth from damaging the fence.

The Town has not encountered any difficulties or issues conducting current O&M efforts. Jon Schock said he was initially concerned with sideslope issues when cutting vegetation with the tractor mowers, but the work was performed last fall with no problems.

2. Municipal concerns with the OU-1 remedy

The Towns were asked if there are any municipal concerns, observations, or suggestions concerning the OU-1 remedy as presently implemented, as it affects the Town?

Jon Schock said that the Towns do not have any municipal concerns, observations, or suggestions concerning the OU-1 remedy as presently implemented.

Jon Schock also indicated that his concern with the gas flare skid, installed as part of the gas flare pilot study, did not have a remote alarm system. He also expressed concern with the exposure of the equipment to potential acts of vandalism.

Discussion was held that the system as presently installed is a pilot system and may not be utilized for long-term. The Town's concerns were acknowledged and would be addressed in the future if a gas flare system is desired for long-term use, specific to controls and vandal resistant enclosures.

3. Municipal concerns with the OU-1 remedy which may affect Town residents

The Towns were asked if there are any municipal concerns with the OU-1 remedy as presently implemented which could affect the residents of the Town (including those who live near the Site and those who do not)? Would the Town have any insight as to the residents' early perceptions pertaining to the construction/operation of the flare?

Jon Schock said the Town hopes that the implementation of active gas collection would eliminate the need for the methane meters which are presently installed in residential homes. Over the course of operating the methane meters, there have been some false alarms (possibly due to condensation). Methane data is digitally recorded and downloaded monthly by Town staff. The downloaded data is provided to a sub-contractor for the Town who is tasked with annual environmental reporting and

maintenance of the technical equipment.

Jon Schock also indicated that some residents had concerns over the amount of tree-cutting involved in implementing the remedy. He said very few complaints were received during the construction of both Phases I and II. Since the project completion, there have been only been two complaints related to the tree removal performed by National Grid on Rose Hill Road, but those types of complaints were received throughout the town for other areas as well.

Jon Schock reported that there have been no adverse comments for or against the implementation of the pilot gas flare program.

4. Potential Future Site Re-use(s)

The Town was asked if any further thought has been given into potential future site re-use(s) within the next five years.

Jon Schock indicated that no future re-use plans are in play, including the BWA, due to lack of local funding. Future use of the BWA may include development of multi-purpose fields for recreation. For short term, the BWA is targeted as a potential debris management site for emergency cleanup activities after hurricane destruction.

5. Future Physical or Operational Changes and Improvements to Town Owned Properties

The Town was asked if any physical or operational changes/improvements to Town owned properties (i.e. transfer station improvement/expansion, BWA use and value, SWA, roadways, fencing, etc.) within and/or immediately adjacent to the Site are anticipated.

Jon Schock said that the Town is planning future improvements to the transfer station and will be working with the private operator to increase the recycling and waste diversion rates for the Towns of South Kingstown and Narragansett. These improvements may include changes to existing buildings at the transfer station for municipal waste and recycling operations. The buildings and/or operations may expand further to the north into the treed area behind the waste station and recycling building. There are no anticipated changes to the roadway or site fencing.

Jon Schock also indicated that the Town has previously had some interest in working with phone service carriers for cellular repeating towers at the transfer station site, but nothing has come of it.

6. Changes in the use of the land at or near the Site

The Town was asked if there have been any changes in the use of the land at or near the Site, in terms of the use of groundwater, target populations or potential exposure routes.

Jon Schock said that there are no changes in the groundwater use. The Town continues to encourage anyone in the vicinity of the Site to use potable water at their residence. No residential developments are presently under review in the vicinity of the Site. No potential exposure routes have resulted based upon changes in the use of the land at or near the Site.

7. Protectiveness of the remedy

The Town indicated that there is not any new information that might call into question the protectiveness of the remedy.

8. Institutional ontrol

The Towns were asked about the status of Institutional Control (IC) implementation and schedule for the Site. Jon Schock indicated that the Town of South Kingstown was close to finishing language for IC for both public and private properties. The IC would reference the Rose Hill Landfill Superfund Site Phase II – Landfill Closure Record Drawings prepared by The Louis Berger Group, Inc. dated September 2008 (As-Built plans). Mylar copies of the drawings were received by the Town in February and will be filed by the Town for use in preparing titles for properties with IC. The Town has met with EPA to discuss the IC template and implementation of the IC. The Town has established a goal of mid-March 2010 for initiating deed restriction letters to private property owners.

The Town does not foresee any obstacles which may delay the implementation of the Institutional Controls within an acceptable time frame for overall protectiveness.

INTERVIEW RECORD #2

Site Name: Rose Hill Landfill Superfund Site South Kingstown, RI	**EPA ID Number:** RID980521025
Type: Telephone call	**Date:** March 1, 2010
Location of Visit: N/A	

CONTACT MADE BY:

Clayton Carlisle, Louis Berger Group, Inc.

INDIVIDUAL CONTACTED:

Patricia Gagne – 349 Rose Hill Road, Wakefield, RI

SUMMARY OF CONVERSATION:

Telephone conversation held on March 1, 2010.

Notes:

1. Do you have any personal concerns with the OU-1 remedy, as presently implemented, as it affects your residence or those of other residents of the Town (including those who live near the Site and those who do not)?

   Response: Ms. Gagne stated she has never been in favor of the cap project and is still opposed to it due to its visual impact and its impact to the wildlife. The cap took away the habitat of the wildlife. She stated that the cap is ugly. She does not dislike the fence, but still does not like the look of the landfill site now. She said that there were only seven houses on the perimeter of the landfill and all of those residents were opposed to the Superfund project right from the start.

2. Do you notice any landfill odors (distinguishable from transfer station operation) coming from the capped landfill site? If so, how frequently and how does this compare to odors you may have noticed prior to the installation of the cap?

   Response: Ms. Gagne has not detected any landfill odors since the cap has been completed. She noticed them frequently during the project construction.

3. The Town cut back vegetation and removed woody growth in the SWA last fall and expects to do this work annually. Are there any other O&M actions which you would suggest the Town would perform that may help with the current condition of the Site?

   Response: Ms. Gagne mentioned that she was very unhappy with the tree cutting performed on Rose Hill Road by National Grid and that she did not see any public notice

that this was going to take place.

4. Do you have any suggestions for the Town, the State or RIDEM regarding the physical or operational changes to the Site?

   Response: Ms. Gagne would like to see more vegetation planted, including trees and plants for the animals to feed from.

5. Do you have any suggestions for the Town for potential site re-uses?

   Response: Ms. Gagne suggests that the future area usage should have nothing which involves people. She would want to see open space uses and leave the BWA undisturbed for natural use by wildlife. She would not like to see ballfields or other recreation uses on the site.

6. Have you changed your use of your property in any way?

   Response: No changes to property use. She noted that her pond has orange tint to it which has been attributed over the years to an iron source from the landfill.

7. Have you altered the property (excavation, building construction, etc.)?

   Response: No alterations to property use.

8. Have you changed your use of the groundwater?

   Response: There is a groundwater well on the property but the Gagne's utilize town water. They don't use the groundwater, but she says it was always excellent water.

9. If you have a monitoring well or landfill gas monitoring probe on your property - are you aware of these and where they are located? Do you have any comments or suggestions concerning these structures? Do you have any comments or suggestions concerning the periodic monitoring?

   Response: Ms. Gagne indicated that she is aware of a monitoring well near the pond and the pet cemetery on her property, but does not believe that anyone uses it for testing or knows about its existence.

10. If you have a methane detector on your property - do you have any concerns, questions, comments, recommendations? What would your reaction be if the methane detector system was removed?

    Response: Ms. Gagne indicated that her methane detector has never gone off and that she would be fine if it was removed from her house.

INTERVIEW RECORD #3

Site Name: Rose Hill Landfill Superfund Site South Kingstown, RI	**EPA ID Number:** RID980521025
Type: Telephone call	**Date:** March 22, 2010
Location of Visit: N/A	

CONTACT MADE BY:

Clayton Carlisle, Louis Berger Group, Inc.

INDIVIDUAL CONTACTED:

Cynthia Knight – 75 Pearls Way, Wakefield, RI

SUMMARY OF CONVERSATION:

Telephone conversation held on March 22, 2010.

Notes:

1. Do you have any personal concerns with the OU-1 remedy, as presently implemented, as it affects your residence or those of other residents of the Town (including those who live near the Site and those who do not)?

   Response: Ms. Knight stated that she likes the way that the capped landfill looks and that the site does look better now that it is capped. She is happy that monitoring is continuing and performed regularly. She did mention having personal health issues in the past few months which have not been diagnosed thus far, but does not believe that it is related to the landfill or flare. Her primary concern is the location of the gas flare in relation to her house and its effect on her property value.

2. Do you notice any landfill odors (distinguishable from transfer station operation) coming from the capped landfill site? If so, how frequently and how does this compare to odors you may have noticed prior to the installation of the cap?

   Response: Ms. Knight has not detected any landfill odors since the cap has been completed. She noticed them during the project construction.

3. The Town cut back vegetation and removed woody growth in the SWA last fall and expects to do this work annually. Are there any other O&M actions which you would suggest the Town would perform that may help with the current condition of the Site?

   Response: Ms. Knight said that her biggest concern was the location of the gas flare. She would like to have screening trees installed between her house and the flare to screen the

flare from her view.

4. Do you have any suggestions for the Town, the State or RIDEM regarding the physical or operational changes to the Site?

   Response: Ms. Knight would like to see the flare moved to another location or at least screened from her house. She is very concerned about the impact on the value of her house and land with the flare in such close proximity to her house. She said she can see the flare and hear the flare and states that it is an eyesore looking out from her property.

5. Do you have any suggestions for the Town for potential site re-uses?

   Response: Ms. Knight did not mention any suggested potential site re-uses.

6. Have you changed your use of your property in any way?

   Response: No changes to property use. She had rented it out in previous years but is now back living in her home for nearly a year.

7. Have you altered the property (excavation, building construction, etc.)?

   Response: No alterations to property use.

8. Have you changed your use of the groundwater?

   Response: She uses Town water and does not have a groundwater well.

9. If you have a monitoring well or landfill gas monitoring probe on your property - are you aware of these and where they are located? Do you have any comments or suggestions concerning these structures? Do you have any comments or suggestions concerning the periodic monitoring?

   Response: Ms. Knight did not indicate that she was aware of any monitoring well or probes on her property.

10. If you have a methane detector on your property - do you have any concerns, questions, comments, recommendations? What would your reaction be if the methane detector system was removed?

    Response: Ms. Knight does not have a methane detector on her property.

INTERVIEW RECORD #4

Site Name: Rose Hill Landfill Superfund Site South Kingstown, RI	**EPA ID Number:** RID980521025
Type: Telephone call	**Date:** March 31, 2010
Location of Visit: N/A	

CONTACT MADE BY:

Clayton Carlisle, Louis Berger Group, Inc.

INDIVIDUAL CONTACTED:

Richard Frisella – 130 Pearls Way, Wakefield, RI

SUMMARY OF CONVERSATION:

Telephone conversation held on March 31, 2010.

Notes:

1. Do you have any personal concerns with the OU-1 remedy, as presently implemented, as it affects your residence or those of other residents of the Town (including those who live near the Site and those who do not)?

   Response: Mr. Frisella does not have any issues with the capped landfill. He said that the landfill looks good. He had questions about the gas flare, its location and how long it would stay in place.

2. Do you notice any landfill odors (distinguishable from transfer station operation) coming from the capped landfill site? If so, how frequently and how does this compare to odors you may have noticed prior to the installation of the cap?

   Response: Mr. Frisella has not detected any landfill odors since the cap has been completed. He said that he occasionally gets odors from the transfer station.

3. The Town cut back vegetation and removed woody growth in the SWA last fall and expects to do this work annually. Are there any other O&M actions which you would suggest the Town would perform that may help with the current condition of the Site?

   Response: Mr. Frisella did not have any O&M suggestions for the Town.

4. Do you have any suggestions for the Town, the State or RIDEM regarding the physical or operational changes to the Site?

   Response: Mr. Frisella did not have any operational changes that he would suggest to the Town or RIDEM. He did suggest that trees should be planted on the west side of the landfill

along Rose Hill Road to replace trees that were either removed or have died. He also noted that the tree work by National Grid cut back the remaining trees, making it even more important to add trees

5. Do you have any suggestions for the Town for potential site re-uses?

   Response: Mr. Frisella did not mention any suggested potential site re-uses. He said he is satisfied with the present setup at the site.

6. Have you changed your use of your property in any way?

   Response: No changes to property use.

7. Have you altered the property (excavation, building construction, etc.)?

   Response: No alterations to property use. He said that he maintains the gravel driveway on Pearls Way.

8. Have you changed your use of the groundwater?

   Response: He is on Town water. He also has an artesian well on his property which is used to provide washdown water for the kennels, but is not used for drinking by either humans or animals. He did say that the well water has been tested and was found to be acceptable.

9. If you have a monitoring well or landfill gas monitoring probe on your property - are you aware of these and where they are located? Do you have any comments or suggestions concerning these structures? Do you have any comments or suggestions concerning the periodic monitoring?

   Response: Mr. Frisella said that he is aware of monitoring wells on his property and knows the well locations. He does not have any problems with the monitoring program.

10. If you have a methane detector on your property - do you have any concerns, questions, comments, recommendations? What would your reaction be if the methane detector system was removed?

    Response: Mr. Frisella does not have a methane detector on his property.

INTERVIEW RECORD #5

Site Name: Rose Hill Landfill Superfund Site South Kingstown, RI	**EPA ID Number:** RID980521025
Type: Telephone call	**Date:** March 31, 2010
Location of Visit: N/A	

CONTACT MADE BY:

Clayton Carlisle, Louis Berger Group, Inc.

INDIVIDUAL CONTACTED:

Myron Duffin – 278 Rose Hill Road, Wakefield, RI

SUMMARY OF CONVERSATION:

Telephone conversation held on March 31, 2010.

Notes:

1. Do you have any personal concerns with the OU-1 remedy, as presently implemented, as it affects your residence or those of other residents of the Town (including those who live near the Site and those who do not)?

   Response: Mr. Duffin does not have any issues with the capped landfill. He said that heis OK with the project.

2. Do you notice any landfill odors (distinguishable from transfer station operation) coming from the capped landfill site? If so, how frequently and how does this compare to odors you may have noticed prior to the installation of the cap?

   Response: Mr. Duffin has not detected any landfill odors since the cap has been completed.

3. The Town cut back vegetation and removed woody growth in the SWA last fall and expects to do this work annually. Are there any other O&M actions which you would suggest the Town would perform that may help with the current condition of the Site?

   Response: Mr. Duffin did not have any O&M suggestions for the Town.

4. Do you have any suggestions for the Town, the State or RIDEM regarding the physical or operational changes to the Site?

   Response: Mr. Duffin did not have any operational changes that he would suggest to the Town or RIDEM. He did suggest that trees should be planted on the west side of the landfill along Rose Hill Road to replace trees that were either removed or have died. He said that the deep rooted trees that were along the east side of Rose Hill Road died over time and

believed it was caused by groundwater tainted from the landfill. He felt that new plantings would be able to survive better now that the landfill is capped.

5. Do you have any suggestions for the Town for potential site re-uses?

   Response: Mr. Duffin did not mention any suggested potential site re-uses.

6. Have you changed your use of your property in any way?

   Response: No changes to property use.

7. Have you altered the property (excavation, building construction, etc.)?

   Response: No alterations to property use.

8. Have you changed your use of the groundwater?

   Response: He is on Town water and does not have any wells on his property.

9. If you have a monitoring well or landfill gas monitoring probe on your property - are you aware of these and where they are located? Do you have any comments or suggestions concerning these structures? Do you have any comments or suggestions concerning the periodic monitoring?

   Response: Mr. Duffin said that he is aware of monitoring wells on his property and knows the well locations. He does not have any problems with the monitoring program.

10. If you have a methane detector on your property - do you have any concerns, questions, comments, recommendations? What would your reaction be if the methane detector system was removed?

    Response: Mr. Duffin has a methane detector in his basement. He said that the alarm only goes off when power is lost or returned back on at the house. He said that it did go off one time in the winter (did not say what year) when the ground was frozen during a very cold spell. He would be happy if the methane detector was removed from his house.

INTERVIEW RECORD #6

Site Name: Rose Hill Landfill Superfund Site South Kingstown, RI	**EPA ID Number:** RID980521025
Type: Telephone call	**Date:** April 1, 2010
Location of Visit: N/A	

CONTACT MADE BY:

Clayton Carlisle, Louis Berger Group, Inc.

INDIVIDUAL CONTACTED:

David Webster – 938 Broad Rock Road, Wakefield, RI

SUMMARY OF CONVERSATION:

Telephone conversation held on April 1, 2010.

Notes:

1. Do you have any personal concerns with the OU-1 remedy, as presently implemented, as it affects your residence or those of other residents of the Town (including those who live near the Site and those who do not)?

   Response: Mr. Webster does not have any issues with the capped landfill. His property is located to the east of the SSA and BWA, and he said that he is fine with the work performed in those areas also.

2. Do you notice any landfill odors (distinguishable from transfer station operation) coming from the capped landfill site? If so, how frequently and how does this compare to odors you may have noticed prior to the installation of the cap?

   Response: Mr. Webster has not detected any landfill odors. He said that he occasionally gets odors from the transfer station.

3. The Town cut back vegetation and removed woody growth in the SWA last fall and expects to do this work annually. Are there any other O&M actions which you would suggest the Town would perform that may help with the current condition of the Site?

   Response: Mr. Webster did not have any O&M suggestions for the Town.

4. Do you have any suggestions for the Town, the State or RIDEM regarding the physical or operational changes to the Site?

   Response: Mr. Webster did not have any operational changes that he would suggest to the

Town or RIDEM.

5. Do you have any suggestions for the Town for potential site re-uses?

   Response: Mr. Webster did not mention any suggested potential site re-uses. He said he would be concerned with any development taking place in the BWA which may impact his property or use of it. He would wait to see what is proposed before taking a position on it.

6. Have you changed your use of your property in any way?

   Response: No changes to property use.

7. Have you altered the property (excavation, building construction, etc.)?

   Response: No alterations to property use.

8. Have you changed your use of the groundwater?

   Response: His water is supplied from a private well located on his property.

9. If you have a monitoring well or landfill gas monitoring probe on your property - are you aware of these and where they are located? Do you have any comments or suggestions concerning these structures? Do you have any comments or suggestions concerning the periodic monitoring?

   Response: Mr. Webster said that his well is used for monitoring as part of the post-closure monitoring. He does not have any problems with the monitoring program.

10. If you have a methane detector on your property - do you have any concerns, questions, comments, recommendations? What would your reaction be if the methane detector system was removed?

    Response: Mr. Webster does not have a methane detector on his property.

APPENDIX C

COMMUNITY NOTIFICATION

LIST OF REMEDIAL ACTION PRESS RELEASES

Date	Issued By	Subject
5/10/2004	**RIDEM**	**Public meeting to present Landfill Cap Design**
5/13/2005	**RIDEM**	**Announcement of start of Phase I Construction Activities**
7/2005	**EPA**	**Site Reuse Profile, Rose Hill Regional Landfill Superfund Site**
10/19/2006	**RIDEM**	**Announcement of start of Phase II Landfill Capping Activities**
11/6/2007	**RIDEM**	**Announcement of completion of Phase II, Landfill Cap Construction**
6/3/2010	**EPA**	**Announcement of start of Five Year Review**

News Release

RI Department of Environmental Management
235 Promenade St., Providence, RI 02908
(401) 222-2771 TDD/(401) 222-4462 www.state.ri.us/dem

For Release: May 10, 2004

Contact: Gail Mastrati 222-4700 ext. 2402
Stephanie Powell 222-4700 ext. 4418

DEM TO HOLD PUBLIC MEETING MAY 20 TO PRESENT LANDFILL CAP DESIGN FOR FORMER ROSE HILL REGIONAL LANDFILL IN SOUTH KINGSTOWN

PROVIDENCE - The Department of Environmental Management, in cooperation with the United States Environmental Protection Agency, will hold a public meeting on Thursday, May 20 to present the remedial design for the Rose Hill Regional Landfill Superfund Site in South Kingstown. Information on results of field activities conducted last year at the site will also be presented.

Those field activities, conducted by an environmental consultant hired by and under the supervision of DEM, were required to complete the engineering design plans, and will also aid in identifying any potential future re-use of the site. The activities included test pits, monitoring, leachate sampling, residential well sampling, survey work, surface water and sediment sampling. Information from the work has been used to engineer the final design, now 90 percent complete, of the multi-layer hazardous waste cap.

The public meeting on May 20 will be held at 7 p.m. in the South Kingstown Town Council Chambers at 180 High Street in Wakefield. Additional public meetings will be held periodically during the remedial action to provide the community with updates on progress being made at the site, and to solicit public input on potential future uses of the site.

The 70-acre Rose Hill Regional Landfill Superfund Site is located in an abandoned sand and gravel quarry, which was used as a municipal landfill from 1967 to 1983. In additional to receiving municipal solid waste, industrial wastes from local industries were also disposed of at the site. Disposal of these wastes led to contamination of groundwater, surface water, and air in and around the site. The site was placed on EPA's Superfund National Priority List in 1989, and a Record of Decision outlining the proposed Remedial Action was signed in 1999.

Individuals with questions about the Rose Hill Regional Landfill Superfund Site may call or email Gary J. Jablonski in DEM's Office of Waste Management, at 222-2797 ext. 7148, or gjablons@dem.state.ri.us; or David Newton in EPA's Office of Site Remediation & Restoration, at (617) 918-1243, Toll Free at (888) 372-7341, or newton.dave@epa.gov; or Sarah White in EPA's Region 1 Office, at 617 918-1026, or white.sarah@epa.gov.

-30-

News Release

RI Department of Environmental Management
235 Promenade St., Providence, RI 02908
(401) 222-2771 TDD/(401) 222-4462 www.dem.ri.gov

For Release: May 13, 2005
Contact: Gail Mastrati 222-4700 ext. 2402
Stephanie Powell 222-4700 ext. 4418

DEM ANOUNCES START OF CONSTRUCTION ACTIVITIES AIMED AT CAPPING FORMER ROSE HILL REGIONAL LANDFILL IN SOUTH KINGSTOWN

PROVIDENCE - The Department of Environmental Management announces that construction activities that will culminate with capping the Rose Hill Regional Landfill Superfund Site in South Kingstown are expected to begin during the week of May 23.

Construction activities will be split into two phases, with all construction due to be completed by 2007. Phase I activities will include clearing and grubbing, consolidating waste, maintaining soil and sediment erosion controls, demolishing an onsite building, installing fencing, reinstalling a washed out culvert at the Mitchell Brook, relocating a six-inch water line to the transfer station, restoring the transfer station road, and preparing the landfill cap. Phase II activities will include restoring the bulky waste area, removing and blending soil from the sewage sludge area, restoring the two impacted wetland areas adjacent to Mitchell Brook, installing the landfill gas collection system, and constructing the multi-layer cap. Phase II of the project is expected to begin next spring.

The design for the landfill cap and field activities associated with the design were completed in December of 2004, at half the estimated $1.8 million originally projected. The Phase I contract, at $3.6 million, was awarded in April to the low bidder, Loureiro Contractors Inc. (LCI), of Plainville, CT, a construction company with experience in Superfund clean-ups both in Rhode Island and throughout New England. The company has done work at the Davis Liquid Superfund site in Smithfield, as well as at the Centredale Manor restoration project Superfund site in North Providence.

The 70-acre Rose Hill Regional Landfill Superfund site is located in an abandoned sand and gravel quarry, which was used as a municipal landfill from 1967 to 1983. In additional to municipal solid waste, industrial wastes from local industries were disposed of at the site. Disposal of those wastes led to contamination of groundwater, surface water, and air in and around the site. The site was placed on the Environmental Protection Agency's Superfund National Priority List in 1989, and a Record of Decision outlining the proposed remedial action was signed in 1999. Under terms of a settlement agreement, South Kingstown and Narragansett, as well the state and federal government, are providing funds for site remediation.

Those with questions about the site can call or email Gary J. Jablonski in DEM's Office of Waste Management, at 222-2797 ext. 7148, or via gary.jablonski@dem.ri.gov; or David Newton in EPA's Office of Site Remediation & Restoration, at (888) 372-7341, or via newton.dave@epa.gov.

United States Environmental Protection Agency New England

Site Reuse Profile

July 2005

Rose Hill Regional Landfill Superfund Site

South Kingstown, Rhode Island

Summary

The Rose Hill Regional Landfill Superfund Site (site), located in the rural Rhode Island town of South Kingstown, consists mostly of a closed municipal landfill that received domestic and industrial waste from 1967 to 1983. The landfill comprises two main areas: the Solid Waste Area (SWA) and the Bulky Waste Area (BWA). Under an agreement with South Kingstown, the adjacent town of Narragansett also cooperatively operated and brought waste to the landfill. Active waste disposal ceased when the landfill capacity was reached. South Kingstown currently operates a regional waste transfer facility immediately south of the former disposal areas.

The discovery that several private wells adjacent to the landfill were contaminated resulted in South Kingstown's extending municipal water lines to affected homes in 1985, as well as other actions by the town, state and EPA to investigate and address risks posed by site contamination. The site was placed on the Superfund National Priority List in October 1989. In December 1999, EPA selected a long-term remedy for the site that includes the consolidation of wastes, construction of a protective cover system, collection and treatment of landfill gas emissions, and management of leachate/storm water to minimize impacts to local water bodies. Long term monitoring and assessment of ground water and surface water will also be conducted.

Quick Facts

Location:	Rose Hill Road
Acreage:	52 acres
Parcels:	Three
Current Uses:	Closed town landfill, refuse transfer facility
Ownership:	Private/public
Zoning:	Governmental and Institutional ("GI")
Cleanup Status:	Ongoing remedial action
Surrounding Land Uses:	Residential and commercial

EPA and the state have been working closely with town officials from South Kingstown and Narragansett to consider future site reuse in the design and implementation of the cleanup. This coordination will help facilitate potential reuse and ensure the long-term protectiveness of the cleanup. Cleanup-related construction activities began in May 2005 and are expected to be completed in early 2007.

Reuse Status

During the time of disposal activities, the 27.7-acre SWA and the 9.4-acre BWA were under a long-term lease to the town of South Kingstown. Both properties were recently purchased by the town. South Kingstown acquired the 15-acre area being used for the waste transfer facility in 1983.

Waste consolidation at SWA (lime-based Posi-Shell™ is sprayed on piles to reduce odors)

To assess potential reuse options for the site, the towns of South Kingstown and Narragansett, in consultation with EPA and the Rhode Island Department of Environmental Management (RIDEM), prepared a report in November 2003 entitled, "Rose Hill Landfill Beneficial Reuse Study" (reuse study). A copy of the reuse study is available on-line at the EPA web site listed at the end of this document.

After considering a number of reuse scenarios, the reuse study recommended a recreation-based plan that could include the following elements: a golf driving range on the former SWA, multi-use fields on the former BWA, a dog exercise park, and nature trails. The reuse study notes that the proposed configuration is only conceptual and subject to future revision. The reuse study also recognizes that a final plan would need to go through South Kingstown's Capital Improvement Program budget process and obtain other municipal approvals.

Although the town has not formally committed to implementing the reuse study's recommendations, the information contained in that study has enabled the EPA and RIDEM to better anticipate future uses and assess whether the planned cleanup will safely support those uses. In addition, this information has been useful in identifying ways that the cleanup can be accomplished without creating unnecessary impediments to the proposed uses. For example, the preliminary design plans for the SWA containment system have been modified to greatly expand the footprint that could be used for a golf driving range. For the town to have made these changes to the SWA after the landfill closure was completed would have been very expensive and technically complex.

Other examples of how the reuse study recommendations were considered in the cleanup plans are:

- Landfill gas collection systems will be located to where they are less likely to interfere with the proposed uses, and where potential human exposure to these gases can be minimized.
- Best management practices (BMPs) will be employed to control storm water runoff (e.g., using "constructed wetlands" instead of traditional detention ponds). In addition to being more visually and functionally-compatible with the planned recreational use of the site, these BMP approaches are expected to more effectively manage the runoff.
- Site grading and engineering plans will allow for better-designed parking facilities and access roads.

EPA and the RIDEM will continue to coordinate with the towns on the cleanup and potential reuse activities, and to make appropriate accommodations when it can be done without compromising the safety of the cleanup or incurring unjustifiable additional costs. This includes ensuring that any site reuse will meet the remedial performance standards, including institutional controls concerning land use and the use, or alteration, of local groundwater.

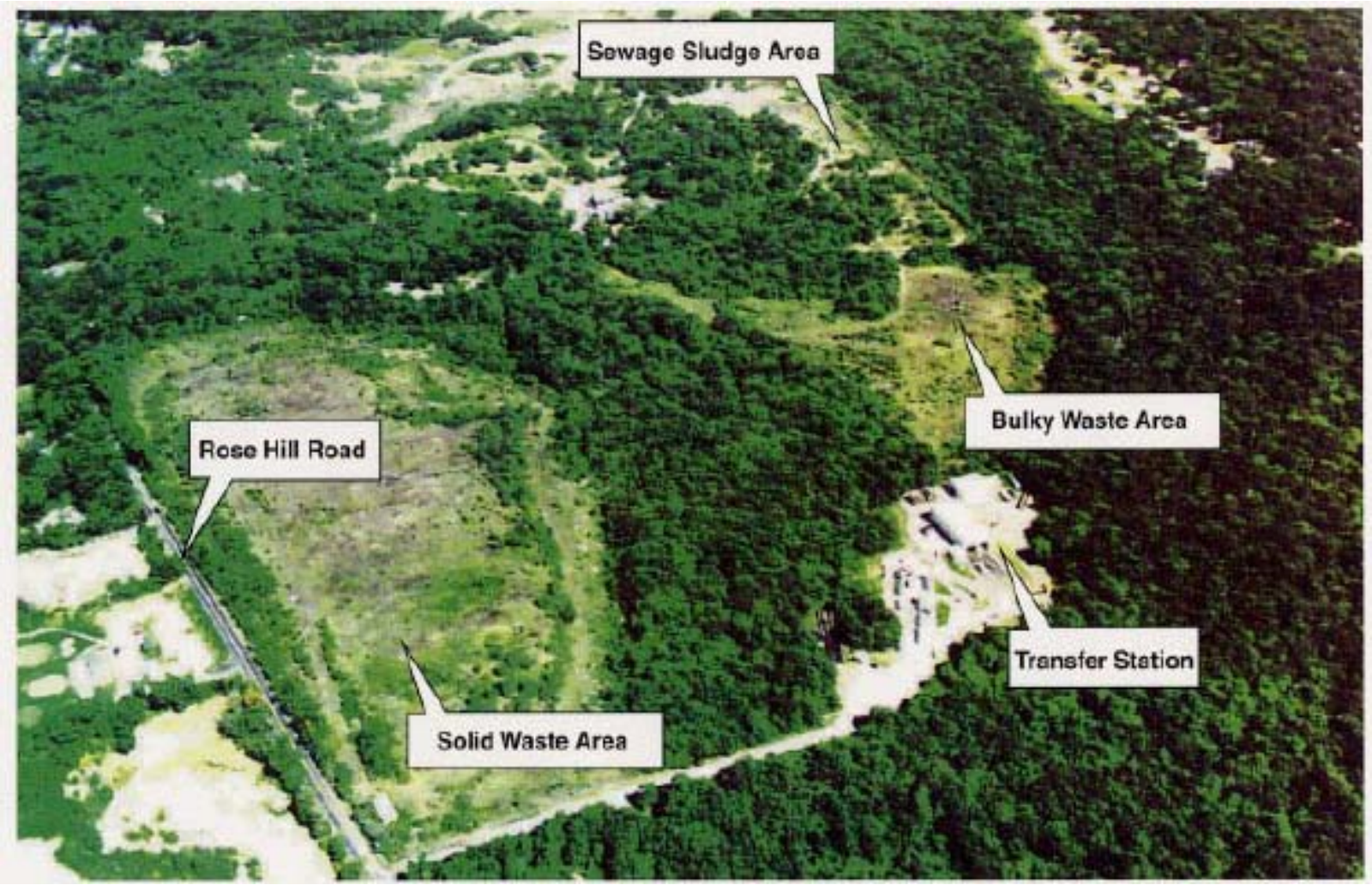
Site preparation for the future SWA "constructed wetlands" and stormwater retention system

Site Description

As described previously, both the SWA and BWA are no longer receiving waste and are not being actively used. The waste transfer facility is expected to continue operating into the foreseeable future. No disposal takes place at the waste transfer facility. Refuse is unloaded from collection trucks and transferred to vehicles that transport it off-site to a state-permitted landfill.

There are currently no buildings or structures on the SWA and BWA other than those associated with the operation, cleanup and monitoring of the landfills (e.g., drainage systems, gas vents, groundwater monitoring wells, fencing, etc.). Public utilities are available along Rose Hill Road and the waste transfer facility road. The SWA, BWA and waste transfer facility are zoned "GI" - governmental and institutional.

Primary vehicular access to the SWA is from Rose Hill Road to the west and the waste transfer facility road to the south. Access to the BWA is currently only from the SWA construction easement that crosses Mitchell Brook over a re-built culvert.



EPA Region 1, New England

Rose Hill Regional Landfill
South Kingstown, RI
Figure 1
Aerial Site Plan (from CDM Beneficial Reuse Study, 11/2003)

Mitchell Brook divides the SWA from the BWA and the waste transfer facility. The area immediately surrounding the brook is generally undeveloped woodland. A wetland area and the Saugatucket River are located just to the east of the BWA. A small section of the BWA that abuts the Saugatucket River lies within a wetland buffer zone established by RIDEM.

Adjacent land uses are primarily residential and commercial. Residences and a 9-hole executive golf course are located on the west side of Rose Hill Road, and an additional residence is adjacent to the northeast corner of the SWA. A large block of privately-owned land is located to the north. Although most of this property is undeveloped, the owner of the site conducts various businesses on the land that include: sport, target, and archery ranges; a kennel; and dog training. To the north of the BWA is a 9-acre area known as the Sewage Sludge Area (SSA), a state-regulated landfill that is not considered part of the Superfund site.

Key Events

***1967* – 1983**	Landfill in operation
1983	Town of South Kingstown purchases waste transfer facility property
1989	Site added to National Priority List
1990	EPA initiates Remedial Investigation/Feasibility Study
1993	Towns install gas sensors/alarms at nearby residences
1994	Towns install bentonite clay dam around water line at residence
1999	Record of Decision signed by EPA
January 2003	Consent Decree signed by EPA, RIDEM, towns of South Kingstown and Narragansett
November 2003	Town of South Kingstown and Narragansett complete reuse study
May 2005	Cleanup-related construction begins

Land use within one mile of the Site is predominantly agricultural and residential. An estimated 17,300 people obtain water from wells located within 3 miles of the site.

Environmental Summary

The contamination of nearby drinking water wells triggered further investigation of the landfill by EPA and the RIDEM, and led to the site being included on the federal Superfund National Priority List. In 1990, EPA initiated a Remedial Investigation (RI) to determine the nature and extent of contamination and to evaluate risks to human health and the environment. Early evaluations indicated that certain residences could be at risk from subsurface soil gases migrating laterally from the landfill. This prompted EPA to issue an order in March 1993 directing the towns of Narragansett and South Kingstown to install methane gas sensors/alarms at three nearby residences and a methane gas ventilation system in one of them. The gas sensors/alarms were installed at two of the

residences in May of that year. The residents of the third were relocated and the "Quonset Hut" style dwelling was razed by the town in June. Later in 1994, the towns also installed a bentonite clay dam around the water line at one of the residences to prevent landfill gases from entering the building.

The RI detected a wide array of contaminants in the landfill that included volatile and semi-volatile organics, pesticides, and metals, among others. It was also determined that contamination had migrated into the ground water, nearby surface waters, and landfill gases. A feasibility study (FS) was conducted to evaluate potential cleanup options. EPA's December 1999 Record of Decision outlined a phased approach for the final site cleanup that included the following major components: excavate and consolidate the BWA landfill materials into the SWA, collect and manage leachate and surface water collected from runoff and de-watering operations, construct a protective cover system over the consolidated materials in the SWA, implement institutional controls to restrict land and groundwater use, and collect and monitor landfill gases. Active treatment of the landfill gases may also be conducted depending on the monitoring results. The site will be monitored to assess the effectiveness of the implemented source control remedy in controlling contaminant migration to surface and ground waters. This information will also assist RIDEM in assessing the total mass daily load (TMDL) of contaminants contributing to the Saugatucket River and other local water bodies. Ammonia is one of the contaminants that resulted in the Saugatucket River being classified by RIDEM as an "impaired water body" under the Clean Water Act. If warranted, EPA and RIDEM plan to excavate composted sludge from the SSA and use it as a soil fertilizer/amendment for the SWA cover. By transferring this sludge from the SSA, it is hoped that the ammonia loading to the river can be reduced, adding to the overall water quality improvement within the watershed.

A Consent Decree signed in January 2003 by EPA, RIDEM, and the towns of South Kingstown and Narragansett outlines the terms of a settlement that, among other things, established responsibilities for designing and implementing the cleanup. The settlement also officially recognizes RIDEM as the lead agency for the remaining cleanup activities under this source control remedy.

For Additional Information

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EPA Public Affairs
Sarah White
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white.sarah@epa.gov

RIDEM Project Manager
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gjablons@dem.state.ri.us

EPA web site: http://www.epa.gov/region01/superfund/sites/rosehill

News Release

RI Department of Environmental Management
235 Promenade St., Providence, RI 02908
(401) 222-2771 TDD/(401) 222-4462 www.dem.ri.gov

For Release: October 19, 2006
Contact: Gail Mastrati 222-4700 ext. 2402
Stephanie Powell 222-4700 ext. 4418

DEM ANOUNCES START OF CONSTRUCTION ACTIVITIES AIMED AT CAPPING FORMER ROSE HILL REGIONAL LANDFILL IN SOUTH KINGSTOWN

PROVIDENCE - The Department of Environmental Management announces that final capping construction activities at capping the Rose Hill Regional Landfill Superfund Site in South Kingstown are expected to begin during the week of October 23.

Landfill cap construction was split into two phases, with all construction due to be completed by winter 2007. Phase I activities that were completed in spring 2006 included clearing and grubbing, consolidating waste from the bulky waste area and from under the road leading to the transfer station, maintaining soil and sediment erosion controls, razing a former weight scale building, reinstalling a damaged culvert at the Mitchell Brook, relocating a six-inch water line to the transfer station, restoring the transfer station road, and preparing the site for the installation of the landfill cap. In total, 243,000 cu/yards of waste material were consolidated. Phase II activities will include restoring the bulky waste area, removing and blending soil from the sewage sludge area, restoring two impacted wetland areas adjacent to Mitchell Brook, installing a landfill gas collection system, and constructing a multi-layer cap.

The design for the landfill cap and field activities associated with the design were completed in December of 2004. The Phase I construction contract was completed in the spring of 2006. The Phase II construction contract was awarded in September to the low bidder, E.T.&L Corporation, of Stow, MA, a construction company with experience in landfill construction both in Rhode Island and throughout New England.

The 70-acre Rose Hill Regional Landfill Superfund Site is located in an abandoned sand and gravel quarry, which was used as a municipal landfill from 1967 to 1983. In additional to municipal solid waste, industrial wastes from local industries were disposed of at the site. Disposal of those wastes led to contamination of groundwater, surface water, and air in and around the site. The site was placed on the Environmental Protection Agency's Superfund National Priority List in 1989, and a Record of Decision outlining the proposed remedial action was signed in 1999. Under terms of a settlement agreement, South Kingstown and Narragansett, as well the state and federal government, are providing funds for site remediation.

Those with questions about the site can call or email Gary J. Jablonski in DEM's Office of Waste Management, at 222-2797 ext. 7148, or via gary.jablonski@dem.ri.gov; or David Newton in EPA's Office of Site Remediation & Restoration, at (888) 372-7341, or via newton.dave@epa.gov.

News Release

RI Department of Environmental Management
235 Promenade St., Providence, RI 02908
(401) 222-2771 TDD/(401) 222-4462 www.dem.ri.gov

For Release: November 6, 2007

Contact: Gail Mastrati 222-4700 ext. 2402
Stephanie Powell 222-4700 ext. 4418

DEM, EPA, TOWNS OF SOUTH KINGSTOWN AND NARRAGANSETT MARK COMPLETION OF LANDFILL CAP CONSTRUCTION ACTIVITIES AT THE FORMER ROSE HILL REGIONAL LANDFILL IN SOUTH KINGSTOWN

PROVIDENCE - The Department of Environmental Management, in partnership with the US Environmental Protection Agency and the Towns of South Kingstown and Narragansett, today marked the completion of Phase II cap construction activities at the Rose Hill Regional Landfill Superfund Site in South Kingstown.

Located in an abandoned sand and gravel quarry, the 70-acre site was used as a municipal landfill from 1967 to 1983. Municipal solid waste and industrial waste from local industries were disposed of at the former regional landfill and led to contamination of groundwater, surface water, and air in and around the site. The site was placed on the Environmental Protection Agency's Superfund National Priority List in 1989, and a Record of Decision outlining the proposed remedial action was signed in 1999. The remediation project cost approximately $14.5 million, and was funded under a settlement agreement between the state, the U.S. EPA and the Towns of South Kingstown and Narragansett.

“Today marks a milestone in the four-year remediation project that was undertaken to protect public health and the environment from the ill-effects of the Rose Hill Regional Landfill,” said DEM Director W. Michael Sullivan, Ph.D. “In today’s challenging fiscal climate it’s important that government agencies find new and creative ways to use their resources, and this project is a sterling example of such an effort. Through efficient management and close oversight of this multi-million dollar remediation project, we kept the project under budget and saved the state and federal governments almost $4 million in costs.”

“Completion of the cap is a major milestone at Rose Hill," said Robert Varney, Regional Administrative, EPA Region 1. “EPA will continue to support DEM’s efforts, as the lead agency, to bring this cleanup project to its final phase.”

The landfill cap construction was split into two phases after the design for the landfill cap and field activities associated with the design were completed in December 2004. Phase I activities included clearing and grubbing, consolidating 243,000 cubic yards of waste material from the bulky waste area and from under the road leading to the transfer station, maintaining soil and

-more-

sediment erosion controls, razing a former weight scale building, reinstalling a damaged culvert at the Mitchell Brook, relocating a six-inch water line to the transfer station, restoring the transfer station road, and preparing the site for the installation of the landfill cap. This phase of the project was finished in spring 2006.

The phase II cap construction activities were completed two weeks ago. Associated work included restoration of the bulky waste area, removing and blending soil from the sewage sludge area, restoring two impacted wetland areas adjacent to Mitchell Brook, installing a landfill gas collection system, and constructing a multi-layer cap. Going forward, DEM will continue to monitor the site with groundwater, surface water, sediment, and landfill gas sampling to ensure that the remedy in place is meeting its objectives.

One of the major benefits of capping the landfill is that it will prevent further migration of a contaminated groundwater plume into Mitchell Brook and the Saugatucket River. In addition, the excavation, removal, and consolidation of the sewage sludge and bulky waste areas will lower the impacts of ammonia and iron and increase biodiversity in both Mitchell Brook and the Saugatucket River. Mitchell Brook flows along the lower western half of the Rose Hill Regional Landfill site and empties into the Saugatucket River. These two surface water bodies are listed as Class B waters, and as such, are designated for fish and wildlife habitat and for primary and secondary contact recreational activities.

For more information about the Rose Hill Regional Landfill Superfund site, call Gary J. Jablonski in DEM's Office of Waste Management at 222-2797 ext. 7148, or email him at gary.jablonski@dem.ri.gov; or contact David Newton in EPA's Office of Site Remediation & Restoration at (888) 372-7341, or via email at newton.dave@epa.gov. Information about the site is available on the EPA website at www.epa.gov/region01/superfund/sites/rosehill.

-30-

The United States Environmental Protection Agency Begins a Five Year Review Rose Hill Landfill Superfund site South Kingstown, Rhode Island

BOSTON- The United States Environmental Protection Agency is conducting a Five Year Review of the remedy for the Rose Hill Landfill Superfund Site in South Kingstown, Rhode Island. The purpose of the five year review is to ensure that the remedy has remained protective of human health and the environment. The Rose Hill site was placed on the Superfund National Priorities list in 1989 after EPA investigations at the site revealed high level of contamination in the soil and groundwater. Currently, the State of Rhode Island, under the Department of Environmental Management (RIDEM), has the lead in overseeing the work at the site.

During the five year review, EPA and RIDEM will:

1. Inspect the site, including the multi-layer cover over the solid waste landfill to ensure that it is preventing precipitation from entering into the landfill and limiting the leaching of contaminants into the groundwater and surface water;

2. Inspect and further assess the passive landfill gas (LFG) treatment system at the solid waste area to ensure that the system is operating effectively to prevent the migration of LFG contaminants;

3. Monitor concentrations of contaminants in the landfill gas, groundwater and surface water to ensure the remedy is effective;

4. Assess the progress in implementing institutional controls for land and groundwater use to prevent risk to human health;

When complete, a copy of EPA's Five Year Review Report, along with other technical documents, is made available for public review at the South Kingstown Public Library 1057 Kingstown Road, Peace Dale, RI. Library hours: Monday and Tuesday 9:30 am-8:00 pm; Wednesday and Thursday 9:00 am-6:00 pm; Friday and Saturday 9:00-5:00 pm; Sunday (winter hours) 1:00 pm -5:00 pm; by appointment at the EPA Records Center One Congress Street, Boston, MA 02203, hours: Monday-Friday; 9:00 am-5:00 pm; and by appointment at the RIDEM office in Providence.

For more information, please contact:

David Newton, EPA Project Manager
U.S. EPA Region 1 (HBO)
1 Congress Street, Suite 1100
Boston, MA 02114-2023
Phone: 617/918-1243 or toll free: 1/888-372-7341
e-mail: newton.dave@epamail.epa.gov

-or-

Gary Jablonski, State Project Manager
RIDEM-Office of Waste Management
235 Promenade Street
Providence, RI 02908
401/222-4700, ext 1748
Gary.Jablonski@dem.ri.gov

For further information, call Sarah White, EPA Superfund Community Involvement Coordinator toll free at 1/888-372-7341

APPENDIX D

SITE INSPECTION CHECKLIST

and

QUARTERLY SITE INSPECTION REPORTS

Site Inspection Checklist

I. SITE INFORMATION	
Site name: Rose Hill Regional Landfill	**Date of inspection: 3/29/10** **(for use in 1st Five Year Review)**
Location and Region: South Kingstown, RI	**EPA ID: RID980521025**
Agency, office, or company leading the five-year review: RIDEM	**Weather/temperature: Rain**

Remedy Includes: (Check all that apply)

- X Landfill cover/containment
- X Access controls
- X Institutional controls
- ☐ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- X Other --LFG monitoring and controls
- x Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Clayton Carlisle, Engineer—Louis Berger Group (for RIDEM) 3/29/10
   Name Title Date
   Interviewed x at site ☐ at office ☐ by phone Phone no. _401-521-1670_
   Problems, suggestions; ☐ Report attached _N/A_____

2. **O&M staff** _N/A_____
   Name Title Date
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached _____

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency USEPA Region 1
Contact David J. Newton Remedial Project Manager 3/29/10 617-918-1243
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _N/A _____

Agency RI Department of Environmental Management
Contact Gary Jablonski, Project Manager 3/29/10 401-222-4700 x7148
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _N/A_____

Agency Town of South Kingstown, Department of Public Srvs.
Contact Jon Schock Engineer 3/29/10 401-789-9331 ext 250
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _N/A_____

Agency _____
Contact _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _ _____

4. **Other interviews** (optional) ☐ Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
   - ☐ O&M manual — ☐ Readily available — ☐ Up to date — x N/A*
   - ☐ As-built drawings — ☐ Readily available — ☐ Up to date — x N/A*
   - ☐ Maintenance logs — ☐ Readily available — ☐ Up to date — x N/A*

   Remarks * No documents are maintained on-site. All pertinent documents are maintained at the RIDEM Office, 235 Promenade St. providence RI and/or at local site repository—readily available upon request and up to date.

2. **Site-Specific Health and Safety Plan** ☐ Readily available ☐ Up to date ☐ N/A
   ☐ Contingency plan/emergency response plan ☐ Readily available ☐ Up to date ☐ N/A
   Remarks__(See above)_____

3. **O&M and OSHA Training Records** ☐ Readily available ☐ Up to date ☐ N/A
   Remarks__(See above)_____

4. **Permits and Service Agreements**
   - ☐ Air discharge permit — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Effluent discharge — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Waste disposal, POTW — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Other permits_____ — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks___(see above)_____

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☐ N/A
   Remarks__(See above)_____

6. **Settlement Monument Records** ☐ Readily available ☐ Up to date ☐ N/A
   Remarks__(See above)_____

7. **Groundwater Monitoring Records** ☐ Readily available ☐ Up to date ☐ N/A
   Remarks__(See above)_____

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date ☐ N/A
   Remarks__(see above)_____

9. **Discharge Compliance Records**
   - ☐ Air — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Water (effluent) — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks__(See above)_____

10. **Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☐ N/A
    Remarks___(N/A)_____

IV. O&M COSTS

1. **O&M Organization**

X State in-house — x Contractor for State
☐ PRP in-house — ☐ Contractor for PRP
☐ Federal Facility in-house — ☐ Contractor for Federal Facility
☐ Other_____

2. **O&M Cost Records**

X Readily available — x Up to date
X Funding mechanism/agreement in place
Original O&M cost estimate_$6,680,000 (net present worth-see ROD)_ ☐ Breakdown attached

Total annual cost by year for review period if available --NOT AVAILABLE-still under evaluation (see below)

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: Landfill Gas Flare Pilot Study -on going; assessing use of enclosed flare to treat LFG. Annual operations and maintenance budget for the Rose Hill Landfill operating with a passive gas system was estimated at $166,000 per year. A cost estimate for the annual operations and maintenance budget operated as an active landfill gas system is anticipated to be approximately $466,000 per year. (see Post Closure Operations and Maintenance Plan, Final Report, 02/08)

V. ACCESS AND INSTITUTIONAL CONTROLS ☐ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☐ N/A

Remarks___No critical damage reducing functionality

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A

Remarks Town of South Kingstown working to secure ICs (see section 6.6 of this report)

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented x Yes ☐ No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) _3/29/10 _____
Frequency _N/A_____
Responsible party/agency Town of South Kingstown_____
Contact Jon Schock_____ _Town Engineer_____ 3/29/10_401-789-9331 ext 250
Name Title Date Phone no.

Reporting is up-to-date x Yes ☐ No ☐ N/A
Reports are verified by the lead agency x Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☐ Yes x No ☐ N/A
Violations have been reported ☐ Yes ☐ No x N/A
Other problems or suggestions: ☐ Report attached
ICs not fully implemented but progress being made (see Section 6.6 of this report)

2. **Adequacy** ☐ ICs are adequate x ICs are inadequate ☐ N/A
Remarks__(see above)

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map x No vandalism evident
Remarks_____

2. **Land use changes on site** x N/A
Remarks_____

3. **Land use changes off site** x N/A
Remarks_____

VI. GENERAL SITE CONDITIONS

A. Roads x Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map x Roads adequate ☐ N/A
Remarks_____

B. Other Site Conditions

Remarks _(see site inspection reports in Appendix D)

VII. LANDFILL COVERS ☐ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map x Settlement not evident
Areal extent_____ Depth_____
Remarks_settlement is minor to non-existent. Areas where issues were found have been repaired prior to inspection and are being monitored qtrly

2. **Cracks** ☐ Location shown on site map x Cracking not evident
Lengths_____ Widths_____ Depths_____
Remarks_____

3. **Erosion** ☐ Location shown on site map x Erosion not evident
Areal extent_____ Depth_____
Remarks__ erosion is minor to non-existent. Areas where issues were found have been repaired prior to inspection and are being monitored qtrly

4. **Holes** ☐ Location shown on site map x Holes not evident
Areal extent_____ Depth_____
Remarks_burrowing animals--minor issues were repaired and monitoing is ongoing._____

5. **Vegetative Cover** ☐ Grass x Cover properly established ☐ No signs of stress
☐ Trees/Shrubs (indicate size and locations on a diagram)
Remarks_____

6. **Alternative Cover (armored rock, concrete, etc.)** ☐ N/A
Remarks_No issues

7. **Bulges** ☐ Location shown on site map x Bulges not evident
Areal extent_____ Height_____
Remarks_____

8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent_____
☐ Ponding ☐ Location shown on site map Areal extent_____
☐ Seeps ☐ Location shown on site map Areal extent_____
☐ Soft subgrade ☐ Location shown on site map Areal extent_____
Remarks____N/A_____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map x No evidence of slope instability
Areal extent_____
Remarks_____

B. Benches ☐ Applicable x N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** ☐ Location shown on site map x N/A or okay
Remarks_____

2. **Bench Breached** ☐ Location shown on site map x N/A or okay
Remarks_____

3. **Bench Overtopped** ☐ Location shown on site map x N/A or okay
Remarks_____

C. Letdown Channels x Applicable ☐ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** ☐ Location shown on site map x No evidence of settlement
Areal extent_____ Depth_____
Remarks_____

2. **Material Degradation** ☐ Location shown on site map x No evidence of degradation
Material type_____ Areal extent_____
Remarks_____

3. **Erosion** ☐ Location shown on site map x No evidence of erosion
Areal extent_____ Depth_____
Remarks_____

4. **Undercutting** ☐ Location shown on site map x No evidence of undercutting
Areal extent_____ Depth_____
Remarks_____

5. **Obstructions** Type_____ x No obstructions
☐ Location shown on site map Areal extent_____
Size_____
Remarks_____

6. **Excessive Vegetative Growth** Type_____
X No evidence of excessive growth
☐ Vegetation in channels does not obstruct flow
☐ Location shown on site map Areal extent_____
Remarks_____

D. Cover Penetrations x Applicable ☐ N/A

1. **Gas Vents** x Active x Passive
x Properly secured/locked x Functioning x Routinely sampled x Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance
☐ N/A
Remarks currently in pilot study for active LFG collection/treatment

2. **Gas Monitoring Probes**
X Properly secured/locked x Functioning x Routinely sampled x Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____

3. **Monitoring Wells** (within surface area of landfill)
X Properly secured/locked x Functioning x Routinely sampled x Good condition
X Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_mw-03 is artesian during certain times of the year. Leakage around protective casing is noted

4. **Leachate Extraction Wells**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance x N/A
Remarks_____

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed x N/A
Remarks_____

E. Gas Collection and Treatment x Applicable ☐ N/A

1. **Gas Treatment Facilities**
   x Flaring ☐ Thermal destruction ☐ Collection for reuse
   x Good condition ☐ Needs Maintenance
   Remarks___enclosed_____

2. **Gas Collection Wells, Manifolds and Piping**
   x Good condition ☐ Needs Maintenance
   Remarks_____

3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings)
   X Good condition ☐ Needs Maintenance ☐ N/A
   Remarks_____

F. Cover Drainage Layer x Applicable ☐ N/A

1. **Outlet Pipes Inspected** x Functioning ☐ N/A
   Remarks_____

2. **Outlet Rock Inspected** x Functioning ☐ N/A
   Remarks_____

G. Detention/Sedimentation Ponds x Applicable ☐ N/A

1. **Siltation** Areal extent_____ Depth_____ ☐ N/A
   X Siltation not evident
   Remarks minor, and monitored/observed periodically_____

2. **Erosion** Areal extent_____ Depth_____
   X Erosion not evident
   Remarks_____

3. **Outlet Works** x Functioning ☐ N/A
   Remarks_____

4. **Dam** x Functioning N/A
   Remarks__flow check dam only

H. Retaining Walls ☐ Applicable x N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident
   Horizontal displacement_____ Vertical displacement_____
   Rotational displacement_____
   Remarks_____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident
   Remarks_____

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☐ N/A

1. **Siltation** ☐ Location shown on site map x Siltation not evident
   Areal extent_____ Depth_____
   Remarks__minor to non existent; monitored and observed qrtly.

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
   X Vegetation does not impede flow
   Areal extent_____ Type_____
   Remarks_____

3. **Erosion** ☐ Location shown on site map x Erosion not evident
   Areal extent_____ Depth_____
   Remarks_old channel flow scar not apparently due to site construction.; south pond area is monitored

4. **Discharge Structure** x Functioning ☐ N/A
   Remarks_____

VIII. VERTICAL BARRIER WALLS ☐ Applicable x N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
   Areal extent_____ Depth_____
   Remarks_____

2. **Performance Monitoring** Type of monitoring_____
   ☐ Performance not monitored
   Frequency_____ ☐ Evidence of breaching
   Head differential_____
   Remarks_____

C. Treatment System ☐ Applicable x N/A

1. **Treatment Train** (Check components that apply)
   ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
   ☐ Air stripping ☐ Carbon adsorbers
   ☐ Filters_____
   ☐ Additive (*e.g.*, chelation agent, flocculent)_____
   ☐ Others_____
   ☐ Good condition ☐ Needs Maintenance
   ☐ Sampling ports properly marked and functional
   ☐ Sampling/maintenance log displayed and up to date ☐ Equipment properly identified
   ☐ Quantity of groundwater treated annually_____
   ☐ Quantity of surface water treated annually_____
   Remarks_____

2. **Electrical Enclosures and Panels** (properly rated and functional)
   ☐ N/A ☐ Good condition ☐ Needs Maintenance
   Remarks_____

3. **Tanks, Vaults, Storage Vessels**
   ☐ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
   Remarks_____

4. **Discharge Structure and Appurtenances**
   ☐ N/A ☐ Good condition ☐ Needs Maintenance
   Remarks_____

5. **Treatment Building(s)**
   ☐ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair
   ☐ Chemicals and equipment properly stored
   Remarks_____

6. **Monitoring Wells** (pump and treatment remedy)
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ All required wells located ☐ Needs Maintenance ☐ N/A
   Remarks_____

D. Monitoring Data

1. Monitoring Data
   X Is routinely submitted on time x Is of acceptable quality

2. Monitoring data suggests:
   x Groundwater plume is effectively contained x Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
   X Properly secured/locked x Functioning x Routinely sampled x Good condition
   ☐ All required wells located ☐ Needs Maintenance ☐ N/A
   Remarks_____

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

The ROD called for consolidation of the Bulky Waste Area onto the Solid Waste Area, containment via a protective cap, leachate collection (during consolidation), and landfill gas treatment (Solid Waste Area). All aspects of construction is complete. Currently the State is conducting a pilot study for active LFG collection and treatment at the Solid waste Area (post cap). Passive gas vents were designed and constructed to allow for this treatment option. Operation and maintenance of the remedy, including routine monitoring has indicated that the remedy is effective and functioning as designed.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Current O&M procedures are discussed in detail in the "Post-closure Operations and Maintenance Plan", February 2008. Aspects of the plan include operations and anticipated use of areas, access, security, contingency procedures, maintenance responsibilities, evaluation and assessment of landfill components, monitoring and periodic inspections, record keeping and reporting, and monitoring well maintenance. Responsibilities for implementing this plan are shared with the Town of South Kingstown, the supervising contractor responsible for environmental engineering, and RIDEM. On whole, the elements of the plan provide a written commitment to inspect and monitor the site to assure that the remedy provides current and long-term protectiveness.

C.	Early Indicators of Potential Remedy Problems
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. None

D.	Opportunities for Optimization
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. To be determined

LIST OF SITE INSPECTION REPORTS

2008

January 8, 2008

February 14, 2008

April 29, 2008

December 15, 2008

2009

March 12, 2009

June 11, 2009

September 24, 2009

2010

January 14, 2010

April 1, 2010

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

DATE OF INSPECTION: January 8, 2008

WEATHER CONDITIONS: Fair, 45 °F

INSPECTION PERFORMED BY: Clayton Carlisle

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
General Site Inspection						
General Site Conditions	*Illegal waste disposal on-site, litter, vegetative cover needs mowing*	No problems observed, site OK.	X		None	
Site Access	*Difficult access, damage to roadways, fences or gates*	No problems observed, site access OK.	X		None	
Sampling and monitoring ports	*Damaged, plugged, broken locks*	Did not check.	X		None	
Site Vegetation	*Damage to planted trees or shrubs, wetlands plants not surviving*	No problems observed, vegetation OK.	X		None	
Landfill Gas Venting System	*Damaged*	Did not check.	X		None	
Landfill Cover System Inspection						
Landfill Cap	*Ponding or poor drainage due to settlement, erosion rills in cover soil, loss of vegetative cover, cracking of cover soil (over 3" deep)*	Minor rills(4" depth max.) observed forming in two locations: center swale and northeast swale. Rills start, but are not continous to the downchute.	X		None required at this time. Rills should be inspected at a later date to see if any additional erosion takes place, and if so, action should be taken at that time to fill the rills back in and reseed.	
Drainage Structures	*Undercutting at downchute, siltation or vegetation needs to be removed from drainage channels or ponds, flow obstructions, riprap needs more stone cover, concrete blocks in ACB mats damaged or broken*	No problems observed, drainage structures OK.	X		None	

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

TODAY'S DATE: **WEATHER CONDITIONS:** **INSPECTION DONE BY:**

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
Landfill Slopes						
General Site Conditions	*Rills formed on slopes, erosion*	No problems observed, landfill slopes	**X**		None	
Roadways, fences and gates						
General Site Conditions	*Potholes, ruts, broken fence or gate sections*	No problems observed, roads and fences OK.	**X**		None	
Downchute, drainage channels and retention ponds OK.						
General Site Conditions	*Cracking in concrete downchute mats, erosion, silt, sedimentation in ponds*	No problems observed, drainage features OK.	**X**		None	
Landfill Gas Venting System						
General Site Conditions		No problems observed, landfill gas venting system OK.	**X**		None	

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

DATE OF INSPECTION: February 14, 2008

WEATHER CONDITIONS: Fair, 45 °F

INSPECTION PERFORMED BY: Clayton Carlisle

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
General Site Inspection						
General Site Conditions	*Illegal waste disposal on-site, litter, vegetative cover needs mowing*	No problems observed, site OK.	X		None	
Site Access	*Difficult access, damage to roadways, fences or gates*	No problems observed, site access OK.	X		None	
Sampling and monitoring ports	*Damaged, plugged, broken locks*	Did not check.	X		None	
Site Vegetation	*Damage to planted trees or shrubs, wetlands plants not surviving*	No problems observed, vegetation OK.	X		None	
Landfill Gas Venting System	*Damaged*	Did not check.	X		None	
Landfill Cover System Inspection						
Landfill Cap	*Ponding or poor drainage due to settlement, erosion rills in cover soil, loss of vegetative cover, cracking of cover soil (over 3" deep)*	Minor rills(4"- 8" depth max.) observed in last month's inspection are getting larger. Rills are found in two locations: center swale and northeast swale. Rills start, but are not continous to the downchute. Rills are not washouts, but will need to be repaired to prevent further erosion damage.		X	None required at this time. Rills should be inspected at a later date to see if any additional erosion takes place, and if so, action should be taken at that time to fill the rills back in and reseed.	
Drainage Structures	*Undercutting at downchute, siltation or vegetation needs to be removed from drainage channels or ponds, flow obstructions, riprap needs more stone cover, concrete blocks in ACB mats damaged or broken*	See comment on Downchute page 2. All other drainage structures look good.		X	Downchute settlement needs to be investigated further to determine if acceptable.	

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
Landfill Slopes						
General Site Conditions	*Rills formed on slopes, erosion*	No problems observed, landfill slopes	**X**		None	
Roadways, fences and gates						
General Site Conditions	*Potholes, ruts, broken fence or gate sections*	No problems observed, roads and fences OK.	**X**		None	

OK.

Downchute, drainage channels and retention ponds						
General Site Conditions	*Cracking in concrete downchute mats, erosion, silt, sedimentation in ponds*	Downchute has settled in the center from about 10' below the top down to about 15' before the bottom. The width is about 6' +/- across. The concrete grouting has broken away, mats have dropped due to lower subsurface elevation. Settlement generally follows geometric contour of DC. Runoff flow steady from underdrain piping at the top. No flow appeared to be coming from anywhere else on top. Flow is still centered in middle of DC at top. Flow travels on mat surface until halfway down the DC, where it drops beneath ACB mats. Appears to come out at bottom of DC near South swale intersection with DC. No "trampoline effect" detected for mats, but some blocks are not fully supported where DC goes from original subsurface support material intact to washed out subsurface, in a crossing direction across DC. Bottom of DC in good shape, no settlement or undermining. All flow still travels into box culvert. Culvert has some gray sedimentation buildup, likely from the VSL that is washed away from beneath DC. Forebay also has grayish silt collected, but not full.		**X**	Downchute settlement needs to be investigated further to determine if acceptable.	
Landfill Gas Venting System						
General Site Conditions		No problems observed, landfill gas venting system OK.	**X**		None	

View of Downchute from bottom. 2/14/08

View of Downchute from top. 2/14/08

View of Downchute at toe on south side next to swale. 2/14/08

View of Downchute near toe on south edge. 2/14/08

View of Downchute near lower-middle section on south edge. 2/14/08

View of Downchute near lower mid-section on south edge. 2/14/08

View of Downchute at riprap entry along top. 2/14/08

View of Downchute at underdrain piping and rain flap liner. 2/14/0

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

DATE OF INSPECTION: April 29, 2008

WEATHER CONDITIONS: Light drizzle, 45 °F

INSPECTION PERFORMED BY: Clayton Carlisle

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
General Site Inspection						
General Site Conditions	*Illegal waste disposal on-site, litter, vegetative cover needs mowing*	No problems observed, site OK.	X		None	
Site Access	*Difficult access, damage to roadways, fences or gates*	No problems observed, site access OK.	X		None	
Sampling and monitoring ports	*Damaged, plugged, broken locks*	Everything in satisfactory condition.	X		None	
Site Vegetation	*Damage to planted trees or shrubs, wetlands plants not surviving*	Observed plants starting to bud. Some plants have no buds, but may be too early for buds on certain species. Observed plants that do not appear healthy or that have been uprooted. Grass planted OK.	X		None	
Landfill Gas Venting System	*Damaged*	Everything in satisfactory condition.	X		None	
Landfill Cover System Inspection						
Landfill Cap	*Ponding or poor drainage due to settlement, erosion rills in cover soil, loss of vegetative cover, cracking of cover soil (over 3" deep)*	Same issues as previous 2/14/08 inspection: Minor rills (now 8"- 12" depth max.) observed in last month's inspection are getting larger. Rills are found in two locations: center swale and northeast swale. Rills start, but are not continous to the downchute. Rills are not washouts, but will need to be repaired to prevent further		X	None required at this time. Contractor to repair washouts and rills formed on site, as discussed at 2/25/08 site meeting.	
Drainage Structures	*Undercutting at downchute, siltation or vegetation needs to be removed from drainage channels or ponds, flow obstructions, riprap needs more stone cover, concrete blocks in ACB mats damaged or broken*	See comments on Downchute page 2. All other drainage structures look good.		X	Downchute repair discussed by all parties on 2/25/08, plan of action determined and anticipated to be implemented before end of May 2008.	

erosion damage.

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
Landfill Slopes						
General Site Conditions	*Rills formed on slopes, erosion*	No problems observed, landfill slopes OK.	**X**		None	
		Rills found on some slopes of pond edges, may cause plants uprooting.		**X**	Contractor to repair rills formed on pond slopes.	
Roadways, fences and gates						
General Site Conditions	*Potholes, ruts, broken fence or gate sections*	No problems observed, roads and fences OK.	**X**		None	

Downchute, drainage channels and retention ponds						
General Site Conditions	*Cracking in concrete downchute mats, erosion, silt, sedimentation in ponds*	Same as previously reported on 2/25/08 site inspection, except concrete revetment mats have dropped down even further in center. Downchute has settled in the center, nearly entire length of downchute. The width is about 8' +/- across. The concrete grouting has broken away, mats have dropped due to lower subsurface elevation. Settlement generally follows geometric contour of DC. Runoff flow steady from underdrain piping at the top. No flow appeared to be coming from anywhere else on top. Flow is still centered in middle of DC at top. Flow travels on mat surface until halfway down the DC, where it drops beneath ACB mats. Appears to come out at bottom of DC near South swale intersection with DC. Bottom of DC in good shape, no settlement or undermining. All flow still travels into box culvert. Culvert has some gray sedimentation buildup, likely from the VSL that is washed away from beneath DC. Forebay also has grayish silt collected, but not full.		**X**	Downchute repair discussed by all parties on 2/25/08, plan of action determined and anticipated to be implemented before end of May 2008.	
Landfill Gas Venting System						
General Site Conditions		No problems observed, landfill gas venting system OK.	**X**		None	

View of rills formed on northeast swale looking south. 4/29/08

View of rills formed in center swale looking west on top. 4/29/08

View of Downchute from top looking east. 4/29/08

View of rills formed on slope in BWA looking towards SSA at top of hill. 4/29/08

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

DATE OF INSPECTION: December 15, 2008

WEATHER CONDITIONS: Overcast, 55 °F

INSPECTION PERFORMED BY: Clayton Carlisle

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
General Site Inspection						
General Site Conditions	*Illegal waste disposal on-site, litter, vegetative cover needs mowing*	No problems observed, site OK.	X		None	
Site Access	*Difficult access, damage to roadways, fences or gates*	No problems observed, site access OK.	X		None	
Sampling and monitoring ports	*Damaged, plugged, broken locks*	Everything in satisfactory condition.	X		None	
Site Vegetation	*Damage to planted trees or shrubs, wetlands plants not surviving*	Plants replaced in September 2008, OK. All other plants, OK also.	X		None	
Landfill Gas Venting System	*Damaged*	Everything in satisfactory condition.	X		None	
Landfill Cover System Inspection						
Landfill Cap	*Ponding or poor drainage due to settlement, erosion rills in cover soil, loss of vegetative cover, cracking of cover soil (over 3" deep)*	Everything in satisfactory condition.	X		None.	
Drainage Structures	*Undercutting at downchute, siltation or vegetation needs to be removed from drainage channels or ponds, flow obstructions, riprap needs more stone cover, concrete blocks in ACB mats damaged or broken*	Downchute repairs made in August 2008. Everything in satifisfactory condition.	X		None.	

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
Landfill Slopes						
General Site Conditions	*Rills formed on slopes, erosion*	No problems observed, landfill slopes OK.	X		None	
			X		None.	
Roadways, fences and gates						
General Site Conditions	*Potholes, ruts, broken fence or gate sections*	No problems observed, roads and fences OK.	X		None	
Downchute, drainage channels and retention ponds						
General Site Conditions	*Cracking in concrete downchute mats, erosion, silt, sedimentation in ponds*	No problems observed. Rills on pond slopes repaired in August 2008.	X		None.	
Landfill Gas Venting System						
General Site Conditions		No problems observed, landfill gas venting system OK.	X		None	

South Kingstown, RI

Photos from December 15, 2008 site inspection

1) View of South Pond and plants around pond. 12/15/08

3) Northeast swale, section repaired in August 2008. 12/15/08

5) View of center swale, repaired in August 2008. 12/15/08

7) View of southeast slope. 12/15/08

9) South Pond. 12/15/08

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

DATE OF INSPECTION: March 12, 2009

WEATHER CONDITIONS: Sunny, 35 °F

INSPECTION PERFORMED BY: Clayton Carlisle

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
General Site Inspection						
General Site Conditions	*Illegal waste disposal on-site, litter, vegetative cover needs mowing*	No problems observed, site OK.	X		None	
Site Access	*Difficult access, damage to roadways, fences or gates*	No problems observed, site access OK.	X		None	
Sampling and monitoring ports	*Damaged, plugged, broken locks*	Everything in satisfactory condition.	X		None	
Site Vegetation	*Damage to planted trees or shrubs, wetlands plants not surviving*	Plants look OK. Most plants still dormant. No evidence of dead or dying plants. All plants upright, OK. Top of landfill has some woody tree growth which needs to be cut down - maybe 5-6 plants total, approx 5' high.	X		When the Town performs grass cutting on the landfill, operator should bring a pair of shears along to cut down the occassional woody plant that may not cut with ordinary grass cutting blades.	
Landfill Gas Venting System	*Damaged*	Everything in satisfactory condition.	X		None	
Landfill Cover System Inspection						
Landfill Cap	*Ponding or poor drainage due to settlement, erosion rills in cover soil, loss of vegetative cover, cracking of cover soil (over 3" deep)*	Everything in satisfactory condition.	X		None.	
Drainage Structures	*Undercutting at downchute, siltation or vegetation needs to be removed from drainage channels or ponds, flow obstructions, riprap needs more stone cover, concrete blocks in ACB mats damaged or broken*	Everything in satifisfactory condition. Downchute and swale repairs, all in good condition.	X		None.	

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
Landfill Slopes						
General Site Conditions	*Rills formed on slopes, erosion*	No problems observed, landfill slopes OK.	X		None	
			X		None.	
Roadways, fences and gates						
General Site Conditions	*Potholes, ruts, broken fence or gate sections*	No problems observed, roads and fences OK.	X		None	
Downchute, drainage channels and retention ponds						
General Site Conditions	*Cracking in concrete downchute mats, erosion, silt, sedimentation in ponds*	No problems observed. No rills on pond slopes observed.	X		None.	
Landfill Gas Venting System						
General Site Conditions		No problems observed, landfill gas venting system OK.	X		None	

South Kingstown, RI

Photos from March 12, 2009 site inspection

1) View of South Pond. 3/12/09

3) Northeast swale, section repaired in August 2008. 3/12/09

5) View of center swale, repaired in August 2008. 3/12/09

7) View of BWA slope looking north to SSA. Note tire tracks, moved boulders. 3/12/09

9) Example of woody growth, top of landfill. 3/12/09

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

DATE OF INSPECTION: June 11, 2009

WEATHER CONDITIONS: Cloudy, 62 °F

INSPECTION PERFORMED BY: Clayton Carlisle

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
General Site Inspection						
General Site Conditions	*Illegal waste disposal on-site, litter, vegetative cover needs mowing*	No problems observed, site OK.	X		None	
Site Access	*Difficult access, damage to roadways, fences or gates*	No problems observed, site access OK.	X		None	
Sampling and monitoring ports	*Damaged, plugged, broken locks*	Everything in satisfactory condition.	X		None	
Site Vegetation	*Damage to planted trees or shrubs, wetlands plants not surviving*	Plants look healthy. Vegetation is extremely thick, both on landfill and in surrounding site. No evidence of woody tree growth to be seen. No evidence of dead or dying plants.	X		No woody growth observed on top of landfill, as reported previously in March 2009 inspection.	
Landfill Gas Venting System	*Damaged*	Everything in satisfactory condition.	X		None	
Landfill Cover System Inspection						
Landfill Cap	*Ponding or poor drainage due to settlement, erosion rills in cover soil, loss of vegetative cover, cracking of cover soil (over 3" deep)*	Everything in satisfactory condition.	X		None.	
Drainage Structures	*Undercutting at downchute, siltation or vegetation needs to be removed from drainage channels or ponds, flow obstructions, riprap needs more stone cover, concrete blocks in ACB mats damaged or broken*	Everything in satifisfactory condition. Downchute and swale repairs, all in good condition. Very minor settlement on outside of downchute near top on southern side, does not appear to be a problem.	X		None.	

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
Landfill Slopes						
General Site Conditions	*Rills formed on slopes, erosion*	No problems observed, landfill slopes OK.	X		None	
			X		None.	
Roadways, fences and gates						
General Site Conditions	*Potholes, ruts, broken fence or gate sections*	No problems observed, roads and fences OK.	X		None	
Downchute, drainage channels and retention ponds						
General Site Conditions	*Cracking in concrete downchute mats, erosion, silt, sedimentation in ponds*	No problems observed. No rills on pond slopes observed.	X		None.	
Landfill Gas Venting System						
General Site Conditions		No problems observed, landfill gas venting system OK.	X		None	

South Kingstown, RI

Photos from June 11, 2009 site inspection

1) View of South Pond. 6/11/09

3) Northeast swale, section repaired in August 2008, looks fine. 6/11/09

5) View of center swale, repaired in August 2008, looks fine. 6/11/09

7) View of North Pond. 6/11/09

9) New trail opening west of boulders to gain access to SSA. 6/11/09 Signpost installed but nothing is posted.

11) Looking down new trail, which curls around towards SSA. 6/11/09

13) Toe of downchute, minor silt collecting at toe. 6/11/09

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

DATE OF INSPECTION: September 24, 2009

WEATHER CONDITIONS: Mostly sunny, 78 °F

INSPECTION PERFORMED BY: Clayton Carlisle

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
General Site Inspection						
General Site Conditions	*Illegal waste disposal on-site, litter, vegetative cover needs mowing*	No problems observed, site OK.		X	Landfill needs to be mowed. Operator to watch for stakes marking valve boxes @ top of slope in SE corner and NE near top of access road.	
Site Access	*Difficult access, damage to roadways, fences or gates*	No problems observed, site access OK.	X		None	
Sampling and monitoring ports	*Damaged, plugged, broken locks*	Everything in satisfactory condition.	X		None	
Site Vegetation	*Damage to planted trees or shrubs, wetlands plants not surviving*	Plants look healthy. Vegetation is extremely thick, both on landfill and in surrounding site. No evidence of woody tree growth to be seen. No evidence of dead or dying plants. Landfill needs to be mowed.	X			
Landfill Gas Venting System	*Damaged*	Everything in satisfactory condition.	X		None	
Landfill Cover System Inspection						
Landfill Cap	*Ponding or poor drainage due to settlement, erosion rills in cover soil, loss of vegetative cover, cracking of cover soil (over 3" deep)*	Critter burrow hole or erosion hole (or combination of both) discovered in soil adjacent to northwest top corner of downchute. Missing soil should be filled back in and reseeded. Hard to detect due to thick grassy cover. Everything else in satisfactory condition.		X	Replace missing soil and reseed.	
Drainage Structures	*Undercutting at downchute, siltation or vegetation needs to be removed from drainage channels or ponds, flow obstructions, riprap needs more stone cover, concrete blocks in ACB mats damaged or broken*	Everything in satifisfactory condition. Downchute and swale repairs, all in good condition. Very minor settlement on outside of downchute near top on southern side, does not appear to be a problem.	X		None.	

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
Landfill Slopes						
General Site Conditions	*Rills formed on slopes, erosion*	No problems observed, landfill slopes OK.	X		None	
			X		None.	
Roadways, fences and gates						
General Site Conditions	*Potholes, ruts, broken fence or gate sections*	No problems observed, roads and fences OK.	X		None	
Downchute, drainage channels and retention ponds						
General Site Conditions	*Cracking in concrete downchute mats, erosion, silt, sedimentation in ponds*	No problems observed. No rills on pond slopes observed. North Pond has plenty of cattails and wetlands plants. South Pond algae has diminished somewhat and has plenty of cattails also.	X		None.	
Landfill Gas Venting System						
General Site Conditions		No problems observed, landfill gas venting system OK.	X		None	

South Kingstown, RI

Photos from September 24, 2009 site inspection

1) View of South Pond. 9/24/09

3) Northeast swale, section repaired in August 2008, looks fine. 9/24/09

5) View of center swale, repaired in August 2008, looks fine. 9/24/09

7) Top of downchute. Small amount of sideslope sloughing at downchute edge 9/24/09

9) View of South Pond. 9/24/09

11) Second view of critter hole, near farthest uphill edge of downchute. 9/24/09

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

DATE OF INSPECTION: January 14, 2010

WEATHER CONDITIONS: Partly cloudy, 35 °F

INSPECTION PERFORMED BY: Clayton Carlisle

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
General Site Inspection						
General Site Conditions	*Illegal waste disposal on-site, litter, vegetative cover needs mowing*	No problems observed, site OK.	X		Landfill mowing completed in October 2009. Looks fine.	
Site Access	*Difficult access, damage to roadways, fences or gates*	No problems observed, site access OK.	X		None	
Sampling and monitoring ports	*Damaged, plugged, broken locks*	Everything in satisfactory condition.	X		None	
Site Vegetation	*Damage to planted trees or shrubs, wetlands plants not surviving*	Snow cover on most of landfill. Plants look fine. Landfill mowing completed in October 2009.	X			
Landfill Gas Venting System	*Damaged*	Everything in satisfactory condition.	X		None	
Landfill Cover System Inspection						
Landfill Cap	*Ponding or poor drainage due to settlement, erosion rills in cover soil, loss of vegetative cover, cracking of cover soil (over 3" deep)*	Critter burrow hole or erosion hole (or combination of both) discovered in soil in September 2009 site visit was repaired by Town. Everything else in satisfactory condition.	X		Town repaired critter burrow hole. Not able to observe repair work on this site visit due to snow cover.	
Drainage Structures	*Undercutting at downchute, siltation or vegetation needs to be removed from drainage channels or ponds, flow obstructions, riprap needs more stone cover, concrete blocks in ACB mats damaged or broken*	Everything in satifisfactory condition. Downchute and swale repairs, all in good condition.	X		None.	

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
Landfill Slopes						
General Site Conditions	*Rills formed on slopes, erosion*	No problems observed, landfill slopes OK.	X		None	
			X		None.	
Roadways, fences and gates						
General Site Conditions	*Potholes, ruts, broken fence or gate sections*	No problems observed, roads and fences OK.	X		None	
Downchute, drainage channels and retention ponds						
General Site Conditions	*Cracking in concrete downchute mats, erosion, silt, sedimentation in ponds*	No problems observed. No rills on pond slopes observed. North Pond has plenty of cattails and wetlands plants. South Pond frozen.	X		None.	
Landfill Gas Venting System						
General Site Conditions		No problems observed, landfill gas venting system OK.	X		None	

South Kingstown, RI

Photos from January 14, 2010 site inspection

1) View of South Pond. 1/14/10

3) Downchute section. 1/14/10

5) View of North Pond. 1/14/10

7) View of South Pond and forebay. 1/14/10

9) Center swale, connection point of two crossing swales, looking east. 1/14/10

11) Condensate tank cover, valve operators for gas header system. 1/14/10

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

DATE OF INSPECTION: April 1, 2010

WEATHER CONDITIONS: Mostly sunny, 55 °F

INSPECTION PERFORMED BY: Clayton Carlisle

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
General Site Inspection						
General Site Conditions	*Illegal waste disposal on-site, litter, vegetative cover needs mowing*	No problems observed, site OK.	X		None	
Site Access	*Difficult access, damage to roadways, fences or gates*	No problems observed, site access OK.	X		None	
Sampling and monitoring ports	*Damaged, plugged, broken locks*	Everything in satisfactory condition.	X		None	
Site Vegetation	*Damage to planted trees or shrubs, wetlands plants not surviving*	Some bushes cut down from fall mowing near South Pond, all else on site OK.	X		Wait to see if bushes will grow back in, otherwise replace where appropriate.	
Landfill Gas Venting System	*Damaged*	Everything in satisfactory condition.	X		None	
Landfill Cover System Inspection						
Landfill Cap	*Ponding or poor drainage due to settlement, erosion rills in cover soil, loss of vegetative cover, cracking of cover soil (over 3" deep)*	Critter burrow holes observed in two locations: 1) south end in middle, 100' west of south header valve boxes and 2) midpoint of center swale. Also minor erosion in center swale at two locations. Sloughing of south side slope, top of downchute. Everything else satisfactory.		X	Repair critter holes and minor erosion observed in center swale. Also repair downchute sideslope using riprap and fabric.	
Drainage Structures	*Undercutting at downchute, siltation or vegetation needs to be removed from drainage channels or ponds, flow obstructions, riprap needs more stone cover, concrete blocks in ACB mats damaged or broken*	Erosion in drainage swale at downstream end of culvert at downchute. Riprap washed out of place, fabric torn.		X	Repair riprap and fabric at downstream side of road culvert. Clean up silt collected near South Pond forebay from washout.	

ROSE HILL LANDFILL: POST-CLOSURE INSPECTION AND MAINTENANCE LOG

Item	Examples of Problems	Actual Observations	Acceptable?		Recommended Remedial Action	Date of Completion
			Yes	No		
Landfill Slopes						
General Site Conditions	*Rills formed on slopes, erosion*	No problems observed, landfill slopes OK.	X		None	
			X		None.	
Roadways, fences and gates						
General Site Conditions	*Potholes, ruts, broken fence or gate sections*	No problems observed, roads and fences OK.	X		None	
Downchute, drainage channels and retention ponds						
General Site Conditions	*Cracking in concrete downchute mats, erosion, silt, sedimentation in ponds*	Erosion in drainage swale at downstream end of culvert at downchute. Riprap washed out of place, fabric torn. Minor siltation in drainage swale near flare.		X	Repair riprap and fabric at downstream side of road culvert. Clean up silt collected near South Pond forebay from washout. Remove silt from drainage swale near flare.	
Landfill Gas Venting System						
General Site Conditions		No problems observed. Landfill gas venting system shut down, now operating gas flare.	X		None	

South Kingstown, RI

Photos from April 1, 2010 site inspection

1) View of South Pond. 4/1/10

This site inspection took place two days after the 200-year flood event on March 29 - 31, 2010.

3) Center swale, minor erosion on eastern end of swale. 4/1/10

5) Top of downchute. 4/1/10

7) View of South Pond and forebay, note silt collected in pile after washout. 4/1/10

9) Washout in downstream side of culvert from downchute. 4/1/10

11) View of drainage from South Pond from 24” RCP culvert on east side. 4/1/10

APPENDIX E

INSTITUTIONAL CONTROLS AND PROPERTY ACCESS AGREEMENTS

ROSE HILL REGIONAL LANDFILL
INSTITUTIONAL CONTROL BOUNDARY MAP

ROSE HILL REGIONAL LANDFILL
INSTITUTIONAL CONTROL TRACKING CHART

LIST OF INSTITUTIONAL CONTROLS AND PROPERTY ACCESS AGREEMENTS

There are no Institutional Controls in place regarding the Site at the time of this Report.

Property Access Agreements in place regarding the Site are presented in Table 6-16 of Section 6 of this Report.

GIS Map

Town of South Kingstown
Washington County, Rhode Island

Horizontal Datum is Rhode Island State Plane Feet, NAD83

The Town of South Kingstown makes no warranty as to the accuracy, reliability, or completeness of the information and is not responsible for any errors or omissions or for results obtained from the use of the information.

Scale 1:7,439
1 Inch = 620 Feet
Parcel Boundaries as of July 2009

Rose Hill Regional Landfill Institutional Control Tracking Chart

Parcel	Owner	Access	Title Report	Restrictions	Issues	Address	Declaration Signed	Recorded
Rose Hill Site P00 L00	Individual, Corp.,Trust, etc. (w/address) *Town = South Kingstown	Y / N Doc Date xx/xx/xx	Date Rec'd by EPA xx/xx/xx	Land use; groundwater; surface water;	Examples: water/electrical easements need to be subordinated; property owner does not want to sign easement; subordinations needed; access denied by owner; progress /next steps		Date signed by landowner xx/xx/xx	book/ page and date recorded
P32 L10	Robert Clark, Vivian Louisa Knowles	No	No	Land use; groundwater	Awaiting final IC approval and Title work	320 Rose Hill Road		
P33 L30	Richard Frisella	No	No	Land use; groundwater	Awaiting final IC approval and Title work	130 Pearls Way		
[SSA]	Richard Frisella	No	No	Land use; groundwater	Awaiting final IC approval and Title work	SSA section at 130 Pearls Way		
P33 L32	*Town of South Kingstown	No	No	Land use; groundwater	Awaiting final IC approval and Title work	Rose Hill Road (SWA landfill)		
P33 L33	Cynthia Knight	No	No	Land use; groundwater	Awaiting final IC approval and Title work	75 Pearls Way		

Parcel	Owner	Access	Title Report	Restrictions	Issues	Address	Declaration Signed	Recorded
P33 L34	*Town of South Kingstown	No	No	Land use; groundwater	Awaiting final IC approval and Title work	Rose Hill Road (SWA landfill)		
P33 L36	Norman and Patricia Gagne	No	No	Land use; groundwater	Awaiting final IC approval and Title work	349 Rose Hill Road		
P33 L40	Eugene Seney	No	No	Land use; groundwater	Awaiting final IC approval and Title work	340 Rose Hill Road		
P33 L41	John Carpenter	No	No	Land use; groundwater	Awaiting final IC approval and Title work	294 Rose Hill Road		
P33 L42	Alice and Myron Duffin	No	No	Land use; groundwater	Awaiting final IC approval and Title work	278 Rose Hill Road		
P33 L43	Bernadette Bosclair	No	No	Land use; groundwater	Awaiting final IC approval and Title work	Rose Hill Road		
P33 L45	Associates of Rose Hill. LLC	No	No	Land use; groundwater	Awaiting final IC approval and Title work	220 Rose Hill Road (golf course)		
P33 L46	*Town of South Kingstown	No	No	Land use; groundwater	Awaiting final IC approval and Title work	163 Rose Hill Road (Transfer Station)		
P33 L109	John Frisella	No	No	Land use; groundwater	Awaiting final IC approval and Title work	129 Pearls Way		

Parcel	Owner	Access	Title Report	Restrictions	Issues	Address	Declaration Signed	Recorded
P33 L110	John Frisella et al – Pearls Way ROW	No	No	Land use; groundwater	Awaiting final IC approval and Title work	Unknown		
P41-1 L18	Ed Timpson & Sons, Inc.	No	No	Land use; groundwater	Awaiting final IC approval and Title work	94, 96 Rose Hill Road		
Rose Hill Rd	*Town of South Kingstown	No	No	Land use; groundwater	Awaiting final IC approval and Title work	Public road		

APPENDIX G

VAPOR INTRUSION

LIST OF VAPOR INTRUSION MEMORANDA

Date	Issued By	Subject
6/9/2010	**Berger**	**Vapor Intrusion, Rose Hill Landfill Superfund Site**
6/22/2010	**EPA**	**Vapor Intrusion Assessment for Rose Hill Regional Landfill Superfund Site**

The LOUIS BERGER GROUP, Inc.
PROVIDENCE, RHODE ISLAND

MEMORANDUM

TO: Claire Willscher, EPA Region 1

DATE: June 9, 2010

FROM: Douglas Ganey,
Principal Environmental Scientist

COPY: David Newton, EPA Region 1
Gary Jablonski, RIDEM/ OWM
Chris Feeney, Louis Berger Group
Clayton Carlisle, Louis Berger Group

SUBJECT: Vapor Intrusion, Rose Hill Landfill Superfund Site

As part of its quarterly environmental monitoring and Five-Year Review processes for the Rose Hill Landfill Superfund Site in South Kingstown, Rhode Island, the Louis Berger Group (Berger) performed an assessment of the potential for vapor intrusion in nearby residences from soil gas and/or groundwater migration. This assessment was performed using U.S. Environmental Protection Agency (EPA) Region 1 Guidance for indoor air intrusion calculations, and draft internal data tables provided directly by EPA. The Rose Hill Landfill site is an EPA National Priority Site (also known as "Superfund" site).

The EPA Office of Solid Waste and Emergency Response *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* document ("Guidance Document", 2002) identifies an approach to determine whether the exposure pathway is complete and, if so, whether the vapors are present at levels that may pose an unacceptable exposure risk.

The 2002 EPA Guidance Document provides a tiered approach to determine whether there is a complete exposure pathway. A complete exposure pathway means that humans are exposed to vapors originating from site contamination. Tier 1 consists of a primary screening of basic questions regarding the potential for exposure. Tier 2 consists of comparing measured or reasonably estimated concentrations of target chemicals in groundwater, soil gas, and/or indoor air to recommended numerical criteria identified in the guidance document that represent a conservative, worst-case scenario. Tier 3 is a site-specific pathway assessment, examining potential exposure pathways in more detail using field data and some calculations/ modeling. For this assessment the Tier 2 and Tier 3 approaches were used.

The 2002 EPA Guidance Document also provides tables that list 113 volatile chemical compounds with target concentrations of these compounds in indoor air, soil gas, and groundwater. These tables also show the risk basis for these target concentrations (i.e. cancer risk or non-cancer risk) and list what the targeted concentrations of these compounds are intended to attain (e.g. prescribed levels of acceptable risk and target hazard index). Some of these compounds do not have risk based targeted concentrations in the Guidance Document, but instead the listed concentrations are truncated at EPA's maximum contaminant

levels (MCLs) for drinking water. The MCLs are standards based on the potential for adverse health risk via ingestion of drinking water, and the potential for treatment to remove contaminants from drinking water.

Berger understands that the 2002 EPA Guidance Document is currently being updated by an EPA contractor. Although this revised guidance was not available at the time of the Five-Year Review, EPA provided internal data tables that will be included as part of the revised guidance document. The tables provided by EPA list health-based screening values for those contaminants (volatile organic compounds (VOCs)) that are truncated at the MCL in the 2002 EPA Guidance Document. These EPA tables are provided as Attachment A.

The first EPA table in Attachment A summarizes EPA's vapor intrusion target groundwater concentrations for residents based on a 10^{-6} cancer risk or a Hazard Quotient (HQ) of 1. The EPA Region 1 performs vapor intrusion screening based on values derived from the 10^{-6} cancer risk. The second table in Attachment A ("Table 1") lists comparative vapor intrusion screening criteria corresponding to target indoor air and groundwater concentrations for chemicals truncated at the MCL, for a 10^{-6} target cancer risk. The following two tables show concentrations corresponding with 10^{-5} and 10^{-4} target cancer risks, which were not used in our analysis.

Berger prepared Tables 1 and 2 below, which provide comparisons between environmental monitoring data from the Rose Hill Landfill site with the draft EPA vapor intrusion guidance criteria. Table 1 shows laboratory analytical results for detected VOCs in groundwater from the two years (2008-2009) of post-closure sampling at Rose Hill Landfill, with the Project Action Limits (PALs) and the EPA's draft vapor intrusion target groundwater concentrations. Table 2 shows laboratory analytical results for VOCs in soil gas from the two years of post-closure monitoring and the EPA's draft vapor intrusion target (shallow) soil gas concentrations.

The vapor intrusion target concentration values in Table 1 for groundwater, along with the PALs for groundwater, were used to make vapor intrusion comparisons based on current groundwater data, which is summarized in Table 1 and Berger's Five-Year Review Report (2010). The PALs for groundwater were based on EPA drinking water standards (e.g., MCLs) and EPA Regional Screening Levels.

The vapor intrusion target concentration values in Table 2 for soil gas, along with the PALs for landfill gas, were used to make vapor intrusion comparisons based on current landfill data, which is summarized in Table 2 and Berger's Five-Year Review Report. The PALs for landfill gas are based on RIDEM Air Pollution Control Regulation No. 22 for Air Toxics (1988, amended in 2004 and 2008).

The mean concentrations of analytes in both Tables 1 and 2 are from positive detections only, so are skewed higher than the actual mean site concentrations. All monitored wells at the site with positive detections were included in these mean concentrations. A discussion of VOC concentrations in the groundwater monitoring wells closest to the most proximate residential properties is provided after the data tables.

It should also be noted that the mean concentration data presented in Table 2 includes sample points from both passive soil probes, and active soil vents, where landfill gas is being mechanically removed from the subsurface. The inclusion of venting data is expected to have skewed the concentration data higher, but these values were still used in our vapor intrusion comparisons to be more conservative.

Table 1: Mean Concentrations of VOCs in Groundwater, Rose Hill Landfill, 2008-2009 with Risk-Based Target Groundwater Concentrations (U.S. EPA Region 1, draft guidance 2010)

ANALYTE	PAL (µg/l)	MEAN CONCENTRATION[1] (µg/l)		
		Risk-Based Vapor Intrusion Target Concentrations (µg/l)	Year 1	Year 2
			Mean (µg/l) (#)	Mean (µg/l) (#)
VOC				
1,1-Dichloroethane	800	2,200	1.27 (3)	1.42 (7)
1,2-Dichlorobenzene	600	2,600	<MQL (0)	<MQL (0)
1,4-Dichlorobenzene	75	8,200	<MQL (0)	<MQL (0)
2-Butanone	1,900	440,000	<MQL (0)	<MQL (0)
Benzene	5	1.36	**1.45** (11)	1.31 (9)
Chlorobenzene	100	390	2.11 (10)	3.48 (7)
Chloroethane	21,000	28,000	8.73 (10)	9.01 (7)
Cis-1,2-Dichloroethene	70	210	0.61 (2)	3.30 (2)
Ethyl ether	1,200	520	4.34 (8)	4.62 (6)
Isopropylbenzene	660	NE	0.62 (4)	0.59 (1)
Methyl tert-butyl ether	12	120,000	2.50 (2)	2.30 (1)
n-Propylbenzene	NE	320	<MQL (0)	<MQL (0)
o-Xylene	1,400	33,000	<MQL (0)	<MQL (0)
p/m-Xylene	1,400	22,000	<MQL (0)	2.00 (1)
Tetrahydrofuran	8.8	NE	<MQL (0)	0.60 (2)
Toluene	1,000	1,500	<MQL (0)	<MQL (0)
Trans-1,2-Dichloroethane	100	180	<MQL (0)	<MQL (0)
Trichloroethene	5	2.89	<MQL (0)	<MQL (0)
Vinyl Chloride	2	0.145	<MQL (0)	**2.90** (2)

Notes:
[1] Mean concentration calculated from positive results only for all wells monitored as part of the Long-Term Monitoring Plan.
Bold Text indicates exceeds Risk-Based Vapor Intrusion Target Concentrations
Shading indicates exceeds PAL
<MQL – Less than method quantitation limit
NE- None Established
PAL – Project Action Limit
µg/l – micrograms per liter
VOCs – volatile organic compounds

Table 2: Mean Concentrations of VOCs in Landfill (Soil) Gas Rose Hill Landfill, 2008-2009 with Risk-Based Target Vapor Concentrations (U.S. EPA Region 1, draft guidance 2010)

ANALYTE	PAL (ppbv)	MEAN CONCENTRATION[1] (ppbv)				
		Risk-Based Vapor Intrusion Target Concentrations[2]	Year 1		Year 2	
			Mean	(#)	Mean	(#)
VOC		**(ppbv)**	**(ppbv)**		**(ppbv)**	
1,1,1-Trichloroethane	700	400	53.5	(4)	47.3	(8)
1,1-Dichloroethane	0.1	120	87.1	(9)	55.8	(9)
1,1-Dichloroethene	0.57	50	**117.3**	(3)	25.3	(5)
1,2,4-Trimethylbenzene	60	1.2	<MQL	(0)	<MQL	(0)
1,3,5-Trimethylbenzene	60	1.2	<MQL	(0)	<MQL	(0)
2-Butanone	1,000	340	94.9	(13)	27.5	(14)
Benzene	9	0.098	**26.1**	(11)	**19.8**	(12)
Carbon disulfide	200	220	2.5	(7)	8.93	(12)
Chloroethane	4,000	3,800	476	(12)	299	(10)
Chloroform	0.04	0.022	**4.64**	(3)	**3.82**	(6)
Chloromethane	200	2.4	**3.0**	(7)	2.32	(12)
cis-1,2-Dichloroethene	200	8.8	**2,139**	(11)	**3,794**	(7)
Cyclohexane	2,000	NE	75.1	(14)	93.4	(11)
Dichlorodifluoromethane	100	40	**282**	(13)	**64.4**	(15)
Ethylbenzene	200	0.51	<MQL	(0)	**2.61**	(3)
Freon-113	NE	NE	<MQL	(0)	2.41	(4)
Freon-114	NE	NE	223	(9)	52.7	(12)
Methylene Chloride	300	1.5	**9.5**	(4)	**3.28**	(4)
p/m-Xylene	700	1,600	3.2	(1)	1.49	(2)
o-Xylene	700	1,600	1.5	(2)	.52	(2)
n-hexane	50	57	**152**	(16)	**160**	(13)
Propylene	2,000	NE	17.6	(2)	89.4	(15)
Styrene	200	230	<MQL	(0)	0.06	(1)
Tetrachloroethene	0.03	0.12	**114**	(2)	**0.47**	(1)
Toluene	100	110	52.1	(13)	18.7	(14)
trans-1,2-Dichloroethene	20	18	10.0	(14)	**28.3**	(6)
Trichloroethene	90	.0041	**208**	(11)	**1,194**	(9)
Trichlorofluoromethane	200	120	2.4	(2)	3.35	(5)

Vinyl chloride	40	0.11	**1,712** (15)	**1,654** (12)

Notes:
[1] Mean concentration calculated from positive results only
[2] Using shallow soil gas concentrations corresponding to Target Indoor Air Concentration Where the Soil Gas to Indoor Air Attenuation Factor = 0.1 (from USEPA Guidance, 2002).
(#) Number of positive analytical results
Bold Text indicates exceeds Risk-Based Vapor Intrusion Target Concentrations
Shading indicates exceeds PAL
<MQL – Less than method quantitation limit
NE- None Established
PAL – Project Action Limit
ppbv – parts per billion by volume
VOCs – volatile organic compounds

Receptor Information

A quick review of Tables 1 and 2 indicates that soil gas concentrations of VOCs are more of a concern than groundwater VOC concentrations at the Rose Hill Landfill site, and migration of VOCs through the unsaturated soil zone appears the most likely path for vapor intrusion into nearby buildings. The general groundwater flow direction across the Rose Hill Landfill site has been determined to be southeasterly. However, near the northwest corner of the site, there is a northwesterly component of groundwater flow, which could affect adjacent residences. Subsurface migration of vapors in the unsaturated soil zone is anticipated to follow a similar pathway. However, landfill gas is controlled by the source control remedy, which includes a landfill cap and the now operational active gas collection and flare system.

Residences abut the site along Rose Hill Road to the west of the site and along Pearl's Way north of the site. The closest residences to the site are located at 278 Rose Hill Road, immediately west of the site, and 349 Rose Hill Road, immediately northwest of the site at the intersection with Pearl's Way.

These houses have either full or partial basements, and alarmed methane gas meters were installed in the basement as part of the 1994 Remedial Investigation. These monitoring points utilize a methane sensor connected to an alarm and data collector installed in the basements of each residence. The Town of South Kingstown currently inspects and calibrates each sensor at both residences monthly. The digital recorder from each residence is downloaded and calibrated monthly. During the monthly calibration events, the Town downloads information containing the maximum, minimum, and average readings for each sensor at both residences. According to the CD, the Town is required to send a report to the EPA and the State for any monthly detection exceedance of 100 ppmv (parts per million by volume) of methane from any of the two sensors. At the end of each calendar year, the Town submits a yearly report to EPA and the State containing all the calibration events and results for each residential sensor. The reports have indicated that the alarms have gone off occasionally, primarily perceived as caused by incidental nuisance conditions such as human error or electrical power outages unrelated to landfill gas migration. However, on a few occasions in past years, the compiled data could be potentially interpreted as a signal for elevated methane concentrations.

There are additional house located along Rose Hill Road north, west, and south of the site. Other houses are located east of the site, across the Saugatucket River. Based on the receipt of elevated methane and VOC readings along the western and northern site boundaries, and the proximity of residences to those

areas, this vapor intrusion analysis was focused on the northwestern area of the site and these adjacent residences.

Groundwater and Soil Gas Contaminant Levels

Groundwater monitoring wells MW-07 and MW-13, and Residential well #11 are the groundwater monitoring locations closest to the most proximate residents. A map of the post-closure groundwater monitoring locations is provided in Attachment B.

The VOCs detected in groundwater samples during the most recent (April 2010) quarterly monitoring round are summarized in the Step 3 vapor intrusion analysis below. Concentrations of VOCs detected did not exceed their respective PAL in any sample. Results were generally similar to previous post-closure monitoring results. Average concentrations of the VOCs benzene and vinyl chloride had exceeded the PAL and/or the EPA's risk-based vapor intrusion target concentrations during the first two years of post-closure monitoring. No VOCs were detected in wells MW-13 and RES #11, located near the residences proximate to the northwest corner of the site. Concentrations of the VOCs chlorobenzene and 1,1-dichloroethane were well below the PALs or EPA risk-based vapor intrusion target concentrations in the MW-07 well cluster.

In addition to VOCs analysis, in the fourth quarter of Year 1 of post-closure monitoring one groundwater sample was collected from an off-site monitoring well and analyzed for alkanes. The purpose of this sample was to determine whether methane might be migrating off-site in groundwater. Both methane and ethane were detected in the groundwater sample; however, these analytes were detected at low levels, below their solubility. Therefore, it is unlikely that that the source of elevated concentrations of methane detected in some of the off-site gas probes is due to methane migrating from the Site in groundwater. A PAL has not been established for alkanes in groundwater.

Soil gas probes GP-10 through GP-22 (excluding GP-20) are located along Rose Hill Road west of the site and Pearl's Way north of the site, closest to the most proximate residences. Additional soil gas probes have been installed extending from Rose Hill Road westward toward residences. These additional soil gas probes are identified as GP-40A through GP-40E and GP-41A through GP-41C.

Monthly landfill gas monitoring is conducted at the gas flare and at 42 gas probes located both within and outside the capped former Solid Waste Area (SWA). The landfill gas monitoring stations sampled are identified as gas flare GF and gas probes GP-01, GP-03, GP-05 through GP-07, GP-10 through GP-19, GP-21, GP-22, GP-26, GP-33, GP-36, GP-37A through GP-37D, GP-38A through GP-38D, GP-39A through GP-39D, GP-40A through GP-40E, and GP-41A through GP-41C. Landfill gas monitoring locations are shown on a figure in Attachment B. Field monitoring is conducted on all of these sample points for methane, hydrogen sulfide, and total VOCs. Selected soil gas probes are sampled quarterly for VOCs laboratory analysis: GP-11, GP-16, GP-18, and GP-21. The VOCs detected in soil gas samples during the most recent (April 2010) quarterly monitoring round are summarized in the Step 3 vapor intrusion analysis below. The VOC chloroform was detected above the PAL in one sample, from GP-21. None of the other VOCs detected exceeded their PAL. GP-21 is located near 349 Rose Hill Road. Several VOCs have exceeded the PALs or risk-based standards based on average concentrations during earlier post-closure monitoring rounds (see Table 3).

An issue that often arises during the vapor intrusion assessment is that the detection limits for some contaminants may not be low enough to detect the 10^{-6} excess cancer risk. In this case one is not able to screen out these contaminants at this risk level. Based on the laboratory detection limits listed in Berger's

2008 Quality Assurance Project Plan, no VOCs have low laboratory detection limits for groundwater or landfill gas samples for which this is the case.

Tier 2 Secondary Screening Process

The following is a step-by-step summary of the Tier 2 Process, as described in the EPA 2002 Guidance Document (text in bold is from the Guidance Document):

A. Secondary Screening – Question #4: Generic Screening

Q4(a): Are indoor air quality data available?
Answer: No indoor air data for VOCs are available. Indoor air data is available for methane concentrations at two residences near the Rose Hill Landfill site. No other parameters are sampled and no other locations are monitored.

If NO – proceed to Subsurface Source Identification – Question 4(c).

Q4(c): Is there any potential contamination (source of vapors) in the unsaturated zone soil at any depth above the water table?

Answer: Yes. Soil gas (also referred to as landfill gas) samples have been collected from the Rose Hill Landfill site for several years that indicate contamination of the unsaturated zone soil above the water table.

If YES- skip to Soil Gas Assessment - Question 4 (g).

Q4(g): Do measured or reasonably estimated soil gas concentrations exceed the generic target media-specific concentrations given in Tables 2(a), 2(b), or 2(c)?

Answer: Yes. As stated above, in addition to these 2002 Guidance Document Tables ("Question 4 Generic Screening Levels and Summary Sheet"), Berger used EPA internal draft tables (attached) with some updated, risk-based criteria to make this comparison. Table 2(c) in the 2002 Guidance Document corresponds with the 10^{-6} cancer risk EPA Region 1 uses for vapor intrusion analysis. During the 2008-2009 quarterly monitoring conducted by Berger, the mean concentrations in soil gas for the following VOCs exceeded these screening criteria: 1,1-dichloroethene, benzene, chloroform, cis-1,2-dichloroethene, dichlorodifluoromethane, ethylbenzene, methylene chloride, n-hexane, tetrachloroethene, and trichloroethene.

Mean concentrations for soil gas are shown in Table 3.

If YES document representative soil gas concentrations and proceed to Question 5.

Q5(a): Do groundwater and/or soil gas concentrations for any constituents of potential concern exceed target media-specific concentrations by a factor greater than 50?

Answer: No for groundwater. Yes for mean concentrations of the following VOCs in soil gas: benzene, chloroform, cis-1,2-dichloroethene, tetrachloroethene, and trichloroethene.

Mean concentrations for soil gas are shown in Table 3.

If YES go to Site-Specific Assessment - Question 6.

Based on the EPA Guidance Document, if observed concentrations are greater than 50 times the target concentrations provided in that Document, there is no benefit in further using the Tier 2 criteria and it is recommended to utilize the Tier 3 expeditious site-specific evaluation.

Tier 3 Site Specific Assessment

The following is a step-by-step summary of the Tier 3 Process, as described in the EPA 2002 Guidance Document:

Q6(a): Have the nature and extent of contaminated soil vapor, unsaturated soil, and/or groundwater as well as potential preferential pathways and overlying building characteristics been adequately characterized to identify the most likely-to-be-impacted buildings?

Answer: Yes. Environmental monitoring data collected for over a decade at the site constitutes a Conceptual Site Model. A detailed description of the site and summary of environmental monitoring data is provided in Berger's 2010 Five Year Review Report as well as numerous quarterly monitoring reports and other investigation reports for the Rose Hill Landfill site since 1975. Several environmental investigations conducted at the Site between 1975 and 1994 were summarized in Metcalf & Eddy's 1994 Remedial Investigation (RI) and Feasibility Study (FS) Reports and 1991 RI/FS Work Plan, prepared for the EPA. The RI investigated the extent of contamination and impact of the Site to public health and the environment. In May 2003, Berger began a quarterly monitoring program as part of the Remedial Design for Rose Hill Landfill. The results of the 2003-2004 sampling events were presented in Berger's Field Investigation Summary Report (August 2004). Berger has conducted quarterly post-closure monitoring at the site since April 2008.

The critical site data for the vapor intrusion analysis is soil gas and groundwater analytical data in proximity to adjacent residences. A figure in Attachment B shows the proximity of soil gas probes to nearby residences. Rows of soil probes, line Rose Hill Road west of the site and Pearl's Way north of the site. Gas probes GP-10 through GP-22 (excluding GP-20) are located in this area. Additional soil gas probes have been installed where elevated concentrations of soil gas contaminants have been detected. Soil gas probes GP-40A through GP-40E extend from Rose Hill Road westward toward the residence at 278 Rose Hill Road, and soil gas probes GP-41A through GP-41C extend from Rose Hill Road westward toward the residence at 294 Rose Hill Road.

Berger most recently conducted landfill gas field monitoring and sampling on April 8, 2010. Landfill gas was monitored at the gas flare installed in February 2010 near the northeast corner of the capped landfill (the former SWA) and at 42 gas probes located both within and outside the SWA. The landfill gas monitoring stations sampled were identified as gas flare GF and gas probes GP-01, GP-03, GP-05 through GP-07, GP-10 through GP-19, GP-21, GP-22, GP-26, GP- 33, GP-36, GP-37A through GP-37D, GP-38A through GP-38D, GP-39A through GP-39D, GP-40A through GP-40E, and GP-41A through GP-41C. Landfill gas monitoring locations are shown on a figure in Attachment B.

Landfill gas samples were monitored in the field for methane, carbon dioxide, oxygen, hydrogen sulfide, and percent lower explosive limit (LEL) using a LandTek GEM-500 landfill gas meter, and for the presence of VOC with a MiniRAE 2000 photoionization meter. VOCs were detected in 21 of the gas probes at concentrations ranging from 0.1 ppmv to 0.7 ppmv.

A subset of five sample locations, GF, GP-11, GP-16, GP-18, and GP-21, were also selected for laboratory analysis for VOCs using Summa® canisters for sample collection, in accordance with the sample collection procedures outlined in Berger's Quality Assurance Project Plan.

The VOCs detected in landfill gas samples included 2-butanone, benzene, carbon disulfide, chloroethane, chloroform, chloromethane, dichlorodifluoromethane, Freon-113, Freon-114, n-hexane, propylene, toluene, trichloroethene, trichlorofluoromethane, and vinyl chloride.

Chloroform was detected at a concentration exceeding the PAL of 0.04 parts per billion by volume (ppbv) in the sample from GP-21 (0.59 ppbv). Although chloroform was not detected in the other samples, the laboratory reporting limits were above the PAL. GP-21 is located on the north side of the site along Pearl's Way. None of the other VOCs detected exceeded their respective PAL. The VOCs 2-butanone, benzene, carbon disulfide, chloromethane, dichlorodifluoromethane, n-hexane, propylene, toluene, and trichlorofluoromethane were detected in all samples; trichloroethene in two, and chloroethane, chloroform, Freon-113, Freon-114 and vinyl chloride were each detected in a single sample.

Low concentrations of total VOCs were detected during field screening of the GP-40 and GP-41 series gas probes adjacent to residences west of Rose Hill Road, with the highest concentration of 0.2 parts per million by volume (ppmv). Field screening concentrations of VOCs in gas probes along Rose Hill Road ranged from 0.1 to 0.7 ppmv. No methane was detected in the GP-40 and GP-41 series probes. The soil gas probes GP-19, GP-21, and GP-21 located closest to the 349 Rose Hill Road residence, had field screening VOCs concentrations of 0.0 ppmv, 0.2 ppmv, and 0.5 ppmv, respectively.

Results of the most recent quarter's soil gas sampling differed from those of previous quarter sampling conducted during Year 1 and Year 2: fewer VOC were detected, VOC concentrations were lower, and fewer PALs were exceeded. This can be directly attributed to the decision to switch to the active gas collection system and the installation of the landfill gas flare. Initially following the landfill closure and capping, the landfill was operated using a passive venting system. The active collection was initiated after post-closure monitoring of gas probes indicated the presence of methane in concentrations above the LEL off-site at certain locations, particularly along Rose Hill Road. Monitoring of methane concentrations was changed to a monthly basis during Year 2.

The landfill gas flare pilot study was implemented to determine if active gas collection would lower the off-site methane concentration levels. The results of methane concentration field monitoring are presented in Table 3, which summarizes pre-flare installation and post-flare installation for comparison. Since the initial gas flare startup in February 2010, it is apparent that the gas flare operation is able to reduce the off-site methane concentrations below the LEL. Monitoring of methane concentrations was initially conducted weekly upon the startup of the landfill gas flare. The observed methane concentrations were found to be reduced almost immediately upon active gas collection operation. Monitoring of methane concentrations is now being conducted on a monthly basis.

It has also been observed that the quantity of landfill gas being delivered to the gas flare has been slowly trending downward since the startup. The landfill gas flare pilot study remains on-going and any future decisions to remove the gas flare or establish it permanently at the site have yet to be made.

Table 3: Methane Concentration in Soil Gas, Pre- and Post Flare Installation

		Gas Probe Monitoring *Pre-Flare Installation* April 2008 - January 2010			Gas Probe Monitoring *Post-Flare Installation* February - April 2010		
TYPE	**ID**	**MEAN VALUE** (%)	**MAXIMUM VALUE** (%)	**MINIMUM VALUE** (%)	**MEAN VALUE** (%)	**MAXIMUM VALUE** (%)	**MINIMUM VALUE** (%)
Gas Probes	GP-01	0.9	11.3	0.0	0.1	0.5	0.0
	GP-03	5.1	58.4	0.0	3.0	5.4	0.2
	GP-05	28.1	55.3	4.2	0.1	0.3	0.0
	GP-06	15.1	35.6	0.0	0.1	0.3	0.0
	GP-07	36.6	54.3	0.0	0.1	0.3	0.0
	GP-10	15.3	24.7	0.0	0.1	0.4	0.0
	GP-11	11.3	27.8	0.9	1.0	7.8	0.0
	GP-12	5.1	12.3	0.0	0.2	0.4	0.0
	GP-13	3.7	13.2	0.3	0.1	0.4	0.0
	GP-14	5.0	17.1	0.5	0.8	6.7	0.0
	GP-15	0.0	0.2	0.0	0.2	1.0	0.0
	GP-16	0.1	0.8	0.0	0.2	0.9	0.0
	GP-17	0.4	5.2	0.0	0.2	0.8	0.0
	GP-18	1.2	17.2	0.0	0.1	0.6	0.0
	GP-19	0.0	0.1	0.0	0.1	0.5	0.0
	GP-21	5.4	13.4	0.0	1.4	8.9	0.0
	GP-22	0.1	0.8	0.0	0.1	0.3	0.0
	GP-26	0.0	0.2	0.0	0.1	0.2	0.0
	GP-28	0.2	1.6	0.0	0.0	0.2	0.0
	GP-30	0.0	0.2	0.0	0.2	0.2	0.1
	GP-33	0.5	1.9	0.0	0.7	4.2	0.0
	GP-36	49.8	71.9	20.3	5.5	32.1	0.0
Soil Gas Vapor Probes	GP-37A	27.7	63.0	0.0	0.1	0.4	0.0
	GP-37B	0.7	3.0	0.0	0.1	0.4	0.0
	GP-37C	0.0	0.1	0.0	0.0	0.0	0.0
	GP-37D	0.0	0.1	0.0	0.1	0.5	0.0
	GP-38A	48.6	69.7	0.1	0.1	0.2	0.0
	GP-38B	30.1	40.5	0.0	0.1	0.4	0.0
	GP-38C	10.3	19.5	0.0	0.1	0.4	0.0
	GP-38D	0.7	5.2	0.0	0.1	0.3	0.0
	GP-39A	57.8	67.0	41.4	0.2	1.0	0.0
	GP-39B	15.3	29.5	0.0	0.1	0.5	0.0
	GP-39C	0.9	7.3	0.0	0.1	0.5	0.0
	GP-39D	0.6	2.0	0.0	0.1	0.3	0.0
	GP-40A	54.0	64.3	44.9	0.1	0.4	0.0
	GP-40B	16.1	23.7	0.5	0.1	0.5	0.0

	GP-40C	0.0	0.1	0.0	0.1	0.4	0.0
	GP-40D	0.0	0.1	0.0	0.1	0.5	0.0
	GP-40E	0.0	0.2	0.0	0.2	0.5	0.0
	GP-41A	24.9	31.4	0.1	5.6	15.0	0.0
	GP-41B	4.5	10.2	0.0	0.1	0.5	0.0
	GP-41C	0.0	0.2	0.0	0.2	0.5	0.0

The VOCs detected in groundwater samples during the most recent (April 2010) quarterly monitoring round included 1,1-dichloroethane (3 monitoring wells), acetone (1 monitoring well), benzene (3 monitoring wells), chlorobenzene (3 monitoring wells), chloroethane (4 monitoring wells), cis-1,2-dichloroethene (2 monitoring wells), ethyl ether (2 monitoring wells), isopropylbenzene (2 monitoring wells), and methyl tert-butyl ether (1 residential well). The laboratory reporting limit of 10 µg/l for tetrahydrofuran exceeded the PAL of 8.8 µg/l. All tetrahydrofuran results for groundwater were below the laboratory reporting limit. Concentrations of other VOCs detected did not exceed their respective PAL in any sample. Results were generally similar to Year 1 and Year 2 sampling results.

If **YES** - **proceed to Question 6(b).**

Q6(b):Are you conducting an Environmental Indicator (EI) determination and are you using an appropriate and applicable model?

Answer: No.

If NO - continue with Question 6(d).

Q6(d): Are subslab soil gas data available?

Answer: No. No soil gas samples for VOCs analysis have been collected under building slabs.

If NO - continue with Question 6(g).

Q6(g): Do measured indoor air concentrations exceed the target concentrations given in the 2002 Guidance Document?

Answer: Not applicable. No indoor air sampling for VOCs has been conducted in building basements. In addition to the aforementioned methane monitoring in residences immediately adjacent to the site, Berger has conducted preliminary inspection of these buildings and identified potential sources of VOCs from within these dwellings. Any indoor air analysis should target VOCs that have been identified as present as constituents of potential concern at the Rose Hill Landfill site.

Conclusions

The answer to Question 6(g) indicates that there is insufficient information to determine whether there is a complete or incomplete exposure pathway to indoor air. Therefore, the stepped Tier 3 screening process was stopped at this point. Based on the environmental monitoring data obtained to date at the Rose Hill

Landfill site, it is possible that indoor air in adjacent residences could be affected by soil gas contaminants from the site, particularly VOCs and methane.

The landfill gas flare pilot study, started in February 2010, has demonstrated that the gas flare operation is able to control the off-site migration of methane resulting in methane concentrations below the LEL. The observed methane concentrations in soil gas were found to be reduced almost immediately upon commencement of active gas collection. It has also been observed that the quantity of landfill gas being delivered to the gas flare has been slowly trending downward since the startup.

It is likely that the active landfill gas collection operation has also reduced the potential for VOC vapor intrusion in nearby residences. However, direct sampling of indoor air should be conducted to confirm this. It is recommended that indoor air samples be collected in accordance with EPA's 2002 Guidance Document and other sampling protocols described in that document. Indoor air samples should be conducted outside of the adjacent residences, inside the basements, and on the first floors. The VOCs to be sampled for include only those identified as present above the PALs and risk-based target concentrations at the Rose Hill Landfill site. It is recommended that samples be collected quarterly for a year to determine the following:

- Are VOCs detected in landfill gas on the site present in indoor air?
- If so, do the concentrations vary spatially (e.g. basement versus first floor) and over time?
- Is the gas flare/active gas venting having an effect on indoor air quality?

If VOCs are determined to be present, appropriate mitigation measures will be recommended upon receipt of results.

ATTACHMENT A

EPA INTERNAL DRAFT TABLES

VAPOR INTRUSION SCREENING, 2010

ATTACHMENT B

FIGURES

Risk-Based Vapor Intrusion Target Concentrations in Groundwater for Chemicals with MCLs

Chemical	MCL (ug/L)	Vapor Intrusion Target Concentration in Groundwater For Residents (ug/L)	Risk Basis for Target Concentration	
			ILCR	HQ
Benzene	5	1.36	1.00E-06	
Carbon tetrachloride	5	0.135	1.00E-06	
Chloroform [a]	80	0.705	1.00E-06	
1,2-Dichloroethane	5	2.34	1.00E-06	
Ethylbenzene	700	3.04	1.00E-06	
Heptachlor	0.4	0.0419	1.00E-06	
Hexachlorobenzene	1	0.0978	1.00E-06	
Hexachlorocyclopentadiene	50	0.18		1
Tetrachloroethylene	5	0.55	1.00E-06	
1,1,2-Trichloroethane	5	4.11	1.00E-06	
Trichloroethylene	5	2.89	1.00E-06	
Vinyl chloride	2	0.145	1.00E-06	

[a] The MCL for chloroform is the MCL for Total Trihalomethanes

MCL = Maximum Contaminant Level

ILCR = Incremental Lifetime Cancer Risk

HQ = Hazard Quotient

3/5/2010

Table 1: Comparative Generic Vapor Intrusion Screening Criteria Corresponding to Target Indoor Air Concentrations and Target Groundwater Concentrations for Chemicals Truncated at the MCL, Target Risk = 1E-06

						Target Indoor Air Concentration to Satisfy the Prescribed Risk Level (TR=1E-06 or THQ=1)		**Target Soil Gas Concentration Corresponding to Target Indoor Air Concentration where the Soil Gas to Indoor Air Attenuation Factor (α) = 0.1**			**Target Groundwater Concentration Corresponding to Target Indoor Air Concentration where the Soil Gas to Indoor Air Attenuation Factor (α) = 0.001 and Partitioning across the Water Table Obeys Henry's Law**	**MCL**	VI Risk at MCL
CAS No.	Chemical	Molecular Weight	Basis of Target Concentration C=Cancer Risk; N/C=Non cancer Risk	Inhalation Unit Risk ($\mu g/m^3)^{-1}$		Reference Concentration ($\mu g/m^3$)		$\mu g/m^3$	ppbv	$\mu g/m^3$	ppbv	Dimensionless Henry's Law Constant (unitless)	µg/L	µg/L	unitless
71432	Benzene	78	C	7.80E-06	I	3.00E+01	I	3.12E-01	9.8E-02	3.12E+00	9.8E-01	2.30E-01	1.36E+00	5.00E+00	3.70E-06
56235	Carbon tetrachloride	154	C	1.50E-05	I	1.90E+02	A	1.62E-01	2.6E-02	1.62E+00	2.6E-01	1.20E+00	1.35E-01	5.00E+00	3.70E-05
67663	Chloroform	119	C	2.30E-05	I	9.80E+01	A	1.06E-01	2.2E-02	1.06E+00	2.2E-01	1.50E-01	7.05E-01	8.00E+01	1.10E-04
107062	1,2-Dichloroethane	99	C	2.60E-05	I	2.40E+03	A	9.36E-02	2.3E-02	9.36E-01	2.3E-01	4.00E-02	2.34E+00	5.00E+00	2.10E-06
100414	Ethylbenzene	106	C	2.50E-06	C	1.00E+03	I	9.73E-01	2.2E-01	9.73E+00	2.2E+00	3.20E-01	3.04E+00	7.00E+02	2.30E-04
76448	Heptachlor	374	C	1.30E-03	I	NA		1.87E-03	1.2E-04	1.87E-02	1.2E-03	4.47E-02	4.19E-02	4.00E-01	9.50E-06
118741	Hexachlorobenzene	285	C	4.60E-04	I	NA		5.29E-03	4.5E-04	5.29E-02	4.5E-03	5.41E-02	9.78E-02	1.00E+00	1.00E-05
77474	Hexachlorocyclopentadiene	273	N/C	NA		2.00E-01	I	2.00E-01	1.8E-02	2.00E+00	1.8E-01	1.11E+00	1.80E-01	5.00E+01	HQ=278
127184	Tetrachloroethylene (PCE)	166	C	5.90E-06	C	2.70E+02	A	4.12E-01	6.1E-02	4.12E+00	6.1E-01	7.50E-01	5.50E-01	5.00E+00	9.10E-06
79005	1,1,2-Trichloroethane	133	C	1.60E-05	I	NA		1.52E-01	2.8E-02	1.52E+00	2.8E-01	3.70E-02	4.11E+00	5.00E+00	1.20E-06
79016	Trichloroethylene (TCE)	132	C	2.00E-06	C			1.22E+00	2.3E-01	1.22E+01	2.3E+00	4.21E-01	2.89E+00	5.00E+00	1.70E-06
79016	Trichloroethylene (TCE)	132	N/C			1.00E+01	N	1.00E+00	1.9E+00	1.00E+02	1.9E+01	4.21E-01	2.50E+01	5.00E+00	1.70E-06
75014	Vinyl chloride*	63	C	4.40E-06	I	1.00E+02	I	1.60E-01	6.3E-02	1.60E+00	6.3E-01	1.10E+00	1.45E-01	2.00E+00	4.00E-06

Notes: I = IRIS, A = ATSDR, C = CalEPA, N = NYSDOH

Carcinogenic Target Indoor Air ($\mu g/m^3$) = Target Cancer Risk x AT_c / (EF x ED x IUR)

where:

Target Cancer Risk = 1E-06, 1E-05, or 1E-04

AT_c = averaging time, carcinogens (25,550 days)

EF = exposure frequency for a resident (350 days/year)

ED = exposure duration for a resident (30 years)

IUR = inhalation unit risk $(ug/m^3)^{-1}$

Non-cancer Target Indoor Air ($\mu g/m^3$) =Target Hazard Quotient (THQ) x RfC

where:

THQ = 1

RfC = Reference Concentration ($\mu g/m^3$)

Concentrations in ppbv (conversion from $\mu g/m^3$ to ppbv) = C($\mu g/m^3$) x 10^9(ppb/atm) x 10^{-3}(m^3/L) x R x T/(MW x 10^6[µg/g])

where:

R = gas constant (0.0821 L-atm/mole-K)

T = absolute temperature (298K)

MW = molecular weight (g/mole)

Target Soil Gas ($\mu g/m^3$) = Target Indoor Air /α

where α = soil gas to indoor air attenuation factor (0.1 for target soil gas)

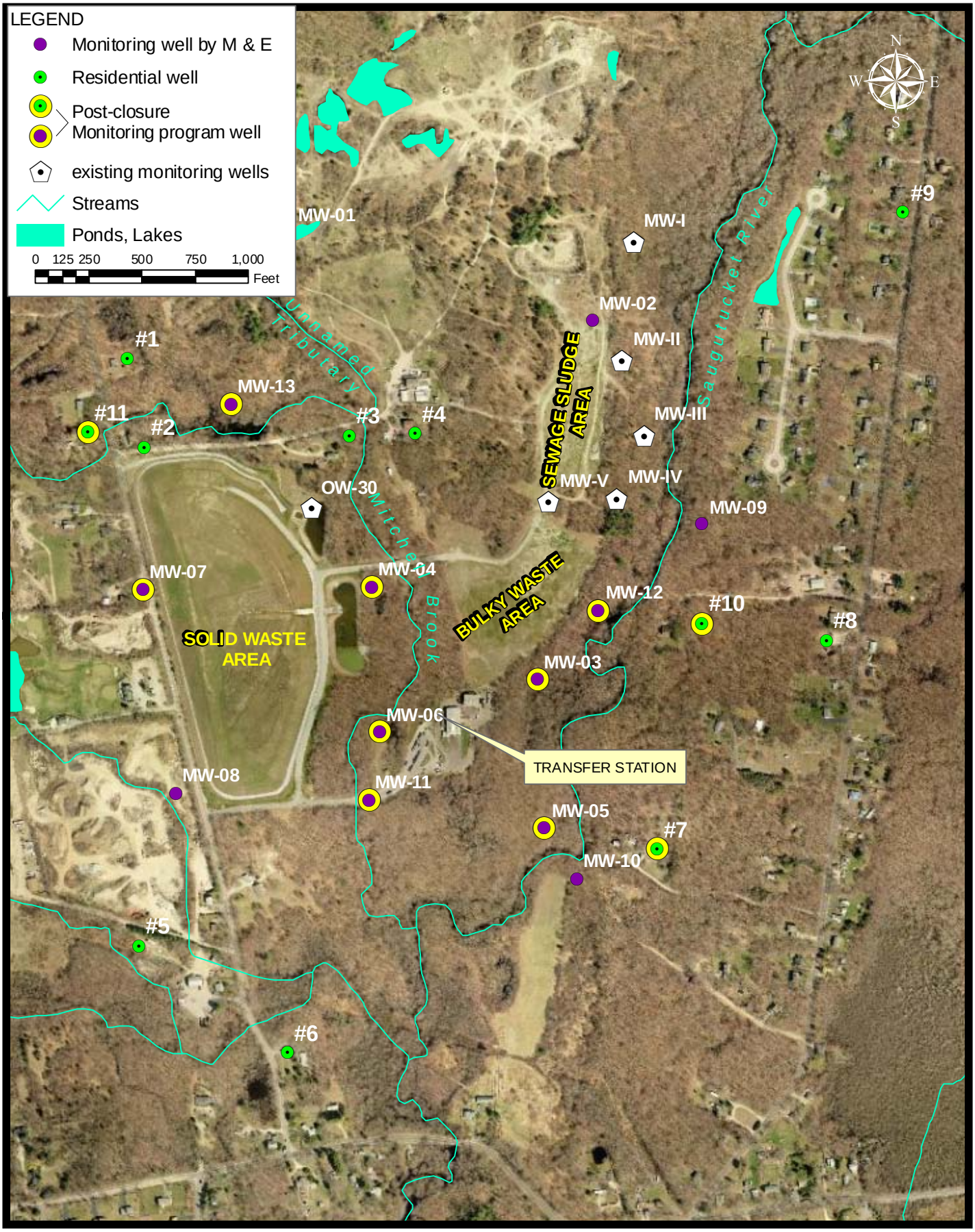
The soil gas to indoor air attenuation factor of α = 0.1 is used for all soil gas. Hence, screening values are for all soil gas.

Target Groundwater (µg/L) = Target Indoor Air x 10^3 m^3/L / (H x α)

where α = soil gas to indoor air attenuation factor (0.001 and partitioning across the water table obeys Henry's Law)

Equation can be found on the RSL User's Guide.

*Early-life exposure is accounted for in this calculation



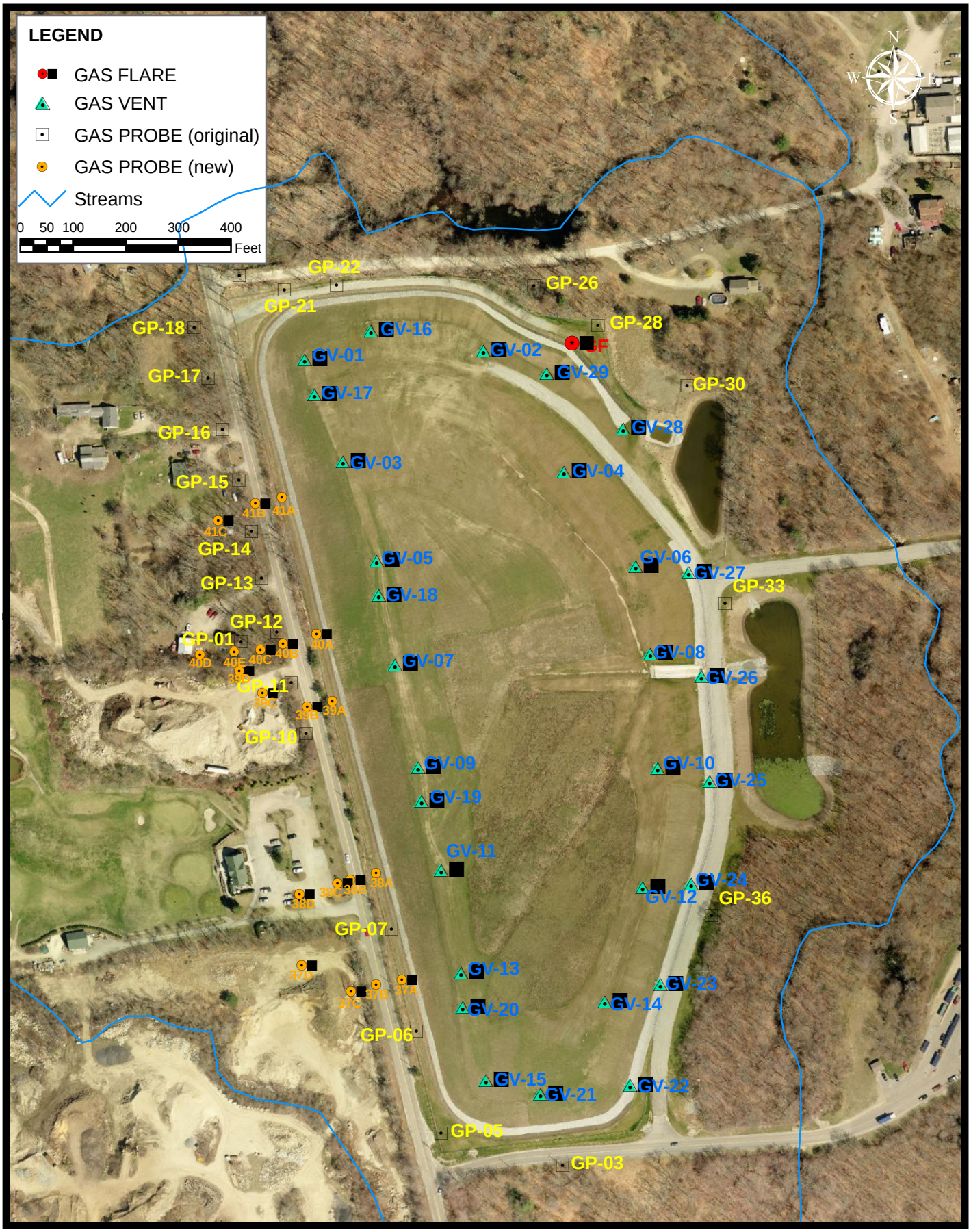
RI Department of Environmental Management

The Louis Berger Group, Inc.

Remedial Action - Rose Hill Landfill

Figure 3: POST CLOSURE MONITORING PROGRAM GROUNDWATER

Source: URI, RIDEM, M&E | *Groundwater_loc* | May 2010



RI Department of Environmental Management

The Louis Berger Group, Inc.

Remedial Action - Rose Hill Landfill

Figure 5: POST CLOSURE MONITORING PROGRAM LANDFILL GAS

Source: URI, RIDEM, M&E | *Landfill Gas Map* | May 2010

Memorandum

Date: June 22, 2010

From: Claire Willscher, Human Health Risk Assessor, Technical Support & Site Assessment

To: Dave Newton, RPM

Subj: Vapor Intrusion Assessment for Rose Hill Regional Landfill Superfund Site

In response to your request I have reviewed the groundwater data that are applicable for screening the vapor intrusion exposure pathway. A comparison of groundwater data to the screening values provided in the 2002 OSWER Draft Guidance for Evaluating the Vapor Intrusion Pathway and the Region 1 Risk-Based Vapor Intrusion Target Concentrations in Groundwater for Chemicals with MCLs (March 11, 2010) shows that vapor intrusion does not pose an unacceptable risk at this time. However, I recommend that groundwater samples continue to be collected and depth to groundwater measurements be taken at RES-11 and other site wells; and that these data be evaluated as they relate to abutting property uses and the potential for vapor intrusion into indoor air at least annually. I also recommend that the detection limit for vinyl chloride be lowered so that the data can be evaluated at the appropriate screening concentration.

The groundwater data used for screening were provided by The Louis Berger Group from the Quarterly Monitoring Reports for Rose Hill Landfill. Data from the following reports were used in the review: April-May 2008, July 2008, April 2009, July 2009, April 2010. Wells MW-03-S, MW-03-BR, MW-04-S, MW-04-DO, MW-05-S, MW-06-DO, MW-07-DO, MW-07-BR, MW-11-S, MW-11-DO, MW-11-BR, MW-12-S, MW-12-DO, MW-13-S, RES#7, RES#10 and RES-11 were sampled during each of these five sampling rounds.

Three wells (MW-07, Res-11 and MW-13) were of primary concern for this review due to their close proximity to residential buildings. MW-07 is located immediately to the west of the landfill along Rose Hill Road. This well is located within 100ft of the residence at 278 Rose Hill Road. Res-11 is located to the northwest of the site within 100ft of the residence near the intersection of Pearl's Way and Rose Hill Road. MW-13 is located immediately north of the site. This well is not within 100ft of any structure presently on-site, but is in close proximity to site residences relative to other wells for which there are data. These well locations are thought to be an adequate representation for the purposes of evaluating the potential for vapor intrusion from groundwater based on site hydrology and the established site conceptual model. The data associated with these wells were screened against the residential values based on the current site use.

Over the five sampling rounds only 1,1-dichloroethane, chlorobenzene, benzene, cis-1,2-dichloroethene, ethyl ether and tetrahydrofuran were detected in MW-07. None of these VOCs exceeded the residential screening value, and all, with the exception of benzene, were detected at concentrations at least 10-fold lower than the corresponding vapor intrusion screening concentrations. The maximum detected concentration of benzene at MW-07 was 1.2 ug/L in

July 2009, and the Region 1 screening concentration based on the IRIS inhalation unit risk of 7.8E-06 $(ug/m^3)^{-1}$ is 1.36 ug/L. No VOC concentrations were detected at RES-11 or MW-13 over these five sampling rounds. Please note that data regarding the depth to groundwater at RES-11 were not available for this review. The 2002 OSWER Guidance recommends that groundwater should be within 100ft vertically of the structure in question to be applicable for screening. I recommend that this data be collected during future sampling rounds if possible.

While concentrations detected at these wells did not exceed the screening levels, a comparison of the detection limits to the corresponding screening levels identifies that the detection limit for vinyl chloride should be lowered in order to most accurately perform a vapor intrusion screening. The reporting limit for vinyl chloride (1.0 ug/L) exceed the Region 1 10^{-6} groundwater screening concentration (0.145 ug/L) and therefore raises the question of whether vinyl chloride may be present in groundwater at concentrations that may be of interest for the vapor intrusion pathway. For future sampling rounds I recommend that the detection limit be low enough to adequately evaluate data at concentrations down to the groundwater screening concentration.

Of the other wells sampled, only MW-04-DO, MW-06-DO, MW-11-S and MW-11-DO had VOC concentrations (benzene and vinyl chloride) that exceeded the residential screening levels for the vapor intrusion pathway. MW-04 is located east of the landfill and west of Mitchell Brook. There are no structures in this area or immediately downgradient of the well and therefore no complete exposure pathway exists. Neither MW-06 nor MW-11 is located near any residential structures, but both are within the vicinity of the transfer station near the southeastern area of the Site. Though the screening levels for benzene and vinyl chloride were exceeded, there is no complete vapor intrusion exposure pathway because the building is an open structure. I recommend that the vapor intrusion pathway be reassessed if structures are built in these areas in the future.

Region 1 does not use soil gas data as the primary means for analysis of the vapor intrusion pathway. Studies have shown that soil gas concentrations are not well correlated with indoor air concentrations and therefore they do not provide a strong first line of evidence to support or refute the potential for the migration of vapors into indoor air. However a review of site soil gas data identifies a supporting line of evidence for the conclusion drawn from the site groundwater data. A review of the eight rounds of sampling data collected between April/May 2008 and April 2010 shows that the soil gas concentrations in the vicinity of the residences along Rose Hill Road (GP-11, GP-16, GP-18 and GP-21) generally decreased to concentrations below soil gas screening values in the April 2010 sampling round (attributed to the site flare becoming active in early 2010). This supports the conclusion, drawn from the review of the groundwater data, that the vapor intrusion pathway presently does not pose an unacceptable risk.

At this time the vapor intrusion pathway does not pose an unacceptable risk based on the information provided above. I recommend that groundwater concentrations and depth to groundwater continue to be monitored so that this pathway can be reassessed annually in the residential areas and in the future should structures be built in other areas of the site. I also recommend that the detection limit for vinyl chloride be lowered so that the data can be evaluated at the appropriate screening concentration.

APPENDIX H

TREND ANALYSIS GRAPHS

LIST OF TREND ANALYSIS GRAPHS

Groundwater
May 2003 – April 2010

Vinyl Chloride
Tetrahydrofuran
1,4-Dichlorobenzene
Benzene
Trichloroethene
Manganese

Surface Water
May 2003 – April 2010

Total Aluminum
Total Lead
Total Copper
Total Zinc
Total Iron
Total Manganese
Dissolved Aluminum
Dissolved Lead
Dissolved Copper
Dissolved Zinc
Dissolved Iron
Dissolved Manganese

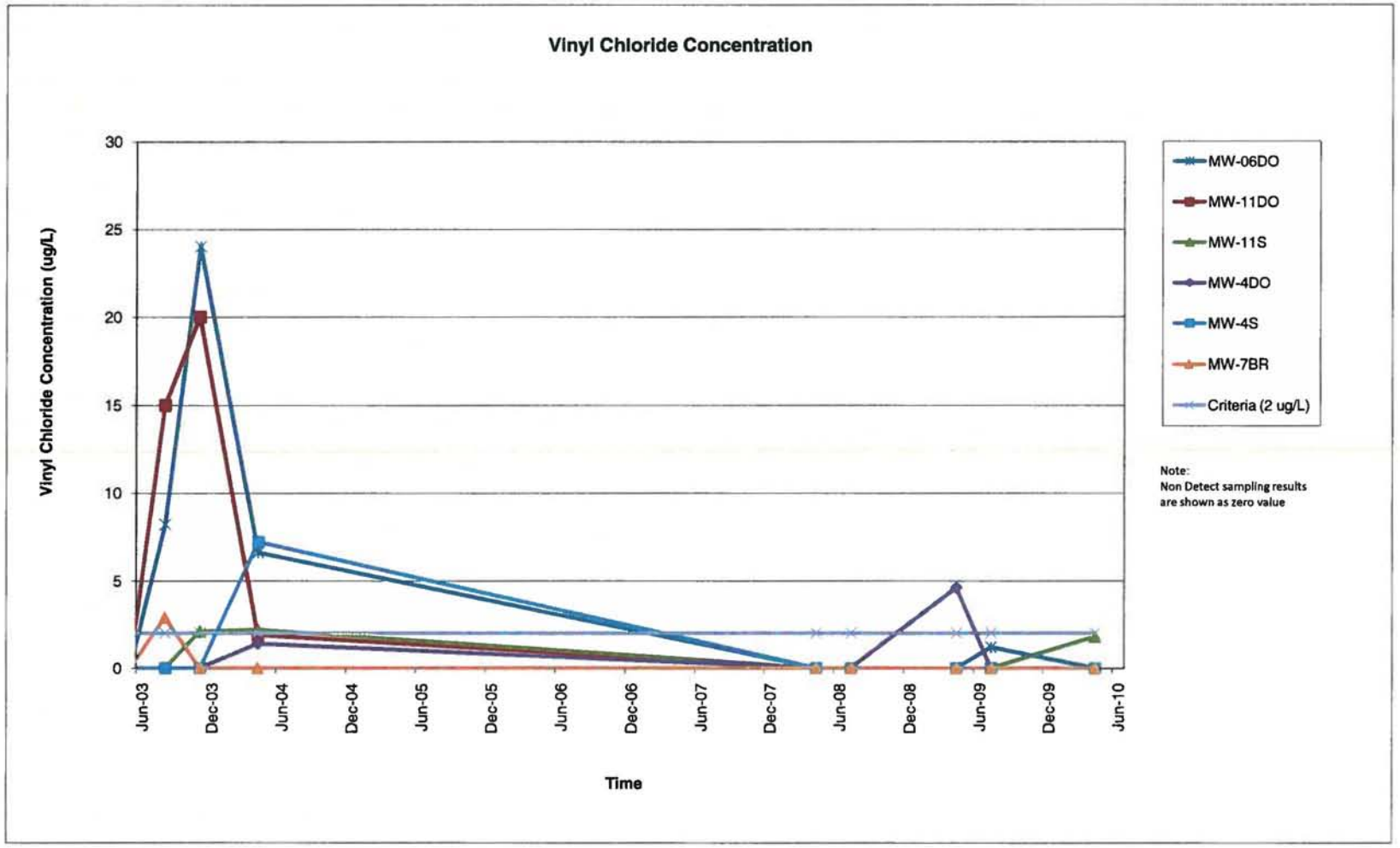
Landfill Gas:
April 2008 – April 2010

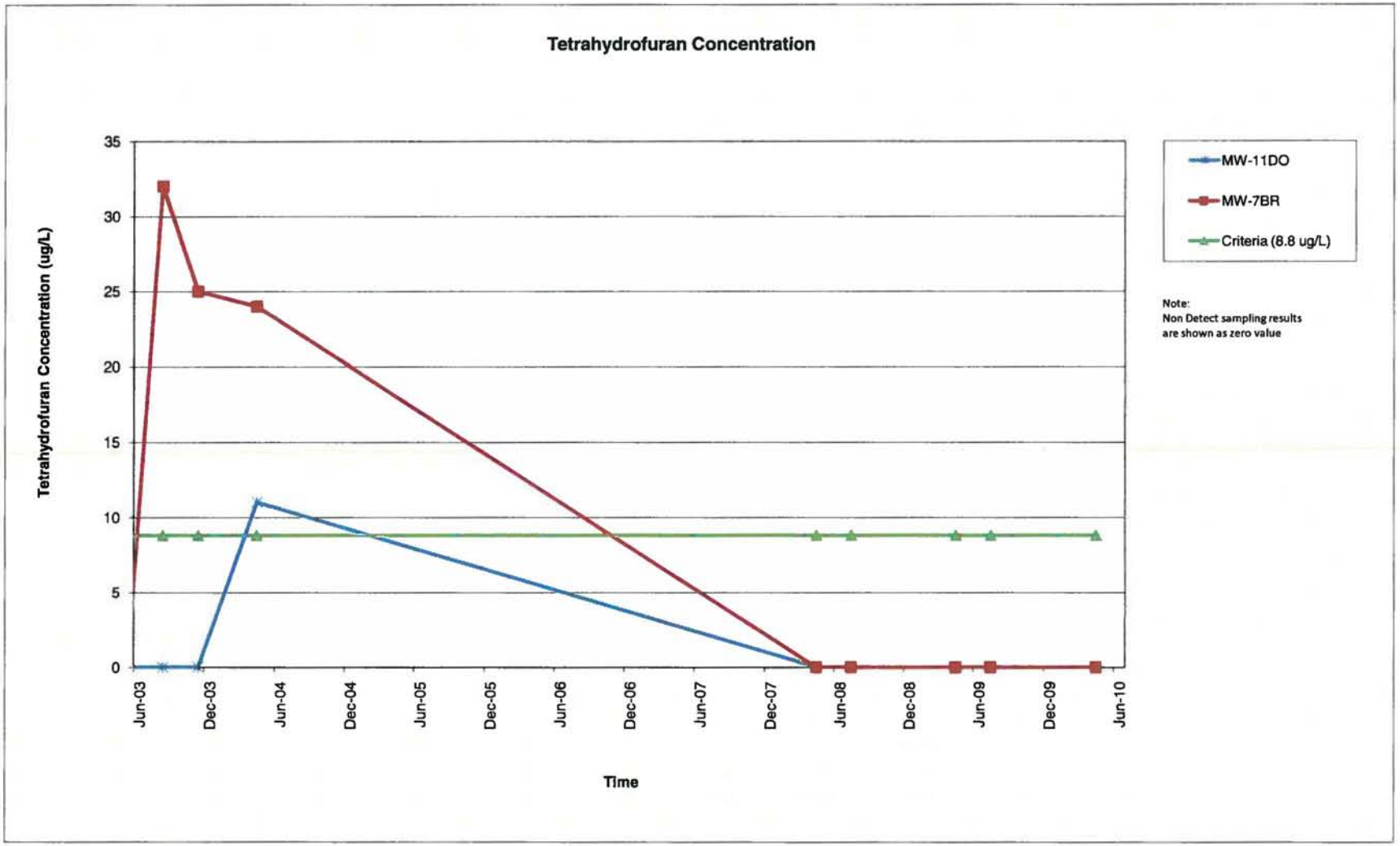
Chloroform
Benzene
Dichlorodifluoromethane
n-hexane
Toluene
Trichloroethane
Vinyl Chloride
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Tetrachloroethene
Trans-1,2-Dichloroethene
Methane

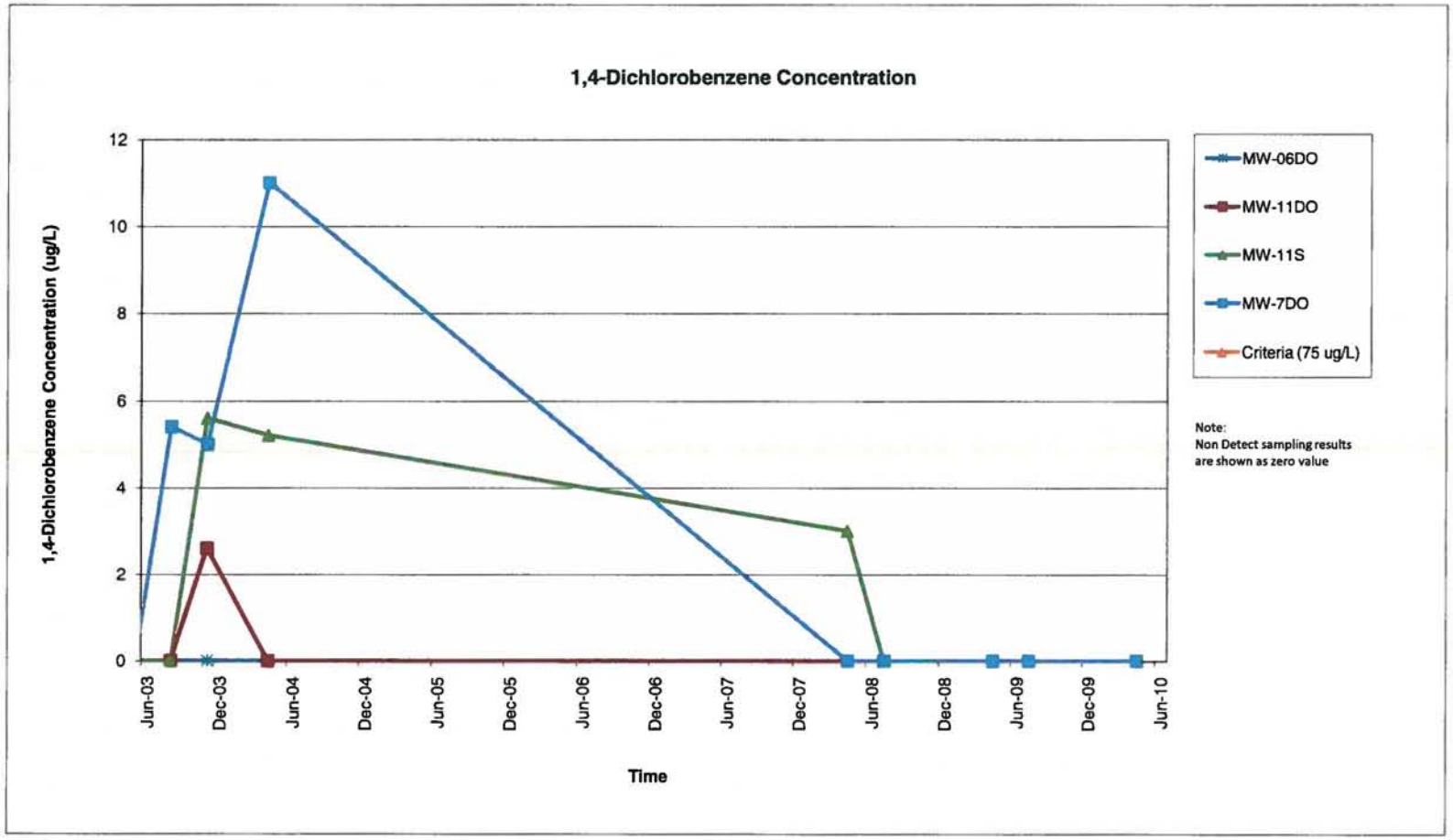
Trend Analysis Graphs

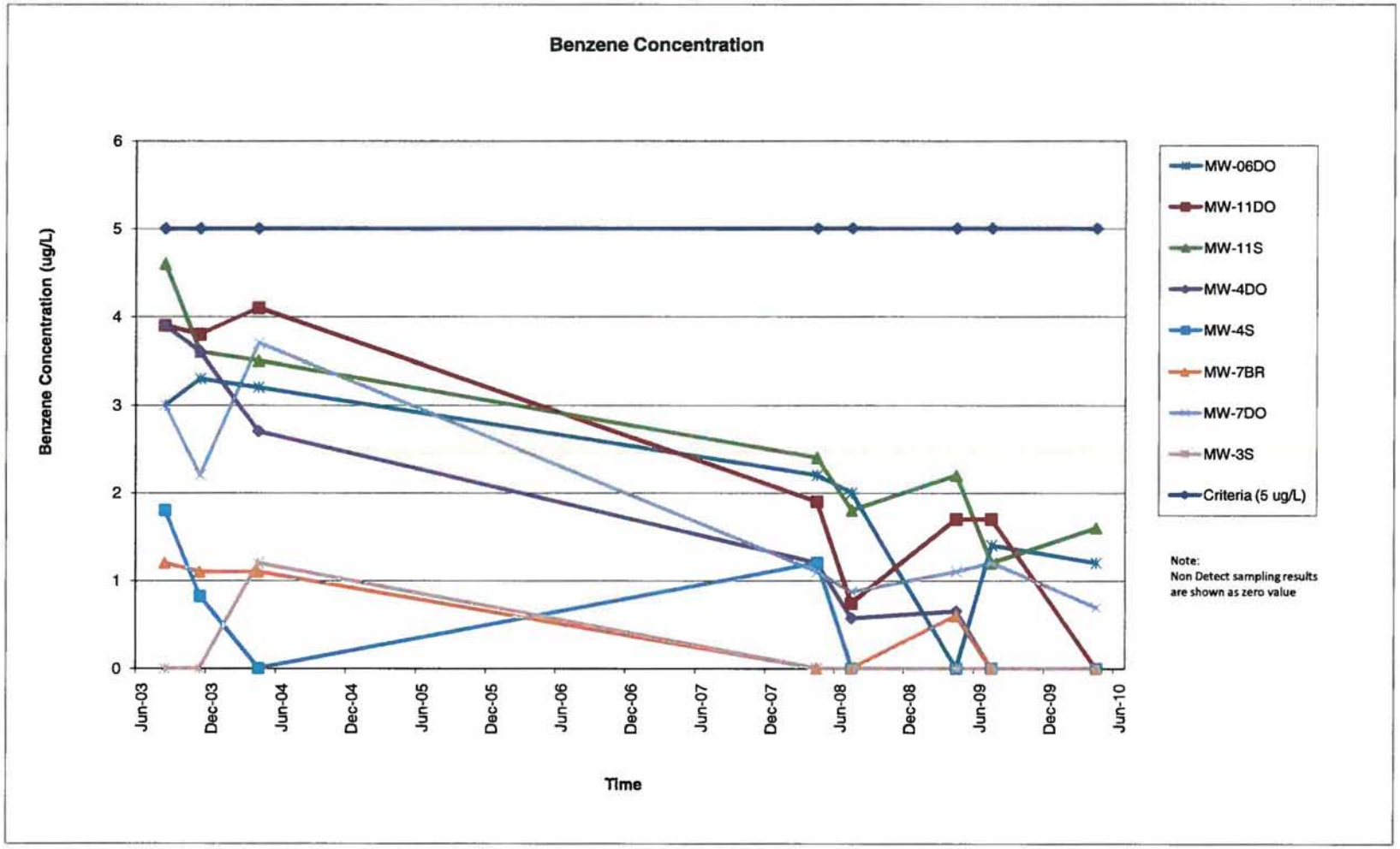
Groundwater

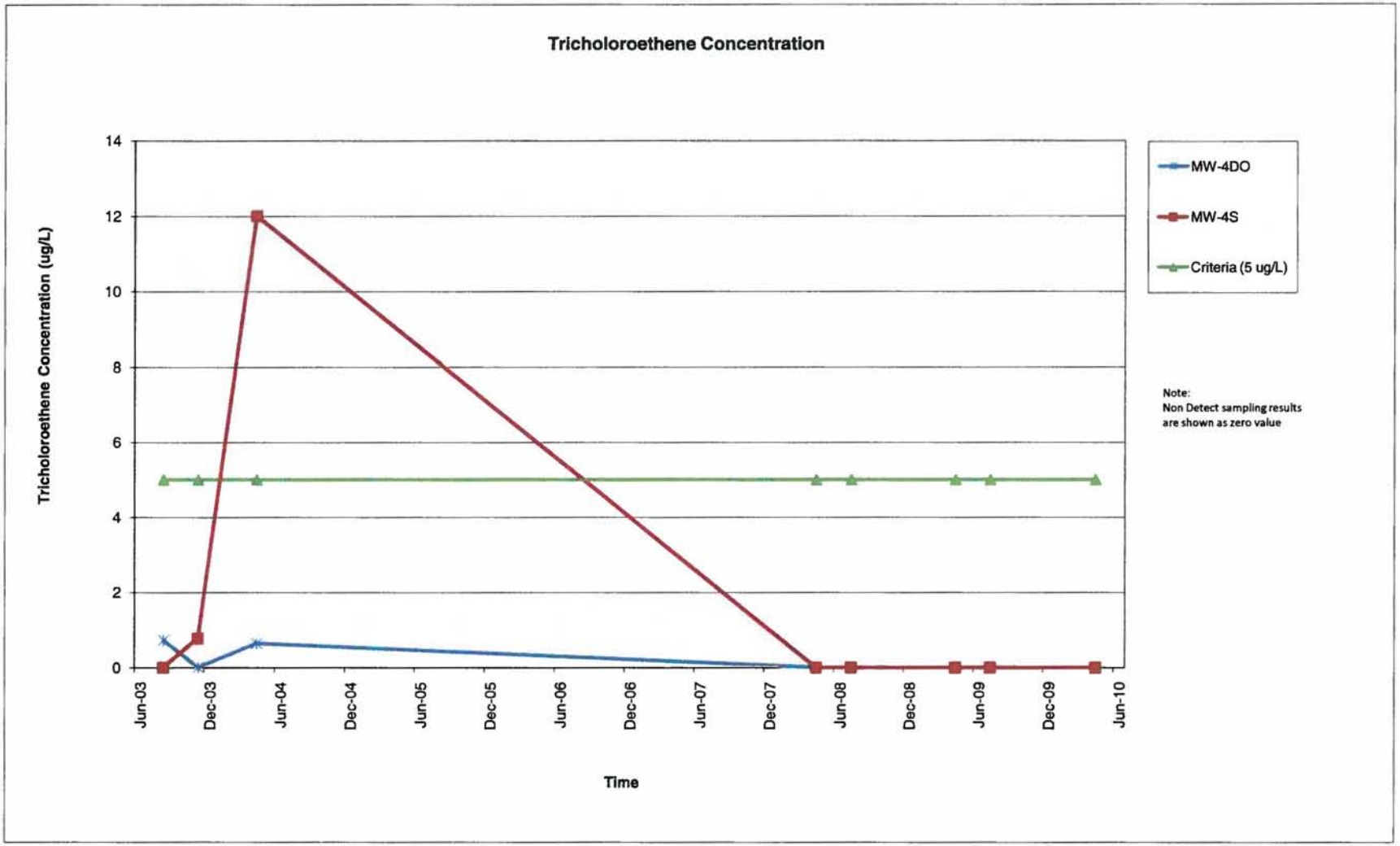
Vinyl Chloride
Tetrahydrofuran
1,4-Dichlorobenzene
Benzene
Trichloroethene
Manganese

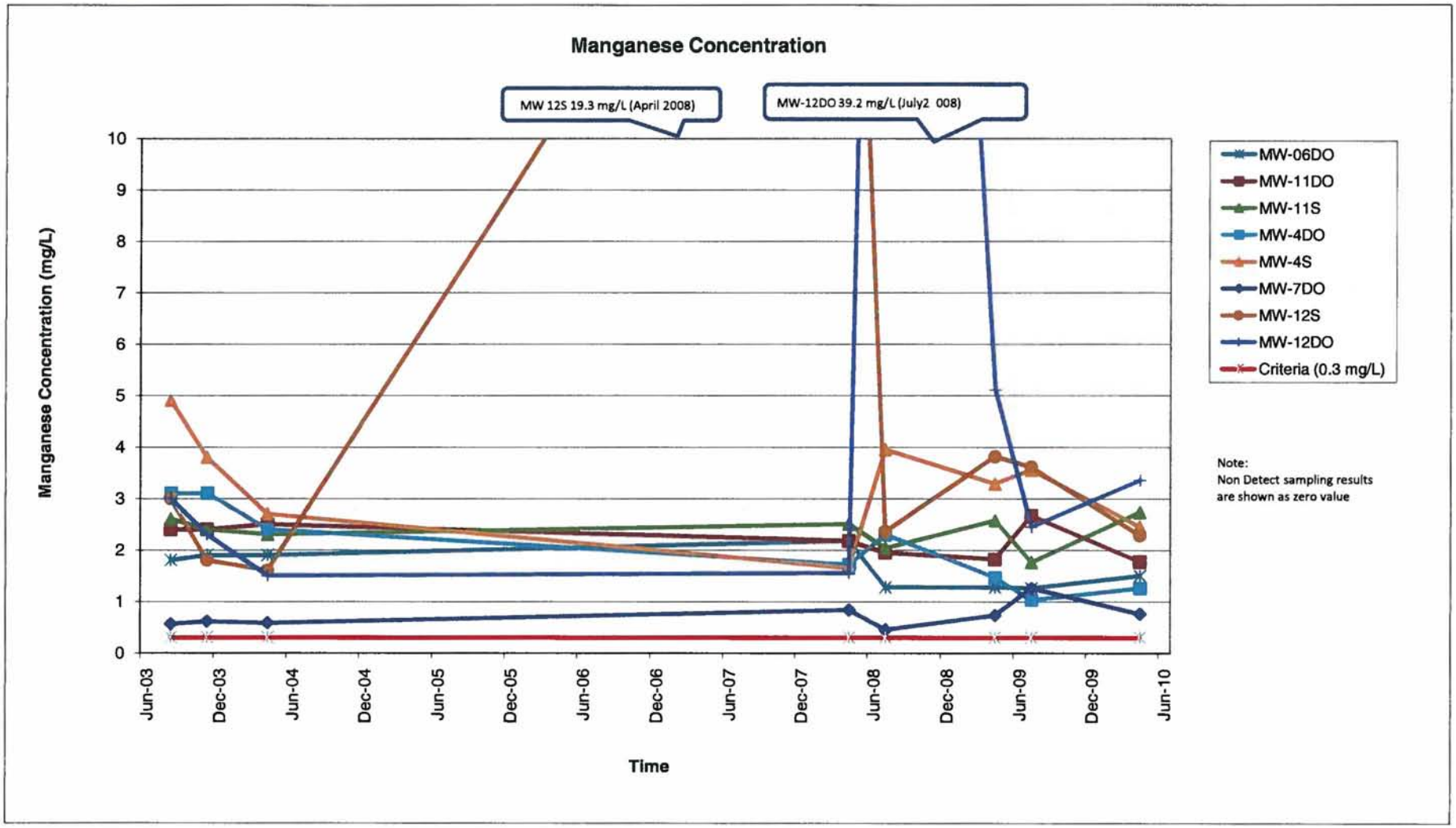

Vinyl Chloride Concentration
Vinyl Chloride Concentration (ug/L)
30
25
20
15
10
5
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
MW-06DO
MW-11DO
MW-11S
MW-4DO
MW-4S
MW-7BR
Criteria (2 ug/L)
Note:
Non Detect sampling results
are shown as zero value


Tetrahydrofuran Concentration
Tetrahydrofuran Concentration (ug/L)
35
30
25
20
15
10
5
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
MW-11DO
MW-7BR
Criteria (8.8 ug/L)
Note:
Non Detect sampling results
are shown as zero value


1,4-Dichlorobenzene Concentration
1,4-Dichlorobenzene Concentration (ug/L)
12
10
8
6
4
2
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
MW-06DO
MW-11DO
MW-11S
MW-7DO
Criteria (75 ug/L)
Note:
Non Detect sampling results
are shown as zero value


Benzene Concentration
Benzene Concentration (ug/L)
6
5
4
3
2
1
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
MW-06DO
MW-11DO
MW-11S
MW-4DO
MW-4S
MW-7BR
MW-7DO
MW-3S
Criteria (5 ug/L)
Note:
Non Detect sampling results
are shown as zero value


Tricholoroethene Concentration
Tricholoroethene Concentration (ug/L)
14
12
10
8
6
4
2
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
MW-4DO
MW-4S
Criteria (5 ug/L)
Note:
Non Detect sampling results
are shown as zero value

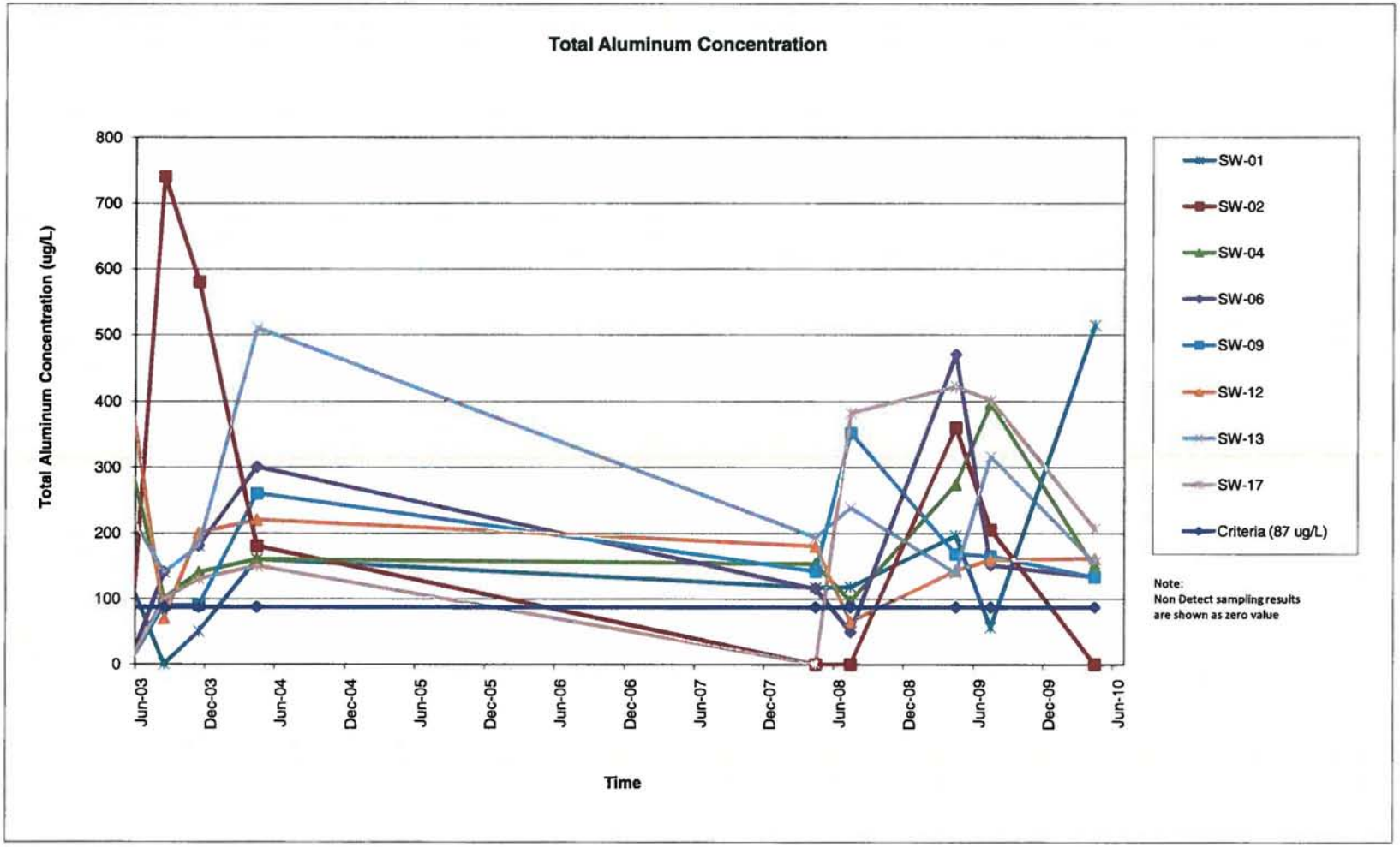

Manganese Concentration
MW 12S 19.3 mg/L (April 2008)
MW-12DO 39.2 mg/L (July2 008)
Manganese Concentration (mg/L)
10
9
8
7
6
5
4
3
2
1
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
MW-06DO
MW-11DO
MW-11S
MW-4DO
MW-4S
MW-7DO
MW-12S
MW-12DO
Criteria (0.3 mg/L)
Note:
Non Detect sampling results
are shown as zero value

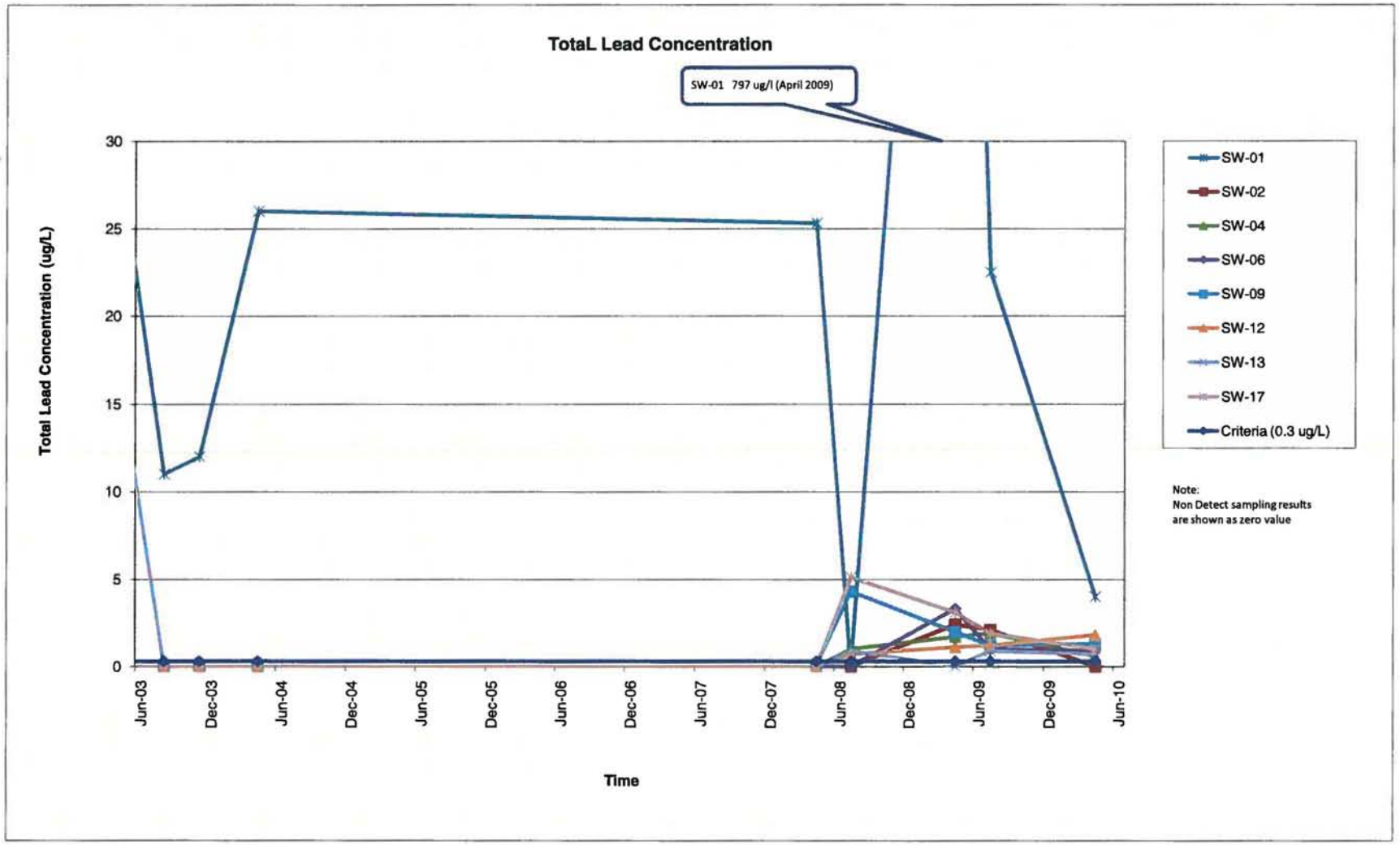
Trend Analysis Graphs

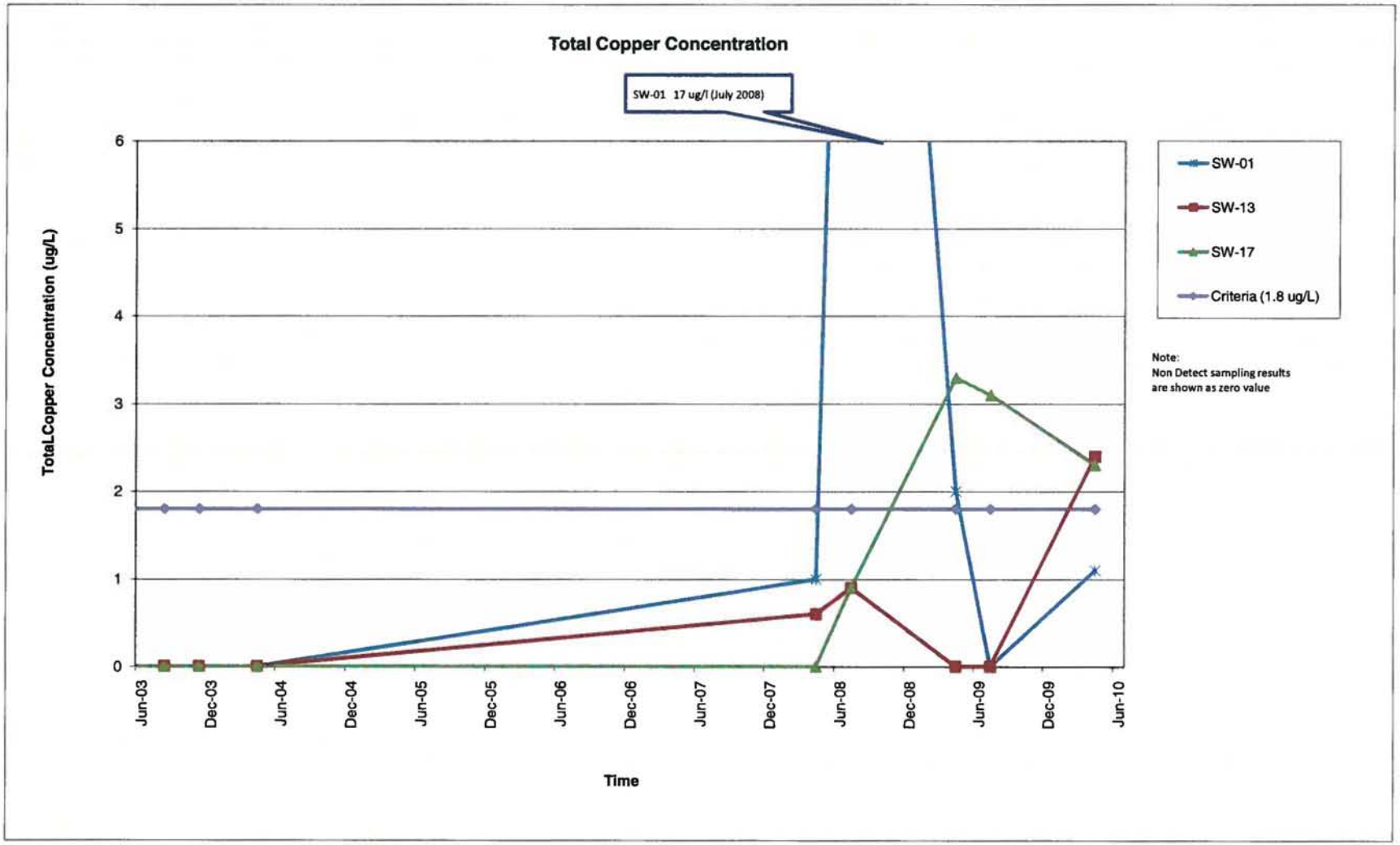
Surface Water

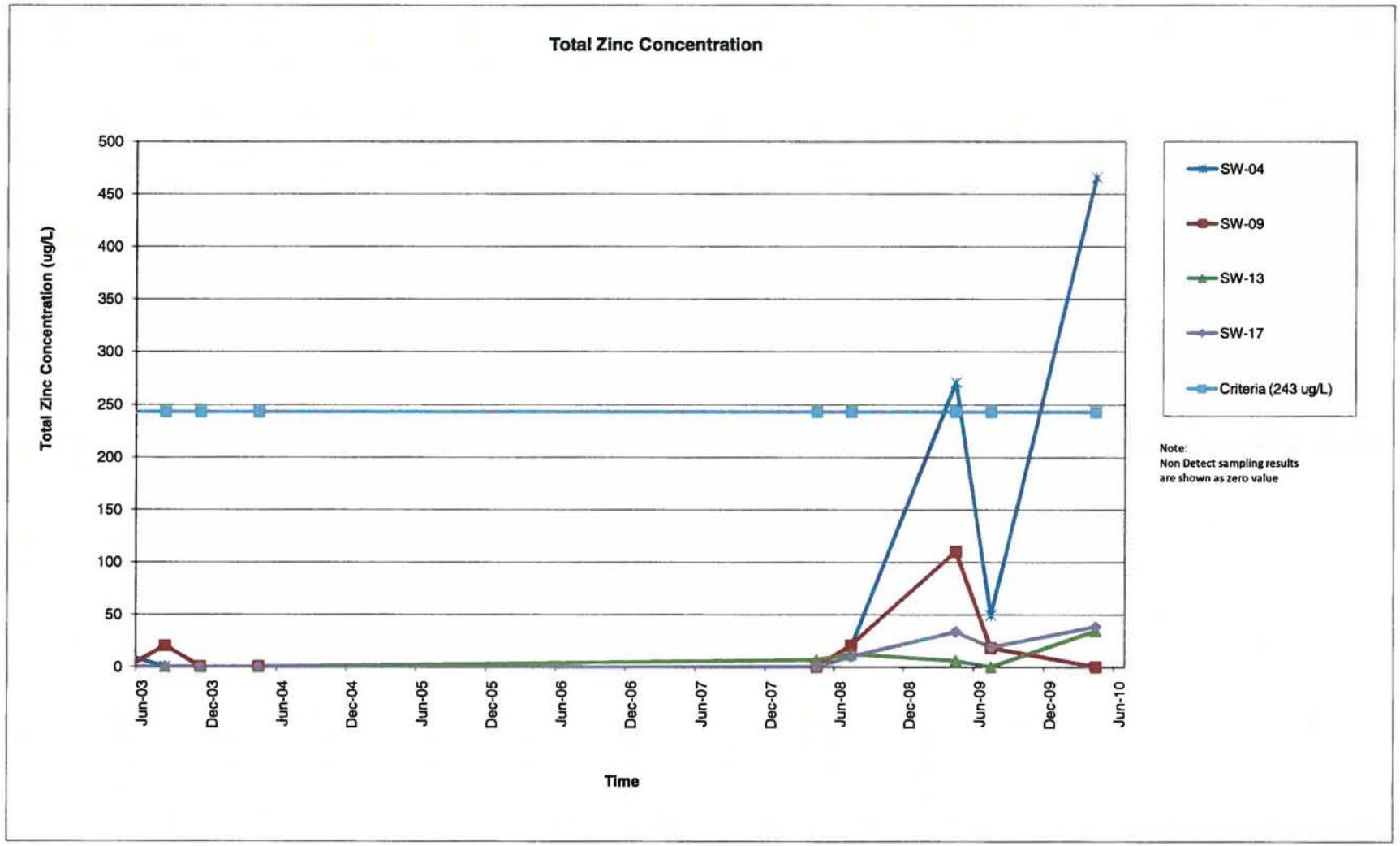
Total Aluminum
Total Lead
Total Copper
Total Zinc
Total Iron
Total Manganese

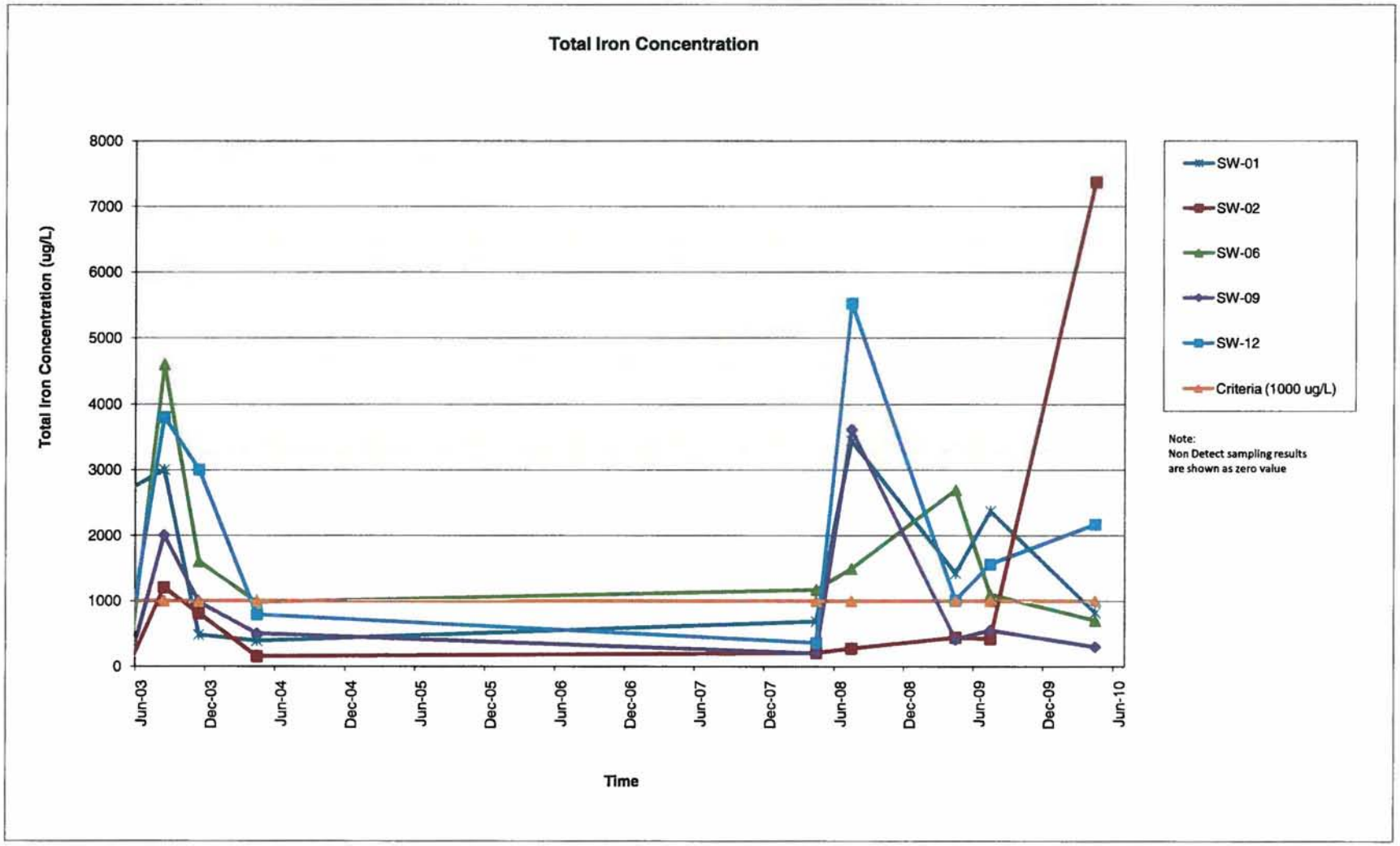
Dissolved Aluminum
Dissolved Lead
Dissolved Copper
Dissolved Zinc
Dissolved Iron
Dissolved Manganese

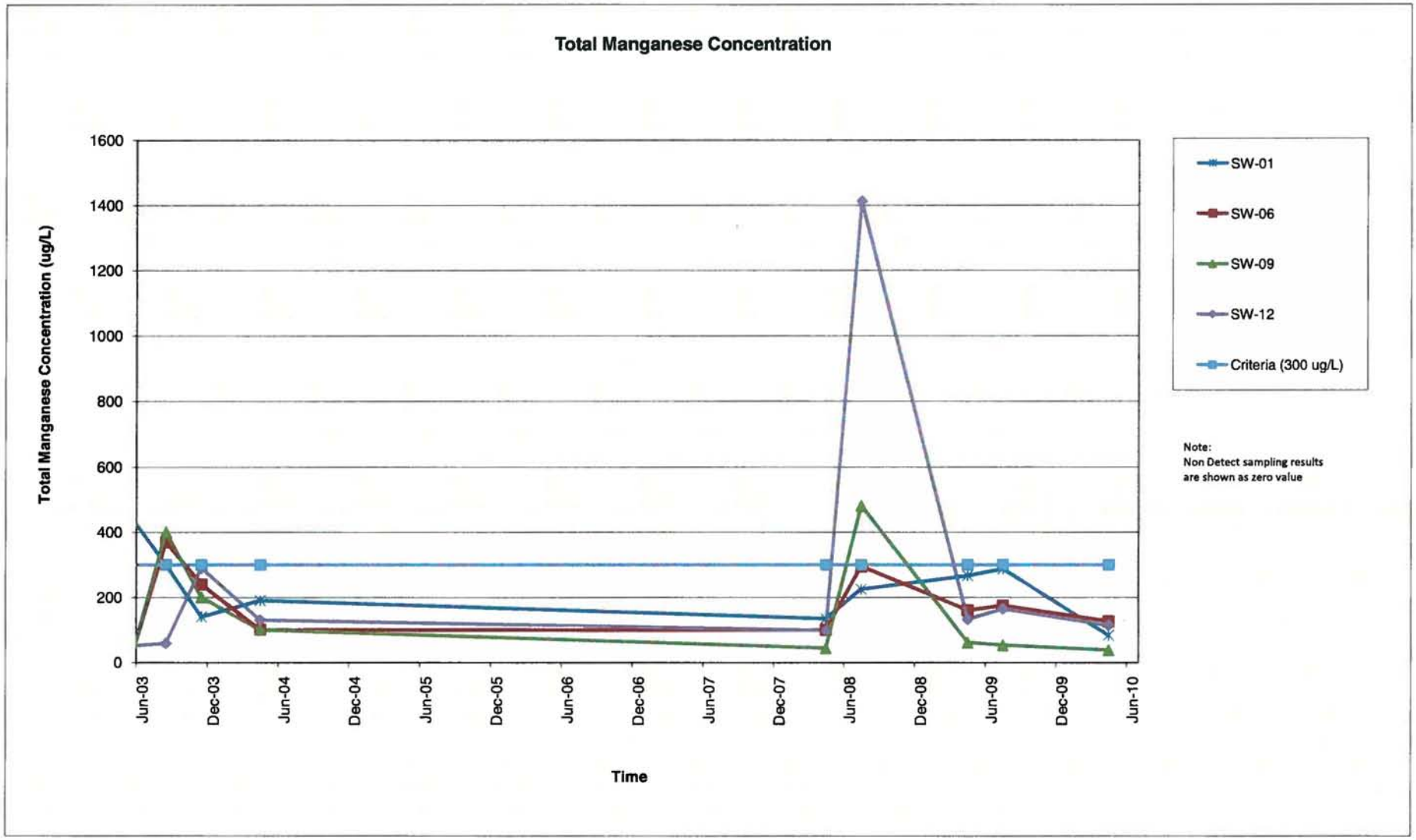

Total Aluminum Concentration
Total Aluminum Concentration (ug/L)
800
700
600
500
400
300
200
100
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
SW-01
SW-02
SW-04
SW-06
SW-09
SW-12
SW-13
SW-17
Criteria (87 ug/L)
Note:
Non Detect sampling results
are shown as zero value

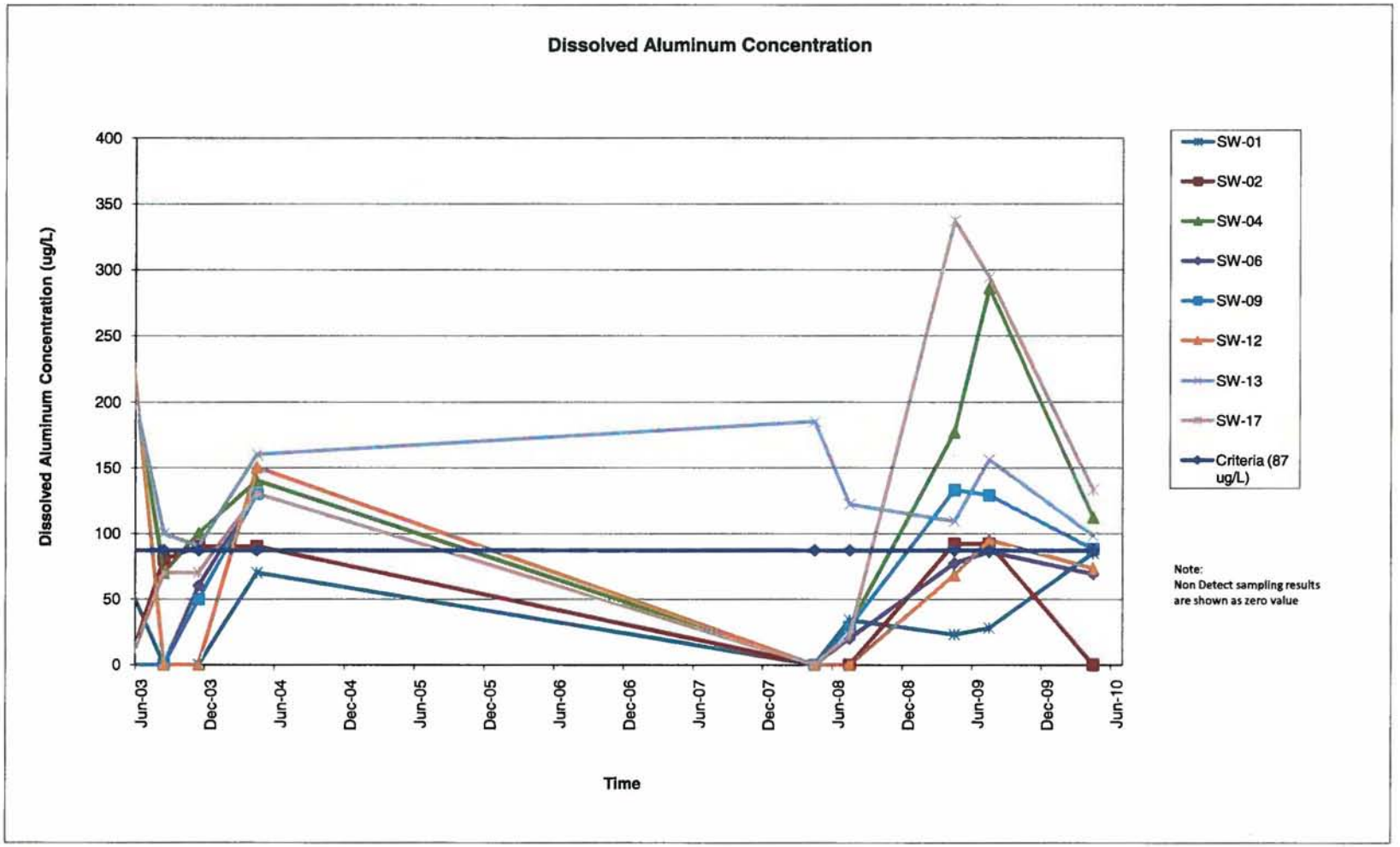

TotaL Lead Concentration
SW-01 797 ug/l (April 2009)
Total Lead Concentration (ug/L)
30
25
20
15
10
5
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
SW-01
SW-02
SW-04
SW-06
SW-09
SW-12
SW-13
SW-17
Criteria (0.3 ug/L)
Note:
Non Detect sampling results
are shown as zero value

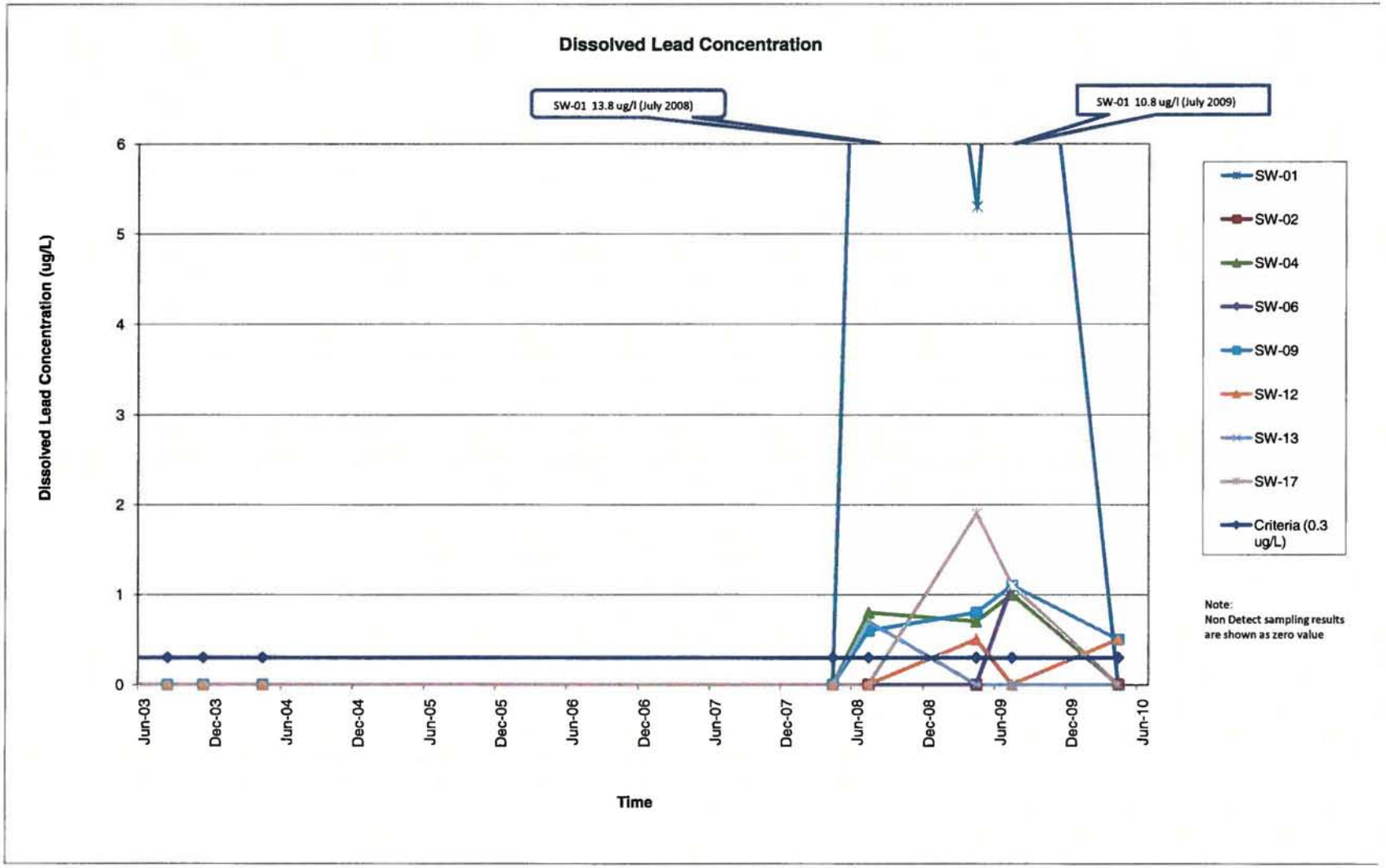

Total Copper Concentration
SW-01 17 ug/l (July 2008)
TotalCopper Concentration (ug/L)
0
1
2
3
4
5
6
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
SW-01
SW-13
SW-17
Criteria (1.8 ug/L)
Note:
Non Detect sampling results
are shown as zero value

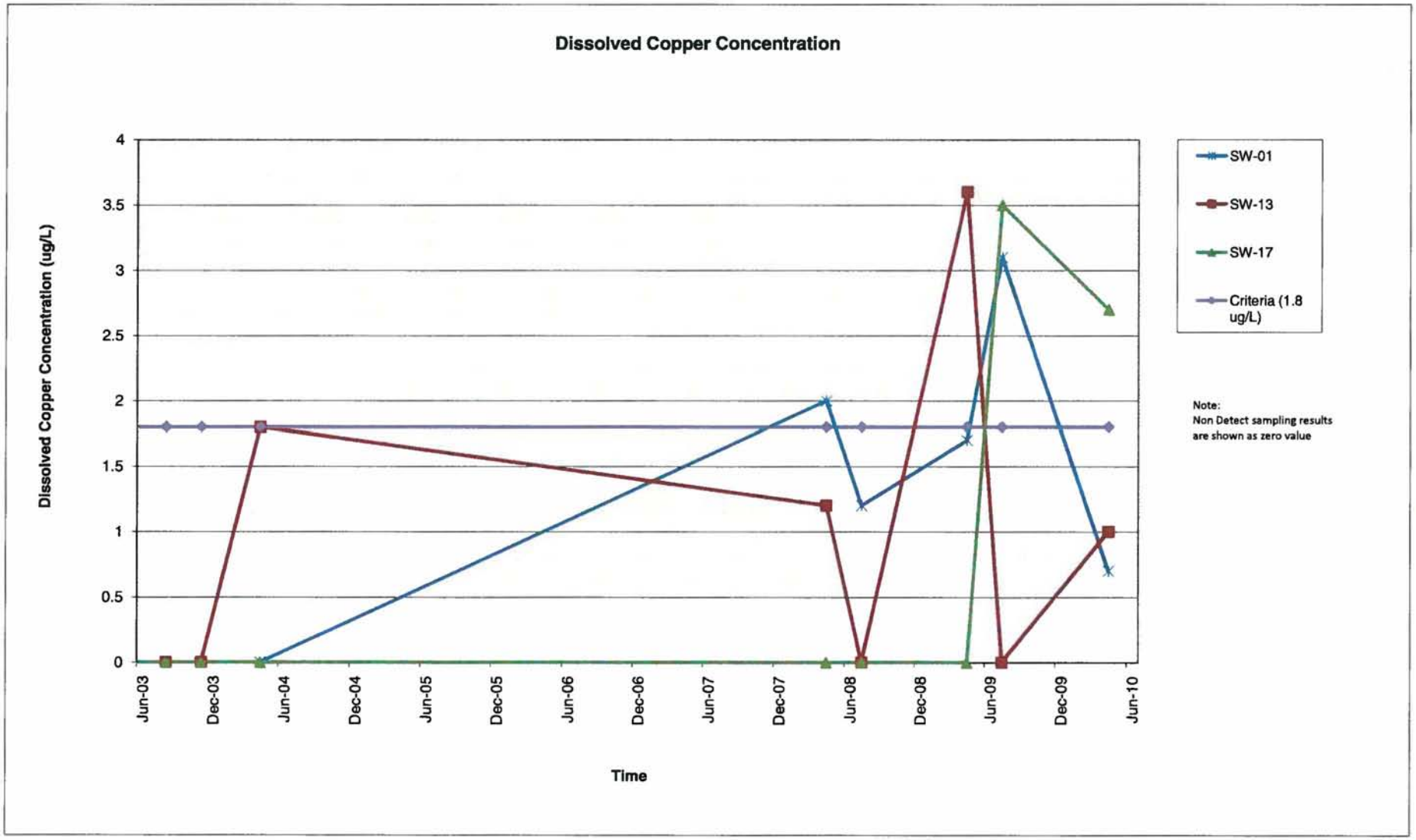

Total Zinc Concentration
Total Zinc Concentration (ug/L)
500
450
400
350
300
250
200
150
100
50
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
SW-04
SW-09
SW-13
SW-17
Criteria (243 ug/L)
Note:
Non Detect sampling results
are shown as zero value

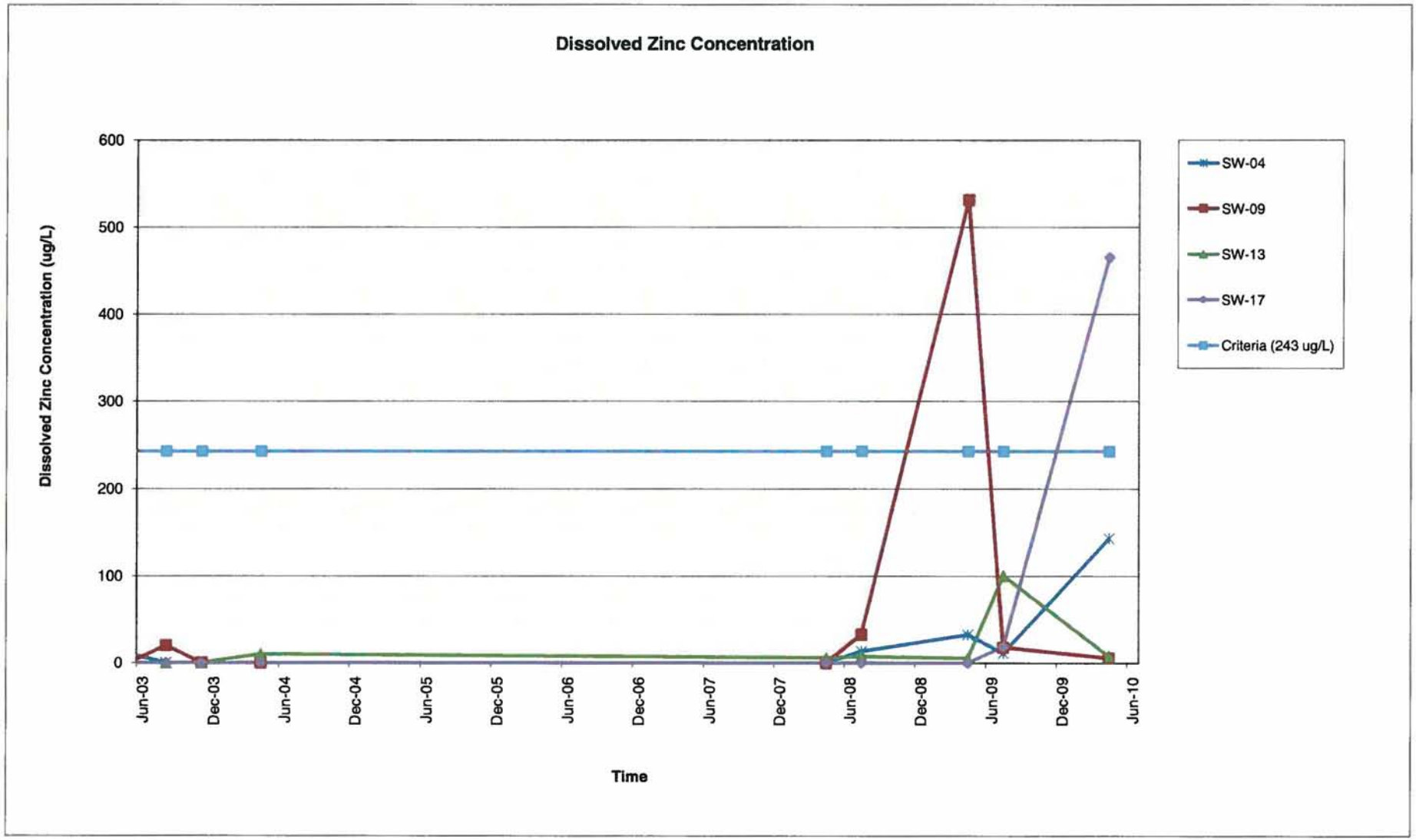

Total Iron Concentration
Total Iron Concentration (ug/L)
8000
7000
6000
5000
4000
3000
2000
1000
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
SW-01
SW-02
SW-06
SW-09
SW-12
Criteria (1000 ug/L)
Note:
Non Detect sampling results
are shown as zero value

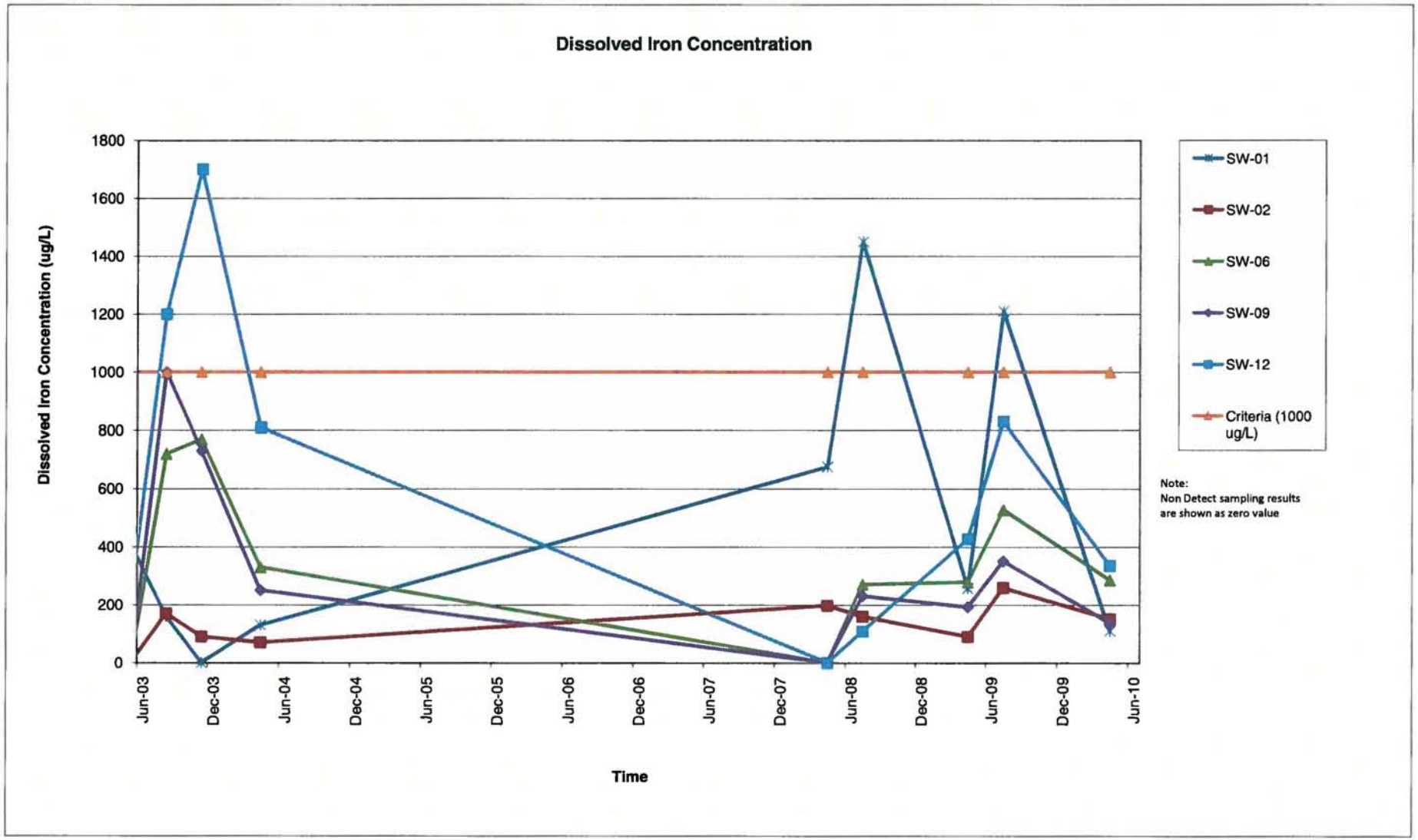

Total Manganese Concentration
Total Manganese Concentration (ug/L)
1600
1400
1200
1000
800
600
400
200
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
SW-01
SW-06
SW-09
SW-12
Criteria (300 ug/L)
Note:
Non Detect sampling results
are shown as zero value

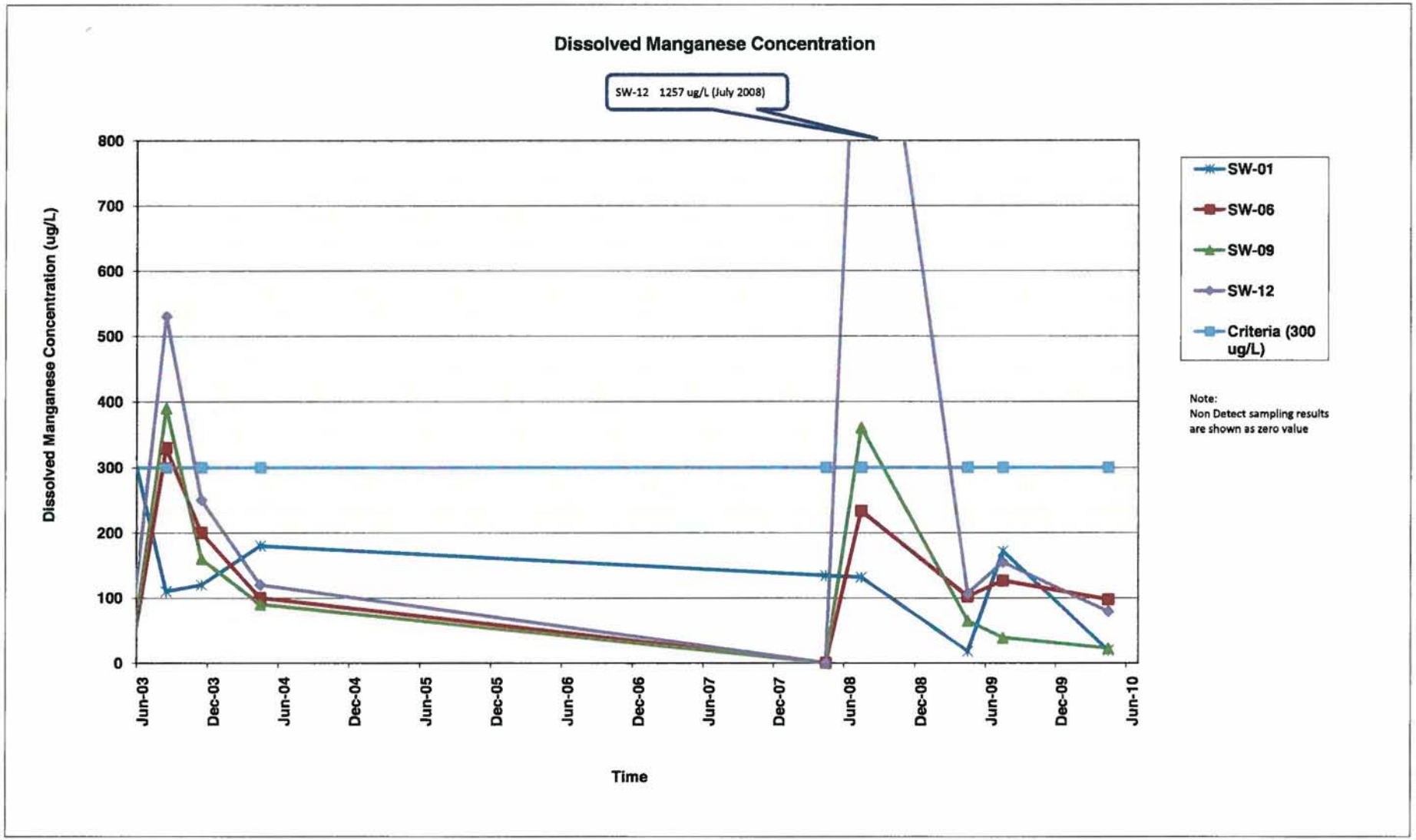

Dissolved Aluminum Concentration
Dissolved Aluminum Concentration (ug/L)
400
350
300
250
200
150
100
50
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
SW-01
SW-02
SW-04
SW-06
SW-09
SW-12
SW-13
SW-17
Criteria (87 ug/L)
Note:
Non Detect sampling results are shown as zero value


Dissolved Lead Concentration
SW-01 13.8 ug/l (July 2008)
SW-01 10.8 ug/l (July 2009)
Dissolved Lead Concentration (ug/L)
6
5
4
3
2
1
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
SW-01
SW-02
SW-04
SW-06
SW-09
SW-12
SW-13
SW-17
Criteria (0.3 ug/L)
Note:
Non Detect sampling results are shown as zero value


Dissolved Copper Concentration
Dissolved Copper Concentration (ug/L)
4
3.5
3
2.5
2
1.5
1
0.5
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
SW-01
SW-13
SW-17
Criteria (1.8 ug/L)
Note:
Non Detect sampling results are shown as zero value


Dissolved Zinc Concentration
Dissolved Zinc Concentration (ug/L)
600
500
400
300
200
100
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
SW-04
SW-09
SW-13
SW-17
Criteria (243 ug/L)

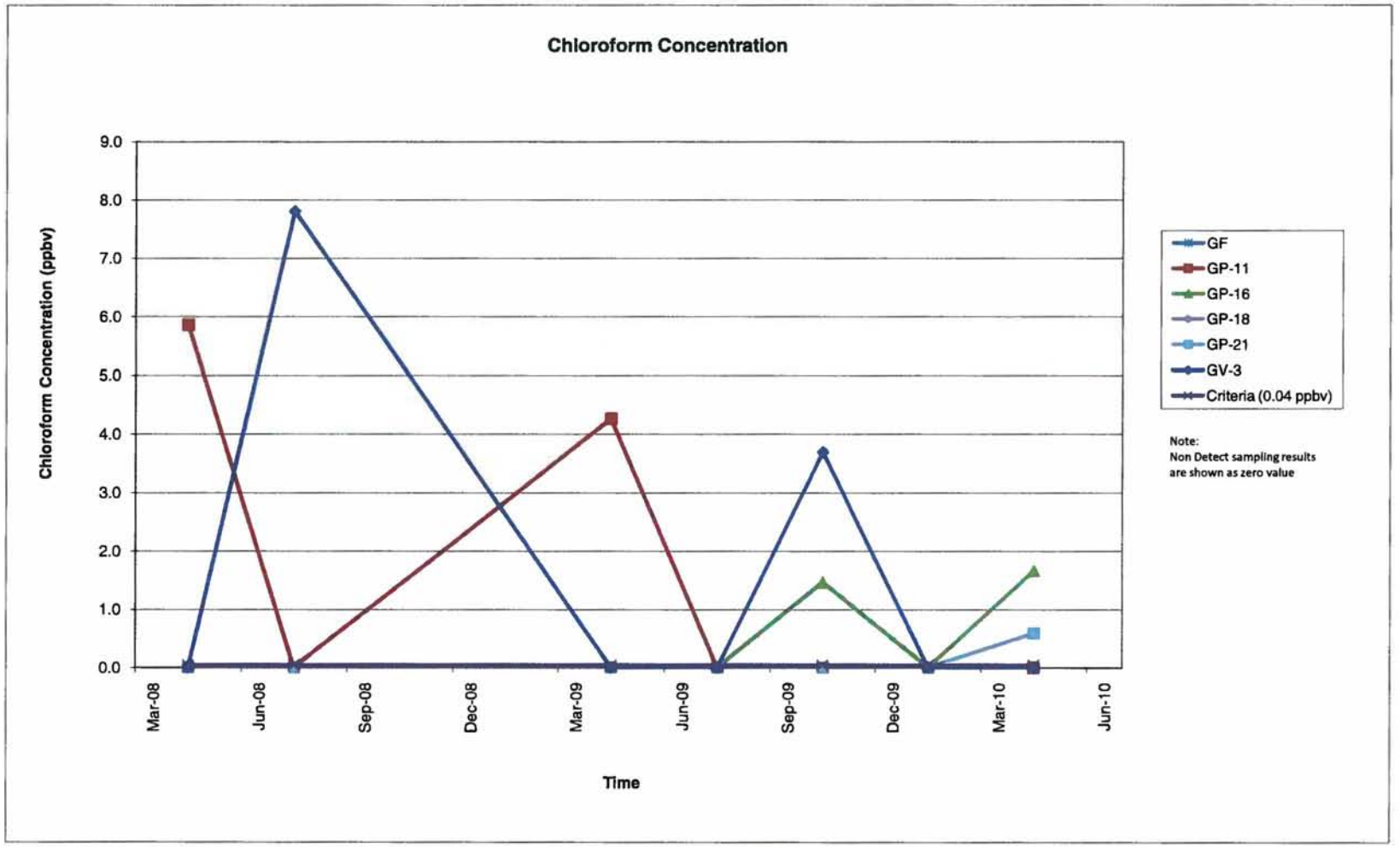

Dissolved Iron Concentration
Dissolved Iron Concentration (ug/L)
1800
1600
1400
1200
1000
800
600
400
200
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
SW-01
SW-02
SW-06
SW-09
SW-12
Criteria (1000 ug/L)
Note:
Non Detect sampling results are shown as zero value

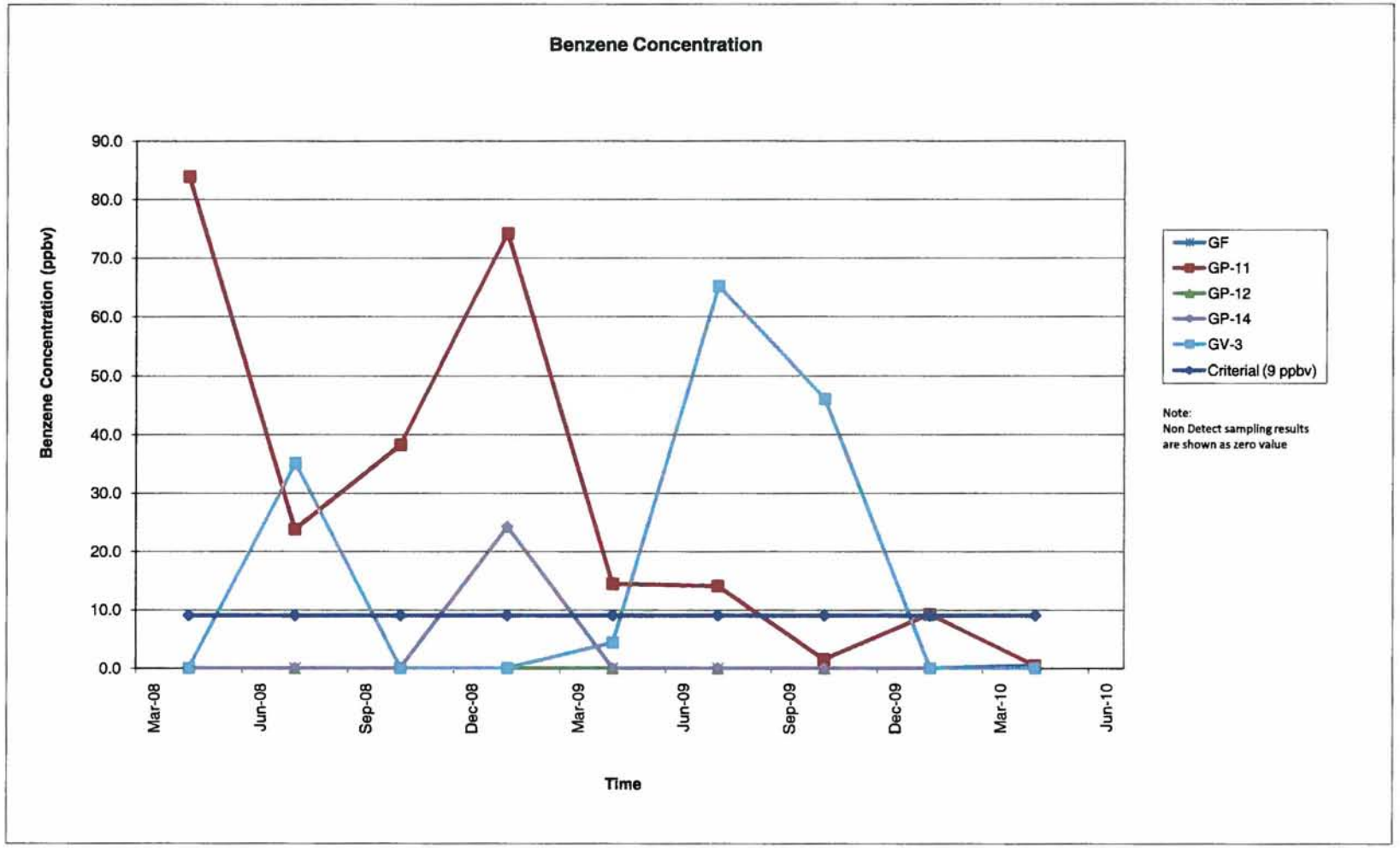

Dissolved Manganese Concentration
SW-12 1257 ug/L (July 2008)
Dissolved Manganese Concentration (ug/L)
800
700
600
500
400
300
200
100
0
Jun-03
Dec-03
Jun-04
Dec-04
Jun-05
Dec-05
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Jun-10
Time
SW-01
SW-06
SW-09
SW-12
Criteria (300 ug/L)
Note:
Non Detect sampling results are shown as zero value

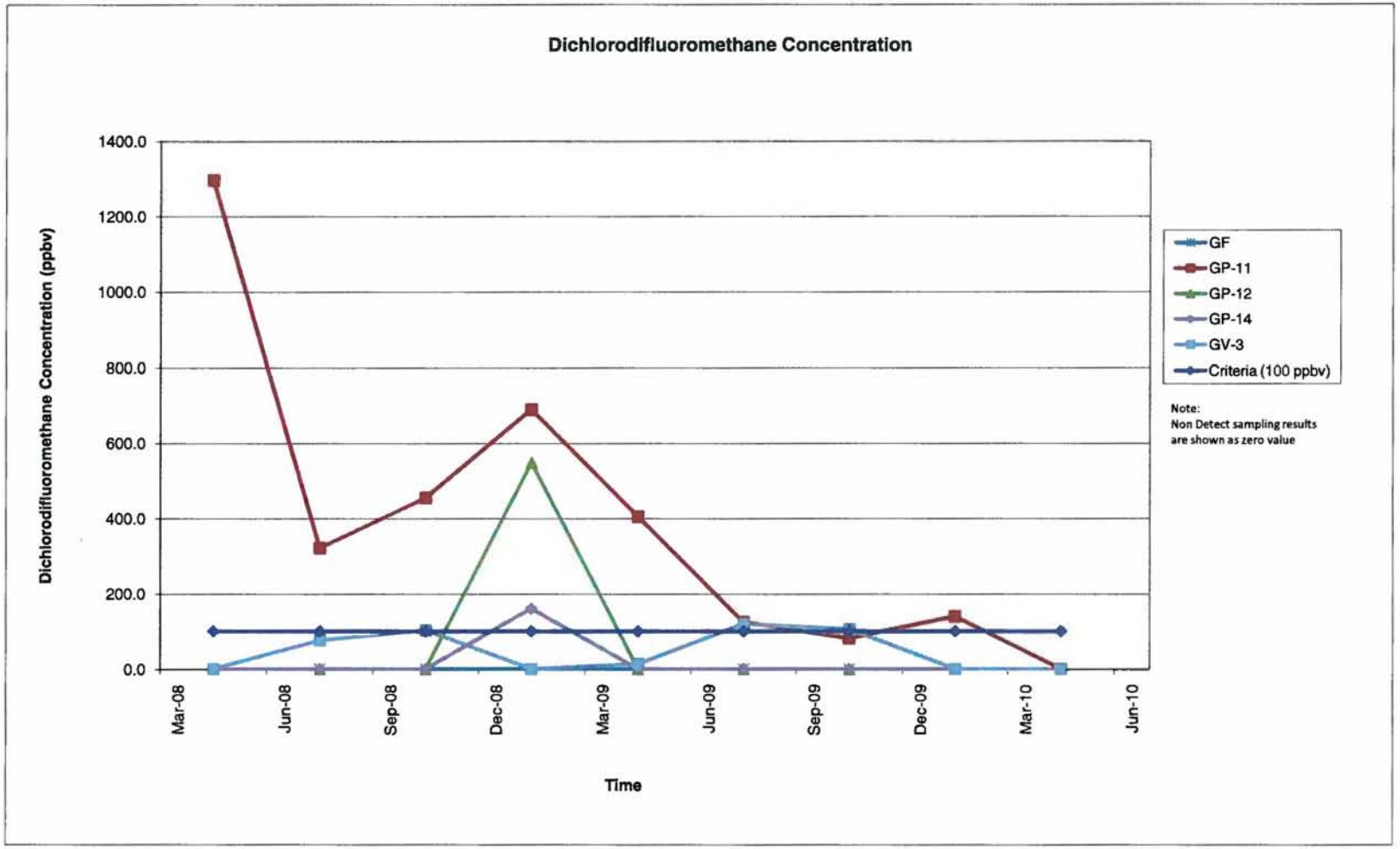
Trend Analysis Graphs

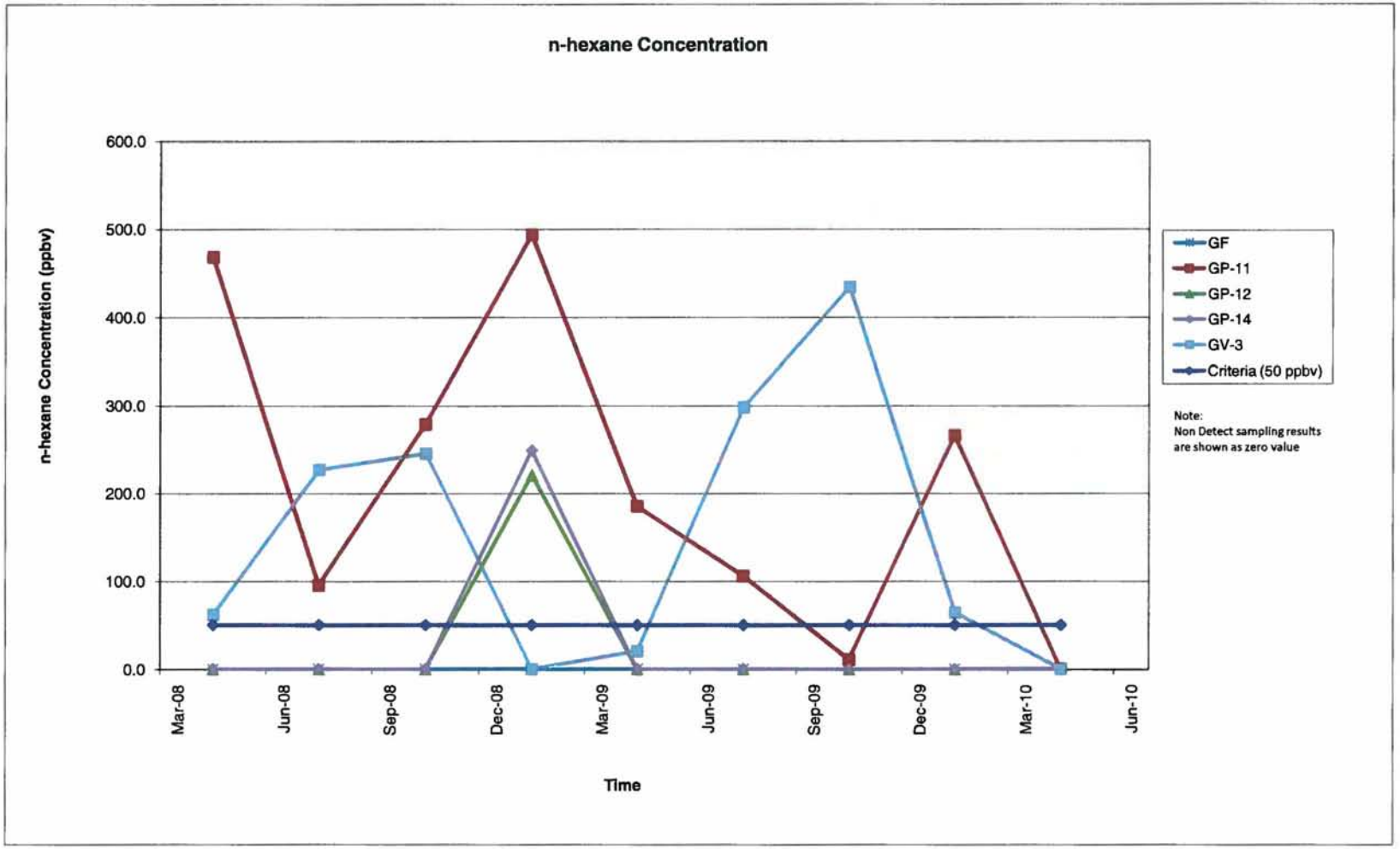
Landfill Gas

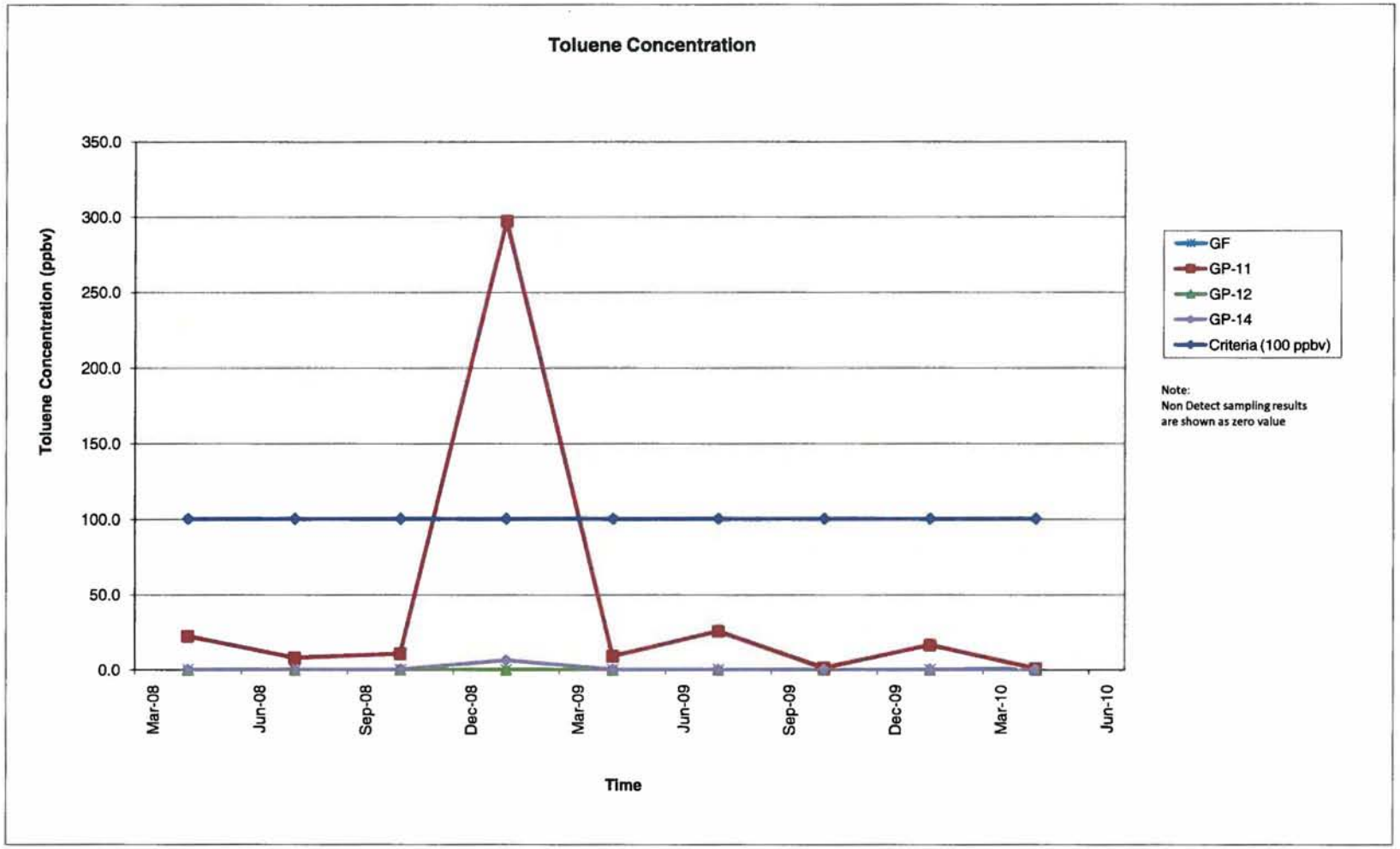
Chloroform
Benzene
Dichlorodifluoromethane
n-hexane
Toluene
Trichloroethane
Vinyl Chloride
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Tetrachloroethene
Trans-1,2-Dichloroethene
Methane

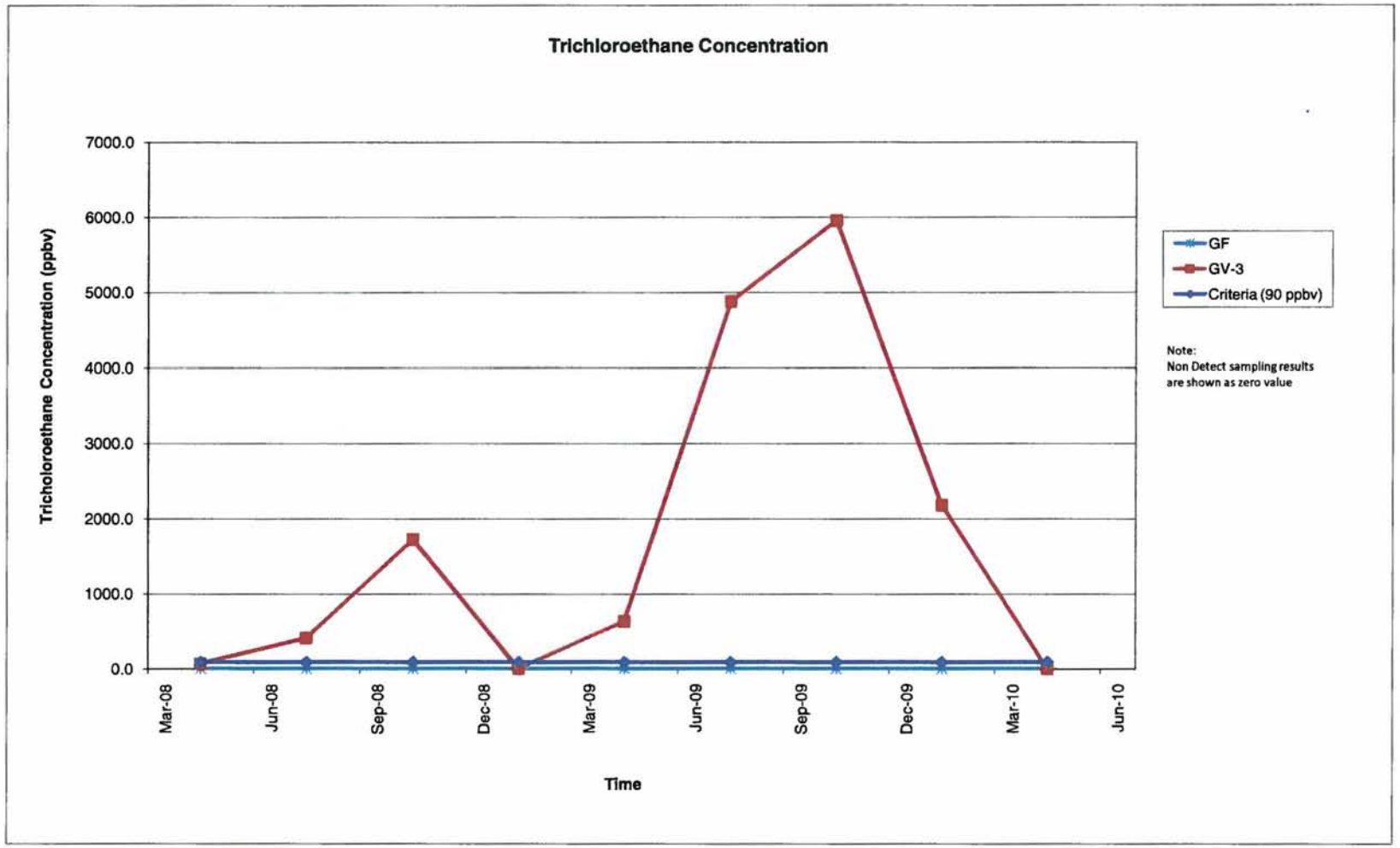

Chloroform Concentration
Chloroform Concentration (ppbv)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Mar-08
Jun-08
Sep-08
Dec-08
Mar-09
Jun-09
Sep-09
Dec-09
Mar-10
Jun-10
Time
GF
GP-11
GP-16
GP-18
GP-21
GV-3
Criteria (0.04 ppbv)
Note:
Non Detect sampling results
are shown as zero value

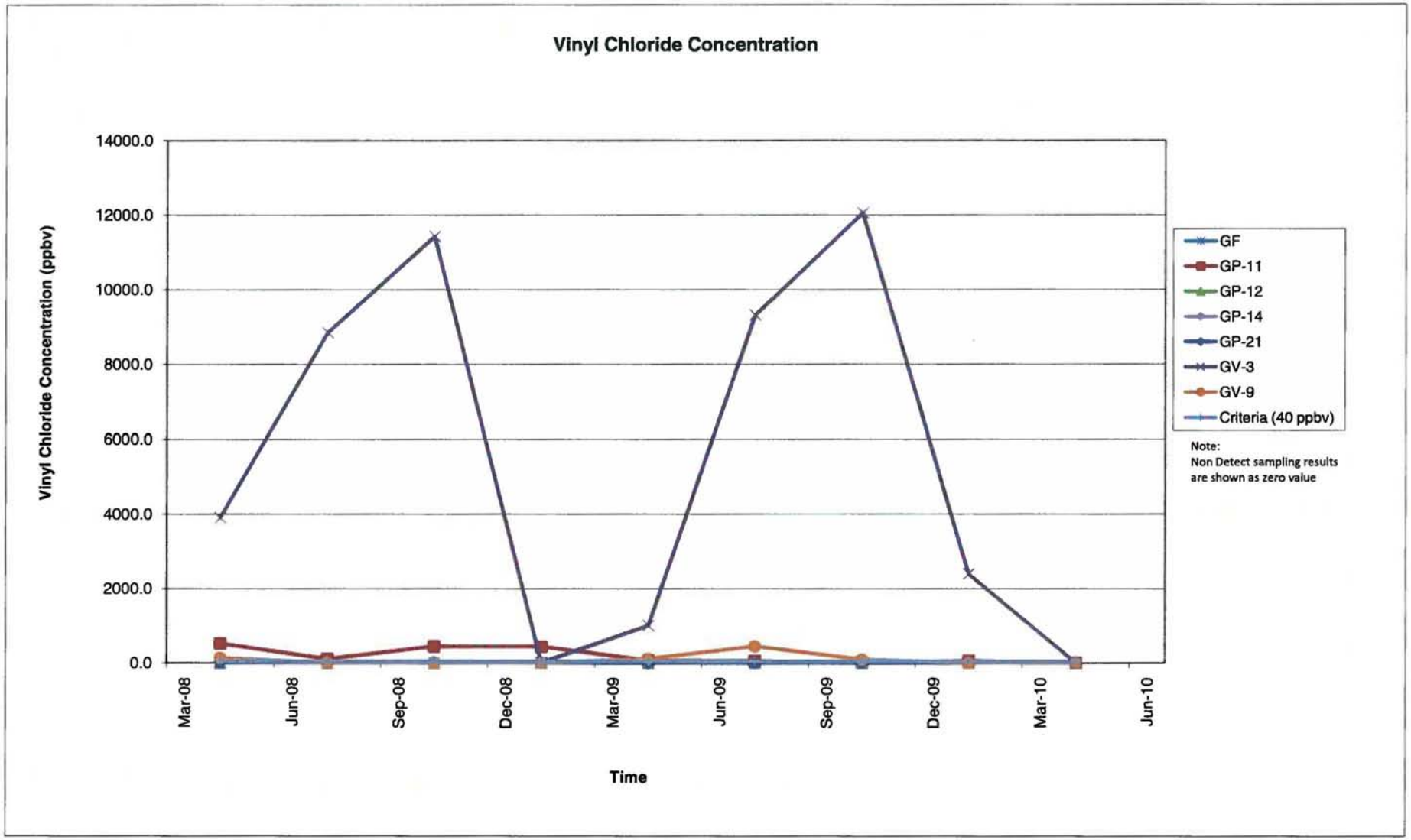

Benzene Concentration
Benzene Concentration (ppbv)
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Mar-08
Jun-08
Sep-08
Dec-08
Mar-09
Jun-09
Sep-09
Dec-09
Mar-10
Jun-10
Time
GF
GP-11
GP-12
GP-14
GV-3
Criterial (9 ppbv)
Note:
Non Detect sampling results
are shown as zero value

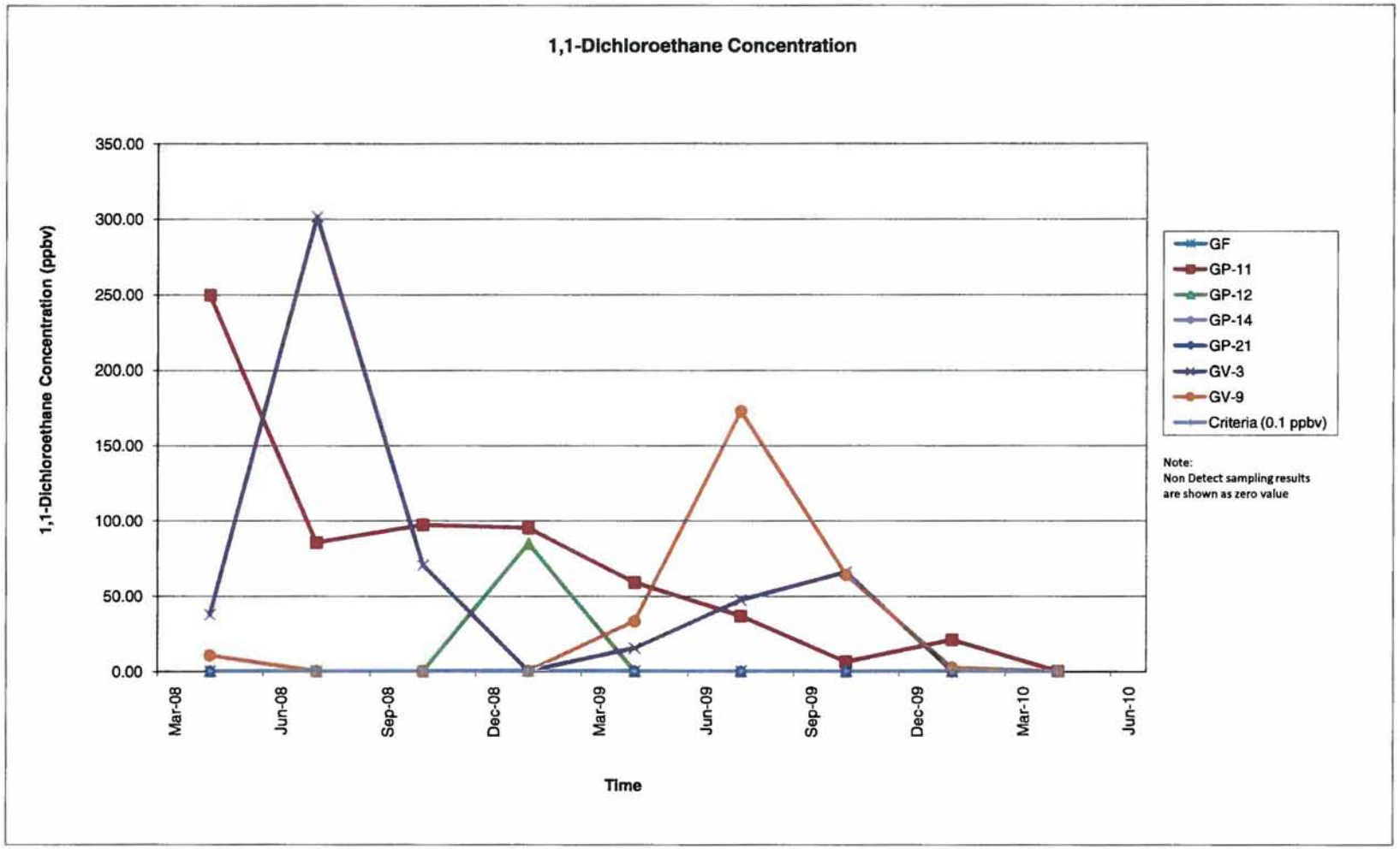

Dichlorodifluoromethane Concentration
Dichlorodifluoromethane Concentration (ppbv)
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
Mar-08
Jun-08
Sep-08
Dec-08
Mar-09
Jun-09
Sep-09
Dec-09
Mar-10
Jun-10
Time
GF
GP-11
GP-12
GP-14
GV-3
Criteria (100 ppbv)
Note:
Non Detect sampling results
are shown as zero value

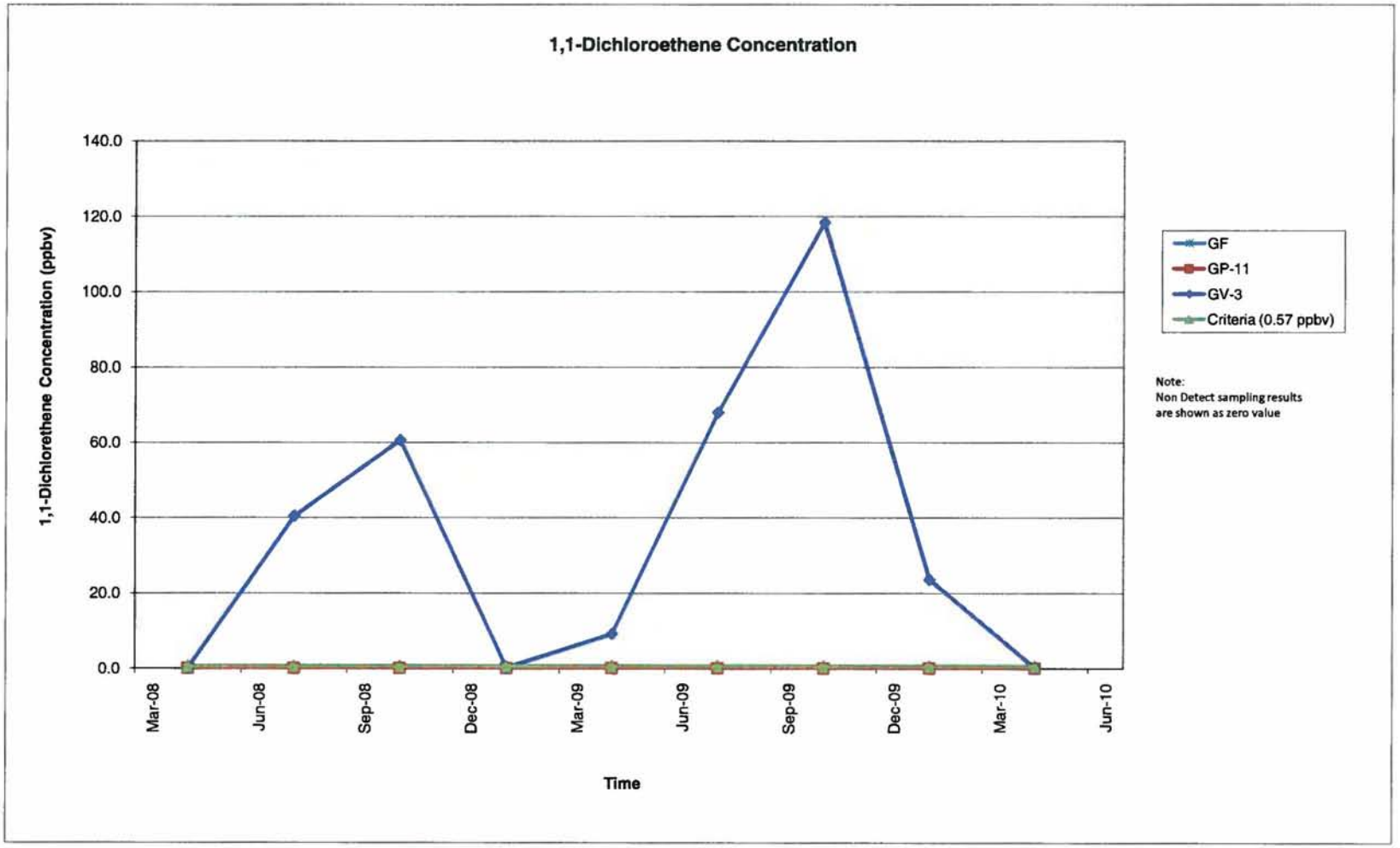

n-hexane Concentration
n-hexane Concentration (ppbv)
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Mar-08
Jun-08
Sep-08
Dec-08
Mar-09
Jun-09
Sep-09
Dec-09
Mar-10
Jun-10
Time
GF
GP-11
GP-12
GP-14
GV-3
Criteria (50 ppbv)
Note:
Non Detect sampling results
are shown as zero value

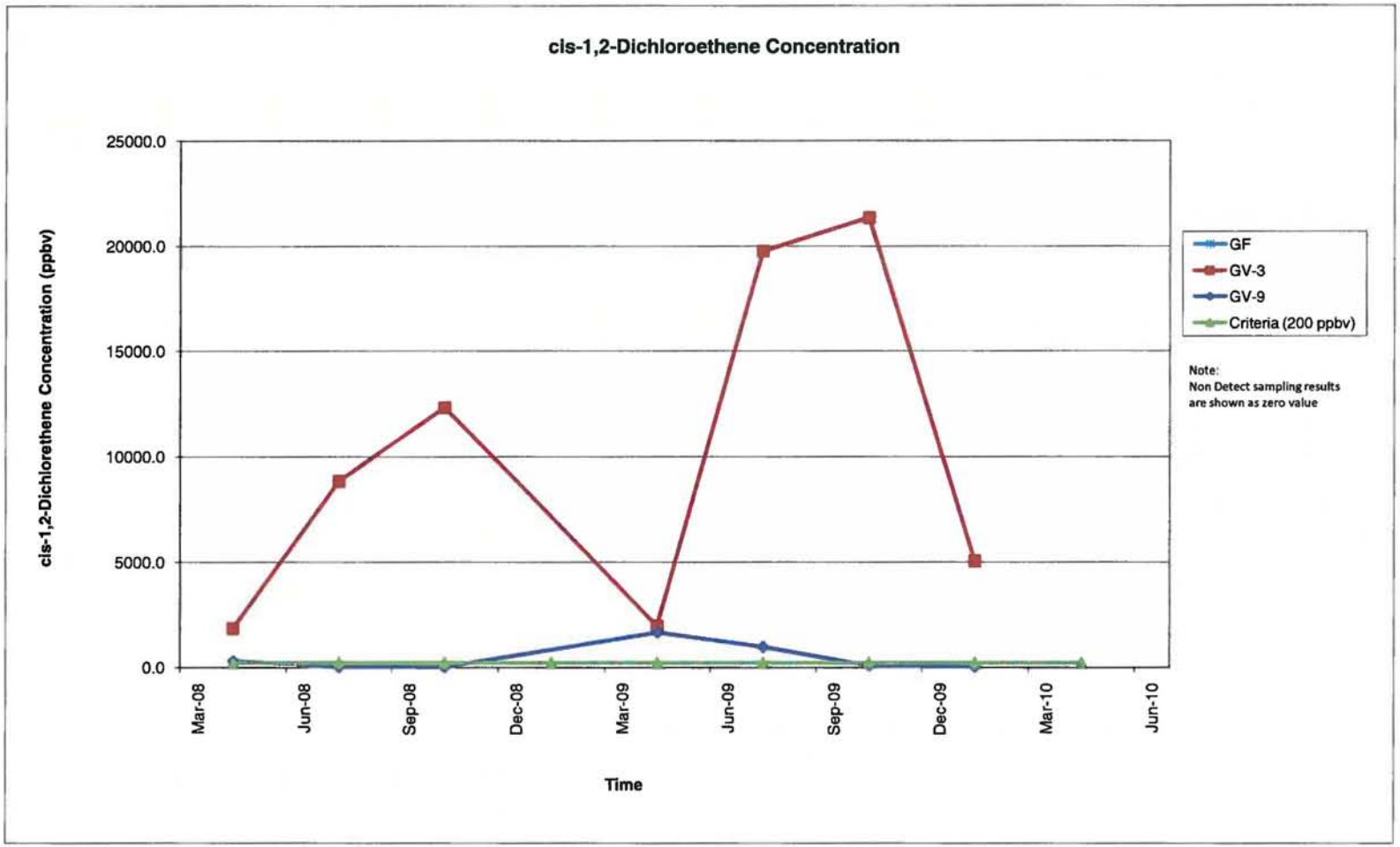

Toluene Concentration
Toluene Concentration (ppbv)
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Mar-08
Jun-08
Sep-08
Dec-08
Mar-09
Jun-09
Sep-09
Dec-09
Mar-10
Jun-10
Time
GF
GP-11
GP-12
GP-14
Criteria (100 ppbv)
Note:
Non Detect sampling results
are shown as zero value

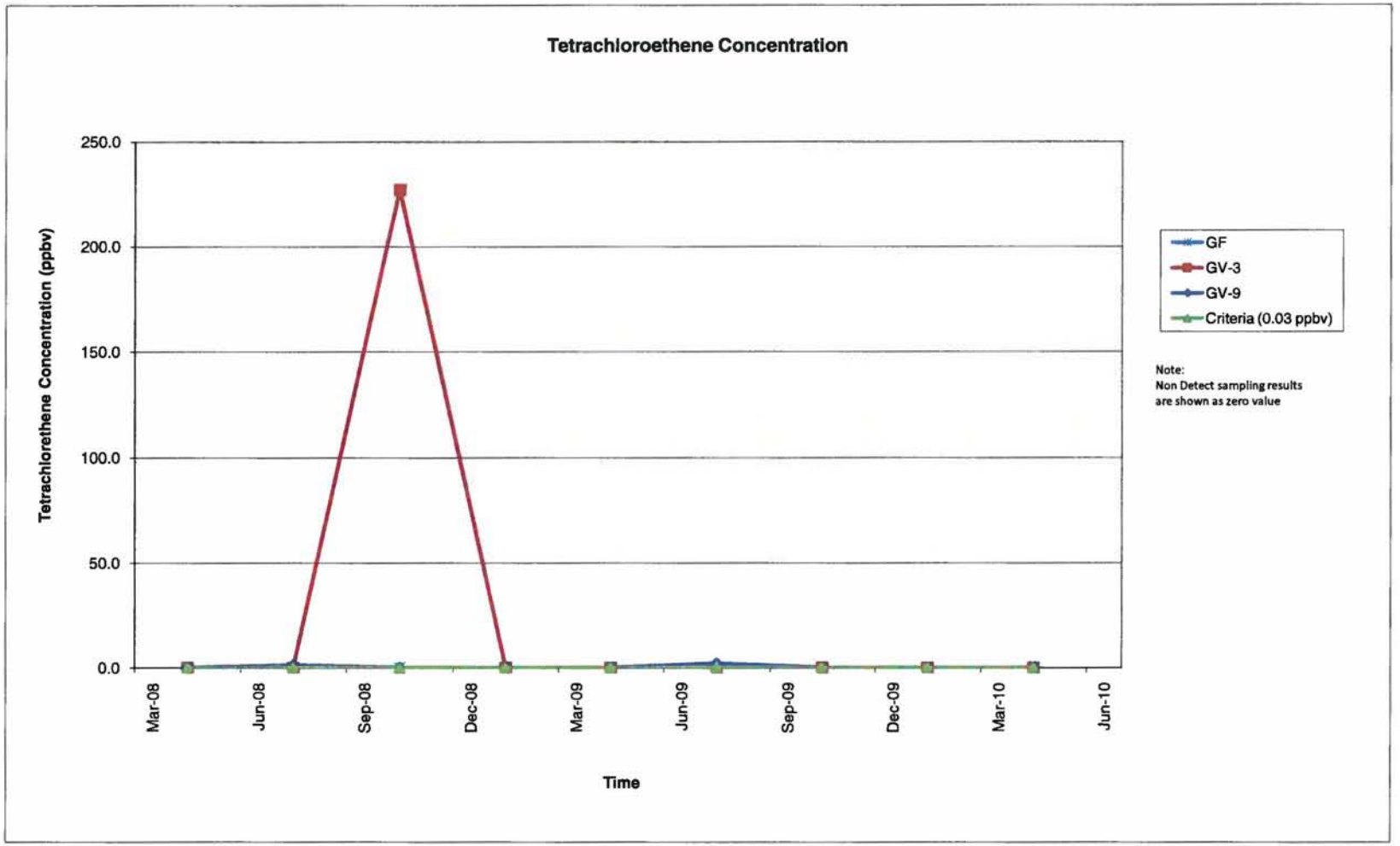

Trichloroethane Concentration
Tricholoroethane Concentration (ppbv)
7000.0
6000.0
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
Mar-08
Jun-08
Sep-08
Dec-08
Mar-09
Jun-09
Sep-09
Dec-09
Mar-10
Jun-10
Time
GF
GV-3
Criteria (90 ppbv)
Note:
Non Detect sampling results
are shown as zero value

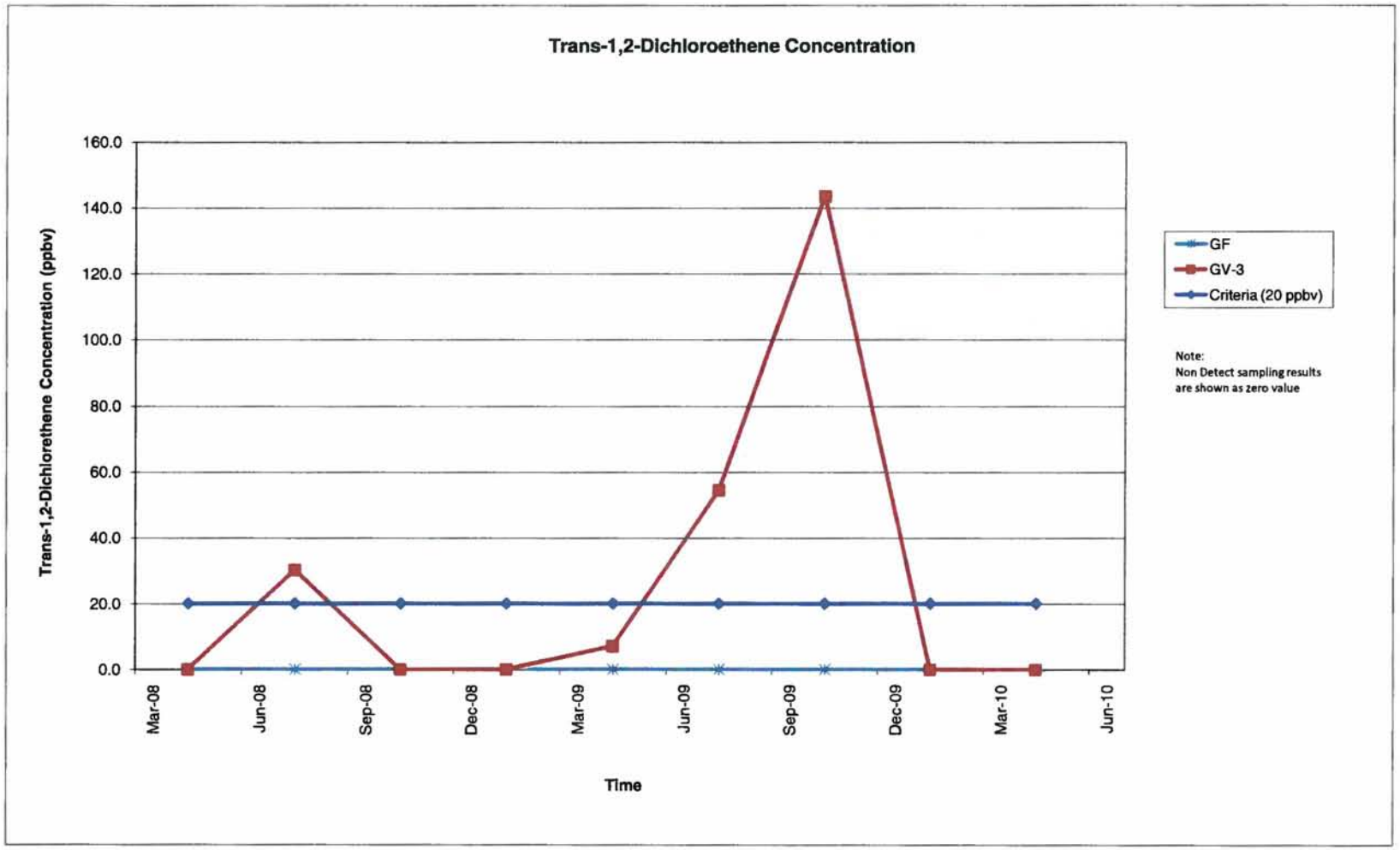

Vinyl Chloride Concentration
Vinyl Chloride Concentration (ppbv)
14000.0
12000.0
10000.0
8000.0
6000.0
4000.0
2000.0
0.0
Mar-08
Jun-08
Sep-08
Dec-08
Mar-09
Jun-09
Sep-09
Dec-09
Mar-10
Jun-10
Time
GF
GP-11
GP-12
GP-14
GP-21
GV-3
GV-9
Criteria (40 ppbv)
Note:
Non Detect sampling results are shown as zero value

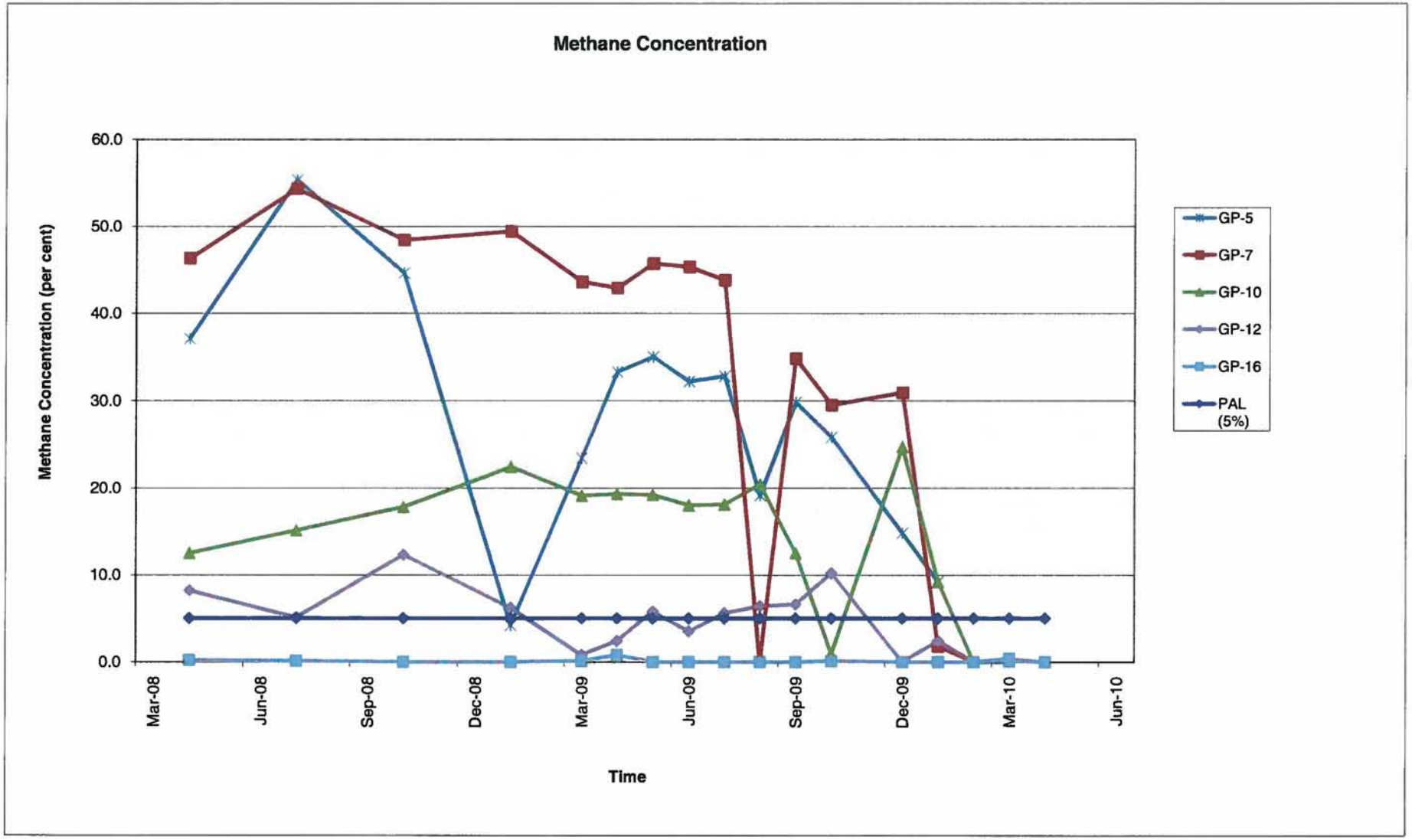

1,1-Dichloroethane Concentration
1,1-Dichloroethane Concentration (ppbv)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Mar-08
Jun-08
Sep-08
Dec-08
Mar-09
Jun-09
Sep-09
Dec-09
Mar-10
Jun-10
Time
GF
GP-11
GP-12
GP-14
GP-21
GV-3
GV-9
Criteria (0.1 ppbv)
Note:
Non Detect sampling results
are shown as zero value


1,1-Dichloroethene Concentration
1,1-Dichlorethene Concentration (ppbv)
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Mar-08
Jun-08
Sep-08
Dec-08
Mar-09
Jun-09
Sep-09
Dec-09
Mar-10
Jun-10
Time
GF
GP-11
GV-3
Criteria (0.57 ppbv)
Note:
Non Detect sampling results
are shown as zero value


cis-1,2-Dichloroethene Concentration
cis-1,2-Dichloroethene Concentration (ppbv)
25000.0
20000.0
15000.0
10000.0
5000.0
0.0
Mar-08
Jun-08
Sep-08
Dec-08
Mar-09
Jun-09
Sep-09
Dec-09
Mar-10
Jun-10
Time
GF
GV-3
GV-9
Criteria (200 ppbv)
Note:
Non Detect sampling results
are shown as zero value


Tetrachloroethene Concentration
Tetrachlorethene Concentration (ppbv)
250.0
200.0
150.0
100.0
50.0
0.0
Mar-08
Jun-08
Sep-08
Dec-08
Mar-09
Jun-09
Sep-09
Dec-09
Mar-10
Jun-10
Time
GF
GV-3
GV-9
Criteria (0.03 ppbv)
Note:
Non Detect sampling results
are shown as zero value


Trans-1,2-Dichloroethene Concentration
Trans-1,2-Dichlorethene Concentration (ppbv)
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Mar-08
Jun-08
Sep-08
Dec-08
Mar-09
Jun-09
Sep-09
Dec-09
Mar-10
Jun-10
Time
GF
GV-3
Criteria (20 ppbv)
Note:
Non Detect sampling results
are shown as zero value


Methane Concentration
Methane Concentration (per cent)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Mar-08
Jun-08
Sep-08
Dec-08
Mar-09
Jun-09
Sep-09
Dec-09
Mar-10
Jun-10
Time
GP-5
GP-7
GP-10
GP-12
GP-16
PAL (5%)