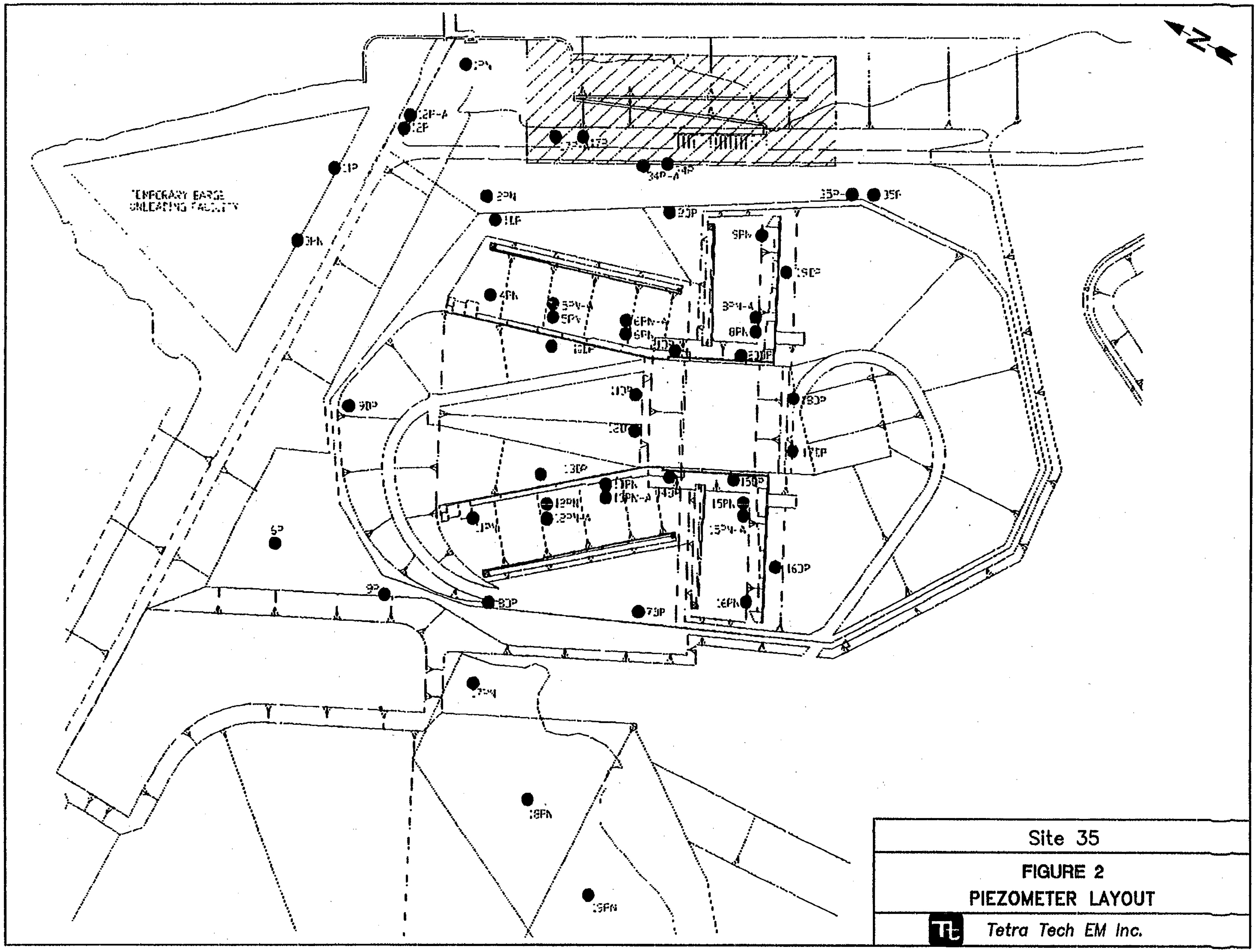
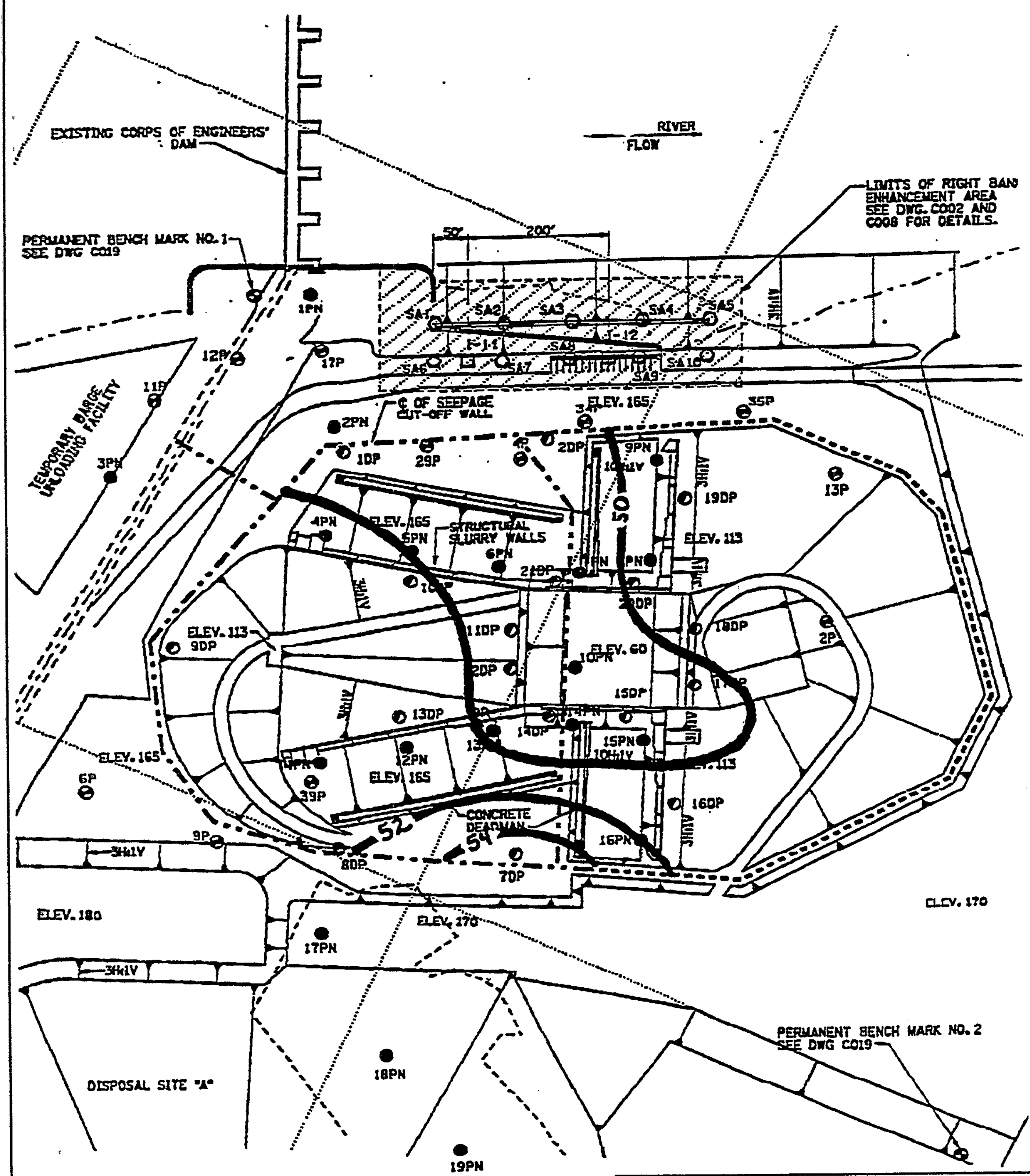


Site 35

FIGURE 2
PIEZOMETER LAYOUT

Tetra Tech EM Inc.



NOTE: DUE TO THE SMALL AMOUNT OF PIEZOMETER DATA AVAILABLE, THE CENTER SEEPAGE CUT-OFF WALL WAS NOT TAKEN INTO ACCOUNT WHEN DEVELOPING GROUNDWATER CONTOURS.

Site 35

FIGURE 3
GROUNDWATER CONTOURS INSIDE THE PERIMETER SEEPAGE CUT-OFF WALL (4/5/96)

Tetra Tech EM Inc.

SITE 36

Barrier Type	CC
Remedial Objective	Minimize Infiltration of Precipitation
Performance	X

1.0 SITE DESCRIPTION AND HISTORY

Site 36, which is located in the northeastern United States, was evaluated as a"cap only" site. The site is made up of a landfill and landfill expansion areas. The original landfill began operation in 1958 and was initially used for processing and disposal of municipal waste. Industrial wastes were also disposed of in the landfill during the late 1960s and early 1970s. The landfill ceased operation in April 1986. The original landfill has an area of about 65 acres and is unlined. The landfill has an elevation of 240 feet above mean sea level, (msl) and the bottom of the landfill is estimated to be 80 feet above msl. Landfill expansion began in 1977. The landfill expansion areas were lined and provided with leachate collection systems.

In 1977, new state regulations were passed that required the site to implement a program to determine the quality of groundwater below the landfill; this program was later expanded to assess the effect of the landfill on the surrounding area. After contamination was found in the groundwater below the landfill, Site 36 underwent partial capping and installation of a leachate and gas control system was completed. The site was placed on the National Priority List (NPL) in September 1983, and the remedy was implemented in 1992 and 1993.

2.0 GEOLOGIC AND HYDROGEOLOGIC SETTING

The site is located in an area underlain by four hydrogeologic units: the Glacial Formation, Magothy Aquifer, Raritan Clay, and Lloyd Aquifer. These units rest on a bedrock surface that lies about 1,100 feet (ft) below msl at the site and dips to the southeast toward the Atlantic Ocean.

The Glacial Formation occurs from directly below the landfill to about 20 ft below msl at the site. The Glacial Formation is made up of irregular deposits of gravel, sand, sandy clay, and clay. Because they vary in permeability, thickness, and extent, these deposits have great influence on recharge and movement of groundwater. Deposits of clay impede infiltration and percolation of water, thus creating perched water conditions locally, whereas permeable beds of sand and gravel offer little resistance to water.

The upper formation of the Magothy Aquifer ranges from about 200 to more than 120 ft below msl. This formation consists chiefly of interbedded, gray, buff, and white fine-grained sand and clayey sand, and of black, gray, white, buff, and red clay. Gravely zones are common near the bottom of the formation but are rare in the upper part.

The water table occurs in the Glacial Formation at approximately 40 to 70 ft above msl. This water-bearing stratum is commonly referred to as the Upper Glacial Aquifer. Groundwater under the landfill flows to the south-southeast. Water level data collected from walls upgradient of the landfill does not indicate components of groundwater flow north and west of the site.

Key: CC=Composite Cap Performance Rating: X=Insufficient data to determine if remedial objectives were met

3.0 NATURE AND EXTENT OF CONTAMINATION

Contamination was identified below the original landfill, and an off-site landfill leachate plume extending about 4,000 feet and having a maximum width of 3,000 feet was also identified. The approximate vertical extent of the landfill leachate plume is about 160 feet below msl. The primary contaminants of concern in groundwater on and off site are 1,2-dichloroethene; 1,1-dichloroethane; vinyl chloride; methylene chloride; trichloroethene; and chloroethene.

4.0 CONTAINMENT REMEDY

In 1979, several investigations revealed problems involving volatile organic compounds (VOCs) in groundwater and landfill leachate. The site was placed on the NPL on September 8, 1983. Remedial activities were already underway at the site, including capping of a 29-acre portion of the landfill. A record of decision (ROD) for the site was signed on March 18, 1988. The ROD called for the following measures to be taken at the site:

- Installation of eight diffusion (reinjection) wells for treated groundwater
- Completion of a 35-acre cap consisting of an 18-inch layer of compacted clay and 18 inches of soil cover
- Improvement of the landfill gas collection and leachate control systems
- Installation of five groundwater recovery wells with a design flow of 1.5 million gallons per day and screened to intersect both the shallow and deep
- Installation of an air stripper to treat VOCs in the groundwater.

A landfill gas collection system was installed at the site in 1992, and a leachate control system was installed and has operated since 1993 on 12 acres of the site. The groundwater remediation program involves use of five groundwater recovery wells installed at the leading edge of the VOC plume. The combined flow from all the wells is directed through common transmission piping to an air stripper. Treated groundwater is discharged to eight diffusion wells located in a recharge basin that lies hydraulically upgradient of the landfill at the western perimeter of the site.

5.0 PERFORMANCE EVALUATION

Hydraulic monitoring is conducted quarterly to verify hydraulic containment of the plume by the recovery well system. Water level measurements are required until equilibrium and appropriate drawdown have been established. Groundwater quality monitoring is to be conducted until groundwater quality criteria defined by the consent decree have been met.

Hydraulic monitoring has indicated that the current plume capture zone was developed soon after the startup of the groundwater recovery walls, and that the size and shape of the capture zone have remained relatively stable over 14 operating quarters. Water level data indicates that water levels in the vicinity of the capture zone initially declined about 10 to 12 feet as a result of pumping.

Groundwater quality data indicates no significant change in the VOC plume. However, reductions in total VOC concentrations in some monitoring wells over time indicate that groundwater quality may be improving as a result of the groundwater remediation program.

The on-site treatment plant has displayed an average treatment efficiency of 99.42 percent since its startup. Treated groundwater is discharged to the diffusion wells.
Remedy performance and contributing factors are discussed further in the following subsections.

Localized mounding may be occurring in the vicinity of the recharge basin. This mounding may have a minimal effect on groundwater flow directions.

5.1 Design

The landfill cap design was slightlybetter than acceptablebased on the criteria described in Section 3, Volume I. State regulations require that the capping process include regrading the slopes of the landfill to a slope of 3 horizontal to 1 vertical. The lowest portion of the cap consists of an 18-inch, compacted clay layer. The clay cap was constructed in 6- to 8-inch-thick lifts (after compaction) and had to meet the following specifications:

- Permeability: 1×10^{7} cm/sec or less
- Grain size: P200 content of 50 percent by weight or greater
- Liquid limits: 25 percent or greater
- Plasticity index: 10 percent or greater
- Compaction: 90 percent modified proctor density or greater
- Moisture content: varying between optimum and 25 percent of wet optimum

5.2 Construction Quality Assurance and Construction Quality Control

The construction quality assurance (CQA) and construction quality control (CQC) for the cap were rated acceptable relative to industry practices discussed in Section 3, Volume I.according to the bid specification for the capping and closure of Site 36. CQA/CQC measures were implemented during construction of the landfill cap.

An independent testing laboratory was used to test the clay seal in place. The parameters tested were permeability, grain size, liquid limits, plasticity index, compaction, and moisture content. In situ compaction was tested using a nuclear densiometer at the intersection points of a 100-foot grid, and the grid was to be offset for each lift of in-place material. One undisturbed sample per acre per lift of clay was collected and analyzed for hydraulic conductivity. One sample for each 500 cubic yards of clay placed was analyzed for grain size distribution, dry density, and moisture content. A qualified soil technician or engineer was present during construction of the cap to provide visual inspection and to direct sampling and testing.

The cover soil (located above the clay seal) was also tested during construction for the following parameters: pH, particle size, liquid limits, plasticity index, moisture content, and unconfined compression strength. The cover soil was placed and compacted to 85 percent of its maximum dry density. Placement was completed in two or more lifts of 6-inch maximum thickness as necessary to achieve the line grade specified.

5.3 Monitoring

A monitoring program was designed and implemented to meet a requirement for ensuring that (1) the off-site leachate plume was being hydraulically controlled and (2) contaminated groundwater was meeting cleanup criteria. Baseline monitoring was conducted from July 30 through August 2, 1991.

The monitoring program is rated acceptable. The cap is inspected quarterly. Quarterly hydraulic monitoring is conducted (1) to verify that equilibrium and appropriate drawdown of the plume is being established to prevent further expansion of the plume and (2) to determine the extent of mounding in the recharge basin area and the effect of that mounding, if any, on local groundwater flow patterns. Review of a third quarter 1995 groundwater sampling report indicates that the current plume capture zone was developed soon after the startup of the groundwater remediation system, and that the size and shape of the capture zone have remained relatively stable over 14 operating quarters. The average flow from the five recovery wells has varied from about 0.90 to 1.44 million gallon per day.

Quarterly monitoring of groundwater quality is being conducted for the leachate plume until the termination criteria are met. Review of quarterly groundwater monitoring results indicates no significant change in the dimensions of the VOC plume. Reductions in total VOC concentrations in some monitoring wells over time indicate that groundwater may be improving as a result of the groundwater remediation program.

Monitoring of the on-site treatment plant influent and effluent is conducted monthly to meet requirements. The treatment plant is also equipped with a gas chromatograph, allowing monitoring of the day-to-day treatment efficiency of the plant. Samples are collected from recovery wells for VOC analysis. The treatment plant is also equipped to monitor water quality parameters for the influent and effluent analysis.

5.4 Operation and Maintenance

A document entitled "Post Closure Operation and Maintenance Manual for the Capping Coverage, Drainage and Roadway Systems" was prepared. This manual presents a protocol for postclosure monitoring and maintenance of the landfill and for corrective measures. The subjects discussed in this manual include the cover system, drainage system, access roads, gabion wall, and materials and equipment required for routine maintenance. No summary reports detailing the results of the operation and maintenance program were available for review.

5.5 Other Considerations

The final costs for the design and construction of the landfill cap are $13,800,000. These costs do not include the costs for the portion of the landfill that was capped in 1983.

5.6 Remedy Performance

The overall performance of the containment remedy appears to be meeting the remedial objectives. The off-site leachate plume appears to have remained relatively stable over 14 operating quarters. Groundwater quality data indicate no significant change in the VOC plume, but reductions in total VOC concentrations have been observed at some monitoring wells. The on-site treatment plant has an average treatment efficiency of 99.42 percent. Localized mounding may be occurring in the vicinity of the upgradient recharge basin.

6.0 SUMMARY

The original landfill at Site 36 began operation in 1958. The landfill initially accepted municipal waste, but industrial wastes were also disposed of in the landfill during the late 1960s and early 1970s. Site 36 was placed on the NPL on September 8, 1983. The landfill ceased operations in April 1986. An investigation of groundwater contamination at and around the landfill begun in 1979 revealed contamination in groundwater below the landfill and in a leachate plume that had migrated about 4,000 feet from the site. The containment remedy consisted of a clay cap, landfill and gas collection and leachate control systems, five groundwater recovery wells, a groundwater treatment plant, and eight diffusion wells for recovered water. The cap design effort was ratedbetter than acceptable, and CQA/CQC of the cap was rated acceptable.

Fourth Five-Year Review Report

for

Western Processing Superfund Site

City of Kent
King County, Washington

July 2008

Prepared by:

United States Environmental Protection Agency
Region 10
Seattle, Washington

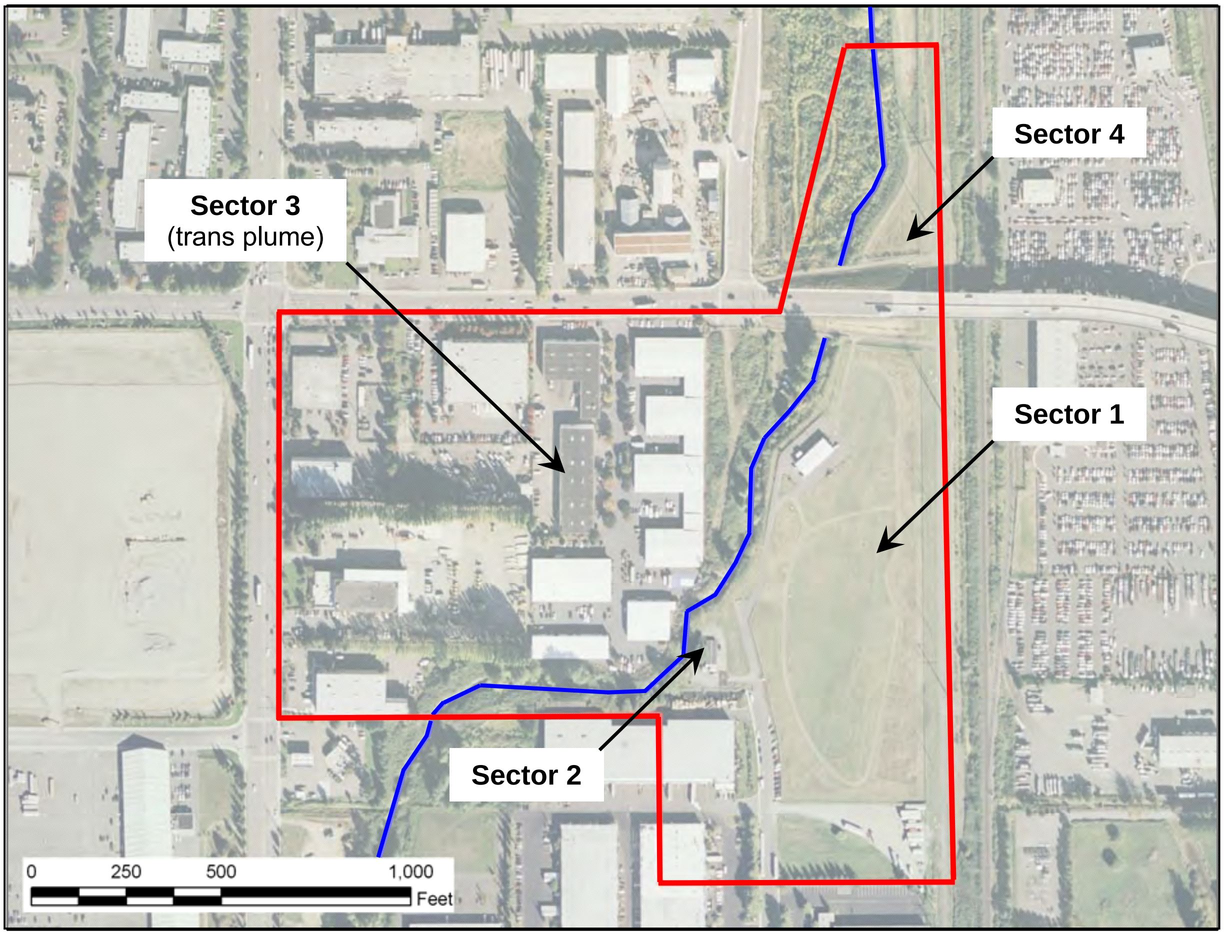
Approved by:

Date:

7/24/2008

Dan Opalski, Director
Office of Environmental Cleanup
U.S. EPA, Region 10

Western Processing Superfund Site



Source: October 1, 2006; Airphoto USA

Table of Contents

List of Acronyms

AWQC	Ambient Water Quality Criteria
ARAR	Applicable or Relevant and Appropriate Requirements
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
DCE	Dichloroethene
DCM	Dichloromethane (i.e. methylene dichloride)
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Difference
gpm	Gallons per minute
HRS	Hazard Ranking System
MCL	Maximum Contaminant Level
NCP	National Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
PAH	Polyaromatic Hydrocarbon
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethene (i.e. perchloroethene)
POTW	Publicly Owned Treatment Works
ppm	Parts per million
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
SRI	Supplementary Remedial Investigation
TCE	Trichloroethene
TCM	Trichoromethane (i.e. chloroform, methylene trichloride)
VOC	Volatile Organic Compound
WDOE	Washington Department of Ecology

Executive Summary

The Western Processing Superfund site is located on 14.5-acres of land within the Green River Valley, three miles north of the city center of Kent, Washington. This site is in the long-term operations and maintenance phase. No construction activity has occurred on site since the last Five Year Review in 2003. As the remedy for the Western Processing site resulted in hazardous substances, pollutants or contaminants remaining on site and was selected before passage of the Superfund Amendments and Reauthorization Act (pre-SARA), this is a policy Five-Year Review.

Current site actions include regular monitoring of onsite contamination and the continuous extraction and treatment of groundwater in the area under the RCRA cap in order to maintain containment. The extracted water is treated before discharge to the local sewer system. A plume of dissolved volatile organic compounds (VOCs) extends from the southwest portion of the Western Processing site towards the northwest in groundwater approximately 50' below ground surface (bgs). This offsite plume and associated geochemical properties are regularly monitored; the plume has been contracting in size and concentration since the Third Five Year Review.

EPA and Washington State Department of Ecology (WDOE), referred to as the Governments in site-related documents, continue to conduct oversight. The Western Processing Trust Fund (the Trust) and the Governments conduct two annual on-site meetings to review site data, documents and other activities. The Trust submits monthly reports to the Governments via e-mail and prepares an Annual Report which provides a summary of system operation, remediation progress, and recommendations. EPA conducts periodic field inspections at the site.

The Trust successfully shifted to a containment strategy prior to the Third Five Year Review, which resulted in a dramatic decrease in the pumping and treatment rates needed to contain the onsite contamination. Implementation of this alternative control strategy has reduced the Trust's annual operating costs from about $5 million to roughly $600,000. In 2000, the extraction wells in the "Trans Plume Area" were turned off as part of a monitored natural attenuation program. The contamination in that area has steadily declined; monitoring data indicates the plume is biodegrading to levels well below the ROD action levels. The site file includes a record of the documentation of site remedial activities and performance.

The remedy at the Western Processing site currently protects human health and the environment because the slurry wall, RCRA cap, containment pumping and extraction treatment system contain the contaminated groundwater and soil within the source area. Groundwater concentrations off the Western Processing property are decreasing and there are no exposure routes from the site contaminants. Current land use is consistent with Institutional Control requirements, however, institutional controls that will run with the land are not in place and still need to be placed on the parcels of property to ensure the remedy remains protective for the long term.

<u>Cross Program Measures</u>

Human Exposure:	Current Human Exposures are Under Control.
Groundwater Migration:	Migration of Contaminated Groundwater is Under Control.
Ready for Reuse:	The entire site is Protective for People under current conditions. Sector 3 is currently in use; Sectors 1 & 2 are Ready for Reuse. Sector 4 reuse is precluded by issues other than contaminants.

Five-Year Review Summary

SITE IDENTIFICATION		
Site name *(from WasteLAN)*: **Western Processing Co., Inc.**		
EPA ID *(from WasteLAN)*: **WAD0009487513**		
Region: 10	**State: WA**	**City/County: Kent / King County**
SITE STATUS		
NPL status: ■ Final ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): ☐ Under Construction ■ Operating ■ Construction Complete		
Multiple OUs? ■ YES ☐ NO	**Construction completion date:** 12 / 23 / 1991	
Has site been put into reuse? ☐ YES ■ NO [1]		
REVIEW STATUS		
Lead agency: ■ EPA ☐ State ☐ Tribe ☐ Other Federal Agency ____________________		
Author name: Chris Bellovary		
Author title: RPM	**Author affiliation: EPA Region 10**	
Review period: 10 / 1 / 2003 to 7 / 25 / 2008		
Date(s) of site inspection: 04 / 03 / 2008		
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: Fourth Five-Year Review		
Triggering action: ☐ Actual RA Onsite Construction at OU #____ ☐ Actual RA Start at OU#____ ☐ Construction Completion ■ Previous Five-Year Review Report ☐ Other (specify)		
Triggering action date *(from WasteLAN)*: 9 / 30 / 2003		
Due date *(five years after triggering action date)*: 9 / 30 / 2008		

[1] Sector 3 of the Western Processing site was never removed from productive use, and remains in productive use today.

Five-Year Review Summary (continued)

Issues

Institutional Controls that will run with the property have not been implemented. The previous land owner died in 2003, which prevented this issue from proceeding. The title to the property has not yet passed on to any heirs or successors of the estate. These controls will be necessary to preclude future property users from accessing subsurface soil or groundwater.

EPA has identified the attorney for the heirs to the decedent's estate. After ownership of the property has been clarified, EPA intends to reopen discussions on implementing land use controls that run with the land.

Recommendations and Follow-up Actions

EPA and the Western Processing Trust Fund (the Trust) will need to determine why title to the property has not passed to a new owner. This will allow discussions with the new owner for the purpose of implementing land use controls that will run with the land. The Trust will also need to initiate discussions with the other four properties that contain portions of the containment cell to implement land use controls that will run with the land. The ROD and the Consent Decree require the Trust to implement deed restrictions so that the remedy remains protective of human health and the environment.

The Western Processing Trust Fund should update the Contingent Action Criteria (CAC) for critical wells. After the 1995 ESD, EPA approved a containment strategy that contains procedures and potential contingent actions to be implemented if loss of containment was to occur. Part of that strategy involved the creation of Contingent Action Criteria (CAC). Since that time, contaminant concentrations have decreased and some of the current CAC no longer reflect present site conditions.

Protectiveness Statement

The remedy at the Western Processing site currently protects human health and the environment because the slurry wall, RCRA cap, containment pumping and extraction treatment system contain the contaminated groundwater and soil within the source area. The groundwater concentrations off the Western Processing property are decreasing and there are no exposure routes to the site contaminants. Current land use is consistent with Institutional Control requirements, however, institutional controls that will run with the land are not in place and still need to be placed on the parcels of property to ensure the remedy remains protective for the long term.

Other Comments

All other institutional controls called for in the Record of Decision are currently in place.

Western Processing Superfund Site
Kent, Washington
Fourth Five-Year Review Report

1. Introduction

1.1 Purpose of the Five-Year Review

The purpose of the five-year review is to determine whether the remedy at the Western Processing Superfund site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in five-year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and identify recommendations to address them.

1.2 Authority for Conducting the Five-Year Review

The Superfund Amendments and Reauthorization Act of 1986 (SARA) added §121(c) to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). CERCLA §121(c) requires the U.S. Environmental Protection Agency (EPA) to review Superfund site every five years after EPA begins the remedial action if the remedy will result in hazardous substances, pollutants or contaminants remaining on site.

CERCLA § 121(c), codified at 42 U.S.C. 9621(c), 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 Agency interpreted this requirement further in the NCP; 40 CFR § 300.430(f)(4)(ii) which states:

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

CERCLA § 121(c) is not retroactive; Superfund sites where the Record of Decision (RODs) was issued prior to the passage of SARA are not required by statute to prepare Five Year Reviews. However, as a matter of policy, EPA decided to review all remedies that result in hazardous substances, pollutants or contaminants remaining on site regardless of when the remedy was selected.

The most recent Record of Decision (ROD) for the Western Processing site was signed before the statutory requirement for Five Year Reviews came into effect[2]. As the remedy will result in hazardous substances, pollutants or contaminants remaining on site[3], this Five Year Review is required by policy.

1.3 Who Conducted the Five-Year Review

EPA Region 10 conducted the Five-Year Review of the remedy implemented at the Western Processing Site, located in Kent, Washington. The Fourth Five-Year Review for Western Processing site was conducted by the EPA Remedial Project Manager (RPM) covering the period from October 2003 through July 2008. This report documents the results of the review.

1.4 Review Status

This is the fourth Five-Year Review for the Western Processing site. The triggering action for this review was the completion of the third Five-Year Review Report, dated September 2003. The five-year review is required because hazardous substances, pollutants, or contaminants remain in the soil and groundwater above levels that allow for unlimited use and unrestricted exposure.

1.5 Areas, Cells, Sectors, and Operating Units

This Five Year Review will only describe the site in terms of Sectors, but this explanatory note may be useful for readers who plan to review earlier site related documents.

<u>Activity</u>

- 1983 through 1984, sitewide: Operating Unit 1 (OU1)
  OU1 occurred from 1983 to 1984 and covered the removal of hazardous wastes.
- 1984 through present, sitewide: Operating Unit 2 (OU2)
  OU2 began in 1985 and covers the containment and remediation of remaining site wastes.

<u>Location</u>

- 1983: Areas I-X
  The remedial investigation divided the site into ten Remedial Action Areas, and each *Area* was separately characterized.
- 1987 through 1997: Cells 1-7
  After the remedial investigation, the original extraction system was installed using a header-lateral configuration. There were 7 main zones in which flow could be controlled, which were named as *Cells* 1-7.
- 1997: Sectors 1-4

2 The Superfund Amendments and Reauthorization Act of 1986 (SARA) became effective on October 17, 1986. The ROD Amendment for the Western Processing site was issued on September 4, 1986.

3 The ROD for the Western Processing site states that the site will be cleaned up to industrial use levels.

After the extraction system was replaced with a containment system in 1997, the term of Cells no longer represented site conditions, so the site was then referred to in terms of four *Sectors*:

- Sector 1: Located within the slurry wall and south of 196th Street
- Sector 2: Located between Sector 1 and Mill Creek
- Sector 3: The Trans Plume
- Sector 4: Located within the slurry wall and north of 196th Street

For additional information, please see Figures 1, 2 and 3, located in the Figures and Tables section of this document.

2. Site Chronology

Event	Sector	Date
Western Processing begins operation on site		1961
EPA issues $210,000 penalty for 28 violations of RCRA	1, 2	05/1982
Warrant for entry issued by Court	1, 2	09/1982
Order to close the site issued by EPA	1, 2	04/1983
Order to close the site issued by Court	1, 2	07/1983
Emergency removal of site wastes completed	1, 2	07/1983
Site placed on NPL		**09/1983**
WDOE implements on site stormwater control measures	1, 2	12/1983
1st Consent Decree entered by the Court[4]		07/1984
Record of Decision issued (Phase I - Removal Action)		**08/1984**
Surface cleanup completed	1, 2	11/1984
RI/FS released		03/1985
Record of Decision issued (Phase II - Remedial Action)		**09/1985**
Record of Decision Amendment issued		09/1986
Consent Decree entered by the Court[1] (Phase I)		10/1986
Consent Decree entered by the Court[1] (Phase II)		04/1987
Subsurface remediation begins		07/1987
Both pump & treat systems begin operations	1, 3	10/1988
Slurry wall constructed around the site[5]	1, 4	10/1988
Construction Complete		12/1991
First Five Year Review		**01/1993**
Mill Creek restoration complete		09/1993
East Drain interceptor system begins operation	1	11/1994
TI Waiver Petition submitted		09/1995
ESD issued in response to TI Waiver Petition		12/1995
Containment wells installed	1	06/1996
Containment pumping phased into operation	1	01/1997
New treatment system started	1, 3	07/1997
Isolation wall completed	1, 4	10/1997
Final on-site subsurface waste removal completed.		10/1997
East Drain interceptor system shut off	1	12/1997
Second Five Year Review		**09/1998**
Slurry Wall intentionally breached in Sector 4	4	09/1998
Completion of work in Sector 4	4	10/1998
RCRA Cap completed	1	10/1999
Start of Monitored Natural Attenuation for the trans plume	1, 3	04/2000
Third Five Year Review		**09/2003**

[4] Only the court documents that were significant for remedy implementation are listed in the timeline.
[5] The last 100' of the slurry wall was constructed in June of 1989, and the slurry wall was modified in September of 1989.

3. Background

3.1 Site Location and Surface Characteristics

The Western Processing Superfund site is located on the 13-acre parcel of land that was the former site of Western Processing facility, and a 1.5-acre adjoining low-lying parcel to the north, which received stormwater runoff from the Western Processing facility. These parcels of land are located approximately three miles north of the city center of Kent, Washington, and within the Green River Valley. (See Figure 1) The region was largely a farming area, but the slow transition to industry was accelerated with the completion of a flood control dam in 1963. The Western Processing site is currently surrounded by light industry. Native surface soil for the site includes Pilchuck fine sandy loam and Newberg silt loam.[6]

The northern border of the site currently contains a small parcel of undeveloped land. The eastern site boundary is the Interurban Trail used by walkers and bicyclists and a drainage ditch for the railroad line (East Drain). The western site boundary is Mill Creek, which flows in a northerly direction until it joins with Springbrook Creek. Springbrook Creek flows into the Black River, which is a tributary of the Green River, which becomes the Duwamish River before ultimately emptying into Puget Sound at Seattle. East Drain flows into Mill Creek north of the Western Processing site. The portions of the site that are immediately adjacent to Mill Creek and East Drain are within a 100-year flood plain, and the rest of the side is within a 500-year flood plain.

3.2 Subsurface Characteristics

The site is located over a shallow alluvial aquifer, with the groundwater table beginning at 5' to 20' below ground surface (bgs). Three major geologic units comprise the hydrogeologic system in the vicinity of the site. These units comprise the White River Alluvium, which are the valley fill deposits that occur throughout the Kent Valley and beneath the site. The alluvial fill consists primarily of sand, silt, and clay with occasional unconsolidated layers of sandy gravel. White River alluvium is not considered to be a major drinking water source in the Kent area because of its relatively low permeability and naturally occurring poor water quality. Many of the wells for which data are available indicate a sulfur odor, natural gas (methane), and/or high iron levels in the water.[7]

Groundwater beneath the site has been delineated into four hydrogeologic zones (A-D). The A-Zone groundwater (to a depth of 40' bgs) is comprised of a complex sequence of discontinuous interbedded silt, sand, and clay lenses. The groundwater in the A-Zone underneath the site flows to the northwest and discharges into Mill Creek. The B-Zone groundwater (depths of 40' to 80' bgs) is comprised of fairly continuous fine to medium sand with intermittent silty zones. The groundwater in the B-zone also flows northwest, but generally passes below Mill Creek. The C-Zone groundwater extends from about 80'

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[6] Natural Resources Conservation Service, U.S. Dept. of Agriculture, Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov. Last accessed on Jan. 3, 2008.

[7] § 3.3.1 of the *Feasibility Study for Subsurface Cleanup*, referencing the Washington Dept. of Water Resources bulletin *Geology and Groundwater Resources of Southwestern King County, Washington*, J. E. Luzier, 1969.

to 120’ bgs; groundwater below 120’ bgs was referred to as D-Zone.[8] Zones C and D will not be discussed in this review, as the groundwater below Zones A and B have not been impacted by site activities.

Contaminants in Zone A originally discharged into Mill Creek. Installation of a slurry wall around the site has isolated the original source of contaminants from Mill Creek. Contaminants in Zone B were transported down-gradient of the site and Mill Creek. Low flow extraction of water from Zone A currently maintains a flow gradient from Zone B into Zone A across the site, to prevent further contaminants from leaving the site. Contaminants that had already been transported off site were initially addressed with a pump and treat solution, which was changed to a monitored natural attenuation program in the spring of 2000. These actions will be discussed in greater detail in Section 4.

There are no wells in this shallow aquifer within a one-mile radius of the site that are currently used for drinking water. The city of Kent (pop. 86,660)[9], of which the site is a part, obtains most of its drinking water from a much deeper, hydraulically isolated artesian aquifer, for which the closest well is slightly more than a mile to the southeast of the site. Fire Station 76 is located 0.4 miles south of the site, where the City of Kent owns a well that is screened at a depth of 85’ to 95’ bgs. This well was previously used to provide flow augmentation for Mill Creek in the mid-1990s, but that well is no longer used.[10]

3.3 History of Contamination

The Western Processing Company, Inc. operated from 1961 to 1983 on a 13 acre parcel of land that encompasses most of the current Superfund site. Originally, Western Processing reprocessed animal by-products and brewer's yeast. During the 1960s, the business expanded their operations, to store, reclaim, or bury waste from over 300 businesses, including some of the Pacific Northwest's largest industries.

Spills and the improper storage or disposal of wastes or reclamation byproducts caused heavy contamination of site soils, shallow groundwater beneath the site, and Mill Creek. Investigations identified more than 90 of EPA's priority pollutants at the site, most in the categories of volatile organic compounds, semivolatile organic compounds and heavy metals. Operation of the Western Processing Company ceased in 1983 by federal court order and the site was placed on the National Priorities List (NPL) in September 1983.

3.3.1 Early Investigations

Following significant attention to the Western Processing facility by many local agencies in the 1970s and early 1980s, EPA inspected the Western Processing facility

8 Initial investigations revealed aquitards and differences in water chemistry between the different zones of water, so these were originally believed to be discrete aquifers. Subsequent investigations showed that to be incorrect. The area underneath the site is part of a complex alluvial geology; although many discontinuous aquitards exist underneath the site, Zones A, B, C, and D are hydraulically interconnected. Nevertheless, the original terminology was maintained for purposes of describing subsurface conditions.

9 Washington State Dept. of Financial Management, *April 1 Population of Cities, Towns, and Counties* (June 27, 2008). Available online at http://www.ofm.wa.gov/pop/april1/finalpop2007.pdf, last visited on Jan. 3, 2008.

10 Conversations with the City of Kent Environmental Engineering Manager, M. Mactutis, on January 7, 2008 and February 22, 2008.

in March 1981 to determine compliance with the then new Resource Conservation and Recovery Act (RCRA) regulations. In August 1982, EPA issued a RCRA § 3013 order requiring site owners/operators to investigate contamination in soil, surface water, and groundwater. After the owners/operators failed to comply, EPA undertook the investigation in September 1982.

Of the approximately 5,000 drums stored on site, many were leaking, corroded, or bulging. In several locations, drums containing incompatible materials (e.g. cyanides and ketones, acids and caustics, acids and ethyl amines) were stored together. During the sampling, battery casings were found at depths of 15’ to 24’ bgs.

Concurrent with the investigations by EPA, Washington State’s Department of Ecology (WDOE) conducted its own investigation of the site under the authority of the laws of Washington State.

3.3.2 Basis for Taking Action

Analysis of over 160 soil and groundwater samples confirmed that hazardous substances had been released into the environment, had contaminated the shallow aquifer, and had caused widespread contamination of soils at the site. Sediment and surface water samples confirmed that site contamination had impacted the creek and that Mill Creek exceeded ambient water quality criteria for aquatic organisms. The site had a Hazard Ranking System (HRS) score of 58.63 at the time it was listed on the NPL. Primary contaminants groups included: Halogenated volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), phenolic compounds, and metals.

3.3.3 Early Actions

EPA issued a CERCLA § 106 order in April 1983 which required the owners/operators to immediately cease operations and provide assurances that they would conduct a cleanup. When the company stated that it was unable to undertake the remedy, EPA used $1.5 million in CERCLA emergency funds to conduct an immediate removal operation to stabilize the site.

The EPA cleanup began in late April 1983 and was completed in July 1983. Over 1,900 cubic yards of solids/sludges and 930,000 gallons of waste liquids and hazardous substances were removed from the site. WDOE used State funds to implement storm water control measures at the site shortly thereafter. The Western Processing facility was permanently closed by federal court order in July 1983 and was listed on the National Priorities List (NPL) in September 1983.

3.3.4 Surface Cleanup

The Focused Feasibility Study for Surface Cleanup was published in June 1984. Under a Consent Decree, a group of over 190 Potentially Responsible Parties (PRPs), currently referred to as the Western Processing Trust Fund, undertook the surface cleanup in July 1984 at a cost of over $10 million. This was Phase I of the site remediation. Over 2,400 truckloads of chemical waste and contaminated soil and debris were removed from the site. Once all surface structures (buildings, tanks, impoundments, and waste piles) were cleared from the site, it was graded to prevent stormwater runoff, a plastic-lined pond was constructed to contain collected storm water, and a portable treatment plant was brought on site to treat this water.

Surface cleanup was completed in November 1984, with the exception of about 3,000 gallons of a dioxin-contaminated oily liquid that was discovered in one storage tank. No other dioxin contamination was found on site. This liquid was placed into double-walled drums and moved into plastic-lined trailers on the site. The initial plan for disposal of this material was to be through off-site incineration. This plan for disposal was not well received by the public or media sources, which led to a continued search for an alternate method of disposal. In 1986, a mobile batch reactor successfully used a KPEG (potassium hydroxide, polyethene glycol) process to treat approximately 6,000 gallons of dioxin-contaminated liquid on site. Residual material from the treatment process was shipped to Chemical Waste Management's SCA incinerator in Chicago.

3.3.5 Remedial Investigation and Planning

EPA's phased Remedial Investigation/Feasibility Study (RI/FS), which began during the summer of 1983 and proceeded simultaneously with the surface cleanup, added to the information obtained from the study following the RCRA § 3013 order. Over 90 of EPA's 126 priority pollutants were found in soil, groundwater, and surface water; the predominant contaminants were heavy metals, polychlorinated biphenyls (PCBs), phenols, and volatile organic compounds (VOCs). Over 95% of the contamination was determined to be in the uppermost 15' of soil. Groundwater contamination for the most part was concentrated from the top of the water table to approximately 30' bgs (Zone A). Extremely high concentrations of contaminants were found in this shallow groundwater with maximum detected concentrations of up to 510 ppm (parts per million; mg/kg) of zinc, up to 5,400 ppm of total semivolatile organic compounds, and up to 1,346 ppm of total volatile organic compounds (VOCs).

In March 1985, the complete RI/FS was released to the public. A series of four public meetings/workshops was held at Kent City Hall. By the second meeting, virtually all attendees were parties with financial interests in the cleanup. Alternatives involving excavation and off-site disposal with groundwater pumping appeared to be favored.

An intensive soil and subsurface waste sampling program was conducted by the Trust in the fall of 1986 to obtain pre-design information for excavation of the most highly contaminated subsurface wastes. During that test program, concentrations of metals in soils were detected at up to approximately 141,000 ppm (parts per million; mg/kg) of lead; 10,000 ppm of PCBs; 53,000 ppm of total polycyclic aromatic hydrocarbons (PAHs); and 580 ppm of individual (e.g., trichloroethene) VOCs. Contamination had not been detected beyond a depth of about 70' bgs. Off-property surface soils analysis indicated the presence of metals and organic compounds, which may have been transported off the property by wind.

Shallow site groundwater (Zone A) flows to the northwest into Mill Creek. The RI/FS indicated that Mill Creek captured groundwater to a depth of approximately 50' to 60' bgs, so it was believed that Mill Creek would act as a hydraulic barrier for the flow of shallow contaminated and deeper, less contaminated groundwater. Groundwater not subject to capture by Mill Creek (also flowing to the northwest) became known as the ‘regional groundwater’. At the time, EPA believed the contaminated groundwater was unlikely to migrate beyond Mill Creek.

Installation of additional monitoring wells west of Mill Creek led to a Supplementary Remedial Investigation (SRI). The SRI, resulting in a July 1986 report, revealed that a plume identified at the time as the trans isomer of 1,2-dichloroethene (referred to as the trans plume) had migrated under Mill Creek and was detected in wells west of the creek. This was addressed in the 1986 ROD amendment, as discussed below.

3.3.6 Record of Decision (ROD)

On September 28, 1985, the EPA Regional Administrator approved the ROD, which required the following remedial objectives/major cleanup elements:

- Conduct extensive soil and subsurface waste sampling program, on and off site property;
- Excavation and off-site disposal of the most-highly contaminated soils and non-soil material;
- Elimination of direct contact threats in nearby off-property areas by excavation of all soils exceeding the acceptable daily intake (ADI) level or the 1×10^{-5} (1 in 100,000) excess cancer risk level and by covering remaining soils having above background concentrations of priority pollutants;
- Construction of a shallow groundwater extraction system and operation of the extraction system for a minimum of 5 to 7 years,
- Construction, operation, and maintenance of a groundwater treatment plant;
- Construction, operation, and maintenance of a stormwater control system;
- Excavation of contaminated Mill Creek and East Drain sediments which may have been affected by Western Processing;
- Attainment of either the Mill Creek performance standard, identified as the ambient water quality criteria for aquatic organisms, or the background conditions, as measured upstream from the site;
- Meeting the Mill Creek performance standard for 30 years after ceasing groundwater extraction.
- Extensive monitoring of Mill Creek, the East Drain, groundwater, and the groundwater extraction/treatment system performance;
- Construction and maintenance of a RCRA consistent cap over Sector I after pumping is completed;
- Long-term surface water and groundwater monitoring;
- Perform conditionally required actions if the performance standards are not achieved or if it appears that more than 20 years of groundwater extraction will be necessary; and
- Apply institutional controls, such as deed restrictions, as needed.

On September 4, 1986, the EPA Regional Administrator approved an amendment to the ROD, which required the following additional element:

- Remediation of the plume of 1,2-dichloroethene, referred to as the trans plume, which was detected just west of Mill Creek during the SRI.

The original identification of the trans isomer of 1,2-dichloroethene within the plume was misleading; the plume was later determined to primarily contain the cis isomer of 1,2 dichloroethene.

3.3.6.1 Performance Goals

As determined by the Consent Decree, the following treatment performance goals were established:

1. Achievement of an inward flow of shallow groundwater (<40 ft bgs) within a specified area (Sector 1) of the site. This area is approximately defined by the property boundaries. Achievement of either: 1) a reversal of groundwater flow for Zone B at a depth of 40’ to 70’ at the western boundary of the site; or 2) establishment of a hydraulic barrier to regional groundwater flow at the 40’ to 70’ depth at the western boundary of the site.

    - Current Assessment: The inward flow of groundwater from Zone B to Zone A within the slurry wall has been consistently maintained.

2. All air emissions must comply with a discharge permit issued from the Puget Sound Air Pollution Control Agency.

    - Current Assessment: Air emission permit discharge requirements have been consistently met by the on-site treatment systems during the five year period covered by this review.

3. Combined wastewater effluent from the treatment systems must meet discharge criteria included in the POTW discharge permit.

    - Current Assessment: Due to reduced discharge levels, the discharge authorization from King County recently changed from an individual permit to a Major Discharge Authorization. Wastewater discharge permit/authorization requirements have been consistently met by the on-site treatment systems.

4. Mill Creek must be restored to meet the ambient water quality criteria for aquatic organisms, or the background conditions, as measured upstream from the site.

    - Current Assessment: Performance standards for surface water in Mill Creek were achieved in 1990 and have remained in attainment since that time.

5. Mill Creek sediments must be tested to determine if leachable and/or bioavailable contaminants, which may have originated at the site, were present and could adversely impact aquatic organisms.

    - Current Assessment: The remediation of Mill Creek was completed in 1994.

3.3.6.2 Cleanup Goals/Standards

As determined by the Consent Decree, the following cleanup goals were established:

1. Surface water quality goals for Mill Creek (adjacent to site) are Federal Ambient Water Quality Criteria (AWQC) or background-derived concentrations where upstream concentrations approach or exceed the AWQC. These goals are applied at designated downstream sampling points. The Consent Decree required that these goals be met within three years.

   - The surface water quality goals for Mill Creek were attained in 1990.

2. Prior to remediation, shallow groundwater from the site discharged to Mill Creek. The surface water requirements were a means of measuring cleanup within shallow groundwater beneath the site. There were no other on-site cleanup goals set for the shallow groundwater. Trans plume groundwater performance standards established in the Consent Decree are the MCLs for cis- and trans-1,2-dichloroethene, 70 µg/l in Zone B. These standards only apply to the trans plume identified at the time of the Consent Decree and do not apply to all offsite areas.

   - Groundwater monitoring of the Sector indicates that the only VOC currently detected within the trans plume is chloroethene (i.e. vinyl chloride). Chloroethene was only detected in one of the trans plume monitoring wells (15M15B) during 2006. No VOCs were detected in the samples taken in 2007 from the trans plume monitoring wells.

3. An Explanation of Significant Difference (ESD)[11] was issued in 1995, which changed the strategy from an aggressive effort to restore groundwater quality to containment. The ESD did not waive, modify, or add any performance standards to the amended ROD; however, it did specifically identify a requirement for revisiting the issue of setting additional standards for chloroethene in the "trans" plume during future five-year reviews.

   - Geochemical sampling continues to support that conditions in the trans plume area are conducive to the natural breakdown of chloroethene; sampling results appear to verify that this breakdown is occurring as expected. EPA believes that the current approach is sufficient at this time.

4. Remedial Actions

4.1 Initial Subsurface Investigation and Cleanup

In the fall of 1986, the Trust conducted an intensive soil and soil/waste sampling program and geophysical investigation. An on-site lab was set up for fast sample turnaround. Over 1,500 soil and waste samples-were taken and analyzed over a four

[11] The ESD is described in greater detail in section 4.6 of this review.

month period. This data was used later to determine the limits of excavation of on-site subsurface specific wastes and off-property contaminated soils.

In January 1987, the Trust selected Chemical Waste Management[12] as prime contractor to conduct the Phase II subsurface cleanup at a cost that was initially estimated at $40 million. The Trust submitted work plans for the remedial action, which were approved by EPA and WDOE. Activities were conducted consistent with the Consent Decree, the NCP, and other state and local requirements. During the summer and fall of 1987, approximately 25,600 cubic yards of highly contaminated soil and sludge were excavated and hauled to a Class I RCRA landfill located in Arlington, Oregon.

The original on-site lab was replaced in January 1988 by a new on-site lab, and was comparable to an EPA Contract Laboratory Program (CLP) lab. Construction of the lab marked the implementation of the long-term monitoring program. The lab was dedicated to processing samples from the Western Processing site, and was designed for a peak load of over 9,000 samples analyzed per year. That capacity was later increased to more than 11,000 site-specific samples per year.

4.2 Source Control

In 1988, the Trust constructed a 4400' long soil-bentonite slurry wall (see Figure 4) around the 14.5 acre site to laterally confine the remaining site contaminants within the site boundaries. The slurry wall is 30" wide, 40' to 50' deep, and is a hanging wall that extends through the aquitard that separates Zone A and Zone B. The soil-bentonite slurry wall was installed using a backhoe and bucket excavator. This vertical barrier also increases efficiency of the groundwater extraction and treatment measures.

Vertical containment of the contaminants was achieved by groundwater extraction, described in detail below. In 1999, an impermeable RCRA style cap (see Figure 8) was placed over the main containment area (Sector 1).

4.3 Groundwater Cleanup

Remedial systems at the site originally included both an on-site and an off-site extraction and treatment system for groundwater cleanup. The original on-site extraction system consisted of 13,000' of infiltration trenches and 206 recovery wells. The main objective of the on-site extraction system was to create and sustain a net inward flow of groundwater at the perimeter of the site and a net upward flow of water within the slurry wall. An infiltration system was placed in shallow on-site soils within the slurry wall for the purpose of flushing contaminants from the shallow soils. During later years of extraction system operation, several well points were used as recharge wells to enable additional clean water to be infiltrated below the shallow silt layer that impeded infiltration from the site surface.

The original groundwater treatment plant was completed in July 1988 and operated until July 1997. It was designed with two major components: air stripping for VOCs, followed

[12] Chemical Waste Management merged into OHM Remediation Services Corp. in the early to mid 1990s which in turn merged with The IT Group in 1998. All assets and liabilities of The IT Group were acquired by The Shaw Group Inc. in 2002. Chemical Waste Management's subcontractors in this phase included Canonie Environmental and HDR Infrastructures.

by treatment for metals and semivolatile organic compounds. Air stripper operations began in August 1988, with thermally regenerating carbon adsorption units to capture vapor-phase contaminants. After processing by the two treatment systems, extracted groundwater was discharged to the local POTW[13] or reinjected into the ground through the infiltration system.

Due to severe fouling of the on-site stripping tower by inorganic precipitates, the treatment sequence was modified in September 1989 to provide metals precipitation before stripping of VOCs. After 1989, phenol oxidation and hexavalent chromium reduction were discontinued. Liquid-phase activated carbon filters were used to remove oxazolidinone from treated water before discharge to the POTW.

The trans plume extraction system consisted of three deep wells (trans wells) screened between 40' and 70' bgs. The Consent Decree required overlapping zones of influence for these extraction wells. A capture zone analysis confirmed that the trans plume extraction wells effectively captured the plume and was adequately containing the contamination in Zone B groundwater. Water extracted from the off-site trans wells was directed to a separate treatment system consisting of a sand filter bed and an air stripper. Effluent from this system was reinjected to the infiltration gallery or discharged to the POTW.

Construction of the shallow groundwater extraction and infiltration system and the trans plume extraction system began in January 1988 and was completed in May 1988. Seven "barrier" monitoring wells were installed west of Mill Creek. Contaminant concentrations in groundwater and water levels are measured using a system of 51 monitoring wells and 28 piezometers located on and off site in both Zone A and Zone B (see Figure 5).

4.4 Mill Creek

The Consent Decree required that Mill Creek be restored to meet the ambient water quality criteria for aquatic organisms, or the background conditions, as measured upstream from the site, and that these conditions be met within 3 years of the effective date of the Consent Decree (April 10, 1987). In March 1990, the Trust reported that the 3 year performance standards for surface water in Mill Creek had been achieved.

The Consent Decree also required that Mill Creek sediments be tested to determine if leachable and/or bioavailable contaminants, which may have originated at the site, were present and could adversely impact aquatic organisms. This investigation was completed in 1992. Specific reaches of Mill Creek were identified for remediation, which involved dredging and placing a 4" gravel bed in the creek. This remediation was completed in 1994 and sediment sampling was discontinued at the end of 1999.

Water quality in Mill Creek is monitored annually. Organic compounds are no longer monitored regularly in Mill Creek as they have not been detected since 1991. Although PCBs were originally detected in the surface soils for Western Processing, PCBs were not detected in Mill Creek sediment or water either downstream or at the site.

[13] The local POTW (publicly owned treatment works) was previously known as METRO, and is currently known as the King County Industrial Waste Program.

The only item of concern from the Mill Creek monitoring data during this five year review period did not come from the site. In 2006-2007, samples from the monitoring point upstream of the site revealed lead concentrations that exceed the Ambient Water Quality Criteria (AWQC). The downstream monitoring site detected lower concentrations of lead than the upstream monitoring site, so the Western Processing site appears not to contribute any lead to Mill Creek. The upstream source of the lead is currently unknown.

4.5 East Drain

The Consent Decree required that East Drain sediments be tested to determine if leachable and/or bioavailable contaminants which may have originated at the site were present and could adversely impact aquatic organisms. Investigation results indicated that certain areas of the East Drain contained metals exceeding cleanup levels. An investigation that was completed in 1992 also found metal contaminants in the relatively stagnant shallow groundwater zone between the East Drain and slurry wall.

Remediation of East Drain sediments was undertaken in 1993 and over 1,140 tons of sediment were removed and shipped to the Waste Management Columbia Ridge Landfill, near Arlington, Oregon. Class A gravel borrow was used as backfill material in excavated areas.

The East Drain extraction system was constructed in late 1993 between the Interurban Trail and the East Drain to intercept contaminated groundwater and prevent it from recontaminating the clean fill. The system began operation in November 1994; extracted water was treated by the Western Processing groundwater treatment plant. The system's operations ended in December of 1997, after the system's operations reached a point of diminishing returns. Results of samples taken from the East Drain in 2006 did show an unexpectedly high concentration of zinc, 597 µg/L. (See Table 4).[14]

Well 13M30A is regularly monitored for the small amount of VOCs that remain to the east of the East Drain area. TCE was last detected at this well in 2002, 1,2-DCE in 2004, and chloroethene (i.e. vinyl chloride) in 2006. Neither TCE, DCE, nor chloroethene were detected in 2007 for this location.

4.6 Explanation of Significant Differences (ESD)

After eight years of remediation (extraction, surface water infiltration, and treatment) to restore the site to clean conditions, the Trust submitted a Technical Impracticability Waiver (TIW) request, stating that the site could not be cleaned in a reasonable time or at a reasonable cost. EPA and WDOE reviewed the TIW, but did not grant a waiver. Instead, EPA issued an ESD in December 1995 which modified the ROD to reflect site conditions and remediation. The objective of the remedial systems was changed from an aggressive effort to restore groundwater quality to acceptable levels within 5 to 7 years to a containment strategy to keep the contamination on site and prevent further off-site migration. EPA and WDOE agreed that the modified remedy is fundamentally consistent with the selected remedy contained in the ROD and amended ROD and would remain protective of human health and the environment.

The ESD included the following alternative strategy:

[14] East Drain Stations D1 and D2 were dry during third quarter 2007 and therefore were not sampled.

1. Containment pumping inside the slurry wall and the trans plume,

2. Hot spot remediation on-site using thermal reduction and stabilization,

3. RCRA consistent cap over the site,

4. Isolation wall,

5. Trans plume control,

6 Bioremediation,

7. Long-term monitoring and five-year reviews,

8. Institutional controls,

9. Minimum of 30 years site maintenance, and

10. Contingency plan.

4.7 Post ESD Status

All components of the ESD requiring construction have been completed. The following is a summary of the work:

4.7.1 Containment Pumping.

A new extraction system was installed in 1996 (see Figure 4) to provide more automated operation during the period of hydraulic containment for both on-site and off-site plumes. The former vacuum extraction system was replaced by new piezometers, monitoring wells and containment wells which used positive displacement pumps. Existing equipment in Sector 2 (a 50' wide area between the west slurry wall and Mill Creek) and Sector 3 (trans plume area) was updated. Two additional extraction wells were added to Sector 4 (the area north of South 196th Street) in late 1997.

The current control system went on line in June 1997, and expanded the control and alarm capabilities for the extraction system. The new extraction system was designed to create a constant upward gradient of groundwater in Sectors 1, 2, 3 and 4 to contain the contaminants on site. The water that is extracted to create this gradient is treated to strip VOCs and discharged under a discharge authorization to the King County sewer system. Off gas from the air stripper is treated with activated carbon prior to atmospheric release under a Puget Sound Clean Air Agency permit. Spent carbon is disposed of as hazardous waste at an approved facility.

The extraction rate for the site averaged around 230 gpm between 1988 to 1997. This rate was reduced to 140 gpm at the end of 1996, because the reinfiltration of treated water was discontinued which in turn resulted in a decreased influx of water inside the containment area. The extraction rate was further decreased to 75 gpm in 1997, in conjunction with the change in strategy from restoration to containment.

Under the current treatment operations, with the trans wells off and the RCRA cap in place, a 6.5 gpm average extraction rate is sufficient to maintain the inward and upward gradient in Sector 1. This amounts to a total rate of extraction of over 3.4 million gallons a year from Sector 1; another 0.3 million gallons a year are extracted from Sector 2.

The system is operational 7 days per week, 24 hours per day. Shutdowns occur for around three hours every eight weeks to change out air stripper trays and around six hours every four months to cycle the carbon filters.[15] The system operates approximately 99% of the time.

4.7.2 "Hot Spot" Remediation.

The ESD required treatment of a shallow area near the center of the site that contained both VOCs and heavy metals. The material was to be excavated, treated, stabilized, and then placed back into the excavated area prior to installation of the RCRA cap.

Soil samples were collected and analyzed from two depths at 39 locations, using an iterative process to identify the most contaminated area of soil using contour and risk-enhanced contour plots. It was originally believed that desorption and stabilization would be the most cost effective way of addressing the hot spots, but after determining it was one large hotspot rather than many small hotspots, offsite disposal was determined to be the most cost-effective method to address the issue.

Soils were excavated from the identified area, and 5761 cubic yards (8983 tons) of contaminated soil were shipped to the hazardous waste disposal facility in Arlington, Oregon. The excavation was backfilled with lifts of clean gravel and crushed rock. Activities began in March 1997 and were completed with regrading of surface soils in October 1997.

4.7.3 RCRA Cap.

The RCRA cap over Sector 1 was completed in October 1999. (See Figures 2, 8) This served to dramatically reduce the amount of infiltration in the area and thereby reduce the amount of pumping necessary to achieve the containment strategy called for in the ESD.[16]

4.7.4 Isolation Wall.

The area north of South 196th Street, known as Sector 4,[17] was located within the slurry wall but had significantly less contamination than the main containment area for the site. Testing of surface soils in this area during 1991 established that remedial activity for the surface soils had achieved industrial cleanup levels, but groundwater treatment in the area was ongoing. The ESD called for an isolation wall to isolate this area of relatively low contamination from the rest of the site. This modification reduced the amount of groundwater pumping necessary to maintain containment. As a result of the low level of contamination in Sector 4, a RCRA cap was not required.

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[15] The carbon filters are operated in a lead-lag-standby configuration (sometimes referred to as a round robin configuration).
[16] Additional information on extraction rates can be found in § 4.7.1.
[17] This area is referred to as Cell 7 in site documents prior to construction of the isolation wall.

The isolation wall was constructed in 1997 using a soil-cement-bentonite backfill material. This varies from the mixture used in the original slurry wall in order to provide additional structural stability during the time when the City of Kent constructed an embankment for the South 196th Street arterial across the site.

4.7.4.1 Engineered Breach.

One year after the isolation wall was constructed, a 15' deep and 250' wide segment of the slurry wall for Sector 4 was removed to allow for a more natural drainage out of the area. Each side of this breach in the slurry wall is flanked with a "guardian" monitoring well, for purposes of ensuring that the natural drainage from this sector does not lead to the migration of contaminated groundwater. Samples collected from these monitoring wells since the creation of the breach indicate that the breach is functioning as expected.[18]

4.7.4.2 Soil Cover.

Two years after the isolation wall was constructed, a soil cover was placed over Sector 4. The purpose of this cover was to reduce rainfall infiltration as the cover was graded to enhance drainage.

4.7.4.3 Downgradient Monitoring Well (8M8B).

In addition to the "guardian" monitoring wells (wells 9M43A and 9M44A), an additional monitoring well is stationed west of Sector 4 for the purpose of detecting contaminants. During the fall 2007 sampling, toluene was detected in this downgradient monitoring well at a concentration of 17 μg/L.[19] This well was been sampled twice in 2008, and no VOCs were detected in those samples. Well 8M8B will be sampled again in the fall of 2008.

The Western Processing site was extensively characterized at the start of the cleanup action and monitored for over a decade; toluene has never been detected in any of the Sector 4 samples. None of the contaminants known to be present in Sector 4 were found at Well 8M8B. EPA currently believes that the toluene detected at well 8M8B may have originated from a source unrelated to Western Processing.[20]

4.7.5 Trans Plume Control.

In 1999, the Trust presented a proposal showing that proper conditions existed around the trans plume where the remaining contaminants could be remediated through monitored natural attenuation. This proposal was approved after a through review by EPA and WDOE and was initiated in April 2000. Geochemical indicators (redox potential, dissolved iron, VOCs, methane, ethane, and ethane) have been monitored since 1999, and the data continues to support that geochemical reducing conditions continue to exist in the trans plume area. The last detection in the trans plume area of TCE was in 1992, of 1,2-DCE was in 2002, and of chloroethene was in 2006. EPA supports the continued use of monitored natural attenuation for the trans plume until it is established that clean up conditions have been achieved.

4.7.6 Bioremediation.

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[18] Sector 4 contains two extraction wells that are not currently in use but can be returned to service if conditions in Sector 4 were to change in the future.

[19] The MCL for toluene under the Safe Drinking Water Act is 1000μg/L.

[20] Several current and former solvent contaminated sites exist within three-quarters of a mile from Western Processing.

The ESD identified bioremediation as a possible cleanup alternative for both shallow and deep groundwater VOC contamination. Field tests indicated that ongoing natural processes (intrinsic bioremediation) would not be significantly enhanced by active remediation. Since there was no technical advantage or cost effectiveness, bioremediation was removed from active consideration as a cleanup option for Sector 1, but was successfully implemented for the trans plume.

4.7.7 Long-Term Monitoring and Five-Year Reviews.

The Trust has prepared a long-term monitoring and sampling plan for the site. This plan was submitted to EPA and WDOE on October 26, 1999 and after some modifications, EPA accepted this plan on March 22, 2000.

Mill Creek and East Drain are monitored annually for metals[21] in addition to conventional surface water quality parameters.[22] Geochemical parameters are measured annually, and are a critical component of the monitored natural attenuation program in the trans plume area. Metals analyses for the groundwater occur annually. VOC analyses range from biannually to semiannually, depending on the location within the site.

EPA Issued Five Year Reviews for the Western Processing site in 1993, 1998 and 2003; EPA will publish this Five Year Review in 2008. The fifth Five Year Review will be due in 2013, five years after this the date of this review.

4.7.8 Institutional Controls.

The Trust has the responsibility for implementing institutional controls to protect the remedy, as required in the ROD and the Consent Decree. An institutional control plan was developed by the Trust, and this plan was approved by EPA and WDOE in March 2000. This plan included the following elements:

1. Deed restrictions and/or environmental easements for Sector I to protect the integrity of the final cap and the monitoring system, prohibit the extraction of groundwater for potable or other uses, and require foundation vapor barriers and building ventilation systems for any buildings that may be constructed.
2. A prohibition on the extraction and/or use of groundwater, other than for remedial purposes, both on site and in neighboring off property areas.
3. Annual notification to neighboring property owners to inform them of
   (a) the groundwater contamination and
   (b) the existing regulations that control groundwater use.
4. Regular maintenance, as specified in the Operations and Maintenance plan.
5. Regular monitoring, as specified in the Long Term Monitoring Program.
6. Maintenance of fencing and the site security plan.
7. A review of the Institutional Control status every five years.

With the exception of deed restrictions on the site property, all of the necessary institutional controls have either been established or are otherwise being carried out as required. Inspections and site visits indicate that these controls are effective in maintaining the remedy.

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[21] Both areas are sampled for cadmium and zinc. Mill Creek is also sampled for lead, nickel, copper, and chromium.
[22] In this case: pH, hardness, suspended solids, conductivity, and temperature

As mentioned previously in this review, the previous land owner for the Western Processing property died in 2003, and deed restrictions were not implemented prior to his death. These will be necessary to ensure the protectiveness of the remedy, however, the title search performed for this review confirmed that title to the property has not yet passed on to any heirs or successors of the estate. After a new land owner is identified, EPA intends to resume efforts for establishing deed restrictions to ensure the remedy remains protective over the long term.

The RCRA cap and containment wall extend beyond the original property lines for Western Processing. As a result, four other parcels of property contain portions of the RCRA cap and/or the slurry wall. A title search was executed as part of this five year review, which identified that none of these parcels have deed restriction put in place in order to protect the remedy. EPA intends to work with the Trust to ensure that the Trust places deed restrictions on those parcels in order to protect the remedy.

4.7.8.1 Groundwater Use.

The area surrounding the site is currently served by a municipal water supply system that provides potable water. As the Western Processing Superfund site is located in King County within the Urban Growth Boundary installation of new private drinking water wells are prohibited in the vicinity of this Superfund site.[23]

4.7.8.2 Engineered Controls.

Engineered controls for the site include fencing, locked well caps or vaults, locked gates and site security. The site property is leased by the Trust and they maintain an office at the site. They actively maintain the site for security and to ensure the engineered and institutional controls are in place and functioning properly.

4.7.8.3 Zoning.

The City of Kent has zoning authority over the area in which the Western Processing Superfund site is located, and has zoned this area for M2 industrial use. The Record of Decision (ROD) set cleanup standards that the site will be cleaned up to industrial use levels.

The City of Kent's parcel database allows the individual parcel records to be cross referenced with short external documents via electronic flags. EPA provided a letter to the City of Kent Planning Department in order to provide an easy record to which these property flags could refer. This letter identified (1) the parcels on which surface contamination was originally located, (2) that these properties will be cleaned to industrial cleanup standards, and (3) that these parcels may not be suitable for other uses (e.g. residential, child care or commercial uses) as some contamination will still be present after being delisted from the NPL.

EPA does not intend for this letter to serve as a permanent institutional control; the letter was only intended to assist the City of Kent. Nevertheless, it may augment the institutional controls, which is why it is noted in this Five Year Review.

4.7.9 Operations and Maintenance.

[23] King County Ordinance 13.24.140, Code of the King County Board of Health § 12.32.010

The Trust currently maintains the site in accordance with various existing work plans. Long-term maintenance and operations are addressed in the long-term site operations and maintenance plans that were approved by EPA and WDOE.

Major elements within the O&M plan include inspection of the grounds for erosion and the maintenance of the cap drainage system and detention basin, piezometers, sump pumps, berms, roads, fences, and gates. In addition to indirect monitoring of the cap and slurry wall through the piezometer network, inspections regularly check for any topographical changes on the surface, such as settlement, bulges, or cracking; no such changes have occurred in the past five years.

Within the water treatment plant, major O&M activities include calibration of the instruments, upkeep of the blower system (changeout of stripper trays, blower oil, belts), changeout of carbon filters, and cleaning scale off the interior of valves and piping, either by washing, scraping, or running a Styrofoam pig through the lines.

4.7.9.1 March 2007 Shutdown.

An abnormal event occurred at 4 pm on Saturday March 24, 2007. The stripper trays require regular cleaning to remove iron and other precipitates, but one of the stripper trays had an unusual amount of precipitate buildup prior to the normal cleaning period. This obstruction caused water to pass into the carbon lead filter, which was detected by existing sensors. The computer control system responded by shutting the system down and sending an alarm, both audible within the control room and via a pager system to two representatives for the Trust.

The Trust was unable to determine the issue by remotely logging into the system, so they arrived on site to fix the problem. The stripper tray was replaced with the clean standby spare. The supplier of the carbon informed the Trust[24] that the wet carbon would continue to remove the VOCs from the heated blower exhaust stream. The Trust instead opted to cycle the carbon filters early, disposing of the damp lead unit at a hazardous waste landfill, placing the damp lag unit into the lead position, and the clean, dry standby unit into the lag position to ensure successful system operation. As this required discussions with the carbon supplier, the system was not fully returned to service until 4 pm on Monday, March 26, 2007.

Continuous monitoring of the aquifers through this period showed that the flux continued in an upward direction, from Zone B into Zone A, so there was continuous containment throughout the event. The water treatment system shut down at the time of the alarm, so no untreated waste water was discharged. The procedures for system fault protection were executed as planned and containment was maintained.

4.7.10 Contingency Plan.

The Western Processing Trust Fund submitted a Long Term Contingency Plan to EPA and WDOE in November 1999, amended with errata and attachments in February 2000. This plan identifies procedures for evaluating containment and actions to be taken if those procedures indicate loss of containment; the plan covers a period of up to 30 years from the approval of the Long Term Contingency Plan. EPA approved this plan in March 2000.

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[24] As stated within a March 27, 2007 e-mail from Wayne Schlappi (Trust) to Lynda Priddy (EPA) and Chris Maurer (WDOE).

5. Progress since Last Review

5.1 Protectiveness Statement from the Third Five-Year Review

The remedy at the Western Processing site currently protects human health and the environment because the slurry wall, RCRA cap, containment pumping and extraction treatment system contain the contaminated groundwater and soil within the source area. The groundwater concentrations off the Western Processing property are decreasing and there are no exposure routes to the site contaminants. Current land use is consistent with Institutional Control requirements, however, institutional controls that will run with the land are not in place and still need to be placed on the parcels of property to ensure the remedy remains protective for the long term.

5.2 Status of Recommendations from the Third Five-Year Review

Recommendations from the Third Five Year Review were to institute permanent Institutional Controls that would run with the land, as required by the ROD and ESD. Since the Third Five Year Review, ownership of the primary property has been unclear. The landowner of the Western Processing site died in 2003. A title search was performed in November 2007, and at that time the title to the property still had not passed on to any heirs or successors.

EPA is currently attempting to determine who the landowner is for the original Western Processing property. No probate proceedings have been filed in King County, which is the location of both the original Western Processing facility and the residence for the former landowner. In late March 2008, EPA located the attorney for the decedent's estate in New York State. At the time of that conversation, the attorney for the estate had not clarified whether the heirs to the estate would be asserting their claim to the property. As the Trust is ultimately responsible for instituting the institutional controls and is interested in purchasing the property, EPA provided the attorney for the estate and the attorney for the Trust with contact information for each other. The attorney for the Trust retired in early May 2008, and had not reached a resolution prior to his retirement. EPA intends to continue towards a resolution on the question of ownership as soon as the Trust selects a new attorney.

During review of the title information, EPA determined that portions of the slurry wall and/or the RCRA cap extend onto four parcels of property that were adjacent to the original Western Processing facility and that these properties lack institutional controls to protect the remedy. As the institutional controls need to protect the entirety of the slurry walls and RCRA cap, EPA is aware of no reason that prevents the implementation of institutional controls on these four properties. EPA will discuss this issue with the attorney for the Trust as soon as the Trust selects their new attorney.

6. Five-Year Review Process

The Five Year Review was conducted according to procedures in OSWER Directive 9355.7-03B-P, Comprehensive Five-Year Review Guidance.

6.1 Administrative Components

The initial planning for this Five Year review commenced with an internal EPA kick off meeting on January 7, 2008. Over the course of the following week, EPA updated the previous site mailing list to ensure current contact names and addresses. EPA Region 10 contacted the Trust on January 10, 2008 to inform them of the upcoming Five Year Review, request updates to their contacts on their mailing list and to ask if any additions that should be added to the site notification list.

Activities in this review consisted of:
a) Community notification,
b) Review of site-related documents,
c) Review of monitoring data,
d) Discussions with the Trust,
e) Site visit and inspection, and,
f) Preparation of the Five-Year Review report.

The Five-Year Review team was led by Chris Bellovary, EPA Remedial Project Manager (RPM). Bernie Zavala, EPA Hydrogeologist, Debra Sherbina, EPA Community Involvement Coordinator (CIC); Ted Yackulic, EPA Site Attorney; and Tim Brincefield, EPA Five Year Review Coordinator provided valuable assistance and review during the preparation of this report. Chris Maurer, WDOE Toxics Cleanup Program, also assisted in the preparation of this review.

6.2 Community Notification

There has not been any interest expressed from the community in the last five years for community involvement in regards to this project, so no community involvement activities have occurred between the last Five Year Review and the beginning of this Five Year Review. Community interest in this site is considered low.

In late January 2008, EPA mailed postcard to the contacts on the site mailing list announcing the beginning of the Five-Year Review. On January 30, 2008, EPA placed a Public Notice in the Kent Reporter stating that EPA was preparing this Five-Year Review and to solicit any comments. At that same time, the public notice was published on the EPA Region 10 website. The comment period closed on April 30, 2008; no comments were received by EPA during this time.

Upon completion and acceptance of this review, EPA will place a public notice in the Kent Reporter and will send a postcard mailing to the site mailing list to inform citizens that the finished report is available. A copy of the review will be sent to the Trust. This review will be publicly available on CD and as a hard copy at the Kent

Regional Library, at the EPA Region 10 office, and will be available in PDF format on the EPA Region 10 Western Processing web page.[25]

6.3 Document Review

The following documents were evaluated as part of the 2008 Five Year Review:

Feasibility Study for Subsurface Cleanup, Western Processing, EPA, Mar. 6, 1985
Record of Decision, EPA, Sept. 1985.
Record of Decision Amendment, EPA, Sept. 1986.
Western Processing Consent Decree (C83-252M), filed April 10, 1987.
1988 Annual Evaluation Western Processing, Landau Associates, Mar. 21, 1990
1989 Annual Evaluation Western Processing, Landau Associates, Dec. 30, 1991
1990 Annual Evaluation Western Processing, Landau Associates, Mar. 11, 1992
1991 Annual Evaluation Western Processing, Landau Associates, Aug. 5, 1992
1992 Annual Evaluation Western Processing, Landau Associates, Sept. 22, 1993
Memo: Western Processing Phase II, from H. Gaskill (Trust) to L. McPhillips (EPA) and M. Kuntz (WDOE), Feb. 9, 1994
1993 Annual Evaluation Western Processing, Landau Associates, July 27, 1994
1994 Annual Evaluation Western Processing, Landau Associates, Feb. 28, 1995
Explanation of Significant Differences, Western Processing Superfund Site, EPA, Dec. 11, 1995.
1995 Annual Evaluation Western Processing, Landau Associates, May 14, 1997
1996 Annual Evaluation Western Processing, Landau Associates, Sept. 1, 1998
1997 Annual Evaluation Western Processing, Landau Associates, Dec. 31, 1998
1998 Annual Evaluation Western Processing, Landau Associates, Sept. 14, 1999
Long-Term Monitoring Work Plan, Landau Associates, Oct. 26, 1999
Long-Term Contingency Plan, Landau Associates, Oct. 27, 1999
Institutional Controls Work Plan, Landau Associates, Nov. 16, 1999
Long-Term Site Security Plan, Landau Associates, Nov.19, 1999
1999 Annual Evaluation Western Processing, Landau Associates, Oct. 3, 2000
2000 Annual Evaluation Western Processing, Landau Associates, Oct. 5, 2001
2001 Annual Evaluation Western Processing, Landau Associates, June 18, 2002
Monitored Natural Attenuation Annual Summary - 2002 Western Processing, Landau Associates, March 19, 2003
2002 Annual Evaluation Western Processing, Landau Associates, April 30, 2003
Third Five Year Review for Western Processing Superfund Site, EPA, Sept. 2003
2003 Annual Report Western Processing, Landau Associates, July 16, 2004
2004 Annual Report Western Processing, Landau Associates, July 29, 2005
2005 Annual Report Western Processing, Landau Associates, May 30, 2006
2006 Annual Report Western Processing, Landau Associates, June 26, 2007
2007 Annual Report Western Processing, Landau Associates, June 23, 2008

6.4 Data Review

During 2007, 3.13 pounds of metals and 44.7 pounds of organics were removed from the extracted groundwater. As of the end of 2007, treatment of the extracted

[25] To locate the EPA Region 10 Western Processing webpage, please visit http://www.epa.gov/r10earth/, click on A to Z Subject Index, then W, then Western Processing.

groundwater has removed 80,328 pounds of metals[26] and 25,390 pounds of organics[27] over the entire course of the groundwater extraction and containment program, most of which occurred during the first eight years. (See Figures 9, 10) Piezometer readings over the past five years confirm that containment at the site has been continuously achieved. The groundwater extraction points are shown in Figure 4 in the Appendix, water quality monitor locations in Figure 5 and the groundwater elevation monitoring locations in Figure 6.

Water quality monitoring results have generally indicated a downward trend for the contaminants of concern for wells outside the Sector 1 containment cell. Chloroethene (i.e. vinyl chloride), a breakdown product of 1,2-DCE, was the only contaminant of concern that was detected in the trans plume area during the review period, and is further evidence that the natural attenuation is occurring as predicted at this location. Mill Creek surface water quality monitoring data do not reflect contamination from the site.

Within the containment area, recent samples from the monitoring wells show concentrations of DCE up to 9800 µg/L. Active containment acts to isolate these concentrations of DCE and other contaminants of concern within Sector 1 through the use of pumping and treatment, slurry walls and the RCRA cap. For additional site data, please refer to Figures 9-10 and Tables 1-6 in the appendix.

6.5 Site Inspection

A site visit was conducted on April 3, 2008. The purpose of the on site visit was to assess the protectiveness of the remedy, including the condition of the extraction and treatment system, condition of the cap and cover, stormwater control, and security fencing. A site inspection report was completed during the visit and is attached in the Appendix with labeled photographs that support the findings from that visit.

Conditions and progress:

1. The Western Processing site remains fenced with access controlled by onsite personnel.
2. The RCRA cap and drainage system are well maintained and appear to functioning as designed.
3. The site groundwater extraction system has operated continuously with only very brief shut-downs for routine maintenance, with the exception of the March 2007 shutdown as detailed in Section 4.7.9. A process flow diagram for the Containment Extraction system can be found on Figure 7 in the Appendix.
4. The treatment plant has operated continuously in compliance with the King County water discharge requirements, and with only very brief shut-downs for routine maintenance and the March 2007 shutdown as detailed in Section 4.7.9. As a result of the reduced volume of treated wastewater discharged, on April 30, 2007 from King County Wastewater Discharge Permit No. 7686-02 was superseded by King County Major Discharge Authorization No. 4111-01. During 2007 the treatment plant

[26] 73521 lbs of zinc, 3583 lbs of nickel, 1557 lbs of chromium, 616 lbs of lead, 609 lbs of copper, and 443 lbs of cadmium.
[27] 603 lbs of PCE, 11315 lbs of TCE, 5693 lbs of DCE, 1002 lbs of TCM, 5571 lbs of DCM, and 1206 lbs of chloroethene.

processed 3.38 million gallons of water, while extracting 2.9 pounds of zinc, 0.2 pounds of chromium, and 44.7 pounds of volatile organic compounds (VOCs).

5. Piezometers are a necessary component for the monitoring system, and have a limited lifespan, so these are replaced as necessary throughout the year.

6.6 Interviews

The following people were interviewed during the process of preparing this Five Year Review:

<u>Western Processing Trust Fund</u>
Wayne Schlappi, Project Manager
Ken Brown, Contractor (Shaw Environmental)
Bill Enkeboll, Contractor (Landau Associates)
Christine Kimmel, Contractor (Landau Associates)

<u>City of Kent</u>
Mike Mactutis, Environmental Engineering Manager

Community interviews were not conducted for this Five Year Review, as the community has not expressed any interest in this site during the past five years.

7. Technical Assessment:

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

No. All components of the remedy have been implemented with the exception of the required deed restrictions. The purpose for the deed restrictions are to ensure that current or future property owners do not damage the containment system. EPA's review of documents, data, and site inspection indicate that all other aspects of the remedy are functioning as intended by the ROD.

7.1.1 Sector 1: Main Containment Area.

The first performance standard for the 1985 ROD is to prevent further degradation of the shallow groundwater, and the 1986 ROD amendment stated that the Trust would satisfy this standard if they achieve a shallow groundwater flow inward from the boundaries of the contaminated zone. In furtherance of this, the 1985 ROD put forth the plan for a RCRA cap and the 1986 ROD Amendment put forth the plan for the slurry wall surrounding the site. The 1995 ESD changed the strategy for Sector 1 from restoration to containment.

- The RCRA cap and slurry walls are in place and functioning properly;
- The monitoring system is in place to verify that containment is maintained,
- The extraction system is successfully maintaining an inward and upward flow throughout Sector 1, and properly contains the contaminants within Sector 1;
- The groundwater treatment plant properly treating the extracted groundwater prior to discharge to the POTW;
- O&M is implemented as approved;

As a result, EPA believes that the containment strategy is functioning as intended under the ESD, and that ingestion and inhalation exposure pathways to contaminated groundwater and/or subsurface soils are under control. By properly containing the contaminants, the first performance standard for the 1985 ROD is being achieved.

7.1.2 Sector 2 and Mill Creek.

The second performance standard for the 1985 ROD is to achieve a water quality within Mill Creek that is protective of aquatic organisms. This standard needs to be achieved both during and after the period in which pumping occurs.

Sector 2 is composed of the 50' buffer strip between the containment wall of Sector 1 and Mill Creek, and the purpose of this buffer strip was to allow the creek to remain in a natural condition after it was properly restored. Containment is maintained in Sector 1 by continuously drawing shallow groundwater into the containment area; if the containment wall was closer than 50' from Mill Creek, there was a risk that this activity could dewater the creek.

Any contaminants from Sector 2 leaching into Mill Creek have not been significant, as the cleanup standards for Mill Creek were achieved in 1993, and the site has continued to meet this standard for almost fifteen years. As a result, EPA believes that the second performance standard for the 1985 ROD is being achieved.

7.1.3 East Drain.

The ROD required the removal of contaminated sediments from East Drain and the 1986 Consent Decree contains the details for the East Drain monitoring program. The Trust completed the removal operations and remediation of East Drain in 1998. The Trust collects surface water from East Drain during each fall sampling period (assuming water is present) and analyzes these samples for metals and conventional parameters to ensure that the cleanup was successful. Groundwater near East Drain is sampled semiannually for VOCs and base-neutral/acid extractables and is sampled annually for geochemical parameters.

EPA has reviewed the sample data for East Drain and believes that the monitoring was performed as intended during the 2003-2008 review period.

7.1.4 Sector 3: Trans Plume Area.

The 1986 ROD Amendment was the document that first addressed the contamination in Sector 3, and stated that the concentration of 1,2-dichloroethene be reduced to below 70 ppb (which is the MCL) throughout the plume. The ESD did not modify this plan, but it did state that EPA and WDOE will revisit the need to set standards for chloroethene (i.e. vinyl chloride) during future five year reviews, or sooner if necessary

- The plume has been contracting, so there are no new areas are at risk of contamination, and
- Sample results have not detected 1,2-dichloroethene in the trans plume since 2002.

- Concentrations of chloroethene have been falling since their peak, and were only detected in one monitoring well for Sector 3 in 2005 and 2006.
- The MCL for chloroethene is 2 ppb; none of the detections over this monitoring period have exceeded 16 ppb.[28]
- Current measurements show that geochemical reducing conditions continue to exist in the trans plume area, so it is anticipated that the remaining contaminants will continue to break down in this area.

EPA believes that the remedy within Sector 3 is functioning as intended under the 1986 ROD Amendment.

7.1.5 Sector 4: North of 196th Street.

The 1985 ROD states that cleanup of surface and subsurface soils is to include the excavation of any soils contaminated with PCBs over 2 ppm and the excavation of all other soils that exceed either the acceptable daily intake (ADI) level or the 10^{-5} (1 in 100,000) excess cancer risk level. Any remaining soils that contain concentrations of priority pollutants which exceed background levels for industrial areas were to be covered. The end goal for soils in Sector 4 was to achieve an adequately low level of soil contamination that the City and the Health Departments could approve the use of the land for industrial development.

7.1.6 Institutional Controls.

The institutional control component to the remedy, in the form of deed restrictions on the parcels of property that contain portions of the containment walls and /or RCRA cap, have not been enacted. When properly implemented, the planned institutional controls are expected to be, and to remain, protective. The delay in implementing the deed restrictions is not affecting the current protectiveness because the current uses of land are consistent with the planned deed restrictions. The Trust is actively maintaining the site and the Governments conduct regular oversight, in order to provide the same protection in the short term that institutional controls are intended to achieve in the long term.

7.1.7 Operations and Maintenance.

During EPA site visits and inspections, it appeared that O&M activities were properly conducted and logs of O&M activities were being maintained on site. O&M activities are discussed in more detail in § 4.7.9 of this review. At this time, EPA believes that O&M activities are being properly conducted and that these activities are effective in maintaining the remedy.

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

Yes. Review of the exposure assumptions, toxicity data, cleanup levels, and RAOs indicate that the remedy selected at the time of the ROD is still properly supported.

7.2.1 Human Exposure

Under current site conditions, potential or actual human exposures are under control. The site is protective for people under current conditions.

[28] For purposes of comparison, sample results detected chloroethene in six wells in 2002 and the maximum concentration in those samples was 150 ppb of chloroethene, so the decline has been significant.

There are no changes known in the physical conditions of the site that would affect the protectiveness of the remedy. This site is zoned industrial and the surface soil cleanup levels are consistent with industrial use. Although performance standards for chloroethene (i.e. vinyl chloride) have not been set at this time, the amount of chloroethene that remains in the trans plume is decreasing and appears to be approaching MCLs. With the exception of deed restrictions, all other necessary protective remedies have been implemented.

7.2.2 Review of Applicable or Relevant and Appropriate Requirements (ARARs)

On-site remedial actions must attain (or waive) Federal and more stringent State ARARs of environmental laws upon completion of the remedial action, and the ARARs are applied as written and interpreted at the time the ROD is signed.[29] EPA reviews changes in ARARs that have occurred during the previous five years during each Five Year Review, to determine whether the change in regulation calls into question the protectiveness of the remedy.[30]

In October 2004, the Washington State Department of Ecology updated risk levels for TCE under Washington State's Model Toxic Control Act to include a cancer slope factor for ingestion and inhalation of trichloroethene (TCE).[31] EPA expects to complete its own review of the carcinogenicity of TCE by late 2010.[32]

At this time, these changes do not appear to require a change in the remedy. The strategy within the slurry wall is for containment of all contaminants within the site boundaries, and this strategy would not be impacted by a change in TCE risk levels. In regards to monitored natural attenuation of offsite areas, no TCE has been detected in any offsite well since 2002.

As a result, no changes are necessary at this time. EPA intends to take any changes in ARARs into consideration for any future remedy changes.

7.2.3 Groundwater Migration

Contaminated groundwater migration at this site is under control.

The Western Processing Superfund site contains several areas of contaminated groundwater. The contaminated groundwater in offsite areas are monitored to ensure that natural attenuation is occurring as predicted, and the data reviewed for this evaluation show that these areas are contracting in area and decreasing in concentration. As a result, migration of groundwater from those areas is under control.

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29 "Once a ROD is signed and a remedy chosen, EPA will not reopen that decision unless the new or modified requirement calls into question the protectiveness of the selected remedy." Preamble to the National Contingency Plan, 55 FR 8757.

30 "[A] policy of freezing ARARs at the time of the ROD signing will not sacrifice protection of human health and the environment, because the remedy will be reviewed for protectiveness every five years, considering new or modified requirements at that point, or more frequently, if there is reason to believe that the remedy is no longer protective of health and environment." Preamble to the National Contingency Plan, 55 FR 8758.

31 Ref: *Trichloroethylene Toxicity Information*, Ecology, October 2004. Available at: https://fortress.wa.gov/ecy/clarc/focussheets/tce%20pce%20oct%202004%20final.pdf. Last accessed on June 26, 2008.

32 Ref: *Economic Impact Analysis of the Halogenated Solvent Cleaners Residual Risk Standard*, EPA, April 2007. Available at http://www.epa.gov/ttnecas1/regdata/EIAs/hsceconanalysisreportfinaldraft60000.pdf. Last accessed on June 26, 2008.

For the area under the RCRA cap, a small amount of groundwater is continuously extracted in order to contain the contaminated soils and groundwater within the containment area. The computer controlled system continuously monitors the efficacy of this extraction through a network of piezometers. Data reviewed for this evaluation show that the system is properly containing the contaminated groundwater within the containment area. As a result, migration of Sector 1 groundwater is under control.

Sector 4, which is north of South 196th Street, historically had lower levels of contamination. As a result, no cap was necessary for this area, and only two extraction wells were located within Sector 4. These pumps were shut down in 2000 as part of the containment strategy, and are only currently used for taking samples, but these pumps remain available for possible use in case site conditions change in the future.

Each side of the 250' wide breach in the slurry wall has a monitoring well, sometimes referred to as guardian wells, for purposes of ensuring that the natural drainage from this sector does not lead to the migration of contaminated groundwater. Data reviewed for this evaluation indicates that the drainage past these guardian wells has not contained contaminants. As a result, migration of Sector 4 groundwater is under control.

7.2.4 Ready for Reuse?

In the 1985 ROD, as later modified by the 1986 ROD Amendment and the 1995 ESD, EPA selected response actions for the Western Processing Site to manage risks to human health and the environment. With the completion of the response actions for surface soils, surface conditions in Sector 1 meet the cleanup criteria and the sector is suitable for development.

Sector 2 largely consists of the buffer zone to the east of Mill Creek. That area of the site is not suitable for development for both zoning and drainage reasons. For the area of Sector 2 that is suitable for development, surface conditions at this are of the site meet cleanup criteria. This area of the site currently houses offices used by the Trust for conducting site security, monitoring, operations and maintenance.

Sector 3 consists of the area west of Mill Creek. This area was not impacted by site-related surface contamination; it is part of the site due to the existence of the trans plume. This area of the site has been used for industrial activities throughout the life of the project, and continues to be suitable for these uses.

Sector 4 physical constraints appear to preclude development. The sector is irregularly shaped, has a 30' wide drainage strip centered on Mill Creek as a western border, the embankment to the elevated S. 196th Street on its southern border, and no road access on any side. The zoning requirements require a 30' setback from property lines, which results in a parcel that has very little available area for development. Due to these physical constraints, Sector 4 has not been considered for reuse at this time.

Restrictions on the potential uses for Sectors 1-2 include:

A. Any use must be appropriate for M2 Light Industrial zoning requirements.[33]
B. Any use must provide access to the monitoring and extraction wells.
C. Any use must protect the integrity of the monitoring and extraction wells.
D. Any use must protect the integrity of the site cap and barrier walls.
E. Any use must not adversely disturb the subsurface soils
F. Any constructed buildings in Sector 1 must include foundation vapor barriers and building ventilation systems.
G. A prohibition on the extraction of groundwater for potable or other uses.

Based on information available as of this date, EPA has determined that the surface soils in Sectors 1-2 are ready for reuse, as long as any lease agreement includes the restrictions above among the provisions that protect the remedy and the intended use does not interfere with ongoing sampling and monitoring. These same provisions will need to be incorporated into a deed restriction once the landowner for the site is identified. Sector 3 has been available for use throughout the history of this site.

The most recent evaluation by the Trust is that there are insufficient profit margins to make reuse a worthwhile goal to pursue at this time, but this may change in response to future market conditions.

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

Yes. To ensure the long term protectiveness of the remedy, the Contingent Action Criteria should be updated to reflect current site conditions.

7.3.1 Contingent Action Criteria

The 1995 ESD altered the remediation strategy for the Western Processing site from restoration to containment, and the Trust phased this containment strategy into effect during 1997. Part of this strategy included the creation of a Long Term Contingency Plan, approved in March of 2000. The purpose of this contingency plan was to evaluate and verify whether the new system properly maintained containment of contaminated soil and groundwater, and this plan identified procedures and potential contingent actions to implement if loss of containment was to occur. Assessments of the effectiveness of the contingency plan were to occur at five year intervals.

The Trust performed a statistical evaluation for critical monitoring wells based on their historic monitoring results in order to establish a series of set points which are referred to as the Contingent Action Criteria (CAC). The previously identified contingency procedures are triggered if the CAC are exceeded.

During this Five Year Review, it was noted that the CAC have not been updated since they were originally approved. Due to declining concentrations of contaminants in many areas, some of the CACs remained set at concentrations that were several orders of magnitude higher than anything recently recorded at that location. EPA has brought this issue to the attention of the Trust, and the Trust has agreed that the CACs for some of the critical wells do need to be updated.

[33] Kent City Code § 15.03.010.

Current discussions involve whether it would be advisable to first perform a long term monitoring optimization (LTMO) analysis based on the site data. LTMO analyses evaluate the historical site data to determine whether the number and placement of monitoring wells are optimal, and what would be the optimal sampling frequencies for these wells. It is possible that the results of a LTMO could reveal that it is not necessary to maintain all of the existing monitoring wells. If a LTMO is to occur at this site at this time, this analysis should occur prior to updating the CAC. These discussions are currently ongoing.

7.3.2 Potential Climate Change Impacts

Average annual temperatures in the Pacific Northwest are projected to increase by 2°F by the 2020s and 3°F by the 2040s when compared with a 1970 to 1999 reference period. This increase is projected to occur in all seasons, but most models project the largest temperature increases in summer (June-August).[34] The remedy selected at the Western Processing Superfund site has been used in similar sites throughout the United States, including those in much warmer climates, and so the anticipated increase in temperature does not pose an area of concern.

Mill Creek is located on the western side of the property, and is a rain dominated watershed with a period of peak flow between December 15 and March 1.[35] Current climate models have a lower degree of certainty in precipitation impacts, but most models project a slight increase in precipitation during the fall and winter months.[36] As portions of the Western Processing Superfund site are located within a 100 year flood plain, increases in winter precipitation could present an increased flood risk for the site in the future. As the projected precipitation changes are smaller than 20th century year-to-year variability, this data is currently inconclusive, but should be re-evaluated during the next five year review.

The Western Processing site has an elevation of 28' above the current sea level. Current estimates of relative sea level rise for the area of the Puget Sound between Tacoma and Seattle are around +1' by the year 2040 and +3' by the year 2100, so the Western Processing Superfund site is well outside of any areas that may be impacted by local sea level rise.

7.4 Technical Assessment Summary

With the exception of the deed restrictions, the site data and site inspection reports show that all other elements of the remedy have been properly implemented, are functioning as intended by the ROD and are effectively maintained by the approved O&M plan. The delay in implementing the deed restrictions has no effect on the current protectiveness but could affect long term protectiveness. There have been no physical changes of the site that would affect the effectiveness of the implemented remedial actions. Surface and groundwater exposure routes are under control.

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[34] Ref: *Climate Change Scenarios*, Climate Impacts Group, University of Washington. Available at http://www.cses.washington.edu/data/ipccar4/. Last accessed on June 27, 2008.

[35] Mill Creek data is available at http://wa.water.usgs.gov/data/realtime/adr/2007/12113349.2007.pdf and http://dnr.metrokc.gov/wlr/waterres/streamsdata/Mill.htm. Last accessed on June 27, 2008.

[36] Ref: *Scenarios of Future Climate for the Pacific Northwest*, Climate Impacts Group, University of Washington. Available at http://cses.washington.edu/db/pdf/kc05scenarios462.pdf. Last accessed on June 27, 2008.

8. Issues, Recommendations and Follow-up Actions

The major issues, recommendations, and follow-up actions for the Western Processing site are presented in the table below:

Issues	Affects Protectiveness	
	Current	Future
Permanent Institutional Controls need to be implemented that run with the land on the original facility property.	No	Yes
Permanent Institutional Controls need to be implemented that run with the land on the adjacent properties which contain part of the cap and/or slurry walls.	Possibly	Yes
The Contingent Action Criteria need to be updated to reflect current site conditions.	Possibly	Yes

Recommendations / Follow-up Actions	Accountable Party	Oversight Agency	Milestone Date	Affects Protectiveness	
				Current	Future
Implement remaining Institutional Controls for the site property	Western Processing Trust Fund	EPA	Dec. 2009	No	Yes
Implement remaining Institutional Controls for adjacent properties	Western Processing Trust Fund	EPA	Oct. 2009	Possibly	Yes
Update Contingent Action Criteria	Western Processing Trust Fund	EPA	Mar. 2009	Possibly	Yes

9. Protectiveness Summary

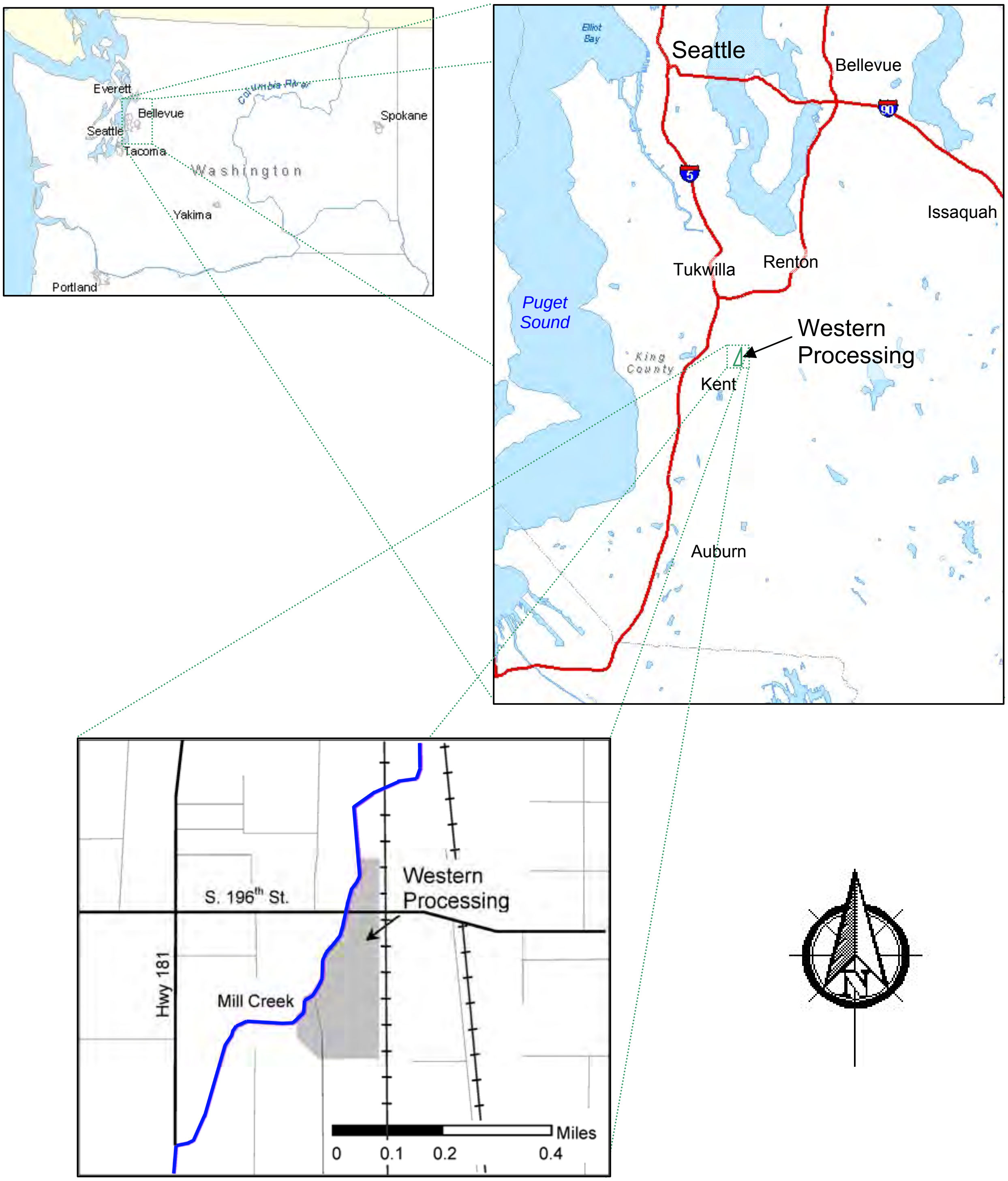
The remedy at the Western Processing site currently protects human health and the environment because the slurry wall, RCRA cap, containment pumping and extraction treatment system contain the contaminated groundwater and soil within the source area. The groundwater concentrations off the Western Processing property are decreasing and there are no exposure routes to the site contaminants. However, institutional controls that will run with the land still need to be placed on the property to ensure long-term protectiveness.

10. Next Review

Hazardous substances remain on site. The Fifth Five-Year Review for the Western Processing Superfund Site will be required to be complete by July 25, 2013.

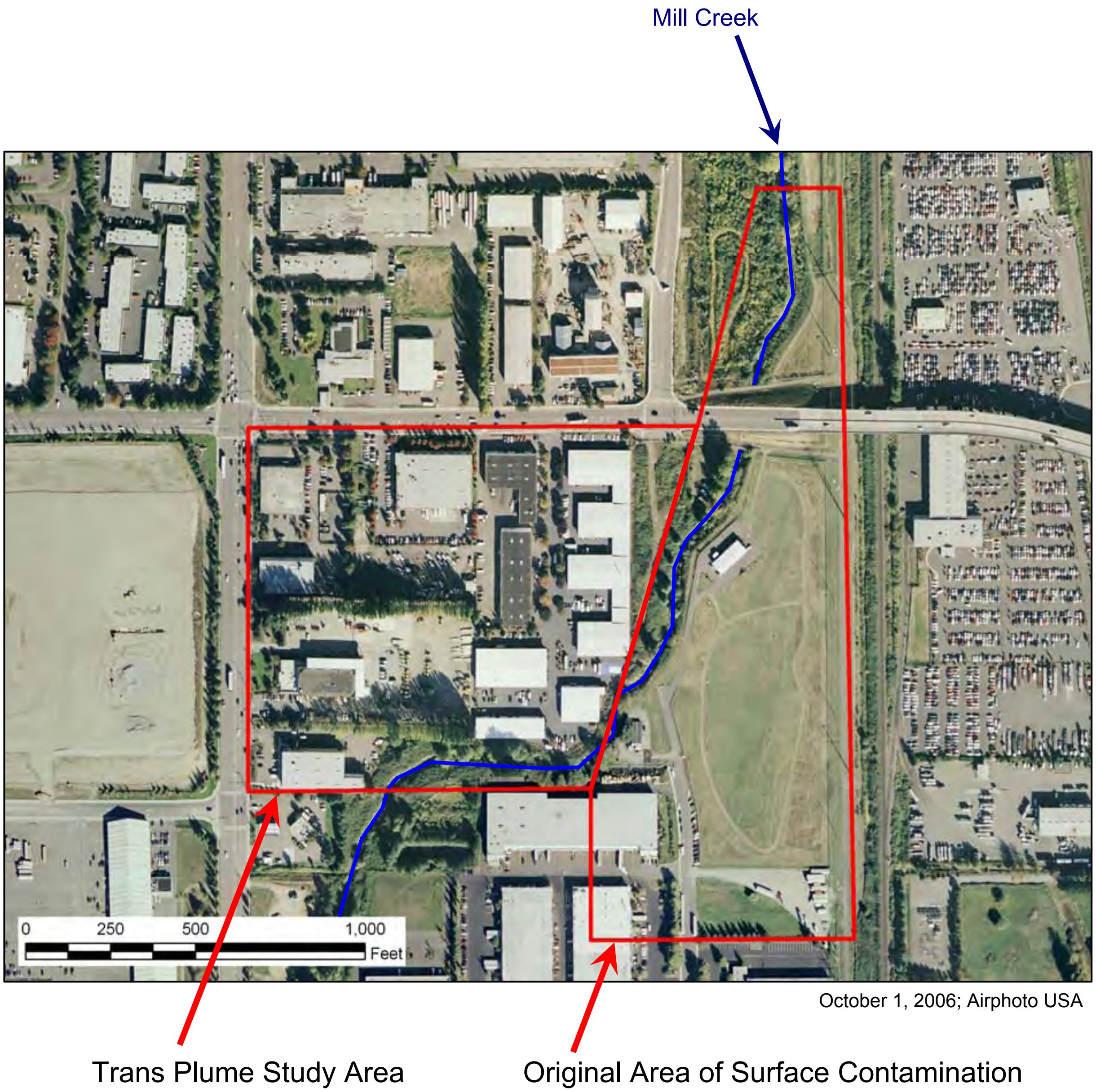
FIGURES AND TABLES

Figure 1: Site Location



Reference Coordinates
Latitude: 47° 25' 30" N
Longitude: 122° 14' 35" W

Figure 2: Aerial Photo of Western Processing Site



October 1, 2006; Airphoto USA

Figure 3: Sector Map

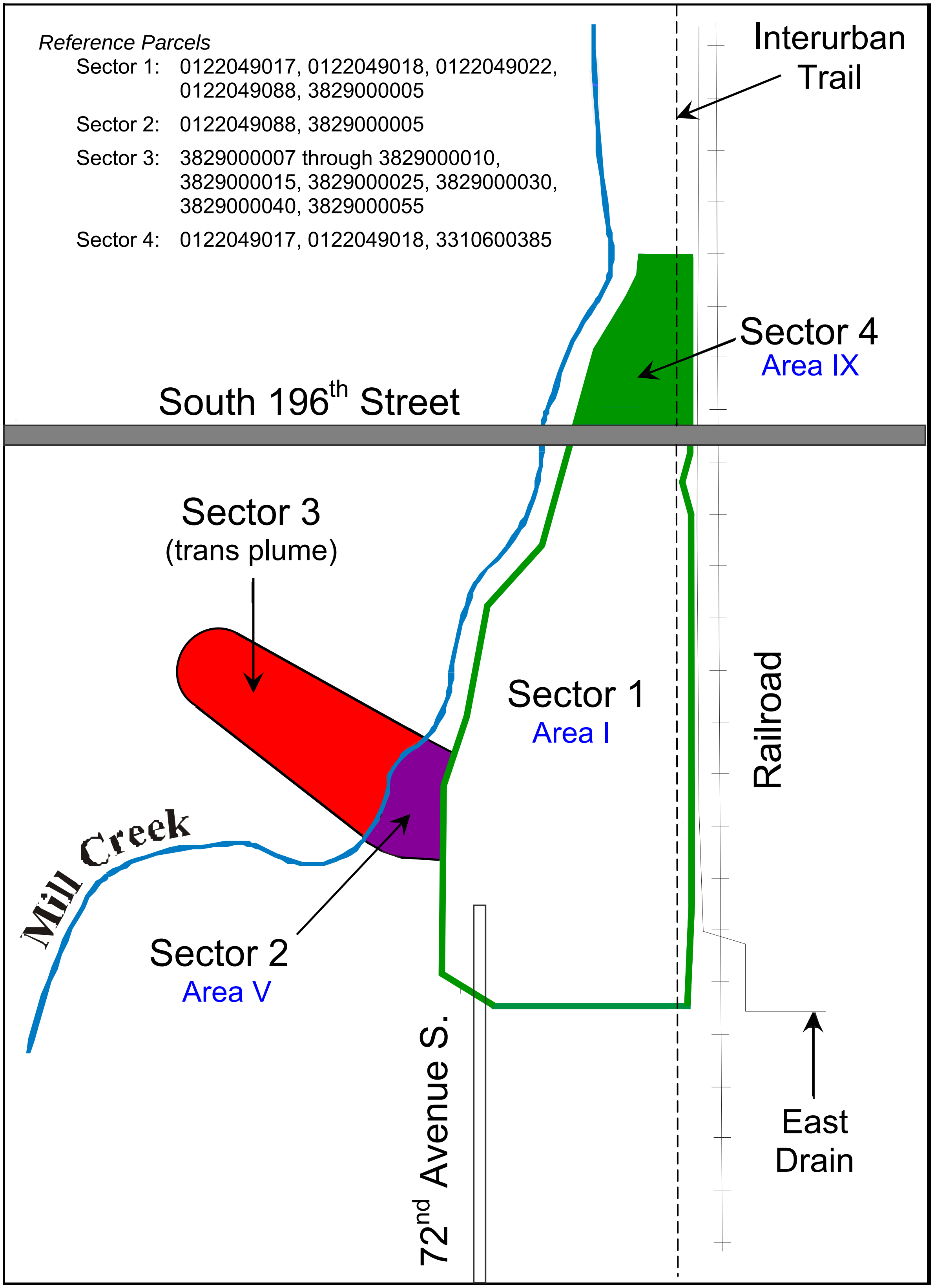


Figure 4: Site Map

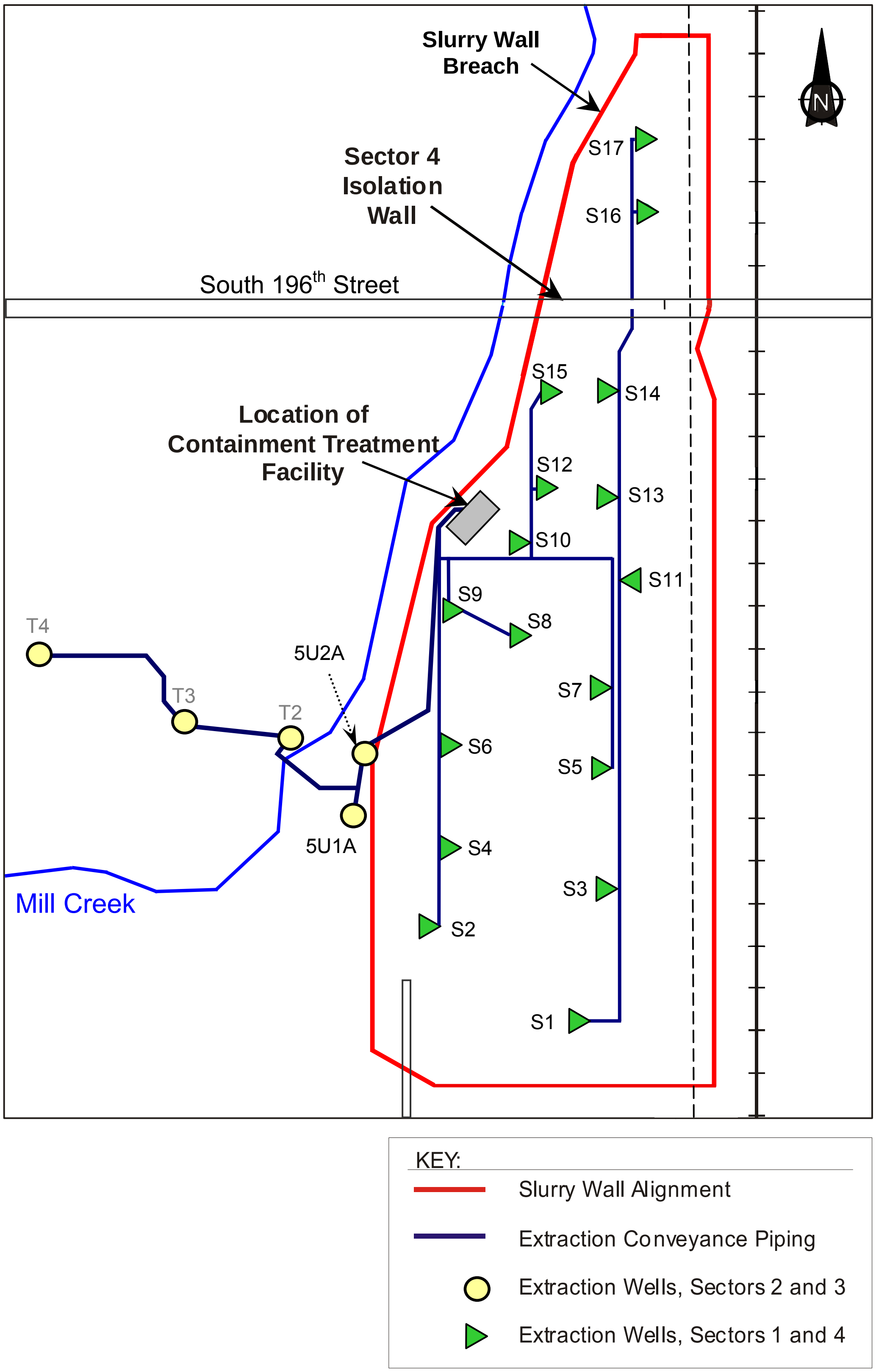


Figure 5: Groundwater Elevation Monitoring Locations

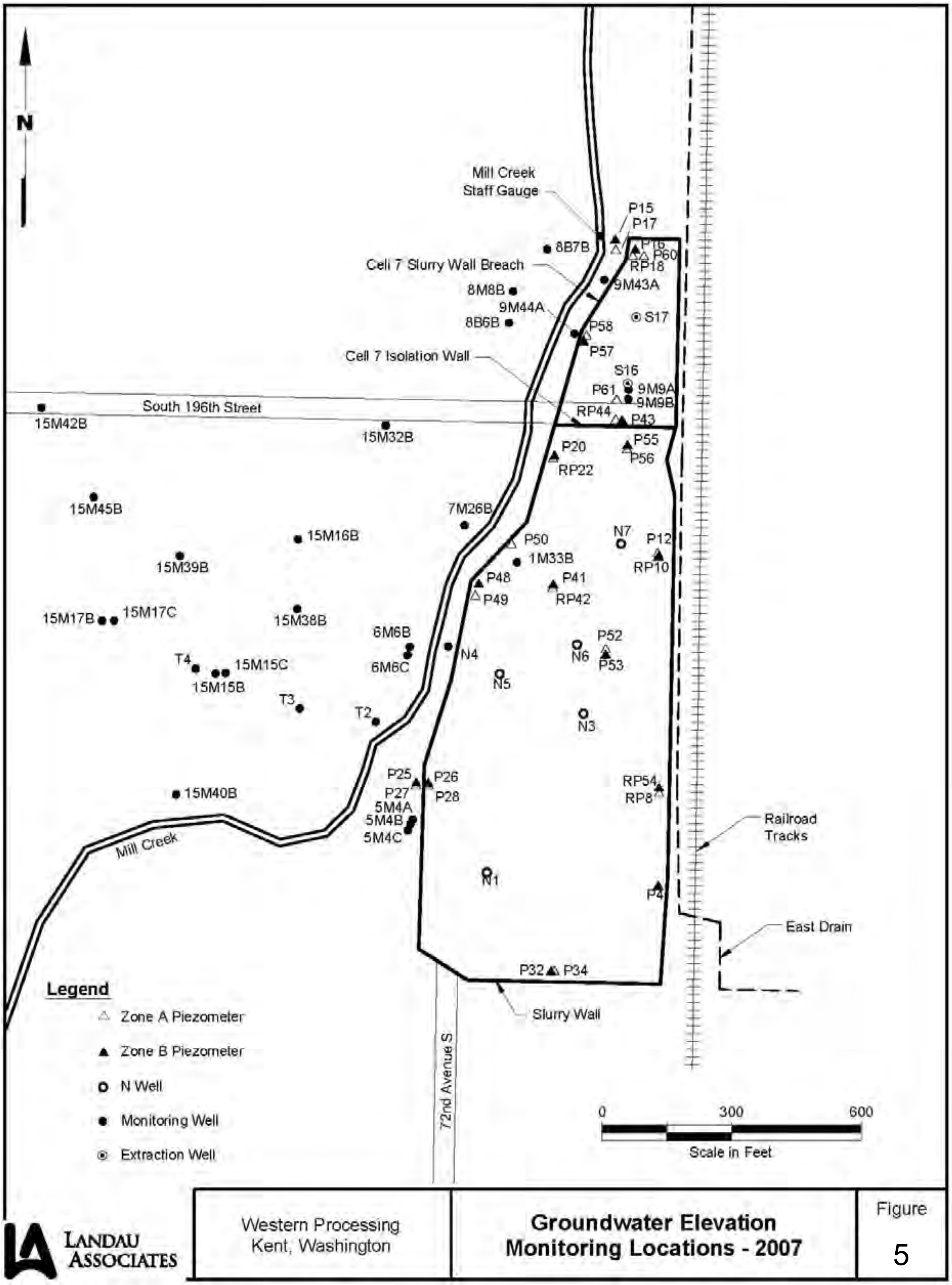


Figure 5 is originally from the *2007 Annual Evaluation Western Processing*, Landau Associates.

Figure 6: Water Quality Monitoring Locations

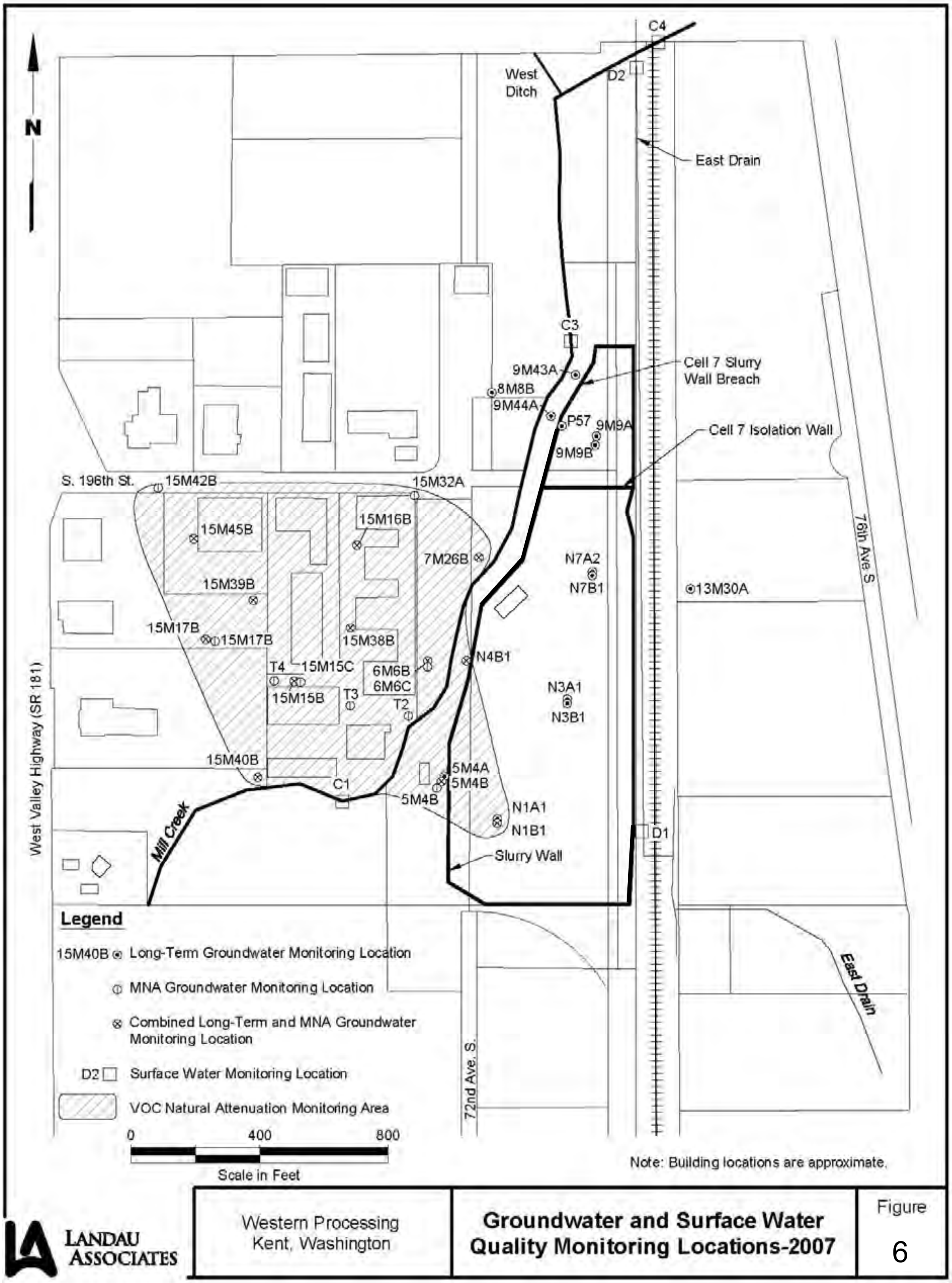


Figure 6 is originally from the *2007 Annual Evaluation Western Processing*, Landau Associates.

Figure 7: Process Flow Diagram for the Extraction System

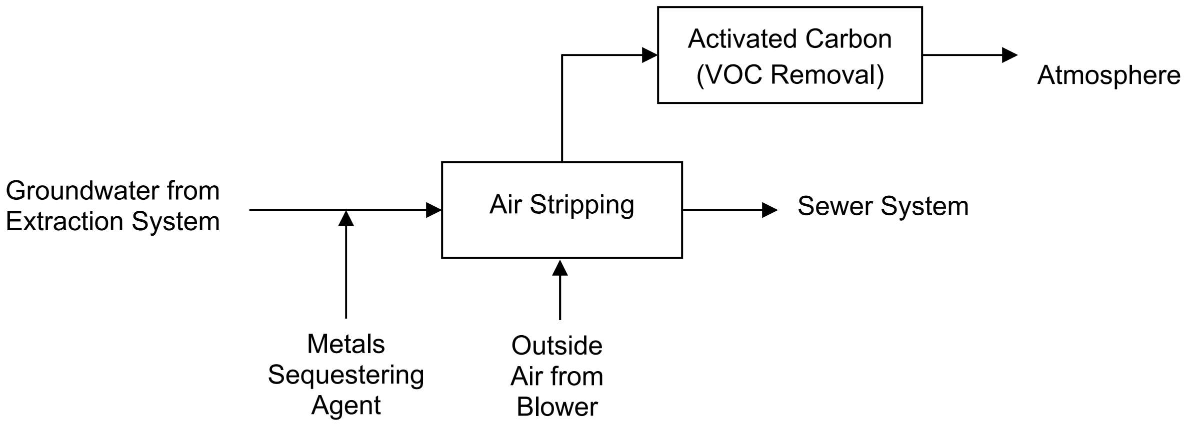


Figure 8: Site Cap Layers

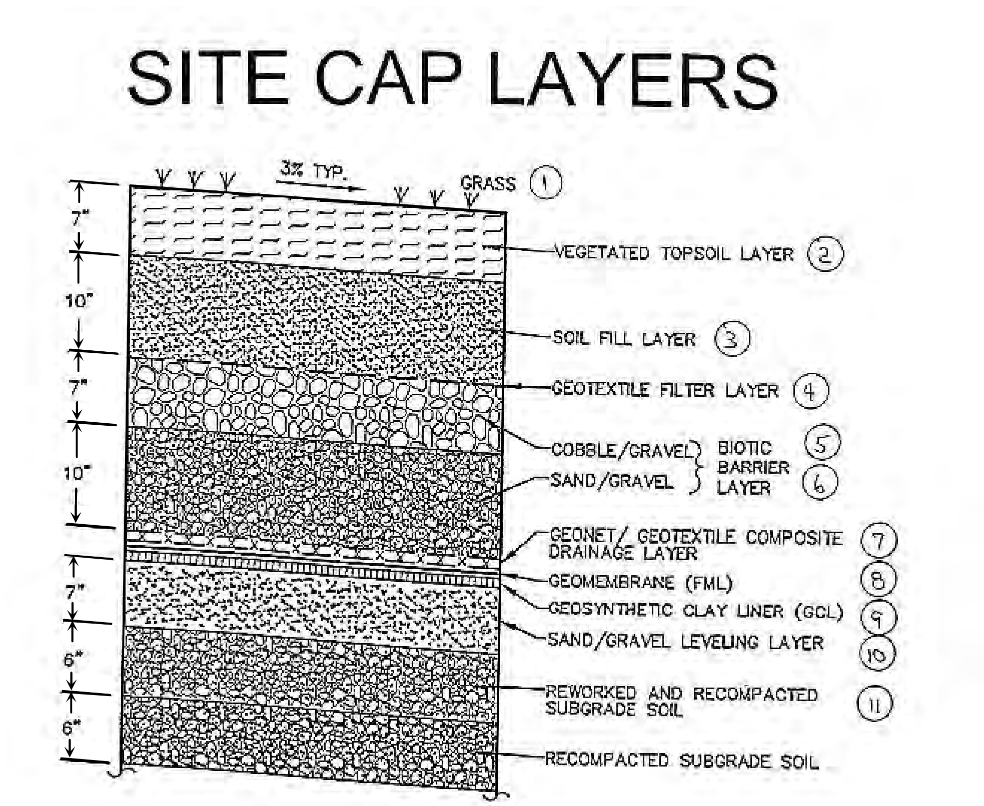


Figure 9: Cumulative Selected Organics Removed

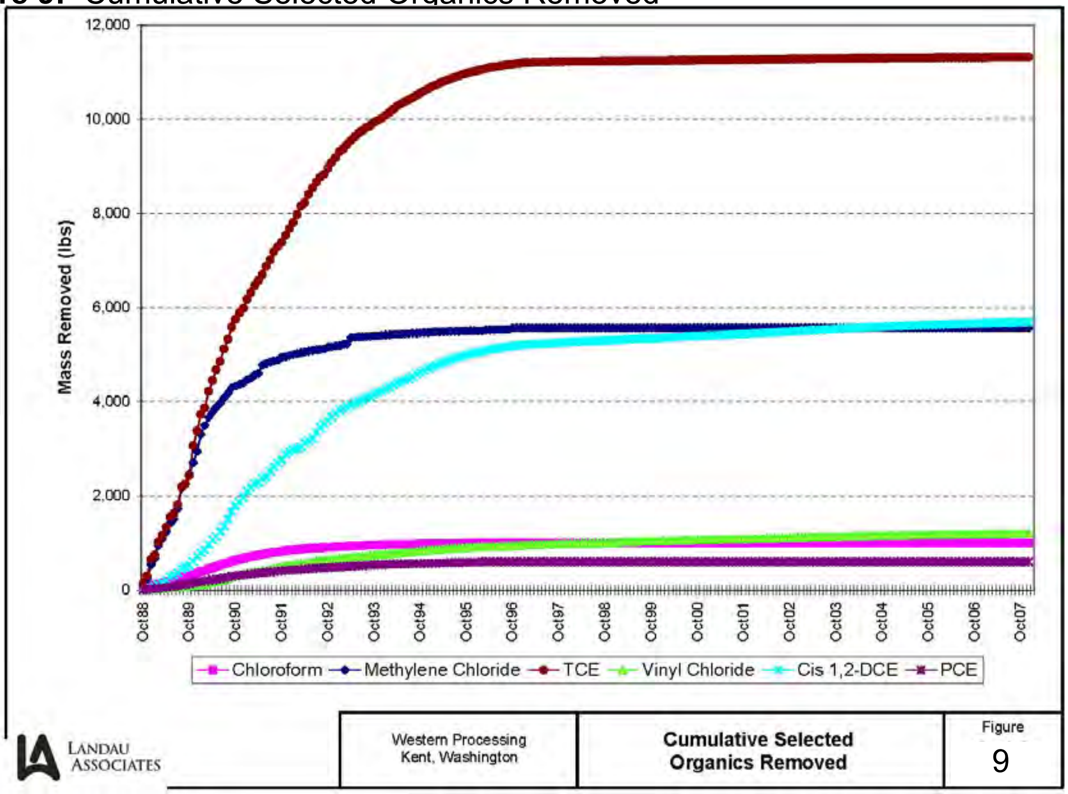
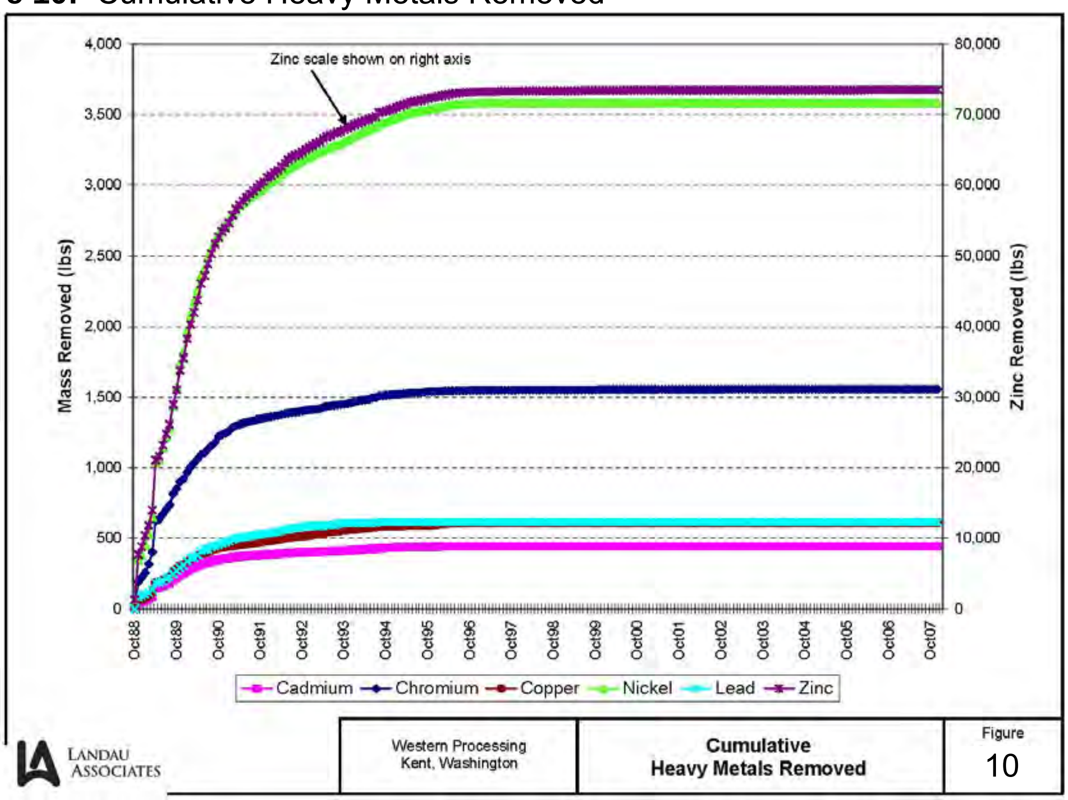


Figure 10: Cumulative Heavy Metals Removed



Figures 9 and 10 are originally from the *2007 Annual Evaluation Western Processing*, Landau Associates.

Table 1: 2007 Environmental Monitoring Schedule[37]

Location	Source	Sites	Frequency	Analytes
Sector 1	Groundwater	6	Annual	VOCs, Metals
		1	Annual	Geochemical Parameters
Sector 2	Groundwater	2	Semiannual	VOCs, Geochemical Parameters
		1	Annual	VOCs
		1	Biennial	VOCs
		1	Annual	Metals
Sector 3	Groundwater	8	Annual (A)	VOCs, Geochemical Parameters
		6	Conditional	VOCs, Geochemical Parameters
		3	Biennial	VOCs
		1	Annual	Metals
Sector 4	Groundwater	5	Annual (A)	VOCs, Metals
Downgradient	Groundwater	1	Annual	VOCs, Metals
East Drain	Groundwater	1	Annual (A)	VOCs
	Groundwater	1	Annual	Geochemical Parameters
	Surface water	2	Annual	Metals, Conventional Parameters
Mill Creek	Surface water	3	Annual	Metals, Conventional Parameters

(A) = Wells 9M44A, 13M30A, 15M15B, 15M16B, 15M17B, 15M39B, 15M40B, and 15M45B are currently sampled semiannually for VOCs.

[37] For an environmental monitoring schedule that is broken down by individual wells, please refer to Table 2-1 of the 2007 Annual Report, Western Processing, Landau Associates (June 23, 2008).

Table 2: Environmental Monitoring Target Compound List

Volatile Organic Compounds	Total Metals	Oxazolidinone
Tetrachloroethene	Cadmium	Oxazolidinone (HPMO)
Trichloroethene	Chromium	Oxazolidinone (OPMO)
cis-1,2-Dichloroethene	Copper	
trans-1,2-Dichloroethene	Lead	
1,1,1-Trichloroethane	Nickel	
1,1-Dichloroethene	Zinc	
Chloroethene (vinyl chloride)		
1,1-Dichloroethane		
Trichloromethane		
1,2-Dichlorobenzene		
Chlorobenzene		
Styrene		
Ethylbenzene		
Toluene		
Benzene		
o-Xylene		
m,p-Xylene		

Table 3: 2007 Mill Creek Surface Water Quality

Location:	Constituent:	Third Quarter 2007 Conc.		Ambient Water Quality Criterion	Units
C1	Conductivity (avg)	190			µmhos/cm
	Hardness	114			mg/L
	pH (avg)	7.36			
	Suspended Solids	14			mg/L
	Temperature (avg)	60.8			deg F
	Cadmium (total)	0.25	U	1.3	µg/L
	Chromium (total)	1.4		230	µg/L
	Copper (total)	3.7		13.2	µg/L
	Lead (total)	3.2		3.8	µg/L
	Nickel (total)	2.5	U	176	µg/L
	Zinc (total)	30		118	µg/L
C3	Conductivity (avg)	193			µmhos/cm
	Hardness	92.1			mg/L
	pH (avg)	7.41			
	Suspended Solids	5			mg/L
	Temperature (avg)	60.8			deg F
	Cadmium (total)	0.25	U	1.1	µg/L
	Chromium (total)	0.8		194	µg/L
	Copper (total)	1	U	11.0	µg/L
	Lead (total)	1	U	2.9	µg/L
	Nickel (total)	2.5	U	147	µg/L
	Zinc (total)	12		99	µg/L
C4	Conductivity (avg)	193			µmhos/cm
	Hardness	100			mg/L
	pH (avg)	7.38			
	Suspended Solids	5	U		mg/L
	Temperature (avg)	60.98			deg F
	Cadmium (total)	0.25	U		µg/L
	Zinc (total)	9.5			µg/L

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Note 1: C1 is located upstream of the site, C3 is immediately downstream of the site, and C4 is 300' downstream of where East Drain discharges into Mill Creek.

Note 2: The Ambient Water Quality Criteria (AWQC) shown are based on the hardness measured during the sampling event. The constituent specific AWQC at C3 also represents the allowable concentration per the Consent Decree if the measured concentration at C1 is less than 2/3 of the AWQC at C1.
If the measured concentration of the constituent at C1 is greater than 2/3 of the AWQC at C1, the allowable concentration at C3 is increased per the Consent Decree.

Table 4: 2006* East Drain Surface Water Quality

Third Quarter 2006	Location **D1**	Location **D2**	Units
Constituent:			
Conductivity (avg)	52	103	µmhos/cm
Hardness	16.3	28.3	mg/L
pH (avg)	6.81	6.24	
Suspended Solids	21	9	mg/L
Temperature (avg)	62.24	55.58	° F
Cadmium (total)	0.45	0.25 U	µg/L
Zinc (total)	145	597	µg/L

* During the third quarter of 2007, East Drain Stations D1 and D2 were dry and therefore were not sampled. For that reason, 2006 data is shown on this table.

Only detected constituents normally analyzed as part of the Long-Term Monitoring Plan are included in this table.

Table 5: 2007 Detected Constituents in Monitoring Wells

Location	Constituent		Units	Contingent Action Criterion	First Quarter Quarter, 2007	Third Quarter Quarter, 2007
Sector 1						
Well N1A1	Zinc	(total)	µg/L		NT	24
	cis-1,2-Dichloroethene		µg/L	8200	NT	350
	Chloroethene		µg/L	35000	NT	390
Well N3A1	Cadmium	(total)	µg/L	70	NT	9.9
	Chromium	(total)	µg/L	150	NT	222
	Copper	(total)	µg/L	129	NT	432
	Lead	(total)	µg/L	99	NT	74.6
	Nickel	(total)	µg/L	1200	NT	112
	Zinc	(total)	µg/L	336000	NT	20300
	1,1,1-Trichloroethane		µg/L	19000	NT	110
	1,1-Dichloroethane		µg/L	556	NT	120
	1,1-Dichloroethene		µg/L	779	NT	43
	Benzene		µg/L	2600	NT	320
	Chloroform		µg/L	3800	NT	170
	cis-1,2-Dichloroethene		µg/L	33000	NT	8200
	Ethylbenzene		µg/L	42000	NT	810
	m,p-Xylene		µg/L	100000	NT	1000
	o-Xylene		µg/L	39000	NT	500
	Tetrachloroethene		µg/L	3200	NT	150
	Toluene		µg/L	515000	NT	2400
	trans-1,2-Dichloroethene		µg/L		NT	27
	Trichloroethene		µg/L	330000	NT	340
	Chloroethene		µg/L	2400	NT	340
Well N7A2	1,1-Dichloroethane		µg/L	690	NT	140
	1,1-Dichloroethene		µg/L		NT	11
	Benzene		µg/L		NT	12
	cis-1,2-Dichloroethene		µg/L	6000	NT	1400
	Toluene		µg/L		NT	6.6
	Chloroethene		µg/L	4800	NT	2800
Sector 2						
Well 5M4A	HPMO		µg/L	14000	NT	261 J
	OPMO		µg/L	64000	NT	382 J
	1,2-Dichlorobenzene		µg/L	10	NT	20
	Chlorobenzene		µg/L	5	NT	19
	Chloroethene		µg/L	1200	NT	2.5
Sector 4						
Well 9M9A	Zinc	(total)	µg/L	227	NT	75
	1,1-Dichloroethane		µg/L	5	NT	31
	cis-1,2-Dichloroethene		µg/L		NT	6.7
	Chloroethene		µg/L	11	NT	100
Well 9M44A	Zinc	(total)	µg/L		5 U	114
Downgradient						
Well 8M8B	Zinc	(total)	µg/L		NT	24
	Toluene		µg/L	5	NT	17

NT = Not tested during this sampling period.
U = Indicates compound was analyzed for, but was not detected at the reported sample detection limit.
J = Data validation flag indicating the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
Only detected constituents analyzed as part of the Long-Term Monitoring Plan are included in this table.
Third quarter data represent the annual sampling of the long-Term monitoring wells.
First quarter data represent results from the semiannual MNA sampling event.

Table 6: 2007 Detected VOCs and SVOCs in S-Wells and U-Wells

Well	Constituent		Units	Mean	Maximum	Minimum	Standard Deviation	Number Detects	Number Samples
				Cumulative Results 1996-2007					
Sector 1									
S1	Bicarbonates		mg/L	275	320	191	36	13	13
	Chloride		mg/L	606	606	606		1	1
	Conductivity	(avg)	µmhos/cm	1743	2340	445	541	22	22
	Dissolved Oxygen	(avg)	mg/L	2	9	0	3	13	13
	Hardness		mg/L	174	245	102	58	14	14
	pH	(avg)		7	7	6	0	22	22
	Sulfate		mg/L	4	4	4		1	1
	Suspended Solids		mg/L	40	102	6	44	5	8
	Temperature	(avg)	° F	58	64	50	5	22	22
	Total Dissolved Solids		mg/L	1370	1370	1370		1	1
	Turbidity		NTU	6	22	1	8	12	12
	Aluminum	(total)	µg/L	369	369	369		1	6
	Calcium	(dissolved)	µg/L	66700	66700	66700		1	1
	Calcium	(total)	µg/L	50900	53200	48600	3253	2	2
	Chromium	(total)	µg/L	12	13	11	1	2	16
	Iron	(dissolved)	µg/L	77200	77200	77200		1	1
	Iron	(total)	µg/L	53107	83200	26500	21960	15	15
	Magnesium	(dissolved)	µg/L	21600	21600	21600		1	1
	Magnesium	(total)	µg/L	18900	21600	16200	3818	2	2
	Manganese	(dissolved)	µg/L	4530	4530	4530		1	1
	Manganese	(total)	µg/L	2573	4730	1360	1025	15	15
	Sodium	(dissolved)	µg/L	332000	332000	332000		1	1
	Sodium	(total)	µg/L	327000	327000	327000		1	1
	Zinc	(dissolved)	µg/L	157	157	157		1	1
	Zinc	(total)	µg/L	139	149	128	15	2	16
	(HPMO) Oxazolidinone		µg/L	107	240	31	72	14	16
	(OPMO) Oxazolidinone		µg/L	95	180	34	51	11	16
S2	Bicarbonates		mg/L	431	482	373	43	13	13
	Chloride		mg/L	469	469	469		1	1
	Conductivity	(avg)	µmhos/cm	2175	3140	793	589	22	22
	Dissolved Oxygen	(avg)	mg/L	2	7	0	3	12	12
	Hardness		mg/L	186	285	128	58	15	15
	pH	(avg)		7	8	7	0	22	22
	Sulfate		mg/L	4	4	4		1	1
	Temperature	(avg)	° F	57	65	52	3	22	22
	Total Dissolved Solids		mg/L	1280	1280	1280		1	1
	Turbidity		NTU	12	35	1	12	11	11
	Aluminum	(total)	µg/L	329	550	212	158	4	6
	Arsenic	(total)	µg/L	22	67	11	19	8	15
	Calcium	(dissolved)	µg/L	45500	45500	45500		1	1
	Calcium	(total)	µg/L	41500	41500	41500		1	1
	Chromium	(dissolved)	µg/L	25	25	25		1	1
	Chromium	(total)	µg/L	33	47	21	9	15	16
	Iron	(dissolved)	µg/L	28200	28200	28200		1	1
	Iron	(total)	µg/L	27400	39200	20000	5227	15	15
	Lead	(total)	µg/L	11	11	11		1	16
	Magnesium	(dissolved)	µg/L	20200	20200	20200		1	1
	Magnesium	(total)	µg/L	19300	19300	19300		1	1
	Manganese	(dissolved)	µg/L	1950	1950	1950		1	1
	Manganese	(total)	µg/L	1673	2270	1250	400	15	15
	Sodium	(dissolved)	µg/L	372000	372000	372000		1	1
	Sodium	(total)	µg/L	357000	357000	357000		1	1

Well	Constituent		Units	Mean	Maximum	Minimum	Standard Deviation	Number Detects	Number Samples
				Cumulative Results 1996-2007					
S2	Zinc	(total)	µg/L	452	1650	34	629	10	16
	(HPMO) Oxazolidinone		µg/L	2339	4500	1080	1041	16	16
	(OPMO) Oxazolidinone		µg/L	3815	9190	1020	2094	16	16
	1,2-Dichlorobenzene		µg/L	7	9	5	2	8	14
	2,4-Dimethylphenol		µg/L	89	167	31	38	15	15
	bis(2-Ethylhexyl)phthalate		µg/L	9	9	9		1	15
	1,1-Dichloroethane		µg/L	18	28	5	7	12	22
	1,1-Dichloroethene		µg/L	16	28	7	7	12	22
	1,2-Dichlorobenzene		µg/L	11	12	10	1	9	22
	Benzene		µg/L	11	14	9	2	21	22
	Chlorobenzene		µg/L	30	39	6	9	21	22
	cis 1,2-Dichloroethene		µg/L	1620	3400	7	1198	21	22
	Methylene Chloride		µg/L	18	18	18		1	22
	Toluene		µg/L	6	6	6		2	22
	trans 1,2-Dichloroethene		µg/L	9	15	5	3	8	22
	Trichloroethene		µg/L	297	670	56	202	18	22
	Chloroethene		µg/L	1472	2700	49	834	21	22
S3	Bicarbonates		mg/L	209	244	156	31	13	13
	Chloride		mg/L	134	134	134		1	1
	Conductivity	(avg)	µmhos/cm	1258	1565	753	235	23	23
	Dissolved Oxygen	(avg)	mg/L	2	6	0	2	13	13
	Hardness		mg/L	159	210	118	28	14	14
	pH	(avg)		7	7	6	0	23	23
	Sulfate		mg/L	12	12	12		1	1
	Suspended	Solids	mg/L	105	118	90	9	8	8
	Temperature	(avg)	° F	57	65	48	4	22	22
	Total Dissolved Solids		mg/L	463	463	463		1	1
	Turbidity		NTU	4	17	1	5	12	12
	Aluminum	(total)	µg/L	352	633	202	244	3	6
	Arsenic	(total)	µg/L	12	14	11	1	8	15
	Cadmium	(total)	µg/L	1	1	1		1	16
	Calcium	(dissolved)	µg/L	28600	28600	28600		1	1
	Calcium	(total)	µg/L	27200	28100	26300	1273	2	2
	Chromium	(total)	µg/L	8	10	6	3	2	16
	Iron	(dissolved)	µg/L	28400	28400	28400		1	1
	Iron	(total)	µg/L	37007	45000	18700	6773	15	15
	Lead	(total)	µg/L	22	22	22		1	16
	Magnesium	(dissolved)	µg/L	14400	14400	14400		1	1
	Magnesium	(total)	µg/L	12500	12600	12400	141	2	2
	Manganese	(dissolved)	µg/L	2760	2760	2760		1	1
	Manganese	(total)	µg/L	2462	3170	1060	554	15	15
	Mercury	(total)	µg/L	0	0	0		1	1
	Selenium	(total)	µg/L	6	6	6		1	1
	Sodium	(dissolved)	µg/L	72000	72000	72000		1	1
	Sodium	(total)	µg/L	81700	81700	81700		1	1
	Zinc	(dissolved)	µg/L	1720	1720	1720		1	1
	Zinc	(total)	µg/L	3676	8950	816	2529	16	16
	(HPMO) Oxazolidinone		µg/L	890	1890	235	501	16	16
	(OPMO) Oxazolidinone		µg/L	2319	4240	460	960	16	16
	1,1,1-Trichloroethane		µg/L	6	6	6		1	22
	1,1-Dichloroethane		µg/L	7	11	5	2	14	22
	1,1-Dichloroethene		µg/L	20	35	6	8	19	22
	Benzene		µg/L	6	7	5	1	9	22
	cis 1,2-Dichloroethene		µg/L	2813	5400	110	1477	22	22
	Toluene		µg/L	9	23	5	6	8	22
	trans 1,2-Dichloroethene		µg/L	19	34	6	8	21	22

Well	Constituent		Units	Mean	Maximum	Minimum	Standard Deviation	Number Detects	Number Samples
				Cumulative Results 1996-2007					
S3	Trichloroethene		µg/L	1482	3000	36	1003	22	22
	Chloroethene		µg/L	984	2060	15	479	22	22
S4	Bicarbonates		mg/L	314	364	59	79	13	13
	Chloride		mg/L	640	640	640		1	1
	Conductivity	(avg)	µmhos/cm	1918	2640	428	697	22	22
	Dissolved Oxygen	(avg)	mg/L	2	8	0	3	12	12
	Hardness		mg/L	192	285	26	73	15	15
	pH	(avg)		7	7	6	0	22	22
	Sulfate		mg/L	8	8	8		1	1
	Suspended	Solids	mg/L	106	162	7	45	8	8
	Temperature	(avg)	° F	60	70	52	6	22	22
	Total Dissolved Solids		mg/L	1440	1440	1440		1	1
	Turbidity		NTU	15	60	1	20	11	11
	Aluminum	(total)	µg/L	3257	8570	503	4602	3	6
	Arsenic	(dissolved)	µg/L	62	62	62		1	1
	Arsenic	(total)	µg/L	58	112	12	23	14	15
	Calcium	(dissolved)	µg/L	64800	64800	64800		1	1
	Calcium	(total)	µg/L	65300	65300	65300		1	1
	Chromium	(total)	µg/L	16	19	11	4	4	16
	Copper	(total)	µg/L	37	44	30	10	2	16
	Iron	(dissolved)	µg/L	39500	39500	39500		1	1
	Iron	(total)	µg/L	43723	83800	7950	18842	15	15
	Lead	(total)	µg/L	40	42	39	2	2	16
	Magnesium	(dissolved)	µg/L	20500	20500	20500		1	1
	Magnesium	(total)	µg/L	23100	23100	23100		1	1
	Manganese	(dissolved)	µg/L	6220	6220	6220		1	1
	Manganese	(total)	µg/L	3216	6010	244	1810	15	15
	Sodium	(dissolved)	µg/L	358000	358000	358000		1	1
	Sodium	(total)	µg/L	413000	413000	413000		1	1
	Zinc	(dissolved)	µg/L	670	670	670		1	1
	Zinc	(total)	µg/L	753	6550	73	1556	16	16
	(HPMO) Oxazolidinone		µg/L	1809	11000	87	2761	16	16
	(OPMO) Oxazolidinone		µg/L	7941	29000	188	7306	16	16
	1,1-Dichloroethane		µg/L	7	12	5	3	5	22
	1,1-Dichloroethene		µg/L	9	9	9		1	22
	cis 1,2-Dichloroethene		µg/L	200	859	5	184	20	22
	Trichloroethene		µg/L	34	58	5	13	17	22
	Chloroethene		µg/L	275	1270	3	325	21	22
S5	Bicarbonates		mg/L	157	190	122	21	13	13
	Chloride		mg/L	49	49	49		1	1
	Conductivity	(avg)	µmhos/cm	1183	1711	501	352	23	23
	Dissolved Oxygen	(avg)	mg/L	2	8	0	3	12	12
	Hardness		mg/L	222	278	102	42	15	15
	pH	(avg)		7	7	6	0	22	22
	Sulfate		mg/L	12	12	12		1	1
	Suspended	Solids	mg/L	103	128	77	17	8	8
	Temperature	(avg)	° F	57	64	50	4	21	21
	Total Dissolved Solids		mg/L	259	259	259		1	1
	Turbidity		NTU	19	92	2	33	11	11
	Aluminum	(total)	µg/L	401	507	294	151	2	6
	Arsenic	(total)	µg/L	10	11	10	0	2	15
	Calcium	(dissolved)	µg/L	22200	22200	22200		1	1
	Calcium	(total)	µg/L	22400	22400	22400		1	1
	Chromium	(total)	µg/L	2	2	2		1	16
	Iron	(dissolved)	µg/L	36600	36600	36600		1	1
	Iron	(total)	µg/L	64333	87400	29200	14524	15	15

Well	Constituent		Units	Mean	Maximum	Minimum	Standard Deviation	Number Detects	Number Samples
				Cumulative Results 1996-2007					
S5	Magnesium	(dissolved)	µg/L	11900	11900	11900		1	1
	Magnesium	(total)	µg/L	11100	11100	11100		1	1
	Manganese	(dissolved)	µg/L	1980	1980	1980		1	1
	Manganese	(total)	µg/L	3753	4770	1710	835	15	15
	Sodium	(dissolved)	µg/L	34100	34100	34100		1	1
	Sodium	(total)	µg/L	27900	27900	27900		1	1
	Zinc	(dissolved)	µg/L	130	130	130		1	1
	Zinc	(total)	µg/L	451	857	133	188	15	16
	(HPMO) Oxazolidinone		µg/L	1683	3100	712	708	16	16
	(OPMO) Oxazolidinone		µg/L	5155	8900	471	2371	16	16
	1,1,1-Trichloroethane		µg/L	37	97	6	29	15	22
	1,1-Dichloroethane		µg/L	37	86	10	23	19	22
	1,1-Dichloroethene		µg/L	17	27	6	6	16	22
	Benzene		µg/L	10	14	6	3	13	22
	Chloroform		µg/L	7	9	5	1	5	22
	cis 1,2-Dichloroethene		µg/L	1357	3600	8	1024	22	22
	Ethylbenzene		µg/L	13	18	6	4	8	22
	m,p-xylene		µg/L	14	20	8	4	7	22
	o-xylene		µg/L	5	5	5		1	22
	Tetrachloroethene		µg/L	10	14	6	3	11	22
	Toluene		µg/L	60	93	31	23	7	22
	trans 1,2-Dichloroethene		µg/L	19	43	7	11	16	22
	Trichloroethene		µg/L	525	1300	13	437	22	22
	Chloroethene		µg/L	271	570	28	182	21	22
S6	Bicarbonates		mg/L	212	252	91	48	13	13
	Chloride		mg/L	202	202	202		1	1
	Conductivity	(avg)	µmhos/cm	1536	5560	225	995	21	21
	Dissolved Oxygen (avg)		mg/L	2	6	0	2	12	12
	Fluoride		mg/L	3	3	3		1	1
	Hardness		mg/L	165	230	31	51	15	15
	pH	(avg)		7	8	6	0	22	22
	Sulfate		mg/L	33	33	33		1	1
	Suspended	Solids	mg/L	130	148	103	16	8	8
	Temperature	(avg)	° F	60	69	50	6	22	22
	Total Dissolved Solids		mg/L	742	742	742		1	1
	Turbidity		NTU	15	43	1	16	11	11
	Aluminum	(total)	µg/L	2884	10100	217	4818	4	6
	Arsenic	(total)	µg/L	12	13	11	2	2	15
	Calcium	(dissolved)	µg/L	22500	22500	22500		1	1
	Calcium	(total)	µg/L	26200	26200	26200		1	1
	Chromium	(total)	µg/L	33	65	12	21	5	16
	Copper	(total)	µg/L	42	42	42		1	16
	Iron	(dissolved)	µg/L	41200	41200	41200		1	1
	Iron	(total)	µg/L	51643	69700	9540	15964	15	15
	Lead	(total)	µg/L	37	37	37		1	16
	Magnesium	(dissolved)	µg/L	13200	13200	13200		1	1
	Magnesium	(total)	µg/L	13500	13500	13500		1	1
	Manganese	(dissolved)	µg/L	2200	2200	2200		1	1
	Manganese	(total)	µg/L	3073	4110	106	1076	15	15
	Nickel	(total)	µg/L	404	404	404		1	16
	Sodium	(dissolved)	µg/L	208000	208000	208000		1	1
	Sodium	(total)	µg/L	176000	176000	176000		1	1
	Zinc	(dissolved)	µg/L	32	32	32		1	1
	Zinc	(total)	µg/L	68	161	26	42	9	16
	(HPMO) Oxazolidinone		µg/L	2679	5100	1050	1012	15	16
	(OPMO) Oxazolidinone		µg/L	5129	10000	2480	2634	15	16

Well	Constituent	Units	Mean	Maximum	Minimum	Standard Deviation	Number Detects	Number Samples
			Cumulative Results 1996-2007					
S6	bis(2-Ethylhexyl)phthalate	µg/L	27	27	27		1	16
	1,1,1-Trichloroethane	µg/L	99	392	37	76	21	22
	1,1-Dichloroethane	µg/L	110	210	46	50	21	22
	1,1-Dichloroethene	µg/L	28	55	12	13	21	22
	Benzene	µg/L	7	9	5	1	9	22
	cis 1,2-Dichloroethene	µg/L	4958	9800	10	2538	22	22
	Ethylbenzene	µg/L	6	6	6		1	22
	m,p-xylene	µg/L	11	11	11		1	22
	o-xylene	µg/L	7	7	7		1	22
	Tetrachloroethene	µg/L	18	104	5	27	13	22
	Toluene	µg/L	10	29	5	6	17	22
	trans 1,2-Dichloroethene	µg/L	34	68	13	17	21	22
	Trichloroethene	µg/L	1339	6310	5	1162	22	22
	Chloroethene	µg/L	507	750	267	125	21	22
S7	Bicarbonates	mg/L	166	225	54	42	13	13
	Chloride	mg/L	60	60	60		1	1
	Conductivity (avg)	µmhos/cm	1514	2180	717	430	20	20
	Dissolved Oxygen (avg)	mg/L	1	4	0	1	11	11
	Fluoride	mg/L	1	1	1		1	1
	Hardness	mg/L	295	386	77	75	15	15
	pH (avg)		7	7	6	0	20	20
	Sulfate	mg/L	23	23	23		1	1
	Suspended Solids	mg/L	141	186	98	31	8	8
	Temperature (avg)	° F	58	65	52	4	20	20
	Total Dissolved Solids	mg/L	440	440	440		1	1
	Turbidity	NTU	14	37	2	13	10	10
	Aluminum (total)	µg/L	245	248	241	5	2	6
	Calcium (dissolved)	µg/L	19500	19500	19500		1	1
	Calcium (total)	µg/L	17200	17200	17200		1	1
	Chromium (total)	µg/L	4	4	4		1	16
	Iron (dissolved)	µg/L	30800	30800	30800		1	1
	Iron (total)	µg/L	92167	126000	28300	23489	15	15
	Magnesium (dissolved)	µg/L	8620	8620	8620		1	1
	Magnesium (total)	µg/L	8270	8270	8270		1	1
	Manganese (dissolved)	µg/L	1520	1520	1520		1	1
	Manganese (total)	µg/L	6381	8940	1640	1892	15	15
	Sodium (dissolved)	µg/L	102000	102000	102000		1	1
	Sodium (total)	µg/L	101000	101000	101000		1	1
	Zinc (dissolved)	µg/L	251	251	251		1	1
	Zinc (total)	µg/L	889	2630	286	603	16	16
	(HPMO) Oxazolidinone	µg/L	1814	3800	386	1098	16	16
	(OPMO) Oxazolidinone	µg/L	3689	10000	228	2689	16	16
	1,1-Dichloroethane	µg/L	10	14	6	3	14	20
	1,2,4-Trichlorobenzene	µg/L	39	39	39		1	20
	Benzene	µg/L	7	10	5	2	9	20
	cis 1,2-Dichloroethene	µg/L	159	370	18	122	20	20
	Methylene chloride	µg/L	30	30	30		1	20
	Toluene	µg/L	7	7	7		1	20
	Trichloroethene	µg/L	25	50	5	12	16	20
	Chloroethene	µg/L	65	120	14	29	20	20
S8	Bicarbonates	mg/L	204	330	134	54	13	13
	Chloride	mg/L	135	135	135		1	1
	Conductivity (avg)	µmhos/cm	1302	2160	246	727	15	15
	Dissolved Oxygen (avg)	mg/L	2	5	0	2	9	9
	Fluoride	mg/L	7	7	7		1	1
	Hardness	mg/L	330	696	74	162	14	14

Well	Constituent		Units	Mean	Maximum	Minimum	Standard Deviation	Number Detects	Number Samples
				Cumulative Results 1996-2007					
S8	pH	(avg)		6	7	6	0	15	15
	Sulfate		mg/L	80	80	80		1	1
	Suspended	Solids	mg/L	50	79	8	28	6	8
	Temperature	(avg)	° F	61	69	50	5	15	15
	Total Dissolved Solids		mg/L	625	625	625		1	1
	Turbidity		NTU	120	484	1	208	8	8
	Aluminum	(total)	µg/L	13206	21600	9730	4812	5	5
	Arsenic	(total)	µg/L	22	22	22		1	14
	Cadmium	(total)	µg/L	20	50	6	12	12	15
	Calcium	(dissolved)	µg/L	54900	54900	54900		1	1
	Calcium	(total)	µg/L	55300	55300	55300		1	1
	Chromium	(total)	µg/L	33	49	17	22	2	15
	Iron	(dissolved)	µg/L	29400	29400	29400		1	1
	Iron	(total)	µg/L	30634	59100	2550	18358	14	14
	Magnesium	(dissolved)	µg/L	23300	23300	23300		1	1
	Magnesium	(total)	µg/L	22800	22800	22800		1	1
	Manganese	(dissolved)	µg/L	3800	3800	3800		1	1
	Manganese	(total)	µg/L	5761	9090	707	1934	14	14
	Nickel	(dissolved)	µg/L	68	68	68		1	1
	Nickel	(total)	µg/L	125	307	45	89	12	15
	Sodium	(dissolved)	µg/L	86800	86800	86800		1	1
	Sodium	(total)	µg/L	84500	84500	84500		1	1
	Zinc	(dissolved)	µg/L	808	808	808		1	1
	Zinc	(total)	µg/L	1828	5270	260	1620	15	15
	(HPMO) Oxazolidinone		µg/L	5310	9840	249	3787	9	15
	(OPMO) Oxazolidinone		µg/L	6362	11800	1200	3431	13	15
	Benzoic	acid	µg/L	66	78	48	16	3	15
	bis(2-Ethylhexyl)phthalate		µg/L	7	10	5	3	2	15
	1,1,1-Trichloroethane		µg/L	15	24	6	6	7	15
	1,1-Dichloroethane		µg/L	14	30	6	8	10	15
	1,1-Dichloroethene		µg/L	7	9	5	1	7	15
	1,2-Dichloroethane		µg/L	6	6	5	1	2	15
	Benzene		µg/L	13	17	6	4	6	15
	Chloroform		µg/L	195	600	21	154	13	15
	cis 1,2-Dichloroethene		µg/L	177	410	5	154	15	15
	Ethylbenzene		µg/L	7	10	5	3	3	15
	m,p-xylene		µg/L	9	12	7	3	3	15
	Methyl ethyl ketone		µg/L	204	240	168	51	2	15
	Methylene Chloride		µg/L	306	688	160	191	7	15
	Tetrachloroethene		µg/L	12	22	6	6	5	15
	Toluene		µg/L	19	19	19		1	15
	trans 1,2-Dichloroethene		µg/L	6	7	5	1	4	15
	Trichloroethene		µg/L	316	800	15	212	15	15
	Chloroethene		µg/L	31	82	3	28	12	15
S9	Bicarbonates		mg/L	226	341	83	68	13	13
	Chloride		mg/L	187	187	187		1	1
	Conductivity	(avg)	µmhos/cm	1654	2280	163	778	15	15
	Dissolved Oxygen (avg)		mg/L	2	7	0	2	9	9
	Fluoride		mg/L	5	5	5		1	1
	Hardness		mg/L	321	607	60	169	14	14
	Nitrate		mg/L	39	39	39		1	1
	pH	(avg)		6	7	6	0	15	15
	Sulfate		mg/L	109	109	109		1	1
	Suspended	Solids	mg/L	72	124	14	43	6	8
	Temperature	(avg)	° F	60	71	51	5	15	15
	Total Dissolved Solids		mg/L	854	854	854		1	1

Well	Constituent		Units	Mean	Maximum	Minimum	Standard Deviation	Number Detects	Number Samples
				Cumulative Results 1996-2007					
S9	Turbidity		NTU	117	350	1	130	8	8
	Aluminum	(total)	µg/L	9920	19100	7230	5141	5	5
	Arsenic	(total)	µg/L	17	24	14	5	4	14
	Cadmium	(total)	µg/L	9	15	5	4	6	15
	Calcium	(dissolved)	µg/L	32400	32400	32400		1	1
	Calcium	(total)	µg/L	38500	38500	38500		1	1
	Chromium	(total)	µg/L	16	18	14	3	2	15
	Iron	(dissolved)	µg/L	5110	5110	5110		1	1
	Iron	(total)	µg/L	15720	48500	235	15379	14	14
	Lead	(total)	µg/L	9	11	6	4	2	15
	Magnesium	(dissolved)	µg/L	17600	17600	17600		1	1
	Magnesium	(total)	µg/L	16900	16900	16900		1	1
	Manganese	(dissolved)	µg/L	2970	2970	2970		1	1
	Manganese	(total)	µg/L	6813	12400	43	3826	14	14
	Nickel	(total)	µg/L	99	183	48	46	9	15
	Sodium	(dissolved)	µg/L	224000	224000	224000		1	1
	Sodium	(total)	µg/L	218000	218000	218000		1	1
	Zinc	(dissolved)	µg/L	110	110	110		1	1
	Zinc	(total)	µg/L	357	677	143	145	15	15
	(HPMO) Oxazolidinone		µg/L	1959	3510	915	964	7	15
	(OPMO) Oxazolidinone		µg/L	4081	8540	175	2770	11	15
	1,1,1-Trichloroethane		µg/L	8	9	6	1	5	15
	1,1-Dichloroethane		µg/L	6	7	5	1	6	15
	Acetone		µg/L	40	40	40		1	15
	Benzene		µg/L	5	5	5		1	15
	Chloroform		µg/L	119	159	40	50	7	15
	cis 1,2-Dichloroethene		µg/L	31	65	7	22	12	15
	Methylene	chloride	µg/L	67	116	20	31	7	15
	Tetrachloroethene		µg/L	15	20	10	4	6	15
	trans 1,2-Dichloroethene		µg/L	5	5	5		1	15
	Trichloroethene		µg/L	98	283	7	111	14	15
	Chloroethene		µg/L	15	33	6	10	8	15
S10	Bicarbonates		mg/L	356	434	222	75	13	13
	Chloride		mg/L	243	243	243		1	1
	Conductivity	(avg)	µmhos/cm	1034	1920	301	507	21	21
	Dissolved Oxygen (avg)		mg/L	1	7	0	2	11	11
	Hardness		mg/L	85	147	48	30	15	15
	pH	(avg)		7	7	6	0	21	21
	Suspended	Solids	mg/L	50	66	34	11	6	8
	Temperature	(avg)	° F	56	67	48	4	21	21
	Total Dissolved Solids		mg/L	915	915	915		1	1
	Turbidity		NTU	5	23	0	8	10	10
	Aluminum	(total)	µg/L	229	237	220	12	2	6
	Calcium	(dissolved)	µg/L	7480	7480	7480		1	1
	Calcium	(total)	µg/L	7320	7320	7320		1	1
	Chromium	(total)	µg/L	14	14	14		1	16
	Iron	(dissolved)	µg/L	3520	3520	3520		1	1
	Iron	(total)	µg/L	12041	23900	2560	6204	15	15
	Magnesium	(dissolved)	µg/L	4030	4030	4030		1	1
	Magnesium	(total)	µg/L	7760	7760	7760		1	1
	Manganese	(dissolved)	µg/L	178	178	178		1	1
	Manganese	(total)	µg/L	568	1120	154	271	15	15
	Selenium	(dissolved)	µg/L	9	9	9		1	1
	Selenium	(total)	µg/L	11	11	11		1	1
	Sodium	(dissolved)	µg/L	332000	332000	332000		1	1
	Sodium	(total)	µg/L	332000	332000	332000		1	1

Well	Constituent		Units	Mean	Maximum	Minimum	Standard Deviation	Number Detects	Number Samples
				Cumulative Results 1996-2007					
S10	Zinc	(total)	µg/L	80	168	20	59	8	16
	(HPMO) Oxazolidinone		µg/L	51	67	35	12	7	16
	(OPMO) Oxazolidinone		µg/L	99	333	25	82	13	16
	4-Methylphenol		µg/L	25	25	25		1	16
	Phenol		µg/L	33	33	33		1	16
	1,1,1-Trichloroethane		µg/L	20	27	10	6	6	21
	1,1-Dichloroethane		µg/L	9	11	5	2	6	21
	1,2,4-Trichlorobenzene		µg/L	10	10	10		1	21
	cis 1,2-Dichloroethene		µg/L	88	160	14	61	11	21
	Ethylbenzene		µg/L	7	10	6	2	5	21
	m,p-xylene		µg/L	9	13	8	2	5	21
	Methyl ethyl ketone		µg/L	168	168	168		1	21
	o-xylene		µg/L	9	9	8	1	5	21
	Toluene		µg/L	11	15	6	3	6	21
	Trichloroethene		µg/L	5	5	5		1	21
	Chloroethene		µg/L	14	17	11	2	8	21
S11	Bicarbonates		mg/L	253	318	193	34	13	13
	Chloride		mg/L	202	202	202		1	1
	Conductivity	(avg)	µmhos/cm	1533	2110	419	546	22	22
	Dissolved Oxygen	(avg)	mg/L	2	7	0	2	12	12
	Fluoride		mg/L	3	3	3		1	1
	Hardness		mg/L	221	349	130	77	15	15
	pH	(avg)		7	7	6	0	22	22
	Sulfate		mg/L	104	104	104		1	1
	Suspended	Solids	mg/L	107	131	93	16	8	8
	Temperature	(avg)	° F	58	68	52	4	22	22
	Total Dissolved Solids		mg/L	712	712	712		1	1
	Turbidity		NTU	11	50	1	18	11	11
	Aluminum	(total)	µg/L	692	1210	220	436	5	6
	Arsenic	(total)	µg/L	10	10	10		1	15
	Calcium	(dissolved)	µg/L	36300	36300	36300		1	1
	Calcium	(total)	µg/L	34700	34700	34700		1	1
	Chromium	(dissolved)	µg/L	13	13	13		1	1
	Chromium	(total)	µg/L	16	30	4	8	7	16
	Iron	(dissolved)	µg/L	68500	68500	68500		1	1
	Iron	(total)	µg/L	68100	115000	37400	28054	15	15
	Magnesium	(dissolved)	µg/L	15100	15100	15100		1	1
	Magnesium	(total)	µg/L	14600	14600	14600		1	1
	Manganese	(dissolved)	µg/L	2570	2570	2570		1	1
	Manganese	(total)	µg/L	3673	5580	2070	1385	15	15
	Nickel	(total)	µg/L	106	153	45	47	6	16
	Selenium	(total)	µg/L	5	5	5		1	1
	Sodium	(dissolved)	µg/L	169000	169000	169000		1	1
	Sodium	(total)	µg/L	167000	167000	167000		1	1
	Zinc	(dissolved)	µg/L	535	535	535		1	1
	Zinc	(total)	µg/L	503	1080	64	404	16	16
	(HPMO) Oxazolidinone		µg/L	650	1590	102	451	16	16
	(OPMO) Oxazolidinone		µg/L	939	1420	551	234	16	16
	2,4-Dimethylphenol		µg/L	39	47	35	7	3	16
	2-Methylphenol		µg/L	40	53	31	8	6	16
	4-Methylphenol		µg/L	31	31	31		1	16
	bis(2-Ethylhexyl)phthalate		µg/L	15	15	15		1	16
	Phenol		µg/L	55	99	27	28	5	16
	1,1,1-Trichloroethane		µg/L	402	1250	5	487	16	22
	1,1-Dichloroethane		µg/L	94	151	47	32	21	22
	1,1-Dichloroethene		µg/L	35	87	7	29	21	22

Well	Constituent		Units	Mean	Maximum	Minimum	Standard Deviation	Number Detects	Number Samples
				Cumulative Results 1996-2007					
S11	1,2-Dichloroethane		µg/L	26	77	8	16	15	22
	Benzene		µg/L	14	21	8	3	15	22
	Chloroform		µg/L	73	206	31	45	14	22
	cis 1,2-Dichloroethene		µg/L	1164	3300	200	887	22	22
	Ethylbenzene		µg/L	8	10	5	2	11	22
	m,p-xylene		µg/L	10	14	6	2	11	22
	Methyl isobutyl ketone		µg/L	16	18	13	2	4	22
	Methylene chloride		µg/L	39	136	6	41	14	22
	o-xylene		µg/L	6	8	5	2	4	22
	Tetrachloroethene		µg/L	45	145	5	39	19	22
	Toluene		µg/L	36	82	7	28	14	22
	trans 1,2-Dichloroethene		µg/L	6	8	5	2	3	22
	Trichloroethene		µg/L	399	1660	39	466	22	22
	Chloroethene		µg/L	239	458	101	89	22	22
S12	Bicarbonates		mg/L	373	413	318	36	13	13
	Chloride		mg/L	350	350	350		1	1
	Conductivity	(avg)	µmhos/cm	1289	1890	388	492	22	22
	Dissolved Oxygen	(avg)	mg/L	1	4	0	1	13	13
	Fluoride		mg/L	1	1	1		1	1
	Hardness		mg/L	116	179	49	47	15	15
	pH	(avg)		7	7	7	0	22	22
	Sulfate		mg/L	2	2	2		1	1
	Suspended	Solids	mg/L	33	44	11	19	3	8
	Temperature	(avg)	° F	56	66	49	4	22	22
	Total Dissolved Solids		mg/L	1040	1040	1040		1	1
	Turbidity		NTU	10	66	1	21	12	12
	Aluminum	(total)	µg/L	526	708	344	257	2	6
	Calcium	(dissolved)	µg/L	26800	26800	26800		1	1
	Calcium	(total)	µg/L	31900	31900	31900		1	1
	Chromium	(total)	µg/L	8	12	5	5	2	16
	Iron	(dissolved)	µg/L	21900	21900	21900		1	1
	Iron	(total)	µg/L	16675	25600	9210	4793	15	15
	Magnesium	(dissolved)	µg/L	22500	22500	22500		1	1
	Magnesium	(total)	µg/L	19500	19500	19500		1	1
	Manganese	(dissolved)	µg/L	1400	1400	1400		1	1
	Manganese	(total)	µg/L	1063	1480	524	370	15	15
	Selenium	(total)	µg/L	19	19	19		1	1
	Sodium	(dissolved)	µg/L	344000	344000	344000		1	1
	Sodium	(total)	µg/L	317000	317000	317000		1	1
	Zinc	(total)	µg/L	42	93	21	28	6	16
	(HPMO) Oxazolidinone		µg/L	108	220	43	55	13	16
	(OPMO) Oxazolidinone		µg/L	161	332	65	81	11	16
	1,1,1-Trichloroethane		µg/L	25	44	6	27	2	22
	1,1-Dichloroethane		µg/L	14	19	7	4	16	22
	cis 1,2-Dichloroethene		µg/L	36	124	5	29	20	22
	Methyl ethyl ketone		µg/L	41	61	21	28	2	22
	Trichloroethene		µg/L	17	67	5	15	15	22
	Chloroethene		µg/L	29	73	7	19	21	22
S13	Bicarbonates		mg/L	253	296	214	30	13	13
	Chloride		mg/L	18	18	18		1	1
	Conductivity	(avg)	µmhos/cm	725	1110	375	218	22	22
	Dissolved Oxygen	(avg)	mg/L	1	5	0	2	13	13
	Hardness		mg/L	118	150	87	18	15	15
	pH	(avg)		7	7	6	0	22	22
	Sulfate		mg/L	1	1	1		1	1
	Suspended	Solids	mg/L	86	100	73	9	8	8

Well	Constituent		Units	Mean	Maximum	Minimum	Standard Deviation	Number Detects	Number Samples
				Cumulative Results 1996-2007					
S13	Temperature	(avg)	° F	55	63	50	4	21	21
	Total Dissolved Solids		mg/L	322	322	322		1	1
	Turbidity		NTU	7	32	2	11	12	12
	Aluminum	(total)	µg/L	245	284	208	38	3	6
	Calcium	(dissolved)	µg/L	21700	21700	21700		1	1
	Calcium	(total)	µg/L	15000	15000	15000		1	1
	Iron	(dissolved)	µg/L	40800	40800	40800		1	1
	Iron	(total)	µg/L	31027	42100	20100	5764	15	15
	Magnesium	(dissolved)	µg/L	14000	14000	14000		1	1
	Magnesium	(total)	µg/L	11900	11900	11900		1	1
	Manganese	(dissolved)	µg/L	1750	1750	1750		1	1
	Manganese	(total)	µg/L	1530	2020	1010	265	15	15
	Selenium	(dissolved)	µg/L	14	14	14		1	1
	Selenium	(total)	µg/L	21	21	21		1	1
	Sodium	(dissolved)	µg/L	47600	47600	47600		1	1
	Sodium	(total)	µg/L	46100	46100	46100		1	1
	Zinc	(total)	µg/L	42	64	22	17	6	16
	(HPMO) Oxazolidinone		µg/L	37	46	29	7	5	16
	(OPMO) Oxazolidinone		µg/L	56	78	28	21	6	16
	1,1,1-Trichloroethane		µg/L	101	340	7	92	12	22
	1,1-Dichloroethane		µg/L	28	94	6	23	22	22
	1,1-Dichloroethene		µg/L	19	58	7	14	11	22
	cis 1,2-Dichloroethene		µg/L	464	1500	51	403	21	22
	Ethylbenzene		µg/L	5	5	5		1	22
	m,p-xylene		µg/L	6	6	6		1	22
	Tetrachloroethene		µg/L	8	12	5	4	3	22
	Toluene		µg/L	12	34	6	8	11	22
	Trichloroethene		µg/L	27	173	6	45	13	22
	Chloroethene		µg/L	66	109	33	20	21	22
S14	Bicarbonates		mg/L	328	350	297	17	13	13
	Chloride		mg/L	131	131	131		1	1
	Conductivity	(avg)	µmhos/cm	1375	1800	437	423	22	22
	Dissolved Oxygen (avg)		mg/L	2	6	0	2	13	13
	Fluoride		mg/L	3	3	3		1	1
	Hardness		mg/L	173	219	121	36	15	15
	pH	(avg)		7	7	7	0	22	22
	Sulfate		mg/L	92	92	92		1	1
	Suspended	Solids	mg/L	59	119	10	57	4	8
	Temperature	(avg)	° F	57	66	52	3	22	22
	Total Dissolved Solids		mg/L	814	814	814		1	1
	Turbidity		NTU	28	110	1	42	12	12
	Aluminum	(total)	µg/L	237	237	237		1	6
	Arsenic	(total)	µg/L	12	12	12		1	15
	Calcium	(dissolved)	µg/L	22100	22100	22100		1	1
	Calcium	(total)	µg/L	19100	19100	19100		1	1
	Chromium	(total)	µg/L	11	11	11		1	16
	Iron	(dissolved)	µg/L	31300	31300	31300		1	1
	Iron	(total)	µg/L	36620	46100	28100	5911	15	15
	Magnesium	(dissolved)	µg/L	15600	15600	15600		1	1
	Magnesium	(total)	µg/L	17700	17700	17700		1	1
	Manganese	(dissolved)	µg/L	1690	1690	1690		1	1
	Manganese	(total)	µg/L	1935	2410	1500	298	15	15
	Mercury	(dissolved)	µg/L	1	1	1		1	1
	Mercury	(total)	µg/L	1	1	1		1	1
	Selenium	(dissolved)	µg/L	15	15	15		1	1
	Selenium	(total)	µg/L	9	9	9		1	1

Well	Constituent		Units	Mean	Maximum	Minimum	Standard Deviation	Number Detects	Number Samples
				Cumulative Results 1996-2007					
S14	Sodium	(dissolved)	µg/L	153000	153000	153000		1	1
	Sodium	(total)	µg/L	195000	195000	195000		1	1
	Zinc	(dissolved)	µg/L	24	24	24		1	1
	Zinc	(total)	µg/L	27	29	24	4	2	16
	(HPMO)	Oxazolidinoı	µg/L	382	599	226	105	16	16
	(OPMO)	Oxazolidinoı	µg/L	802	1580	510	277	16	16
	Di-n-butylphthalate		µg/L	6	6	6		1	16
	1,1,1-Trichloroethane		µg/L	7	10	6	2	4	22
	1,1-Dichloroethane		µg/L	36	54	6	12	22	22
	Benzene		µg/L	6	6	5	1	2	22
	cis 1,2-Dichloroethene		µg/L	41	79	8	21	21	22
	Ethylbenzene		µg/L	11	16	5	4	7	22
	m,p-xylene		µg/L	8	9	7	1	2	22
	Methyl ethyl ketone		µg/L	81	126	36	64	2	22
	o-xylene		µg/L	7	7	6	1	2	22
	Chloroethene		µg/L	171	400	11	111	22	22
S15	Bicarbonates		mg/L	337	373	324	12	13	13
	Chloride		mg/L	663	663	663		1	1
	Conductivity	(avg)	µmhos/cm	1626	2620	321	639	22	22
	Dissolved Oxygen (avg)		mg/L	1	4	0	1	13	13
	Hardness		mg/L	183	298	106	72	15	15
	pH	(avg)		7	7	6	0	22	22
	Sulfate		mg/L	73	73	73		1	1
	Suspended	Solids	mg/L	65	75	30	15	8	8
	Temperature	(avg)	° F	57	65	51	4	22	22
	Total Dissolved Solids		mg/L	1500	1500	1500		1	1
	Turbidity		NTU	5	21	1	8	12	12
	Aluminum	(total)	µg/L	223	257	205	30	3	6
	Arsenic	(total)	µg/L	24	24	24		1	15
	Calcium	(dissolved)	µg/L	47100	47100	47100		1	1
	Calcium	(total)	µg/L	51700	51700	51700		1	1
	Chromium	(total)	µg/L	7	12	3	6	2	16
	Iron	(dissolved)	µg/L	73900	73900	73900		1	1
	Iron	(total)	µg/L	39713	64700	15400	16084	15	15
	Magnesium	(dissolved)	µg/L	44100	44100	44100		1	1
	Magnesium	(total)	µg/L	40900	40900	40900		1	1
	Manganese	(dissolved)	µg/L	2190	2190	2190		1	1
	Manganese	(total)	µg/L	1858	2860	778	686	15	15
	Mercury	(total)	µg/L	0	0	0		1	1
	Selenium	(dissolved)	µg/L	7	7	7		1	1
	Selenium	(total)	µg/L	42	42	42		1	1
	Sodium	(dissolved)	µg/L	432000	432000	432000		1	1
	Sodium	(total)	µg/L	458000	458000	458000		1	1
	Zinc	(dissolved)	µg/L	22	22	22		1	1
	Zinc	(total)	µg/L	221	421	23	199	3	16
	(HPMO)	Oxazolidinoı	µg/L	618	1100	200	221	16	16
	(OPMO)	Oxazolidinoı	µg/L	801	1360	141	314	16	16
	Di-n-butylphthalate		µg/L	7	7	7		1	16
	1,1-Dichloroethane		µg/L	27	200	6	44	18	22
	1,2,3-Trichlorobenzene		µg/L	30	30	30		1	22
	1,2,4-Trichlorobenzene		µg/L	24	24	24		1	22
	1,2-Dichloroethane		µg/L	12	12	12		1	22
	1,3,5-Trichlorobenzene		µg/L	19	19	19		1	22
	Benzene		µg/L	10	57	5	15	12	22
	Chloroethane		µg/L	12	14	10	1	10	22
	cis 1,2-Dichloroethene		µg/L	26	183	6	46	14	22

Well	Constituent	Units	Mean	Maximum	Minimum	Standard Deviation	Number Detects	Number Samples
			Cumulative Results 1996-2007					
S15	Ethylbenzene	µg/L	34	136	10	50	6	22
	m,p-xylene	µg/L	35	35	35		1	22
	Methyl ethyl ketone	µg/L	260	260	260		1	22
	Methylene Chloride	µg/L	5	5	5		1	22
	o-xylene	µg/L	18	18	18		1	22
	Toluene	µg/L	21	21	21		1	22
	Trichloroethene	µg/L	25	45	7	19	3	22
	Chloroethene	µg/L	31	100	3	27	12	22
Sector 2								
U1	Bicarbonates	mg/L	333	360	245	44	6	6
	Chloride	mg/L	203	203	203		1	1
	Conductivity (avg)	µmhos/cm	1045	1460	595	178	44	44
	Dissolved Oxygen (avg)	mg/L	1	3	0	1	12	12
	Hardness	mg/L	146	262	109	55	7	7
	pH (avg)		7	8	7	0	44	44
	Sulfate	mg/L	72	72	72		1	1
	Suspended Solids	mg/L	60	89	18	27	8	8
	Temperature (avg)	° F	57	92	40	9	44	44
	Turbidity	NTU	6	19	1	7	11	11
	Aluminum (dissolved)	µg/L	246	263	228	25	2	14
	Aluminum (total)	µg/L	985	985	985		1	1
	Arsenic (dissolved)	µg/L	854	1520	22	538	9	10
	Arsenic (total)	µg/L	36	36	36		1	2
	Cadmium (dissolved)	µg/L	5	5	5		2	14
	Calcium (dissolved)	µg/L	32986	52600	18800	11837	14	14
	Calcium (total)	µg/L	39500	39500	39500		1	1
	Chromium (dissolved)	µg/L	10	10	10		3	14
	Iron (dissolved)	µg/L	32007	43400	22400	7690	14	14
	Iron (total)	µg/L	29250	29600	28900	495	2	2
	Magnesium (dissolved)	µg/L	13895	21100	8000	4651	14	14
	Magnesium (total)	µg/L	16600	16600	16600		1	1
	Manganese (dissolved)	µg/L	2659	3560	1920	612	10	10
	Manganese (total)	µg/L	2550	3010	2090	651	2	2
	Potassium (dissolved)	µg/L	6580	8140	5780	1083	4	4
	Sodium (dissolved)	µg/L	210143	244000	179000	22156	14	14
	Sodium (total)	µg/L	211000	211000	211000		1	1
	Zinc (dissolved)	µg/L	287	511	111	147	14	14
	Zinc (total)	µg/L	280	693	72	358	3	4
	(HPMO) Oxazolidinone	µg/L	1138	2200	154	499	23	23
	(OPMO) Oxazolidinone	µg/L	4135	7530	2500	1148	23	23
	bis(2-Ethylhexyl)phthalate	µg/L	12	12	12		1	3
	1,1,1-Trichloroethane	µg/L	10	13	6	2	8	44
	1,1-Dichloroethane	µg/L	17	35	5	10	26	44
	1,1-Dichloroethene	µg/L	13	24	5	6	20	44
	1,3,5-Trichlorobenzene	µg/L	6	6	6		1	43
	Chloromethane	µg/L	14	14	14		1	43
	cis 1,2-Dichloroethene	µg/L	940	3150	6	936	38	44
	Tetrachloroethene	µg/L	17	32	5	10	18	44
	Toluene	µg/L	5	5	5		1	44
	trans 1,2-Dichloroethene	µg/L	21	42	5	12	20	44
	Trichloroethene	µg/L	356	1320	7	345	30	44
	Chloroethene	µg/L	389	2000	2	401	44	44
U2	Bicarbonates	mg/L	296	424	253	65	6	6
	Chloride	mg/L	181	181	181		1	1
	Conductivity (avg)	µmhos/cm	849	1240	259	200	43	43

Cumulative Results 1996-2007

Well	Constituent		Units	Mean	Maximum	Minimum	Standard Deviation	Number Detects	Number Samples
U2	Dissolved Oxygen (avg)		mg/L	1	6	0	2	12	12
	Hardness		mg/L	148	224	102	45	7	7
	pH	(avg)		7	7	7	0	43	43
	Sulfate		mg/L	14	14	14		1	1
	Suspended	Solids	mg/L	89	152	24	47	8	8
	Temperature	(avg)	° F	59	86	43	8	43	43
	Turbidity		NTU	25	174	0	53	11	11
	Aluminum	(total)	µg/L	843	843	843		1	1
	Arsenic	(dissolved)	µg/L	1661	2660	1000	614	7	10
	Cadmium	(dissolved)	µg/L	6	6	5	1	2	14
	Calcium	(dissolved)	µg/L	39843	53300	31200	7246	14	14
	Calcium	(total)	µg/L	36400	36400	36400		1	1
	Iron	(dissolved)	µg/L	56157	73600	44700	9426	14	14
	Iron	(total)	µg/L	41750	41900	41600	212	2	2
	Magnesium	(dissolved)	µg/L	20121	29300	14700	4448	14	14
	Magnesium	(total)	µg/L	25100	25100	25100		1	1
	Manganese	(dissolved)	µg/L	3045	3640	2490	387	10	10
	Manganese	(total)	µg/L	2325	2500	2150	247	2	2
	Potassium	(dissolved)	µg/L	5768	6970	5040	841	4	4
	Sodium	(dissolved)	µg/L	133286	205000	105000	27028	14	14
	Sodium	(total)	µg/L	166000	166000	166000		1	1
	Zinc	(dissolved)	µg/L	28	34	20	6	4	14
	Zinc	(total)	µg/L	30	34	25	6	2	4
	(HPMO) Oxazolidinone		µg/L	639	2100	104	449	23	23
	(OPMO) Oxazolidinone		µg/L	855	2990	126	586	23	23
	bis(2-Ethylhexyl)phthalate		µg/L	10	10	10		1	3
	1,1-Dichloroethane		µg/L	36	130	9	29	36	43
	1,1-Dichloroethene		µg/L	19	42	5	12	17	43
	Chloromethane		µg/L	13	13	13		1	42
	cis 1,2-Dichloroethene		µg/L	2052	6410	9	2351	35	43
	Methylene chloride		µg/L	6	6	6		1	43
	trans 1,2-Dichloroethene		µg/L	33	74	6	23	21	43
	Trichloroethene		µg/L	68	323	5	93	24	43
	Chloroethene		µg/L	730	1510	5	503	37	43
Sector 4									
S16	Bicarbonates		mg/L	246	356	126	92	6	6
	Chloride		mg/L	315	320	310	7	2	2
	Conductivity	(avg)	µmhos/cm	1199	1890	264	350	24	24
	Dissolved Oxygen (avg)		mg/L	2	7	0	2	15	15
	Hardness		mg/L	162	257	128	48	6	6
	pH	(avg)		7	7	6	0	24	24
	Sulfate		mg/L	9	12	7	4	2	2
	Suspended	Solids	mg/L	99	124	80	19	5	6
	Temperature	(avg)	° F	59	70	52	5	23	23
	Total Dissolved Solids		mg/L	886	1020	752	190	2	2
	Turbidity		NTU	22	110	1	33	13	13
	Arsenic	(total)	µg/L	14	14	14		1	8
	Calcium	(total)	µg/L	57500	59000	56000	2121	2	2
	Chromium	(total)	µg/L	17	26	10	7	5	22
	Iron	(total)	µg/L	46698	76200	285	24911	8	8
	Magnesium	(total)	µg/L	43500	44200	42800	990	2	2
	Manganese	(total)	µg/L	2193	4420	37	1421	8	8
	Mercury	(total)	µg/L	1	1	1		1	2
	Sodium	(total)	µg/L	112500	117000	108000	6364	2	2
	Zinc	(total)	µg/L	89	162	34	55	4	22
	(HPMO) Oxazolidinone		µg/L	158	250	28	96	7	9

Well	Constituent	Units	Cumulative Results 1996-2007 Mean	Maximum	Minimum	Standard Deviation	Number Detects	Number Samples
S16	(OPMO) Oxazolidinone	µg/L	654	1050	43	349	6	9
	1,1-Dichloroethane	µg/L	42	54	29	10	6	24
	Acetone	µg/L	95	95	95		1	23
	cis 1,2-Dichloroethene	µg/L	35	62	6	22	6	24
	Methyl ethyl ketone	µg/L	110	110	110		1	23
	Chloroethene	µg/L	227	360	110	103	6	24
S17	Bicarbonates	mg/L	240	357	106	104	6	6
	Chloride	mg/L	425	460	390	49	2	2
	Conductivity (avg)	µmhos/cm	1061	1897	152	499	32	32
	Dissolved Oxygen (avg)	mg/L	2	7	0	2	23	23
	Hardness	mg/L	149	237	73	56	6	6
	pH (avg)		7	7	6	0	33	33
	Sulfate	mg/L	38	42	33	6	2	2
	Suspended Solids	mg/L	111	282	7	102	6	6
	Temperature (avg)	°F	60	70	52	5	32	32
	Total Dissolved Solids	mg/L	1049	1110	988	86	2	2
	Turbidity	NTU	77	368	2	117	20	20
	Arsenic (total)	µg/L	13	16	11	3	3	8
	Calcium (total)	µg/L	67400	70100	64700	3818	2	2
	Chromium (total)	µg/L	21	35	12	7	9	30
	Iron (total)	µg/L	66441	112000	3030	35534	8	8
	Magnesium (total)	µg/L	41500	41700	41300	283	2	2
	Manganese (total)	µg/L	2576	5250	110	1823	8	8
	Sodium (total)	µg/L	195500	199000	192000	4950	2	2
	Zinc (total)	µg/L	222	794	26	229	13	30
	(HPMO) Oxazolidinone	µg/L	170	289	74	100	4	8
	(OPMO) Oxazolidinone	µg/L	639	1210	162	442	4	9
	1,1-Dichloroethane	µg/L	30	56	5	22	5	32
	Acetone	µg/L	66	66	66		1	28
	cis 1,2-Dichloroethene	µg/L	18	53	5	17	7	32
	Methyl ethyl ketone	µg/L	61	61	61		1	28
	Tetrachloroethene	µg/L	10	10	10		1	32
	Chloroethene	µg/L	118	410	2	148	8	32

Table 5 is originally from the *2007 Annual Evaluation Western Processing*, Landau Associates.

APPENDICES

A1: Community Notification

A2: Site Inspection Report

A3: Interview Records

A4: Site Photographs

A1: Community Notification

Kent Reporter

January 30, 2008 • Kent Reporter

EPA to Review Cleanup at Western Processing Superfund Site
Your Comments Invited Through April 30, 2008

The U.S. Environmental Protection Agency (EPA) is doing the fourth Five-Year Review of the Western Processing Superfund Site in Kent, Washington. EPA reviews cleanups at Superfund sites every five years, to make sure the remedy continues to protect people and the environment. In 1983, the Western Processing site was listed on EPA's National Priorities List of the nation's most contaminated hazardous waste sites. The 13-acre site is in the highly industrialized Kent Valley. Wastes from past electroplating and steel mill operations, among other activities, contaminated the site. Contaminants include volatile organic compounds, phenols, and heavy metals.

The cleanup at Western Processing was a combination of removing contaminated soil and sediment, controlling storm water, extracting and treating groundwater, and capping contaminated areas left in place. A slurry wall was built around the site to keep contaminants from moving from the more contaminated area of the site to the cleaner area. In the mid 1990s, a new extraction system was built within the slurry wall. The system is operated by a computer-controlled treatment facility.

EPA welcomes your participation. If you have information that may help with the review, or any concerns you would like to share about the site, call Chris Bellovary, EPA Project Manager **by April 30, 2008** at 800-424-4372, x2723, or e-mail: bellovary.chris@epa.gov. To learn more, visit www.epa.gov/r10earth/, click on *A to Z Subject Index*, then *W*, then *Western Processing*. *TTY users may call the Federal Relay Service at 800-877-8339 and give the operator Chris Bellovary's phone number.*

Postcard Notification

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Your Comments Invited Through April 30, 2008

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TTY users may call the Federal Relay Service at 800-877-8339 and give the operator Chris Bellovary's phone number.

A2: **Site Inspection Checklist**

I. SITE INFORMATION			
Site name:	Western Processing	**Date of inspection:**	April 3, 2008
Location and Region:	Kent, WA; R10	**EPA ID:**	WAD0009487513
Agency, office, or company leading the five-year review:	EPA Region 10	**Weather/temperature:**	47°F, 4 mph wind, Slightly overcast; shadows were distinct & visible.

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☒ Surface water collection ~~and treatment~~
- ☒ Other: Surface water monitoring for Mill Creek
- ☒ Monitored natural attenuation
- ☒ Groundwater containment
- ☒ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached
☒ Inspection team roster on bottom of page

II. INTERVIEWS (Check all that apply)

1. **O&M site manager:** Wayne Schlappi (Name) Project Manager (Title) April 3, 2008 (Date)
   Interviewed ☒ at site ☐ at office ☐ by phone Phone no. 425-965-4177
   Problems, suggestions; ☐ Report attached ________________

2. **O&M staff:** Ken Brown (Name) Senior Technician 3 (Title) April 3, 2008 (Date)
   Interviewed ☒ at site ☐ at office ☐ by phone
   Problems, suggestions; ☐ Report attached ________________

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 City of Kent
Contact Mike Mactutis (Name) Environmental Engineering Manager (Title) Jan. 8, 2008 (Date)

Our discussion was in regards to a well that the City of Kent has that is located to the south of the site. This is a flow augmentation well for Mill Creek, but hasn't been used since the mid-1990s. Mr. Mactutis was familiar with the Western Processing site, and actively involved in meetings with the site when the 196th Street overpass was being constructed.

I provided Mr. Mactutis an overview of the current site status

Inspection Team:

Chris Bellovary	EPA Region 10, Remedial Project Manager	206-553-2723
Bernie Zavala	EPA Region 10, Hydrogeologist	206-553-1562

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

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

   Remarks: A review of the maintenance log and inspection notebook displayed that maintenance logs are being maintained and that the inspections are being performed. The latest inspection data had not been transferred from the inspection book onto the official recording forms yet, but it was within the inspection book.

2. **Site-Specific Health and Safety Plan** — ☐ Readily available ☐ Up to date ☐ N/A
   - ☐ Contingency/emergency response plan — ☐ Readily available ☐ Up to date ☐ N/A

   Remarks: I did not verify these elements during the interview and inspection.

3. **O&M and OSHA Training Records** — ☒ Readily available ☒ Up to date ☐ N/A

   Remarks: HAZWOPER certification is current.

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__________

5. **Gas Generation Records** — ☐ Readily available ☐ Up to date ☒ N/A

   Remarks__________

6. **Settlement Monument Records** — ☐ Readily available ☐ Up to date ☒ N/A

7. **Groundwater Monitoring Records** — ☒ Readily available ☒ Up to date ☐ N/A

   Remarks__________

8. **Groundwater Extraction Records** — ☒ Readily available ☒ Up to date ☒ N/A

   Remarks__________

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

   Remarks__________

10. **Daily Access/Security Logs** — ☐ Readily available ☐ Up to date ☒ N/A

    Remarks: The sector is fenced off with a security gate. Either a combination or an electronic pass card is necessary to open the gate. All well vaults that I viewed were padlocked. None of the waste material remains on the surface, so there is not a surface waste hazard that needs to be secured.

IV. O&M COSTS

1. **O&M Organization**
   - ☐ State in-house — ☐ Contractor for State
   - ☐ PRP in-house — ☒ Contractor for PRP
   - ☐ Federal Facility in-house — ☐ Contractor for Federal Facility
   - ☐ Other__________

2. **O&M Cost Records**

☐ Readily available ☐ Up to date

☒ Funding mechanism/agreement in place

Original O&M cost estimate____________________ ☐ Breakdown attached

Total annual cost by year for review period if available

From 1/1/2007 (Date) To 12/31/2007 (Date) $600,000 (Total cost) ☐ Breakdown attached

Remarks: Per Wayne Schlappi, costs dropped to around $600,000 per year since the containment strategy was adopted and implemented, and have remained around $600,000.

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

Describe costs and reasons: not applicable.

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

A. Fencing

1. **Fencing** ☒ Intact ☐ Damaged ☐ Location shown on site map

Remarks: Due to soil settling or other reasons, some of the fencing leans up to 15° off of vertical, but is intact and in place. There is a coyote hole dug under one spot on the fenceline, but it is too small for a person to use for access. I did note one area where there is a gap under the fence in which a person might be able to enter. (See § A4.) One of the gates at the detention pond would not open.

B. Other Access Restrictions

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

Remarks: The road is blocked by a gate that requires an access key to enter. All of the other observed fence gates were locked with padlocks, as were the the observed well vaults. Ken Brown and Wayne Schlappi informed me that the water treatment building has an entry alarm system.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring: Self-reporting by the Trust; office on site.

Frequency Varies: monthly to every other year. See table 1.

Responsible party/agency Western Processing Trust Fund.

Contact: Wayne Schlappi (Name) Project Manager (Title) April 3, 2008 (Date) 425-965-4177 (Phone no.)

Reporting is up-to-date ☒ Yes ☐ No ☐ N/A

Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☒ No ☐ N/A

Violations have been reported ☐ Yes ☒ No ☐ N/A

Other problems or suggestions: ☐ Report attached

2.	**Adequacy**	☐ ICs are adequate ☒ ICs are inadequate ☐ N/A	
	Remarks:	Title to the property has not passed on to any heirs or successors of the estate at this time. After that occurs, EPA will resume discussions for implementing the restrictive covenants on the title.	
D. General			
1.	**Vandalism/trespassing**	☐ Location shown on site map ☒ No vandalism evident	
	Remarks:	During the period since the last five year review, there was one unsuccessful attempt to break into a truck. That is the only known incident of trespassing.	
2.	**Land use changes on site**	☒ N/A	
3.	**Land use changes off site**	☒ N/A	
	Remarks:	The City of Kent continues to evaluate the possibility of extending 72nd Avenue across the Western Processing site, but at this time there have not been any significant land use changes.	

VI. GENERAL SITE CONDITIONS		
A. Roads	☒ Applicable ☐ N/A	
1. **Roads damaged**	☐ Location shown on site map ☒ Roads adequate ☐ N/A	
B. Other Site Conditions		
Remarks: I viewed the many of the storm grates in Sector 1, a few discharge lines from the Sector 1 cap into East Drain (of which there are approximately 20-30, each of which was approximately 8” in diameter), overflow area from the detention pond, and the discharge line from the detention pond into Mill Creek. These were all clear of obstruction. There was a good amount of vegetative growth in the detention pond. Mr. Brown stated that he had recently cut back that area, and was amazed at how quickly it grows back in the spring months. Based on the color and thickness of this vegetation, it appeared reasonable that this was new growth as stated.		

VII. LANDFILL COVERS ☑ Applicable ☐ N/A		
A. Landfill Surface		
1. **Settlement** (Low spots)	☐ Location shown on site map ☒ Settlement not evident	
Areal extent______________	Depth____________	
Remarks	No settlement was evident in the area covered by the RCRA Cap. There is a low area in Sector 4 which may indicate some settlement, as the area was graded back in 1999 to enhance drainage. However, if that is correct, the groundwater sampling in Sector 4 has not shown an adverse effect.	
2. **Cracks**	☐ Location shown on site map ☒ Cracking not evident	
Lengths____________ Widths___________	Depths__________	
Remarks______________________________		
3. **Erosion**	☐ Location shown on site map ☒ Erosion not evident	
Areal extent______________	Depth____________	
Remarks______________________________		

4. **Holes** ☐ Location shown on site map ☒ Holes not evident
Areal extent______________ Depth____________
Remarks: One small animal hole was noted in the surface soils. Ken Brown pointed this out and stated that he would take care of it. Only dirt was visible; no cobble was seen.

5. **Vegetative Cover** ☒ Grass ☒ Cover properly established ☐ No signs of stress
☐ Trees/Shrubs (indicate size and locations on a diagram)
Remarks: Some trees were previously starting to establish themselves at the western fence line for Sector 4, but these trees have been removed. There were several Scotch Broom plants in Sector 4 and the detection pond.

6. **Alternative Cover (armored rock, concrete, etc.)** ☒ N/A
Remarks____

7. **Bulges** ☐ Location shown on site map ☒ 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: The ground east of S17 in Sector 4 appeared to be waterlogged, but not to a problematic amount. An estimate of that sector is approximately 200 square feet.

9. **Slope Instability**
☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Areal extent______________
Remarks____

B. Benches ☐ Applicable ☒ 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.)

C. Letdown Channels ☐ 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.)

D. Cover Penetrations ☒ Applicable ☐ N/A

1. **Gas Vents** ☐ Active ☐ Passive
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☒ N/A
Remarks____

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

3. **Monitoring Wells** (within surface area of landfill)
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks____

4. **Containment Wells**	☒ Properly secured/locked	☒ Functioning	☒ Routinely sampled	☒ Good condition
	☐ Evidence of leakage at penetration		☐ Needs Maintenance	☐ N/A
Remarks				
5. **Settlement Monuments**	☐ Located	☐ Routinely surveyed	☒ N/A	
Remarks				
E. Gas Collection and Treatment	☐ Applicable	☒ N/A		
F. Cover Drainage Layer	☒ Applicable	☐ N/A		
1. **Outlet Pipes Inspected**	☒ Functioning	☐ N/A		
Remarks				
2. **Outlet Rock Inspected**	☐ Functioning	☒ N/A		
Remarks				
G. Detention/Sedimentation Ponds	☒ Applicable	☐ N/A		
1. **Siltation**	Areal extent	Depth	☐ N/A	☒ Siltation not evident
Remarks				
2. **Erosion**	Areal extent	Depth		☒ Erosion not evident
Remarks				
3. **Outlet Works**	☒ Functioning	☐ N/A		
Remarks				
4. **Spillover**	☒ Functioning	☐ N/A		
Remarks				
H. Retaining Walls	☐ Applicable	☒ N/A		
I. Perimeter Ditches/Off-Site Discharge	☒ Applicable	☐ N/A		
1. **Siltation**	☐ Location shown on site map	☒ Siltation not evident		
Areal extent	Depth			
Remarks				
2. **Vegetative Growth**	☐ Location shown on site map	☐ N/A		
	☒ Vegetation does not impede flow			
Areal extent	Type			
Remarks:	Vegetation was encroaching on some of the drainage grates, but upon viewing these, it appears this was relatively recent growth and that the sector is regularly cleared. I saw no vegetative debris either that would impede flow.			
3. **Erosion**	☐ Location shown on site map	☒ Erosion not evident		
Areal extent	Depth			
Remarks				
4. **Discharge Structure**	☒ Functioning	☐ N/A		
Remarks				

VIII. VERTICAL BARRIER WALLS	☑ Applicable	☐ N/A

1. **Settlement** ☐ Location shown on site map ☒ Settlement not evident
   Areal extent______________ Depth____________
   Remarks____

2. **Performance Monitoring**
   Remarks: Described in detail within this Five Year Review.

A. Treatment System ☒ Applicable ☐ 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): metals sequestering agents.
   ☐ 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: not applicable.
   Remarks: Floor was kept clean, instruments and flow lines were properly labeled, walkways were kept clear. The control system, as explained by Wayne Schlappi and Ken Brown, appears to contain redundant safety mechanisms, including a battery backup to send an alarm via pager if the power is ever lost.

2. **Electrical Enclosures and Panels** (properly rated and functional)
   ☐ N/A ☒ Good condition ☐ Needs Maintenance
   Remarks: Approximately 1" of water is on the bottom of the vaults, and enters the lowermost electrical enclosures. Wayne Schlappi stated that the sump pumps need a small amount of suction head, which is why the water is present, and that they have verified that all of the connections within the lower enclosures are completely encased.

3. **Tanks, Vaults, Storage Vessels**
   ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
   Remarks: See note J.2 "Electrical Enclosures and Panels".

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** (containment remedy)
   ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
   ☐ All required wells located ☐ Needs Maintenance ☐ N/A
   Remarks____

B. Monitoring Data		
1.	Monitoring Data ☒ Is routinely submitted on time	☒ Is of acceptable quality
2.	Monitoring data suggests: ☒ Groundwater plume is effectively contained	☒ Contaminant concentrations are declining

C. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ 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.).

<u>The remedy selected for the Western Processing site involves containment of the source contaminants on site through the use of barrier walls, a RCRA cap, and sufficient extraction of groundwater to prevent outward migration. The remedy also calls for a pump and treat system to contain the trans plume. After a study showed the area to be an ideal site for monitored natural attenuation, the pump and treat system was turned off.</u>

<u>The remedy is functioning as intended and is described in detail earlier in this Five Year Review. The Monitored Natural Attenuation of the trans plume is ongoing and effective.</u>

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.

<u>There were a few issues that were identified during the inspection, many of which were pointed out by representatives of the Trust, but none of these issues had the appearance of any sort of a long-term or recurring problem. Trust staff stated that they would take care of the issues as soon as they were identified.</u>

<u>None of the identified issues were out of the ordinary for the type of site and setting of the site. EPA believes that the results of this inspection indicate that the on site O&M is adequately implemented and is protective of the remedy.</u>

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. The inspection data does not appear to contain indicators of a potential remedy problem.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. The system has been in operation long enough that there is enough data for a proper statistical analysis, and prior to the start of the inspection, we discussed the possibility of using statistical methods for Long Term Monitoring Optimization. EPA used the MAROS (Monitoring and Remediation Optimization System) Software for an analysis at the Frontier Hard Chrome site, to good effect. The analysis would focus on the adequacy of the sampling frequency and locations based on the data collected over several years. It is quite possible that this may indicate that the sampling frequency at some of the wells could be reduced. This will be discussed in more detail after the Trust has had the opportunity to become familiar with these methods.

A3: Interview Records

Site Interviews
I spoke with Mr. Wayne Schlappi (Western Processing Trust Fund), Mr. Ken Brown (Shaw Environmental), Mr. Bill Enkeboll (Laundau Associates) and Ms. Christine Kimmel (Laundau Associates) on April 3, 2008 at the Western Processing Superfund site.

Water Issues
I stated that I had recently looked at flood plain maps in the area, and although most of the site is in the 500 year flood plain, some areas of the site fell within the 100 year flood plain. I asked if the site has ever had any problems with flooding, and if so, what occurred. Mr. Schlappi stated that although the water level in Mill Creek has gotten very high during the spring of some years to the point of almost filling the culvert that the creek flows through, they have not experienced any problems with flooding on site. Mr. Brown stated that in the beginning (of their management of the site), the detention basin used to fill to the overflow spillway, but that has not happened in a long time.

I asked if they have ever had a situation where heavy rainfall has overwhelmed the drainage system for the cap. Mr. Schlappi stated that they have not. He stated that they inspect the drains from the cap regularly, that Ken Brown removes any Scotch Broom that appears, and that neither of them have seen any erosion control issues. Mr. Schlappi stated that of the stormwater off the cap, some is discharged to Mill Creek, some is discharged to East Drain, but the majority is discharged into the detention pond to the north of Sector 4. I did observe some Scotch Broom that was present in Sector 4; it was several feet high but the base was not very thick in diameter, which indicates that it was probably relatively new growth.

I stated that I understood that water discharged from the water treatment building lead to the local sewer system; Mr. Schlappi confirmed that was correct. I asked where water discharges from the office building lead, and Mr. Schlappi confirmed that those discharges also go to the sewer system.

Treatment Center
I asked to see the operating permits to ensure that they were kept on site. Mr. Schlappi provided me with a binder that contained the operating permits, which I looked through to verify. Mr. Schlappi stated that they are inspected once a year by the Clean Air Agency to ensure they are in compliance with their operating permit.

Site Security
I asked Mr. Schlappi if they kept a log of people who access the site. Mr. Schlappi stated that they do not, but that the fence requires either one of their electronic openers or a key code to enter, and they maintain access control over the site using those methods.

Operations and Maintenance
At the time of the inspection, one of the Trust's electrical contractors showed up at the control room. Messrs. Schlappi and Brown described how the electrical connections are checked for faults using an IR camera, because heat will be generated where there is a problem with the connection. According to Mr. Schlappi, this allows them to detect problems before they would otherwise be visible.

I asked to see a copy of their on site daily O&M log. Mr. Brown showed me a copy of the official records. He stated that they copy the data from their field inspection notebook onto the official record forms, that the latest inspections were not in the official record book yet, but that it was possible that he had submitted those for review and merely not received them back to place in the binder yet. I asked to see the field inspection notebook, and this was present right next to the O&M binder. I did not perform an in depth verification at that time, but I did review some records from each book. It appears that between the two books, all of the inspection data is present, and that it is also possible to verify the official records against the field inspection notebook.

Mr. Brown stated that for the water treatment center, they log the instrumentation, chemical use, and carbon use; he also stated that after the 2001 earthquake, they pressure tested the entire system. Mr. Brown stated that they have alarms, both local and remove, for smoke, building access, high level sump (both for the building and for the vaults), chemical feed system, and for the blower. Mr. Brown stated that they have dual pumps (one online, one as a full spare) and that they compare the total flow rates of what leaves all of the individual pumps with what arrives at the building as another method of verifying that they have no leaks in the system.

Mr. Brown stated that on their discharge, they get an alarm, both local and remote; if the pH ever drops below 6.0 and that the system shuts down if the effluent pH drops to 5.2. That shutdown point is to ensure that they do not violate their King County discharge authorization. Mr. Brown stated that they have a battery backup for the entire system, including the paging system, in case of power loss; he also showed me the containment sump to collect any spilled liquids. Mr. Brown stated that they currently change out the trays on the stripper around every eight weeks: it takes around 2 hours to change out a tray, 2 hours for flush the line and adjust the belt tension, and that the system is down for a total of 3 hours during each changeout.

Ms. Kimmel stated that they test the carbon filters once a month using a Summa canister, and they cycle these when they are seeing a 25% breakthrough from the lead carbon filter.

Mr. Brown showed us the Pig that he stated they use to shoot through the line to remove iron and scale. They have a Y in a well header within the building to inject the pig, and they collect it on the exit side outside.

Mr. Schlappi stated that they now only use wells 16 and 17 for sampling; those were only used for a few years, and Wayne stated that they received permission from the governments to stop using those wells for extraction because they were continuously becoming fouled with iron. Mr. Schlappi stated that they manually check the piezometers, on a monthly basis for the variable ones and on a quarterly basis for the stable ones.

Other Issues
When we were crossing under the bridge, moving from Sector 1 to Sector 4, Mr. Enkeboll described some of the work that was done when the 196th St. overpass was put in place. He stated that it was an interesting design, because in order to ensure the contaminants did not migrate, the bridge foundations were not allowed to breach the aquitard.

Telephone Interviews
I spoke with Mr. Mactutis, the Environmental Engineering Manager for the City of Kent, over the telephone on January 7 and February 25 of 2008. The main purpose for our conversation was because during a review of well logs around the Western Processing Superfund site, I noticed that the City of Kent owned a well around 1 half mile south of the site and I wanted to find out more information about this well. Mr. Mactutis informed me that in the mid to late 1990s, the city drilled a number of wells to be able to provide flow augmentation for Mill Creek. This well has not been used since the late 1990s and that the City has no current plans to use that particular well again in the future.

Mr. Mactutis was knowledgeable about the Western Processing Superfund site, and used to attend weekly meetings for the site at the time that the South 196th Street overpass was being constructed. I gave him a summary of the site, and answered some of his questions in regards to the slurry wall breach in Sector 4 and the upset condition that occurred in March 2007. I also informed Mr. Mactutis about the upcoming Five Year Review for the Western Processing site.

A4: Site Photographs

Photo 1: The entrance sign at the approach to the site.[38]

Photo 2: Immediately outside of the entrance. The gate was opened just prior to taking this photo to provide a better view of the road and the water treatment building. Sector 1 is behind the fence.

[38] The phone numbers on the Regulating Authorities sign were for previous EPA and WDOE project managers. The Trust was notified of this and the sign was corrected before the June 26, 2008 meeting at the Western Processing site. The correct contact numbers are 206-553-0247 for EPA and 360-407-7223 for WDOE.

Photo 3: This photo was taken on top of the RCRA cap, looking north. One of the storm drains for the RCRA cap (center) is visible as is one of the extraction vaults (right center). The storm drain was kept clear of overgrowth. The water treatment building and the South 196th Street bridge are both visible in the background.

Photo 4: A view inside one of the extraction vaults.

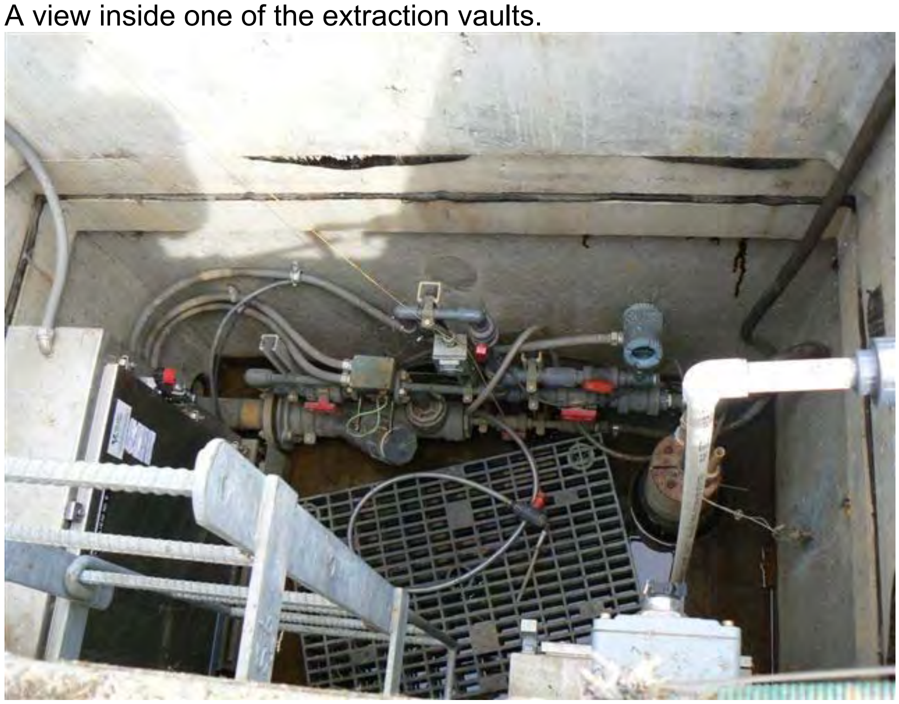

Photo 5: The water treatment plant (manifold, air striper, blower).

Photo 6: VOCs are removed from the stripper air by carbon filters (shown in blue). The carbon in the carbon filters is eventually disposed of in a hazardous waste landfill.

Photo 7: The SCADA system has a number of graphic display screens to enable real-time monitoring and control of the extraction and treatment systems. Shown below is the water treatment system display screen.

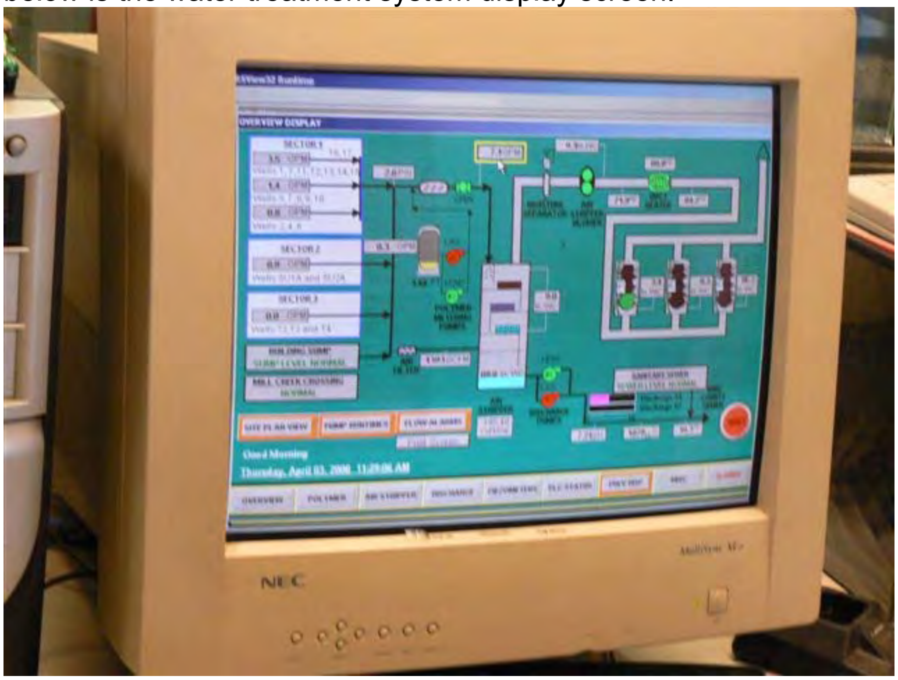

Photo 8: A view of the Sector 1 RCRA cap from the water treatment building.

Photo 9: Interurban trail and the 196th Street overpass. This view is towards the north. Sector 1 is on the left side of the fence line.

Photo 10: A storm drain in Sector 1 for the RCRA cap. The vegetation seen in this photo is in the foreground; the drain was clear of any overgrowth. The fence does not reach the ground at this location, but the reinforcement line near the bottom would still make access to the site rather difficult.

Photos 11: A view of the detention area, facing north from Sector 4.

Photos 12: A view of the detention area, from within the fence.

Photo 13: The design overflow from the detention area leads to Mill Creek.

Photo 14: Mill Creek, looking north from the edge of Sector 4.

Photo 15: Mill Creek, west of the detention area. A depth gauge is visible in the center.

Photo 16: A view of East Drain, facing south-southeast.

Third Five-Year Review Report

For

Coakley Landfill Superfund Site

North Hampton and Greenland
Rockingham County, New Hampshire

September, 2011

PREPARED BY:

EPA New England

With assistance from

New Hampshire Department of Environmental Services

Approved by: ______________________ FOR JTO   Date: 9/22/11

James T. Owens, III, Director
Office of Site Remediation and Restoration
U.S. Environmental Protection Agency, Boston, MA

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

ABBREVIATIONS AND ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLG	Coakley Landfill Group
COC	Contaminants of Concern
ESD	Explanation of Significant Difference
GMP	Groundwater Management Permit
GMZ	Groundwater Management Zone
IC	Institutional Controls
ICL	Interim Cleanup Levels
ICP	Institutional Control Plan
LFG	Landfill Gas
MCL	Maximum Contaminant Level
NCP	National Contingency Plan
NHDES	New Hampshire Department of Environmental Services
NPL	National Priorities List
O&M	Operation and Maintenance
OMP	Operation and Maintenance Plan
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbons
PRPs	Potential Responsible Parties
RA	Remedial Action
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
TBCs	To Be Considered Requirements
ug/l	micrograms per liter (i.e., parts per billion)
EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds

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Executive Summary

The United States Environmental Protection Agency, Region 1 (EPA) has conducted a Five-Year Review of the Remedial Actions (RAs) implemented at the Coakley Landfill Superfund Site in North Hampton and Greenland, New Hampshire in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. Section 9601, et seq. EPA conducted this review between December 2010 and September 2011 with technical assistance from the New Hampshire Department of Environmental Services (NHDES).

This is the third Five-Year Review Report for the Site. The triggering action for this review was the date of the second Five-Year Review, signed September 21, 2006. Subsequent reviews are conducted at least every five years. The purpose of the Five-Year Review is to evaluate whether response actions and original performance standards remain protective of human health and the environment.

The response actions for the Site are documented in two Records of Decision (RODs) and five Explanations of Significant Differences (ESDs). The Site is divided into two separate operable units (OUs). The first OU (source control) provided for the remediation of the source of contamination at the Coakley Landfill Site, including the contaminated groundwater beneath and in the vicinity of the landfill. Source control included consolidation onto the landfill of wastes and sediments identified beyond the edge of the landfill and covering the landfill with an impermeable cap. The remedy for the second OU (management of migration) addresses groundwater contamination which has migrated from the landfill. The response action includes using institutional controls (ICs) to prevent use of contaminated groundwater; utilizing natural attenuation to remediate the contaminated groundwater plume; and groundwater monitoring. The Coakley Landfill Site achieved construction completion status with the signing of the Preliminary Close-Out Report on September 29, 1999.

Overall, the remedy at the Coakley Landfill Superfund Site currently protects human health and the environment in the short-term. Long-term protectiveness has been achieved already in OU-1 through the completion and continued maintenance of the landfill cap, long-term monitoring, and use restrictions. Long-term protectiveness will be achieved in OU-2 when interim groundwater cleanup levels for all contaminants of concern are met and restrictions on the use of groundwater within OU-2 can be removed. Monitoring of the Site will continue until cleanup levels for all contaminants of concern are met.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name: Coakley Landfill		
EPA ID: NHD064424153		
Region: 1	**State:** NH	**City/County:** North Hampton and Greenland, Rockingham County
SITE STATUS		
NPL status: Final		
Remediation status Complete		
Multiple OUs? Yes	**Construction completion date:** 09/29/1999	
Has site been put into reuse? No		
REVIEW STATUS		
Lead agency: Potential Responsible Party (PRP) with U.S. Environmental Protection Agency (EPA) and State oversight		
Author name: Gerardo Millán-Ramos		
Author title: Remedial Project Manager	**Author affiliation:** EPA Region 1	
Review period: 12/2010 to 09/2011		
Date(s) of site inspection: 04/27/2011		
Type of review: X Post-SARA Pre-SARA NPL-Removal only Non-NPL Remedial Action Site NPL State/Tribe-lead Regional Discretion		
Review number: Third		
Triggering action: Completion of Second Five-Year Review		
Triggering action date: 09/21/2006		
Due date ***(five years after triggering action date)*****:** 09/21/2011		

Five-Year Review Summary Form cont'd.

Issues:

1. *Even though no one within the Groundwater Management Zone (GMZ) and its immediate vicinity is exposed to the groundwater, 1,4-Dioxane has been detected at levels exceeding the New Hampshire Ambient Groundwater Quality Standards (NHAGQS) at most monitoring wells within OU-1 and several within OU-2. Additionally, manganese has been detected outside the current GMZ (wells GZ-123 and FPC-2A/B outside the southern edge of the GMZ) above the EPA Health Advisory, and both manganese and arsenic concentrations in the FPC-6 well cluster (inside the eastern edge of the GMZ) suggest that concentrations may exceed the Interim Compliance Levels (ICLs) beyond the GMZ boundary.*

2. *Damage to the fence must be repaired; unlocked monitoring wells and gates must be locked and properly labeled; excessive vegetation in some swales and near the fence must be removed; also construction equipment and materials that are too close to the fence and monitoring wells, must be relocated.*

3. T*here is a possible need for groundwater extraction restrictions for properties on the eastern side of the landfill. Groundwater extraction in this area has the potential to alter the flow of groundwater and increase the extent of the plume, thus adding complexities and time to the ongoing remedy.*

4. C*hanges to the Institutional Control Plan (ICP) were made at the time the GMZ was being discussed and implemented. However, these changes have not been incorporated into the final ICP that was approved by EPA.*

5. *Groundwater Management Permit will expire on June 18, 2013. Site contaminants within the GMZ continue to exceed state and federal cleanup levels. Exceedences outside GMZ suggest that concentrations may also exceed ICLs beyond the GMZ boundary.*

Recommendations and Follow up actions:

1. *a) Sample monitoring wells at the outermost edge of the GMZ and the two residential wells for 1,4 –Dioxane for the next two rounds.*
b) Perform additional analysis to determine whether the site contaminants are moving beyond the edge of the GMZ and whether the current GMZ needs to be expanded and Institutional Controls (ICs) need to be established on additional properties and evaluate the need for further response action.
c) *Prepare an Explanation of Significant Differences (ESD) to add 1,4-Dioxane as a COC with an ICL.*

2. *Perform the necessary repairs to the fence, and lock / properly label all monitoring wells that were lacking these features at the time of the inspection. Also remove excessive vegetation and relocate the construction equipment and materials to a safe distance from the fence. Coordinate and document this activity with the regulatory agencies and the Coakley Landfill Group (CLG).*

3. *Evaluate the need for further ICs in the area east of the landfill to prevent altering of groundwater flow as a means of containing the contaminated groundwater plume.*

4. *Update the Final ICP to incorporate changes that were made during the planning and implementation of the GMZ.*

5. *Renew GMP for GMZ and potentially expand boundary if additional tests show site contaminants migrating beyond the current GMZ boundary.*

Protectiveness Statement(s):

OU-1

The remedy at Operable Unit 1 currently protects human health and the environment, both in the short and long term. All human health threats at the Site have been addressed through stabilization and capping of the landfill and the landfill cap is functioning as intended. Installation of fencing and warning signs and deed restrictions are preventing human exposures at the capped landfill. Toxicity tests that were applied to a "worst case scenario" in the sediment samples, revealed no significant ecological impact, and EPA concluded that it is likely there are no significant ecological impacts in surface water and sediment at the Site. In order to ensure that the currently non-toxic concentrations are not increasing significantly, a reduced surface water and sediment monitoring effort will remain in place. Also, the landfill gas monitoring program will remain in place.

OU-2

The remedy at OU-2 currently protects human health and the environment in the short-term because on-site residents are not exposed to the groundwater, as water utility service has been provided, and there is no evidence of such exposure for off-site residents. Also, a GMZ has been established via a NHDES GMP, and ICs have been established for all properties within the GMZ. Groundwater monitoring to determine compliance with the groundwater monitoring standards for the landfill, will continue to be conducted as a component of OU-2. Long-term protectiveness will be achieved when interim groundwater cleanup levels for all contaminants of concern are met.

Site-Wide

Overall, the remedy at the Coakley Landfill Superfund Site currently protects human health and the environment in the short-term. Long-term protectiveness has been achieved already in OU-1 based on the maintenance of the landfill cap, long-term monitoring, and use restrictions. Long-term protectiveness will be achieved in OU-2 when interim groundwater cleanup levels for all contaminants of concern are met and restrictions on the use of groundwater within OU-2 can be removed. Monitoring of the Site will continue until cleanup levels for the contaminants of concern are met.

1.0 INTRODUCTION

The purpose of a five-year review is to determine whether a remedy at a Superfund Site is protective of human health and the environment. The methods, findings and conclusions of reviews are documented in Five-Year Review Reports. In addition, Five-Year Review Reports identify issues found during the review, if any, and identify recommendations to address them.

The Agency has prepared this Five-Year Review Report pursuant to CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300. CERCLA Section 121(c) as amended 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 review, and any actions taken as a result of such reviews.*

The Agency interpreted this requirement further in the NCP; 40 CFR Section 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 initiation of the remedial action.*

EPA has conducted this five-year review of the selected remedy at the Coakley Landfill Superfund Site (Site) in Greenland and North Hampton, New Hampshire. The review was conducted from December 2010 through September 2011, with assistance from the New Hampshire Department of Environmental Services (NHDES). This report documents the results of the review.

This is the third five-year review for the Site, which is required due to the fact that hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure. The triggering action for this statutory review is the date of the second Five-Year Review Report signed on September 21, 2006.

2.0 SITE CHRONOLOGY

Table 1 lists the chronology of events for the Coakley Landfill Superfund Site.

Table 1: Chronology of Site Events

Date	Event
1972	Landfill operations begin
1979	Initial discovery of the problem
1983-1986	Water main extension completed near the site by the towns of North Hampton and Rye Water Districts
July, 1985	Landfill operations cease
June 10, 1986	Final listing on the National Priorities List (NPL)
March 2, 1990	Operable Unit 1(OU-1) Remedial Investigation/Feasibility Study (RI/FS) complete
June 28, 1990	OU-1 Record of Decision (ROD) signature
March 22, 1991	OU-1 Explanation of Significant Differences (ESD) addressing landfill cap design
May 23, 1994	Operable Unit 2 (OU-2) RI/FS complete
September 30, 1994	OU-2 ROD signature
May 17, 1996	OU-1 ESD addressing landfill gas system design
September 24, 1996	OU-1 construction start
September 29, 1999	OU-1 ESD addressing leachate collection and treatment
September 29, 1999	Construction completion
September 25, 2001	First five-year review report

September 21, 2006	Second Five Year Review Report
September 28, 2007	ESD for OU-1 and OU-2 updating ARARs to include revised and additional standards
June 19, 2008	Groundwater Management Zone (GMZ) established and all Institutional Controls (ICs) in place
July 1st, 2009	ESD for OU-2 clarifying the revision of the Arsenic Maximum Contaminant Level (MCL)
July 29, 2009	Addendum to the Second Five Year Review Report
May 10, 2010	Approval of an updated Project Operations Plan for OU-2

3.0 BACKGROUND

3.1 Physical Characteristics

The Coakley Landfill Superfund Site (Site) includes approximately 92 acres located within the towns of Greenland and North Hampton, Rockingham County, New Hampshire. The actual landfill covers approximately 27 acres. The Site is located about 400 to 800 feet west of Lafayette Road (U.S. Route 1), directly south of Breakfast Hill Road, and about 2.5 miles northeast of the center of the town of North Hampton. The landfill borders farmland, undeveloped woodlands and wetlands to the north and west and commercial and residential properties to the east and south.

3.2 Land and Resource Use

Landfill operations began in 1972, with the southern portion of the Site used for waste disposal from the New Hampshire municipalities of Portsmouth, North Hampton, Newington, and New Castle, along with Pease Air Force Base.

Concurrent with landfill operations, rock quarrying was conducted from approximately 1973 through 1977. Much of the refuse disposed of at the Site was placed in open (some liquid-filled) trenches created by rock quarrying and sand and gravel mining.

In 1982, the city of Portsmouth began operating a refuse-to-energy plant on leased property at Pease Air Force Base. From July 1982 through July 1985, Pease Air Force Base and the municipalities of Rye, North Hampton, Portsmouth, New Castle, Newington and Derry, among others, began transporting their refuse to this plant for incineration. The Site generally accepted incinerator residue from the refuse-to-energy plant after July, 1982. In March 1983, the New Hampshire Bureau of Solid Waste Management ordered the landfill closed to all waste disposal except burnt residue from the incinerator. In July, 1985 the landfill was closed to all disposal activities.

3.3 History of Contamination

In 1979, the New Hampshire Waste Management Division received a complaint concerning leachate breakouts in the area. A subsequent investigation by the Bureau of Solid Waste Management resulted in the discovery of allegedly empty drums with markings indicative of cyanide waste. A second complaint was received in early 1983 by the New Hampshire Water Supply and Pollution Control Commission regarding the water quality from a domestic drinking water well. *Testing revealed the presence of five different volatile organic compounds (VOCs).*

3.3 Initial Response

A subsequent confirmatory sampling beyond these initial wells detected VOC contamination to the south, southeast, and northeast of the Coakley Landfill. As a result, the town of North Hampton extended public water to Lafayette Terrace in 1983 and to Birch and North Roads in 1986. Prior to this time, commercial and residential water supply in these areas was obtained from private wells.

Also in 1983, the Rye Water District completed a water main extension along Washington Road to the corner of Lafayette Road (U.S. Route 1) and along Dow Lane. This extension brought the public water supply into the area due east and southeast of the intersection of Breakfast Hill Road and U.S. Route 1. See Figure 1-1 (Site Location Plan) for a map showing the aforementioned roads and the dwelling units. In December 1983, the Coakley Landfill was proposed for listing on the NPL, and was listed in 1986.

3.4 Basis for Taking Action

EPA signed a cooperative agreement with the state of New Hampshire on August 12, 1985 to conduct a RI/FS. The RI/FS for OU-1 (Source Control) was completed on March 2, 1990. The RI/FS for OU-2 (Management of Migration) was conducted by the EPA and completed on May 23, 1994. Both studies found contaminants in groundwater beneath the landfill as well as outside the landfill boundaries. VOCs detected at the Site included benzene, ethyl benzene, chloroethane, chlorobenzene and xylene. Semi-volatile organic compounds (SVOCs) detected included predominantly polycyclic aromatic hydrocarbons (PAHs) and dichlorinated benzenes. Inorganic compounds were detected in all groundwater and sediment samples and included arsenic, barium, iron, lead, manganese, nickel, beryllium, selenium and vanadium.

The objectives of the OU-1 ROD were to eliminate threats posed by direct contact with or ingestion of contaminated soils and wastes at the Site, and protect the drinking water aquifer by minimizing further migration of contaminants to the groundwater and surface water. The objective of the OU-2 ROD was to manage the migration of contaminated groundwater outside the landfill boundaries. Groundwater in this area is classified a drinking water aquifer. Investigations at the Site have identified ingestion of groundwater as the primary threat to human health at this Site. Interim cleanup levels (ICL) for groundwater were established for 16 contaminants of concern (COC):

Table 2: Contaminants of Concern

Contaminant	ICL (ug/l)*	Revised ICL (ug/l)
Benzene	5	
Chlorobenzene	100	
Tetrachloroethene	3.5	
1,2-Dichloropropane	5	
2-Butanone	200	
Diethyl phthalate	2,800	
Trans-1,2-dichloroethene	100	
Phenol	280	
Antimony	6	
Arsenic	50	10** (MCL)
Beryllium	4	
Chromium	50	
Lead	15	
Manganese	180 (health advisory)	300 ** (health advisory)
Nickel	100	
Vanadium	260	
Tetrahydrofuran	154 (NH AGQS)***	

* ICLs from 1990 and 1994 RODs.

** Revised MCL (effective January 23, 2006) and health advisory (as of 2004) was addressed in a 2007 ESD.

*** New Hampshire Ambient Groundwater Quality Standards (NH AGQS) (Env-Or 603.03, Table 600-1). Tetrahydrofuran was added as a COC by the 2007 ESD.

4.0 REMEDIAL ACTIONS

4.1 Remedy Selection

On June 28, 1990, EPA issued a ROD for the source control operable unit (OU-1) of the Site. On March 22, 1991, EPA issued an ESD concerning modifications to the source control remedy related to landfill cap construction and emissions from air strippers proposed to be used to treat the groundwater. A second ESD was issued on May 17, 1996, which changed active landfill gas collection and treatment to a passive collection system. A third ESD was issued on September 29, 1999 which documented the decision to eliminate groundwater collection and treatment. On September 20, 2007, a fourth ESD was issued, revising the MCL for Arsenic from 0.5mg/L to 0.10 mg/L, increasing the EPA Health Advisory for Manganese from 180 ug/L to 300 ug/L, and adding tetrahydrofuran to the list of COCs. Lastly, on July 1, 2009 an ESD was issued, clarifying that the MCL for Arsenic was revised to 0.010 mg/L and re-issuing the 2007 ESD, to reflect the correct MCL.

The remedial action objectives, as stated in the OU-1 ROD, are to:

- Prevent ingestion of groundwater containing contamination in excess of federal and state drinking water standards or criteria, or that poses a threat to public health and the environment.
- Prevent the public from direct contact with contaminated soils, sediments, solid waste and surface water which may present a health risk.
- Eliminate or minimize the migration of contaminants from the soil into groundwater.
- Prevent the off-site migration of contaminants above levels protective of public health and the environment.
- Restore ground and surface water, soils and sediments to levels which are protective of public health and the environment.

The major components of the source control remedy, as modified by the five ESDs are:

- Excavation with disposal of wetlands sediment onto the landfill.
- Consolidate solid waste.
- Cap the landfill.
- Fence the landfill.
- Collect and vent landfill gases.
- Long-term environmental monitoring.
- Institutional controls (ICs) - to prevent contact with Site contaminants and to protect components of the remedy.

The ROD for the management of migration operable unit (OU-2) was issued on September 30, 1994. The ROD called for natural attenuation of the contaminated groundwater, which had migrated from beneath the landfill into off-site areas, together with long-term environmental monitoring and institutional controls. The major components of the management of migration remedy, as modified by the 2007 and 2009 ESDs are:

- ICs to prevent use of contaminated groundwater.
- Natural attenuation for the contaminated groundwater plume.
- Groundwater monitoring.

4.2 Remedy Implementation

4.2.1 Source Control and Management of Migration

A Consent Decree (CD) for the remedial design (RD), construction, operation and maintenance (O&M) of the source control remedy became effective on May 5, 1992. The Coakley Landfill Group (CLG), representing parties potentially responsible for the contamination, completed the design of the OU-1 remedy, and EPA approved the design on January 25, 1996. Construction began September 24, 1996 with the relocation of trash from along the perimeter of the landfill to the top of the landfill. Wetland sediments were removed and placed on the landfill during 1997. The landfill cap was completed in the fall of 1998 and a pre-final inspection was conducted by EPA and NHDES on September 15, 1998 which concluded that no significant construction items remained. Similarly, a pre-final inspection was conducted on October 6, 1998 which determined that wetland construction/restoration activities were complete.

Monitoring of groundwater quality and water levels continued throughout the RD, construction and post-construction phases. EPA evaluated that data and determined that the landfill cap was effective in reducing leachate generation such that the collection and treatment of contaminated groundwater at the edge of the landfill was no longer necessary. EPA's decision was documented in the ESD issued on September 29, 1999.

A CD for the implementation of the management of migration remedy became effective on January 11, 1999. The CLG submitted an environmental monitoring plan for the OU-2 remedy which EPA approved on March 10, 1999. The monitoring plan objective was to 1) assess OU-1 Remedial Action (RA) impacts on site sediment, surface water, groundwater, and 2) monitor natural attenuation of cleanup standard constituents in the OU-2 area, sediments, surface water and groundwater. To attain this objective, the monitoring plan originally required sediment, surface water and groundwater sampling and analysis in April, August and November of each year. The monitoring plan also required analysis for VOCs, SVOCs, metals, natural attenuation indicators and water quality indicators. Annual monitoring of groundwater and surface water continues today and an annual data assessment report is provided to the EPA and NHDES. However, sediment sampling was subsequently modified to be collected every five years, and ambient air and landfill gas monitoring occurs quarterly after which reports are provided to both agencies.

An updated version of the Project Operations Plan (POP) for the management of migration remedy was conditionally approved on May 10, 2010; it contains an Environmental Monitoring Plan, a Quality Assurance Project Plan, a Health and Safety Plan, and a Methane Monitoring Plan. The Environmental Monitoring Plan's purpose is to monitor the extent of migration of the contaminated groundwater and other potentially affected media (surface water and sediments), and to track the natural attenuation of the groundwater contamination. The plan outlines the methods and procedures that will be used to demonstrate conformance and compliance with ICLs.

Under the POP, wells at OU-1 and OU-2 are monitored annually for field parameters (i.e. static water level, turbidity, specific conductance, temperature, pH, and dissolved oxygen), dissolved metals, total metals, and volatile organic compounds (see figure 2, table 2-2 and table 2-3 in **Appendix G** for further details). Surface water and leachate samples are collected and analyzed annually for field parameters, inorganic parameters, total metals and volatile organic compounds. Sediment samples are collected and analyzed every 5 years for total metals (see table 2-5 in **Appendix G** for further details).

4.2.2 Institutional Controls

A plan for implementation of ICs was submitted to EPA by CLG in June 2000 and the final draft of the Groundwater Use Restriction documents for incorporation into the plan was submitted in June 2001. Both documents were approved by EPA in August 2001. The objectives of the Institutional Control Plan (ICP) are to: 1) provide a plan and schedule to implement institutional controls to restrict ingestion of the degraded groundwater plume that is migrating from the Site in accordance with Section X of the OU-2 ROD, and 2) evaluate the effectiveness of the selected and implemented ICs. The CD defines these ICs as deed restrictions or other declarations of covenants, easements or notices created to restrict the use of groundwater at the Site, limit exposure to waste material, ensure non-interference with the remedy and ensure the integrity and effectiveness of the remedy. More specifically, the statement of work attached to the CD states that with respect to groundwater use, ICs for the Site will include an ICP that creates a GMZ for the landfill and the contaminated groundwater plume.

A GMZ was established via a Groundwater Management Permit (GMP) issued by NHDES on June 19, 2008. Groundwater easements to restrict and/or control the use of groundwater were obtained by the CLG from property owners located within the GMZ that do not have alternate water available. In addition, notifications were recorded with the registry of deeds on all parcels contained within the GMZ which have alternate water available. See **Appendix I** for a copy of the notice of GMP as filed at the Rockingham County Registry of Deeds, a list of the properties located within the GMZ, and a copy of the GMP issued by NHDES.

Restrictions on the landfill property prohibit any activity, including, but not limited to any construction, or use of the property which would damage the landfill cap, or interfere with the performance, operation or maintenance of remedial actions for OU-1 and OU-2.

4.3 System Operations/Operation and Maintenance (O&M)

Required system operations in the OU-1 Operation and Maintenance Plan (OMP) include: annual mowing and inspection of the landfill cap and surface water drainage systems, and quarterly ambient air and landfill gas monitoring. Annual sampling and monitoring of groundwater and surface water is required for both OUs. Sediment sampling is performed every five years. Since ICs are in place, annual monitoring of the effectiveness of ICs is also required.

Table 3: Annual Operating and Maintenance Expenses by Operable Unit

Year	Operable Unit 1	Operable Unit 2
2010	$ 46,292.97	$ 40,447.39
2009	$ 47,048.95	$ 45,841.22
2008	$ 45,311.65	$ 71,175.57
2007	$ 33,967.79	$ 63,881.71
2006	$ 51,494.55	$ 47,479.73
TOTAL	$ 224,115.91	$ 268,825.62
Estimated annual cost (3 year average)	$ 46, 217.86	$ 52,488.06

5.0 PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

5.1 Protectiveness Statement from the Previous Five-Year Review

The protectiveness statements from the entire site, taken from the Second Five Year Review read as follows:

A protectiveness determination of the source control remedy at OU-1 cannot be made at this time until further information is obtained. Metals exceedances are present above ecological benchmarks in the surface water, leachate and sediment at the Site. Additional monitoring data has been collected and will be analyzed to determine if adverse ecological impacts are present in these media. It is expected that the data analysis will take approximately 15 months to complete, at which time a protectiveness determination will be made. In addition, sporadic violation of off-site methane gas levels must be brought into compliance with state regulations. All human health threats at the Site have been addressed through stabilization and capping of the landfill and the landfill cap is functioning as intended. Installation of fencing and warning signs and deed restrictions are preventing human exposures at the capped landfill.

A protectiveness determination of the management of migration remedy at OU-2 cannot be made at this time until further information is obtained. High levels of arsenic and manganese are present in wells at the edge of the proposed groundwater management zone. Additional data must be collected so that a determination can be made whether elevated levels are a result of landfill impacts or from a source other than the NPL Site. Dependent on these findings, the scope of the groundwater remedy may need to be modified. A protectiveness determination will be made in 15 months when all data has been evaluated. The extent of the GMZ needs to be determined and institutional controls established for all properties within the GMZ. Monitoring of the Site will continue until cleanup levels for the contaminants of concern are met. It is expected to take approximately 15 years to reach cleanup levels.

A site-wide protectiveness determination for the Coakley Superfund Site cannot be made at this time until further information is obtained. Metals exceedances are present above ecological benchmarks in the surface water, leachate and sediment at the Site and high levels of arsenic and manganese are present in wells at the edge of the proposed groundwater management zone. Additional data has been and/or will be collected and analyzed and a protectiveness determination will be made in 15 months.

Subsequently, on July 29, 2009 and Addendum to the Second Five Year Review was approved and modified these statements to read:

The remedy at Operable Unit 1 is protective of human health and the environment. However, the landfill gas monitoring program will remain in place, as will a reduced surface water and sediment monitoring effort to ensure that the currently non-toxic concentrations are not increasing significantly. Groundwater monitoring to determine compliance with the revised groundwater monitoring standards for the landfill will be conducted as a component of OU-2. A plan for future monitoring will be developed by the agencies and CLG as appropriate for the next five year review.

The remedy at Operable Unit 2 is protective of human health and the environment in the short-term. Long-term protectiveness will be achieved when interim groundwater cleanup levels for all contaminants *of concern are met.*

The remedy at the Coakley Landfill Superfund Site is protective of human health and the environment in the short-term. Long-term protectiveness has been achieved already in OU-1 based on the maintenance of the landfill cap, long-term monitoring, and use restrictions. Long-term protectiveness will be achieved in OU-2 when interim groundwater cleanup levels for all contaminants of concern are met and restrictions on the use of groundwater within OU-2 can be removed.

5.2 Progress Since the Last Five-Year Review

The recommendations of the 2006 review, as modified by the 2009 Addendum, are stated as follows:

- Prepare an ESD (to reflect the changes in the Arsenic MCL and Manganese Health Advisory).
- Affirm boundary of GMZ and if it needs to be expanded, establish ICs at additional properties.
- Obtain GMP approval from NHDES.
- Obtain easements for three properties which currently require ICs, and others, if GMZ is expanded.
- Install active measures to control methane gas exceedances in compliance with state regulations
- Follow up sampling and discussion with EPA and NHDES to determine whether the sediment, surface water and leachate pose an ecological risk and, if so, how it should be addressed.
- Continue methane gas monitoring program.
- Perform chemistry testing to ensure that the currently non-toxic concentrations (at sediment, surface water, and leachate samples) do not show an upward trend.

5.3 Status of Recommendations Since the Last Five-Year Review

Table 4: Status of Recommendations since Last Five-Year Review

Issues from Previous Review	Action Taken and Outcome
Arsenic MCL has been lowered to 10 ug/l from current site ICL of 50 ug/l and health advisory for manganese has changed from 180 ug/l to 300 ug/l.	An ESD documenting the changes in the arsenic MCL and the manganese health advisory was written and finalized on September 30, 2007. Subsequently, on July 1, 2009 another ESD corrected an error in the reported numeric value of the revised arsenic MCL.
Boundary of proposed GMZ needs to be affirmed.	The CLG defined a clean edge for the plume and provided all the necessary information to apply for a GMP in 2008.
GMP must be obtained.	On June 19, 2008, NHDES approved the GMP application submitted by the CLG.
All Institutional Controls must be in place.	ICs at the remaining properties were implemented at the time of the GMP approval, establishing a GMZ, on June 19, 2008. Deed notices were placed on all affected properties within the GMZ and the notices were recorded at the Rockingham County Registry of Deeds in June 2008. The CLG is required to annually notify residents at all affected properties. Annual monitoring at the Site will continue until the interim groundwater cleanup levels for all contaminants of concern, as required under the OU-2 ROD are met.
Off-site methane gas levels must be brought into compliance with state regulations.	The Coakley Landfill Group (CLG) installed methane gas alarms in buildings on abutting properties in 2007 and no violations have been reported on those properties since that time. From September 21, 2006 to the present, no methane has been detected above the state standard for methane soil gas (2.5%) at three of the six gas monitoring probes (M-2, M-4, and M-5). For the other three monitoring probes (M-1, M-6, and M-7), sporadic violations have been observed ranging from single detections of 2.6% at M-1 on September 24, 2007, and 4.2% at M-7 on September 30, 2008, to several detections at M-6 (8.1% on September 30, 2008, 4.5% on September 18, 2009, 8.0% on June 30, 2010, and lastly, 3.4% on March 30, 2011). The agencies will continue to require CLG to perform quarterly landfill gas monitoring of landfill gas probes M-4, M-5, M-6 and M-7 and allow scaled back landfill gas monitoring at M-1 and M-2 to twice a year based on historical data and lack of any nearby structures.
Leachate, surface water and sediment metal exceedances must be addressed.	In 2008 and 2009 additional sediment and surface water samples, respectively, were collected and toxicity tests were run, which showed no significant ecological impact. Since the sampled area was selected as the "worst case area" based on chemistry testing, EPA concluded that it is likely there are no significant ecological impacts in surface water and sediment at the Site. This was documented in July 29, 2009 as an Addendum to the Second 5 Year Review.
Methane Gas	CLG has continued the methane gas monitoring program as described above, under the oversight of EPA and NHDES.

Issues from Previous Review	Action Taken and Outcome
Sediment, Surface Water and Leachate Sampling Plan	CLG performed annual chemistry testing of these samples and in 2010 it performed a statistical analysis of all historical data to ensure that the currently non-toxic concentrations do not show an upward trend.

6.0 THE FIVE-YEAR REVIEW PROCESS

6.1 Administrative Components

The Coakley Landfill Superfund Site five-year review was conducted by Gerardo Millán-Ramos, the EPA Remedial Project Manager, with assistance from the following review team members:

Joseph Donovan	NHDES Remedial Project Manager
Lloyd Selbst, Esq.	U.S.EPA Attorney
Cynthia Catri	U.S. EPA Attorney
Rudy Brown	U.S. EPA Community Involvement Coordinator
Richard Sugatt	U.S. EPA Risk Assessor
Stephen Mangion	U.S. EPA Hydro-geologist
Charles Porfert	U.S. EPA QA/QC Chemist

The five-year review was conducted between December 2010 and September 2011.

6.2 Community Notification and Involvement

Community notification was initiated by the release of a fact sheet announcing the start of the five-year review. Rudy Brown, EPA Community Involvement Coordinator issued the fact sheet on Friday January 21, 2011. The notification was published in the "Portsmouth Herald" and the "Hampton Union" newspapers. A copy of each notice as published in the newspapers is shown in Appendix N.

Another fact sheet and notification to the newspapers will be issued announcing the completion of the report and the results of the review. A copy of the final report will be available for review at the North Hampton Public Library, 235 Atlantic Avenue, North Hampton, NH; at the EPA Region I office, 5 Post Office Square, Boston, MA; and at http://www.epa.gov/region1/superfund/sites/coakley.

6.3 Document Review

The project team reviewed several documents and files to understand the history and status of the cleanup in order to assess the protectiveness of the remedy at the Site. Specific documents reviewed included:

1. Records of Decision: June 28, 1990 and September 30, 1994
2. Consent Decrees: May 4, 1992 and October 29, 1998
3. Explanation of Significant Differences: March 22, 1991; May 17, 1996; September 29, 1999; September 28, 2007; July 1, 2009
4. Initial Data Analysis and Monitoring Report: September 1999
5. Final Institutional Control Plan: June 2000
6. Initial Five-Year Review Report: September 25, 2001
7. Second Five-Year Review Report: September 21, 2006
8. Addendum to the Second Five-Year Review Report: July 29, 2009
9. Project Operations Plan: May 10, 2010
10. Annual Monitoring Reports: 2000-2010
11. Methane Soil Gas Survey Work Plan: January 2006
12. Landfill Gas Monitoring Results: 2006-2010

6.4 Data Review

6.4.1 Groundwater Monitoring

Sixteen (16) groundwater contaminants of concern were identified and ICLs were established in the OU-2 ROD. A seventeenth (17) groundwater COC (tetrahydrofuran) was added in September 2007 via an ESD. See Table 2 in Section 3 herein for more details. Thirty-six compliance wells were sampled in the latest groundwater sampling round for which data are available (August, 2010) and Mann-Kendall data evaluations were performed to evaluate trends for arsenic at 19 wells, for manganese at 19 wells, and for benzene at 5 wells, with data from the most recent 16 sampling events. The trend analysis was performed for these three contaminants because they have historically been the most prevalent at the edge of the GMZ.

For arsenic, decreasing trends were observed for 10 wells, increasing trends were observed for 6 wells, and no trend was observed for 3 wells. For manganese, decreasing trends were observed for 13 wells, increasing trends were observed for 4 wells, and no trend was observed for 2 wells. For benzene, decreasing trends were observed for all 5 wells. Overall, contaminant concentrations in groundwater at the Site show a decreasing trend. Data sheets for the Mann-Kendall evaluation are included in **Appendix C**. A summary of results by wells and compounds is also included.

While there appears to be a general downward trending site-wide of contaminant concentrations, many COCs within the GMZ continue to exceed state and federal cleanup standards. In addition, manganese exceedances were found in two wells outside the GMZ. During the past six years, nine chemicals of concern, in decreasing order of prevalence (i.e. number of detections above ICLs) did not meet their specified cleanup levels: manganese, arsenic, benzene, lead, chromium, nickel, beryllium, antimony and vanadium. Also, concentrations for tetrahydrofuran and most recently (starting with sampling in 2008 at the request of NHDES)1,4- Dioxane exceeded the NH AGQS.

After reviewing the data from the past six annual monitoring reports, twenty-eight wells exceeded the manganese cleanup level (health advisory of 300 ug/l) with concentrations ranging from 310 ug/l to 13,000 ug/l. Twenty-one wells exceeded the arsenic cleanup level (MCL of 10 ug/l) with concentrations ranging from 11 ug/l to 280 ug/l; three wells exceeded the benzene cleanup level (MCL of 5 ug/l) with concentrations ranging from 6 to 8 ug/l; two wells exceeded the nickel cleanup level (MCL of 100 ug/l) with concentrations ranging from 130 to 410 ug/l; one well exceeded the chromium cleanup level (50 ug/l) with concentrations ranging from 140 ug/l to 600 ug/l; one well exceeded the lead cleanup level (15 ug/l) with concentrations ranging from 23 to 100 ug/l; two wells exceeded the beryllium cleanup level (4 ug/L) with concentrations ranging from 23 to 85 ug/L; one well exceeded the antimony cleanup level (6 ug/L) at 8 ug/L; and one well exceeded the vanadium cleanup level (260 ug/L) at 350 ug/L. The NH AGQS for tetrahydrofuran (154 ug/L) was exceeded at one well with concentrations at 160 and 180 ug/L.

The NH AGQS for 1,4-Dioxane (3 ug/L), which is not an ICL, was exceeded at ten wells (all of them located within the established GMZ) with concentrations ranging from 6 to 310 ug/L. All the wells showing exceedances of the ICLs, are located within the established GMZ, except wells GZ-123, and FPC-2A, which are outside the GMZ, south of the landfill. These two wells show exceedances of the manganese ICL (300 ug/L) that range from 2,200 to 3,300 ug/L, and from 500 to 730 ug/L, respectively. See figure 2 (site plan) on Appendix B for the location of these two wells and the GMZ boundary.

While VOCs are still detected above cleanup levels within the GMZ, VOCs have not been detected in either of the off-site residential water supply wells at concentrations that exceeded the laboratory detection limits of 0.5 ug/l, except for one sample collected from well R-3 on January 24, 2008 which detected Methyl tert-butyl ether (MTBE) at 1.6 ug/L (below the New Hampshire GW-1 standard of 13 ug/L). The analytical results for samples collected from off-site residential water supply wells do not indicate any impacts from the landfill Site.

The potential for vapor intrusion was evaluated following the 2002 EPA Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. A risk evaluation of the worst case scenario (a building directly above the location with the highest benzene concentration) revealed that the potential risk would be within EPA's acceptable risk range of 1E-04 to 1E-06. Also, according to the most current concentration contours and the known direction of groundwater flow, no structures exist within a 100 feet from the presumed extent of the plume, nor is the plume expanding in the direction of any structures or non-wetland areas where future construction is a possibility. Please see figures 3 and 4 in **Appendix B** for maps showing overburden and bedrock groundwater flow, and **Appendix K** for a memo detailing the evaluation performed.

The lateral distributions of arsenic, manganese, and 1,4-Dioxane in overburden and bedrock wells, and graphs illustrating contaminant concentrations over time for arsenic, manganese, and benzene in selected wells, are included in **Appendix C**.

6.4.2 Landfill Gas Monitoring

Based on data generated during extensive pre-design studies and other new information developed after the OU-1 ROD was issued in June 1990, the landfill gas management component of the selected remedy was modified from an active interior gas collection system and on-site thermal destruction to a passive gas collection and venting system. This new data indicated that rates of gas generation and levels of hazardous substances in the landfill gas would be lower than those assumed and used for the preparation of the OU-1 ROD. Therefore, after consultation with NHDES, EPA concluded that a passive landfill gas collection and venting system would prevent off-site, sub-surface migration of landfill gases and be protective of human health and the environment, while saving significant costs. This change was documented by an Explanation of Significant Differences (ESD) issued on May 17, 1996. As a result, "turbine vents" were installed on several landfill gas vent pipes in order to prevent the off-site migration of landfill gas.

At the time of the Second Five Year Review, sporadic violations of off-site methane gas levels needed to be brought into compliance with state regulations (Env-Hw 702.09 and 702.11). In 2007, the Coakley Landfill Group (CLG) installed methane gas alarms in buildings on six abutting properties along the eastern edge of the landfill, and discontinued the quarterly monitoring of landfill gas at these locations. The methane gas alarms are still in place in order to alert the occupants of any unsafe gas conditions on the premises, should those occur. Subsequently, NHDES and EPA required the CLG to continue quarterly monitoring of landfill gas probes M-4, M-5, M-6 and M-7 and allowed scaled back landfill gas monitoring at M-1 and M-2 to twice a year based on historical data and lack of any nearby structures.

From September 21, 2006 to the present, no methane has been detected above the state standard for methane soil gas (2.5%) at three of the six gas monitoring probes (M-2, M-4, and M-5). For the other three monitoring probes (M-1, M-6, and M-7), sporadic violations have been observed ranging from single detections of 2.6% at M-1 on September 24, 2007, and 4.2% at M-7 on September 30, 2008, to several detections at M-6 (8.1% on September 30, 2008, 4.5% on September 18, 2009, 8.0% on June 30, 2010, and lastly, 3.4% on March 30, 2011. No indication of methane in the six nearby occupied buildings being monitored has been found to date.

Given the sporadic nature of these excursions (six excursions out of a total of ninety two readings (6.5%) taken during the last five years), and the lack of methane detections in the occupied buildings, EPA and NHDES have recommended the CLG to continue with the quarterly monitoring of landfill gas for probes M-4, M-5, M-6 and M-7, and bi-annual monitoring for probes M-1 and M-2. **Appendix C** contains a figure showing the location of the landfill gas monitoring probes, and graphs of the concentrations observed at all probes since the start of the monitoring program in 1999.

6.4.3 Surface Water/Sediment Monitoring

Comparison of the first five years of monitoring results (2001-2005) with ecological benchmarks for freshwater organisms revealed exceedances by some metals in landfill leachate, surface water and sediment. The CLG performed an additional round of sampling in August, 2006 which revealed additional exceedances. As a result, EPA in consultation with NHDES evaluated the data and determined that the concentrations had the potential for significant ecological impact. Thus, EPA requested that additional sediment and surface water samples be collected in 2008 and 2009 and ran for various toxicity tests. EPA concluded that these results showed no significant ecological impact. Since the sampled area was selected as the "worst case area" based on frequency and magnitude of benchmark exceedances, EPA concluded that it is likely there are no significant ecological impacts in surface water and sediment at the Site. This was documented in July 29, 2009 as an Addendum to the Second 5 Year Review Report.

In accordance with the Environmental Monitoring Plan (EMP) dated April 2010, sediment sampling was reduced to once every 5 years, with the next sediment sampling to be performed in 2014. Therefore, sediment sampling was not performed in August 2010. Surface water and leachate sampling continue on a yearly basis, however surface water sample locations SW-4, SW-5, and SW-103 were dry in August 2010, thus surface water samples could not be collected at these locations. The leachate and surface water sample locations are indicated on figure 2 at **Appendix B**.

The EPA risk assessor evaluated the historical data for the sediment samples and developed an approach for evaluating the potential toxicity of sediments at the Site during five year review periods. The approach basically requires that the worst case sediment location (SED-05) be sampled and analyzed for inorganics every five years. It uses a benchmark quotient approach to identify conditions that might result in toxicity. Please see **Appendix J** for a detailed explanation of this approach.

6.4.4 Institutional Controls

Restrictions on the landfill property prohibit any activity, including, but not limited to any construction, or use of the property which would damage the landfill cap, or interfere with the performance, operation or maintenance of remedial actions for OU-1 and OU-2.

EPA endorses the State Comprehensive Ground Water Protection Program embodied in RSA 485C. New Hampshire law requires that all groundwater must meet drinking water quality standards. The exception is for areas contained within a GMZ where a GMP has been issued. A

GMP establishes an area within which New Hampshire acknowledges that groundwater is contaminated above drinking water quality standards and includes monitoring criteria that will ensure the long-term protection of public health and the environment. The goal in establishing a GMZ is to bring groundwater back to drinking water quality standards.

There are two categories of ICs under the NHDES GMP regulations: 1) deed notices and 2) easements. Deed notices are required for properties within the GMZ with access to public water supplies; permission of the landowner is not required to record a deed notice. Easements are required on properties within the GMZ where no alternative water supply exists and are designed to restrict and/or control the use of groundwater. Easements are obtained by the permittee from property owners within the GMZ.

A GMP was issued by NH DES for the Coakley Landfill on June 19, 2008 with an expiration date of June 18, 2013. It established a GMZ consisting of 23 properties with a recorded deed notice and 11 properties with recorded easements. Six of the 34 properties have recorded groundwater restrictions. Permission was obtained for all properties within the GMZ, and the GMZ boundaries were affirmed. (See the GMZ boundary plan on figure 2 at **Appendix B**).

The implementation of the current ICs is monitored at least on an annual basis at the time of the sampling events. The contractor retained by the CLG is required to observe any developments within the GMZ property lots they enter and notify the CLG of any such findings. In addition every year, the CLG sends letters to all the property owners of the GMZ lots, requesting that they notify the CLG technical committee of any new drinking water supply wells within their property. See **Appendix H** for a sample letter.

Item 2.e of the OU-2 Statement of Work (SOW) requires EPA to review and approve an ICP that among other things requires *...a program and schedule for follow-up to evaluate the effectiveness of the ICs and to implement other types of ICs if not effective, and to evaluate if additional properties require ICs because of the contaminated groundwater plume migrating from the Coakley Landfill beyond the areas in which ICs have been implemented and to implement ICs on such additional properties.* An ICP was approved by EPA in August 2001, however, many changes were made at the time the GMZ was being discussed and implemented, and have not been formally documented. Thus an updated version of the Institutional Control Plan is necessary.

6.5 Site Inspection

The third five-year review's site inspection to assess the protectiveness of the remedy was conducted on April 27, 2011. The inspection was conducted by Gerardo Millán-Ramos, EPA Remedial Project Manager, and Stephen Mangion, EPA hydro-geologist. Peter Britz, CLG Landfill Project Coordinator, and Mr. Robert P. Sullivan, CLG Executive Committee Chairman were present at the time of the inspection. During the inspection, the integrity of the landfill cap and surface drainage system was evaluated. The condition of the landfill gas venting and monitoring system, groundwater monitoring wells and the perimeter fence were also observed. Warning signs were posted, however extensive damage to the fence was observed and some of the monitoring wells were found unlocked. Observations and recommendations were made on-site at the time of the inspection; most notable was the presence of construction equipment and materials extremely close to the southwestern corner of the fence. On May 24, 2011 EPA sent letters to the owners of the properties where these materials and equipment were observed, requiring them to coordinate their relocation with the CLG and EPA. See **Appendix E** for photos documenting Site conditions and **Appendix F** for the inspection checklist.

6.6 Interviews

Gerardo Millán-Ramos interviewed the CLG Landfil Project Coordinator, the NHDES Project Manager, and an adjacent business owner. During the interview with the adjacent business owner, he indicated his interest in using groundwater for irrigation purposes. EPA cautioned him against such use given the potential for that action to change the groundwater flow in the area. Altering the groundwater flow could likely cause complications by expanding the extent of the groundwater contamination and increasing costs. There are currently no recorded groundwater use restrictions on his property. Further evaluation is necessary to determine whether additional groundwater restrictions on properties east of the landfill are necessary.

Both the CLG Landfill Project Coodinator and the NHDES project manager raised concerns about the presence of 1,4-Dioaxane within the GMZ. A report of those interviews can be found in **Appendix D**.

7.0 TECHNICAL ASSESSMENT

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

Yes. A review of all available documents, applicable or relevant and appropriate requirements (ARARs), risk assumptions and the results of the Site inspections indicates that the remedy is functioning as intended. Even though the concentration of some metals and VOCs in leachate, sediment, and surface water samples exceeded the NH standards during the past five years, toxicity tests using the worst case scenario have demonstrated these concentrations pose no significant risk to the ecosystem. Sporadic exceedances to the NH landfill gas standard for methane have been observed at some of the landfill gas monitoring probes, however, no methane has been detected by the methane alarms installed at any of the residential and commercial buildings being monitored. Although a number of wells have shown elevated levels of metals, tetrahydrofuran and most recently, 1,4-Dioxane, the vast majority of these wells are within the established GMZ. The exceptions are two wells: FPC-2A/B, and GZ-123 which showed levels of manganese exceeding the 300 ppb health advisory, but not exceeding the NH AGQS for manganese of 840 ppb. In addition, public water is provided to all potential drinking water users in the immediate area of the landfill, thus no one is exposed to the groundwater. While natural attenuation processes are occurring at the Site, additional analysis is required to determine whether the current GMZ needs to be expanded and ICs need to be established on additional properties. Because COCs within, and potentially beyond the GMZ, still exceed state and federal cleanup levels, and are expected to remain above these levels for the foreseeable future, the GMP, currently set to expire on June 18, 2013, must be renewed, prior to that date. Finally, changes to the ICP were made at the time the GMZ was being discussed and implemented and these changes need to be incorporated into the Final ICP.

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

Yes. There have been no changes in land use at and surrounding the Site which would change the exposure assumptions contained in the RODs or affect the protectiveness of the remedy. No new sources or exposure pathways were identified during this five-year review. A new COC (tetrahydrofuran) was identified. This was documented in the July 1, 1999 ESD for OU-1.

Several annual monitoring reports have indicated four wells (MW-8, GZ-105, AE-2A, and AE-2B) contaminated with tetrahydrofuran in concentrations which exceed the NH AGQS of 154 (ug/l). Presently, there are no federal drinking water standards for tetrahydrofuran. Nonetheless, these detections do not require a change in the selected remedy, nor do they impact the overall protectiveness of the remedy, as they have all occurred in monitoring wells located within the GMZ, and no one is exposed to the groundwater.

There have been no changes in toxicity factors that would affect the risk calculated for the Site, or significant enough to require a change in the selected remedy. An Addendum to the Second Five Year Review Report was finalized on July 29, 2009, documenting that there is no significant ecological risk associated with surface water and sediment at the Site. Two ESDs were finalized on September 28, 2007, and July 1, 2009, to include revised and additional standards (i.e. a more stringent MCL for arsenic from 50 ug/L to 10 ug/L, and a less stringent health advisory for manganese from 180 ug/l to 300 ug/l). These changes will not affect the risk calculated at the Site; however, the revised manganese cleanup level for groundwater may require a revision to the size of the existing GMZ.

A Project Operations Plan (POP) is currently in place which requires annual groundwater, leachate, and surface water monitoring. Additionally, sediment monitoring is required every five years. A landfill gas (LFG) monitoring plan is also in place which requires quarterly monitoring at several locations. These monitoring events continue to provide the necessary data to ensure that the cleanup levels and remedial action objectives (RAOs) are still valid at the Site. The updated POP was established on May 10, 2010, and contains an Environmental Monitoring Plan (EMP), a Quality Assurance Project Plan (QAPP), a Health and Safety Plan, and a Methane

Monitoring Plan. The EMP describes how the extent of migration of the contaminated groundwater and other potentially affected media (surface water and sediments) will be monitored, and how the natural attenuation of the contamination will be tracked. It outlines the methods and procedures that will be used to demonstrate conformance and compliance with ICLs.

All chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBCs) criteria were reviewed for changes that could affect protectiveness and no changes were found. See **Appendix L** for a complete list including legal references, a synopsis of the requirements and the actions to be taken. Data provided and analyzed indicate no change in Site conditions which would warrant a re-evaluation of risk, except for additional data collection and analysis that is required to determine whether the current GMZ adequately includes the entire area of groundwater contamination attributable to the Site.

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

Yes. Although no newly identified human health risks have been identified to date, the implementation of recent (2008) changes in the NHDES sampling requirements for this Site (See **Appendix M** for a copy of the NHDES letter describing the changes) have revealed the presence of 1,4-Dioxane at most wells in the periphery of OU-1, several wells within OU-2, and in sediment samples. The concentrations of 1,4-Dioxane detected above the NHDES AGQS (3 ug/L) in the monitoring wells ranges from 6 to 310 ug/L, and in the sediment samples from 20 to 26 ug/L. The CLG has recommended that the extent of the impact and the temporal trends be evaluated by monitoring 5 additional wells (MW-6, FPC-5A, FPC-7A, AE-1A, and AE-1B) added to the 15 wells currently sampled for 1,4-dioxane (MW-4, MW-5S, MW-5D, MW-8, MW-9, MW-11, BP-4, OP-2, OP-5, FPC-8A, FPC-8B, AE-2A, AE-2B, AE-3A, and AE-3B). EPA and NHDES have agreed in principle with this recommendation and will be further evaluating this recommendation plus the appropriateness of additional measures, to determine whether the area of the existing GMZ needs to be revised. An ICL has not been established for 1,4-Dioxane at this site; however, a decision document will be issued to add 1,4-Dioxane to the site COCs and to establish an ICL.

Two of the property owners adjacent to the east side of the landfill expressed interest in using an existing well in their property for irrigation purposes. EPA, NHDES, and the CLG met with these two property owners to dissuade them from such idea. While preparing for this meeting it became evident that their lot and many others at this area (east of the landfill) do not have recorded groundwater use restrictions in place. Groundwater extraction in this area has the potential to alter the flow of groundwater and increase the extent of the plume, thus adding complexities and time to the ongoing remedy. Thus the possibility of instituting such restrictions via a City ordinance will be explored.

No other information has come to light which could affect the protectiveness of the remedy.

7.4 Technical Assessment Summary

According to the data reviewed, the Site inspections and interviews conducted, the remedy is functioning as intended by the existing RODs and ESDs, except additional information and analysis is required to better determine the extent of the groundwater contamination and whether an adjustment of the GMZ boundaries is necessary. Institutional controls have been implemented to restrict use of the landfill-impacted groundwater surrounding the Site. Continued monitoring is required to ensure that methane emissions are compliant, that the boundaries of the GMZ are adequate and that potential surface water-sediment exposures do not pose unacceptable risks in the future.

8.0 ISSUES

The following issues were identified as a result of the Five-Year Review:

Table 5: Issues

ISSUES	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
Even though no one within the Groundwater Management Zone (GMZ) and its immediate vicinity is exposed to the groundwater, 1,4-Dioxane has been detected at levels exceeding the New Hampshire Ambient Groundwater Quality Standards (NHAGQS) at most monitoring wells within OU-1 and several within OU-2. Additionally, manganese has been detected outside the current GMZ (wells GZ-123 and FPC-2A/B outside the southern edge of the GMZ) above the EPA Health Advisory, and both manganese and arsenic concentrations in the FPC-6 well cluster (inside the eastern edge of the GMZ) suggest that concentrations may exceed the Interim Compliance Levels (ICLs) beyond the GMZ boundary.	N	Y
Damage to the fence must be repaired; unlocked monitoring wells and gates must be locked and properly labeled; excessive vegetation in some swales and near the fence must be removed; also construction equipment and materials that are too close to the fence and monitoring wells, must be relocated.	N	Y

There is a possible need for groundwater extraction restrictions for properties on the eastern side of the landfill. Groundwater extraction in this area has the potential to alter the flow of groundwater and increase the extent of the plume, thus adding complexities and time to the ongoing remedy.	N	Y
Changes to the Institutional Control Plan were made at the time the GMZ was being discussed and implemented. However, these changes have not been incorporated into the Final Institutional Control Plan that was approved by EPA.	N	Y
Groundwater Management Permit will expire on June 18, 2013. Site contaminants within the GMZ continue to exceed state and federal cleanup levels. Exceedences outside GMZ suggest that concentrations may also exceed ICLs beyond the GMZ boundary.	N	Y

9.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

The following recommendations have been made based on the data review for the Site.

Table 6: Recommendations and Follow-up Actions

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
Even though no one within the Groundwater Management Zone (GMZ) and its immediate vicinity is exposed to the groundwater, 1,4-Dioxane has been detected at levels exceeding the New Hampshire Ambient Groundwater Quality Standards (NHAGQS) at most monitoring wells within OU-1 and several within OU-2. Additionally, manganese has been detected outside the current GMZ (wells GZ-123 and FPC-2A/B outside the southern edge of the GMZ) above the EPA Health Advisory, and both manganese and arsenic concentrations in the FPC-6 well cluster (inside the eastern edge of the GMZ) suggest that concentrations may exceed the Interim Compliance Levels (ICLs) beyond the GMZ boundary.	a) Sample monitoring wells at the outermost edge of the GMZ and the two residential wells for 1,4 –Dioxane for the next two rounds.	CLG	EPA and NHDES	August 2013	N	Y
	b) Perform additional analysis to determine whether the site contaminants are moving beyond the edge of the GMZ and whether the current GMZ needs to be expanded and Institutional Controls (ICs) need to be established on additional properties and evaluate the need for further response action.	CLG	EPA and NHDES	August 2013	N	Y
	c) Prepare an Explanation of Significant Differences (ESD) to add 1,4-Dioxane as a COC with an ICL.	EPA	EPA and NHDES	August 2013	N	Y

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
Damage to the fence must be repaired; unlocked monitoring wells and gates must be locked and properly labeled; excessive vegetation in some swales and near the fence must be removed; also construction equipment and materials that are too close to the fence and monitoring wells, must be relocated.	Perform the necessary repairs to the fence, and lock / properly label all monitoring wells that were lacking these features at the time of the inspection. Also remove excessive vegetation and relocate the construction equipment and materials to a safe distance from the fence. Coordinate and document this activity with the regulatory agencies and the CLG.	CLG, Town of North Hampton, abutting property owner	EPA and NHDES	November 2011	N	Y
There is a possible need for groundwater extraction restrictions for properties on the eastern side of the landfill. Groundwater extraction in this area has the potential to alter the flow of groundwater and increase the extent of the plume, thus adding complexities and time to the ongoing remedy.	Evaluate the need for further ICs in the area east of the landfill to prevent altering of groundwater flow as a means of containing the contaminated groundwater plume.	CLG	EPA & NHDES	September 2013	N	Y
Changes to the Institutional Control Plan were made at the time the GMZ was being discussed and implemented. However, these changes have not been incorporated into the Final Institutional Control Plan that was approved by EPA.	Update the Final Institutional Control Plan to incorporate changes that were made to the follow-up requirements for ICs.	CLG	EPA & NHDES	March 2012	N	Y

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
Groundwater Management Permit will expire on June 18, 2013. Site contaminants within the GMZ continue to exceed state and federal cleanup levels. Exceedences outside GMZ suggest that concentrations may also exceed ICLs beyond the GMZ boundary.	Renew GMP for GMZ and potentially expand boundary if additional tests show site contaminants migrating beyond the current GMZ boundary.	CLG	EPA & NHDES	June 2013	N	Y

10.0 PROTECTIVENESS STATEMENTS

OU-1

The remedy at OU-1 currently protects human health and the environment, both in the short and long term. Also, the landfill gas monitoring program will remain in place. All human health threats at the Site have been addressed through stabilization and capping of the landfill and the landfill cap is functioning as intended. Installation of fencing and warning signs and deed restrictions are preventing human exposures at the capped landfill. Toxicity tests that were

applied to a "worst case scenario" in the sediment samples, revealed no significant ecological impact, and EPA concluded that it is likely there are no significant ecological impacts in surface water and sediment at the Site. In order to ensure that the currently non-toxic concentrations are not increasing significantly, a reduced surface water and sediment monitoring effort will remain in place. Also, the landfill gas monitoring program will remain in place.

OU-2

The remedy at OU-2 currently protects human health and the environment in the short-term because on-site residents are not exposed to the groundwater, as water utility service has been provided, and there is no evidence of such exposure for off-site residents. Also, a GMZ has been established via a NHDES GMP, and ICs have been established for all properties within the GMZ. Groundwater monitoring to determine compliance with the groundwater monitoring standards for the landfill will continue to be conducted as a component of OU-2. Long-term protectiveness will be achieved when interim groundwater cleanup levels for all contaminants of concern are met.

Site-Wide

Overall, the remedy at the Coakley Landfill Superfund Site currently protects human health and the environment in the short-term. Long-term protectiveness has been achieved already in OU-l based on the maintenance of the landfill cap, long-term monitoring, and use restrictions. Long-term protectiveness will be achieved in OU-2 when interim groundwater cleanup levels for all contaminants of concern are met and restrictions on the use of groundwater within OU-2 can be removed. Monitoring of the Site will continue until cleanup levels for the contaminants of concern are met.

11.0 NEXT REVIEW

The next statutory five-year review for the Coakley Landfill Superfund Site will be issued either on or prior to September 21, 2016, five years from the date of signature of this review.

APPENDIX A - REFERENCES

"Record of Decision Operable Unit 1", U.S. Environmental Protection Agency, June 28, 1990

"Record of Decision Operable Unit 2", U.S. Environmental Protection Agency, September 30, 1994

"Explanation of Significant Differences", U.S. Environmental Protection Agency, March 22, 1991

"Explanation of Significant Differences", U.S. Environmental Protection Agency, May 17, 1996

"Explanation of Significant Differences", U.S. Environmental Protection Agency, September 29, 1999

"Explanation of Significant Differences", U.S. Environmental Protection Agency, September 28, 2007

"Explanation of Significant Differences", U.S. Environmental Protection Agency, July 1, 2009

"Second Five Year Review Report", U.S. Environmental Protection Agency, September 21, 2006

"Addendum to the Second Five Year Review Report", U.S. Environmental Protection Agency, July 29, 2009

"Project Operations Plan Coakley Landfill Superfund Site North Hampton and Greenland, New Hampshire, Revision 1.0", Golder Associates Inc., April 2010

"Initial Data Analysis and Monitoring Report," Aries Engineering, Inc., September 1999

"Initial Five-Year Review Report," U.S. Environmental Protection Agency, September, 2001

"2001 Annual Monitoring Report," Aries Engineering, Inc., July 2001

"2002 Annual Monitoring Report," Aries Engineering, Inc., March, 2003

"2003 Annual Monitoring Report", Aries Engineering, Inc., April, 2004

"2004 Annual Monitoring Report", Coakley Landfill Group, May, 2005

"2005 Annual Monitoring Report", Coakley Landfill Group, May, 2006

"2006 Annual Monitoring Report", Coakley Landfill Group, June 2007

"2007 Post Closure Annual Monitoring Report", Provan & Lorber Inc., July 7, 2008

"2008 Post Closure Annual Monitoring Report", Provan & Lorber Inc., February 3, 2009

"2009 Post Closure Annual Monitoring Report", Provan & Lorber Inc., December 8, 2009

"2010 Post Closure Annual Monitoring Report", Provan & Lorber Inc., April 25, 2011

"Methane Soil Gas Survey Work plan," Golder Associates Inc., January, 2006

"Landfill Gas Monitoring Results," Aries Engineering, Inc., February, 2006

"March 2006 Landfill Gas Monitoring Results," Aries Engineering, Inc., April 12, 2006

"June 2006 Landfill Gas Monitoring Results," Aries Engineering, Inc., July 25, 2006

"September 2006 Landfill Gas Monitoring Results," Aries Engineering, Inc., October 20, 2006

"December 2006 Landfill Gas Monitoring Results," Aries Engineering, Inc., January 23, 2007

"March 2007 Landfill Gas Monitoring Results," Aries Engineering, Inc., May 7, 2007

"June 2007 Landfill Gas Monitoring Results," Aries Engineering, Inc., August 13, 2007

"September 2007 Landfill Gas Monitoring Results," Aries Engineering, Inc., November 5, 2007

"December 2007 Landfill Gas Monitoring Results," Aries Engineering, Inc., January 17, 2008

"June 2008 Landfill Gas Monitoring Results," Aries Engineering, Inc., September 29, 2008

"September 2008 Landfill Gas Monitoring Results," Aries Engineering, Inc., October 17, 2008

"December 2008 Landfill Gas Monitoring Results," Aries Engineering, Inc., March 25, 2009

"September 2009 Landfill Gas Monitoring Results," Aries Engineering, Inc., December 8, 2009

"December 2009 Landfill Gas Monitoring Results," Aries Engineering, Inc., February 19, 2010

"June 2010 Landfill Gas Monitoring Results," Aries Engineering, Inc., October 12, 2010

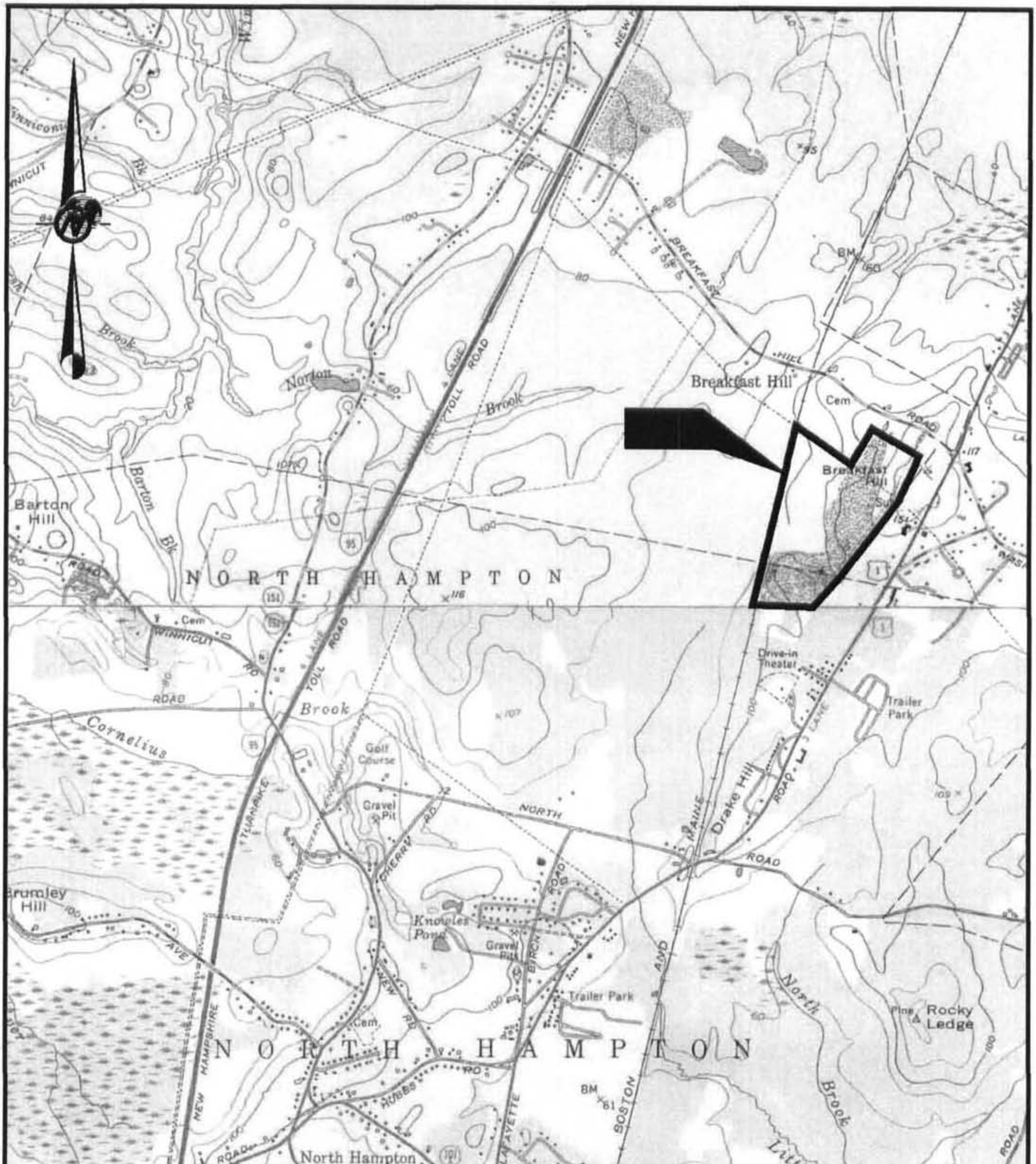
"March 2010 Landfill Gas Monitoring Results," Aries Engineering, Inc., June 21, 2010

"September 2010 Landfill Gas Monitoring Results," Aries Engineering, Inc., October 26, 2010

"February 2011 Landfill Gas Monitoring Results," Aries Engineering, Inc., February 17, 2011

"March 2011 Landfill Gas Monitoring Results," Aries Engineering, Inc., May 19, 2011

APPENDIX B – SITE MAP, SITE PLAN, AND GROUNDWATER ELEVATION CONTOUR MAPS



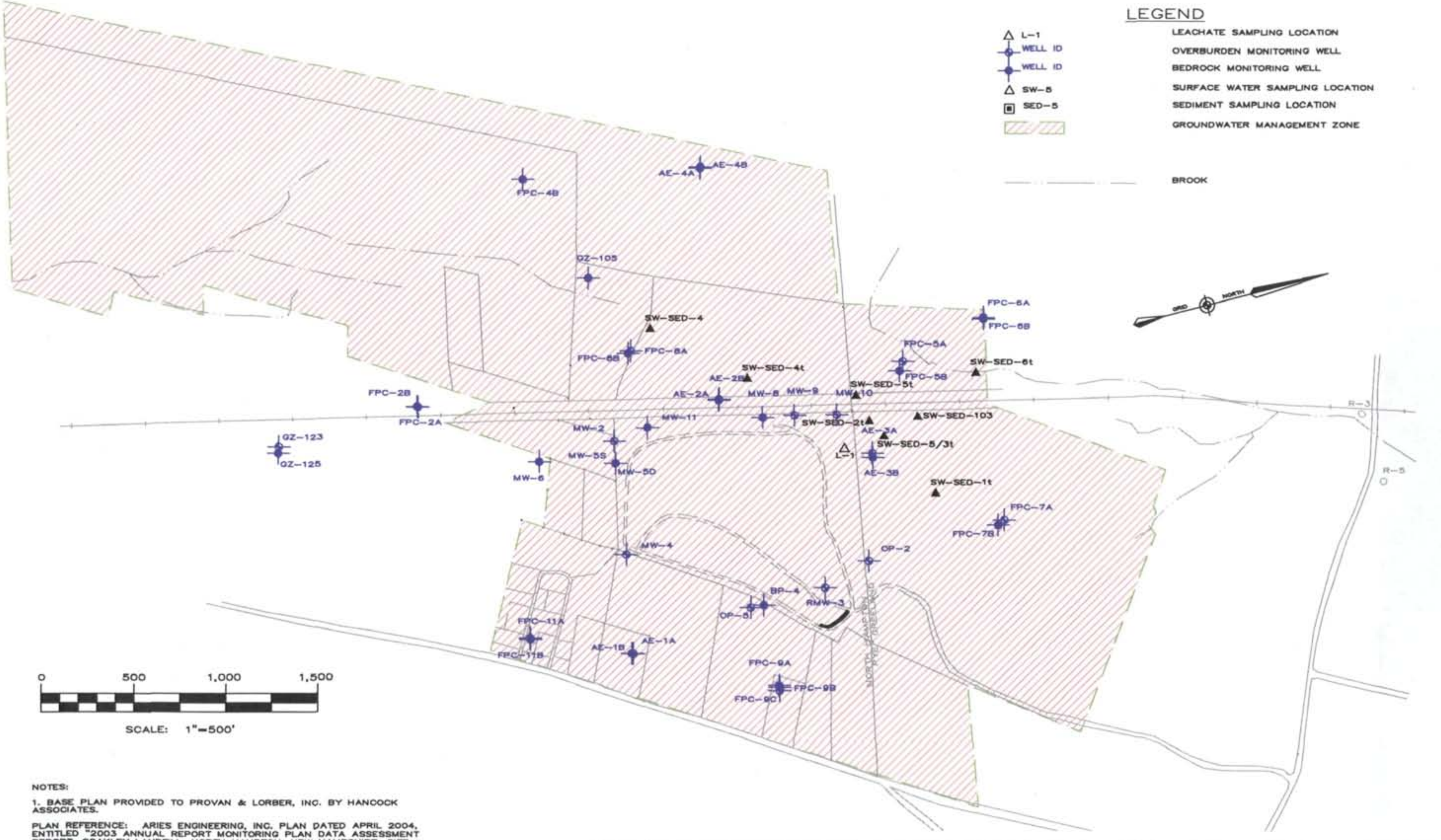
REFERENCE

1.) USGS MAP TITLED "HAMPTON, NH", 1:24,000 TOPOGRAPHIC QUADRANGLE DATED 1957 PHOTOREVISED 1973.

2000 0 2000
SCALE APPROXIMATE FEET

Golder Associates BRUNSWICK, MAINE	SCALE AS SHOWN	TITLE	
	DATE 08/16/07	SITE LOCATION PLAN	
	DESIGN ERM		
	CADD MPB		
FILE No. 0636944A002	CHECK APTM		
PROJECT No. 063-6944 REV. 0	REVIEW APTM	COAKLEY LANDFILL/HAMPTON, NH	FIGURE 1-1

Drawing file: 0636944A002.dwg Apr 07, 2010 – 2:38pm



NOTES:

1. BASE PLAN PROVIDED TO PROVAN & LORBER, INC. BY HANCOCK ASSOCIATES.

PLAN REFERENCE: ARIES ENGINEERING, INC. PLAN DATED APRIL 2004, ENTITLED "2003 ANNUAL REPORT MONITORING PLAN DATA ASSESSMENT REPORT, COAKLEY LANDFILL, NORTH HAMPTON, NEW HAMPSHIRE, SITE PLAN.

2. ADDITIONAL MONITORING WELL LOCATIONS BASED ON PLAN BY GOLDER ASSOCIATES TITLED "ENVIRONMENTAL MONITORING NETWORK" DATED 08/16/07.

3. SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS BASED ON A SEPTEMBER 2007 PLAN FROM THE CITY OF PORTSMOUTH TITLED "SEDIMENT TOXICITY SAMPLE LOCATIONS".

NO.	DATE	REVISION	ENG	DWG

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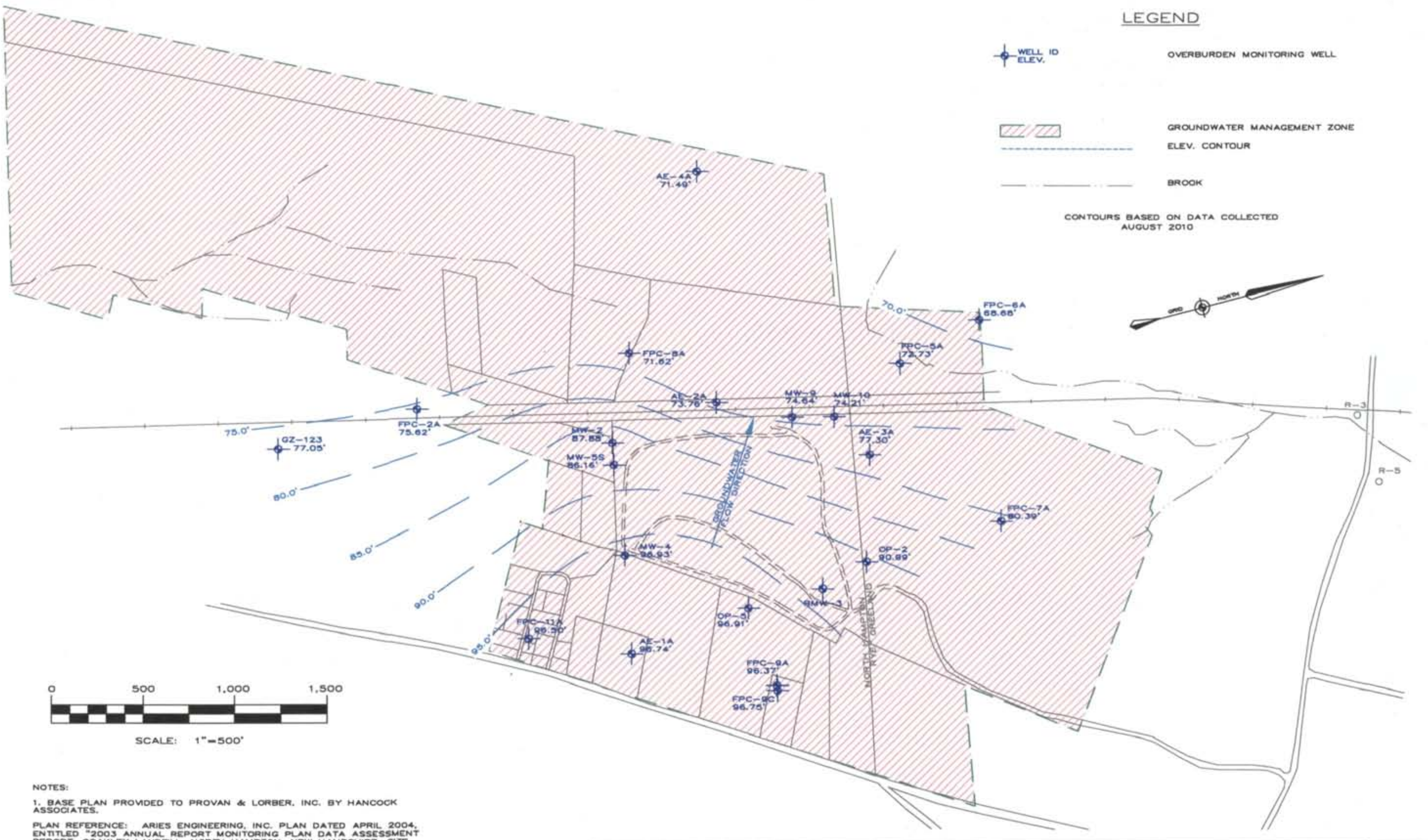
COAKLEY LANDFILL
NORTH HAMPTON, NH

SITE PLAN

DATE FEBRUARY 2011	
ENG. BY ENG	DRWN. BY DRWN
CHKD.BY KMM	PROJ. NO. P0081
FIGURE 2	



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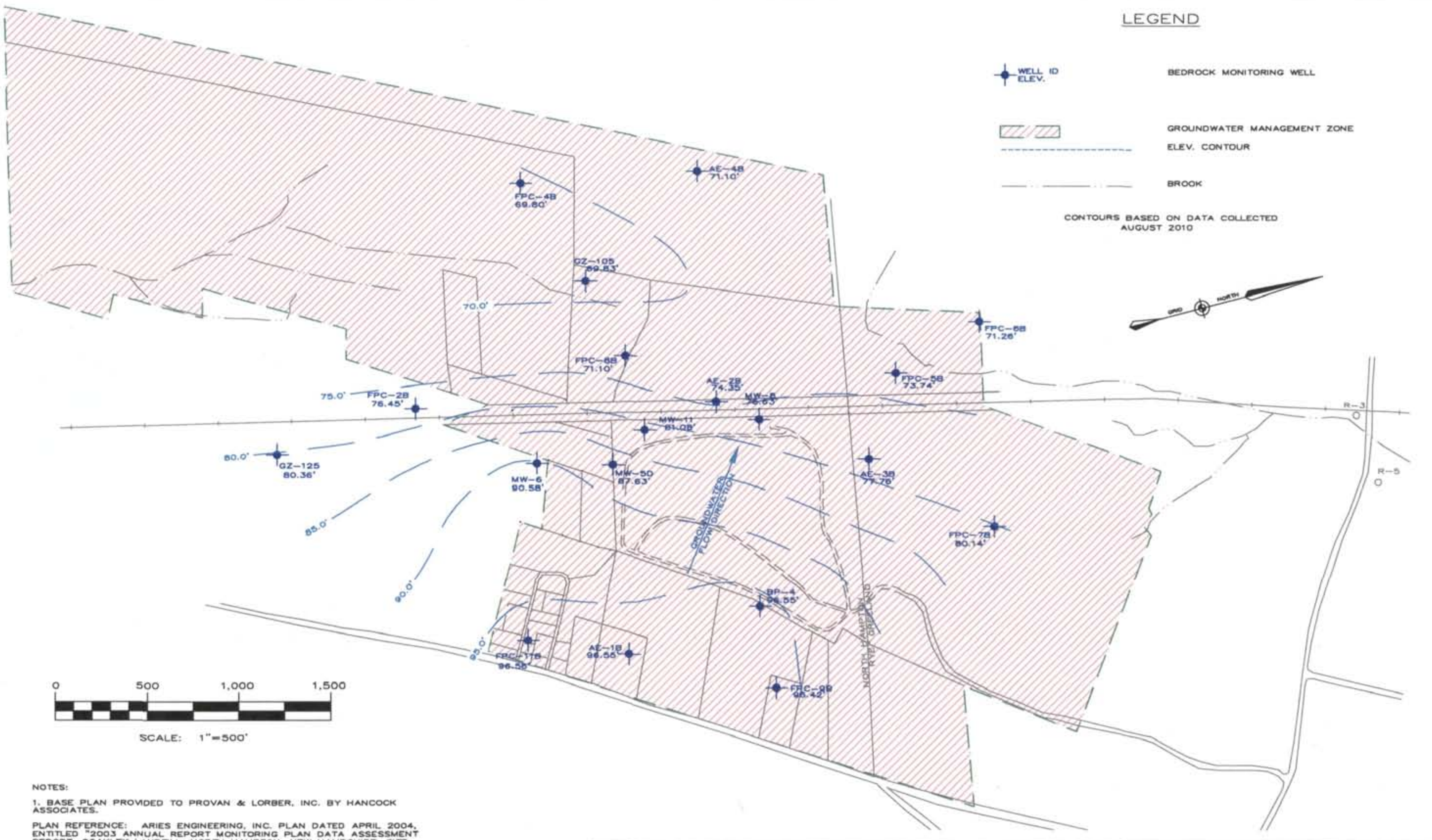
COAKLEY LANDFILL
NORTH HAMPTON, NH

OVERBURDEN GROUNDWATER
ELEVATION CONTOUR MAP
AUGUST 2010

DATE	
FEBRUARY 2011	
ENG. BY: KMM	DRWN. BY: DRWN
CHKD.BY: KMM	PROJ. NO.: P0081

FIGURE 3



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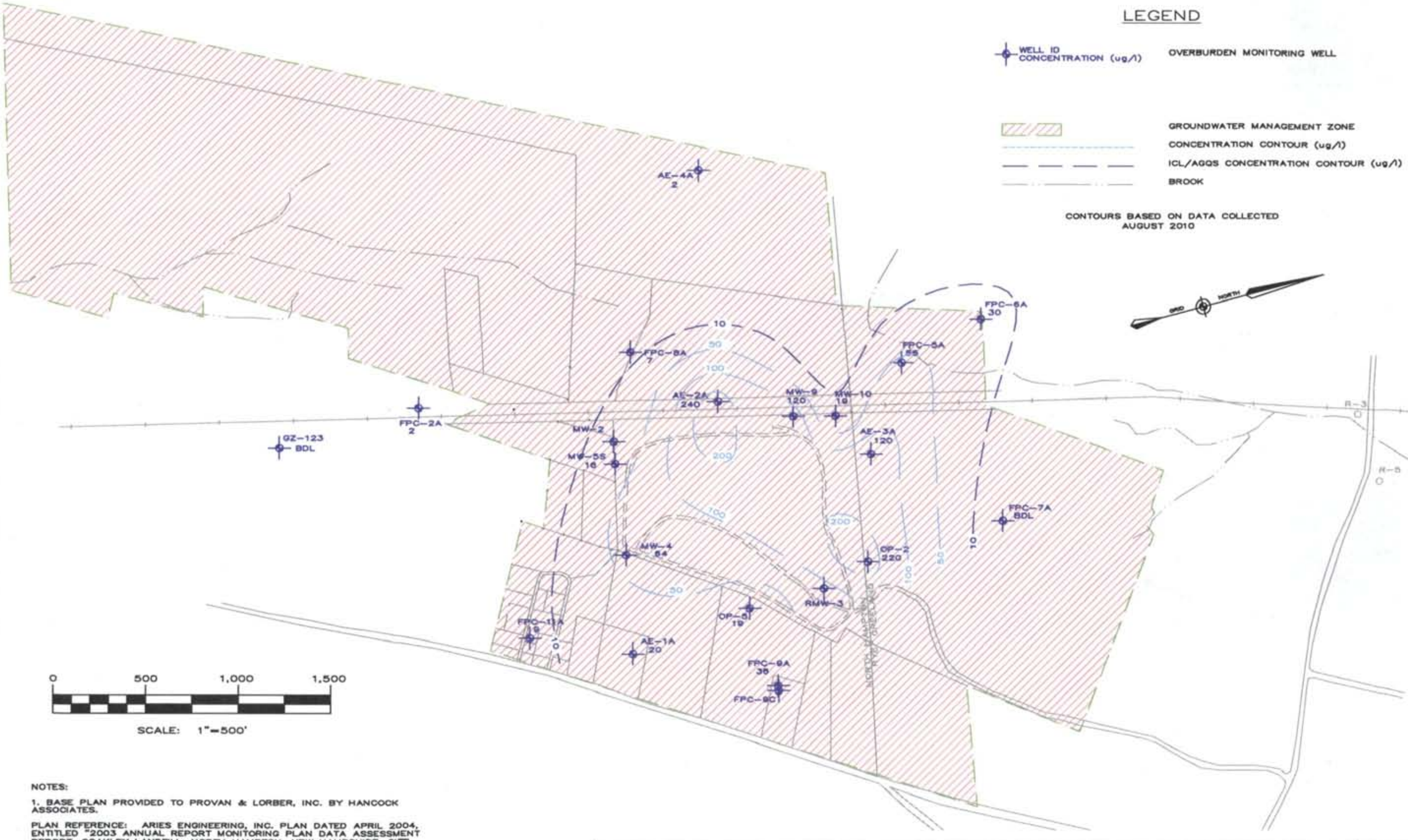
BEDROCK GROUNDWATER
ELEVATION CONTOUR MAP
AUGUST 2010

DATE	
FEBRUARY 2011	
ENG. BY KMM	DRWN. BY DRWN
CHKD.BY KMM	PROJ. NO. P0051
FIGURE 4	

APPENDIX C – ANNUAL MONITORING RESULTS



NOTES:

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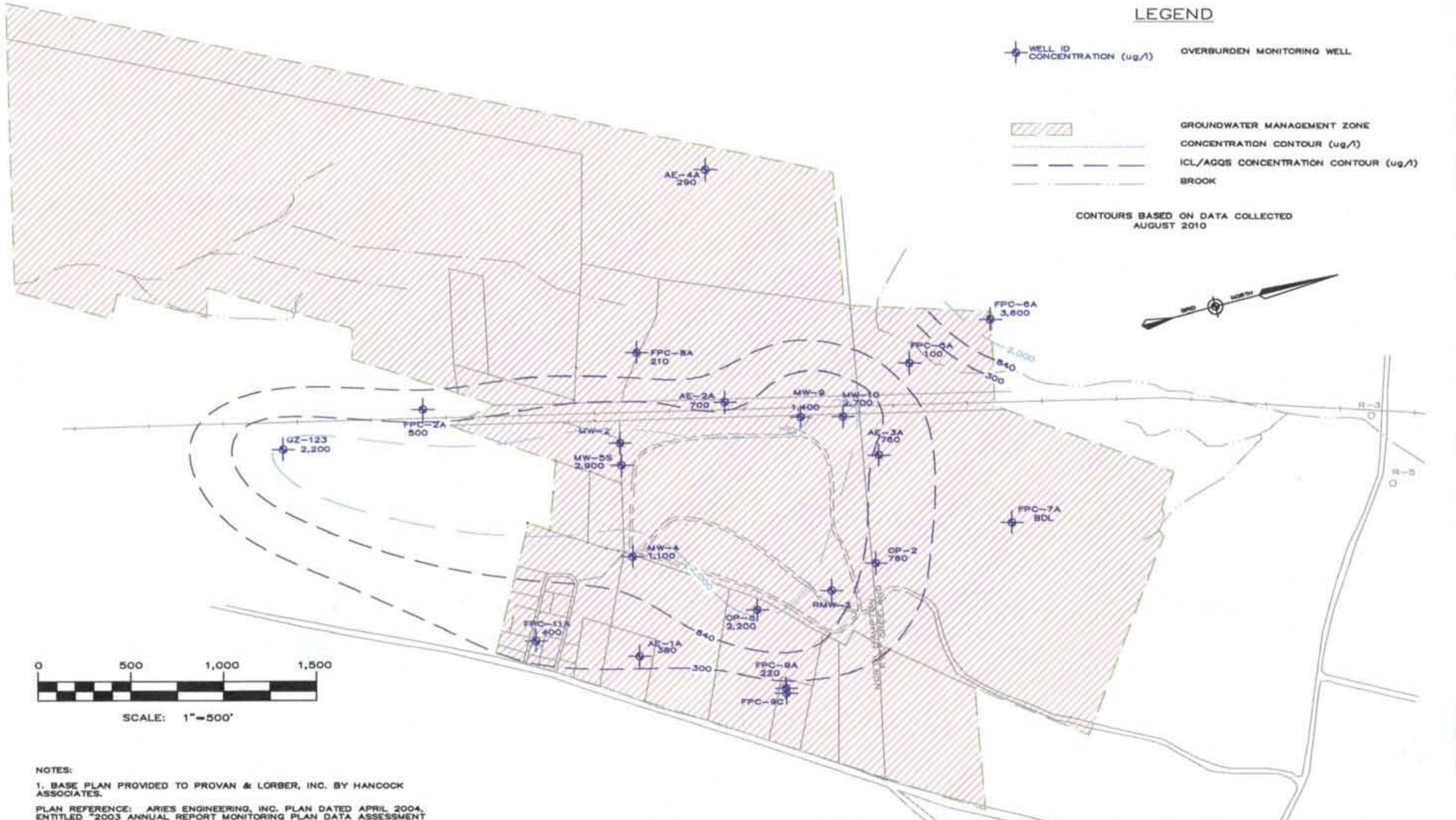
COAKLEY LANDFILL
NORTH HAMPTON, NH

ARSENIC CONCENTRATIONS
OVERBURDEN WELLS
AUGUST 2010

DATE	
FEBRUARY 2011	
ENG. BY KMM	DRWN. BY DRWN
CHKD.BY KMM	PROJ. NO. P0081
FIGURE 5	



NOTES:

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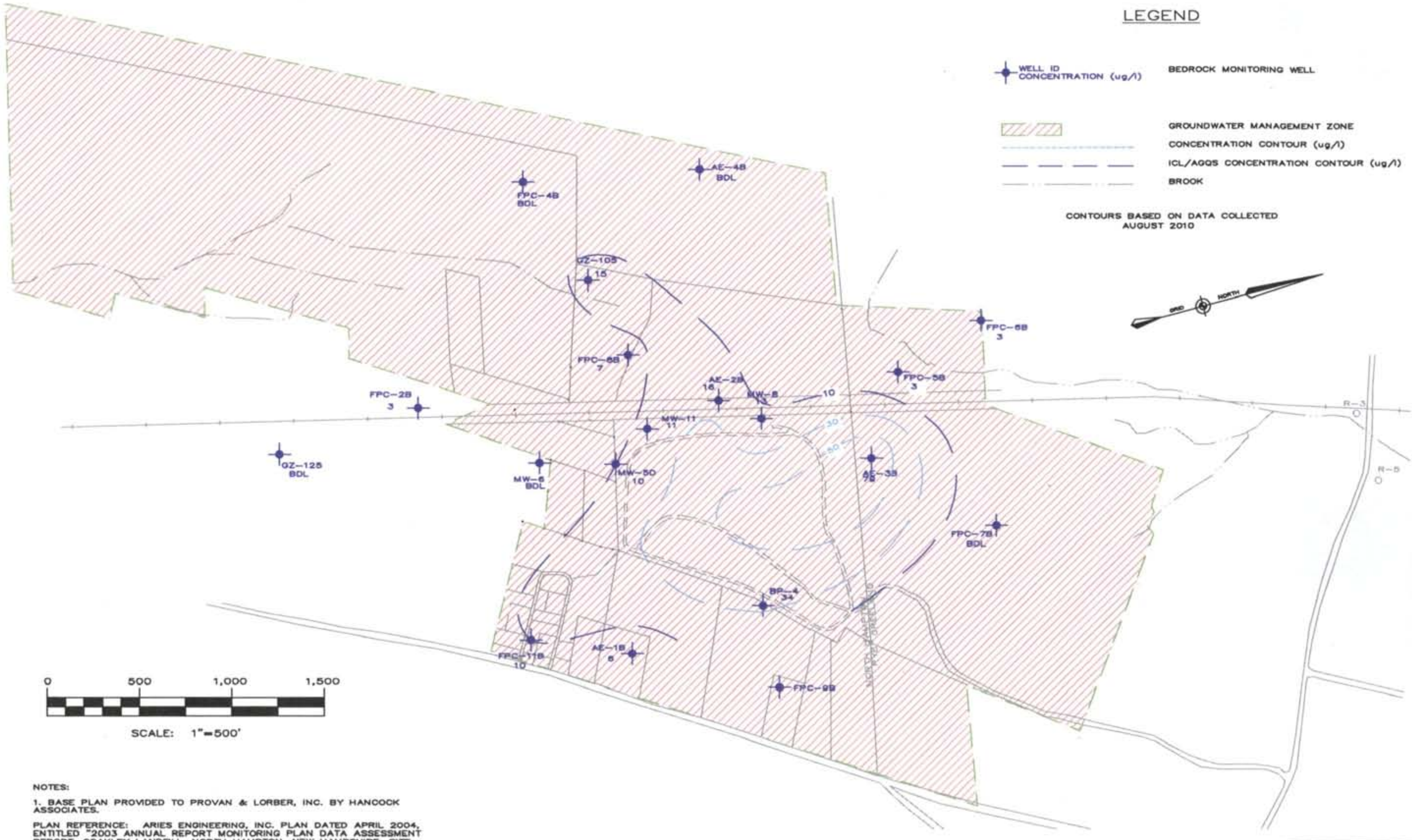
MANGANESE CONCENTRATIONS
OVERBURDEN WELLS
AUGUST 2010

DATE FEBRUARY 2011	
ENG. BY KMM	DRWN. BY DRWN
CHKD.BY KMM	PROJ. NO. P0081
FIGURE 6	



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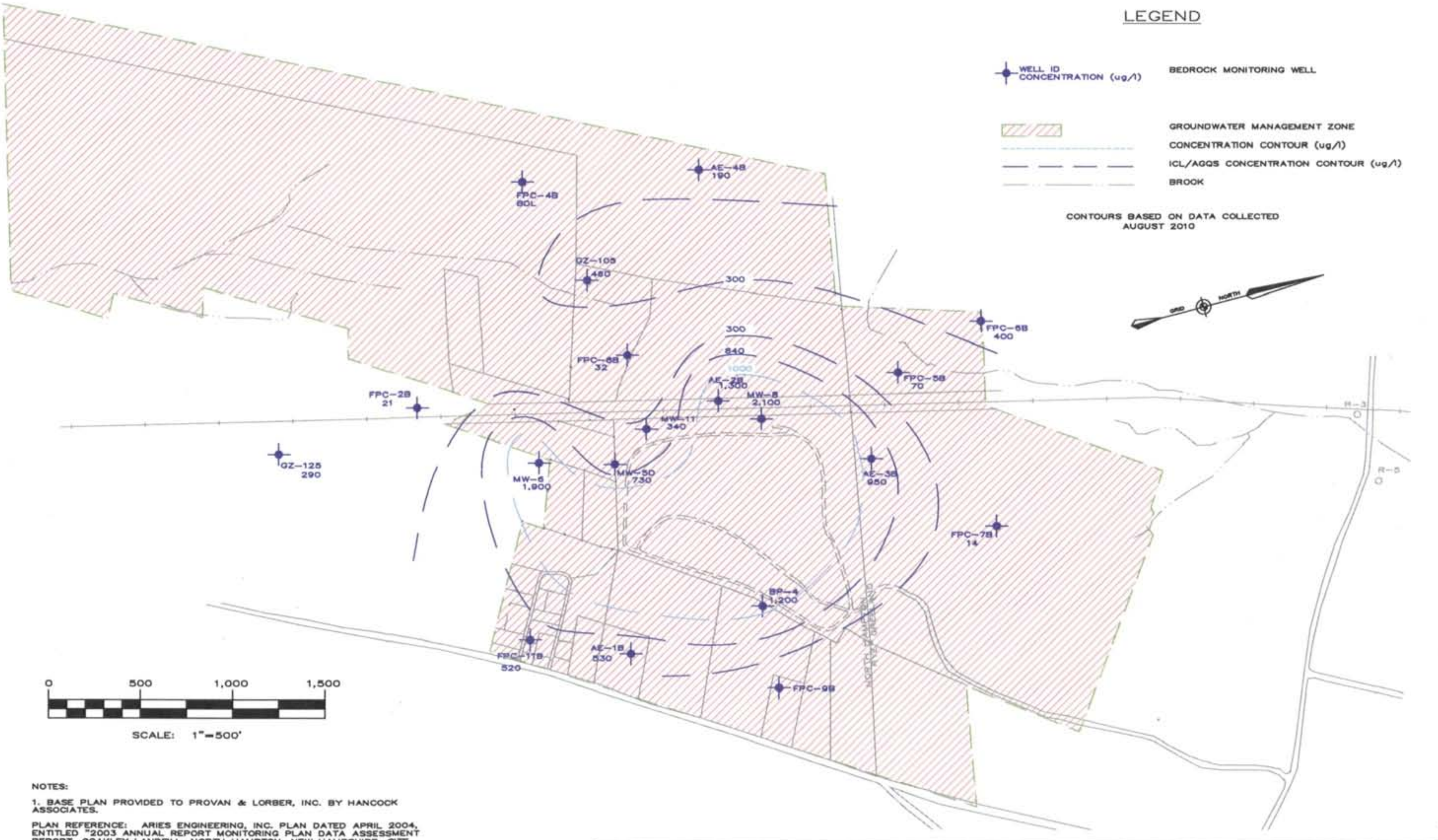
ARSENIC CONCENTRATIONS
BEDROCK WELLS
AUGUST 2010

DATE	
FEBRUARY 2011	
ENG. BY	DRWN. BY
KMM	DRWN
CHKD.BY	PROJ. NO.
KMM	P0081

FIGURE 7



SCALE: 1"=500'

LEGEND

WELL ID / CONCENTRATION (ug/l)	BEDROCK MONITORING WELL
	GROUNDWATER MANAGEMENT ZONE
	CONCENTRATION CONTOUR (ug/l)
	ICL/AGQS CONCENTRATION CONTOUR (ug/l)
	BROOK

CONTOURS BASED ON DATA COLLECTED AUGUST 2010

NOTES:

1. BASE PLAN PROVIDED TO PROVAN & LORBER, INC. BY HANCOCK ASSOCIATES.

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NO.	DATE	REVISION	ENG	DWG

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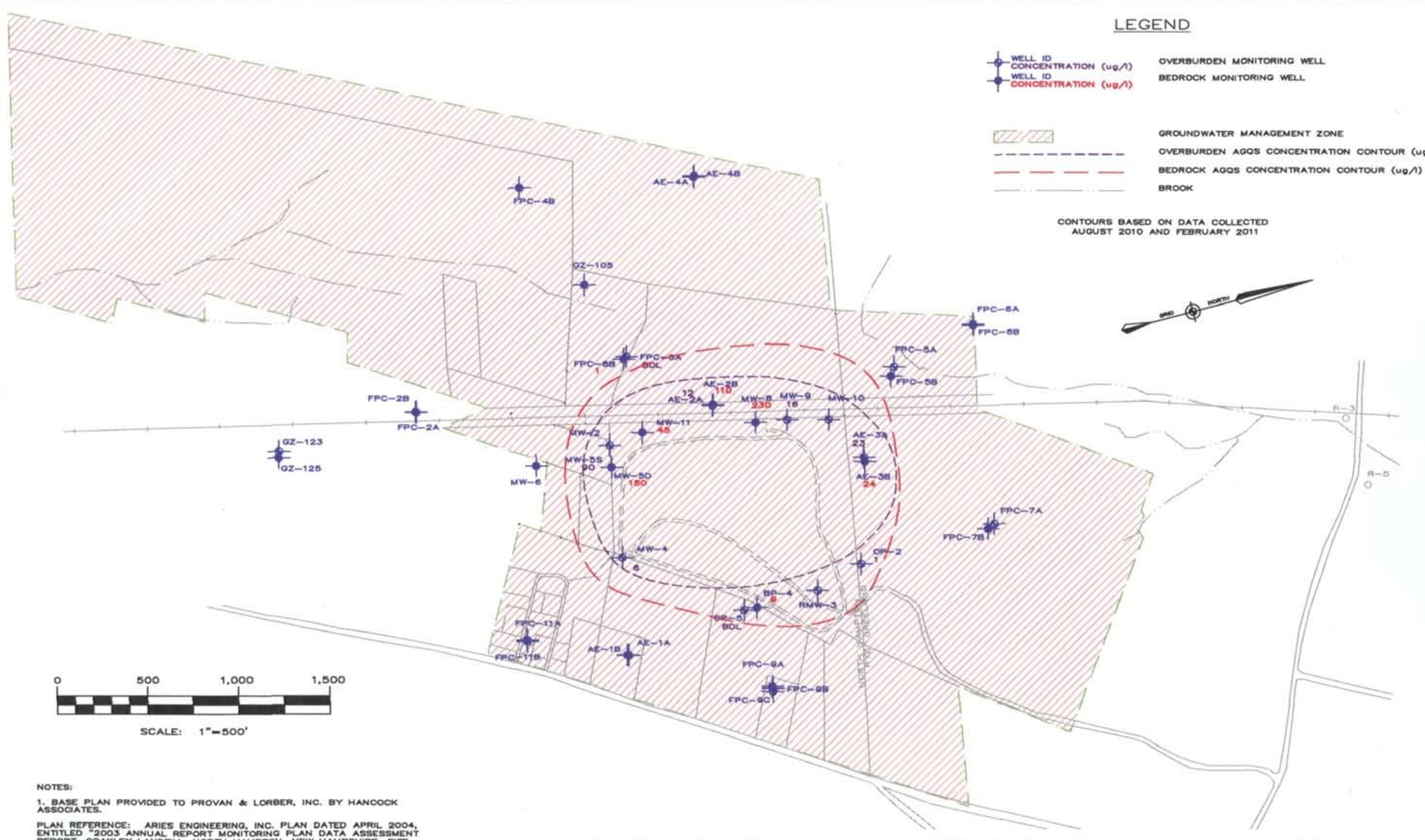
MANGANESE CONCENTRATIONS
BEDROCK WELLS
AUGUST 2010

DATE FEBRUARY 2011	
ENG. BY KMM	DRWN. BY DRWN
CHKD.BY KMM	PROJ. NO. P0081
FIGURE 8	



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NO.	DATE	REVISION	ENG	DWG

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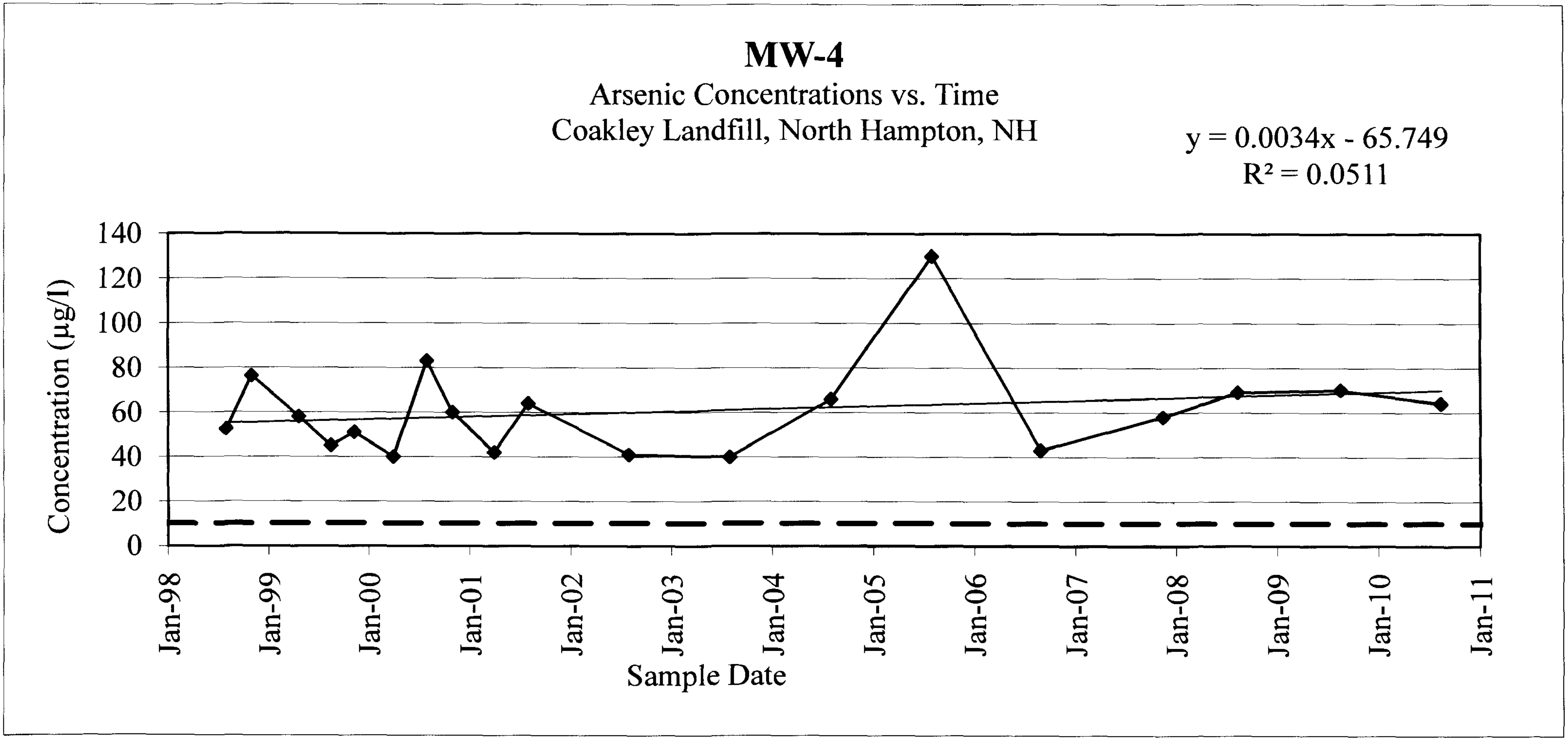
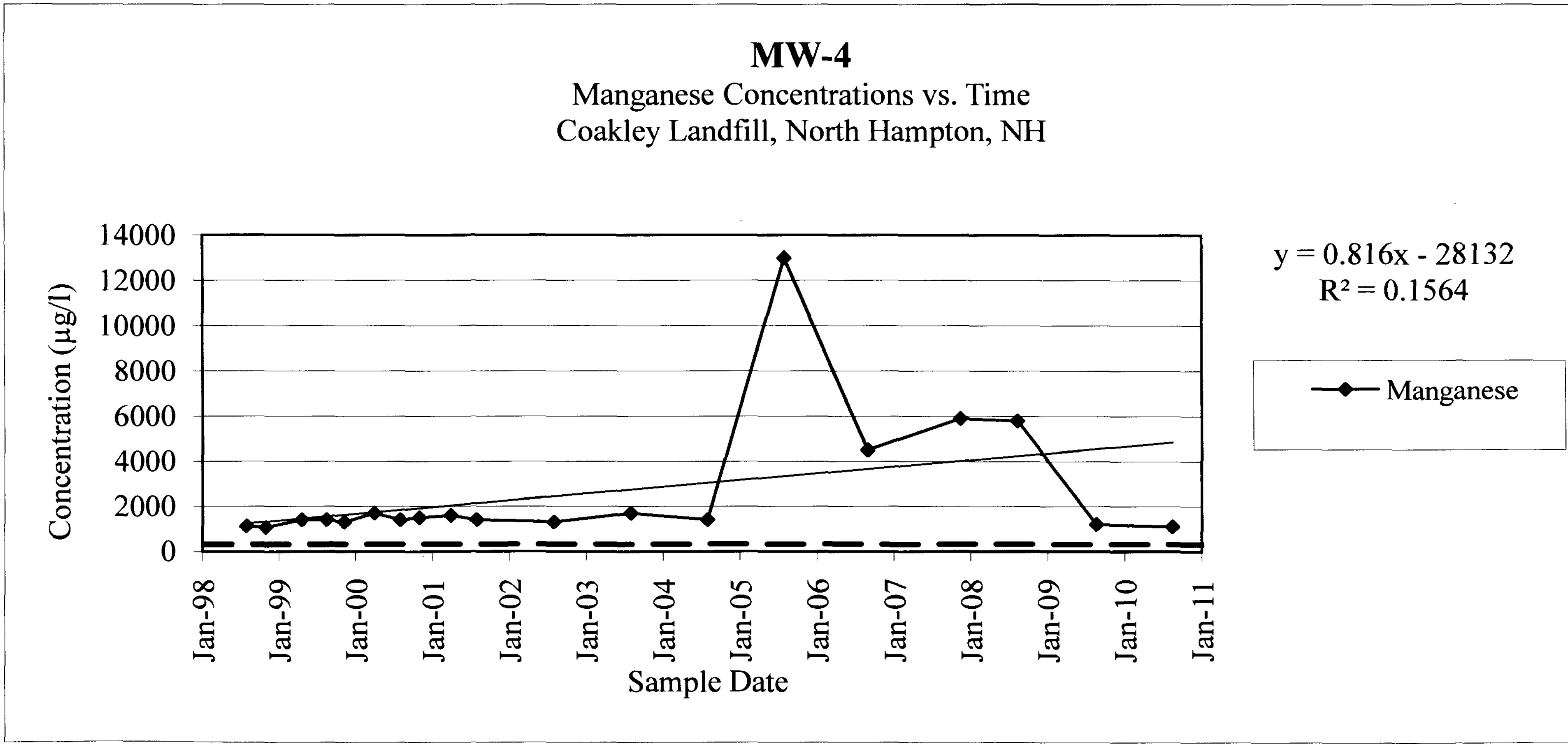
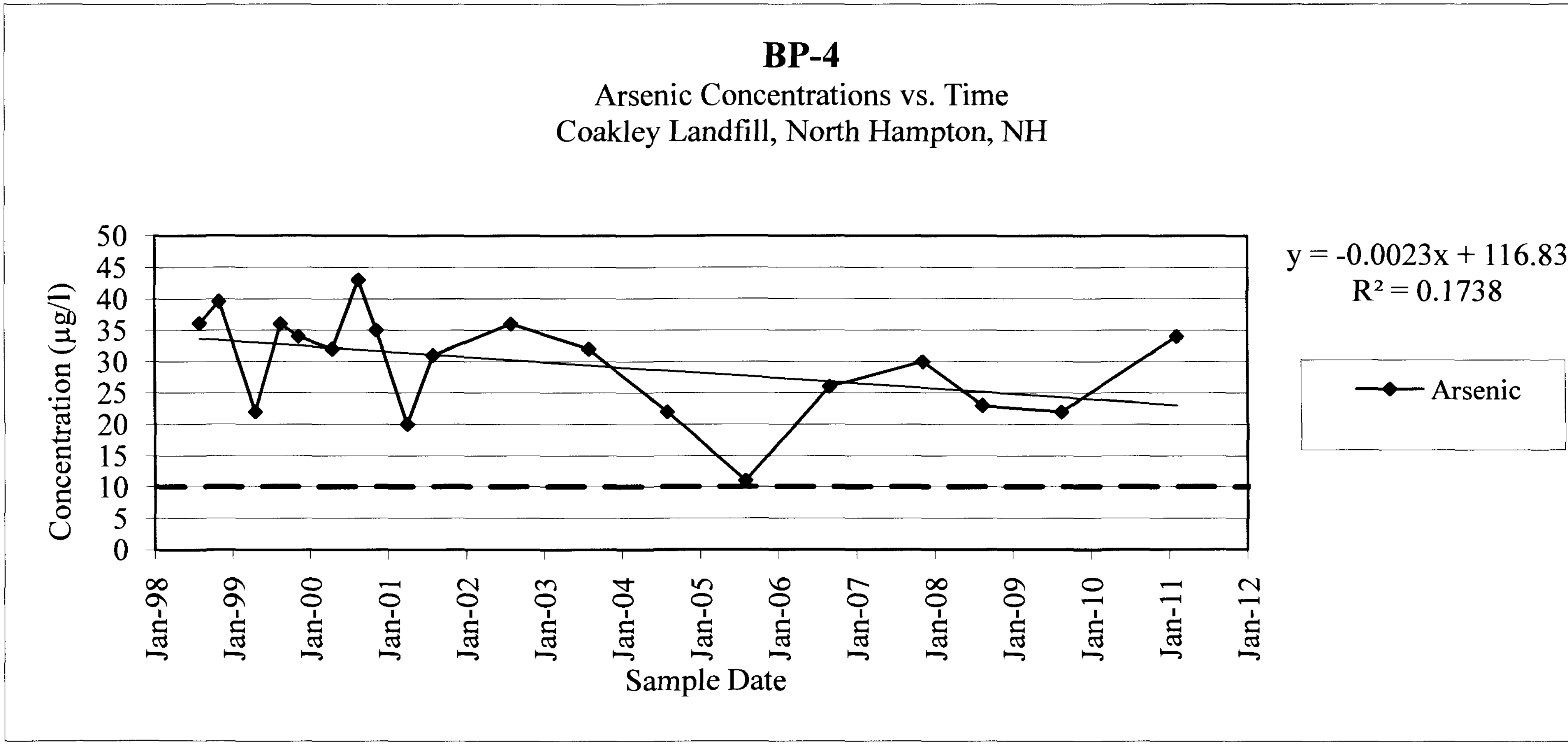
1,4-DIOXANE CONCENTRATIONS
OVERBURDEN & BEDROCK WELLS
AUGUST 2010

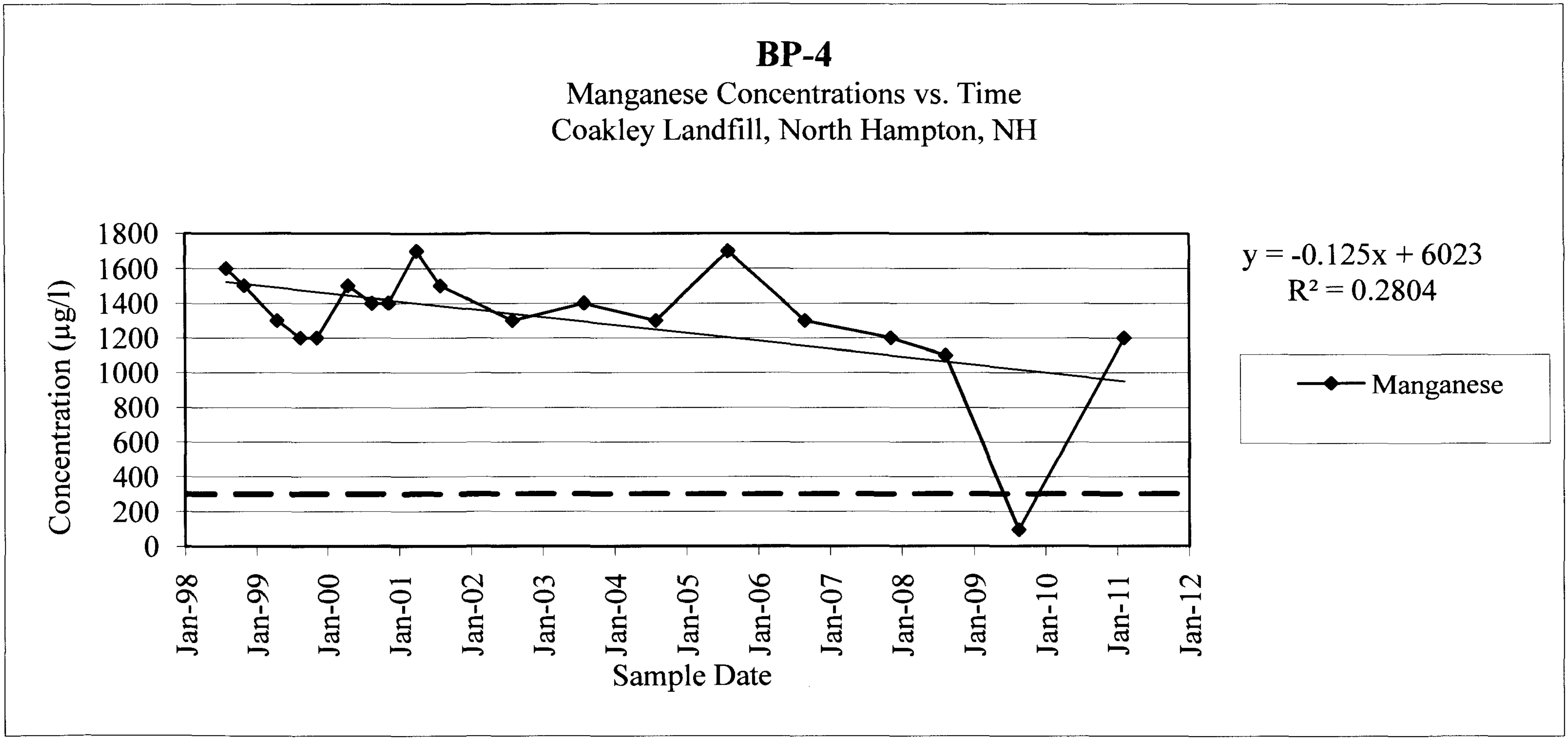
DATE FEBRUARY 2011	
ENG. BY KMM	DRWN. BY DRWN
CHKD.BY KMM	PROJ. NO. P0061
FIGURE 9	

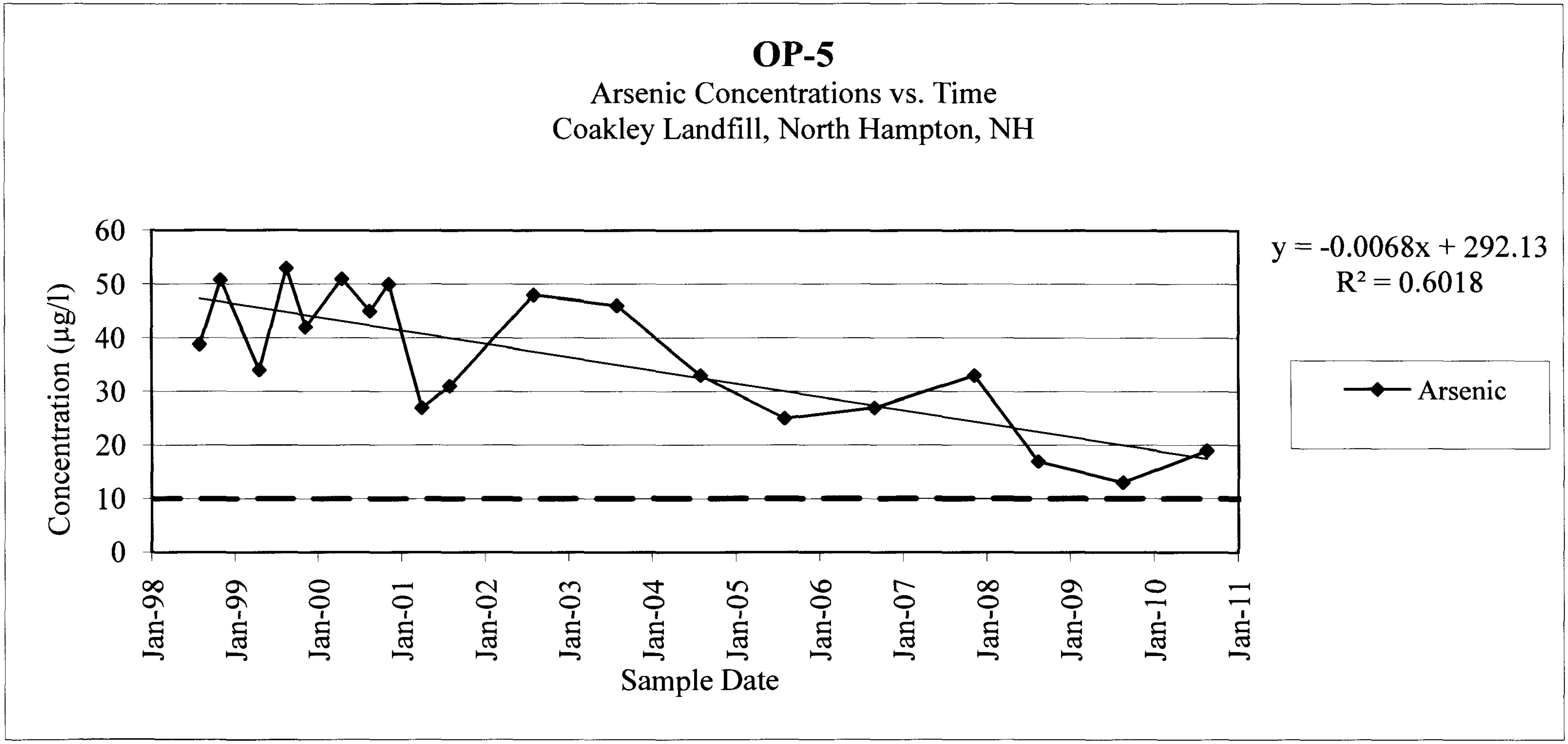

MW-4
Arsenic Concentrations vs. Time
Coakley Landfill, North Hampton, NH
y = 0.0034x - 65.749
R² = 0.0511
Concentration (µg/l)
140
120
100
80
60
40
20
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date


MW-4
Manganese Concentrations vs. Time
Coakley Landfill, North Hampton, NH
y = 0.816x - 28132
R² = 0.1564
Manganese
Concentration (µg/l)
14000
12000
10000
8000
6000
4000
2000
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date

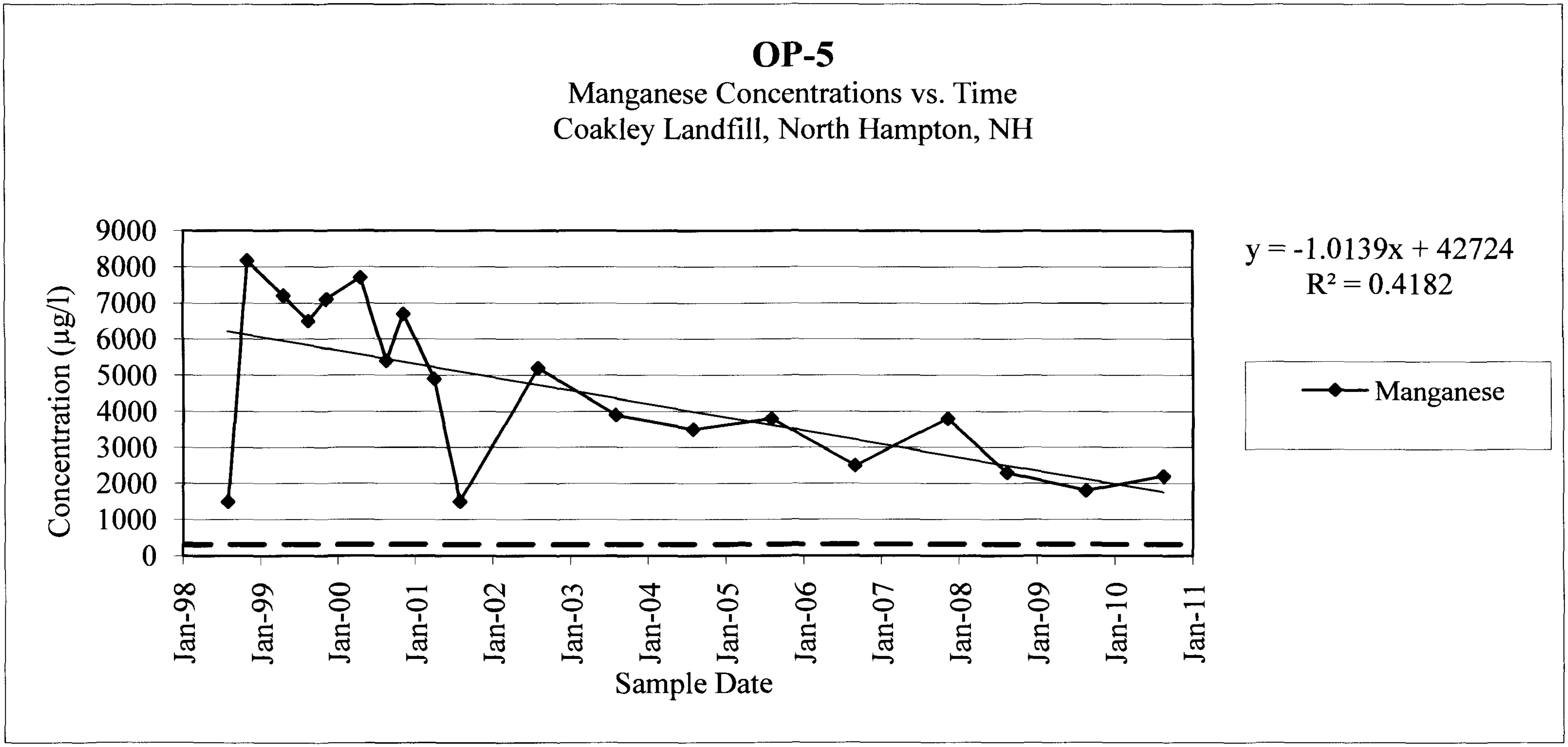


BP-4
Arsenic Concentrations vs. Time
Coakley Landfill, North Hampton, NH
y = -0.0023x + 116.83
R² = 0.1738
Arsenic
Concentration (µg/l)
50
45
40
35
30
25
20
15
10
5
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Sample Date

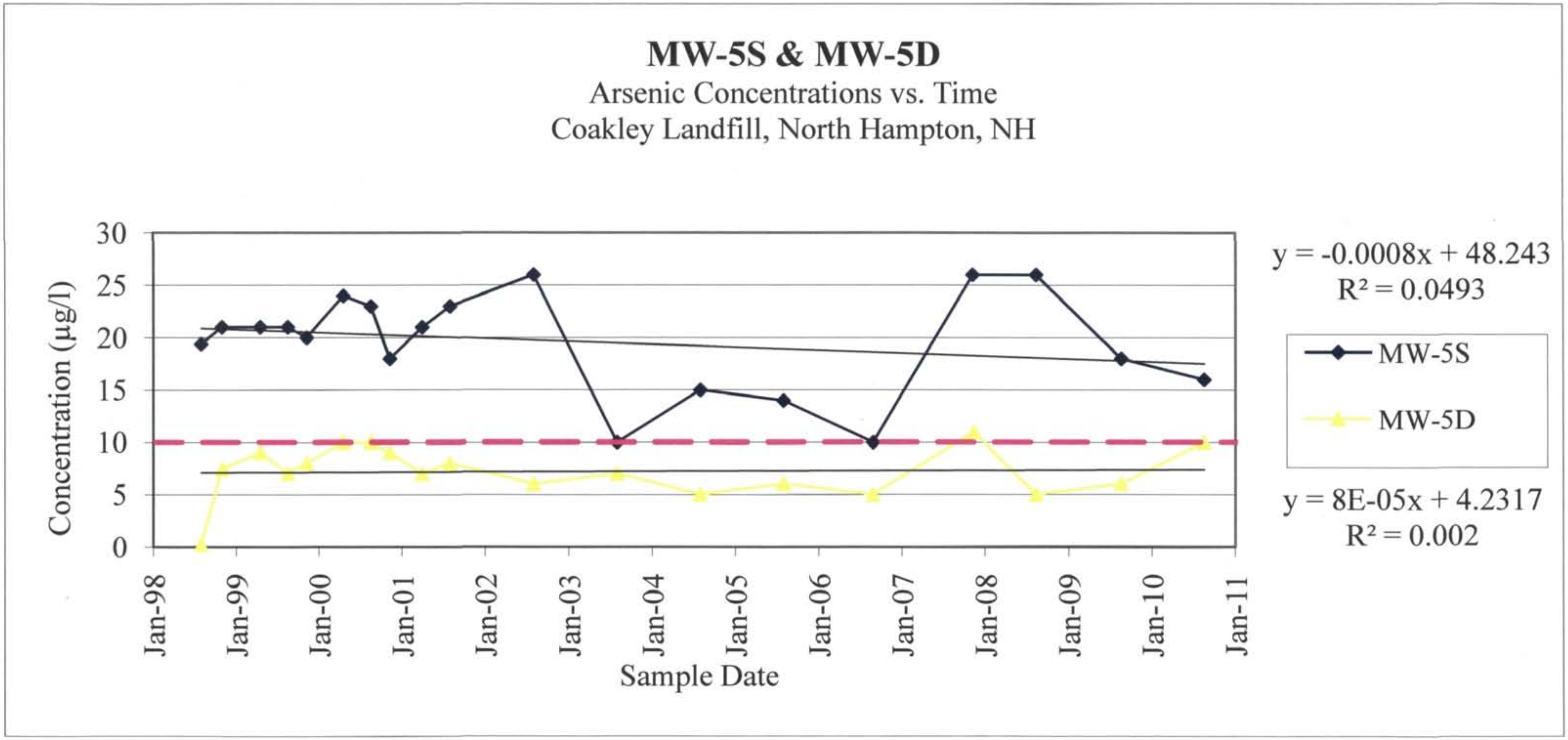

BP-4
Manganese Concentrations vs. Time
Coakley Landfill, North Hampton, NH
1800
1600
1400
1200
1000
800
600
400
200
0
Concentration (µg/l)
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Sample Date
y = -0.125x + 6023
R² = 0.2804
Manganese

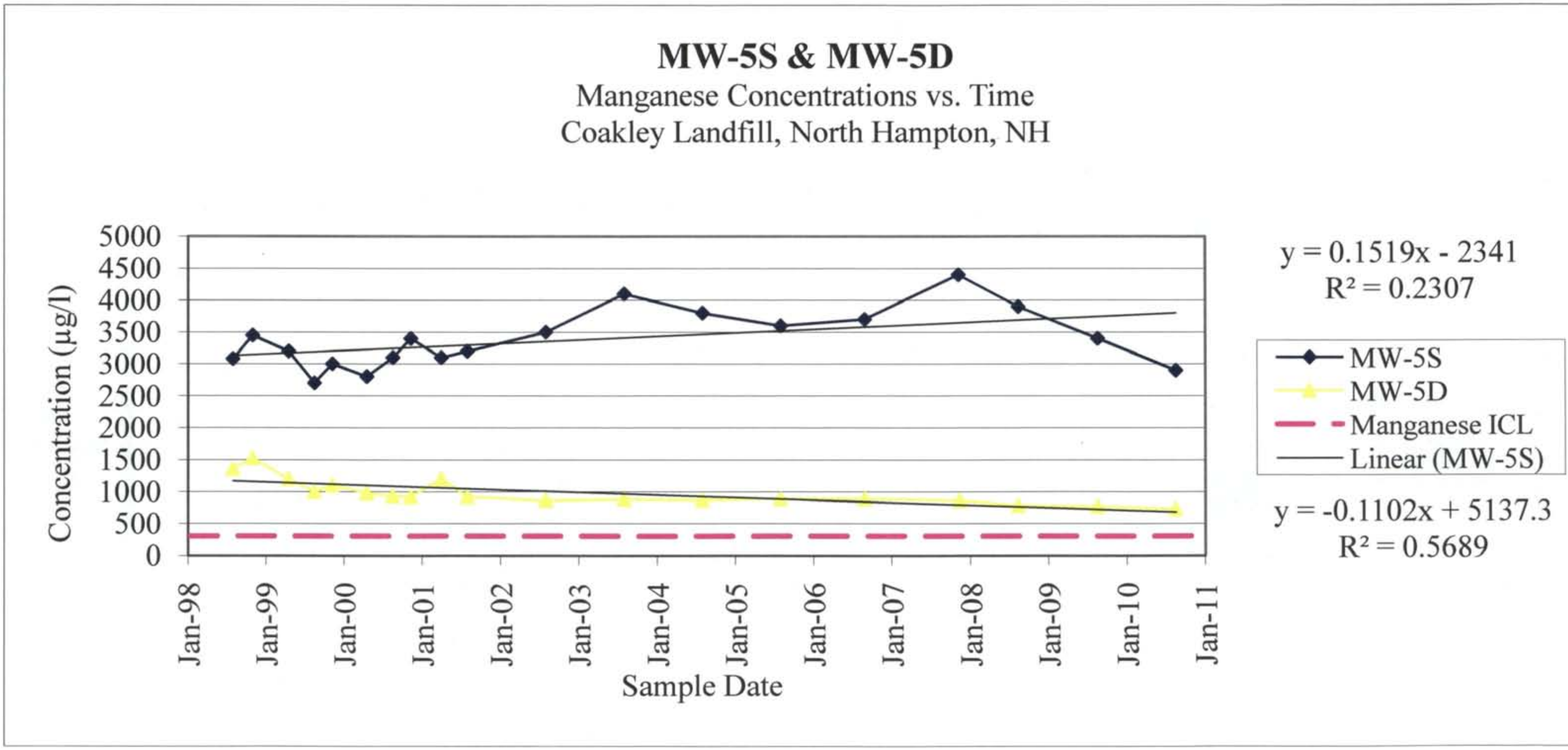


OP-5
Arsenic Concentrations vs. Time
Coakley Landfill, North Hampton, NH
Concentration (µg/l)
60
50
40
30
20
10
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = -0.0068x + 292.13
R² = 0.6018
Arsenic

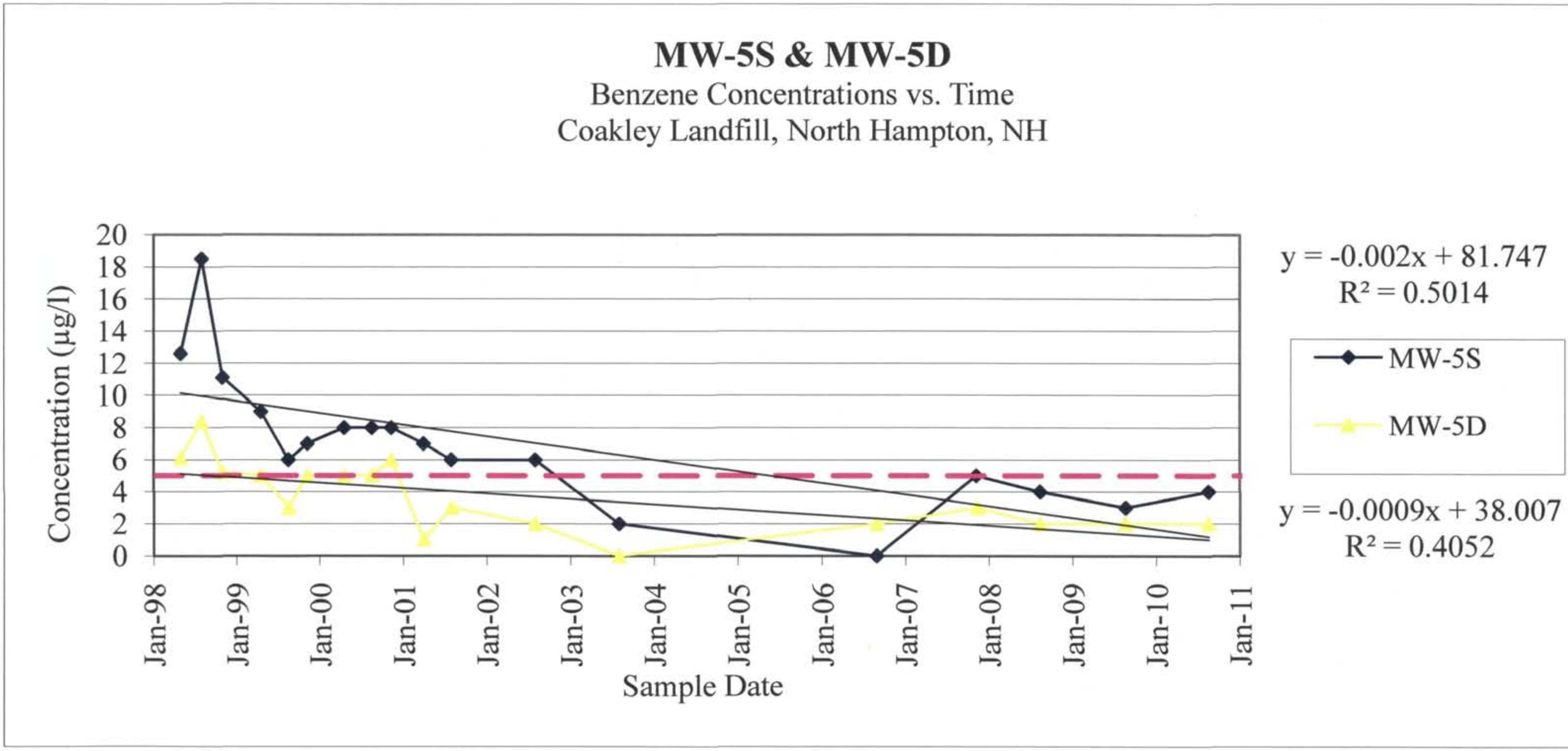


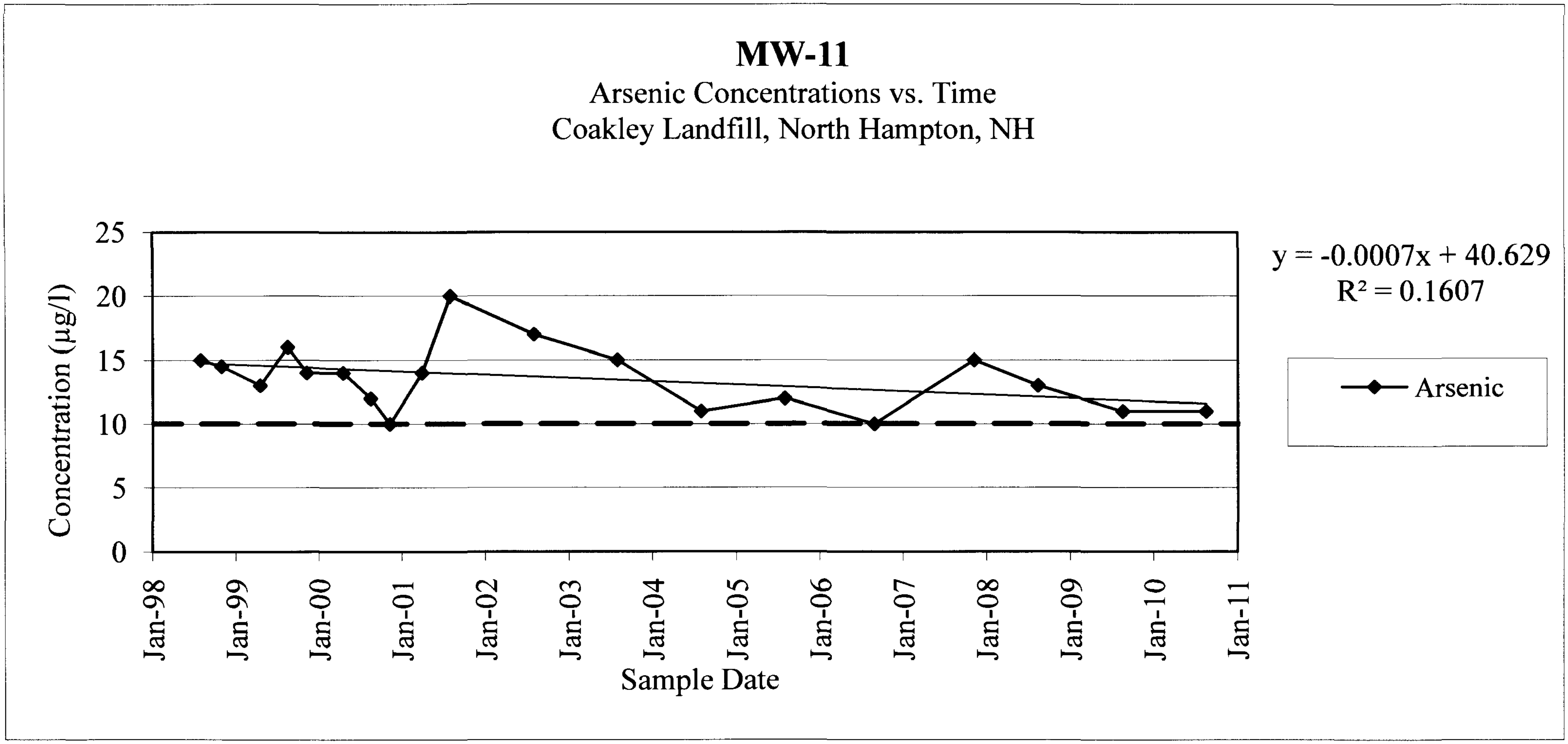
OP-5
Manganese Concentrations vs. Time
Coakley Landfill, North Hampton, NH
y = -1.0139x + 42724
R² = 0.4182
Manganese
Concentration (µg/l)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date


MW-5S & MW-5D
Arsenic Concentrations vs. Time
Coakley Landfill, North Hampton, NH
Concentration (µg/l)
30
25
20
15
10
5
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = -0.0008x + 48.243
R² = 0.0493
MW-5S
MW-5D
y = 8E-05x + 4.2317
R² = 0.002

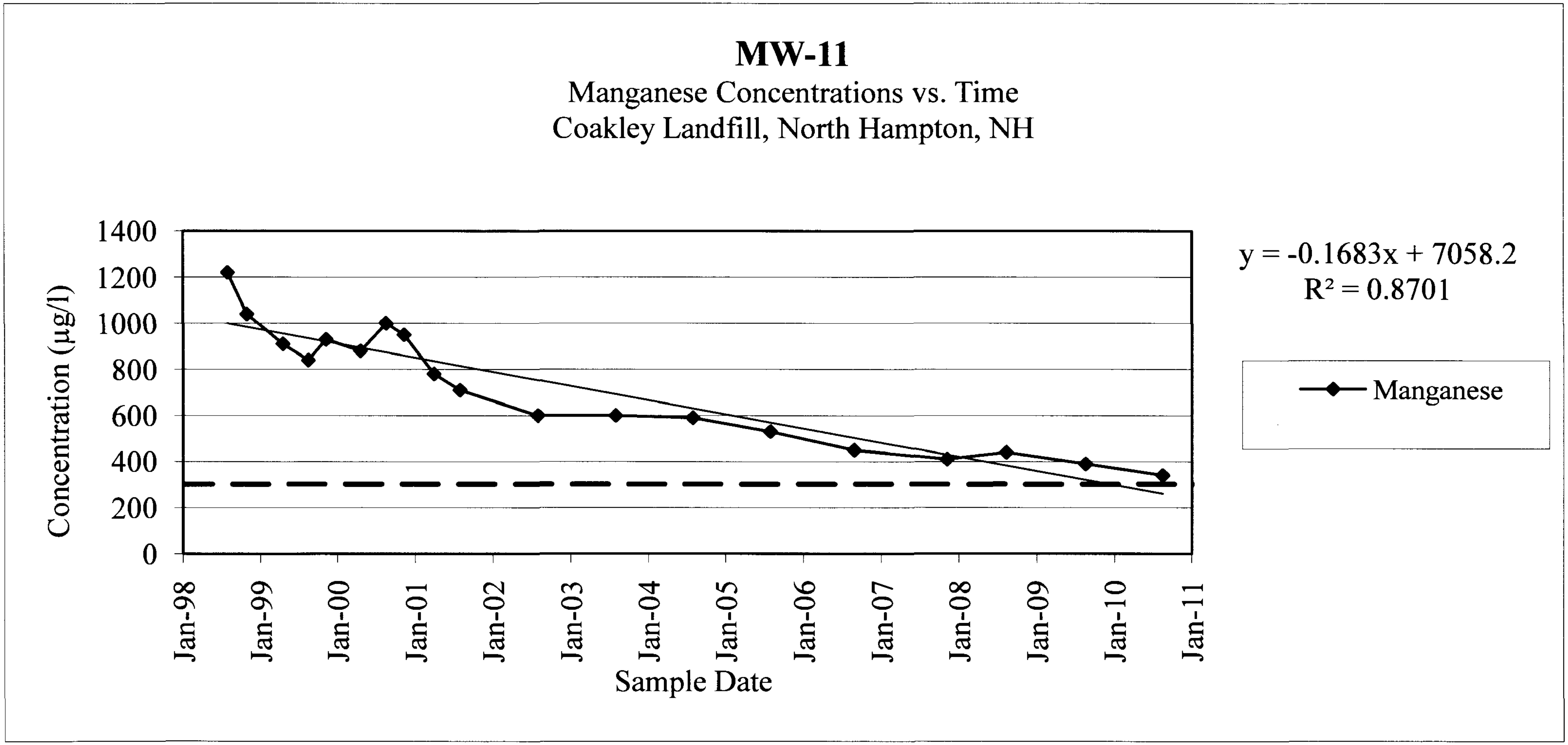


MW-5S & MW-5D
Manganese Concentrations vs. Time
Coakley Landfill, North Hampton, NH
Concentration (µg/l)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = 0.1519x - 2341
R² = 0.2307
MW-5S
MW-5D
Manganese ICL
Linear (MW-5S)
y = -0.1102x + 5137.3
R² = 0.5689

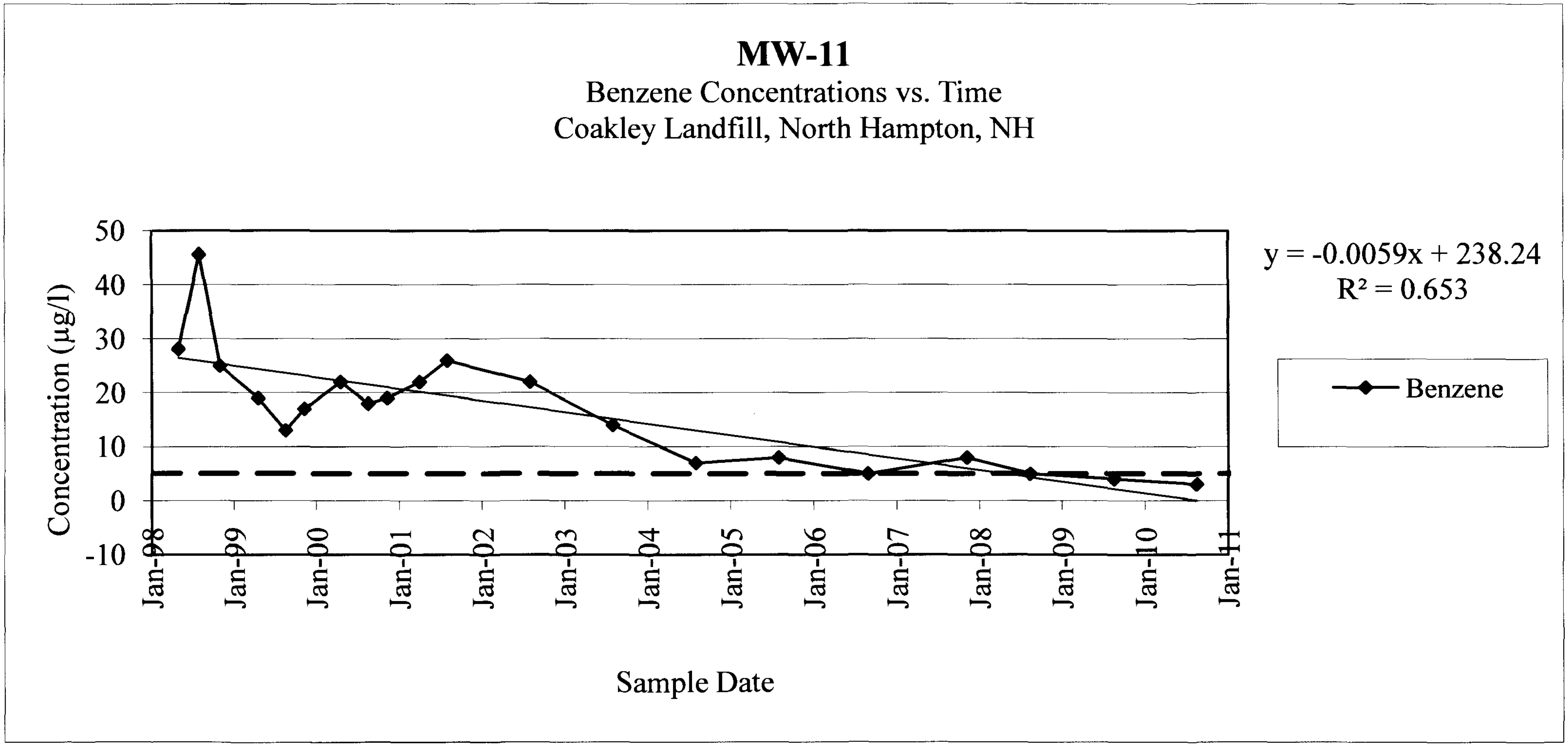

MW-5S & MW-5D
Benzene Concentrations vs. Time
Coakley Landfill, North Hampton, NH
Concentration (µg/l)
0
2
4
6
8
10
12
14
16
18
20
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = -0.002x + 81.747
R² = 0.5014
MW-5S
MW-5D
y = -0.0009x + 38.007
R² = 0.4052



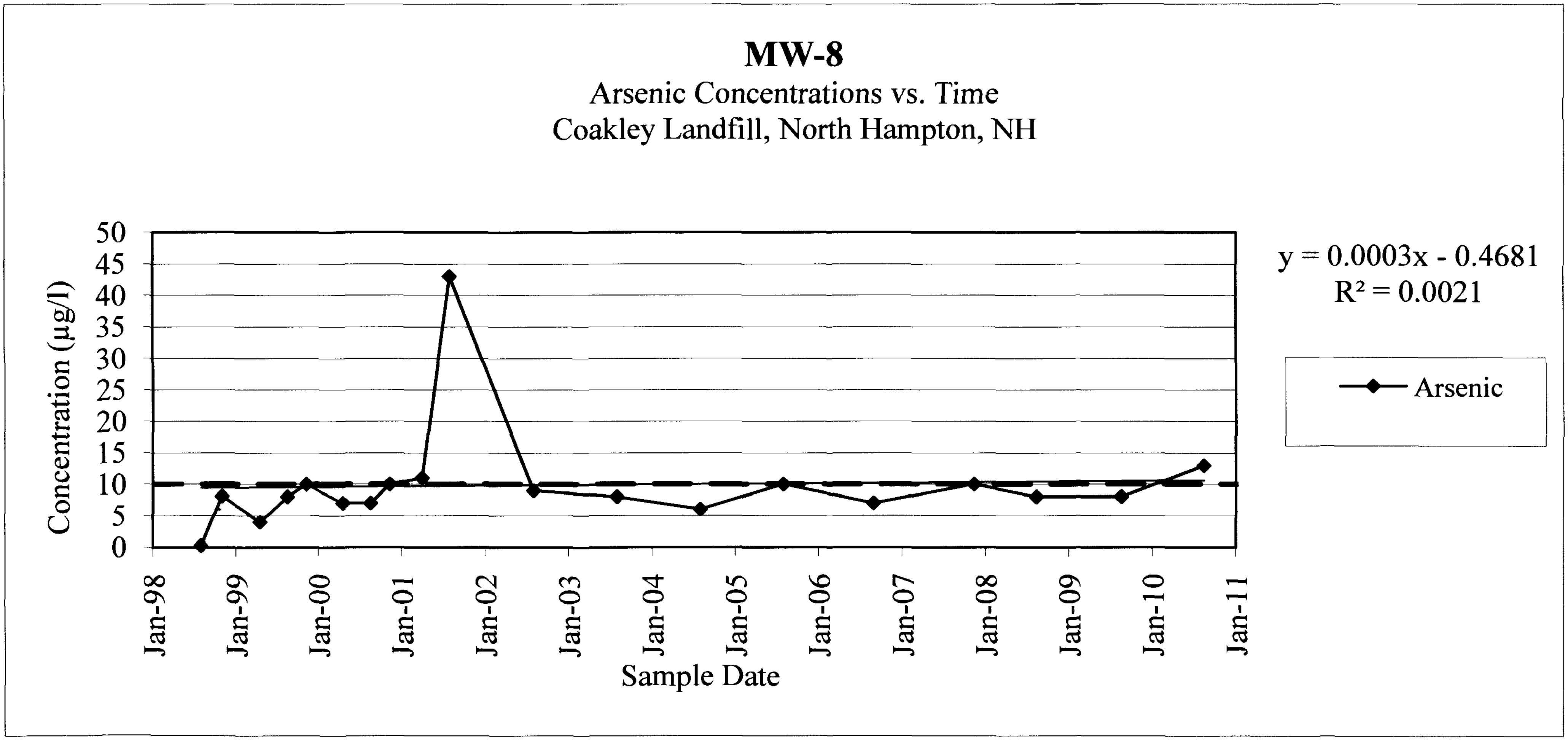
MW-11
Arsenic Concentrations vs. Time
Coakley Landfill, North Hampton, NH
y = -0.0007x + 40.629
R² = 0.1607
Arsenic
Concentration (µg/l)
0
5
10
15
20
25
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date



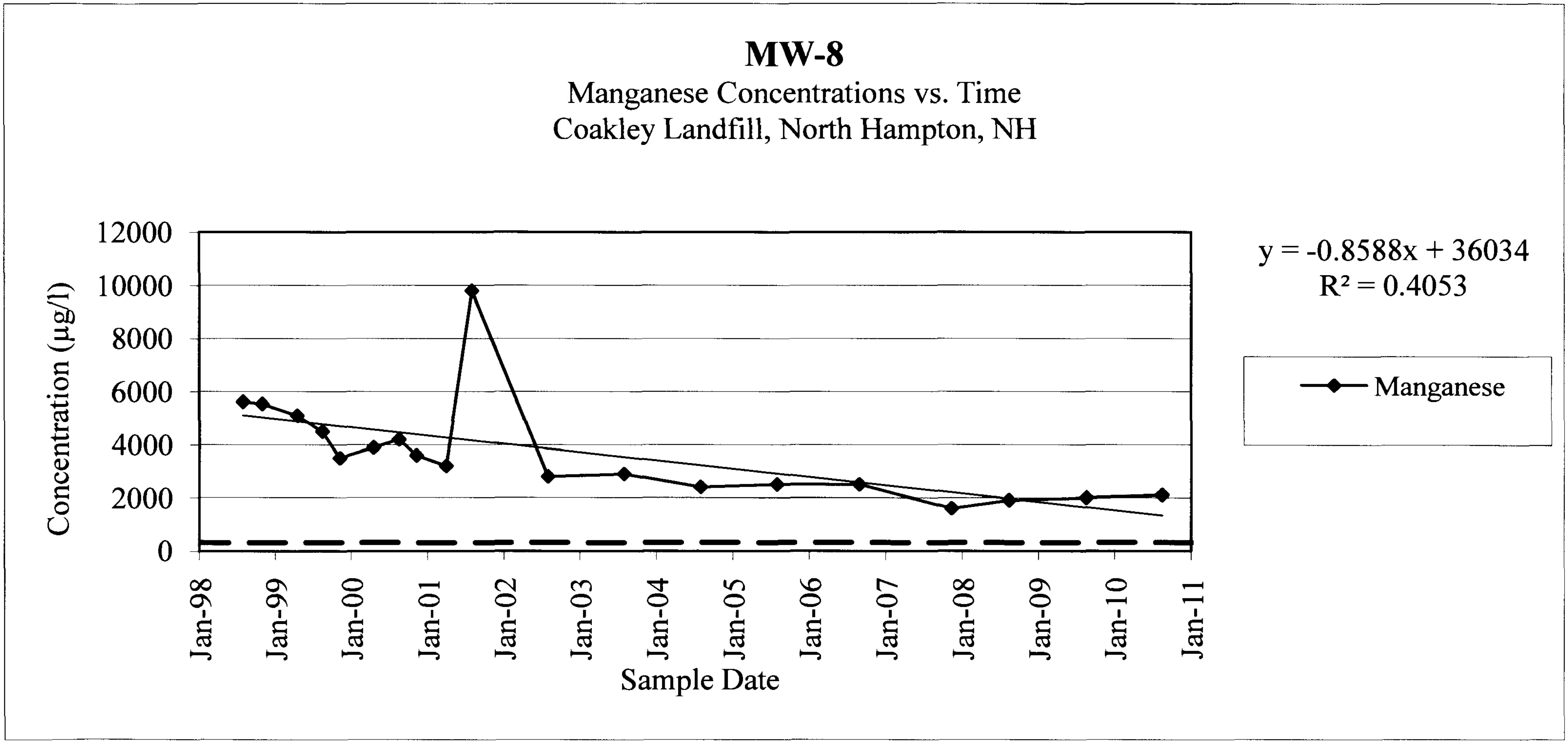
MW-11
Manganese Concentrations vs. Time
Coakley Landfill, North Hampton, NH
y = -0.1683x + 7058.2
R² = 0.8701
Manganese
Concentration (µg/l)
1400
1200
1000
800
600
400
200
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date



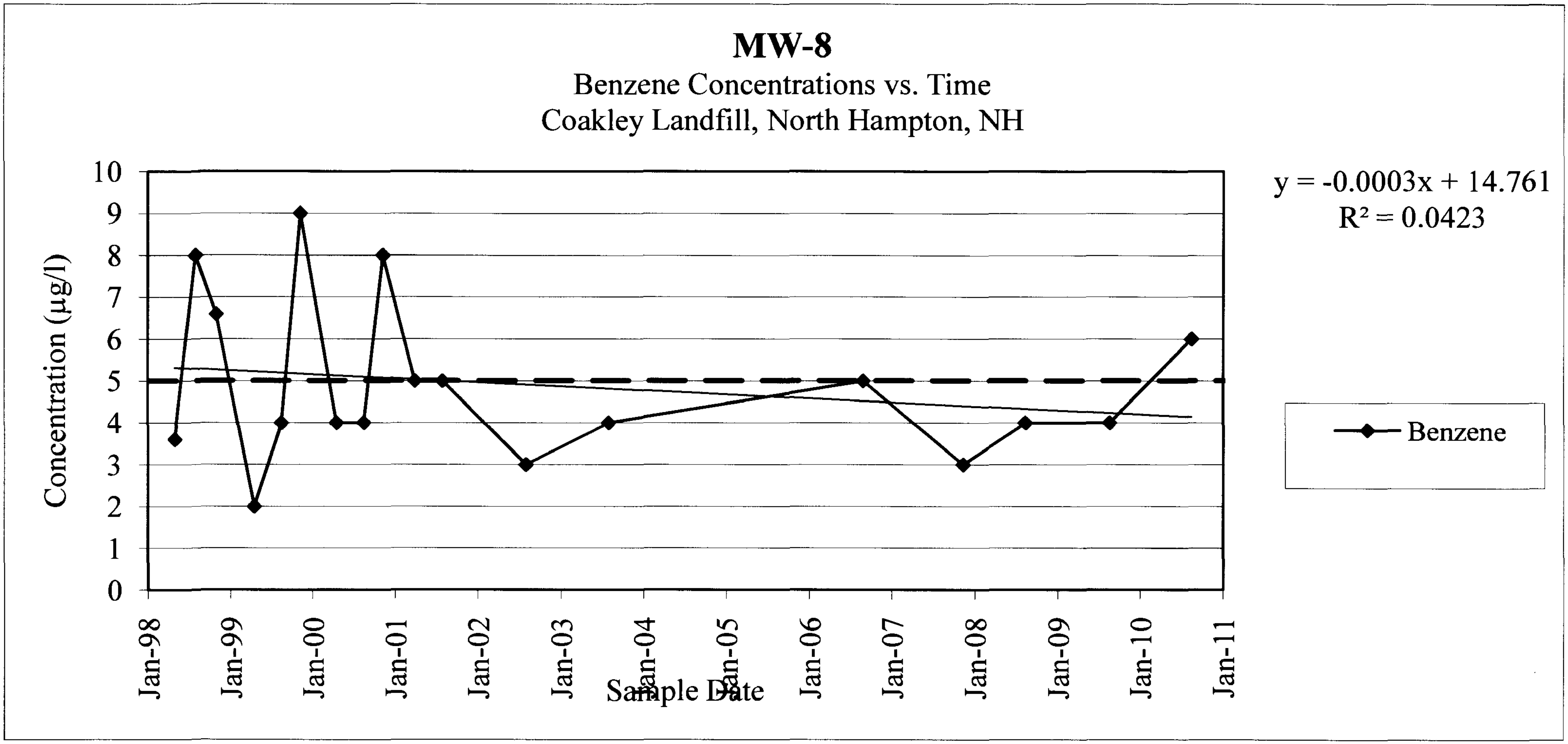
MW-11
Benzene Concentrations vs. Time
Coakley Landfill, North Hampton, NH
Concentration (µg/l)
50
40
30
20
10
0
-10
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = -0.0059x + 238.24
R² = 0.653
Benzene



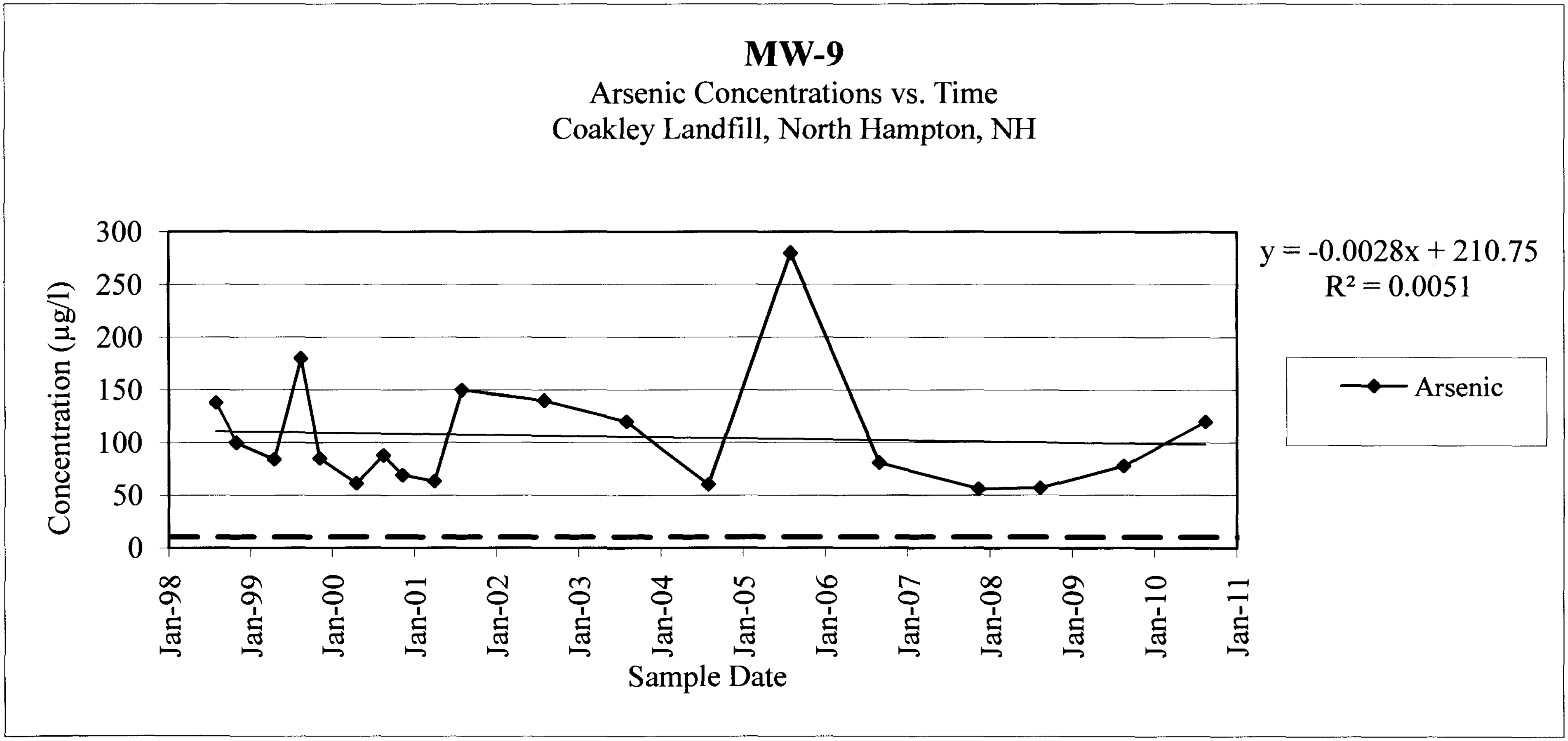
MW-8
Arsenic Concentrations vs. Time
Coakley Landfill, North Hampton, NH
Concentration (µg/l)
50
45
40
35
30
25
20
15
10
5
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = 0.0003x - 0.4681
R² = 0.0021
Arsenic



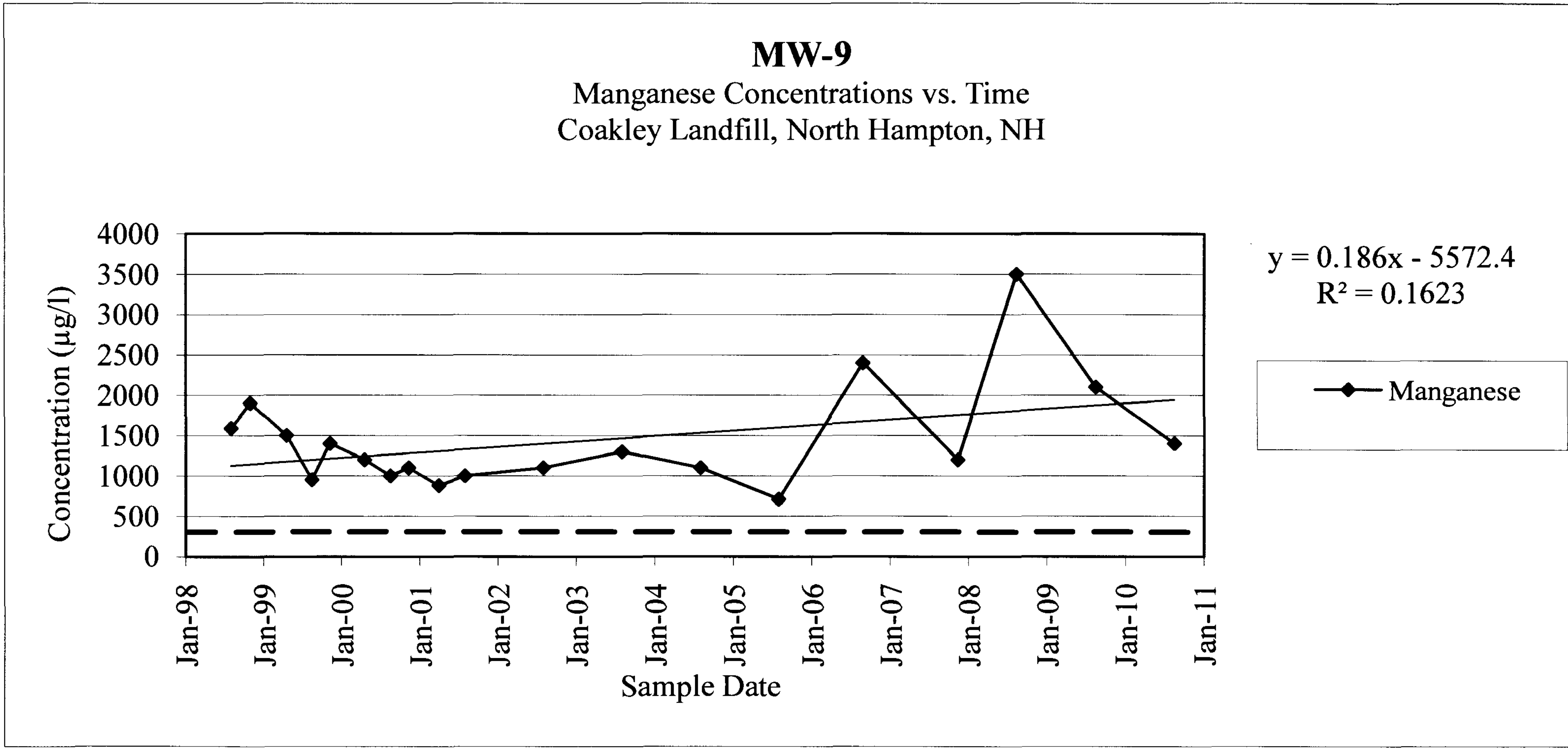
MW-8
Manganese Concentrations vs. Time
Coakley Landfill, North Hampton, NH
y = -0.8588x + 36034
R² = 0.4053
Manganese
Concentration (µg/l)
12000
10000
8000
6000
4000
2000
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date



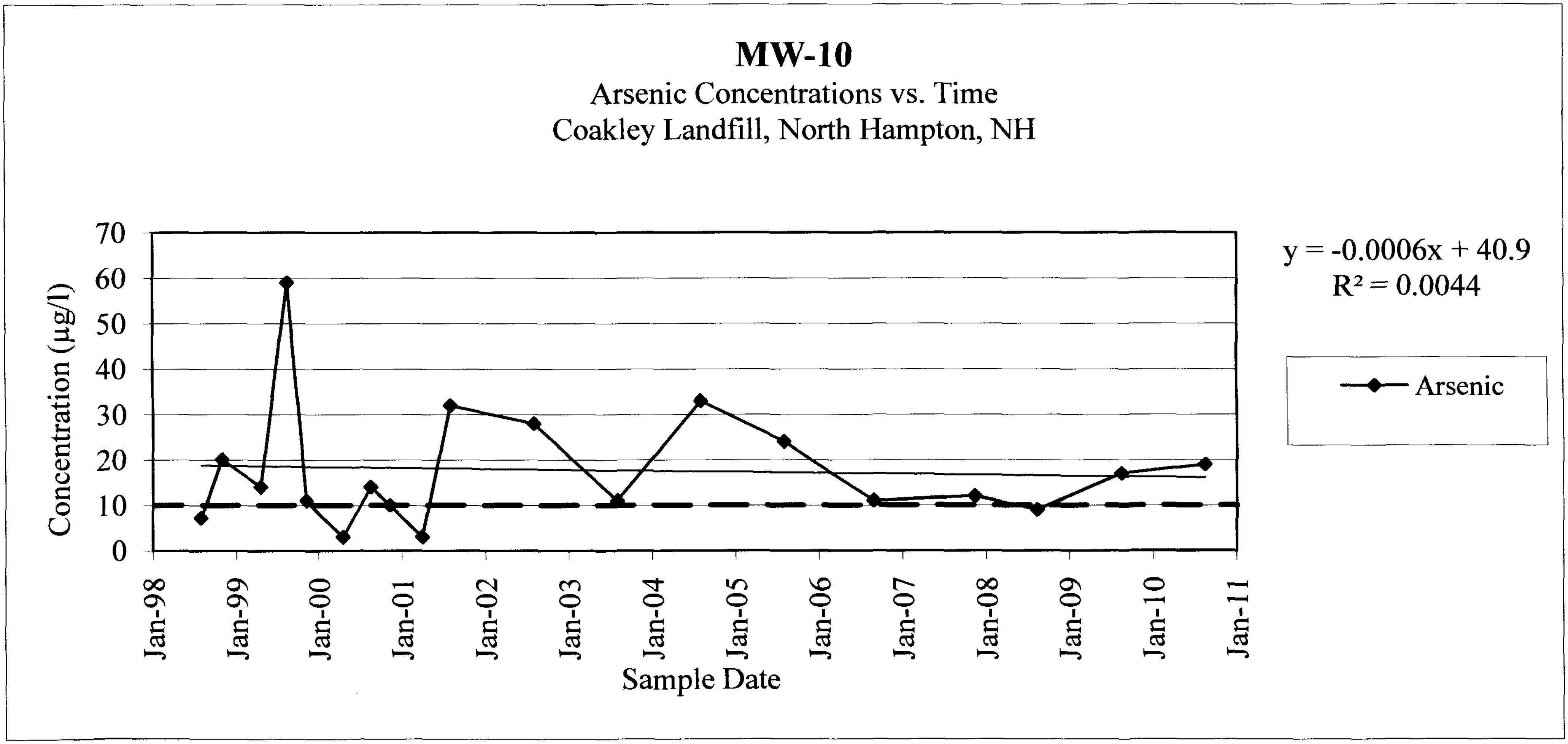
MW-8
Benzene Concentrations vs. Time
Coakley Landfill, North Hampton, NH
10
9
8
7
6
5
4
3
2
1
0
Concentration (µg/l)
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = -0.0003x + 14.761
R² = 0.0423
Benzene



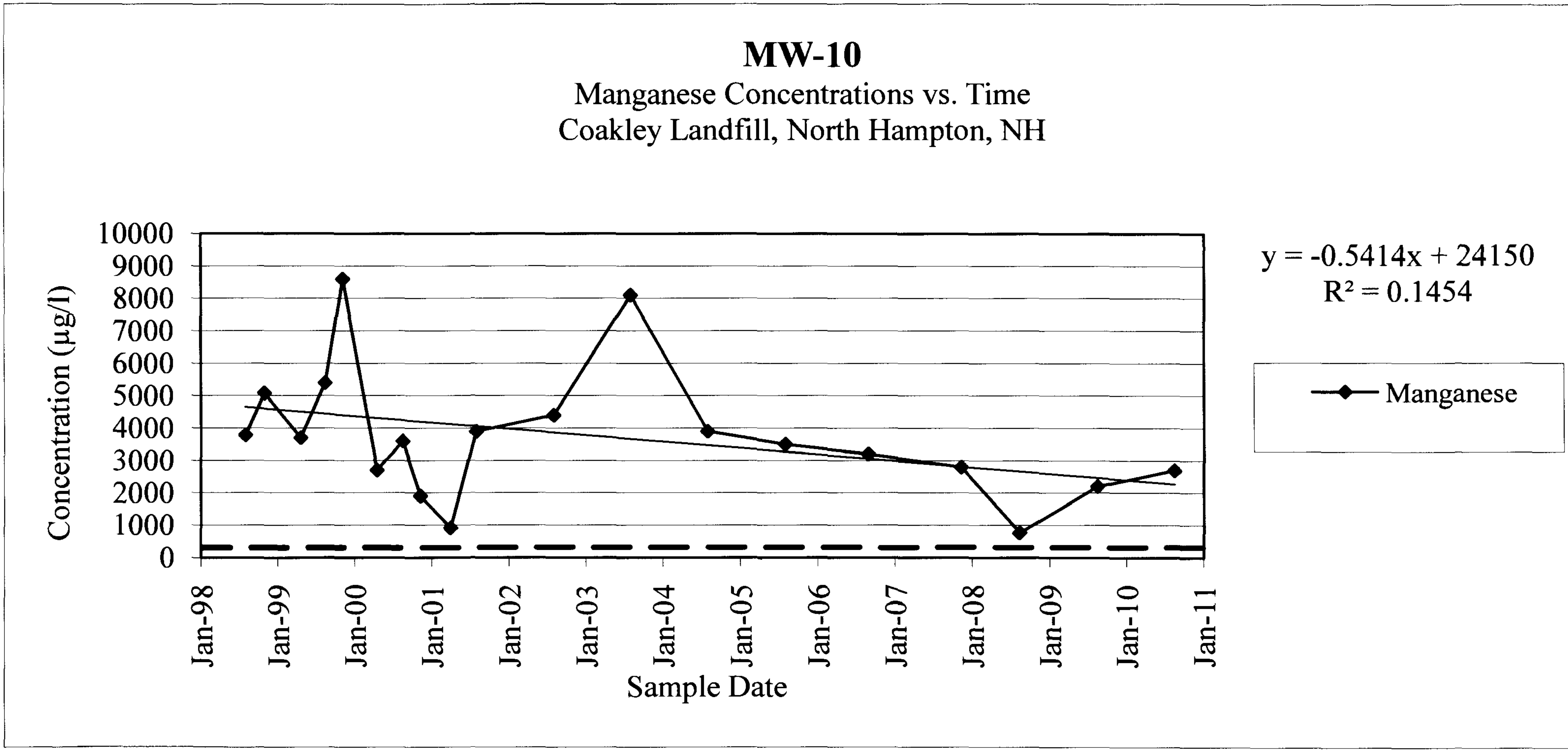
MW-9
Arsenic Concentrations vs. Time
Coakley Landfill, North Hampton, NH
Concentration (µg/l)
300
250
200
150
100
50
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = -0.0028x + 210.75
R² = 0.0051
Arsenic

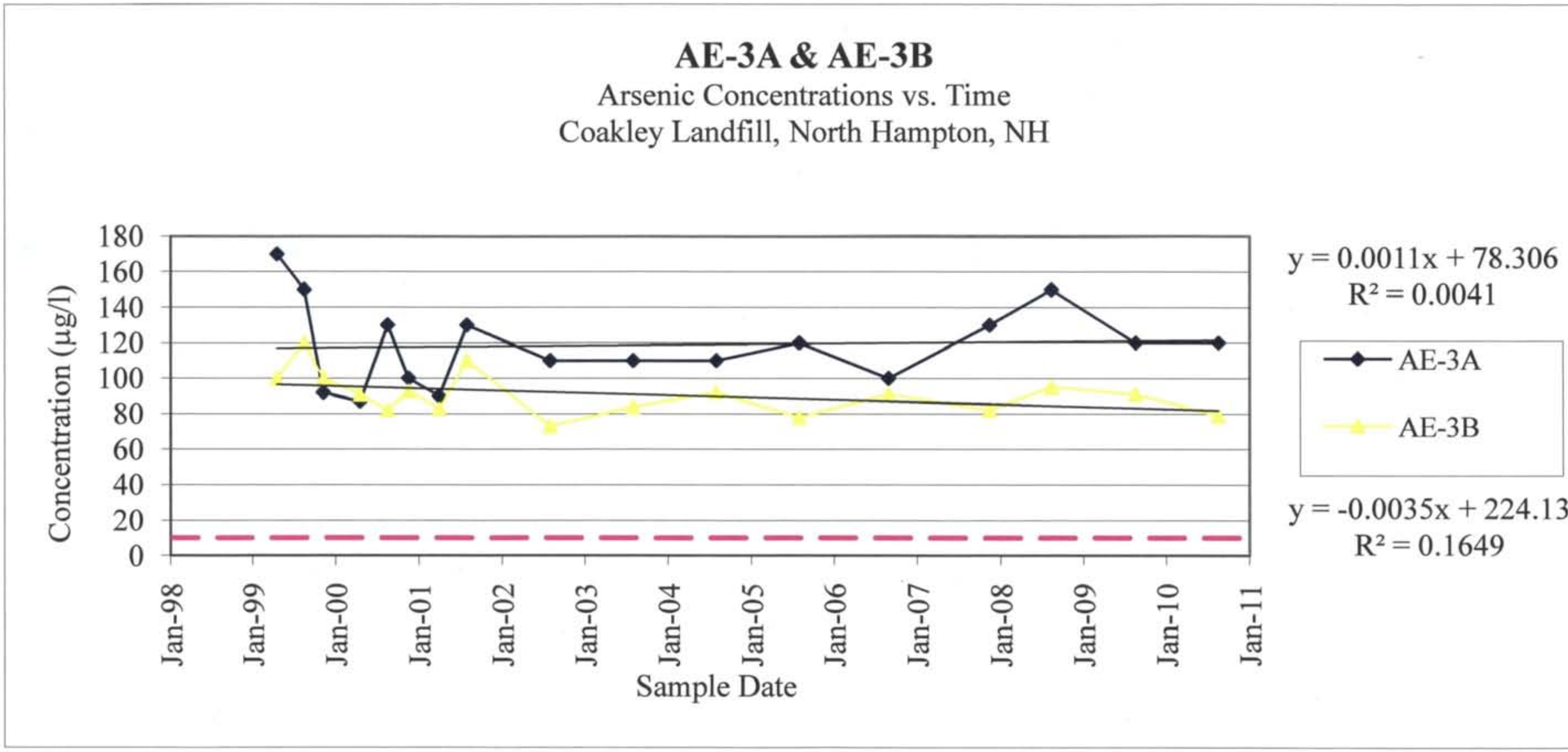


MW-9
Manganese Concentrations vs. Time
Coakley Landfill, North Hampton, NH
4000
3500
3000
2500
2000
1500
1000
500
0
Concentration (µg/l)
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = 0.186x - 5572.4
R² = 0.1623
Manganese

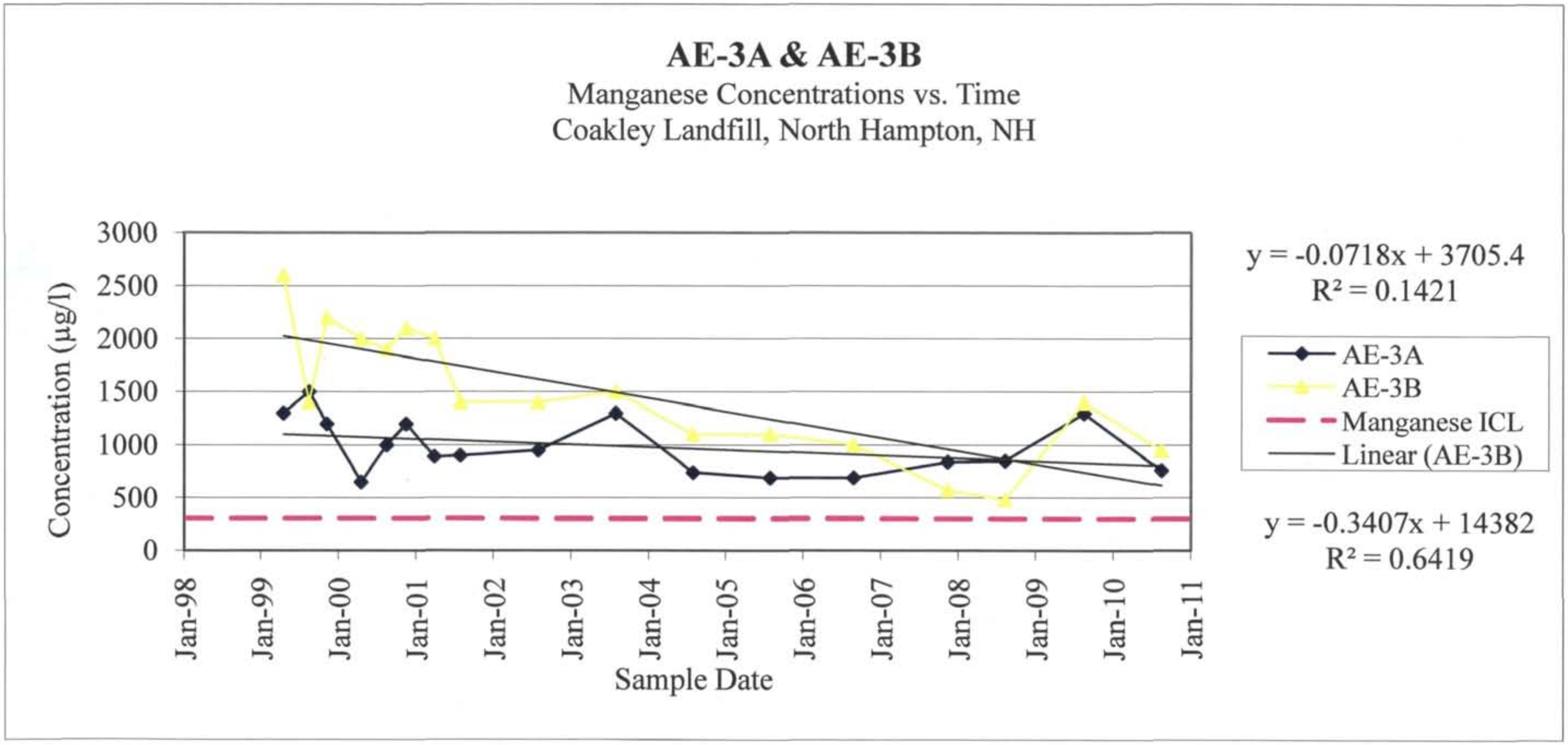


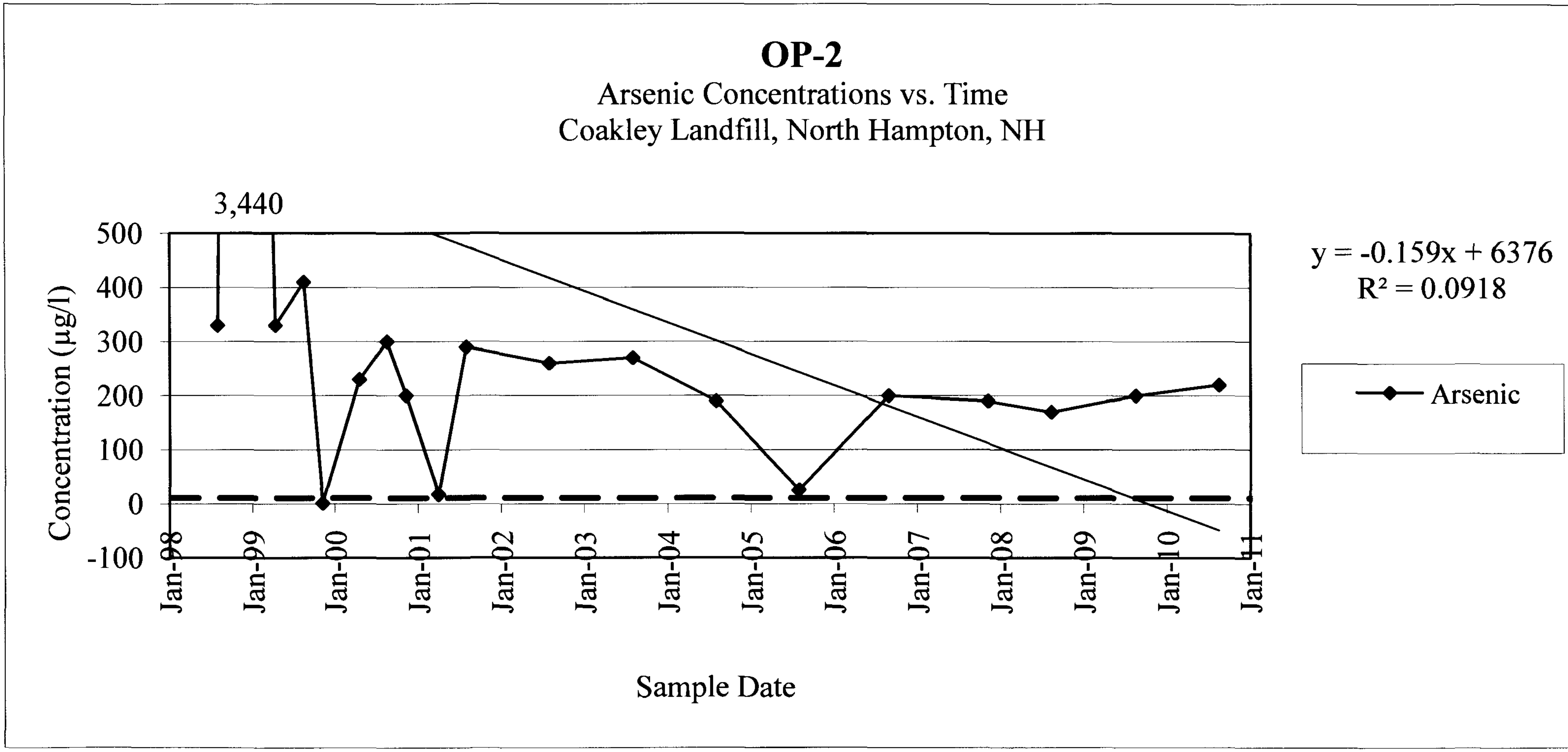
MW-10
Arsenic Concentrations vs. Time
Coakley Landfill, North Hampton, NH
70
60
50
40
30
20
10
0
Concentration (µg/l)
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = -0.0006x + 40.9
R² = 0.0044
Arsenic

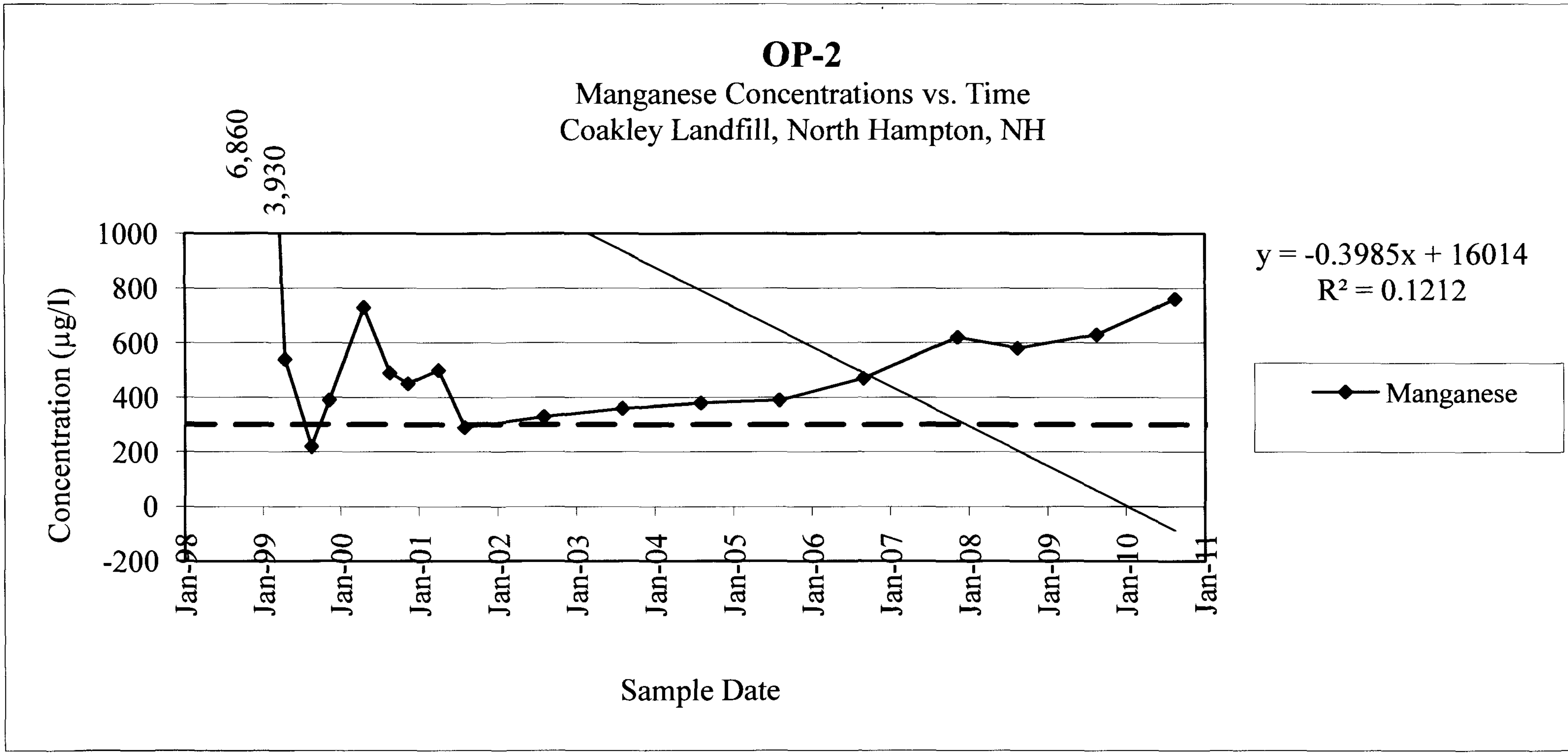

MW-10
Manganese Concentrations vs. Time
Coakley Landfill, North Hampton, NH
Concentration (µg/l)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = -0.5414x + 24150
R² = 0.1454
Manganese

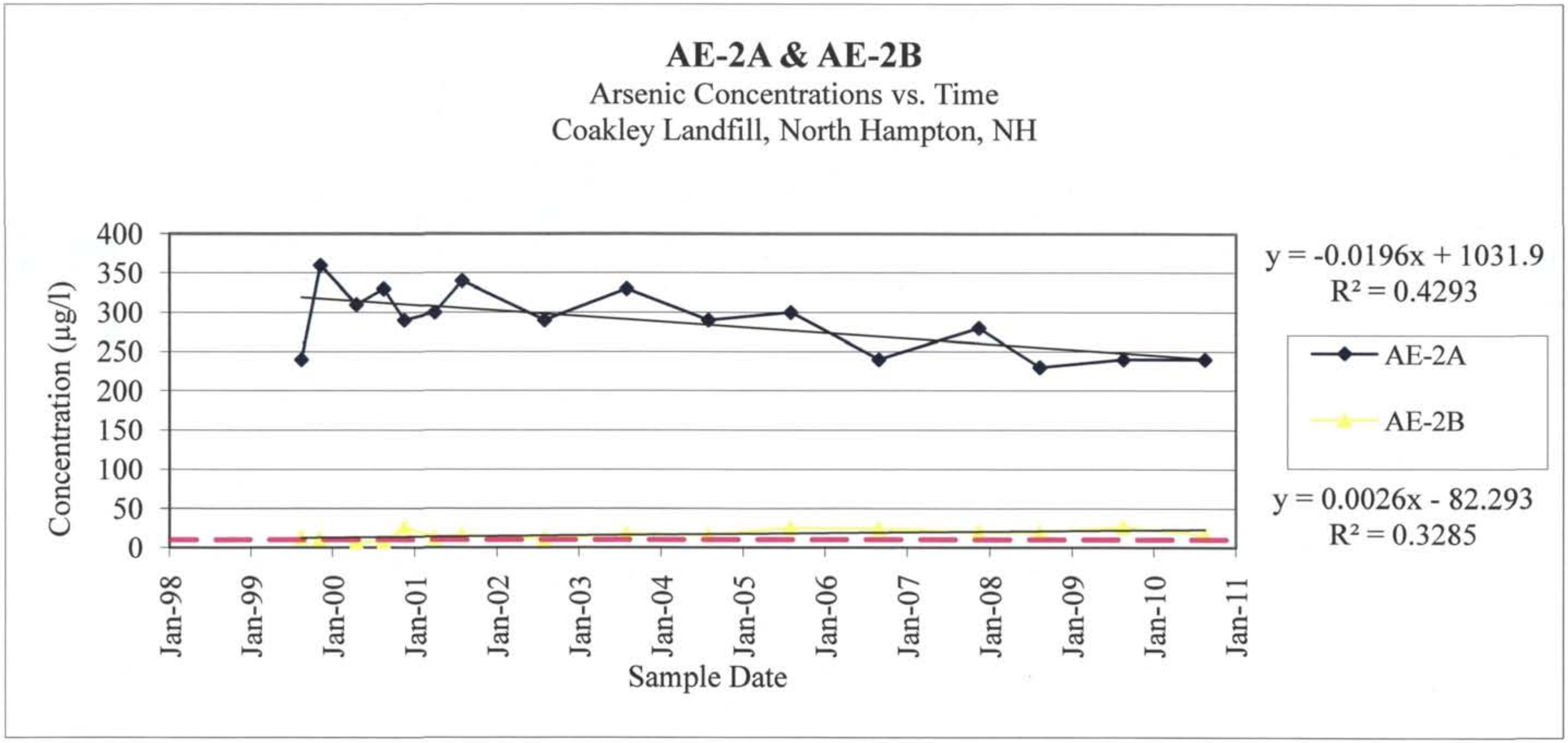


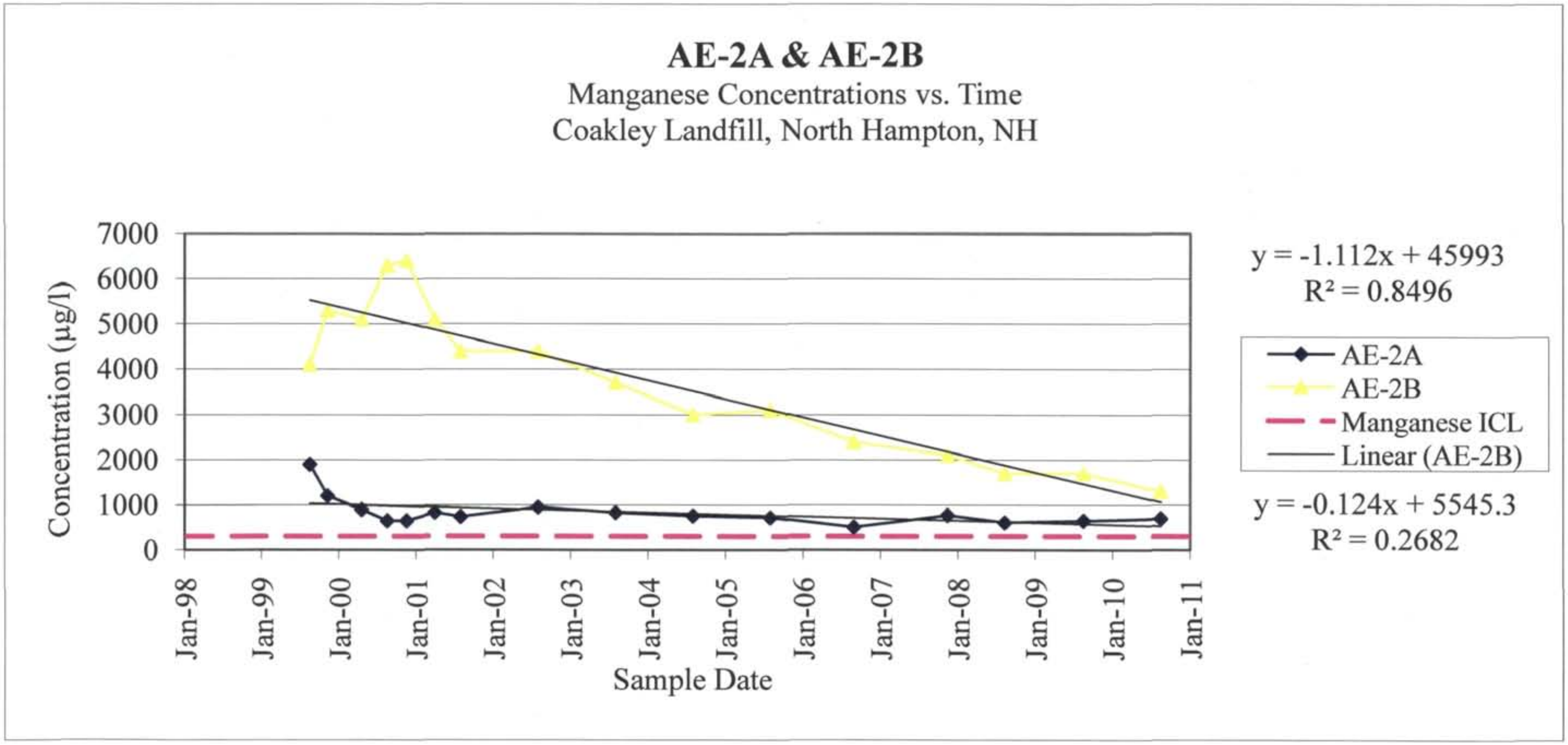
AE-3A & AE-3B
Arsenic Concentrations vs. Time
Coakley Landfill, North Hampton, NH
Concentration (µg/l)
180
160
140
120
100
80
60
40
20
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = 0.0011x + 78.306
R² = 0.0041
AE-3A
AE-3B
y = -0.0035x + 224.13
R² = 0.1649

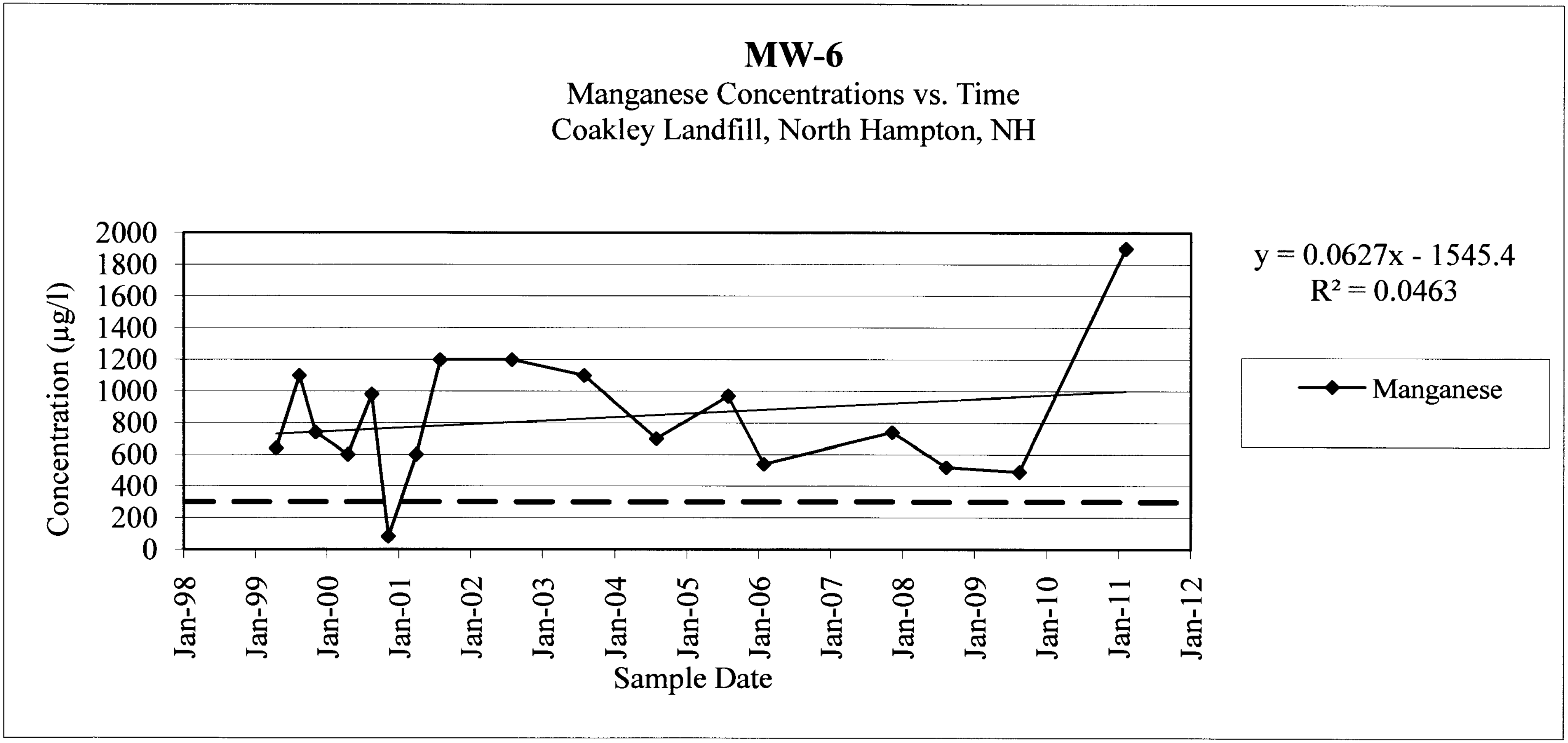

AE-3A & AE-3B
Manganese Concentrations vs. Time
Coakley Landfill, North Hampton, NH
3000
2500
2000
1500
1000
500
0
Concentration (µg/l)
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = -0.0718x + 3705.4
R² = 0.1421
AE-3A
AE-3B
Manganese ICL
Linear (AE-3B)
y = -0.3407x + 14382
R² = 0.6419

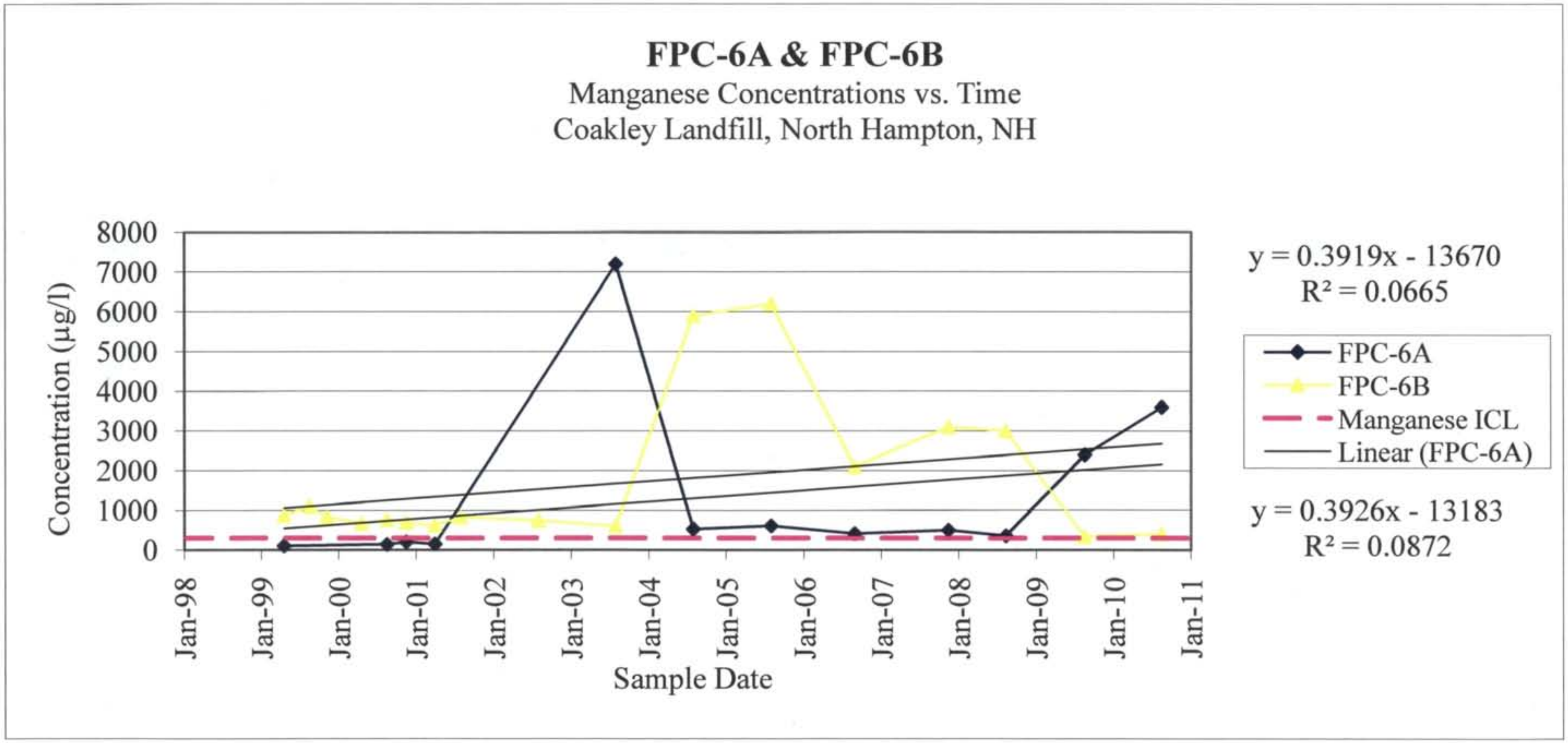

OP-2
Arsenic Concentrations vs. Time
Coakley Landfill, North Hampton, NH
3,440
500
400
300
200
100
0
-100
Concentration (µg/l)
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = -0.159x + 6376
R² = 0.0918
Arsenic

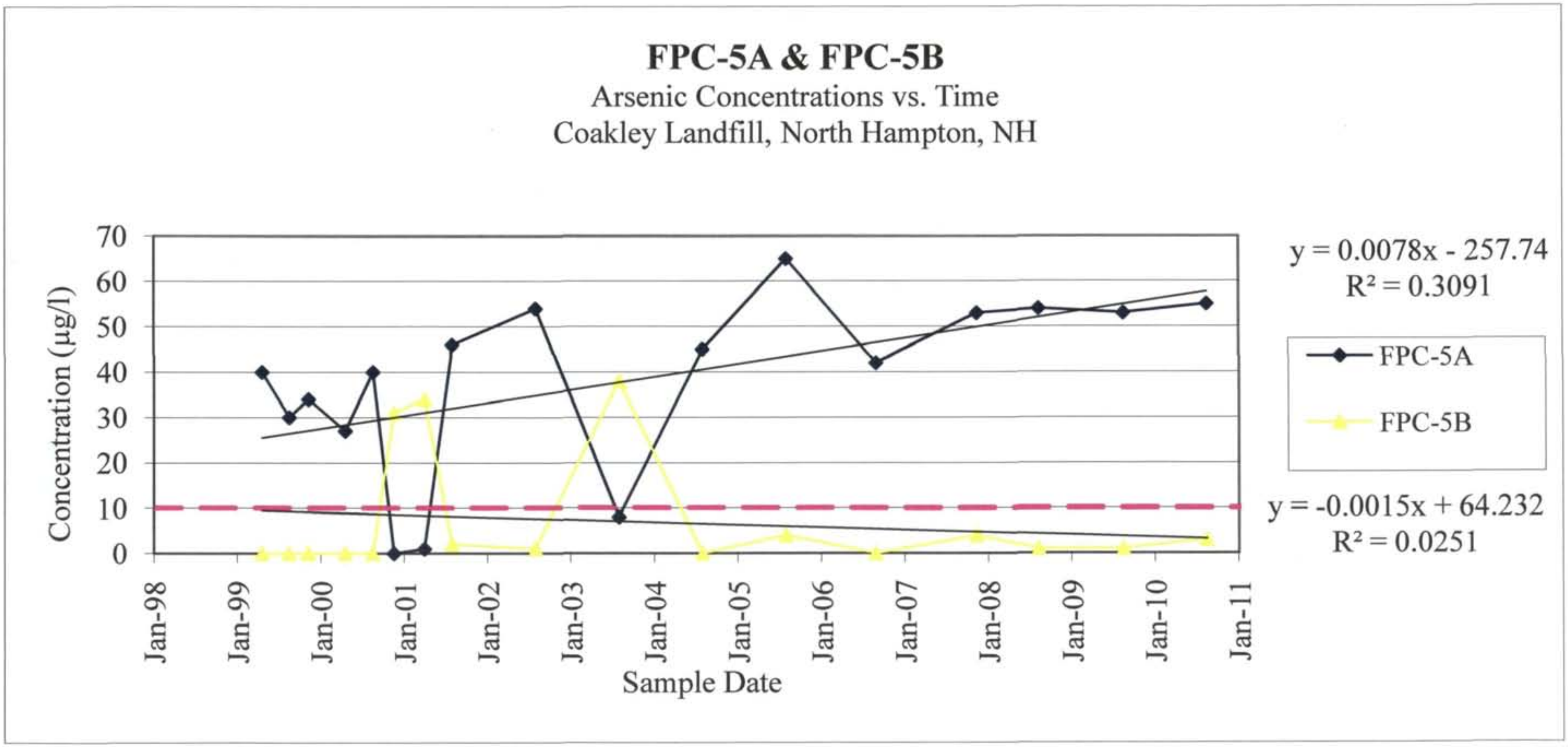

OP-2
Manganese Concentrations vs. Time
Coakley Landfill, North Hampton, NH
6,860
3,930
1000
800
600
400
200
0
-200
Concentration (µg/l)
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = -0.3985x + 16014
R² = 0.1212
Manganese

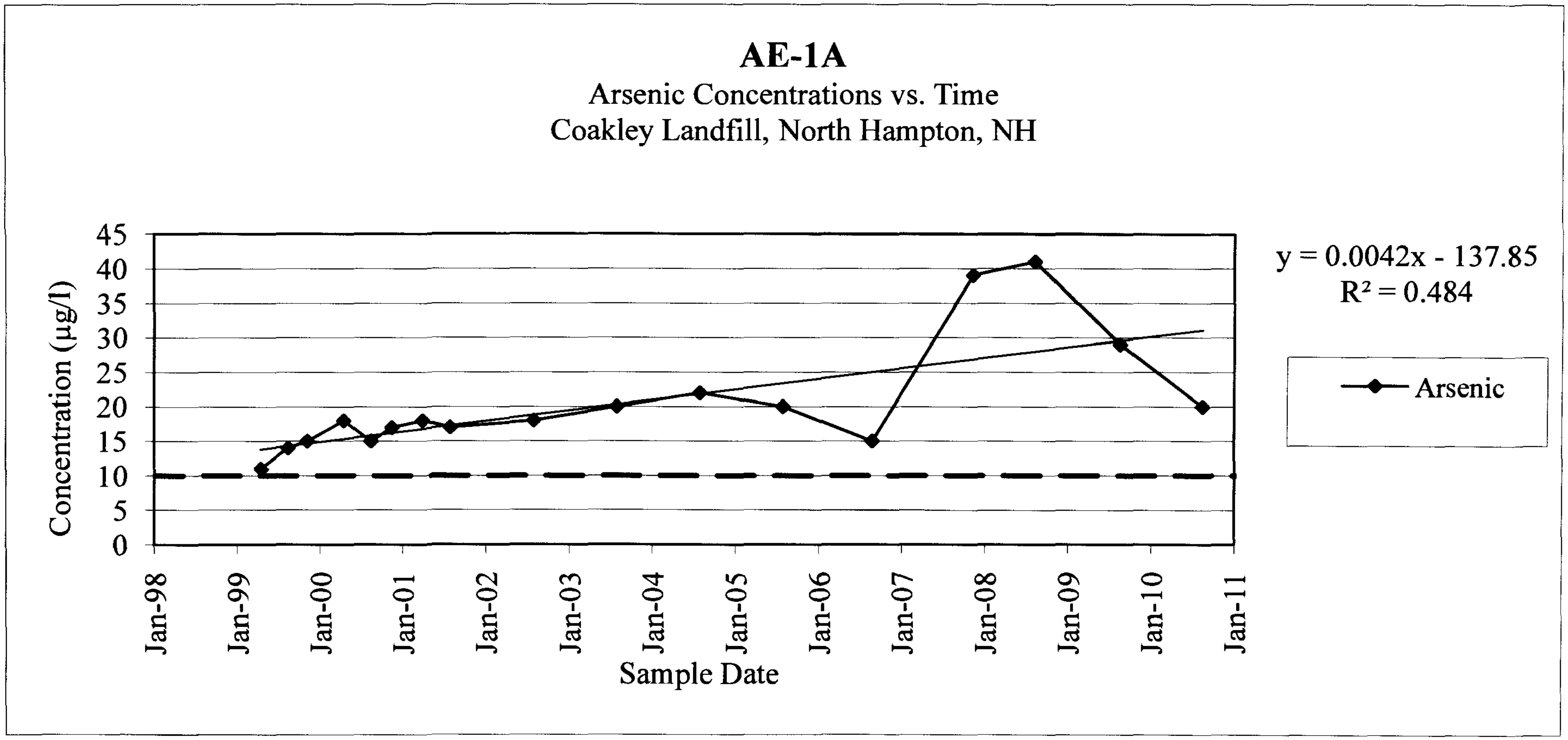

AE-2A & AE-2B
Arsenic Concentrations vs. Time
Coakley Landfill, North Hampton, NH
Concentration (µg/l)
400
350
300
250
200
150
100
50
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = -0.0196x + 1031.9
R² = 0.4293
AE-2A
AE-2B
y = 0.0026x - 82.293
R² = 0.3285


AE-2A & AE-2B
Manganese Concentrations vs. Time
Coakley Landfill, North Hampton, NH
Concentration (µg/l)
7000
6000
5000
4000
3000
2000
1000
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = -1.112x + 45993
R² = 0.8496
AE-2A
AE-2B
Manganese ICL
Linear (AE-2B)
y = -0.124x + 5545.3
R² = 0.2682

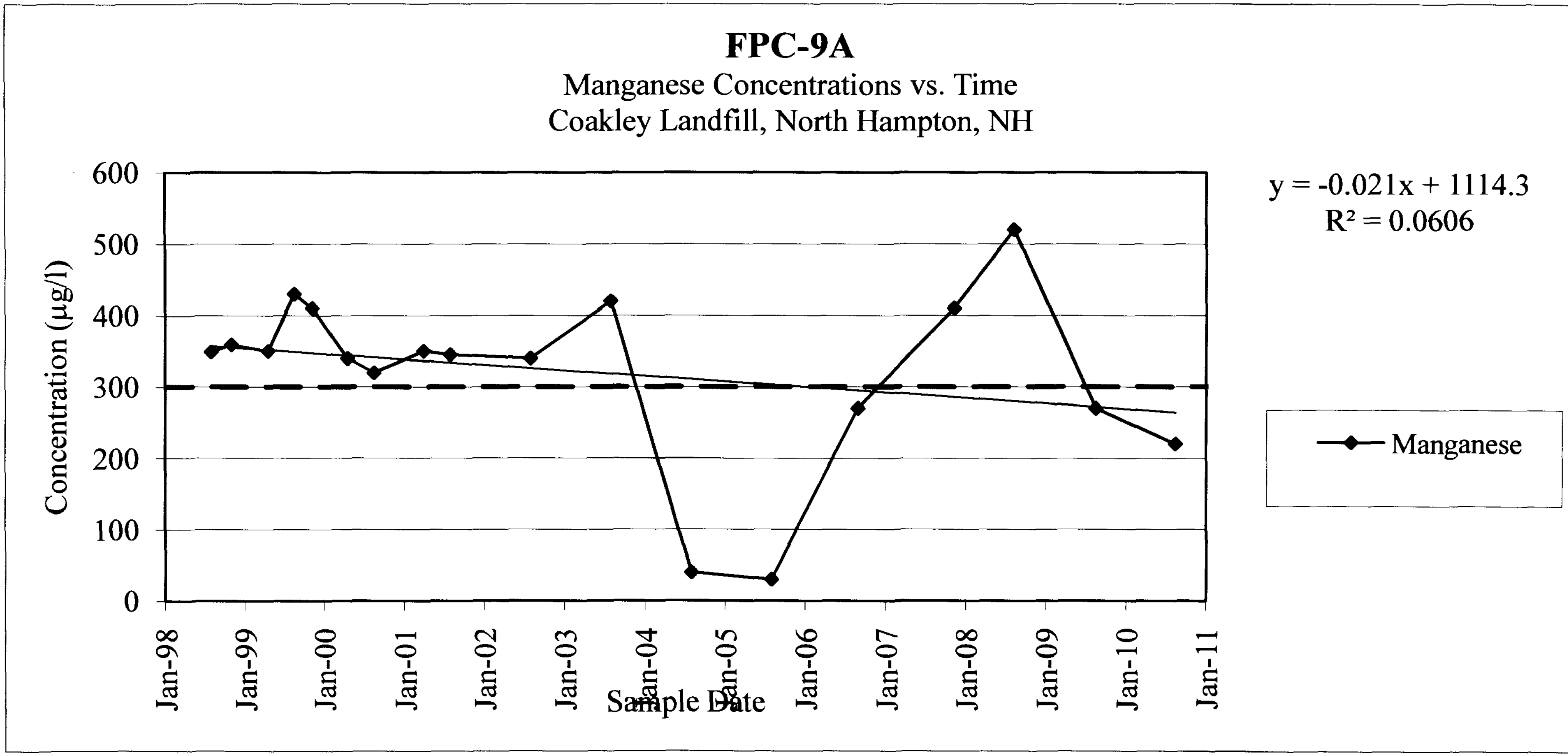

MW-6
Manganese Concentrations vs. Time
Coakley Landfill, North Hampton, NH
Concentration (µg/l)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Sample Date
y = 0.0627x - 1545.4
R² = 0.0463
Manganese

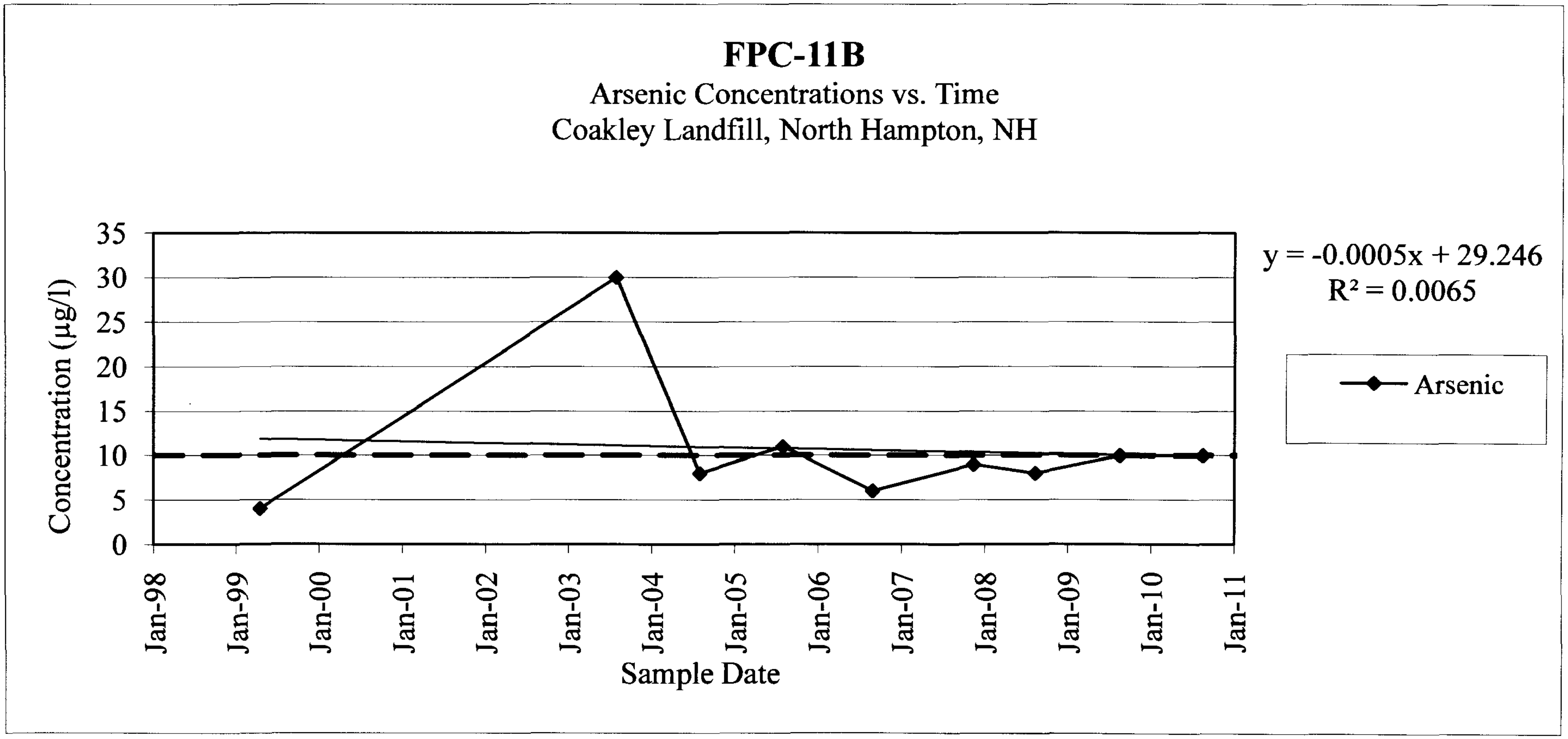

FPC-6A & FPC-6B
Manganese Concentrations vs. Time
Coakley Landfill, North Hampton, NH
Concentration (µg/l)
8000
7000
6000
5000
4000
3000
2000
1000
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = 0.3919x - 13670
R² = 0.0665
FPC-6A
FPC-6B
Manganese ICL
Linear (FPC-6A)
y = 0.3926x - 13183
R² = 0.0872

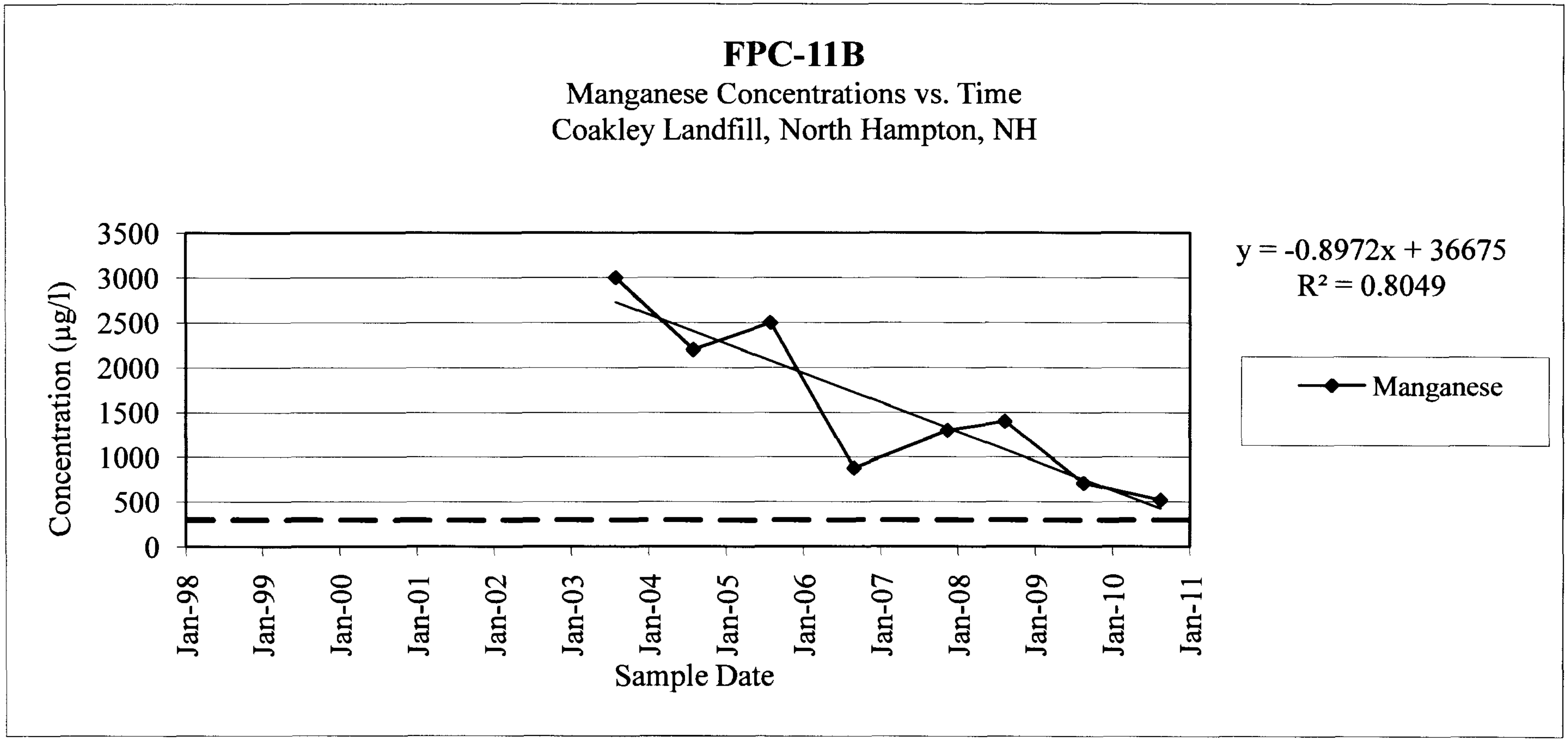

FPC-5A & FPC-5B
Arsenic Concentrations vs. Time
Coakley Landfill, North Hampton, NH
Concentration (µg/l)
70
60
50
40
30
20
10
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = 0.0078x - 257.74
R² = 0.3091
FPC-5A
FPC-5B
y = -0.0015x + 64.232
R² = 0.0251

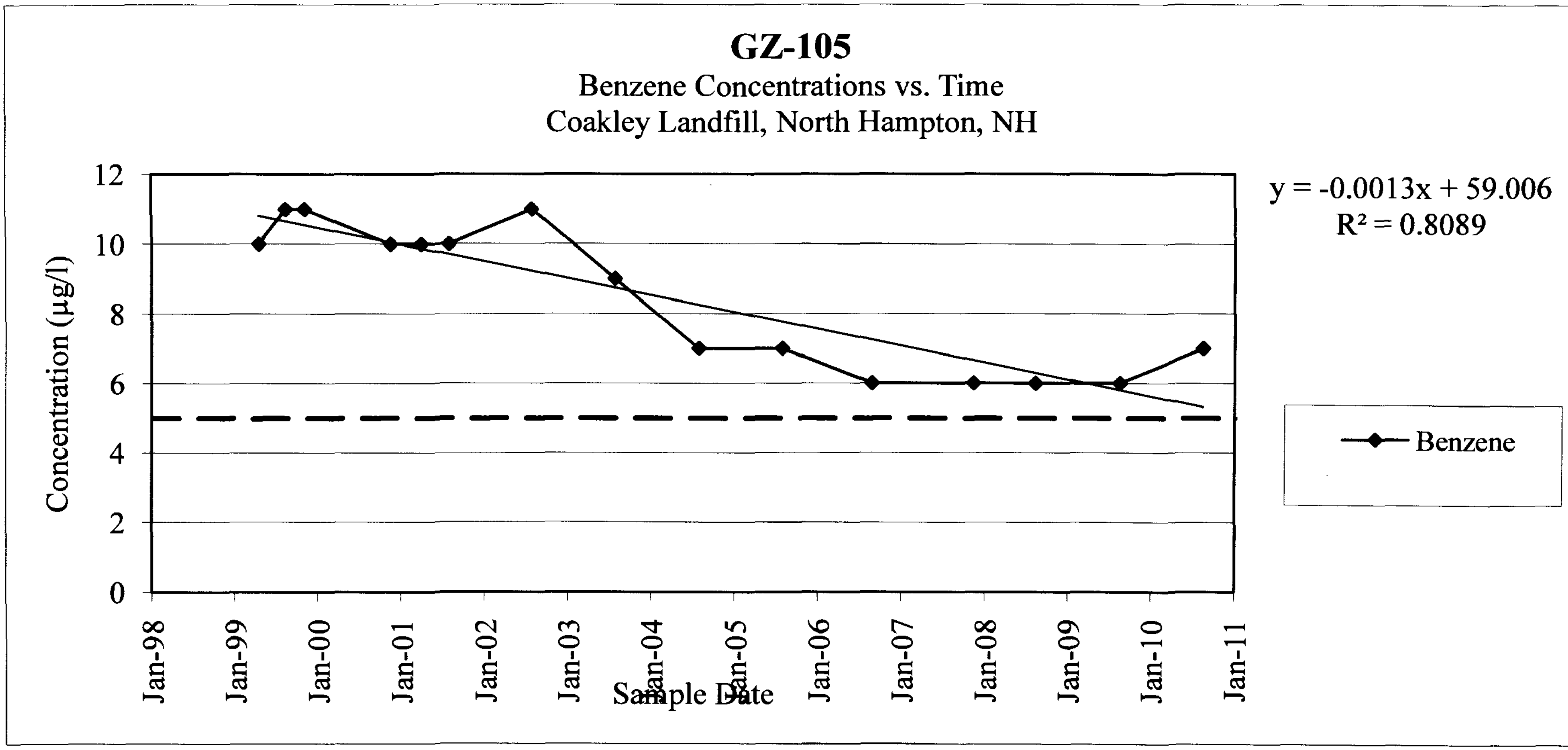


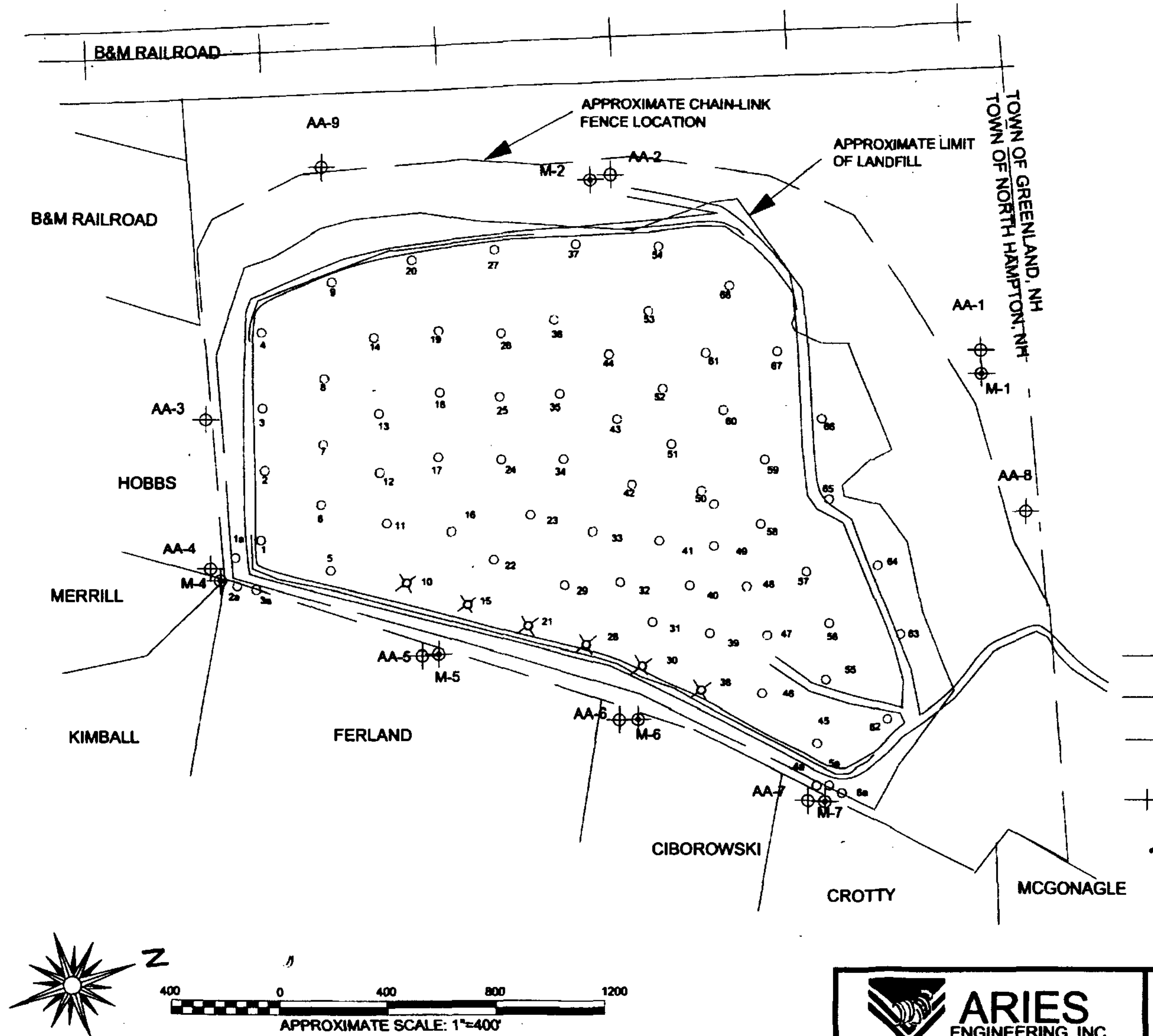
AE-1A
Arsenic Concentrations vs. Time
Coakley Landfill, North Hampton, NH
y = 0.0042x - 137.85
R² = 0.484
Arsenic
Concentration (µg/l)
45
40
35
30
25
20
15
10
5
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date


FPC-9A
Manganese Concentrations vs. Time
Coakley Landfill, North Hampton, NH
y = -0.021x + 1114.3
R² = 0.0606
Manganese
Concentration (µg/l)
600
500
400
300
200
100
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date


FPC-11B
Arsenic Concentrations vs. Time
Coakley Landfill, North Hampton, NH
Concentration (µg/l)
35
30
25
20
15
10
5
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
y = -0.0005x + 29.246
R² = 0.0065
Arsenic


FPC-11B
Manganese Concentrations vs. Time
Coakley Landfill, North Hampton, NH
y = -0.8972x + 36675
R² = 0.8049
Manganese
Concentration (µg/l)
3500
3000
2500
2000
1500
1000
500
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date


GZ-105
Benzene Concentrations vs. Time
Coakley Landfill, North Hampton, NH
y = -0.0013x + 59.006
R² = 0.8089
Concentration (µg/l)
0
2
4
6
8
10
12
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Sample Date
Benzene



NOTES:

1. Aries developed the Institutional Control Zone Area Plan from a plan titled "Study Area Base Map" contained in the May 1994 Management of Migration Remedial Investigation Feasibility Study prepared by Camp Dresser & McKee Inc. of Boston, MA.
2. Approximate property boundary locations are from Town of Greenfield, NH Tax Map R-1, Town of Rye, NH Tax Map 10, Town of North Hampton Tax Map 17 and a Town of North Hampton map titled "Properties Within or Adjacent to the Coakley GMZ".
3. Methane volume percent measurements were collected with a Geotechnical Instrument, Ltd Model GEM-500 Infrared Gas Analyzer.
4. Site feature locations are approximate.

LEGEND:

- M-1 — Landfill gas monitoring probe.
- AA-1 — Ambient air monitoring station.
- 55 — Landfill Gas Vent Discontinued From Sampling Program
- 63 — Landfill Gas Vent
- Chain-link fence.
- Approximate limit of landfill.
- Approximate property boundary based on Town of Greenfield, Rye and North Hampton Tax Maps.
- Railroad tracks.

JOB # 97070E

ARIES ENGINEERING, INC.
environmental engineers and hydrogeologists

TECHNICAL ASSISTANCE SERVICES
COAKLEY LANDFILL
NORTH HAMPTON, NEW HAMPSHIRE

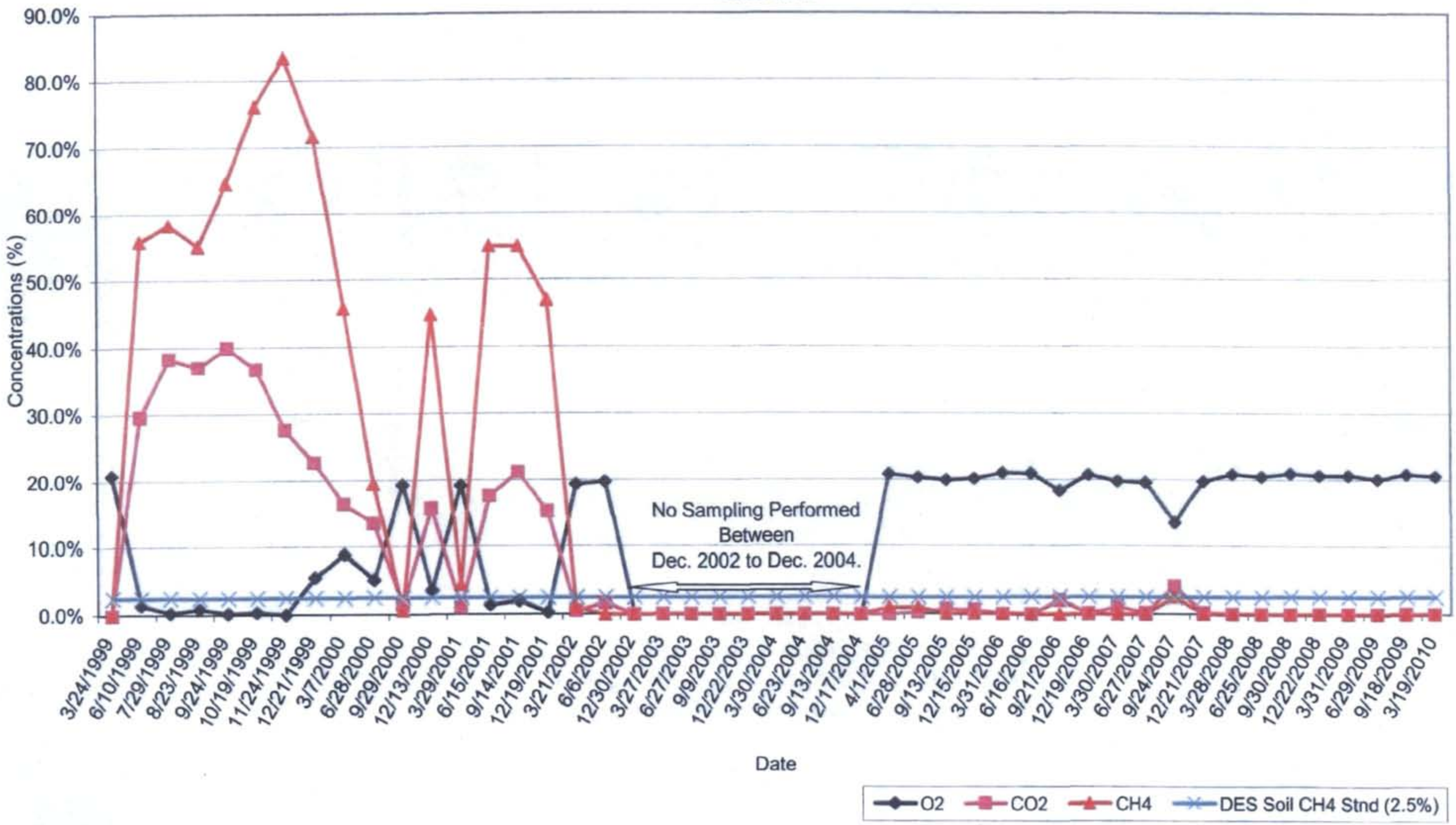
LANDFILL GAS MONITORING LOCATIONS

OCTOBER 2010 FIGURE 1

 97070E.LFG.10.10(1).DWG

PROBE M-1

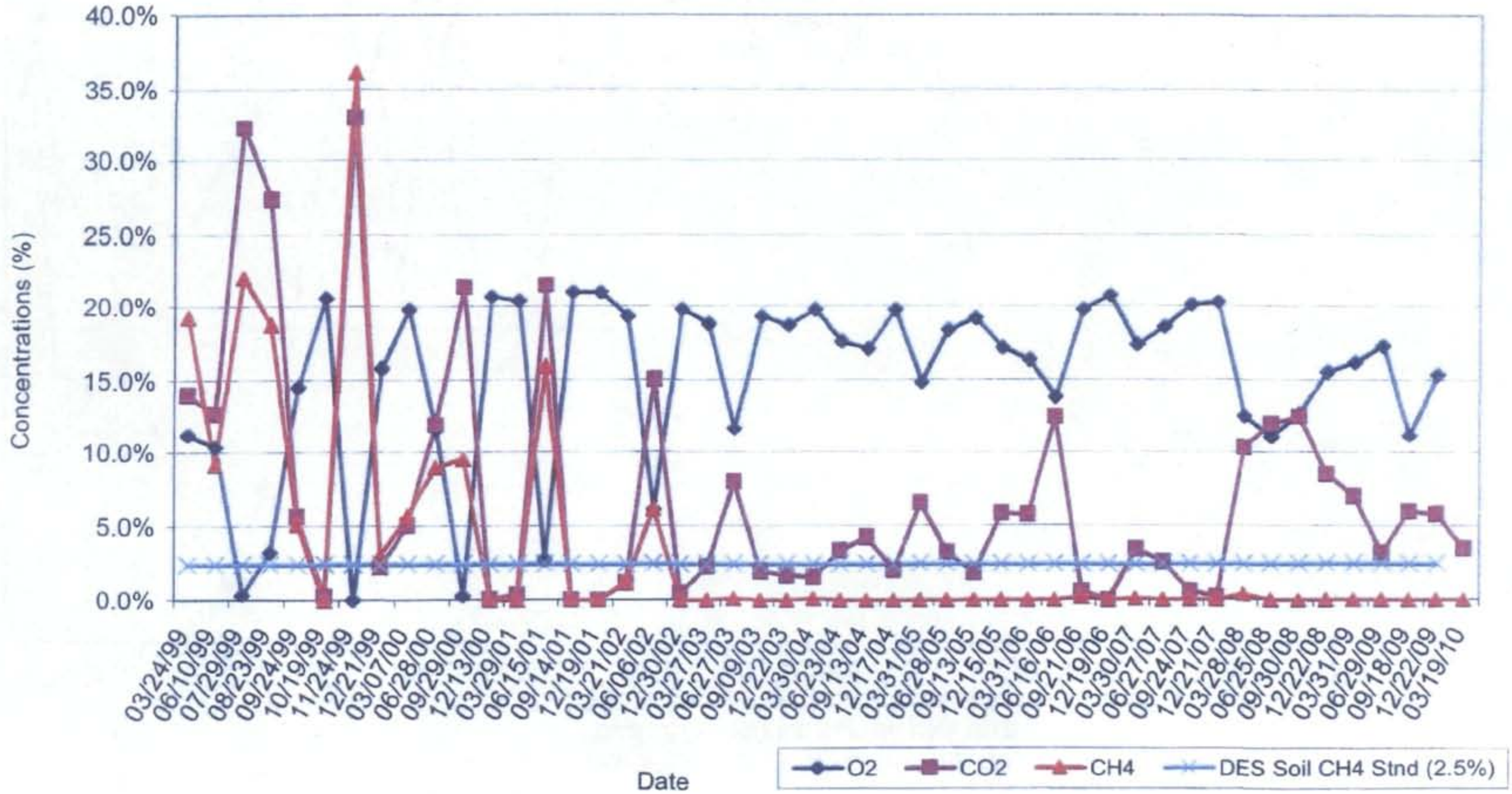
LANDFILL GAS MONITORING TRENDS
COAKLEY LANDFILL SUPERFUND SITE
NORTH HAMPTON, NEW HAMPSHIRE
JUNE 2010



Aries Engineering, Inc.

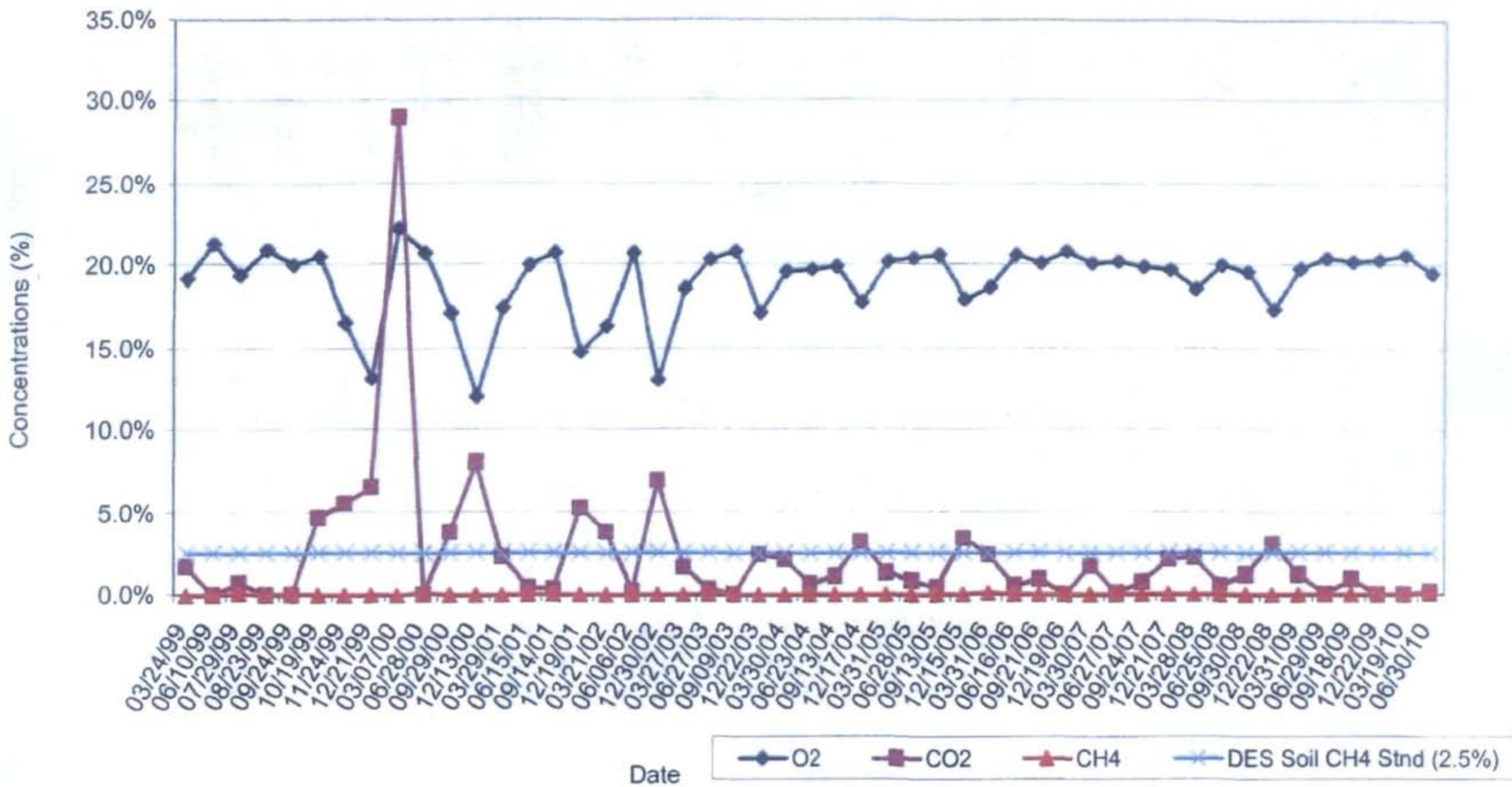
PROBE M-2

LANDFILL GAS MONITORING TRENDS
COAKLEY LANDFILL SUPERFUND SITE
NORTH HAMPTON, NEW HAMPSHIRE
JUNE 2010



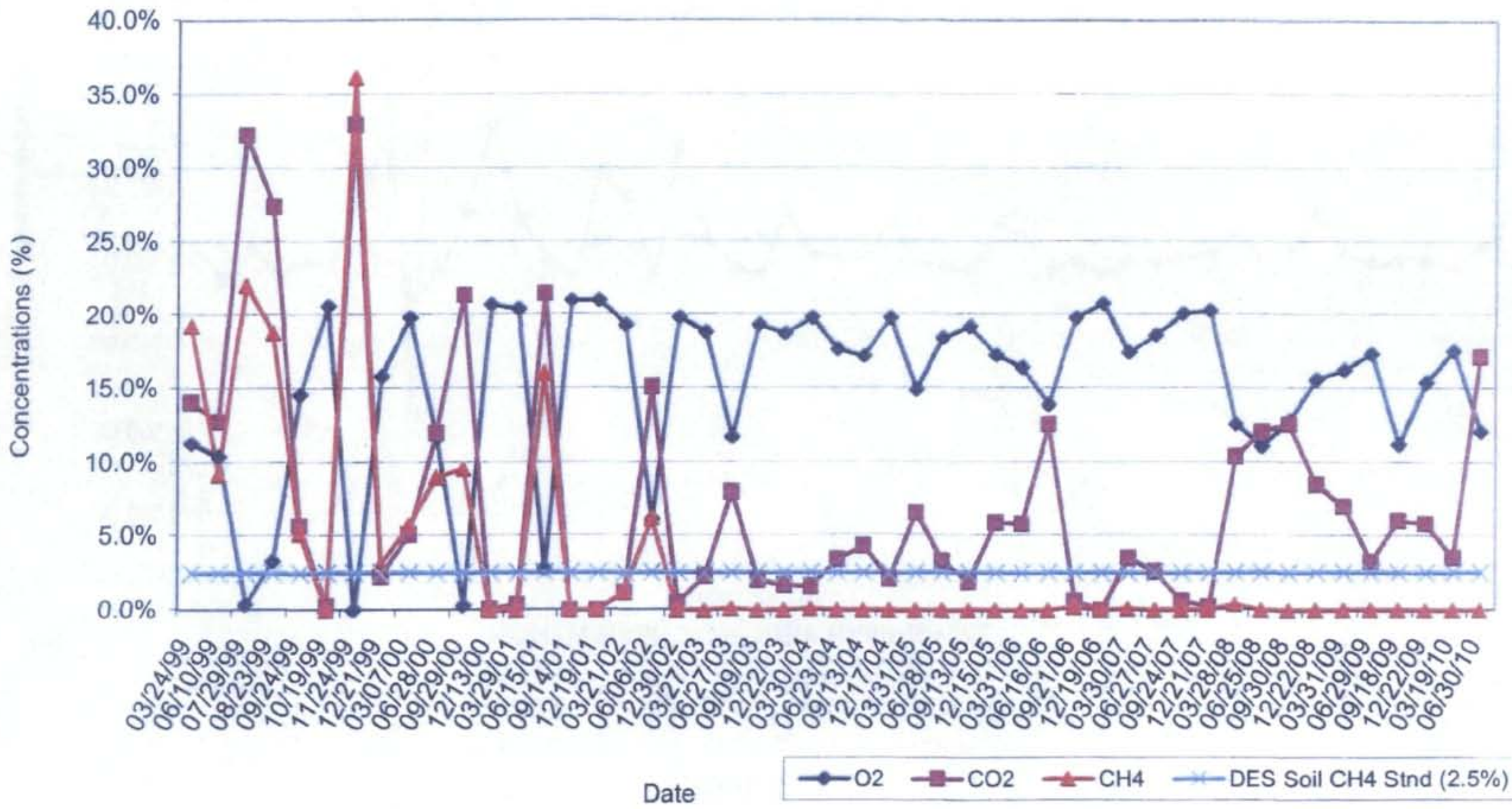
PROBE M-4

LANDFILL GAS MONITORING TRENDS
COAKLEY LANDFILL SUPERFUND SITE
NORTH HAMPTON, NEW HAMPSHIRE
JUNE 2010



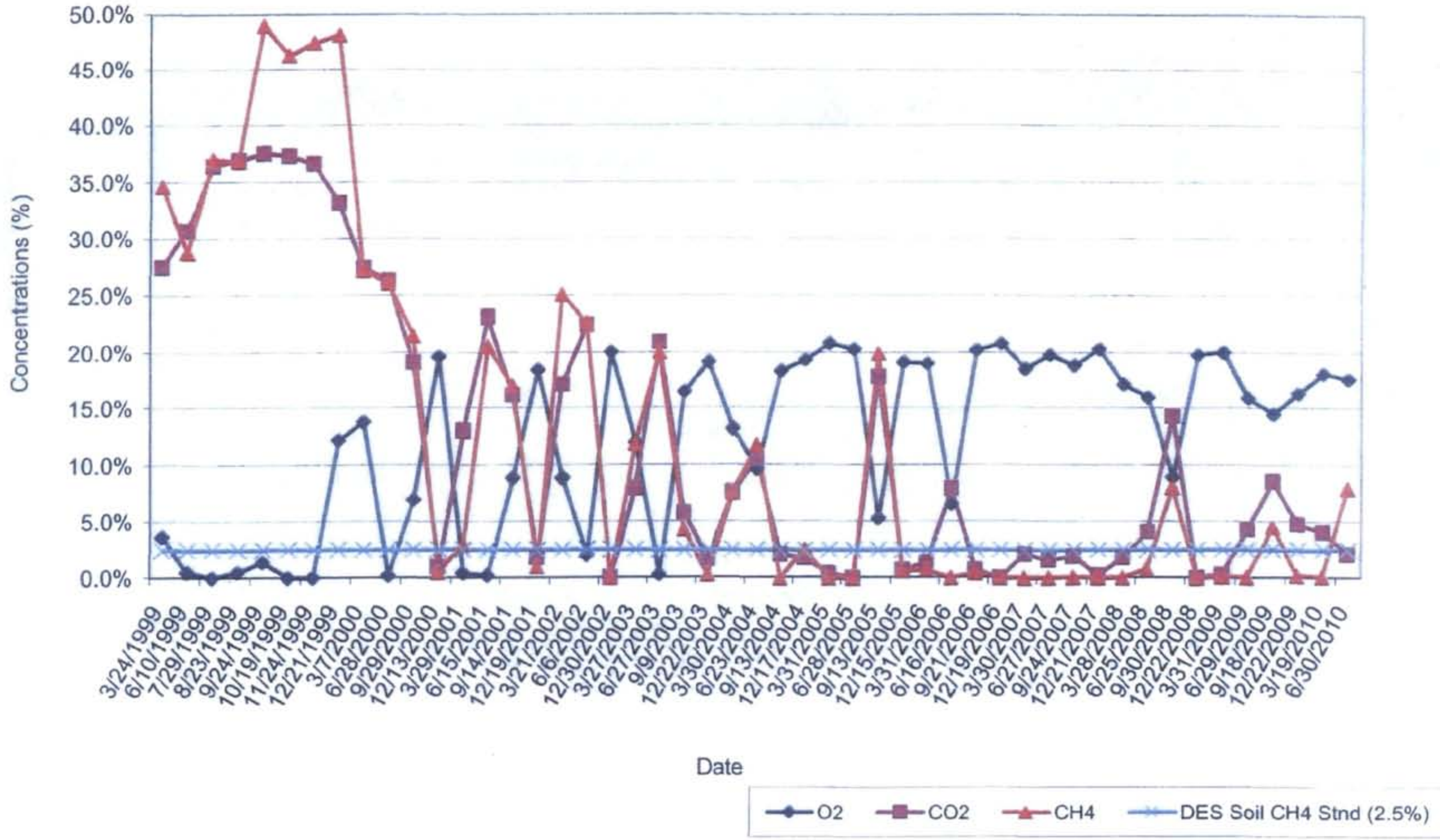
PROBE M-5

LANDFILL GAS MONITORING TRENDS
COAKLEY LANDFILL SUPERFUND SITE
NORTH HAMPTON, NEW HAMPSHIRE
JUNE 2010



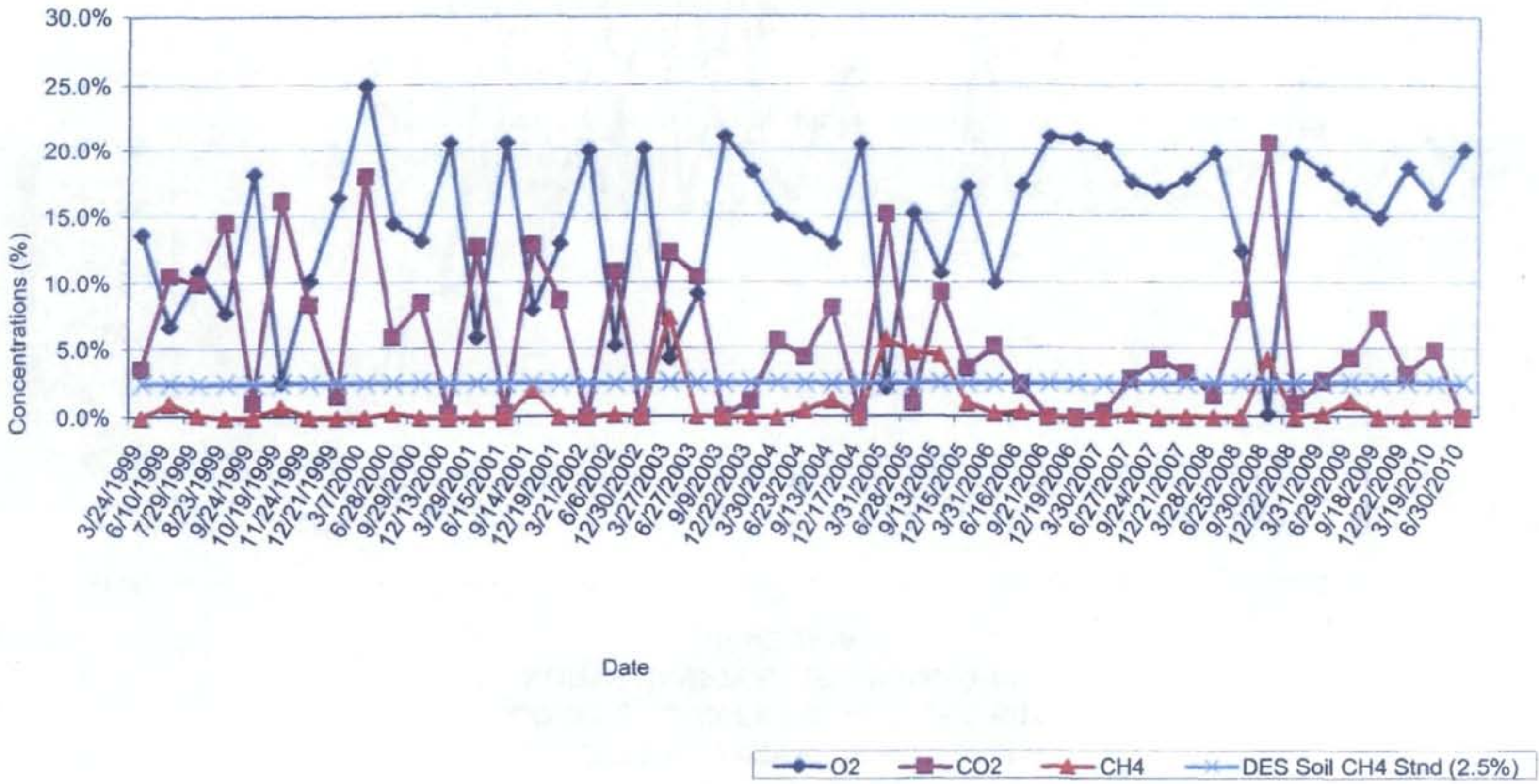
Aries Engineering, Inc.

PROBE M-6
LANDFILL GAS MONITORING TRENDS
COAKLEY LANDFILL SUPERFUND SITE
NORTH HAMPTON, NEW HAMPSHIRE
JUNE 2010



Aries Engineering, Inc.

PROBE M-7
LANDFILL GAS MONITORING TRENDS
COAKLEY LANDFILL SUPERFUND SITE
NORTH HAMPTON, NEW HAMPSHIRE
JUNE 2010



Aries Engineering, Inc.

MANN-KENDALL DATA EVALUATION SUMMARY

	Arsenic		Manganese		Benzene	
Well	Trend	Confidence	Trend	Confidence	Trend	Confidence
BP-4	Decreasing	95	Decreasing	90		
MW-4	Increasing	90	No Trend	Not stable		
MW-5S	Decreasing	70	Increasing	99	Decreasing	99.5
MW-5D	Decreasing	90	Decreasing	99.5	Decreasing	95
MW-6			Decreasing	70		
MW-8	No Trend	Stable	Decreasing	99.5	Decreasing	70
MW-9	Decreasing	75	Increasing	95		
MW-10	No Trend	Stable	Decreasing	95		
MW-11	Decreasing	90	Decreasing	99.5	Decreasing	99.5
OP-2	Decreasing	80	Increasing	97.5		
OP-5	Decreasing	99.5	Decreasing	99.5		
AE-1A	Increasing	99.5				
AE-2A	Decreasing	99	Decreasing	99		
AE-2B	Increasing	97.5	Decreasing	99.5		
AE-3A	Increasing	85	Decreasing	85		
AE-3B	Decreasing	90	Decreasing	99.5		
FPC-5A	Increasing	99.5				
FPC-5B	Increasing	85				
FPC-6A			Increasing	95		
FPC-6B			No Trend	Not stable		
FPC-9A	Decreasing	95	Decreasing	90		
FPC-11B	No Trend	Stable	Decreasing	99		
GZ-105					Decreasing	99.5

Shaded cells are for bedrock wells

Summary

Arsenic		Manganese		Benzene	
Decreasing	10	Decreasing	13	Decreasing	5
Increasing	6	Increasing	4	Increasing	0
No Trend	3	No Trend	2	No Trend	0

MANN-KENDALL DATA EVALUATION

Site Name	Coakley Landfill	NHDES Site #	198712001	Compound =	Arsenic
		EPA ID #	NHD064424153		
	Well ID =	MW-4	MW-5S	MW-9	MW-10
Event Number	Sampling Date (most recent last)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)
1	8/18/99	45	21	180	59
2	11/10/99	51	20	85	11
3	4/19/00	40	24	61	3
4	8/18/00	83	23	88	14
5	11/18/00	60	18	69	10
6	4/1/01	42	21	63	3
7	8/1/01	64	23	150	32
8	8/1/02	41	26	140	28
9	8/1/03	40	10	120	11
10	8/1/04	66	15	60	33
11	8/1/05	130	14	280	24
12	8/1/06	43	10	81	11
13	11/15/07	58	26	56	12
14	8/12/08	69	26	57	9
15	8/19/09	70	18	78	17
16	8/18/10	64	16	120	19
	Mann Kendall Statistic (S) =	32.0	-15.0	-19.0	4.0
	Number of Rounds (n) =	16	16	16	16
	Average =	60.38	19.44	105.50	18.50
	Standard Deviation =	22.745	5.316	59.814	14.213
	Coefficient of Variation(CV)=	0.377	0.274	0.567	0.768
Error Check, Blank if No Errors Detected					
Trend		INCREASING	DECREASING	DECREASING	No Trend
Confidence Level		90%	70%	75%	No Trend
Stability Test, If No Trend Exists at 70% Confidence Level		NA	NA	NA	CV <= 1 STABLE
Entry By =	KMM	Date =	24-Mar-11		

Data entered in yellow cells

MANN-KENDALL DATA EVALUATION

Coakley Landfill	NHDES Site # 198712001		Compound = Arsenic	
	EPA ID # NHD064424153			
Well ID =	MW-4	MW-5S	MW-9	MW-10
Number of tied groups	Count Ties	Count Ties	Count Ties	Count Ties
#tied 2 times	2	4	1	1
#tied 3 times	0	1	0	1
#tied 4 times	0	0	0	0
#tied 5 times	0	0	0	0
#tied 6 times	0	0	0	0
#tied 7 times	0	0	0	0
#tied 8 times	0	0	0	0
#tied 9 times	0	0	0	0
#tied 10 times	0	0	0	0
Count Error?				
n =	16	16	16	16
V(S) =	491.33	485.67	492.33	488.67
S =	32	-15	-19	4
Z =	1.399	-0.635	-0.811	0.136

n = Number of Samples

V(S) = variance of S = 1/18 $[n(n-1)(2n+5) - \sum p=1 \rightarrow g\ \ w_p(w_p-1)(2w_p+5)]$

where g = number of tied groups and w_p represents the number of data points in the p^{th} group

S = Mann-Kendall Statistic, number of increases versus number of decreases in data comparrision

$Z = (S-1)/[V(S)]^{1/2}$ if S>0, Z=0 if S=0, $Z= (S+1)/[V(S)]^{1/2}$ if S<0

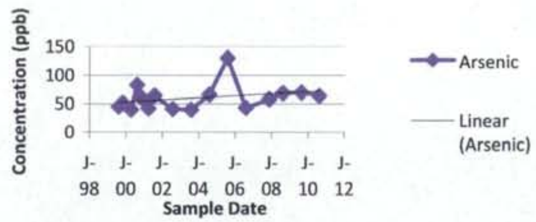
Z is comparred to table of critical values to determine confidence in trend

Trend confidences defined at 99.5%, 99%, 97.5%, 95%, 90%, 85%, 80%, 75%, 70%, and no trend

Mann Kendall Statistic Calculations

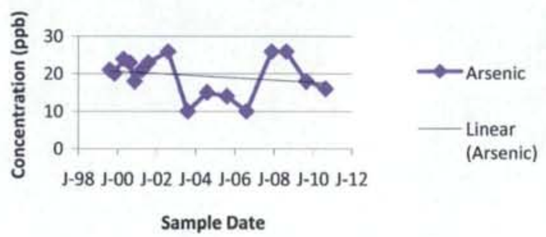
MW-4 | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Arsenic

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
45	51	40	83	60	42	64	41	40	66	130	43	58	69	70	64	Sum Rows
	1	-1	1	1	-1	1	-1	-1	1	1	-1	1	1	1	1	5
		-1	1	1	-1	1	-1	-1	1	1	-1	1	1	1	1	4
			1	1	1	1	1	0	1	1	1	1	1	1	1	12
				-1	-1	-1	-1	-1	-1	1	-1	-1	-1	-1	-1	-10
					-1	1	-1	-1	1	1	-1	-1	1	1	1	1
						1	-1	-1	1	1	1	1	1	1	1	6
							-1	-1	1	1	-1	-1	1	1	0	0
								-1	1	1	1	1	1	1	1	6
									1	1	1	1	1	1	1	7
										1	-1	-1	1	1	-1	0
											-1	-1	-1	-1	-1	-5
												1	1	1	1	4
													1	1	1	3
														1	-1	0
															-1	-1
													Mann Kendall Statistic (S) =			32



MW-5S | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Arsenic

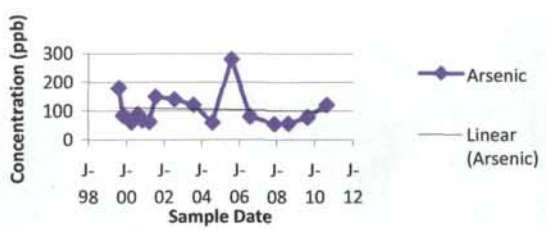
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
21	20	24	23	18	21	23	26	10	15	14	10	26	26	18	16	Sum Rows
	-1	1	1	-1	0	1	1	-1	-1	-1	-1	1	1	-1	-1	-2
		1	1	-1	1	1	1	-1	-1	-1	-1	1	1	-1	-1	0
			-1	-1	-1	-1	1	-1	-1	-1	-1	1	1	-1	-1	-7
				-1	-1	0	1	-1	-1	-1	-1	1	1	-1	-1	-5
					1	1	1	-1	-1	-1	-1	1	1	0	-1	0
						1	1	-1	-1	-1	-1	1	1	-1	-1	-2
							1	-1	-1	-1	-1	1	1	-1	-1	-3
								-1	-1	-1	-1	0	0	-1	-1	-6
									1	1	0	1	1	1	1	6
										-1	-1	1	1	1	1	2
											-1	1	1	1	1	3
												1	1	1	1	4
													0	-1	-1	-2
														-1	-1	-2
															-1	-1
													Mann Kendall Statistic (S) =			-15



Mann Kendall Statistic Calculations

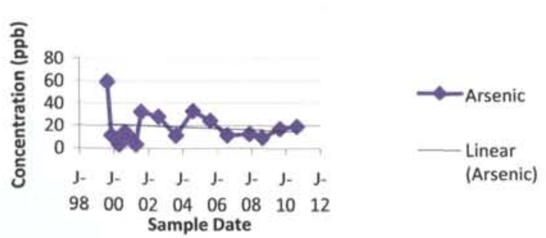
MW-9 Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Arsenic

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
180	85	61	88	69	63	150	140	120	60	280	81	56	57	78	120	Sum Rows
	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1	-1	-1	-13
		-1	1	-1	-1	1	1	1	-1	1	-1	-1	-1	-1	1	-2
			1	1	1	1	1	1	-1	1	1	-1	-1	1	1	7
				-1	-1	1	1	1	-1	1	-1	-1	-1	-1	1	-2
					-1	1	1	1	-1	1	1	-1	-1	1	1	3
						1	1	1	-1	1	1	-1	-1	1	1	4
							-1	-1	-1	1	-1	-1	-1	-1	-1	-7
								-1	-1	1	-1	-1	-1	-1	-1	-6
									-1	1	-1	-1	-1	-1	0	-4
										1	1	-1	-1	1	1	2
											-1	-1	-1	-1	-1	-5
												-1	-1	-1	1	-2
													1	1	1	3
														1	1	2
															1	1
													Mann Kendall Statistic (S) =			-19



MW-10 Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Arsenic

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
59	11	3	14	10	3	32	28	11	33	24	11	12	9	17	19	Sum Rows
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-15
		-1	1	-1	-1	1	1	0	1	1	0	1	-1	1	1	4
			1	1	0	1	1	1	1	1	1	1	1	1	1	12
				-1	-1	1	1	-1	1	1	-1	-1	-1	1	1	0
					-1	1	1	1	1	1	1	1	-1	1	1	7
						1	1	1	1	1	1	1	1	1	1	10
							-1	-1	1	-1	-1	-1	-1	-1	-1	-7
								-1	1	-1	-1	-1	-1	-1	-1	-6
									1	1	0	1	-1	1	1	4
										-1	-1	-1	-1	-1	-1	-6
											-1	-1	-1	-1	-1	-5
												1	-1	1	1	2
													-1	1	1	1
														1	1	2
															1	1
													Mann Kendall Statistic (S) =			4



MANN-KENDALL DATA EVALUATION

Site Name	Coakley Landfill	NHDES Site #	198712001	Compound =	Arsenic
		EPA ID #	NHD064424153		
	Well ID =	OP-2	OP-5	AE-1A	AE-2A
Event Number	Sampling Date (most recent last)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)
1	8/18/99	410	53	14	240
2	11/10/99	1	42	15	360
3	4/19/00	230	51	18	310
4	8/18/00	300	45	15	330
5	11/18/00	200	50	17	290
6	4/1/01	17	27	18	330
7	8/1/01	290	31	17	340
8	8/1/02	260	48	18	290
9	8/1/03	270	46	20	330
10	8/1/04	190	33	22	290
11	8/1/05	25	25	20	300
12	8/1/06	200	27	15	240
13	11/15/07	190	33	39	280
14	8/12/08	170	17	41	230
15	8/19/09	200	13	29	240
16	8/18/10	220	19	20	240
	Mann Kendall Statistic (S) =	-22.0	-74.0	72.0	-54.0
	Number of Rounds (n) =	16	16	16	16
	Average =	198.31	35.00	21.13	290.00
	Standard Deviation =	108.557	13.064	8.197	41.952
	Coefficient of Variation(CV)=	0.547	0.373	0.388	0.145
Error Check, Blank if No Errors Detected					
Trend		DECREASING	DECREASING	INCREASING	DECREASING
Confidence Level		80%	99.5%	99.5%	99%
Stability Test, If No Trend Exists at 70% Confidence Level		NA	NA	NA	NA
Entry By =	KMM	Date =	24-Mar-11		

Data entered in yellow cells

MANN-KENDALL DATA EVALUATION

Coakley Landfill	NHDES Site # 198712001		Compound = Arsenic	
	EPA ID # NHD064424153			
Well ID =	OP-2	OP-5	AE-1A	AE-2A
Number of tied groups	Count Ties	Count Ties	Count Ties	Count Ties
#tied 2 times	1	2	1	0
#tied 3 times	1	0	3	2
#tied 4 times	0	0	0	1
#tied 5 times	0	0	0	0
#tied 6 times	0	0	0	0
#tied 7 times	0	0	0	0
#tied 8 times	0	0	0	0
#tied 9 times	0	0	0	0
#tied 10 times	0	0	0	0
Count Error?				
n =	16	16	16	16
V(S) =	488.67	491.33	481.33	477.33
S =	-22	-74	72	-54
Z =	-0.950	-3.293	3.236	-2.426

n = Number of Samples

V(S) = variance of S = 1/18 $[n(n-1)(2n+5) - \sum p=1 \rightarrow g\ \ w_p(w_p-1)(2w_p+5)]$

where g = number of tied groups and w_p represents the number of data points in the p^{th} group

S = Mann-Kendall Statistic, number of increases versus number of decreases in data comparrision

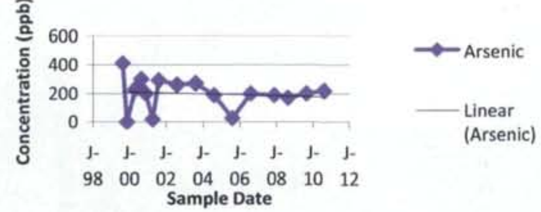
$Z = (S-1)/[V(S)]^{1/2}$ if S>0, Z=0 if S=0, $Z= (S+1)/[V(S)]^{1/2}$ if S<0

Z is comparred to table of critical values to determine confidence in trend

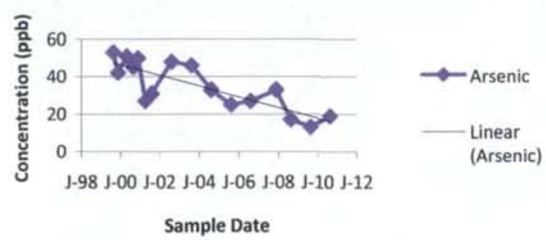
Trend confidences defined at 99.5%, 99%, 97.5%, 95%, 90%, 85%, 80%, 75%, 70%, and no trend

Mann Kendall Statistic Calculations

OP-2		Site = Coakley Landfill				NHDES#: 198712001			EPA ID #: NHD064424153					Compound = Arsenic		
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
410	1	230	300	200	17	290	260	270	190	25	200	190	170	200	220	Sum Rows
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-15
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
			1	-1	-1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-5
				-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-12
					-1	1	1	1	-1	-1	0	-1	-1	0	1	-1
						1	1	1	1	1	1	1	1	1	1	10
							-1	-1	-1	-1	-1	-1	-1	-1	-1	-9
								1	-1	-1	-1	-1	-1	-1	-1	-6
									-1	-1	-1	-1	-1	-1	-1	-7
										-1	1	0	-1	1	1	1
											1	1	1	1	1	5
												-1	-1	0	1	-1
													-1	1	1	1
														1	1	2
															1	1
													Mann Kendall Statistic (S) =			-22



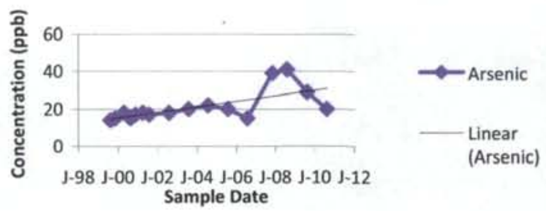
OP-5		Site = Coakley Landfill				NHDES#: 198712001			EPA ID #: NHD064424153					Compound = Arsenic		
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
53	42	51	45	50	27	31	48	46	33	25	27	33	17	13	19	Sum Rows
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-15
		1	1	1	-1	-1	1	1	-1	-1	-1	-1	-1	-1	-1	-4
			-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-13
				1	-1	-1	1	1	-1	-1	-1	-1	-1	-1	-1	-6
					-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-11
						1	1	1	1	-1	0	1	-1	-1	-1	1
							1	1	1	-1	-1	1	-1	-1	-1	-1
								-1	-1	-1	-1	-1	-1	-1	-1	-8
									-1	-1	-1	-1	-1	-1	-1	-7
										-1	-1	0	-1	-1	-1	-5
											1	1	-1	-1	-1	-1
												1	-1	-1	-1	-2
													-1	-1	-1	-3
														-1	1	0
															1	1
													Mann Kendall Statistic (S) =			-74



Mann Kendall Statistic Calculations

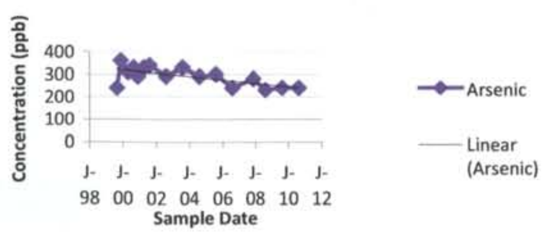
AE-1A | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Arsenic

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
14	15	18	15	17	18	17	18	20	22	20	15	39	41	29	20	Sum Rows
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
		1	0	1	1	1	1	1	1	1	0	1	1	1	1	12
			-1	-1	0	-1	0	1	1	1	-1	1	1	1	1	3
				1	1	1	1	1	1	1	0	1	1	1	1	11
					1	0	1	1	1	1	-1	1	1	1	1	8
						-1	0	1	1	1	-1	1	1	1	1	5
							1	1	1	1	-1	1	1	1	1	7
								1	1	1	-1	1	1	1	1	6
									1	0	-1	1	1	1	0	3
										-1	-1	1	1	1	-1	0
											-1	1	1	1	0	2
												1	1	1	1	4
													1	-1	-1	-1
														-1	-1	-2
															-1	-1
													Mann Kendall Statistic (S) =			72



AE-2A | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Arsenic

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
240	360	310	330	290	330	340	290	330	290	300	240	280	230	240	240	Sum Rows
	1	1	1	1	1	1	1	1	1	1	0	1	-1	0	0	10
		-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-14
			1	-1	1	1	-1	1	-1	-1	-1	-1	-1	-1	-1	-5
				-1	0	1	-1	0	-1	-1	-1	-1	-1	-1	-1	-8
					1	1	0	1	0	1	-1	-1	-1	-1	-1	-1
						1	-1	0	-1	-1	-1	-1	-1	-1	-1	-7
							-1	-1	-1	-1	-1	-1	-1	-1	-1	-9
								1	0	1	-1	-1	-1	-1	-1	-3
									-1	-1	-1	-1	-1	-1	-1	-7
										1	-1	-1	-1	-1	-1	-4
											-1	-1	-1	-1	-1	-5
												1	-1	0	0	0
													-1	-1	-1	-3
														1	1	2
															0	0
													Mann Kendall Statistic (S) =			-54



MANN-KENDALL DATA EVALUATION

Site Name	Coakley Landfill	NHDES Site #	198712001	Compound =	Arsenic
		EPA ID #	NHD064424153		
	Well ID =	AE-3A	FPC-5A	FPC-9A	
Event Number	Sampling Date (most recent last)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)
1	8/18/99	150	30	81	
2	11/10/99	92	34	18	
3	4/19/00	87	27	60	
4	8/18/00	130	40	70	
5	11/18/00	100	0.5		
6	4/1/01	90	1	53	
7	8/1/01	130	46	65	
8	8/1/02	110	54	79	
9	8/1/03	110	8	64	
10	8/1/04	110	45	2	
11	8/1/05	120	65	2	
12	8/1/06	100	42	44	
13	11/15/07	130	53	37	
14	8/12/08	150	54	26	
15	8/19/09	120	53	34	
16	8/18/10	120	55	35	
	Mann Kendall Statistic (S) =	27.0	60.0	-38.0	0.0
	Number of Rounds (n) =	16	16	15	0
	Average =	115.56	37.97	44.67	#DIV/0!
	Standard Deviation =	19.422	19.982	25.634	#DIV/0!
	Coefficient of Variation(CV)=	0.168	0.526	0.574	#DIV/0!
Error Check, Blank if No Errors Detected					n<4
Trend		INCREASING	INCREASING	DECREASING	n<4
Confidence Level		85%	99.5%	95%	n<4
Stability Test, If No Trend Exists at 70% Confidence Level		NA	NA	NA	n<4 n<4
Entry By =	KMM	Date =	24-Mar-11		

Data entered in yellow cells

MANN-KENDALL DATA EVALUATION

Coakley Landfill	NHDES Site # 198712001		Compound = Arsenic	
	EPA ID # NHD064424153			
Well ID =	AE-3A	FPC-5A	FPC-9A	0
Number of tied groups	Count Ties	Count Ties	Count Ties	No Ties
#tied 2 times	2	2	1	0
#tied 3 times	3	0	0	0
#tied 4 times	0	0	0	0
#tied 5 times	0	0	0	0
#tied 6 times	0	0	0	0
#tied 7 times	0	0	0	0
#tied 8 times	0	0	0	0
#tied 9 times	0	0	0	0
#tied 10 times	0	0	0	0
Count Error?				
n =	16	16	15	0
V(S) =	480.33	491.33	407.33	0.00
S =	27	60	-38	0
Z =	1.186	2.662	-1.833	0.000

n = Number of Samples

V(S) = variance of S = 1/18 $[n(n-1)(2n+5) - \sum p=1 \rightarrow g \ w_p(w_p-1)(2w_p+5)]$

where g = number of tied groups and w_p represents the number of data points in the p^{th} group

S = Mann-Kendall Statistic, number of increases versus number of decreases in data comparrision

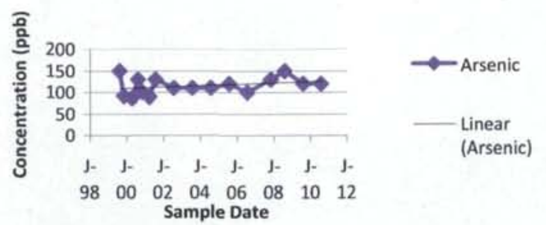
$Z = (S-1)/[V(S)]^{1/2}$ if S>0, Z=0 if S=0, $Z= (S+1)/[V(S)]^{1/2}$ if S<0

Z is comparred to table of critical values to determine confidence in trend

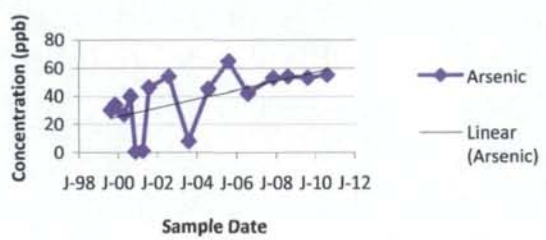
Trend confidences defined at 99.5%, 99%, 97.5%, 95%, 90%, 85%, 80%, 75%, 70%, and no trend

Mann Kendall Statistic Calculations

AE-3A		Site = Coakley Landfill				NHDES#: 198712001			EPA ID #: NHD064424153						Compound = Arsenic	
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
150	92	87	130	100	90	130	110	110	110	120	100	130	150	120	120	Sum Rows
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-14
		-1	1	1	-1	1	1	1	1	1	1	1	1	1	1	10
			1	1	1	1	1	1	1	1	1	1	1	1	1	13
				-1	-1	0	-1	-1	-1	-1	-1	0	1	-1	-1	-8
					-1	1	1	1	1	1	0	1	1	1	1	8
						1	1	1	1	1	1	1	1	1	1	10
							-1	-1	-1	-1	-1	0	1	-1	-1	-6
								0	0	1	-1	1	1	1	1	4
									0	1	-1	1	1	1	1	4
										1	-1	1	1	1	1	4
											-1	1	1	0	0	1
												1	1	1	1	4
													1	-1	-1	-1
														-1	-1	-2
															0	0
													Mann Kendall Statistic (S) =			27

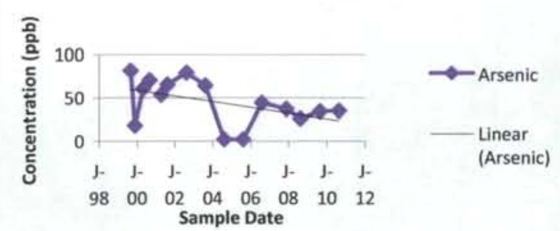


FPC-5A		Site = Coakley Landfill				NHDES#: 198712001			EPA ID #: NHD064424153						Compound = Arsenic	
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
30	34	27	40	1	1	46	54	8	45	65	42	53	54	53	55	Sum Rows
	1	-1	1	-1	-1	1	1	-1	1	1	1	1	1	1	1	7
		-1	1	-1	-1	1	1	-1	1	1	1	1	1	1	1	6
			1	-1	-1	1	1	-1	1	1	1	1	1	1	1	7
				-1	-1	1	1	-1	1	1	1	1	1	1	1	6
					1	1	1	1	1	1	1	1	1	1	1	11
						1	1	1	1	1	1	1	1	1	1	10
							1	-1	-1	1	-1	1	1	1	1	3
								-1	-1	1	-1	-1	0	-1	1	-3
									1	1	1	1	1	1	1	7
										1	-1	1	1	1	1	4
											-1	-1	-1	-1	-1	-5
												1	1	1	1	4
													1	0	1	2
														-1	1	0
															1	1
													Mann Kendall Statistic (S) =			60

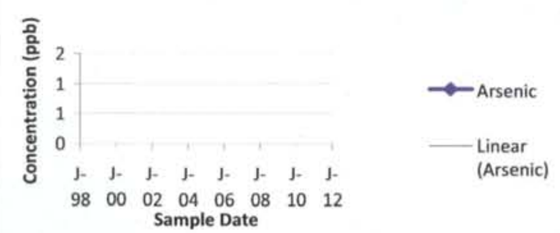


Mann Kendall Statistic Calculations

FPC-9A	Site = Coakley Landfill			NHDES#: 198712001			EPA ID #: NHD064424153							Compound = Arsenic		
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
81	18	60	70		53	65	79	64	2	2	44	37	26	34	35	Sum Rows
	-1	-1	-1		-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-14
		1	1		1	1	1	1	-1	-1	1	1	1	1	1	9
			1		-1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-4
					-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-9
																0
						1	1	1	-1	-1	-1	-1	-1	-1	-1	-4
							1	-1	-1	-1	-1	-1	-1	-1	-1	-7
								-1	-1	-1	-1	-1	-1	-1	-1	-8
									-1	-1	-1	-1	-1	-1	-1	-7
										0	1	1	1	1	1	5
											1	1	1	1	1	5
												-1	-1	-1	-1	-4
													-1	-1	-1	-3
														1	1	2
															1	1
													Mann Kendall Statistic (S) =			-38



0	Site = Coakley Landfill			NHDES#: 198712001			EPA ID #: NHD064424153							Compound = Arsenic		
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
																Sum Rows
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
													Mann Kendall Statistic (S) =			0



MANN-KENDALL DATA EVALUATION

Site Name	Coakley Landfill	NHDES Site #	198712001	Compound =	Arsenic
		EPA ID #	NHD064424153		

	Well ID =	BP-4	MW-5D	MW-8	MW-11
Event Number	Sampling Date (most recent last)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)
1	8/18/99	36	7	8	16
2	11/10/99	34	8	10	14
3	4/19/00	32	10	7	14
4	8/18/00	43	10	7	12
5	11/18/00	35	9	10	10
6	4/1/01	20	7	11	14
7	8/1/01	31	8	43	20
8	8/1/02	36	6	9	17
9	8/1/03	32	7	8	15
10	8/1/04	22	5	6	11
11	8/1/05	11	6	10	12
12	8/1/06	26	5	7	10
13	11/15/07	30	11	10	15
14	8/12/08	23	5	8	13
15	8/19/09	22	6	8	11
16	8/18/10	34	10	13	11
	Mann Kendall Statistic (S) =	-44.0	-31.0	7.0	-33.0
	Number of Rounds (n) =	16	16	16	16
	Average =	29.19	7.50	10.94	13.44
	Standard Deviation =	7.960	2.000	8.737	2.756
	Coefficient of Variation(CV)=	0.273	0.267	0.799	0.205

Error Check, Blank if No Errors Detected

Trend	DECREASING	DECREASING	No Trend	DECREASING
Confidence Level	95%	90%	No Trend	90%
Stability Test, If No Trend Exists at 70% Confidence Level	NA	NA	**CV <= 1 STABLE**	NA

Entry By = KMM | Date = 24-Mar-11

Data entered in yellow cells

MANN-KENDALL DATA EVALUATION

Coakley Landfill	NHDES Site # 198712001		Compound = Arsenic	
	EPA ID # NHD064424153			
Well ID =	BP-4	MW-5D	MW-8	MW-11
Number of tied groups	Count Ties	Count Ties	Count Ties	Count Ties
#tied 2 times	4	1	0	3
#tied 3 times	0	4	1	2
#tied 4 times	0	0	2	0
#tied 5 times	0	0	0	0
#tied 6 times	0	0	0	0
#tied 7 times	0	0	0	0
#tied 8 times	0	0	0	0
#tied 9 times	0	0	0	0
#tied 10 times	0	0	0	0
Count Error?				
n =	16	16	16	16
V(S) =	489.33	477.67	472.33	483.00
S =	-44	-31	7	-33
Z =	-1.944	-1.373	0.276	-1.456

n = Number of Samples

V(S) = variance of S = 1/18 $[n(n-1)(2n+5) - \sum p=1 \rightarrow g\ \ w_p(w_p-1)(2w_p+5)]$

where g = number of tied groups and w_p represents the number of data points in the p^{th} group

S = Mann-Kendall Statistic, number of increases versus number of decreases in data comparrision

$Z = (S-1)/[V(S)]^{1/2}$ if S>0, Z=0 if S=0, $Z= (S+1)/[V(S)]^{1/2}$ if S<0

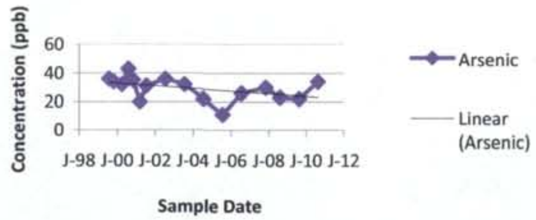
Z is comparred to table of critical values to determine confidence in trend

Trend confidences defined at 99.5%, 99%, 97.5%, 95%, 90%, 85%, 80%, 75%, 70%, and no trend

Mann Kendall Statistic Calculations

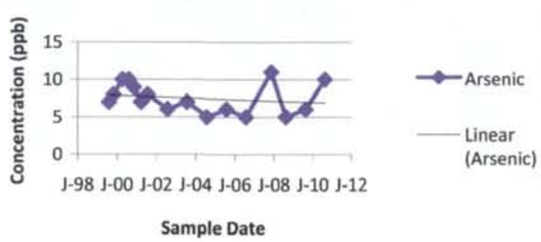
BP-4 | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Arsenic

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
36	34	32	43	35	20	31	36	32	22	11	26	30	23	22	34	Sum Rows
	-1	-1	1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-12
		-1	1	1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	0	-7
			1	1	-1	-1	1	0	-1	-1	-1	-1	-1	-1	1	-4
				-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-12
					-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-9
						1	1	1	1	-1	1	1	1	1	1	8
							1	1	-1	-1	-1	-1	-1	-1	1	-3
								-1	-1	-1	-1	-1	-1	-1	-1	-8
									-1	-1	-1	-1	-1	-1	1	-5
										-1	1	1	1	0	1	3
											1	1	1	1	1	5
												1	-1	-1	1	0
													-1	-1	1	-1
														-1	1	0
															1	1
													Mann Kendall Statistic (S) =			-44



MW-5D | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Arsenic

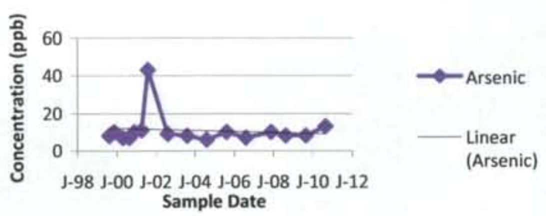
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
7	8	10	10	9	7	8	6	7	5	6	5	11	5	6	10	Sum Rows
	1	1	1	1	0	1	-1	0	-1	-1	-1	1	-1	-1	1	1
		1	1	1	-1	0	-1	-1	-1	-1	-1	1	-1	-1	1	-3
			0	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	0	-9
				-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	0	-9
					-1	-1	-1	-1	-1	-1	-1	1	-1	-1	1	-7
						1	-1	0	-1	-1	-1	1	-1	-1	1	-3
							-1	-1	-1	-1	-1	1	-1	-1	1	-5
								1	-1	0	-1	1	-1	0	1	0
									-1	-1	-1	1	-1	-1	1	-3
										1	0	1	0	1	1	4
											-1	1	-1	0	1	0
												1	0	1	1	3
													-1	-1	-1	-3
														1	1	2
															1	1
													Mann Kendall Statistic (S) =			-31



Mann Kendall Statistic Calculations

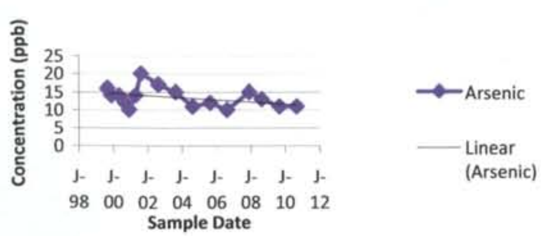
MW-8 Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Arsenic

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
8	10	7	7	10	11	43	9	8	6	10	7	10	8	8	13	Sum Rows
	1	-1	-1	1	1	1	1	0	-1	1	-1	1	0	0	1	4
		-1	-1	0	1	1	-1	-1	-1	0	-1	0	-1	-1	1	-5
			0	1	1	1	1	1	-1	1	0	1	1	1	1	9
				1	1	1	1	1	-1	1	0	1	1	1	1	9
					1	1	-1	-1	-1	0	-1	0	-1	-1	1	-3
						1	-1	-1	-1	-1	-1	-1	-1	-1	1	-6
							-1	-1	-1	-1	-1	-1	-1	-1	-1	-9
								-1	-1	1	-1	1	-1	-1	1	-2
									-1	1	-1	1	0	0	1	1
										1	1	1	1	1	1	6
											-1	0	-1	-1	1	-2
												1	1	1	1	4
													-1	-1	1	-1
														0	1	1
															1	1
													Mann Kendall Statistic (S) =			7



MW-11 Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Arsenic

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
16	14	14	12	10	14	20	17	15	11	12	10	15	13	11	11	Sum Rows
	-1	-1	-1	-1	-1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-11
		0	-1	-1	0	1	1	1	-1	-1	-1	1	-1	-1	-1	-4
			-1	-1	0	1	1	1	-1	-1	-1	1	-1	-1	-1	-4
				-1	1	1	1	1	-1	0	-1	1	1	-1	-1	1
					1	1	1	1	1	1	0	1	1	1	1	10
						1	1	1	-1	-1	-1	1	-1	-1	-1	-2
							-1	-1	-1	-1	-1	-1	-1	-1	-1	-9
								-1	-1	-1	-1	-1	-1	-1	-1	-8
									-1	-1	-1	0	-1	-1	-1	-6
										1	-1	1	1	0	0	2
											-1	1	1	-1	-1	-1
												1	1	1	1	4
													-1	-1	-1	-3
														-1	-1	-2
															0	0
													Mann Kendall Statistic (S) =			-33



MANN-KENDALL DATA EVALUATION

Site Name	Coakley Landfill	NHDES Site #	198712001	Compound =	Arsenic
		EPA ID #	NHD064424153		

Event Number	Sampling Date (most recent last)	Well ID = AE-2B Concentration (leave blank if no data)	AE-3B Concentration (leave blank if no data)	FPC-5B Concentration (leave blank if no data)	FPC-11B Concentration (leave blank if no data)
1	8/18/99	13	120	0.5	
2	11/10/99	11	100	0.5	
3	4/19/00	7	91	0.5	
4	8/18/00	8	82	0.5	
5	11/18/00	26	93	31	
6	4/1/01	13	83	34	
7	8/1/01	16	110	2	
8	8/1/02	11	73	1	
9	8/1/03	18	84	38	30
10	8/1/04	16	92	0.5	8
11	8/1/05	25	78	4	11
12	8/1/06	24	91	0.5	6
13	11/15/07	20	82	4	9
14	8/12/08	19	95	1	8
15	8/19/09	26	91	1	10
16	8/18/10	16	79	3	10
	Mann Kendall Statistic (S) =	52.0	-32.0	23.0	-2.0
	Number of Rounds (n) =	16	16	16	8
	Average =	16.81	90.25	7.63	11.50
	Standard Deviation =	6.199	12.130	13.367	7.635
	Coefficient of Variation(CV)=	0.369	0.134	1.753	0.664

Error Check, Blank if No Errors Detected

Trend	INCREASING	DECREASING	INCREASING	No Trend
Confidence Level	97.5%	90%	85%	No Trend
Stability Test, If No Trend Exists at 70% Confidence Level	NA	NA	NA	CV <= 1 STABLE

Entry By =	KMM	Date =	24-Mar-11

Data entered in yellow cells

MANN-KENDALL DATA EVALUATION

Coakley Landfill	NHDES Site # 198712001		Compound = Arsenic	
	EPA ID # NHD064424153			
Well ID =	AE-2B	AE-3B	FPC-5B	FPC-11B
Number of tied groups	Count Ties	Count Ties	Count Ties	Count Ties
#tied 2 times	3	1	1	2
#tied 3 times	1	1	1	0
#tied 4 times	0	0	0	0
#tied 5 times	0	0	0	0
#tied 6 times	0	0	1	0
#tied 7 times	0	0	1	0
#tied 8 times	0	0	0	0
#tied 9 times	0	0	0	0
#tied 10 times	0	0	0	0
Count Error?				
n =	16	16	16	8
V(S) =	486.67	488.67	449.33	63.33
S =	52	-32	23	-2
Z =	2.312	-1.402	1.038	-0.126

n = Number of Samples

V(S) = variance of S = 1/18 $[n(n-1)(2n+5) - \sum p=1 \rightarrow g \ w_p(w_p-1)(2w_p+5)]$

where g = number of tied groups and w_p represents the number of data points in the p^{th} group

S = Mann-Kendall Statistic, number of increases versus number of decreases in data comparrision

$Z = (S-1)/[V(S)]^{1/2}$ if S>0, Z=0 if S=0, $Z= (S+1)/[V(S)]^{1/2}$ if S<0

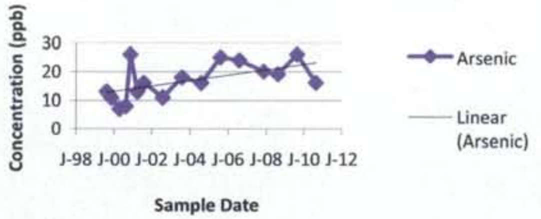
Z is comparred to table of critical values to determine confidence in trend

Trend confidences defined at 99.5%, 99%, 97.5%, 95%, 90%, 85%, 80%, 75%, 70%, and no trend

Mann Kendall Statistic Calculations

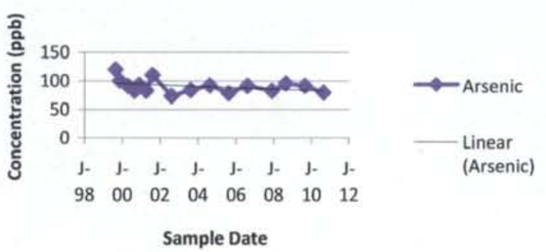
AE-2B | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Arsenic

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
13	11	7	8	26	13	16	11	18	16	25	24	20	19	26	16	Sum Rows
	-1	-1	-1	1	0	1	-1	1	1	1	1	1	1	1	1	6
		-1	-1	1	1	1	0	1	1	1	1	1	1	1	1	9
			1	1	1	1	1	1	1	1	1	1	1	1	1	13
				1	1	1	1	1	1	1	1	1	1	1	1	12
					-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-10
						1	-1	1	1	1	1	1	1	1	1	8
							-1	1	0	1	1	1	1	1	0	5
								1	1	1	1	1	1	1	1	8
									-1	1	1	1	1	1	-1	3
										1	1	1	1	1	0	5
											-1	-1	-1	1	-1	-3
												-1	-1	1	-1	-2
													-1	1	-1	-1
														1	-1	0
															-1	-1
													Mann Kendall Statistic (S) =			52



AE-3B | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Arsenic

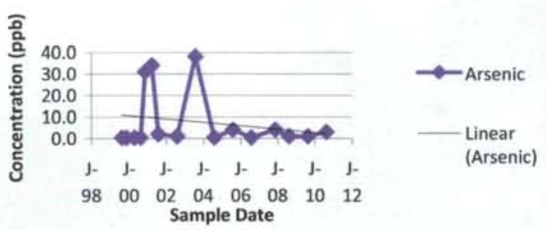
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
120	100	91	82	93	83	110	73	84	92	78	91	82	95	91	79	Sum Rows
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-15
		-1	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-12
			-1	1	-1	1	-1	-1	1	-1	0	-1	1	0	-1	-3
				1	1	1	-1	1	1	-1	1	0	1	1	-1	5
					-1	1	-1	-1	-1	-1	-1	-1	1	-1	-1	-7
						1	-1	1	1	-1	1	-1	1	1	-1	2
							-1	-1	-1	-1	-1	-1	-1	-1	-1	-9
								1	1	1	1	1	1	1	1	8
									1	-1	1	-1	1	1	-1	1
										-1	-1	-1	1	-1	-1	-4
											1	1	1	1	1	5
												-1	1	0	-1	-1
													1	1	-1	1
														-1	-1	-2
															-1	-1
													Mann Kendall Statistic (S) =			-32



Mann Kendall Statistic Calculations

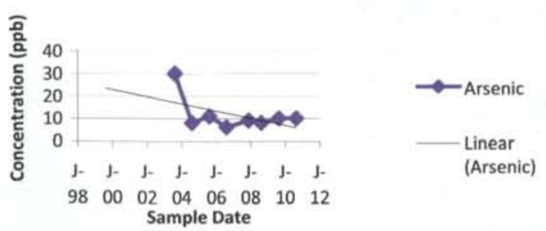
FPC-5B Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Arsenic

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
1	1	1	1	31	34	2	1	38	1	4	1	4	1	1	3	Sum Rows
	0	0	0	1	1	1	1	1	0	1	0	1	1	1	1	10
		0	0	1	1	1	1	1	0	1	0	1	1	1	1	10
			0	1	1	1	1	1	0	1	0	1	1	1	1	10
				1	1	1	1	1	0	1	0	1	1	1	1	10
					1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-7
						-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-8
							-1	1	-1	1	-1	1	-1	-1	1	-1
								1	-1	1	-1	1	0	0	1	2
									-1	-1	-1	-1	-1	-1	-1	-7
										1	0	1	1	1	1	5
											-1	0	-1	-1	-1	-4
												1	1	1	1	4
													-1	-1	-1	-3
														0	1	1
															1	1
													Mann Kendall Statistic (S) =			23



FPC-11B Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Arsenic

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
								30	8	11	6	9	8	10	10	Sum Rows
																0
																0
																0
																0
																0
																0
																0
																0
									-1	-1	-1	-1	-1	-1	-1	-7
										1	-1	1	0	1	1	3
											-1	-1	-1	-1	-1	-5
												1	1	1	1	4
													-1	1	1	1
														1	1	2
															0	0
													Mann Kendall Statistic (S) =			-2



MANN-KENDALL DATA EVALUATION

Site Name	Coakley Landfill	NHDES Site #	198712001	Compound =	Manganese
		EPA ID #	NHD064424153		

Event Number	Sampling Date (most recent last)	MW-4 Concentration (leave blank if no data)	MW-5S Concentration (leave blank if no data)	MW-9 Concentration (leave blank if no data)	MW-10 Concentration (leave blank if no data)
	Well ID =	MW-4	MW-5S	MW-9	MW-10
1	8/18/99	1,400	2,700	950	5,400
2	11/10/99	1,300	3,000	1,400	8,600
3	4/19/00	1,700	2,800	1,200	2,700
4	8/18/00	1,400	3,100	1,000	3,600
5	11/18/00	1,500	3,400	1,100	1,900
6	4/1/01	1,600	3,100	880	910
7	8/1/01	1,400	3,200	1,000	3,900
8	8/1/02	1,300	3,500	1,100	4,400
9	8/1/03	1,700	4,100	1,300	8,100
10	8/1/04	1,400	3,800	1,100	3,900
11	8/1/05	13,000	3,600	710	3,500
12	8/1/06	4,500	3,700	2,400	3,200
13	11/15/07	5,900	4,400	1,200	2,800
14	8/12/08	5,800	3,900	3,500	760
15	8/19/09	1,200	3,400	2,100	2,200
16	8/18/10	1,100	2,900	1,400	2,700

	MW-4	MW-5S	MW-9	MW-10
Mann Kendall Statistic (S) =	12.0	58.0	40.0	-42.0
Number of Rounds (n) =	16	16	16	16
Average =	2887.50	3412.50	1396.25	3660.63
Standard Deviation =	3149.153	484.252	708.462	2188.346
Coefficient of Variation(CV)=	1.091	0.142	0.507	0.598

Error Check, Blank if No Errors Detected

	MW-4	MW-5S	MW-9	MW-10
Trend	No Trend	INCREASING	INCREASING	DECREASING
Confidence Level	No Trend	99%	95%	95%
Stability Test, If No Trend Exists at 70% Confidence Level	CV > 1 NON-STABLE	NA	NA	NA

Entry By =	KMM	Date =	24-Mar-11

Data entered in yellow cells

MANN-KENDALL DATA EVALUATION

Coakley Landfill	NHDES Site # 198712001		Compound = Manganese	
	EPA ID # NHD064424153			
Well ID =	MW-4	MW-5S	MW-9	MW-10
Number of tied groups	Count Ties	Count Ties	Count Ties	Count Ties
#tied 2 times	2	2	3	2
#tied 3 times	0	0	1	0
#tied 4 times	1	0	0	0
#tied 5 times	0	0	0	0
#tied 6 times	0	0	0	0
#tied 7 times	0	0	0	0
#tied 8 times	0	0	0	0
#tied 9 times	0	0	0	0
#tied 10 times	0	0	0	0
Count Error?				
n =	16	16	16	16
V(S) =	482.67	491.33	486.67	491.33
S =	12	58	40	-42
Z =	0.501	2.572	1.768	-1.850

n = Number of Samples

V(S) = variance of S = 1/18 $[n(n-1)(2n+5) - \sum p=1 \rightarrow g \;\; w_p(w_p-1)(2w_p+5)]$

where g = number of tied groups and w_p represents the number of data points in the p^{th} group

S = Mann-Kendall Statistic, number of increases versus number of decreases in data comparrision

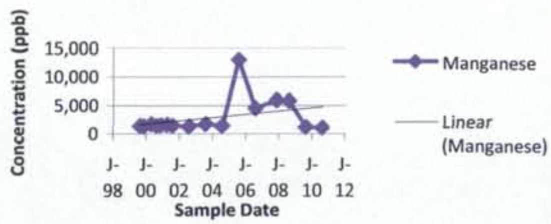
$Z = (S-1)/[V(S)]^{1/2}$ if S>0, Z=0 if S=0, $Z= (S+1)/[V(S)]^{1/2}$ if S<0

Z is comparred to table of critical values to determine confidence in trend

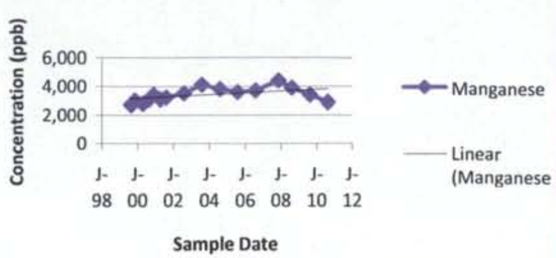
Trend confidences defined at 99.5%, 99%, 97.5%, 95%, 90%, 85%, 80%, 75%, 70%, and no trend

Mann Kendall Statistic Calculations

MW-4			Site = Coakley Landfill				NHDES#: 198712001			EPA ID #: NHD064424153					Compound = Manganese	
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
1,400	1,300	1,700	1,400	1,500	1,600	1,400	1,300	1,700	1,400	13,000	4,500	5,900	5,800	1,200	1,100	Sum Rows
	-1	1	0	1	1	0	-1	1	0	1	1	1	1	-1	-1	4
		1	1	1	1	1	0	1	1	1	1	1	1	-1	-1	9
			-1	-1	-1	-1	-1	0	-1	1	1	1	1	-1	-1	-4
				1	1	0	-1	1	0	1	1	1	1	-1	-1	4
					1	-1	-1	1	-1	1	1	1	1	-1	-1	1
						-1	-1	1	-1	1	1	1	1	-1	-1	0
							-1	1	0	1	1	1	1	-1	-1	2
								1	1	1	1	1	1	-1	-1	4
									-1	1	1	1	1	-1	-1	1
										1	1	1	1	-1	-1	2
											-1	-1	-1	-1	-1	-5
												1	1	-1	-1	0
													-1	-1	-1	-3
														-1	-1	-2
															-1	-1
													Mann Kendall Statistic (S) =			12



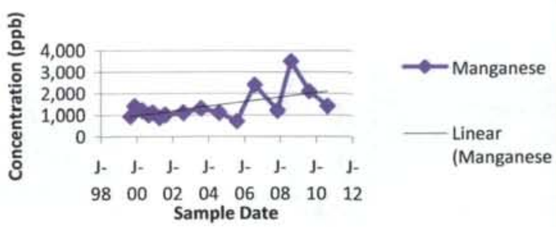
MW-5S			Site = Coakley Landfill				NHDES#: 198712001			EPA ID #: NHD064424153					Compound = Manganese	
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
2,700	3,000	2,800	3,100	3,400	3,100	3,200	3,500	4,100	3,800	3,600	3,700	4,400	3,900	3,400	2,900	Sum Rows
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
		-1	1	1	1	1	1	1	1	1	1	1	1	1	-1	10
			1	1	1	1	1	1	1	1	1	1	1	1	1	13
				1	0	1	1	1	1	1	1	1	1	1	-1	9
					-1	-1	1	1	1	1	1	1	1	0	-1	4
						1	1	1	1	1	1	1	1	1	-1	8
							1	1	1	1	1	1	1	1	-1	7
								1	1	1	1	1	1	-1	-1	4
									-1	-1	-1	1	-1	-1	-1	-5
										-1	-1	1	1	-1	-1	-2
											1	1	1	-1	-1	1
												1	1	-1	-1	0
													-1	-1	-1	-3
														-1	-1	-2
															-1	-1
													Mann Kendall Statistic (S) =			58



Mann Kendall Statistic Calculations

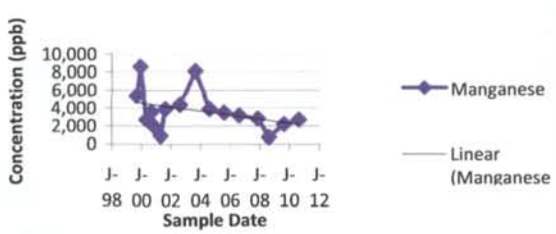
MW-9 Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Manganese

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
950	1,400	1,200	1,000	1,100	880	1,000	1,100	1,300	1,100	710	2,400	1,200	3,500	2,100	1,400	Sum Rows
	1	1	1	1	-1	1	1	1	1	-1	1	1	1	1	1	11
		-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	1	1	0	-7
			-1	-1	-1	-1	-1	1	-1	-1	1	0	1	1	1	-2
				1	-1	0	1	1	1	-1	1	1	1	1	1	7
					-1	-1	0	1	0	-1	1	1	1	1	1	3
						1	1	1	1	-1	1	1	1	1	1	8
							1	1	1	-1	1	1	1	1	1	7
								1	0	-1	1	1	1	1	1	5
									-1	-1	1	-1	1	1	1	1
										-1	1	1	1	1	1	4
											1	1	1	1	1	5
												-1	1	-1	-1	-2
													1	1	1	3
														-1	-1	-2
															-1	-1
													Mann Kendall Statistic (S) =			40



MW-10 Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Manganese

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
5,400	8,600	2,700	3,600	1,900	910	3,900	4,400	8,100	3,900	3,500	3,200	2,800	760	2,200	2,700	Sum Rows
	1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-11
		-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-14
			1	-1	-1	1	1	1	1	1	1	1	-1	-1	0	4
				-1	-1	1	1	1	1	-1	-1	-1	-1	-1	-1	-4
					-1	1	1	1	1	1	1	1	-1	1	1	7
						1	1	1	1	1	1	1	-1	1	1	8
							1	1	0	-1	-1	-1	-1	-1	-1	-4
								1	-1	-1	-1	-1	-1	-1	-1	-6
									-1	-1	-1	-1	-1	-1	-1	-7
										-1	-1	-1	-1	-1	-1	-6
											-1	-1	-1	-1	-1	-5
												-1	-1	-1	-1	-4
													-1	-1	-1	-3
														1	1	2
															1	1
													Mann Kendall Statistic (S) =			-42



MANN-KENDALL DATA EVALUATION

Site Name	Coakley Landfill	NHDES Site #	198712001	Compound =	Manganese
		EPA ID #	NHD064424153		
	Well ID =	OP-2	OP-5	AE-2A	AE-3A
Event Number	Sampling Date (most recent last)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)
1	8/18/99	220	6,500	1,900	1,500
2	11/10/99	390	7,100	1,200	1,200
3	4/19/00	730	7,700	900	650
4	8/18/00	490	5,400	650	1,000
5	11/18/00	450	6,700	650	1,200
6	4/1/01	500	4,900	830	890
7	8/1/01	290	1,500	740	900
8	8/1/02	330	5,200	950	950
9	8/1/03	360	3,900	830	1,300
10	8/1/04	380	3,500	760	740
11	8/1/05	390	3,800	720	690
12	8/1/06	470	2,500	510	690
13	11/15/07	620	3,800	770	840
14	8/12/08	580	2,300	610	850
15	8/19/09	630	1,800	650	1,300
16	8/18/10	760	2,200	700	760
	Mann Kendall Statistic (S) =	49.0	-81.0	-54.0	-29.0
	Number of Rounds (n) =	16	16	16	16
	Average =	474.38	4300.00	835.63	966.25
	Standard Deviation =	155.090	1990.310	326.005	258.763
	Coefficient of Variation(CV)=	0.327	0.463	0.390	0.268
Error Check, Blank if No Errors Detected					
Trend		INCREASING	DECREASING	DECREASING	DECREASING
Confidence Level		97.5%	99.5%	99%	85%
Stability Test, If No Trend Exists at 70% Confidence Level		NA	NA	NA	NA
Entry By =	KMM	Date =	24-Mar-11		

Data entered in yellow cells

MANN-KENDALL DATA EVALUATION

Coakley Landfill	NHDES Site # 198712001		Compound = Manganese	
	EPA ID # NHD064424153			
Well ID =	OP-2	OP-5	AE-2A	AE-3A
Number of tied groups	Count Ties	Count Ties	Count Ties	Count Ties
#tied 2 times	1	1	1	3
#tied 3 times	0	0	1	0
#tied 4 times	0	0	0	0
#tied 5 times	0	0	0	0
#tied 6 times	0	0	0	0
#tied 7 times	0	0	0	0
#tied 8 times	0	0	0	0
#tied 9 times	0	0	0	0
#tied 10 times	0	0	0	0
Count Error?				
n =	16	16	16	16
V(S) =	492.33	492.33	488.67	490.33
S =	49	-81	-54	-29
Z =	2.163	-3.605	-2.398	-1.264

n = Number of Samples

V(S) = variance of S = 1/18 [n(n-1)(2n+5) - ∑p=1→g $w_p(w_p-1)(2w_p+5)$]

where g = number of tied groups and w_p represents the number of data points in the p^{th} group

S = Mann-Kendall Statistic, number of increases versus number of decreases in data comparrision

$Z = (S-1)/[V(S)]^{1/2}$ if S>0, Z=0 if S=0, $Z= (S+1)/[V(S)]^{1/2}$ if S<0

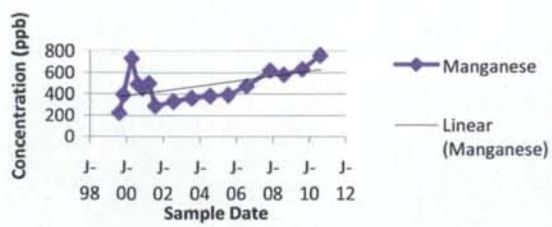
Z is comparred to table of critical values to determine confidence in trend

Trend confidences defined at 99.5%, 99%, 97.5%, 95%, 90%, 85%, 80%, 75%, 70%, and no trend

Mann Kendall Statistic Calculations

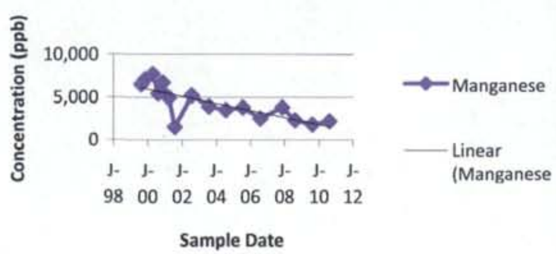
OP-2 | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Manganese

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
220	390	730	490	450	500	290	330	360	380	390	470	620	580	630	760	Sum Rows
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15
		1	1	1	1	-1	-1	-1	-1	0	1	1	1	1	1	5
			-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-11
				-1	1	-1	-1	-1	-1	-1	-1	1	1	1	1	-2
					1	-1	-1	-1	-1	-1	1	1	1	1	1	1
						-1	-1	-1	-1	-1	-1	1	1	1	1	-2
							1	1	1	1	1	1	1	1	1	9
								1	1	1	1	1	1	1	1	8
									1	1	1	1	1	1	1	7
										1	1	1	1	1	1	6
											1	1	1	1	1	5
												1	1	1	1	4
													-1	1	1	1
														1	1	2
															1	1
													Mann Kendall Statistic (S) =			49



OP-5 | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Manganese

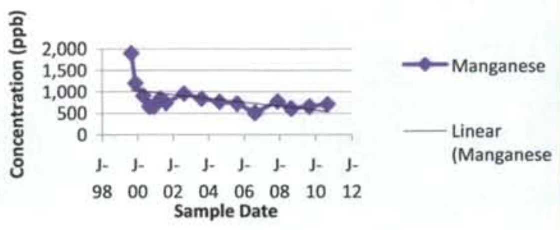
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
6,500	7,100	7,700	5,400	6,700	4,900	1,500	5,200	3,900	3,500	3,800	2,500	3,800	2,300	1,800	2,200	Sum Rows
	1	1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-9
		1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-12
			-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-13
				1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-10
					-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-11
						-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-8
							1	1	1	1	1	1	1	1	1	9
								-1	-1	-1	-1	-1	-1	-1	-1	-8
									-1	-1	-1	-1	-1	-1	-1	-7
										1	-1	1	-1	-1	-1	-2
											-1	0	-1	-1	-1	-4
												1	-1	-1	-1	-2
													-1	-1	-1	-3
														-1	-1	-2
															1	1
													Mann Kendall Statistic (S) =			-81



Mann Kendall Statistic Calculations

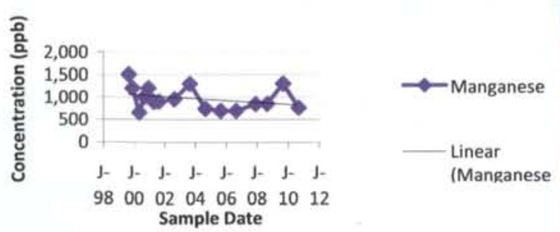
AE-2A Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Manganese

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
1,900	1,200	900	650	650	830	740	950	830	760	720	510	770	610	650	700	Sum Rows
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-15
		-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-14
			-1	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-11
				0	1	1	1	1	1	1	-1	1	-1	0	1	6
					1	1	1	1	1	1	-1	1	-1	0	1	6
						-1	1	0	-1	-1	-1	-1	-1	-1	-1	-7
							1	1	1	-1	-1	1	-1	-1	-1	-1
								-1	-1	-1	-1	-1	-1	-1	-1	-8
									-1	-1	-1	-1	-1	-1	-1	-7
										-1	-1	1	-1	-1	-1	-4
											-1	1	-1	-1	-1	-3
												1	1	1	1	4
													-1	-1	-1	-3
														1	1	2
															1	1
													Mann Kendall Statistic (S) =			-54



AE-3A Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Manganese

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
1,500	1,200	650	1,000	1,200	890	900	950	1,300	740	690	690	840	850	1,300	760	Sum Rows
	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-15
		-1	-1	0	-1	-1	-1	1	-1	-1	-1	-1	-1	1	-1	-9
			1	1	1	1	1	1	1	1	1	1	1	1	1	13
				1	-1	-1	-1	1	-1	-1	-1	-1	-1	1	-1	-6
					-1	-1	-1	1	-1	-1	-1	-1	-1	1	-1	-7
						1	1	1	-1	-1	-1	-1	-1	1	-1	-2
							1	1	-1	-1	-1	-1	-1	1	-1	-3
								1	-1	-1	-1	-1	-1	1	-1	-4
									-1	-1	-1	-1	-1	0	-1	-6
										-1	-1	1	1	1	1	2
											0	1	1	1	1	4
												1	1	1	1	4
													1	1	-1	1
														1	-1	0
															-1	-1
													Mann Kendall Statistic (S) =			-29



MANN-KENDALL DATA EVALUATION

Site Name	Coakley Landfill	NHDES Site #	198712001	Compound =	Manganese
		EPA ID #	NHD064424153		
	Well ID =	FPC-6A	FPC-9A		
Event Number	Sampling Date (most recent last)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)
1	8/18/99		430		
2	11/10/99		410		
3	4/19/00		340		
4	8/18/00	140	320		
5	11/18/00	200			
6	4/1/01	150	350		
7	8/1/01		345		
8	8/1/02		340		
9	8/1/03	7,200	420		
10	8/1/04	530	40		
11	8/1/05	610	30		
12	8/1/06	410	270		
13	11/15/07	500	410		
14	8/12/08	360	520		
15	8/19/09	2,400	270		
16	8/18/10	3,600	220		
	Mann Kendall Statistic (S) =	23.0	-28.0	0.0	0.0
	Number of Rounds (n) =	11	15	0	0
	Average =	1463.64	314.33	#DIV/0!	#DIV/0!
	Standard Deviation =	2197.231	135.658	#DIV/0!	#DIV/0!
	Coefficient of Variation(CV)=	1.501	0.432	#DIV/0!	#DIV/0!
Error Check, Blank if No Errors Detected				n<4	n<4
Trend		INCREASING	DECREASING	n<4	n<4
Confidence Level		95%	90%	n<4	n<4
Stability Test, If No Trend Exists at 70% Confidence Level		NA	NA	n<4 n<4	n<4 n<4
Entry By =	KMM	Date =	24-Mar-11		

Data entered in yellow cells

MANN-KENDALL DATA EVALUATION

Coakley Landfill	NHDES Site #	198712001	Compound =	Manganese		
	EPA ID #	NHD064424153				
Well ID =	FPC-6A	FPC-9A	0	0		
Number of tied groups	No Ties	Count Ties	No Ties	No Ties		
#tied 2 times	0	3	0	0		
#tied 3 times	0	0	0	0		
#tied 4 times	0	0	0	0		
#tied 5 times	0	0	0	0		
#tied 6 times	0	0	0	0		
#tied 7 times	0	0	0	0		
#tied 8 times	0	0	0	0		
#tied 9 times	0	0	0	0		
#tied 10 times	0	0	0	0		
Count Error?						
n =	11	15	0	0		
V(S) =	165.00	405.33	0.00	0.00		
S =	23	-28	0	0		
Z =	1.713	-1.341	0.000	0.000		

n = Number of Samples

V(S) = variance of S = 1/18 $[n(n-1)(2n+5) - \sum p=1 \rightarrow g\ w_p(w_p-1)(2w_p+5)]$

where g = number of tied groups and w_p represents the number of data points in the p^{th} group

S = Mann-Kendall Statistic, number of increases versus number of decreases in data comparrision

$Z = (S-1)/[V(S)]^{1/2}$ if S>0, Z=0 if S=0, $Z= (S+1)/[V(S)]^{1/2}$ if S<0

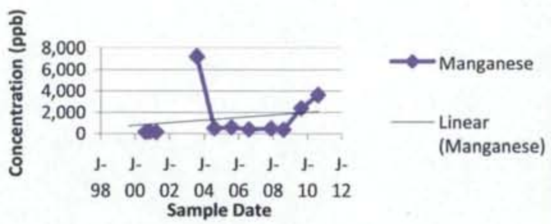
Z is comparred to table of critical values to determine confidence in trend

Trend confidences defined at 99.5%, 99%, 97.5%, 95%, 90%, 85%, 80%, 75%, 70%, and no trend

Mann Kendall Statistic Calculations

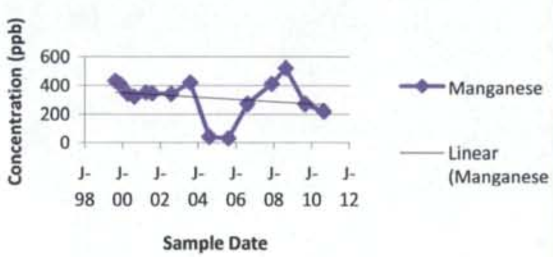
FPC-6A | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Manganese

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	Sum Rows
			140	200	150			7,200	530	610	410	500	360	2,400	3,600	
																0
																0
																0
				1	1			1	1	1	1	1	1	1	1	10
					-1			1	1	1	1	1	1	1	1	7
								1	1	1	1	1	1	1	1	8
																0
																0
									-1	-1	-1	-1	-1	-1	-1	-7
										1	-1	-1	-1	1	1	0
											-1	-1	-1	1	1	-1
												1	-1	1	1	2
													-1	1	1	1
														1	1	2
															1	1
													Mann Kendall Statistic (S) =			23



FPC-9A | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Manganese

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	Sum Rows
430	410	340	320		350	345	340	420	40	30	270	410	520	270	220	
	-1	-1	-1		-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-12
		-1	-1		-1	-1	-1	1	-1	-1	-1	0	1	-1	-1	-8
			-1		1	1	0	1	-1	-1	-1	1	1	-1	-1	-1
					1	1	1	1	-1	-1	-1	1	1	-1	-1	1
																0
						-1	-1	1	-1	-1	-1	1	1	-1	-1	-4
							-1	1	-1	-1	-1	1	1	-1	-1	-3
								1	-1	-1	-1	1	1	-1	-1	-2
									-1	-1	-1	-1	1	-1	-1	-5
										-1	1	1	1	1	1	4
											1	1	1	1	1	5
												1	1	0	-1	1
													1	-1	-1	-1
														-1	-1	-2
															-1	-1
													Mann Kendall Statistic (S) =			-28



MANN-KENDALL DATA EVALUATION

Site Name	Coakley Landfill	NHDES Site #	198712001	Compound =	Manganese
		EPA ID #	NHD064424153		
	Well ID =	BP-4	MW-5D	MW-6	MW-8
Event Number	Sampling Date (most recent last)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)
1	8/18/99	1,200	1,000	1,100	4,500
2	11/10/99	1,200	1,100	740	3,500
3	4/19/00	1,500	980	600	3,900
4	8/18/00	1,400	930	980	4,200
5	11/18/00	1,400	920	80	3,600
6	4/1/01	1,700	1,200	600	3,200
7	8/1/01	1,500	920	1,200	9,800
8	8/1/02	1,300	860	1,200	2,800
9	8/1/03	1,400	880	1,100	2,900
10	8/1/04	1,300	870	700	2,400
11	8/1/05	1,700	890	970	2,500
12	8/1/06	1,300	890	540	2,500
13	11/15/07	1,200	860	740	1,600
14	8/12/08	1,100	780	520	1,900
15	8/19/09	94	770	490	2,000
16	8/18/10	1,200	730	1,900	2,100
	Mann Kendall Statistic (S) =	-36.0	-89.0	-14.0	-81.0
	Number of Rounds (n) =	16	16	16	16
	Average =	1280.88	911.25	841.25	3337.50
	Standard Deviation =	361.348	118.596	416.475	1922.802
	Coefficient of Variation(CV)=	0.282	0.130	0.495	0.576
Error Check, Blank if No Errors Detected					
Trend		DECREASING	DECREASING	DECREASING	DECREASING
Confidence Level		90%	99.5%	70%	99.5%
Stability Test, If No Trend Exists at 70% Confidence Level		NA	NA	NA	NA
Entry By =	KMM	Date =	24-Mar-11		

Data entered in yellow cells

MANN-KENDALL DATA EVALUATION

Coakley Landfill	NHDES Site # 198712001		Compound =	Manganese
	EPA ID #	NHD064424153		
Well ID =	BP-4	MW-5D	MW-6	MW-8
Number of tied groups	Count Ties	Count Ties	Count Ties	Count Ties
#tied 2 times	2	3	4	1
#tied 3 times	2	0	0	0
#tied 4 times	1	0	0	0
#tied 5 times	0	0	0	0
#tied 6 times	0	0	0	0
#tied 7 times	0	0	0	0
#tied 8 times	0	0	0	0
#tied 9 times	0	0	0	0
#tied 10 times	0	0	0	0
Count Error?				
n =	16	16	16	16
V(S) =	475.33	490.33	489.33	492.33
S =	-36	-89	-14	-81
Z =	-1.605	-3.974	-0.588	-3.605

n = Number of Samples

V(S) = variance of S = 1/18 [n(n-1)(2n+5) - ∑p=1→g $w_p(w_p-1)(2w_p+5)$]

where g = number of tied groups and w_p represents the number of data points in the p^{th} group

S = Mann-Kendall Statistic, number of increases versus number of decreases in data comparrision

Z = $(S-1)/[V(S)]^{1/2}$ if S>0, Z=0 if S=0, Z= $(S+1)/[V(S)]^{1/2}$ if S<0

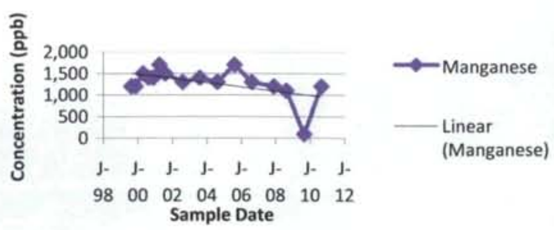
Z is comparred to table of critical values to determine confidence in trend

Trend confidences defined at 99.5%, 99%, 97.5%, 95%, 90%, 85%, 80%, 75%, 70%, and no trend

Mann Kendall Statistic Calculations

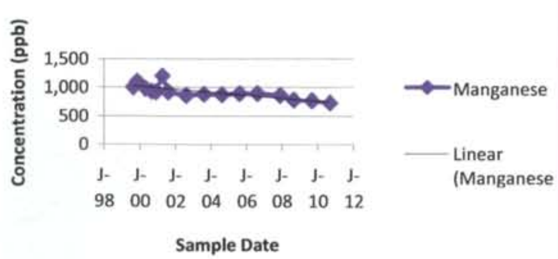
BP-4 Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Manganese

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
1,200	1,200	1,500	1,400	1,400	1,700	1,500	1,300	1,400	1,300	1,700	1,300	1,200	1,100	94	1,200	Sum Rows
	0	1	1	1	1	1	1	1	1	1	1	0	-1	-1	0	8
		1	1	1	1	1	1	1	1	1	1	0	-1	-1	0	8
			-1	-1	1	0	-1	-1	-1	1	-1	-1	-1	-1	-1	-8
				0	1	1	-1	0	-1	1	-1	-1	-1	-1	-1	-4
					1	1	-1	0	-1	1	-1	-1	-1	-1	-1	-4
						-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-9
							-1	-1	-1	1	-1	-1	-1	-1	-1	-7
								1	0	1	0	-1	-1	-1	-1	-2
									-1	1	-1	-1	-1	-1	-1	-5
										1	0	-1	-1	-1	-1	-3
											-1	-1	-1	-1	-1	-5
												-1	-1	-1	-1	-4
													-1	-1	0	-2
														-1	1	0
															1	1
													Mann Kendall Statistic (S) =			-36



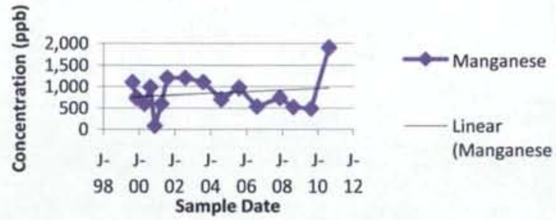
MW-5D Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Manganese

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
1,000	1,100	980	930	920	1,200	920	860	880	870	890	890	860	780	770	730	Sum Rows
	1	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-11
		-1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-12
			-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-11
				-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-10
					1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-8
						-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-10
							-1	-1	-1	-1	-1	-1	-1	-1	-1	-9
								1	1	1	1	0	-1	-1	-1	1
									-1	1	1	-1	-1	-1	-1	-3
										1	1	-1	-1	-1	-1	-2
											0	-1	-1	-1	-1	-4
												-1	-1	-1	-1	-4
													-1	-1	-1	-3
														-1	-1	-2
															-1	-1
													Mann Kendall Statistic (S) =			-89

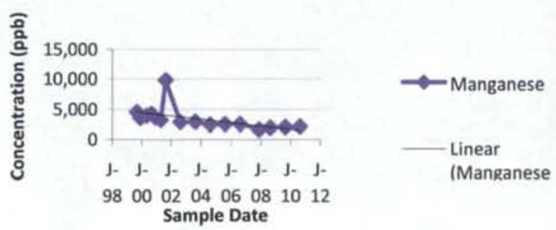


Mann Kendall Statistic Calculations

MW-6		Site = Coakley Landfill				NHDES#: 198712001			EPA ID #: NHD064424153							Compound = Manganese
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
1,100	740	600	980	80	600	1,200	1,200	1,100	700	970	540	740	520	490	1,900	Sum Rows
	-1	-1	-1	-1	-1	1	1	0	-1	-1	-1	-1	-1	-1	1	-8
		-1	1	-1	-1	1	1	1	-1	1	-1	0	-1	-1	1	-1
			1	-1	0	1	1	1	1	1	-1	1	-1	-1	1	4
				-1	-1	1	1	1	-1	-1	-1	-1	-1	-1	1	-4
					1	1	1	1	1	1	1	1	1	1	1	11
						1	1	1	1	1	-1	1	-1	-1	1	4
							0	-1	-1	-1	-1	-1	-1	-1	1	-6
								-1	-1	-1	-1	-1	-1	-1	1	-6
									-1	-1	-1	-1	-1	-1	1	-5
										1	-1	1	-1	-1	1	0
											-1	-1	-1	-1	1	-3
												1	-1	-1	1	0
													-1	-1	1	-1
														-1	1	0
															1	1
													Mann Kendall Statistic (S) =			-14



MW-8		Site = Coakley Landfill				NHDES#: 198712001			EPA ID #: NHD064424153							Compound = Manganese
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
4,500	3,500	3,900	4,200	3,600	3,200	9,800	2,800	2,900	2,400	2,500	2,500	1,600	1,900	2,000	2,100	Sum Rows
	-1	-1	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-13
		1	1	1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-6
			1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-9
				-1	-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-10
					-1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-9
						1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-8
							-1	-1	-1	-1	-1	-1	-1	-1	-1	-9
								1	-1	-1	-1	-1	-1	-1	-1	-6
									-1	-1	-1	-1	-1	-1	-1	-7
										1	1	-1	-1	-1	-1	-2
											0	-1	-1	-1	-1	-4
												-1	-1	-1	-1	-4
													1	1	1	3
														1	1	2
															1	1
													Mann Kendall Statistic (S) =			-81



MANN-KENDALL DATA EVALUATION

Site Name	Coakley Landfill	NHDES Site #	198712001	Compound =	Manganese
		EPA ID #	NHD064424153		
	Well ID =	MW-11	AE-2B	AE-3B	FPC-6B
Event Number	Sampling Date (most recent last)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)
1	8/18/99	840	4,100	1,400	1,100
2	11/10/99	930	5,300	2,200	830
3	4/19/00	880	5,100	2,000	670
4	8/18/00	1,000	6,300	1,900	760
5	11/18/00	950	6,400	2,100	690
6	4/1/01	780	5,100	2,000	620
7	8/1/01	710	4,400	1,400	830
8	8/1/02	600	4,400	1,400	750
9	8/1/03	600	3,700	1,500	600
10	8/1/04	590	3,000	1,100	5,900
11	8/1/05	530	3,100	1,100	6,200
12	8/1/06	450	2,400	1,000	2,100
13	11/15/07	410	2,100	570	3,100
14	8/12/08	440	1,700	480	3,000
15	8/19/09	390	1,700	1,400	340
16	8/18/10	340	1,300	950	400
	Mann Kendall Statistic (S) =	-101.0	-91.0	-76.0	-3.0
	Number of Rounds (n) =	16	16	16	16
	Average =	652.50	3756.25	1406.25	1743.13
	Standard Deviation =	220.409	1642.749	528.342	1885.509
	Coefficient of Variation(CV)=	0.338	0.437	0.376	1.082
Error Check, Blank if No Errors Detected					
Trend		DECREASING	DECREASING	DECREASING	No Trend
Confidence Level		99.5%	99.5%	99.5%	No Trend
Stability Test, If No Trend Exists at 70% Confidence Level		NA	NA	NA	CV > 1 NON-STABLE
Entry By =	KMM	Date =	24-Mar-11		

Data entered in yellow cells

MANN-KENDALL DATA EVALUATION

Coakley Landfill	NHDES Site # 198712001		Compound = Manganese	
	EPA ID # NHD064424153			
Well ID =	MW-11	AE-2B	AE-3B	FPC-6B
Number of tied groups	Count Ties	Count Ties	Count Ties	Count Ties
#tied 2 times	1	3	2	1
#tied 3 times	0	0	0	0
#tied 4 times	0	0	1	0
#tied 5 times	0	0	0	0
#tied 6 times	0	0	0	0
#tied 7 times	0	0	0	0
#tied 8 times	0	0	0	0
#tied 9 times	0	0	0	0
#tied 10 times	0	0	0	0
Count Error?				
n =	16	16	16	16
V(S) =	492.33	490.33	482.67	492.33
S =	-101	-91	-76	-3
Z =	-4.507	-4.064	-3.414	-0.090

n = Number of Samples

V(S) = variance of S = 1/18 $[n(n-1)(2n+5) - \sum p=1 \rightarrow g \ w_p(w_p-1)(2w_p+5)]$

where g = number of tied groups and w_p represents the number of data points in the p^{th} group

S = Mann-Kendall Statistic, number of increases versus number of decreases in data comparrision

$Z = (S-1)/[V(S)]^{1/2}$ if S>0, Z=0 if S=0, $Z= (S+1)/[V(S)]^{1/2}$ if S<0

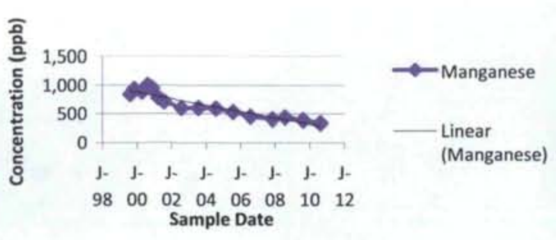
Z is comparred to table of critical values to determine confidence in trend

Trend confidences defined at 99.5%, 99%, 97.5%, 95%, 90%, 85%, 80%, 75%, 70%, and no trend

Mann Kendall Statistic Calculations

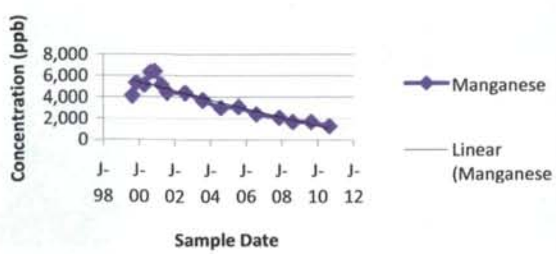
MW-11 — Site = Coakley Landfill — NHDES#: 198712001 — EPA ID #: NHD064424153 — Compound = Manganese

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
840	930	880	1,000	950	780	710	600	600	590	530	450	410	440	390	340	Sum Rows
	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-7
		-1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-10
			1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-9
				-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-12
					-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-11
						-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-10
							-1	-1	-1	-1	-1	-1	-1	-1	-1	-9
								0	-1	-1	-1	-1	-1	-1	-1	-7
									-1	-1	-1	-1	-1	-1	-1	-7
										-1	-1	-1	-1	-1	-1	-6
											-1	-1	-1	-1	-1	-5
												-1	-1	-1	-1	-4
													1	-1	-1	-1
														-1	-1	-2
															-1	-1
													Mann Kendall Statistic (S) =			-101



AE-2B — Site = Coakley Landfill — NHDES#: 198712001 — EPA ID #: NHD064424153 — Compound = Manganese

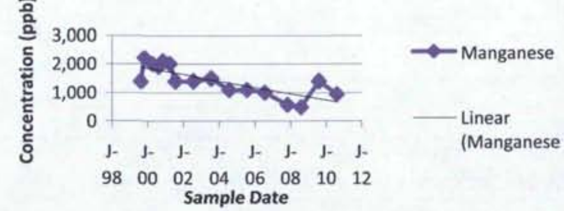
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
4,100	5,300	5,100	6,300	6,400	5,100	4,400	4,400	3,700	3,000	3,100	2,400	2,100	1,700	1,700	1,300	Sum Rows
	1	1	1	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
		-1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-10
			1	1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-8
				1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-10
					-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-11
						-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-10
							0	-1	-1	-1	-1	-1	-1	-1	-1	-8
								-1	-1	-1	-1	-1	-1	-1	-1	-8
									-1	-1	-1	-1	-1	-1	-1	-7
										1	-1	-1	-1	-1	-1	-4
											-1	-1	-1	-1	-1	-5
												-1	-1	-1	-1	-4
													-1	-1	-1	-3
														0	-1	-1
															-1	-1
													Mann Kendall Statistic (S) =			-91



Mann Kendall Statistic Calculations

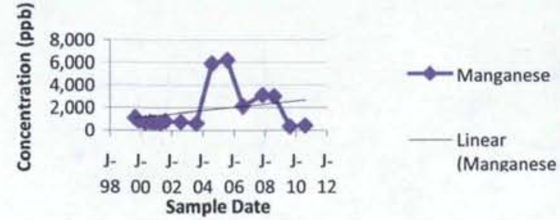
AE-3B Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Manganese

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
1,400	2,200	2,000	1,900	2,100	2,000	1,400	1,400	1,500	1,100	1,100	1,000	570	480	1,400	950	Sum Rows
	1	1	1	1	1	0	0	1	-1	-1	-1	-1	-1	0	-1	0
		-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-14
			-1	1	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-10
				1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-8
					-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-11
						-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-10
							0	1	-1	-1	-1	-1	-1	0	-1	-5
								1	-1	-1	-1	-1	-1	0	-1	-5
									-1	-1	-1	-1	-1	-1	-1	-7
										0	-1	-1	-1	1	-1	-3
											-1	-1	-1	1	-1	-3
												-1	-1	1	-1	-2
													-1	1	1	1
														1	1	2
															-1	-1
													Mann Kendall Statistic (S) =			-76



FPC-6B Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Manganese

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
1,100	830	670	760	690	620	830	750	600	5,900	6,200	2,100	3,100	3,000	340	400	Sum Rows
	-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1	1	-1	-1	-5
		-1	-1	-1	-1	0	-1	-1	1	1	1	1	1	-1	-1	-3
			1	1	-1	1	1	-1	1	1	1	1	1	-1	-1	5
				-1	-1	1	-1	-1	1	1	1	1	1	-1	-1	0
					-1	1	1	-1	1	1	1	1	1	-1	-1	3
						1	1	-1	1	1	1	1	1	-1	-1	4
							-1	-1	1	1	1	1	1	-1	-1	1
								-1	1	1	1	1	1	-1	-1	2
									1	1	1	1	1	-1	-1	3
										1	-1	-1	-1	-1	-1	-4
											-1	-1	-1	-1	-1	-5
												1	1	-1	-1	0
													-1	-1	-1	-3
														-1	-1	-2
															1	1
													Mann Kendall Statistic (S) =			-3



MANN-KENDALL DATA EVALUATION

Site Name	Coakley Landfill	NHDES Site #	198712001	Compound =	Manganese
		EPA ID #	NHD064424153		
	Well ID =	FPC-11B			
Event Number	Sampling Date (most recent last)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)
1	8/18/99				
2	11/10/99				
3	4/19/00				
4	8/18/00				
5	11/18/00				
6	4/1/01				
7	8/1/01				
8	8/1/02				
9	8/1/03	3,000			
10	8/1/04	2,200			
11	8/1/05	2,500			
12	8/1/06	880			
13	11/15/07	1,300			
14	8/12/08	1,400			
15	8/19/09	710			
16	8/18/10	520			
	Mann Kendall Statistic (S) =	-20.0	0.0	0.0	0.0
	Number of Rounds (n) =	8	0	0	0
	Average =	1563.75	#DIV/0!	#DIV/0!	#DIV/0!
	Standard Deviation =	904.464	#DIV/0!	#DIV/0!	#DIV/0!
	Coefficient of Variation(CV)=	0.578	#DIV/0!	#DIV/0!	#DIV/0!
Error Check, Blank if No Errors Detected			n<4	n<4	n<4
Trend		DECREASING	n<4	n<4	n<4
Confidence Level		99%	n<4	n<4	n<4
Stability Test, If No Trend Exists at 70% Confidence Level		NA	n<4 n<4	n<4 n<4	n<4 n<4
Entry By =	KMM	Date =	24-Mar-11		

Data entered in yellow cells

MANN-KENDALL DATA EVALUATION

Coakley Landfill	NHDES Site # 198712001		Compound = Manganese	
	EPA ID #	NHD064424153		
Well ID =	FPC-11B	0	0	0
Number of tied groups	No Ties	No Ties	No Ties	No Ties
#tied 2 times	0	0	0	0
#tied 3 times	0	0	0	0
#tied 4 times	0	0	0	0
#tied 5 times	0	0	0	0
#tied 6 times	0	0	0	0
#tied 7 times	0	0	0	0
#tied 8 times	0	0	0	0
#tied 9 times	0	0	0	0
#tied 10 times	0	0	0	0
Count Error?				
n =	8	0	0	0
V(S) =	65.33	0.00	0.00	0.00
S =	-20	0	0	0
Z =	-2.351	0.000	0.000	0.000

n = Number of Samples

V(S) = variance of S = 1/18 $[n(n-1)(2n+5) - \sum p=1 \rightarrow g\ w_p(w_p-1)(2w_p+5)]$

where g = number of tied groups and w_p represents the number of data points in the p^{th} group

S = Mann-Kendall Statistic, number of increases versus number of decreases in data comparrision

$Z = (S-1)/[V(S)]^{1/2}$ if S>0, Z=0 if S=0, $Z= (S+1)/[V(S)]^{1/2}$ if S<0

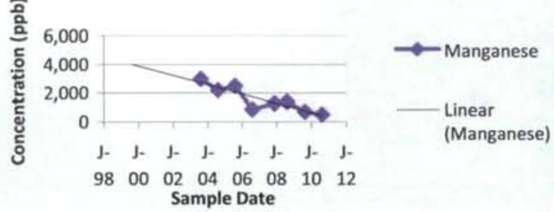
Z is comparred to table of critical values to determine confidence in trend

Trend confidences defined at 99.5%, 99%, 97.5%, 95%, 90%, 85%, 80%, 75%, 70%, and no trend

Mann Kendall Statistic Calculations

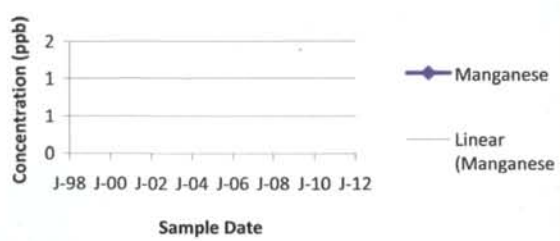
FPC-11B | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Manganese

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
								3,000	2,200	2,500	880	1,300	1,400	710	520	Sum Rows
																0
																0
																0
																0
																0
																0
																0
																0
									-1	-1	-1	-1	-1	-1	-1	-7
										1	-1	-1	-1	-1	-1	-4
											-1	-1	-1	-1	-1	-5
												1	1	-1	-1	0
													1	-1	-1	-1
														-1	-1	-2
															-1	-1
													Mann Kendall Statistic (S) =			-20



0 | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Manganese

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
																Sum Rows
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
													Mann Kendall Statistic (S) =			0



MANN-KENDALL DATA EVALUATION

Site Name	Coakley Landfill	NHDES Site #	198712001	Compound =	Benzene
		EPA ID #	NHD064424153		
	Well ID =	MW-5S			
Event Number	Sampling Date (most recent last)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)
1	8/18/99	6			
2	11/10/99	7			
3	4/19/00	8			
4	8/18/00	8			
5	11/18/00	8			
6	4/1/01	7			
7	8/1/01	6			
8	8/1/02	6			
9	8/1/03	2			
10	8/1/04				
11	8/1/05				
12	8/1/06	0.5			
13	11/15/07	5			
14	8/12/08	4			
15	8/19/09	3			
16	8/18/10	4			
	Mann Kendall Statistic (S) =	-49.0	0.0	0.0	0.0
	Number of Rounds (n) =	14	0	0	0
	Average =	5.32	#DIV/0!	#DIV/0!	#DIV/0!
	Standard Deviation =	2.350	#DIV/0!	#DIV/0!	#DIV/0!
	Coefficient of Variation(CV)=	0.442	#DIV/0!	#DIV/0!	#DIV/0!
Error Check, Blank if No Errors Detected			n<4	n<4	n<4
Trend		DECREASING	n<4	n<4	n<4
Confidence Level		99.5%	n<4	n<4	n<4
Stability Test, If No Trend Exists at 70% Confidence Level		NA	n<4 n<4	n<4 n<4	n<4 n<4
Entry By =	KMM	Date =	24-Mar-11		

Data entered in yellow cells

MANN-KENDALL DATA EVALUATION

Coakley Landfill	NHDES Site #	198712001	Compound =	Benzene
	EPA ID #	NHD064424153		
Well ID =	MW-5S	0	0	0
Number of tied groups	Count Ties	No Ties	No Ties	No Ties
#tied 2 times	2	0	0	0
#tied 3 times	2	0	0	0
#tied 4 times	0	0	0	0
#tied 5 times	0	0	0	0
#tied 6 times	0	0	0	0
#tied 7 times	0	0	0	0
#tied 8 times	0	0	0	0
#tied 9 times	0	0	0	0
#tied 10 times	0	0	0	0
Count Error?				
n =	14	0	0	0
V(S) =	324.33	0.00	0.00	0.00
S =	-49	0	0	0
Z =	-2.665	0.000	0.000	0.000

n = Number of Samples

V(S) = variance of S = 1/18 $[n(n-1)(2n+5) - \sum p=1 \rightarrow g \;\; w_p(w_p-1)(2w_p+5)]$

where g = number of tied groups and w_p represents the number of data points in the p^{th} group

S = Mann-Kendall Statistic, number of increases versus number of decreases in data comparrision

$Z = (S-1)/[V(S)]^{1/2}$ if S>0, Z=0 if S=0, $Z= (S+1)/[V(S)]^{1/2}$ if S<0

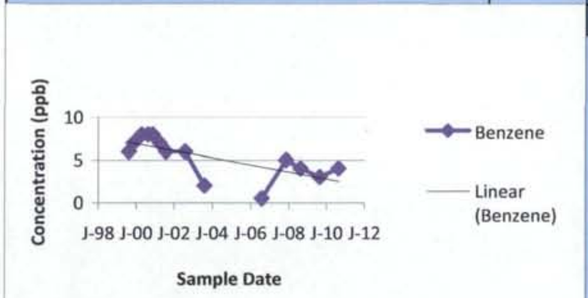
Z is comparred to table of critical values to determine confidence in trend

Trend confidences defined at 99.5%, 99%, 97.5%, 95%, 90%, 85%, 80%, 75%, 70%, and no trend

Mann Kendall Statistic Calculations

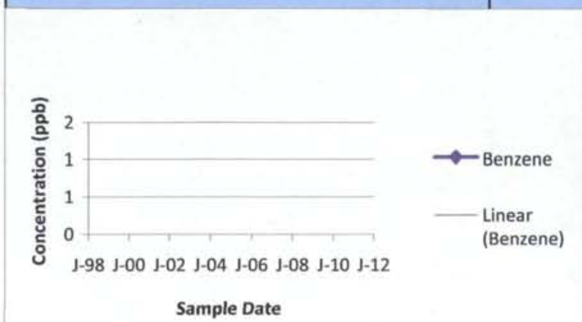
MW-5S Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Benzene

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	Sum Rows
6	7	8	8	8	7	6	6	2			1	5	4	3	4	
	1	1	1	1	1	0	0	-1			-1	-1	-1	-1	-1	-1
		1	1	1	0	-1	-1	-1			-1	-1	-1	-1	-1	-5
			0	0	-1	-1	-1	-1			-1	-1	-1	-1	-1	-9
				0	-1	-1	-1	-1			-1	-1	-1	-1	-1	-9
					-1	-1	-1	-1			-1	-1	-1	-1	-1	-9
						-1	-1	-1			-1	-1	-1	-1	-1	-8
							0	-1			-1	-1	-1	-1	-1	-6
								-1			-1	-1	-1	-1	-1	-6
											-1	1	1	1	1	3
																0
																0
												1	1	1	1	4
													-1	-1	-1	-3
														-1	0	-1
															1	1
													Mann Kendall Statistic (S) =			-49



0 Site = Coakley Landfill NHDES#: 198712001 EPA ID #: NHD064424153 Compound = Benzene

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	Sum Rows
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
																0
													Mann Kendall Statistic (S) =			0



MANN-KENDALL DATA EVALUATION

Site Name	Coakley Landfill	NHDES Site #	198712001	Compound =	Benzene
		EPA ID #	NHD064424153		
	Well ID =		MW-5D	MW-8	MW-11	GZ-105

Event Number	Sampling Date (most recent last)	MW-5D Concentration (leave blank if no data)	MW-8 Concentration (leave blank if no data)	MW-11 Concentration (leave blank if no data)	GZ-105 Concentration (leave blank if no data)
1	8/18/99	3	4	13	11
2	11/10/99	5	9	17	11
3	4/19/00	5	4	22	
4	8/18/00	5	4	18	
5	11/18/00	6	8	19	10
6	4/1/01	1	5	22	10
7	8/1/01	3	5	26	10
8	8/1/02	2	3	22	11
9	8/1/03	0.5	4	14	9
10	8/1/04			7	7
11	8/1/05			8	7
12	8/1/06	2	5	5	6
13	11/15/07	3	3	8	6
14	8/12/08	2	4	5	6
15	8/19/09	2	4	4	6
16	8/18/10	2	6	3	7

	MW-5D	MW-8	MW-11	GZ-105
Mann Kendall Statistic (S) =	-33.0	-10.0	-63.0	-62.0
Number of Rounds (n) =	14	14	16	14
Average =	2.96	4.86	13.31	8.36
Standard Deviation =	1.669	1.748	7.674	2.098
Coefficient of Variation(CV)=	0.563	0.360	0.576	0.251

Error Check, Blank if No Errors Detected

	MW-5D	MW-8	MW-11	GZ-105
Trend	DECREASING	DECREASING	DECREASING	DECREASING
Confidence Level	95%	70%	99.5%	99.5%
Stability Test, If No Trend Exists at 70% Confidence Level	NA	NA	NA	NA

Entry By =	KMM	Date =	24-Mar-11

Data entered in yellow cells

MANN-KENDALL DATA EVALUATION

Coakley Landfill	NHDES Site # 198712001		Compound = Benzene	
	EPA ID # NHD064424153			
Well ID =	MW-5D	MW-8	MW-11	GZ-105
Number of tied groups	Count Ties	Count Ties	Count Ties	Count Ties
#tied 2 times	0	1	2	0
#tied 3 times	2	1	1	3
#tied 4 times	0	0	0	1
#tied 5 times	1	0	0	0
#tied 6 times	0	1	0	0
#tied 7 times	0	1	0	0
#tied 8 times	0	0	0	0
#tied 9 times	0	0	0	0
#tied 10 times	0	0	0	0
Count Error?				
n =	14	14	16	14
V(S) =	309.67	289.67	487.67	314.00
S =	-33	-10	-63	-62
Z =	-1.818	-0.529	-2.808	-3.442

n = Number of Samples

V(S) = variance of S = 1/18 $[n(n-1)(2n+5) - \sum p=1 \rightarrow g \ w_p(w_p-1)(2w_p+5)]$

where g = number of tied groups and w_p represents the number of data points in the p^{th} group

S = Mann-Kendall Statistic, number of increases versus number of decreases in data comparrision

$Z = (S-1)/[V(S)]^{1/2}$ if S>0, Z=0 if S=0, $Z= (S+1)/[V(S)]^{1/2}$ if S<0

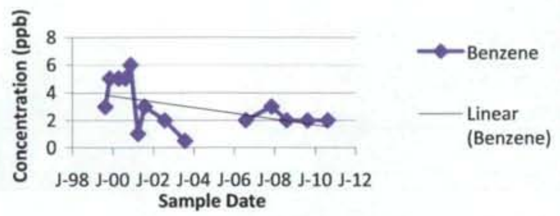
Z is comparred to table of critical values to determine confidence in trend

Trend confidences defined at 99.5%, 99%, 97.5%, 95%, 90%, 85%, 80%, 75%, 70%, and no trend

Mann Kendall Statistic Calculations

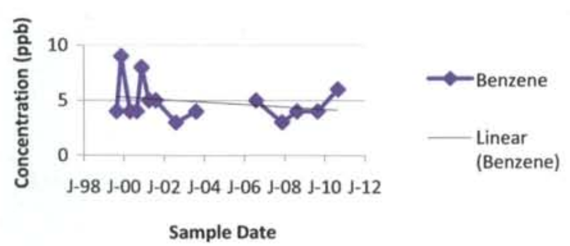
MW-5D | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Benzene

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
3	5	5	5	6	1	3	2	1			2	3	2	2	2	Sum Rows
	1	1	1	1	-1	0	-1	-1			-1	0	-1	-1	-1	-3
		0	0	1	-1	-1	-1	-1			-1	-1	-1	-1	-1	-8
			0	1	-1	-1	-1	-1			-1	-1	-1	-1	-1	-8
				1	-1	-1	-1	-1			-1	-1	-1	-1	-1	-8
					-1	-1	-1	-1			-1	-1	-1	-1	-1	-9
						1	1	-1			1	1	1	1	1	6
							-1	-1			-1	0	-1	-1	-1	-6
								-1			0	1	0	0	0	0
											1	1	1	1	1	5
																0
																0
												1	0	0	0	1
													-1	-1	-1	-3
														0	0	0
															0	0
													Mann Kendall Statistic (S) =			-33



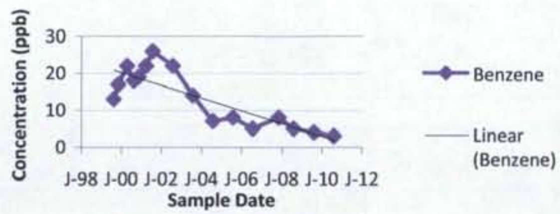
MW-8 | Site = Coakley Landfill | NHDES#: 198712001 | EPA ID #: NHD064424153 | Compound = Benzene

Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
4	9	4	4	8	5	5	3	4			5	3	4	4	6	Sum Rows
	1	0	0	1	1	1	-1	0			1	-1	0	0	1	4
		-1	-1	-1	-1	-1	-1	-1			-1	-1	-1	-1	-1	-12
			0	1	1	1	-1	0			1	-1	0	0	1	3
				1	1	1	-1	0			1	-1	0	0	1	3
					-1	-1	-1	-1			-1	-1	-1	-1	-1	-9
						0	-1	-1			0	-1	-1	-1	1	-4
							-1	-1			0	-1	-1	-1	1	-4
								1			1	0	1	1	1	5
											1	-1	0	0	1	1
																0
																0
												-1	-1	-1	1	-2
													1	1	1	3
														0	1	1
															1	1
													Mann Kendall Statistic (S) =			-10

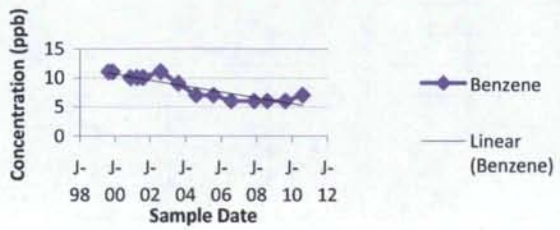


Mann Kendall Statistic Calculations

MW-11			Site = Coakley Landfill				NHDES#: 198712001			EPA ID #: NHD064424153					Compound = Benzene	
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
13	17	22	18	19	22	26	22	14	7	8	5	8	5	4	3	Sum Rows
	1	1	1	1	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	1
		1	1	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-2
			-1	-1	0	1	0	-1	-1	-1	-1	-1	-1	-1	-1	-9
				1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-4
					1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-5
						1	0	-1	-1	-1	-1	-1	-1	-1	-1	-7
							-1	-1	-1	-1	-1	-1	-1	-1	-1	-9
								-1	-1	-1	-1	-1	-1	-1	-1	-8
									-1	-1	-1	-1	-1	-1	-1	-7
										1	-1	1	-1	-1	-1	-2
											-1	0	-1	-1	-1	-4
												1	0	-1	-1	-1
													-1	-1	-1	-3
														-1	-1	-2
															-1	-1
													Mann Kendall Statistic (S) =			-63



GZ-105			Site = Coakley Landfill				NHDES#: 198712001			EPA ID #: NHD064424153					Compound = Benzene	
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12	Event 13	Event 14	Event 15	Event 16	
11	11			10	10	10	11	9	7	7	6	6	6	6	7	Sum Rows
	0			-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-11
				-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	-11
																0
																0
					0	0	1	-1	-1	-1	-1	-1	-1	-1	-1	-7
						0	1	-1	-1	-1	-1	-1	-1	-1	-1	-7
							1	-1	-1	-1	-1	-1	-1	-1	-1	-7
								-1	-1	-1	-1	-1	-1	-1	-1	-8
									-1	-1	-1	-1	-1	-1	-1	-7
										0	-1	-1	-1	-1	0	-4
											-1	-1	-1	-1	0	-4
												0	0	0	1	1
													0	0	1	1
														0	1	1
															1	1
													Mann Kendall Statistic (S) =			-62



APPENDIX D – INTERVIEW REPORT

INTERVIEW DOCUMENTATION FORM

The following is a list of individuals interviewed for this five-year review. See the attached contact record(s) for a detailed summary of the interviews.

Peter Britz	Landfill Project Coordinator	Coakley Landfill Group	
Joseph Donovan, P.G.	Project Manager	NHDES	June 14, 2011
Don Mitchell	Adjacent Neighbor	North Hill Nursery, Greenland, NH	March 24, 2011

INTERVIEW RECORD

Site Name: Coakley Landfill, North Hampton & Greenland NH		**EPA ID No.:** NHD064424153	
Subject: 3rd Five Year Review		**Time:** AM	**Date:** 03/24/2011
Type: ■ Telephone □ Visit □ Other **Location of Visit:**		□ Incoming ■ Outgoing	

Contact Made By:

Name: Gerardo Millán-Ramos	**Title:** Remedial Project Manager	**Organization:** U.S. EPA Region 1

Individual Contacted:

Name: Mr. Don Mitchell	**Title:** Adjacent neighbor	**Organization:** North Hill Nursery
Telephone No: 603-964-7104 **Fax No:** **E-Mail Address:**	**Street Address:** 206 Lafayette Road **City, State, Zip:** North Hampton, NH, 03862	

Summary Of Conversation

Mr. Mitchell is the owner of a plant nursery adjacent to the site, located at 206 Lafayette Road, North Hampton NH. His property lies east of the landfill and up gradient from the GW flow. Representatives from EPA, NHDES and the CLG met with him and his wife on March 11, 2011 to discuss the technical and legal concerns posed by the potential use of an inactive irrigation well in their property. I called Mr. Mitchell to give him an update on the status of the information he requested (i.e. well completion report on the inactive irrigation well in his property, and list of possible options to alleviate high cost of irrigation water). I also explained Mr. Mitchell, the reason for these questions and assured him that they are totally unrelated to the irrigation well issue. I told Mr. Mitchell that his responses would be part of the Five Year Review Report, which will be available to the public, after its completion in September 2011. I proceeded to ask the questions listed on page C-3 of the June 2001 Comprehensive Five Year Review Guidance. The following is a list of the questions and a summary of Mr. Mitchell's response.

1. What is your overall impression of the project (general sentiment)?

   I think the project is moving along. I also understand that it needs time for you to see the results you want.

2. What effects have site operations had on the surrounding community?

   I haven't heard of anything. I imagine some people may want to use the groundwater just as I would, but I am not aware of any such person.

3. Are you aware of any community concerns regarding the site or its operation and administration? If so please give details.

   No. Some customers ask us about the lump and pipes they see at a distance. We tell them is a Superfund site and that it is being cleaned.

4. Are you aware of any events, incidents, or activities at the site such as vandalism, trespassing, or emergency responses from local authorities? If so please give details.

   No. From time to time we see some people mowing the grass and providing maintenance to it, but that's it.

5. Do you feel well informed about the site's activities and progress?

   I feel more informed now. After the meeting we had, I understand you have a timeframe for the cleanup and what is going on.

6. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

   No, I don't.

INTERVIEW RECORD

Site Name: Coakley Landfill, North Hampton & Greenland NH	**EPA ID No.:** NHD064424153
Subject: 3rd Five Year Review	**Time:** 1:30 PM / **Date:** 08/02/11
Type: ■ Telephone ☐ Visit ☐ Other **Location of Visit:**	☐ Incoming ■ Outgoing

Contact Made By:

Name: Gerardo Millán-Ramos	**Title:** Remedial Project Manager	**Organization:** U.S. EPA Region 1

Individual Contacted:

Name: Mr. Peter Britz	**Title:** Landfill Project Coordinator	**Organization:** Coakley Landfill Group
Telephone No: 603-610-7215 **Fax No:** **E-Mail Address:** plbritz@cityofportsmouth.com	**Street Address:** 1 Junkins Ave. **City, State, Zip:** Portsmouth NH 03801	

Summary Of Conversation

I interviewed Mr. Britz with the questions listed on page C-6 of the June 2001 Comprehensive Five Year Review Guidance. The following is a list of the questions and a summary of Mr. Britz's response.

1. What is your overall impression of the project (general sentiment)?

   I think that things are generally progressing. It is not a difficult site to manage but there are some uncertainties about future actions regarding some contaminants, such as 1,4 dioxane, arsenic and manganese. It is difficult to identify trends for these contaminants.

   Is the remedy functioning as expected? How well is the remedy performing?

   Yes, all contaminants are decreasing at different rates, except arsenic, manganese, and 1-4 dioxane all of which are difficult to identify trends.: The remedy is performing well, except for the uncertainties mentioned above.

2. What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?

   Yes, the monitoring data shows that all contaminants have concentrations that are decreasing over time, except the three contaminants aforementioned.

3. Is there a continuous on-site O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of site inspections and activities.

   There is not a continuous site presence, but there are frequent maintenance activities that take place, such as: a) annual sampling and grass mowing.

   b) quarterly maintenance of fencing and gates (usually it is done more frequently than quarterly).

4. Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or the effectiveness of the remedy? Please describe changes and impacts.

   There have been changes in the sampling routines during the last five years. As a result of changes in the NHDES requirements for the monitoring of hazardous waste sites, we are now sampling for 1,4 dioxane in a selected number of wells. Per EPA and NHDES instructions, for six inch wells with screen lengths greater than 10 feet we are using discrete interval sampling for all analytes. Also, a number of gas monitoring stations have been discontinued due to lack of observed exceedances and at two of the gas monitoring stations the sampling frequency has decreased from four times a year to two times a year.

   None, of these changes affect the protectiveness of the remedy. The changes implemented have increased the remedy's efficiency and effectiveness in meeting both NHDES and EPA QA/QC requirements.

5. Have there been unexpected O&M difficulties or costs at the site since start-up or in the last five years? If so, please give details.

   The only unexpected costs were those caused by the refinements to the sampling routines described above. They amount to a one time cost of approximately $7800 plus an annual increase in laboratory and sampling costs.

6. Have there been opportunities to optimize O&M, or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.

   The decrease in the number of the gas monitoring stations and their frequency of sampling were opportunities to optimize sampling efforts. They did augment the efficiency of field operations and resulted in cost savings. Also the use of discrete interval sampling at a number of wells has optimized the probability of detecting contaminants at the correct horizontal strata of groundwater flow.

7. Do you have any comments, suggestions, or recommendations regarding the project?

   No, not at this time.

INTERVIEW RECORD

Site Name: Coakley Landfill, North Hampton & Greenland NH		**EPA ID No.:** NHD064424153	
Subject: 3rd Five Year Review		**Time:** 9:20 AM	**Date:** 06/14/2011
Type: ■ Telephone ☐ Visit ☐ Other **Location of Visit:** n/a		☐ Incoming ■ Outgoing	

Contact Made By:

Name: Gerardo Millán-Ramos	**Title:** Remedial Project Manager	**Organization:** U.S. EPA Region 1

Individual Contacted:

Name: Mr. Joseph Donovan	**Title:** Project Manager	**Organization:** NH DES
Telephone No: 603 271-6811 **Fax No:** 603 271-2181 **E-Mail Address:** jdonovan@des.state.nh.us	**Street Address:** 6 Hazen Drive **City, State, Zip:** Concord NH 03302-0095	

Summary Of Conversation

I called Mr. Donovan to perform this interview and ask him question about his comments on this Review. I proceeded to ask the questions listed on page C-4 of the June 2001 Comprehensive Five Year Review Guidance. The following is a list of the questions and a summary of Mr. Donovan's response.

1. What is your overall impression of the project (general sentiment)?

   It seems to be running well. I am little bit more nervous about it than Somersworth Sanitary Landfill because of the presence of 1,4-Dioxane. I want to make sure we get a good handle on the situation to ensure it is safe for everyone.

2. Have there been routine communications or activities (site visits, inspections, reporting activities, etc.) conducted by your office regarding the site?

   Yes, I have joined EPA at a couple of site visits/inspections, also, I have attended a number of conference calls to discuss ongoing work at the site, and I have reviewed documents prepared by the CLG contractor.

3. Have there been any complaints, violations, or other incidents related to the site requiring a response by your office? If so please give details.

   No.

4. Do you feel well informed about the site's activities and progress?

   Yes.

5. Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

   No, I don't.

APPENDIX E – PHOTOS DOCUMENTING SITE CONDITIONS

APPENDIX E – PHOTOS DOCUMENTING SITE CONDITIONS

Figure 1. First Gate. Looking South East from the church parking lot

Figure 2. Sign at first gate

Figure 3. Second gate and fence. Entrance to the landfill (looking south).

Figure 4. Sign at the second gate.

Figure 5. Rip-Rap on top of drainage swale. Looking west.

Figure 6. Drainage culvert showing partial obstruction from rip rap.

Figure 7. View of the North Hill Nursery from the top of the landfill (Looking South-South East)

Figure 8. Rubber casing protecting one of the most recent settlement gauges.

Figure 9. South-eastern section of fence showing snowstorm/ice damage

Figure 10. Snowstorm/ice damage to eastern section of the fence.

Figure 11. Damaged fence with well MW-4 in the background (Looking south)

Figure 12. Damaged fence on the southern section (Looking south)

Figure 13. Unidentified well without lock.

Figure 14. View of pedestrian gate at the Southeastern corner of the fence, gas vent, and partial erosion of the drainage slope's toe.

Figure 15. Wells MW-5S and MW-5D with posts directly behind.

Figure 16. View of construction equipment depot along the southwestern section of the fence (looking south from the top of the landfill)

Figure 17. View of wooden post protruding into the fence

Figure 18. View of geotextile exposed

Figure 19. View of pedestrian gate at the southwestern corner of the fence unlocked, open and without a sign.

Figure 20. Section of the drainage slope (toe) showing rupture of the geotextile and exposure of the gravel underneath. Southwestern corner of the landfill.

Figure 21. Fallen tree on top of a section of the western side of the fence. Looking north.

Figure 22. Unlocked pedestrian gate on the western side of the fence.

Figure 23. Unlocked pedestrian gate at western side of the fence.

Figure 24. Overgrowth of vegetation on top of drainage swale.

Figure 25. View of the sampling location for Leachates (L-1)

APPENDIX F – INSPECTION CHECKLIST

Site Inspection Checklist

I. SITE INFORMATION	
Site name: Coakley Landfill	**Date of inspection:** April 27, 2011
Location and Region: 480 Breakfast Hill Road, Greenland/North Hampton, New Hampshire 03840	**EPA ID:** NHD064424153
Agency, office, or company leading the five-year review: U.S. EPA Region 1 – New England, Office of Site Remediation and Restoration	**Weather/temperature:** Sunny / 52° F

Remedy Includes: (Check all that apply)

■ Landfill cover/containment
■ Access controls
■ Institutional controls
☐ Groundwater pump and treatment
☐ Surface water collection and treatment
☐ Other Permeable Reactive Barrier
■ 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** ______ ______ ______
   Name Title Date
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no.
   Problems, suggestions; ☐ Report attached ______________________

2. **O&M staff** ______ ______ ______
   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
Contact
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______________________________
____

Agency ______________________
Contact ______________________ ______________ ________ __________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______________________________
____

Agency ______________________
Contact ______________________ ______________ ________ __________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______________________________
____

Agency ______________________
Contact ______________________ ______________ ________ __________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______________________________
____

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	☐ O&M manual	☐ Readily available	☐ Up to date	■ N/A
	☐ As-built drawings	☐ Readily available	☐ Up to date	■ N/A
	☐ Maintenance logs	☐ Readily available	☐ Up to date	■ N/A
	Remarks			
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			
3.	**O&M and OSHA Training Records**	☐ Readily available	☐ Up to date	■ N/A
	Remarks			
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 GW Management Permit	☐ Readily available	■ Up to date	☐ N/A
	Remarks NH DES issued a Groundwater Management Permit on 06/19/2008			
5.	**Gas Generation Records**	☐ Readily available	☐ Up to date	■ N/A
	Remarks			
6.	**Settlement Monument Records**	☐ Readily available	☐ Up to date	■ N/A
	Remarks			
7.	**Groundwater Monitoring Records**	☐ Readily available	■ Up to date	☐ N/A
	Remarks			
8.	**Leachate Extraction Records**	☐ Readily available	☐ Up to date	■ N/A
	Remarks			
9.	**Discharge Compliance Records**			
	☐ Air	☐ Readily available	☐ Up to date	■ N/A
	☐ Water (effluent)	☐ Readily available	☐ Up to date	■ N/A
	Remarks			
10.	**Daily Access/Security Logs**	☐ Readily available	☐ Up to date	■ N/A
	Remarks			

IV. O&M COSTS

1. **O&M Organization**
☐ State in-house ☐ Contractor for State
☐ PRP in-house ■ Contractor for PRP
☐ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other ______

2. **O&M Cost Records**
☐ Readily available ■ Up to date
☐ Funding mechanism/agreement in place
Original O&M cost estimate ______ ☐ Breakdown attached

Total annual cost by year for review period if available (**Breakdown shown on Table 3 of the 5 YR Review Report**)

From	To		
______ Date	______ Date	______ Total cost	☐ Breakdown attached
______ Date	______ Date	______ Total cost	☐ Breakdown attached
______ Date	______ Date	______ Total cost	☐ Breakdown attached
______ Date	______ Date	______ Total cost	☐ Breakdown attached
______ Date	______ Date	______ Total cost	☐ Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**
Describe costs and reasons: Not available at the time of inspection. See table 3 in report for information obtained from the CLG. No unanticipated or unusually high O&M cost was noticed.

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

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ■ Gates secured ☐ N/A
Remarks Extensive damage due to severe snow storms was observed and two pedestrian gates were unsecured. See photos on Appendix E.

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A
Remarks Most gates had attached signs and there are some signs mounted in posts, however there were two pedestrian gates without signs. See photos on Appendix E.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented	☐ 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)

On a yearly basis, in accordance with NH Department of Environmental Services rule Env-Or 607.06(d), the Coakley Landfill Group (CLG) sends a letter to all property owners within the GMZ established by the GMP. This letter requests the self-reporting of any new drinking water wells installed within these properties. Appendix H shows a sample of the letters sent on February 2011 and a copy of the certified mail receipts. Also, during the sampling events (Spring and Fall every year) the contractor performing the work is required to note any observations about new wells and report it to the CLG.

Responsible party/agency Coakley Landfill Group

Contact	Mr. Peter Britz	Executive Director/Project Manager	________	603-610-7215
	Name	Title	Date	Phone no.

Reporting is up-to-date	■ Yes	☐ No	☐ N/A
Reports are verified by the lead agency	■ Yes	☐ No	☐ N/A
Specific requirements in deed or decision documents have been met	■ Yes	☐ No	☐ N/A
Violations have been reported	☐ Yes	☐ No	■ N/A

Other problems or suggestions: ■ Report attached (Appendix H)

2. **Adequacy** ☐ ICs are adequate ■ ICs are inadequate ☐ N/A

Remarks

There is a need for groundwater extraction restrictions for properties on the eastern side of the landfill. Research of the ICs in this area revealed that there is no legal instrument to prohibit the extraction of groundwater in this area. Groundwater extraction in this area has the potential to alter the flow of groundwater and increase the extent of the plume, thus adding complexities and time to the ongoing remedy.

D. General

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

Remarks No vandalism or trespassing was evident on-site, however several of the signs mounted on posts outside the fence had bullet holes in them.

2. **Land use changes on site** ☐ N/A

Remarks Three parcels of land abutting the fence on the southern side of the landfill (see site map/figure and photos in Appendix E), are being used for the storage of construction equipment and materials. Wood posts are extremely close to the fence and wells and are a potential hazard.

3. **Land use changes off site** ■ N/A

Remarks

VI. GENERAL SITE CONDITIONS

A. Roads ■ Applicable ☐ N/A

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

Remarks

B. Other Site Conditions

Remarks None

VII. LANDFILL COVERS ■ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ■ Settlement not evident
   Areal extent______________ Depth___________
   Remarks____

2. **Cracks** ☐ Location shown on site map ■ Cracking not evident
   Lengths____________ Widths___________ Depths_________
   Remarks____

3. **Erosion** ■ Location shown on site map ☐ Erosion not evident
   Areal extent______________ Depth___________
   Remarks The toe at the drainage slope in some areas of the landfill has been eroded to the point of exposing the membrane and crushed stone underneath. See photos in Appendix E. However an examination of the design specifications and a cross-section of the cap components revealed that this geotextile is not a post-construction component of the cap. The geotextile was a temporary device to hold in place the gravel of a drainage layer on top of the liner, while the cap was constructed. It was left in place with the understanding that it would eventually be exposed and disintegrate.

4. **Holes** ☐ Location shown on site map ■ Holes not evident
   Areal extent______________ Depth___________
   Remarks____

5. **Vegetative Cover** ■ Grass ■ 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____

7. **Bulges** ☐ Location shown on site map ■ 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____

9.	**Slope Instability** ☐ Slides ☐ Location shown on site map ■ No evidence of slope instability Areal extent______________ Remarks______________
B. Benches	■ Applicable ☐ 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 ■ N/A or okay Remarks______________
2.	**Bench Breached** ☐ Location shown on site map ■ N/A or okay Remarks______________
3.	**Bench Overtopped** ☐ Location shown on site map ■ N/A or okay Remarks______________
C. Letdown Channels	■ 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 ■ No evidence of settlement Areal extent______________ Depth______________ Remarks______________
2.	**Material Degradation** ☐ Location shown on site map ■ No evidence of degradation Material type______________ Areal extent______________ Remarks______________
3.	**Erosion** ☐ Location shown on site map ■ No evidence of erosion Areal extent______________ Depth______________ Remarks______________

4.	**Undercutting** ☐ Location shown on site map ■ No evidence of undercutting Areal extent______________ Depth______________ Remarks______________
5.	**Obstructions** Type______________ ■ No obstructions ☐ Location shown on site map Areal extent______________ Size______________ Remarks A few rocks from the Rip Rap were observed on the culverts directly across the main entrance of the fence. These rocks were not forming an obstruction at the time, but if more of these accumulate, the culverts could become obstructed. All drainage channels like these should be kept clear of such debris at the time of regular maintenance activities.

6.	**Excessive Vegetative Growth** Type__tall grass and a shrub__________________ ☐ No evidence of excessive growth ■ Vegetation in channels does not obstruct flow ☐ Location shown on site map Areal extent______________ Remarks__Some of the drainage swales with rip rap show excessive growth of vegetation. See photos on Appendix E. Such vegetation should be removed at the time of the scheduled maintenance activities.
D. Cover Penetrations ■ Applicable ☐ N/A	
1.	**Gas Vents** ☐ Active ■ Passive ■ Properly secured/locked ■ Functioning ■ Routinely sampled ■ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks______________________________
2.	**Gas Monitoring Probes** ■ Properly secured/locked ■ Functioning ■ Routinely sampled ■ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks None
3.	**Monitoring Wells** (within surface area of landfill) ☐ Properly secured/locked ■ Functioning ■ Routinely sampled ■ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks Three wells had no lock and the label underneath the cover was barely legible. See photos in Appendix E.
4.	**Leachate Extraction Wells** ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ■ N/A Remarks______________________________
5.	**Settlement Monuments** ☐ Located ☐ Routinely surveyed ■ N/A Remarks______________________________

E. Gas Collection and Treatment ■ Applicable ☐ N/A	
1.	**Gas Treatment Facilities** ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse ☐ Good condition ☐ Needs Maintenance Remarks N/A
2.	**Gas Collection Wells, Manifolds and Piping** ■ Good condition ☐ Needs Maintenance Remarks
3.	**Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) ■ Good condition ☐ Needs Maintenance ☐ N/A Remarks
F. Cover Drainage Layer ☐ Applicable ■ N/A	
1.	**Outlet Pipes Inspected** ☐ Functioning ☐ N/A Remarks
2.	**Outlet Rock Inspected** ☐ Functioning ☐ N/A Remarks
G. Detention/Sedimentation Ponds ☐ Applicable ■ N/A	
1.	**Siltation** Areal extent______ Depth______ ☐ N/A ☐ Siltation not evident Remarks
2.	**Erosion** Areal extent______ Depth______ ☐ Erosion not evident Remarks
3.	**Outlet Works** ☐ Functioning ☐ N/A Remarks
4.	**Dam** ☐ Functioning ☐ N/A Remarks

H. Retaining Walls ☐ Applicable ■ 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 ☐ Siltation not evident
Areal extent__________ Depth__________
Remarks____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
☐ Vegetation does not impede flow
Areal extent__________ Type__________
Remarks____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
Areal extent__________ Depth__________
Remarks____

4. **Discharge Structure** ☐ Functioning ☐ N/A
Remarks____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ■ 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 ■ 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 ■ Is routinely submitted on time ■ Is of acceptable quality
2. Monitoring data suggests: ☐ Groundwater plume is effectively contained ■ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☐ Properly secured/locked ■ Functioning ■ Routinely sampled ■ Good condition
■ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks Well MW-4 was found unlocked as well as three wells within OU-1 (the fenced landfill).

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. N/A

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 objective of the OU-1 ROD is to protect the drinking water aquifer by minimizing further migration of contaminants to the groundwater and surface water and eliminate threats posed by direct contact with or ingestion of contaminated soils and wastes at the site. The OU-1 (source control) response action includes caping and fencing the landfill, collecting and venting landfill gases, the long term monitoring of groundwater, surface water and lecheates from the landfill, and the implementation of institutional controls to prevent contact with site contaminants and to protect the components of the remedy. The objective of the OU-2 ROD is to manage the migration of contaminated groundwater outside the landfill boundaries. The OU-2 (management of migration) response action includes using institutional controls to prevent use of contaminated groundwater; using natural attenuation for the contaminated groundwater plume; and groundwater monitoring.

The integrity of the landfill cap, gas vents, monitoring wells, gas monitoring probes, and drainage swales is intact. Rain and surface water runoff is being diverted from the landfill wastes, therefore further migration of contaminants to the groundwater and surface water is being effectively minimized. The intact integrity of these components also creates an effective barrier between the landfill wastes, its contaminated soils, and people or animals that may have direct contact and/or ingest these. However, the extensive damage on the fence and the lack of locks on some gates and monitoring wells, the proximity of construction materials to the fence (i.e. wooden posts), and the excessive growth of vegetation on some drainage wells and at a section of the fence, pose potential threats that could compromise the integrity of the remedy components and its long-term protectiveness.

The integrity of the monitoring wells in OU-2, the continued performance of annual groundwater, surface water and leacheate sampling events, and the existence of Institutional Controls (ICs) in the form of a Groundwater Management Permit issued by NHDES, is effectively managing the migration of contaminated groundwater and preventing its ingestion by humans. However, the fact that some wells were unlocked and poorly identified poses a potential threat to the long term effectiveness of the remedy.

In conclusion, the inspection observations indicate that the remedy is functioning as designed, but the deficiencies noted need to be corrected in order to ensure long-term protectiveness and continued monitoring is required.

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. • <u>Fence damage</u> Extensive damage created by winter storms was observed. It does not bear on current protectiveness but future protectiveness could be compromised if repairs are not made. • <u>Gates w/o locks and/or signs</u> Some pedestrian gates were observed to be missing locks and/or signs. No indication of trespassing was observed but gates must be locked in order to insure protectiveness. • <u>Monitoring wells w/o locks and proper label</u> Three wells had no lock and the label underneath the cover was barely legible. This needs to be addressed in order to avoid cross-contamination and ensure future protectiveness. • <u>Electrical posts too close to well MW-5 and one of them almost penetrating the fence</u> These posts and construction equipment pose a potential threat of damage to wells MW-5 and MW-2, and to the fence. Current protectiveness is not affected but future protectiveness is compromised if equipment and materials are not relocated at least five feet from these structures. • <u>Tree too close to fence with limbs on top of it</u> A tree was observed to be too close to the western section of the fence and some branches were over the fence and lying directly on top of the fence. Current protectiveness is not affected but future protectiveness could be compromised if tree is not removed and/or trimmed. • <u>Excesive vegetation on some drainage swales and a few rocks inside culverts.</u> All drainage channels must be free of excessive vegetation and debris in order to ensure the free flow of runoff water. Left unchecked, they have the potential to compromise future 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. <u>NONE</u>
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. <u>NONE</u>

APPENDIX G – MONITORING NETWORK, ANALYTICAL PARAMETERS & SAMPLING FREQUENCY

TABLE 2-2
COAKLEY LANDFILL SUPERFUND SITE
OU-1 GROUNDWATER MONITORING NETWORK,
ANALYTICAL PARAMETERS, AND SAMPLING FREQUENCY

	Groundwater												Residential Wells	
Sampling Point	MW-4	MW-5S	MW-5D	MW-6	MW-8	MW-9	MW-10	MW-11	RMW-3	BP-4	OP-2	OP-5	R-3	R-5
Field Parameters														
Static Water Level	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Turbidity	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Specific Conductance	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Temperature	A	A	A	A	A	A	A	A	A	A	A	A	A	A
pH	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Dissolved Oxygen	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Dissolved Metals														
Dissolved Iron	A	A	N/A	A	N/A	A	N/A	N/A	N/A	N/A	A	A	N/A	N/A
Dissolved Manganese	A	A	N/A	A	N/A	A	N/A	N/A	N/A	N/A	A	A	N/A	N/A
TAL Metals (Total)														
Aluminum	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Arsenic	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Barium	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Cadmium	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Calcium	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Chromium	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Copper	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Iron	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Lead	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Magnesium	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Mercury	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Nickel	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Potassium	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Selenium	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Silver	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Sodium	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Thallium	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Zinc	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Cobalt	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Beryllium	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Manganese	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Antimony	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Vanadium	A	A	A	A	A	A	A	A	A	A	A	A	N/A	N/A
Volatile Organic Compounds														
NHDES Full List	N/A	A	A	A	A	N/A	N/A	A	N/A	N/A	N/A	N/A	A	A
1,4 Dioxane, EDP and DBCP	Note 3	Note 3	Note 3	N/A	Note 3	Note 3	N/A	Note 3	N/A	Note 3	Note 3	Note 3	N/A	N/A

Notes:
1. A = Annual
2. N/A = Not Analyzed
3. Samples collected from these wells during the 2010 annual monitoring event shall be analyzed for 1,4 Dioxane, ethylene dibromide (EDB) and dibromochloropropane (DBCP). The Group, USEPA and NHDES shall determine whether analysis of 1,4 Dioxane, EDP and DBCP is required after 2010.

TABLE 2-3
COAKLEY LANDFILL SUPERFUND SITE
OU-2 GROUNDWATER MONITORING NETWORK,
ANALYTICAL PARAMETERS, AND SAMPLING FREQUENCY

Sampling Point	FPC-2A	FPC-2B	FPC-4B	FPC-5A	FPC-5B	FPC-6A	FPC-6B	FPC-7A	FPC-7B	FPC-8A	FPC-8B	FPC-9A	FPC-11A	FPC-11B	GZ-105	GZ-123	GZ-125	AE-1A	AE-1B	AE-2A	AE-2B	AE-3A	AE-3B	AE-4A	AE-4B
Field Parameters																									
Static Water Level	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Turbidity	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Specific Conductance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Temperature	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
pH	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Dissolved Oxygen	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Dissolved Metals																									
Dissolved Iron	A	A	A	N/A	N/A	A	A	A	A	N/A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Dissolved Manganese	A	A	A	N/A	N/A	A	A	A	A	N/A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
TAL Metals (Total)																									
Aluminum	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Arsenic	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Barium	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Beryllium	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Calcium	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Cadmium	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Chromium	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Copper	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Iron	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Lead	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Magnesium	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Mercury	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Nickel	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Potassium	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Selenium	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Silver	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Sodium	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Thallium	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Zinc	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Cobalt	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Manganese	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Antimony	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Vanadium	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Volatile Organic Compounds																									
NHDES Full List	A	A	A	N/A	N/A	A	A	N/A	N/A	A	A	N/A	N/A	N/A	A	A	A	N/A	N/A	A	A	A	A	A	A
1,4 Dioxane, EDP and DBCP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note 3	Note 3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Note 3	Note 3	Note 3	Note 3	N/A	N/A

Notes:
1. A = Annual
2. N/A = Not Analyzed
3. Samples collected from these wells during the 2010 annual monitoring event shall be analyzed for 1,4 Dioxane, ethylene dibromide (EDB) and dibromochloropropane (DBCP). The Group, USEPA and NHDES shall determine whether analysis of 1,4 Dioxane, EDP and DBCP is required after 2010.

TABLE 2-5
COAKLEY LANDFILL SUPERFUND SITE
SURFACE WATER, SEDIMENT, AND LEACHATE MONITORING NETWORK,
ANALYTICAL PARAMETERS, AND SAMPLING FREQUENCY

	Surface Water			Sediment		Leachate
Sampling Point	SW-4	SW-5	SW-103	SED-4	SED-5	L-1
Field Parameters						
Turbidity	A	A	A	N/A	N/A	A
Specific Conductance	A	A	A	N/A	N/A	A
Temperature	A	A	A	N/A	N/A	A
pH	A	A	A	N/A	N/A	A
Dissolved Oxygen	A	A	A	N/A	N/A	A
Inorganic Paramters						
Chemical Oxygen Demand	N/A	N/A	N/A	N/A	N/A	A
Ammonia	A	A	A	N/A	N/A	A
TAL Metals (Total)						
Aluminum	A	A	A	5-YR	5-YR	A
Arsenic	A	A	A	5-YR	5-YR	A
Barium	A	A	A	5-YR	5-YR	A
Cadmium	A	A	A	5-YR	5-YR	A
Calcium	A	A	A	5-YR	5-YR	A
Chromium	A	A	A	5-YR	5-YR	A
Copper	A	A	A	5-YR	5-YR	A
Iron	A	A	A	5-YR	5-YR	A
Lead	A	A	A	5-YR	5-YR	A
Magnesium	A	A	A	5-YR	5-YR	A
Mercury	A	A	A	5-YR	5-YR	A
Nickel	A	A	A	5-YR	5-YR	A
Potassium	A	A	A	5-YR	5-YR	A
Selenium	A	A	A	5-YR	5-YR	A
Silver	A	A	A	5-YR	5-YR	A
Sodium	A	A	A	5-YR	5-YR	A
Thallium	A	A	A	5-YR	5-YR	A
Zinc	A	A	A	5-YR	5-YR	A
Cobalt	A	A	A	5-YR	5-YR	A
Beryllium	A	A	A	5-YR	5-YR	A
Manganese	A	A	A	5-YR	5-YR	A
Antimony	A	A	A	5-YR	5-YR	A
Vanadium	A	A	A	5-YR	5-YR	A
Volatile Organic Compounds (4)	A	A	A	N/A	N/A	A

Notes:
1. A = Annual
2. N/A = Not Analyzed
3. 5-YR - Sample once every 5 years beginning in 2014.
4. The Volatile Organic Compounds alalyte list for surface water and leachate shall be the NHDES Waste Management Division Full List of Analytes for Volatile Organics (NHDES Full List). Leachate sample (L-1) shall be analyzed for 1,4 Dioxane, ethylene dibromide (EDB) and dibromochloropropane (DBCP) during the 2010 sampling event. Surface water samples shall not be analyzed for 1,4 Dioxane, EDB or DBCP. The Group, USEPA and NHDES shall determine whether analysis of 1,4 Dioxane, EDB or DBCP is required after 2010.

APPENDIX H – INQUIRY ON NEW DRINKING WATER WELLS

February 17, 2011

Elmer Sewall
340 Breakfast Hill Road
Greenland, NH 03840

Dear Mr. Sewall,

Approximately one year ago you were notified because your property is one of the properties within the proposed groundwater management zone for the Coakley Landfill.

As required by NH Department of Environmental Services rule Env-Or 607.06(d), this letter is being sent to inquire as to whether there are any new drinking water supply wells on your property. If so please notify me at the address below.

If you have questions or would like additional information please contact me at 603-610-7215, by email at plbritz@cityofportsmouth.com or by mail at the City of Portsmouth, 1 Junkins Avenue, Portsmouth, NH 03801.

Sincerely,

Peter L. Britz
Coakley Technical Committee

Pg. 1 of 3

Name and Address of Sender
Planning Department
City of Portsmouth
1 Junkins Avenue
Portsmouth, NH 03801

Check type of mail or service:
- [x] Certified
- [ ] COD
- [ ] Delivery Confirmation
- [ ] Express Mail
- [ ] Insured
- [ ] Recorded Delivery (International)
- [ ] Registered
- [ ] Return Receipt for Merchandise
- [ ] Signature Confirmation

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D - 15

Article Number	Addressee (Name, Street, City, State, & ZIP Code)	Postage	Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	DC Fee	SC Fee	SH Fee	RD Fee	RR Fee

Town of Greenland
PO Box 100
Greenland, NH 03840
7005-0390-0000-9117-6701

Alexis Perron
9 Lafayette Terrace
North Hampton, NH 03862
7005 — 1607

John Wylie
Darleena Wylie
8 Lafayette Terrace
North Hampton, NH 03862
7005 — 6282

Sewall Rev.Tr.96
reakfa Hill Road
land, NH 03840
7005 — 1645

Joseph Hanley
20 Lafayette Terrace
North Hampton, NH 03862
7005 — 6718

Joan Nordstrom
67 North Road
North Hampton, NH 03862
7005 — 6299

ZCCMMXIIV0000IIII/5/
NH Ltd Ptshp
PO Box 65
Portsmouth, NH 03802
7005 — 1652

Joseph McKittrick
Helen McKittrick
188 Lafayette Road
North Hampton, NH 03862
7005 — 6244

Boston & Maine Corp,c/o Gilford
Trans.Inc
n Horse Park
North Billerica, MA 01802
7005 — 6312

Town of N. Hampton
nserv n Commisssion
O Box 7
rth H ton, NH 03862
7005 — 1638

William Adinolfo
Christine Adinolfo
16 Lafayette Terrace
North Hampton, NH 03862
7005 — 6251

Elmer Sewall
340 Breakfast Hill Road
Greenland, NH 03840
7005 — 6329

William Warman
380 Lafayette Rd,11-102
Seabrook, NH 03874
7005 — 1621

Ambrose Laffey
Susan Laffey
12 Lafayette Terrace
North Hampton, NH 03862
7005 — 6275

Coakley Landfill LLC
PO Box 190
Greenland, NH 03840
7005 — 6336

Delivery Confirmation | Signature Confirmation | Special Handling | Restricted Delivery | Return Receipt

PORTSMOUTH NH FEB 22 2011 USPS

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Total Number of Pieces Received at Post Office 15
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PS Form **3877**, February 2002 *(Page 1 of 2)*
Complete by Typewriter, Ink, or Ball Point Pen

Pg. 2 of 3

Planning Department
Name and Address of Sender
City of Portsmouth
1 Junkins Avenue
Portsmouth, NH 03801

Check type of mail or service:

- ☑ Certified
- ☐ COD
- ☐ Delivery Confirmation
- ☐ Express Mail
- ☐ Insured
- ☐ Recorded Delivery (International)
- ☐ Registered
- ☐ Return Receipt for Merchandise
- ☐ Signature Confirmation

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Postmark and Date of Receipt

D-15

Article Number	Addressee (Name, Street, City, State, & ZIP Code)	Postage	Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	DC Fee	SC Fee	SH Fee	RD Fee	RR Fee

Richard R. Grenier I.V. Trust
Richard Grenier & Charter Trust, CoTrustees
10 Canterbury Lane
Bedford, NH 03110-4435
7005 —— 6343

Leo Crotty, Jr.
216 Lafayette Road
North Hampton, NH 03862
7005 —— 6350

MA NEGM, LLC
302 Main Street
Somersworth, MA 03878
7005 —— 6367

Luck Enterprises
[illegible] Lafayette Road
North Hampton, NH 03862
7005 —— 6374

Louis Fucci
Christopher & Ricardo Fucci-
180 Lafayette Road
North Hampton, NH 03862
7005 —— 1683

Lori Lessard, Trustee
186 Lafayette Road
North Hampton, NH 03862
7005 —— 1713

Kenneth Margeson
Tracy Margeson
15 Lafayette Terrace
North Hampton, NH 03862
7005 —— 1591

Edward Gabree
Anita Gabree
15 Lafayette Terrace
North Hampton, NH 03862
7005 —— 1577

Joseph Conner
Bridget Conner
44 Lafayette Terrace
North Hampton, NH 03862
7005 —— 1584

Joseph Fitzgerald
Yolanda Fitzgerald
PO Box 626
North Hampton, NH 03862
7005 —— 1560

Gozinta LLC
c/o Rodney Booker
198 Lafayette Road
North Hampton, NH 03862
7005 —— 1553

Derek Burt
8774 Mustic Circle
Northport, FL 34287
7005 —— 1546

206 Lafayette Road LLC
206 Lafayette Road
North Hampton, NH 03862
7005 —— 1539

Stella Cibrowski
PO Box 443
Concord, NH 03301
7005 —— 1522

Kent Norman, Trustee
S&L Realty Trust
PO Box 4276
Portsmouth, NH 03802-4276
7005 —— 1515

PORTSMOUTH NH 03801 FEB 22 2011 USPS

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PS Form 3877, February 2002 (Page 1 of 2)
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Name and Address of Sender
Planning Department
City of Portsmouth
1 Junkins Avenue
Portsmouth, NH 03801

Check type of mail or service:

- [x] Certified
- [ ] COD
- [ ] Delivery Confirmation
- [ ] Express Mail
- [ ] Insured
- [ ] Recorded Delivery (International)
- [ ] Registered
- [ ] Return Receipt for Merchandise
- [ ] Signature Confirmation

Affix Stamp Here
(If issued as a certificate of mailing, or for additional copies of this bill)
Postmark and Date of Receipt

D-5

NH 03801 FEB 22 2011 USPS PORTSMOUTH

Article Number	Addressee (Name, Street, City, State, & ZIP Code)	Postage	Fee	Handling Charge	Actual Value if Registered	Insured Value	Due Sender if COD	DC Fee	SC Fee	SH Fee	RD Fee	RR Fee
First and Ten Property Management PO Box 1058 Hampton, NH 03843 7005 —— 1508												
Kathleen Simmel 3 Lafayette Terrace North Hampton, NH 03862 7005 —— 1492												
Judith Tracey Bernard Tracey 257 Washington Road Rye, NH 03870 7005 —— 62237												
Richard Bartlett Kimberly Bartlett 7005 —— 1614 5 Lafayette Terrace North Hampton, NH 03862												
James Jones 207 Atlantic Avenue North Hampton, NH 03862 7005 —— 6268												

Delivery Confirmation | Signature Confirmation | Special Handling | Restricted Delivery | Return Receipt

Total Number of Pieces Listed by Sender	Total Number of Pieces Received at Post Office	Postmaster, Per (Name of receiving employee)
5	5	[illegible]

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APPENDIX I – GMP & GMP NOTICE

The State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

June 19, 2008

Peter Britz
Environmental Planner
City of Portsmouth
1 Junkins Avenue
Portsmouth, NH 03801

SUBJECT: **North Hampton** – Coakley Landfill Superfund Site, 480 Breakfast Hill Road
Groundwater Management Permit, DES Site # 198712001, Project RSN # 431

Groundwater Management Permit Application, prepared by Hancock & Associates, dated May 14, 2008

Dear Mr. Britz:

Please find enclosed Groundwater Management Permit Number GWP-198712001-N-001, approved by the Department of Environmental Services (Department). This permit is issued for a period of 5 years to monitor the effects of past discharges of contaminants of concern, as defined in Table 12 of the 1994 Site Record of Decision.

All monitoring summaries and all required sampling results must be submitted to the Groundwater Management Permits Coordinator at the address below. All correspondence shall contain a cover letter that clearly shows the Department identification number for the site (DES Site # 198712001). **Please note that upon issuance of this permit, it is only necessary to submit monitoring results to the "Groundwater Management Permits Coordinator" and not to my attention.**

Please note that Condition # 9 requires the permit holder to provide notice of the permit by certified mail, within 30 days of permit issuance, to all owners of lots of record within the Groundwater Management Zone. Documentation of the notification, in the form of a copy of the notice with return receipt(s), shall be submitted to the Department within 60 days of permit issuance.

Also, please note that Condition # 10 requires the permit holder to record "Notice" of the permit (not the permit), within 60 days of issuance, at the registry of deeds in the chain of title for each lot within the Groundwater Management Zone. An example Notice is enclosed for your use. A copy of each recorded Notice shall be submitted to the Department within 30 days of recordation.

Should you have any questions, please contact me at the Waste Management Division.

Sincerely,

Dept. of Environmental Services

Digitally signed by Dept. of Environmental Services
DN: CN = Dept. of Environmental Services, C = US, O = Hazardous Waste Remediation Bureau, OU = Waste Management Division
Reason: I attest to the accuracy and integrity of this document
Date: 2008.06.19 07:50:04 -04'00'

Andrew Hoffman, P.E.
State Project Coordinator
Hazardous Waste Remediation Bureau
Tel: (603) 271-6778
Fax: (603) 271-2181
Email: Andrew.Hoffman@des.nh.gov

Enclosure(s): Groundwater Management Permit No. GWP-198712004-N-001
Sample Recordation Notice

cc: Daniel MacRitchie, Hancock Associates
Kim McNamara, City Health Officer
Richard Pease, Federal Sites, Supervisor
Karlee Kenison, HWRB-GR&P, Supervisor
Peter Roth, NH DoJ

The

NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES

hereby issues

GROUNDWATER MANAGEMENT PERMIT NO. GWP-198712001-N-001

to the permittee

COAKLEY LANDFILL GROUP

to monitor the past discharge of

Contaminants of Concern, as identified in Table 12 of the 1994 Record of Decision

at

COAKLEY LANDFILL
(480 Breakfast Hill Road)

in NORTH HAMPTON, N.H.

via the groundwater monitoring system comprised of

12 OU-1 monitoring wells, 25 OU-2 monitoring wells, 3 surface water, and 2 sediment and 1 leachate sampling station(s)

as depicted on the Site Plan entitled

"Environmental Monitoring Network"

dated August 16, 2007, prepared by Golder & Associates, Inc. of Manchester, New Hampshire

TO: COAKLEY LANDFILL GROUP
1 JUNKINS AVENUE
PORTSMOUTH, NEW HAMPSHIRE 03801

Date of Issuance: June 19, 2008
Date of Expiration: June 18, 2013

Pursuant to authority in N.H. RSA 485-C:6-a, the New Hampshire Department of Environmental Services (Department), hereby grants this permit to monitor past discharges to the groundwater at the above described location for five years subject to the following conditions:

(continued)

STANDARD MANAGEMENT PERMIT CONDITIONS

1. The permittee shall not violate Ambient Groundwater Quality Standards adopted by the Department (N.H. Admin. Rules Env-Or 600) in groundwater outside the boundaries of the Groundwater Management Zone, as shown on the referenced site plan.

2. The permittee shall not cause groundwater degradation that results in a violation of surface water quality standards (N.H. Admin. Rules Env-Ws 1700) in any surface water body.

3. The permittee shall allow any authorized staff of the Department, or its agent, to enter the property covered by this permit for the purpose of collecting information, examining records, collecting samples, or undertaking other action associated with this permit.

4. The permittee shall apply for the renewal of this permit at least 90 days prior to its expiration date.

5. This permit is transferable only upon written request to, and approval of, the Department. Compliance with the existing Permit shall be established prior to permit transfer. Transfer requests shall include the name and address of the person to whom the permit transfer is requested, signature of the current and future permittee, and a summary of all monitoring results to date.

6. The Department reserves the right, under N.H. Admin. Rules Env-Or 600, to require additional hydrogeologic studies and/or remedial measures if the Department receives information indicating the need for such work.

7. The permittee shall maintain a water quality monitoring program and submit monitoring results inclusive with the annual report to the Department's Groundwater Management Permits Coordinator no later than 120 days after sampling. Samples shall be taken from on-site monitoring wells and surface water sampling points as shown and labeled on the referenced site plan and other sampling points listed on the following table in accordance with the schedule outlined herein:

Monitoring Locations	**Sampling Frequency**	**Parameters**
MW-5S, MW-6, FPC-2A, FPC-2B, FPC-4B, FPC-6A, FPC-6B, FPC-8B, GZ-105, GZ-123, GZ-125, AE-2A, AE-2B, AE-3A, AE-3B, AE-4A, AE-4B	August each year	Field parameters, dissolved iron & manganese, target analyte list (TAL) metals (total), NHDES Waste Management Division Full List of Analytes for Volatile Organics (Full List VOCs).
MW-4, MW-9, OP-2, OP-5, FPC-7A, FPC-7B, FPC-9A, FPC-11A, FPC-11B, AE-1A, AE-1B	August each year	Field parameters, dissolved iron & manganese, TAL metals (total).
MW-5D, MW-8, MW-11,FPC-8A	August each year	Field parameters, TAL metals (total), Full List VOCs.
MW-10, RMW-3, BP-4, FPC-5A, FPC-5B	August each year	Field parameters, TAL metals (total).

(continued)

Monitoring Locations	Sampling Frequency	Parameters
R-3, R-5	August each year	Field parameters, Full List VOCs.
SW-4, SW-5, SW-103	August each year	Field parameters, ammonia, TAL metals (total), Full List VOCs.
SED-4, SED-5	August each year	TAL metals (total).
L-1	August each year	Field parameters, COD, ammonia, TAL metals (total), Full List VOCs.

Sampling shall be performed in accordance with the documents listed in Env-Or 610.02 (e). Samples shall be analyzed by a laboratory certified by the U.S. Environmental Protection Agency or the New Hampshire Department of Environmental Services. All overburden groundwater samples collected for metal analyses (iron, manganese, and Drinking Water Metals) shall be analyzed for dissolved metals; and thus must be field filtered (with a 0.45-micron filter) and acidified after filtration in the field. Surface water samples and samples collected from bedrock or water supply wells shall be analyzed for total metals, and shall not be filtered. Surface water samples shall be collected and analyzed in accordance with 40 CFR 136. As referred to herein, the term "Target Analyte Metals (TAL)" refers to aluminum, arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, magnesium, mercury, nickel, potassium, selenium, silver, sodium, thallium, zinc, cobalt, beryllium, manganese, antimony and vanadium.

Summaries of water quality shall be submitted annually in December to the Department's Waste Management Division, attention Groundwater Management Permits Coordinator, using a format acceptable to the Department. The Summary Report shall include the information listed in Env-Or 607.04 (a), as applicable.

The Annual Summary Report shall be prepared and stamped by a professional engineer or professional geologist licensed in the State of New Hampshire.

8. Issuance of this permit is based on the Groundwater Management Permit Application dated May 14, 2008, and the historical documents found in the Department file DES Site # 198712001. The Department may require additional hydrogeologic studies and/or remedial measures if invalid or inaccurate data are submitted.

9. Within 30 days of the date of Department approval of this Groundwater Management Permit, the permittee shall provide notice of the permit by certified mail, return receipt requested, to all owners of lots of record within the Groundwater Management Zone. The permittee shall submit documentation of this notification to the Department within 60 days of permit issuance.

10. Within 60 days of the date of Department approval of this Groundwater Management Permit, the permit holder shall record notice of the permit in the registry of deeds in the chain of title for each **lot** within the Groundwater Management Zone. **This recordation requires that the registry be provided with the name of current property owner and associated book and page numbers for the deed of each lot encumbered by this permit. Portions of State/Town/City roadways and associated right-of-way properties within the Groundwater Management Zone do not require recordation.** A copy of each recorded notice shall be submitted to the Department within 30 days of recordation.

(continued)

11. Within 30 days of discovery of a violation of an ambient groundwater quality standard at or beyond the Groundwater Management Zone boundary, the permittee shall notify the Department in writing. Within 60 days of discovery, the permittee shall submit recommendations to correct the violation. The Department shall approve the recommendations if the Department determines that they will correct the violation.

SPECIAL CONDITIONS FOR THIS PERMIT

12. Recorded property within the Groundwater Management Zone shall include the lots as listed and described in the following table:

Tax Map/ Lot #	Property Address	Owner Name and Address	Deed Reference (Book/Page)
Map 10 Lot 11	355 Lafayette Road Rye	First & Ten Property Management PO Box 1058 Rye 03843	Book 3294 Page 2953
Map 17 Lot 72	67 North Road North Hampton	Joan Nordstrom 67 North Road North Hampton 03862	Book 2416 Page 583
Map 17 Lot 73	65 North Road North Hampton	Yolanda Fitzgerald PO Box 626 North Hampton 03862	Book 3007 Page 2807
Map 17 Lot 82	160 Lafayette Rd North Hampton	Luck Enterprises 115 Lafayette Road North Hampton 03862	Book 2473 Page 1659
Map 17 Lot 86	180 Lafayette Rd North Hampton	Christopher & Ricardo Fucci 180 Lafayette Road North Hampton 03862	Book 3319 Page 952
Map 17 Lot 87	186 Lafayette Rd North Hampton	Lori Lessard, Trustee 186 Lafayette Road North Hampton 03862	Book 2760 Page 2101
Map 21 Lot 8	188 Lafayette Rd North Hampton	Helen McKittrick 188 Lafayette Road North Hampton 03862	Book 2641 Page 2656
Map 21 Lot 10	8A Lafayette Terrace North Hampton	Darleena Wylie 8 Lafayette Terrace North Hampton 03862	Book 3219 Page 2588
Map 21 Lot 11	12A Lafayette Terrace North Hampton	Susan Laffey 12 Lafayette Terrace North Hampton 03862	Book 2964 Page 2565
Map 21 Lot 12	16A Lafayette Terrace North Hampton	Christine Adinolfo 16 Lafayette Terrace North Hampton 03862	Book 2963 Page 1721
Map 21 Lot 14	20 Lafayette Terrace North Hampton	Joseph Hanley 20 Lafayette Terrace North Hampton 03862	Book 4682 Page 1265

(continued)

Tax Map/ Lot #	Property Address	Owner Name and Address	Deed Reference (Book/Page)
Map 21 Lot 14-1	40-42 Lafayette Terrace North Hampton	James Jones 207 Atlantic Avenue North Hampton 03862	Book 4451 Page 1104
Map 21 Lot 15	44 Lafayette Terrace North Hampton	Bridget Conner 44 Lafayette Terrace North Hampton 03862	Book 4183 Page 1638
Map 21 Lot 16	46 Lafayette Terrace North Hampton	Rodney Booker 46 Lafayette Terrace North Hampton 03862	Book 4275 Page 902
Map 21 Lot 17	1 Lafayette Terrace North Hampton	Bernard Tracey 257 Washington Road Rye 03870	Book 2450 Page 687
Map 21 Lot 18	3 Lafayette Terrace North Hampton	Kathleen Tracey 3 Lafayette Terrace North Hampton 03862	Book 1243 Page 317
Map 21 Lot 19	5 Lafayette Terrace North Hampton	Kimberly Bartlett 5 Lafayette Terrace North Hampton NH 03862	Book 3824 Page2799
Map 21 Lot 20	9 Lafayette Terrace North Hampton	Alexis Perron 9 Lafayette Terrace North Hampton NH 03862	Book 3088 Page 1774
Map 21 Lot 21	15 Lafayette Terrace North Hampton	Tracy Margeson 15 Lafayette Terrace North Hampton NH 03862	Book 3121 Page 1606
Map 21 Lot 22	15 Lafayette Terrace North Hampton	Anita Gabree 15 Lafayette Terrace North Hampton 03862	Book 3013 Page 2221
Map 21 Lot 23	15 Lafayette Terrace North Hampton	Tracy Margeson 15 Lafayette Terrace North Hampton NH 03862	Book 3121 Page 1606
Map 21 Lot 24	43 Lafayette Terrace North Hampton	William Warman 380 Lafayette Rd,11-102 Seabrook NH 03874	Book 4374 Page1365
Map 21 Lot 25	45 Lafayette Terrace North Hampton	ZCCMMXIIV0000IIII/5 NH Ltd Partnership PO Box 65 Portsmouth NH 03802	Book 2530 Page 1863
Map 21 Lot 26	198 Lafayette Road North Hampton	Gozinta LLC 198 Lafayette Road North Hampton NH 03862	Book 4275 Page 902
Map 21 Lot 27	206 Lafayette Road North Hampton	206 Lafayette Road LLC 206 Lafayette Road North Hampton NH 03862	Book 4785 Page 379
Map 21 Lot 27-1	200 Lafayette Road North Hampton	Derek Burt 8774 Mustic Circle Northport FL 34287	Book 2491 Page 339

(continued)

Tax Map/ Lot #	Property Address	Owner Name and Address	Deed Reference (Book/Page)
Map 21 Lot 28	216 Lafayette Road North Hampton	Stella Ciboroski PO Box 443 Concord, NH 03301	Book 2366 Page 1127
Map 21 Lot 28-1	216 Lafayette Road North Hampton	Leo Crotty, Jr. 216 Lafayette Road North Hampton NH 03862	Book 2475 Page 1278
Map 21 Lot 29	212 Lafayette Road North Hampton	S&L Realty Trust PO Box 4276 Portsmouth NH 03802	Book 3666 Page 1199
Map 21 Lot 31	224 Lafayette Road North Hampton	MA NEGM, LLC 302 Main Street Somersworth MA 03878	Book 4649 Page 2366
Map 21 Lot 41	North Road Rear North Hampton	Elmer Sewell 340 Breakfast Hill Road Greenland NH 03840	Book 1340 Page 524
Map 21 Lot 46	8A Lafayette Terrace, North Hampton	Darleena Wylie 8 Lafayette Terrace North Hampton NH 03862	Book 3219 Page 2588
*Map R1 Lot 13	340 Breakfast Hill Rd Greenland	Elmer Sewell, Rev. Tr. 96 340 Breakfast Hill Road, Greenland NH 03840	Book 3159 Page 928
Map R1 Lot 9B	560 Breakfast Hill Rd Greenland	Town of Greenland PO Box 100 Greenland NH 03840	Book 3454 Page 1131

*A portion of the Sewall parcel (Tax Map R1, Lot #13) is included as within the GMZ and is described as follows:

Commencing at a point at the intersection of the westerly sideline of the Boston and Maine Railroad right of way and the town line of Greenland and North Hampton, thence; N80°19'25"W four hundred sixty-six and fourteen hundredths feet (466.14') by the town line of North Hampton to a point, thence; N79°55'00"W eighteen and ninety-nine hundredths feet (18.99') by the town line of North Hampton to a point, thence; N17°29'30"E one thousand ninety-seven and eighty hundredths feet (1097.80') by other land of the Barbara E. Sewall Revocable Trust to a point, thence; S76°51'30"E four hundred thirty-four and zero hundredths feet (434.00') by other land of the Barbara E. Sewall Revocable Trust to a point, thence; S13°08'30"W one hundred sixty-three and twenty-one hundredths feet (163.21') by land of the Boston and Maine Railroad right of way to a point, thence; S35°09'35"W eighty-eight and two hundredths feet (88.02') by land of the Boston and Maine Railroad right of way to a point, thence; S13°08'30"W eight hundred twenty and sixty-four hundredths feet (820.64') by land of the Boston and Maine Railroad right of way to the point of beginning.

13. All monitoring wells at the site shall be properly maintained and secured from unauthorized access or surface water infiltration.

(continued)

14. UNDEVELOPED LOTS WITHIN THE GROUNDWATER MANAGEMENT ZONE:

A) Consistent with Env-Or 607.06(d), for each undeveloped lot which is included (in whole or part) in the groundwater management zone and which lacks access to a public water system, the permittee shall inquire of the property owner at least once each year as to whether there are any new drinking water supply well(s) on the property. The permittee shall include a report on this inquiry in the Annual Summary Report required in Standard Permit Condition # 7.

B) Upon discovery of a new drinking water supply well(s), whether as a result of the annual inquiry, upon notice from the lot owner or by any other means, the permittee shall provide written notification to the Department and, to ensure compliance with Env-Or 607.06(a), prepare a contingency plan to provide potable drinking water in the event a well is or becomes contaminated above the drinking water standards. The potable water supply shall meet applicable federal and state water quality criteria. This plan shall be submitted to the Department for approval within 15 days of the date of discovery.

C) Consistent with Env-Or 607.06(e), the permittee shall cause all new drinking water supply well(s) to be sampled within 30 days of discovery. The well(s) shall be sampled for all the parameters included in Standard Condition # 7, unless otherwise specified in writing by the Department. The permittee shall forward all analytical results to the Department and the owner of the drinking water supply well within 7 days of receipt of the results.

Based on the results:

i. If the new well is not contaminated as defined in Env-Or 603.01, the permittee shall continue to sample the new wells annually as part of the permit.

ii. If analytical results indicate the water is contaminated above applicable federal and state water quality criteria, the permittee shall:

a. Notify the owner immediately;

b. Obtain a confirmation set of analytical samples within 14 days of receipt of the original results indicating a groundwater quality standard exceedence; and

c. Following confirmation of groundwater quality standard exceedence, immediately implement the contingency plan submitted for approval pursuant to Special Permit Condition # 14B, above.

Carl W. Baxter, P.E., Administrator
Hazardous Waste Remediation Bureau
Waste Management Division

Under RSA 21-0:14 and 21-0:9-V, any person aggrieved by any terms or conditions of this permit may appeal to the Waste Management Council in accordance with RSA 541-A and N.H. Admin. Rules, Env-WMC 200. Such appeal must be made to the Council within 30 days and must be addressed to the Chairman of the Waste Management Council, c/o Appeals Clerk, Department of Environmental Services Legal Unit, 29 Hazen Drive, P.O. Box 95, Concord, NH 03302-0095.

Example

NOTICE OF GROUNDWATER MANAGEMENT PERMIT
GWP-________-A-001
TO BE RECORDED AGAINST:

[IDENTIFY OWNER OF PARCEL AND
BOOK AND PAGE OF DEED IN TO THAT PARTY]

NOTICE IS HEREBY GIVEN THAT: The New Hampshire Department of Environmental Services (Department) has issued Groundwater Management Permit #GWP-________-A-001 ("Permit") to [Permittee]. Pursuant to Env-Or 607.09(a) this notice is recorded for each property located within the groundwater management zone identified in the Permit at the Registry of Deeds for the county in which the property is located.

The Permit establishes a Groundwater Management Zone ("GMZ"), an area within which groundwater use must be controlled and monitored due to the presence of groundwater contaminants that exceed the State's Ambient Groundwater Quality Standards ("AGQS"). The Permit may include conditions to and restrictions upon the use of the properties within the GMZ, including restrictions on the use of groundwater.

The Permit was issued on [Date] and expires on [Date], unless renewed for subsequent five-year period(s). This Notice will remain in effect until such time as the AGQS are restored within the GMZ and the Department issues a Release of Recordation to the Permittee. The Permit is available for review at the New Hampshire Department of Environmental Services, 29 Hazen Drive, Concord, NH 03301 or can be viewed by searching under our OneStop Data Retrieval Site at http://www2.des.nh.gov/OneStop/ORCB_Query.aspx?Project+CCST .

The following properties are located within the GMZ:

Property Owner/Address	**Tax Map/Lot**	**Deed Reference Book/Page**

/s/ [Permittee Name], Permittee
[Company Name]

____
Date

CITY OF PORTSMOUTH

Community Development Department
(603) 610-7232

Planning Department
(603) 610-7216

RECEIVED
JUL 21 2008
DES/DWGWB
By____

DES Site # 198712001
Groundwater Management Permits Coordinator
P.O. Box 95, 29 Hazen Drive
Concord, NH 03302-0095

July 18, 2008

Dear Permit Coordinator:

Enclosed please find certified mail receipts for each of the owners of the lots of record within the Groundwater Management Zone. As required by Permit # 198712001-2-001 condition 9. Of the notices sent one had no receipt returned and four were returned from sender.

Also included please find a sample copy of the letter which was sent out and the notice which was included in the letter.

I believe this satisfies all of the requirements for the initial filing of this permit. I will be reporting in approximately one year's time to provide the annual requirements found in the permit.

If you have any questions or need additional information please do not hesitate to contact me at (603)610-7215 or plbritz@ch.cityofportsmouth.com

Sincerely,

Peter Britz

Peter L. Britz
Coakley Technical Advisory Committee

ecc: Coakley Executive Committee
Andrew Hoffman, NHDES
Mike Jasinski, USEPA
Brenda Haslett, USEPA

1 Junkins Avenue
Portsmouth, New Hampshire 03801
Fax (603) 427-1593

CITY OF PORTSMOUTH

LEGAL DEPARTMENT

Robert P. Sullivan, City Attorney – 603-610-7204 (Direct Dial)
Kathleen M. Dwyer, Assistant City Attorney – 603-427-1338 (Phone/Fax)
Suzanne M. Woodland, Assistant City Attorney – 603-610-7240 (Direct Dial)

Municipal Complex
1 Junkins Avenue
Portsmouth, NH 03801
(603) 431-2000
(603) 427-1577 (FAX)

June 26, 2008

Kathleen Tracey
3 Lafayette Terrace
North Hampton, NH 03862

RE: Property at 3 Lafayette Terrace
Assessor Plan 21, Lot 18

Dear Sir/Madam:

Below please find the notice of Groundwater Management Permit as filed at the Rockingham Registry of Deeds. This letter and the notice, found below, was filed on June 25th 2008 in accordance with the permit conditions of the Groundwater Management Permit issued by the New Hampshire Department of Environmental Services on June 19th 2008. If you have questions please contact Peter Britz at (603)610-7215 or by email at plbritz@ch.cityofportsmouth.com.

Sincerely,

Robert P. Sullivan, City Attorney
Chairman Coakley Executive Committee

h\rps\coakley\ltr re-recorded gmp

Recorded on
6/25/08
at 8:57 a.m.
Book 4929, Book
0795

NOTICE OF GROUNDWATER MANAGEMENT PERMIT
GWP-198712001-N-001
TO BE RECORDED AGAINST:

Coakley Landfill Inc. Bk1340 P254 and Bk1347 P172

NOTICE IS HEREBY GIVEN THAT: The New Hampshire Department of Environmental Services (Department) has issued Groundwater Management Permit #GWP-198712001-N-001 ("Permit") to the Coakley Landfill Group. Pursuant to Env-Or 607.09(a) this notice is recorded for each property located within the groundwater management zone identified in the Permit at the Registry of Deeds in Rockingham County.

The Permit establishes a Groundwater Management Zone ("GMZ"), an area within which groundwater use must be controlled and monitored due to the presence of groundwater contaminants that exceed the State's Ambient Groundwater Quality Standards ("AGQS"). The Permit may include conditions to and restrictions upon the use of the properties within the GMZ, including restrictions on the use of groundwater.

The Permit was issued on June 19, 2008 and expires on June 18, 2013, unless renewed for subsequent five-year period(s). This Notice will remain in effect until such time as the AGQS are restored within the GMZ and the Department issues a Release of Recordation to the Permittee. The Permit is available for review at the New Hampshire Department of Environmental Services, 29 Hazen Drive, Concord, NH 03301 or can be viewed by searching under our OneStop Data Retrieval Site at http://www2.des.nh.gov/OneStop/ORCB_Query.aspx?Project+CCST .

The following properties are located within the GMZ:

Property Owner/Address	**MAP**	**LOT**	**Deed Reference Book/Page**	
First and Ten Property Management 355 Lafayette Road, Rye	10	1	3294	2953
Joan Nordstrom 67 North Road, North Hampton	17	72	2416	583
Yolanda Fitzgerald 65 North Road, North Hampton	17	73	3007	2807

Luck Enterprises 160 Lafayette Road, North Hampton	17	82	2473	1659
Christopher & Ricardo Fucci 180 Lafayette Road, North Hampton	17	86	3319	952
Lori Lessard, Trustee 186 Lafayette Road, North Hampton	17	87	2760	2101
Helen McKittrick 188 Lafayette Road, North Hampton	21	8	2641	2656
Darleena Wylie 8A Lafayette Terrace, North Hampton	21	10	3219	2588
Susan Laffey 12A Lafayette Terrace, North Hampton	21	11	2964	2565
Christine Adinolfo 16A Lafayette Terrace, North Hampton	21	12	2963	1721
Joseph Hanley 20 Lafayette Terrace, North Hampton	21	14	4682	1265
James Jones 40-42 Lafayette Terrace, North Hampton	21	14-1	4451	1104
Bridget Conner 44 Lafayette Terrace, North Hampton	21	15	4183	1638
Rodney Booker 46 Lafayette Terrace, North Hampton	21	16	4275	902
Bernard Tracey 1Lafayette Terrace, North Hampton	21	17	2450	687
Kathleen Tracey 3 Lafayette Terrace, North Hampton	21	18	1243	317
Kimberly Bartlett 5 Lafayette Terrace, North Hampton	21	19	3824	2799
Alexis Perron 9 Lafayette Terrace, North Hampton	21	20	3088	1774
Tracy Margeson 15 Lafayette Terrace, North Hampton	21	21	3121	1606
Anita Gabree 15 Lafayette Terrace, North Hampton	21	22	3013	2221
Tracy Margeson 15 Lafayette Terrace, North Hampton	21	23	3121	1606
William Warman 43 Lafayette Terrace, North Hampton	21	24	4374	1365
ZCCMMXIIV0000IIII/5/ NH Ltd Ptshp 45 Lafayette Terrace, North Hampton	21	25	2530	1863
Gozinta LLC 198 Lafayette Road, North Hampton	21	26	4275	904
206 Lafayette Road LLC206 Lafayette RoadNorth Hampton	21	27	4785	379

Hampton				
Stella Ciboroski 216 Lafayette, RoadNorth Hampton	21	28	2366	1127
Leo Crotty, Jr. 216 Lafayette Road, North Hampton	21	28-1	2475	1278
S&L Realty Trust 212 Lafayette Road, North Hampton	21	29	3666	1199
MA NEGM, LLC 224 Lafayette Road, North Hampton	21	31	4649	2366
Coakley Landfill LLC Lafayette Road Rear,North Hampton	21	32	3117	2934
Coakley Landfill, LLC Lafayette Road Rear, North Hampton	21	33	3117	2934
James Jones Lafayette Terrace Rear, North Hampton	21	34	4451	1102
James Jones Lafayette Terrace Rear, North Hampton	21	35	4451	1102
James Jones Lafayette Terrace Rear, North Hampton	21	36	4451	1102
Town of N. Hampton Conservation Commissionn Lafayette Road Rear, North Hampton	21	37	3451	1661
Boston & Maine Corp,c/o Gilford Trans.Inc North Road Rear, North Hampton	21	38		
Richard Grenier & Charter Trust, CoTrustees North Road Rear, North Hampton	21	39	3550	1660
Boston & Maine Corp, c/o Gilford Trans.Inc North Road Rear, North Hampton	21	40		
Elmer Sewell North Road Rear, North Hampton	21	41	1340	524
Darleena Wylie8ALafayette TerraceNorth Hampton	21	46	3219	2588
Elmer M. Sewell Rev. Tr. 96340 Breakfast Hill Road, Greenland	R1	13	3159	928
Town of Greenland 560 Breakfast Hill Road, Greenland	R1	9B	3454	1131

/s/Robert Sullivan, Permittee
Coakley Landfill Group

June 24, 2008

Approved pursuant to authorization of Coakley
Executive Committee via electronic communication dated June 24, 2008.

SENDER: COMPLETE THIS SECTION	COMPLETE THIS SECTION ON DELIVERY
■ Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired. ■ Print your name and address on the reverse so that we can return the card to you. ■ Attach this card to the back of the mailpiece, or on the front if space permits.	A. Signature X [signature] ☐ Agent ☒ Addressee B. Received by (Printed Name) Christine Adinolfo C. Date of Delivery 6-28-08
1. Article Addressed to: Christine Adinolfo 16 Lafayette Terrace North Hampton, NH 03862	D. Is delivery address different from item 1? ☐ Yes If YES, enter delivery address below: ☐ No 3. Service Type ☒ Certified Mail ☐ Express Mail ☐ Registered ☐ Return Receipt for Merchandise ☐ Insured Mail ☐ C.O.D. 4. Restricted Delivery? (Extra Fee) ☐ Yes
2. Article Number (Transfer from service label)	7007 1490 0003 0669 9838

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: COMPLETE THIS SECTION	COMPLETE THIS SECTION ON DELIVERY
■ Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired. ■ Print your name and address on the reverse so that we can return the card to you. ■ Attach this card to the back of the mailpiece, or on the front if space permits.	A. Signature X Kimberly Bartlett ☐ Agent ☐ Addressee B. Received by (Printed Name) C. Date of Delivery
1. Article Addressed to: Kimberly Bartlett 5 Lafayette Terrace North Hampton, NH 03862	D. Is delivery address different from item 1? ☐ Yes If YES, enter delivery address below: ☐ No 3. Service Type ☒ Certified Mail ☐ Express Mail ☐ Registered ☐ Return Receipt for Merchandise ☐ Insured Mail ☐ C.O.D. 4. Restricted Delivery? (Extra Fee) ☐ Yes
2. Article Number (Transfer from service label)	7007 1490 0003 0669 9777

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: COMPLETE THIS SECTION	COMPLETE THIS SECTION ON DELIVERY
■ Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired. ■ Print your name and address on the reverse so that we can return the card to you. ■ Attach this card to the back of the mailpiece, or on the front if space permits.	A. Signature X [signature] ☐ Agent ☒ Addressee B. Received by (Printed Name) K Booker C. Date of Delivery 6-30-08
1. Article Addressed to: Rodney Booker 46 Lafayette Terrace North Hampton, NH 03862	D. Is delivery address different from item 1? ☐ Yes If YES, enter delivery address below: ☐ No 3. Service Type ☒ Certified Mail ☐ Express Mail ☐ Registered ☐ Return Receipt for Merchandise ☐ Insured Mail ☐ C.O.D. 4. Restricted Delivery? (Extra Fee) ☐ Yes
2. Article Number (Transfer from service label)	7001 2510 0008 7668 0041

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Boston & Maine Corp,c/o Gilford Trans.Inc
Iron Horse Park
North Billerica, MA 01802

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Chad Moores ☑ Agent ☐ Addressee

B. Received by (*Printed Name*) Chad Moores

C. Date of Delivery 6/12/08

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7007 1490 0003 0669 9890

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Derek Burt
8774 Mustic Circle
Northport, FL 34287

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X [illegible] ☐ Agent ☒ Addressee

B. Received by (*Printed Name*)

C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7001 2510 0008 7668 0072

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Stella A. Cibrowski
PO Box 443
Concord, NH 03301

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Mark Cibrowski ☐ Agent ☐ Addressee

B. Received by (*Printed Name*) Mark Cibrowski

C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

CONCORD NH
JUN 30 2008
USPS
03301

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7001 2510 0008 7668 0096

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Coakley Landfill LLC
PO Box 190
Greenland, NH 03840

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X ☐ Agent ☐ Addressee

B. Received by (*Printed Name*) C. Date of Delivery 7/1/08

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

JUL 03 2008

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number (*Transfer from service label*) 7007 1490 0003 0669 9920

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Bridget Conner
44 Lafayette Terrace
North Hampton, NH 03862

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X ☐ Agent ☐ Addressee

B. Received by (*Printed Name*) C. Date of Delivery 7/1/08

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number (*Transfer from service label*) 7001 2510 0008 7668 0010

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Leo Crotty, Jr.
216 Lafayette Road
North Hampton, NH 03862

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Jennifer Wood ☐ Agent ☑ Addressee

B. Received by (*Printed Name*) J. Wood C. Date of Delivery 7-2-08

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number (*Transfer from service label*) 7007 1490 0003 0669 9944

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

First and Ten Property Management
PO Box 1058
Hampton, NH 03843

COMPLETE THIS SECTION ON DELIVERY

A. Signature X [illegible] ☒ Agent ☐ Addressee

B. Received by (Printed Name) [illegible] C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

JUL -2 [illegible]

3. Service Type
☒ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7001 2510 0008 7668 0119

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Christopher & Ricardo Fucci
180 Lafayette Road
North Hampton, NH 03862

COMPLETE THIS SECTION ON DELIVERY

A. Signature X [illegible] ☐ Agent ☒ Addressee

B. Received by (Printed Name) RICK FUCCI C. Date of Delivery 6-30-08

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☒ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7007 1490 0003 0669 9975

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Anita Gabree
15 Lafayette Terrace
North Hampton, NH 03862

COMPLETE THIS SECTION ON DELIVERY

A. Signature X [illegible] ☐ Agent ☐ Addressee

B. Received by (Printed Name) Anita GABREE C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

NORTH HAMPTON [redacted]

[redacted]

JUN 30 2008

3. Service Type
☒ Certified Mail ☐ [redacted] Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail [redacted]

NH 03862

4. Restricted Delivery? (Extra Fee) ☒ Yes

2. Article Number (Transfer from service label) 7001 2510 0008 7668 0003

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Gozinta LLC
198 Lafayette Road
North Hampton, NH 03862

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X ☐ Agent ☑ Addressee

B. Received by (*Printed Name*) Booker

C. Date of Delivery 6-25-02

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number (*Transfer from service label*) 7001 2510 0008 7668 0065

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

Article Addressed to:

Richard R. Grenier I.V. Trust
Richard Grenier & Charter Trust,
CoTrustees
10 Canterbury Lane
Bedford, NH 03110-4435

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X ASargent ☐ Agent ☐ Addressee

B. Received by (*Printed Name*) A. Sargent

C. Date of Delivery 6/25/08

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number (*Transfer from service label*) 7007 1490 0003 0669 9937

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

James Jones
207 Atlantic Avenue
North Hampton, NH 03862

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X ☐ Agent ☐ Addressee

B. Received by (*Printed Name*) Jean Jones

C. Date of Delivery 6-20-08

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number (*Transfer from service label*) 7007 1490 0003 0669 9883

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: COMPLETE THIS SECTION	COMPLETE THIS SECTION ON DELIVERY
■ Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired. ■ Print your name and address on the reverse so that we can return the card to you. ■ Attach this card to the back of the mailpiece, or on the front if space permits.	A. Signature X ☐ Agent ☐ Addressee B. Received by (Printed Name) C. Date of Delivery 6/30/08
1. Article Addressed to: James Jones 207 Atlantic North Hampton, NH 03862	D. Is delivery address different from item 1? ☐ Yes If YES, enter delivery address below: ☐ No
	3. Service Type ☑ Certified Mail ☐ Express Mail ☐ Registered ☐ Return Receipt for Merchandise ☐ Insured Mail ☐ C.O.D.
	4. Restricted Delivery? (Extra Fee) ☐ Yes
2. Article Number (Transfer from service label)	7001 2510 0008 7668 0058

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: COMPLETE THIS SECTION	COMPLETE THIS SECTION ON DELIVERY
■ Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired. ■ Print your name and address on the reverse so that we can return the card to you. ■ Attach this card to the back of the mailpiece, or on the front if space permits.	A. Signature X ☐ Agent ☑ Addressee B. Received by (Printed Name) C. Date of Delivery 6-28-08
1. Article Addressed to: 206 Lafayette Road LLC 206 Lafayette Road North Hampton, NH 03862	D. Is delivery address different from item 1? ☐ Yes If YES, enter delivery address below: ☐ No
	3. Service Type ☑ Certified Mail ☐ Express Mail ☐ Registered ☐ Return Receipt for Merchandise ☐ Insured Mail ☐ C.O.D.
	4. Restricted Delivery? (Extra Fee) ☐ Yes
2. Article Number (Transfer from service label)	7001 2510 0008 7668 0089

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: COMPLETE THIS SECTION	COMPLETE THIS SECTION ON DELIVERY
■ Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired. ■ Print your name and address on the reverse so that we can return the card to you. ■ Attach this card to the back of the mailpiece, or on the front if space permits.	A. Signature X ☐ Agent ☐ Addressee B. Received by (Printed Name) John Holmes C. Date of Delivery 7-7-08
1. Article Addressed to: Susan Laffey 12 Lafayette Terrace North Hampton, NH 03862	D. Is delivery address different from item 1? ☐ Yes If YES, enter delivery address below: ☐ No
	3. Service Type ☑ Certified Mail ☐ Express Mail ☐ Registered ☐ Return Receipt for Merchandise ☐ Insured Mail ☐ C.O.D.
	4. Restricted Delivery? (Extra Fee) ☐ Yes
2. Article Number (Transfer from service label)	7007 1490 0003 0669 9845

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Lori Lessard, Trustee
186 Lafayette Road
North Hampton, NH 03862

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X
☐ Agent
☑ Addressee

B. Received by (*Printed Name*)

C. Date of Delivery 6-30-08

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7007 1490 0003 0669 9982

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Luck Enterprises
115 Lafayette Road
North Hampton, NH 03862

NORTH HAMPTON
JUN 2 8 2008
NH 03862

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Edward A Luck
☐ Agent
☐ Addressee

B. Received by (*Printed Name*)
Edward Luck

C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

[redacted]

3. Service Type
[redacted]rtified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
[redacted]sured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7007 1490 0003 0669 9968

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

MA NEGM, LLC
302 Main Street
Somersworth, MA 03878

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Pamela Casey
☐ Agent
☐ Addressee

B. Received by (*Printed Name*)

C. Date of Delivery 7/1/08

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

Pamela Casey

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7007 1490 0003 0669 9951

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Tracy Margeson
15 Lafayette Terrace
North Hampton, NH 03862

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X [signature] ☐ Agent ☐ Addressee

B. Received by (*Printed Name*)

C. Date of Delivery 9-2-08

D. Is delivery address different from item 1? ☑ Yes
If YES, enter delivery address below: ☐ No

11 LAFAYETTE TERRACE
NORTH HAMPTON, NH 03862

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7001 2510 0008 7667 9991

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Helen McKittrick
188 Lafayette Road
North Hampton, NH 03862

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X H. Kendall ☐ Agent ☑ Addressee

B. Received by (*Printed Name*)

C. Date of Delivery 6-30-08

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7007 1490 0003 0669 9869

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Joan Nordstrom
67 North Road
North Hampton, NH 03862

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X W. Nordstrom ☐ Agent ☐ Addressee

B. Received by (*Printed Name*) W Nordstrom

C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

NORTH HAMPTON
JUN 2008
NH 03862

[redacted]

3. Service Type
☑ Certified Mail [redacted]ss Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured M[redacted]D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7007 1490 0003 0669 9876

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Alexis Perron
9 Lafayette Terrace
North Hampton, NH 03862

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X
☐ Agent
☐ Addressee

B. Received by (*Printed Name*)

C. Date of Delivery 6-30-08

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☒ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7001 2510 0008 7667 9977

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

S&L Realty Trust
PO Box 4276
Portsmouth, NH 03802-4276

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X
☐ Agent
☐ Addressee

B. Received by (*Printed Name*) Daniel Kett

C. Date of Delivery 7/10/08

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☒ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7001 2510 0008 7668 0102

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Elmer Sewell
340 Breakfast Hill Road
Greenland, NH 03840

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X
☐ Agent
☐ Addressee

B. Received by (*Printed Name*) Elmer M Sewall

C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

GREENLAND NH
USPS

3. Service Type
☐ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7007 1490 0003 0669 9913

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Elmer M. Sewall Rev.Tr.96
340 Breakfast Hill Road
Greenland, NH 03840

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Elmer M Sewall ☐ Agent ☐ Addressee

B. Received by (Printed Name) Elmer M Sewall C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

JUL 01 2008
USPS

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7007 1490 0003 0669 9999

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Town of Greenland
PO Box 100
Greenland, NH 03840

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Liz Cummings ☐ Agent ☑ Addressee

GREENLAND NH 03840

B. Received by (Printed Name) Liz Cummings C. Date of Delivery 28 Jun 08

D. Is delivery address different from item 1? ☑ Yes
If YES, enter delivery address below: ☐ No

JUN 2 2008
USPS

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7001 2510 0008 7668 0126

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Town of N. Hampton Conservation Commsn
PO Box 710
North Hampton, NH 03862

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Wendy V. Chase ☑ Agent ☐ Addressee

B. Received by (Printed Name) Wendy Chase C. Date of Delivery 6/30/08

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7007 1490 0003 0669 9906

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Bernard Tracey
257 Washington Road
Rye, NH 03870

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X ☐ Agent ☐ Addressee

B. Received by (*Printed Name*) BERNARD TRACEY
C. Date of Delivery 6-30-08

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7007 1490 0003 0669 9814

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

William Warman
380 Lafayette Rd, 11-102
Seabrook, NH 03874

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X ☐ Agent ☑ Addressee

B. Received by (*Printed Name*)
C. Date of Delivery

UNITED STATES POSTAL SERVICE
JUN 30 2008
SEABROOK NH 03874-9998

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7007 1490 0003 0669 9784

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

SENDER: *COMPLETE THIS SECTION*

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Darleena Wylie
8 Lafayette Terrace
North Hampton, NH 03862

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X ☐ Agent ☐ Addressee

B. Received by (*Printed Name*)
C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7007 1490 0003 0669 9852

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

CERTIFIED MAIL

City of Portsmouth
1 Junkins Avenue
Portsmouth, New Hampshire 03801

7001 2510 0008 7668 0027

UNITED STATES POSTAGE
PITNEY BOWES
02 1M $ 05.49[0]
0004243738 JUN 27 2008
MAILED FROM ZIP CODE 03801

UNC

YolandaFitzgerald
PO Box 626
North Hampton NH 03862

1st NOTICE 6-28
2nd NOTICE 7-3
RETURNED 7-8

NIXIE 031 5E 1 23 07/10/08
RETURN TO SENDER
UNCLAIMED
UNABLE TO FORWARD
BC: 03801455599 *1784-00175-10-27

03862+0626-26 B001
03801@4555

CERTIFIED MAIL

City of Portsmouth
1 Junkins Avenue
Portsmouth, New Hampshire 03801

7001 2510 0008 7668 0034

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APPENDIX J – EVALUATION OF POTENTIAL TOXICITY OF SEDIMENTS

TECHNICAL MEMORANDUM

To: Gerardo Millan-Ramos

From: Richard Sugatt

Date: June 29, 2011

Subject: Approach for evaluating sediment at Coakley Landfill during five year review periods

Summary

The approach for evaluating potential toxicity of sediments at Coakley Landfill Superfund Site in the future is summarized here and detailed below. Every five years the worst-case sediment location at Coakley Landfill Superfund Site (SED-05) will be sampled and analyzed for inorganics. The Benchmark quotient (BQ) will be calculated by dividing the measured concentration of each metal by its site-specific benchmark, derived herein. The average BQ for all of the detected inorganics will be calculated and compared to the empirically demonstrated average BQ of 1 for the samples shown to be non-toxic by toxicity testing in 2007. Based on the average ratio of 4 between Threshold Effect Concentrations (TECs) and Probable Effect Concentrations (PECs) for metals from MacDonald et al (2000), additional toxicity testing will be required only if the average BQ exceeds 4 in future sediment samples. Otherwise, only analysis of inorganics in one sample from SED-05 would be conducted once during the next five year review period and evaluated by the describe BQ process.

Detailed Description of Approach

Sediment samples from several locations at Coakley Landfill have been analyzed on an annual basis since at least 2001. As part of the latest Five Year Review, it was determined that several inorganics in sediment exceeded generally accepted no-effect ecological benchmarks. The ecological benchmarks were the freshwater sediment benchmarks from EPA Region 3, which, for metals, are the same as the Threshold Effect Concentrations (TECs) from MacDonald et al (2000). Since exceedance of these benchmarks suggested that the site sediments might be toxic to aquatic organisms, it was decided to investigate prior to the subsequent five year review period whether there was any toxicity to aquatic organisms by sediment sampled at the site.

Since sediments with benchmark exceedances are often not toxic when tested in laboratory toxicity tests, it was not justified to conduct expensive toxicity testing at all historic sediment locations that had benchmark exceedances. Instead, it was decided to analyze another round of samples from these locations for inorganics concentrations and to conduct one toxicity test on the location that had the highest frequency and magnitude of benchmark exceedances. SED-05 was selected for toxicity testing because it had the highest benchmark quotients for the most chemicals. In 2007, a sediment sample was collected from this location and tested for toxicity on the freshwater amphipod *Hyallela azteca* in a standard 10-day test. There were no ecologically significant effects on the test organisms. As a result, it was concluded that the concentrations of inorganics measured in the sediment sample comprised site-specific no-effect concentrations that could be used as site-specific benchmarks for this site.

As shown in Table 1, the site-specific no-effect concentration was higher than the EPA Region 3 ecological benchmark for most of the chemicals that have benchmarks. Since the EPA Region 3 benchmarks represent non-toxic concentrations on a generic, non-site-specific basis, and the site-specific no-effect concentrations represent non-toxic concentrations in the particular type of sediments at the site, it is reasonable to assume that the site-specific no-effect benchmark should be the higher of the site-specific no-effect concentration or the EPA Region 3 benchmark.

The approach for evaluating potential toxicity of sediment collected in the future uses a benchmark quotient approach to evaluate the frequency and magnitude of benchmark exceedances using future data compared to site-specific no-effect benchmarks. This approach is exemplified in Table 1 in which the concentration of each inorganic in sample SED-05 taken in August 2009 is divided by its site-specific benchmark to derive a benchmark quotient. The benchmark quotient (BQ) approach is similar to the Hazard Quotient (HQ) approach in which the concentration at a site is divided by the no-effect concentration.

As shown in Table 1, the August 2009 concentration of chromium, nickel, and cobalt exceeded the site-specific benchmark concentration, with benchmark quotients of 1.1, 1.1, and 1.1, respectively. The toxicity of the August, 2009 sample was not measured, so the next step in developing an approach for future sampling is to estimate how much higher the concentrations would have to be compared to the non-toxic samples in November 2007 in order to be toxic. Of course, this can be done with total certainty only by conducting toxicity tests; however, the following approach can be used to estimate how high the BQ must go before toxicity is likely.

MacDonald et al (2000) derived TECs which are the concentrations, <u>below</u> <u>which</u> no toxicity is expected, but they also derived Probable Effect Concentrations (PECs) which are the concentrations, <u>above</u> <u>which</u> toxicity is likely, but not necessarily certain, to occur. For metals, the PEC was, on average, a factor of four higher than the TEC (Table 2). Therefore, it is reasonable to conclude that benchmark quotients would have to be about four times higher than no-effect benchmarks for toxicity to be likely.

Since the site-specific no-effect benchmarks for the inorganics in the 2007 non-toxic SED-05 sample are the same as the maximum measured concentrations of the same inorganics in the non-toxic sample, the average BQ in that non-toxic sample must be equal to 1, by definition. Therefore, the average benchmark quotient in a future sample would have to be 1 or less to be assured that the future sample is non-toxic. Conversely, the average BQ in a future sample would have to be no more than 4 to ensure that the future sample is unlikely to be toxic. Therefore, a future sample is likely to be non-toxic if the average BQ is less than or equal to 1, and likely to be toxic if the average BQ is equal to or greater than 4. It will be uncertain whether or not the sample is likely to be toxic if the average BQ is between 1 and 4. Therefore, the following criteria will be used to evaluate the potential for toxicity in future sediment samples:

- If average BQ is ≤ 1, conclude sample is likely to be non-toxic.
- If average BQ is > 1 but <4, conclude that it is uncertain whether sample is likely to be toxic.
- If average BQ is ≥ 4, conclude sample is likely to be toxic.

As an example of this type of approach, Table 1 shows that the average BQ for the sediment sample taken from SED-05 in August 2009 is 0.7. Based on the above criteria, it is concluded that this sample is likely to be non-toxic. If the average BQ had been between 1 and 4, then no conclusion could be made whether or not the sample was likely to be toxic. If the average BQ had been 4 or greater, then it would be concluded that the sample is likely to be toxic; however, only a toxicity test would be able to confirm that the sample was actually toxic. Therefore, it is proposed that a toxicity test be conducted only if future sampling shows that the average BQ is 4 or greater.

The concentrations of inorganics in the worst-case area of SED-05 are likely to increase only very slowly, if at all, based on the balance of leachate input via groundwater, overland erosive transport from the landfill surface and output via surface water export. Table 3 shows that there is no discernible trend in inorganics concentrations in SED-05 from 2001 to 2009. Therefore, it is reasonable to conclude that measuring inorganics and conducting the described BQ evaluation at an interval of five years will be sufficient to identify the development of conditions that might result in toxicity.

Therefore, the recommended criteria are summarized below along with the action(s) to be taken for each criterion:

- If average BQ is ≤ 1, conclude sample is likely to be non-toxic. Once during the next five year review period, collect and analyze one sample from SED-05 for inorganics and repeat BQ evaluation.
- If average BQ is > 1 but <4, conclude that it is uncertain whether sample is likely to be toxic. Once during the next five year review period, collect and analyze one sample from SED-05 and repeat the BQ evaluation.
- If average BQ is ≥ 4, conclude sample is likely to be toxic. Conduct 10-day amphipod toxicity test on a stored refrigerated aliquot of this sample or a freshly collected sample from SED-05 that is also analyzed for inorganics.
- If the tested sample is non-toxic, conclude that the area is not toxic and once during the next five year review period collect and analyze one sample from SED-05 for inorganics and repeat the BQ evaluation.
- If the tested sample is toxic, design appropriate remedial actions during the next five year review period.

Reference

MacDonald, D., C. Ingersoll, and T. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Archives of Environmental Contamination and Toxicology. 39: 20-31.

Table 1. Derivation of Site-Specific Benchmarks and Benchmark Quotients-Coakley Landfill Superfund Site

Chemical	Sediment Benchmark[1] Concentration	Non-Toxic[2] Site Sediment Concentration	Site-specific Sediment[3] Benchmark	SED-05 26-Apr-01	SED-05 27-Aug-03	SED-05 26-Aug-04	SED-05 29-Aug-05	SED-05 30-Aug-06	SED-5/SED-3T[4] SED-5/SED-3T 1107 15-Nov-07	SED-5/SED-3T-DUP 15-Nov-07	SED-05 19-Aug-09	
(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	BQ[5]
Aluminum	NA		NA	27000	18000	17000	6600	34000			17,000	
Arsenic	9.8	15	15	25	19	36	310	17	15	14	15	1.0
Barium	NA			150	88	130	270	150			110	
Cadmium	0.99	2	3	BDL	BDL	BDL	BDL	BDL	2.7	0.6	BDL	
Calcium	NA			4300	4700	11000	8900	3600			1,700	
Chromium	43.4	43	43	70	46	56	13	69	39	43	49	1.1
Copper	31.6	55	55	40	37	20	6	45	55	40	28	0.5
Iron	20000	54000	54000	36000	31000	37000	210000	40000	54000	53000	29,000	0.5
Lead	35.8	4000	4000	24	25	40	20	23	4000	860	18	0.0
Magnesium	NA			8400	6500	6000	3200	10000			7,700	
Mercury	0.18	1	1	BDL	BDL	BDL	0.5	BDL	0.9	0.5	BDL	
Nickel	22.7	34	34	53	38	38	9	53	32	34	38	1.1
Potassium	NA			25000	4400	2000	1300	8200			5,400	
Selenium	2			BDL	BDL	BDL	BDL	BDL	<0.5	<0.5	BDL	
Silver	1	1	1	BDL	BDL	BDL	BDL	BDL	1.4	0.5	BDL	
Sodium	NA			350	480	270	240	800			300	
Thallium	NA			BDL	BDL	BDL	BDL	BDL			BDL	
Zinc	121	700	700	110	170	120	38	130	700	250	80	0.1
Cobalt	50	10	10	14	12	13	6	14	9.7	10	11	1.1
Beryllium	NA			BDL	BDL	BDL	BDL	BDL			1.0	
Manganese	460	600	600	680	840	1400	2500	500	600	570	300	0.5
Antimony	2	2	2	BDL	BDL	BDL	BDL	BDL	1	0.8	BDL	
Vanadium	NA			53	35	38	17	55			41	

Average BQ: 0.7

Highlighted numbers exceed the site-specific benchmark.

BDL = Below Detection Limit

[1]EPA Region III benchmarks for freshwater sediment
http://www.epa.gov/reg3hwmd/risk/eco/btag/sbv/fwsed/screenbench.htm

[2] highest measured concentration in sediment sample that was not toxic to amphipods in 10-day sediment toxicity test, rounded to nearest significant figure

[3] The higher of the EPA Region III benchmark for freshwater sediment or the concentration in non-toxic site sediment sample

[4] Sediment sample was tested for toxicity to amphipods

[5] BQ = Benchmark Quotient, calculated as the concentration at the site divided by the site-specific benchmark.

Table 2. Ratio of Sediment PEC to TEC for Metals

Chemical (mg/kg)	Threshold Effect Concentration[1] (mg/kg)	Probable Effect Concentration[1] (mg/kg)	PEC/TEC
Aluminum			
Arsenic	9.8	33	3.4
Barium			
Cadmium	0.99	4.98	5.0
Calcium			
Chromium	43.4	111	2.6
Copper	31.9	149	4.7
Iron			
Lead	35.8	128	3.6
Magnesium			
Mercury	0.18	1.06	5.9
Nickel	22.7	48.6	2.1
Potassium			
Selenium			
Silver			
Sodium			
Thallium			
Zinc	121	459	3.8
Cobalt			
Beryllium			
Manganese			
Antimony			
Vanadium			
Average:			3.9

[1] MacDonald, D. , C. Ingersoll, T. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Archives of Environmental Contamination and Toxicology 39: 20-31.

Table 3. Concentrations of Inorganics in Sediment Location SED-05 from 2001 to 2009, Coakley Landfill Superfund Site

Chemical	Concentration (mg/kg)						
	2001	2003	2004	2005	2006	2007	2009
Aluminum	27000	18000	17000	6600	34000		17,000
Arsenic	25	19	36	310	17	15	15
Barium	150	88	130	270	150		110
Cadmium						2.7	
Calcium	4300	4700	11000	8900	3600		1,700
Chromium	70	46	56	13	69	43	49
Copper	40	37	20	6	45	55	28
Iron	36000	31000	37000	210000	40000	54000	29,000
Lead	24	25	40	20	23	4000	18
Magnesium	8400	6500	6000	3200	10000		7,700
Mercury				0.5		0.9	
Nickel	53	38	38	9	53	34	38
Potassium	25000	4400	2000	1300	8200		5,400
Selenium							
Silver						1.4	
Sodium	350	480	270	240	800		300
Thallium							
Zinc	110	170	120	38	130	700	80
Cobalt	14	12	13	6	14	10	11
Beryllium							1.0
Manganese	680	840	1400	2500	500	600	300
Antimony						1	
Vanadium	53	35	38	17	55		41

APPENDIX K - EVALUATION OF POTENTIAL VAPOR INTRUSION

MEMORANDUM

To: Gerardo Millan-Ramos

From: Richard Sugatt

Date: July 19, 2011

Subject: Evaluation of potential vapor intrusion at Coakley Landfill Superfund Site

The maximum concentrations of volatile organic chemicals (VOCs) in groundwater at Coakley Landfill Superfund Site were compiled and compared with the vapor intrusion target groundwater concentration in Table 2c of the November 2002 "OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance" (EPA, 2002). These target concentrations represent the concentration in groundwater associated with a cancer risk of 1×10^{-6} or a hazard quotient of 1 in indoor air with an attenuation factor of 0.001 from groundwater to indoor air. However, the target concentration for those VOCs with a Maximum Contaminant Level (MCL) was set to the MCL as a matter of policy, rather than risk. Benzene is the only chemical that has a MCL and occurred in groundwater at the Site.

In order to provide a cancer risk-based target concentration in groundwater for this chemical, EPA Region I calculated a risk-based target concentration in groundwater using the equations in the 2002 EPA draft guidance, as follows:

1) Target Indoor Air (ug/m^3) = Target Cancer Risk x ATc / (EF x ED x IUR)

   where: Target Cancer Risk = 1E-06

   ATc = 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)$^{-1}$

2) Target Soil Gas (ug/m^3) = Target Indoor Air/α

   where: α = soil gas to indoor air attenuation factor (0.1 for target soil gas)

3) Target Groundwater (ug/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 water table obeys Henry's Law

   H = Henry's Law Constant (dimensionless)

Using these equations, the target groundwater concentration for benzene is 1.36 ug/L (for a cancer risk of 1E-06). The target concentrations in groundwater from EPA (2002) and EPA Region I are compared with the maximum concentration in groundwater in Table 1 below.

As shown in the table, the only chemical which exceeded the risk-based target concentration was benzene, which occurred at a maximum concentration of 8 ug/l. This concentration is about 5.9 times higher than the target level, equating to a potential cancer risk of about 6E-06 (i.e. 8E-06/1.36E-06 = 5.9E-06). The cancer risk of 6E-06 is within EPA's acceptable risk range of 1E-04 to 1E-06 so the hypothetical vapor intrusion risk would be acceptable, if buildings occurred or potentially occurred above the location where the maximum benzene concentration was measured. Although the target concentration of 1.36 ug/L was exceeded, the groundwater plume is more than 100 feet horizontally from any structure. According to the 2002 EPA draft guidance, vapor intrusion is not of concern if a structure is 100 feet or more distant, either horizontally or vertically, from contaminated groundwater. In addition, the existing plume is not expanding in the direction of any structures or non-wetland areas where structures could be built in the future. Therefore, it is concluded that there is no current or potential future vapor intrusion risk associated with the Site.

Table 1. Comparison of Maximum Concentrations in Groundwater with Regulatory Criteria and Vapor Intrusion Target Levels
Coakley Landfill Superfund Site-Prepared by EPA, July, 2011

Chemical	Interim Cleanup Level	Revised ICL	Federal MCL	NH MCL	NH AGQS	VI Target Level: EPA (2002) (ug/L)	VI Target Level: EPA Region I (ug/L)	Maximum Concentration (ug/L)
Acetone	6,000	NA	NA	NA	NA	220000		BDL
Benzene	5	5	5	5	5	**5**	**1.36**	**8**
Chlorobenzene	100	100	100	100	100	390		79
Chloroethane	NA	NA	NA	NA	NA	28000		38
Chloromethane (methyl chloride)	30	NA	NA	NA	NA	6.7		BDL
1,4 Dichlorobenzene	75	NA	75	NA	NA	8200		19
1,1 Dichloroethane	81	NA	NA	NA	NA	2200		3
trans-1, 2-Dichloroethene	100	100	100	100	100	180		NR
1,2-Dichloropropane	5	5	5	5	5	35		NR
Diethyl Phthalate	2,800	2,800	NA	NA	NA	NA		NR
Ethylbenzene	700	NA	700	NA	NA	700	3.04	BDL
Isopropylbenzene	800	NA	NA	NA	NA	NA		4
p – Isopropyltoluene	260	NA	NA	NA	NA	NA		BDL
Naphthalene	20	NA	NA	NA	NA	150		BDL
Phenol	280	280	NA	NA	4,000	NA		NR
Diethyl Ether	1,400	NA	NA	NA	NA	NA		130
Tetrachloroethene	3.5	3.5	5	5	5	5	0.55	NR
Tetrahydrofuran	NA	154	NA	NA	154	NA		180
Toluene	1,000	NA	1,000	NA	NA	1500		BDL
1,2,4 Trimethylbenzene	330	NA	NA	NA	NA	24		2
1,3,5 Trimethylbenzene	330	NA	NA	NA	NA	25		BDL
o-Xylene	NA	NA	NA	NA	NA	NA		1
m&p – Xylene	NA	NA	NA	NA	NA	NA		12
1,4-Dioxane	NA	NA	NA	NA	3	NV		310
Methylethylketone (2-butanone)	200	200	NA	NA	4,000	440000		BDL
Methylisobutylketone (MIBK)	2,000	NA	NA	NA	NA	14000		BDL
Methyl-t-butyl Ether (MTBE)	NA	13	NA	13	13	120000		5
Tertiary-butyl Alcohol (TBA)	NA	NA	NA	NA	NA	NA		70

ICL = Interim Cleanup Level
BDL = Below Detection Limit
NA = Not Available
NR = Not Reported

APPENDIX L - ARARs & TBCs

APPENDIX L - ARARs & TBCs

Attachment 2 - Coakley Landfill Superfund Site, Operable Unit 1 Chemical-specific ARARs

Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
EPA Risk Reference Dose (RfDs)	To Be Considered	RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	Hazards due to noncarcinogens with EPA RfDs are used to evaluate exposures to contaminated media. The source control remedy prevents exposure and migration of contaminants. Use restrictions on the landfill and other remedial components, as well as groundwater use restrictions will be maintained until risks identified under these standards are eliminated.
EPA Carcinogenicity Slope Factor	To Be Considered	Slope factors are developed by EPA from Health Effects Assessments and present the most up-to-date information on cancer risk potency. Slope factors are developed by EPA from Health Effects Assessments by the Carcinogenic Assessment Group.	Risks due to carcinogens as assessed with slope factors are used to evaluate exposures to contaminated media. The source control remedy prevents exposure and migration of contaminants. Use restrictions on the landfill and other remedial components, as well as groundwater use restrictions will be maintained until risks identified under these standards are eliminated.
Guidelines for Carcinogen Risk Assessment EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk.	Risks due to carcinogens are assessed using these guidelines. The source control remedy prevents exposure and migration of contaminants. Use restrictions on the landfill and other remedial components, as well as groundwater use restrictions will be maintained until risks identified under these standards are eliminated.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance of assessing cancer risks to children.	Risks to children due to carcinogens are assessed using these guidelines. The source control remedy prevents exposure and migration of contaminants. Use restrictions on the landfill and other remedial components, as well as groundwater use restrictions will be maintained until risks identified under these standards are eliminated.

Attachment 2 - Coakley Landfill Superfund Site, Operable Unit 1 Chemical-specific ARARs

Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
Health Advisories (EPA Office of Drinking Water)	To Be Considered	Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only. To be considered for contaminants in groundwater that may be used for drinking water where the standard is more conservative than either federal or state statutory or regulatory standards. The Health Advisory standard for manganese is 0.3 mg/l.	Health advisories will be used to evaluate the non-carcinogenic risk resulting from exposure to certain compounds (e.g., manganese). The source control remedy prevents exposure and migration of contaminants. Use restrictions on the landfill and other remedial components, as well as groundwater use restrictions will be maintained until risks identified under these standards are eliminated.
Soil Remediation Criteria, Env-Or 606.19	Applicable	Numeric soil remediation standards for organic and inorganic contaminants are established, with a provision for development of risk-based site-specific soil remediation standards.	Risks posed by contaminated soils and debris under the landfill cover will be controlled through operation and maintenance of the cap and institutional controls
New Hampshire Department of Environmental Services Risk Characterization and Management Policy (Section 7.4(5))	To be Considered	Establishes GW-1 and GW-2 guidelines for contaminants in groundwater. GW-1 values are equal to the NH AGQS values for ambient groundwater. GW-2 values are based on a subsurface vapor intrusion into buildings to calculate indoor air conservative risk assessments, and therefore apply to volatile contaminants only.	Risks due to groundwater contaminants are assessed using these guidelines. The source control remedy prevents exposure and migration of contaminants. Use restrictions on the landfill and other remedial components, as well as groundwater use restrictions will be maintained until risks identified under these standards are eliminated.

Attachment 2 - Coakley Landfill Superfund Site, Operable Unit 1
Location-specific ARARs

Authority	Requirements	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
Federal Requirements	Fish and Wildlife Coordination Act (16 U.S.C.. §661 *et seq*.); Fish and Wildlife Protection (40 C.F.R. §6.302(g))	Applicable	Any modification of a body of water or wetland requires consultation with the U.S. Fish and Wildlife Service and the appropriate state wildlife agency to develop measures to prevent, mitigate, or compensate for losses of fish and wildlife.	Wetlands are in close proximity to OU 1 where the landfill cap has been constructed. Operation and maintenance of the remedy may have some limited impacts to fish and wildlife resource areas. Planning and decision making will incorporate fish and wildlife protection considerations in consultation with the resource agencies.
	Protection of Wetlands (40 C.F.R. § 6.302(a); Appendix A)	Applicable	This regulation codifies standards established under Executive Order 11990. Under this requirement, no activity that adversely affects a federal jurisdictional wetland shall be permitted if a practicable alternative with lesser effects is available. Action to avoid, whenever possible, the long- and short-term impacts on wetlands and to preserve and enhance wetlands.	Wetlands are in close proximity to OU 1 where the landfill cap has been constructed. Operation and maintenance of the remedy, along with monitoring activities may have some limited impacts to Federal jurisdictional wetlands. Wetlands disturbed by well installation, landfill cap operation and maintenance, monitoring, or other remedial activities will be mitigated in accordance with requirements.
	Clean Water Act, Section 404 (33 U.S.C.. § 1344); Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 C.F.R. Part 230, 231 and 33 C.F.R. Parts 320-323)	Applicable	Under this requirement, no activity that adversely affects a federal jurisdictional wetland shall be permitted if a practicable alternative with lesser effects is available. Controls discharges of dredged or fill material to protect aquatic ecosystems.	Operation and maintenance, along with monitoring activities that require activity in wetlands will be implemented to meet these requirements. EPA has determined that this alternative is the least damaging practicable alternative to protect wetland resources both on-site and off-site. At the time of the issuance of the ROD there was no public oposition to this finding.

Attachment 2 - Coakley Landfill Superfund Site, Operable Unit 1
Location-specific ARARs

Authority	Requirements	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
State Requirements	Criteria and Conditions for Fill and Dredge In Wetlands: RSA Ch. 482-A and NH Admin. Code Env-Wt Parts 300 400, 600, and 700	Applicable	These standards regulate filling and other activities in or adjacent to wetlands, and establish criteria for the protection of wetlands from adverse impacts on fish, wildlife, commerce, and public recreation.	Wetlands are in close proximity to OU 1 where the landfill cap has been constructed. Operation and maintenance of the remedy, along with monitoring activities may have some limited impacts to State jurisdictional wetlands. Wetlands disturbed by well installation, landfill cap operation and maintenance, monitoring, or other remedial activities will be mitigated in accordance with requirements.
	Terrain alteration adjacent to surface waters; Env-Ws 415 and RSA 485-A:17	Relevant and Appropriate	The purpose of these rules is to protect surface water quality from degradation resulting from any activity which significantly alters terrain or occurs in or on the border of the surface waters of the state. The permanent methods for protecting water quality decribed include: vegetated filter strips, grassed swales, detention ponds, wet ponds, constructed wetlands, infiltration trenches, infiltration basins and water quality inlets.	Activities performed in association with the implementation of the remedy, including operation and maintenance of the landfill cap, along with monitoring, will be compliant with these standards and will result in the least adverse impact to surface waters/wetlands. Engineering controls (e.g. siltation controls, erosion controls) will be implemented during remedial activities to minimize harm to surface waters/wetlands. Excavated material, including well drillings, will be stockpiled and dewatered outside of wetland areas prior to off Site disposal. Wetlands would be restored (using suitable soil and vegetation) where altered temporarily by the remedy.

Attachment 2 - Coakley Landfill Superfund Site, Operable Unit 1 Action-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
Federal Requirements	Resource Conservation and Recovery Act (RCRA), 42 U.S.C.. §§ 6901 *et seq.*, Standards for identification and listing of hazardous waste, 40 C.F.R. Part 261	Applicable	New Hampshire has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations (Env-Wm 400). These provisions have been adopted by the State.	Any wastes generated by remedial activity will be analyzed by appropriate test methods. If found to be hazardous wastes, then they will be managed in accordance with the substantive requirements of the State hazardous waste regulations. Wastes that may be generated include: investigation derived waste from monitoring activities and contaminated media produced during the operation and maintenance of the landfill cap and other components of the remedy.
	RCRA, Standards applicable to generators of hazardous wastes, 40 C.F.R. Part 262	Applicable	New Hampshire has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations (Env-Wm 500). These provisions have been adopted by the State.	If remedial activity generates hazardous wastes, then they will be managed in accordance with the substantive requirements of the State hazardous waste regulations.
	RCRA, Standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, 40 C.F.R. Part 264	Applicable	New Hampshire has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations (Env-Wm 700).	The Site's landfill meets regulatory standards to be a hazardous waste facility. Therefore, it will be operated and maintained in compliance with the substantive requirements of the State hazardous waste regulations.
	Clean Water Act (CWA), Section 402, 33 U.S.C. § 1342; 40 C.F.R.. 122-124, 131, 136 - Discharge of Pollutants	Applicable	These standards address water discharges which may be directed to surface water.	If a discharge from the remedial action is directed to surface water the discharge will be treated, if necessary, so that these standards will be achieved. Monitoring will be performed to determine whether operation and maintenance of the remedy could potentially affect nearby surface water bodies, in accordance with Env-Or-607 (see below).

Attachment 2 - Coakley Landfill Superfund Site, Operable Unit 1 Action-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
	CWA, Ambient Water Quality Criteria (AWQC), 40 C.F.R. 122.44	Relevant and Appropriate	These regulations establish water quality standards for protection of human health and aquatic life.	Used to establish monitoring standards for surface waters and sediments. Surface water and sediment will be monitored annually to determine whether this alternative is effective in protecting areas outside of OU 1 from the migration of contaminants from the landfill.
	Safe Drinking Water Act (42 U.S.C. §300f *et seq.*); National primary drinking water regulations (40 C.F.R. 141, Subpart B and G)	Relevant and Appropriate	Establishes maximum contaminant levels (MCLs) for common organic and inorganic contaminants applicable to public drinking water supplies. Used as relevant and appropriate monitoring standards for aquifers and surface water bodies that are potential drinking water sources.	Used to establish monitoring standards for groundwater. The source control (landfill cap) remedy will be operated and maintained to prevent migration of contaminants outside of the compliance boundary established as OU 1. Long-term monitoring of contaminants, based on these standards, will be performed to evaluate whether the source control remedy is effective in preventing the migration of contaminants.
	Safe Drinking Water Act (42 U.S.C. §300f *et seq.*); National primary drinking water regulations (40 C.F.R.. 141, Subpart F)	Relevant and Appropriate for non-zero MCLGs only; MCLGs set as zero are To Be Considered.	Establishes maximum contaminant level goals (MCLGs) for public water supplies. MCLGs are health goals for drinking water sources. These unenforceable health goals are available for a number of organic and inorganic compounds.	Used to establish monitoring standards for groundwater. The source control (landfill cap) remedy will be operated and maintained to prevent migration of contaminants outside of the compliance boundary established as OU 1. Long-term monitoring, utilizing these standards, will be performed to evaluate whether the source control remedy is effective in preventing the migration of contaminants. Non-zero MCLGs are relevant and appropriate. MCLGs set at zero are to be considered.

Attachment 2 - Coakley Landfill Superfund Site, Operable Unit 1 Action-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
State Requirements	Contaminated Site Management, NH Admin. Code Env-Or 600: Part 607, Groundwater Management Permits; Part 608, Activity and Use Restrictions; Part 610, Monitoring; Part 611, Contaminated Soils	Applicable	Env-Or Part 607 provides for establishment of Groundwater Management Zones (GMZ) to control use of groundwater that exceeds AGQS, requires monitoring of the groundwater quality within the GMZ, requires implementation of measures to restore the groundwater quality, and requires an evaluation of the effectiveness of the measures. Part 608 establishes standards for setting institutional controls to protect human health and components of the remedy. Part 610 establishes standards for monitoring groundwater, including requirements and criteria for constructing, developing, and decommissioning monitoring wells. Part 611 establishes standards for managing contaminated soils.	A GMZ will be established for OU 1 to protect against use of contaminated groundwater. Note that even if compliance with these standards is acheived, groundwater use restrictions may still be required for the remedy if there are more stringent federal compliance standards that still have not been achieved. Activity and use restrictions will be established to prevent human exposure to contaminated groundwater and protect components of the remedy. Groundwater monitoring will be required until State ground water standards are acheived throughout the GMZ (monitoring will be continued if additional Federal groundwater standards still need to be achieved). Groundwater monitoring wells will be installed, operated, and decommissioned under these standards. Contaminated soils generated from installation of wells, operation and maintenance of the landfill cap, and any other remedial activity will be managed in compliance with these standards.
	Identification and Listing of Hazardous Wastes, N.H.. Admin. Code Env-Wm 400, Toxicity Characteristic	Applicable	These standards list particular hazardous wastes and identify the maximum concentration of contaminants for which the waste would be a RCRA characteristic waste. The analytical test set out in Appendix II of 40 C.F.R.. Part 261 is referred to as the Toxicity Characteristic Leaching Procedure (TCLP). The federal requirements 40 C.F.R. Part 261 are incorporated by reference.	Any wastes generated by remedial activity will be analyzed to determine whether they are listed or characteristic hazardous waste under these standards. Materials that are listed waste or exceed TCLP hazardous waste thresholds will be disposed off-site in a RCRA Subtitle C facility. Non-hazardous materials will be disposed appropriately.

Attachment 2 - Coakley Landfill Superfund Site, Operable Unit 1 Action-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
	Requirements for Hazardous Waste Generators, N.H. Admin. Code Env-Wm 500 [formerly He-P Ch. 1905.06]: including Part 507 Storage Requirements; Part 513 Emergency/Remedial Actions	Applicable	Requires determination as to whether waste materials are hazardous and, if so, requirements for managing such materials on site prior to shipment off site. The federal requirements 40 C.F.R. Part 262 are incorporated by reference.	If remedial activity generates hazardous wastes, then they will be managed in accordance with the substantive requirements of these regulations.
	Requirements for Owners and Operators of Hazardous Waste Facilities/Hazardous Waste Transfer Facilities, N.H.. Admin. Code Env-Wm 700 [formerly He-P Ch. 1905.08]: including § 702.10 Groundwater Monitoring; § 702.11, Other Monitoring; Part 706, Emergency/Remedial Actions; Part 708, Facility Standards	Applicable	This regulation establishes requirements for owners or operators of hazardous waste sites. Part 708 incorporates by reference the federal requirements under 40 C.F.R. Part 264, including but not limited to Subpart G (closure/post closure), Subpart I (containers), Subpart J (tanks)	The landfill meets regulatory standards to be a hazardous waste facility. Therefore, it will be operated and maintained in compliance with these standards.

Attachment 2 - Coakley Landfill Superfund Site, Operable Unit 1 Action-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
	Rules Governing the Control of Air Pollution, RSA Ch. 125-C, Air Pollution Control; NH Admin. Code Env-A 100-4300	Applicable	These provisions establish standards for the release of air emissions, including VOCs and hazardous air pollutants. Applicable standards include the most stringent of the following requirements: (1) New Source Performance Standards, (40 C.F.R. Part 60); (2) National Emissions Standards for Hazardous Air Pollutants (40 C.F.R. Part 61); and (3) New Hampshire State Implementation Plan limits. See RSA 125-C:6.	If operation and maintenance actions, along with monitoring, causes a release of contaminants from groundwater to the unsaturated zone, emissions controls will be included in the remedial design to control emissions.
	Drinking Water Quality Standards: NH Admin. Code Env-Ws 314 MCLs and MCLGs for Inorganics; NH Admin. Code Env-Ws 315 MCLs and MCLGs for Regulated Organics	Relevant and Appropriate for MCLs and non-zero MCLGs only; MCLGs set as zero are To Be Considered.	State MCLs and MCLGs establish maximum contaminant levels permitted in public water supplies and are the basis of State Ambient Groundwater Quality Standards (AGQS) that are applicable to site ground water. The regulations are generally equivalent to the Federal Safe Drinking Water Act (SDWA).	Used to establish monitoring standards for groundwater. The source control (landfill cap) remedy will be operated and maintained to prevent migration of contaminants outside of the compliance boundary established as OU 1. Long-term monitoring of contaminants, based on these standards, will be performed to evaluate whether the source control remedy is effective in preventing the migration of contaminants.
	New Hampshire Ambient Groundwater Quality Standards (NH AGQS) (Env-Or 603.03, Table 600-1).	Relevant and Appropriate	Establishes maximum concentration levels for regulated contaminants in groundwater which result from human operations or activities. NH AGQS are equivalent to MCLs for contaminants that have MCLs. NH AGQS have been established for site groundwater contaminants for which no MCLs are established, and are derived to be protective for drinking water uses. The NH AGQS will be used for site contaminants where MCLs are not currently established.	Used to establish monitoring standards for groundwater. The source control (landfill cap) remedy will be operated and maintained to prevent migration of contaminants outside of the compliance boundary established as OU 1. Long-term monitoring of contaminants, based on these standards, will be performed to evaluate whether the source control remedy is effective in preventing the migration of contaminants.

Attachment 2 - Coakley Landfill Superfund Site, Operable Unit 1 Action-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
	Groundwater Protection Standards: NH Admin. Code Env-Or 603.01(a) and (b)	Applicable	Wm-Or 603.01(a) and (b) provide that groundwater shall be suitable for use as drinking water without treatment and shall not contain any regulated contaminant in concentrations greater than ambient groundwater quality standards established in Env-Or 603.03.	Used to establish monitoring standards for groundwater. The source control (landfill cap) remedy will be operated and maintained to prevent migration of contaminants outside of the compliance boundary established as OU 1. Long-term monitoring of contaminants, based on these standards, will be performed to evaluate whether the source control remedy is effective in preventing the migration of contaminants.
	Nondegradation of Groundwater to Protect Surface Water: NH Admin. Code Env-Or 603.01 (c)	Applicable	Wm-Or 603.01(c) provides that, unless naturally occurring, groundwater shall not contain any contaminants at concentrations such that groundwater to surface water results in a violation of surface water standards in any surface water body within or adjacent to the site. Env-Or 603.01 (c) therefore incorporates surface water standards set forth at Env-Ws 1700.	Used to establish monitoring standards for groundwater. The source control (landfill cap) remedy will be operated and maintained to prevent migration of contaminants outside of the compliance boundary established as OU 1. Long-term monitoring of contaminants, based on these standards, will be performed to evaluate whether the source control remedy is effective in preventing the migration of contaminants.
	Ambient Air Quality Standards, NH Admin. Code Env-A 300	Applicable	These regulations set primary and secondary ambient air quality standards (equivalent to federal standards). The standards do not allow significant deterioration of existing air quality in any portion of the state for: particulate matter, sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone hydrocarbons and lead.	If there are remedial processes that result in releases of contaminants into the air, air quality standards will be complied with during remedial activities.
	Fugitive Dust, N.H.. Admin. Code Env-A Part 1002	Applicable	Requires precautions to prevent, abate and control fugitive dust during specified activities, including excavation, maintenance, and construction.	Precautions to control fugitive dust emissions will be required during site remediation activities that could generate dust, such as maintenance of the landfill cap and monitoring well installation.

Attachment 2 - Coakley Landfill Superfund Site, Operable Unit 1 Action-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
	Regulated Toxic Air Pollutants, NH Admin. Code Env-A Part 1400	Applicable	This regulation identifies toxic air pollutants to be regulated. These pollutants are also listed by EPA in 40 CFR 261. High, moderate and low Toxicity Classifications are established. Air toxics in these classifications are regulated when they occur in concentrations that cause adverse health effects including increased cancer risk.	If there are remedial processes that result in releases of contaminants into the air, air quality standards will be complied with during remedial activities.
	Surface Water Quality Regulations, NH Admin. Code Env-Ws 1700	Applicable	These rules establish water quality standards for the state's surface waters. Water quality criteria for toxic substances are established. [See Part Env-Ws 1703 Water Quality Standards and Env-Ws 1704 Alternative Site Specific Criteria]. These rules are applicable to point or non-point discharge(s) of pollutants to surface waters.	Standards will be used for monitoring to measure the performance and effectiveness of the remedial action in preventing contaminated groundwater from degrading nearby surface waters.
	Interim Criteria for Groundwater Discharges: NH Admin. Code Env-Ws 1500	Applicable	These regulations establish substantive requirements for discharges to groundwater, including prohibited discharges (Env-Ws 1503,04), compliance criteria (Env-Ws 1504.03), and water quality sampling (Env-Ws 1507.01).	If the operation and maintenance of the landfill cover or the monitoring system requires discharge to groundwater, these standards will be complied with.
	Management of Contaminated Soil, NH Admin. Code Env-Or 611	Applicable	Establishes requirements for managing contaminated soils, including requirements for sampling and analysis of soil destined for off-site treatment or disposal, storage requirements for stockpiled soil, and disposal requirements.	Any remedial activities on the site that generates and stockpiles contaminated soil requiring on-site management or off-site disposal will comply with these requirements. Minimal soil generation is anticipated from the installation of monitoring wells and the operation and maintenance of the landfill cap.

Attachment 2 - Coakley Landfill Superfund Site, Operable Unit 1 Action-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
	Standards for Construction, Maintenance and Abandonment of Wells, NH Admin. Code Env-We 600	Applicable	This provision requires that wells be constructed, maintained, relocated, and/or abandoned according to these regulations.	Wells used for the remedy will be created, operated, and closed in compliance with these standards.

Attachment 2 - Coakley Landfill Superfund Site,
Operable Unit 2
Chemical-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
Federal Requirements	Safe Drinking Water Act (42 U.S.C. §300f *et seq.*); National primary drinking water regulations (40 C.F.R. 141, Subpart B and G)	Relevant and Appropriate	Establishes maximum contaminant levels (MCLs) for common organic and inorganic contaminants applicable to public drinking water supplies. Used as relevant and appropriate cleanup standards for aquifers and surface water bodies that are potential drinking water sources.	Used to establish cleanup standards for groundwater. Long-term monitoring of contaminants, based on these standards, will be performed to evaluate whether the natural attenuation remedy is effective in preventing the migration of contaminants and achieving drinking water standards.
	Safe Drinking Water Act (42 U.S.C. §300f *et seq*.); National primary drinking water regulations (40 C.F.R. 141, Subpart F)	Relevant and Appropriate for non-zero MCLGs only; MCLGs set as zero are To Be Considered	Establishes maximum contaminant level goals (MCLGs) for public water supplies. MCLGs are health goals for drinking water sources. These unenforceable health goals are available for a number of organic and inorganic compounds.	Used to establish cleanup standards for groundwater. Long-term monitoring of contaminants, based on these standards, will be performed to evaluate whether the natural attenuation remedy is effective in preventing the migration of contaminants and achieving drinking water standards. Non-zero MCLGs are relevant and appropriate. MCLGs set at zero are to be considered.
Federal Criteria, Advisories, and Guidance	EPA Risk Reference Dose (RfDs)	To Be Considered	RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	Hazards due to noncarcinogens with EPA RfDs are used to evaluate exposures to contaminated media. The remedy prevents exposure to contaminants though institutional controls and monitoring of the natural attenuation process. Groundwater use restrictions will be maintained until risks identified under these standards are eliminated.

Attachment 2 - Coakley Landfill Superfund Site,
Operable Unit 2
Chemical-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
	EPA Carcinogenicity Slope Factor	To Be Considered	Slope factors are developed by EPA from Health Effects Assessments and present the most up-to-date information on cancer risk potency. Slope factors are developed by EPA from Health Effects Assessments by the Carcinogenic Assessment Group.	Risks due to carcinogens as assessed with slope factors are used to evaluate exposures to contaminated media. The remedy prevents exposure to contaminants though institutional controls and monitoring of the natural attenuation process. Use restrictions will be maintained until risks identified under these standards are eliminated.
	Guidelines for Carcinogen Risk Assessment EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk.	Risks due to carcinogens are assessed using these guidelines. The remedy prevents exposure to contaminants though institutional controls and monitoring of the natural attenuation process. Use restrictions will be maintained until risks identified under these standards are eliminated.
	Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance of assessing cancer risks to children.	Risks to children due to carcinogens are assessed using these guidelines. The remedy prevents exposure to contaminants though institutional controls and monitoring of the natural attenuation process. Use restrictions will be maintained until risks identified under these standards are eliminated.

Attachment 2 - Coakley Landfill Superfund Site, Operable Unit 2 Chemical-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
	Health Advisories (EPA Office of Drinking Water)	To Be Considered	Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only. To be considered for contaminants in groundwater that may be used for drinking water where the standard is more conservative than either federal or state statutory or regulatory standards. The Health Advisory standard for manganese is 0.3 mg/l.	Health advisories will be used to evaluate the non-carcinogenic risk resulting from exposure to certain compounds (e.g., manganese). The remedy prevents exposure to contaminants though institutional controls and monitoring of the natural attenuation process. Use restrictions will be maintained until risks identified under these standards are eliminated.
State Requirements	Drinking Water Quality Standards: NH Admin. Code Env-Ws 314 MCLs and MCLGs for Inorganics; NH Admin. Code Env-Ws 315 MCLs and MCLGs for Regulated Organics	Relevant and Appropriate for MCLs and non-zero MCLGs only; MCLGs set as zero are To Be Considered	State MCLs and MCLGs establish maximum contaminant levels permitted in public water supplies and are the basis of State Ambient Groundwater Quality Standards (AGQS) that are applicable to site groundwater. The regulations are generally equivalent to the Federal Safe Drinking Water Act (SDWA).	Used to establish cleanup standards for groundwater. Long-term monitoring of contaminants, based on these standards, will be performed to evaluate whether the natural attenuation remedy is effective in preventing the migration of contaminants and achieving drinking water standards.

Attachment 2 - Coakley Landfill Superfund Site,
Operable Unit 2
Chemical-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
	New Hampshire Ambient Groundwater Quality Standards (NH AGQS) (Env-Or 603.03, Table 600-1)	Relevant and Appropriate	Establishes maximum concentration levels for regulated contaminants in groundwater which result from human operations or activities. NH AGQS are equivalent to MCLs for contaminants that have MCLs. NH AGQS have been established for site groundwater contaminants for which no MCLs are established, and are derived to be protective for drinking water uses. The NH AGQS will be used for site contaminants where MCLs are not currently established.	Used to establish cleanup standards for groundwater. Long-term monitoring of contaminants, based on these standards, will be performed to evaluate whether the natural attenuation remedy is effective in preventing the migration of contaminants and achieving drinking water standards.
	Groundwater Protection Standards: NH Admin. Code Env-Or 603.01(a) and (b)	Applicable	Wm-Or 603.01(a) and (b) provide that groundwater shall be suitable for use as drinking water without treatment and shall not contain any regulated contaminant in concentrations greater than ambient groundwater quality standards established in Env-Or 603.03.	Used to establish cleanup standards for groundwater. Long-term monitoring of contaminants, based on these standards, will be performed to evaluate whether the natural attenuation remedy is effective in preventing the migration of contaminants and achieving drinking water standards.

Attachment 2 - Coakley Landfill Superfund Site,
Operable Unit 2
Chemical-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
	Nondegradation of Groundwater to Protect Surface Water: NH Admin. Code Env-Or 603.01(c)	Applicable	Wm-Or 603.01(c) provides that, unless naturally occurring, groundwater shall not contain any contaminants at concentrations such that groundwater to surface water results in a violation of surface water standards in any surface water body within or adjacent to the site. Env-Or 603.01 (c) therefore incorporates surface water standards set forth at Env-Ws 1700.	Used to establish cleanup standards for groundwater. Long-term monitoring of contaminants, based on these standards, will be performed to evaluate whether the natural attenuation remedy is effective in preventing the migration of contaminants and achieving drinking water standards.
State Criteria, Advisories, and Guidance	New Hampshire Department of Environmental Services Risk Characterization and Management Policy (Section 7.4(5))	To be Considered	Establishes GW-1 and GW-2 guidelines for contaminants in groundwater. GW-1 values are equal to the NH AGQS values for ambient groundwater. GW-2 values are based on a subsurface vapor intrusion into buildings to calculate indoor air conservative risk assessments, and therefore apply to volatile contaminants only.	Risks due to groundwater contaminants are assessed using these guidelines. The remedy prevents exposure to contaminants though institutional controls and monitoring of the natural attenuation process. Use restrictions will be maintained until risks identified under these standards are eliminated.

Attachment 2 - Coakley Landfill Superfund Site,
Operable Unit 2
Location-specific ARARs

Authority	Requirements	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
Federal Requirements	Fish and Wildlife Coordination Act (16 U.S.C.. §661 *et seq*.); Fish and Wildlife Protection (40 C.F.R. §6.302(g))	Applicable	Any modification of a body of water or wetland requires consultation with the U.S. Fish and Wildlife Service and the appropriate state wildlife agency to develop measures to prevent, mitigate, or compensate for losses of fish and wildlife.	Wetlands are present in OU 2 adjacent to monitoring wells. Operation and maintenance of the remedy may have some limited impacts to fish and wildlife resource areas. Planning and decision-making will incorporate fish and wildlife protection considerations in consultation with the resource agencies.
	Floodplain Management (40 C.F.R. 6.302(b); Appendix A)	Applicable	This regulation codifies standards established under Executive Order 11988. Action to avoid, whenever possible, the long- and short-term impacts associated with the occupancy and modifications of floodplains development, wherever there is a practical alternative. Promotes the preservation and restoration of floodplains so that their natural and beneficial value can be realized.	Portions of the area of OU 2 are within the 100 year floodplain. Remedial actions that involve construction in the floodplain areas, other than the potential installation of additional monitoring wells, are not anticipated. If such actions are later found to be necessary, the remedial design will include all practicable means to minimize harm to and preserve beneficial values of the floodplains. Floodplains disturbed by remedial actions will be restored to their original conditions and utility.

Attachment 2 - Coakley Landfill Superfund Site,
Operable Unit 2
Location-specific ARARs

Authority	Requirements	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
	Protection of Wetlands (40 C.F.R. § 6.302(a); Appendix A)	Applicable	This regulation codifies standards established under Executive Order 11990. Under this requirement, no activity that adversely affects a federal jurisdictional wetland shall be permitted if a practicable alternative with lesser effects is available. Action to avoid, whenever possible, the long- and short-term impacts on wetlands and to preserve and enhance wetlands.	Wetlands are present within OU 2. Operation and maintenance of the remedy may have some limited impacts to Federal jurisdictional wetlands. Wetlands disturbed by well installation, monitoring, or other remedial activities will be mitigated in accordance with requirements.
	Clean Water Act, Section 404 (33 U.S.C. § 1344); Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 C.F.R. Part 230, 231 and 33 C.F.R. Parts 320-323)	Applicable	Under this requirement, no activity that adversely affects a federal jurisdictional wetland shall be permitted if a practicable alternative with lesser effects is available. Controls discharges of dredged or fill material to protect aquatic ecosystems.	Wetlands are present within OU 2. Operation and maintenance of the remedy may have some limited impacts to Federal jurisdictional wetlands. Wetlands disturbed by well installation, monitoring, or other remedial activities will be mitigated in accordance with requirements. EPA has determined that this alternative is the least damaging practicable alternative to protect wetland resources both on-site and off-site. At the time of the issuance of the ROD there was no public opposition to this finding.

Attachment 2 - Coakley Landfill Superfund Site,
Operable Unit 2
Location-specific ARARs

Authority	Requirements	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
State Requirements	Criteria and Conditions for Fill and Dredge In Wetlands: RSA Ch. 482-A and NH Admin. Code Env-Wt Parts 300 400, 600, and 700	Applicable	These standards regulate filling and other activities in or adjacent to wetlands, and establish criteria for the protection of wetlands from adverse impacts on fish, wildlife, commerce, and public recreation.	Wetlands are present within OU 2. Operation and maintenance of the remedy may have some limited impacts to State jurisdictional wetlands. Wetlands disturbed by well installation, monitoring, or other remedial activities will be mitigated in accordance with requirements.
	Native Plant Protection Act; RSA 217A and Res 1100-1108	Applicable	Prohibits damaging plant species listed as endangered within the State.	Listed plant species will be identified and remedial activities will comply with these standards.
	Terrain alteration adjacent to surface waters; Env-Ws 415 and RSA 485-A:17	Relevant and Appropriate	The purpose of these rules is to protect surface water quality from degradation resulting from any activity which significantly alters terrain or occurs in or on the border of the surface waters of the state. The permanent methods for protecting water quality described include: vegetated filter strips, grassed swales, detention ponds, wet ponds, constructed wetlands, infiltration trenches, infiltration basins and water quality inlets.	Activities performed in association with the implementation of the remedy, including groundwater monitoring, will be compliant with these standards and will result in the least adverse impact to surface waters/wetlands. Engineering controls (e.g. siltation controls, erosion controls) will be implemented during remedial activities to minimize harm to surface waters/wetlands. Excavated material, including well drillings, will be stockpiled and dewatered outside of wetland areas prior to off site disposal. Wetlands would be restored (using suitable soil and vegetation) where altered temporarily by the remedy.

Attachment 2 - Coakley Landfill Superfund Site,
Operable Unit 2
Action-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
Federal Requirements	Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§ 6901 *et seq.,* Standards for identification and listing of hazardous waste, 40 C.F.R. Part 261	Applicable	New Hampshire has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations (Env-Wm 400). These provisions have been adopted by the State.	Any wastes generated by remedial activity will be analyzed by appropriate test methods. If found to be hazardous wastes, then they will be managed in accordance with the substantive requirements of the State hazardous waste regulations. Wastes that may be generated include investigation derived waste from monitoring activities and contaminated media produced during the operation and maintenance of other components of the remedy.
	RCRA, Standards applicable to generators of hazardous wastes, 40 C.F.R. Part 262	Applicable	New Hampshire has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations (Env-Wm 500). These provisions have been adopted by the State.	If remedial activity generates hazardous wastes, then they will be managed in accordance with the substantive requirements of the State hazardous waste regulations.
	RCRA, Standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, 40 C.F.R. Part 264	Applicable	New Hampshire has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations (Env-Wm 700).	If any hazardous waste is generated from remedial activities it will be treated, stored, and disposed of under these standards.

Attachment 2 - Coakley Landfill Superfund Site,
Operable Unit 2
Action-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
	Clean Water Act (CWA), Section 402, 33 U.S.C. § 1342; 40 C.F.R.. 122-124, 131, 136 - Discharge of Pollutants	Applicable	These standards address water discharges which may be directed to surface water.	If a discharge from the remedial action is directed to surface water the discharge will be treated, if necessary, so that these standards will be achieved. Monitoring will be performed to determine whether operation and maintenance of the remedy could potentially affect nearby surface water bodies, in accordance with Env-Or-607 (see below).
	CWA, Ambient Water Quality Criteria (AWQC), 40 C.F.R. 122.44	Relevant and Appropriate	These regulations establish water quality standards for protection of human health and aquatic life.	Used to establish monitoring standards for surface waters and sediments. Surface water and sediment will be monitored annually to determine whether this alternative is effective in protecting areas from the migration of contaminants from the landfill.

**Attachment 2 - Coakley Landfill Superfund Site,
Operable Unit 2
Action-specific ARARs**

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
State Requirements	Contaminated Site Management, NH Admin. Code Env-Or 600: Part 607, Groundwater Management Permits; Part 608, Activity and Use Restrictions; Part 610, Monitoring; Part 611, Contaminated Soils	Applicable	Env-Or Part 607 provides for establishment of Groundwater Management Zones (GMZ) to control use of groundwater that exceeds AGQS, requires monitoring of the groundwater quality within the GMZ, requires implementation of measures to restore the groundwater quality, and requires an evaluation of the effectiveness of the measures. Part 608 establishes standards for setting institutional controls to protect human health and components of the remedy. Part 610 establishes standards for monitoring groundwater, including requirements and criteria for constructing, developing, and decommissioning monitoring wells. Part 611 establishes standards for managing contaminated soils.	A GMZ will be established for OU 2 to protect against use of contaminated groundwater. Note that even if compliance with these standards is achieved, groundwater use restrictions may still be required for the remedy if there are more stringent federal compliance standards that still have not been achieved. Activity and use restrictions will be established to prevent human exposure to contaminated groundwater and protect components of the remedy. Groundwater monitoring will be required until State groundwater standards are acheived throughout the GMZ (monitoring will be continued if additional Federal groundwater standards still need to be achieved). Groundwater monitoring wells will be installed, operated, and decommissioned under these standards. Contaminated soils generated from installation of wells and any other remedial activity will be managed in compliance with these standards.
	Identification and Listing of Hazardous Wastes, N.H. Admin. Code Env-Wm 400, Toxicity Characteristic	Applicable	These standards list particular hazardous wastes and identify the maximum concentration of contaminants for which the waste would be a RCRA characteristic waste. The analytical test set out in Appendix II of 40 C.F.R.. Part 261 is referred to as the Toxicity Characteristic Leaching Procedure (TCLP). The federal requirements 40 C.F.R. Part 261 are incorporated by reference.	Any wastes generated by remedial activity will be analyzed to determine whether they are listed or characteristic hazardous waste under these standards. Materials that are listed waste or exceed TCLP hazardous waste thresholds will be disposed off-site in a RCRA Subtitle C facility. Non-hazardous materials will be disposed appropriately.

Attachment 2 - Coakley Landfill Superfund Site,
Operable Unit 2
Action-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
	Requirements for Hazardous Waste Generators, N.H.. Admin. Code Env-Wm 500 [formerly He-P Ch. 1905.06]: including Part 507 Storage Requirements; Part 513 Emergency/Remedial Actions	Applicable	Requires determination as to whether waste materials are hazardous and, if so, requirements for managing such materials on site prior to shipment off site. The federal requirements 40 C.F.R. Part 262 are incorporated by reference.	If remedial activity generates hazardous wastes, then they will be managed in accordance with the substantive requirements of these regulations.
	Requirements for Owners and Operators of Hazardous Waste Facilities/Hazardous Waste Transfer Facilities, N.H. Admin. Code Env-Wm 700 [formerly He-P Ch. 1905.08]: including § 702.10 Groundwater Monitoring; § 702.11, Other Monitoring; Part 706, Emergency/Remedial Actions; Part 708, Facility Standards	Applicable	This regulation establishes requirements for owners or operators of hazardous waste sites. Part 708 incorporates by reference the federal requirements under 40 C.F.R. Part 264, including but not limited to Subpart G (closure/post closure), Subpart I (containers), Subpart J (tanks)	If any hazardous waste is generated from remedial activities it will be treated, stored, and disposed of under these standards.

Attachment 2 - Coakley Landfill Superfund Site,
Operable Unit 2
Action-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
	Fugitive Dust, N.H. Admin. Code Env-A Part 1002	Applicable	Requires precautions to prevent, abate and control fugitive dust during specified activities, including excavation, maintenance, and construction.	Precautions to control fugitive dust emissions will be required during site remediation activities that could generate dust, such as maintenance of the landfill cap and monitoring well installation.
	Regulated Toxic Air Pollutants, NH Admin. Code Env-A Part 1400	Applicable	This regulation identifies toxic air pollutants to be regulated. These pollutants are also listed by EPA in 40 CFR 261. High, moderate and low Toxicity Classifications are established. Air toxics in these classifications are regulated when they occur in concentrations that cause adverse health effects including increased cancer risk.	If there are remedial processes that result in releases of contaminants into the air, air quality standards will be complied with during remedial activities.
	Surface Water Quality Regulations, NH Admin. Code Env-Ws 1700	Applicable	These rules establish water quality standards for the state's surface waters. Water quality criteria for toxic substances are established. [See Part Env-Ws 1703 Water Quality Standards and Env-Ws 1704 Alternative Site Specific Criteria]. These rules are applicable to point or non-point discharge(s) of pollutants to surface waters.	Standards will be used for monitoring to measure the performance and effectiveness of the remedial action in preventing contaminated groundwater from degrading nearby surface waters.
	Interim Criteria for Groundwater Discharges: NH Admin. Code Env-Ws 1500	Applicable	These regulations establish substantive requirements for discharges to groundwater, including prohibited discharges (Env-Ws 1503,04), compliance criteria (Env-Ws 1504.03), and water quality sampling (Env-Ws 1507.01).	If the operation and maintenance of the remedy requires discharge to groundwater, these standards will be complied with.

Attachment 2 - Coakley Landfill Superfund Site,
Operable Unit 2
Action-specific ARARs

Authority	Requirement	Status	Requirement Synopsis	Action to be Taken to Attain ARAR
	Management of Contaminated Soil, NH Admin. Code Env-Or 611	Applicable	Establishes requirements for managing contaminated soils, including requirements for sampling and analysis of soil destined for off-site treatment or disposal, storage requirements for stockpiled soil, and disposal requirements.	Any remedial activities on the site that generates and stockpiles contaminated soil requiring on-site management or off-site disposal will comply with these requirements. Minimal soil generation is anticipated from the installation of monitoring wells.
	Standards for Construction, Maintenance and Abandonment of Wells, NH Admin. Code Env-We 600	Applicable	This provision requires that wells be constructed, maintained, relocated, and/or abandoned according to these regulations.	Wells used for the remedy will be created, operated, and closed in compliance with these standards.

APPENDIX M - NHDES SAMPLING REQUIREMENTS

The State of New Hampshire

DEPARTMENT OF ENVIRONMENTAL SERVICES

NHDES

Thomas S. Burack, Commissioner

June 30, 2009

Peter Britz
City of Portsmouth
City Hall
1 Junkins Avenue
Portsmouth, NH 03801

Superfund Records Center
SITE: Coakley
BREAK: 8.4
OTHER:

SUBJECT: NORTH HAMPTON – Coakley Landfill, Breakfast Hill Road,
DES # **198712001**, Project # 431

SDMS DocID 452893

Changes in Volatile Organic Sampling Requirements

I am writing to summarize recent changes in sampling requirements at the Coakley Landfill and other Superfund sites in New Hampshire.

1. Analyses for the Waste Management Division's Full List of Analytes for Volatile Organic Compounds "WMD Full List" (attached) are required for all soil, groundwater and drinking water samples collected for hazardous waste sites, landfills and petroleum sites. The Department's January 30, 2008 correspondence to analytical laboratories and environmental professionals can be accessed at the following link.

http://des.nh.gov/organization/divisions/waste/hwrb/documents/voc_changes.pdf

2. At all Superfund Sites, wells regularly sampled for Volatile Organic Compounds (VOCs) need two consecutive rounds of the WMD Full List, and a subset of representative wells must be analyzed for 1,4-dioxane. Due to the high solubility and mobility of 1,4-dioxane in groundwater several wells should be selected in source areas with high VOC concentrations and a few wells should be selected at downgradient locations.

3. The Waste Management Division will consider reducing the requirement to test for some chemicals, including 1,4-dioxane, if two consecutive rounds of analyses fail to detect the chemicals above reporting limits. At a minimum the WMD Full List must be analyzed for once every five years on a schedule that allows the data to be included in the Five Year Review.

4. Not all labs who run 8260B routinely analyze for all the analytes in the WMD Full List. Therefore, it may be necessary to request that the lab(s) analyze for all the compounds, and to confirm that detection limits for the laboratory are low enough to determine if regulatory benchmarks have been exceeded.

5. Five compounds designated with an asterisk (*) in the WMD Full List, i.e., Bromodichloromethane, Hexachlorobutadiene, Ethylene dibromide (EDB), Dibromochloropropane, and 1,3-Dichloropropene (mixed isomers), have typical reporting limits using 8260B that are above the Department's Ambient Groundwater Quality Standards. If any of these five compounds are a concern at a site it may be necessary for the lab(s) to use a different analytical method.

6. The NHDES Lab uses Method 524 for Bromodichloromethane or Hexachlorobutadiene and Method 504 for Ethylene dibromide (EDB) or Dibromochloropropane. The 504 method could be used in place of both the 8260B and 524 methods to reach the lower reporting limits.

We appreciate your willingness to address environmental concerns at this site. Should you have any questions, please contact me at the Department's Waste Management Division at the letterhead address, by e-mail or by phone.

Sincerely,

Joseph Donovan

Waste Management Division

Digitally signed by Waste Management Division
DN: cn=Waste Management Division, o=NHDES, ou=WMD, email=kimberly.durgin@des.nh.gov, c=US
Date: 2009.06.30 15:50:53 -04'00'

Joseph Donovan, P.G.
Hazardous Waste Remediation Bureau
Tel: (603) 271-6811
Fax: (603) 271-2181
E-mail: Joseph.Donovan@des.nh.gov

cc: Kenneth N. Kettenring, Ph.D, P.G., NHDES
Richard Pease, P.E., NHDES
Mike Jasinski, USEPA
Brenda M. Haslett, USEPA
Alistair Macdonald, Golder Associates
North Hampton Health Officer

APPENDIX N - EPA PUBLIC NOTICES ABOUT START OF FIVE YEAR REVIEW

Ad Number: 076484
Insertion Number: N/A
Size: 2 Col x 2.5 in
Color Type: N/A

Advertiser: US Environmental Protection Agenc...
Agency: N/A
Section-Page-Zone(s): B-6-All
Description: FIVE-YEAR REVIE

Hampton Union
Friday, January 21, 2011

Superfund Records Center
SITE: Coakley
BREAK: 8.3
OTHER: 481855

SDMS DocID 481855

FAMILY NOTICE

Judith Franzoso

DOVER — Judith (Demarais) Franzoso, 67, died Monday, Jan. 17, 2011.

Judy was born March 4, 1943 in Haverhill, Mass., the daughter of Melvin and Eleanor (Hosford) Demarais. She graduated from Portsmouth High School, Class of 1961, and Colby Sawyer College, Class of 1963.

Judy was a familiar face along with her brother, Ric, for 14 years at E. Richard Ltd., dressing hundreds of clients in the finest men's and women's wear north of Boston. Judy also worked at the Portsmouth Visiting Nurses Association from 1993 through 2008.

She is survived by son Anthony Franzoso and his wife, Nicole, of Shrewsbury, Mass. and their children, Anthony, Matthew, Joseph and Gabrielle; son Christopher and his wife, Ann, of Hampton, and children Alexa, Benjamin, Zachary and Sydney; and son Michael Stephen and his daughters, Rio and Mira. She also is survived by her brother, Stephen Demarais of Hampton; and sister Melanie Demarais of Worcester, Mass. She was predeceased by her brother, Ric Demarais.

Judy's love of family grew during summers at local beaches, working at her family's restaurant, Flagstones, and remained strong through her hosting of Nana's Camp for her many grandchildren during the summers. She loved her family unconditionally and cherished the times they spent before and during her strong fight.

She enjoyed her life and many wonderful caring friends, including Gene and Colleen Franzoso, Barbara Smucker and Sandy Bussiere, and especially her closest friend, Suzette Beevers, whose love and support helped Judy and her family through this very challenging time.

Calling hours are from 2 to 5 p.m. Sunday, Jan. 23, 2011, at Farrell Funeral Home, 684 State St., Portsmouth, NH 03801; (603) 436-5418. Mass will be conducted at 11 a.m. Monday, Jan. 24, 2011, at Immaculate Conception Church, 98 Summer St., Portsmouth, NH 03801. In lieu of flowers, donations can be made to Seacoast Cancer Center at Wentworth-Douglass Hospital, 789 Central Ave., Dover, NH 03820.

Roger J. Dignard Sr.

SEABROOK — Roger J. Dignard Sr., "Roger the Roofer," died Saturday, Jan. 15, 2011 in Exeter Hospital.

He was born July 27, 1933, in Amesbury, Mass., the son of the late Edmund and Flora (McLaughlin) Dignard. He raised his children in Salisbury, Mass., before moving to Seabrook.

Mr. Dignard was the longtime owner and operator of Roger's Roofing Co., which was based in Salisbury, working in many of the surrounding areas.

He was a member of the Elks Lodge, the St. Jean Club and the Lafayette Club.

He is survived by two sons, Roger Dignard Jr. and his wife Cheryl, and Edmond Dignard, all of Lake Worth, Fla.; one daughter, Deborah Benning of Wayne, Maine; eight grandchildren; several great-grandchildren; two brothers and their wives, Joe and Maxine Dignard of New Hampshire and Normand and Pat Dignard of Florida; one sister, Laura McFadden of Connecticut; and many nieces and nephews.

SERVICES: At Mr. Dignard's request, there will be no calling hours or funeral services.

Memorial donations may be made to the Roger J. Dignard Sr. Memorial Fund, c/o. Deborah Benning, 21 Tall Timbers Road, Wayne, ME 04284.

Arrangements were by the Brewitt Funeral Home, Exeter. To sign an online guest book, visit www.brewittfuneralhome.com.

James R. West

EXETER — James Russell West, 83, died Saturday, Jan. 15, 2011.

Mr. West retired from Exeter and Hampton / Unitil Electric Co. after 35 years of service. He was a U.S. Navy veteran of World War II serving aboard the USS Macon.

He was a loving father, father-in-law, grandfather, and great-grandfather and enjoyed spending time with his family.

He is survived by his wife of 42 years, Rita (Hope) West; two sons and their wives, Michael and Evelyn West of Benton and Jeffrey and Ana West of Milton; one stepson and his wife, Robert and Ellen Corning of Londonderry; one stepdaughter and her husband, Marilyn and Shawn Sweeney of Hooksett; his son Jeffrey's children, William, Joshua and Mi Yon of Sarasota, Fla.; and step-grandchildren Richard and Matthew Corning of Londonderry; and three great-grandchildren, Amelia, Sienna and Aaron, all of Sarasota.

He was predeceased by his parents.

WE REMEMBER: He loved the outdoors, his favorite days were spent skiing in New Hampshire's mountains, fishing in its lakes, and hunting with his buddies in the fall.

SERVICES: For those that wish to share in honoring the life of Jim West, visiting hours will be held Saturday, Jan. 22, from 11 a.m. to 12:30 p.m., at the Brewitt Funeral Home, 14 Pine St., Exeter.

A funeral service with military honors will be held following calling hours on Saturday at 12:30 p.m., in the funeral home. Spring burial will be in Exeter Cemetery.

In lieu of flowers, memorial donations may be made to the Rockingham Visiting Nurse Association, 137 Epping Road, Exeter, NH 03833.

To sign an online guest book, visit www.brewittfuneralhome.com.

Ethyle W. Sperry

MIRROR LAKE — Ethyle Wiggin Sperry, 89, died Saturday, Jan. 8, 2011, after a brief illness.

She was born Nov. 7, 1921, in Lynn, Mass., the daughter of the late Leon and Agnes (O'Brien) Wiggin.

The widow of Robert E. Sperry, her husband of 61 years, she is survived by her children, Victoria Sperry Wheeler and her husband, Randolph, of Colchester, Vt., and Robert B. Sperry and his wife, Linda Harmon, of Hampton; and two grandchildren, Kathleen Wheeler of Wrightwood, Calif., and Christopher Wheeler of Colchester.

She was a 1939 graduate of Lynn English High School and opted for the General Electric Drafting School in lieu of attending Vesper George School of Art (to which she had been awarded a scholarship).

Following graduation from the drafting program, she began work in the GE Steam Turbine Engineering Department.

In 1945 she was moved to serve her country and joined the Women Accepted for Volunteer Service (WAVES) and trained at Great Lakes Naval Training Station to be a gunnery instructor (20 mm). At the conclusion of World War II she returned to General Electric where she met her husband who was the manager of Steam Turbine Design.

WE REMEMBER: Early in their married life they were active in the Thomson Golf and Country Club of Nahant and North Reading, Mass., particularly in playing duplicate bridge at sanctioned events, garnering many master points. Also as a member of the Thomson Club, Mrs. Sperry hit a "hole-in-one" and was Club Champion in 1963.

After the birth of their two children, they moved to Lynnfield, Mass., where she soon became active in a variety of organizations: P.T.A., LHS Band Boosters, Lynnfield Art Guild and The Spotlighters of Lynnfield, community theatre group. As a member of three of these groups, she initiated scholarships to help enable graduating high school seniors to pursue careers in art, music, or theatre. Her personal participation in the Spotlighters ranged from behind the scenes work in stage design and make-up to a variety of character roles on stage, and her art work garnered many awards at local art exhibitions.

In 1979, the Sperrys moved to Mirror Lake, and again she committed herself to becoming an integral part of her new community. She was an original member of the Lakes Region Newcomers Club and she organized two duplicated bridge groups that are still in existence today.

[illegible] a 12-year member of the New Hampshire Women's Golf League.

New Hampshire was the perfect place to retire for Mrs. Sperry. She began skiing in 1940 at Cranmore Mountain and had many fond memories of the famous ski-mobile and the early ski trains from Boston. She ultimately became a member of the "70+" ski club in New Hampshire and traveled with her late husband to ski in Switzerland as well as to tour Ireland, England, Greece and Spain.

SERVICES: A memorial celebration of her life will be held in the spring. Memorial donations may be made to the Visiting Nursing Association Hospice Program, P.O. Box 1620, S. Main Street, Wolfeboro, NH 03894 (www.vnahospice.net); The Caregivers of Wolfeboro, Main Street, Wolfeboro, NH 03894; or the New England Ski Museum, Franconia, NH 03580. Funeral arrangements are by the Baker-Gagne Funeral Home and Cremation Service of Wolfeboro, NH. To sign an online guest book, visit www.baker-gagnefuneralhomes.com.

HAMPTON POLICE LOG

Monday, Jan. 10

■ 1:22 a.m. — Melissa L. Coffey, 29, of Holland, Mass., was charged with driving or operating under the influence of drugs or liquor, possession of drug paraphernalia and unregistered vehicle.

■ 9:09 a.m. — A 15 year-old juvenile was charged with possession of drug paraphernalia and violation of the controlled drug act.

■ 12:48 p.m. — Stephen Fraser, 39, of Hampton, was charged with driving after revocation or suspension.

Tuesday, Jan. 11

■ 9:38 a.m. — Lawrence F. McGovern Jr., 43 of Hampton, was charged on arrest warrant, governor's warrant and being a fugitive from justice.

■ 7:55 p.m. — Steven Patten, 53, of Hampton, was charged with alcoholism and possession of a controlled/ narcotic drugs.

Wednesday, Jan. 12

■ 2:21 a.m. — Joseph F. Paquette Jr., 29, was charged with simple assault.

Friday, Jan. 14

■ 5:54 p.m. — Donald J. Murphy, 39, of Seabrook, was charged with harassment and on an arrest warrant.

Saturday, Jan. 15

■ 1:12 a.m. — Charles R. Locke, 53, of Hampton, was charged with driving or operating under the influence of drugs or liquor.

Obituary Guidelines

For guidelines on how to submit an obituary, visit www.seacoastonline.com/SubmitObit

COLD TURKEYS: YOU COULD HELP WINTER CENSUS

Residents ask to report when they see wild turkeys

BY CHARLES MCMAHON
cmcmahon@seacoastonline.com

PORTSMOUTH — State Fish and Game officials are asking Seacoast residents who spy wild turkeys this winter to report the feathered flocks.

The New Hampshire Fish and Game Department has asked "citizen conservationists" all over the Granite State to report wild turkey flock sightings from now through March 31.

The initiative, known as the Winter Flock Survey, is entering its third consecutive year and is conducted in order to bolster Fish and Game's understanding of the abundance and distribution of turkeys during New Hampshire's challenging winter months.

According to Ted Walski, turkey project leader at Fish and Game, the survey is designed to fill gaps in the department's existing winter flock data collection efforts.

"For parts of the state, especially eastern and northern New Hampshire, we could benefit by additional sighting reports," Walski said. "This reporting system will allow the public to contribute important information to our understanding of winter turkey status in an inexpensive, efficient and, hopefully, enjoyable way."

The survey asks participants to report the number of turkeys in the flock; the location where they were seen; the type of habitat in which the birds were observed, and what the turkeys were feeding on, such as acorns, beechnuts, seed at birdfeeders or corn silage, Walski said.

Last winter, the surveys were used to report approximately 1,279 flocks, totaling 19,050 turkeys and encompassing all areas of the state.

According to results, the southeast corner of New Hampshire had the most reports, with 239 flocks.

Perhaps one of the most popular places for turkey sightings is the Pease International Tradeport in Portsmouth.

Turkey sightings are so prevalent that officials from the Pease Development Authority enter into a contract each year with the U.S. Department of Agriculture Wildlife Service to monitor flocks.

Recently, PDA officials spent $12,400 for the purpose of providing integrated turkey, other large bird, and animal control and monitoring service at the airfield.

The mitigation efforts are done to ensure the safety of the flying public, Bill Hopper, manager of airport operations.

The last time an event occurred related to turkeys was in 2003, when a KC-135E was significantly damaged when it ingested a turkey on the runway while landing.

Fish and Game officials say turkeys are easy to see this time of year because they gather in large, highly visible flocks.

Currently, there are an estimated 45,000 wild turkeys in New Hampshire.

The wild turkey population all but vanished from the New Hampshire landscape by the mid-1800s because of overuse and habitat loss from extensive land clearing.

Fish and Game officials say they were able to successfully reintroduce turkeys beginning in 1975 when 25 turkeys were relocated to New Hampshire.

www.seacoastonline.com

Julius J. Sarosiek

STRATHAM — Julius J. Sarosiek, 59, of Stratham, died unexpectedly Tuesday, Jan. 18, 2011, at Exeter Hospital.

Julius was born Sept. 9, 1951, in Framingham, Mass., the son of the late Julius J. and Dorothy (Gardella) Sarosiek Sr.

In addition to his wife of 22 years, Susan (Graban) Sarosiek, *family members* include his children, Karen Sarosiek of Stratham, Julius J. Sarosiek III and his wife, Cherie, of Fall River, Mass., and Jennifer Martinez and her husband, Pino, of Havelock, N.C.; his grandchildren, Alfonso Martinez and Ashley Sarosiek; his sister, Priscilla Moniz and her husband, Alan, of Palm Harbor, Fla.; his father-in-law, James Garrity *of Clifton, Maine; his sister-*in-law, Linda Bamford and her husband, Mike, of Clifton; his niece and nephews, with whom he shared very special relationships, Kelly Ginn, Gary Moniz and Will McKen*ney; his brothers-in-law,* Tom, Jimmy, David and Brian; and several nieces and nephews.

WE REMEMBER: He was raised in Framingham and graduated from Carolina Military Academy in Maxton, N.C. He entered the boilermaker trade after school and lived and worked in Freetown, Mass., for many years. Julius was a 19-year firefighter and emergency medical technician with the Freetown Fire Department as well volunteering as the town's civil defense director. He and his wife Susan moved to Stratham in 2002 to raise their daughter. Julius was an eight-year veteran of the Stratham Fire Department.

He was a member of the International Brotherhood of Boilermakers, Local 29, of Quincy, Mass., was a member of the First United Methodist Church of Portsmouth Building Study Committee and the Board of Trustees, and also was on the Board of Directors of the New England Country Music Organization.

Julius was a loving husband and a doting father, and spending time with family was the most important part of his life. A true tinkerer, he could fix and build almost anything. Julius will be sadly missed by all who knew and loved him.

SERVICES: A celebration of life will be held at 1 p.m. Monday, Jan. 24, 2011, at the First United Methodist Church, 129 Miller Ave., Portsmouth. Relatives and friends *are respectfully invited. Burial* will be private. In lieu of flowers, the family suggests donations to Karen E. Sarosiek College Fund, Northeast Credit Union, P.O. Box 1240, Portsmouth, NH 03802, or to the Building Fund at First United Methodist Church, 129 Miller Ave., Portsmouth, NH 03801. Assistance with arrangements was by the Remick & Gendron Funeral Home, Hampton. An online guest book is available at www.RemickGendron.com.

Robert J. Crompton

PALM COAST, Fla. — Robert J. "Bob" Crompton, died Tuesday, Jan. 18, 2011, at home, surrounded by loving family.

Bob was born March 11, 1928, in Portsmouth, N.H., to Frederick and Margaret (Flanagan) Crompton.

He is survived by his wife Priscilla, and their four children and their spouses; nine grandchildren; and three great-grandchildren. They include son Gef and wife Kathy Crompton of Newfields, N.H., and their children Bridget and Nathaniel; Gregory and wife Cindy Crompton of Dunbarton, N.H., and children Les, Emily and wife Darcie; and Amy and husband Ray LaBelle, and their children Anne, Audrey and Ray. He also leaves son Matt and wife Maureen Crompton of Ponte Vedra Beach, Fla., and children Shauna and Kyle; and daughter Jennifer and her husband, Bob Marchewka, of Portsmouth, N.H., and their children Haley and Brady Marchewka; sister-in-law Suzanne Stetson and husband Jim of Milford, N.H.; sister Ann Carberry of *Ocala*, Fla.; and several nieces, nephews and cousins.

WE REMEMBER: He graduated from Portsmouth High School in 1945, and the University of New Hampshire, completing a masters program and post-graduate studies. He was a member and captain of the basketball and track teams at both Portsmouth High and UNH. He also served in both the United States Navy and Air Force.

Bob was a lifelong New Hampshire educator and administrator. He began his career at Keene Junior High teaching English before becoming principal. He was the assistant superintendent of schools in Salem, and was superintendent of the Timberlane and Hampstead districts until his retirement in 1987. Bob was active in many school and community organizations. He served on the board of the New Hampshire School Administrators' Association, and was president in 1986. He was on the board of the N.H. Interscholastic Athletic Association, was a basketball referee and member of the IAABO, and served as director of the Greater Haverhill, Mass., Chamber of Commerce.

After retirement, he and his wife of 60 years, Priscilla "Tilly Tacy," traveled on their boat down the Intracoastal Waterway to Palm Coast, Fla., where they built their beloved retirement home. Bob enjoyed sailing, especially around the Isles of Shoals. He loved golf, basketball, following UNH sports and all Boston sports teams, *singing, writing humorous poetry,* and spending time with his many friends and loving family.

In the evening of the day he died, an owl perched opposite his home and watched it for a long time.

SERVICES: A celebration of Bob's life will be held in the spring in New Hampshire. For online condolences, visit www.craigflaglerpalms.com. Arrangements are in the care and trust of Craig Flagler Palms Funeral Home.

CUTS: Residents express concern over school plan

Continued from page A1

budget is moving too far away from the educational core at the cost of taxpayers.

"Protect the core," said Lisa Sweet, a former board member and current teacher at Portsmouth Middle School. Sweet presented data Thursday stating the city spends 9 percent less than the state average of *its tax income on local education.* "You do need to look and say, 'Is there waste? Is there bloat?' I don't think so if we're spending 9 percent less than the New Hampshire average."

Sweet and others asked the board to define the term "educational core."

"What I want to let you know is that protecting the academic core is more than just the teacher (who) stands in the front of the room. You need to protect the curriculum, student support, professional development; you have to support the social, societal and medical concerns that kids are coming in with every day," she said.

Bill St. Laurent spoke as a *representative of the Association* of Portsmouth Taxpayers, saying taxes are too high and schools play a large role in that.

"Most of the people (who) speak are geared toward their children, and I think you've done a great job with the children," St. Laurent said. "I don't think throwing more money at it is going to make it any better because it is what it is now. I don't know how much more you can take from the people of Portsmouth. You've got to keep these budgets either level or reduce them."

Fear of damaging students' technological growth and education, particularly *with the constantly increasing* and changing world of technology, was a primary concern for many who spoke Thursday. The technology director would be eliminated under the budget proposal, with duties of the position reassigned to the assistant superintendent.

"The fact that the technology director is being cut when we live in a global society that technology is all around us, the idea that we are going to rely upon not a centralized person to look at technology and guide us forward — particularly when we are about to build out all this new technology in the middle school — I'm concerned about that," said parent *Patrick Ellis.*

In urging the board to be "careful" in striving for a zero percent budget increase, parent John Bouchard argued that Portsmouth is already behind when it comes to technology, especially in the city's elementary schools.

PIMP: Arrest warrant issued by police

Continued from page A1

agencies "to bring all the responsible parties to justice." Because the case is ongoing, he said, no further information will be released before the wanted man is arrested.

Police previously said the *minor was sold as a prostitute* in a city hotel room after being advertised through the Web site www.backpage.com. Owned by Village Voice Media, Backpage has been targeted by prosecutors around the country for allegedly facilitating the human trafficking of minors.

MacDonald said police detectives monitoring online sites discovered the girl was *being pimped in Portsmouth* last fall.

Backpage is being sued by a Minnesota girl identified in court records as "M.A." who alleges a pimp posted pornographic images of her on the site to force her into prostitution, according to The Associated Press. Through an attorney, the minor claims Backpage knew or should have known that images posted of her at age 14 were illegal and *promoted child exploitation,* the AP reported.

In Tennessee, the state Bureau of Investigation announced a 15-year-old girl was allegedly sold for sex and two adults were indicted on charges of aggravated sexual exploitation of a minor and promoting prostitution.

A month later, the attorneys general of 21 states, including Maine and New Hampshire, *called on Backpage to remove* its adult services listings, claiming the site can't filter illegal posts. One of them, Connecticut Attorney General Richard Blumenthal, announced in a written statement that Backpage made $17.5 mil*lion from prostitution ads.*

"Adult services sections are little more than online brothels, enabling human trafficking and sexual exploitation of women and children," Blumen*thal said.* "Because Backpage cannot properly police adult services, the section should be shut down immediately."

The attorneys general request was made a month after Craigslist removed its adult services section, also under pressure by prosecutors.

Village Voice Media announced in an October blog post that it would not remove adult ads from Backpage and *the ads remain active.*

The teenager arrested by Portsmouth police is being prosecuted through the city's confidential juvenile court.

PEASE: $1M grant coming to airport

Continued from page A1

and Port City Air Inc. Pease will be responsible for no *more than a $75,000 share* of the agreement.

Following Thursday's announcement, PDA executive director David Mullen said the airport was fortunate to meet the enplanement threshold.

Mullen said the fact Pease has met the minimum requirement means the airport will qualify for the $1 million subject to the *consideration of federal* aviation officials.

The PDA has received the annual entitlement funds since 1992.

N.H. bill to limit college student voting criticized

CONCORD (AP) — Opponents of a bill that would prevent many college students from voting in New Hampshire say imposing such restrictions clearly violates the U.S. Constitution.

The bill, sponsored by Republican Rep. Gregory Sorg of Easton, would bar students from voting in college towns unless they had lived there before enrolling. *House Speaker* William O'Brien, who supports the bill, has complained about young people with no life experience voting liberal.

Paul Twomey, a lawyer who has represented voters in election law cases, says the bill violates the 26th amendment, which gave 18-year-olds the right to vote. And he says a 1972 federal lawsuit in New Hampshire further settled the issue by saying voters don't have to intend to stay in one location in order to vote there.

N.H. radiologists' computer hacked by online gamers

ROCHESTER (AP) — A New Hampshire radiology practice said its computer server was broken into by hackers looking for more bandwidth so they could play the online game "Call of Duty: Black Ops."

Seacoast Radiology in Rochester said in a Jan. 11 letter to its patients that information such as name, address, Social *Security number, date of* birth, some medical information and limited billing information was contained on the server that was broken into. But no radiology reports, images or financial information were on the server.

The attack was discovered Nov. 12 and the computer taken offline immediately.

Lisa MacKenzie, spokeswoman for a company brought in to secure the server, told Foster's Daily Democrat there's no indication any information was compromised.

FDA: Seafood processor signs consent decree

PORTLAND, Maine (AP) — The Food and Drug Administration said a Maine company has agreed to stop shipping ready-to-eat lobster, shrimp and crab products after tests uncovered listeria.

The FDA said Portland Shellfish Co. officials signed a consent decree, approved Thursday by a federal judge, that arose from a 2010 inspection that found listeria contamination both at the plant and in a ready-to-eat product. The bacteria can cause serious and sometimes fatal infections.

The FDA said the company ships its products to retailers in Massachusetts, California, Georgia, Illinois, Nevada, Washington, New Jersey and *Louisiana. It's been the sub*ject of four recalls in the past two years.

The consent decree calls for the FDA to approve various plans to ensure product safety. A massage left with the company's general manager wasn't immediately returned Thursday evening.

Maine's Pingree chooses two House committees

AUGUSTA, Maine (AP) — U.S. Rep. Chellie Pingree says she'll be serving on the House Armed Services and Agriculture committees during the new congressional session. The Maine Democrat says she requested both assignments.

It'll be Pingree's second term on Armed Services, which will deal with issues such as defense spending and the war in Afghanistan. Her subcommittee assignments to Personnel and Seapower will deal with Navy shipbuilding jobs and other matters.

This will be Pingree's first term serving on the Agriculture Committee. The appointment drew support from Russell Libby, president of the Maine Organic Farmers and *Gardeners Association.*

Cable TV not protected utility in N.H. House bill

CONCORD (AP) — New Hampshire landlords should be allowed to cut off the cable television services they provide to tenants without being sued, a lawmaker told the *House Judiciary Committee* on Thursday.

State Rep. Carol McGuire, R-Epsom, said her bill would exempt cable television from enjoying protections from shut-off the law now provides for necessities such as heat, water and lights.

The bill would let the landlord cut off television service if the landlord was paying for it.

The Judiciary Committee began working on an amendment to clarify that only cable television provided by the landlord would be exempt.

Legal Notice
TOWN OF GREENLAND
PUBLIC HEARING NOTICE

The Greenland Municipal Budget Committee will hold a public hearing to take comments on the annual proposed town and school budgets and proposed warrant articles on Wed., February 9th (snow date 2/10/10) at the Greenland *Central School, Post Road, Greenland beginning at 7:00 PM.*

#8508 1tP1/21

Legal Notice
EPA Starts Five-Year Review for Coakley Landfill Superfund Site

[illegible]

Legal Notice
PUBLIC NOTICE

The New Hampshire Coastal Program (NHCP) is reviewing the following activities for consistency with its enforceable policies:

- The U.S. Coast Guard is proposing the nationwide use of high *frequency and ultra high frequency active sound navigation ranging* (SONAR) technologies from mobile platforms to broaden its capability to locate, image, and classify submerged/underwater targets of interest.

- The National Marine Fisheries Service (NMFS) is proposing Amendment 11 to the Atlantic Mackerel, Squid, and Butterfish (MSB) Fishery Management Plan (FMP). The primary purposes of the Amendment are to: 1) Establish a cap on capacity in the mackerel fishery via a limited access program that does not impede optimal U.S. utilization of the fishery; 2) update the essential fish habitat (EFH) designations for species in the MSB FMP, per NMFS regulatory guidance; 3) evaluate fishing-related impacts on Loligo squid egg EFH and, if necessary, minimize any adverse effects on Loligo egg EFH caused by fishing; and 4) establish an allocation for the recreational mackerel fishery to facilitate implementation of upcoming Annual Catch Limits and Accountability Measures.

The deadline for written comments on the above proposals is February 4, 2011. For additional information please visit the NHCP web site at http://des.nh.gov/organization/divisions/water/wmb/coastal/public_notices.htm, or contact Christian Williams at (603) 559-0028 or Christian.Williams@des.nh.gov.

#28708 1tP1/21

Office of Solid Waste and
Emergency Response
(5102G)

EPA-540-R-11-020
October 2010
www.epa.gov/tio
www.clu-in.org/optimization

Remediation System Evaluation
Colbert Landfill Superfund Site

Spokane County, Washington

REMEDIATION SYSTEM EVALUATION

COLBERT LANDFILL SUPERFUND SITE
SPOKANE COUNTY, WASHINGTON

Report of the Remediation System Evaluation
Site Visit Conducted at the Colbert Landfill Superfund Site
April 13, 2010

Final Report
October 14, 2010

NOTICE

Work described herein was performed by GeoTrans, Inc. (GeoTrans) for the U.S. Environmental Protection Agency (U.S. E.P.A). Work conducted by GeoTrans, including preparation of this report, was performed under Work Assignment #48 of EPA contract EP-W-07-078 with Tetra Tech EM, Inc., Chicago, Illinois. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

PREFACE

This report was prepared as part of a project conducted by the United States Environmental Protection Agency Office of Superfund Remediation and Technology Innovation (U.S. EPA OSRTI). The objective of this project is to conduct independent, expert reviews of soil and groundwater remedies with public funding with the purpose of optimizing the remedy for protectiveness, cost-effectiveness, and sustainability. The project contacts are as follows:

Organization	Key Contact	Contact Information
U.S. EPA Office of Superfund Remediation and Technology Innovation (OSRTI)	Jennifer Hovis	USEPA Headquarters – Potomac Yard 2777 Crystal Drive Arlington, VA 22202 phone: 703-603-8888 hovis.jennifer@epa.gov
Tetra Tech EM, Inc. (Contractor to EPA)	Therese Gioia	Tetra Tech EM Inc. 1 South Wacker, Suite 3700 Chicago, IL 60606 phone: 312-201-7431 therese.gioia@tetratech.com
GeoTrans, Inc. (Contractor to Tetra Tech EM, Inc.)	Doug Sutton	GeoTrans, Inc. 2 Paragon Way Freehold, NJ 07728 phone: 732-409-0344 dsutton@geotransinc.com

TABLE OF CONTENTS

Tables

Attachments

1.0INTRODUCTION

1.1 PURPOSE

During fiscal years 2000 and 2001 independent reviews called Remediation System Evaluations (RSEs) were conducted at 20 operating Fund-lead pump and treat (P&T) sites (i.e., those sites with pump and treat systems funded and managed by Superfund and the States). Due to the opportunities for system optimization that arose from those RSEs, EPA OSRTI has incorporated RSEs into a larger post-construction complete strategy for Fund-lead remedies as documented in *OSWER Directive No. 9283.1-25, Action Plan for Ground Water Remedy Optimization*, and has also started conducting RSEs at some PRP-lead sites. A strong interest in sustainability has also developed in the private and public sector. Consistent with this interest, OSRTI has developed a Green Remediation Primer (http://cluin.org/greenremediation/) and as a pilot effort now considers green remediation during independent evaluations.

The RSE process involves a team of expert hydrogeologists and engineers that are independent of the site, conducting a third-party evaluation of the operating remedy. It is a broad evaluation that considers the goals of the remedy, site conceptual model, available site data, performance considerations, protectiveness, cost-effectiveness, closure strategy, and sustainability. The evaluation includes reviewing site documents, potentially visiting the site for one day, and compiling a report that includes recommendations in the following categories:

- Protectiveness
- Cost-effectiveness
- Technical improvement
- Site closure
- Sustainability

The recommendations are intended to help the site team identify opportunities for improvements. In many cases, further analysis of a recommendation, beyond that provided in this report, may be needed prior to implementation of the recommendation. Note that the recommendations are based on an independent evaluation, and represent the opinions of the evaluation team. These recommendations do not constitute requirements for future action, but rather are provided for consideration by the Region and other site stakeholders.

The Colbert Landfill Superfund Site was selected by EPA OSRTI based on a nomination from EPA Region 10. The site is located approximately 2.5 miles north of Colbert, Washington, and approximately 15 miles north of Spokane, Washington. Contaminants of concern in groundwater are specific volatile organic compounds (VOCs):

- 1,1,1-Trichloroethane (TCA)
- 1,1-Dichloroethene (DCE)
- 1,1-Dichloroethane (DCA)
- Trichloroethene (TCE)

- Tetrachloroethene (PCE)
- Methylene Chloride (MC)

There have also been low levels of 1,4-Dioxane observed in groundwater. The groundwater remedy includes a pump-and-treat (P&T) system as well as components of landfill post-closure (e.g., landfill cap, landfill gas system) that serve to reduce contaminant source loading to groundwater over time. The remedy has also included the provision of an alternate water supply to impacted residents plus institutional controls. The RSE provides an opportunity for an independent third-party review of these remediation efforts.

1.2 TEAM COMPOSITION

The RSE team consisted of the following individuals:

Name	Affiliation	Phone	Email
Peter Rich	GeoTrans, Inc.	410-990-4607	prich@geotransinc.com
Rob Greenwald	GeoTrans, Inc.	732-409-0344	rgreenwald@geotransinc.com

In addition, the following individuals from EPA Headquarters participated in the RSE site visit.

- Jennifer Hovis
- Jennifer Edwards

1.3 DOCUMENTS REVIEWED

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

- Fourth Five Year Review Report (USEPA Region 10) – September 2009
- Quarterly Progress Reports (Spokane County)
    - Second Quarter 2009
    - Fourth Quarter 2008
    - Third Quarter 2008
    - Second Quarter 2008
    - First Quarter 2008
- Map showing layout of landfill gas system (CH2MHill) and spreadsheet with landfill gas concentrations over time
- Operation and Maintenance Manual (Landau Associates, Inc.), December 15, 1999
- Operations and Maintenance Manual for Colbert Landfill Closure (CH2MHILL) – May 1997
- Final Extraction Well Plan – Phase II Remedial Design/Remedial Action (Landau Associates, Inc.) – August 7, 1992

- Final Phase 1 Engineering Report: Volume 1 of 3 (Landau Associates, Inc.) - December 30, 1991

- Scope of Work for Remedial Action to Address Groundwater Contamination Emanating from Colbert Landfill (also referred to as the "Consent Decree") - September 27, 1988

- Record of Decision (downloaded without figures) – September 29, 1987

In addition, Deb Geiger from Spokane County forwarded information via email after the RSE site visit regarding electrical usage and costs, estimated labor costs for system operation and project management (for County personnel), specific capacity values at extraction wells, recent water level maps, gas probe locations, results of field gas concentrations at the blower over time, and annual VOC analyses for extracted landfill gas (before and after the vapor GAC units).

1.4 PERSONS CONTACTED

The following individuals associated with the site were present for the visit:

Name	Affiliation	Phone	Email
Piper Peterson Lee (RPM)	U.S. EPA Region 10	206-553-4951	peterson-lee.piper@epa.gov
Bernie Zavala	U.S. EPA Region 10		
Michael Kuntz	Washington Dept. of Ecology		
Deb Geiger	Spokane County		
Bill Wedlake	Spokane County		
Larry Beard	Landau Associates		

Spokane County operates the remedy, and Landau Associates is a consultant to Spokane County.

1.5 BASIC SITE INFORMATION AND SCOPE OF REVIEW

1.5.1 LOCATION

Colbert Landfill is located approximately 2.5 miles north of Colbert, Washington, and approximately 15 miles north of Spokane, Washington (see Figure 1 from the Fourth Five Year Review Report, included in Attachment A of this report). The closed landfill is bounded by Elk-Chattaroy Road on the east and Big Meadows Road on the south. Groundwater impacts associated with the site extend west to the Little Spokane River, which is approximately 3,000 feet to the west of the closed landfill. Groundwater impacts associated with the site also extend more than 1 mile to the south of the closed landfill. There are also groundwater impacts that extend up to several thousand feet north and east of the closed landfill, though the exact cause of the impacts north and east of the landfill are not fully understood.

The closed landfill is surrounded primarily by residential developments and open lands. The area south of the site contains forested lands, open fields, and a few residential homes. The Spokane County Recycling Center and Transfer Station is located immediately west of the treatment facility. There are residences located within the footprint of the groundwater plume (i.e., beyond the landfill) in all directions around the landfill.

1.5.2 SITE HISTORY, POTENTIAL SOURCES, AND RSE SCOPE

The 1987 ROD and the Fourth Five-Year Review (September 2009) provides the following information:

- The landfill operated from 1968 to 1986. During a five year period between 1975 and 1980 the Landfill accepted solvent and other chemical waste from Key Tronic Corporation (a local electronic manufacturing company) and Fairchild Air Force Base (FAFB). Typically these wastes were delivered to the landfill in 55-gallon drums and were subsequently poured into open trenches to mix with the soil or ordinary municipal refuse already in the trench. According to Table 1 of the ROD, the solvents from Key Tronic were methylene chloride and 1,1,1-TCA, and the solvents from Fairchild Air Force Base were methyl ethyl ketone, poly thinner, enamel thinner, toluene, paint remover, and primer wastes.

- In 1980, nearby residents complained to the Eastern Regional Office of the Washington Department of Ecology (Ecology) about the chemical disposal practices. EPA and Ecology along with Spokane County Utilities Department conducted an investigation into these complaints by initiating a groundwater sampling study of nearby domestic water wells. Twenty domestic water wells had samples with contaminants at concentrations above drinking water standards which could in part be traced to the spent solvents disposed of at the landfill.

- Following the initial domestic groundwater sampling investigation, Phase I and II studies resulted in the installation of monitoring wells, injection testing, and development of a groundwater monitoring program. In 1983, EPA placed the Colbert Landfill on the National Priorities List (NPL) and identified Spokane County, Key Tronic Corporation and FAFB as potentially responsible parties (PRP). In 1984, Ecology entered into a cooperative agreement with EPA for conducting a Remedial Investigation/Feasibility Study (RI/FS). During that same year, bottled water was supplied to some of the households with high contamination levels in their water wells. In 1985, the County extended the Whitworth Water District public water supply main to affected households where concentrations of contaminants were greater than Maximum Contaminant Levels (MCLs), and the hookup was subsidized by the PRPs if the resident was less than 500 feet from a water supply main, and the resident signed a hold-harmless agreement. Other residents who did not meet these conditions elected to receive this water supply at their own expense.

- The final RI report was completed in May 1987, and the final FS report was submitted for public comment in May 1987. On September 29, 1987, EPA issued the Record of Decision (ROD) which selected an interim final remedy for the site based on the Remedial Investigation/Feasibility Study (RI/FS). The selected remedy included a pump and treat (P&T) system for water, connection to public water for residences negatively impacted by site contaminants and/or the groundwater remedy, institutional controls, and landfill closure and post-closure maintenance (e.g., capping, landfill gas management, monitoring, etc.).

- During the RSE site visit it was stated that there is some disagreement among the site stakeholders if the 1987 ROD was “interim”. The RSE team notes that the term “interim final remedial action” is used in ROD Section VI (Selected Remedy), and the term “interim final ROD” is used in the State concurrence letter (Appendix C of the 1987 ROD). Additionally, section VI of the ROD refers to a future “final ROD” with respect to evaluating the closure of the landfill. These examples suggest this was intended as an interim ROD.

- On January 23, 1989, a Consent Decree between EPA, Ecology, Spokane County and Key Tronics Corporation was lodged in federal court. Fairchild Airforce Base contributed waste to the landfill; however, they were not a party to this Consent Decree. On February 28, 1989, the Decree was entered by the Court. The Decree addressed implementation of remedial actions specified in the 1987 ROD.

This RSE includes a holistic third-party review of overall site remedy.

1.5.3 HYDROGEOLOGIC SETTING

The hyrdrogeology of this site is extremely complex. The interpretation of the hydrogeologic system presented in the ROD (1987) was subsequently updated in the Final Phase 1 Engineering Report by Landau Associates, Inc. (1991), and the reader is referred to that document for the most detailed description of the hydrogeologic system. A series of cross-sections provided in the Phase 1 Engineering Report (1991) are included in Attachment A of this RSE report. Key components of the hydrogeologic system in the vicinity of the Colbert Landfill are described below.

The geology consists of vertically stratified and laterally discontinuous geologic units derived from glacial material, modified by erosional (and possibly landslide) process, overlaid on granitic bedrock. There are two primary aquifers (according to the fourth five-year review, the primary aquifers would be classified as drinking water sources according to the EPA groundwater classification system):

- The *upper aquifer* is unconfined and consists of a sand and gravel unit that extends from the eastern hills west to the bluffs of the Little Spokane River. Groundwater flow in the upper aquifer is predominantly toward the southwest and south (see January 2010 water level map for upper aquifer prepared by Spokane County in Attachment A), towards a discharge point well south of the landfill. The fluvial unit associated with the Little Spokane River (west of the landfill) receives some recharge from the upper aquifer, and there are some springs reportedly present on the bluff adjacent to the Little Spokane River. The Phase 1 Engineering Report (1991) stated that pump testing performed at extraction well CP-S1 indicated transmissivity of 10,000 to 12,000 ft^2/d, and hydraulic conductivity of 530 to 640 ft/day (using approximate saturated thickness of 19 ft). This represents very conductive aquifer material.

- The l*ower aquifer* is confined to the west of the landfill and unconfined to the east of the landfill. To the west of the landfill, the upper and lower aquifers are separated by the lacustrine unit which causes the confined conditions in that area. The lower aquifer consists of sands and gravels. Groundwater flow in the lower aquifer is predominantly toward the west (see January 2010 water level map for lower aquifer prepared by Spokane County in Attachment A), with discharge to the Little Spokane River. The Phase 1 Engineering Report (1991) stated that pump testing performed at extraction well CP-W1 indicated transmissivity of 30,000 to 40,000 ft^2/d, and hydraulic conductivity of 170 to 230 ft/day (using approximate saturated thickness of 175 ft). The Phase 1 Engineering Report (1991) stated that pump testing performed at extraction well CP-E1 indicated transmissivity of 10,000 to 14,000 ft^2/d, and hydraulic conductivity of 100 to 140 ft/day (using approximate saturated thickness of 100 ft). These values for hydraulic conductivity also represent very conductive aquifer material.

The lacustrine unit, which consists of silt and clay with sand interbeds, pinches out under the eastern portion of the landfill, and where it is not present the upper and lower aquifers are connected. West of the landfill, where the lacustrine unit is present, the water levels in the upper aquifer are nearly 100 ft higher than in the lower aquifer.

Other stratigraphic units that are illustrated on the cross-sections in Attachment A (for instance, section B-B' and C-C') include the following:

- *Latah Formation and Weathered Latah.* The Latah Formation consists of fine-grained lacustrine sediments that overlie the granitic bedrock. The Basalt Unit (described below) is interbedded within the Latah Formation. The Weathered Latah, where present, overlies the Latah formation and consists of weathered material from the Latah Formation and also weathered material from the basalt that is contained within the Latah Formation. In some places the Latah/Weathered Latah are below the lower aquifer, and in other places the lower aquifer is absent and the Latah/Weathered Latah are below the upper aquifer.

- *Basalt Unit.* Interbedded within the Latah Formation, these basalts form secondary aquifers that appear to be of limited extent. One of the remedy extraction wells (CP-E2) is completed in the basalt. The Phase 1 Engineering Report (1991) stated that pump testing performed at extraction well CP-E2 indicated transmissivity of 25 ft^2/d, and hydraulic conductivity of 0.7 ft/day (using approximate saturated thickness of 35 ft). These parameter values are much lower than for the upper aquifer and lower aquifer, and limit the rate at which groundwater can be extracted.

- *Granite*. This represents the bedrock unit. As illustrated on the cross sections in Attachment A, the granite bedrock is several hundred feet below ground surface in the vicinity of the landfill.

The discontinuous nature of the lacustrine unit, the lower aquifer, and the other units (Latah/Weathered Latah/bedrock) makes the hydrogeology extremely complex, and has impacted the contaminant distribution and remedy design.

1.5.4 POTENTIAL RECEPTORS

Based on discussions during the RSE site visit, the primary potential receptors are groundwater users. Residents whose wells have been impacted by the site have reportedly been provided alternate water and the Spokane County Health Department has procedures in place to detect any wells installed as part of a new development (discussed in Section 4.2.3 and Section 5.1).

The fourth five-year review summarized the potential for impacts due to vapor intrusion. It stated that the current landfill gas management system would prevent this pathway for indoor air in residences or businesses adjacent to the landfill. With respect to areas away from the landfill, the fourth five-year review included a screening level analysis using the Johnson and Ettinger (J&E) Vapor Intrusion Model, and concluded that the concentrations of COCs in groundwater in the upper aquifer do not appear to pose a risk to indoor air. The RSE team reviewed these calculations and agrees with the conclusion that the vapor intrusion pathway does not appear to be a concern. The J&E model incorporates a groundwater concentration value at the top of the groundwater surface that attenuates via several mechanisms in the distance between the water table and the structure, and the larger that distance, the lower the impact due to vapor intrusion will be in the structure (for a specific concentration in groundwater). The J&E calculations in the five-year review very conservatively used a groundwater depth of only three feet (which is the case immediately adjacent to the Little Spokane River). The RSE team notes that depth to groundwater in the upper aquifer is generally on the order of 80 to 90 ft. Even using the conservatively small depth to water, the J&E results in the five-year review suggested for most COCs that concentrations in the upper aquifer would need to be orders of magnitude higher than are actually observed in the upper aquifer (e.g., the threshold concentration for 1,1,1-TCA was greater than 5,000 ug/l). The two constituents with relatively low threshold concentrations were PCE (~1 ug/l) and TCE (~ 5 ug/l). However, based on the groundwater data presented in Attachments 3 to 5 of the five-year review (Compliance Monitoring Wells, Compliance Extraction Wells, and MFS Wells) the concentrations of PCE and TCE are below these threshold levels in the upper aquifer. Coupled with the conservatively shallow depth to groundwater utilized for the J&E analysis, the RSE team does not feel that vapor intrusion is a concern.

1.5.5 DESCRIPTION OF GROUNDWATER PLUME

The primary site contaminants are VOCs. The observed VOC concentrations have not been high enough to suggest the presence of any significant free product (i.e., concentrations in groundwater are well below one percent of the aqueous solubility of each COC). As stated earlier, the complex hydrogeology at the site has led to a complex distribution of contaminants. The pre-remedy plume extended to the southwest and south of the landfill in the upper aquifer, and primarily to the west of the landfill in the lower aquifer.

Concentrations of VOCs in the upper aquifer are very low (i.e., close to cleanup standards), and the groundwater extraction wells in the upper aquifer associated with the remedy (located more than one mile south of the landfill) have been shut off for several years. Concentrations of VOCs in the lower aquifer are higher than in the upper aquifer. Figures 27 to 29 from the fourth five-year review are included in Attachment A, and represent results from the 2007 “supplemental monitoring” at lower aquifer wells for PCE, DCE, and TCE. These figures provide a general summary of the concentration distribution in the lower aquifer. It is particularly noteworthy that some of the highest concentrations in the lower aquifer are found east and south of the landfill, which seem to be upgradient from the landfill in that aquifer. Based on discussion during the RSE site visit, it is not certain why this occurs.

Low concentrations of 1,4-Dioxane, which was frequently used as a stabilizer for TCA, have also been detected in groundwater within the footprint of the VOC plume. That chemical is often found in association with TCA, and it is likely associated with the solvents disposed of in the landfill. There is currently no attempt made at the site to actively capture and treat groundwater with 1,4-Dioxane levels above standards (i.e., in locations beyond the capture zone of the P&T system); rather, if 1,4-Dioxane is found at supply wells the approach is for Spokane to provide bottled water and then pay for a hook-up to public water. This approach for 1,4-Dioxane is essentially the same approach that is used in the domestic well program for the other site COCs.

2.0 SYSTEM DESCRIPTION

The primary active components of the groundwater remedy include the following:

- A P&T system that began operation in May 1994, and has consisted of three separate extraction systems (only two of which are now operating). Extracted water is conveyed to a treatment plant with an air stripper that is located at the closed landfill, and treated water is discharged to surface water (Little Spokane River).

- Landfill post-closure components (e.g., landfill cap, landfill gas system) that serve to reduce contaminant source loading to groundwater over time.

These active remedy components are discussed in more detail below. As discussed earlier, the remedy has also included alternate water supply to impacted residents plus institutional controls.

2.1 GROUNDWATER EXTRACTION SYSTEMS

The remedy has included three groundwater extraction systems (locations indicated on Figure 3-2 from the O&M Manual which is included in Attachment A):

- West System – Consists of three extraction wells (CP-W1 to CP-W3) screened in the lower aquifer, intended to provide hydraulic containment at the western edge of the closed landfill. Extraction well CP-W1, which is located southwest of the closed landfill, was shut down in January 2005 because it achieved low concentrations of target COCs. The remaining two west system extraction wells currently pump on the order of 400 to 450 gpm combined.

- East System – Consists of three extraction wells (CP-E1 to CP-E3) screened in lower aquifer and/or weathered basalt/Latah, intended to remove groundwater with highest concentrations located near the eastern edge of the closed landfill. CP-E1 and CP-E3 currently pump on the order of 225 to 250 gpm combined. CP-E2 is screened in the basalt and has a much lower pumping rate (approximately 0.5 to 2 gpm).

- South System (shut down since June 2004 due to low concentrations) – Consists of four extraction wells (CP-S1 and CP-S4 to CP-S6) located more than one mile south of the closed landfill, screened in the upper aquifer, and intended to control contaminant migration to the south of those wells. During the 2006 fourth quarter groundwater monitoring event, water from one of the south system extraction wells had a TCE concentration of 3.3 ug/L, which is just over the "adjustment criteria" that is used to determine when wells can be shut off (discussed later). This well was reactivated and ran until January 2007 when concentrations of TCE decreased to below the adjustment criteria. All of the south extraction wells have been on standby since that date (and are sampled quarterly).

The extracted groundwater from each system is conveyed through a PVC piping system (illustrated on Figure 3-2 from the O&M Manual which is included in Attachment A) to a treatment facility located in the southwest corner of the Landfill property.

2.2 GROUNDWATER TREATMENT SYSTEM

This is a relatively simple treatment system that consists of an air stripper that removes VOCs from the groundwater. The O&M manual indicates the air stripper is capable of treating up to 1600 gpm, though recent flow rates for this system have been lower (currently on the order of 650 gpm). The air stripper has a 50 Hp blower with a motor controlled by a variable frequency drive (VFD) such that less electricity is used when the motor is throttled down, and during the RSE site visit the system operator indicated that the stripper operates at approximately 15 Hz (or approximately 10 HP). A scale control chemical (NALCO 8357, shipped from Carson, CA) is added to the water at a rate of 20 ml diluted solution per 1000 gallons of water (the diluted solution is 1 part scale inhibitor to 7 parts water). There is also a small tank near the air stripper that was intended for use with disinfection chemicals, but those have only been used once.

There is no vapor treatment for the stripped VOCs. It was stated during the RSE site visit that there were no permit issues for discharged vapors based on the original flow rates and concentrations, and the current system has lower flow rates and lower concentrations. Treated groundwater is discharged via gravity to the Little Spokane River through an underground 12-inch diameter PVC pipeline.

2.3 COMPONENTS ASSOCIATED WITH LANDFILL POST-CLOSURE

2.3.1 LANDFILL COVER

The landfill cover (approximately 32 acres), installed in 1996, consists of one 60 mil (0.06" or 1.52mm) thick High Density Polyethylene (HDPE) membrane installed over a 6 in. subgrade of prepared native material. The HDPE membrane is covered with a free-draining 18 inch sand layer, then a 6 inch layer of topsoil. A strip drain collection system is installed directly on top of the cover system to carry surface water that has infiltrated through the topsoil and granular cover material to a toe discharge system or directly into the perimeter drainage ditch. The landfill does not have a bottom liner or leachate collection system.

2.3.2 LANDFILL GAS (LFG) SYSTEM

A landfill gas (LFG) system was installed to prevent off-site gas migration and to prevent build-up of gas pressure. It consists of wells inside the landfill and at the perimeter of the landfill, as well as trenches.

The system utilizes a 15 Hp blower (no VFD). The extracted gas is treated with granular activated carbon (GAC), followed by discharge to the atmosphere. Two condensate traps remove condensate droplets and other particles from the gas stream, and condensate is manually drained into a transport vehicle for treatment off-site.

2.4 MONITORING PROGRAM

The following components of monitoring are discussed below:

- Water Levels – Section 2.4.1
- P&T process monitoring (including extraction wells) – Section 2.4.2
- Sampling at groundwater monitoring wells – Section 2.4.3
- Sampling at domestic wells – Section 2.4.4
- LFG system monitoring – Section 2.4.5

Currently there are quarterly reports prepared by Spokane County that summarize monitoring results.

2.4.1 WATER LEVELS

Water levels are measured quarterly at a variety of monitoring wells and residential wells. In some cases the site operator estimates values where water levels could not be collected based on historical/recent data that are available. Water level maps for the upper and lower aquifers are prepared using Surfer and presented in the quarterly reports. Discussion regarding these water level maps is presented in Section 4.2.1 of this RSE report.

2.4.2 P&T PROCESS MONITORING (INCLUDING EXTRACTION WELLS)

Process monitoring for P&T system includes the following:

- The extraction wells are sampled quarterly for VOCs plus field parameters (pH, temperature, conductivity, turbidity)
- Influent to the treatment system is analyzed monthly for VOCs and field parameters
- Effluent from the treatment system is analyzed as follows:
    - Monthly for VOCs and field parameters
    - Quarterly for chloride
    - Four times per year (January, May, June, July) for total phosphorous and NO3+NO2
    - Semi-annual for "toxicity"

Sampling is performed by County personnel.

2.4.3 SAMPLING AT GROUNDWATER MONITORING WELLS

Groundwater monitoring is comprised of several components:

- Compliance monitoring (24 wells)
- Supplemental monitoring (approximately 40 wells)
- Minimal Function Standards (MFS) monitoring (currently at 4 upper aquifer wells)

Each of these is described below.

Compliance Monitoring

Compliance monitoring is based on the Consent Decree and detailed in the O&M Manual. The compliance monitoring program is intended to focus on the down-gradient boundaries to determine if the interception systems are containing the groundwater plume. The 24 compliance wells are sampled annually for VOCs. The compliance monitoring cluster locations are illustrated on Figure 8 from the fourth five-year review (which is included in Attachment A) and are summarized below:

- *West Extraction System*. These are designated as follows.
  - Set A monitoring well clusters (CD-41C1/2/3, CD-42C1/2/3, and CD-48C1/2/3) are located down-gradient of the system and monitor those portions of the lower aquifer believed to be within the capture zone of existing supply wells. These well clusters are located directly up-gradient of the existing supply wells.
  - Set B monitoring well clusters (CD-43C1/2/3 and CD-44C1/2/3) monitor portions of the lower aquifer not directly impacting the water quality of the existing supply wells.
  - Two monitoring well clusters were also placed at the outboard limit of the interception system (CD-45C1/2/3and CD-48C1/2/3). One of these clusters (CD-48/C1/2/3) is also considered to be part of Set A.
- *East Extraction System*. The east extraction system was intended for source control and does not have required performance monitoring.
- *South Interception System*. Six upper aquifer monitoring wells are used to monitor performance: four wells are located directly down-gradient of the south extraction system (CD-31A1, CD-36A1, CD-37A1, and CD-38A1) and two wells are located near the western and eastern outboard limits of the system (CP-S3 and CD-34A1).

Supplemental Monitoring

The compliance monitoring locations listed above do not provide a comprehensive monitoring network for tracking groundwater concentrations within much of the plume. To address this issue, the County voluntarily collects supplemental groundwater samples about every 5 years throughout the extent of the plume. The last supplemental sampling was completed in May 2007 and the data were presented in the second quarter 2007 monitoring report. The supplemental sampling occurs at approximately 40 wells with analysis for VOCs. It was stated during the RSE site visit that many of the monitoring wells associated with the supplemental sampling do not have dedicated pumps, and this makes the supplemental sampling a major effort.

MFS Monitoring

The MFS groundwater monitoring is required as a component of the landfill post-closure. Samples are analyzed for COCs plus chloride, nitrite/nitrate/ammonia, sulfate, total organic carbon, chemical oxygen demand, iron, manganese, and zinc. Initially, quarterly sampling was performed at a total of six wells (four in the upper aquifer and two in the lower aquifer). Quarterly monitoring and monitoring of the two lower aquifer wells was discontinued in January 1999, and currently the four upper aquifer wells are sampled annually. The four current MFS monitoring locations are illustrated on Figure 8 from the fourth five-year review (which is included in Attachment A).

2.4.4 SAMPLING AT DOMESTIC WELLS

Approximately 40 domestic wells are monitored for VOCs according to a schedule (see Attachment 6 of the fourth five-year review). Domestic well sampling locations are illustrated on Figure 28 from the fourth five-year review (which is included in Attachment A). According to Section VII of the Consent Decree, all wells in the domestic well monitoring program are required to be sampled annually. Specific wells can be sampled more frequently if necessary. Sampling of a well may be discontinued or reduced if (1) an alternative water supply has been provided, (2) it is determined the well is not threatened by contamination from the Colbert Landfill Site or (3) the remedial action is complete. According to the fourth five-year review, the County uses the following methodology to determine the appropriate sampling frequency:

- Quarterly – Wells near the leading edge of the plume or in areas where contaminants are not migrating in the direction of groundwater flow and contaminants have been detected at levels below Evaluation Criteria; wells in areas where contaminants exceeding Evaluation Criteria were detected in nearby wells; multiple user wells where contaminants were previously detected at levels below Evaluation Criteria.

- Semi-Annual – Wells in close proximity of the leading edge of the plume that are not separated from the plume by another well currently in the sampling program.

- Annual – Previously contaminated wells that currently show non-detectable levels of contaminants; wells without detectable concentrations of contaminants and that do not fall into the Bi-annual sampling category.

- Bi-Annual – wells previously in the sampling program that do not fall into any of the above categories (could be used as a transition from annual to no sampling).

- No Sampling - Wells hooked up to an Alternate Water Supply; wells not used for domestic purposes; wells that the owner requests not to be tested; no access to the property or sampling site.

The fourth five-year review (September 2009) indicated there is little documentation on the domestic wells that have been connected to municipal water since the original water supply extension, and recommended that a review of all residences within the groundwater plume area also be completed. It also recommended that changes to the domestic sampling program or new wells installed within the groundwater plume area should be documented in the quarterly reports including the sampling frequency (quarterly, semi-annual, etc), well numbers and addresses, and a location map.

It was stated during the RSE site visit that all potable wells were sampled once for 1,4-Dioxane during 2008 and 2009, and there were no detections except for one well (with a detection close to the performance criterion). It was stated that follow-up sampling would only occur at wells with detections.

2.4.5 LANDFILL GAS (LFG) SYSTEM MONITORING

The LFG system is part of landfill post-closure and is not a focus of this RSE. However, the RSE team notes that there is a variety of sampling for vacuum and landfill gas (methane and carbon dioxide) at a variety of sampling points throughout the collection/treatment system as well as at gas probes. The frequency of this monitoring ranges from monthly to quarterly to annually depending on the type of location. The RSE team also notes that, in addition to field measurements for vacuum and landfill gases, VOC analyses are performed annually, before and after the vapor GAC, by method TO-14A (note that this is an older method than method TO-15 which is now more widely used). Additionally, Gastech (tube) readings are taken monthly after the carbon adsorbers to monitor for possible breakthrough.

3.0 SYSTEM OBJECTIVES, PERFORMANCE, AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The 1987 ROD identifies the following objectives:

- Prevent further spread of contaminated groundwater (in the south and west) in two aquifers by installing and operating interception wells and treating the extracted groundwater

- Remove contaminated materials (in the east) which have entered the aquifers and are contributing to the contaminant plume, by installing and operating extraction wells in the area where the plumes originate and treating the effluent

- Provide an alternate water supply system to any residents who are deprived of their domestic supply by demonstrated contamination from the landfill or due to the action of the extraction systems

The 1987 ROD stated that extraction wells and pumping rates should be implemented to prevent contamination from migrating beyond the down-gradient extent of the plume (at the time of the remedy implementation). The 1987 ROD indicated the following performance criteria to be met in groundwater to indicate completion of the remedy.

Groundwater Performance Standards in the 1987 ROD

Compound	Maximum Concentration (ppb)	Basis
1,1,1-Trichloroethane	200	MCL
1,1-Dichloroethene	7	MCL
1,1-Dichloroethane	4050	MAC
Trichloroethene	5	MCL
Tetrachloroethene	0.7	$1e^{-6}$ cancer risk
Methylene Chloride	2.5	$1e^{-6}$ cancer risk

MAC = maximum acceptable concentrations values which should not be exceeded in water used for drinking (ingestion) or bathing (dermal) calculated in Risk Assessment and summarized in Table 5of the 1987 ROD

The consent decree states the following objectives for the remedial action:

- Prevent ingestion of contaminated groundwater

- Provide alternative drinking water supplies to those residents whose domestic water supply well(s), in use prior to the date of entry of this Consent Decree, are now contaminated or become contaminated at levels exceeding those described in Section

VIII of [the Consent Decree], or where the productivity of their existing supply well(s) is adversely impacted by remedial measures

- Prevent the further spread of contaminated groundwater and remove contamination related to the site from the groundwater

- Protect surface waters from groundwater discharges potentially harmful to aquatic organisms

- Establish institutional controls as authorized by law to promote and support remedial actions

- Prevent transfer of Constituents of Concern from water to air at levels above health protection criteria

The Consent Decree indicates additional criteria to the performance criteria identified in the 1987 ROD, summarized below.

Additional Criteria Described in the Consent Decree and O&M Manual

Compound	Performance Criteria (ppb)	Evaluation Criteria (ppb)	Adjustment Criteria (a) (ppb)
1,1,1-Trichloroethane	200	200	103 (South), 101 (West)
1,1-Dichloroethene	7	7	4.5
1,1-Dichloroethane	4050	4050	2026
Trichloroethene	5	5	3.3
Tetrachloroethene	0.7	7	na
Methylene Chloride	2.5	25	na

(a) Calculated in O&M Manual based on method presented in the Consent Decree
na – not applicable

The Fourth Five Year Review defines these criteria as follows:

- *Performance Criteria*. Identified in the 1987 ROD (Section V, Alternatives Evaluation, Table 6). Numeric standards used for discharge levels of treated groundwater and groundwater performance standards for termination of the remedial action.

- *Evaluation Criteria*. Identified in the Consent Decree (Section IV.2.b, Table IV1). At the time the Consent Decree was written, quantifying PCE and MC concentrations in the groundwater was not possible using the available analytical methods; therefore, alternative evaluation criteria were developed to substitute for the performance criteria for these two COCs. The evaluation criteria for the remaining COCs (1,1,1-TCA; 1,1-DCE; 1,1DCA; and TCE) are equal to the performance criteria. The evaluation criteria for PCE and MC are ten times higher than the performance criteria. The Consent Decree provided for potential improvements to the analytical methods and stated: “If the levels to which these compounds can be accurately quantified (using Method 8010) change during the source of this project, the evaluation criteria will be adjusted accordingly.” The project is now using EPA Method 524.2 to analyze for VOCs, which is capable of quantifying PCE and MC to the performance criteria. For this reason, the evaluation criteria for PCE and MC are no longer applicable and only the performance criteria should be used to determine compliance.

- *Adjustment Criteria*. Identified in the Consent Decree (Section V.A.2.a, Table V-1 and Section V.C.2.a). Adjustment criteria were developed to conservatively evaluate the need for extraction system operational changes and are also used to determine when an extraction well can be put into standby mode. The Consent Decree identified a method to develop adjustment criteria for indicator compounds (1,1,1-TCA; 1,1-DCA; 1,1-DCE; and TCE), which was equal to the lesser value of (1) the baseline concentration (average of the time-averaged concentrations in the performance monitoring wells following startup) plus 50% of the evaluation criteria or (2) 65% of the evaluation criteria. Adjustment criteria are only used to manage operation of the extraction systems. The termination of the entire remedial action will be complete when the performance criteria for groundwater have been met throughout the plume extent.

1,4-Dioxane was not identified as a COC but has been sampled for as an emerging contaminant. It was stated during the RSE site visit that a performance criteria for 1,4-Dioxane at this site is 4 ug/l, which is the Washington Department of Ecology Model Toxics Control Act (MTCA) Method B (carcinogenic) cleanup level for 1,4-dioxane.

3.2 TREATMENT PLANT OPERATION STANDARDS

The 1987 ROD specified that the performance of the treatment plant would be to "[treat] the wastewater effluent to or below the MCLs (40 CFR 141.65) or a similar health-based level (the 10^{-6} risk level for carcinogens) for contaminants for which MCLs have not been determined." Table 6 of the 1987 ROD presented the treatment plant criteria, which were identical to the remedy performance criteria described above.

Groundwater Treatment Performance Criteria in the 1987 ROD

Compound	Treatment Performance Criteria (ppb)
1,1,1-Trichloroethane	200
1,1-Dichloroethene	7
1,1-Dichloroethane	4050
Trichloroethene	5
Tetrachloroethene	0.7
Methylene Chloride	2.5

4.0FINDINGS

4.1 GENERAL FINDINGS

The RSE team observed that the active remedy components are operated by an extremely capable and organized operator. The observations provided below are not intended to imply a deficiency in the work of the system designers, system operators, or site managers but are offered as constructive suggestions in the best interest of the EPA and the public. These observations have the benefit of being formulated based upon operational data unavailable to the original designers. Furthermore, it is likely that site conditions and general knowledge of groundwater remediation have changed over time.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

4.2.1 PLUME CAPTURE

The design of the extraction system was intended to provide hydraulic capture in the upper aquifer with the south system extraction wells (located more than one mile south of the site), and to provide hydraulic capture in the lower aquifer with the west system extraction wells (located on the western side of the closed landfill). The east system extraction wells are intended as source area wells and are not intended to provide plume capture.

The south system wells have generally been shut off since 2004 due to concentrations below the pertinent criteria. Thus, the current evaluation of capture focuses on the west system extraction wells. Extraction well CP-W1 (located southwest of the closed landfill) has been shut off since 2005 due to low concentrations. Extraction well CP-W2 (located at the northwest corner of the closed landfill) generally pumps between 170 and 200 gpm. Extraction well CP-W3 (located west of the closed landfill) generally pumps between 200 and 250 gpm.

Capture for the west system (i.e., lower aquifer) is evaluated by Spokane County using two primary lines of evidence: potentiometric surface maps generated quarterly using the Surfer software, and concentration trends at the compliance monitoring wells located downgradient of the west system extraction wells. The RSE team makes the following observations:

- An example of the potentiometric surface maps for the lower aquifer is provided in Attachment A (for lower aquifer, January 2010). The water level values used to develop the contours are not posted, which makes it difficult for the reader to establish the validity of the contours.

- The values used to generate this map were provided to the RSE team. Based on these data, it appears that the water levels at the extraction wells are utilized to generate the contours, which is not recommended because water levels at extraction wells are subject to well losses and/or inefficiencies that often make the water levels measured in extraction wells lower than water levels in the surrounding aquifer materials. Based on *A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems* (EPA/600/R-08/003, January 2008), EPA recommends that piezometers be placed near extraction wells for determining water levels in the aquifer adjacent to the pumping wells. There are no water levels available near CP-W2 (other than the pumping well itself) and only one well near CP-W3 (location CD-46) with no other locations nearby.

- The overall density of water level measurement points does not allow for extent of capture to be clearly discerned. The RSE team notes that this is true for most sites, and other lines of evidence (such as concentration trends downgradient of the interpreted capture) should also be considered as is being done at this site. At this site, the lower aquifer compliance monitoring wells to the west of the western extraction wells along Hwy 2 (clusters at locations CD-41, CD-42, and CD-43) have remained generally non-detect for site COCs, with only a few minor detections of COCs well below criteria, and this is consistent with water level contour maps generated by the County which suggest that hydraulic containment is provided by the extraction wells.

- There is no clearly defined "Target Capture Zone" for the lower aquifer described in text or figures of the quarterly reports. This makes evaluation of the adequacy of hydraulic capture difficult to interpret within those reports. The intended capture zone for the lower aquifer was illustrated on Figure 2-7 in the Final Extraction Well Plan (Landau Associates, 1992) which is included in Attachment A.

- Some of the VOC impacts in the lower aquifer are in areas that might not be captured by these extraction wells. For instance, based on the supplemental sampling results (see figures in Attachment A) some of the highest VOC concentrations (e.g., DCE of 32.4 ug/l in 2007 versus performance criteria of 7, and TCE concentration of 79 ug/l in 2007 versus performance criteria of 5 ug/l) are located at CD-26, located appoximately1500 ft south of the closed landfill. Based on the potentiometric surfaces, which are based on relatively sparse water level measurements, impacted water in this area might be captured by the extraction wells, but it is also possible that impacted water in this area may not be captured by the extraction wells.

- Prior to the remedy, groundwater flow in the vicinity of CP-W3 was generally to the west (see, for instance, Figure ER-4.19 of the Final Phase 1 Engineering Report), and there does not appear to be a compliance monitoring well due west of extraction well CP-W3 (see "Figure 8 – Groundwater Monitoring Locations" in Attachment A).

- Given the heterogeneity of the subsurface at this site, simple calculations of capture zone width using simplifying assumptions are likely not meaningful.

In summary, there are some uncertainties regarding the exact extent of capture, but the Surfer maps produced by the County and the concentration histories at the compliance wells are consistent with hydraulic capture of most, if not all, of the impacted portion of the lower aquifer.

4.2.2 GROUNDWATER CONTAMINANT CONCENTRATIONS

Groundwater concentrations have declined significantly over time at the extraction wells and throughout the plume. Attachment A includes Figures 9 to 15 from the fourth five-year review which illustrate concentration trends for key VOCs at the extraction wells (i.e., not included for VOCs that are typically below performance criteria). Observations from these figures (and the VOC database for the site) include the following:

- For the south system, COC concentrations are at or near the performance criteria (in some events the PCE concentrations at CP-S4 are just above the criteria of 0.7 ug/l). The south system extraction wells have generally been shut down since 2004 due to low concentrations.

- For the east system, the highest concentrations are at CP-E2 (e.g., TCE and DCE concentrations are currently on the order of 100 ug/l at CP-E2), which is screened in basalt and pumps at a very low rate. The concentrations at CP-E2 declined by approximately 50% between 1994 and 1998, and have remained stable since 1998. At the other two east system extraction wells, concentrations are lower than at CP-E2. At those wells concentrations declined significantly early in the remedy (e.g., DCE declined at CP-E1 from more than 250 ug/l in the mid-1990s to less than 50 ug/l by 1998), but at CP-E1 and CP-E3 concentrations have also been relatively stable since 1998.

- For the west system, CP-W1 was shut down in early 2005 due to low concentrations. At CP-W2 and CP-W3 concentrations of COCs are low (e.g., DCE concentrations of approximately 10 to 20 ug/l versus performance criteria of 7 ug/l, and TCE concentrations of approximately 5 to 10 ug/l versus performance criteria of 5 ug/l). The concentrations have generally declined slowly over the course of the remedy. For instance, at CP-W3 the DCE concentration has declined from more than 200 ug/l in the mid-1990s to approximately 10 ug/l recently. Again, much of that decline occurred by 1998.

Based on Attachment 3 of the fourth five-year review, the compliance wells typically exhibit low concentrations of COCs (generally below the performance criteria). For instance, compliance wells CD-43C1, CD-43C2 and CD-43C3, which are located downgradient of extraction well CP-W2, have generally been non-detect for site COCs through the entire period monitored (since 1994 when the P&T system began). It is unclear if VOC concentrations would exceed criteria at this compliance location in the absence of remedy pumping. With respect to the supplemental sampling (which provides a more comprehensive picture of the plume extent approximately every five years), the fourth five-year review observed that concentrations of COCs above performance criteria remain in the lower aquifer to the north, east, and south of the landfill. The fourth five-year review also observed that overall size and shape of the contaminated groundwater plume has not changed significantly since the active extraction remedy began operation in 1994, but contaminant concentrations in the upper and lower aquifers have declined. The fourth five-year review attributed this to the active extraction associated with the remedy. The RSE team attributes it to a combination of groundwater extraction and treatment, the construction of the low permeability cap over the landfill (which essentially eliminates the infiltration of precipitation through affected soil and further release to the aquifer), natural dilution, and to a lesser extent other natural processes (e.g. biodegradation if present based on field conditions) and landfill gas extraction. As discussed later, the groundwater extraction has removed significantly more mass of VOCs than the landfill gas extraction. However, it is not possible to determine how much of the concentration reductions over time are attributable to the extraction versus other factors listed above. Initial notable concentration reductions (1994-1998), during the time when the groundwater extraction wells were removing >1000lbs/yr of VOCs, was likely due to the groundwater extraction. Since about 1998 concentrations at the extraction wells have remained relatively stable, and our conceptual model is that relatively higher VOC concentrations that are remaining in the lower permeability Latah sediments and basalt (e.g., at CP-E2 and other similar locations) are continuing to diffuse out into the higher permeability sediments. This diffusion causes lower (but stable) concentrations in the lower aquifer than were observed when the remedy first started to operate (i.e., before significant mass was flushed/removed from the lower aquifer). It is possible that pulsed pumping could have led to even greater mass removal over time, but perhaps at the expense of some plume capture effectiveness.

As mentioned earlier, there have been low level detections of 1,4-Dioxane within the footprint of the plume. Initial 1,4-Dioxane sampling was performed from 2005 through 2007 at every extraction, compliance, MFS, domestic and supplemental well in both the upper and lower aquifers of the Colbert Landfill site program at least one time. Subsequent sampling was performed quarterly at wells selected near known concentrations of 1,4-dioxane as outlined in a Work Plan approved by EPA and Ecology (not reviewed by the RSE team). This quarterly sampling concluded in April 2009 and is currently ongoing on an annual basis. Based on the Second Quarter 2009 Progress Report (Chapter 6) concentrations of 1,4-Dioxane were detected at five of the six locations. The locations and results are illustrated on Figures 6-1 and 6-2 and Table 6-2 from the Second Quarter 2009 Progress Report, which are included in Attachment A. The highest concentrations were at CD-40C1 (southwest of the landfill near Little Spokane River with 1,4-Dioxane concentrations up to 13 ug/l) and at south system extraction well CP-S1 (with 1,4-Dioxane concentrations up to 20 ug/l). These exceed the MTCA Method B cleanup standard of 4 ug/l, and do not appear to be within the capture zone of the P&T system. There is currently no attempt made at the site to actively capture and treat groundwater with 1,4-Dioxane levels above standards (i.e., in locations beyond the capture zone of the P&T system); rather, if 1,4-Dioxane is found at supply wells the approach is for Spokane to provide bottled water and then pay for a hook-up to public water. This approach for 1,4-Dioxane is essentially the same approach that is used in the domestic well program for the other site COCs. The fourth five-year review recommends that sampling of wells with concentrations of 1,4-dioxane above cleanup criteria be included in the long-term monitoring program.

4.2.3 INSTITUTIONAL CONTROLS TO PREVENT USE OF IMPACTED GROUNDWATER

The following description is provided in the fourth five-year review regarding the procedures for preventing consumption of impacted water:

> *The Spokane County Health Department maintains procedures for groundwater protection and prevention of the use of contaminated water within the Colbert Landfill plume boundaries. The following procedures were described by Jim Sackville-West of the Spokane County Health Department. The historical extent of the 1,1,1-TCA plume is used to define the groundwater protection area. For reference, the 1994/1995 1,1,1-TCE plumes for the upper and lower aquifers are presented on Figures 4 and 6 [of the fourth five-year review]. According to Spokane County Health Department officials, new wells are identified through applications for new development. If a proposed development is within the plume boundaries, they are encouraged to connect to municipal water. If a proposed residence is within 0.5 miles of the plume boundary and a well is installed, the Health Department will sample the groundwater for VOCs to verify that groundwater is not contaminated. This procedure does not detect any new wells that would be installed at existing residences; however, the Health Department reviews start cards (i.e. notice of intent to construct a water well) from Ecology for new wells and should be able to detect wells installed within the groundwater protection area. No official documentation of these procedures exists;*

maintenance of such procedures is based on Health Department officials working in conjunction with Ecology to ensure institutional controls for the Colbert Landfill area are met. An Institutional Control Plan is needed to ensure that the process for permitting wells is protective of human health and a lead agency is designated for oversight.

The RSE team concurs with the five-year review findings that the current institutional controls are somewhat lacking with respect to documentation of procedures.

4.3 COMPONENT PERFORMANCE

4.3.1 GROUNDWATER EXTRACTION SYSTEM

Information about the extraction pumps is provided below.

Extraction Pump Information

Extraction Well	Original Pump Size(1) (Hp)	Designed Pump Capacity(1) (gpm)	Converted to Newer VFD?(3)	Typical Current Pumping Rate(2) (gpm)
CP-W1	30	250	Yes	0
CP-W2	30	250	Yes	170 – 200
CP-W3	30	250	Yes	200 – 250
CP-E1	20	200	Yes	125 – 135
CP-E2	0.75	6	Yes	0 – 2
CP-E3	20	200	No	100 -120
CP-S1	10	90	No	0
CP-S4	10	90	No	0
CP-S5	7.5	90	No	0
CP-S6	7.5	90	No	0

(1) from O&M Manual
(2) based on specific capacity calculation spreadsheet provided by system operator, except CP- W1 based on fourth five-year review report
(3) All extraction wells were originally installed with VFDs. Spokane County is currently replacing old VFDs with newer more efficient models that don't require the inclusion of an air conditioning unit, thus saving on power and associated equipment and repair costs.

Wells may be operated by either a flow mode or a level mode setting. Unless there is a need to acquire a specific flow or the level instrumentation is in repair, wells are operated using level controls that are set by the plant operator. For the western extraction wells, the operator seeks a balance between maximizing extracted concentrations and achieving adequate capture based on her experience interpreting capture for the system. The east and west system well pumps (except CP-E3) have had the original variable frequency drive (VFD) motors updated to newer models, and during the RSE site visit the system operator said that the VFDs for the operating extraction wells are running at anywhere from 65% to 98% of possible output based on a scale of 30 to 60Hz. There are plans to update the VFD at CP-E3. The south system has had updates to the VFDs since the wells are no longer in use. Each well has its own totalizing flow meter and electricity meter.

4.3.2 TREATMENT SYSTEM FOR EXTRACTED WATER

Quarterly progress reports prepared by the County include calculations of mass of the COCs removed by the groundwater extraction system. In the report for Q2 2009, the total mass removed to date was reported to be approximately 10,500 lbs, and the current removal rate was estimated at approximately 200 lbs/yr. Figure 2-18 of that same report suggests that the mass removal rate was much higher (more than 1,000 lbs/month) when the system was first operated in 1997, but stabilized at values similar to current levels by approximately 2002.

4.3.3 VOCS REMOVED BY LFG SYSTEM

The County provided the RSE team with TO-14a results for a variety of dates. The RSE team calculated mass removed by the LFG system for three dates (August 1996, August 1997, and July 2004) for the following four major COCs: DCA, DCE, TCA, and TCE (PCE concentrations were minimal and VC concentrations were low and inconsistent):

- August 1996:
  - DCA= 460 ppbv
  - DCE = 600 ppbv
  - TCA = 240 ppbv
  - TCE = 28 ppbv
  - Approximate flow rate of 200 cfm
  - Calculate mass removed = 38 lbs/yr

- August 1997
  - DCA= 290 ppbv
  - DCE = 190 ppbv
  - TCA = 190 ppbv
  - TCE = 24 ppbv
  - Approximate flow rate of 200 cfm
  - Calculated mass removed = 21 lbs/yr

- July 2004
  - DCA= 33 ppbv
  - DCE = 62 ppbv
  - TCA = 17 ppbv
  - TCE = 9.9 ppbv
  - Approximate flow rate of 50 cfm
  - Calculated mass removed = 1 lb/yr

To calculate mass, the concentrations in ppbv must first be converted to units of ug/m^3:

$$C_{air}(ug/m^3) = \frac{Conc(ppbv)}{10^6} \times \frac{\text{1 mole air}}{\text{24.1 L}} \times \frac{\text{1000 L}}{\text{m}^3} \times \frac{\text{1000 mg}}{\text{g}} \times \text{MW}_\text{X}$$

where MW_x is the molecular weight of each compound in grams per mole (DCA = 99, DCE = 97, TCA = 133, and TCE = 131). Then the mass (M_{air} in lbs/day) is calculated as follows:

$$M_{air} = Q_{air} \times C_{air} \times \frac{0.0283 \text{ m}^3}{\text{ft}^3} \times \frac{1440 \text{ min.}}{\text{day}} \times \frac{2.2 \text{ lbs.}}{10^9 \text{ ug}}$$

Where Q_{air} is the flow rate (cfm).

It is evident from the data and calculations provided above that the extracted landfill gas concentrations declined over time, and the mass removed by the LFG system (less than 50 lbs per year in the mid-1990s and 1 lb per year recently) is far lower than the mass removed by the groundwater extraction wells (which was initially more than 1,000 lbs per year and is currently on the order of 200 lbs per year).

4.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF ANNUAL COSTS

Rough annual cost estimates for operating this remedy are summarized below, based on information provided by the site team and/or estimated by the RSE team based on discussions with the site team.

Item Description	**Approximate Annual Cost***
Project Management (County)	$ 26,000
O&M Labor including sampling (County)	$ 215,000
Electricity	$ 54,000
Materials Vapor Carbon for LFG System Scale Inhibitor for Air Stripper Other	 $ 10,000 $ 6,600 $ 3,400
Misc Equipment/Supplies etc.	$15,000
Lab Analysis	$22,000
Total Estimated Annual Cost	**$352,000**

*does not include supplemental groundwater sampling approximately every 5 years

Additional details regarding these items are provided below.

4.4.1 UTILITIES

The site operator provided electric usage and costs by month for each of the 10 extraction wells, plus the “plant” which includes the LFG system blower. The total usage for 2009 was approximately 703,000 kWh and the total cost for 2009 was approximately $54,000. This translates to an approximate unit cost of $0.08 per kWh. The site operator indicates the rate for the extraction wells is slightly higher than this amount per kWh, and the rate for the plant is slightly lower than this amount per kWh, resulting in the blended rate of $0.08 per kWh.

4.4.2 NON-UTILITY CONSUMABLES AND DISPOSAL COSTS

Based on discussions during the RSE site visit, the vapor carbon for the LFG system requires approximately 4,400 lbs exchanged each year by Siemens (located in the Yakima area). The scale inhibitor cost is approximately $6,600 per year.

4.4.3 LABOR

Estimated costs were provided by the County for routine project management ($26,000 per year) and O&M ($215,000 per year). The O&M labor includes operating the treatment plant and the LFG system, all related sampling for process monitoring and groundwater monitoring, and reporting.

4.4.4 CHEMICAL ANALYSIS

There are likely on the order of 200 samples per year for VOCs consisting of extraction wells samples (40 per year), influent/effluent samples (24 per year), compliance well samples (24 per year), MFS samples (4 per year), domestic well samples (approximately 80 per year), and various duplicates and blanks. Assuming VOC analysis cost of approximately $100/sample, this would translate to approximately $20,000 per year. Additional lab analyses, such as the annual TO-14a for the LFG system, influent/effluent, toxicity testing for treatment plant process water, and the additional parameters for the MFS samples, should be minimal (less than ~$2,000 per year). Thus, the RSE team estimates that laboratory analysis cost is on the order of $22,000 per year. Note that this does not include supplemental groundwater sampling that is conducted approximately every five years. It also does not include extra analysis for 1,4 dioxane, which likely requires approximately $150 additional per sample.

4.5 APPROXIMATE ENVIRONMENTAL FOOTPRINTS ASSOCIATED WITH REMEDY

Direct energy usage for the site includes electricity and diesel associated with materials transportation. Energy is also associated with manufacturing of materials that are used at the site (e.g., vapor GAC and scaling inhibitor). We have not included off-site services associated with laboratory analysis. Air emissions of greenhouse gases, nitrogen oxides (NOx) and sulfur oxides (SOx) result from the direct energy usage and from manufacturing site-related materials. Greenhouse gas emissions are of global concern, and other pollutants are of more local concern as they adversely affect local/regional air quality. Briefly, nitrogen oxides (NOx) are respiratory irritants and precursors to ground level ozone. Sulfur dioxide is also a respiratory irritant and is a precursor to acid rain. Emissions of other pollutants may also be of concern, but these common pollutants were selected because emissions information is more readily available for them and they may be adequate indicators for other potential air emissions.

Spreadsheets were used to calculate the energy and emissions footprints for the remedy on an annual basis(see Attachment B). The landfill gas system is included in these calculations (e.g., electricity and methane), though CO_2 for the landfill gas system is not included in GHG emission because similar CO_2 would ultimately be emitted under any approach. Footprint results are summarized in Table 4.1.

Table 4.1 Summary of Footprint Results

Green and Sustainable Remediation Parameter	Annual Value (per year)
Greenhouse gas emissions	990,775lbs CO2e
Nitrogen oxide emissions	617 lbs
Sulfur oxide emissions	971 lbs
Total energy use	8,471,922 MMbtu
Water use (groundwater extraction)	343,210,000 gallons

CO2e = carbon dioxide equivalents of global warming potential
MMbtu = million British thermal units

For the greenhouse gas emissions (CO2e) approximately 83% is from methane emissions from landfill gas, approximately 11% is from electricity use, and the remaining 6% is from various other activities. By contrast, almost all of the energy use is associated with electricity use. The disparity between greenhouse gas emissions and energy use is because over 80% of the electricity provided by the local electricity provider is from hydropower.

With respect to water usage, essentially all of the water use is from the groundwater extraction system. The water that is extracted and treated from this system is discharged to Little Spokane River, and therefore is unavailable as a resource for groundwater usage.

Waste disposal associated with this remedy is minimal. With respect to more qualitative issues, the remedy does not cause any aesthetic issues (noise, visual, odor) and there are no major traffic issues associated with the remedy that would impact the surrounding land or ecosystems.

4.6 RECURRING PROBLEMS OR ISSUES

No significant issues reported.

4.7 REGULATORY COMPLIANCE

During the RSE process, the site team did not report any exceedances of discharge standards or other compliance related standards.

4.8 SAFETY RECORD

During the RSE process, the site team did not report any health and safety concerns or incidents related to the remedial activities.

5.0EFFECTIVENESS OF THE SYSTEM TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

5.1 GROUNDWATER

The following protectiveness statement was included in the fourth five-year review:

> *The remedy at the Colbert Landfill Site currently protects human health and the environment because residences with affected wells have been connected to County water supplies; the groundwater extraction systems are preventing further migration of the groundwater plume; domestic wells are sampled on a schedule to confirm that the drinking water exposure pathway is blocked; and the Spokane County Health Department has procedures in place to detect any wells installed as part of a new development.*
>
> *However, in order for the remedy to be protective of human health and the environment in the long term the following actions need to be taken:*
>
> - *Put restrictive covenants in place for the landfill and complete an Institutional Controls Plan that documents procedures to control installation of domestic wells.*
> - *Improve the current groundwater monitoring program to track the remaining contaminant concentrations within the plume area. Currently, the County voluntarily collects samples throughout the plumes (upper and lower aquifer) approximately every five years to account for this short coming.*
> - *Conduct a RSE to determine if the current extraction system is adequate to maintain containment and/or achieve long term cleanup goals within a reasonable timeframe.*

The RSE team is not certain that the current groundwater extraction from the east and west systems adds to the overall protectiveness of the remedy, for the following reasons:

- Initial concentration reductions at the extraction wells (1994 to 1998) were likely due to flushing and mass removal associated with the P&T system plus the implementation of landfill post-closure systems (capping, landfill gas collection, etc.). However, there have only been minor concentration reductions at the extraction wells since 1998, and it is not clear if continued extraction leads to meaningfully reduced concentrations of COCs observed in the lower aquifer.

- The overall extent of the VOC plume in the lower aquifer has not changed significantly, although concentrations have gone down over the course of the remedy. If extraction did not continue, it is not clear that the plume extent would subsequently grow and/or that concentrations of COCs away from the landfill would increase, given the remaining strength of the contaminant source which has been reduced over time by groundwater remedy extraction and engineered controls such as landfill capping.

The RSE team believes this is a challenging site because there are diffuse COC concentrations in the lower aquifer over a large area, with some apparent source areas to the north, east, and/or south of the actual landfill. It is likely that some low levels of VOCs (and 1,4-dioxane) will persist above performance standards for some period of time over a large area, some of which are beyond the capture zone of the P&T system. These relatively low level concentrations of the COCs (and 1-4-Dioxane) that persist are being addressed with a combination of domestic well sampling, institutional controls, and hook-ups to public water. The RSE team agrees that this general approach is appropriate, given the complex nature of the site and the large extent of a diffuse plume. The RSE team also feels that a shut-down test of the remaining extraction wells may be appropriate, in conjunction with some increased monitoring, to determine if terminating extraction has a negative impact on water quality. The RSE team also agrees with the fourth five-year review that the process for documenting and implementing the institutional controls should be improved, and that the process for sampling VOCs and 1,4-Dioxane throughout the plume footprint should be more clearly defined.

5.2 SURFACE WATER

The RSE did not focus on surface water, but the RSE team believes it is very unlikely that the low levels of VOCs observed in the groundwater plume would have negative impacts on surface water quality, including the Little Spokane River.

5.3 AIR

The fourth five-year review summarized the potential for impacts due to vapor intrusion. It stated that the current landfill gas management system would prevent this pathway for indoor air in residences or businesses adjacent to the landfill. With respect to areas away from the landfill, the fourth five-year review included a screening level analysis using the Johnson and Ettinger (J&E) Vapor Intrusion Model, and concluded that the concentrations of COCs in groundwater do not appear to pose a risk to indoor air. As discussed in Section 1.5.4, the RSE team agrees that vapor intrusion does not appear to be a concern.

5.4 SOIL

Not addressed as part of the RSE, but not expected to be a concern.

5.5 WETLANDS AND SEDIMENTS

Not addressed as part of the RSE, but not expected to be a concern.

6.0 RECOMMENDATIONS

Cost estimates provided herein have levels of certainty comparable to those done for CERCLA Feasibility Studies (-30%/+50%), and these cost estimates have been prepared in a manner consistent with EPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, July, 2000. The costs and sustainability impacts of these recommendations are summarized in Tables 6-1 and 6-2.

6.1 RECOMMENDATIONS TO IMPROVE EFFECTIVENESS

6.1.1 ADD MONITORING WELL WEST OF CP-W3

As noted in Section 4.2.1, there does not appear to be a compliance monitoring due west of extraction well CP-W3, and based on the figures included in Attachment A, there also do not appear to be supplemental or domestic monitoring wells in that region. If a shut-down test of the P&T system is to be considered, it will be important to have at least one monitoring well due west of CP-W3. It is recommended that at least one monitoring well be drilled to the west of CP-W3 (i.e., between the CD-42 and CD-43 compliance locations), perhaps at a depth consistent with CD-42C2 and CD-43C2 (i.e., middle of lower aquifer). Based on cross-section E-E' in Attachment A, this would correspond to a depth of approximately 300 ft, and using a generic approximate cost of $100/ft for well installation (including oversight and associated equipment and logistics), this would require a capital cost of approximately $30,000 (assuming no major access limitations). Note this is not a site-specific cost estimate, it is only intended as a rough estimate. Annual sampling of this well for VOCs (similar schedule as compliance wells) would have a minor cost impact (perhaps $500/yr). This well will provide valuable information under continued pumping conditions, and is especially important for monitoring a shut-down test of the extraction system if that occurs (see Section 6.4.1).

6.1.2 INCLUDE 1,4-DIOXANE IN FUTURE RESIDENTIAL SAMPLING (AT SOME FREQUENCY)

As discussed in Section 4.2.2, there have been low level detections of 1,4-Dioxane within the footprint of the plume. It was stated during the RSE site visit that follow-up sampling for 1,4-dioxane at residential wells would only occur for wells with detections. The RSE team recommends that future residential well samples be analyzed for 1,4-Dioxane (at some frequency) in addition to the other COCs. The lack of a detection for 1,4-Dioxane in one sampling event does not guarantee that future detections will not occur at that location, especially if the flow system changes (for instance, due to changes in remedy pumping). Perhaps the 1,4-Dioxane analysis at residences could be done at reduced frequency relative to other COC's. Assuming 80 residential samples are taken per year for other site COCs, and analysis for 1,4-Dioxane is performed for every other sample over time at each residential well (i.e., 40 analyses per year for 1,4-Dioxane), and a cost of approximately $150 per analysis for 1,4-Dioxane, this should add approximately $8,000 per year of cost for analysis and reporting. The actual frequency for 1,4-Dioxane analysis should be worked out by site stakeholders, and could possibly be different for wells in different locations. The RSE team recommendation, however, is that residential wells not be excluded from all future analysis for 1,4-Dioxane base on one result of "non-detect".

6.1.3 TIGHTEN INSTITUTIONAL CONTROLS REGARDING GROUNDWATER USE AND DOCUMENT APPROACH REGARDING 1,4-DIOXANE DETECTIONS

As discussed in Section 5.1, the RSE team agrees with the fourth five-year review that the process for documenting and implementing the institutional controls should be improved. Based on the RSE site visit and the documents reviewed, it appears that the current implementation of the institutional controls is likely effective but not fully documented or formalized. Furthermore, it was stated during the RSE site visit that if 1,4-Dioxane is detected at "high enough levels" (assumed to be 4 ug/l, which is the MTCA Method B cleanup level), Spokane County then provides bottled water and subsequently pays for a hook-up to public water. However, the RSE team is not aware if this approach has been formally documented as part of the remedy, and recommends that this be documented more clearly. The RSE does not have a basis for quantifying the cost of implementing this recommendation to tighten and document the institutional controls, buts suspects it could cost on the order of $40,000 to address this recommendation for the entire site.

6.2 RECOMMENDATIONS TO REDUCE COSTS

None are provided above and beyond the potential cost savings associated with recommendations in other categories.

6.3 RECOMMENDATIONS FOR TECHNICAL IMPROVEMENT

6.3.1 MODIFICATIONS TO WATER LEVEL MAPS

It is recommended that future water level maps include posted data values. If necessary, the plots can be zoomed in to the area of interest (using the limits and scale properties in Surfer) so the labels can be viewed. Also, it is best to avoid use of water levels from pumping wells, but if they are to be used it should be clearly noted on the water levels maps. Also, in some cases the site operator estimates values where water levels could not be collected based on historical/recent data that are available. It is recommended that any estimated water levels be clearly documented on figures and/or tables associated with the water levels. Implementing this recommendation is not expected to have any cost impact.

6.3.2 OTHER SUGGESTED MODIFICATIONS TO QUARTERLY REPORTS

The quarterly reports present an impressive amount of information. It is recommended that an executive summary be included to indicate any important (i.e., non-routine) changes or observations from the reporting period. Also, there are some instances where concentrations for domestic wells are reported as "ND" and it is recommended that the detection limits be included (i.e., "1 U" or "< 1"). Implementing this recommendation is not expected to have any cost impact.

6.4 CONSIDERATIONS FOR GAINING SITE CLOSE OUT

6.4.1 CONSIDER SHUT DOWN TEST OF REMAINING ACTIVE EXTRACTION WELLS

As discussed in Section 5.1, the RSE team is not certain that the current groundwater extraction from the east and west systems adds to the overall protectiveness of the remedy. The RSE team believes it is technically reasonable to consider a shut-down test of the remaining extraction wells, with monitoring to determine if concentrations increase significantly downgradient of the landfill (including at the new monitoring well west of extraction well CP-W3 recommended in Section 6.1.1).

A shut-down test seems technically appropriate given that source area strength has been reduced due to previous groundwater extraction associated with the remedy, plus engineering controls for the closed landfill such as the cap. The concentrations at the remedy extraction wells are quite low (except CP-E2, which removes water from the basalt at a very low rate). There are many areas at distance from the landfill with relatively low COC concentrations that are nevertheless above cleanup standards (i.e., a diffuse plume over a large area), and the overall extent of the COC plume has not been changed dramatically since the remedy began operation. It is not clear that the current P&T system will achieve the goal of remediating groundwater to cleanup levels throughout the entire impacted area. The impacted areas away from the landfill are being addressed with a combination of domestic sampling, institutional controls, and water hookups, and this seems appropriate. This shut down test and associated monitoring can help determine if a final remedy at the site should or should not include P&T, and can also indicate if a TI waver should be considered as part of the final remedy. Given the low concentrations of COCs over a large area, there are no in-situ technologies that could reasonably be suggested to achieve cleanup levels throughout the plume. If the shutdown test indicates that the P&T system provides no significant benefit with respect to achieving cleanup levels, and there are no identified alternatives that are likely to achieve cleanup goals throughout the plume, then evaluating a TI waiver as part of the final remedy may be appropriate.

Although a shut-down test may be technically reasonable, it is beyond the scope of the RSE to determine how to implement such a test given the existing ROD, Consent Decree, and EPA policy. It is anticipated that this would require substantial work among the stakeholders to develop an acceptable approach and work plan. The approach and work plan would need to establish a monitoring program and related triggers for turning back on the P&T system based on observed concentrations and concentration trends. The existing compliance monitoring wells west of the landfill, plus the suggested new monitoring well west of CP-W3, would provide a good network for monitoring potential plume migration to the west after a shut down test is initiated. Groundwater flow in the lower aquifer near CP-W1 was reported to be on the order of 0.6 feet/day (approximately 200 feet/year) per year in the 1991 Final Phase 1 Engineering Report, and the pertinent compliance wells are on the order of 1,000 feet west of the western extraction wells, so the shut down test will have to be monitored initially for years to determine if there are unacceptable results. The RSE team has no basis for calculating the required level of effort for establishing a shut down test approach and work plan. The RSE team notes that a shut-down test should not be implemented until effectiveness recommendations 6.1.1 to 6.1.3 provided above are all implemented, to ensure protectiveness of the remedy during the shutdown test and to better monitor the shutdown test.

A shutdown test would likely lead to significant annual cost savings. It would eliminate approximately $45,000 per year of electrical usage, and approximately $15,000 of materials and supplies (such as the anti-scaling chemical and other miscellaneous supplies). It is assumed that quarterly sampling at the extraction wells would continue, but it would eliminate process monitoring analysis costs for influent and effluent (approximately 24 samples per year for VOCs plus toxicity testing), which likely would save approximately $4,000 per year. We assume that some significant savings would be realized on labor (perhaps a savings of $70,000 from the estimated $215,000 per year for the current system, since there would still be labor associated with monitoring, reporting, landfill gas control, etc). These add up to approximately $134,000 per year of savings. We anticipate that the work plan developed to implement a shut-down test may include some additional sampling frequency at selected wells west of the landfill, perhaps reducing the net savings to approximately $125,000 per year. It is noted, however, that this recommendation for a shut-down test is made primarily with regard to potential for achieving site closeout, and the potential cost savings associated with a shut down test should not be the primary basis for determining if this approach is acceptable to all stakeholders.

Implementing this recommendation will preclude the need to add additional water level monitoring points to better resolve capture zones for the extraction wells. If the extraction system is expected to operate for a long time into the future, then additional water level measurement locations would be recommended for drawing improved potentiometric surface maps, particularly at locations near the extraction wells (to preclude the use of water levels at extraction wells) to be consistent with EPA guidance regarding capture zone evaluation. Therefore, it is likely that the addition of multiple new water level measurement points would be appropriate if a shut-down test is not anticipated, but we have not quantified the costs since we believe the shut-down test is merited.

Although this recommendation for a shut-down test is not being made based on sustainability considerations, a shut-down test would also have positive results with respect to sustainability. The current system uses approximately 700,000 kWh per year of electricity, and the vast majority of that would be eliminated (electricity would still be required for the LFG system, which we estimate is approximately 17% of the electricity usage). The use and transport of the anti-scaling chemical would also be eliminated. In sum, we estimate that implementing this recommendation would cut the calculated greenhouse gas emissions per year (CO2e per year) from approximately 794,708 lbs to approximately 136,903 lbs (approximately an 83% reduction). Reductions in NO_x and SO_x would scale accordingly.

6.5 RECOMMENDATIONS FOR IMPROVED SUSTAINABILITY

The site team has initially implemented VFDs for motors, and has upgraded these VFDs for most of the motors used in the remedy, which is commendable. No specific recommendations for sustainability are recommended. As discussed earlier, a shut-down test at the remaining extraction wells would eliminate significant electrical usage and some supplies, but the recommendation is made on the basis of costs savings and not sustainability.

Table 6-1. Cost Summary Table

Recommendation	Reason	Additional Capital Costs ($)	Estimated Change in Annual Costs ($/yr)	Estimated Change in Life-Cycle Costs $*	Estimated Change in Life-Cycle Costs (net present value) $**
6.1.1 Add Monitoring Well West Of CP-W3	Effectiveness	$30,000	$500	$37,500	$40,000
6.1.2 Include 1,4-Dioxane In Future Residential Sampling (At Some Frequency)	Effectiveness	$0	$8,000***	$120,000	$160,000
6.1.3 Tighten Institution Controls Regarding Groundwater Use And Document Approach Regarding 1,4-Dioxane Detections	Effectiveness	$40,000	$0	$40,000	$40,000
6.3.1 Modifications To Water Level Maps	Technical Improvement	$0	$0	$0	$0
6.3.2 Other Suggested Modifications To Quarterly Reports	Technical Improvement	$0	$0	$0	$0
6.4.1 Consider Shut-Down Test Of Remaining Active Extraction Wells	Site Closeout	Not quantified, potentially substantial	(125,000)	($1,850,000)	($2,500,000)

Costs in parentheses imply cost reductions
* assumes 20 years of operation with a discount rate of 0% (i.e., no discounting)
** assumes 20 years of operation with a discount rate of 3% and no discounting in the first year
***assumes 80 residential samples per year for site COCs, but only every other sample per well over time sampled for 1,4-Dioxane (i.e., 40 per year for 1,4-Dioxane)

Table 6-2. Sustainability Summary Table for Recommendations

Recommendation	Reason	Effects on Sustainability
6.1.1 Add Monitoring Well West Of CP-W3	Effectiveness	Minor
6.1.2 Include 1,4-Dioxane In Future Residential Sampling (At Some Frequency)	Effectiveness	Minor
6.1.3 Tighten Institution Controls Regarding Groundwater Use And Document Approach Regarding 1,4-Dioxane Detections	Effectiveness	None
6.3.1 Modifications To Water Level Maps	Technical Improvement	None
6.3.2 Other Suggested Modifications To Quarterly Reports	Technical Improvement	None
6.4.1 Consider Shut-Down Test Of Remaining Active Extraction Wells	Cost-Effectiveness	Major

ATTACHMENT A

SELECTED FRIGURES FROM SITE DOCUMENTS

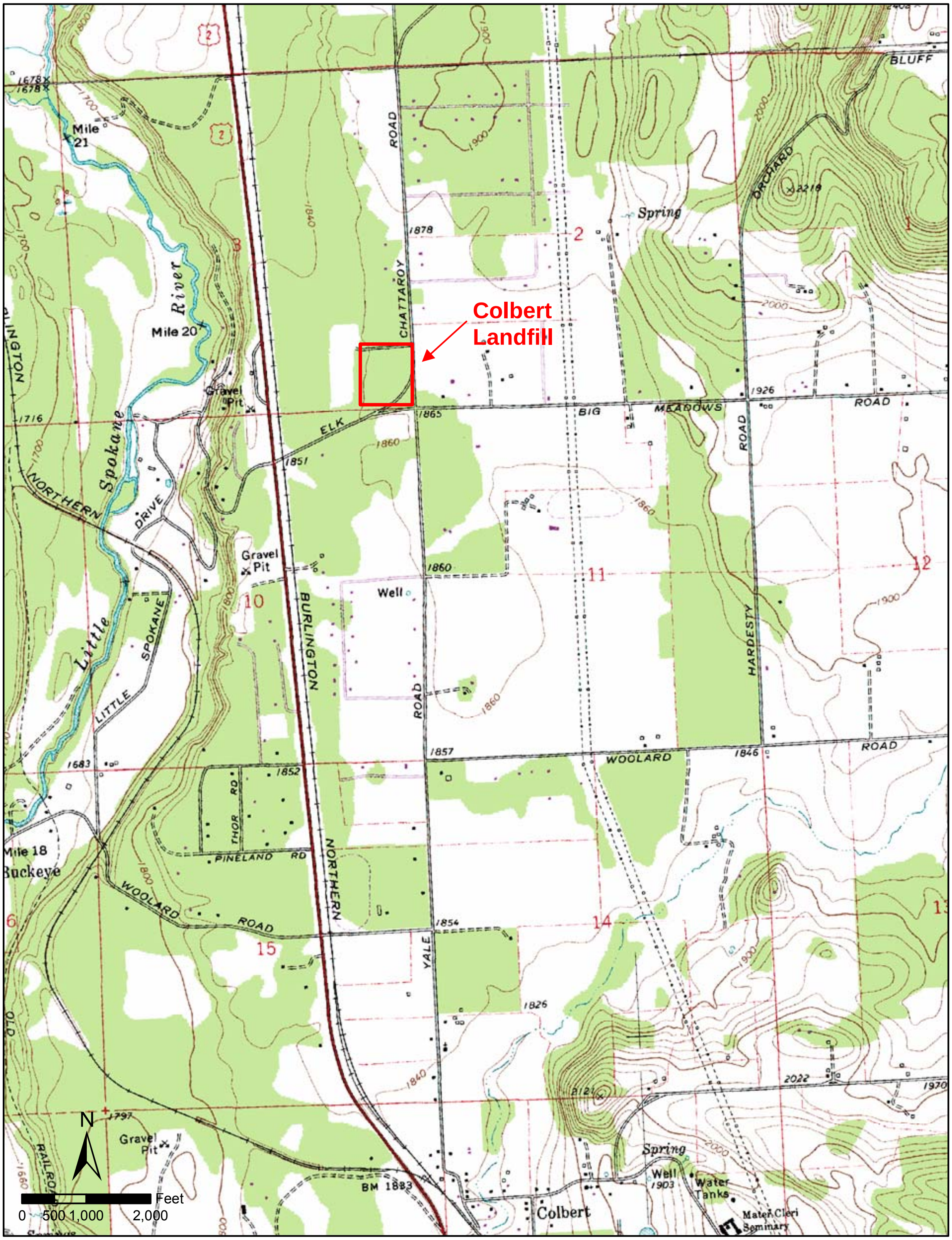
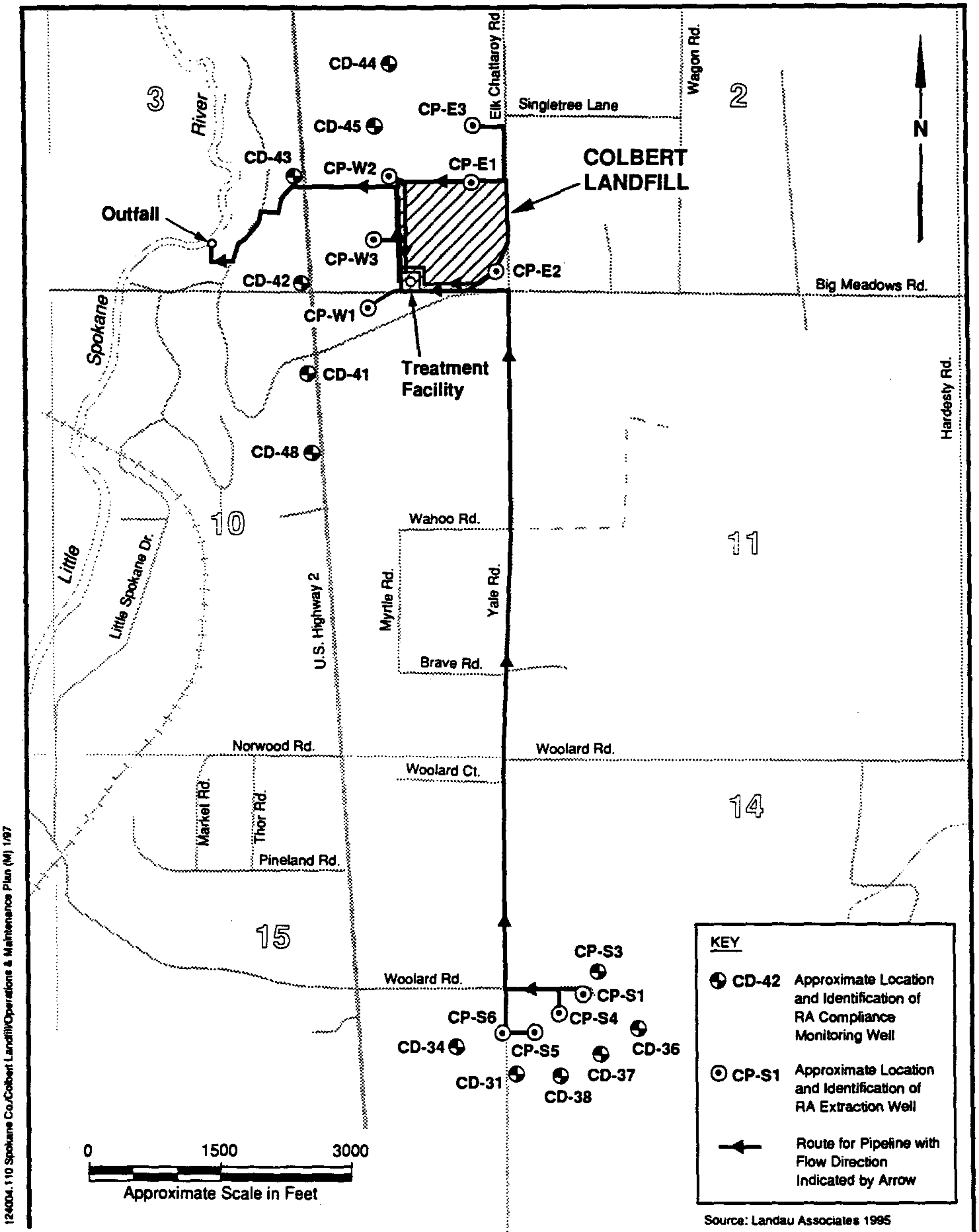


Figure 1. Location of Colbert Landfill

From Fourth Five-Year Review (September 2009)



Remediation Action System Components	Figure 3-2

From O&M Manual (Landau Associates, December 1999)

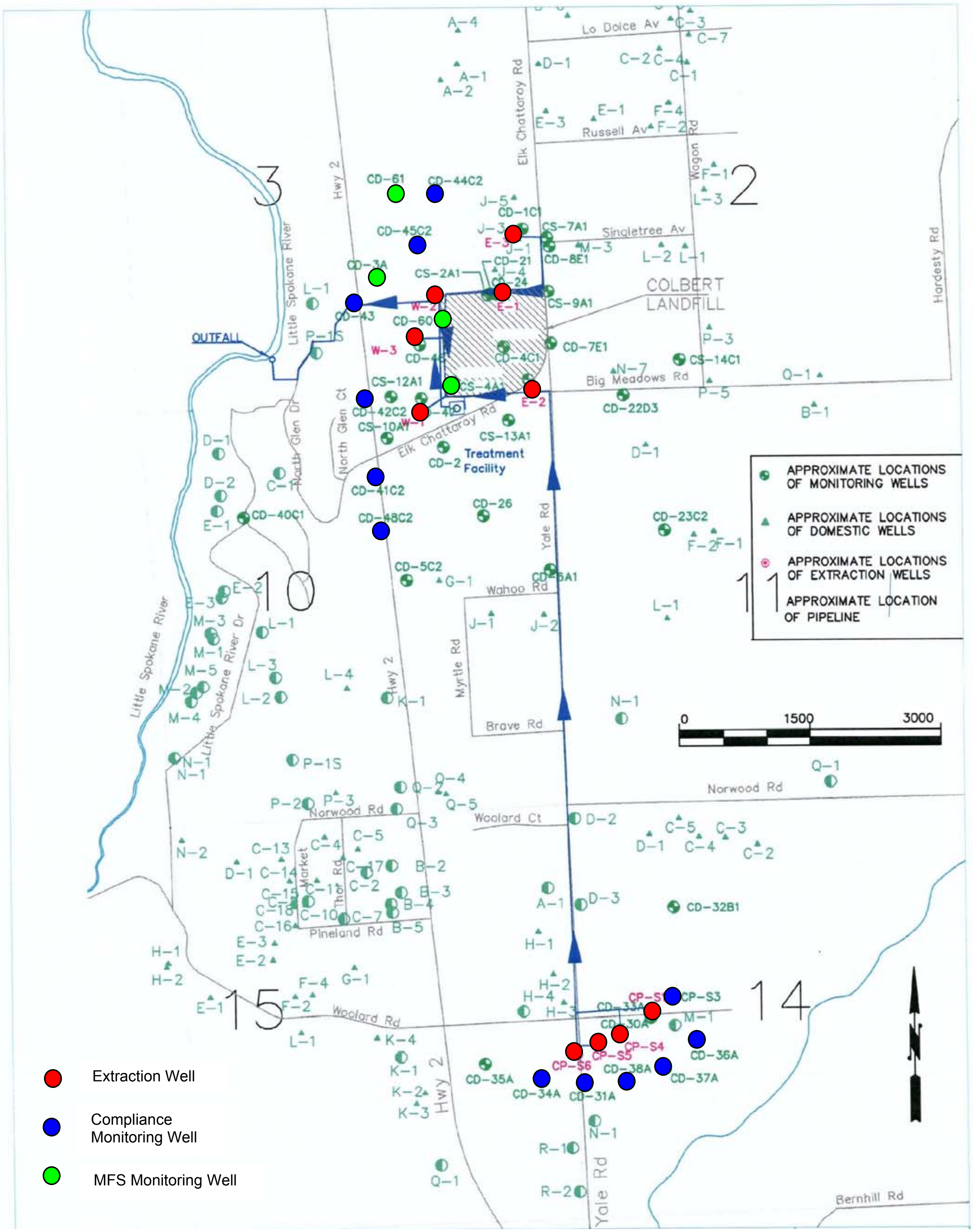
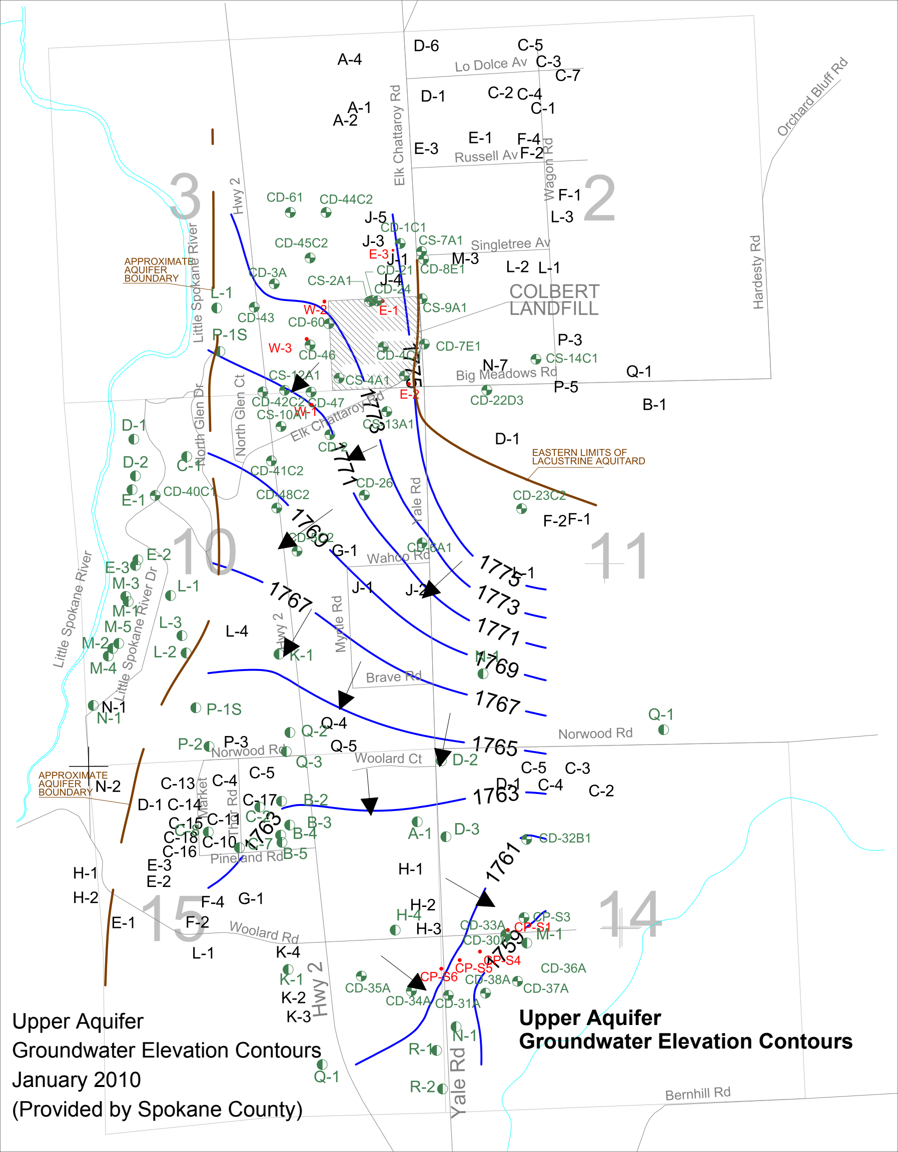


Figure 8. Groundwater Monitoring Locations



Upper Aquifer
Groundwater Elevation Contours
January 2010
(Provided by Spokane County)
Upper Aquifer
Groundwater Elevation Contours
COLBERT LANDFILL
APPROXIMATE AQUIFER BOUNDARY
EASTERN LIMITS OF LACUSTRINE AQUITARD
Little Spokane River
Lo Dolce Av
Russell Av
Singletree Av
Big Meadows Rd
Elk Chattaroy Rd
Wagon Rd
Hardesty Rd
Orchard Bluff Rd
Hwy 2
North Glen Dr
North Glen Ct
Little Spokane River Dr
Yale Rd
Wahoo Rd
Myrtle Rd
Brave Rd
Norwood Rd
Woolard Ct
Woolard Rd
Pineland Rd
Market
Thar Rd
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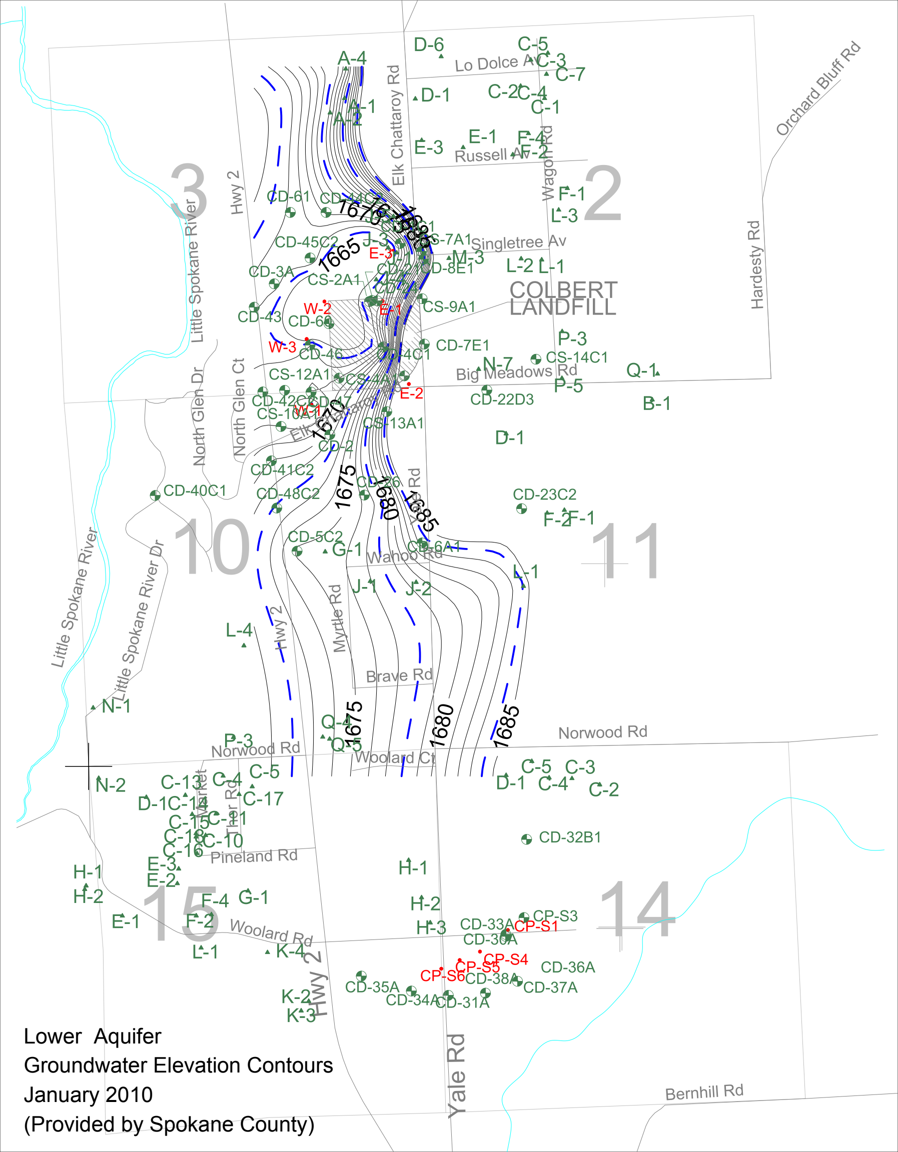
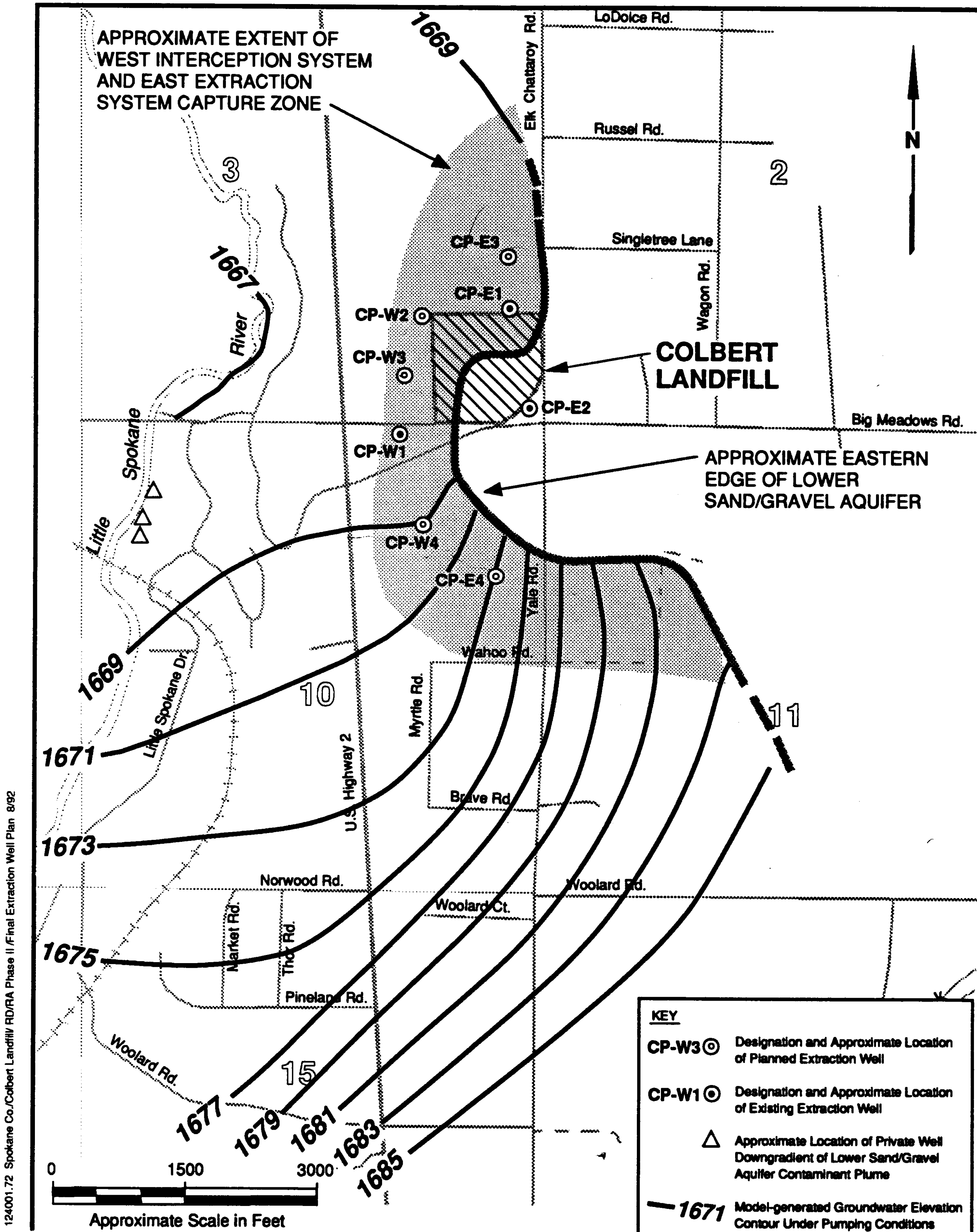


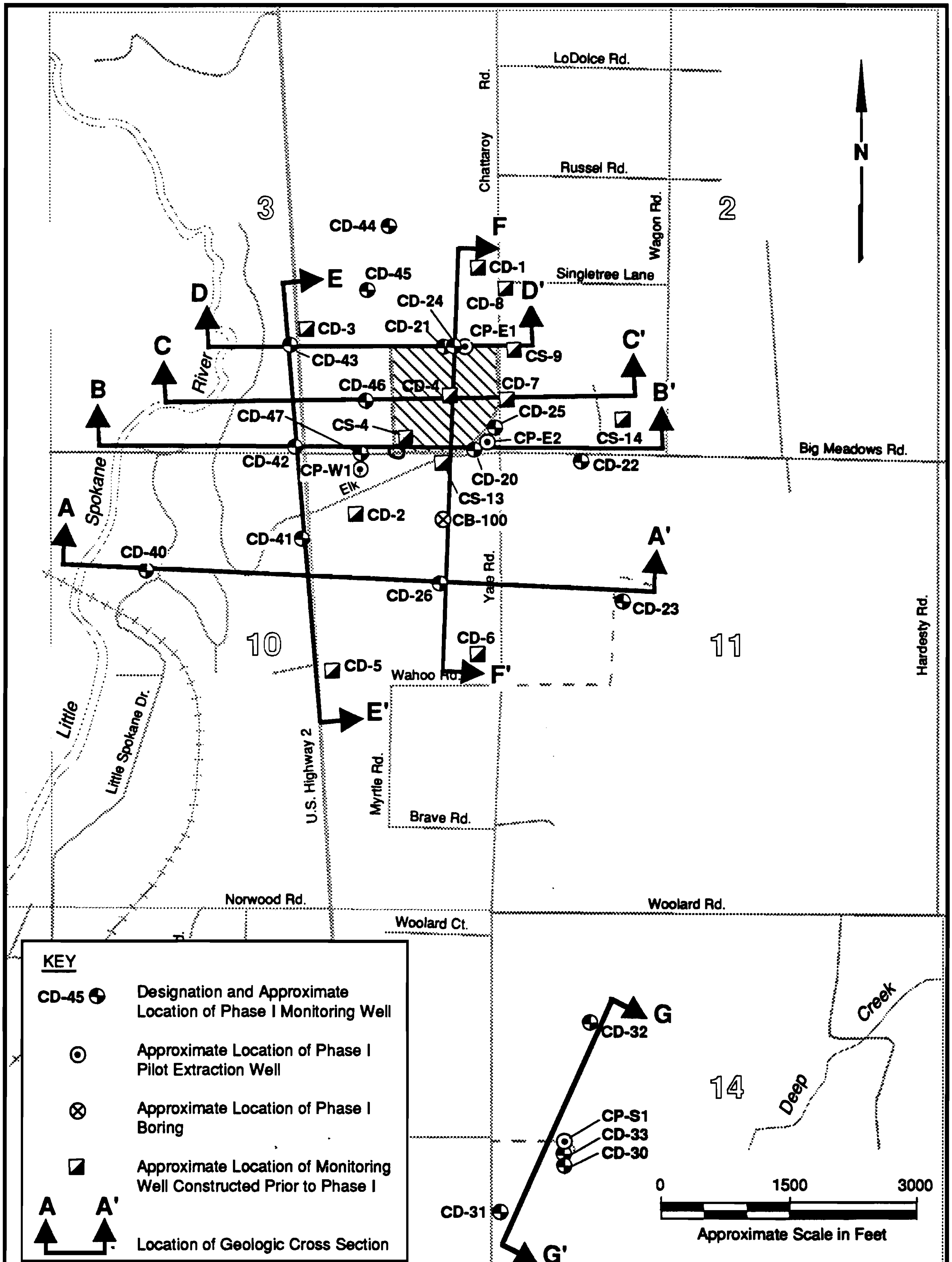
Lower Aquifer
Groundwater Elevation Contours
January 2010
(Provided by Spokane County)



Combined West Interception and East Extraction System Capture Zone

Figure 2-7

From Final Extraction Well Plan (Landau Associates, 1992)



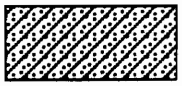
LANDAU ASSOCIATES, INC. | Geologic Cross Section Location Map

124-01.61 Spokane Co./Colbert Landfill/RD/RA Phase I/Final Engineering Report 12/91

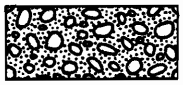
Figure ER-4.1

From Final Phase 1 Engineering Report (Landau Associates, 1991)

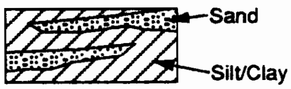
KEY TO GEOLOGIC CROSS SECTIONS



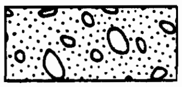
Fluvial sands, silts and gravels



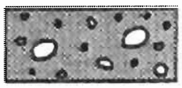
Upper Sand/Gravel Unit (Unit A), composed of gravelly, fine to coarse sand



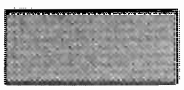
Lacustrine Unit (Unit B), composed of silt and clay with interbedded fine sand



Lower Sand/Gravel Unit (Unit C), composed of gravelly, fine to coarse sand

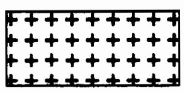


Weathered Latah Subunit (Unit D_1), composed of gravelly (basalt) silt and clayey silt

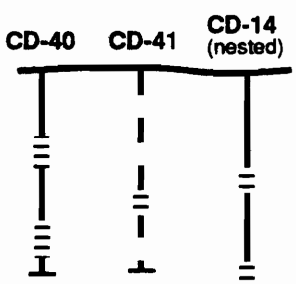


Latah Formation (Unit D), composed of silt, clayey silt and fine sand

Basalt Unit (Unit E), composed of highly fractured to massive Basalt rock



Granite Unit (Unit F), composed of Pre-Tertiary granitic rock, highly weathered with zones encountered during Phase I



Approximate location and number of monitoring well cluster, with screen intervals shown for individual monitoring wells. Projected boring logs have dashed lines. Nested wells are noted, and screen intervals shown.

Ground water elevation line, dashed when representing a piezometric surface in a confined aquifer

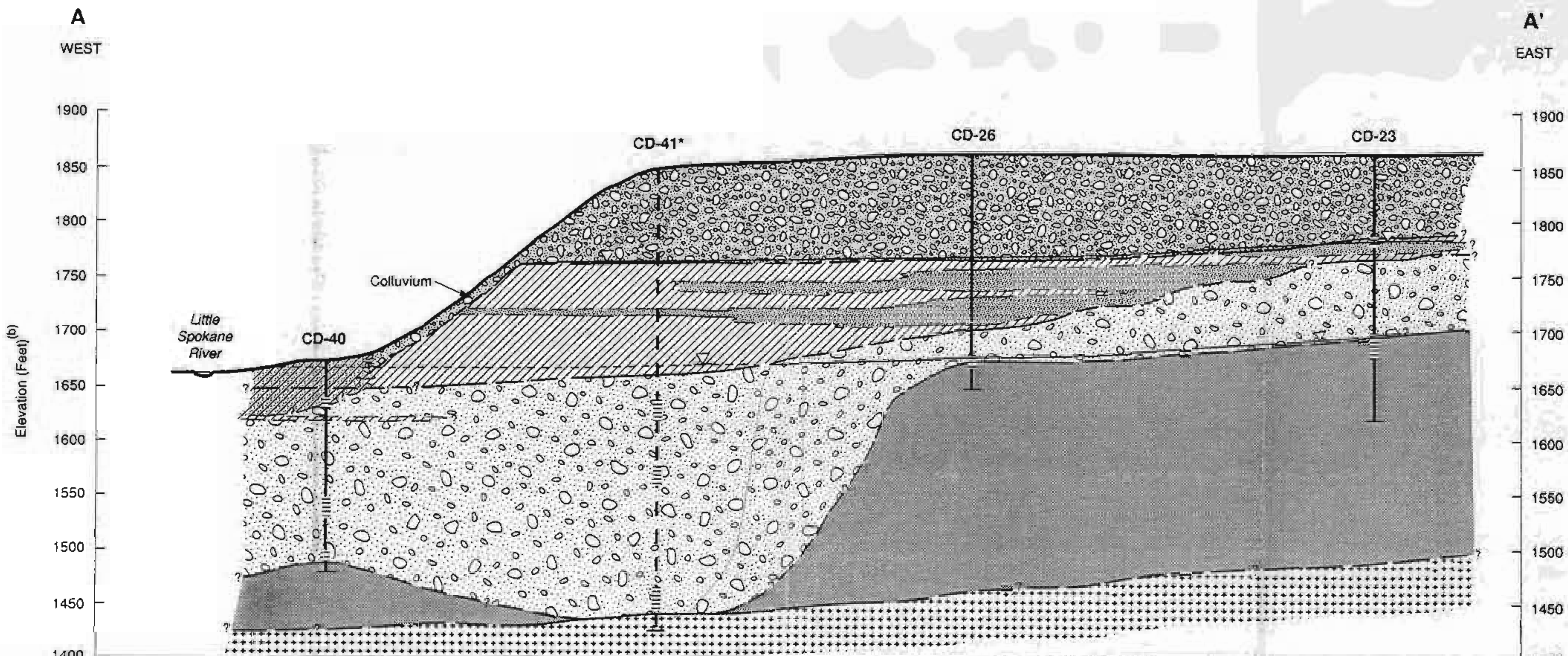
Contact between stratigraphic units; question marks indicate contact projection based on limited data

124-01.61 Spokane Co./Colbert Landfill/RD/RA Phase I/Final Engineering Report 12/91

LANDAU ASSOCIATES, INC.	Key to Geologic Cross Sections

Figure ER-4.2

From Final Phase 1 Engineering Report (Landau Associates, 1991)



Notes: a) Subsurface profiles shown have been generalized from data obtained during Phase I and other Site investigations. Variations between this profile and the actual soil conditions may be encountered. The boring logs and the discussion in the text of this Report must be referenced for a proper understanding of the nature of subsurface materials.

b) All elevations in feet above mean sea level (MSL) based on 1929, National Geodetic Vertical Datum.

* Well drilled by air rotary; detailed geology not identified in Lacustrine Aquitard Unit.

0 600 1200

Approximate Scale in Feet

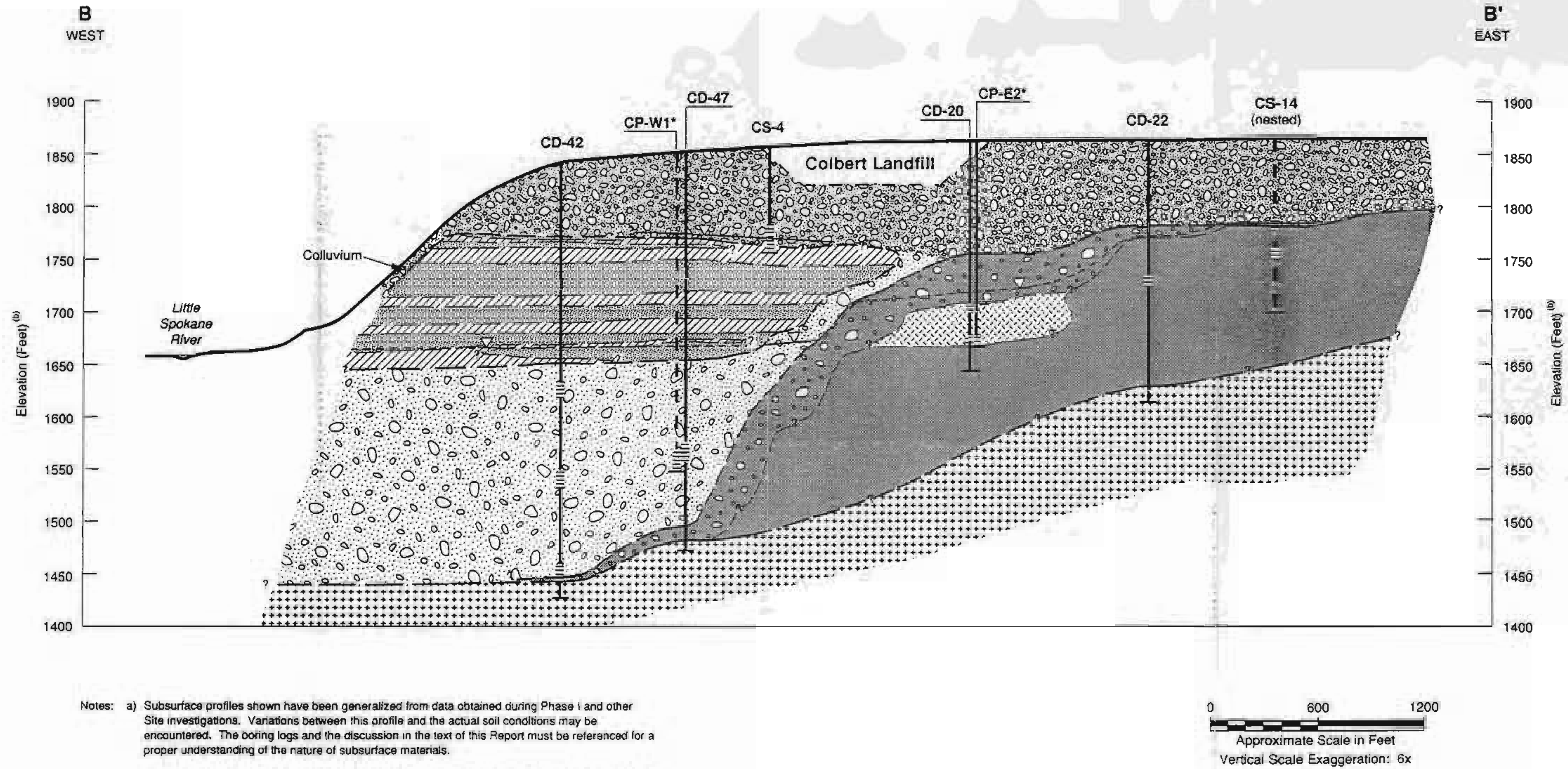
Vertical Scale Exaggeration: 6x

124-01.61 Spokane Co./Colbert Landfill/RD/RA Phase I/Final Engineering Report 12/91

LANDAU ASSOCIATES, INC.

Geologic Cross Section A-A'

From Final Phase 1 Engineering Report (Landau Associates, 1991) Figure ER-4.3



Notes: a) Subsurface profiles shown have been generalized from data obtained during Phase I and other Site investigations. Variations between this profile and the actual soil conditions may be encountered. The boring logs and the discussion in the text of this Report must be referenced for a proper understanding of the nature of subsurface materials.

b) All elevations in feet above mean sea level (MSL) based on 1929, National Geodetic Vertical Datum.

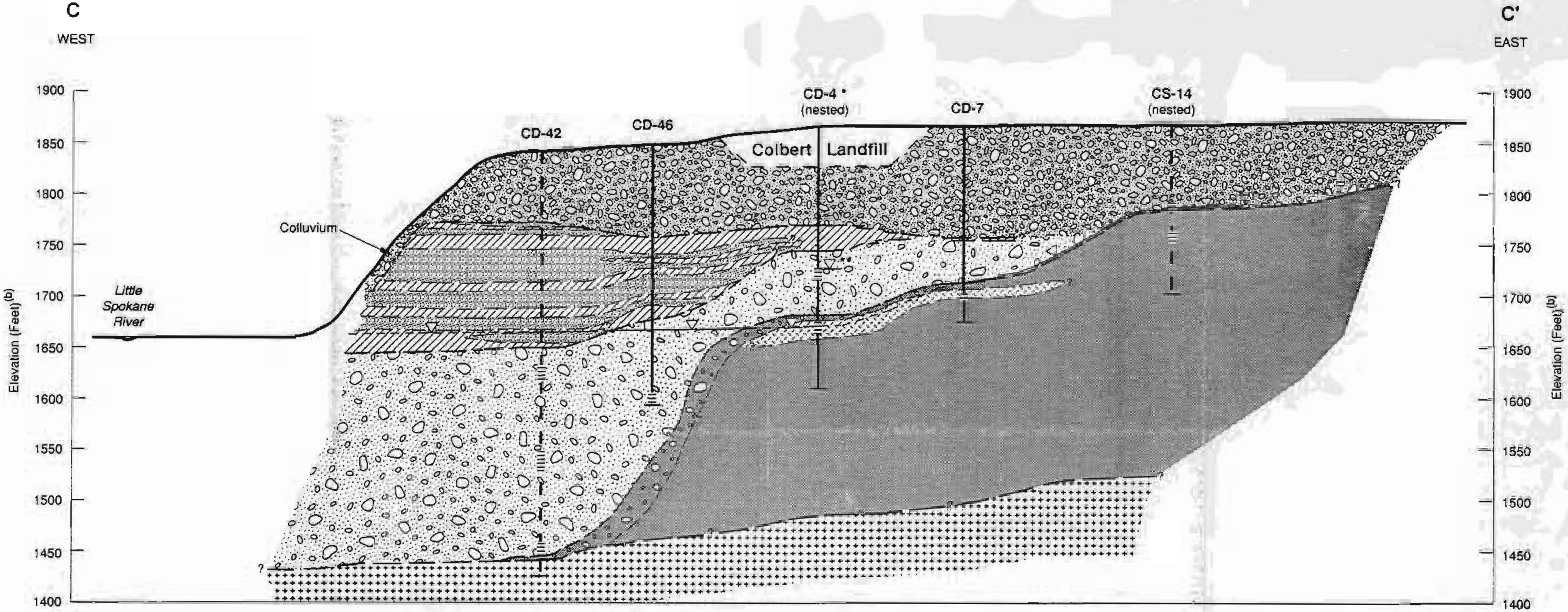
* Pilot Well included in cross section to show screen interval, geologic information is based on adjacent monitoring well boring data.

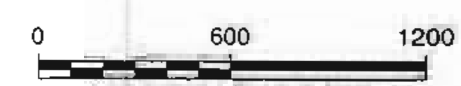
124-01.61 Spokane Co/Colbert Landfill/RD/RA Phase I/Final Engineering Report 12/91

LANDAU ASSOCIATES, INC.

Geologic Cross Section B-B'

From Final Phase 1 Engineering Report (Landau Associates, 1991) Figure ER-4.4





Notes: a) Subsurface profiles shown have been generalized from data obtained during Phase I and other Site investigations. Variations between this profile and the actual soil conditions may be encountered. The boring logs and the discussion in the text of this Report must be referenced for a proper understanding of the nature of subsurface materials.

b) All elevations in feet above mean sea level (MSL) based on 1929; National Geodetic Vertical Datum.

* Well drilled by air rotary; detailed geology not identified in Lacustrine Aquitard Unit.

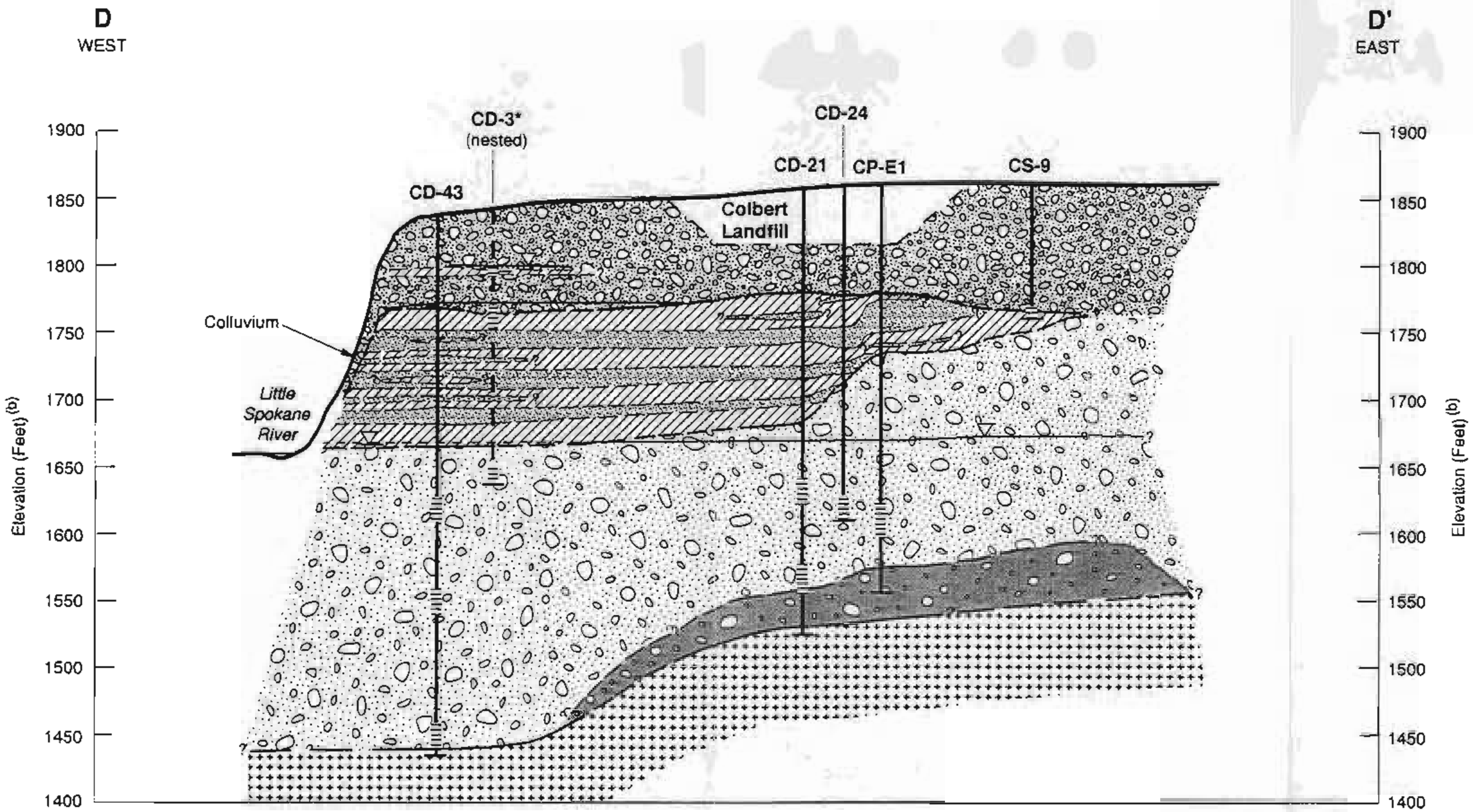
** Ground water in CD-4(U) appears to be perched. However, an underlying aquitard is not identified on the boring log.

124-01 61 Spokane Co/Colbert Landfill/RD/RA Phase I/Final Engineering Report 12/91

LANDAU ASSOCIATES, INC.

Geologic Cross Section C-C'

From Final Phase 1 Engineering Report (Landau Associates, 1991) Figure ER-4.5



Notes: a) Subsurface profiles shown have been generalized from data obtained during Phase I and other Site investigations. Variations between this profile and the actual soil conditions may be encountered. The boring logs and the discussion in the text of this Report must be referenced for a proper understanding of the nature of subsurface materials.

b) All elevations in feet above mean sea level (MSL) based on 1929, National Geodetic Vertical Datum.

0 600 1200

Approximate Scale in Feet

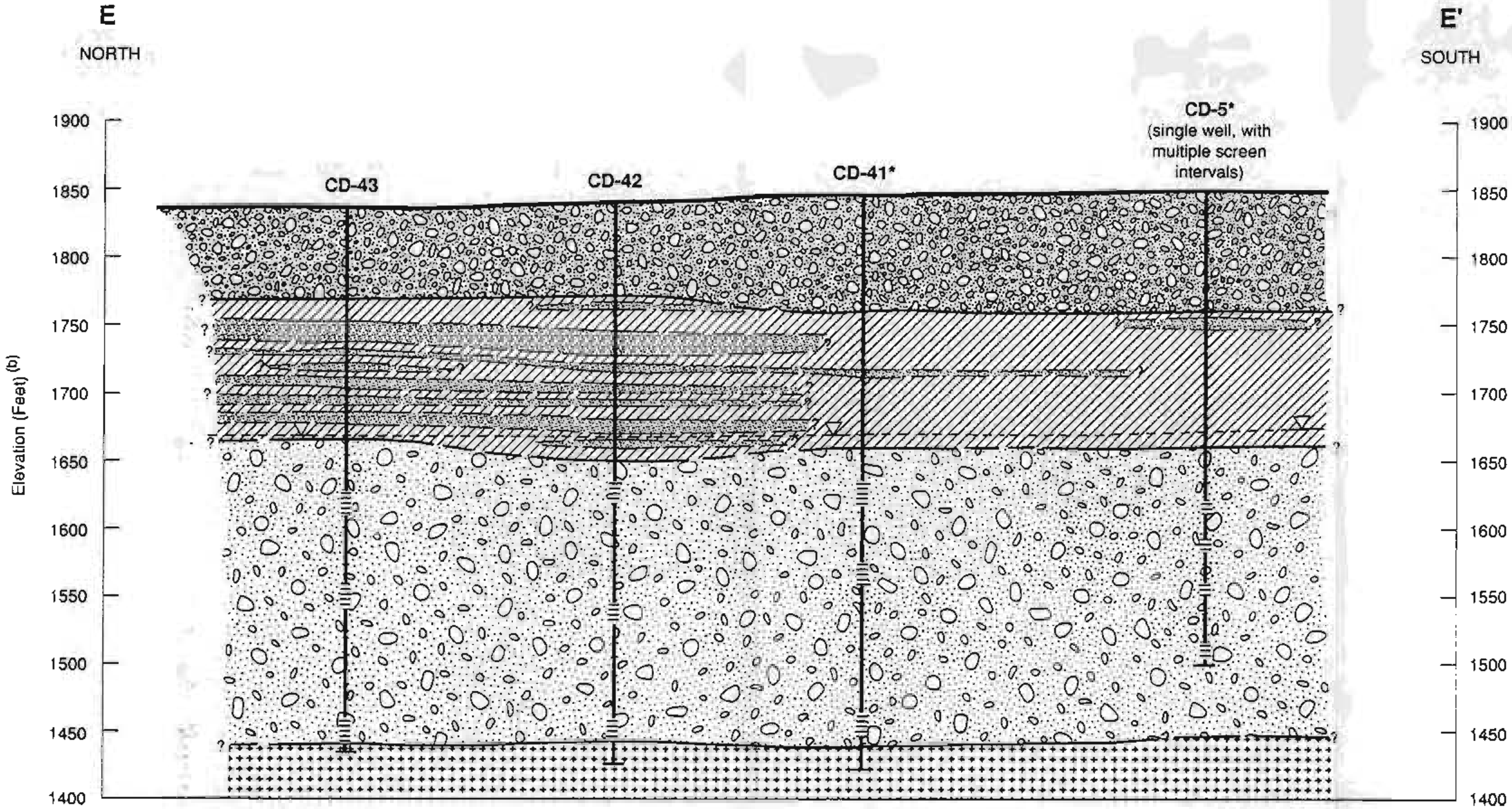
Vertical Scale Exaggeration: 6x

* Well drilled by air rotary; detailed geology in Lacustrine Aquitard Unit based on CD-43 boring data.

124-01 61 Spokane Co.\Colbert Landfill\RD/RA Phase I\Final Engineering Report 12/91

LANDAU ASSOCIATES, INC.	Geologic Cross Section D-D'

From Final Phase 1 Engineering Report (Landau Associates, 1991) Figure ER-4.6



Notes: a) Subsurface profiles shown have been generalized from data obtained during Phase I and other Site Investigations. Variations between this profile and the actual soil conditions may be encountered. The boring logs and the discussion in the text of this Report must be referenced for a proper understanding of the nature of subsurface materials.

b) All elevations in feet above mean sea level (MSL) based on 1929, National Geodetic Vertical Datum.

0 600 1200

Approximate Scale in Feet

Vertical Scale Exaggeration: 6x

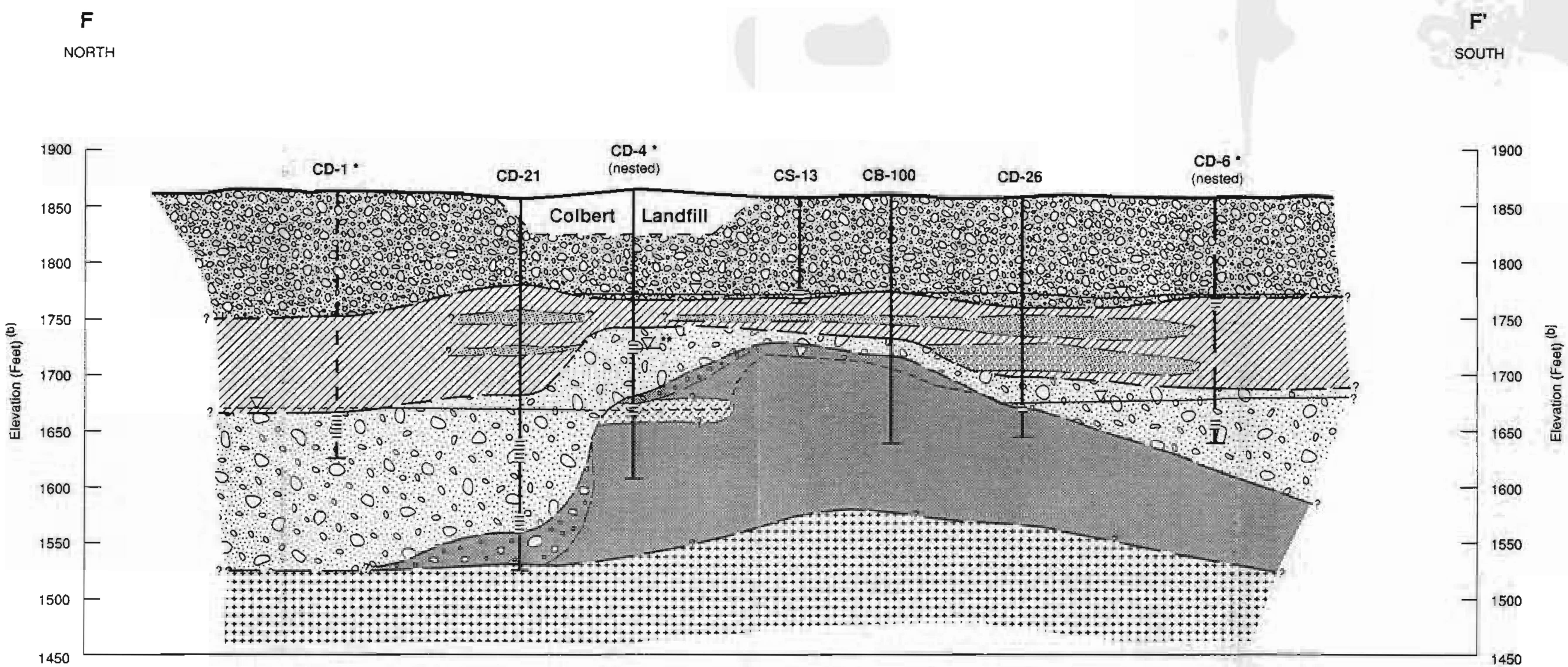
* Well drilled by air rotary; detailed geology not identified in Lacustrine Aquitard Unit.

124 01 61 Spokane Co./Colbert Landfill RD/RA Phase I Final Engineering Report 12/91

LANDAU ASSOCIATES, INC.

Geologic Cross Section E-E'

From Final Phase 1 Engineering Report (Landau Associates, 1991) Figure ER-4.7

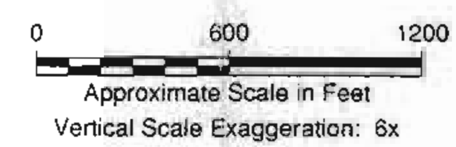


Notes: a) Subsurface profiles shown have been generalized from data obtained during Phase I and other Site investigations. Variations between this profile and the actual soil conditions may be encountered. The boring logs and the discussion in the text of this Report must be referenced for a proper understanding of the nature of subsurface materials.

b) All elevations in feet above mean sea level (MSL) based on 1929, National Geodetic Vertical Datum.

* Well drilled by air rotary; detailed geology not identified in Lacustrine Aquitard Unit.

** Ground water in CD-4(U) appears to be perched. However, an underlying aquitard is not identified on the boring log.



123-01.61 Spokane Co/Colbert Landfill/RD/RA Phase I/Final Engineering Report 12/91

LANDAU ASSOCIATES, INC.

Geologic Cross Section F-F'

From Final Phase 1 Engineering Report (Landau Associates, 1991) Figure ER-4.8

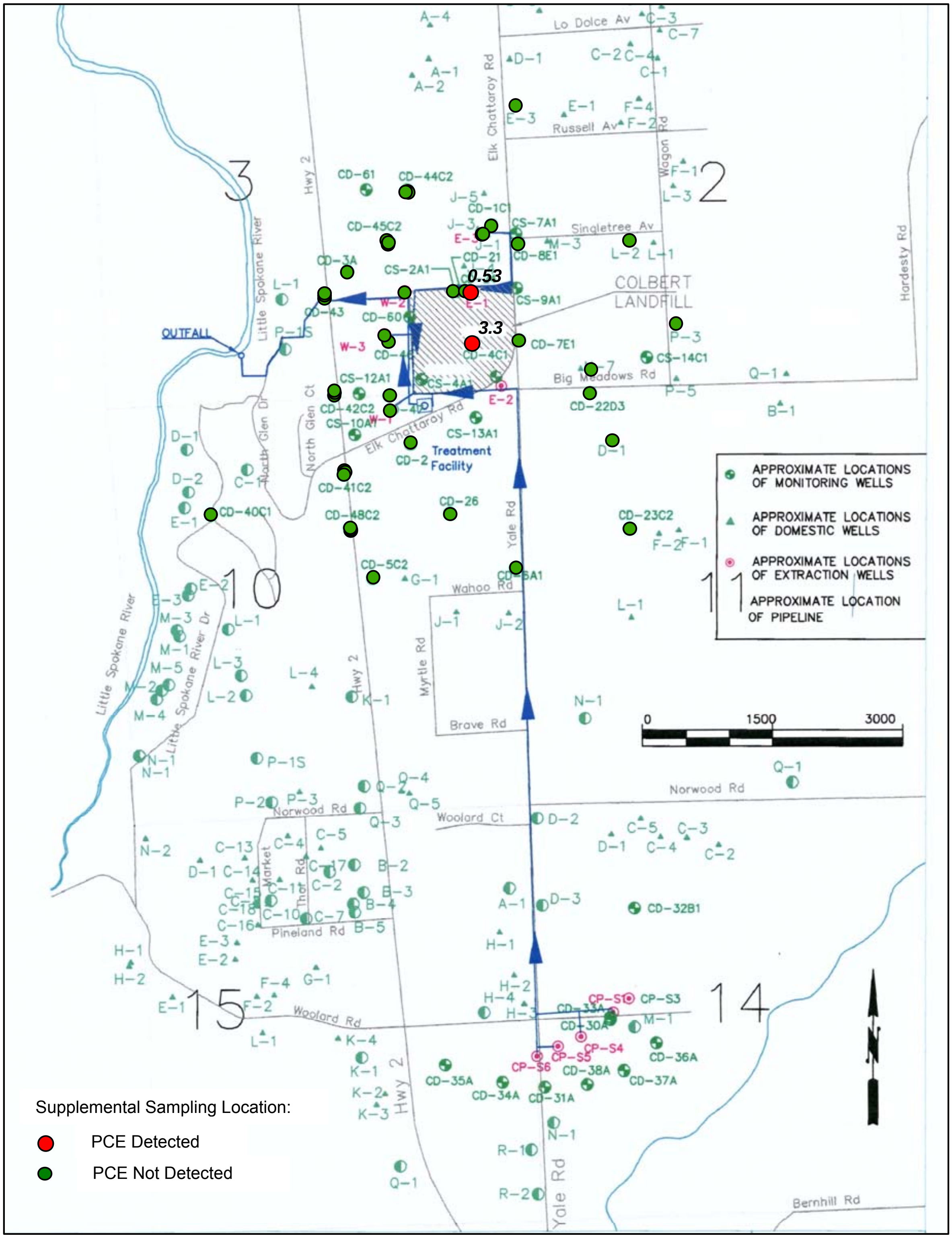


Figure 25. PCE concentrations detected in Lower Aquifer during Supplemental Sampling

From Fourth Five-Year Review (September 2009)

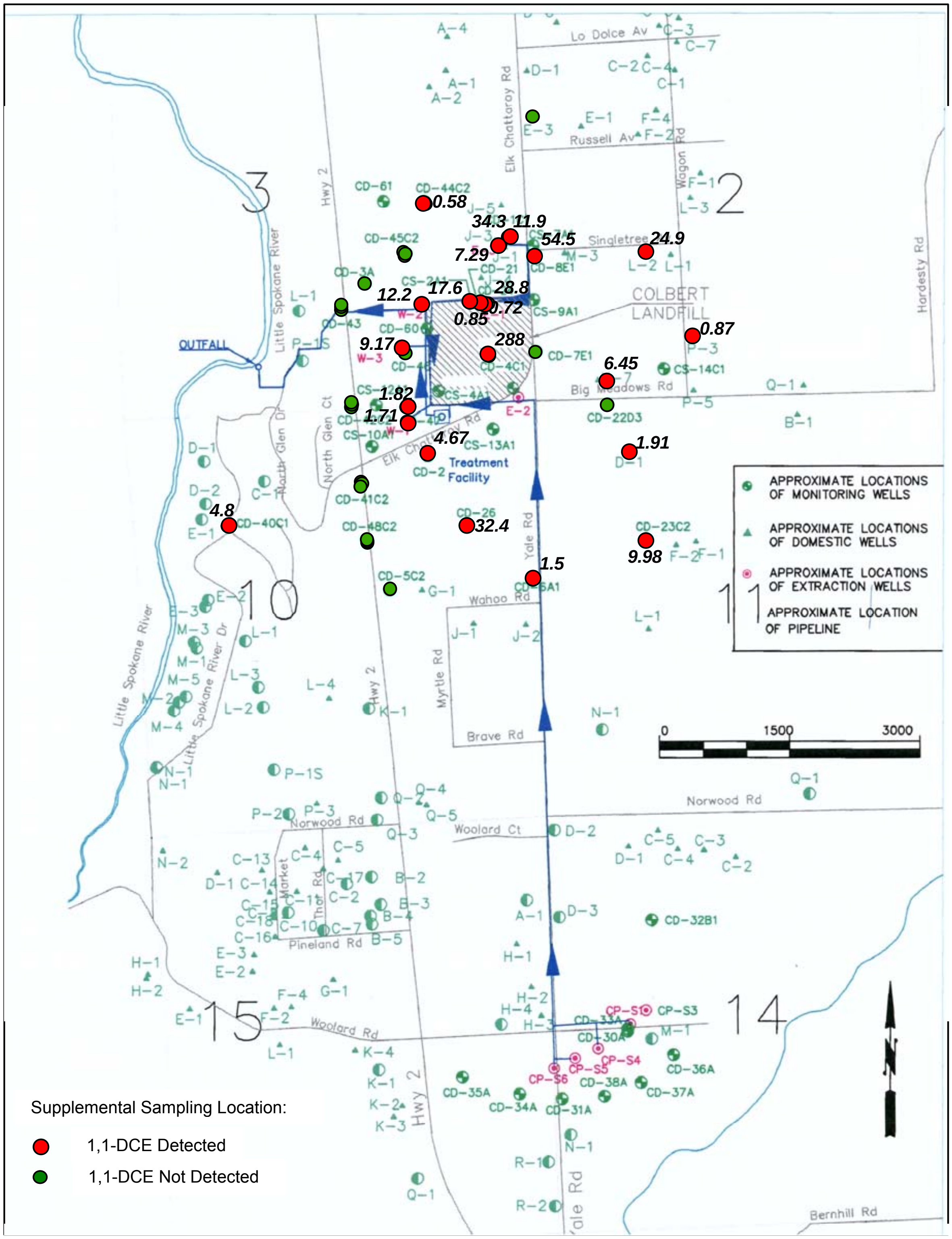


Figure 26. 1,1-DCE concentrations detected in Lower Aquifer during Supplemental Sampling

From Fourth Five-Year Review (September 2009)

Note: It was stated to the RSE team that the TCE concentrations for CD-7E1 and CD-4E1 indicated on this figure are incorrect and should be "swapped".

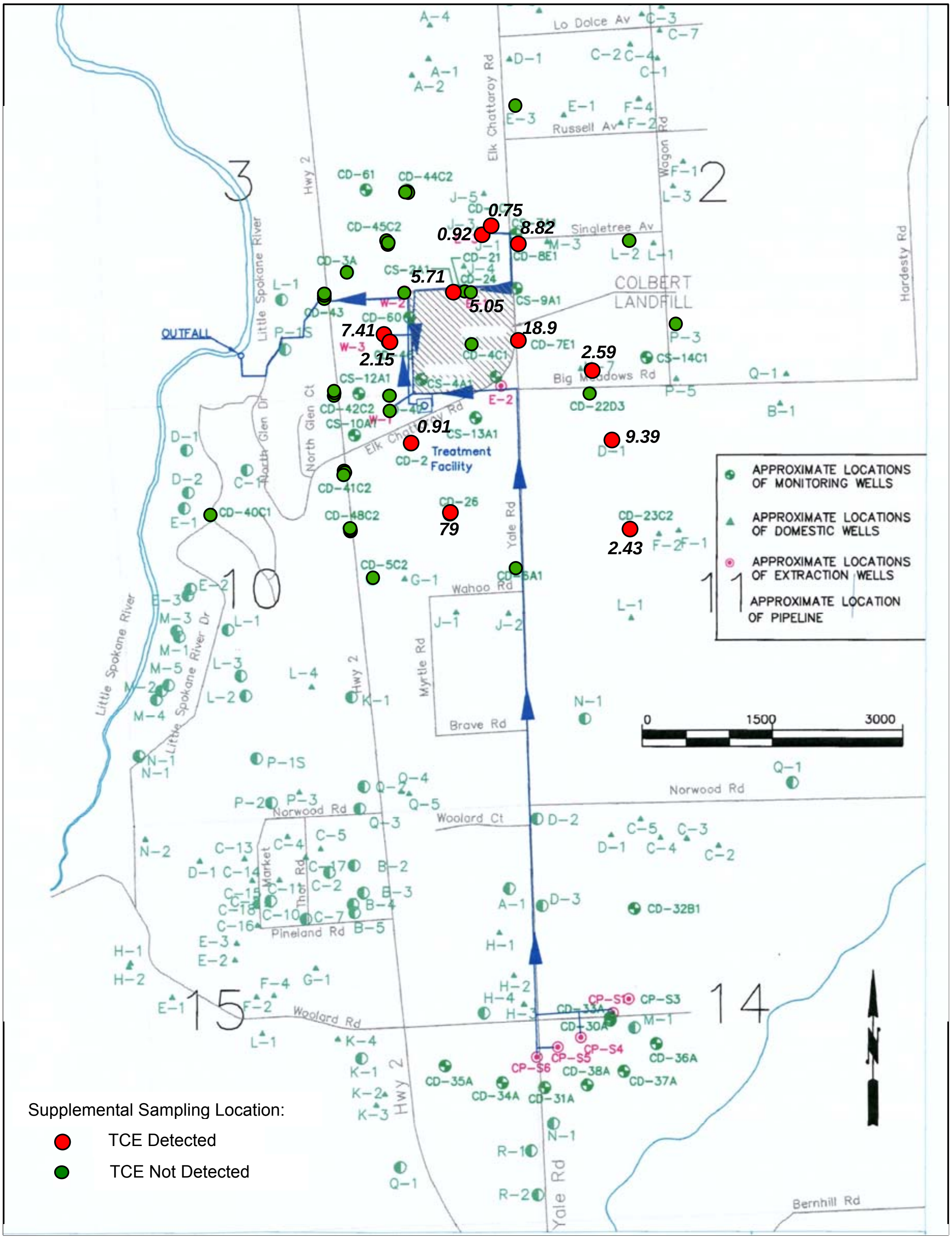


Figure 27. TCE Concentrations detected in Lower Aquifer during Supplemental Sampling

From Fourth Five-Year Review (September 2009)

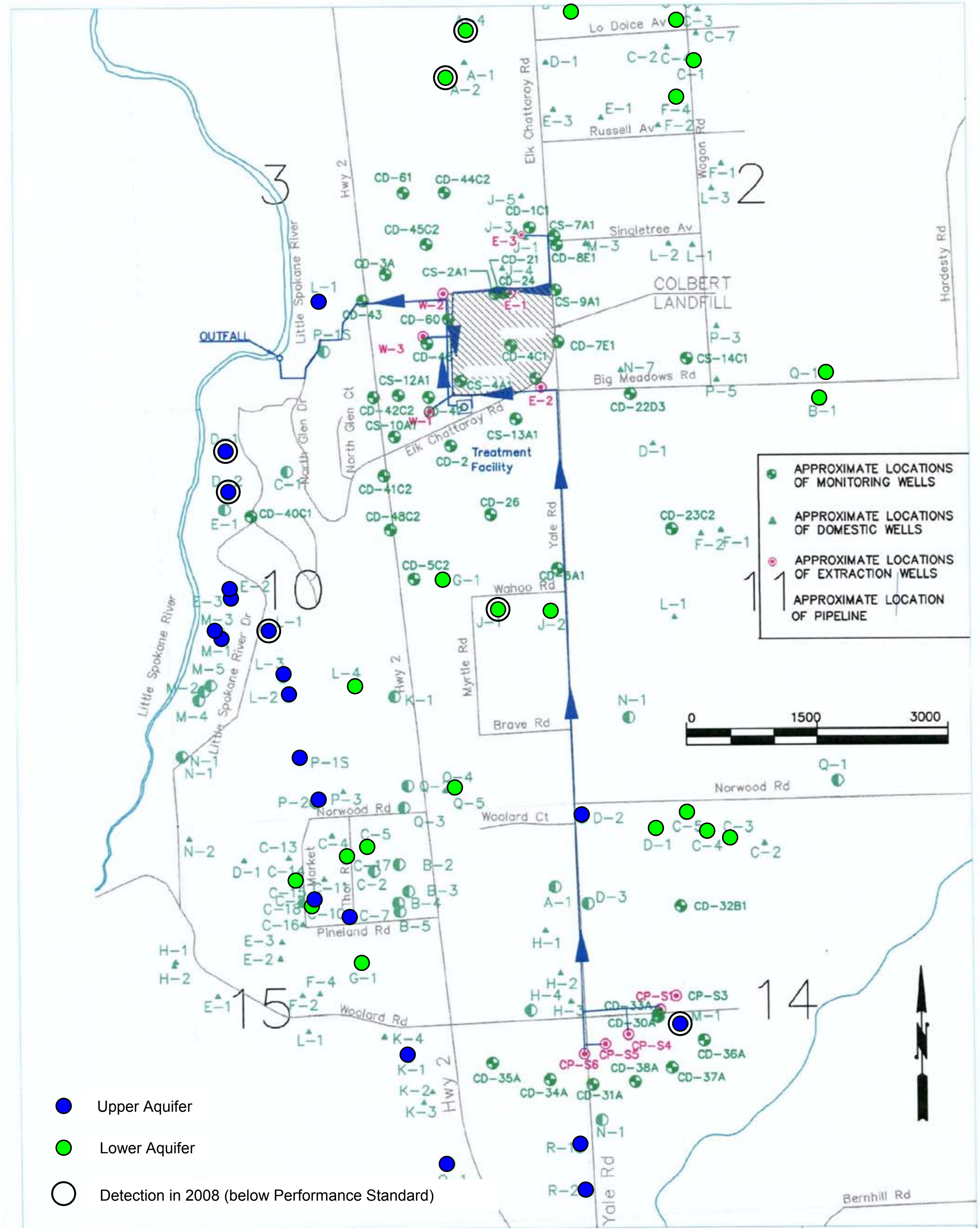


Figure 28. Domestic well monitoring locations (2004 – 2008)

Note:"system shutdown" on this figure refers to shutdown of the southern extraction well system.

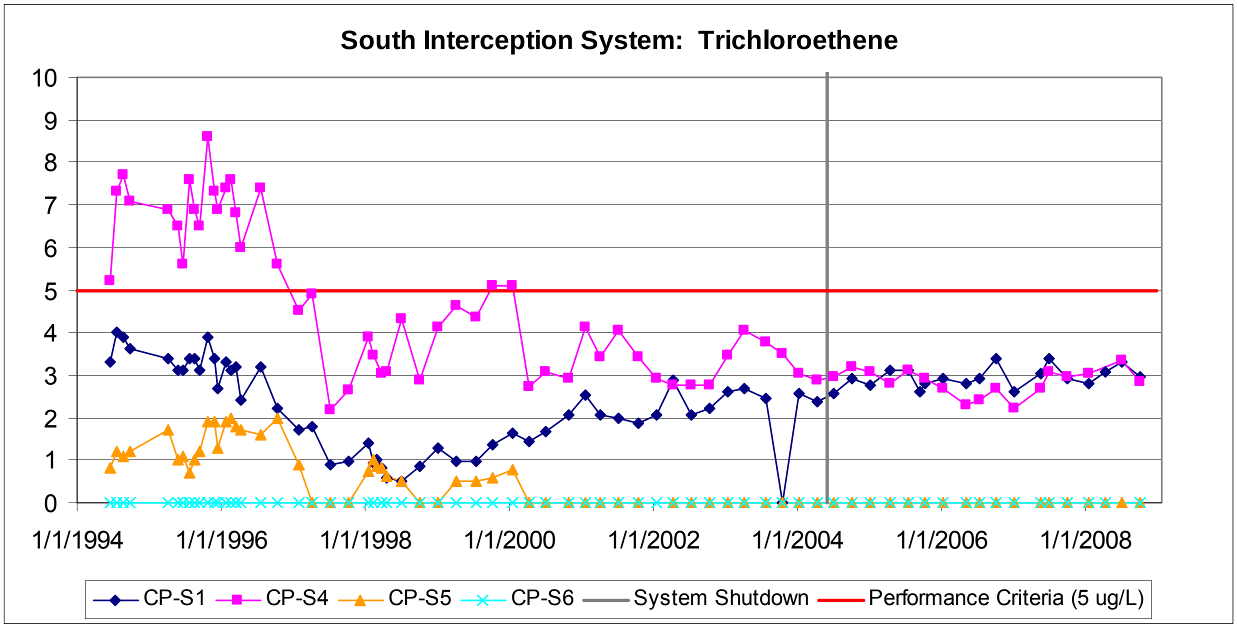


Figure 9. Concentration of TCE in South Interception System Extraction Wells

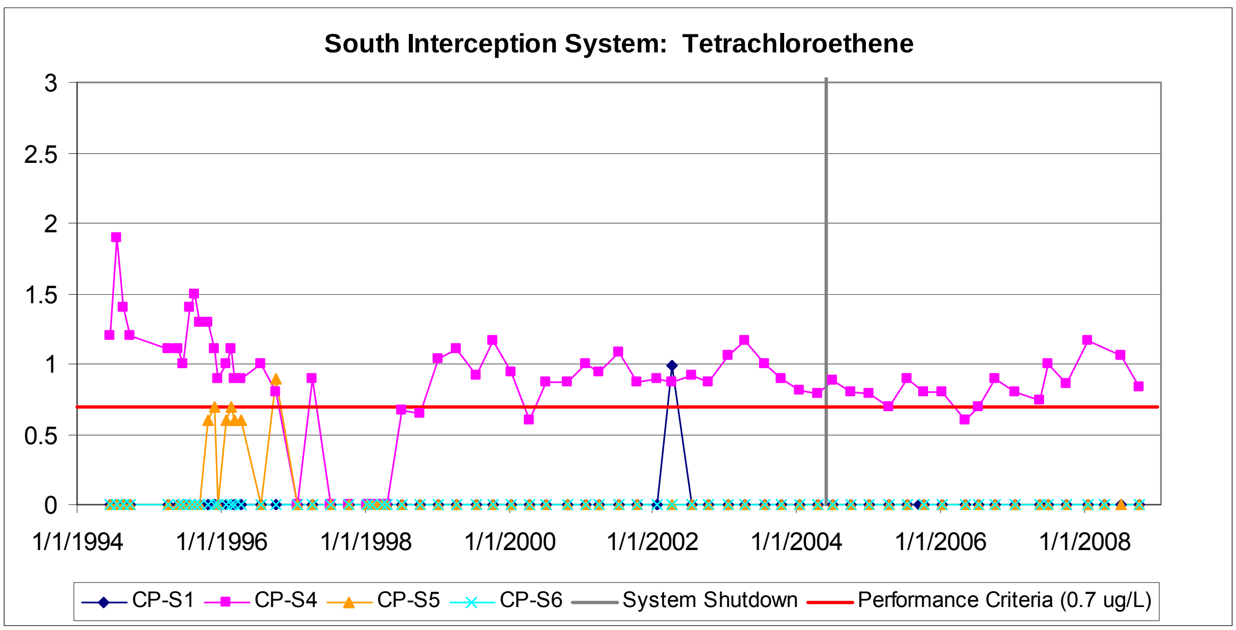


Figure 10. Concentration of PCE in South System Extraction Wells

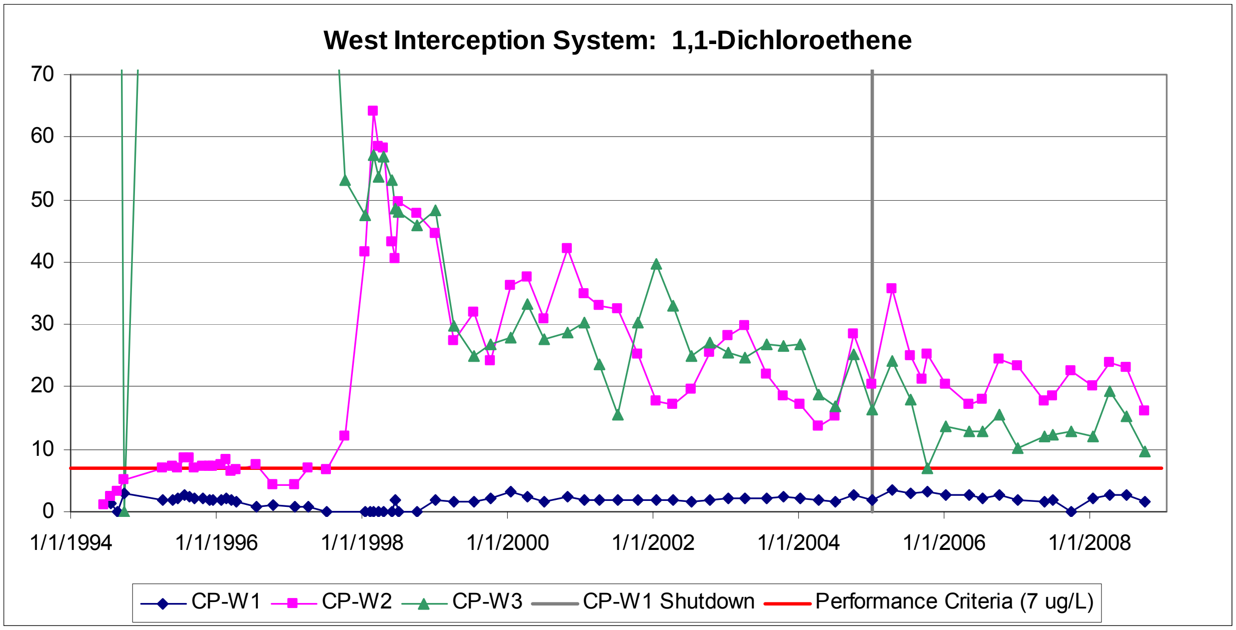


Figure 11. Concentration of 1,1-DCE in West System Extraction Wells

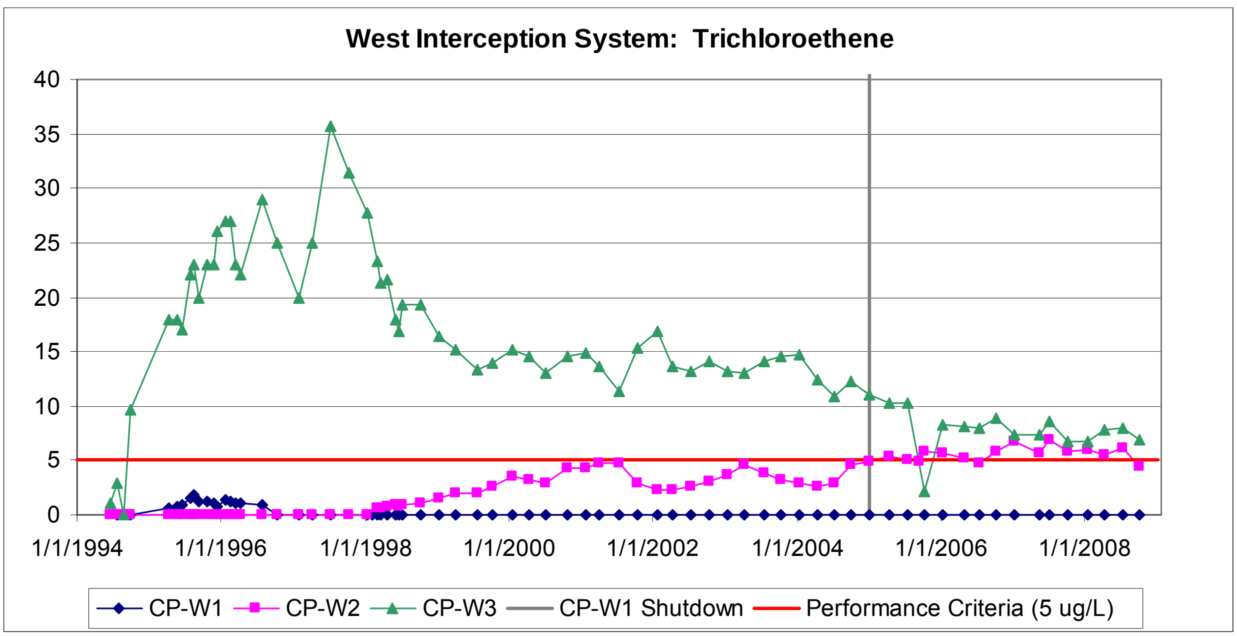


Figure 12. Concentrations of TCE in West System Extraction Wells

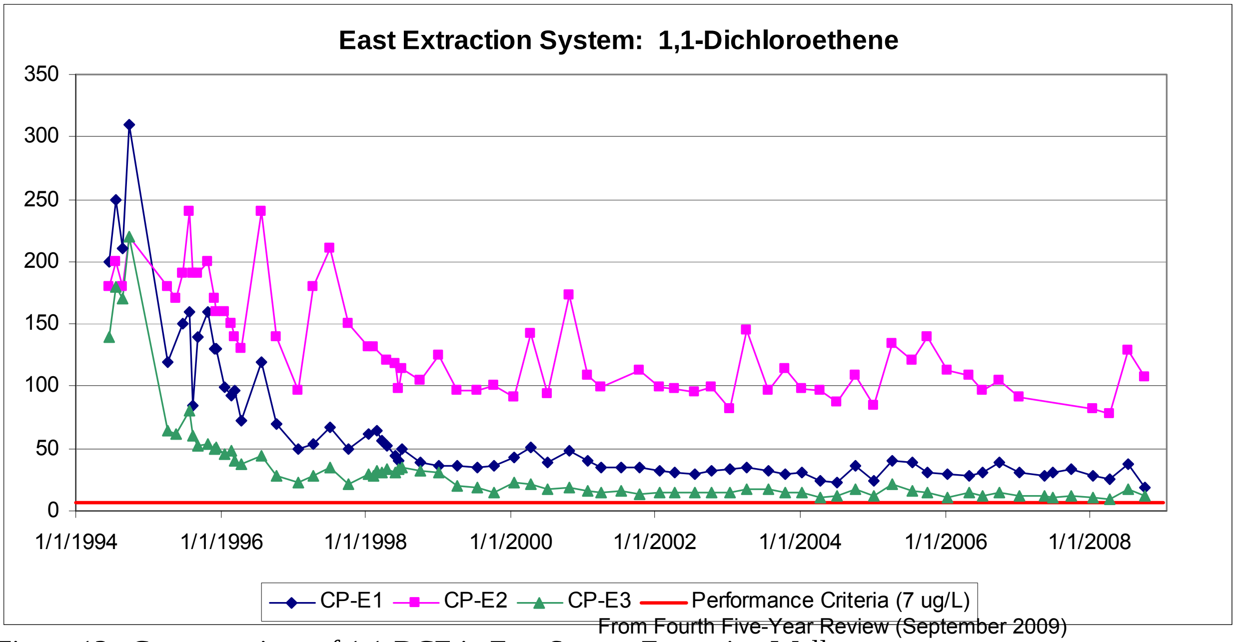


Figure 13. Concentrations of 1,1-DCE in East System Extraction Wells

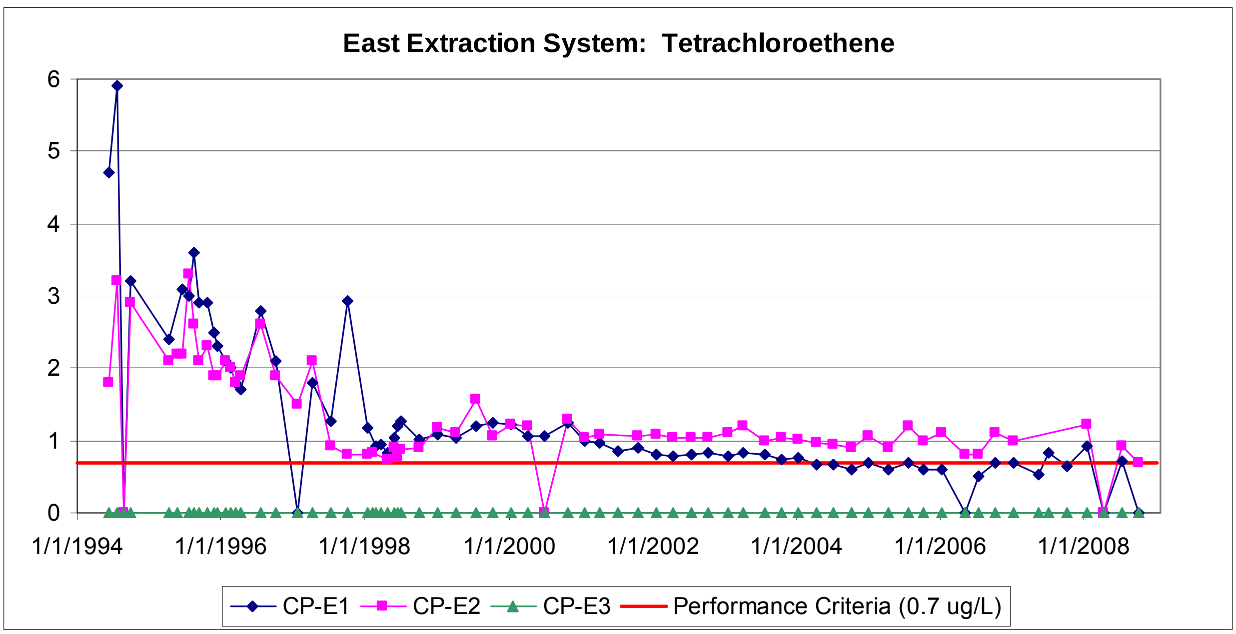


Figure 14. Concentrations of PCE in East System Extraction Wells

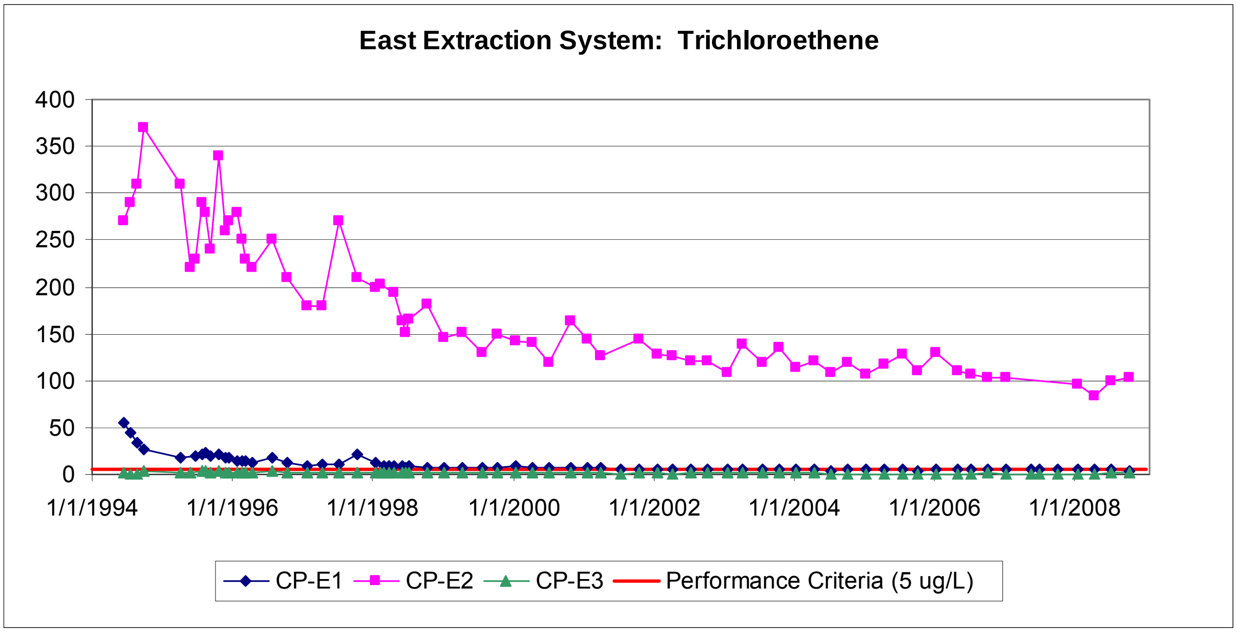


Figure 15. Concentrations of TCE in East System Extraction Wells

From Fourth Five-Year Review (September 2009)

Figure 6-1 Colbert Landfill 1,4-Dioxane Sampling Locations April 2008

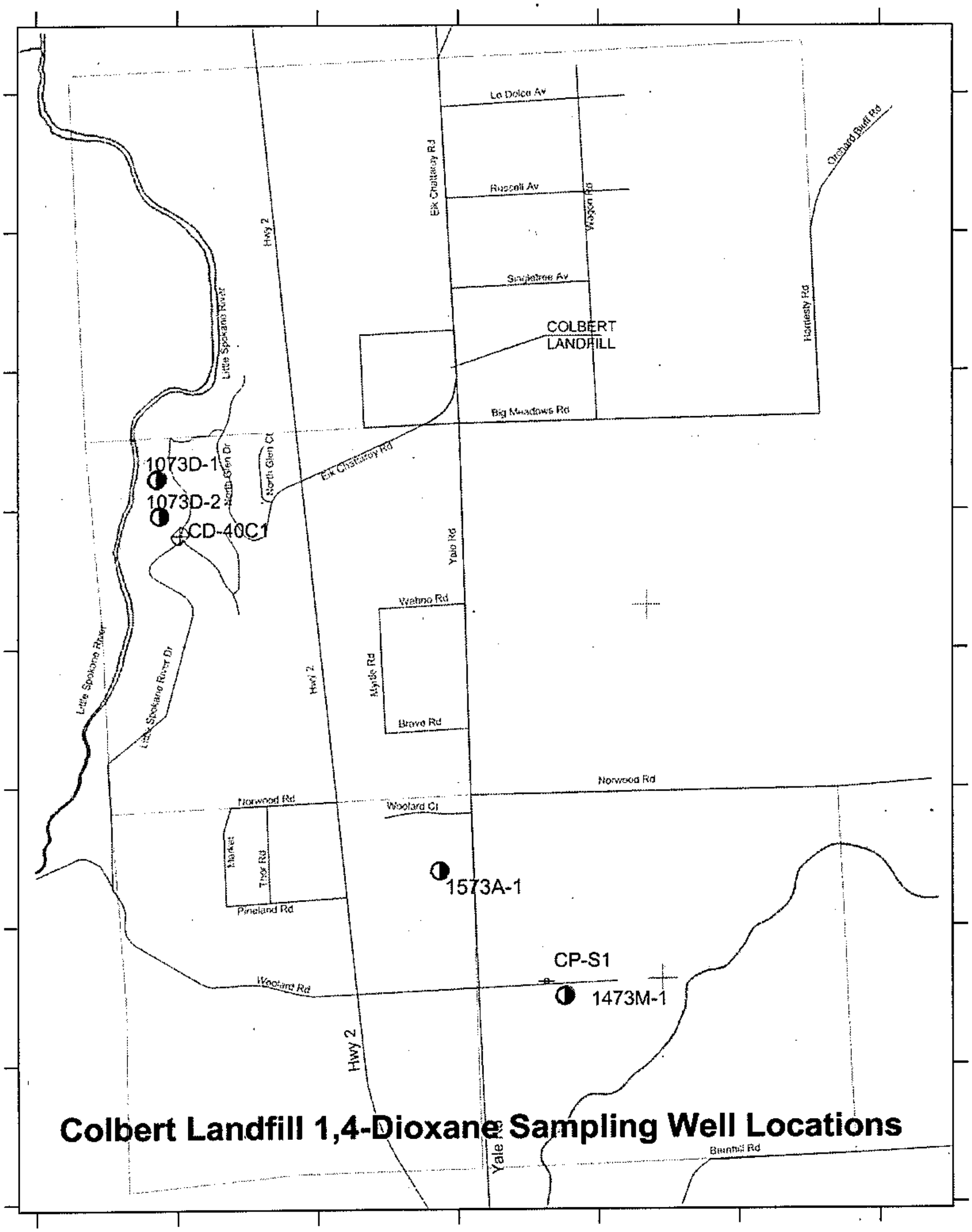
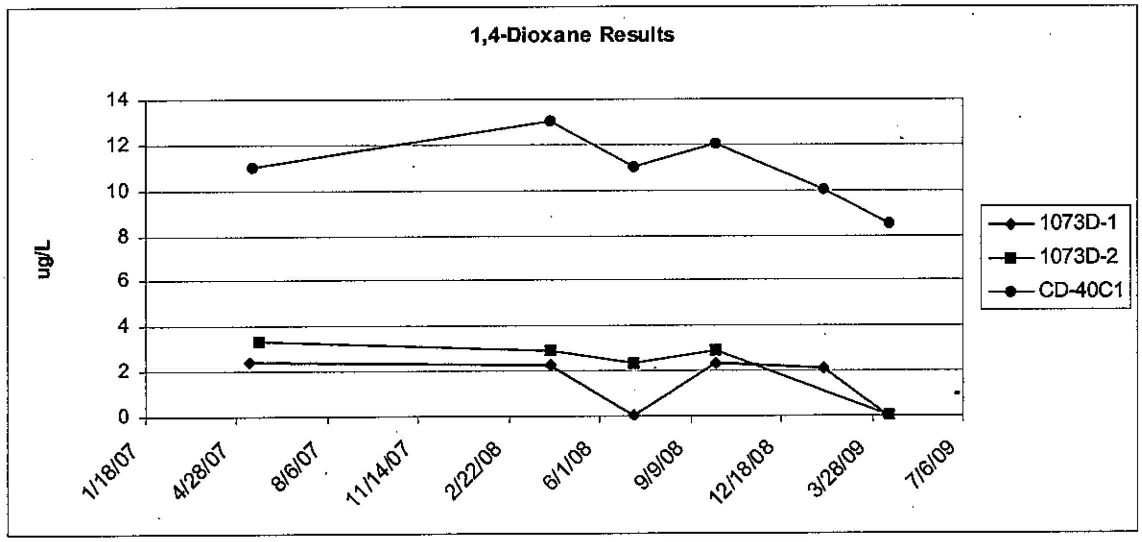
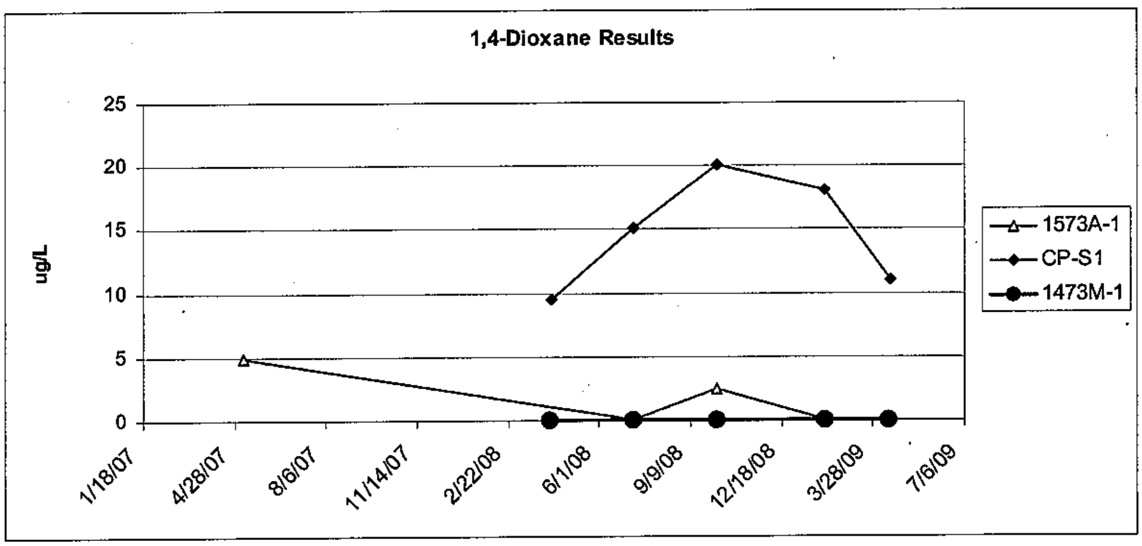


Figure 6-2 Colbert Landfill 1,4-Dioxane Concentrations vs. Time





From Quarterly Progress Report, Second Quarter 2009 (Spokane County)

Table 6-2 1,4-Dioxane Sampling Field and Analysis Results

(April 2008 through April 2009)

StationID	SampleDate	Analyte	Result	Qualifier	Units	Temperature	pH	Conductivity	Turbidity	Depth to Water
1073D-1	4/8/2008	1,4-Dioxane	2.2		ug/L	9.2	8.01	412		1.79
1073D-1	7/8/2008	1,4-Dioxane	2	U	ug/L	13	7.92	396	0.08	2.76
1073D-1	10/7/2008	1,4-Dioxane	2.3		ug/L	11.1	8.01	389	0.19	2.89
1073D-1	2/3/2009	1,4-Dioxane	2.1		ug/L	10.6	8.04	372	0.23	2.99
1073D-1	4/14/2009	1,4-Dioxane	2	U	ug/L	10.9	8.02	393	0.36	1.76
1073D-2	4/8/2008	1,4-Dioxane	2.9		ug/L	10.3	7.94	411		
1073D-2	7/8/2008	1,4-Dioxane	2.3		ug/L	11.9	8.01	397	0.09	2.11
1073D-2	7/8/2008	1,4-Dioxane	2.1		ug/L					
1073D-2	10/7/2008	1,4-Dioxane	2.9		ug/L	11.9	8.01	394	0.73	3.11
1073D-2	4/15/2009	1,4-Dioxane	2	U	ug/L	10.2	7.91	404	0.49	1.25
1473M-1	4/8/2008	1,4-Dioxane	2	U	ug/L	10.3	7.61	535		
1473M-1	7/8/2008	1,4-Dioxane	2	U	ug/L	11.9	7.55	504	0.2	
1473M-1	10/7/2008	1,4-Dioxane	2	U	ug/L	11.2	7.62	451	0.17	
1473M-1	2/3/2009	1,4-Dioxane	2	U	ug/L	10	7.6	497	0.18	
1473M-1	4/14/2009	1,4-Dioxane	2	U	ug/L	10.4	7.52	502	0.15	90
1573A-1	7/8/2008	1,4-Dioxane	2	U	ug/L	12.9	7.52	521	0.19	93.03
1573A-1	10/7/2008	1,4-Dioxane	2.4		ug/L	11.3	7.54	515	0.12	92.87
1573A-1	2/3/2009	1,4-Dioxane	2	U	ug/L	8.1	7.52	525	1.1	93.31
1573A-1	4/14/2009	1,4-Dioxane	2	U	ug/L	10.7	7.49	500	0.9	93.26
CD-40C1	4/8/2008	1,4-Dioxane	12		ug/L	9.6	7.8	531	0.34	8.75
CD-40C1	4/8/2008	1,4-Dioxane	13		ug/L					
CD-40C1	7/8/2008	1,4-Dioxane	11		ug/L	10.2	7.8	503	0.16	9.81
CD-40C1	10/7/2008	1,4-Dioxane	12		ug/L	9.9	7.65	510	0.12	10.01
CD-40C1	10/7/2008	1,4-Dioxane	12		ug/L					
CD-40C1	2/3/2009	1,4-Dioxane	10		ug/L	9.9	7.72	519	0.3	10.01
CD-40C1	2/3/2009	1,4-Dioxane	9.9		ug/L					
CD-40C1	4/15/2009	1,4-Dioxane	8.5		ug/L					
CD-40C1	4/15/2009	1,4-Dioxane	8.3		ug/L	9.4	7.69	518	0.29	8.55
CP-S1	4/9/2008	1,4-Dioxane	9.4		ug/L	10.5	7.27	665	0.25	84.56
CP-S1	7/8/2008	1,4-Dioxane	15		ug/L	11.1	7.22	486	0.15	90.78
CP-S1	10/7/2008	1,4-Dioxane	20		ug/L	11.6	7.18		0.32	87.06
CP-S1	2/3/2009	1,4-Dioxane	18		ug/L	9.5	7.21	722	0.69	79.96
CP-S1	4/16/2009	1,4-Dioxane	11		ug/L	11	7.29	735		89.7
						(degrees C)		(umhos/cm)	(NTU)	(FT)

ATTACHMENT B

REFERENCE VALUES FOR SUSTAINABILITY FOOTPRINT CALCULATIONS

Input for Pump and Treat System

General Scope	***Typical Scope Items***	***Useful Information***
- Air stripper operation and off-gas emissions - Landfill gas extraction, exhaust treatment, and emissions - Laboratory analysis for process sampling and groundwater monitoring - Commute for labor not included because staff is assumed to be on-site for other related activities		

Labor, Mobilizations, Mileage, and Fuel

Participant	Crew Size	Number of Days	Hours Worked Per Day	Total Hours Worked	Trips to Site	Roundtrip Miles to Site	Mode of Transport.	Fuel Type	Total Miles Traveled	Miles Per Gallon	Total Fuel Used	Activity or Notes

Equipment Use, Mobilization, and Fuel Usage

Equipment Type	HP	Load Factor	Equip. Fuel Type	Gallons Fuel Used per Hour	Total Hours Operated	Gallons Fuel Used On-Site	Trips to Site	Distance to Site	Total Miles Traveled	Transport Fuel Type	Miles per Gallon	Gallons Fuel Used for Transport.	Activity or Notes
Other	2	0.5	Gasoline	0.054	56	3.024							**Generator use for well sampling (2hours per well)**

Electricity Usage

Equipment Type	HP	% Full Load	Efficiency	Electrical Rating (kW)	Hours Used	Energy Used (kWh)	Notes
	N/A						
	N/A						
	N/A						
			Totals	0		703000	Total electricity usage from bills

Natural Gas Usage

Equipment Type	Heat Load (btu/hr)	Power Rating (btu/hr)	Effiency	Total Hours Used	Btus Required	Total Therms Used	Activity or Notes
			Totals				

Input for Pump and Treat System

Materials Usage

Material Type	Unit	Quantity	Trips	Total Miles Transported	Mode of Transport.	Fuel Type	Fuel Use Rate	Total Fuel Use	Notes
GAC: regenerated	lbs	4400	1	1000	Truck B (5-15 tons)	Diesel	7.2	138.9	Assumed roundtrip distance
Sequestering agent	lbs	2000	1	2400	Truck A (< 5 tons)	Diesel	8.5	282.4	Round trip from Carson, CA

gptm = gallons per ton-mile

Laboratory Analysis

Parameter and Notes	Unit Cost	Number of Samples	Total Cost
Total analytical cost			$22,000
Other			
Other			
Other			
Other			
Other			
Other			
Other			
Other			
Other			
Totals		**0**	**22000**

Waste Generation

Waste Type	Unit	Quantity	Trips	Total Miles Transport.	Mode of Transport.	Fuel Type	Fuel Use Rate	Total Fuel Use	Notes
Non-hazardous	tons								
Hazardous	tons								
Recyclable oil	tons								
Hauled to POTW	tons								
For incineration	tons								

gptm = gallons per ton-mile

On-Site Water Usage

Resource Type	Quantity	Use of Resource
Public water (1000 x gal.)		
Extracted GW #1 (1000 x gals)	341640000	P&T water extracted
Extracted GW #2 (1000 x gals)		
Surface water (1000 x gals)		
Reclaimed water (1000 x gals)		
Stormwater (1000 x gals)		

Fate of On-Site Water Usage

Discharge Location	Quantity	Activity or Notes
Discharge to surface water	341640000	treated P&T water
Reinjected to aquifer		
Discharge to POTW		
Discharge to atmosphere		
Public Use		
Irrigation		
Industrial process water		
Other beneficial use		

Other

Item	Quantity	Activity or Notes
On-site HAP emissions	200	emissions from air stripper and LFG off-gas (all VOCs emitted assumed to be HAPs)
On-site GHG emissions	822206.071	Methane emitted in extracted landfill gas
On-site GHG reductions		(CO2 not included in GHG emissios because waste would degrade to CO2 if not landfilled)
On-site NOx reductions		
On-site SOx reductions		
On-site PM reductions		

Landfill Gas Emissions

Compound Emitted			Ext. Rate (cfm)	Conc. by Volume	Mass Emitted (lbs/yr)	Global Warming Potential (lbs CO2e/lb)	Total CO2e* Emitted (lbs)
methane	MW=	16	20	9%	39153	21	**822206**
					0		**0**
					0		**0**
					0		**0**
					0		**0**
					0		**0**
					0		**0**
Total greenhouse gas emissions (GHGs)							**822206.1**

Notes:

$$M_e = C \times Q \times \frac{28.3\,L}{ft^3} \times \frac{1\,mole}{24.1\,L} \times \frac{1440\,min}{day} \times \frac{365\,days}{year} \times MW \times \frac{1\,pound}{454\,grams}$$

where

M_e = mass emitted (pounds per year)

Q = flow rate (cfm)

C = concentration by volume

MW = molecular weight (grams / mole)

divide ppmv by 10^6 to obtain C

divide ppbv by 10^9 to obtain C

		Quantity Used	Parameters Used, Extracted, Emitted, or Generated for P&T											
			Energy		CO2e		NO x		SO x		PM		Air Toxics	
			Conv. Factor	Used	Conv. Factor	Emitted	Conv. Factor	Emitted	Conv. Factor	Emitted	Conv. Factor	Emitted	Conv. Factor	Emitted
				Mbtu		lbs		lbs		lbs		lbs		lbs
Totals				***8,471,922.***		***990,775.***		***617.***		***971.***		***82.***		***235.0446***
ON-SITE														
Energy														
Diesel (on-site)	gal	0	139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	5E-06	0
Gasoline (on-site use)	gal	3.024	124	375.	19.6	59.	0.11	0	0.0045	0	0.0005	0	4E-05	0.0001
On-site electricity use	MWh	703	3400	2,390,200.	0	0	0	0	0	0	0	0	0	0
Other														
On-site process emissions (HAPs)	lbs	200	0	0	0	0	0	0	0	0	0	0	1	200.
On-site process emissions (GHGs)	lbs CO2e	822206.07	0	0	1	822,206.	0	0	0	0	0	0	0	0
ON-SITE TOTAL				**2,390,575.**		**822,265.**		**0**		**0**		**0**		**200.0001**
ELECTRICITY GENERATION														
Electricity production	MWh	703	7800	5,483,400.	150	105,450.	0.36	253.	1	703.	0.088	62.	0.0393	27.6279
TRANSPORTATION														
Diesel (off-site use)	gal	421.3	139	58,561.	22.5	9,479.	0.17	72.	0.0054	2.	0.0034	1.	5E-06	0.0022
Gasoline (off-site use)	gal	0	124	0	19.6	0	0.11	0	0.0045	0	0.0005	0	4E-05	0
Electricity transmission	MWh	703	410	288,230.	18	12,654.	0.0432	30.	0.12	84.	0.0106	7.	0.0047	3.3153
TRANSPORTATION TOTAL				**346,791.**		**22,133.**		**102.**		**86.**		**8.**		**3.3175**
OFF-SITE OTHER														
Materials														
Diesel Produced	gal	421.3	18.5	7,794.	2.7	1,138.	0.0064	3.	0.013	5.	0.0003	0	0.0001	0.0506
GAC: regenerated	lbs	4400	9.6	42,240.	2	8,800.	0.025	110.	0.015	66.	0	0	0	0
Gasoline Produced	gal	3.024	21	64.	4.4	13.	0.008	0	0.019	0	0.0005	0	0.0002	0.0005
Sequestering agent	$	6600	8.83	58,278.	1.36	8,976.	0.0065	43.	0.0049	32.	0.0005	3.	0.0002	1.188
Off-Site Services														
Laboratory Analysis	$	22000	6.49	142,780.	1	22,000.	0.0048	106.	0.0036	79.	0.0004	9.	0.0001	2.86
OFF-SITE OTHER TOTAL				251,156.		40,927.		262.		182.		12.		4.0991

Power Sources and Global Emissions Factors for Electricity Provided by
State of Washington Department of Commerce, 2010 Utility Fuel Mix Report for Inland Power & Light

Type	Percentage Used*	Water (gal/kWh)		CO2e (lbs/kWh)		NOx (lbs/kWh)		SOx (lbs/kWh)		PM (lbs/kWh)		HAPs (lbs/kWh)		Lead (lbs/kWh)		Mercury (lbs/kWh)		Dioxins (lbs/kWh)	
		Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted
Biomass	0%	55	0	0	0	0.0015	0	0.00060	0	0.000084	0	0	0	0	0	0	0	0	0
Coal	5%	0.63	0.0315	2.4	0.12	0.0067	0.000335	0.015	0.00075	0.0017	0.000085	0.0007	0.000035	0.00000024	0.000000012	0.000000042	2.1E-09	3.8E-13	1.197E-14
Geothermal	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydro	82%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Natural Gas	2%	0.57	0.0114	1.4	0.028	0.0012	0.000024	0.012	0.00024	0.000088	0.00000176	0.000193	0.00000386	1.31E-08	2.62E-10	2.9E-09	5.8E-11	0	0
Nuclear	8%	0.55	0.044	0.024	0.00192	0.000056	0.0000045	0.000131	0.00001048	0.0000126	0.000001008	0.0000053	0.000000424	5.2E-09	4.16E-10	4.6E-10	3.68E-11	2.9E-15	1.276E-16
Oil	0%	0.55	0	1.9	0	0.0036	0.0000000	0.0041	0	0.00029	0	0.0000902	0	0.00000129	0	1.01E-08	0	1.04E-12	0
Solar	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wind	3%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total based on kWh at plant	**100%**		**0.1**		**0.15**		**0.00036**		**0.001**		**0.000088**		**0.0000393**		**0.00000001**		**0.000000002**		**1E-14**

Notes:
*- Water consumption for thermoelectric power plants U.S. Average - 0.47 gallons per kWh**
- Water consumption for hydroelectric power assumed to be 0 gallons per kWh (i.e., considers evaporation from reservoir as non-additive)
*- Water consumption for coal resource extraction and fuel processing - 0.16 gallons per kWh***
*- Water consumption for uranium resource extraction and fuel processing - 0.082 gallons per kWh***
*- Water consumption for natural gas resource extraction and fuel processing - 0.10 gallons per kWh***
*- Water consumption for biomass based on 55 gallons per kWh****
*- CO2e, Nox, SOx, and PM emissions from NREL LCI for each fuel type *****

** Consumptive Water Use for U.S. Power Production, December 2003 • NREL/TP-550-33905*
*** Gleick PH. Water and energy. Annu. Rev. Energy Environ. Vol 19, 1994. p 267-99.*
**** The Water Footprint of Energy Consumption : an Assessment of Water Requirements of Primary Energy Carriers, Winnie Gerbens-Leenes, Arjen Hoekstra, Theo an der Meer, ISESCO Science and Technology Vision, Volume 4 - Number 5, May 2008*
***** "NREL LCI" refers to the U.S. Dept. of Energy, National Renewable Energy Laboratory (NREL), Life-Cycle Inventory Database (www.nrel.gov/lci) maintained by the Alliance for Sustainable Energy, LLC.*

Electricity and Energy Used for the Production, Transmission, and On-Site Use of Electricity

For the purpose of this study, the sum of the "energy used" for "electricity production", "electricity transmission", and "on-site electricity use" equals the total amount of energy used to generate the 1 MWh used by the consumer. According to the U.S. Dept. of Energy (GridWorks: Overview of the Electric Grid http://sites.energetics.com/gridworks/grid.html) approximately power plants have a thermal efficiency of approximately 33% and the transmission of electricity results in a loss of approximately 10% of the electricity produced. In addition, the National Renewable Energy Laboratory (Consumptive Water Use for U.S. Power Production December 2003 • NREL/TP-550-33905) states that thermoelectric plants use approximately 5% of the gross electricity produced for on-site demand (i.e., parasitic loads).

This study assumes that the 33% thermal efficiency includes the 5% parasitic load.

For use of 1 MWh of electricity on-site, the following calculations illustrate the electricity and energy used.

$$G = P + T + U$$
$$G = 5\%G + 10\%G + 1$$
$$G(1 - 15\%) = 1$$
$$G = 1.18$$

where

G = *electricity generated* (MWh)

P = *parasitic load* (MWh): 5% *of* G

T = *transmission loss* (MWh): 10% *of* G

U = *energy used onsite* (MWh)

$$P = 5\% \times 1.18 = 0.06\ MWh$$
$$T = 10\% \times 1.18 = 0.12\ MWh$$

$$E_I = E_P + E_T + E_U$$
$$E_U + E_T = \eta \times E_I$$

$$E_U = 1\ MWh \times \frac{3{,}413 btu}{MWh} = 3{,}413 btu$$
$$E_T = 0.12\ MWh \times \frac{3{,}413 btu}{MWh} = 410 btu$$

$$E_I = \frac{(3{,}413 + 410)}{33\%} = 11{,}584 btu$$

$$E_P = 11{,}584 - 3{,}413 - 410 = 7{,}761 btu$$

where

E_I = *energy input* (btu)

E_P = *energy lost electricity production* (*thermal loss and parasitic load*) (btu)

E_T = *energy lost electricity transmission* (btu)

E_U = *energy used onsite in the form of electricity* (btu)

η = *thermal efficiency* (33%)

Default Environmental Footprint Conversion Factor References

Material/Fuel/Service	Green Indicator	Value	Units	Assumptions	Information Source
Gasoline (on-site use)	Energy Used	124	Mbtu/gal	The reference provides the higher heating value of gasoline as 5.218 MMBTU per barrel and defines a barrel as 42 gallons. This converts to approximately 124 Mbtu/gallon.	Climate Leader GHG Inventory EPA-430--K-08-004, May 2008
	Electricity Used		MWh/gal	not applicable -- no electricity used when gasoline is combusted on-site or in transportation	
	All Water Used		gal x 1000/gal	not applicable -- no water used when gasoline is combusted on-site or in transportation	
	Potable Water Used		gal x 1000/gal	not applicable -- no water used when gasoline is combusted on-site or in transportation	
	Groundwater Extracted		gal x 1000/gal	not applicable -- no water used when gasoline is combusted on-site or in transportation	
	CO2e Emitted	19.6	lbs/gal	The reference provides CO2e emitted as 8.81 kg of CO2 per gallon. This converts to 19.4 pounds per gallon. Additionally, N2O and CH4 emissions are provided as g/gal. Values are converted to lbs/gal using a global warming potential (GWP) of 1 for carbon dioxide, 21 for methane, and 310 for nitrous oxide.	Climate Leader GHG Inventory EPA-430--K-08-004, May 2008
	NO x Emitted	0.11	lbs/gal	NREL LCI reported the amount of gasoline in liters required to transport one ton-kilometer (tkm) and provided outputs to nature in kg. The output (nitrogen oxides) generated from transporting 1 tkm was divided by the amount of gasoline required to transport 1 tkm, and the units of the result were converted from kg/L to lbs/gallon.	NREL LCI File: SS_Transport, single unit truck, gasoline powered.xls
	SO x Emitted	0.0045	lbs/gal	NREL LCI reported the amount of gasoline in liters required to transport one ton-kilometer (tkm) and provided outputs to nature in kg. The output (sulfur oxides) generated from transporting 1 tkm was divided by the amount of gasoline required to transport 1 tkm, and the units of the result were converted from kg/L to lbs/gallon.	NREL LCI File: SS_Transport, single unit truck, gasoline powered.xls
	PM Emitted	0.00054	lbs/gal	NREL LCI reported the amount of gasoline in liters required to transport one ton-kilometer (tkm) and provided outputs to nature in kg. The output (Particulates, > 2.5 um, and < 10um) generated from transporting 1 tkm was divided by the amount of gasoline required to transport 1 tkm, and the units of the result were converted from kg/L to lbs/gallon.	NREL LCI File: SS_Transport, single unit truck, gasoline powered.xls
	Solid Waste Generated		tons/gal	not applicable -- no waste generated when gasoline is combusted on-site or in transportation (solid waste and waste oil from maintenance would be tracked separately)	
	Haz. Waste Generated		tons/gal	not applicable -- no waste generated when gasoline is combusted on-site or in transportation (solid waste and waste oil from maintenance would be tracked separately)	
	Air Toxics Emitted	0.000039	lbs/gal	Not available in NREL LCI transport files. Summed hazardous air pollutants emitted from combusting gasoline in industrial equipment. NREL LCI provides results in kg per L combusted. Converted this to pounds per gallon by multiplying by 3.785 and multiplying by .2.2	NREL LCI File: SS_gasoline combusted in industrial equipment.xls
	Mercury Released	0	lbs/gal	EUROPA ELCD - Reference does not indicate a release of mercury.	EUROPA file location: Lorry transport; Euro 0, 1, 2, 3, 4 mix; 22 t total weight, 17,3 t max payload (excluding fuel supply): http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/b444f4d2-3393-11dd-bd11-0800200c9a66_02.00.000.xml
	Lead Released	0	lbs/gal	EUROPA ELCD - Reference does not indicate a release of lead	
	Dioxins Released	0	lbs/gal	EUROPA ELCD - Reference does not indicate a release of dioxins.	

"NREL LCI" refers to the U.S. Dept. of Energy, National Renewable Energy Laboratory (NREL), Life-Cycle Inventory Database (www.nrel.gov/lci) maintained by the Alliance for Sustainable Energy, LLC.

Default Environmental Footprint Conversion Factor References

Material/Fuel/Service	Green Indicator	Value	Units	Assumptions	Information Source
Diesel (off-site use)	Energy Used	139	Mbtu/gal	The reference provides the higher heating value of diesel as 5.825 MMBTU per barrel and defines a barrel as 42 gallons. This converts to approximately 139 Mbtu/gallon.	Climate Leader GHG Inventory EPA-430--K-08-004, May 2008
	Electricity Used		MWh/gal		
	All Water Used		gal x 1000/gal		
	Potable Water Used		gal x 1000/gal		
	Groundwater Extracted		gal x 1000/gal		
	CO2e Emitted	22.5	lbs/gal	The reference provides CO2e emitted as 10.15 kg of CO2 per gallon. This converts to 22.3 pounds per gallon. Additionally, N2O and CH4 emissions are provided as g/gal. Values are converted to lbs/gal using a global warming potential (GWP) of 1 for carbon dioxide, 21 for methane, and 310 for nitrous oxide.	Climate Leader GHG Inventory EPA-430--K-08-004, May 2008
	NO x Emitted	0.17	lbs/gal	NREL LCI reported the amount of diesel in liters required to transport one ton-kilometer (tkm) and provided outputs to nature in kg. The output (nitrogen oxides) generated from transporting 1 tkm was divided by the amount of diesel required to transport 1 tkm, and the units of the result were converted from kg/L to lbs/gallon.	NREL LCI File: SS_Transport, single unit truck, diesel powered.xls
	SO x Emitted	0.0054	lbs/gal	NREL LCI reported the amount of diesel in liters required to transport one ton-kilometer (tkm) and provided outputs to nature in kg. The output (sulfur oxides) generated from transporting 1 tkm was divided by the amount of diesel required to transport 1 tkm, and the units of the result were converted from kg/L to lbs/gallon.	NREL LCI File: SS_Transport, single unit truck, diesel powered.xls
	PM Emitted	0.0034	lbs/gal	NREL LCI reported the amount of diesel in liters required to transport one ton-kilometer (tkm) and provided outputs to nature in kg. The output (Particulates, > 2.5 um, and < 10um) generated from transporting 1 tkm was divided by the amount of diesel required to transport 1 tkm, and the units of the result were converted from kg/L to lbs/gallon.	NREL LCI File: SS_Transport, single unit truck, diesel powered.xls
	Solid Waste Generated		tons/gal	not applicable -- no waste generated when diesel is combusted on-site or in transportation (solid waste and waste oil from maintenance would be tracked separately)	
	Haz. Waste Generated		tons/gal	not applicable -- no waste generated when diesel is combusted on-site or in transportation (solid waste and waste oil from maintenance would be tracked separately)	
	Air Toxics Emitted	0.0000052	lbs/gal	Not available in NREL LCI transport files. Summed hazardous air pollutants emitted from combusting diesel in industrial equipment. NREL LCI provides results in kg per L combusted. Converted this to pounds per gallon by multiplying by 3.785 and multiplying by .2.2	NREL LCI File: SS_diesel combusted in industrial equipment.xls
	Mercury Released	0	lbs/gal	EUROPA ELCD - Reference does not indicate a release of mercury.	EUROPA file location: Lorry transport; Euro 0, 1, 2, 3, 4 mix; 22 t total weight, 17,3 t max payload (excluding fuel supply): http://lca.jrc.ec.europa.eu/lcainfohub/datasets/elcd/processes/b444f4d2-3393-11dd-bd11-0800200c9a66_02.00.000.xml
	Lead Released	0	lbs/gal	EUROPA ELCD - Reference does not indicate a release of lead	
	Dioxins Released	0	lbs/gal	EUROPA ELCD - Reference does not indicate a release of dioxins.	

EUROPA ECLD refers to the European Reference Life Cycle Database (ELCD core database), version II compiled under contract on behalf of the European Commission - DG Joint Research Centre - Institute for Environment and Sustainability with technical and scientific support by JRC-IES from early 2008 to early 2009. (http://lca.jrc.ec.europa.eu/lcainfohub/datasetArea.vm)

Default Environmental Footprint Conversion Factor References

Material/Fuel/Service	Green Indicator	Value	Units	Assumptions	Information Source
Diesel Produced	Energy Used	18.5	Mbtu/gal	EUROPA ELCD - All forms of energy summed and converted to Mbtus per gallon of product.	Primary NREL LCI File: -SS_crude oil, in refinery.xls Secondary NREL LCI File: -SS_crude oil, at production.xls EUROPA file location: Diesel at refinery: http://lca.jrc.ec.europa.eu/lcainfohub/datasets/html/processes/244524ed-7b85-4548-b345-f58dc5cf9dac_02.00.000.html
	Electricity Used	0.00059	MWh/gal	Not provided by EUROPA ELCD. NREL LCI includes electricity usage for crude oil, in refinery with an allocation to diesel. Electricity from crude oil, in refinery (allocated to diesel) and crude oil, at production are included.	
	All Water Used	0.00077	gal x 1000/gal	EUROPA ELCD - Sum of "water", "surface water", "groundwater", and "river water". Negative values (indicating return of water to the hydrosphere) were not included. Sea water was also not included. Result converted to thousands of gallons per gallon of product	
	Potable Water Used		gal x 1000/gal	Not applicable -- no local potable water used during diesel production.	
	Groundwater Extracted		gal x 1000/gal	Not applicable -- no local or on-site ground water extracted during diesel production.	
	CO2e Emitted	2.7	lbs/gal	EUROPA ELCD - Sum of total global warming potential for carbon dioxide, methane, and nitrous oxide released to atmosphere. A global warming potential of 21 is used for methane and a global warming potential of 310 is used for nitrous oxide. Results converted to pounds of carbon dioxide equivalents per gallon of product.	
	NO x Emitted	0.0064	lbs/gal	EUROPA ELCD - Sum of nitrogen oxides emitted to atmosphere. Results converted to pounds of NO x per gallon of product.	
	SO x Emitted	0.013	lbs/gal	EUROPA ELCD - Sum of sulfur oxides emitted to atmosphere. Results converted to pounds of SO x per gallon of product.	
	PM Emitted	0.00034	lbs/gal	EUROPA ELCD - Sum of particulate matter (PM 10 and smaller) emitted to atmosphere. Results converted to pounds of PM per gallon of product.	
	Solid Waste Generated	0.00000036	tons/gal	EUROPA ELCD - Sum of all listed wastes (demolition debris) except for radioactive wastes, slag, and mining wastes, which would likely not be disposed of in a landfill.	
	Haz. Waste Generated	0	tons/gal	EUROPA ELCD - "Chemical waste, toxic" converted into tons per pound of product. No hazardous waste is listed in EUROPA for diesel production, suggesting that little or no hazardous waste is produced as a result of these activities.	
	Air Toxics Emitted	0.00012	lbs/gal	EUROPA ELCD - Sum of all hazardous air pollutants and groups of contaminants as defined by EPA (HAPs) emitted to atmosphere. Reported as pounds per gallon of product.	
	Mercury Released	0.000000048	lbs/gal	EUROPA ELCD - Sum of all mercury and mercury compounds released to air or water. Reported as pounds per gallon of product.	
	Lead Released	0.0000015	lbs/gal	EUROPA ELCD - Sum of all lead and lead compounds released to air or water. Reported as pounds per gallon of product.	
	Dioxins Released	3E-14	lbs/gal	EUROPA ELCD - Sum of all dioxins released to air or water. Reported as pounds per gallon of product.	

Default Environmental Footprint Conversion Factor References

Material/Fuel/Service	Green Indicator	Value	Units	Assumptions	Information Source
GAC: regenerated	Energy Used	9.6	Mbtu/lbs	Calculated using information from the cited reference. See support file for calculations.	Use of Adsorbents for the Removal of Pollutants from Wastewaters, by Gordon McKay, published by CRC Press, 1995, ISBN 0849369207
	Electricity Used	0.00044	MWh/lbs	Calculated using information from the cited reference. See support file for calculations.	
	All Water Used	0.0064	gal x 1000/lbs	Calculated using information from the cited reference. See support file for calculations.	
	Potable Water Used		gal x 1000/lbs	Not applicable -- no local potable water used.	
	Groundwater Extracted		gal x 1000/lbs	Not applicable -- no local or on-site ground water extracted.	
	CO2e Emitted	2	lbs/lbs	Calculated using information from the cited reference. See support file for calculations.	
	NO x Emitted	0.025	lbs/lbs		
	SO x Emitted	0.015	lbs/lbs		
	PM Emitted	0	lbs/lbs	Not calculated	
	Solid Waste Generated	0	tons/lbs	Information not available. To be added when additional information becomes available.	
	Haz. Waste Generated	0	tons/lbs	Information not available. To be added when additional information becomes available.	
	Air Toxics Emitted	0	lbs/lbs	Information not available. To be added when additional information becomes available.	
	Mercury Released	0	lbs/lbs	Information not available. To be added when additional information becomes available.	
	Lead Released	0	lbs/lbs	Information not available. To be added when additional information becomes available.	
	Dioxins Released	0	lbs/lbs	Information not available. To be added when additional information becomes available.	

Default Environmental Footprint Conversion Factor References

Material/Fuel/Service	Green Indicator	Value	Units	Assumptions	Information Source
Gasoline Produced	Energy Used	21	Mbtu/gal	EUROPA ELCD - All forms of energy summed and converted to Mbtus per gallon of product.	Primary NREL LCI File: -SS_crude oil, in refinery.xls Secondary NREL LCI File: -SS_crude oil, at production.xls EUROPA file location: Gasoline at refinery: http://lca.jrc.ec.europa.eu/lcainfohub/datasets/html/processes/5f62ed77-85d0-4c99-8d2c-be56951d8fb3_02.00.000.html
	Electricity Used	0.00059	MWh/gal	Not provided by EUROPA ELCD. NREL LCI includes electricity usage for crude oil, in refinery with an allocation to diesel. Electricity from crude oil, in refinery (allocated to diesel) and crude oil, at production are included.	
	All Water Used	0.00079	gal x 1000/gal	EUROPA ELCD - Sum of "water", "surface water", "groundwater", and "river water". Negative values (indicating return of water to the hydrosphere) were not included. Sea water was also not included. Result converted to thousands of gallons per gallon of product	
	Potable Water Used		gal x 1000/gal	Not applicable -- no local potable water used during gasoline production.	
	Groundwater Extracted		gal x 1000/gal	Not applicable -- no local or on-site ground water extracted during gasoline production.	
	CO2e Emitted	4.4	lbs/gal	EUROPA ELCD - Sum of total global warming potential for carbon dioxide, methane, and nitrous oxide released to atmosphere. A global warming potential of 21 is used for methane and a global warming potential of 310 is used for nitrous oxide. Results converted to pounds of carbon dioxide equivalents per gallon of product.	
	NO x Emitted	0.008	lbs/gal	EUROPA ELCD - Sum of nitrogen oxides emitted to atmosphere. Results converted to pounds of NO x per gallon of product.	
	SO x Emitted	0.019	lbs/gal	EUROPA ELCD - Sum of sulfur oxides emitted to atmosphere. Results converted to pounds of SO x per gallon of product.	
	PM Emitted	0.00052	lbs/gal	EUROPA ELCD - Sum of particulate matter (PM 10 and smaller) emitted to atmosphere. Results converted to pounds of PM per gallon of product.	
	Solid Waste Generated	0.00000042	tons/gal	EUROPA ELCD - Sum of all listed wastes (demolition debris) except for radioactive wastes, slag, and mining wastes, which would likely not be disposed of in a landfill.	
	Haz. Waste Generated	0	tons/gal	EUROPA ELCD - "Chemical waste, toxic" converted into tons per pound of product. No hazardous waste is listed in EUROPA for diesel production, suggesting that little or no hazardous waste is produced as a result of these activities.	
	Air Toxics Emitted	0.00016	lbs/gal	EUROPA ELCD - Sum of all hazardous air pollutants and groups of contaminants as defined by EPA (HAPs) emitted to atmosphere. Reported as pounds per gallon of product.	
	Mercury Released	0.000000085	lbs/gal	EUROPA ELCD - Sum of all mercury and mercury compounds released to air or water. Reported as pounds per gallon of product.	
	Lead Released	0.0000022	lbs/gal	EUROPA ELCD - Sum of all lead and lead compounds released to air or water. Reported as pounds per gallon of product.	
	Dioxins Released	3.1E-14	lbs/gal	EUROPA ELCD - Sum of all dioxins released to air or water. Reported as pounds per gallon of product.	

Default Environmental Footprint Conversion Factor References

Material/Fuel/Service	Green Indicator	Value	Units	Assumptions	Information Source
Sequestering agent	Energy Used	8.83	Mbtu/$	Based on the cited reference, approximatley 1.36 lb of CO2 is emitted per dollar of output in the manufacturing sector. In the absence of other information, it is assumed that the chemical manufacturer also has an emission profile of approximately 1.36 lb of CO2 emitted per dollar of product. Conversion factor estimates assume that 50% of this 1 lb of CO2 per dollar of sample cost results from electricity use (U.S. average fuel blend) and 50% is due to diesel use. A pound of product can then be converted into electricity and diesel usage. The conversion factors result from this electricity and diesel usage.	U.S. CARBON DIOXIDE EMISSIONS AND INTENSITIES OVER TIME: A DETAILED ACCOUNTING OF INDUSTRIES, GOVERNMENT AND HOUSEHOLDS, APRIL 2010
	Electricity Used	0.00048	MWh/$		
	All Water Used	0.0009	gal x 1000/$		
	Potable Water Used		gal x 1000/$		
	Groundwater Extracted		gal x 1000/$		
	CO2e Emitted	1.36	lbs/$		
	NO x Emitted	0.0065	lbs/$		
	SO x Emitted	0.0049	lbs/$		
	PM Emitted	0.00052	lbs/$		
	Solid Waste Generated	0	tons/$		
	Haz. Waste Generated	0	tons/$		
	Air Toxics Emitted	0.00018	lbs/$		
	Mercury Released	0.000000011	lbs/$		
	Lead Released	0.00000012	lbs/$		
	Dioxins Released	1.1E-13	lbs/$		

Default Environmental Footprint Conversion Factor References

Material/Fuel/Service	Green Indicator	Value	Units	Assumptions	Information Source
Laboratory Analysis	Energy Used	6.49	Mbtu/$	Based on the cited reference, approximatley 1 lb of CO2 is emitted per dollar of GDP. Conversion factor estimates assume that 50% of this 1 lb of CO2 per dollar of sample cost results from electricity use (U.S. average fuel blend) and 50% is due to diesel use. A pound of product can then be converted into electricity and diesel usage. The conversion factors result from this electricity and diesel usage.	U.S. CARBON DIOXIDE EMISSIONS AND INTENSITIES OVER TIME: A DETAILED ACCOUNTING OF INDUSTRIES, GOVERNMENT AND HOUSEHOLDS, APRIL 2010
	Electricity Used	0.00035	MWh/$		
	All Water Used	0.00066	gal x 1000/$		
	Potable Water Used		gal x 1000/$		
	Groundwater Extracted		gal x 1000/$		
	CO2e Emitted	1	lbs/$		
	NO x Emitted	0.0048	lbs/$		
	SO x Emitted	0.0036	lbs/$		
	PM Emitted	0.0004	lbs/$		
	Solid Waste Generated	0	tons/$		
	Haz. Waste Generated	0	tons/$		
	Air Toxics Emitted	0.00013	lbs/$		
	Mercury Released	8.4E-09	lbs/$		
	Lead Released	0.000000085	lbs/$		
	Dioxins Released	7.9E-14	lbs/$		

COST AND PERFORMANCE REPORT

Pump and Treat and In Situ Bioventing at the Onalaska Municipal Landfill Superfund Site Onalaska, Wisconsin

April 2006

Prepared by:

EPA

U.S. Environmental Protection Agency
Office of Superfund Remediation
and Technology Innovation (OSRTI)

SITE INFORMATION

IDENTIFYING INFORMATION [9]

Site Name: Onalaska Municipal Landfill Superfund Site

Location: Onalaska, Wisconsin

CERCLIS #: WID980821656

ROD Date: August 14, 1990

ESD Date: September 29, 2000; November 13, 2001

TECHNOLOGY APPLICATION

Type of Action: Remedial

Period of Operation:

- Pump and Treat (P&T) (for groundwater) – June 1994 through November 2001
- In Situ Bioventing (for soil) – May 1994 to February 1997
- Monitored Natural Attenuation (MNA) (for groundwater) – November 2001 to present

Quantity of Material Treated during Application:

- 2.17 billion gallons of groundwater treated from 1994 through 2001
- Quantity of soil treated was not reported

BACKGROUND [1,3]

Waste Management Practice that Contributed to Contamination: Disposal of municipal and chemical wastes in a landfill

Facility Operations:

- The Onalaska Municipal Landfill Superfund Site (Onalaska) is located in Onalaska, Wisconsin, about 10 miles north of La Crosse, Wisconsin. The 11-acre site is located 400 feet from the Black River and within 500 feet of several residences.

- The site was used as a sand and gravel quarry from the early to mid-1960s. In the mid-1960s, the Town of Onalaska began using the site as a landfill for both municipal and chemical wastes. In 1978, the Wisconsin Department of Natural Resources (WDNR) concluded that the landfill operation did not comply with state codes and ordered the landfill closed. Landfill operations stopped in September 1980, and the landfill was capped in June 1982.

- WDNR site investigations in September 1982 identified elevated levels of organic and inorganic contaminants in the aquifer beneath the landfill, which also served as the primary source of drinking water for the residents in the area. The site was placed on the National Priorities List in September 1984.

- Results of the remedial investigation (RI) conducted in 1988 and 1989 indicated that soils above the groundwater table and adjacent to the southwestern edge of the landfill were contaminated with petroleum solvents, including naphtha, at levels as high as 550 milligrams per kilogram (mg/kg). Groundwater was contaminated with (1) volatile organic compounds (VOCs), primarily toluene; 1,1-dichloroethane (1,1-DCA); and trichloroethene (TCE); and (2) metals, including barium and arsenic. The groundwater plume extended at least 800 feet from the southwestern edge of the landfill and discharged to nearby wetlands and the adjacent river. Figure 1 shows the extent of groundwater and nonaqueous phase liquid (NAPL) contamination at the site.

- Also during the RI, the U.S. Environmental Protection Agency (EPA) determined that the landfill cap installed in 1982 did not meet state closure requirements. The cap was found to be only 1 foot thick in some areas, and the soils encountered in the landfill cap did not satisfy the requirements for particle size or saturated hydraulic conductivity. It was also found that the landfill cap had deteriorated from surface runoff and frost damage. Erosion gullies and animal burrows were also discovered in some areas. Figure 2 shows the damaged areas of the landfill cap.

- A new landfill cap was constructed in 1993 and was designed to prevent storm water infiltration into the landfill. This landfill cap was installed in accordance with applicable federal and state requirements and consists of the following layers: grading, 2-foot clay (minimum), gravel drainage, frost-protective soil, and 6-inch topsoil. The cap also has a passive methane gas venting system.

Regulatory Context:

- A record of decision (ROD) was signed in August 1990. The ROD specified a P&T system for groundwater; bioventing for soils; monitoring for groundwater, surface water and sediments; and installing a landfill cap that met federal and state requirements.

- An explanation of significant difference (ESD) was signed in September 2000, which changed the cleanup goals specified in the ROD to updated state groundwater cleanup goals.

- A second ESD was signed in November 2001, allowing for the temporary shutdown of the groundwater P&T system to study the potential for natural attenuation to address remaining contamination in groundwater and to revise the monitoring program.

- The first 5-year review of the site was conducted in 1998.

- The second 5-year review of the site was conducted in 2003.

Remedy Selection:

- Groundwater – P&T followed by MNA
- Soil – in situ bioventing

Figure 1. Extent of Groundwater and Non-Aqueous Phase Liquid Contamination [12]

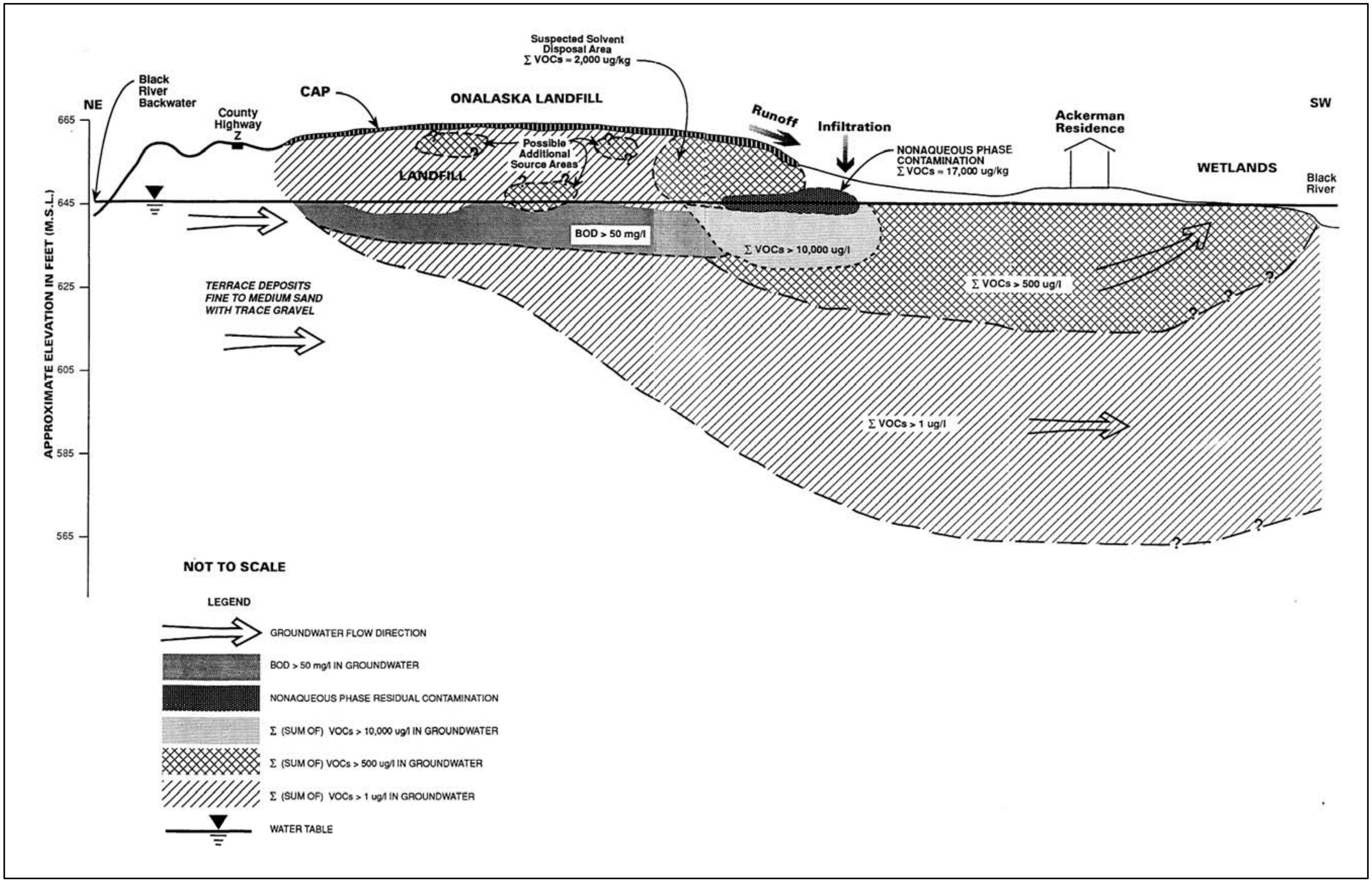
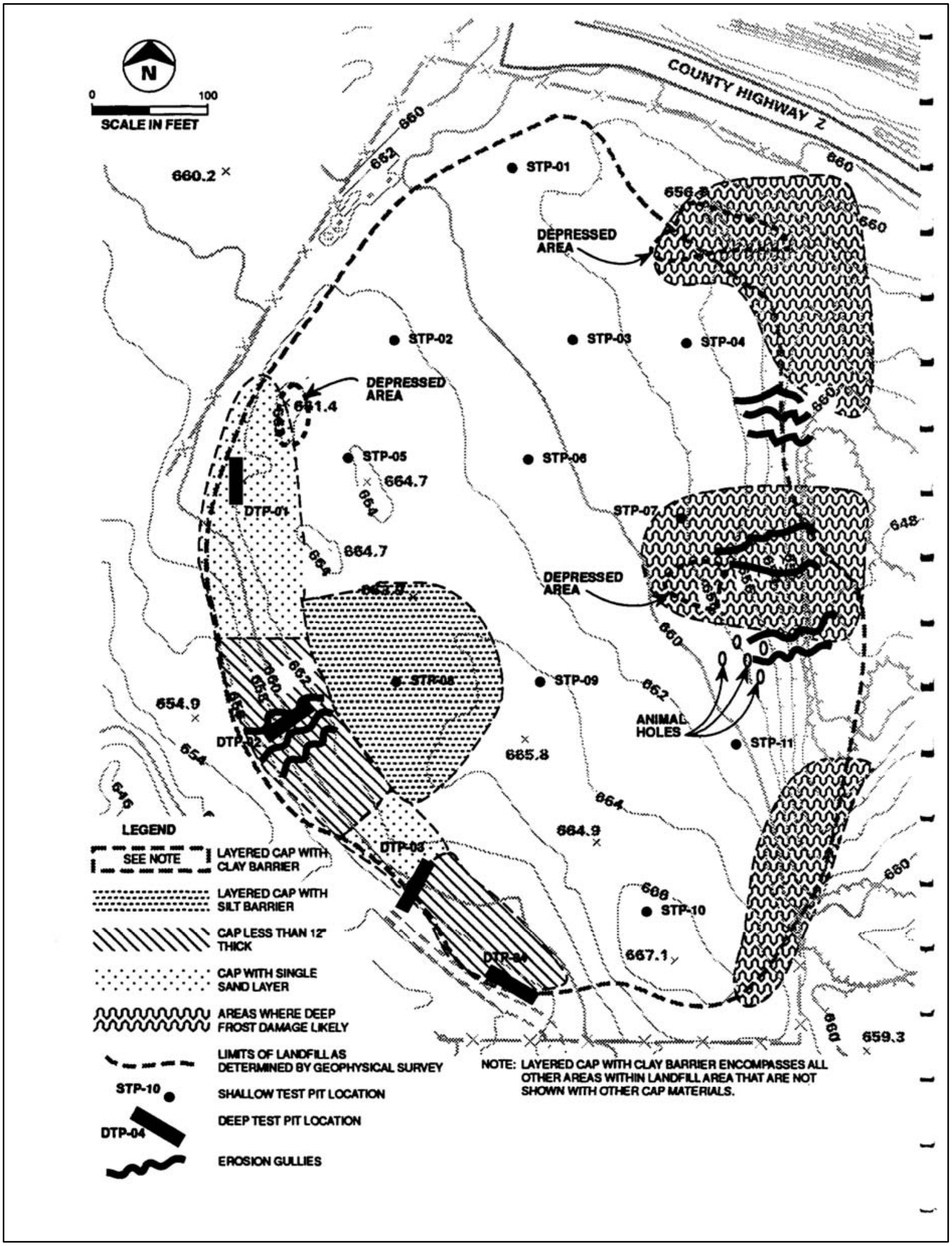


Figure 2. Damaged Areas of the Landfill Cap [12]



SITE LOGISTICS/CONTACTS

Site Lead: Federal Lead/Fund Financed

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MATRIX DESCRIPTION

MATRIX IDENTIFICATION

Soil and Groundwater

CONTAMINANT CHARACTERIZATION [1,2,3,9]

Primary Contaminant Groups:

VOCs, semivolatile organic compounds (SVOCs), metals

- The groundwater beneath the landfill was contaminated with VOCs, including TCE; 1,1-DCA; 1,1,1-trichloroethane (1,1,1-TCA); 1,1-dichloroethene (1,1-DCE); 1,2-dichlorethene (1,2-DCE); and benzene, toluene, ethylbenzene, and xylene (BTEX). During the RI, concentrations of chlorinated VOCs were as high as 800 micrograms per liter (µg/L) for 1,1-DCA, 27 µg/L for 1,2-DCE, and 8 µg/L for TCA (cleanup goals are shown in Table 4).

- The soil in the vadose zone immediately above the water table and downgradient of the landfill was contaminated with petroleum hydrocarbon solvents, primarily naphtha, at levels as high as 550 mg/kg.

- Metals of concern in groundwater included barium, arsenic, iron, manganese, and lead.

MATRIX CHARACTERISTICS AFFECTING TREATMENT COSTS OR PERFORMANCE [1,2,6,9,11,12]

The table below provides matrix characteristics for each of the three remedial technologies. These values were based on baseline sampling or were observed during startup of each remedy.

Matrix Characteristics Affecting Treatment Costs or Performance

Matrix Characteristic	Value
Pump and Treat (Groundwater)	
Thickness of zone of interest	10 – 70 feet bgs
Presence of NAPLs	Yes
In Situ Bioventing (Soil)	
Depth bgs/thickness of zone of interest	11 – 15 feet
Presence of NAPLs	Yes
Oxygen	11.5%
Carbon dioxide	5.5%
Methane	1.3%
Monitored Natural Attenuation (Groundwater)	
pH	5.2 – 7.2
Thickness of zone of interest	10 – 70 feet bgs
Total organic carbon	4 mg/L
Oil & grease	0.7 mg/L
Oxidation/reduction potential	180 mV

Notes:
bgs = Below ground surface
mg/L = Milligrams per liter
mV = Millivolts

SITE HYDROGEOLOGY [1,5]

The upper groundwater aquifer consists primarily of sand and gravel and is 135 to 142 feet thick. This aquifer serves as a primary source of drinking water for local residents. The depth to the groundwater table is generally 15 feet below ground surface (bgs) but rises to 11 feet during the spring. Groundwater flow is generally to the south-southwest, toward the wetlands and the Black River, at a rate of 55 to 110 feet per year. Groundwater flow is to the south-southeast during high groundwater table conditions, which occur a few months a year.

TREATMENT SYSTEM DESCRIPTION

PRIMARY TREATMENT TECHNOLOGY

- Groundwater – P&T (treatment for metals using sodium hydroxide and polymer addition; air stripping for VOCs) followed by MNA
- Soil – in situ bioventing

SYSTEM DESCRIPTION AND OPERATION [2,4,6,7,8,9,10]

Groundwater P&T

- The groundwater P&T system consisted of five extraction wells located along the downgradient edge of the landfill, as shown in Figure 3. The design flow rate of the P&T system was 600 to 800 gallons per minute (gpm); the following describes the extraction well designs:

  - In spring 1991, a pump test was conducted to establish the number and location of wells and flowrates required to achieve the design capacity. Based on this testing, 5 extraction wells (EW-1 to -5) were identified to capture the plume and treat a total of 800 gpm. The wells were spaced 150 to 200 feet apart, with one well pumping at a rate of 100 gpm, two wells at 150 gpm, and the other two wells at 200 gpm.
  - EW-3 was designed with a 50-foot screen and a total depth of 85 feet bgs, while the other four extraction wells were each designed with a 45-foot screen and a total depth of 80 feet. All five extraction wells were 8 inches in diameter.
  - The depths specified were chosen because they contain the highest groundwater contaminant concentrations.

- The groundwater treatment system was designed to remove VOCs and iron. The system included aeration, clarification, and the addition of sodium hydroxide and polymer for iron removal. Air stripping was used to remove VOCs. The treated water was discharged to the river, and the clarifier sludge was dewatered and disposed in a landfill.

- The total volume of groundwater extracted and treated from 1994 through 2001 was more than 2 billion gallons. Table 1 provides information about the volume of groundwater treated by year, the average daily extraction rate, and the average pumping rate:

- Groundwater monitoring samples were collected from monitoring wells, extraction wells, and two residential wells. Baseline samples were collected in November 1993 (before system startup), then quarterly beginning in March 1995. In March 1997, the monitoring frequency was reduced to semi-annual.

- The system was operated from June 1994 to November 2001 and was operational about 80 percent of the time. The downtime was caused by equipment failures, maintenance, power outages, and automatic shutoffs.

- In November 2001, EPA issued an ESD allowing shutdown of the groundwater P&T system for a natural attenuation study. The system was shut down on November 26, 2001. Before the system was shut down, the groundwater monitoring program was revised to monitor plume behavior under non-pumping conditions and to allow for the natural attenuation study.

Figure 3. Extraction Well and Groundwater Monitoring Network [4]

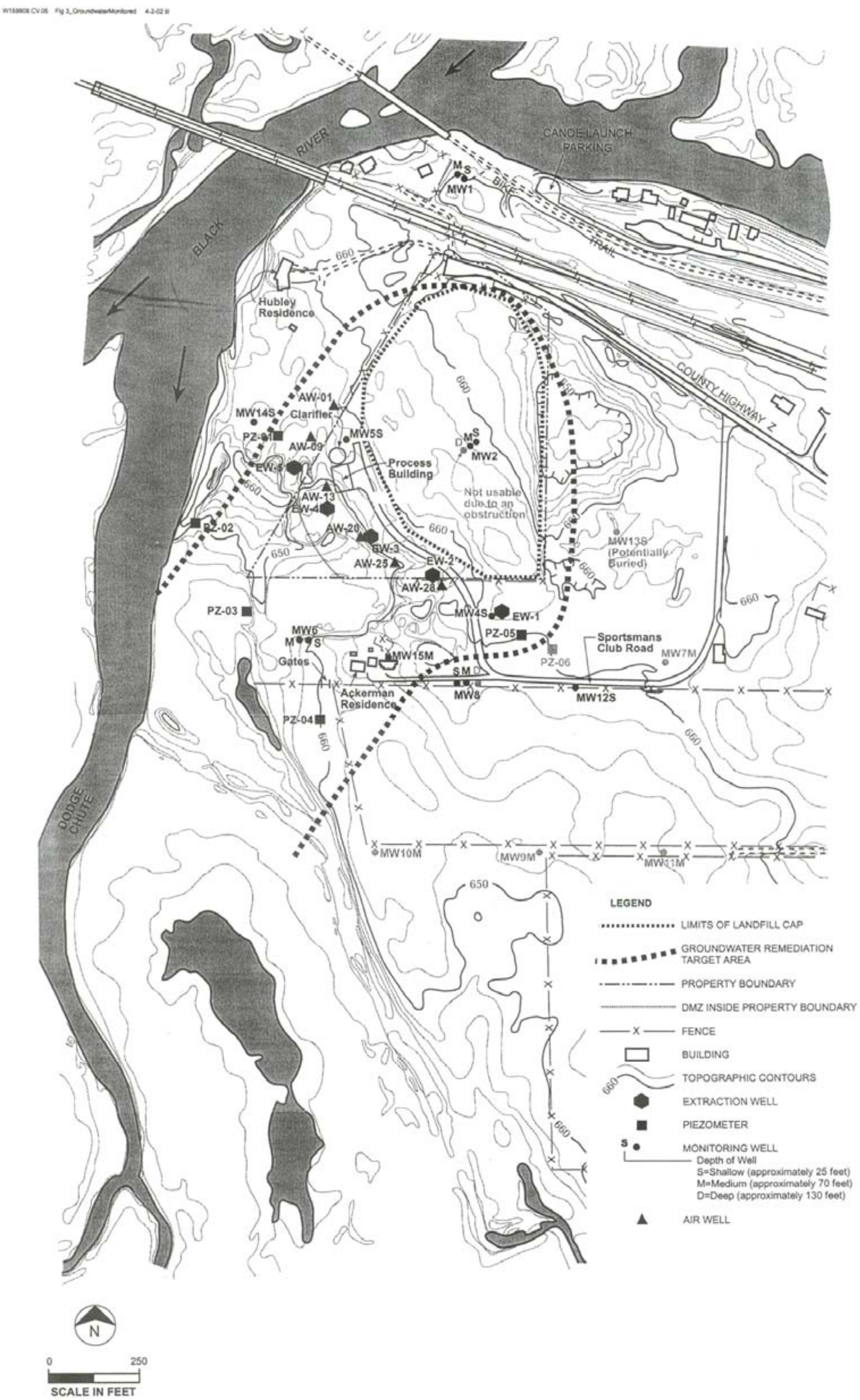


Table 1. Groundwater Pumping Rates [9]

Year	Total Volume Extracted and Treated (gal)	Average Daily Extraction Rate (gal/day)	Average Pumping Rate (gpm)
1994	176,247,120	855,568*	594*
1995	261,374,480	716,094	497
1996	247,556,080	678,236	471
1997	279,514,300	765,793	532
1998	257,877,450	706,514	491
1999	344,720,570	944,440	656
2000	365,955,490	1,002,618	696
2001	234,774,790	815,190*	566*
Total	**2,168,020,280**	**810,557**	**563**

Notes:
*Based on partial year due to startup in 1994 and shutdown in 2001.
gal = Gallons
gal/day = Gallons per day
gpm = Gallons per minute

In Situ Bioventing

- In situ bioventing of soils consisted of injecting air into the area of petroleum NAPL contamination, to stimulate naturally occurring aerobic microbes and to promote biodegradation of the organic compounds. The area of NAPL contamination targeted for bioremediation was 2.5 acres downgradient of the landfill. The 3- to 5-foot NAPL layer was estimated to be at a depth of 8 to 12 feet bgs.

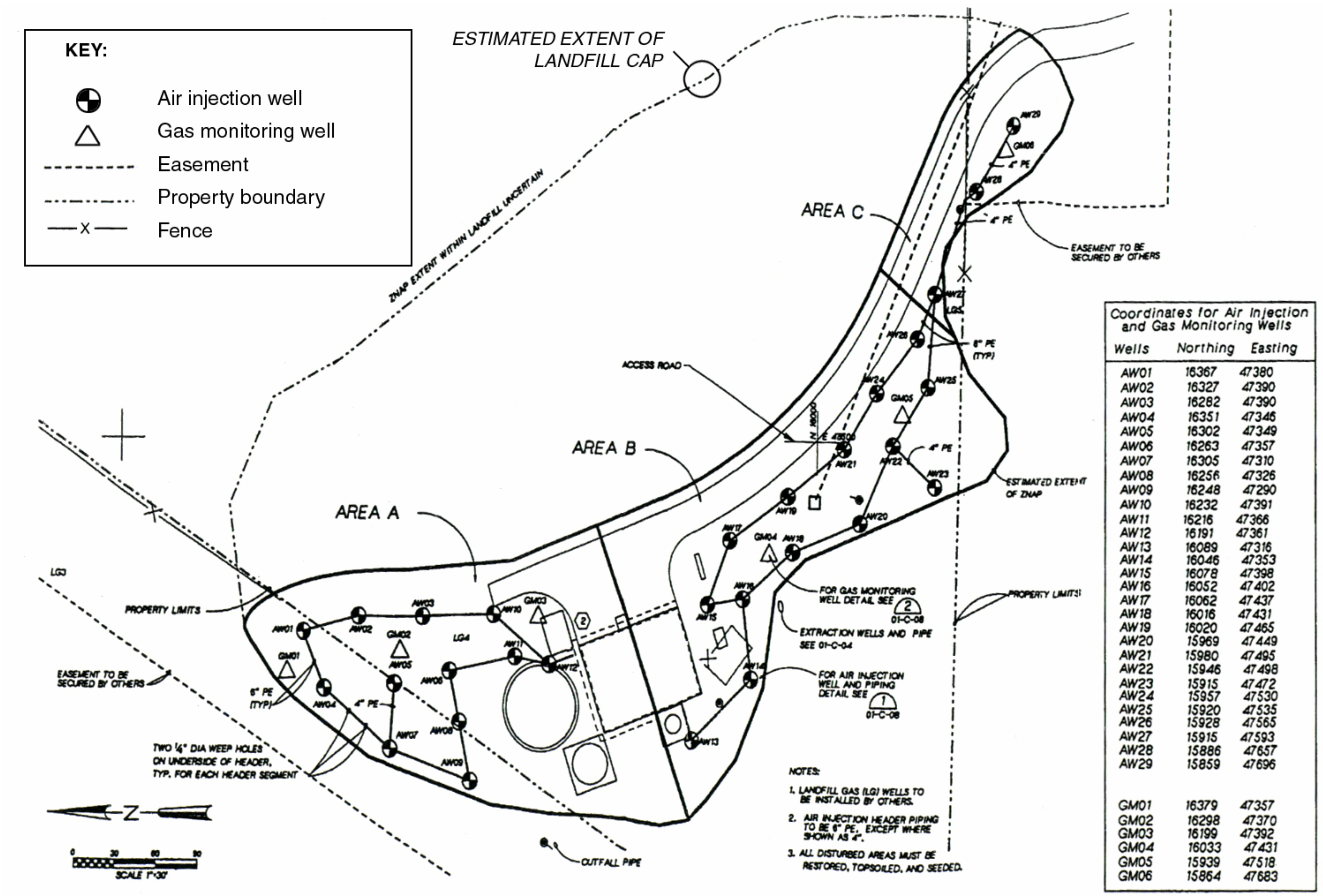
- In situ treatment to address contamination in the landfill was not considered technically feasible because of the potential for aerobic surface conditions to cause the landfill to smolder.

- The in situ remediation system, shown in Figure 4, consisted of 29 vertical air injection wells (AW-01 to AW-29), each 2 inches in diameter. The wells were installed on 40- to 50-foot centers, screened within the NAPL layer. The wells were connected by a header piping network to a single aeration well blower. The wells were equipped with valves used to modulate the air supply in response to the rate of oxygen consumption in each area. The system was designed to provide air at a rate of 100 to 420 standard cubic feet per minute (scfm). In addition, six soil gas probes were installed, with two probes per nest (one probe in the top and one in the bottom of the NAPL layer). The probes supported monitoring of subsurface conditions over time.

- Based on initial results for soil gas samples, the target NAPL area was divided into three subareas:

  - Area A – Oxygen conditions in Area A were low, but not depleted. Oxygen concentrations ranged from 9 to 19.1 percent; carbon dioxide concentrations were less than 7 percent; and methane was not detected above 1 percent. In general, soil in this area was less contaminated than in other subareas. There appeared to be ongoing microbial activity that was not limited by the availability of oxygen in soil gas.
  - Area B – Oxygen levels at Area B were significantly depleted (less than 2 percent). Carbon dioxide concentrations were as high as 17.5 percent. Methane concentrations were as high as 29 percent, although they generally measured less than 5 percent in most soils in this area. The area appeared to be the most contaminated, and microbial activity appeared to be limited by the low levels of oxygen.
  - Area C – Oxygen levels in Area C were similar to conditions in Area A. Although there was some oxygen depletion in the soil, oxygen levels were adequate to sustain microbial activity.

Figure 4. In Situ Bioventing System – Vertical Air Injection Well Locations [2]



Wells	Northing	Easting
AW01	16367	47380
AW02	16327	47390
AW03	16282	47390
AW04	16351	47346
AW05	16302	47349
AW06	16263	47357
AW07	16305	47310
AW08	16256	47326
AW09	16248	47290
AW10	16232	47391
AW11	16216	47366
AW12	16191	47361
AW13	16089	47316
AW14	16046	47353
AW15	16078	47398
AW16	16052	47402
AW17	16062	47437
AW18	16016	47431
AW19	16020	47465
AW20	15969	47449
AW21	15980	47495
AW22	15946	47498
AW23	15915	47472
AW24	15957	47530
AW25	15920	47535
AW26	15928	47565
AW27	15915	47593
AW28	15886	47657
AW29	15859	47696
GM01	16379	47357
GM02	16298	47370
GM03	16199	47392
GM04	16033	47431
GM05	15939	47518
GM06	15864	47683

- The system operated from May 1994 to February 1997. The total system air flow ranged between 270 and 320 scfm.

- In 1998, as part of the first 5-year review, EPA concluded that bioventing was no longer affecting biodegradation, and the system was shut down. Based on confirmation of oxygen levels in soil gas, EPA determined that the bioremediation cleanup phase was completed.

MNA

- The ESD issued in November 2001 allowed for the temporary shutdown of the P&T system to evaluate the effectiveness of MNA, based on the long-term groundwater monitoring that was being conducted at the site. Previous monitoring results showed consistent, low levels of groundwater contaminants, with a few exceptions. In addition, none of the wells that were used as a primary source of drinking water were within the plume area. Because of the low levels of contamination and limited exposure pathways, it was determined that P&T was likely not more effective than less expensive remedies, such as MNA, to address remaining contamination.

- A final plan was prepared in December 2001 to study natural attenuation at the site. The monitoring network comprises 26 monitoring points, including 6 air injection wells, 5 piezometers, 13 monitoring wells, and 2 residential wells. Analytes include VOCs, metals, BTEX, naphthalene, and natural attenuation parameters such as oxidation-reduction potential, dissolved oxygen, pH, temperature, and specific conductance.

- The MNA study was expected to last for at least 2 years, and the P&T system was to be restarted if concentrations increased or if the plume started to migrate.

- Baseline monitoring of natural attenuation was performed in October 2001. The second and third monitoring events occurred in December 2002 and April 2003.

- In August 2002, WDNR assumed responsibility for managing the natural attenuation study and maintaining the idle groundwater P&T and in situ bioventing systems.

OPERATING PARAMETERS THAT AFFECT TREATMENT COST OR PERFORMANCE [2,8,9]

Table 2 presents the operating parameters for each of the remedial technologies. These values were observed during operation of each remedy.

Table 2. Operating Parameters Affecting Treatment Cost or Performance

Operating Parameter	Value
Pump and Treat (Groundwater) [as of 2001]	
pH	5.2 – 7.2
Pump rate	563 gpm
In Situ Bioventing (Soil) [based on data from 1994 through 1997]	
Air flow rate	270 – 320 scfm
Operating pressure/vacuum	0.09 – 0.69 inches of water
Oxygen uptake rate	1.08% (total average change)
Carbon dioxide evolution	Decreased to less than 1%
Biodegradation rate for organics	0.55 – 1.05 mg/kg/day (3-year average)
Methane concentrations	Reduced to 0.1%

Operating Parameter	Value
Monitored Natural Attenuation (Groundwater) [based on data from 2002 and 2003]	
Temperature	7.35 – 12.4 °C
Presence of breakdown products and levels of ethane, ethene, or methane	Methane: 0.58 – 2,200 µg/L
Conductivity	0.209 – 0.709 mg/L
Alkalinity	72 – 600 mg/L
Chloride	1.8 – 16 mg/L
Redox conditions, dissolved oxygen levels, electron acceptors, electron donors	Oxidation/Reduction potential: 87 - 190mV, Dissolved oxygen: 0.23 – 7.07 mg/L, Nitrate (electron acceptor): <0.0076 – 2.2 mg/L Sulfate (electron acceptor): <0.11 – 19.7 mg/L
Total Organic Carbon	5 mg/L (approximate value)

Notes:
gpm = Gallons per minute
µg/L = Micrograms per liter
mg/kg/day = Milligrams per kilogram per day
mg/L = Milligrams per liter
mV = Millivolts
ND = Not detected
scfm = Standard cubic feet per minute

TIMELINE

Table 3 presents a timeline for remedial applications at this site.

Table 3. Timeline for this Application

Activity	Timeline
Record of decision	August 14, 1990
Groundwater pump and treat	June 8, 1994 to November 26, 2001
In situ bioventing	May 1994 to February 1997
First 5-year review	July 1998
Explanation of significant difference to update groundwater goals	September 29, 2000
Baseline monitoring for natural attenuation	October 2001
Explanation of significant difference to allow temporary shutdown of pump and treat system and begin natural attenuation study	November 3, 2001
Monitored natural attenuation monitoring and evaluation	Ongoing
Wisconsin Department of Natural Resources assumes responsibility for managing natural attenuation study and maintenance of idle pump and treat system and bioventing system	August 1, 2002
Second 5-year review	July 2003

TREATMENT SYSTEM PERFORMANCE

CLEANUP GOALS/STANDARDS [1,3,10]

The ROD did not establish chemical-specific soil cleanup goals. The estimated cleanup goal was 80 to 95 percent reduction of the organic contaminant mass in the soil. Cleanup goals for groundwater were revised to the current state goals in the ESD in 2000. Table 4 shows the original and revised site cleanup goals.

Table 4. State Groundwater Cleanup Goals for the Onalaska Municipal Landfill [1,3,10]

Compound	Original Cleanup Goal (µg/L)	Revised Cleanup Goal (µg/L)
1,1-Dichloroethane	0.04	85
1,1-Dichloroethene	0.024	0.7
1,1,1-Trichloroethane	40	40
Trichloroethene	0.18	0.5
Benzene	0.067	0.5
1,2,4- and 1,3,5- Trimethylbenzene*	NA	96*
Toluene	68.6	200
Xylene	124	1000
Ethylbenzene	272	140
Lead	5	1.5
Arsenic	5	5
Barium	200	400
Manganese*	NA	25
Iron*	NA	150

Notes:
*Not included in ROD list of contaminants
µg/L = Micrograms per liter
NA = Not applicable

The state cleanup goals for 1,1-DCA was revised to 85 µg/L based on a reclassification of 1,1-DCA from a type B-2 (probable human) carcinogen to a type C (possible human) carcinogen. State cleanup goals for benzene, TCE, and 1,1-DCE were revised because the original cleanup goals were below the standard laboratory detection limits for those compounds. In addition, state cleanup goals for ethylbenzene and lead have become more stringent. State cleanup goals for toluene, xylene, and barium were also revised.

Based on the original design of the P&T system, treated effluent was discharged to the Black River. This discharge was considered an on-site action, and therefore did not require a Wisconsin Pollutant Discharge Elimination System (WPDES) permit. However, the P&T system was required to meet the effluent standards listed in a WPDES permit, which included a daily maximum of 750 µg/L of BTEX. The state also mandated that effluent not be acutely toxic to test microorganisms.

PERFORMANCE DATA ASSESSMENT [2,4,6,7,8,9]

Groundwater P&T

- Performance data for the P&T system are available for May 2001 and for October and November 2001.

- By May 2001, concentrations for organic contaminants (except benzene and trimethylbenzene) had decreased to below cleanup goals, based on results for samples collected from 14 wells located on- and off-site. Trimethylbenzenes (1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene), although not included in the ROD list of contaminants, were monitored starting in early 2001. Arsenic, barium, iron, and manganese continued to be detected in groundwater at concentrations above the cleanup goals.

- As of October and November 2001, elevated concentrations of organic contaminants were present, primarily in well MW-5S. Trimethylbenzenes were present in wells MW-4S and MW-5S, with concentrations as high as 670 µg/L.

- As of November 2001, arsenic, barium, and manganese were present in several monitoring wells at levels as high as 14.9 µg/L arsenic; 997 µg/L barium; and 3,780 µg/L manganese. Iron was detected at concentrations below the cleanup goal, with the exception of well MW-14S, which had a concentration of 9,370 µg/L. According to the contractor, it is possible that the high concentration of iron was caused by a source other than the landfill. The concentration of iron in this downgradient well is higher than at monitoring points closer to the landfill.

In Situ Bioventing

- The in situ bioventing resulted in aerobic soil conditions, as evidenced by a steady increase in oxygen concentrations at the site, to levels as high as 21 percent. Carbon dioxide concentrations decreased from an average of 10 percent to less than 1 percent, and average methane concentrations decreased from 1.4 to 0.1 percent.

- The average hydrocarbon degradation rate was estimated to be 1 milligram per kilogram per day (mg/kg/day) in Areas A and B and 0.5 mg/kg/day in Area C.

- The average oxygen uptake in each of the three areas decreased to a level where it was concluded that active aeration was no longer needed to maintain aerobic conditions in the soil.

- The total mass of hydrocarbons removed was estimated to be 7,780 kilograms (kg) from Area A; 11,000 kg from Area B and 1,247 kg from Area C.

- EPA decided not to sample the affected soil layer to evaluate whether the ROD estimate of 80 to 95 percent destruction had occurred. This decision was made because of the large variation in initial VOC concentrations in soil over a small sampling area. EPA determined that no further remediation was required to protect human health and the environment because the groundwater P&T system was expected to capture residual contamination from the soil. The bioventing system was shut down in 1998.

MNA

- Monitoring of natural attenuation at the site is ongoing. Data are available for the baseline monitoring event (October 2001) and for two additional sampling events (December 2002 and April 2003).

- As of April 2003, two organic contaminants, trimethlybenzenes and methylene chloride, remained at concentrations above their respective cleanup goals. In addition, two inorganic compounds, iron and manganese, remain at concentrations above their respective cleanup goals.

- The results of the December 2002 and April 2003 sampling events showed the potential for natural attenuation at the site. According to the August 2003 MNA report, the "data indicates that natural attenuation may be an effective modification to the ROD." The data showed that the oxidation-reduction potential (ORP) ranged from 87 to 190 millivolts (mV), indicating that reductive dechlorination may be occurring. Concentrations of dissolved oxygen ranged from 0.23 to 7.07 milligrams per liter (mg/L), indicating aerobic conditions in the groundwater.

- The MNA report recommended continuing to monitor and evaluate natural attenuation to assess whether MNA can be effective at the site and achieve cleanup goals.

TREATMENT SYSTEM COST

COST INFORMATION [7]

Operation and maintenance (O&M) costs for the P&T system were provided in the second 5-year review report. O&M costs for 1998 through 2001, before the system was shut down, were about $200,000 per year including groundwater extraction, wastewater treatment plant O&M, sampling and monitoring, monitoring well maintenance, and reporting. After system shutdown, O&M costs were about $60,000 per year for 2002 and 2003.

OBSERVATIONS AND LESSONS LEARNED

PERFORMANCE OBSERVATIONS AND LESSONS LEARNED [2,7,9]

- The P&T system at the Onalaska Superfund Site reduced concentrations of contaminants in groundwater to below cleanup goals, with the exception of the organic contaminants trimethylbenzene, TCE, and benzene, and the metals arsenic, barium, iron, and manganese. Initial results from a MNA study suggest that natural attenuation at the site may be capable of addressing the remaining contaminants in groundwater to cleanup goals; however, further evaluation is needed and the MNA study is ongoing. In addition, the use of in situ bioventing reduced concentrations of contaminants in soil.

- During the remedial investigation of the site, trimethylbenzenes (1,2,4-trimethlbenzene and 1,3,5-trimethylbenzene) were not included in the original list of chemicals of concern and groundwater samples were not analyzed for these compounds. However, trimethylbenzenes were recently found as prominent chemicals in the groundwater at the site. Sampling for these chemical compounds began in 2001 and sampling data indicate that trimethylbenzenes exceed the state goal in 4 of the 26 wells sampled. Trimethylbenzenes were not evaluated in the original risk assessment; the toxicity data are still valid but may need to be modified to include the trimethylbenzenes.

REFERENCES

1. U.S. Environmental Protection Agency (EPA). Record of Decision. Onalaska Municipal Landfill, Onalaska, WI. August 14, 1990.

2. CH2M Hill. In Situ Bioremediation Final Report. Onalaska Municipal Landfill. July 30, 1997.

3. EPA. Explanation of Significant Differences: Onalaska Municipal Landfill, Operable Unit (OU) 1, Onalaska, WI. September 29, 2000.

4. CH2M Hill. Long-Term Remedial Action Report. Onalaska Municipal Landfill, Onalaska, WI. August 27, 2002.

5. EPA. Explanation of Significant Differences: Onalaska Municipal Landfill, OU1, Onalaska, WI. November 13, 2001.

6. EPA. Five-Year Review. Onalaska Municipal Landfill Site. 1998.

7. Wisconsin Department of Natural Resources. Second Five-Year Review Report. Onalaska Municipal Landfill Site. July 2003.

8. ENSR International. 2002/2003 Monitored Natural Attenuation Report for the Onalaska Municipal Landfill Site, Onalaska, Wisconsin. August 2003.

9. CH2MHill. Annual Groundwater Quality and Baseline Natural Attenuation Report for 2001, Onalaska Municipal Landfill Site. April 2002.

10. CH2MHill. Groundwater Extraction and Treatment Predesign Report, Onalaska Municipal Landfill. October 1991.

11. Annual Groundwater Quality Report for 2000, Onalaska Municipal Landfill Site.

12. CH2MHill. Remedial Investigation Report. Onalaska Municipal Landfill, Onalaska, Wisconsin. December 22, 1989.

ANALYSIS PREPARATION

This case study was prepared for the U.S. Environmental Protection Agency's Office of Solid Waste and Emergency Response, Office of Superfund Remediation and Technology Innovation, by Tetra Tech EM Inc., under EPA Contract No. 68-W-02-034.

Five-Year Review Report

Third Five-Year Review Report
for
Onalaska Landfill Superfund Site
Town of Onalaska
La Crosse County, Wisconsin

July 2008

PREPARED BY:

Wisconsin Department of Natural Resources
West Central Region
Eau Claire, Wisconsin

Approved by: Date:

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9/14/08
Richard C. Karl
Division Director, Superfund
U.S. EPA, Region 5

Table of Contents

Tables

Attachments

List of Acronyms

ACL	Alternative Concentration Limit
ARAR	Applicable or Relevant and Appropriate Requirement
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DMZ	Design Management Zone
ES	Wisconsin Administrative Code NR140 Enforcement Standard
ESD	Explanation of Significant Difference
IC	Institutional Control
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MNA	Monitored Natural Attenuation
NCP	National Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
PAL	Wisconsin Administrative Code NR140 Preventive Action Limit
PPB	Parts per billion
PPM	Parts per million
RA	Remedial Action
RAO	Remedial Action Objective
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager

TCE	Trichloroethene
TMB	Trimethylbenzene
U.S. EPA	United States Environmental Protection Agency
UU/UE	Unlimited Use/Unrestricted Exposure
VOC	Volatile Organic Compound
WAC	Wisconsin Administrative Code
WDNR	Wisconsin Department of Natural Resources
WPDES	Wisconsin Pollutant Discharge Elimination System

Executive Summary

The United States Environmental Protection Agency (U.S. EPA), in consultation with the Wisconsin Department of Natural Resources (WDNR), began a Remedial Investigation and Feasibility Study (RI/FS) at the Onalaska, Wisconsin municipal sanitary landfill in 1988. The RI/FS was completed in 1990, upon issuance of a cleanup decision by the U.S. EPA. The U.S. EPA determined that construction of a landfill cover (cap), a groundwater extraction and treatment system, and a bioremediation system would be protective of human health and the environment.

U.S. EPA, in concert with the WDNR, began construction of the cleanup remedy in 1993. The cleanup remedy was completed in July 1994; operation of the groundwater extraction and treatment and the bioremediation systems commenced at that time. The groundwater extraction and treatment system operated until November 2001, and the bioremediation system was shut down in February 1997. The systems are currently shut down to allow the WDNR to evaluate the effectiveness of natural attenuation in reducing the levels of contamination through natural biological, physical and chemical processes.

The groundwater extraction and treatment system pumped 2.2 billion gallons of water for treatment (via air stripping), reducing the levels of contaminants in the groundwater. Current data indicates that iron, manganese and arsenic and two volatile organic chemicals (1,2,4-and 1,3,5-trimethylbenzene are the only contaminants above the WDNR Enforcement Standards. Background levels of iron and manganese in groundwater in Wisconsin are similar to the concentrations detected at the site. The bioremediation system, which supplied oxygen (air) to the subsurface soil, effectively reduced the concentrations of the hydrocarbons in the soils. The bioremediation system was discontinued in 1998 after soil gas data showed that the system no longer contributed to the cleanup.

The U.S. EPA completed an Explanation of Significant Differences (ESD) on September 29, 2000. This ESD addressed changes to the groundwater cleanup standards, bringing the standards up-to-date with then current State cleanup standards.

On November 13, 2001 U.S. EPA completed a second ESD for the site. This ESD allows for the temporary shut down of the groundwater treatment system to study natural attenuation as an alternative to cleanup the remaining groundwater contamination. The system was shut down on November 26, 2001. The WDNR took over the operation and maintenance of the site in June of 2002.

Groundwater contaminants not previously analyzed for have been observed starting in 1999. The WDNR conducted additional investigation in 2005, identifying residual soil contamination that may be acting as an on-going source of impact to the groundwater. It should be evaluated as to whether additional remediation of the soil should be implemented.

From 2001 to 2008, the Site has been evaluated for natural attenuation as a viable, cost effective remedy over the groundwater extraction remedy. Monitoring for natural attenuation began in the fall of 2001. The 2008 Monitored Natural Attenuation Study (MNA) did not recommend the adoption of MNA as an alternative remedy. However, the contaminants of concern listed in the Record of Decision (ROD), except arsenic and barium, meet the cleanup standards established in the ROD, 1991. Elevated arsenic and barium levels above the Wisconsin Administrative Code (WAC) NR140 Preventive Action Limit (PALS) are unlikely to be reduced by reactivation of the pump and treat system.

In 1999, contaminants not part of the original list in the ROD, trimethylbenzene compounds (TMBs), were detected in monitoring wells above State PALs. Because of this discovery, additional investigation of contaminated soil that may be acting as a source of TMB contamination to the groundwater is recommended.

Currently, the Onalaska Landfill Superfund Site is protective of human health and the environment in the short-term because the landfill cap is effective; groundwater monitoring assures that drinking water supplies remain safe and that the plume is contained; most contaminants of concern have been remediated to meet ROD cleanup standards, and institutional controls prevent activities that would compromise the cap or expose parties to contaminated groundwater. However, in order to remain protective in the long-term additional soil investigation, and possible remediation of TMB, will be needed, on-going monitoring and evaluation of arsenic and barium in groundwater must be done, and the required restrictive covenant for the landfill cap must be drafted and recorded as required by the 1996 Consent Decree (CD).

Long term protectiveness also requires compliance with the land and groundwater use restrictions. Compliance with effective Institutional Controls (ICs) will be ensured by implementing, monitoring and maintaining effective ICs as well as maintaining the site remedy components. Long-term stewardship must be ensured to verify compliance with ICs.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name ***(from WasteLAN)***: Onalaska Landfill Superfund Site		
EPA ID ***(from WasteLAN)***: WID980821656		
Region: 5	**State:** WI	**City/County:** Town of Onalaska/La Crosse
SITE STATUS		
NPL status: ☒ Final		
Remediation status (choose all that apply): Operating		
Multiple OUs?* No		**Construction completion date:** 06 / 01 / 1994
Has site been put into reuse? YES, the site is a natural area, and wildlife preserve		
REVIEW STATUS		
Lead agency: ☒ State		
Author name: Eileen Kramer		
Author title: Remedial Project Manager		**Author affiliation:** WDNR West Central Region
Review period:** 07 / 15 / 2003 to 07 / 16 / 2008		
Date(s) of site inspection: 09 / 26-27 / 2007		
Type of review: ☒ Post-SARA		
Review number: ☒ 3 (Third)		
Triggering action: Previous Five-Year Review Report		
Triggering action date ***(from WasteLAN)***: 07 / 16 / 2003		
Due date ***(five years after triggering action date)***: 07 / 16 / 2008		

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd

Issues:

1. Increasing TMB concentrations in two monitoring wells located within the area where non-aqueous phase naphtha solvents had been observed during the RI.
2. Increasing TMB concentration (although not in exceedance of the PAL) in MW-8M which is located outside the design management zone (DMZ)
3. Concentrations of arsenic and barium exceed the cleanup standards, although there are no exceedances of the federal MCL or state WAC NR140 Enforcement Standards (ES) outside the DMZ.
4. Damaged fence at southern perimeter of landfill
5. A deed restriction on the landfill property that is enforceable by the WDNR and U.S. EPA has not been recorded at the La Crosse Co. Register of Deeds office. Implementing, maintaining and monitoring of the ICs will be required to assure protectiveness of the remedy.
6. The Prinsen property is located south of the site and within 1200 feet of the landfill. NR812 would prohibit construction of a water supply on the property without a variance from the WDNR, but no deed notice that runs with the land has been recorded.
7. Report of possible vehicle operation at night on the landfill.
8. MW-5S does not have an above grade protective top
9. Quality of groundwater immediately outside the landfill DMZ requires additional characterization.
10. Potable wells in proximity to the landfill.
11. The need to evaluate current ICs at the Site to determine if any additional ICs should be implemented.

Recommendations and Follow-up Actions:

1. Additional data regarding residual contamination in the soil southwest of the landfill where naphtha solvents had been observed during the RI should be acquired and evaluated to determine whether the soil is acting as an on-going source of contamination to the groundwater.
2. On-going monitoring of MW-8M to evaluate whether concentrations of TMB will begin to stabilize and decrease due to decrease in loading in the up-gradient area.
3. Proposed alternative concentration limits (ACLs) for arsenic and barium should be finalized.
4. Repair and possible improvement of the fence.
5. The Town should draft for WDNR and U.S. EPA review and approval, and record a deed instrument that restricts activities and access to the landfill to protect the integrity of the cap and to prevent exposure to contaminated media as required by the 1996 CD.
6. Regarding the Prinsen property, south of the landfill, the agencies should determine whether a deed instrument that runs with the land to restrict its use is necessary to assure protectiveness
7. Discuss with Town Administrator. Encourage routine drive-by surveillance. Evaluate whether extending fence would prevent vehicular access
8. A protective top, a metal pipe and cover that sticks up above the ground around the polyvinyl chloride well riser, that complies with NR141 WAC should be constructed for well MW-5S.

Five-Year Review Summary Form, cont'd

9. Additional monitoring wells to determine concentrations of arsenic and barium at the DMZ should be installed.
10. Monitoring of the four drinking water wells in proximity to the site should continue and the potential for impact from the landfill be evaluated again.
11. Implement an IC Plan for the Site which will evaluate the need for additional ICs.

Protectiveness Statement:

Currently, the Onalaska Landfill Superfund Site is protective of human health and the environment in the short-term because the landfill cap is effective; groundwater monitoring assures that drinking water supplies remain safe and that the plume is contained; most contaminants of concern have been remediated to meet ROD cleanup standards, and institutional controls prevent activities that would compromise the cap or expose parties to contaminated groundwater. However, in order to remain protective in the long-term additional soil investigation, and possible remediation of TMB, will be needed, on-going monitoring and evaluation of arsenic and barium in groundwater must be done, and the required restrictive covenant for the landfill cap must be drafted and recorded as required by the CD.

Long term protectiveness also requires compliance with the land and groundwater use restrictions. Compliance with effective ICs will be ensured by implementing, monitoring and maintaining effective ICs as well as maintaining the site remedy components. Long-term stewardship must be ensured to verify compliance with ICs.

Other Comments:

None

Onalaska Landfill Superfund Site
Town of Onalaska, Wisconsin
Third Five-Year Review Report

I. Introduction

The purpose of the Five-Year Review is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and identify recommendations to address them.

The WDNR is preparing this Five-Year Review report pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP). 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 Agency interpreted this requirement further in the NCP; 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.*

The WDNR, with the assistance of the U.S. EPA, conducted the Five-Year Review of the remedy implemented at the Onalaska Landfill Superfund Site in the Town of Onalaska, Wisconsin. This review was conducted by the Remedial Project Manager (RPM) for the entire site from September 2007 through July 2008. This report documents the results of the review.

This is the third Five-Year Review for the Onalaska Landfill Superfund Site. The triggering action for this statutory review is the completion of the second Five-Year Review on July 16, 2003. The Five-Year Review is required due to the fact that hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

II. Site Chronology

Table 1 - Chronology of Site Events

Event	Date
The site was mined as a sand and gravel quarry in the early 1960s. Quarry operations ceased in the mid-1960s and the Town began to use the site as a municipal landfill.	1960s
In 1978, the WDNR determined that the landfill operation did not meet state solid waste codes and ordered the Town to close the landfill by September 1980. After disposal operations ceased, the Town capped the landfill in June 1982.	1978 to 1982
In September 1982, the WDNR sampled four landfill monitor wells and several nearby residential wells for compliance with drinking-water standards, and determined that one residential well, located southwest of the landfill, was found to exceed the Federal drinking-water standard for barium (1.0 mg/L). The well sample also contained five organic compounds at concentrations above background levels. The Town replaced the contaminated residential well with a deep, uncontaminated well in January 1983.	1982 to 1983
Pursuant to CERCLA, U.S. EPA inspected the Onalaska site in 1983. Subsequent to the submittal of the Site Inspection report in May 1983, the U.S. EPA placed the site on the NPL in September 1984.	1983 to 1984
U.S. EPA, in consultation with the WDNR, completed a RI at the Onalaska Landfill on December 22, 1989. The RI concluded that the landfill is the source of groundwater contamination, and that the original landfill cap had deteriorated and did not meet the landfill closure regulations in effect at the time the landfill closed	12/22/1989
Based on the findings of the RI, U.S. EPA completed an FS that evaluated remedial alternatives to address migration of the groundwater contaminant plume. U.S. EPA completed the FS in December 1989.	12/1989
U.S. EPA then issued a ROD in August 1990 that called for the: installation of a landfill cap in accordance with federal and state requirements; installation of a groundwater extraction and treatment system to capture and treat contaminants in the groundwater immediately downgradient of the landfill; installation of an air injection system within the area of soils contamination to enhance the bioremediation of organic contaminants; and implementation of a groundwater, surface water, and sediment monitoring program to ensure the adequacy of the cleanup	8/1990
U.S. EPA entered into a Superfund State Contract with WDNR in 1991 which provided that the state would fund 50% of the remedial action	1991
U.S. EPA completed the landfill cap remedial design (RD) in July 1992 and the groundwater extraction and treatment and the bioremediation systems RD in September 1992	1992
The landfill cap construction subcontract was awarded on March 25, 1993, and construction commenced on May 1, 1993. A multi-layer clay cap was installed over the landfill. The cap was completed in November 1993. The groundwater and soils construction subcontract was awarded on June 11, 1993, and construction began on July 12, 1993. The groundwater extraction and treatment system was completed in June 1994.	1993 to 1994

A pre-final inspection was conducted by the project managers for U.S. EPA and WDNR on June 1, 1994. At that time, it was determined that the landfill cap, groundwater, and bioremediation systems were constructed as designed and that they were operational.	6/1/1994
U.S. EPA entered into a CD with the town of Onalaska that would address additional ICs needed at the Site and to outline who would perform the Operation and Maintenance at the Site.	10/29/1996
The Five-Year Review Report at the Onalaska site was completed on July 13, 1998	7/13/1998
U.S. EPA issued an ESD for the Onalaska Municipal Landfill on September 29, 2000. The ESD addressed changes to the performance standards addressed in the ROD based on changes to State of Wisconsin drinking Public Health and Public Welfare Groundwater Quality Standards	9/29/2000
U.S. EPA issued an ESD for the Onalaska Municipal Landfill on November 13, 2001. The ESD allows for the temporary shutdown of the groundwater extraction and treatment system to evaluate the need for continuous operation of the system and to determine whether natural attenuation processes exist at the site which might address the remaining groundwater contamination	11/13/2001
In June 2002, WDNR assumed the lead in the operation and maintenance of the Site.	June 2002
The second Five-Year Review Report was completed.	July 20, 2003
WDNR conducted additional investigation, installing four new monitoring wells.	March 2006
WDNR developed proposed ACLs in accordance with the ROD and WAC NR140.	June 2006
The third Five-Year Review started.	Sept. 2007
A report, Evaluation of Monitored Attenuation as a Containment Remedy for the Onalaska Municipal Landfill Site was completed.	June 2008

III. Background

Physical Characteristics

The Onalaska site is located in the Township of Onalaska, about 10 miles north of La Crosse, Wisconsin. Figure 1, presented in Attachment 1, is a map illustrating the Site location. The 11-acre site includes the 7-acre former Township landfill and is situated 400 feet east of the Black River, near the confluence of the Mississippi and Black Rivers. The Black River is located within the Upper Mississippi River Wildlife and Fish Refuge, a wetlands area that supports numerous migrating species of birds and is also used for hiking, fishing, hunting, and other recreational purposes by area residents and visitors.

The area surrounding the site is generally rural, although several residences are located within 500 feet to the north and to the south of the landfill. A subdivision of about 50 homes is located about 1.25 miles southeast of the site. Agricultural lands are located south of the landfill, and intermittent woods and grasslands border the site to the east. A railroad line runs west-northwest approximately 200 feet north of the northern extent of the waste. North of the rail line there is a state recreational bike trail developed on old railroad bed. There is a public canoe landing on the Black River about 500 feet north of the landfill.

The December 1989 remedial investigation report indicates that the site sits on glacio-fluvial and alluvial sand and gravels that was deposited as glacial outwash in an eroded bedrock valley. The underlying sandstone bedrock was encountered in four borings at depths from 118 to 140 feet below ground surface. Groundwater flow direction was found to be predominantly to south-southwest, with springtime periods of high river stage causing flow to the south-southeast. In-situ testing in several site monitoring wells determined that hydraulic conductivity at the site averages 0.039 centimeters/second (cm/sec). The hydraulic gradient, is approximately 0.006 (no units).

Land and Resource Use

The Onalaska site was mined as a sand and gravel quarry in the early 1960s. Quarry operations ceased in the mid-1960s and the Town began to use the site as a municipal landfill, although for a time both municipal and chemical wastes were disposed of in the landfill. In 1978, the WDNR determined that the landfill operation did not meet state solid waste codes and ordered the Town to close the landfill by September 1980. After disposal operations ceased, the Town capped the landfill in June 1982.

The site is adjacent to the Upper Mississippi River Wildlife and Fish Refuge, which contains a wide variety of wildlife. The area is used for fishing, hiking, and other recreational purposes. The site is a known nesting area for turtles including several threatened species.

History of Contamination

In September 1982, the WDNR sampled four landfill monitor wells and several nearby residential wells for compliance with drinking-water standards. The investigation documented that the sand and gravel aquifer beneath the landfill serves as the primary source of drinking water for area residents and that groundwater contamination had occurred within and around the site. One residential well, located southwest of the landfill, was found to exceed the Federal drinking-water standard for barium (1.0 mg/L). The residential well sample also contained five organic compounds at concentrations above background levels. A landfill monitor-well sample was found to be contaminated with toluene at a concentration of 14.7 mg/L, which is above the State groundwater-quality ES (1 mg/L) and the federal drinking water (1.0 mg/L) standard. The Town replaced the contaminated residential well with a deep, uncontaminated well in January 1983.

Initial Response

Pursuant to CERCLA, U.S. EPA inspected the Onalaska site in 1983. Subsequent to the submittal of the Site Inspection report in May 1983, the U.S. EPA placed the site on the NPL in September 1984.

Basis for Taking Action

U.S. EPA, in consultation with the WDNR, conducted a RI/FS at Onalaska from April 1988 through December 1989. The major findings of the RI included:

- The landfill is the source of groundwater contamination. Soils located above the water table and adjacent to the southwestern edge of the landfill were contaminated with naphtha solvents that migrated from the landfill. The contaminated soil zone occurred from 11 feet to 15 feet below ground surface and up to 150 feet from the landfill. Soil samples indicated that contaminant levels of up to 550 mg/kg were present and were a continual source of groundwater contamination.
- The aqueous phase plume consisting of organic and inorganic compounds had migrated at least 800 feet from the southwestern edge of the landfill. The leading edge of the contaminant plume appeared to be discharging into nearby wetlands and the adjacent Black River.
- The upper aquifer consists primarily of sand and is approximately 135 feet thick. Local residences utilized this aquifer as a primary source of drinking water.
- The predominant organic compounds of concern included toluene, xylene, 1, 1 - dichloroethane, and trichloroethene (TCE), based upon concentrations and potential impacts to human health and the environment.
- Site original landfill cap had deteriorated and did not meet the landfill closure regulations in effect at the time the landfill closed. The cap was originally to be composed of 2 feet of compacted clay, but the RI showed that the cap was composed of sandy soils in certain portions and that it was only one foot thick in other portions.
- Magnetometer anomalies, as well as site records, suggested that up to 1000 55-gallon drums were likely to have been disposed of in the landfill. Although several crushed and empty drums were found in the landfill during excavation of test pits, the RI could not ascertain whether the drums are concentrated in any one area, although it may be likely that many of the drums would be in the same condition as the drums that were found in the test pits.
- The average depth to the water table and the depth of waste disposal was 15 feet. Thus, the refuse was periodically in direct contact with groundwater. Soil below the water table did not appear to be greatly affected by landfill contaminants.

The ROD identified Chemicals of Concern as follows:

Toluene	Lead	Trichloroethene
Xylene	1,1,1-Trichloroethane	1,1-Dichloroethane
Barium	Benzene	1,1-Dichloroethene
Ethylbenzene	Arsenic	

Potential long-term exposure to low levels of volatile organic compounds (VOCs) through the use of private wells in contaminated groundwater and plausible adverse discharges of contaminants to the wetlands and Black River downgradient of the landfill were identified as the principal threats to human health and the environment.

In 1996, the town of Onalaska entered into a CD with U.S. EPA providing access to all site personnel who would be conducting sampling and other work activities at the Site. The CD also outlined numerous ICs that were to be implemented at the Site, including installation of a perimeter fence, recording restrictive covenants on the landfill property that prohibit construction, well installation and recreational activities on the Site and recording restrictive covenants on adjoining properties which the town purchased in the form of conservation easements, compatible with the use of the adjoining National Wildlife Refuge. The CD also provided specific instruction on the Operation and Maintenance (O&M) activities that were to be conducted relating to the landfill.

IV. Remedial Actions

Remedy Selection

Based on the findings of the RI, U.S. EPA completed a FS that evaluated remedial alternatives to address migration of the groundwater contaminant plume. U.S. EPA completed the FS in December 1989. U.S. EPA then issued a ROD in August 1990 that stated, "The principal threats at the site are considered to be the groundwater contaminant plume and a contaminated soil zone adjacent to the southwestern portion of the landfill, which is a major source of groundwater contamination. The landfill itself is considered to be a low-level, long-term threat to human health and the environment, primarily as a further source of groundwater contamination. The ROD called for the following actions to mitigate the areas of concern:

- Installation of a landfill cap in accordance with federal and state requirements;
- Installation of a groundwater extraction and treatment system to capture and treat contaminants in the groundwater immediately downgradient of the landfill;
- Installation of an air injection system within the area of soils contamination to enhance the bioremediation of organic contaminants; and
- Implementation of a groundwater, surface water, and sediment monitoring program to ensure the adequacy of the cleanup.
- Institutional controls including deed restrictions limiting surface and ground-water use at the site; and State regulations governing groundwater use within 1200 feet of landfills and the development of landfills.

The selected remedy established a containment and treatment system to eliminate the principal threat posed to human health and the environment by capping the landfill to isolate the source of groundwater contaminants in the landfill; eliminating contaminants in the adjacent soils by enhanced bio-remediation; preventing the further migration of VOCs in groundwater by extracting contaminated groundwater; and treating extracted groundwater to acceptable discharge limits.

The ROD established cleanup standards for groundwater based on Safe Drinking Water Act Maximum Contaminant Levels (MCLs) and WAC NR 140 ES and PALs for groundwater protection. The selected remedy established an estimated cleanup goal of 80 to 95 percent biodegradation of the organic compounds in the soils adjacent to the landfill.

U.S. EPA entered into a Superfund State Contract with WDNR in 1991, which provided that the state would fund 50% of the remedial action. U.S. EPA then began to implement the RD and Remedial Action (RA).

Remedy Implementation

- U.S. EPA completed the landfill cap RD in July 1992 and the groundwater extraction and treatment and the bioremediation systems RD in September 1992.
- A Wisconsin Pollution Discharge Elimination System (WPDES) "permit" was issued by the WDNR for the discharge of treated groundwater to the Black River. WDNR determined that air stripping and iron precipitation were acceptable Best Available Technology for treatment.
- A 3-month soil treatability study was conducted in the laboratory to determine the ability of the organic contaminants to degrade and to attempt to determine plausible cleanup goals, optimal air injection conditions, and losses of VOCs due to air stripping or volatilization. Testing showed that approximately 15% of the hydrocarbons were biodegraded during the 3-month test and that approximately 5-6 years of air injection would be needed to reach the target cleanup goal. As a result, U.S. EPA recommended that a full-scale biotreatment system be installed, for the cost of performing a pilot study in the field would approach that of a full-scale treatment system.
- The landfill cap construction subcontract was awarded on March 25, 1993, and construction commenced on May 1, 1993. A multi-layer clay cap was installed over the landfill. The cap was completed in November 1993.
- The groundwater and soils construction subcontract was awarded on June 11, 1993, and construction began on July 12, 1993. Five groundwater extraction wells were installed downgradient of the landfill and are designed to pump a total of 800 to 1000 gallons per minute. A treatment plant was constructed nearby, where the extracted groundwater is subjected to aeration and pH adjustment (iron precipitation), clarification (iron removal), air stripping (VOC removal), and pH readjustment prior to discharge to the Black River. Temporary activated carbon units were placed in the treatment train prior to discharge as a back-up measure while the treatment plant components underwent a 3-month "shakedown" period. The groundwater extraction and treatment system was completed in June 1994.
- Approximately 29 shallow air-injection wells were installed to enhance bioremediation of the organic compounds in the contaminated soils adjacent to the landfill. During start-up, the contractor turned the air injection system on to achieve steady-state conditions, and then off to measure oxygen uptake (respiration) rates in the wells. Results showed that biodegradation was occurring as oxygen levels began to fall rapidly. The air permeability of the soil was measured and found to be as predicted, based on the laboratory study. Lastly, the system was balanced so that each well was injecting the proper amount of air into the soil. Installation of the biotreatment system was completed in June 1994.
- The project managers conducted a pre-final inspection for U.S. EPA and WDNR on June 1, 1994. It was determined that the landfill cap, groundwater extraction and treatment, and soil bioremediation systems were constructed as designed and that they were operational. A punch list of minor tasks to be completed was developed and a schedule for completion of those items was given to the landfill cap and the groundwater subcontractors by U.S. EPA's contractor.
- Region 5 signed the Onalaska preliminary close-out report on July 29, 1994, and within that document scheduled the completion of the first Five-Year Review by May 1998.
- In 1999, a full priority pollutant scan was performed on site groundwater samples to determine whether any new contaminants were present. Previous groundwater analyses were limited to the

chemical of concern identified in the ROD. The priority pollutant scan detected TMB compounds at levels greater than the NR140 ES

- On September 29, 2000, U.S. EPA completed an ESD revising the Site cleanup standards to reflect the then current State of Wisconsin groundwater cleanup standards.
- U.S. EPA issued an ESD for the Onalaska Municipal Landfill on November 13, 2001. The ESD allows for the temporary shutdown of the groundwater extraction and treatment system to evaluate the need for continuous operation of the system and to determine whether natural attenuation processes exist at the site, which might address the remaining groundwater contamination.
- On November 26, 2001, the groundwater extraction and treatment system was shut down.
- In June 2002, WDNR assumed responsibility for the operation and maintenance of the Site.
- From 2002 until today, a groundwater sampling program has been implemented to determine whether MNA will be an effective remedy at the site and to verify that the groundwater contamination plume does not expand.
- In 2006, in order to improve the quality of groundwater data, the WDNR installed four additional NR 140 compliant monitoring wells.
- In June 2008 the Monitored Attenuation Report was completed

Institutional Controls

A review of institutional controls was conducted for this Five-Year Review. ICs are required to ensure the protectiveness of the remedy. ICs are non-engineered instruments, such as administrative and/or legal controls, that help minimize the potential for exposure to contamination and protect the integrity of the remedy. Compliance with ICs is required to assure long-term protectiveness for any areas which do not allow for unlimited use or unrestricted exposure (UU/UE).

The following table lists institutional controls that are known at this time to be required, implemented or recommended.

Table 2: Institutional Controls Summary Table

Media, Engineered Controls & Areas that Do Not Support UU/UE based on Current Conditions	Institutional Control Objective	Title of IC Instrument Implemented, Planned or Recommended
Landfill cap and other remedy components	To prevent activity that would compromise integrity of the cap or the passive gas vent system. To prevent exposure to waste or contaminated soil or groundwater.	WAC NR506.085 currently prohibits use of the waste area for agriculture, construction of any building, and excavation of the cover or any waste material. It is recommended that a deed restriction that runs with the land be recorded.
Contaminated Groundwater	To prevent consumption of or other exposure to contaminated groundwater.	A Declaration of Restriction on Use of Real Property has been recorded at the La Crosse Co.

Media, Engineered Controls & Areas that Do Not Support UU/UE based on Current Conditions	Institutional Control Objective	Title of IC Instrument Implemented, Planned or Recommended
		Register of Deeds Office. The instrument applies to three parcels west, south and east of the landfill property, but not the landfill property itself. The Restriction prohibits use of groundwater underlying the three parcels, any activity that may interfere with the remedy, any construction not approved by the U.S. EPA, and any residential use of the properties. A similar document must be recorded for the real estate parcel on which the landfill itself is located. WAC NR812.08(4)(g) prohibits construction of a water supply well within 1200' of the nearest area of waste disposal. Variances to this prohibition can be issued by WDNR.

Maps which depict the current conditions of the site and areas which do not allow for UU/UE will be developed as part of an IC Plan discussed below.

At this time, initial IC evaluation activities have determined that required ICs have been implemented on three parcels adjacent to the Site but not on the Landfill property. Initial IC evaluation activities have also revealed that additional steps must be taken to evaluate the protectiveness of existing ICs. It is anticipated that the IC Plan, which includes evaluation activities and planning for implementation of ICs at the landfill, will be completed by U.S. EPA and WDNR within 6 months of the Five-Year Review.

ROD Requirement:

The 1990 ROD addressed the need for ICs at the Site. It stated that institutional controls including deed restrictions limiting surface and ground-water use at the site; and State regulations governing groundwater use within 1200 feet of landfills and the development of landfills would be relied on. The ROD did not specifically address or include objectives to prevent interference with the landfill cap (except routine maintenance) nor prohibit any uses of the area such as for residential, commercial or industrial purposes. EPA and DNR will create and IC Plan for the Site which will evaluate the need for any additional ICs that need to be implemented at the Site.

Existing ICs:

Based on the initial evaluation of the institutional controls in place, the following additional actions should be taken: 1) There is no current evaluation of the title for the three properties. An evaluation of the site title should be performed for each property to ensure that there are no prior in time encumbrances or interests such as a mortgage or utility easement which would defeat the efficacy of the restrictive covenants. 2) Maps should be developed to show the restrictions in place for both the on-site and off-site areas. 3) The covenants should be reviewed to ensure that they cover the areas of concern, that the restrictions properly address the IC objectives required by U.S. EPA and WDNR, and that the instruments run with the land and are enforceable. 4) A mechanism and responsible party for long-term stewardship through inspection and monitoring of the institutional controls should also be developed. The IC Plan will address the IC evaluation activities which need to be completed, and additional IC activities as needed to plan for long-term site stewardship. The IC Plan will be developed by U.S. EPA and WDNR within six months of this review.

Current Compliance:

Based on inspections and interviews, neither the U.S. EPA nor WDNR is aware of any uses of the Site including groundwater which are inconsistent with the objectives which will be served by the planned ICs. There is no evidence of Site or groundwater uses which are inconsistent with the objectives of the required use restrictions. There appears to be compliance with the stated objectives of areas requiring use restrictions. No one is being exposed to site-related contaminants. There are no drinking water supply wells installed within the impacted groundwater area. Access to the site is limited. Restrictions on site access and groundwater restrictions appear to be functioning as intended. Long-term compliance with ICs will be accomplished by implementing an IC Plan, which will include various activities such as mapping and a title search, and by providing for long-term stewardship of the Site, which includes maintaining and monitoring effective ICs for the long term.

Long-Term Stewardship:

Since compliance with ICs is necessary to assure the protectiveness of the remedy, planning for long-term stewardship is required. Long-term stewardship involves assuring effective procedures are in place to properly maintain and monitor the site. Long-term stewardship will ensure effective ICs are maintained and monitored and the remedy continues to function as intended with regard to ICs. An IC Plan will be developed to include procedures to ensure long-term IC stewardship such as regular inspection of ICs at the site and annual certification to U.S. EPA and WDNR that ICs are in place and effective.

System Operation/Operation and Maintenance

In accordance with the November 2001 ESD allowing for the temporary shutdown of the groundwater pump and treat system, operation and maintenance for the period of this Five-Year Review include facility maintenance activities conducted in accordance with the Groundwater Treatment Facility Shutdown/Restart Plan (December 5, 2001), groundwater and drinking water sampling and analyses, monitoring well maintenance, and reporting.

Prior to the shut down of the groundwater pump and treat system, annual O &M costs for the years of 1998 through 2001 were approximately $200,000 per year. O&M costs for the groundwater remedy had been estimated in the 1990 ROD to be $150,000 per year. Since shut down of the system, O&M costs from

2002 to 2005 were approximately $60,000 per year. For the years 2006 and 2007, annual O&M costs were about $59,000 per year.

Maintenance of the landfill cap and passive gas vent system, and landfill gas monitoring are carried out by the Town of Onalaska. The prairie grass cap is mowed annually by the Town of Onalaska. Perimeter gas probes are sampled and a report submitted to the WDNR every 3 months.

V. Progress Since the Last Five-Year Review

Table 3: Actions Taken Since the Last Five-Year Review

Issues from Previous Review	Recommendations of Previous Review	Party Respon-sible	Mile-stone Date	Action Taken/Outcome	Date
Review of data indicates that MNA may be effective.	Continue MNA monitoring. Consider whether ROD can be modified to MNA	WDNR	2005	WDNR installed four additional monitoring wells to evaluate concentrations of TMBs near the landfill and within the naphtha contaminated area southwest of the landfill. Data supporting MNA is not strong enough to support amendment to ROD at this time. U.S EPA contracted for evaluation of groundwater data.	2005 2008
1,2,4- and 1,3,5-TMBs were not identified in the ROD as chemicals of concern and were not evaluated for health impacts	Determine if the TMBs require an additional health assessment.	WDNR	2005	Four potable wells were sampled semi-annually. TMBs exceed ES in 4 monitoring wells within the DMZ and close to the waste boundary. There are no exceedances of PAL for TMBs outside DMZ.	2005
Methylene chloride and acetone appear to be lab artifacts in analytical data.	Require laboratory to implement better practices.	WDNR		Lab contaminants were detected occasionally, but not consistently in site samples during the past five year period.	2008
Iron and manganese in groundwater exceed ES in background as well as downgradient wells.	Develop ACLs in accordance with WAC NR140.	WDNR	2005	ACLs are not required, as these are not contaminants of concern in the ROD, background levels are high, and they pose no human health or ecological risk..	2006

Issues from Previous Review	Recommendations of Previous Review	Party Respon-sible	Mile-stone Date	Action Taken/Outcome	Date
The Ackerman private well is directly down-gradient of the landfill.	Increase sampling frequency to semi-annual to assure protectiveness	WDNR	2003	Ackerman well was sampled semi-annually during this five year period and no VOC impacts have been observed. Iron exceeds the PAL, but it should be noted the Ackerman well is deeper than any background wells, draws water from the sandstone, and may have high naturally occurring iron.	2003-2007

VI. Five-Year Review Process

Administrative Components

From September 2007 to July 2008, the review team established the review schedule which included the following components:

- Community Involvement,
- Document Review,
- Data Review,
- Site Inspection,
- Local Interviews, and
- Five-Year Review Report Development and Review.

Members of the review team include Eileen Kramer, Hydrogeologist and Project Manager for the WDNR, Kyle Rogers, Environmental Scientist and Remedial Project Manager for the U.S. EPA.

Community Involvement

Activities to involve the community in the Five-Year Review were initiated in September 2007, with a notification to the Town of Onalaska Chairman of the conduct and goals of the Five-Year Review. In October 2007 display ads were placed in the La Crosse Tribune, Holmen Courier and Onalaska Community Life advising the public that a Five-Year Review would be conducted and providing contact information for individuals wishing to comment or provide information.

Interviews were conducted with members of the community, including Mr. Tim Dienger, the Town Administrator, Mr. Frank Fogel a member of the Town Board, and other local residents.

Document Review

This Five-Year Review consisted of a review of relevant documents including semi-annual and annual groundwater monitoring and O&M reports, the ROD, the two ESDs, the CD between the U.S. EPA and the Town of Onalaska, and ICs related to this site.

Data Review

Groundwater Monitoring

A monitoring program was established for the Long Term Response Action, O&M and Natural Attenuation phases of the cleanup. Initially, quarterly groundwater monitoring was performed to ensure that hydraulic capture of the plume was occurring and that chemical levels in the groundwater were decreasing. Analytes included the chemicals of concern listed in the ROD and those parameters required under the WPDES discharge "permit" issued by WDNR.

When the active groundwater pump and treat system was shut down in accordance with the 2001 ESD, a monitored natural attenuation sampling and analysis program was established. That program has been modified several times based on the interpretation of analytical results and the construction of four new NR141 compliant groundwater monitoring wells. Currently groundwater sampling is performed on a semi-annual basis.

Groundwater flow direction is usually to the west southwest, toward the Black River. Springtime, during high river stage, flow direction swings toward the south. The water table is observed at approximately 10 to 15 feet below ground surface. Monitoring wells with an "S" suffix are water table wells. Monitoring wells with an "M" suffix are approximately 75 feet deep and have 10 foot screens. The wells labeled with "PZ" are screened at about 20 to 30 feet bgs. "EW" wells are extraction wells and are screened from 32 to 82 feet bgs.

- Of the eight VOCs identified in the ROD as chemicals of concern, only benzene has been detected at levels greater than the NR140 PAL during this review period. These exceedances were observed in water from two wells, both within the 250 foot DMZ (See Attachment 9 – Papadopoulos & Associates Report – Figure 4). The last exceedances occurred in 2007. This contrasts with the previous five-year period of January 1998 to December 2002 during which time there were exceedances of five VOC chemicals of concern; benzene, 1,1-dichloroethene, TCE, xylene, and toluene.

- In 1999, a full priority pollutant scan was performed on groundwater samples to determine whether any new contaminants were present. Previous groundwater analyses had been limited to the chemicals of concern identified in the ROD. The priority pollutant scan detected TMB compounds at levels greater than the NR140 ES. Groundwater VOC analyses since 2001 have included full VOCs, including naphthalene and TMBs.

- During this five-year period, naphthalene has exceeded the PAL at least once at five monitoring points. All but one (MW-14S) of these wells are within the landfill DMZ. MW-14S is in close proximity to the Johnson (former Hubley) well. No landfill related VOCs have been detected in water samples collected from the Johnson well during this review period. There have been no exceedances of the NR140 ES for naphthalene in any of the groundwater samples collected during this Five-Year Review period.

- TMBs have exceeded the ES at least once at seven monitoring wells; all of these wells are well within the 250 foot landfill DMZ. An additional three monitoring wells have had at least one exceedance of the PAL for TMBs. Utilizing Mann-Kendall statistical analysis, two monitoring wells, MW-5S and MW-16S, show increasing trends; one well, MW-4S, is stable; and one well, MW-17S, is determined to be non-stable with no trend.

- Wells MW-5S and MW-16S have apparent increasing trends for TMBs. Results from other wells down-gradient of these two should be evaluated. MW-5S and MW-16S are both located within the DMZ and the area observed during the RI to be impacted by non-aqueous phase naphtha solvents.

  Wells down-gradient of MW-5S are PZ-1, EW-5, MW-17S and MW-17M. Groundwater samples from PZ-1 have been collected five times during this review period with no detects of TMBs. EW-5 has been sampled three times with one detect of 0.98 parts per billion (ppb) of 1,2,4-TMB. MW-17S has ES exceedances of TMBs that do not indicate an upward or downward trend. PZ-2, which is down-gradient of MW-17S and outside the DMZ, has had no detects of TMBs. MW-17M, which is within the DMZ, has had low level detects, although no PAL exceedances of TMBs. To date, exceedances of TMBs in the area of MW-5S and down-gradient are confined to within the landfill DMZ. The VOC plume does not appear to be expanding in the area of and down-gradient of MW-5S.

  Wells down-gradient of MW-16S include EW-4, PZ-2, PZ-3, MW-6S, and MW-6M. These wells are outside of the landfill DMZ except for EW-4. EW-4 was sampled three times during the review period and samples exceeded the PAL for TMBs for two of those sample events. PZ-2 and PZ-3, sampled annually, had no exceedances for TMBs and for the most part detects were single digit ppb. MW-6S and MW-6M were sampled annually and had no exceedances and only very low level (<1ppb) detects of TMBs. Based on this data, it appears that TMBs in the area of and down-gradient of MW-16S exceed PAL only within the landfill DMZ; TMBs observed outside the DMZ are well below the PAL. Evaluation of VOC analyses provides no evidence of VOC plume expansion in the area and down-gradient of MW-16S.

- Samples collected from MW-8M, which is located outside of the DMZ, approximately 300 feet south of the waste, have shown increasing concentrations of TMBs, although there have been no exceedances. Wells which are up-gradient of MW-8M and down-gradient of the waste are PZ-5 and MW-4S. While MW-4S, located 40 feet south of the waste, has ES exceedances for TMBs, the trend according to the Mann-Kendall analysis is stable. PZ-5 has had detects of TMBs in two of eight sampling events, although concentrations have been less than 10 ppb, well below the PAL. If groundwater quality up-gradient of MW-8M does not continue to degrade, water quality at MW-8M should eventually improve. MW-10M is down-gradient of MW-8M and has no detects of TMBs during this review period. MW-8M should continue to be monitored with frequent evaluation of results.

- Manganese and iron are the only metals that exceeded the ES outside of the DMZ during this review period. The concentrations of manganese and iron detected at the site are within a general range of background levels of manganese and iron in groundwater in Wisconsin. In the sand and gravel aquifer in the Trempealeau—Black River hydrologic basin, iron in groundwater generally can range from zero to almost 8000 parts per billion, with a great deal of variability within short distances. (Young and Borman, USGS). Observed levels of iron and manganese in drinking water wells up-gradient of the site indicate that much of the dissolved iron and manganese down-gradient of the landfill can be attributed to natural background. These are not contaminants of concern for the site as they pose no human health or ecological risk.

- The MCL for arsenic has been revised. It is now 10 ppb. Wells MW-2M, MW-16M, EW-2, EW-3, EW-4 and EW-5 exceed the MCL for arsenic. These wells are all located within the landfill DMZ. The ES for barium is not exceeded in any monitoring point. The PAL for barium is exceeded at four wells outside the DMZ (MW-6M, MW-8M, MW-15M, and the Miller well) and at seven wells within the DMZ (MW-2M, MW-16S, MW-16M, MW-17M, EW-2, EW-3 and EW-4).

- The Ackerman residential well is located downgradient of the landfill and has been sampled semi-annually. The well is open in sandstone from 181 to 207 feet bgs. No VOCs have been detected. Iron and manganese are observed consistently in exceedance of the ES. Based on the depth of the well and distance from the waste, it is most likely that the observed dissolved metals are naturally occurring.

- The Johnson private well is side-gradient of the landfill and has also been sampled semi-annually. No VOCs have been detected during this review period, except one detect of 1,2,4-TMB at 0.18 ppb in October 2003. Iron and manganese have been detected in exceedance of PAL and ES, although concentrations are within the range of naturally occurring concentrations.

- The Miller and Pretasky private wells are up-gradient of the landfill, have been sampled semi-annually during this review period, and have had exceedances of iron, manganese and arsenic. Neither has had detects of landfill related VOCs. The Miller well is 300 feet north of the landfill and approximately 50 feet from the Black River. The Pretasky well is about 230 feet north of the landfill and 175 feet from the Black River. The concentrations of iron and manganese in the Miller well are about five times the concentrations in the Pretasky well. A review of groundwater elevations and potentiometric surfaces including data from up-gradient and source area monitoring wells, does not indicate groundwater mounding and radial flow from the landfill nor any other instances of groundwater flow toward the north. Given the relative locations of these two private wells along with lack of evidence for groundwater mounding under the landfill nor any component of groundwater movement from the landfill to the north, it does not appear likely that the metals in these two private wells are migrating from the landfill. Iron and manganese concentrations exceed the ES. Arsenic concentrations in these two drinking water wells have exceeded the PAL, but not the ES or MCL.

U.S. EPA contracted with S.S. Papadopoulos & Associates for an evaluation report on the MNA monitoring at the site. The text portion of the report is included as Attachment 9. Groundwater data tables, as well as the groundwater sampling schedule, are included in Attachment 3.

Soil

In March 2006, four new monitoring wells were installed by WDNR to obtain more representative groundwater data than data acquired from the "AW" wells which are screened only one foot into the water table. Two water table wells and two medium depth piezometers nested with the water table wells were constructed; the MW-16 nest about 45 feet west of the waste and the MW-17 nest about 150 feet west of the waste. Both are within the area documented during the RI to be impacted by non aqueous phase naphtha solvents. Soil samples were collected in each of the borings for the shallow wells at the water table. The highest concentrations in soil were of the TMB compounds. Combined TMBs in soil at MW-16S were 96 parts per million (ppm); at MW-17S they were 6.53 ppm. WAC NR720 does not specify allowable residual contaminant levels for the TMBs. It is not known whether the contaminated soil may be a source of the increasing levels of TMBs in the groundwater. Additional data regarding residual contamination in the soil southwest of the landfill where naphtha solvents had been observed during the RI should be acquired and evaluated to determine whether the soil is acting as an on-going source of contamination to the groundwater.

Soil Vapors

In March 2006, soil gas samples were collected and evaluated. Field screening with a landfill gas meter and a photoionization detector indicated that an area around AW-15 and GM-4 had soil vapors with depleted oxygen and elevated methane and carbon dioxide. Five vapor samples were collected with Summa canisters and laboratory analyzed. The highest concentrations of benzene and TMBs were observed in the sample from AW-15. The figure indicating the locations where vapor samples were collected and tabulated results are included in Attachment 4.

Site Inspection

Inspection of the site was conducted on September 26 and 27, 2007, by the WDNR project manager and hydrogeologist and the U.S. EPA RPM. The purpose of the inspection was to assess the protectiveness of the remedy, including the presence of fencing to restrict access, the integrity of the cap and the condition of the remediation system.

No significant issues were identified at any time regarding the cap. The prairie grass cover was observed to cover the cap evenly, although it had just been mowed to facilitate the inspection. The ROD requires a line of fencing to limit vehicular access at the southern edge of the landfill. The split rail fence was observed to be damaged and should be repaired and possibly improved. It should be noted that fencing at the site is intended to allow the movement of wildlife. The site is adjacent to a U.S. Fish and Wildlife Service Preserve and is a known turtle nesting area. No evidence of trespassing or vandalism was noted.

The groundwater pump & treat system and its associated building and equipment were observed to be in good condition and regularly maintained. Four of the five extraction wells are pumped for five minutes each once per month to minimize fouling and assure operation of the pumps. One well, EW-1, is not operable and would require troubleshooting and repair if the active groundwater remediation were required to be re-started. (The site maintenance person believes it may be a faulty electric transformer.) The components of the soil bio-remediation air injection system are still present and in good condition, although injection wells may require cleaning out if the air injection system were re-started. The condensate trap on the large Ingersoll Rand air compressor would need to be repaired if the active groundwater remediation were to be re-started. Also, the bearings in the floor sump pump are noisy when the pump is operated, and would require repair if the facility were to return to full-time use. Rubber gaskets in the sludge pumps would need to be replaced if the sludge press and pumps were re-activated. The overall condition of the facility is very good.

The monitoring wells were located and inspected. All wells were in good condition, properly labeled, and accessible. All wells, except MW-5S, had appropriate protective tops or flush mounts and surface seals in good condition. MW-5S was recently converted to a stick up type well to alleviate the potential for ponding around the well where the ground surface grade had been raised. An above-grade protective top is yet to be installed.

Interviews

Interviews were conducted with various parties connected to the site. Peter Moore of ENSR, the State's contractor for the site, has provided maintenance and monitoring oversight at the site for at least eight years. Work at the site has gone well. The neighbors have been cooperative in allowing potable well sampling. Bill Wood, an employee of ENSR, has provided most of the on-site maintenance. He has been associated with the site also for at least eight years. He is concerned that the equipment remain in good condition and operable. Mr. Frank Fogel, a member of the Town of Onalaska Board, was interviewed on the phone. Mr. Fogel expressed concern with the increasing cost of the quarterly landfill gas monitoring.

On September 27, 2007, the U.S.EPA and WDNR representatives visited Mr. Tim Dienger, Administrator for the Town of Onalaska. Mr. Dienger stated that he is pleased with the progress that has been made at the site. The agencies and Mr. Dienger discussed a recent request from the Prinsens who own a land parcel south of the site, for an easement across the adjacent Town owned parcel for road access. The Prinsens have advertised for the sale of their parcel. The agencies have encouraged the Town to purchase the Prinsen parcel to assure its future use being consistent with the neighboring wildlife preserve. Based on proximity to the landfill, WAC NR812.11 would not allow construction of a water supply well on the Prinsen parcel making its use for commercial or residential development questionable.

During the site inspection the agencies also visited with Mr. Roy Ackerman who lives south of the site and whose water supply well is sampled regularly by the WDNR. Mr. Ackerman stated that he observes "headlights" of vehicles on the cap sometimes at night. This information was passed on to the Town administrator along with direction that the fence at the south end of the landfill should be repaired. A follow-up inspection should be conducted.

Photos from the site inspection and the Site Inspection Checklist are included in Attachments 10 and 7 respectively.

VII. Technical Assessment

<u>Question A: Is the remedy functioning as intended by the decision documents?</u>

Yes. From 2001 to 2008, the Site has been evaluated for natural attenuation as a viable cost effective remedy over the groundwater extraction remedy. Monitoring for natural attenuation began in the fall of 2001. Results do not demonstrate that natural attenuation is more effective than the current remedy, and the contaminants of concern, except for arsenic and barium, within the design management zone meet the cleanup standards established in the 1991 ROD and subsequent ESD. The elevated arsenic and barium levels are unlikely to be reduced below cleanup standards through the pump and treat system.

In 1999, new contaminants of concern were identified. Trimethylbenzene compounds were detected in monitoring wells above State PALs, A risk analysis for these contaminants and additional investigation of contaminated soil that may be acting as a source of contamination to the groundwater is recommended.

Currently, the Onalaska Landfill Superfund Site is protective of human health and the environment because the landfill cap is effective; groundwater monitoring assures that drinking water supplies remain safe; and that the plume is contained, most of the contaminants have been remediated; and institutional controls prevent activities that would compromise the cap or expose parties to contaminated groundwater.

Institutional controls including deed restrictions and the WAC Ch. NR812 *prohibition on* construction of water supply wells within 1200 feet of any landfill prevent potential exposure to contaminated groundwater. The water supply wells have been sampled regularly and should continue to be sampled regularly to prevent any potential exposure.

The institutional controls that are in place include prohibitions on the use or disturbance of groundwater until cleanup levels are achieved, and prohibitions on excavation activities, disturbance of the cap, and any other activities or actions that might interfere with the implemented remedy. No activities were observed that would have violated the institutional controls. The cap and the surrounding area were undisturbed, and no new uses of groundwater were observed. The fence around the site is intact, but in need of some repair.

While deed restrictions have been recorded on Town owned parcels adjacent to the landfill property, and WAC NR506 prohibits activities on the landfill property that would compromise the cap and the protectiveness of the remedy, a deed restriction has not been recorded for the property on which the landfill is located. An appropriate document should be drafted by the Town, reviewed by the US. EPA and WDNR , and recorded at the La Crosse County Register of Deeds Office.

Additionally, to assure that the remedy continues to function as intended, the ICs must be fully evaluated to assure that effective ICs are implemented, monitored and maintained. To that end, an IC Plan will be prepared.

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?

No, WAC NR140 standards for arsenic have changed. In January 2001, the U.S. EPA established a new federal drinking water MCL of 10 ppb. Subsequently the State has adopted the federal MCL of 10 ppb as the NR 140 enforcement standard for arsenic. Because arsenic is a known carcinogen, an NR 140 preventive action limit of 1 ppb, 10% of the recommended 10 ppb enforcement standard, has been promulgated. On March 1, 2004, the NR140 standards for arsenic changed from an ES of 50 ppb to 10 ppb, and the PAL from 5 ppb to 1 ppb. Other exposure assumptions, toxicity data, cleanup levels and RAOs are still valid. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

The change in NR140 standards for arsenic results in ES exceedances for arsenic within the landfill DMZ. NR140 specifies a range of responses for ES exceedances within a DMZ; one of which is "no action".

Applicable or Relevant and Appropriate Requirements (ARARs) that still must be met at this time and that have been evaluated include: the Safe Drinking Water Act (40 CFR 141.11-141.16) and WAC NR140 from which many of the groundwater cleanup levels were derived - [NR140 PAL and ES, MCLs, and MCL Goals (MCLGs)]; and ARARs related to post-closure monitoring.

The exposure assumptions used to develop the Human Health Risk Assessment included the ingestion of contaminated groundwater, ingestion of and/or dermal contact with on-site soils, and direct contact with contaminated surface waters or sediments due to recreational use of the Black River and wetlands area. Based on data collected to date, there has been no impact to surface waters or sediments surrounding the Site, and thus there is no exposure risk associated with the recreational use of the Black River or wetlands area. The remaining exposure pathways consist of ingestion of and/or dermal contact with contaminated groundwater and with on-site soils. There are currently institutional controls that prohibit construction in or disturbance of site soils and construction of wells near the site. Overall the concentrations of total VOCs at the site have been reduced since the 1992 risk assessment through operation of the treatment systems, and thus the resulting toxicity of the chemicals is now lower. Therefore the risk associated with VOCs in site soils and groundwater has been minimized. The trimethylbenzenes were not included as chemicals of concern in the risk assessment and were found in the groundwater at the site during a priority pollutant scan in 1999. It should be noted that there has only been one PAL exceedance for TMBs outside the 250 foot landfill DMZ during this review period. Arsenic was observed to exceed the NR140 PAL at one monitoring well, MW-8. Groundwater and drinking water monitoring have demonstrated that impacts to the groundwater are not affecting potable wells.

The original exposure assumptions used in the risk assessment are considered to be conservative and reasonable in evaluating risk and developing risk-based cleanup levels. No changes to these assumptions is warranted. There have been no changes to the standardized risk assessment methodology that could affect the protectiveness of the remedy.

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

No, no other information has come to light that calls into question the protectiveness of the remedy.

Technical Assessment Summary

There have been no changes in the physical conditions of the site that would affect the short-term protectiveness of the remedy. There have been no changes in the toxicity factors for the contaminants of concern that were used in the baseline risk assessment other than those noted above, and there has been no change to the standardized risk assessment methodology that could affect the protectiveness of the remedy. There is no other information that calls into question the short-term protectiveness of the remedy.

VIII. Issues

Table 4 - Issues

Issue	Currently Affects Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
1. Increasing TMB concentrations in two monitoring wells located within the area where non-aqueous phase naphtha solvents had been observed during the RI.	N	Y
2. Increasing TMB concentration (although not in exceedance of the PAL) in MW-8M which is located outside the DMZ	N	Y
3. Concentrations of arsenic and barium exceed the cleanup standards, although there are no exceedances of the federal MCL or State ES outside the DMZ.	N	Y
4. Damaged fence at southern perimeter of landfill	N	Y
5. The required deed restriction on the landfill property that is enforceable by the WDNR and U.S. EPA has not been recorded at the La Crosse Co. Register of Deeds office. Implementing, maintaining and monitoring of the ICs will be required to assure protectiveness of the remedy.	N	Y
6. Prinsen property is located south of the site and within 1200 feet of the landfill. NR812 prohibits construction of a water supply on the property without a variance from the WDNR, but no deed notice that runs with the land has been recorded.	N	Y
7. Report of possible vehicle operation at night on the landfill.	N	Y
8. MW-5S does not have an above-grade protective top.	N	N
9. Quality of groundwater immediately outside the landfill DMZ requires additional characterization.	N	Y
10. Potable wells in proximity to landfill.	N	Y
11. The need to evaluate current ICs at the Site to determine if any additional ICs should be implemented.	N	Y

IX. Recommendations and Follow-Up Actions

Table 5 - Recommendations and Follow-Up Actions

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
					Current	Future
1. Increasing concentrations of TMBs in some monitoring wells	Additional data regarding residual contamination in the soil southwest of the landfill where naphtha solvents had been observed during the RI should be acquired and evaluated to *determine whether the* soil is acting as an on-going source of contamination to the groundwater.	U.S. EPA WDNR	U.S. EPA WDNR	Finalize scope of work by January 2009. Initiate field work by May 2009.	N	Y
2. Increasing TMB concentration (although not in exceedance of the PAL) in MW-8M which is located outside the DMZ.	On-going monitoring of MW-8M to evaluate whether concentrations will begin to stabilize and decrease due to decrease in loading in the up-gradient area.	U.S. EPA WDNR	U.S. EPA WDNR	Annual	N	Y
3. Arsenic and barium exceed the cleanup standards	Proposed ACLs for arsenic, barium which occur naturally should be finalized.	WDNR	WDNR U.S. EPA	April 2009	N	Y
4. Damaged fence at southern *perimeter of* landfill	The fence should be restored and perhaps extended.	Town of Onalaska	WDNR	December 2008	N	Y

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
					Current	Future
5. A deed restriction on the landfill property that is enforceable by the WDNR and U.S. EPA has not been recorded at the La Crosse Co. Register of Deeds office.	*The Town should* draft for WDNR and U.S. EPA review and approval a deed instrument that restricts activities and access to the landfill to protect the integrity of the cap and to prevent exposure to contaminated media.	Town of Onalaska	WDNR U.S. EPA	June 2009	N	Y
6. Prinsen property is located south of the site. NR812 would prohibit construction of a water supply on the property without a variance from the WDNR, but no deed notice that runs with the land has been recorded.	The agencies should determine whether a deed instrument that runs with the land to restrict its use is necessary to assure protectiveness	WDNR U.S. EPA	WDNR U.S. EPA	June 2010	N	Y
7. Report of possible vehicle operation at night on the landfill.	Discuss with Town Administrator. Encourage routine drive-by surveillance. Evaluate whether extending fence would prevent vehicular access	Town of Onalaska	WDNR	December 2008	N	Y

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
					Current	Future
8. MW-5S	A protective top that complies with NR141 WAC should be constructed.	WDNR	WDNR	June 2009	N	N
9. Quality of groundwater immediately outside the DMZ	Additional monitoring wells to determine concentrations of arsenic and barium at the DMZ should be installed.	WDNR U.S. EPA	WDNR U.S. EPA	August 2009	N	Y
10. Potable wells in proximity to landfill	Monitoring of the four drinking water wells in proximity to the site should continue and the potential for impact from the landfill be evaluated again.	WDNR U.S. EPA	WDNR U.S. EPA	Annually	N	Y
11. No IC Plan in place for the Site	Implement an IC Plan for the Site to evaluate if any additional ICs need to be added.	WDNR U.S. EPA	WDNR U.S. EPA	June 2009	N	Y

X. Protectiveness Statement

Currently, the Onalaska Landfill Superfund Site is protective of human health and the environment in the short-term because the landfill cap is effective; groundwater monitoring assures that drinking water supplies remain safe and that the plume is contained; most contaminants of concern have been remediated to meet ROD cleanup standards; and institutional controls prevent activities that would compromise the cap or expose parties to contaminated groundwater. However, in order to remain protective in the long-term additional soil investigation, and possible remediation of TMB, will be needed, on-going monitoring and evaluation of arsenic and barium in groundwater must be done, and the required restrictive covenant for the landfill cap must be drafted and recorded as required by the Consent Decree.

Long term protectiveness also requires compliance with the land and groundwater use restrictions. Compliance with effective ICs will be ensured by implementing, monitoring and maintaining effective ICs as well as maintaining the site remedy components. Long-term stewardship must be ensured to verify compliance with ICs.

XI. Next Review

The next Five-Year Review for the Onalaska Landfill Superfund Site is required by July 2013, five years from the date of this review.

ATTACHMENTS

ATTACHMENT 1
MAPS

Site Location

Site Features

Onalaska Landfill Superfund Site

Legend

- Open Sites (ongoing cleanups)
- County Boundary
- Railroads
- Major Highways
  - Interstate
  - US Highway
  - State Highway
- Local Roads
- Civil Towns
  - Civil Town
- 24K Open Water
- 24K Rivers and Shorelines
- Municipalities
- DNR Managed Lands
  - Fee

0 5000 10000 15000 ft.

Map created on May 1, 2008

Note: Not all RR Sites have been geo-located yet.

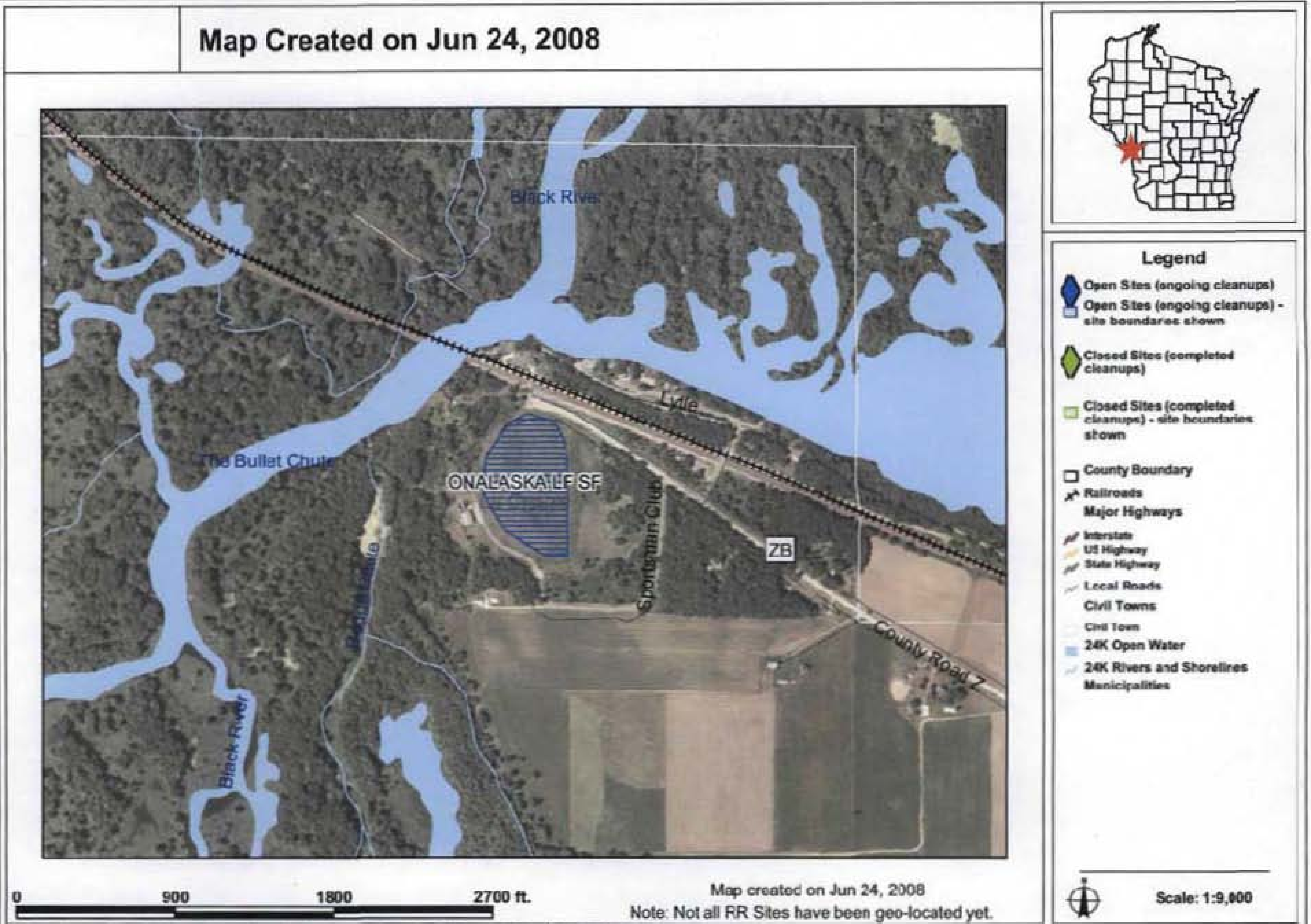
Scale: 1:50,347

This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

Notes: Location in La Crosse County

Figure 1

Map Created on Jun 24, 2008



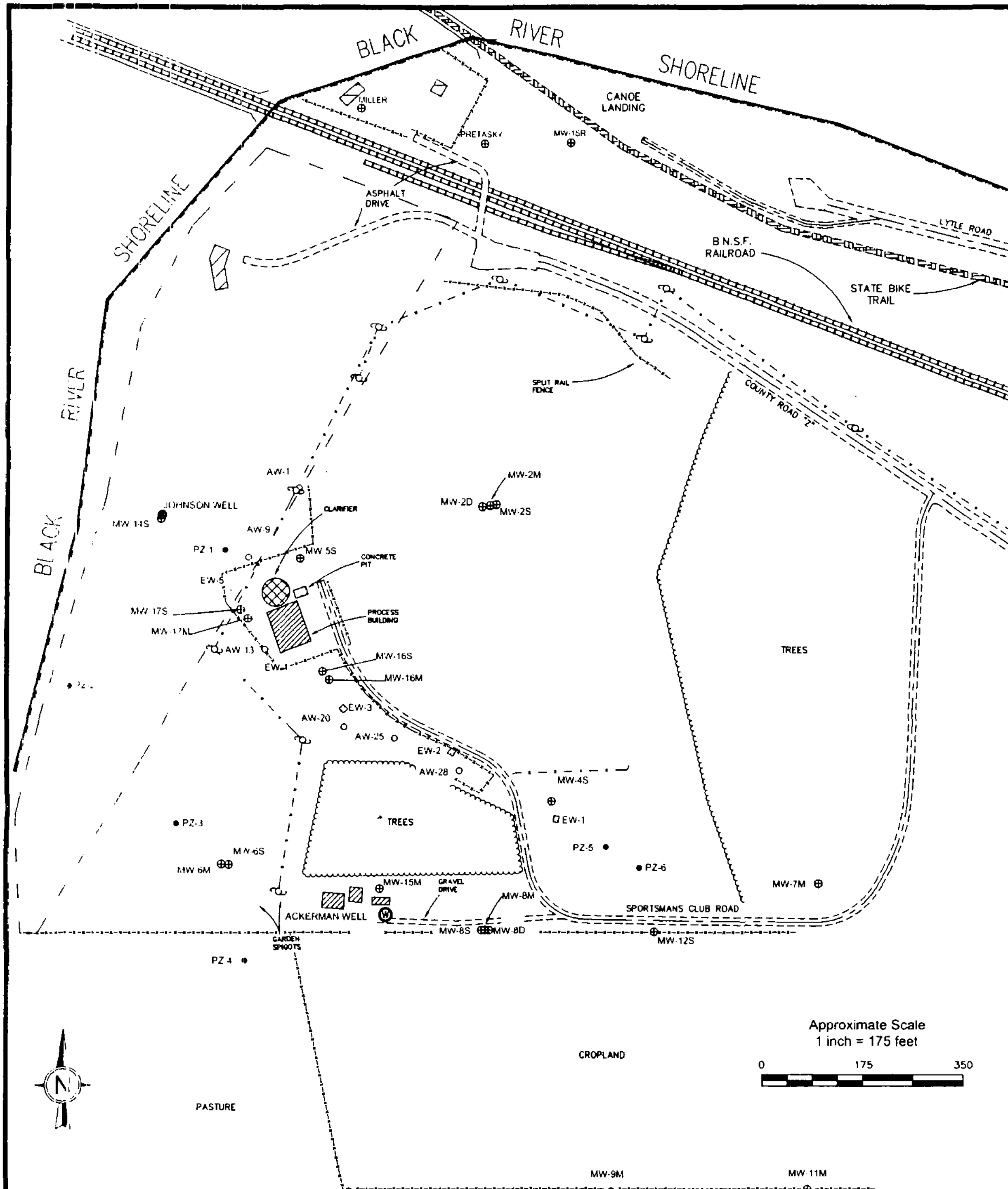
Map created on Jun 24, 2008

Note: Not all RR Sites have been geo-located yet.

This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

Notes: Onalaska Landfill Superfund Site
Town of Onalaska
La Crosse County
Wisconsin

FIGURE 1 A



LEGEND

- ⊕ = Monitoring Well
- ● = Piezometer
- = Extraction Well
- O = Air Well
- = Approximate Property Line
- = Centerline
- = Fence line
- = Utility lines
- = Utility pole
- = Hydrant

NOTES

Source:
Onalaska Landfill Site Plan Survey, prepared by Coulee Region Land Surveyors, Inc., project no. S-4754, dated 5/14/03.

FIGURE NUMBER	SITE PLAN			ENSR AECOM	DESIGNED BY: AC	REVISIONS			
	ONALASKA LANDFILL				DRAWN BY: BLK	NO.:	DESCRIPTION	DATE	BY
	ONALASKA, WISCONSIN			ENSR CORPORATION ST LOUIS PARK, MINNESOTA 55416 PHONE: (952) 924-0117 FAX: (952) 942-0317 WEB: HTTP://WWW.ENSR.AECOM.COM	CHECKED BY: DCP				
SHEET NUMBER	SCALE: 1" =	DATE: 11/16/07	PROJECT NUMBER: 7349-002		APPROVED BY: PJM				

ATTACHMENT 2

List of Documents Reviewed

DOCUMENTS REVIEWED

CH2M HILL, Remedial Investigation Report, Onalaska Municipal Landfill, December 22, 1989.

CH2M HILL, Groundwater Treatment Facility Shutdown/Restart Plan, Onalaska Municipal Landfill, December 2001.

CH2M HILL, Monitored Natural Attenuation Plan, Onalaska Municipal Landfill Site, 2001.

ENSR International, 2004/2005 Annual Monitored Natural Attenuation Report for the Onalaska Municipal Landfill Site, September 2005.

ENSR/AECOM, *2006 Annual Monitored Natural Attenuation Report for the Onalaska Municipal Landfill* Site, November 2006.

ENSR/AECOM, 2007, Annual Monitored Natural Attenuation Report for the Onalaska Municipal Landfill Site, November 2007.

Papadopulos, S.S., Evaluation of Monitored Natural Attenuation as A Containment Remedy for the Onalaska Municipal Landfill Site, Onalaska, Wisconsin, June 2008.

U.S. EPA, Record of Decision, Selected Remedial Alternative for the Onalaska Municipal Landfill Site, August 14, 1990.

U.S. EPA, Explanation of Significant Difference, Onalaska Municipal Landfill Superfund Site, September 29, 2000.

U.S. EPA, Explanation of Significant Difference, Onalaska Municipal Landfill Superfund Site, November 13, 2001.

WDNR, *Second Five-Year Review Report of the Onalaska Municipal Landfill Site*, July 2003.

ATTACHMENT 3

Groundwater Data

MW-4S
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	12/12/2002	04/22/2003	10/08/2003	04/13/2004	09/24/2004	12/02/2004	03/10/2005	06/09/2005	03/23/2006	09/07/2006
1,2,4-Trimethylbenzene	**540**	**780**	**1100**	**1100**	**1900**	**1600**	**1100**	**1500**	**580**	**1200**
1,3,5-Trimethylbenzene	**120**	**170**	**230**	**310**	**390**	**410**	**260**	**380**	**150**	**260**
Acetone	< 28	< 31	< 55	< 26	<53	<37	<25	<37	48	<25
Benzene	< 9.2	< 11	< 17	**13**	<16	<11	<7.3	<11	<3.7	<7.3
Ethylbenzene	10	16	38	9.4	50	26	21	32	4.1	9.6
Methylene chloride	< 7.2	< 8.3	< 23	< 11	<14	**49**	<6.3	<9.5	<3.2	<6.3
Naphthalene	< 10	14	20	< 6.4	<11	<7.5	14	32	7	18
Xylenes (total)	29	54	160	52	210	93	77	140	23	52

Metals, mg/L										
Arsenic	0.0089	0.0065	0.0091	0.0086	0.0066	0.0095	0.0083	0.0091	0.0052	<0.0043
Barium	0.3	0.26	0.29	0.33	0.29	0.32	0.315	0.361	0.248	0.267
Cadmium	< 0.00028	< 0.00028	< 0.00036	< 0.00028	<0.00028	<0.00028	<0.00028	<0.00028	<0.00042	<0.00042
Cobalt	< 0.00074	< 0.00074	< 0.0011	< 0.00096	<0.00096	<0.00096	<0.00096	<0.00096	<0.0012	<0.0012
Iron	**16.9**	**15.4**	**18.9**	**24.7**	**18**	**22.9**	**23.8**	**27.5**	**17**	**16.1**
Lead	< 0.0016	< 0.0016	< 0.0023	< 0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017
Manganese	**2.1**	**1.8**	**2.1**	**2.1**	**2.1**	**2.5**	**2.14**	**2.29**	**1.41**	**1.78**
Mercury	< 0.000087	< 0.000087	< 0.000067	< 0.000029	0.000045	<0.000029	<0.000029	0.000087	<0.00009	<0.00009
Vanadium	< 0.00067	< 0.00067	< 0.00096	< 0.00071	<0.00071	<0.00071	0.0011	<0.00071	<0.0019	<0.0019

Natural Attenuation Parameters, mg/L										
Chloride	13.5	10.2	7.7	11.4	---	5.9	----	15.9	13.8	9.6
Nitrate as N	< 0.0076	< 0.0076	< 0.019	< 0.016	---	<0.016	----	<0.016	<0.015	<0.031
Sulfate	0.98	0.22	0.15	1	---	0.14	----	0.16	2.9	0.68
Total Alkalinity	280	260	290	310	---	---	----	----	220	260
Total Organic Carbon	5	5	4	12	---	---	----	----	9	12

pH	6.66	---	6.825	---	6.34	6.61	7.22	6.44	6.96	-94.2
Conductivity (mS/cm)	0.612	---	0.611	---	0.635	0.645	0.596	391	330	343
Temperature (C)	12.02	---	11.72	---	11.88	12.44	11.19	10.49	11.21	12.13
ORP (mV)	117	---	133	---	181	173	179	-78.3	-73	-94.2
Dissolved Oxygen (mg/L)	4.49	---	7.49	---	3.02	1.13	2.08	1.43	3.6	0.18

MW-4S
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	03/22/2007	09/11/2007	PAL	ES
1,2,4-Trimethylbenzene	**660**	**1200**	96	480
1,3,5-Trimethylbenzene	**110**	**280**	96	480
Acetone	<12	<55	200	1000
Benzene	<3.7	<6.5	0.5	5
Ethylbenzene	3.7	19	140	700
Methylene chloride	<3.2	<16	0.5	5
Naphthalene	8.3	30	10	100
Xylenes (total)	25	120	1,000	10,000

Metals, mg/L

Arsenic	<0.0043	0.0058	0.001	0.01
Barium	0.244	0.328	0.4	2
Cadmium	<0.00042	<0.00042	0.0005	0.005
Cobalt	<0.0012	<0.0012	0.008	0.04
Iron	**13.3**	**14.9**	0.15	0.3
Lead	<0.0017	<0.0017	0.0015	0.015
Manganese	**1.28**	**1.84**	0.025	0.05
Mercury	<0.00009	<0.00009	0.0002	0.002
Vanadium	<0.0019	<0.0019	0.006	0.03

Natural Attenuation Parameters, mg/L

Chloride	8.9	4.4	125	250
Nitrate as N	0.36	<0.023	2	10
Sulfate	0.83	<0.12	125	250
Total Alkalinity	240	340	----	----
Total Organic Carbon	10	14	----	----

pH	6.89	6.75	----	----
Conductivity (mS/cm)	350	0.404	----	----
Temperature (C)	10.58	11.73	----	----
ORP (mV)	-56.7	118.6	----	----
Dissolved Oxygen (mg/L)	0.75	1.09	----	----

MW-5S
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	03/10/2005	06/10/2005	Duplicate 6/10/2005	03/23/2006	09/07/2006	03/22/2007	09/11/2007	PAL	ES
1,2,4-Trimethylbenzene	**490**	**1300**	**1200**	**670**	**710**	**1200**	**1100**	96	480
1,3,5-Trimethylbenzene	**48**	**390**	**370**	**73**	**110**	**120**	**160**	96	480
2-Butanone	<4.9	<16	<16	10	<7.1	<7.8	<28	90	460
Acetone	<9.2	<31	<31	38	<13	<15	<55	200	1000
Benzene	<2.8	<9.2	<9.2	<4.4	<4	<4.4	<6.5	0.5	5
Ethylbenzene	17	57	51	41	19	23	10	140	700
Methylene chloride	<2.4	<7.9	<7.9	<3.8	<3.5	<3.8	<16	0.5	5
Naphthalene	19	41	40	48	42	44	32	10	100
Xylenes (total)	61	250	240	53	83	30	40	1,000	10,000

Metals, mg/L

Metals, mg/L	03/10/2005	06/10/2005	Duplicate 6/10/2005	03/23/2006	09/07/2006	03/22/2007	09/11/2007	PAL	ES
Arsenic	**0.0151**	**0.0231**	**0.0227**	**0.0137**	**0.0138**	**0.0121**	0.0062	0.001	0.01
Barium	0.391	0.5	0.519	0.392	0.382	0.383	0.281	0.4	2
Cadmium	<0.00028	<0.00028	<0.00028	<0.00042	<0.00042	<0.00042	<0.00042	0.0005	0.005
Cobalt	0.0086	0.0126	0.0127	0.0099	0.0105	0.0109	0.0056	0.008	0.04
Iron	**39.7**	**60.7**	**59.1**	**39.2**	**40.7**	**39.1**	**14.6**	0.15	0.3
Lead	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**2.83**	**3.86**	**3.83**	**3.98**	**4.87**	**3.79**	**1.85**	0.025	0.05
Mercury	<0.000029	0.00009	0.000058	<0.00009	<0.00009	<0.00009	<0.00009	0.0002	0.002
Vanadium	<0.00071	0.0013	<0.00071	<0.0019	<0.0019	<0.0019	<0.0019	0.006	0.03

Natural Attenuation Parameters, mg/L

Natural Attenuation Parameters, mg/L	03/10/2005	06/10/2005	Duplicate 6/10/2005	03/23/2006	09/07/2006	03/22/2007	09/11/2007	PAL	ES
Chloride	----	4.8	4.6	6	2.5	5.9	4.2	125	250
Nitrate as N	----	<0.016	<0.016	0.18	<0.031	0.63	0.2	2	10
Sulfate	----	0.2	0.18	0.52	2.5	1	3.6	125	250
Total Alkalinity	----	----	----	200	250	220	280	----	----
Total Organic Carbon	----	----	----	9	13	9	7	----	----

Field Parameters	03/10/2005	06/10/2005	Duplicate 6/10/2005	03/23/2006	09/07/2006	03/22/2007	09/11/2007	PAL	ES
pH	7.12	6.08	----	6.76	6.59	6.71	6.49	----	----
Conductivity (mS/cm)	0.489	340	----	320	365	339	0.367	----	----
Temperature (C)	10.51	10.5	----	10.69	12.64	9.83	13.27	----	----
ORP (mV)	183	-75.2	----	-59.2	-88.8	-53.5	168.1	----	----
Dissolved Oxygen (mg/L)	2.51	0.76	----	0.97	0.62	0.65	0.53	----	----

MW-5S
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	12/12/2002	04/22/2003	10/07/2003	04/14/2004	Duplicate 4/14/2004	09/23/2004	Duplicate 9/23/2004	12/02/2004	Duplicate 12/2/2004
1,2,4-Trimethylbenzene	210	180	**750**	67	51	210	150	**1300**	**1200**
1,3,5-Trimethylbenzene	47	38	**200**	2.7	2.4	19	15	**350**	**330**
2-Butanone	< 4.5	< 3.4	< 24	< 1.2	< 0.72	<2.2	<3	<20	<20
Acetone	< 8.5	< 6.3	< 44	< 2.2	< 1.3	<4.2	<5.7	<37	<37
Benzene	< 2.8	< 2.1	< 13	1.5	0.56	<1.3	<1.7	<11	<11
Ethylbenzene	6.2	5.1	29	1.5	1.2	5.9	5.7	60	54
Methylene chloride	3.9	< 1.7	< 19	< 0.93	< 0.56	<1.1	<1.5	**41**	**41**
Naphthalene	6.2	5.4	28	2.2	1.6	7.7	14	<7.5	<7.5
Xylenes (total)	12	13	150	2	1.8	120	94	160	160

Metals, mg/L

Metals, mg/L	12/12/2002	04/22/2003	10/07/2003	04/14/2004	Duplicate 4/14/2004	09/23/2004	Duplicate 9/23/2004	12/02/2004	Duplicate 12/2/2004
Arsenic	0.0098	**0.011**	**0.022**	**0.01**	**0.012**	0.0053	0.0047	**0.012**	**0.012**
Barium	0.18	0.28	0.27	0.27	0.28	0.29	0.29	0.31	0.29
Cadmium	< 0.00028	< 0.00028	< 0.00036	< 0.00028	< 0.00028	<0.00028	<0.00028	0.00032	0.00033
Cobalt	0.0025	0.0041	0.0058	0.0045	0.0041	0.0056	0.0054	0.0094	0.0091
Iron	**10.2**	**19.4**	**30.5**	**11.2**	**11.7**	**15.9**	**16.3**	**34.7**	**31.9**
Lead	< 0.0016	< 0.0016	< 0.0023	< 0.0017	< 0.0017	<0.0017	0.003	<0.0017	<0.0017
Manganese	**1.6**	**2**	**2.3**	**1.3**	**1.3**	**2.5**	**2.6**	**3.3**	**3.1**
Mercury	0.000088	< 0.000087	0.000075	< 0.000029	< 0.000029	<0.000029	<0.000029	<0.000029	<0.000029
Vanadium	< 0.00067	< 0.00067	< 0.00096	< 0.00071	< 0.00071	<0.00071	<0.00071	<0.00071	<0.00071

Natural Attenuation Parameters, mg/L

Natural Attenuation Parameters, mg/L	12/12/2002	04/22/2003	10/07/2003	04/14/2004	Duplicate 4/14/2004	09/23/2004	Duplicate 9/23/2004	12/02/2004	Duplicate 12/2/2004
Chloride	5.8	5.7	4.3	4.6	4.5	---	---	5	5
Nitrate as N	0.1	0.62	0.02	0.94	1.3	---	---	0.47	0.45
Sulfate	0.34	3.3	0.16	1.8	2.3		---	0.77	0.81
Total Alkalinity	140	160	180	160	160	---	---	---	---
Total Organic Carbon	5	4	9	6	6	---	---	---	---

	12/12/2002	04/22/2003	10/07/2003	04/14/2004	Duplicate 4/14/2004	09/23/2004	Duplicate 9/23/2004	12/02/2004	Duplicate 12/2/2004
pH	6.99	7.12	6.65	---	---	6.1	---	6.42	---
Conductivity (mS/cm)	0.333	0.379	0.425	---	---	0.645	---	0.549	---
Temperature (C)	12.4	9.66	12.77	---	---	13.51	---	12.73	---
ORP (mV)	106	117	151	---	---	192	---	178	---
Dissolved Oxygen (mg/L)	1.75	0.74	5.12	---	---	2.27	---	1.17	---

MW-6S
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	12/12/2002	10/07/2003	12/02/2004	06/08/2005	03/21/2007	PAL	ES
1,1-Dichloroethane	0.55	0.71	0.29	0.31	<0.21	85	850
1,2,4-Trimethylbenzene	< 0.37	< 0.14	<0.12	<0.12	0.27	96	480
Acetone	2.6	< 0.66	<0.74	<0.74	<0.74	200	1000
cis-1,2-Dichloroethene	< 0.35	0.59	0.36	0.49	0.33	7	70
Methylene chloride	2.2	< 0.28	0.54	<0.19	<0.19	0.5	5
Trichloroethene	< 0.42	0.37	<0.28	<0.28	<0.28	0.5	5

Metals, mg/L							
Arsenic	< 0.0021	< 0.0029	<0.0026	<0.0026	<0.0043	0.001	0.01
Barium	0.17	0.13	0.22	0.265	0.191	0.4	2
Cadmium	< 0.00028	< 0.00036	<0.00028	<0.00028	<0.00042	0.0005	0.005
Cobalt	0.0022	< 0.0011	0.0025	0.0019	0.0016	0.008	0.04
Iron	0.065	< 0.044	0.25	0.16	<0.032	0.15	0.3
Lead	< 0.0016	< 0.0023	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**2.7**	**2.7**	**3.6**	**4.68**	**2.72**	0.025	0.05
Mercury	< 0.000087	< 0.000067	<0.000029	<0.000029	<0.00009	0.0002	0.002
Vanadium	< 0.00067	< 0.00096	0.00071	<0.00071	<0.0019	0.006	0.03

Natural Attenuation Parameters, mg/L							
Chloride	6.7	5.6	11	12.7	8.8	125	250
Nitrate as N	< 0.0076	< 0.019	<0.016	<0.016	<0.031	2	10
Sulfate	4	3.6	9.7	0.99	0.86	125	250
Total Alkalinity	160	150	---	----	210	----	----
Total Organic Carbon	6	5	---	----	4	----	----

pH	7.45	7.37	7.25	6.97	7.3	----	----
Conductivity (mS/cm)	0.342	0.307	0.506	316	274	----	----
Temperature (C)	11.1	10.28	11.4	9.17	9.53	----	----
ORP (mV)	113	127	191	31	69.5	----	----
Dissolved Oxygen (mg/L)	2.86	3.08	0.84	7.47	0.66	----	----

MW-6M
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	12/12/2002	10/07/2003	12/02/2004	06/08/2005	03/21/2007	PAL	ES
1,1-Dichloroethane	< 0.3	0.61	0.27	0.21	<0.21	85	850
1,2,4-Trimethylbenzene	< 0.37	< 0.14	0.23	26	<0.12	96	480
1,3,5-Trimethylbenzene	< 0.4	< 0.18	<0.16	<0.16	<0.16	96	480
Acetone	2.1	< 0.66	<0.74	<0.74	<0.74	200	1000
cis-1,2-Dichloroethene	< 0.35	0.42	0.35	0.42	<0.21	7	70
Ethylbenzene	< 0.41	< 0.19	<0.19	0.22	<0.19	140	700
Methylene chloride	2.1	< 0.28	0.44	<0.19	<0.19	0.5	5

Metals, mg/L							
Arsenic	0.0024	< 0.0029	<0.0026	<0.0026	<0.0043	0.001	0.01
Barium	0.75	0.89	0.77	1.07	0.744	0.4	2
Cadmium	< 0.00028	< 0.00036	<0.00028	<0.00028	<0.00042	0.0005	0.005
Cobalt	< 0.00074	< 0.0011	<0.00096	<0.00096	<0.0012	0.008	0.04
Iron	< 0.042	0.12	<0.049	<0.049	<0.032	0.15	0.3
Lead	< 0.0016	0.0024	0.0023	<0.0017	<0.0017	0.0015	0.015
Manganese	**1.7**	**2.8**	**2**	**2.48**	**1.9**	0.025	0.05
Mercury	0.000097	< 0.000067	<0.000029	0.000055	<0.00009	0.0002	0.002
Vanadium	< 0.00067	< 0.00096	<0.00071	<0.00071	<0.0019	0.006	0.03

Natural Attenuation Parameters, mg/L							
Chloride	6	4.7	5	7.4	5.5	125	250
Nitrate as N	< 0.0076	0.02	<0.016	<0.016	<0.031	2	10
Sulfate	0.42	1.8	0.2	0.21	<0.12	125	250
Total Alkalinity	100	140	---	----	130	----	----
Total Organic Carbon	4	3	---	----	4	----	----

pH	7.49	7.44	7.64	7.53	7.75	----	----
Conductivity (mS/cm)	0.227	0.289	0.3	199	178	----	----
Temperature (C)	10.5	10.71	10.25	10.51	10.13	----	----
ORP (mV)	96	140	195	25.4	77.9	----	----
Dissolved Oxygen (mg/L)	0.42	4.41	3.22	1.42	1.67	----	----

MW-8S
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	12/11/2002	10/07/2003	12/02/2004	06/08/2005	03/21/2007	PAL	ES
Acetone	2.2	< 0.66	<0.74	<0.74	1	200	1000
Methylene chloride	2.6	< 0.28	0.5	<0.19	0.2	0.5	5

Metals, mg/L							
Arsenic	< 0.0021	< 0.0029	<0.0026	<0.0026	<0.0043	0.001	0.01
Barium	0.088	0.093	0.073	0.0637	0.0525	0.4	2
Cadmium	< 0.00028	< 0.00036	0.00029	<0.00028	<0.00042	0.0005	0.005
Cobalt	*< 0.00074*	*< 0.0011*	*<0.00096*	*<0.00096*	*<0.0012*	*0.008*	*0.04*
Iron	0.052	< 0.044	**0.45**	<0.049	<0.032	0.15	0.3
Lead	< 0.0016	< 0.0023	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**0.59**	**0.32**	**0.79**	**0.33**	**0.135**	0.025	0.05
Mercury	< 0.000087	< 0.000067	<0.000029	<0.000029	<0.00009	0.0002	0.002
Vanadium	< 0.00067	< 0.00096	0.001	<0.00071	<0.0019	0.006	0.03

Natural Attenuation Parameters, mg/L							
Chloride	9.5	17.2	7.1	6.8	17.4	125	250
Nitrate as N	1.5	0.15	0.21	0.087	0.051	2	10
Sulfate	12.3	5.6	12.2	9.4	2.4	125	250
Total Alkalinity	190	230	---	---	230	----	----
Total Organic Carbon	0.9	2	---	---	3	----	----

pH	7.32	7.15	7.41	7.15	7.32	----	----
Conductivity (mS/cm)	0.44	0.497	0.373	237	316	----	----
Temperature (C)	11.73	11.96	12.14	9.5	9.52	----	----
ORP (mV)	124	177	208	163	271.5	----	----
Dissolved Oxygen (mg/L)	7.07	4.3	3.34	6.64	5.32	----	----

MW-8M
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	12/11/2002	10/07/2003	12/02/2004	06/08/2005	03/21/2007	PAL	ES
1,2,4-Trimethylbenzene	< 0.37	0.36	1.7	4.1	28	96	480
1,3,5-Trimethylbenzene	< 0.4	0.22	<0.16	1.6	<0.27	96	480
Acetone	2.9	< 0.66	<0.74	<0.74	1.9	200	1000
Benzene	< 0.37	< 0.2	0.3	0.53	<0.37	0.5	5
Chloroethane	< 0.29	< 0.22	0.43	<0.24	<0.4	80	400
cis-1,2-Dichloroethene	< 0.35	< 0.25	0.41	0.39	<0.35	7	70
Ethylbenzene	< 0.41	< 0.19	2.4	2.6	0.74	140	700
Methylene chloride	3.2	< 0.28	0.55	<0.19	0.32	0.5	5
Naphthalene	< 0.42	< 0.16	<0.15	0.43	<0.25	10	100
Trichloroethene	< 0.42	0.23	0.3	<0.28	<0.47	0.5	5

Metals, mg/L

Arsenic	< 0.0021	< 0.0029	0.0027	0.0047	0.0058	0.001	0.01
Barium	0.68	0.73	0.7	0.997	0.874	0.4	2
Cadmium	< 0.00028	< 0.00036	0.0003	<0.00028	<0.00042	0.0005	0.005
Cobalt	< 0.00074	< 0.0011	<0.00096	<0.00096	<0.0012	0.008	0.04
Iron	< 0.042	0.045	0.12	**0.4**	0.27	0.15	0.3
Lead	< 0.0016	< 0.0023	0.002	<0.0017	<0.0017	0.0015	0.015
Manganese	**2.7**	**2.8**	**3.3**	**4.34**	**3.97**	0.025	0.05
Mercury	0.00009	< 0.000067	<0.000029	0.000063	<0.00009	0.0002	0.002
Vanadium	< 0.00067	< 0.00096	<0.00071	<0.00071	<0.0019	0.006	0.03

Natural Attenuation Parameters, mg/L

Chloride	2.6	12.8	14	21.9	12.4	125	250
Nitrate as N	< 0.0076	< 0.019	<0.016	<0.016	<0.031	2	10
Sulfate	5.7	1.1	0.84	0.48	0.45	125	250
Total Alkalinity	220	240	---	----	330	----	----
Total Organic Carbon	2	3	---	----	4	----	----

pH	7.41	7.31	7.37	7.3	7.48	----	----
Conductivity (mS/cm)	0.422	0.479	0.558	393	426	----	----
Temperature (C)	9.95	10.44	10.21	10.88	10.64	----	----
ORP (mV)	105	150	194	-49.1	-39.1	----	----
Dissolved Oxygen (mg/L)	1.74	0.92	1.02	0.79	1	----	----

MW-10M
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	06/08/2005	03/22/2006	03/21/2007	PAL	ES
Acetone	1	0.79	<0.74	200	1000
Carbon disulfide	0.71	<0.28	<0.28	200	1000
cis-1,2-Dichloroethene	0.34	0.21	0.25	7	70
Methylene chloride	<0.19	0.38	<0.19	0.5	5
Trichloroethene	0.37	<0.28	<0.28	0.5	5

Metals, mg/L

Arsenic	<0.0026	<0.0043	<0.0043	0.001	0.01
Barium	0.104	0.0653	0.0604	0.4	2
Cadmium	<0.00028	<0.00042	<0.00042	0.0005	0.005
Cobalt	0.0012	<0.0012	<0.0012	0.008	0.04
Iron	0.068	<0.032	0.035	0.15	0.3
Lead	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**2.33**	**1.86**	**1.52**	0.025	0.05
Mercury	0.000048	<0.00009	<0.00009	0.0002	0.002
Vanadium	0.00095	<0.0019	<0.0019	0.006	0.03

Natural Attenuation Parameters, mg/L

Chloride	1.6	3	3.6	125	250
Nitrate as N	<0.016	<0.015	<0.031	2	10
Sulfate	6.2	8.7	5.2	125	250
Total Alkalinity	----	220	170	----	----
Total Organic Carbon	----	1	2	----	----

pH	7.22	7.55	7.51	----	----
Conductivity (mS/cm)	232	2.65	236	----	----
Temperature (C)	11.06	10.73	10.69	----	----
ORP (mV)	126	112	123	----	----
Dissolved Oxygen (mg/L)	1.45	1.1	0.53	----	----

MW-12S
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	**12/11/2002**	**10/07/2003**	**06/09/2005**	**PAL**	**ES**
Acetone	3	< 0.66	<0.74	200	1000
Methylene chloride	2.7	< 0.28	<0.19	0.5	5
Naphthalene	< 0.42	< 0.16	0.17	10	100

Metals, mg/L

Arsenic	< 0.0021	< 0.0029	<0.0026	0.001	0.01
Barium	0.021	0.021	0.0158	0.4	2
Cadmium	< 0.00028	< 0.00036	<0.00028	0.0005	0.005
Cobalt	< 0.00074	< 0.0011	<0.00096	0.008	0.04
Iron	< 0.042	< 0.044	<0.049	0.15	0.3
Lead	0.0034	< 0.0023	<0.0017	0.0015	0.015
Manganese	0.0023	0.0017	0.0025	0.025	0.05
Mercury	< 0.000087	< 0.000067	<0.000029	0.0002	0.002
Vanadium	< 0.00067	0.0013	<0.00071	0.006	0.03

Natural Attenuation Parameters, mg/L

Chloride	24.3	9.1	3.5	125	250
Nitrate as N	1.6	1.4	1	2	10
Sulfate	7.2	5	4.4	125	250
Total Alkalinity	170	210	---	---	---
Total Organic Carbon	1	0.8	---	---	---

pH	7.29	7.44	6.81	---	---
Conductivity (mS/cm)	0.444	0.438	197	---	---
Temperature (C)	12.04	11.97	9.34	---	---
ORP (mV)	132	190	185.5	---	---
Dissolved Oxygen (mg/L)	5.86	9.0	11.92	---	---

MW-14S
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	12/12/2002	04/23/2003	10/08/2003	04/13/2004	12/02/2004	06/09/2005	03/22/2006	09/08/2006	03/22/2007	09/10/2007	PAL	ES
1,2,4-Trimethylbenzene	1.7	0.97	5.5	2.1	3.1	2.5	1.9	3.7	1.1	4.4	96	480
1,3,5-Trimethylbenzene	0.64	< 0.4	1.8	0.8	1.3	0.96	0.66	1.1	0.34	1.8	96	480
2-Butanone	< 0.59	< 0.59	< 1.8	< 0.36	<0.65	<0.39	1.2	<0.65	<0.39	<0.57	90	460
Acetone	4.3	< 1.1	< 3.3	< 0.66	2	<0.74	2.3	<1.2	2.1	<1.1	200	1000
Benzene	< 0.37	< 0.37	< 1	0.43	<0.37	<0.22	<0.22	<0.37	<0.22	<0.13	0.5	5
Ethylbenzene	< 0.41	< 0.41	1.2	0.4	0.78	0.76	0.49	0.98	0.35	1	140	700
Methylene chloride	2.1	< 0.29	< 1.4	< 0.28	1.2	<0.19	<0.19	<0.32	0.3	<0.33	0.5	5
Naphthalene	5	2.2	18	6	11	13	8.8	18	7.5	16	10	100
Xylenes (total)	1.4	0.47	2.3	1.1	2.1	2.3	1.4	2.6	0.86	2.9	1,000	10,000
Metals, mg/L												
Arsenic	< 0.0021	< 0.0021	< 0.0029	< 0.0026	0.0029	<0.0026	<0.0043	<0.0043	<0.0043	<0.0043	0.001	0.01
Barium	0.18	0.084	0.19	0.11	0.16	0.168	0.117	0.154	0.0893	0.13	0.4	2
Cadmium	0.00045	< 0.00028	< 0.00036	< 0.00028	<0.00028	<0.00028	<0.00042	<0.00042	<0.00042	<0.00042	0.0005	0.005
Cobalt	0.0052	0.0015	< 0.0011	0.0017	0.0013	0.0018	<0.0012	<0.0012	<0.0012	0.0013	0.008	0.04
Iron	11.6	2.5	17.8	5.4	12.1	12.9	7.4	13.6	3.5	8.4	0.15	0.3
Lead	< 0.0016	< 0.0016	< 0.0023	< 0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	3.7	0.83	7	1.9	3.1	2.88	1.9	3.36	1.05	2.2	0.025	0.05
Mercury	0.000088	< 0.000087	< 0.000067	< 0.000029	<0.000029	0.000069	<0.00009	<0.00009	<0.00009	<0.00009	0.0002	0.002
Vanadium	< 0.00067	< 0.00067	< 0.00096	< 0.00071	0.0011	<0.00071	<0.0019	<0.0019	<0.0019	<0.0019	0.006	0.03
Natural Attenuation *Parameters, mg/L*												
Chloride	5	5.4	7.3	5.7	3.4	4.4	6	5.6	5.8	2.6	125	250
Nitrate as N	0.01	0.34	< 0.019	0.21	0.082	0.13	0.16	<0.031	0.16	0.1	2	10
Sulfate	3	5.4	0.18	8.4	4.3	3.9	7.9	2.6	4.4	6.3	125	250
Total Alkalinity	210	150	170	160	---		170	180	140	190	----	----
Total Organic Carbon	14	5	12	10	---		7	9	6	13	----	----
pH	6.88	6.96	6.89	---	6.41	6.45	6.91	6.75	6.77	6.59	----	----
Conductivity (mS/cm)	0.441	0.328	0.404	---	0.385	229	223	247	201	0.248	----	----
Temperature (C)	11.13	7.7	12.24	---	11.6	9.3	8.52	12.05	7.97	12.38	----	----
ORP (mV)	114	166	162	---	188	-45.5	-23.3	-88.1	13.4	181.3	----	----
Dissolved Oxygen (mg/L)	3.22	5.02	6.03	---	2.11	4.08	7.56	0.84	4.35	6.13	----	----

MW-15M
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	12/12/2002	10/07/2003	Duplicate 10/7/2003	12/02/2004	06/08/2005	03/22/2006	09/07/2006	03/22/2007	09/11/2007	PAL	ES
1,1-Dichloroethane	1	< 0.26	< 0.26	<0.21	<0.21	<2.1	<0.21	<0.21	<0.15	85	850
1,2,4-Trimethylbenzene	< 0.37	0.29	0.28	<0.12	<0.12	290	12	4.1	<0.12	96	480
1,3,5-Trimethylbenzene	< 0.4	< 0.18	< 0.18	<0.16	<0.16	<1.6	<0.16	<0.16	<0.096	96	480
2-Butanone	< 0.59	< 0.36	< 0.36	<0.39	<0.39	5.7	<0.39	<0.39	<0.57	90	460
Acetone	< 1.1	< 0.66	< 0.66	<0.74	<0.74	12	<0.74	<0.74	1.2	200	1000
Chlorobenzene	< 0.38	< 0.16	< 0.16	<0.2	0.26	<2	<0.2	<0.2	0.39	-----	-----
cis-1,2-Dichloroethene	0.56	0.29	0.26	<0.21	<0.21	<2.1	<0.21	<0.21	0.24	7	70
Methylene chloride	3	< 0.28	< 0.28	0.44	<0.19	<1.9	<0.19	<0.19	<0.33	0.5	5
Naphthalene	< 0.42	< 0.16	< 0.16	<0.15	<0.15	2.5	<0.15	<0.15	<0.24	8	40

Metals, mg/L

Metals, mg/L	12/12/2002	10/07/2003	Duplicate 10/7/2003	12/02/2004	06/08/2005	03/22/2006	09/07/2006	03/22/2007	09/11/2007	PAL	ES
Arsenic	0.0054	< 0.0029	< 0.0029	<0.0026	0.0026	<0.0043	<0.0043	<0.0043	<0.0043	0.001	0.01
Barium	0.86	0.74	0.75	0.44	0.958	1.06	0.874	0.679	0.834	0.4	2
Cadmium	0.00031	0.00092	< 0.00036	<0.00028	<0.00028	<0.00042	<0.00042	<0.00042	<0.00042	0.0005	0.005
Cobalt	0.0012	< 0.0011	< 0.0011	<0.00096	<0.00096	<0.0012	<0.0012	<0.0012	<0.0012	0.008	0.04
Iron	1.1	4.1	1.6	0.51	0.64	0.67	0.13	0.069	0.3	0.15	0.3
Lead	0.0049	0.13	0.043	<0.0017	0.002	<0.0017	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	3.6	3.4	3.5	2.2	4.65	5.53	5.01	3.43	4.72	0.025	0.05
Mercury	0.000092	< 0.000067	< 0.000067	<0.000029	0.0001	<0.00009	<0.00009	<0.00009	<0.00009	0.0002	0.002
Vanadium	< 0.00067	< 0.00096	< 0.00096	<0.00071	<0.00071	<0.0019	<0.0019	<0.0019	<0.0019	0.006	0.03

Natural Attenuation Parameters, mg/L

Natural Attenuation Parameters, mg/L	12/12/2002	10/07/2003	Duplicate 10/7/2003	12/02/2004	06/08/2005	03/22/2006	09/07/2006	03/22/2007	09/11/2007	PAL	ES
Chloride	5.2	5.1	5.2	3.8	12.3	7.3	9.1	8.5	12.8	125	250
Nitrate as N	0.03	< 0.019	< 0.019	<0.016	<0.016	<0.015	<0.031	<0.031	<0.023	2	10
Sulfate	2.4	5.8	5.6	5.5	3.6	0.84	0.67	1.8	0.2		250
Total Alkalinity	240	230	230	---	---	330	300	220	320	----	----
Total Organic Carbon	3	2	2	---	---	7	5	6	5	----	----

Field Parameters	12/12/2002	10/07/2003	Duplicate 10/7/2003	12/02/2004	06/08/2005	03/22/2006	09/07/2006	03/22/2007	09/11/2007	PAL	ES
pH	7.25	7.2	---	7.44	7.2	7.43	7.41	7.44	7.3	----	----
Conductivity (mS/cm)	0.466	0.469	---	0.299	320	397	344	297	0.377	----	----
Temperature (C)	10.65	10.76	---	10.31	10.64	10.18	10.84	10.18	10.67	----	----
ORP (mV)	93	100	---	172	-59.2	-50	-74.6	-32.5	202.3	----	----
Dissolved Oxygen (mg/L)	0.51	2.3	---	0.68	0.66	1.42	0.64	0.71	0.56	----	----

MW-16S
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	03/23/2006	06/09/2006	09/07/2006	12/11/2006	03/23/2007	06/21/2007	09/11/2007	PAL	ES
1,2,4-Trimethylbenzene	**1500**	390	**1800**	400	370	**610**	400	96	480
1,3,5-Trimethylbenzene	**150**	16	**200**	9.8	9.3	11	<2.7	96	480
Acetone	120	27	<46	<4.9	<4.9	<37	<31	200	1000
Chlorobenzene	<13	<3.3	<12	<1.3	1.7	<5	<4.3	-----	-----
Ethylbenzene	22	4.6	20	8.1	8.1	<5.7	<4.9	140	700
Methylene chloride	<13	<3.2	<12	4.7	<1.3	**58**	<9.4	0.5	5
Naphthalene	**37**	4.9	**37**	**27**	**49**	8	7.1	10	10
Xylenes (total)	91	22	61	15	12	16	16	1,000	10,000

Metals, mg/L	03/23/2006	06/09/2006	09/07/2006	12/11/2006	03/23/2007	06/21/2007	09/11/2007	PAL	ES
Arsenic	0.0099	0.0076	**0.0111**	0.0057	**0.0124**	**0.012**	**0.0104**	0.001	0.01
Barium	0.45	0.408	0.366	0.212	0.274	0.513	0.461	0.4	2
Cadmium	<0.00042	<0.00042	<0.00042	<0.00042	<0.00042	<0.00042	<0.00042	0.0005	0.005
Cobalt	0.0052	0.0072	0.0039	0.0021	0.0025	0.0054	0.0036	0.008	0.04
Iron	**42.6**	**46.4**	**37.3**	**22.3**	**32.6**	**43.1**	**29.6**	0.15	0.3
Lead	0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**9.53**	**12.2**	**8.42**	**4.52**	**5.38**	**11.8**	**12.2**	0.025	0.05
Mercury	<0.00009	<0.00009	<0.00009	<0.00009	<0.00009	0.000095	<0.00009	0.0002	0.002
Vanadium	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019	0.006	0.03

Natural Attenuation Parameters, mg/L	03/23/2006	06/09/2006	09/07/2006	12/11/2006	03/23/2007	06/21/2007	09/11/2007	PAL	ES
Chloride	4.7	17.8	12.3	36.2	21.8	14.2	39.7	125	250
Nitrate as N	<0.015	<0.015	<0.031	<0.031	<0.031	<0.031	<0.023	2	10
Sulfate	2.4	4.4	<0.12	<0.12	1.9	6.1	1.8		250
Total Alkalinity	470	570	460	180	260	610	590	----	----
Total Organic Carbon	12	9	11	7	10	11	10	----	----

pH	6.75	6.62	6.58	6.68	6.63	6.69	6.58	----	----
Conductivity (mS/cm)	624	766	625	393	419	819	0.843	----	----
Temperature (C)	9.27	10.44	14.16	11.59	9.3	10.79	15.49	----	----
ORP (mV)	-55.8	-89.1	-110.6	-92	-42.5	-82.3	-64.3	----	----
Dissolved Oxygen (mg/L)	2.22	2.2	0.83	1.59	0.54	1.42	1.17	----	----

MW-16M
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	03/23/2006	Duplicate 3/23/2006	06/09/2006	09/07/2006	12/11/2006	03/23/2007	Duplicate 3/23/2007	06/21/2007	09/11/2007	PAL	ES
1,2,4-Trimethylbenzene	34	37	15	190	68	240	240	47	2.7	96	480
1,3,5-Trimethylbenzene	<0.32	<0.32	<0.16	<1.1	<0.16	7.1	8.6	<0.24	<0.096	96	480
2-Butanone	<0.78	1.4	<0.39	<2.6	<0.39	<1.3	<1.3	<1.4	<0.57	90	460
Acetone	4.3	4.2	<0.74	<4.9	<0.74	<2.5	<2.5	<2.8	<1.1	200	1000
Benzene	0.97	0.86	0.76	<1.5	0.59	1.6	1.7	<0.32	0.88	0.5	5
Chlorobenzene	2.2	2.2	1.7	<1.3	1.7	2.9	2.8	1.8	1	-----	-----
Chloroethane	1.3	1.4	1.3	<1.6	<0.24	<0.8	0.87	<0.72	0.44	80	400
Methylene chloride	<0.38	<0.38	<0.19	<1.3	<0.19	<0.63	<0.63	2.7	<0.33	0.5	5
Naphthalene	3.1	3	1.8	23	5.8	13	12	2.1	0.3	1-	100
Xylenes (total)	4.2	4	1.4	3.6	2.7	5	7	<0.7	0.7	1,000	10,000
Metals, mg/L											
Arsenic	**0.0225**	**0.0213**	**0.0204**	**0.0103**	<0.0043	**0.0277**	**0.0245**	**0.0234**	**0.0141**	0.001	0.01
Barium	1.04	0.981	1.13	1.31	1.14	1.84	1.81	1.01	1.13	0.4	2
Cadmium	<0.00042	<0.00042	<0.00042	<0.00042	<0.00042	<0.00042	<0.00042	<0.00042	<0.00042	0.0005	0.005
Cobalt	<0.0012	<0.0012	<0.0012	0.0022	<0.0012	0.0013	<0.0012	<0.0012	<0.0012	0.008	0.04
Iron	**22.1**	**20.7**	**22.6**	**20.9**	**7.5**	**32.9**	**31.8**	**18.1**	**18**	0.15	0.3
Lead	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**1.43**	**1.36**	**1.28**	**1.88**	**1.14**	**1.82**	**1.78**	**1.06**	**1.32**	0.025	0.05
Mercury	<0.00009	<0.00009	<0.00009	<0.00009	<0.00009	<0.00009	<0.00009	<0.00009	<0.00009	0.0002	0.002
Vanadium	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019	0.006	0.03
Natural Attenuation Parameters, mg/L											
Chloride	31.9	32	41.1	43.5	42.4	35.2	35.3	23.8	30.1	125	250
Nitrate as N	<0.015	<0.015	<0.015	<0.031	<0.031	<0.031	<0.031	<0.031	<0.023	2	10
Sulfate	<0.12	<0.12	0.34	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12		250
Total Alkalinity	180	180	170	250	170	260	270	170	180	----	----
Total Organic Carbon	5	120	5	7	5	7	7	5	5	----	----
pH	7.15	---	7.05	6.99	7.31	7.2	----	7.27	7.17	----	----
Conductivity (mS/cm)	329	---	355	410	352	481	----	327	0.301	----	----
Temperature (C)	10.83	---	11.27	11.48	9.85	11.17	----	11.38	10.87	----	----
ORP (mV)	-114	---	-140.6	-149.7	-153	-131.5	----	-155.3	-40.5	----	----
Dissolved Oxygen (mg/L)	0.88	---	0.85	0.17	0.48	0.52	----	0.4	0.62	----	----

MW-17S
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	03/23/2006	06/09/2006	09/07/2006	12/11/2006	03/23/2007	06/21/2007	09/11/2007	PAL	ES
1,2,4-Trimethylbenzene	400	420	1100	550	240	1200	1200	96	480
1,3,5-Trimethylbenzene	47	74	67	38	21	45	15	96	480
Acetone	82	14	<25	<7.4	<2.5	<69	<69	200	1000
Ethylbenzene	7.8	4.9	<6.3	2.7	1.6	<11	<11	140	700
Methylene chloride	<7.6	<2.7	<6.3	6.3	<0.63	130	<21	0.5	5
Naphthalene	<6	<2.1	7.7	10	1.4	<15	<15	10	100
Xylenes (total)	22	17	<15	8.7	1.8	<18	<18	1,000	10,000

Metals, mg/L

Arsenic	0.0086	0.0095	0.009	0.0063	<0.0043	0.0117	0.0116	0.001	0.01
Barium	0.23	0.183	0.229	0.216	0.146	0.265	0.272	0.4	2
Cadmium	<0.00042	<0.00042	<0.00042	<0.00042	<0.00042	<0.00042	<0.00042	0.0005	0.005
Cobalt	<0.0012	0.0016	<0.0012	<0.0012	0.0017	<0.0012	0.0025	0.008	0.04
Iron	21	22.2	25.4	22.3	7.6	31.7	30.4	0.15	0.3
Lead	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	3.65	3.22	3.79	3.33	1.39	3.51	4.38	0.025	0.05
Mercury	<0.00009	<0.00009	<0.00009	<0.00009	<0.00009	0.00011	<0.00009	0.0002	0.002
Vanadium	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019	0.006	0.03

Natural Attenuation Parameters, mg/L

Chloride	4.2	5.8	4.9	6.4	4.6	4.5	3.1	125	250
Nitrate as N	0.97	0.29	<0.031	0.2	2.1	0.3	0.4	2	10
Sulfate	1.6	3.3	0.34	0.63	16	1.5	2.7		250
Total Alkalinity	230	190	200	190	220	250	300	----	----
Total Organic Carbon	4	4	4	3	3	3	5	----	----

pH	7.06	1.51	6.78	6.92	6.97	6.88	6.67	----	----
Conductivity (mS/cm)	322	295	313	324	312	375	0.418	----	----
Temperature (C)	9.29	10.33	13.35	11.24	7.79	9.99	13.8	----	----
ORP (mV)	-88.7	-92.7	-123	-103.8	-12.4	-86.7	49.5	----	----
Dissolved Oxygen (mg/L)	1.1	1.51	0.26	1.43	3.09	1.25	0.45	----	----

MW-17M
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	03/23/2006	06/09/2006	09/07/2006	12/11/2006	03/23/2007	06/21/2007	09/11/2007	PAL	ES
1,2,4-Trimethylbenzene	<0.12	1.3	<0.12	5.2	<0.12	34	9.7	96	480
1,3,5-Trimethylbenzene	<0.16	<0.16	<0.16	<0.16	<0.16	<0.096	<0.096	96	480
Acetone	1.6	1.3	<0.74	<0.74	<0.74	<1.1	<1.1	200	1000
Methylene chloride	<0.19	1.7	<0.19	<0.19	<0.19	<0.33	<0.33	0.5	5
Toluene	<0.17	0.56	<0.17	<0.17	<0.17	<0.13	<0.13	200	1,000

Metals, mg/L									
Arsenic	0.0059	0.0078	0.006	<0.0043	0.0069	0.0086	0.0074	0.001	0.01
Barium	0.433	0.586	0.713	0.756	0.683	0.77	1.05	0.4	2
Cadmium	<0.00042	<0.00042	<0.00042	<0.00042	<0.00042	<0.00042	<0.00042	0.0005	0.005
Cobalt	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	0.008	0.04
Iron	**2.8**	**4.1**	**0.53**	0.11	**4.7**	**4.7**	**2.5**	0.15	0.3
Lead	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**1.71**	**2.03**	**2.43**	**2.27**	**2.09**	**2.2**	**3.52**	0.025	0.05
Mercury	<0.00009	<0.00009	<0.00009	<0.00009	<0.00009	0.000093	<0.00009	0.0002	0.002
Vanadium	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019	<0.0019	0.006	0.03

Natural Attenuation Parameters, mg/L									
Chloride	4.8	6.1	5.4	5	4.9	3.2	5.1	125	250
Nitrate as N	<0.015	<0.015	<0.031	<0.031	<0.031	<0.031	<0.023	2	10
Sulfate	0.89	0.83	0.35	<0.12	2.2	1.9	0.6		250
Total Alkalinity	150	190	200	240	210	260	320	----	----
Total Organic Carbon	5	6	8	7	4	4	5	----	----

pH	7.39	7.23	7.4	7.61	7.56	7.56	7.54	----	----
Conductivity (mS/cm)	204	257	249	305	288	332	0.361	----	----
Temperature (C)	10.53	10.97	11.12	9.65	10.48	10.84	10.76	----	----
ORP (mV)	-113	-136.8	-159	-162.7	-146	-159.3	-155.6	----	----
Dissolved Oxygen (mg/L)	2.45	1.23	0.18	0.31	0.35	0.45	0.61	----	----

PZ-1
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	12/12/2002	04/23/2003	10/08/2003	04/13/2004	03/22/2006	03/22/2007	PAL	ES
Acetone	< 1.1	< 1.1	< 0.66	< 0.66	1.3	<0.74	200	1000
Benzene	< 0.37	< 0.37	< 0.2	0.5	<0.22	<0.22	0.5	5
Methylene chloride	3.4	< 0.29	< 0.28	< 0.28	0.39	<0.19	0.5	5

Metals, mg/L	12/12/2002	04/23/2003	10/08/2003	04/13/2004	03/22/2006	03/22/2007	PAL	ES
Arsenic	0.0029	< 0.0021	< 0.0029	0.0035	<0.0043	<0.0043	0.001	0.01
Barium	0.024	0.031	0.033	0.039	0.0245	0.0349	0.4	2
Cadmium	< 0.00028	< 0.00028	< 0.00036	< 0.00028	<0.00042	<0.00042	0.0005	0.005
Cobalt	< 0.00074	< 0.00074	< 0.0011	< 0.00096	<0.0012	<0.0012	0.008	0.04
Iron	< 0.042	< 0.042	< 0.044	0.058	<0.032	<0.032	0.15	0.3
Lead	< 0.0016	< 0.0016	< 0.0023	< 0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**0.19**	**0.3**	**0.37**	**0.49**	**0.258**	**0.371**	0.025	0.05
Mercury	0.000091	< 0.000087	< 0.000067	< 0.000029	<0.00009	<0.00009	0.0002	0.002
Vanadium	0.0013	0.0011	0.0012	0.0015	<0.0019	<0.0019	0.006	0.03

Natural Attenuation Parameters, mg/L	12/12/2002	04/23/2003	10/08/2003	04/13/2004	03/22/2006	03/22/2007	PAL	ES
Chloride	9.4	12.8	5.8	7.2	8.5	7.3	125	250
Nitrate as N	0.23	0.23	< 0.019	< 0.016	<0.015	<0.031	2	10
Sulfate	1.6	5.5	6.1	9.1	9.5	9	125	250
Total Alkalinity	120	130	190	150	120	130	---	---
Total Organic Carbon	3	< 0.7	2	3	2	2	---	---

pH	7.54	7.43	7.31	---	8.08	7.97	---	---
Conductivity (mS/cm)	0.271	0.314	0.404	---	170	194	---	---
Temperature (C)	11.33	9.93	11.09	---	9.96	9.74	---	---
ORP (mV)	105	169	186	---	223.6	70.2	---	---
Dissolved Oxygen (mg/L)	2.78	4.8	3.99	---	3.3	0.64	---	---

PZ-2
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	12/11/2002	10/07/2003	12/02/2004	06/09/2005	03/22/2006	03/22/2007	PAL	ES
Acetone	2.6	< 0.66	2.9	<0.74	0.76	<0.74	200	1000
Carbon disulfide	< 0.24	< 0.21	<0.28	0.56	<0.28	<0.28	200	1000
Methylene chloride	2.4	< 0.28	0.64	<0.19	0.42	<0.19	0.5	5
Metals, mg/L								
Arsenic	**0.056**	< 0.0029	**0.011**	0.007	<0.0043	<0.0043	0.001	0.01
Barium	0.66	0.071	0.14	0.117	0.0601	0.0522	0.4	2
Cadmium	< 0.00028	< 0.00036	0.00033	<0.00028	<0.00042	<0.00042	0.0005	0.005
Cobalt	0.011	< 0.0011	0.0024	0.0046	<0.0012	<0.0012	0.008	0.04
Iron	**98.8**	**20.8**	**39.6**	**17.3**	**35.6**	**13.5**	0.15	0.3
Lead	0.0062	< 0.0023	<0.0017	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**5.2**	**1.5**	**3.4**	**3.59**	**4.04**	**1.51**	0.025	0.05
Mercury	0.00013	< 0.000067	<0.000029	0.00005	0.00014	<0.00009	0.0002	0.002
Vanadium	0.026	0.0016	0.0017	0.0014	<0.0019	<0.0019	0.006	0.03
Natural Attenuation Parameters, mg/L								
Chloride	8.6	6.6	9.1	6.7	8.2	11.9	125	250
Nitrate as N	< 0.0076	< 0.019	<0.016	<0.016	<0.015	<0.031	2	10
Sulfate	2.4	< 0.14	3.2	2	0.81	9	125	250
Total Alkalinity	160	77	---	---	160	110	----	----
Total Organic Carbon	15	7	---	---	9	6	----	----
pH	6.68	6.67	6.41	5.72	6.83	6.79	----	----
Conductivity (mS/cm)	0.432	0.239	0.412	235	275	207	----	----
Temperature (C)	11.03	11.08	10.89	8.85	8.4	8.02	----	----
ORP (mV)	116	149	173	-68.1	-78.7	-33.1	----	----
Dissolved Oxygen (mg/L)	5.14	4.43	1.6	0.92	8.45	1.38	----	----

PZ-3
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	12/11/2002	10/07/2003	12/02/2004	06/08/2005	03/22/2006	03/21/2007	PAL	ES
1,2,4-Trimethylbenzene	< 0.37	< 0.14	<0.12	4.3	<0.12	2.1	96	480
Acetone	3.1	< 0.66	1.3	<0.74	0.8	1.1	200	1000
cis-1,2-Dichloroethene	< 0.35	< 0.25	<0.21	0.26	0.23	0.26	7	70
Methylene chloride	2.5	< 0.28	1.1	<0.19	0.38	0.21	0.5	5

Metals, mg/L								
Arsenic	0.0038	< 0.0029	<0.0026	<0.0026	<0.0043	<0.0043	0.001	0.01
Barium	0.097	0.081	0.16	0.166	0.148	0.152	0.4	2
Cadmium	0.00099	< 0.00036	<0.00028	<0.00028	<0.00042	<0.00042	0.0005	0.005
Cobalt	0.0018	< 0.0011	0.0014	0.0016	<0.0012	0.0021	0.008	0.04
Iron	**1.2**	**0.58**	**1.5**	**2.4**	**0.7**	0.28	0.15	0.3
Lead	< 0.0016	< 0.0023	<0.0017	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**2.7**	**2.2**	**3.9**	**4.14**	**3.87**	**4.2**	0.025	0.05
Mercury	0.00012	0.00007	<0.000029	0.000055	<0.00009	<0.00009	0.0002	0.002
Vanadium	0.0028	< 0.00096	0.00092	0.0012	<0.0019	<0.0019	0.006	0.03

Natural Attenuation Parameters, mg/L								
Chloride	6.3	5.5	7.8	6.9	7.1	5.1	125	250
Nitrate as N	< 0.0076	< 0.019	<0.016	<0.016	<0.015	<0.031	2	10
Sulfate	1.2	3.5	0.74	1.5	1.7	0.42	125	250
Total Alkalinity	160	180	---	---	260	300	----	----
Total Organic Carbon	---	6	---	---	6	6	----	----

pH	7.06	6.96	6.97	6.89	7.25	7.14	----	----
Conductivity (mS/cm)	0.33	0.363	0.558	304	313	370	----	----
Temperature (C)	10.98	10.18	11.09	9.46	9.97	9.81	----	----
ORP (mV)	133	191	179	-18.9	-14.9	13.7	----	----
Dissolved Oxygen (mg/L)	4.48	3.83	0.78	1.39	4.27	0.43	----	----

PZ-4
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	**12/12/2002**	**10/07/2003**	**06/08/2005**	**PAL**	**ES**
1,1-Dichloroethane	< 0.3	0.33	0.25	85	850
Acetone	3.5	< 0.66	<0.74	200	1000
cis-1,2-Dichloroethene	< 0.35	0.46	0.55	7	70
Methylene chloride	2.6	< 0.28	<0.19	0.5	5
Trichloroethene	< 0.42	0.34	<0.28	0.5	5

Metals, mg/L					
Arsenic	< 0.0021	< 0.0029	<0.0026	0.001	0.01
Barium	0.12	0.077	0.145	0.4	2
Cadmium	< 0.00028	< 0.00036	<0.00028	0.0005	0.005
Cobalt	0.001	< 0.0011	0.0029	0.008	0.04
Iron	< 0.042	< 0.044	<0.049	0.15	0.3
Lead	< 0.0016	< 0.0023	<0.0017	0.0015	0.015
Manganese	**2.6**	**2**	**3.84**	0.025	0.05
Mercury	0.000088	< 0.000067	<0.000029	0.0002	0.002
Vanadium	< 0.00067	< 0.00096	<0.00071	0.006	0.03

Natural Attenuation Parameters, mg/L					
Chloride	5.5	4.5	13.1	125	250
Nitrate as N	< 0.0076	< 0.019	<0.016	2	10
Sulfate	4.2	5.1	1.7	125	250
Total Alkalinity	130	130	---	---	---
Total Organic Carbon	5	4	---	---	---

pH	7.53	7.17	7.11	---	---
Conductivity (mS/cm)	0.278	0.283	239	---	---
Temperature (C)	11.80	11.52	9.68	---	---
ORP (mV)	105	133	67	---	---
Dissolved Oxygen (mg/L)	12	3.89	0.84	---	---

PZ-5
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	**12/12/2002**	**04/23/2003**	**10/08/2003**	**04/13/2004**	**12/02/2004**	**06/09/2005**	**03/23/2006**	**03/22/2007**	**PAL**	**ES**
1,2,4-Trimethylbenzene	< 0.37	< 0.37	< 0.14	< 0.14	<0.12	<0.12	5.9	5.7	96	480
1,3,5-Trimethylbenzene	< 0.4	< 0.4	< 0.18	< 0.18	<0.16	<0.16	2.6	2.4	96	480
Acetone	3	< 1.1	< 0.66	< 0.66	<0.74	<0.74	0.91	<0.74	200	1000
Benzene	< 0.37	< 0.37	< 0.2	0.49	<0.22	<0.22	<0.22	<0.22	0.5	5
Methylene chloride	2.5	0.34	< 0.28	< 0.28	0.48	<0.19	0.45	0.21	0.5	5
Xylenes (total)	< 0.44	< 0.44	< 0.45	< 0.45	<0.44	<0.44	0.52	<0.44	1,000	10,000

Metals, mg/L										
Arsenic	< 0.0021	< 0.0021	< 0.0029	< 0.0026	<0.0026	<0.0026	<0.0043	<0.0043	0.001	0.01
Barium	0.091	0.075	0.082	0.061	0.061	0.0767	0.097	0.0957	0.4	2
Cadmium	< 0.00028	< 0.00028	< 0.00036	< 0.00028	0.00048	<0.00028	<0.00042	<0.00042	0.0005	0.005
Cobalt	< 0.00074	< 0.00074	< 0.0011	0.001	<0.00096	0.0019	0.0018	<0.0012	0.008	0.04
Iron	0.13	0.12	< 0.044	**0.59**	0.091	0.074	0.069	**0.38**	0.15	0.3
Lead	< 0.0016	< 0.0016	< 0.0023	< 0.0017	<0.0017	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**0.18**	**0.17**	**0.43**	**0.67**	**0.73**	**1.67**	**3.69**	**4.46**	0.025	0.05
Mercury	0.000098	< 0.000087	< 0.000067	< 0.000029	<0.000029	0.000048	<0.00009	<0.00009	0.0002	0.002
Vanadium	0.0011	0.00075	< 0.00096	0.0012	0.0011	<0.00071	<0.0019	<0.0019	0.006	0.03

Natural Attenuation Parameters, mg/L										
Chloride	9.7	8.6	5.6	2.6	1.4	2.8	4.9	2	125	250
Nitrate as N	0.48	0.37	0.28	0.47	0.088	1.3	0.16	0.094	2	10
Sulfate	5.7	10.1	5.5	4.6	3.6	6.5	3.4	4.5	125	250
Total Alkalinity	260	220	260	190	---	----	270	240	----	----
Total Organic Carbon	2	1	2	2	---	----	0.7	2	----	----

pH	7.15	7.18	7.16	---	7.31	6.87	7.38	7.24	----	----
Conductivity (mS/cm)	0.529	0.469	0.492	---	0.361	249	302	301	----	----
Temperature (C)	10.98	8.72	10.56	---	10.95	9.11	9.75	9.41	----	----
ORP (mV)	112	159	157	---	208	164.4	35.8	33.5	----	----
Dissolved Oxygen (mg/L)	1.21	2.42	3.63	---	4.17	4.32	2.98	3.2	----	----

Ackerman
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	04/22/2003	10/07/2003	09/23/2004	06/08/2005	06/09/2006	09/07/2006	06/21/2007	09/10/2007	PAL	ES
1,2,4-Trimethylbenzene	< 0.37	< 0.14	<0.12	<0.12	0.16	<0.12	<0.12	<0.12	96	480
1,3,5-Trimethylbenzene	< 0.4	< 0.18	<0.16	<0.16	<0.16	<0.16	<0.096	<0.096	96	480
Acetone	< 1.1	< 0.66	<0.74	<0.74	1.3	<0.74	<1.1	<1.1	200	1000
Chloromethane	< 0.49	< 0.26	<0.14	<0.14	0.17	<0.14	<0.3	<0.3	0.3	3
	(No VOCs Detected)									

Metals, mg/L	04/22/2003	10/07/2003	09/23/2004	06/08/2005	06/09/2006	09/07/2006	06/21/2007	09/10/2007	PAL	ES
Arsenic	< 0.0021	< 0.0029	<0.0026	<0.0026	<0.0043	<0.0043	<0.0043	<0.0043	0.001	0.01
Barium	0.024	0.023	0.022	0.0217	0.0202	0.0181	0.0217	0.0197	0.4	2
Cadmium	< 0.00028	< 0.00036	<0.00028	<0.00028	<0.00042	<0.00042	<0.00042	<0.00042	0.0005	0.005
Cobalt	< 0.00074	< 0.0011	<0.00096	<0.00096	<0.0012	<0.0012	<0.0012	<0.0012	0.008	0.04
Iron	**5.9**	**1.7**	**5.4**	**3.8**	**4.1**	**0.57**	**4.4**	**0.88**	0.15	0.3
Lead	0.0034	< 0.0023	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**0.12**	**0.085**	**0.13**	**0.105**	**0.116**	**0.138**	**0.132**	**0.148**	0.025	0.05
Mercury	< 0.000087	< 0.000067	0.000061	0.000044	<0.00009	<0.00009	<0.00009	<0.00009	0.0002	0.002
Vanadium	< 0.00067	< 0.00096	<0.00071	<0.00071	<0.0019	<0.0019	<0.0019	<0.0019	0.006	0.03

Johnson
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	**04/22/2003**	**10/08/2003**	**09/23/2004**	**12/02/2004**	**03/10/2005**	**06/09/2005**	**03/23/2006**	**09/07/2006**	**03/22/2007**	**09/10/2007**	**PAL**	**ES**
1,2,4-Trimethylbenzene	< 0.37	0.18	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	96	480
1,3,5-Trimethylbenzene	< 0.4	< 0.18	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<0.096	96	480
Acetone	< 1.1	< 0.66	<0.74	<0.74	<0.74	<0.74	0.77	0.82	<0.74	<1.1	200	1000
Chloromethane	< 0.49	< 0.26	0.18	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.3	0.3	3
Methylene chloride	< 0.29	< 0.28	<0.19	0.4	<0.19	<0.19	<0.19	0.2	0.24	<0.33	0.5	5
Metals, mg/L												
Arsenic	< 0.0021	< 0.0029	<0.0026	<0.0026	<0.0026	<0.0026	<0.0043	<0.0043	<0.0043	<0.0043	0.001	0.01
Barium	0.084	0.087	0.083	0.089	0.0751	0.116	0.0827	0.0815	0.0829	0.0726	0.4	2
Cadmium	< 0.00028	< 0.00036	<0.00028	<0.00028	<0.00028	<0.00028	<0.00042	<0.00042	<0.00042	<0.00042	0.0005	0.005
Cobalt	< 0.00074	< 0.0011	<0.00096	<0.00096	<0.00096	<0.00096	<0.0012	<0.0012	<0.0012	<0.0012	0.008	0.04
Iron	0.16	0.16	0.079	0.17	0.0576	**0.72**	0.038	<0.032	0.06	0.033	0.15	0.3
Lead	< 0.0016	< 0.0023	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**0.2**	**0.32**	**0.35**	**0.2**	0.0424	**0.948**	0.0477	**0.295**	0.0378	**0.277**	0.025	0.05
Mercury	< 0.000087	< 0.000067	<0.000029	<0.000029	<0.000029	0.000086	<0.00009	<0.00009	<0.00009	<0.00009	0.0002	0.002
Vanadium	< 0.00067	< 0.00096	<0.00071	<0.00071	<0.00071	<0.00071	<0.0019	<0.0019	<0.0019	<0.0019	0.006	0.03

Pretasky
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	04/14/2004	09/23/2004	12/02/2004	03/10/2005	06/09/2005	03/23/2006	09/07/2006	03/22/2007	09/10/2007	PAL	ES
Acetone	< 0.66	<0.74	<0.74	<0.74	<0.74	0.87	1.7	<0.74	<1.1	200	1000
Benzene	0.34	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.13	0.5	5
Chloromethane	< 0.26	0.16	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.3	0.3	3
Methylene chloride	< 0.28	<0.19	0.58	<0.19	<0.19	<0.19	0.22	0.23	<0.33	0.5	5

Metals, mg/L

Arsenic	0.0082	0.0035	0.0074	0.0068	0.0081	0.0066	0.0057	0.0077	0.0055	0.001	0.01
Barium	0.083	0.1	0.093	0.0962	0.116	0.119	0.105	0.122	0.107	0.4	2
Cadmium	< 0.00028	<0.00028	<0.00028	<0.00028	<0.00028	<0.00042	<0.00042	<0.00042	<0.00042	0.0005	0.005
Cobalt	< 0.00096	<0.00096	<0.00096	<0.00096	<0.00096	<0.0012	<0.0012	<0.0012	<0.0012	0.008	0.04
Iron	0.22	**0.51**	0.15	0.17	0.19	0.091	<0.032	0.24	0.1	0.15	0.3
Lead	< 0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**1.1**	**1.3**	**1.2**	**1.17**	**1.41**	**1.52**	**1.44**	**1.52**	**1.46**	0.025	0.05
Mercury	< 0.000029	0.000061	<0.000029	<0.000029	0.000053	<0.00009	<0.00009	<0.00009	<0.00009	0.0002	0.002
Vanadium	0.0019	<0.00071	0.0015	0.001	0.0012	<0.0019	<0.0019	<0.0019	<0.0019	0.006	0.03

EW-2
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	06/09/2005	03/23/2006	03/22/2007	PAL	ES
1,2,4-Trimethylbenzene	68	3.4	1.1	96	480
1,3,5-Trimethylbenzene	<0.32	1.2	<0.16	96	480
Acetone	1.7	1.3	0.82	200	1000
Carbon disulfide	1.5	<0.28	<0.28	200	1000
Chlorobenzene	<0.4	0.21	<0.2	-----	-----
Methylene chloride	<0.38	0.35	0.23	0.5	5
Naphthalene	1.4	2.1	<0.15	10	100
Xylenes (total)	1.6	<0.44	<0.44	1,000	10,000

Metals, mg/L					
Arsenic	**0.0353**	**0.0212**	**0.0242**	0.001	0.01
Barium	0.918	0.637	0.638	0.4	2
Cadmium	<0.00028	<0.00042	<0.00042	0.0005	0.005
Cobalt	<0.00096	<0.0012	<0.0012	0.008	0.04
Iron	**13.2**	**5.4**	**4**	0.15	0.3
Lead	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**2.16**	**1.37**	**1.27**	0.025	0.05
Mercury	0.000076	<0.00009	<0.00009	0.0002	0.002
Vanadium	<0.00071	<0.0019	<0.0019	0.006	0.03

EW-3
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	06/09/2005	Duplicate 6/9/2005	03/23/2006	03/22/2007	PAL	ES
1,2,4-Trimethylbenzene	9.3	9.2	1.2	7.1	96	480
1,3,5-Trimethylbenzene	1.6	1.7	<0.16	<0.16	96	480
Acetone	0.91	0.91	1	0.84	200	1000
Benzene	0.44	0.43	0.23	0.45	0.5	5
Carbon disulfide	0.72	0.77	<0.28	<0.28	200	1000
Chlorobenzene	0.66	0.65	<0.2	0.35	-----	-----
Chloroethane	1	<0.24	<0.24	<0.24	80	400
Methylene chloride	<0.19	<0.19	0.64	<0.19	0.5	5
Naphthalene	0.37	0.38	2	0.27	10	100
Xylenes (total)	0.92	0.88	<0.44	0.64	1,000	10,000

Metals, mg/L						
Arsenic	**0.0335**	**0.0314**	**0.016**	**0.0214**	0.001	0.01
Barium	1.1	1.1	1.02	0.964	0.4	2
Cadmium	<0.00028	<0.00028	<0.00042	<0.00042	0.0005	0.005
Cobalt	0.00098	0.0013	<0.0012	<0.0012	0.008	0.04
Iron	**11.6**	**11.5**	**4.7**	**5.9**	0.15	0.3
Lead	<0.0017	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**2.98**	**2.98**	**3.12**	**2.67**	0.025	0.05
Mercury	0.00012	0.000051	0.00009	<0.00009	0.0002	0.002
Vanadium	<0.00071	<0.00071	<0.0019	<0.0019	0.006	0.03

EW-4
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	06/09/2005	03/23/2006	03/22/2007	PAL	ES
1,2,4-Trimethylbenzene	86	150	160	96	480
1,3,5-Trimethylbenzene	3	2.5	<1	96	480
Acetone	2.6	1.7	<4.6	200	1000
Carbon disulfide	2	<0.47	<1.8	200	1000
Ethylbenzene	<0.48	1.9	<1.2	140	700
Methylene chloride	<0.48	0.68	3	0.5	5
Naphthalene	1.1	3.9	4.6	10	100
Xylenes (total)	2.5	3.2	<2.8	1,000	10,000

Metals, mg/L					
Arsenic	**0.0282**	**0.0199**	**0.0272**	0.001	0.01
Barium	0.896	0.717	1.17	0.4	2
Cadmium	<0.00028	<0.00042	<0.00042	0.0005	0.005
Cobalt	<0.00096	<0.0012	<0.0012	0.008	0.04
Iron	**11.9**	**4.8**	**7.5**	0.15	0.3
Lead	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**2.11**	**2.05**	**3.31**	0.025	0.05
Mercury	0.00011	<0.00009	<0.00009	0.0002	0.002
Vanadium	0.00083	<0.0019	<0.0019	0.006	0.03

EW-5
Summary of Detected Compounds
Former Onalaska Landfill

Volatile Organic Compounds (VOC), ug/L	06/09/2005	03/23/2006	03/22/2007	PAL	ES
1,2,4-Trimethylbenzene	<0.12	0.98	<0.12	96	480
Acetone	<0.74	<0.74	1	200	1000
Methylene chloride	<0.19	0.44	0.29	0.5	5

Metals, mg/L					
Arsenic	**0.0152**	**0.0148**	**0.0168**	0.001	0.01
Barium	0.384	0.313	0.373	0.4	2
Cadmium	<0.00028	<0.00042	<0.00042	0.0005	0.005
Cobalt	<0.00096	<0.0012	<0.0012	0.008	0.04
Iron	**1.7**	0.28	**0.97**	0.15	0.3
Lead	<0.0017	<0.0017	<0.0017	0.0015	0.015
Manganese	**1.07**	**0.984**	**1.03**	0.025	0.05
Mercury	0.000053	<0.00009	<0.00009	0.0002	0.002
Vanadium	<0.00071	<0.0019	<0.0019	0.006	0.03

2006-2007 Groundwater Monitoring Program

Quarterly:	MW-16S, MW-16M, MW-17S and MW-17M. (December 2006, March 2007, June 2007 and September 2007)
Semiannual:	MW-4S, MW-5S, MW-15M, AW-13, AW-20, AW-25, AW-28, and MW-14S (March 2007 and September 2007)
Annual:	AW-1, MW-1SR, MW-2S, MW-2M, MW-10, EW-2, EW-3, EW-4, EW-5, PZ-1, PZ-2, PZ-3, PZ-5 (March 2007)

Four nearby private water supply wells (Ackerman, Miller, Pretasky, and Johnson) were sampled semiannually (March and September) for organics and metals only. ENSR facilitated access arrangements for the residential wells.

At the request of the WDNR, there was a modification to the March 2007 sampling event. The purpose of the modification was to further evaluate groundwater conditions at the downgradient extent of the plume. Thus, in lieu of sampling AW-13, AW-20, and AW-28; wells MW-6S, MW-6M, MW-8S, and MW-8M were sampled.

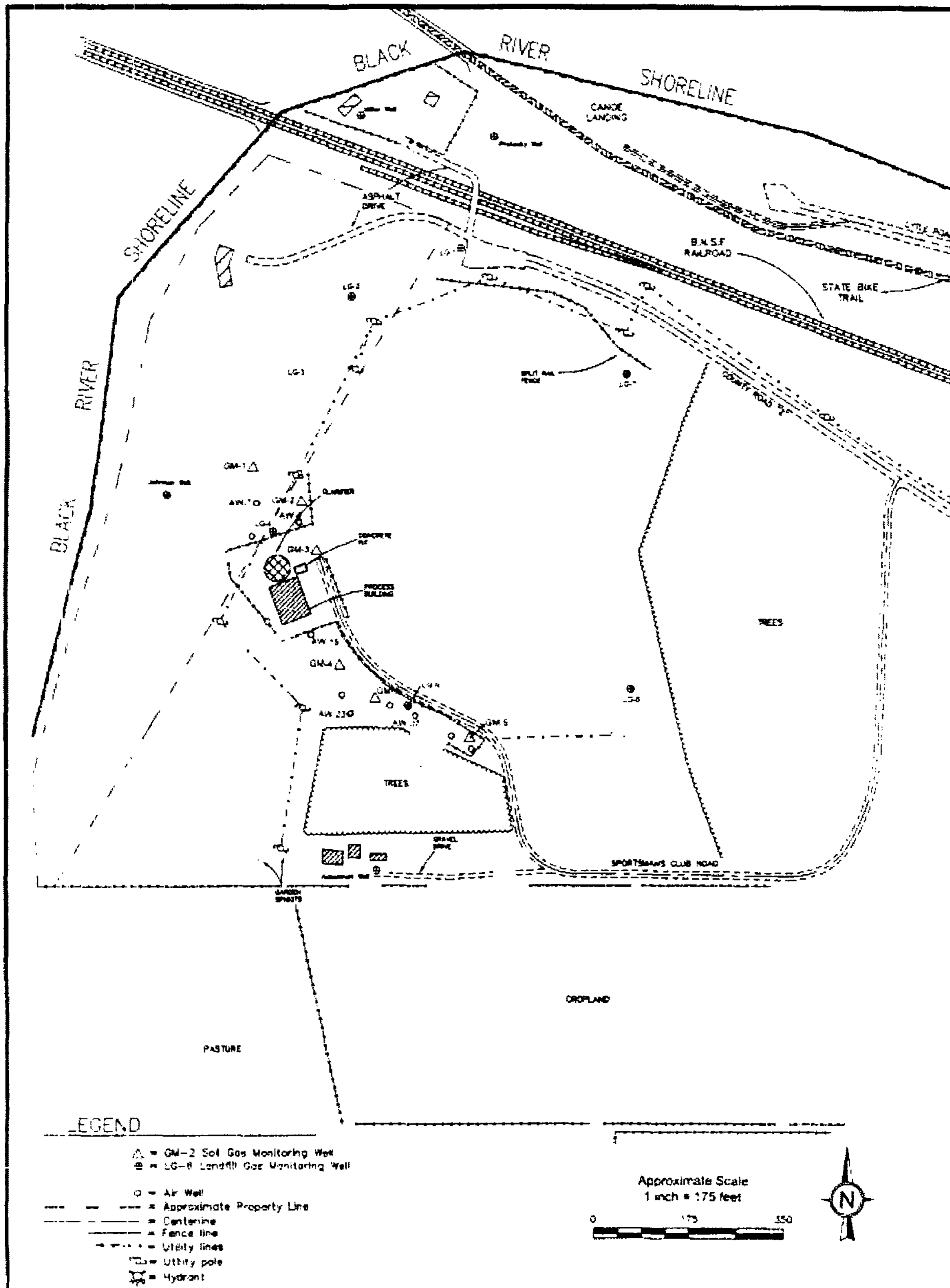
Notes:

1. Residential wells were sampled for VOCs and metals.
2. All other wells were sampled for VOCs, metals, chloride, nitrate, sulfate, total alkalinity, and total organic carbon.

Source Sampling schedule and testing requirements established by the WDNR.

ATTACHMENT 4

Soil and Soil Vapor Data



Source:
Onalaska Landfill Site Plan Survey, prepared by Coulee Region Land Surveyors, Inc., project no. S-4754 dated 5/14/03.
Location of landfill gas monitoring wells (LG) based upon a CH2MHILL figure - Landfill Gas Piping, June 1992.

Note:

Soil Gas Samples Collected on March 7, 2006

FIGURE NUMBER		DESIGNED BY:	REVISIONS
5	Vapor Testing Points MARCH 2006 ONALASKA LANDFILL ONALASKA, WISCONSIN	AC	
SHEET NUMBER	SCALE: 1"=175' / DATE: 6-12-06 / PROJECT NUMBER: 7349-002	DRAWN BY: BLK	
	ENSR ENSR CORPORATION ST. LOUIS PARK, MINNESOTA 55416 PHONE: (952) 924-0117 FAX: (952) 942-0317 WEB: HTTP://WWW.ENSR.AECOM.COM	CHECKED BY: CCP	
		APPROVED BY: PJM	

Soil Gas Results Table
Summary of Detected Compounds
Former Onalaska Landfill

Compound Name	AW-15 3/7/2006 ppm (v/v)	GM-3 3/7/2006 ppm (v/v)	GM-4 3/7/2006 ppm (v/v)	GM-5 3/7/2006 ppm (v/v)	GM-6 3/7/2006 ppm (v/v)
1,1,1-Trichloroethane	<0.00036	0.0026	0.00064	0.0017	0.00069
1,1,2-Trichloro-1,2,2-trifluoroethane	<0.00036	0.00009	0.000055	0.000079	0.000077
1,1-Dichloroethane	0.0029	0.00017	<0.000029	<0.000029	0.000092
1,2,4-Trimethylbenzene	0.0098	0.00026	0.0003	0.00022	0.00025
1,2-Dichloro-1,1,2,2-tetrafluoroethane	0.011	0.00017	<0.000057	0.00041	<0.000057
1,3,5-Trimethylbenzene	0.0031	0.000071	0.00007	0.00006	0.000085
Benzene	0.0024	0.00015	0.00012	0.00011	0.00012
Carbon tetrachloride	<0.00044	<0.000024	<0.000024	<0.000024	0.000034
Chloroethane	0.0033	<0.000051	<0.000051	<0.000051	<0.000051
Chloroform	<0.00055	<0.00003	0.00038	0.000048	0.000042
Chloromethane	<0.0018	0.00037	<0.000099	<0.000099	<0.000099
cis-1,2-Dichloroethene	0.0022	<0.000027	<0.000027	<0.000027	<0.000027
Dichlorodifluoromethane	<0.00075	0.0019	0.0018	0.0091	0.00082
Ethylbenzene	0.0016	0.00088	0.00095	0.00069	0.00087
Methylene chloride	0.0012	0.000099	0.00016	0.00011	0.00019
m-Xylene & p-Xylene	0.0061	0.0036	0.0041	0.0027	0.003
o-Xylene	<0.0012	0.00083	0.0011	0.00064	0.00068
Styrene	<0.0012	<0.000068	<0.000068	<0.000068	0.00039
Tetrachloroethene	<0.00058	<0.000032	0.0009	0.00082	0.00023
Toluene	0.0036	0.0007	0.00078	0.0006	0.0016
Trichloroethene	<0.00065	<0.000036	<0.000036	<0.000036	0.000051
Trichlorofluoromethane	<0.0013	0.00065	0.00023	0.00048	0.00025

Note: < indicates compound was not detected at or above the specified detection limit.

Field Screening Results
March 3, 2006
Former Onalaska Landfill

Sample ID	Date	PID [1]	CO_2	O_2	Methane
		ppmeq	%	%	%
LG-1	3/6/2006	0.0	1.7	19.3	0.0
LG-2	3/6/2006	0.0	0.6	20.2	0.0
LG-3	3/6/2006	0.0	0.0	20.5	0.0
LG-4	3/6/2006	0.0	0.0	20.2	0.0
LG-5	3/6/2006	0.0	0.3	20.2	0.0
LG-6	3/6/2006	0.0	0.3	20.3	0.0
LG-7	3/6/2006	0.0	1.4	19.5	0.0
GM-01	3/6/2006	0.0	2.4	18.5	0.0
GM-02	3/6/2006	0.0	2.0	18.5	0.0
GM-03 Shallow	3/6/2006	0.0	0.8	19.6	0.0
GM-03 Deep	3/6/2006	0.0	8.6	9.5	0.0
GM-04 Shallow	3/6/2006	2.8*	6.8	11.1	0.0
GM-04 Deep	3/6/2006	12.2*	11.8	0.0	3.0
GM-05	3/6/2006	3.4*	4.4	16.5	0.0
GM-06	3/6/2006	2.2*	0.7	20.0	0.0
AW-06	3/6/2006	0.0	3.6	15.9	0.0
AW-07	3/6/2006	0.0	0.6	20.3	0.0
AW-15	3/6/2006	0.2	5.8	0.0	15.1
AW-23	3/6/2006	5.7*	1.6	19.2	0.0
AW-27	3/6/2006	2.3*	2.5	16.8	1.2

Notes:

1. PID = Photoionization Detector. Readings measured in parts per million (ppm) equivalent units (calibrated to 100 ppm isobutylene).

* Indicated the PID may not have been functioning properly.

CO_2, O_2, and methane were measured using a Land Tech GA 90 Analyzer.

"Kramer, Eileen - DNR"
<Eileen.Kramer@wisconsin.g
ov>

07/03/2008 02:16 PM

To

Subject Onalaska

<<OnalaskaSigPage.pdf>> <<onalaskaVaporStudy.pdf>>
Kyle, here are three pages with figure and data tables from the semi-annual report that included the vapor work. Also, I have included the signature page with my boss' approval. I will send you the Docs Reviewed sheet as soon as I get back to my own computer. I have hijacked someone else's computer that has a scanner.

OnalaskaSigPage.pdf onalaskaVaporStudy.pdf

INSTITUTIONAL CONTROLS

Institutional Controls

Map of Real Estate Parcels with Parcel ID Numbers &
Indicating Which Parcels Have Been Restricted

Declaration of Restrictions
Recorded April 14, 1997 by Town of Onalaska

Most Recent Recorded Deed for Landfill
Parcel ID 1418-0

Most Recent Recorded Deed for Parcel East of Landfill
Parcel ID 1422-0

Most Recent Recorded Deed for Parcel West of Landfill
Parcel ID1417-4

Most Recent Recorded Deed for Parcel South of Landfill
Parcel ID1423-0

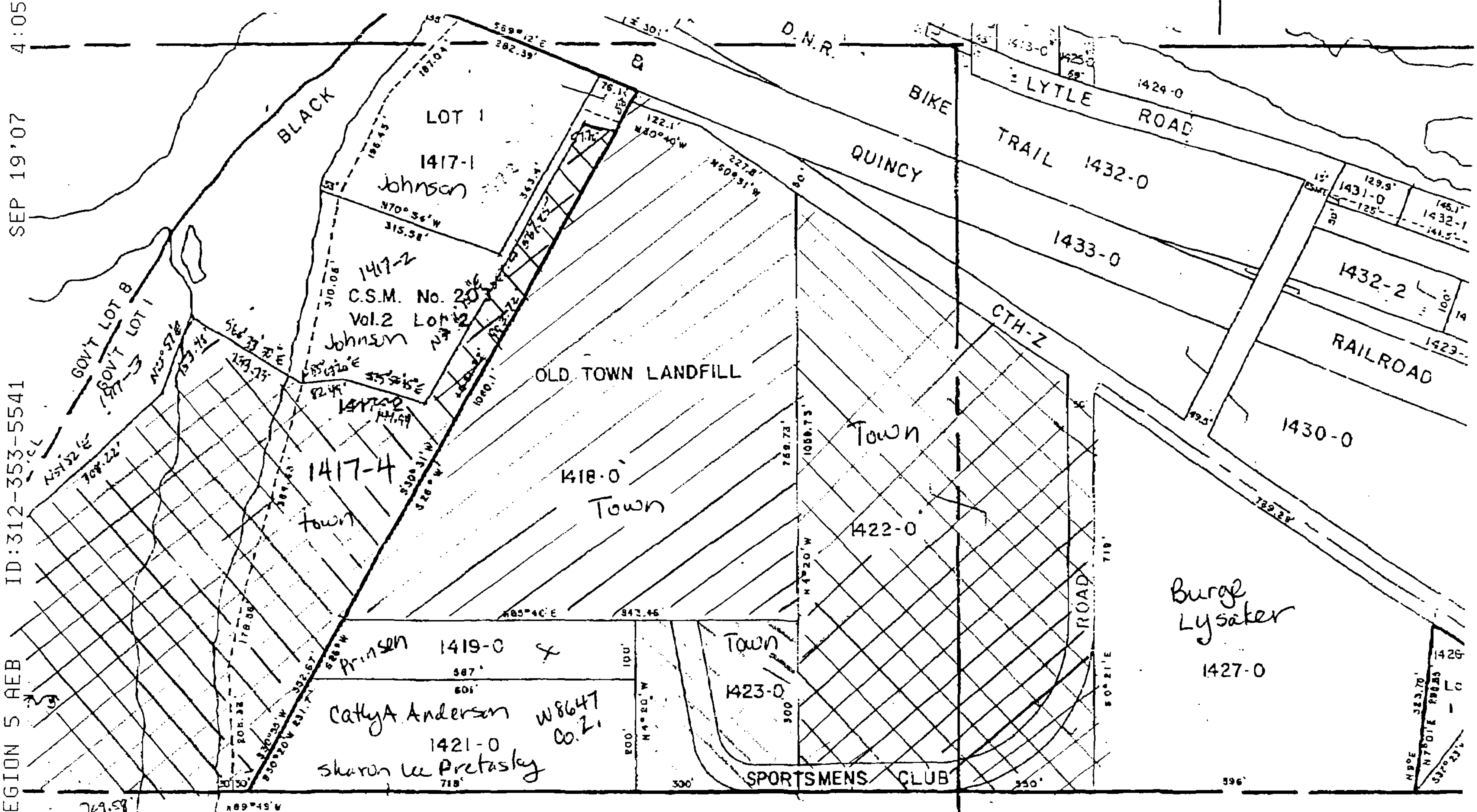
Easement Granted by Township to Owners of
Parcel ID 1419-0 for Ingress/Egress Across Parcel ID 14230-0

Wisconsin Administrative Code Ch. NR 500.06(4)
Affidavit of Facility Registry

Wisconsin Administrative Code Ch. NR 506.085
Final Use of Landfill

Wisconsin Administrative Code Ch. NR 812.08(4)(g)
Supply Well Location in Relation to Contamination Sources

ONALASKA LANDFILL SUPERFUND SITE
Real Estate Parcels
as Recorded at the La Crosse
Co. Register of Deeds Office
MARCH 2008



PARCEL OWNED BY TOWN OF ONALASKA

PARCEL OWNED BY TOWN OF ONALASKA & RESTRICTED BY DOCUMENT RECORDED AT LA CROSSE COUNTY

VOL 1173 PAGE 498

1171023

Document Number

DECLARATION OF RESTRICTION
ON USE OF REAL PROPERTY

Document Title

RECORD[illegible]

AT 3:45 P. M

APR 14 1997

DEBORAH J. FLOCK
REGISTER OF DEEDS
LA CROSSE COUNTY

Recording Area #45 26.00

Name and Return Address

Daniel E. Dunn
401 Main Street
Ste. 400
PO BOX 1627
LaCrosse, WI 54602-1627

Parcel Identification Number (PIN)

This information must be completed by submitter: document title, name & return address, and PIN (if required). Other information such as the granting clauses, legal description, etc. may be placed on this first page of the document or may be placed on additional pages of the document. Note: Use of this cover page adds one page to your document and $2.00 to the recording fee. Wisconsin Statutes, 59.517. WRDA 2/96

26.00

DECLARATION OF RESTRICTION ON USE OF REAL PROPERTY

The record owner(s) hereby declare and impose the following restrictions on the real property (also known as the Onalaska Municipal Landfill) located in the County of LaCrosse, Onalaska Township, more particularly described as follows:

See Exhibits "A", "B" and "C".

RECITALS

WHEREAS, the United States Environmental Protection Agency (U.S. EPA) has issued a Record of Decision (ROD) adopting a remedial action plan which requires remedial action to be undertaken on the property and further institutional controls to assure that the remedy is protective of human health and the environment;

WHEREAS, the United States District Court for the Western District of Wisconsin has approved a Consent Decree entered into between the United States of America and Settling Defendant and (in a case styled United States of America v. Township of Onalaska) which Consent Decree concerns the remedial actions to be undertaken at the Onalaska Municipal Landfill. Section IX, of the Consent Decree identifies institutional controls which are necessary to effectuate and protect the remedial action chosen in the ROD at the Onalaska Municipal Landfill and to protect the public health or welfare or the environment at the Onalaska Municipal Landfill site;

NOW, THEREFORE, by this instrument there are created, declared and established at the property the following restrictive covenants and requirements, which shall, unless amended, run with land and remain in full force and effect in perpetuity from the date hereof, irrespective of any sale, conveyance, alienation, or other transfer of any interest or estate in such property.

RESTRICTIONS APPLICABLE TO THE PROPERTY

The following restrictions shall apply to the property described above:

1. There shall be no consumptive or other use of the groundwater underlying the property.

2. There shall be no use of, or activity at, the property that may interfere with the work performed or to be performed under the Consent Decree or pursuant to the ROD at the property, or any activity which may damage any remedial action component constructed for or installed pursuant to the Consent Decree or the ROD or otherwise impair the effectiveness of any Work to be performed pursuant to the Consent Decree or the ROD.

3. There shall be no installation, construction, removal or use of any buildings, wells, pipes, roads, ditches or any other structures at the property except as approved by the U.S. EPA as consistent with the Consent Decree and the ROD.

4. There shall be no residential use of the property.

The restrictions specified above shall continue in full force and effect until the Onalaska Municipal Landfill site is deleted from the National Priorities List, all remedial action clean-up and performance standards have been met, or until such time as the U.S. EPA issues a determination in writing or the court rules to either modify or terminate the restrictions in response to a petition from the owner(s) of the property, as provided below.

If the Owner, its successors and assigns, at any time violates, threatens or attempts to violate, or fails to faithfully observe or perform each of the foregoing restrictions and covenants upon the Real Estate, it shall be lawful for U.S. EPA, the State of Wisconsin or the Settling Defendants, in addition to other remedies available under law or equity, to institute and prosecute appropriate proceedings, judicial or other, at law or in equity for the wrong done, threatened or attempted.

COPY OF RESTRICTIONS

A copy of these restrictions shall be provided by the owner(s) of the property to all respective successors, assigns and transferee of the property.

PETITION TO MODIFY OR TERMINATE DEED RESTRICTIONS

After all work, as defined in the Consent Decree and as required to be performed under the ROD, has been completed and upon achievement of Cleanup Standards, consistent with the ROD, the owner(s) of the property may petition the Regional Administrator of the U.S. EPA, Region V, or his delegate, to modify or terminate the deed restrictions. Any petition for modification or termination shall state the specific provision sought to be modified or terminated and any proposed additional uses of the property. Any proposed modification or terminations must not be inconsistent with the requirements set forth in the Consent Decree.

The property owner(s) shall provide to the Settling Defendant a copy of any petition for modification or termination of deed restriction submitted to the U.S. EPA. Any party may object to the proposed use of the property on the grounds that such use is not consistent with the Consent Decree, or may result in exceedances of the Clean-up Standards required by the ROD. Any party so objecting shall notify the owner(s) of the property, the U.S. EPA, and the State of Wisconsin in writing, within thirty (30) days of receipt of the petition. The Regional Administrator may allow or deny the owner's petition for modification or termination in whole or in part. Any dispute as to the Regional Administrator's determination is subject to Section XI (Dispute Resolution) of the Consent Decree.

SEVERABILITY

If any provision of this Declaration of Restriction On User of Real Property is held to be invalid by any court of competent jurisdiction, the invalidity of such provision shall not affect the validity of any other provisions hereof. All such other provisions shall continue unimpaired in full force and effect.

CONFLICT OF LAWS

If any provision of this Declaration of Restrictions On Use of Real Property is also the subject of any law or regulation established by any federal, state or local government, the stricter of the two standards shall prevail.

HARMONIOUS CONSTRUCTION

No provision of this Declaration of Restriction On Use of Real Property shall be construed so as to violate any applicable zoning laws, regulations or ordinances. If any such conflict does arise, the applicable zoning laws, regulations or ordinances shall prevail, unless they are inconsistent with CERCLA.

The undersigned persons executing this Declaration of Restrictions On Use of Real Property on behalf of the owner(s) of the property represent and certify that they are duly authorized and have been fully empowered to execute this Declaration.

IN WITNESS WHEREOF, the owner(s) of the property have caused this Declaration of Restrictions On Use of Real Property to be executed on this 2 day of April, 1997.

OWNER SETTLING DEFENDANT
TOWN OF ONALASKA

By: Carl Pedretti
Carl Pedretti, Chairman

By: Linda M. Carlson
Linda Carlson, Clerk

Subscribed and sworn to before me
this 2 day of April, 1997.

Notary Public, State of Wisconsin
My commission ~~expires~~: is permanent

DRAFTED BY:
Attorney Daniel E. Dunn
Fitzpatrick, Smyth, Dunn &
Fitzpatrick
401 Main Street, Suite 400
La Crosse, WI 54601

Part of Lot Two (2) of Certified Survey Map #203, Doc. #954321, filed in Volume 2 of La Crosse County Certified Survey Maps, Page 203 and part of Government Lot One (1) (being that part of the Southwest quarter of the Southeast quarter (SW 1/4-SE 1/4) and that part of the Southeast quarter of the Southwest quarter (SE 1/4-SW 1/4), lying Easterly of the Black River) of Section 9, Township 17 North, Range 8 West, described as follows: Commencing at the Southeast corner of said Section 9; thence North 89° 49' 48" West, along the South line of said Section 9, a distance of 2640.26 feet to the Southeasterly corner of said Lot 2 of Certified Survey Map #203 and the point of beginning of this description; thence South 89° 56' 30" West, along the South line of said Section 9, a distance of 769.58 feet to a point on the Easterly boundary of the United States Department of Agriculture, Upper Mississippi River Wildlife and Fish Refuge; thence North 34° 36' 00" East, along said Refuge boundary, 300.30 feet; thence continue along said Refuge boundary North 40° 42' 00" East 326.04 feet; thence continue along said Refuge boundary North 51° 52' 00" East 308.22 feet; thence continue along said refuge boundary North 23° 57' 00" East 153.48 feet; thence South 60° 33' 30" East 233.73 feet; thence North 85° 03' 20" East 82.49 feet; thence South 75° 50' 35" East 144.94 feet; thence North 30° 11' 15" East 567.25 feet; thence South 77° 11' 00" East 57.72 feet to a point of the Easterly line of said Lot 2 of Certified Survey Map #203; thence South 30° 31' 50" West, along the Easterly line of said Lot 2, a distance of 993.72 feet; thence continue along said Easterly line South 30° 55' 46" West 352.67 feet to the point of beginning.

This is description
of PID# 10-1417-4

EXHIBIT "A"

Part of the Southeast quarter of the Southeast quarter (SE 1/4 - SE 1/4) and part of Government Lot One (1), of Section 9, Township 17 North, Range 8 West, described as follows: Commencing at the Southeast corner of said Section 9; thence South 85 40' West 1618.60 feet to the point of beginning of this description; thence North 04 20' West 1059.73 feet; thence South 60 31' East 661.15 feet; thence South 04 20' East 719.00 feet; thence South 85 40' West 550.00 feet to the point of beginning.

This is description of PID# 10-1422-0

EXHIBIT "B"

Part of Government Lot One (1), (being that part of the Southwest quarter of the Southeast quarter (SW 1/4-SE 1/4), lying Easterly of the Black River), of Section 9, Township 17 North, Range 8 West, described as follows: Commencing at the Southeast corner of the SE 1/4 of the SE 1/4 of said Section; thence South 85° 40' West, along the South line of said Section, a distance of 1618.6 feet to the point of beginning of this description; thence North 04° 20' West 300.0 feet; thence South 85° 40' West 300.0 feet; thence South 04° 20' East 300.0 feet; thence North 85° 40' East 300.0 feet to the point of beginning.

This is description of PID # 10-1423-0

EXHIBIT "C"

PID # 1418-0

DOCUMENT NO. 781241

VOL 432 PAGE 446

WARRANTY DEED—By Corporation
STATE OF WISCONSIN—FORM 4
THIS SPACE RESERVED FOR RECORDING DATA

RECORDED
SEP 18 1967
AT 11:20 A. M.
EVERETTE B. RUNGE
REGISTER OF DEEDS

RETURN TO

THIS INDENTURE, Made this 22nd day of August A. D., 19 67, between Fred J. Domke, a widower, part y of the first part and Town of Onalaska, a Municipal x Corporation duly organized and existing under and by virtue of the laws of the State of Wisconsin, located at Onalaska Wisconsin, party of the second part.

Witnesseth, That the said part y of the first part, for and in consideration of the sum of One Dollar and other good and valuable consideration to him in hand paid by the said party of the second part, the receipt whereof is hereby confessed and acknowledged, ha s given, granted, bargained, sold, remised, released, aliened, conveyed and confirmed, and by these presents do es give, grant, bargain, sell, remise, release, alien, convey and confirm unto the said party of the second part, its successors and assigns forever, the following described real estate situated in the County of LaCrosse and State of Wisconsin, to-wit:

Part of the SW¼ of the SE¼ of Section 9, Township 17 North, Range 8 West, lying in Government Fractional Lot 1, and described as follows:

Commencing at the SE corner of said Section 9; thence South 85° 40' West along the South line thereof 1618.6 feet; thence North 4° 20' West 300 feet to the point of beginning; thence continuing North 4° 20' West 759.73 feet; thence North 60° 31' West 227.8 feet; thence North 80° 40' West 122.1 feet; thence South 26° 00' West 1060.1 feet; thence North 85° 40' East 843.46 feet to the point of beginning, containing 11.66 acres.

This deed corrects an erroneous description in deed recorded in Volume 347 of Records, Page 563 and therefore, (OVER)

Together with all and singular the hereditaments and appurtenances thereunto belonging or in any wise appertaining; and all the estate right, title, interest, claim or demand whatsoever, of the said part y of the first part, either in law or equity, either in possession or expectancy of, in and to the above bargained premises, and their hereditaments and appurtenances.

To Have and To Hold the said premises as above described with the hereditaments and appurtenances unto the said party of the second part, and to its successors and assigns FOREVER.

And the said Fred J. Domke, a widower, for himself and his heirs, executors and administrators, do es covenant, grant, bargain and agree to and with the said party of the second part, its successors and assigns, that at the time of the ensealing and delivery of these presents he is well seized of the premises above described, as of a good, sure, perfect, absolute and indefeasible estate of inheritance in the law, in fee simple, and that the same are free and clear from all incumbrances whatever,

and that the above bargained premises in the quiet and peaceable possession of the said party of the second part, its successors and assigns, against all and every person or persons lawfully claiming the whole or any part thereof, it will forever WARRANT AND DEFEND.

In Witness Whereof, the said part y of the first part ha s hereunto set his hand and seal this 22nd day of August, A. D., 19 67.

SIGNED AND SEALED IN PRESENCE OF

Robert C. Skemp

Robert C. Skemp

Doris Horton

Doris Horton

Fred J. Domke (SEAL.)
Fred J. Domke

(SEAL.)

(SEAL.)

(SEAL.)

STATE OF WISCONSIN,
La Crosse County. } ss.

Personally came before me, this 22nd day of August, A. D., 19 67 the above named Fred J. Domke, a widower, to me known to be the person who executed the foregoing instrument and acknowledged the same.

NOTARY SEAL
R. C. SKEMP NOTARY PUBLIC LA CROSSE COUNTY, WIS.

Robert C. Skemp
Robert C. Skemp

Notary Public LaCrosse County, Wis.

My Commission (Expires) (Is) permanent.

This instrument drafted by

Peter G. Pappas

(Section 59.51 (1) of the Wisconsin Statutes provides that all instruments to be recorded shall have plainly printed or typewritten thereon the names of the grantors, grantees, witnesses and notary).

PID# 10-1422-0

DOCUMENT NO.

1132938

WARRANTY DEED
STATE OF WISCONSIN—FORM 10

THIS SPACE RESERVED FOR RECORDING DATA

VOL 1084 PAGE 86
RECORDED
AT 3:45 PM
MAY 11 1995
DEBORAH J. FLOCK
REGISTER OF DEEDS
La Crosse County, WI

RETURN TO

#45 $10.00

THIS INDENTURE, Made by Fifteen "15" Sportsmen's Club, Inc.

a Corporation duly organized and existing under and by virtue of the laws of the State of Wisconsin, grantor, of La Crosse County, Wisconsin, hereby conveys and warrants to Town of Onalaska ..., grantee, of La Crosse County, Wisconsin, for the sum of ...

the following tract of land in La Crosse County, State of Wisconsin:

Part of the Southeast quarter of the Southeast quarter (SE 1/4 - SE 1/4) and part of Government Lot One (1), of Section 9, Township 17 North, Range 8 West, described as follows: Commencing at the Southeast corner of said Section 9; thence South 85 40' West 1618.60 feet to the point of beginning of this description; thence North 04 20' West 1059.73 feet; thence South 60 31' East 661.15 feet; thence South 04 20' East 719.00 feet; thence South 85 40' West 550.00 feet to the point of beginning.

FEE
77.25 (12)
EXEMPT

(IF NECESSARY, CONTINUE DESCRIPTION ON REVERSE SIDE)

In Witness Whereof, the said grantor has caused these presents to be signed by CLAIR RUSSELL, its President, and countersigned by GARY SKOGEN, its Secretary, at LA CROSSE, Wisconsin, and its corporate seal to be hereunto affixed this 18th day of April, A. D., 1995.

SIGNED AND SEALED IN PRESENCE OF

Fifteen "15" Sportsmen's Club, Inc.
Corporate Name

X Clair Russell
Clair Russell
President

COUNTERSIGNED:
X Gary Skogen
Gary Skogen
Secretary

STATE OF WISCONSIN
LA CROSSE County. } ss.

Personally came before me, this 18th day of April, A. D., 1995, CLAIR RUSSELL, President, and GARY SKOGEN, Secretary of the above named Corporation, to me known to be the persons who executed the foregoing instrument, and to me known to be such President and Secretary of said Corporation, and acknowledged that they executed the foregoing instrument as such officers as the deed of said Corporation, by its authority.

THIS INSTRUMENT WAS DRAFTED BY

Bannen & Bannen
305 State Bank Bldg., La Crosse, WI 54601

NOTARY SEAL

JAMES J BANNEN
Notary Public, LA CROSSE County, Wis.
My commission (expires) (is) Perm

(Section 59.51 (1) of the Wisconsin Statutes provides that all instruments to be recorded shall have plainly printed or typewritten thereon the names of the grantors, grantees, witnesses and notary. Section 59.513 similarly requires that the name of the person who, or governmental agency which, drafted such instrument, shall be printed, typewritten, stamped or written thereon in a legible manner.)

Parcel ID# 10-1417-4

DOCUMENT NO.

1132936

WARRANTY DEED

STATE BAR OF WISCONSIN FORM 2 — 1982

THIS SPACE RESERVED FOR RECORDING DATA

VOL 1084 PAGE 83

RECORDED AT 3:45 PM

MAY 11 1995

DEBORAH J. FLOCK
REGISTER OF DEEDS
La Crosse County, WI

Raymond C. Hubley, Jr. and Mary J. Hubley, husband and wife

conveys and warrants to The Town of Onalaska

the following described real estate in La Crosse County, State of Wisconsin:

RETURN TO

#45 $10.00

Tax Parcel No:

Part of Lot Two (2) of Certified Survey Map #203, Doc. #954321, filed in Volume 2 of La Crosse County Certified Survey Maps, Page 203 and part of Government Lot One (1) (being that part of the Southwest quarter of the Southeast quarter (SW 1/4-SE 1/4) and that part of the Southeast quarter of the Southwest quarter (SE 1/4-SW 1/4), lying Easterly of the Black River) of Section 9, Township 17 North, Range 8 West, described as follows: Commencing at the Southeast corner of said Section 9; thence North 89° 49' 48" West, along the South line of said Section 9, a distance of 2640.26 feet to the Southeasterly corner of said Lot 2 of Certified Survey Map #203 and the point of beginning of this description; thence South 89° 56' 30" West, along the South line of said Section 9, a distance of 769.58 feet to a point on the Easterly boundary of the United States Department of Agriculture, Upper Mississippi River Wildlife and Fish Refuge; thence North 34° 36' 00" East, along said Refuge boundary, 300.30 feet; thence continue along said Refuge boundary North 40° 42' 00" East 326.04 feet; thence continue along said Refuge boundary North 51° 52' 00" East 308.22 feet; thence continue along said refuge boundary North 23° 57' 00" East 153.48 feet; thence South 60° 33' 30" East 233.73 feet; thence North 85° 03' 20" East 82.49 feet; thence South 75° 50' 35" East 144.94 feet; thence North 30° 11' 15" East 547.25 feet; thence South 77° 11' 00" East 57.72 feet to a point of the Easterly line of said Lot 2 of Certified Survey Map #203; thence South 30° 31' 50" West, along the Easterly line of said Lot 2, a distance of 993.72 feet; thence continue along said Easterly line South 30° 55' 46" West 352.67 feet to the point of beginning.
CONTAINING 12.305 ACRES, [initials]

This is homestead property.
(is) (is not)

FEE 77.25 (12) EXEMPT

Exception to warranties: easements, restrictions and zoning ordinances of record.

Dated this 3rd day of May, 1995.

Raymond C. Hubley Jr. (SEAL)
* Raymond C. Hubley, Jr.

Mary J. Hubley (SEAL)
* Mary J. Hubley

(SEAL)
*

(SEAL)
*

AUTHENTICATION

Signature(s) Raymond C. Hubley, Jr. and Mary J. Hubley

authenticated this 3rd day of May, 1995

Daniel E. Dunn
* Daniel E. Dunn

TITLE: MEMBER STATE BAR OF WISCONSIN

(If not, authorized by § 706.06, Wis. Stats.)

THIS INSTRUMENT WAS DRAFTED BY

Attorney Daniel E. Dunn
401 Main Street, Suite 400
La Crosse, WI 54601

(Signatures may be authenticated or acknowledged. Both are not necessary.)

ACKNOWLEDGMENT

STATE OF WISCONSIN } ss.
.... County.

Personally came before me this .... day of ...., 19...... the above named ....

to me known to be the person .... who executed the foregoing instrument and acknowledge the same.

*

Notary Public .... County, Wis.
My Commission is permanent. (If not, state expiration date: ...., 19.....)

*Names of persons signing in any capacity should be typed or printed below their signatures.

PID#10-1423-0

DOCUMENT NO.

1131612

WARRANTY DEED

STATE BAR OF WISCONSIN FORM 2 — 1982

THIS SPACE RESERVED FOR RECORDING DATA

VOL 1081 PAGE 201

RECORDED AT 3:00 P M

APR 13 1995

DEBORAH J. FLOCK
REGISTER OF DEEDS
La Crosse County, WI

RETURN TO

#45 $10.00

Leroy E. Holley

conveys and warrants to The Town of Onalaska

the following described real estate in La Crosse County, State of Wisconsin:

Tax Parcel No: ....

Part of Government Lot One (1), (being that part of the Southwest quarter of the Southeast quarter (SW 1/4-SE 1/4), lying Easterly of the Black River), of Section 9, Township 17 North, Range 8 West, described as follows: Commencing at the Southeast corner of the SE 1/4 of the SE 1/4 of said Section; thence South 85° 40' West, along the South line of said Section, a distance of 1618.6 feet to the point of beginning of this description; thence North 04° 20' West 300.0 feet; thence South 85° 40' West 300.0 feet; thence South 04° 20' East 300.0 feet; thence North 85° 40' East 300.0 feet to the point of beginning.

FEE
77.25 (12)
EXEMPT

This is not homestead property.
(is) (is not)

Exception to warranties: easements, restrictions and zoning ordinances of record.

Dated this 5th day of April, 1995.

.................(SEAL) ....(SEAL)
* Leroy E. Holley * ....

.................(SEAL) ....(SEAL)
* .... * ....

AUTHENTICATION

Signature(s) Leroy E. Holley

authenticated this 5th day of April, 1995

* Daniel E. Dunn

TITLE: MEMBER STATE BAR OF WISCONSIN

(If not, authorized by § 706.06, Wis. Stats.)

THIS INSTRUMENT WAS DRAFTED BY

Attorney Daniel E. Dunn
401 Main Street, Suite 400
La Crosse, WI 54601

(Signatures may be authenticated or acknowledged. Both are not necessary.)

ACKNOWLEDGMENT

STATE OF WISCONSIN } ss.
.... County.

Personally came before me this .... day of ...., 19...... the above named ....

to me known to be the person .... who executed the foregoing instrument and acknowledge the same.

....

* ....

Notary Public .... County, Wis.
My Commission is permanent. (If not, state expiration date: ...., 19........)

*Names of persons signing in any capacity should be typed or printed below their signatures.

1479124

LACROSSE COUNTY
REGISTER OF DEEDS
CHERYL A. MCBRIDE

RECORDED ON
06/28/2007 02:09PM

REC FEE: 15.00
TRANSFER FEE:
EXEMPT #:

PAGES: 3

Easement

Document Number | Document Title

Recording Area

Name and Return Address

Richard & Sue Prinsen
W 4867 Gills Coulee Rd
West Salem WI 54669

10-1419-0

Parcel Identification Number (PIN)

See legal description for easement located on page 2 of 2 of attached Plat of Survey

This instrument was drafted by David Karl

This information must be completed by submitter: document title, name & return address, and PIN (if required). Other information such as the granting clauses, legal description, etc. may be placed on this first page of the document or may be placed on additional pages of the document. Note: Use of this cover page adds one page to your document and $2.00 to the recording fee. Wisconsin Statutes, 59.43(2m) WRDA 2/99

215 32 (2/99)

LAND SURVEYOR
DAVID J. KARL
2222 MISSISSIPPI ST.
LA CROSSE, WI 54601

I, DAVID J. KARL, A WISCONSIN REGISTERED LAND SURVEYOR, HEREBY CERTIFY THAT THIS SURVEY HAS BEEN PREPARED UNDER MY DIRECTION AND CONTROL. I FURTHER CERTIFY THAT THIS INFORMATION IS CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

WISCONSIN
DAVID J. KARL
S-2136
LA CROSSE
WI
LAND SURVEYOR

David J. Karl

6/20/2007

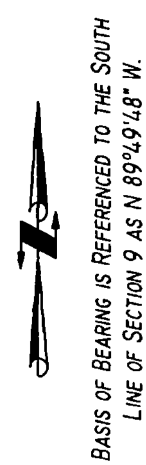
PLAT OF SURVEY

LOCATED IN GOVERNMENT LOT 1, SECTION 9, T 17 N, R 8 W, TOWN OF ONALASKA, LA CROSSE COUNTY, WISCONSIN.

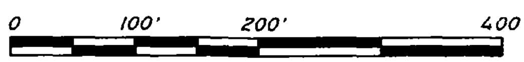
PARCEL IS DESCRIBED AS COMMENCING AT THE SOUTHEAST CORNER OF SECTION 9, T17N, R8W; THENCE WESTERLY ALONG THE SOUTH LINE OF GOVERNMENT LOT 1 TO THE SOUTHEAST CORNER OF A CSM RECORDED ON PAGE 203 OF VOLUME 2 OF LA CROSSE COUNTY; THENCE NORTHEASTERLY ALONG THE EAST LINE OF SAID CSM TO A PIPE AT THE SOUTHWEST CORNER OF THE LOT SURVEYED AND DESCRIBED HEREIN, SAID CORNER ALSO BEING THE P.O.B. THENCE S 89°49'48" E, A DISTANCE OF 586.35' TO A PIPE AT THE SOUTHEAST CORNER OF THIS PARCEL; THENCE N 0°10'12" E, A DISTANCE OF 100.00'; THENCE N 89°49'48" W, A DISTANCE OF 526.69' TO A PIPE ON THE EAST LINE OF THE AFOREMENTIONED CSM, SAID PIPE BEING THE NORTHWEST CORNER OF THIS PARCEL, THENCE S 30°58'35" W ALONG SAID EAST LINE, A DISTANCE OF 116.46' TO THE P.O.B.

LAND OWNERS

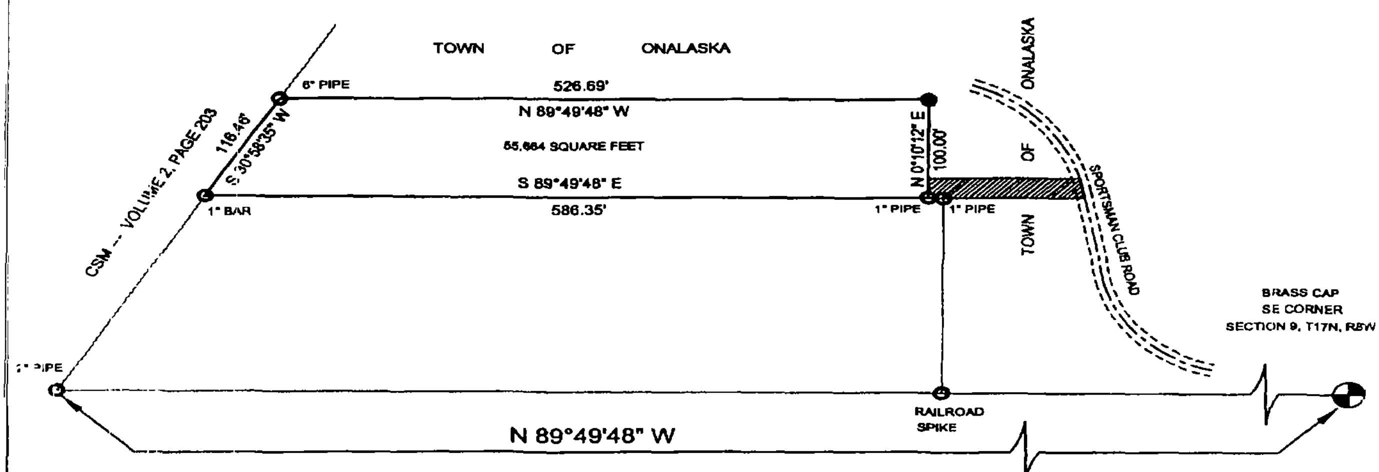
RICHARD & SUE PRINSEN
W4567 GILLS COULEE ROAD
WEST SALEM, WI 54669



SCALE: 1" = 150'



LEGEND		
○	=	FOUND MONUMENT
●	=	SET 24" x 3/4" IRON BAR @ 1.5# / FT.
(hatched)	=	PROPOSED EASEMENT



LAND SURVEYOR

DAVID J. KARL
2222 MISSISSIPPI ST.
LA CROSSE, WI 54601

I, DAVID J. KARL, A WISCONSIN REGISTERED LAND SURVEYOR, HEREBY CERTIFY THAT THIS SURVEY HAS BEEN PREPARED UNDER MY DIRECTION AND CONTROL. I FURTHER CERTIFY THAT THIS INFORMATION IS CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

6/20/2007

GRANT OF EASEMENT

LOCATED IN GOVERNMENT LOT I, SECTION 9, T 17 N, R 8 W, TOWN OF ONALASKA, LA CROSSE COUNTY, WISCONSIN.

EASEMENT PARCEL IS DESCRIBED AS COMMENCING AT THE SOUTHEAST CORNER OF SECTION 9, T17N, R8W; THENCE WESTERLY ALONG THE SOUTH LINE OF GOVERNMENT LOT 1 TO THE SOUTHEAST CORNER OF A CSM RECORDED ON PAGE 203 OF VOLUME 2 OF LA CROSSE COUNTY; THENCE NORTHEASTERLY ALONG THE EAST LINE OF SAID CSM TO A PIPE AT THE SOUTHWEST CORNER OF THE LOT SURVEYED AND DESCRIBED HEREIN, THENCE S 89°49'48" E, A DISTANCE OF 586.35' TO A PIPE AT THE SOUTHEAST CORNER OF THIS PARCEL AND THE P.C.B. OF THIS EASEMENT. THENCE CONTINUING S 89°49'48" E, A DISTANCE OF 126.30' TO THE CENTERLINE OF SPORTSMAN CLUB ROAD; THENCE N 11°04'09" W ALONG SAID CENTERLINE, A DISTANCE OF 20.39'; THENCE N 89°49'48" W, A DISTANCE OF 122.33' TO THE EAST LINE OF THE LOT SURVEYED AND DESCRIBED HEREIN, THENCE S 0°10'12" W ALONG SAID EAST LINE, A DISTANCE OF 20.00' TO THE P.O.B. OF THIS EASEMENT DESCRIPTION.

TOWN OF ONALASKA RESOLUTION

THE TOWN OF ONALASKA GRANTS AN INGRESS/EGRESS EASEMENT TO RICHARD AND SUE PRINSEN, OR THEIR ASSIGNS, ALLOWING ACCESS TO THE PARCEL DESCRIBED ON PAGE 1 OF THIS DOCUMENT. THIS PERMANENT EASEMENT WILL BE 20 FEET IN WIDTH AND IS DESCRIBED ABOVE.

RESOLVED THIS 25th DAY OF JUNE, 2007.

Stanley S. Hauser

CHAIR, TOWN OF ONALASKA, WISCONSIN

THE ABOVE RESOLUTION WAS PASSED BY THE TOWN BOARD OF ONALASKA, WISCONSIN.
DATED THIS 25th DAY OF JUNE, 2007.

Sue Schultz

CLERK, TOWN OF ONALASKA, WISCONSIN

STATE OF WISCONSIN)
)ss.
COUNTY OF LA CROSSE)

Personally came before me this 25th day of June, 2007, the above named Stanley S. Hauser and Sue Schultz to me known as the persons who executed the foregoing instrument and acknowledged the same.

SUE A. PRINSEN
NOTARY PUBLIC
STATE OF WISCONSIN

Sue A. Prinsen

Notary Public, La Crosse County, WI
My commission expires: 7-18-2010

GRANTOR
TOWN OF ONALASKA, WISCONSIN

GRANTEE
RICHARD AND SUE PRINSEN SP.

NR 500.05 General submittal requirements. Unless otherwise specified, all submittals for review and approval of any initial site report, feasibility report, plan of operation, site investigation report, remedial action options report, construction documentation report or closure plan shall include the following:

(1) REVIEW FEE. The appropriate review fee specified in s. NR 520.04 shall be identified. The department will send an invoice for the plan review fee to the contact for the facility upon receipt of the submittal. Payment in check or money order shall be sent to the department's bureau of finance within 30 days after receipt of the invoice.

(2) COVER LETTER. A letter detailing the desired department action or response.

(3) PAPER AND ELECTRONIC COPIES. Unless otherwise specified, 4 paper copies and one electronic copy of the plan or report prepared pursuant to the appropriate section of chs. NR 500 to 538, and an additional electronic copy of any plan sheets or drawings submitted as a part of the plan or report. Three paper copies shall be submitted to the department's field office responsible for the area in which the facility is located and one paper copy, one electronic copy, and the additional electronic copy of associated plans or drawings shall be submitted to the bureau of waste management in Madison unless otherwise specified by the department. The complete electronic copy of the report and the separate electronic copy of any plan sheets or drawings shall be provided in formats and on media acceptable to the department.

(4) CERTIFICATION. (a) The reports and plan sheets shall be under the seal of a licensed professional engineer. In addition, the following certification shall be included:

"I, ______________________, hereby certify that I am a licensed professional engineer in the State of Wisconsin in accordance with the requirements of ch. A–E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A–E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 500 to 538, Wis. Adm. Code."

(b) Initial site reports, feasibility reports, plans of operation, site investigation, remedial action options reports and any other reports where interpretation of geology or hydrogeology is necessary shall be under the seal of a licensed professional geologist. In addition, the following certification shall be included:

"I, _________________, hereby certify that I am a licensed professional geologist in the State of Wisconsin in accordance with the requirements of ch. GHSS 2, Wis. Adm. Code; that the preparation of this document has not involved any unprofessional conduct as detailed in ch. GHSS 5, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 500 to 538, Wis. Adm. Code."

(5) TECHNICAL PROCEDURES. All technical procedures used to investigate a solid waste facility shall be the current standard procedures as specified by ASTM International, United States geological survey, USEPA's standard methods for the examination of water and wastewater, or other equivalent or appropriate methods approved by the department. Test procedures used shall be specified. Any deviation from a standard method shall be explained in detail with reasons provided.

(6) VISUALS. Maps, figures, photographs and tables to clarify information or conclusions. The visuals shall be legible. All paper copies of maps, plan sheets, drawings, isometrics, cross–sections and aerial photographs shall meet the following requirements:

(a) No larger than 32 inches by 44 inches and no smaller than 8 1/2 inches by 11 inches.

(b) Be of appropriate scale to show all required details in sufficient clarity.

(c) Be numbered, referenced in the narrative, titled, have a legend of all symbols used, contain horizontal and vertical scales, where applicable, and specify drafting or origination dates.

(d) Use uniform scales.

(e) Contain a north arrow.

(f) Use mean sea level as the basis for all elevations.

(g) Contain a survey grid based on monuments established in the field which utilizes a coordinate system and datum acceptable to the department. Examples of acceptable coordinate systems include state plane, Universal Transverse Mercator, and Wisconsin Transverse Mercator.

(h) Show original topography and the grid system on plan sheets showing construction, operation or closure topography. For complex plans, existing conditions within the landfill area may be shown by lighter lines or may be eliminated.

(i) Show survey grid location and reference major plan sheets on all cross–sections. A reduced diagram of a cross–section location plan view map shall be included on the sheets with the cross–sections.

(7) TABLE OF CONTENTS. A table of contents listing all sections of the submittal.

(8) APPENDIX. An appendix listing names of all references, all raw data, testing and sampling procedures and calculations.

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88; am. (intro.), (1), (3), (4) and (6) (h), Register, June, 1996, No. 486, eff. 7–1–96; am. (3) and (4), Register, December, 1997, No. 504, eff. 1–1–98; **CR 05–020: am. (3), (4), (5), (6) (intro.), (a), (f) and (g) Register January 2006 No. 601, eff. 2–1–06.**

NR 500.06 License applications. Unless otherwise specified, no person may operate or maintain a solid waste facility without a license from the department. A submittal for initial licensing or relicensing of any solid waste facility shall include:

(1) LICENSE FEE. The appropriate fee as specified in s. NR 520.04 in check or money order payable to the department. Except as provided in s. NR 500.065, license fees are not transferable, proratable or refundable.

(2) APPLICATION FORM. A completed copy of the appropriate application form.

(3) FINANCIAL RESPONSIBILITY. For all land disposal facilities with plans of operation approved under s. 289.30, Stats., proof of financial responsibility as specified in s. NR 520.05.

(4) AFFIDAVIT OF FACILITY REGISTRY. Submittal on form 4400–067 that proof that a notation of the existence of the facility has been recorded in the office of the register of deeds in each county in which a portion of the facility is located. Owners of landfills applying for relicensure need only submit this form if the legal description of the landfill has changed from that identified on a previously submitted form 4400–067.

Note: This form may be obtained from the Department of Natural Resources, Bureau of Waste Management, 101 S. Webster Street, P.O. Box 7921, Madison, WI 53707–7921, (608) 266–2111, waste.management@dnr.state.wi.us.

(5) NONCOMPLIANCE WITH PLANS OR ORDERS. A submittal for initial licensing of a new or expanded solid waste disposal facility shall contain the following information:

(a) Identification of all persons owning a 10% or greater legal or equitable interest in the applicant or in the assets of the applicant, including shareholders of a corporation which is an applicant and partners of a partnership which is an applicant.

(b) Identification of all other Wisconsin solid or hazardous waste facilities for which the applicant or any person identified in par. (a), is named in, or subject to an order or plan approval issued by the department.

(c) Identification of all other Wisconsin solid or hazardous waste facilities which are owned by persons, including corporations and partnerships, in which the applicant or person identified in par. (a) owns or previously owned a 10% or greater legal or equitable interest or a 10% or greater interest in the assets.

all users of the landfill of the intent to close the landfill so that alternative disposal options can be arranged.

(b) Signs shall be posted at all points of access to the landfill at least 30 days prior to closure indicating the date of closure and alternative disposal facilities. Facilities which are operated by and serve only a single waste generator and are not open to the public are exempt from this provision.

(c) Notice of the upcoming closure shall be published in a local newspaper at least 30 days prior to closure and a copy of the notice shall be provided to the department within 10 days of the date of publication. Facilities which are operated by and serve only a single waste generator and are not open to the public are exempt from this provision.

(2) GENERAL REQUIREMENTS. Within 10 days after ceasing to accept solid waste, the owner or operator shall restrict access by the use of gates, fencing or other appropriate means to insure against further use of the landfill. If the final use allows access, such access shall be restricted until closure has been completed and approved by the department.

(3) CLOSURE. Closure activities shall begin within 30 days after ceasing to accept solid waste. Closure shall be accomplished in the following manner for facilities without a closure plan or plan of operation approved in writing by the department. Placement of final cover in accordance with s. NR 504.07 may be required if the department determines that this type of final cover system is necessary to prevent or abate attainment or exceedance of the groundwater standards contained in ch. NR 140. Municipal solid waste landfills that accepted greater than 100 tons of solid waste per day on an annual basis and ceased accepting municipal solid waste on or before October 8, 1993 shall have final cover placement completed by July 1, 1996. Municipal solid waste landfills that accepted 100 tons or less of solid waste per day on an annual basis and ceased accepting municipal solid waste on or before April 8, 1994 shall have final cover placement completed by July 1, 1996.

(a) The entire area previously used for disposal purposes shall be covered with at least 2 feet of compacted earth having a hydraulic conductivity of no more than 1×10^{-5} cm/sec or if the hydraulic conductivity of the underlying soils or any base liner system is less than 1×10^{-5} cm/sec, then the 2 feet of compacted earth shall have a hydraulic conductivity that is equal to or less than the underlying soils or any base liner system. The final grades shall be sloped adequately to allow storm water runoff. A specific soil type may be required by the department for this 2–foot layer. The department may require the cover layer to be more than 2 feet thick.

(b) Storm water run–on shall be diverted around all areas used for solid waste disposal to limit the potential for erosion of the cover soils and increased infiltration. Drainage swales conveying storm water runoff over previous solid waste disposal areas shall be lined with a minimum thickness of 2 feet of clay.

(c) The final slopes of the landfill shall be greater than 5%, but may not exceed 4 horizontal to one vertical unless otherwise approved by the department.

(d) The finished surface of the disposal area shall be covered with a minimum of 6 inches of topsoil.

(4) ESTABLISHMENT OF VEGETATION. Within 180 days after ceasing to accept solid waste, or if solid waste termination is after September 15, by June 15 of the following year, the owner or operator shall complete seeding, fertilizing and mulching of the finished surface. The seed type and amount of fertilizer applied shall be selected depending on the type and quality of topsoil and compatibility with both native vegetation and the final use. Unless otherwise approved by the department in writing, seed mixtures and sowing rates shall be those specified for right–of–ways in accordance with section 630, Wisconsin department of transportation standard specifications for highway and structure construction.

Note: The Wisconsin department of transportation standard specifications for highway and structure construction is available at www.dot.wisconsin.gov/business/engrserv/construction–library.htm or can be obtained from the department of natural resources, bureau of waste management, 101 S. Webster Street, P.O. Box 7921, Madison, WI 53707–7921, (608) 266–2111, waste.management@dnr.state.wi.us. Copies are also available for inspection at the offices of the legislative reference bureau and the secretary of state.

(5) DEED NOTATION. Following closure of a landfill phase which accepted municipal solid waste after July 1, 1996, the owner or operator shall, within 90 days after closure, record a notation on the deed to the landfill property. The notation in the deed shall in perpetuity notify any potential purchaser of the property that the land has been used as a landfill and its use is restricted to prevent disturbing the integrity of the final cover, liner or any other components of the containment system or the function of the monitoring systems.

(6) HAZARDOUS AIR CONTAMINANT CONTROL. All landfills which have a design capacity of greater than 500,000 cubic yards and have accepted municipal solid waste shall install a department approved system to efficiently collect and combust hazardous air contaminants emitted by the landfill within 18 months of February 1, 1988 unless the owner can demonstrate that the performance criteria of s. NR 504.04 (4) (f) can be achieved without implementing such a system. Control techniques other than combustion may be approved by the department.

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88; am. (intro.), (1) (a), (b), (2), (3) (intro.), (a) to (c), (4), (6), r. and recr. (5), Register, June, 1996, No. 486, eff. 7–1–96; CR 05–020: am. (4) Register January 2006 No. 601, eff. 2–1–06.

NR 506.085 Final use. The following activities are prohibited at solid waste disposal facilities which are no longer in operation unless specifically approved by the department in writing:

(1) Use of the waste disposal area for agricultural purposes.

(2) Establishment or construction of any buildings over the waste disposal area.

(3) Excavation of the final cover or any waste materials.

Note: Activities at closed solid waste disposal facilities shall be restricted in accordance with the applicable transference of responsibility provisions of s. 289.46 (2), Stats.

History: Cr. Register, June, 1996, No. 486, eff. 7–1–96.

NR 506.09 Waste characterization. (1) GENERAL. No person may dispose in a landfill prohibited items under s. NR 506.095. Wastes which are limited under ss. NR 506.10 to 506.155 may only be disposed in accordance with those sections. Solid wastes which are not prohibited or limited under ss. NR 506.095 to 506.155 and which do not constitute more than 5% of the total proposed design capacity may be disposed without additional department approval providing they do not pose a significant threat to landfill operations, leachate or landfill gas quality, or groundwater quality, and they are handled in accordance with an approved special waste management plan. The physical and chemical characteristics of any high volume industrial waste stream such as foundry process waste, papermill sludge, utility coal–ash wastes, and other non–municipal waste streams that are anticipated to individually constitute more than 5% of the total proposed design capacity shall be analyzed and described in accordance with this section.

(2) SUBMITTAL REQUIREMENTS. Requests for authorization to accept additional waste types shall include the following information at a minimum:

(a) Detailed physical and chemical characteristics including percent solids, material safety data sheets where appropriate and the results of the paint filter test.

(b) The volume of waste to be disposed of on a daily and yearly basis.

(c) The source of the wastes and a description of the processes which generated the waste.

(d) The duration of disposal.

(121) "Well casing pipe" means pipe meeting standards specified in s. NR 812.17 which is driven or set to seal off the vertical zone of contamination.

(122) "Well constructor" means any person, firm or corporation that constructs a well which is not required to be constructed by a licensed well driller.

(123) "Well driller" has the meaning as designated in ch. 280, Stats.

(124) "Well drilling" has the meaning designated in ch. 280, Stats., and includes any activity which requires the use of a well drilling rig or similar equipment, any activity which changes the character of a drilled well or which is conducted using a well drilling rig or similar equipment with the exception of the driving of points. Well drilling includes constructing, reconstructing or deepening a well, installation of a liner, installing or replacing a screen, well rehabilitation, hydrofracturing, blasting and chemical conditioning.

(125) "Well–point driving" means constructing a well by joining a drive point screen with lengths of pipe and driving the assembly into the ground with percussion equipment or by hand, but without removing material from a drillhole more than 10 feet below the ground surface.

(126) "Well vent" means a screened opening in a well seal to allow atmospheric pressure to be maintained in the well.

(127) "Well yield" means the quantity of water which may flow or be pumped from the well per unit of time.

(128) "Zone of saturation" means that part of the earth's crust beneath the shallowest water table in which all voids are filled with water under pressure greater than atmospheric.

History: Cr. Register, January, 1991, No. 421, eff. 2–1–91; am. (3), (4), (48), (61m), (74) (b), (79), (81), (82), (107) and (119) cr. (27m) (30l), (30m), (30t), (30x), (72m), (79m), (97m) and (110m), renum. (36) and (39) to be (61q) and (61u) and am. Register, September, 1994, No. 465, eff. 10–1–94; corrections made under s. 13.93 (2m) (b) 7., Stats., Register, September, 1994, No. 465; correction in (29), (30) and (79m) made under s. 13.93 (2m) (b) 6. and 7., Stats., Register, September, 1996, No. 489; corrections in (50), (81), (97), (123) and (124) made under s. 13.93 (2m) (b) 7., Stats., Register, December, 1998, No. 516, correction in (71) made under s. 13.93 (2m) (b) 7., Stats., Register July 2002 No. 559. **CR 05–020: cr. (24m) and (57w) Register January 2006 No. 601, eff. 2–1–06; correction in (56) made under s. 13.93 (2m) (b) 7., Stats.**

NR 812.08 Well, reservoir and spring location. (1) GENERAL. Any potable or nonpotable well or reservoir shall be located:

(a) So the well and its surroundings can be kept in a sanitary condition.

(b) At the highest point on the property consistent with the general layout and surroundings if reasonably possible, but in any case protected against surface water flow and flooding and not downslope from a contamination source on the property or on an adjacent property regardless of what was installed first, the well or the contamination source. When a contamination source is installed upslope from a well in violation of this section after the well construction has been completed, the violation is not the responsibility of the well driller, except if the well driller knew or should have known of the proposed upslope installation of the contamination source. When there is no location on the property where this requirement can be met a well may be constructed without a variance if it is constructed with a minimum of 20 or more feet of well casing pipe than is required by ss. NR 812.12 and 812.13 and Tables I and II or with a minimum of 60 feet of well casing pipe provided that the minimum well casing pipe depth requirements of s. NR 812.12 or 812.13 and Table I or II are met. This exception does not apply to high capacity, school or wastewater treatment plant wells. A well or reservoir is located downslope from a contamination source, regardless of the presence or absence of a structure between the well and the contamination source, if:

1. The ground surface elevation at the well or reservoir is lower than the elevation at the contamination source, and

2. Surface water that washes over the contamination source would travel within eight feet of the well or reservoir, or over the well or reservoir.

(c) As far away from any known or possible source of contamination as the general layout of the premises and the surroundings allow.

Note: Section PSC 114.234 C8 requires that a horizontal clearance of at least 3/4 of the vertical clearance of the conductors, including overhead power lines to the ground required by Rule 232 shall be maintained between open conductors and wells. Persons installing wells must comply with this requirement.

(d) Such that any potential contaminant source, not identified in this section or in Table A, is a minimum of 8 feet from the well or reservoir.

(e) Every well shall be located so that it is reasonably accessible with proper equipment for cleaning, treatment, repair, testing, inspection and any other maintenance that may be necessary.

(2) RELATION TO BUILDINGS. In relation to buildings, the location of any potable or nonpotable well shall be as follows:

(a) When a well is located outside and adjacent to a building, it shall be located so that the center line of the well extended vertically will clear any projection from the building by not less than 2 feet and so that the top of the well casing pipe extends at least 12 inches above the final established ground grade.

(b) When a structure is built over a drilled well, it shall have an access hatch or removable hatch, or provide other access to allow for pulling of the pump. The well casing pipe shall extend at least 12 inches above the floor and be sealed watertight at the point where it extends through the floor.

(c) No well may be located, nor a building constructed, such that the well casing pipe will terminate in or extend through the basement of any building or terminate under the floor of a building having no basement. The top of a well casing pipe may terminate in a walkout basement meeting the criteria of s. NR 812.42 (9) (b) 1. to 4. A well may not terminate in or extend through a crawl space having a below ground grade depression or excavation.

(3) RELATION TO FLOODPLAINS. (a) A potable or nonpotable well may be constructed, reconstructed or replaced in a floodfringe provided that the top of the well is terminated at least 2 feet above the regional flood elevation for the well site.

(b) A well may be reconstructed or replaced in a floodway provided that the top of the well is terminated at least 2 feet above the regional flood elevation for the well site.

(c) A well may not be constructed on a floodway property that is either undeveloped or has building structures but no existing well.

(d) The regional flood elevation may be obtained from the department.

(4) RELATION TO CONTAMINATION SOURCES. Minimum separating distances between any new potable or nonpotable well, reservoir or spring and existing sources of contamination; or between new sources of contamination and existing potable or nonpotable wells, reservoirs or springs shall be maintained as described in this subsection. The minimum separating distances of this subsection do not apply to dewatering wells approved under s. NR 812.09 (4) (a). Greater separation distances may be required for wells requiring plan approval under s. NR 812.09. Separation distance requirements to possible sources of contamination will not be waived because of property lines. Minimum separating distances are listed in Table A and are as follows:

(a) Eight feet between a well or reservoir and a:

1. Buried gravity flow sanitary or storm building drain having pipe conforming to ch. Comm 84;

2. Buried gravity flow sanitary or storm building sewer having pipe conforming to ch. Comm 84;

3. Watertight clear water waste sump;

4. Buried clear water waste drain having pipe conforming to ch. Comm 84;

5. Buried gravity flow foundation drain;

6. Rainwater downspout outlet;

7. Cistern;

8. Buried building foundation drain connected to a clear water waste drain or other subsoil drain;

9. Noncomplying pit, subsurface pumproom, alcove, or reservoir;

10. Nonpotable well;

11. Fertilizer or pesticide storage tank with a capacity of less than 1,500 gallons, but only when the well is nonpotable;

Note: For potable wells see par. (d) 1.

12. Plastic silage storage and transfer tube;

13. Yard hydrant;

14. Swimming pool, measured to the nearest edge of the water; or

15. Dog or other small pet house, animal shelter or kennel housing not more than 3 adult pets on a residential lot.

(b) Twenty-five feet between a well or reservoir and a:

1. Buried grease interceptor or trap;

2. Septic tank;

3. Holding tank;

4. Buried building drain or building sewer having pipe not conforming to ch. Comm 84, wastewater sump, or non-watertight clear water waste sumps.

5. Buried pressurized sanitary building sewer having pipe conforming to ch. Comm 84;

6. Buried gravity manure sewer;

7. Lake, river, stream, ditch or stormwater detention pond or basin measured to the regional high water elevation in the case of a lake or stormwater detention pond, to the edge of the floodway in the case of a river or stream or to the edge in the case of a ditch or stormwater detention basin;

9. Liquid-tight barn gutter;

10. Animal barn pen with concrete floor;

11. Buried pressurized sewer pipe conveying manure provided that the pipe meets ASTM specification D 2241, with standard dimension ratio of 21 or less or pressure pipe meeting the requirements of s. NR 110.13 (6) (f) or 811.62.

Note: There is no NR 110.13 (6) (f).

12. Buried fuel oil tanks serving single family residences, including any associated buried piping;

13. Discharge to ground from a water treatment device;

14. Vertical shaft installed below grade used for intake of air for a heating or air conditioning system; or

15. Buried sanitary or storm collector sewer serving 4 or fewer living units or having a diameter of 6 inches or less.

(c) Fifty feet between a well or reservoir and a:

1. Soil absorption unit receiving less than 8,000 gallons/day, existing, abandoned or alternate, but not including a school soil absorption unit;

Note: For school soil absorption units see par. (e); for soil absorption units receiving more than 8,000 gallons/day see par. (f) 3.

2. Privy;

3. Pet waste pit disposal unit;

4. Animal shelter;

5. Animal yard;

6. Silo;

7. Buried sewer used to convey manure having pipe conforming to ch. Comm 84 that does not meet the specifications in par. (b);

8. Liquid tight manure hopper or reception tank;

9. Filter strip;

10. Buried sanitary or storm collector sewer serving more than 4 living units or larger than 6 inches in diameter except that wells may be located or sewers installed such that a well is less than 50 feet, but at least 25 feet, from gravity collector sewers smaller than 16 inches in diameter or from force main collector sewers 4 inches or smaller in diameter provided that within a 50-foot radius of the well the installed sewer pipe meets the allowable leakage requirements of AWWA C600 and the requirements for water main equivalent type pipe as follows:

a. For sewers > 4″ diameter, but < 16″ diameter: PVC pipe > 4″ diameter, but < 12″ diameter shall meet AWWA C900 with elastomeric joints having a standard dimension ratio of 18 or less; PVC pipe > 12″ diameter, but < 16″ diameter shall meet AWWA C905 with elastomeric joints having a standard dimension ratio of 18 or less; Ductile iron pipe shall meet AWWA C115 or AWWA C151 having a thickness class 50 or more.

b. For sewers < 3″ diameter, the pipe shall be any rigid pipe in the ch. Comm 84 "Table for Pipe and Tubing for Water Services and Private Water Mains," including approved ABS, brass, cast iron, CPVC, copper (not including type M copper) ductile iron, galvanized steel, polybutylene (PB), polyethylene (PE), PVC, or stainless steel pipe.

11. An influent sewer to a wastewater treatment plant;

12. The nearest existing or future grave site in cemeteries;

13. Wastewater treatment plant effluent pipe;

14. Buried pressurized sewer having pipe not conforming to ch. Comm 84; or

15. Manure loading area.

Note: The minimum separating distance between a well or reservoir and a lift station is based on the presence of a sewer force main at the lift station.

(d) One hundred feet between a well or reservoir and a:

1. Bulk surface storage tank with a capacity greater than 1,500 gallons or any bulk buried storage tank regardless of capacity, including, for both surface or buried tanks, associated buried piping for any solid, semi-solid or liquid product but not including those regulated under par. (b) 12. This subdivision includes, but is not limited to petroleum product tanks, waste oil tanks and pesticide or fertilizer storage tanks not regulated under par. (a) 11. This subdivision does not include septic, holding and manure reception tanks, or liquified petroleum gas tanks as specified in ch. Comm 11.

2. Liquid-tight, fabricated manure or silage storage structure, in ground or at ground surface;

3. Wastewater treatment plant structure, conveyance or treatment unit; or

4. Dry fertilizer or pesticide storage building or area when more than 100 pounds of either or both materials are stored;

5. Well, drillhole or water system used for the underground placement of any waste, surface or subsurface water or any substance as defined in s. 160.01 (8), Stats.;

6. Stormwater infiltration basin;

7. Uncovered storage of silage on the ground surface;

8. Water-tight silage storage trench or pit; or

9. Lift station.

(e) Two hundred feet between a school well and a soil absorption unit receiving less than 8,000 gallons per day, existing or abandoned.

(ee) One hundred fifty feet between a well or reservoir and a temporary manure stack.

(f) Two hundred fifty feet between a well or reservoir and a:

1. Manure stack.

2. Earthen or excavated manure storage structure.

Note: Variances from the separating distances may be granted as specified in s. NR 812.43 for earthen storage and manure stacks constructed and maintained to the specifications of Soil Conservation Standards No. 425 or 312, respectively.

3. Soil absorption unit receiving 8,000 or more gallons per day, existing, abandoned, or alternate.

4. Sludge landspreading or drying area.

5. An earthen silage storage trench or pit.

6. Liquid waste disposal system including, but not limited to a treatment pond or lagoon, ridge and furrow system and spray irrigation system.

Note: Variance from this separating distance may be granted for treatment ponds or lagoons constructed and maintained to an approval granted under ch. NR 213.

7. Salvage yard.

8. A salt or deicing material storage area including the building structure and the surrounding area where the material is transferred to vehicles. This subdivision does not include bagged deicing material.

9. Solid waste processing facility.

10. Solid waste transfer facility.

11. The boundaries of a landspreading facility for spreading of petroleum–contaminated soil regulated under ch. NR 718 while that facility is in operation.

(g) Twelve hundred feet between a well or reservoir and:

1. The nearest edge of the limits of filling of an existing, proposed or abandoned landfill, measured to the nearest fill area of abandoned landfills, if known. Otherwise measured to the nearest property line where the landfill is located. The department may require, as part of a variance request, a land survey map, a scaled diagram of the landfill and the well location, or another accurate measurement method to determine and demonstrate the distance between the landfill and the well;

2. The nearest edge of a coal storage area in excess of 500 tons; or

3. A hazardous waste treatment facility regulated by the department.

ATTACHMENT 6

Community Notice

SUDOKU

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10/18

Wisconsin Department of Natural Resources to Review Onalaska Landfill Cleanup
Brice Prairie, La Crosse County, Wisconsin

In accordance with Superfund law the Wisconsin Department of Natural Resources is conducting a Five Year Review of the Onalaska Landfill cleanup. These reviews are done where construction of the cleanup is complete but hazardous waste remains on the site. Soil and groundwater have been contaminated with volatile organic compounds related to past disposal practices. The remedy at the site includes a multi-layer cap on the landfill, passive gas venting and groundwater extraction and treatment. In 2002 the groundwater extraction system was shut down for the purpose of studying the effectiveness of groundwater monitored natural attenuation. The purpose of this review is to verify that the remedy continues to protect human health and the environment.

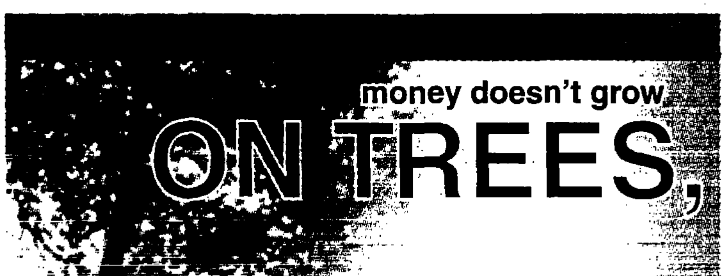
The public is invited to comment and provide input. To comment or to obtain additional information contact:

Eileen Kramer
Hydrogeologist
Wisconsin Department of Natural Resources
1300 W. Clairemont Ave.
P. O. Box 4001
Eau Claire, WI 54702

715-839-3824 E-mail: eileen.kramer@wisconsin.gov

The five-year review report will be completed July 14, 2008.

2067500



CORRECTION

The inauguration of Chancellor Joe Gow will be Friday at the Recreational Eagle Center on the University of Wisconsin-La Crosse Crosse campus. The location was incorrect in Wednesday's Tribune.

The La Crosse Tribune believes accuracy is important and publishes corrections when necessary. If you have a question or information regarding any news story, call (608) 782-9710 and ask for the local news desk.

LOTTERIES

Wednesday's numbers:

Powerball: 14-15-19-42-46
Powerball: 37
Power Play: 4
Jackpot: $20 million
Wisconsin SuperCash: 10-15-21-22-27-34
Wisconsin Megabucks: 6-29-36-38-41-42
Jackpot: $3.7 million
Wisconsin Pick 3: 7-3-9
Wisconsin Pick 4: 9-7-6-6
Wisconsin Badger 5: 4-10-16-25-28
Minnesota Daily 3: 4-7-5
Minnesota Northstar Cash: 3-6-9-16-22
Iowa Pick 3: 6-3-1
Iowa Pick 4: 7-5-3-4

8297.
Album Encounters: Jimi Hendri "Electric Ladyland," 7 p.m., Planetarium, Cowley Hall, Basement Room 20, UW-L, $3, (608) 785-8669.

including $212,000 for fill and site preparation, but the building will last "longer than our children will be around," said Hagman.

The center will continue to be on hold for at least another month, as state Sen. Jeffrey Plale, D-South Milwaukee, took Division of Facilities Development's recommendation to defer it and visitors centers at Council Grounds and Blue Mound State Park, along with replacing a ranger station at Tomah, to the November meeting. And that will be contingent on having a state budget by then.

Plans for 20 new walk-in campsites near Wildcat Mountain's family campground won't be held up by a lack of a state budget, said Schroeder.

centage point lower than the 3.3 percent adjustment for 2007. In 2006, the COLA increase was 4.1 percent, the largest in 15 years.

Advocates for the elderly said the small increase high-

he Year of Fog' well worth a read

ile, a novel about a
hild won't get my
I know it will be sad,
door or by calling 785-8415. Suggested
nations are $3 for students and $5 for adults.

LIBRARY NOTES

Libraries launch 'I Want My Mummy'

8-9 and 15-16 at 7 p.m. ... An adult must accompany
www.bjorkostrom.com.

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Gibson, who has coa
women's gymnastics te
1985, was a standout g
while a student at UW-L
'70s. She'll enter the wa
fom alumni — Ann Hea
class of '86. Richard He
class of '59; James Ihe
of '80, and '88; and Wil
Parza, class of '82.
Radio station WKTY's
caster Mike Kearns will
the Donald Gordon Merit

Photo by Tim Anderson

he Year of Fog' well worth a read

r by calling 785-8415. Suggested are $3 for students and $5 for adults.

8-9 and 15-16 at 1 p.m.

about him at www.bjorkostrom.com.

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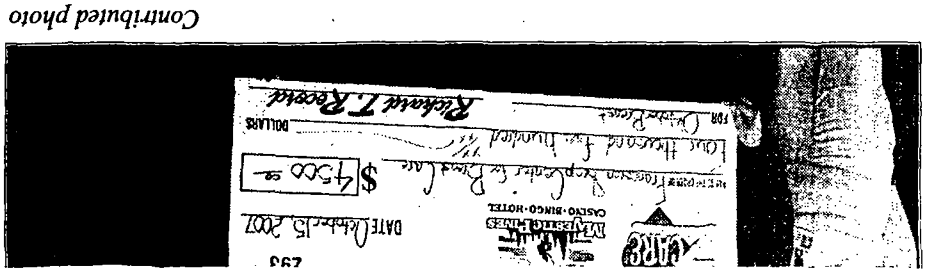
20067500



Contributed photo

Pictured above for a ceremonial check signifying a $4,500 donation to the Franciscan Skemp Healthcare Center for Breast Care, are, from left, Lisa Belling, Franciscan Skemp breast health educator, Dr. Kathleen Christian, Franciscan Skemp surgeon/breast clinician, Jen O'Brien, Z93 program director and Michelle Amberg, Majestic Pines Casino public relations manager.

The clinic, which averages 100 visits a week, serves those who ar gible for private, state or federal h and reside in Houston, La Crosse, Trempealeau or Vernon counties.

It is estimated that 45 million A are without health insurance and n mission's patients are the working

"Over 250 volunteers give their talent to the mission, treating patie conditions from the common cold heart disease and cancer," said Sa Brekke, director of St. Clare Healt Mission.

ATTACHMENT 7

Site Inspection Check List

Five-Year Review Site Inspection Checklist (Template)

(Working document for site inspection. Information may be completed by hand and attached to the Five-Year Review report as supporting documentation of site status. "N/A" refers to "not applicable.")

I. SITE INFORMATION	
Site name: Onalaska Landfill	**Date of inspection:** Sept. 26 & 27, 2007
Location and Region: Brice Prairie / Reg. 5	**EPA ID:** WID 980821656
Agency, office, or company leading the five-year review: WDNR	**Weather/temperature:** Sunny, lt. cloudy ~60°F

Remedy Includes: (Check all that apply)

- ✓ Landfill cover/containment
- ✓ Access controls
- ✓ Institutional controls
- ✓ Groundwater pump and treatment
- Surface water collection and treatment
- Other______________________________
- ✓ 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** Peter Moore — Hydrogeologist — 9/26/2007
   Name / Title / Date
   Interviewed at site at office ~~by phone~~ Phone no. 952-924-0117
   Problems, suggestions; Report attached ______________________

2. **O&M staff** Bill Wood — Operator — 9/26/2007
   Name / Title / Date
   Interviewed ✓at site at office by phone Phone no. 608-792-9510
   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 Town of Onalaska
Contact Tim Dienger | Administrator | 9/27/2007 | 608-783-4958
Name | Title | Date | Phone no.
Problems; suggestions; Report attached

Agency ____
Contact ____ | ____ | ____ | ____
Name | Title | Date | Phone no.
Problems; suggestions; Report attached ____

Agency ____
Contact ____ | ____ | ____ | ____
Name | Title | Date | Phone no.
Problems; suggestions; Report attached ____

Agency ____
Contact ____ | ____ | ____ | ____
Name | Title | Date | Phone no.
Problems; suggestions; Report attached ____

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

Mr. Roy Ackerman, neighbor

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)			
1. **O&M Documents**			
✓ O&M manual	✓ Readily available	✓ Up to date	N/A
✓ As-built drawings	✓ Readily available	✓ Up to date	N/A
✓ Maintenance logs	✓ Readily available	✓ Up to date	N/A
Remarks			
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			
3. **O&M and OSHA Training Records**	✓ Readily available	✓ Up to date	N/A
Remarks			
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			
5. **Gas Generation Records**	Readily available	Up to date	✓ N/A
Remarks			
6. **Settlement Monument Records**	Readily available	Up to date	✓ N/A
Remarks			
7. **Groundwater Monitoring Records**	✓ Readily available	✓ Up to date	N/A
Remarks			
8. **Leachate Extraction Records**	Readily available	Up to date	✓ N/A
Remarks			
9. **Discharge Compliance Records**			
Air	Readily available	Up to date	✓ N/A
Water (effluent)	✓ Readily available	✓ Up to date	N/A
Remarks Wastewater discharge during this period was to La Crosse POTW.			
10. **Daily Access/Security Logs**	Readily available	Up to date	✓ N/A
Remarks			

IV. O&M COSTS

1. **O&M Organization**

State in-house ✓Contractor for State
PRP in-house Contractor for PRP
Federal Facility in-house Contractor for Federal Facility
Other ENSR Corp. has been contractor for maintenance & monitoring since 2002

2. **O&M Cost Records**

✓Readily available ✓Up to date
Funding mechanism/agreement in place
Original O&M cost estimate $150K/an. Breakdown attached
Original O+M estimate referred to operation of P+T
Total annual cost by year for review period if available

From______ (Date)	To______ (Date)	______ (Total cost)	Breakdown attached
From______ (Date)	To______ (Date)	______ (Total cost)	Breakdown attached
From______ (Date)	To______ (Date)	______ (Total cost)	Breakdown attached
From______ (Date)	To______ (Date)	______ (Total cost)	Breakdown attached
From______ (Date)	To______ (Date)	______ (Total cost)	Breakdown attached

Facility maintenance & groundwater monitoring - approx $60K/an.

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

Describe costs and reasons: None

V. ACCESS AND INSTITUTIONAL CONTROLS Applicable N/A

A. Fencing

1. **Fencing damaged** ✓Location shown on site map ✓Gates secured N/A
Remarks Damage to split rail fence at landfill perimeter. Chain link fence around remediation facility is in v. good condition

B. Other Access Restrictions

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

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented	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) Site visits by WDNR

Frequency 2/year

Responsible party/agency Wisc. Dept. of Natural Resources

Contact Eileen Kramer — Hydrogeologist — ~~Date~~ — 715-839-3824
Name — Title — ~~Date~~ — Phone no.

Reporting is up-to-date	Yes	No	✓ N/A
Reports are verified by the lead agency	Yes	No	✓ N/A
Specific requirements in deed or decision documents have been met	Yes	✓ No	N/A
Violations have been reported	Yes	✓ No	N/A

Other problems or suggestions: Report attached

Deed restriction has not been recorded for real estate parcel on which landfill is located

2. **Adequacy** ICs are adequate ✓ ICs are inadequate N/A
Remarks Restriction or covenant to run with land must be recorded for real estate parcel where land fill is located

D. General

1. **Vandalism/trespassing** Location shown on site map ✓ No vandalism evident
Remarks

2. **Land use changes on site** N/A
Remarks None

3. **Land use changes off site** N/A
Remarks None at present. Owner of parcel south of site may sell property to commercial developer.

VI. GENERAL SITE CONDITIONS

A. Roads Applicable N/A

1. **Roads damaged** Location shown on site map ✓ Roads adequate N/A
Remarks

B. Other Site Conditions

Remarks

VII. LANDFILL COVERS ✓Applicable N/A

A. Landfill Surface

1. **Settlement** (Low spots) Location shown on site map ✓Settlement not evident
Areal extent ____ Depth ____
Remarks Slightly depressed area observed - no evidence of standing water

2. **Cracks** Location shown on site map ✓Cracking not evident
Lengths ____ Widths ____ Depths ____
Remarks

3. **Erosion** Location shown on site map ✓Erosion not evident
Areal extent ____ Depth ____
Remarks

4. **Holes** Location shown on site map ✓Holes not evident
Areal extent ____ Depth ____
Remarks

5. **Vegetative Cover** Grass ✓Cover properly established No signs of stress
Trees/Shrubs (indicate size and locations on a diagram)
Remarks Some invasive grass noted, does not compromise cap

6. **Alternative Cover (armored rock, concrete, etc.)** N/A
Remarks

7. **Bulges** Location shown on site map ✓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_______			
9. **Slope Instability**	Slides	Location shown on site map	✓No evidence of slope instability
Areal extent_______			
Remarks_______			
B. Benches	Applicable	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	N/A or okay	
Remarks_______			
2. **Bench Breached**	Location shown on site map	N/A or okay	
Remarks_______			
3. **Bench Overtopped**	Location shown on site map	N/A or okay	
Remarks_______			
C. Letdown Channels	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	No evidence of settlement	
Areal extent_______	Depth_______		
Remarks_______			
2. **Material Degradation**	Location shown on site map	No evidence of degradation	
Material type_______	Areal extent_______		
Remarks_______			
3. **Erosion**	Location shown on site map	No evidence of erosion	
Areal extent_______	Depth_______		
Remarks_______			

4. **Undercutting** Location shown on site map No evidence of undercutting
Areal extent______________ Depth__________
Remarks____

5. **Obstructions** Type____________________ No obstructions
Location shown on site map Areal extent____________
Size__________
Remarks____

6. **Excessive Vegetative Growth** Type________________
No evidence of excessive growth
Vegetation in channels does not obstruct flow
Location shown on site map Areal extent____________
Remarks____

D. Cover Penetrations ✓Applicable N/A

1. **Gas Vents** Active ✓Passive
Properly secured/locked Functioning Routinely sampled ✓Good condition
Evidence of leakage at penetration - NO NO Needs Maintenance
N/A
Remarks____

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

3. **Monitoring Wells** (within surface area of landfill)
✓Properly secured/locked ✓Functioning ✓Routinely sampled ✓Good condition
Evidence of leakage at penetration Needs Maintenance N/A
Remarks Three nested groundwater wells present. The deepest well has some blockage + cannot be sampled

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

5. **Settlement Monuments** Located Routinely surveyed ✓N/A
Remarks____

E. Gas Collection and Treatment Applicable ✓N/A
1. **Gas Treatment Facilities** Flaring Thermal destruction Collection for reuse Good condition Needs Maintenance Remarks________________
2. **Gas Collection Wells, Manifolds and Piping** Good condition Needs Maintenance Remarks________________
3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) Good condition Needs Maintenance N/A Remarks________________
F. Cover Drainage Layer Applicable ✓N/A
1. **Outlet Pipes Inspected** Functioning N/A Remarks________________
2. **Outlet Rock Inspected** Functioning N/A Remarks________________
G. Detention/Sedimentation Ponds Applicable ✓N/A
1. **Siltation** Areal extent________ Depth________ N/A Siltation not evident Remarks________________
2. **Erosion** Areal extent________ Depth________ Erosion not evident Remarks________________
3. **Outlet Works** Functioning N/A Remarks________________
4. **Dam** Functioning N/A Remarks________________

H. Retaining Walls	Applicable	✓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	Siltation not evident	
Areal extent_____	Depth_____		
Remarks_____			
2. **Vegetative Growth**	Location shown on site map	N/A	
Vegetation does not impede flow			
Areal extent_____	Type_____		
Remarks_____			
3. **Erosion**	Location shown on site map	Erosion not evident	
Areal extent_____	Depth_____		
Remarks_____			
4. **Discharge Structure**	Functioning	N/A	
Remarks_____			
VIII. VERTICAL BARRIER WALLS	Applicable	✓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_____			

IX. GROUNDWATER/SURFACE WATER REMEDIES	✓ Applicable	N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines	✓ Applicable	N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
✓ Good condition ✓ All required wells properly operating Needs Maintenance N/A
Remarks Except EW-1, which would require repair to actively operate groundwater pump & treat system

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
✓ Good condition Needs Maintenance
Remarks

3. **Spare Parts and Equipment**
✓ Readily available ✓ Good condition Requires upgrade Needs to be provided
Remarks

B. Surface Water Collection Structures, Pumps, and Pipelines	Applicable	✓ N/A

1. **Collection Structures, Pumps, and Electrical**
Good condition Needs Maintenance
Remarks

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
Good condition Needs Maintenance
Remarks

3. **Spare Parts and Equipment**
Readily available Good condition Requires upgrade Needs to be provided
Remarks

C. Treatment System Applicable N/A Currently shut down in accordance w/ 2001 ESD.

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 0
   Quantity of surface water treated annually 0
   Remarks System being maintained in good stand-by status

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 no treatment chemicals currently on site

6. **Monitoring Wells** (pump and treatment remedy)
   ✓ Properly secured/locked ✓ Functioning ✓ Routinely sampled ✓ Good condition
   ✓ All required wells located Needs Maintenance - MW-5S N/A
   Remarks All wells in good condition except MW-5S which requires a protective cover

D. Monitoring Data

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

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

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
✓ Properly secured/locked ✓ Functioning ✓ Routinely sampled ✓ Good condition
✓ All required wells located Needs Maintenance - MW-55 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 groundwater plume appears to be contained adequately. Continued ground water monitoring is necessary to ~~evaluate for natural attenuation~~ + assure protectiveness.

B. Adequacy of O&M

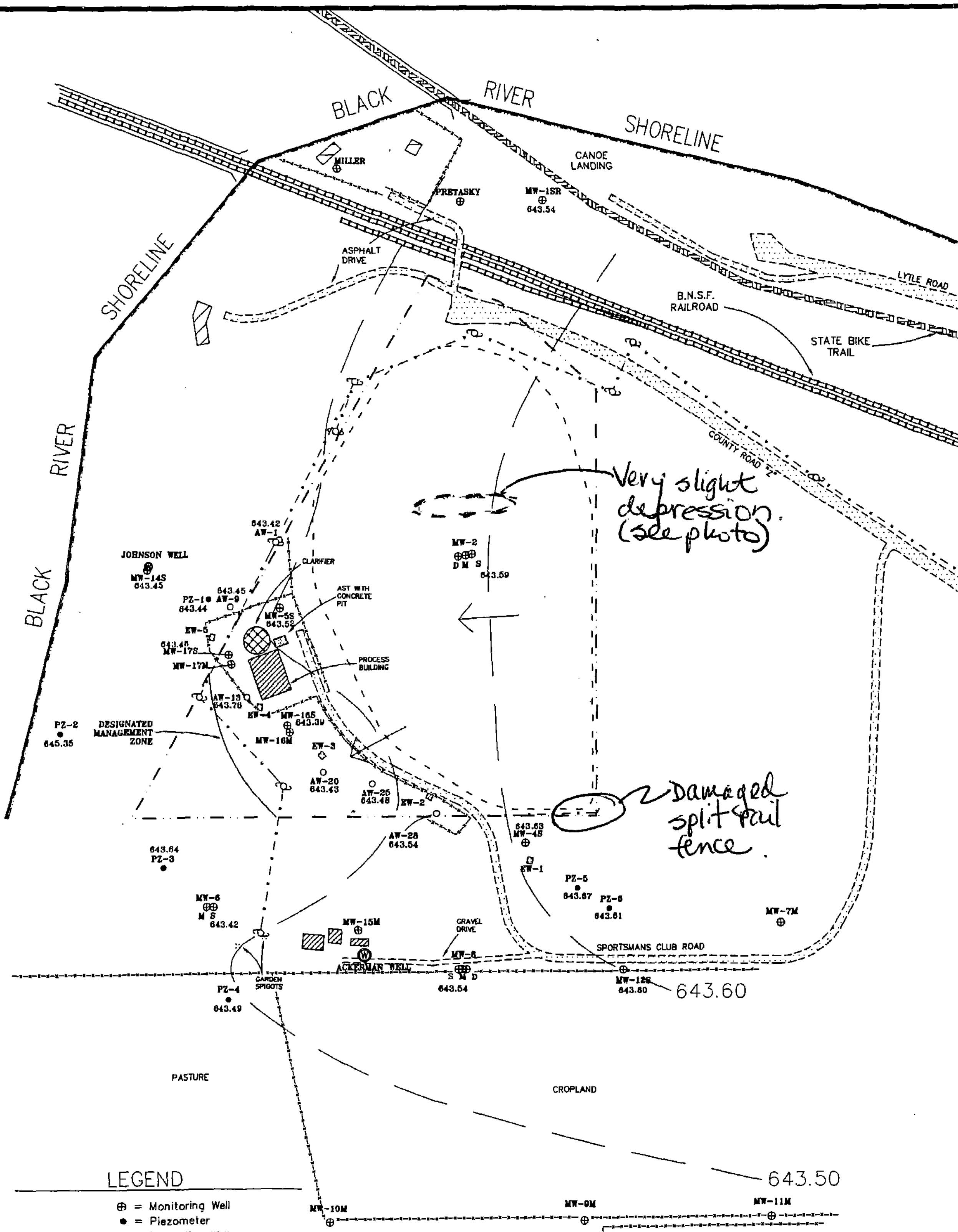
Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

O&M is adequate. If it were necessary to restart the groundwater pump & treat system or the ~~[illegible]~~ soil air injection system, it could be accomplished within two weeks with an estimated expenditure of $15K.

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. Long term groundwater monitoring should continue.

Onalaska Municipal
Landfill Site
Five-Year Review Site Inspection
Sept. 26, 2007
Roster

Name	Organization
Eileen Kramer	Wisc DNR
Peter Moore	ENSR
Kyle Rogers	US EPA
William Wood	ENSR



LEGEND

- ⊕ = Monitoring Well
- • = Piezometer
- ◻ = Extraction Well
- ○ = Air Well
- — · — = Approximate Property Boundary
- - - - - = Approximate extent of landfill cap
- —x— = Fence line
- —u— = Utility lines
- = Utility pole
- = Hydrant
- ← = Inferred Direction of Groundwater Flow

Approximate Scale
1 inch = 175 feet
0 175 350

N

Source:

Onalaska Landfill Site Plan Survey, prepared by Coulee Region Land Surveyors, Inc., project no. S-4754, dated 5/14/03.

Note:

Groundwater Elevations were Gauged on September 10 and September 11, 2007

FIGURE NUMBER:	Groundwater Elevation Map Shallow Zone Wells SEPTEMBER 2007 ONALASKA LANDFILL ONALASKA, WISCONSIN			ENSR AECOM	DESIGNED BY: AC	REVISIONS			
3-3				ENSR CORPORATION ST. LOUIS PARK, MINNESOTA 55416 PHONE: (952) 924-0117 FAX: (952) 942-0317 WEB: HTTP://WWW.ENSR.AECOM.COM	DRAWN BY: AC	NO.:	DESCRIPTION:	DATE:	BY:
SHEET NUMBER:	SCALE:	DATE:	PROJECT NUMBER:		CHECKED BY: PJM				
1	1"=175'	10-16-07	7349-002		APPROVED BY: PJM				

ATTACHMENT 8

Interviews

INTERVIEW DOCUMENTATION FORM

The following is a list of individual interviewed for this five-year review. See the attached contact record(s) for a detailed summary of the interviews.

Name	Title/Position	Organization	Date
Peter Moore	Project Manager	ENSR	9/26/07
William Wood	Operator Maint. Staff	ENSR	9/26/07
Tim Dienger	Town Administrator	Town of Onalaska	9/27/07

INTERVIEW RECORD

Site Name: Onalaska Municipal Landfill Site		EPA ID No.: WID980821656	
Subject: Five Year Review		Time: 9AM	Date: 9/27/07
Type: Telephone Visit Other Location of Visit: Town of Onalaska Hall		Incoming Outgoing	
Contact Made By:			
Name: Eileen Kramer	Title: Hydrogeologist	Organization: WDNR	
Individual Contacted:			
Name: Tim Dienger	Title: Town Administrator	Organization: Town	
Telephone No: 608-783-4958 Fax No: 608-779-9605 E-Mail Address: ~~tadon~~ townona@charter.net		Street Address: W7052 Second St City, State, Zip: Onalaska, WI 54650	
Summary Of Conversation			

Mr. Dienger has been impressed by progress at the site. He has heard of potential future use of Prinsen property for boat storage. He will discuss possible town acquisition of property with the Town Board; Town board mtgs are 4th Monday. Town has a potential brownfield - a former petroleum above ground tank facility.
(DNR sent follow up info about Brownfields assistance)

INTERVIEW RECORD

Site Name: Onalaska Municipal Landfill Site	**EPA ID No.:** WID980821656
Subject: Five Year Review	**Time:** 1 PM **Date:** 9/26/07
Type: Telephone Visit Other **Location of Visit:** Site	Incoming Outgoing

Contact Made By:

Name: Eileen Kramer	**Title:** Hydrogeologist	**Organization:** WDNR

Individual Contacted:

Name: William Wood	**Title:** Maintenance Staff	**Organization:** ENSR

Telephone No: 608-792-9510 **Fax No:** **E-Mail Address:**	**Street Address:** W2788 Birch Lane **City, State, Zip:** La Crosse, WI 54601

Summary Of Conversation

Maintenance of the system has been going well with no major problems. Plant does need a portable sump pump w/ ~30' head to help handle the water storage during the winter. The electrician has ordered a new part for the control panel & Bill will make arrangements to get the work finished.

Bill has not noticed any unusual activities or circumstances at plant or on landfill. He provided orientation & description of operations for water treatment plant.

INTERVIEW RECORD

Site Name: Onalaska Municipal Landfill Site	EPA ID No.: WID980821656
Subject: Five Year Review	Time: 1 PM Date: 9/26/2007
Type: Telephone **Visit** Other Location of Visit: Site	Incoming Outgoing

Contact Made By:

Name: Eileen Kramer	Title: Hydrogeologist	Organization: WDNR

Individual Contacted:

Name: Peter Moore	Title: Project Manager	Organization: ENSR

Telephone No: 952-924-0117 Fax No: E-Mail Address:	Street Address: 4500 Park Glen Rd. City, State, Zip: St. Louis Park, MN 55416

Summary Of Conversation

Work at the site has been going well. There have been no surprises. Peter provided an orientation to the site. Helped locate the monitoring wells for inspection. Discussed the history of the site.

ATTACHMENT 9

Text Portion of Evaluation of Monitored
Natural Attenuation as a Containment Remedy
For the Onalaska Municipal Landfill Site

Evaluation of Monitored Natural Attenuation as a Containment Remedy for the Onalaska Municipal Landfill Site, Onalaska, Wisconsin

S.S. PAPADOPULOS & ASSOCIATES, INC.
Environmental & Water-Resource Consultants

June 2008

7944 Wisconsin Avenue, Bethesda, Maryland 20814-3620 • (301) 718-8900

Evaluation of Monitored Natural Attenuation as a Containment Remedy for the Onalaska Municipal Landfill Site, Onalaska, Wisconsin

Prepared for:

U.S. EPA Region 5

Prepared by:

S.S. PAPADOPULOS & ASSOCIATES, INC.
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GEOS

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List of Figures

Table of Contents

List of Tables

List of Appendices

REPORT

Section 1 Introduction

The Onalaska Municipal Landfill site is located in the Township of Onalaska, about 10 miles north of La Crosse, Wisconsin (Figure 1). The site is situated 400 feet east of the Black River, near the confluence of the Mississippi and Black Rivers. The 11- acre site includes the 7-acre former township landfill which was in use between 1969 and 1980, and prior to 1969 the site was mined as a sand and gravel quarry.

The Black River is located within the Upper Mississippi River Wildlife and Fish Refuge, a wetlands area that supports numerous migrating species of birds and is also used for hiking, fishing, hunting, and other recreational purposes by area residents and visitors. The area surrounding the site is generally rural, although several residences are located within 500 feet of the landfill. A subdivision of about 50 homes is located about 1.25 miles southeast of the site. Agricultural lands are located south of the landfill, and intermittent woods and grasslands border the site to the east.

The site consists of 135 to 142 feet thick unconsolidated deposits primarily composed of sand and gravel (Figure 2). Beneath the unconsolidated deposits lies sandstone bedrock. The natural groundwater flow direction in the unconsolidated material is predominantly south-southwesterly toward the wetlands that border the Black River. During high river stages (i.e. spring), the groundwater flow direction is toward the south-southeast (Figure 3). Average groundwater flow velocity beneath the site was estimated during the Remedial Investigation (CH2M Hill, 1989) to range between 55 and 110 feet per year, with an estimated average of 70 feet per year.

Investigation and Remediation History

In September 1982, Wisconsin Department of Natural Resources (WDNR) sampled and analyzed water from site monitoring wells and nearby private wells for compliance with drinking water standards for organic and inorganic constituents. The investigations indicated that groundwater contamination had occurred. The barium concentrations in the water from a residential well south of the site exceeded the drinking water standard, and five organic compounds were detected above background levels.

On May 2, 1983, an EPA Potential Hazardous Waste site inspection report was submitted. In September 1984, the Onalaska Landfill was placed on the National Priorities List. U.S. EPA, in consultation with the WDNR, conducted a Remedial Investigation and Feasibility Study (RI/FS) at Onalaska from April 1988 through December 1989. The RI determined the landfill as the source of groundwater contamination at the site. According to the study, a groundwater contaminant plume consisting of organic and inorganic compounds had migrated at least 800 feet from the southwestern edge of the landfill. The report identified potential long-term exposure to low levels of volatile organic compounds (VOCs) from private wells and plausible discharges of contaminants to the wetlands and Black River as the principal threats to human health and the environment.

Preliminary investigations determined that contaminant concentrations in the groundwater at individual monitoring wells exceeded one or more Federal or State standards or criteria. The Safe Drinking Water Act maximum contaminant levels (MCLs) for the following contaminants were exceeded at one or more monitoring well locations.

- arsenic,
- barium,
- benzene,
- 1,1- dichloroethene(1,1-DCE),
- toluene,
- 1,1,1-trichloroethane(1,1,1-TCA),
- trichloroethene, and
- xylenes

The majority of volatile organic compounds (VOCs) detected were in shallow monitoring wells (MW-5S and MW-3S and B4S) and consisted of benzene, toluene, ethylbenzene and xylenes (BTEX). The vertical extent of BTEX and chlorinated compounds contamination was found to be confined to the upper 10 to 20 feet of the aquifer. Ethylbenzene, 1 ,1- DCA and chloroethane, however, were detected at depths up to 50 to 60 feet below the water table. The vertical extent of semi-volatile organic compounds (SVOCs) contamination was also mostly confined to the upper 10 to 20 feet of the aquifer. There were no SVOCs detected in any of the deep monitoring wells. Based on these findings, U.S. EPA issued a Record of Decision (ROD) in August 1990 that called for the following actions to mitigate the areas of concern:

- Installation of a landfill cap in accordance with federal and state requirements (completed in November 1993);
- Installation of a groundwater extraction and treatment system to capture and treat contaminants in the groundwater immediately downgradiant of the landfill (5 extraction wells were installed in June 1994);
- Installation of an air injection system within the area of soils contamination to enhance the bioremediation of organic contaminants (29 shallow injection wells were completed in June 1994);
- Implementation of a groundwater, surface water, and sediment monitoring program to ensure the adequacy of the cleanup.

The selected remedy established a containment and treatment system to eliminate the principal threat posed to human health and the environment by isolating the source of groundwater contaminants in the landfill and eliminating those in the adjacent soils, preventing the further migration of VOCs in groundwater, and by treating extracted groundwater to acceptable discharge limits.

The original groundwater monitoring program at the site was implemented in 1995 and included collection of groundwater samples from monitoring wells, extraction wells, and nearby residential wells. In addition to sampling, groundwater elevations were measured in monitoring wells, air injection wells (i.e. bioventing wells), and piezometers (Figure 4). From March 1995, through December 1996, sampling was conducted quarterly. From 1997 to 2004, sampling was completed semiannually, and from 2005 to the present, sampling has been completed quarterly, semi-annually, or annually for different wells. The wells included in the groundwater-monitoring program, as well as the parameters analyzed, have changed on several occasions since the groundwater monitoring program was implemented in 1995. The rationales for these changes are documented in the Annual Monitored Natural Attenuation Reports for the Onaslaska Municipal Landfill Site. Each change was approved by the USEPA prior to implementation.

On November 13, 2001, U.S. EPA issued an Explanation of Significant Difference (ESD) for the Onalaska Municipal Landfill, based on the results from the long-term groundwater study, which showed significantly reduced levels of contaminants and limited exposure pathways. The document concluded that continued operation of the groundwater extraction/treatment system may be no more effective than other, more cost-effective methods in addressing the remaining contamination. The ESD allowed for the temporary shutdown of the groundwater extraction and treatment to evaluate the need for continuous operation of the system and to determine whether natural attenuation processes exist at the site.

The groundwater extraction system has been on stand-by since November 26, 2001 and natural attenuation is being evaluated as a potential modification to the ROD. The most recent report on Monitored Natural Attenuation is the 2007 report (ENSR, 2007).

Section 2
Contaminant Concentrations

Under the remedy selected in the ROD, the following cleanup standards were adopted (ENSR Corporation, 2007):

- The contaminant plume located at any point beyond the property boundary or design management zone (DMZ) must meet the following criteria:
  - Preventive Action Limits (PALs) from Wisconsin Administrative Code Chapter NR 140
- The groundwater contaminant plume located at the landfill waste boundary must meet the following criteria:
  - Maximum Contaminant Levels (MCLs) from the Safe Drinking Water Act, 40 CFR 141 .61 and 40CFR143
  - Non-zero Maximum Contaminant Level Goals (MCLGs) from the Safe Drinking Water Act, 40 CFR 141. 50

The DMZ defined for the Onalaska site extends 250 feet horizontally from the waste boundary. Wisconsin standards (PALs) must be met at any point beyond the property boundary or the DMZ. The DMZ, as defined in NR 140, is a 3-dimensional boundary surrounding a regulated facility and extends from the ground surface through all saturated geological strata. Specific cleanup standards (i.e., chemical-specific concentrations) were established in the ROD for 11 indicator chemicals (e.g. Chemicals of Concern).

The USEPA amended the ROD on October 10, 2000, by an Explanation of Significant Differences (ESD) to revise the cleanup standards for these chemicals to the latest NR 140 PALs and Enforcement Standards (ESs). Thus, the ES is the cleanup goal for the DMZ and the PAL is the cleanup goal for areas outside the DMZ. The list of contaminants (e.g. contaminants of concern (COC)) included in the MNA Plan consists of the original 11 indicator chemicals, other contaminants detected at concentrations above PALs during the Remedial Investigation, and contaminants identified above Wisconsin PALs since the groundwater monitoring program was implemented in 1995. This list and the applicable cleanup standards are presented in Table 1. If it becomes apparent that it is technically impracticable to achieve the groundwater cleanup standards, including potential Alternate Concentration Limits (ACLs), then USEPA in consultation with the WDNR may consider the use of alternate methods to control the groundwater contaminant plume or source to achieve the standards. If those alternate methods cannot attain groundwater cleanup standards, including potential ACLs, then a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) waiver may be considered.

Current Conditions (2002 to 2007)

Figure 5 illustrates the VOC contaminants predominantly detected above regulatory limits in the past five years. The BTEX compounds are excluded from Figure 5. These compounds – benzene, ethylbenzene, toluene, and xylenes are also detected in groundwater at the site. Xylenes are present at concentrations in the hundreds of ug/l, but because the PAL standard for xylenes is 1,000 ug/l, these concentrations do not exceed standards. There have also been limited detections of benzene above the PAL standard (0.5 ug/L) outside the DMZ in 2002 and 2005. These included detections in the upgradient wells MW-1S and MW-1M. Because of the sporadic nature of these occurrences, however, they are not highlighted in this report. The key contaminants under current conditions are:

- 1,2,4-trimethylbenzene (124-TMB)
- 1,3,5-trimethylbenzene (135-TMB)
- naphthalene

In 2002, 1,1-dichloroethylene, tetrachloroethene, trichloroethene, and vinyl chloride were also detected above PAL levels in wells MW-2S, MW-2M, MW-5S, and MW-14S. These compounds have not been detected above regulatory limits in subsequent years, however. 1,2-Dichloromethane (methylene chloride) has also been detected in a number of wells. These occurrences are likely an artifact of laboratory contamination, and this compound is not considered a contaminant of concern at the site.

Total VOCs (excluding BTEX) observed over the 2002 to 2007 time period are represented in Figures 6 and 7. These data represent the sum of all VOCs detected in any monitoring wells, as averaged over the entire year.

A number of metals are also detected in groundwater at the site above regulatory levels. These include arsenic, barium, cadmium, iron, manganese, and lead. These are also contaminants of concern at the Onalaska site (Table 1). Because of the close relationship between redox conditions and metals concentration in groundwater, and the fact that these metals are naturally occurring, these will be addressed separately in later sections of this report.

Statistical Trends

SSP&A collaborated with USEPA Region V to complete statistical analyses of groundwater concentration data for the principal COCs at all monitoring locations throughout the site. This report only presents the results of the analyses completed for TMBs and naphthalene. USEPA staff used an in-house statistical analysis program, the PAM statistical software package, developed by Subterranean Research Inc., to complete the following three analyses for each sampled location:

- Standard Test: compares the 95% upper confidence limit (UCL) calculated using the 4 most recent data points, or using data collected after a specified date, to COC-specific standards. The Standard Test reports the result (Compliance, Exceedance), the 95% UCL, and the COC specific standard in consistent units.

- Trend Test: identifies upward or downward trends through time. The trend method used is the Sen's Test, a non-parametric trend analysis similar to the Mann-Kendall test. The trend statistics reported are the slope result (Upward, Downward, No Trend) and the slope estimate (in concentration units per year). Upward and Downward tests are each calculated at the 95% confidence level. Because the trend is calculated on the natural logarithm of the concentration, the slope estimate is reported in terms of the log of the concentration units per year.
- Baseline Test: compares the most recent datum to the upper prediction limit (UPL) calculated from a baseline subset of the data, the first 8 available samples collected at each point. The Baseline Test reports the result (Better, Worse, No Change); and the 95% prediction limit UPL.

Results of the PAM analyses are provided in the Appendix. The calculated UCLs are used in this report to prepare maps illustrating the approximate extent of the contaminants of concern.

Contaminant Concentration Trends - VOCs

Figure 8 through 11 show the concentration trends calculated with the PAM analysis for the three primary contaminants of concern. For both the trimethylbenzenes, as well as naphthalene, increasing concentration trends are observed in at least one of the following wells: MW-4S, MW-5S, MW-8M, MW-14S, and MW-17S (Table 2). Of these wells, only a single one is screened in the medium depth wells, MW-8M. Concentrations of 1,2,4-trimethylbenzene have been increasing in this well since 2003. A single well, AW-25 exhibits decreasing 1,2,4-TMB concentrations. Four shallow wells (AW-13, AW-20, MW-16S, and AW-28) indicate decreasing concentrations of 1,3,5-TMB over the same period. The AW wells are typically screened across only the upper foot (or less) of the saturated zone. Consequently, their results may not be representative of deeper portions of the saturated zone.

Three of the shallow wells with increasing 1,2,4-TMB concentrations- MW-4S, MW-5S, and MW-14S- also show increasing naphthalene concentrations. No increasing concentrations of naphthalene were observed in the wells screened at medium depths.

Contaminant Concentration Trends - Metals

Figure 12 and 13 show the concentration trends calculated with the PAM analysis for arsenic and barium. These metals are highlighted because they are COCs, occur in excess of the Wisconsin PAL standards, and are not commonly-used indicators of redox conditions (e.g. Mn and Fe). Other metals, including cobalt exhibit more limited exceedances and/or upward concentration trends. These are highlighted in the summary of statistical analyses in the Appendix.

Section 3
Target Zones

Values for Upper Confidence Limits (UCLs) were calculated from the time series data (concentration data) as part of the PAM analysis. These were calculated for naphthalene concentrations and for total TMBs.

Figures 14 through 16 depict the extent of target zones for these contaminants. The target zones are defined as that area in the aquifer that is likely to exceed cleanup criteria. They are constructed using the UCL values calculated for each COC at each well, and by applying a contouring (kriging) technique to interpolate between those values. The boundaries of the target zones are defined by a lower cutoff value, typically equal to the cleanup criteria for the relevant compound(s). In this report, the target zones are represented with lower cutoff values equal to the PAL regulatory levels. To calculate the total TMBs, non-detect values were treated as equal to one-half the detection limit. This introduces some uncertainty into the UCL calculations. For total TMBs, however, the PAL regulatory level is 96 ug/l, whereas detection limits were generally below 1 ug/l. Thus, the actual uncertainty introduced is minimal with respect to the regulatory levels.

For both the shallow and medium-depth wells, portions of the UCL target zones extend beyond the DMZ at 250 feet from the edge of the landfill cap. On the northwest and southern edges of the DMZ, these excursions outside of the DMZ are associated with wells with increasing TMB and naphthalene trends – e.g. Wells MW-14S and MW-8M.

The target zones for arsenic and barium are depicted in Figures 17 and 18. All of the UCL values for As exceed the PAL standard of 1 ug/l. In addition, increasing arsenic trends are calculated for MW-8M and at PZ-02. Reported detection limits for arsenic, however, are generally greater than the PAL standard of 1 ug/l. The reported detection limits range from 1.1 ug/l to 10 ug/l, but are generally 5 ug/l or less. Because the ND surrogate used in the statistical calculations is 0.5 x the median of reported detection limits, these UCLs and resultant target zones are strongly impacted by these detection limits. At PZ-02, for example, the upward trend calculated by PAM is influenced by varying detection limits and may not be meaningful (Appendix). Consequently, the actual extent of the As target zone depicted here will be impacted by these relatively elevated detection limits, and should be considered with caution below values of 5 ug/l.

The extent of the target zones for Ba above the PAL standard outside of the DMZ is greater for the medium-depth than shallow-depth wells. In addition, increasing barium trends are observed in MW-8M outside of the DMZ.

The PAM analysis of dissolved lead indicates no upward trends in shallow and medium-depth wells, but many wells are determined to be in exceedance of the the PAL standards outside of the DMZ. These lead exceedances, however, are calculated largely on the basis of detection limits close to or in excess of the PAL standard of 0.5 ug/l. Consequently, it is not clear if lead concentrations do exceed the standard or if it is merely an artifact of an elevated detection limit with respect to the standard.

Section 4
Natural Attenuation as a Remedy

The primary goal of this evaluation is to determine whether monitored natural attenuation (MNA) is a suitable final remedy for the Onalaska Landfill site. Groundwater parameters descriptive of redox conditions in the groundwater have been collected at the site. From 2002 to 2007, in particular, the following data were collected for evaluation of MNA:

- Oxidation-Reduction Potential (ORP; field parameter)
- Dissolved Oxygen (field parameter)
- Dissolved Iron
- Dissolve Manganese
- Total Sulfate
- Total Nitrate
- Methane
- Chloride

Figure 19 illustrates trends in ORP from 2002 to 2007. For many wells in both the shallow and medium depth zones, there is an apparent trend from more oxidizing conditions in 2002-2003 followed by a swing to more reducing conditions in 2005. In some wells, this trend appears to have reversed starting in 2006. Dissolved oxygen data collected simultaneously with the ORP data are more variable, and not well correlated with the ORP results.

The air-injection system at the Onalaska Landfill was shut down in 1997. It is therefore conceivable that the observed redox trends could be related to this change in the subsurface environment. Examination of the ORP trends for the air-injection (AW) wells suggests that generally oxidizing conditions persisted in these wells through 2004 or 2005, but that the swing to more reducing ORP values (Figure 19) occurred nearly simultaneously across the site, including in the AW bioremediation wells. It is difficult to conceptualize a physical mechanism whereby all monitoring wells at the site would respond simultaneously to the AW well shutdown, regardless of proximity of the AW wells, their shallow screens, or groundwater flow direction and rates. Similarly, the groundwater extraction system was shut down in 2001. While this may have impacted redox conditions in the subsurface, it is unlikely that the rapid change in redox conditions, several years later, across the entire site is a response to the extraction well shutdown.

It is noted in the annual MNA reports produced by ENSR Corporation (2003 to 2007) that field parameters were measured during

> "the purging process using a water quality meter equipped with a flow-through cell (when possible). If using a flow cell was not possible, then field parameters were measured from purge water collected in a container."

Considering the apparent variations in field methods for collecting these parameters, and the difficulty of achieving good ORP and DO measurements without interference or calibration drift, it is most likely that the observed trends in ORP and dissolved oxygen values are influenced more by the collection methodology than actual redox condtions in the aquifer.

Other redox parameters collected for Onalaska site include major ions and methane in groundwater. Across the site as a whole, these redox parameters have varied both geographically and temporally (Figures 20 – 27). To interpret these data, it is essential that redox conditions downgradient of the landfill be considered with respect to upgradient or background conditions. There are few data collection locations situated upgradient of the landfill and of known screen depth. These locations are MW-1S, its replacement MW-1SR (both which are screened in the shallow interval) and MW-1M, screened in the medium-depth interval. Other upgradient private wells are either screened in the deep aquifer or at an unknown interval.

To facilitate an interpretation, all MNA parameter analytical results for the background wells were plotted against downgradient wells in cumulative frequency distribution curves (Figure 28). In each of these curves, all of the data were ranked in ascending order and then assigned a percentile ranking from 0 to 1.0. When viewed in this format, a number of key observations are clear:

- For a given percentile value, concentrations of nitrate are generally higher in the upgradient than in the downgradient wells
- Similarly, concentrations of sulfate are higher in the background well(s) than in the downgradient wells
- For a given percentile value, concentrations of Fe and Mn are generally higher in the downgradient than the upgradient wells

To put the redox conditions at the Onalaska site into broader perspective, site data was compared to major ion concentrations elsewhere in the sand and gravel aquifer of the Black River watershed. The background data used for comparison were obtained from the USGS NWIS database. Locations were selected that were located within the Black River watershed (hydrological unit HUC 07040007) and the sand and gravel aquifer. The selected 12 background wells ranged from 12-108 feet in depth. All the background wells were located upstream of the Onalaska site, with the closest site being 32 miles from the Onalaska landfill perimeter, and the farthest background site 90 miles away. The samples at the background sites were collected between 1946 and 1986.

As shown on Figure 29, the nitrate concentrations are generally higher in the background wells than in the site wells, with the 75th percentile value equal to 2.7 mg/l, as compared to 0.52 and 0.02 mg/l on-site (excluding MW-1S and MW-1SR). Background nitrate concentrations in the aquifer have a median value of about 0.7 mg/l, whereas wells in the shallow and medium depth site wells have median values between 0.01and 0.1 mg/l. Similarly, the 75th percentile sulfate value for background wells is 21 mg/l, as compared to 5.7 to 2.4 mg/l on-site. The median background sulfate concentrations are 10 mg/l, as compared to 2.9 mg/l and 0.67 mg/l on-site. Dissolved iron and manganese in the background aquifer are both higher on-site than in the background, although dissolved iron concentrations in the shallow wells are higher than in the medium-depth wells. In addition, the range of chloride concentrations in the downgradient wells exceeds the background well by more than an order of magnitude

Collectively, these data are consistent with a scenario in which all of the monitoring wells at the Onalaska site, with the exception of MW-1S, MW-1SR, and MW-1M are influenced by the reducing redox conditions typically observed downgradient of landfills. Wastes and disposal methods at the site are typical of municipal landfills, where conditions are generally more reducing than surrounding areas (Kjeldsen et al 2002). The Onalaska landfill was used for municipal, commercial, and industrial waste disposal from 1969 to 1980. Wastes deposited at the Site include municipal refuse, animal carcasses, septic sludge, construction debris, tires, industrial solvents, and other chemicals (Table 3). Municipal, commercial, and industrial wastes were usually not segregated, and are mixed throughout the landfill (CH2MHill 1989). Chloride is often a significant component of municipal landfill leachate; the data described here suggest that the highest chloride concentrations do also occur downgradient of the landfill.

Correlation of MNA Parameters with Observed Contaminant Trends

Trimethylbenzenes and naphthalene will degrade through biologically-mediated reactions under aerobic redox conditions in groundwater. Both are more recalcitrant under reducing conditions, although their degradation under nitrate-reducing and sulfate-reducing conditions has been demonstrated (Thierrin et al. 1993; Haner et al., 1997; Zheng et al., 2001). In fact, stability of the TMBs under reducing conditions is sufficient that they have been used as conservative tracers for other more degradable petroleum components (Weidemeier et al., 1996).

The MNA data outlined above suggest a correlation between reducing redox conditions, and increasing trends in TMBs and naphthalene. Prior to 2002, the groundwater environment downgradient of the landfill was potentially altered substantially by the pumping of extraction wells, and the presence of air injection wells. Absent these disturbances, the predominant groundwater conditions downgradient of the landfill are under conditions at least as reducing as sulfate-reducing. (Some methane has also been detected, suggesting methanogenic conditions locally.) Consequently, it is consistent with these conditions for TMBs and naphthalene to persist in groundwater downgradient of the landfill.

The trends in 1,2,4-TMB and naphthalene are consistent across several wells. It is therefore likely that these contaminant concentration trends reflect redox conditions, and that increases in TMBs and naphthalene since 2002 are a product of groundwater conditions under non-pumping, non-air-injecting conditions. This relationship is not absolute – note, for example the decreasing trends in 1,3,5-TMB during the same time period. There is some research to suggest that 1,3,5-TMB may degrade under sulfate-reducing conditions (Thierrin et al. 1993), which could be an explanation for the varying response to 1,2,4-TMB and 1,3,5-TMB in different wells. Of course, subsurface heterogeneity, and the presence of redox microenvironments cannot be discounted.

It is possible that further downgradient of the DMZ, redox conditions dominated by the natural, more oxidizing background geochemistry are present, thereby enabling degradation of the TMBs and naphthalene (i.e., a mixed Type I to Type III system, Weidemeir et al., 1999). But there are no monitoring data available with which to test this theory.

As noted above, arsenic and barium are observed at concentrations that have remained above relevant standards (Table 4). Both of these are naturally-occurring elements whose concentrations in groundwater are highly dependent upon redox conditions. Arsenic in groundwater can be present in various forms such as H_3AsO_3, H_2AsO_3, $HAsO_3$, H_3AsO_4, H_2AsO_4 and $HAsO_4$. The dominant As oxidation states in water are arsenate As^{5+} and arsenite As^{3+} (Hem, 1985). Studies have shown that concentrations of dissolved arsenic increases with decreasing pH and Eh (Saxena et al, 2004). At the same time, removal mechanisms include adsorption of As by hydrous iron oxides or coprecipitation with sulfides, depending upon redox conditions and availability of other ions. The speciation of As at the Onalaska site is not known, but its solubility is strongly influenced by redox conditions, and under existing conditions, As concentrations exceed the PAL standards.

Concentrations of barium in water are controlled mainly by sulfate concentrations. Formation of barium sulfate or barite is highly favorable thermodynamically and barite is highly insoluble (Hem, 1985). Reducing conditions at the Onalaska site and limited sulfate concentrations may hinder the formation barium sulfate, thereby enhancing the concentrations of dissolved barium. Barium concentrations in water are also limited by adsorption to metal oxides or hydroxides (Hem, 1985). Under the redox conditions observed at this site, such adsorption would be limited.

Section 5
Discussion, Conclusions and Recommendations

Groundwater conditions at the Onalaska Municipal Landfill site are characterized by a relatively homogenous aquifer. Wells are screened at multiple depths, but do not indicate significant upward or downward gradients. This is consistent with the persistence of groundwater contamination primarily with the shallow zone, with limited apparent migration to the deeper zones.

Evaluation of MNA parameter data collected since 2002 suggests that redox conditions in groundwater downgradient of the landfill are more highly reducing than under background conditions in the aquifer. Under these conditions, TMBs and naphthalene, compounds that are persistent under anaerobic conditions, are seen to be increasing in concentration both inside and outside of the DMZ. It is possible that further downgradient, redox conditions dominated by the natural, more oxidizing background geochemistry are present, thereby enabling degradation of the TMBs and naphthalene. There are, however, no monitoring data available with which to test this theory.

While MNA parameters have been collected over an appropriate period of time, and at suitable intervals, the collection and analysis of these data could be improved to enhance monitoring of MNA and compliance with ROD requirements. While the MNA evaluation reports (e.g. ENSR, 2007) address degradation of chlorinated solvents, they do not explicitly include the possibility of compounds that are persistent under the reducing conditions that facilitate dechlorination. Nor do they include a full evaluation of COC metals such as arsenic and barium whose concentrations are strongly impacted by redox condition. Previous MNA analyses have failed to take into account variations in background versus downgradient conditions. Ultimately, all of these shortcomings reflect the lack of a relevant site conceptual model that is appropriate for this landfill (e.g. USEPA, 2008). A complete site conceptual model for the MNA remedy must consider

- Groundwater flow directions and monitoring of locations upgradient, downgradient, and side-gradient (USEPA, 2008)
- The amenability of each COC to degrade under varying redox conditions
- An understanding of the geographic and hydrostratigraphic limits of each redox zone, so that these may be compared to the extent of COC contamination
- The impact of site activities (e.g. pumping, landfill capping, air injection) on subsurface redox conditions.

Conclusions

At the current time, the target zones for contaminant containment, based upon UCL concentrations, extend beyond the Design Management Zone. In addition, at locations outside the DMZ, concentrations of TMBs and naphthalene are increasing. The naturally-occurring metals iron, manganese, arsenic, and barium are currently present at concentrations that exceed PAL standards outside the DMZ, and at the most distal monitoring well locations. While MNA may be an appropriate final remedy for the Onalaska Municipal Landfill, the redox parameters collected to date are, with the exception of a single upgradient well in each of the shallow and medium-depth zones, influenced by the highly reducing conditions associated with the landfill. Consequently, the data are insufficient to determine if TMBs and naphthalene will degrade to acceptable levels in groundwater beyond the existing groundwater monitoring system.

Recommendations

The following recommendations address shortcomings that may be considered to improve the MNA program.

- The site conceptual model should be updated to incorporate the degradation potential of all COCs (including metals other than Fe and Mn), and the redox conditions under which they may be degraded or immobilized, groundwater flow directions, and the extent of different redox zones
- Because of the apparent persistence of compounds downgradient of the DMZ, it is recommended that additional monitoring of MNA parameters be conducted in the shallow and medium zones beyond the current extent of monitoring wells. This monitoring will help determine if redox conditions downgradient of the landfill are suitable for further immobilization of dissolved contaminants. In addition, "side-gradient" monitoring wells should be considered (EPA, 2008) to help define the lateral extents of the downgradient redox zones
- Continue monitoring groundwater levels, contaminants of concern and MNA parameters on the current schedule, but include water level measurements during all sampling events;
- To improve understanding of groundwater flow directions and mapping, water level measurements should include stage measurements on the Black river, north and west of the landfill; these measurements should be tied into the same vertical and horizontal datums as the existing monitoring well network, and should be collected at the same time as water levels from the monitoring wells.
- Additional MNA parameters should be incorporated into the analytical set to facilitate evaluation of redox zonation. In order to better delineate redox zones the following parameters should be included:
    - Nitrite, and
    - Sulfide
- Annual MNA reports should include interpretations of the shallow and medium depth zones independently. These interpretations should include

  - Maps of complementary oxidized/reduced pairs such as nitrate/nitrite and sulfate/sulfite to establish relative zone of redox conditions
  - Comparison of these data to background levels in the aquifer
  - Evaluation of parameters such as chloride should consider known background concentrations in the aquifer and the likelihood that chloride is also a common contaminant from landfills unrelated to dechlorination reactions.
- Each year, MNA conditions and contaminant concentration trends should be re-evaluated to determine whether site conditions are sufficiently stable to rely upon MNA as a final remedy for the site.

Notwithstanding these recommendations for improving the MNA program, the Onalaska site is not currently in compliance outside of the DMZ for naphthalene (at MW-14S) several metals (Table 4). If current trends continue, it may soon be out of compliance for the sum of trimethylbenzenes at MW-8M. The analysis completed here suggests that many or all of these contaminant concentrations are reflecting the predominantly reducing redox conditions present at both the shallow and medium depth intervals in the aquifer. Consequently, remedial options to address these issues may include:

- Resumption of the air-injection system downgradient of the landfill. The injection of air may serve to induce oxidizing conditions suitable for degradation of BTEX, TMBs, and naphthalene, and help maintain low levels of chlorinated solvents through direct physical transfer of VOCs to the vapor phase. The most positive impact of this approach will be on the shallowest portion of the aquifer (where the AW wells are screened) and possible in overlying source area materials. It is not clear whether resumption of air injection will have a positive impact on contaminant concentrations in the entire shallow depth zone or medium-depth zone, but this should be evaluated prior to resumption of the remedy.
- Alternately, resumption of active pumping in extraction wells EW-1 though EW-5 may be a reasonable approach, as this will serve to contain contaminant within the DMZ (assuming the design- and actual pumping rates are appropriate). It may also serve to bring addition oxygenated shallow water into the medium-depth portions of the aquifer thereby enhancing containment of metals including arsenic and barium.

In addition, reported detection limits for some COCs, particularly the metals arsenic and lead, are frequently higher than the relevant groundwater standards. This makes evaluation of compliance difficult, at best. Work plans for future monitoring must consider the detection limits for these compound with regard to the relevant standards to ensure that useable data are obtained.

Section 6
References

CH2M Hill, (1989). Remedial Investigation (RI) Report. Vol 1.

ENSR Corporation (2007). Annual Monitored Natural Attenuation Report for the Onalaska Municipal Landfill Site, Onalaska, Wisconsin, Wisconsin Department of Natural Resources.

Haner, A., Hohener, P., and Zayer, J., 1997, Degradation of Trimethylbenzene Isomers by an Enrichment Culture under N2O-Reducing Conditions, Applied and Environemental Microbiology, 63, 3, 1171-1174.

Hem, J.D. (985). Study and Interpretation of the Chemical Characteristics of Natural Water. U.S. Geological Survey. Water-Supply Paper 2254. Washington D.C.

Kjelsdsen, P., Barlaz, M., Rooker, A., Baun, A., Ledlin, A., Christensen, T., 2002, Present and Long-Term Composition of MSW Landfill Leachate: A Review, Critical Reviews in Environmental Science and Technology, 32, 4, 297-336.

Saxena, V.K., Kumar, S., and Singh, V.S., 2004, Occurrence, behavior and speciation of arsenic in groundwater, Current Science, 86: 2, 281-284.

Thierrin, J, Davis, G, Barber, BP. et. al.(1993) Natural degradation rates of BTEX compounds and naphthalene in a sulfate reducing groundwater environment. Hydrological Sciences. 38(4), 309-322.

U.S. Environmental Protection Agency (USEPA) (2001). Explanation of Significant Differences (ESD) Onalaska Municipal Landfill.

Zheng, Z., Breedveld G., and Aagaard, A., 2001. Biodegradation of soluble aromatic compounds of jet fuel under anaerobic conditions: laboratory batch experiments, Applied Microbiology and Biotechnology, 57, 572-578.

Wiedemeier TH, Swanson MA, Wilson JT, Kampbell DH, Miller RN, Hansen JE (1996) approximation of biodegradation rate constants for monoaromatic hydrocarbons (BTEX) in ground water. Ground Water Monit Rem 16:186–194

Wiedemeier TH, Rifai, HS., Newell, CJ, and Wilson, JT. 1999, Natural Attenuation of Fuels and Chlorinated Solvents in the Subsurface, New York, John Wiley & Sons, 617 pp.

FIGURES

S.S. PAPADOPULOS & ASSOCIATES, INC.

Figure 1 Location of the Onalaska Municipal Landfill Site

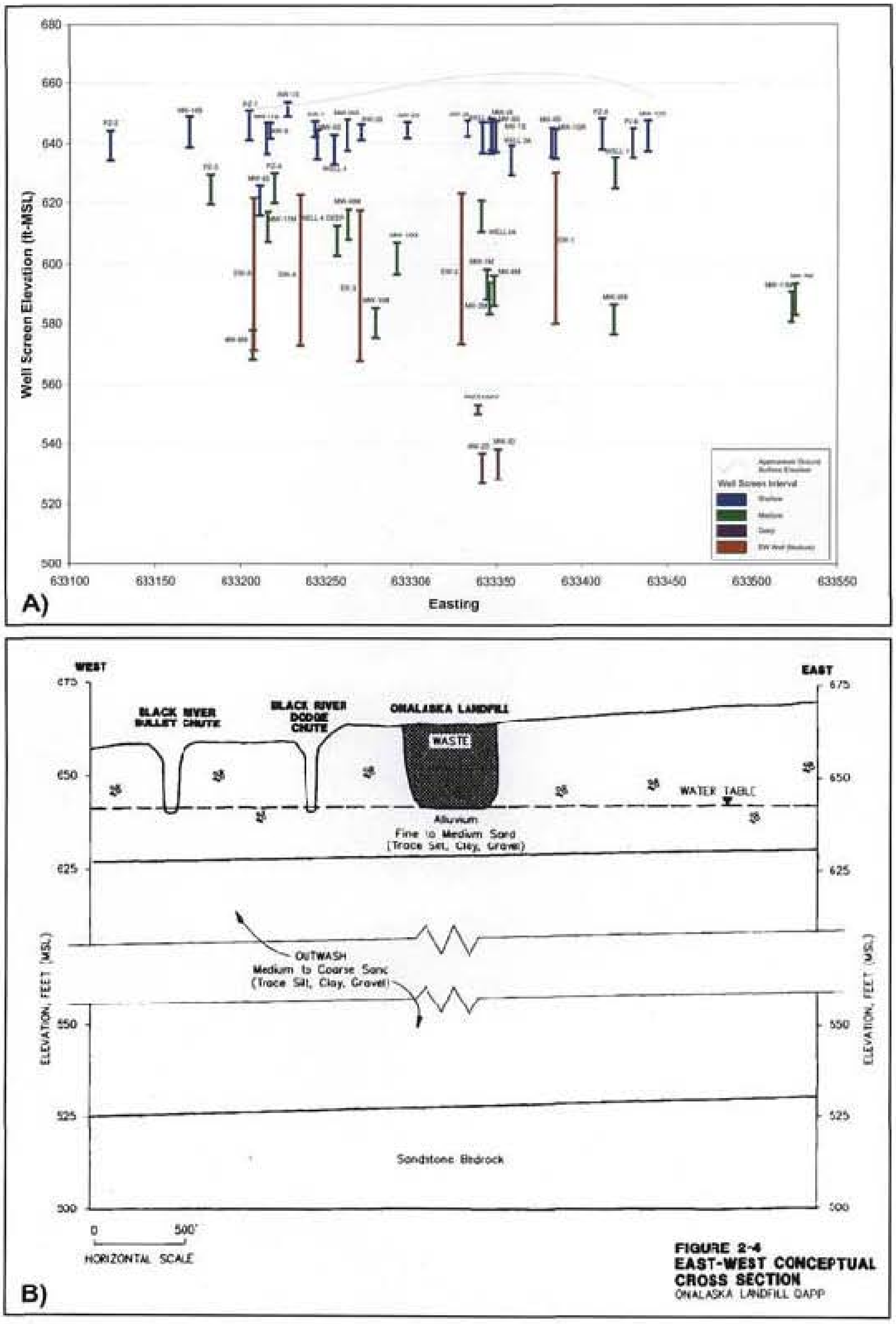


Figure 2 East West Cross Sections showing A) Well Screen Elevations, and B) Conceptual Cross Section (from CH2M Hill, Inc. 1989)

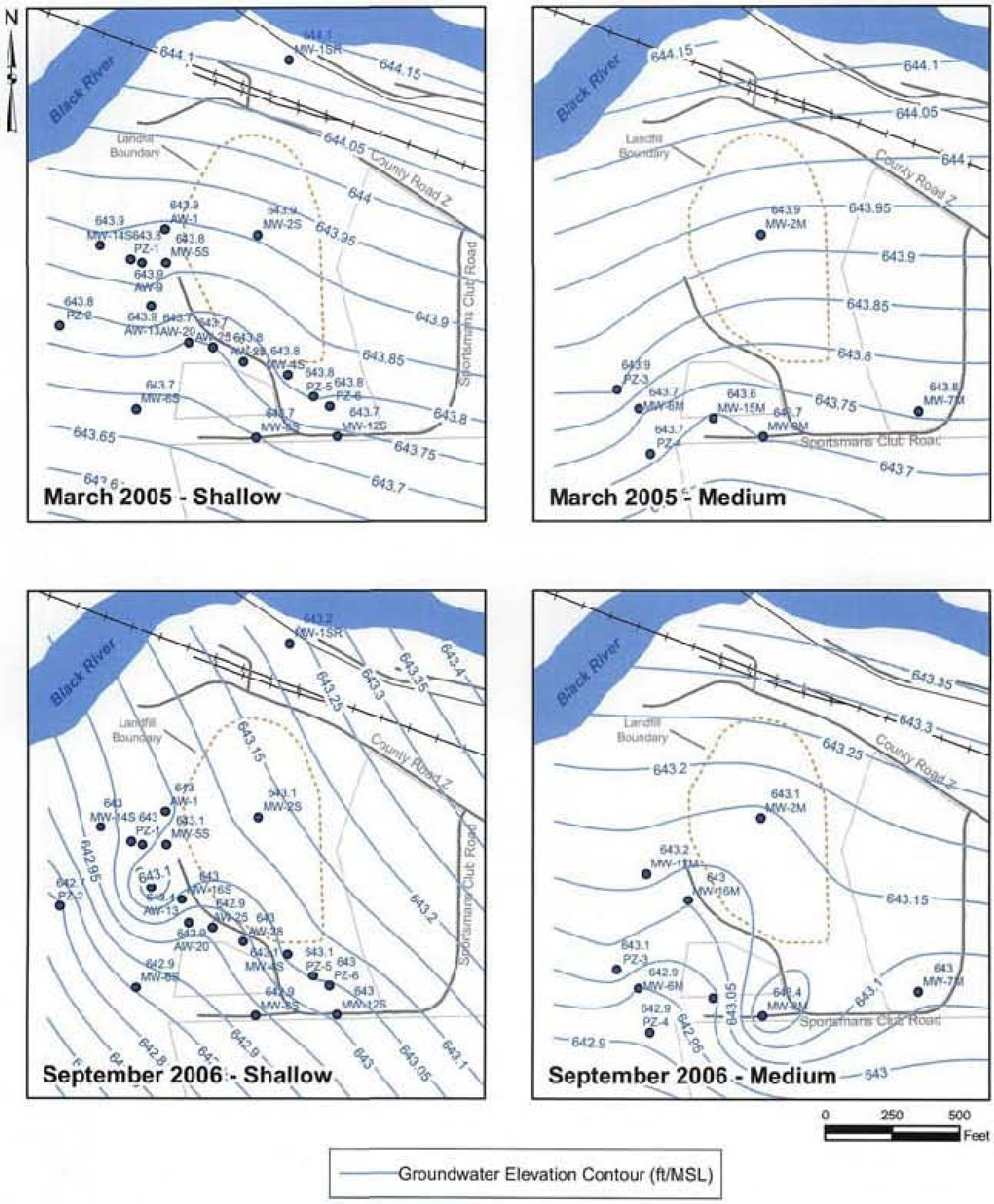


Figure 3 Groundwater Contours in March 2005 and September 2006, in Shallow and Medium-Depth Intervals

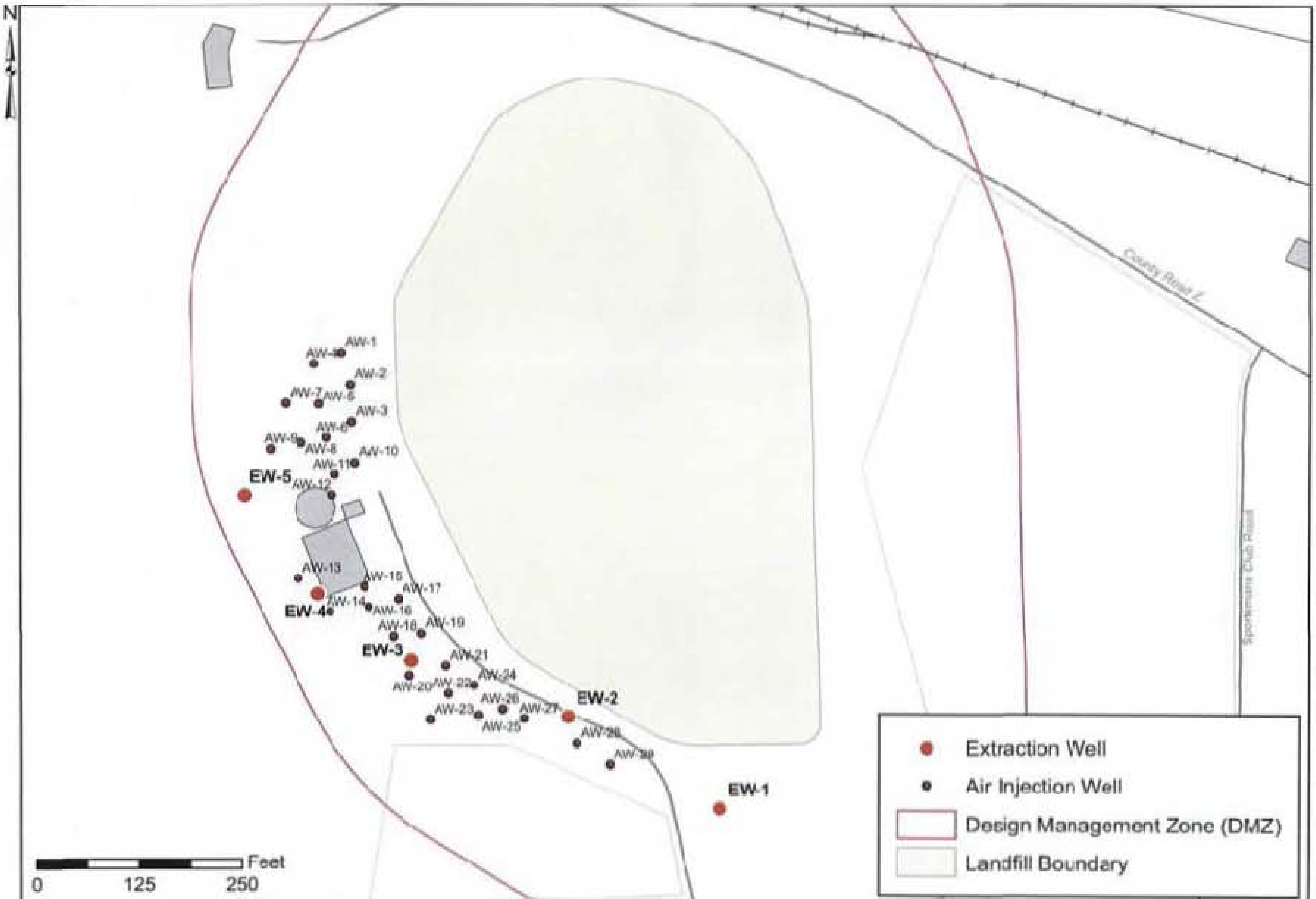


Figure 4 Remediation System Components, 1994 to 2001

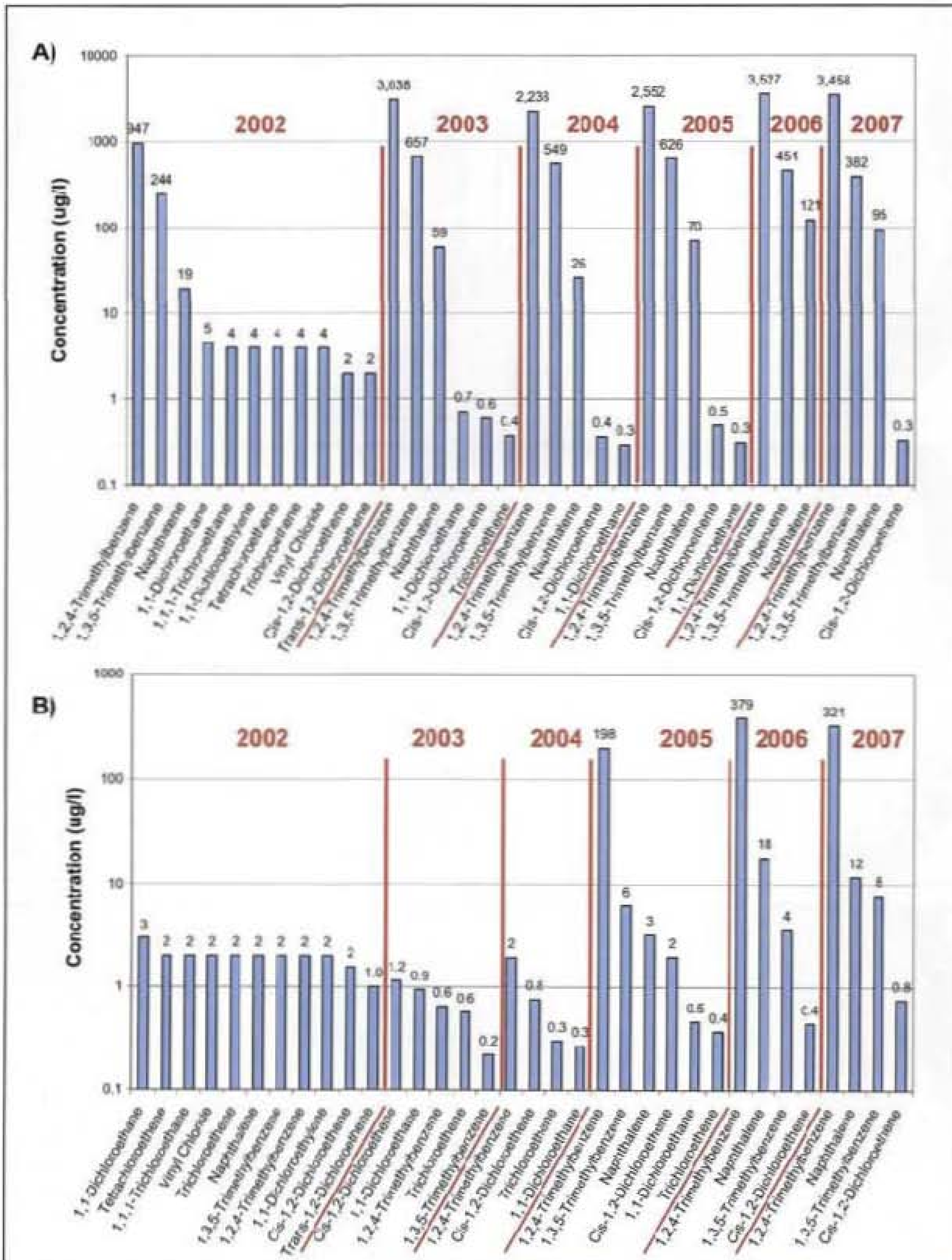


Figure 5 VOC Compounds Detected in Groundwater (excluding BTEX), Sums of Individual Well Annual Averages 2002 to 2007, in A) Shallow Wells, and B) Medium-Depth Wells

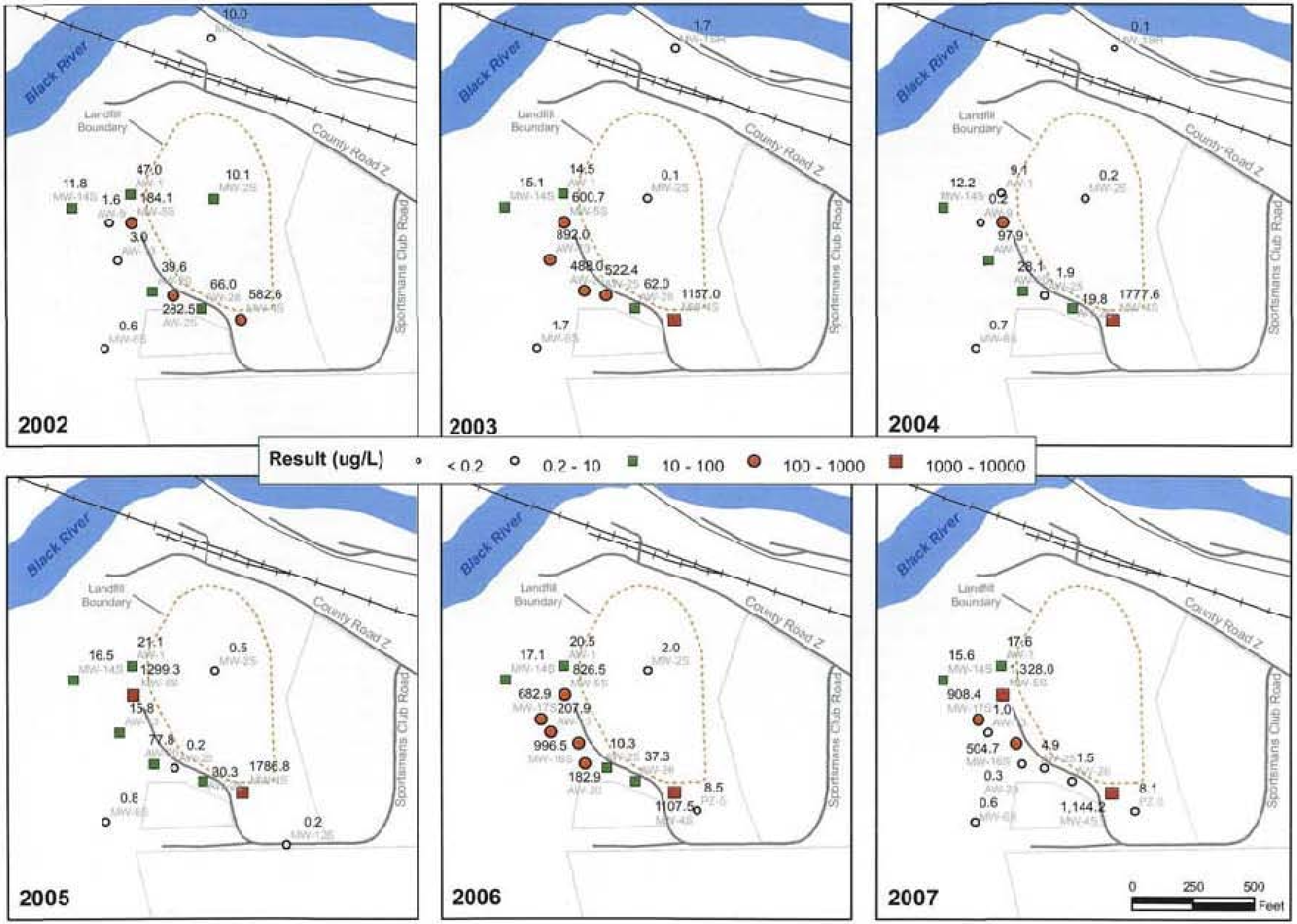


Figure 6 Total VOC Concentrations, 2002 to 2007, Shallow Wells

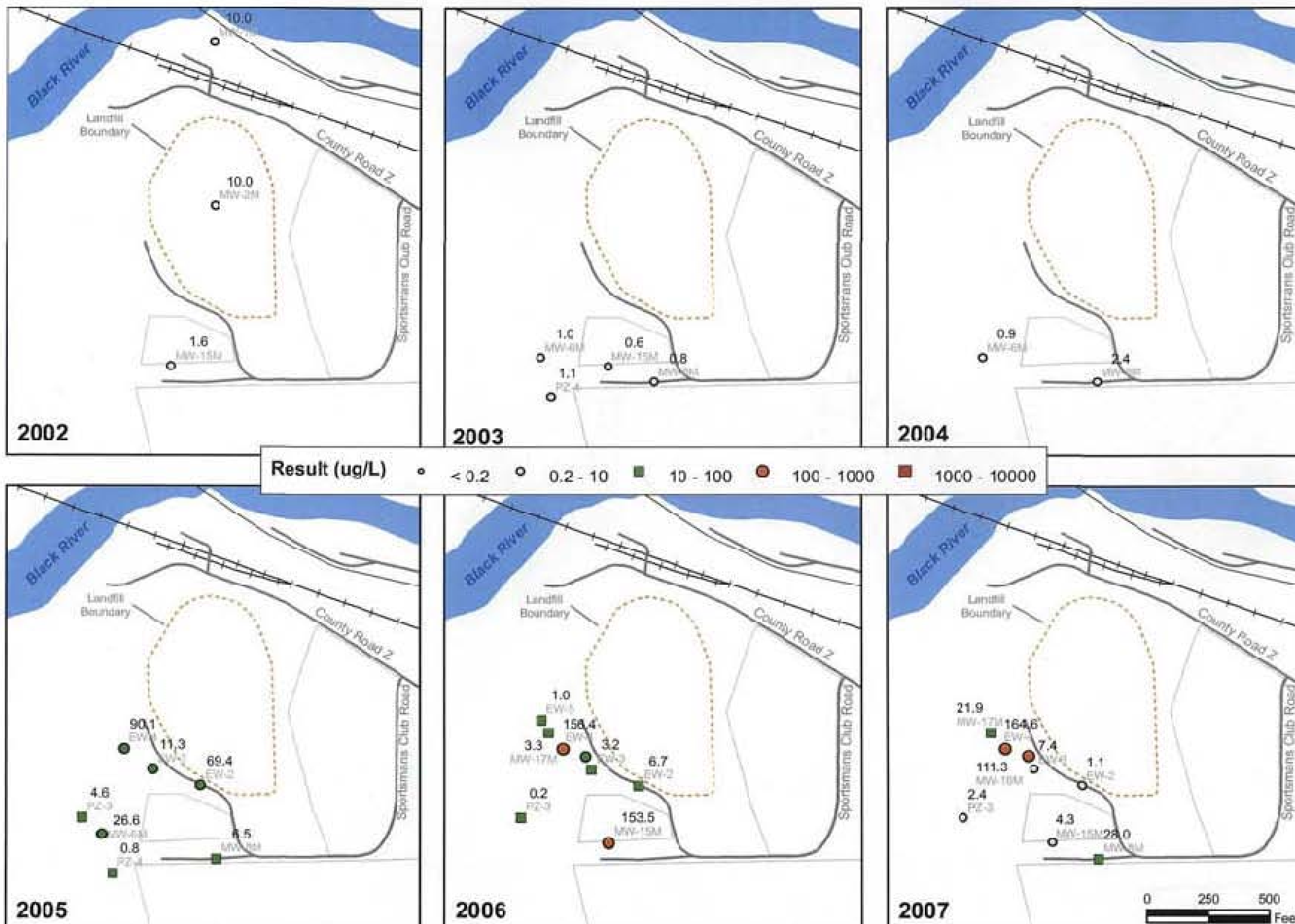


Figure 7 Total VOC Concentrations, 2002 to 2007, Medium-Depth Wells

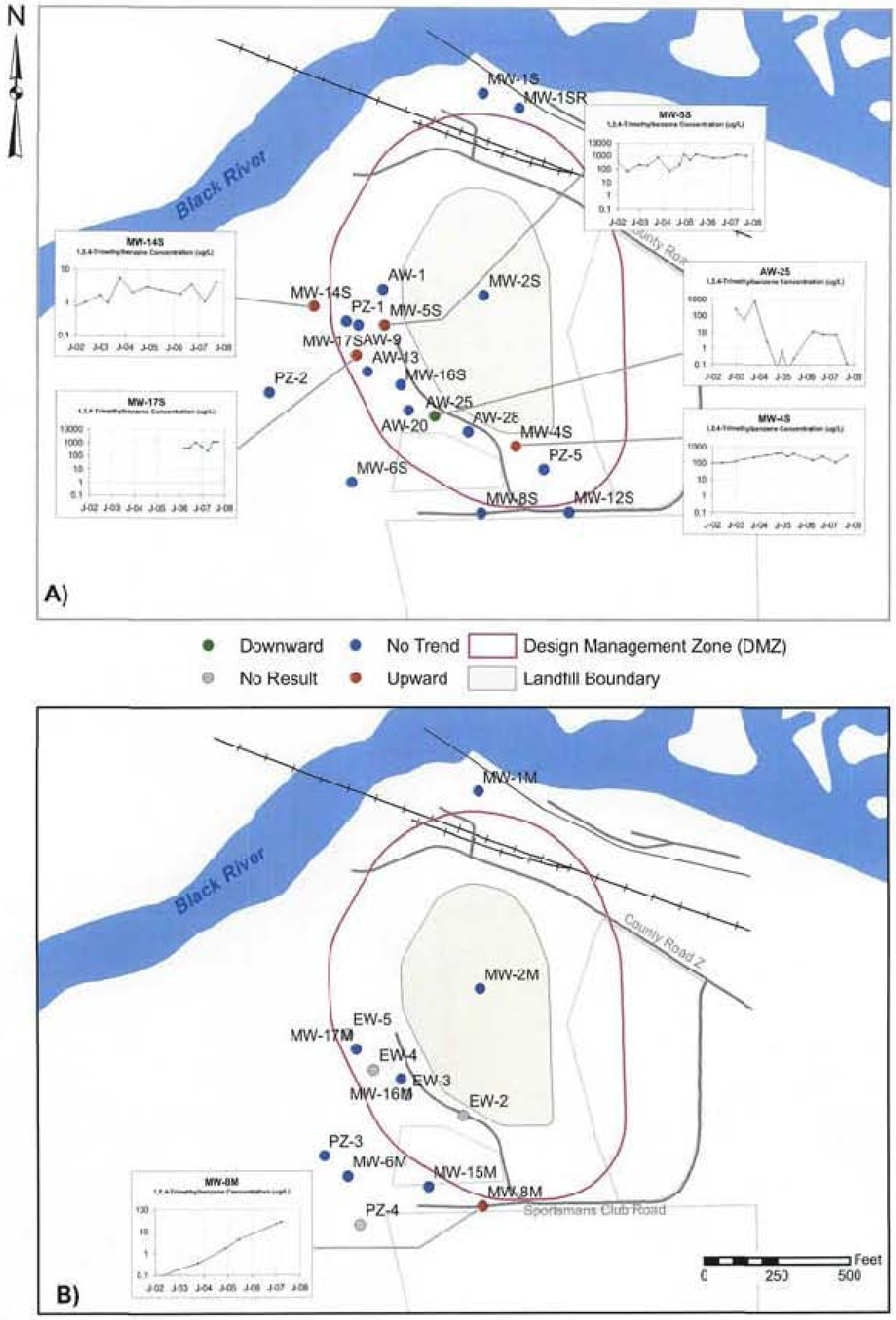


Figure 8 1,2,4-Trimethylbenzene Concentration Trends from PAM analysis for the A) Shallow Wells and B) Medium-Depth Wells

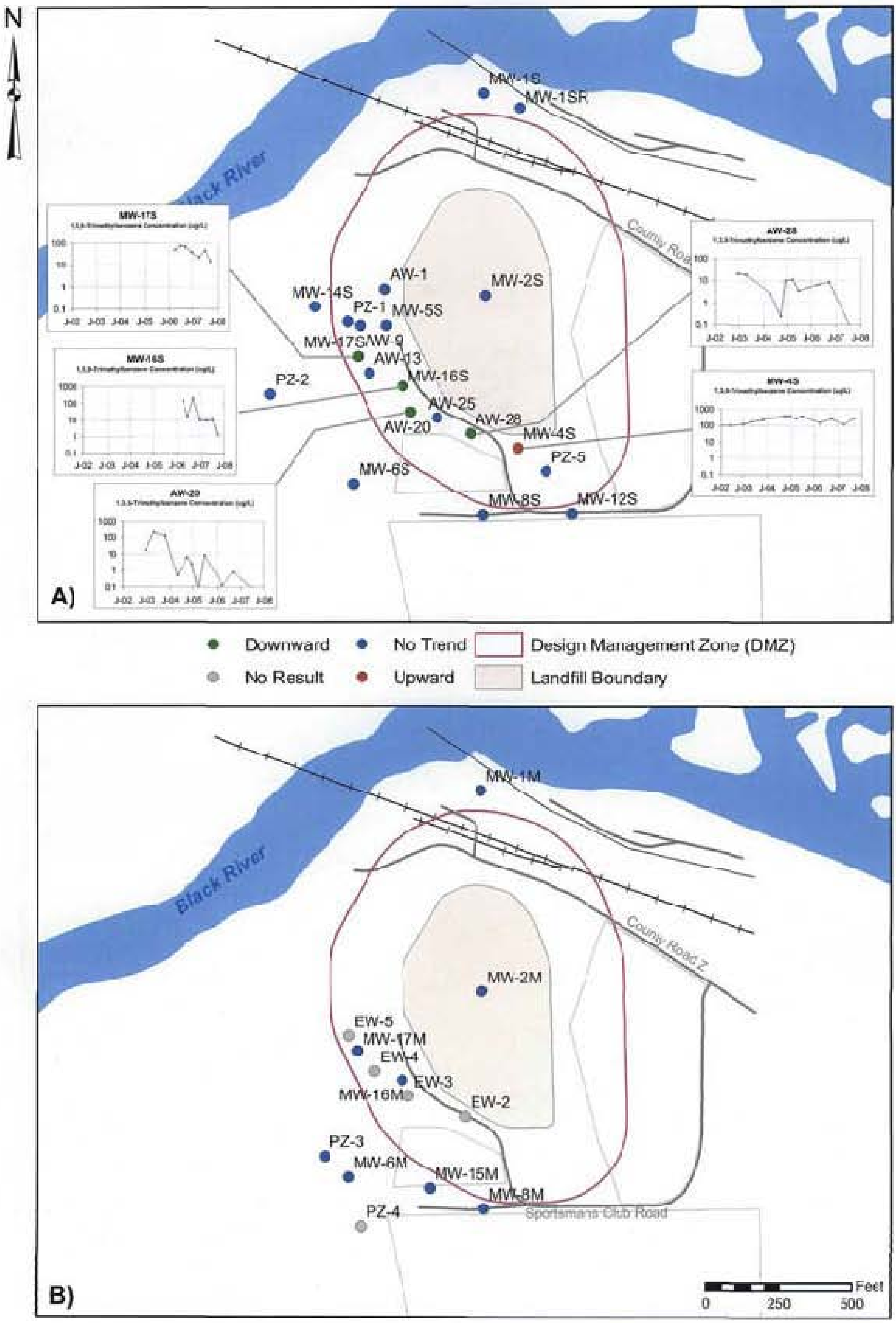


Figure 9 1,3,5-Trimethylbenzene Concentration Trends from PAM analysis for the A) Shallow Wells and B) Medium-Depth Wells

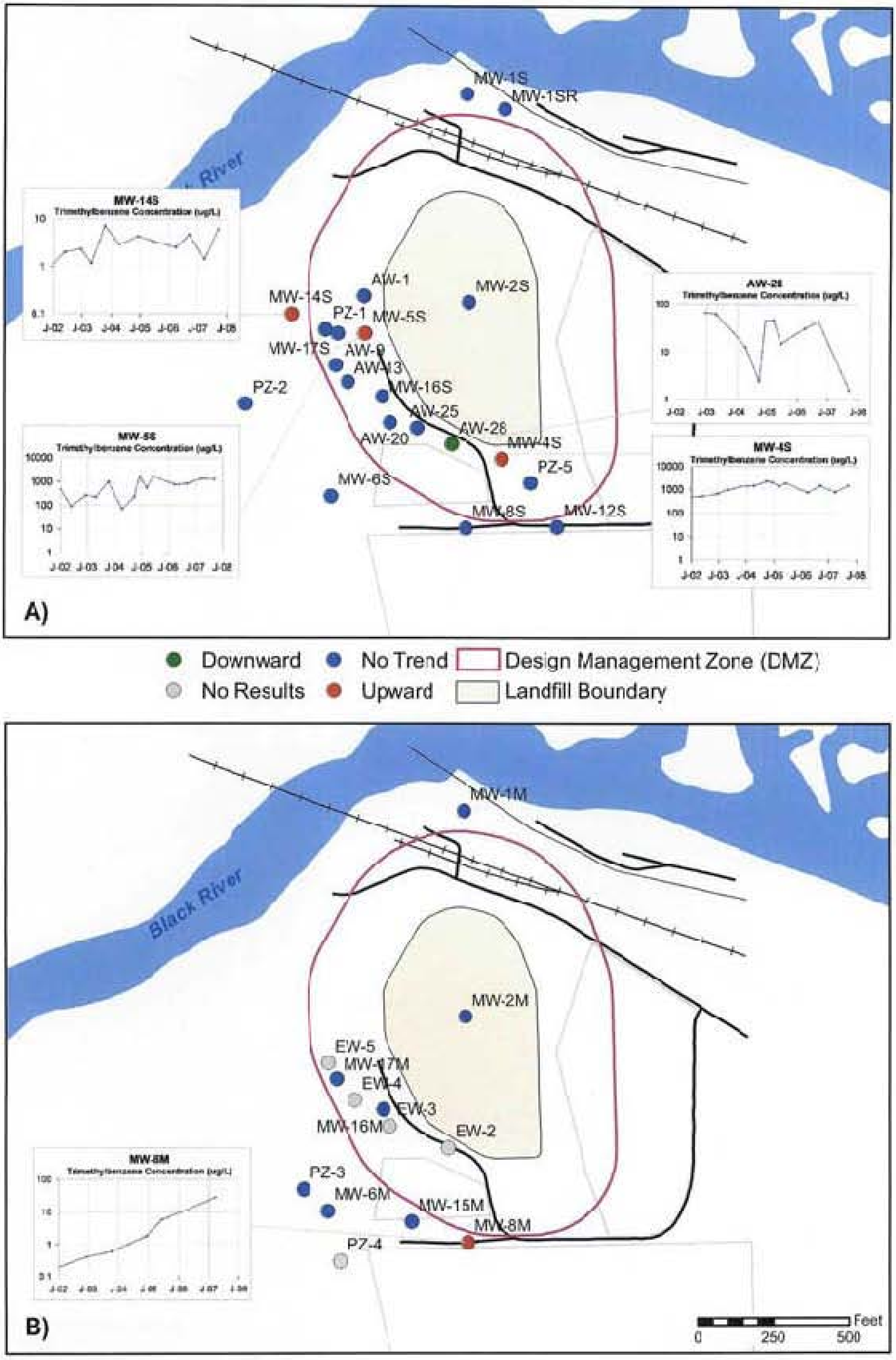


Figure 10 Total Trimethylbenzenes Concentration Trends from PAM analysis for the A) Shallow Wells and B) Medium-Depth Wells

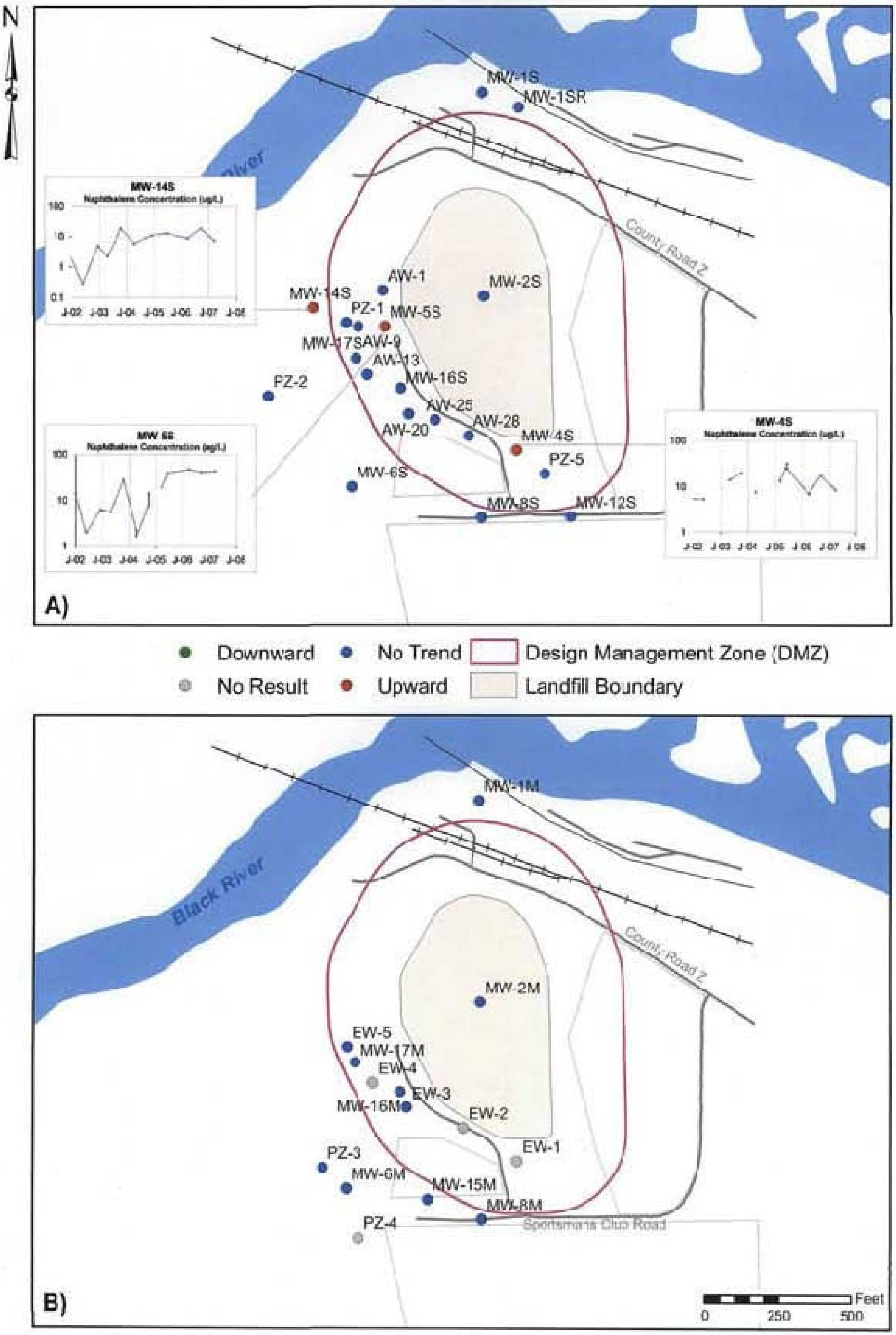


Figure 11 Naphthalene Concentration Trends from PAM analysis for the A) Shallow Wells and B) Medium-Depth Wells

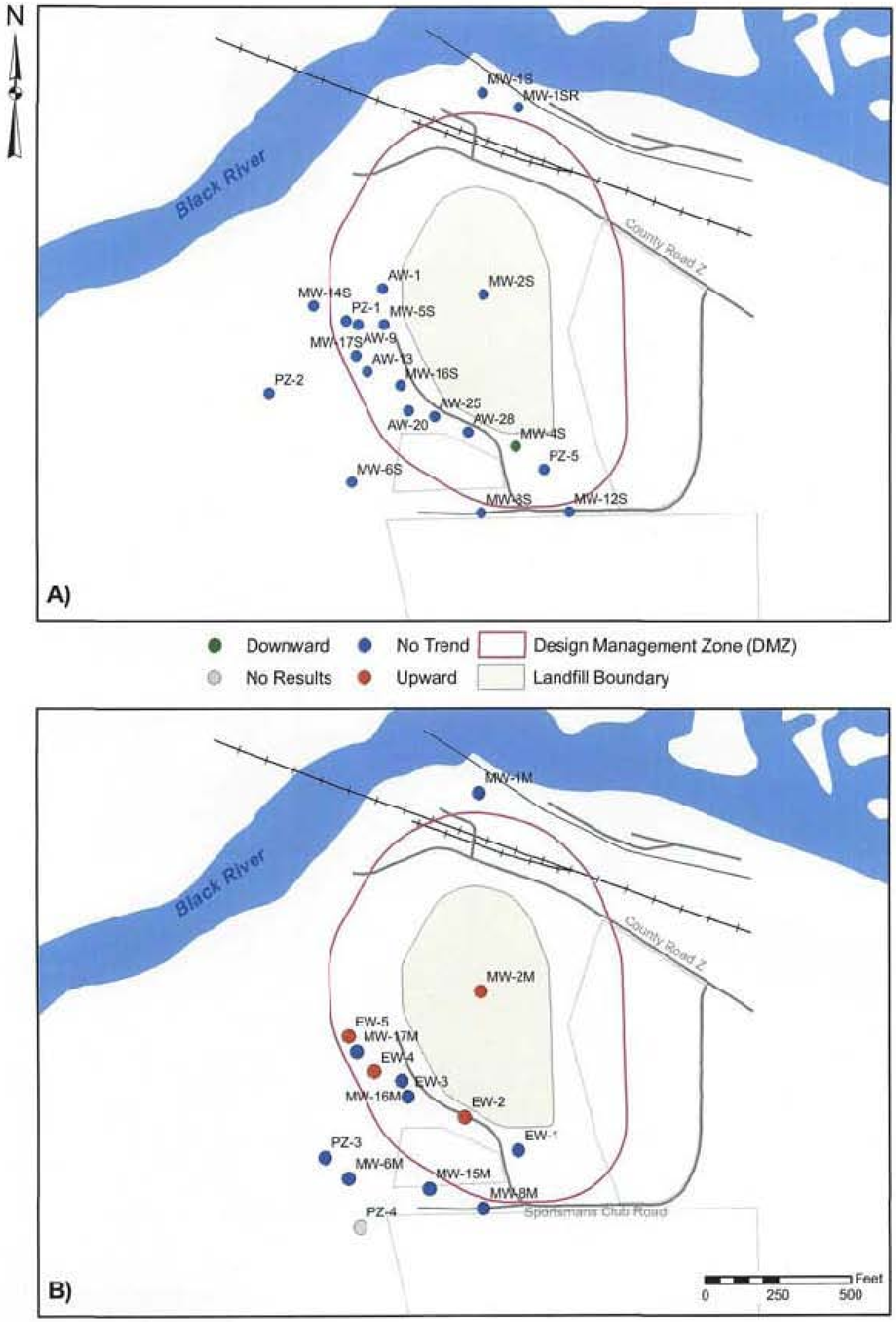


Figure 12 Dissolved Arsenic Concentration Trends from PAM analysis for the A) Shallow Wells and B) Medium-Depth Wells

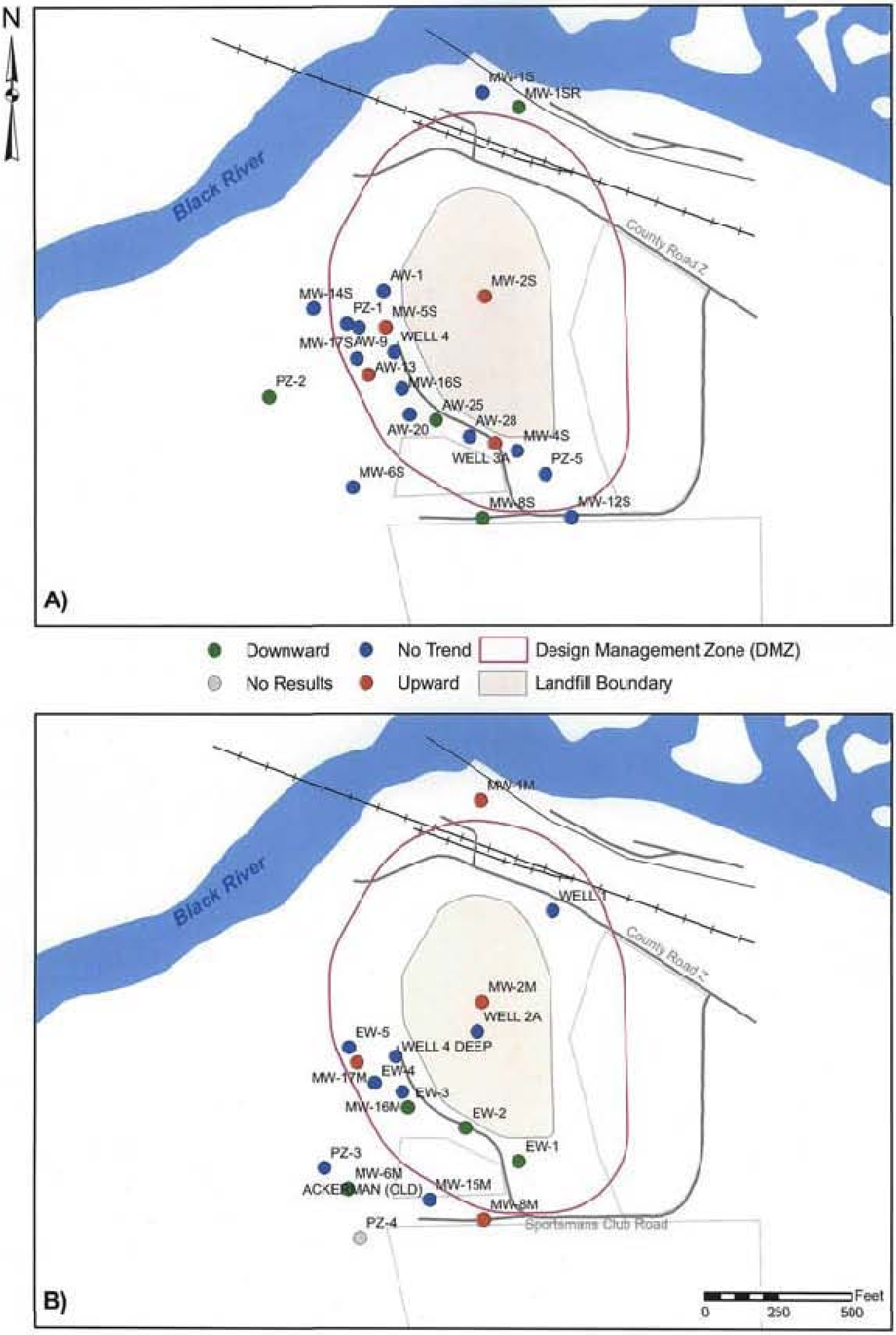


Figure 13 Dissolved Barium Concentration Trends from PAM analysis for the A) Shallow Wells and B) Medium-Depth Wells

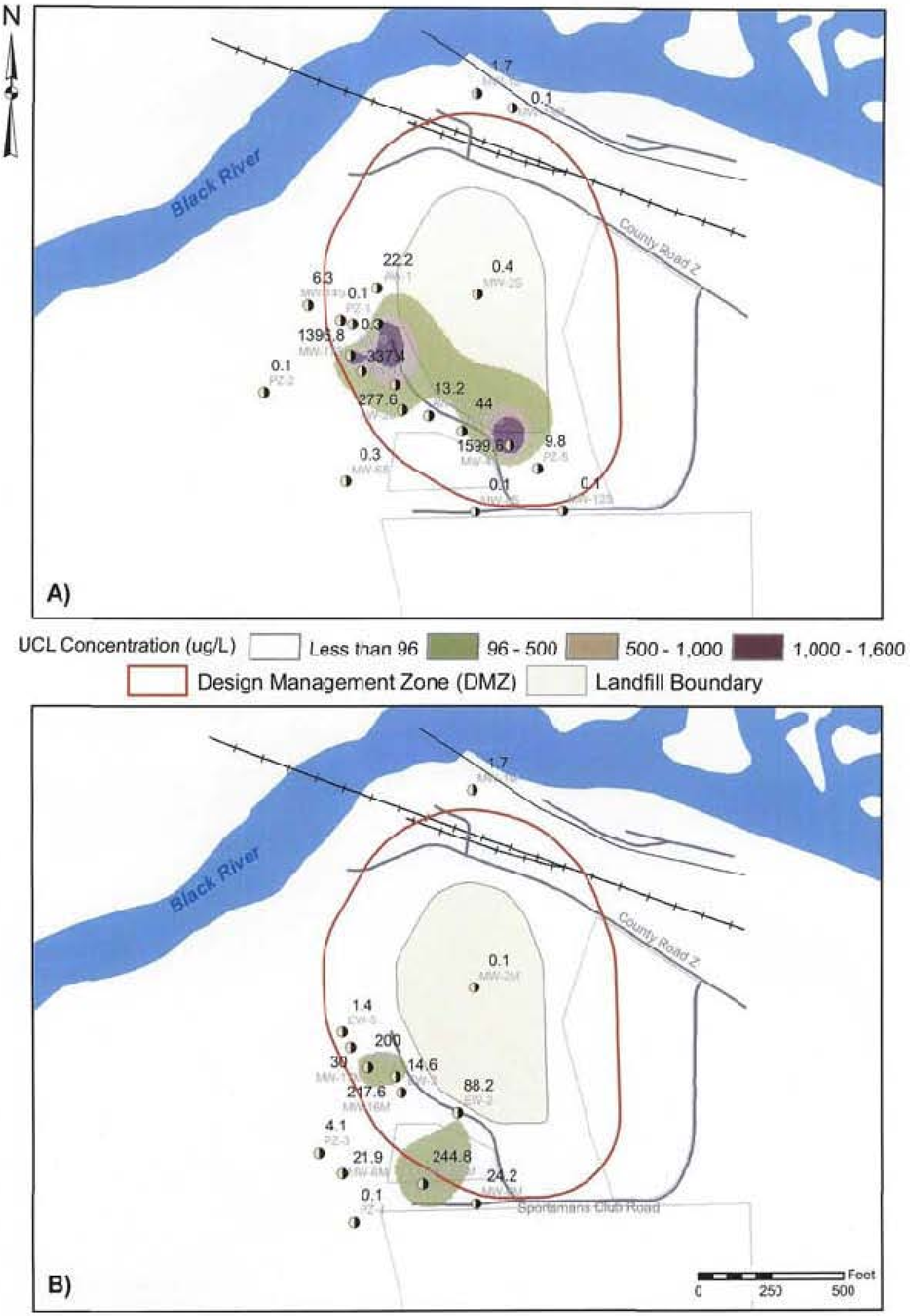


Figure 14 Map of UCL Target Zones for Total Trimethylbenzenes at A) Shallow Wells and B) Medium-Depth Wells

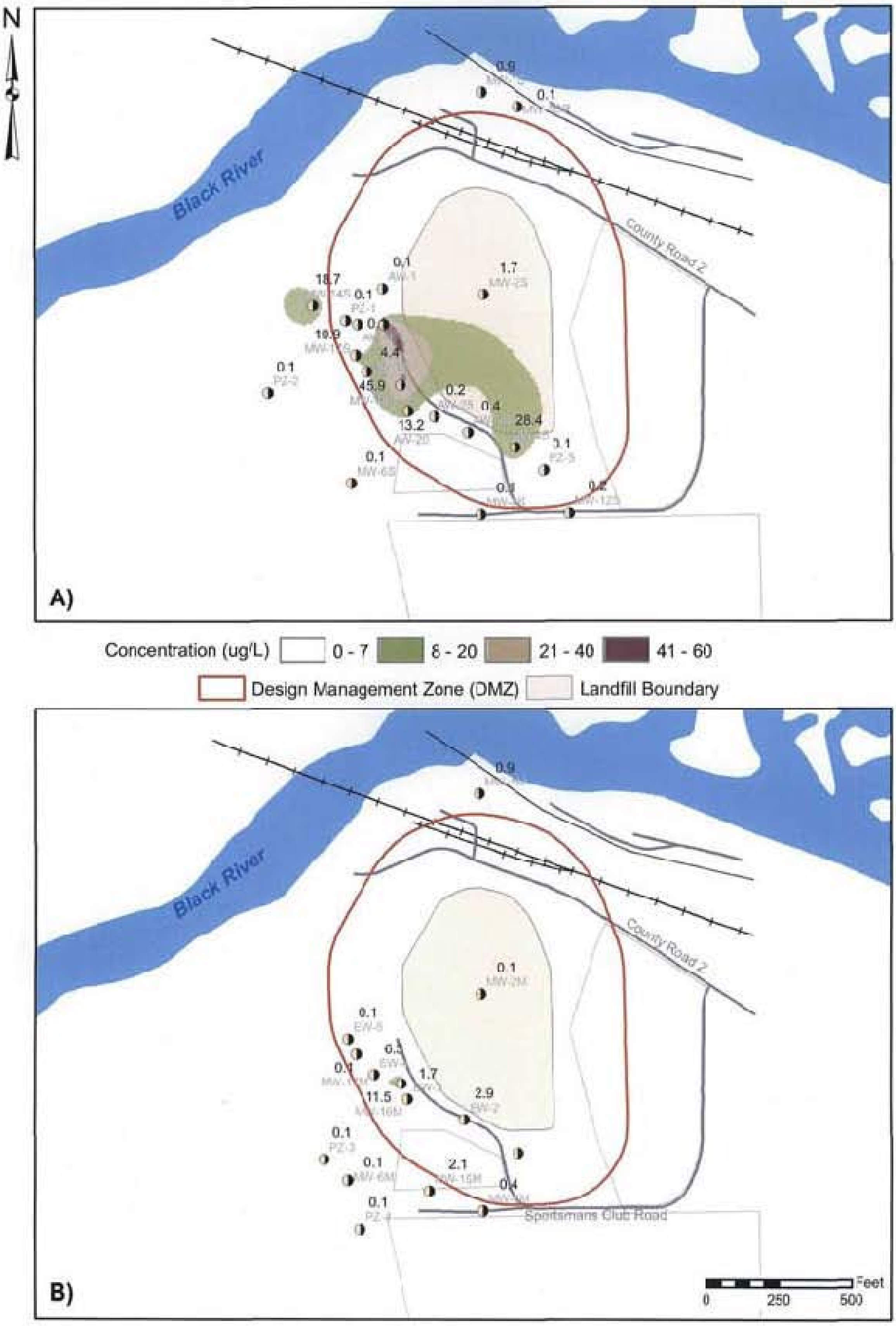


Figure 15 Map of UCL Target Zones for Naphthalene at A) Shallow Wells and B) Medium-Depth Wells

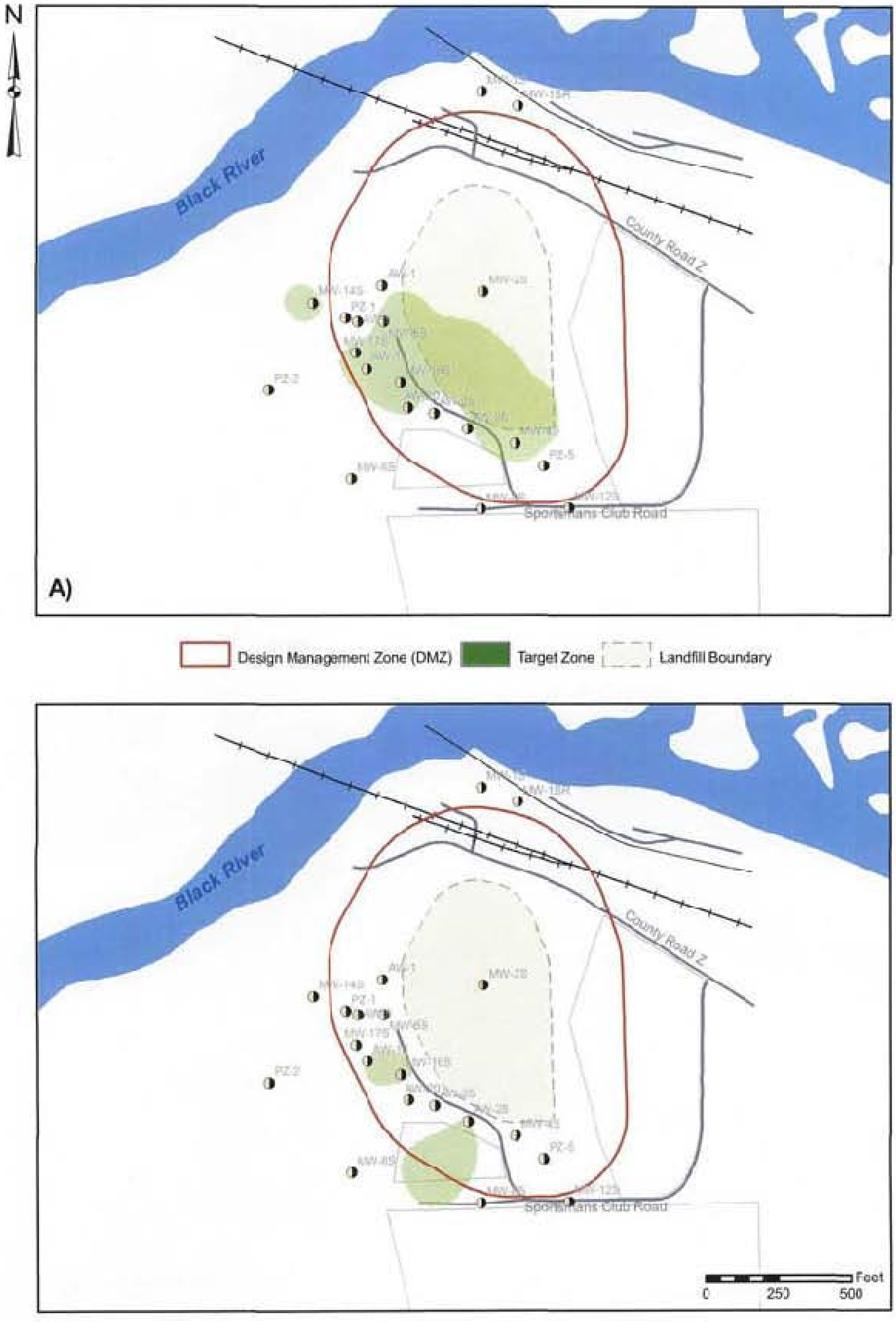


Figure 16 Map of Combined VOC UCL Target Zones for the A) Shallow Wells and B) Medium-Depth Wells

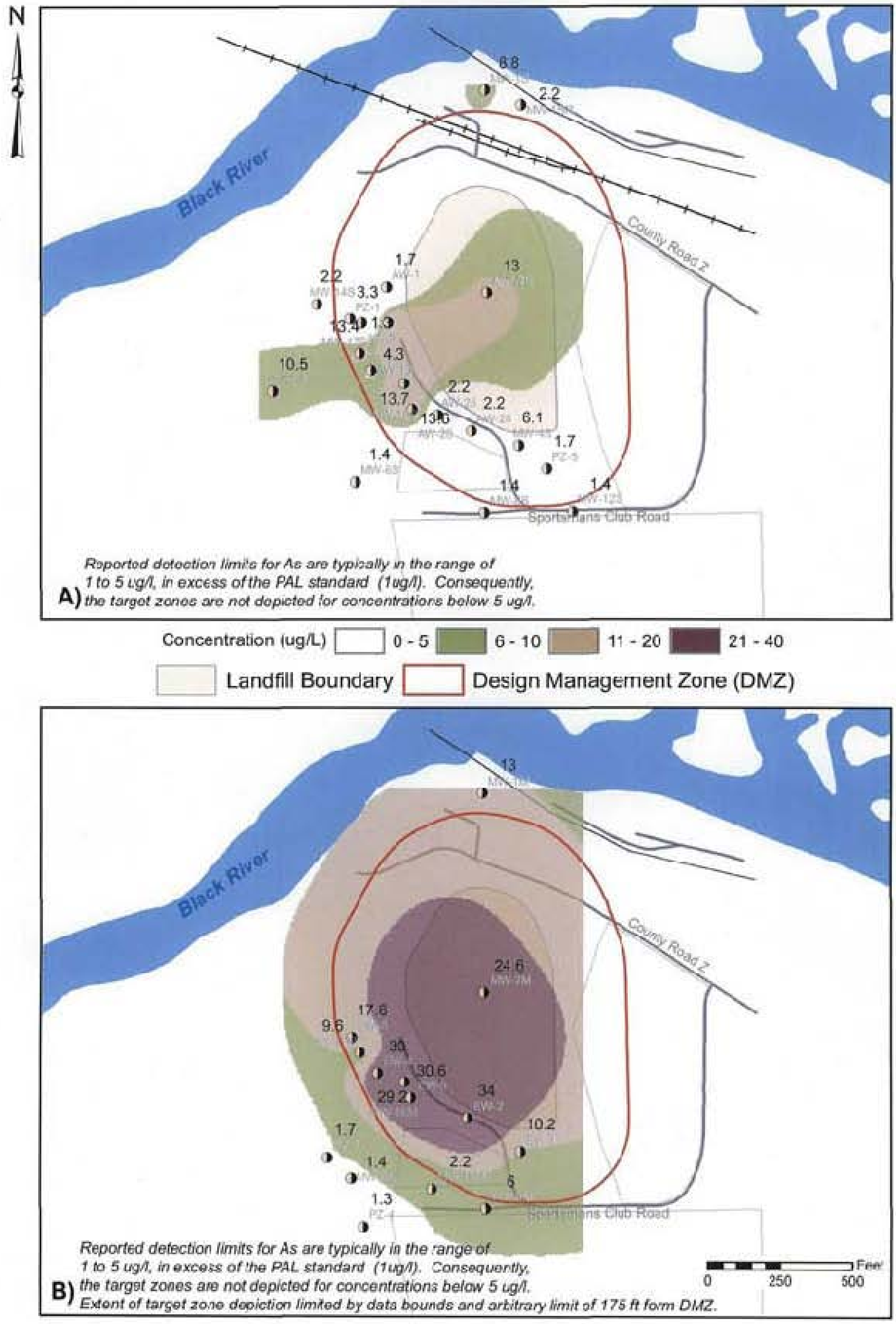


Figure 17 Map of UCL Target Zones for Dissolved Arsenic at A) Shallow Wells and B) Medium-Depth Wells

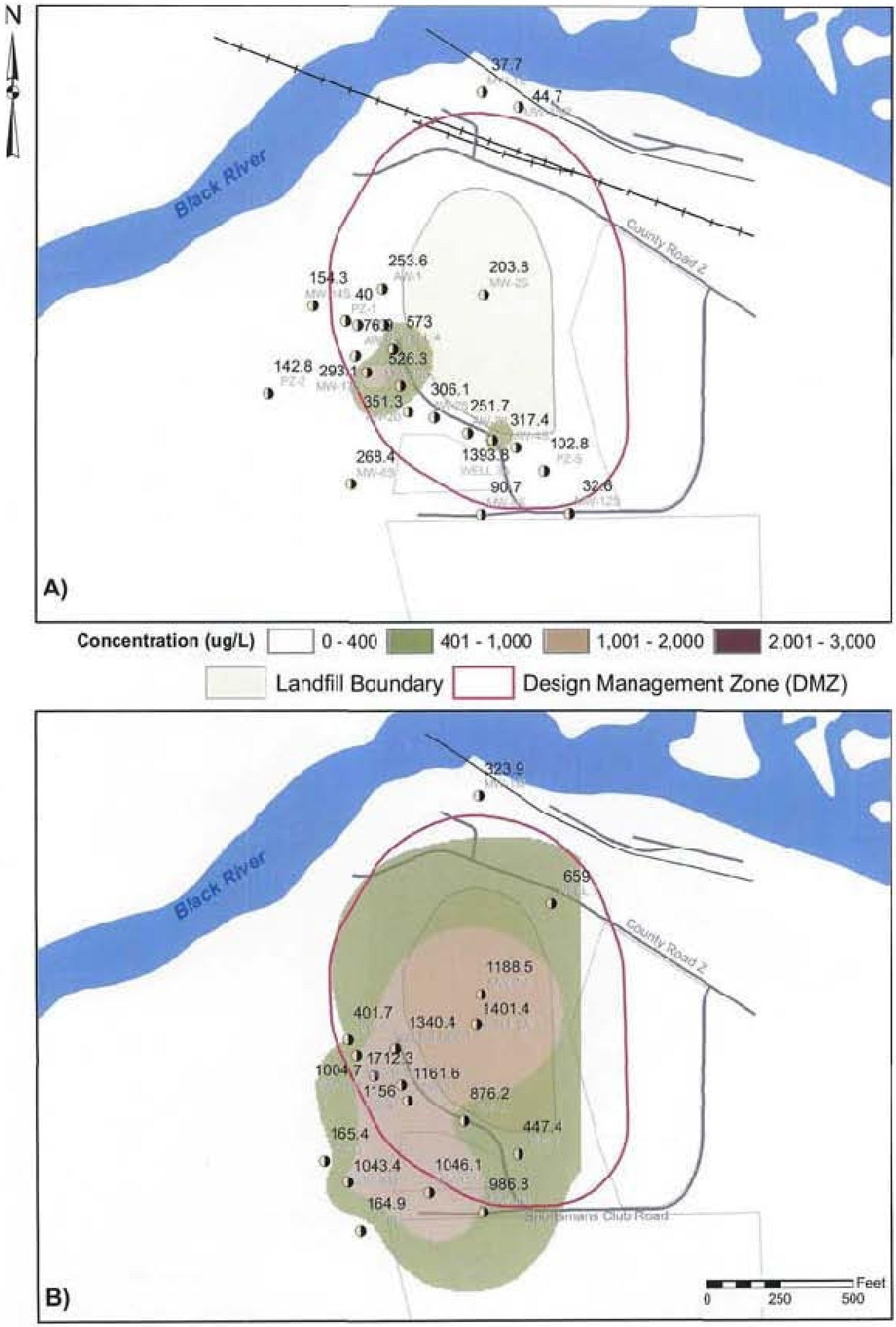


Figure 18 Map of UCL Target Zones for Dissolved Barium at A) Shallow Wells and B) Medium-Depth Wells

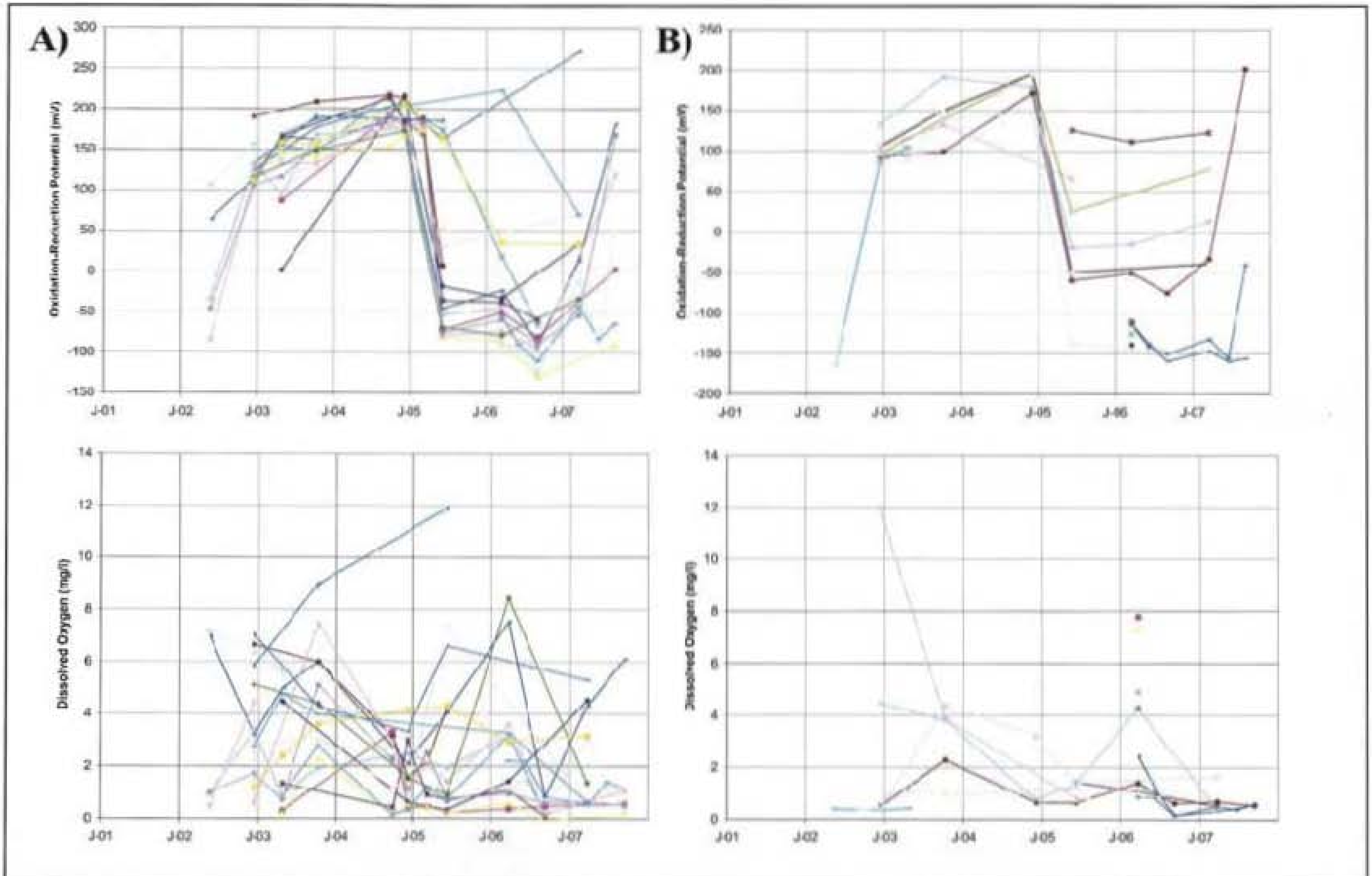


Figure 19 Oxidation-Reduction Potential (ORP) and Dissolved Oxygen in a) Shallow Monitoring Wells, and B) Medium-Depth Wells

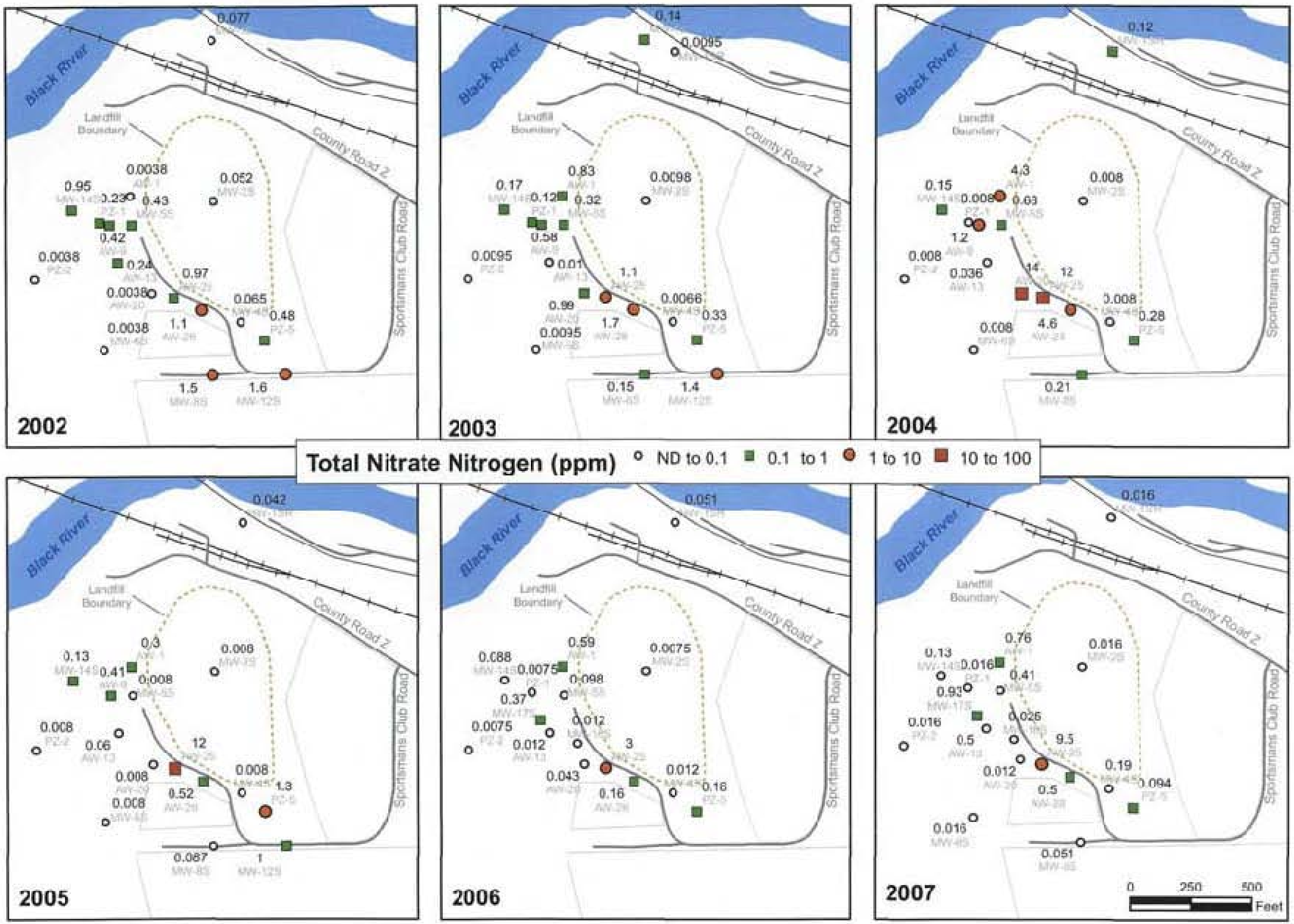


Figure 20 Nitrate Concentrations in Shallow Wells

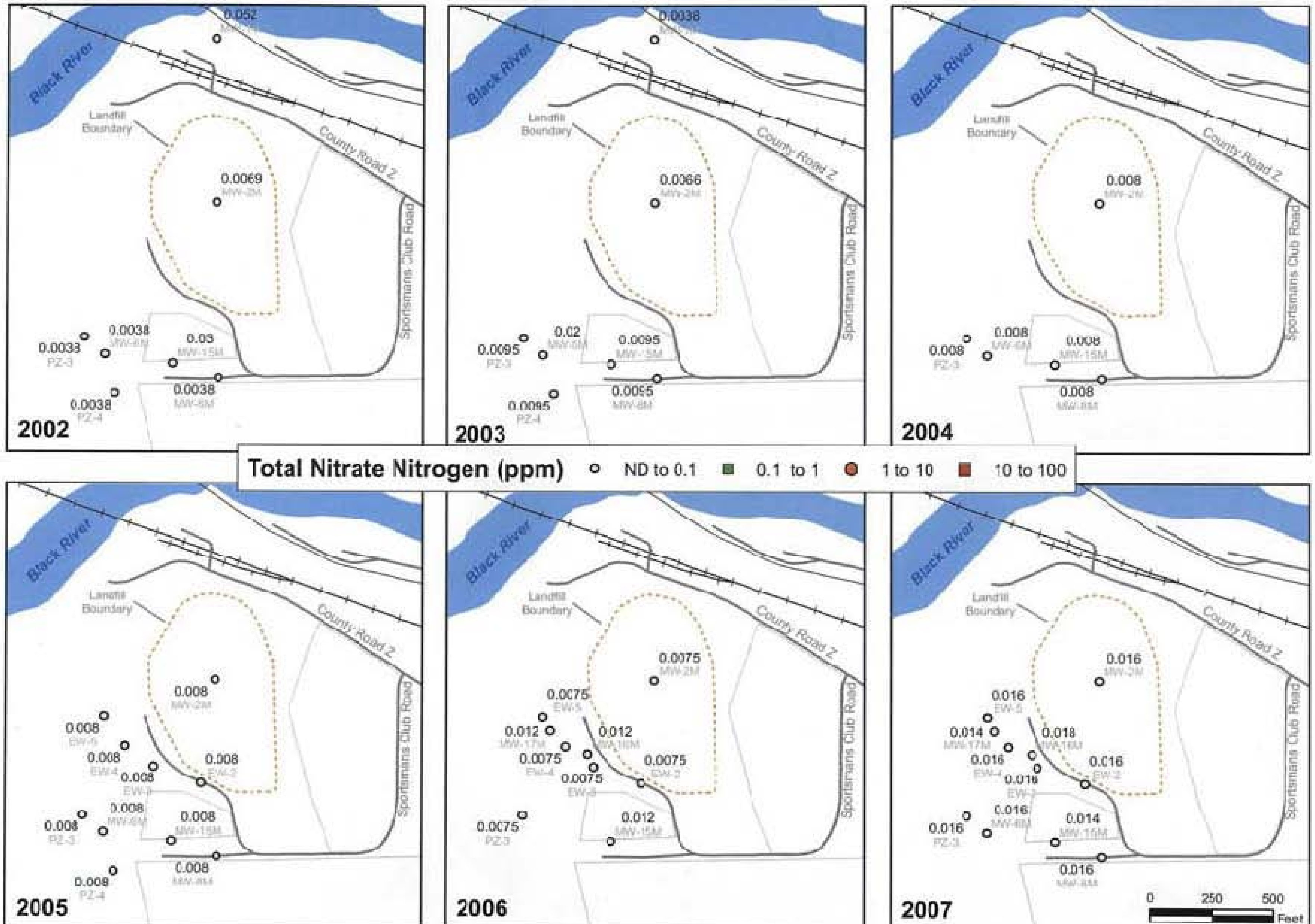


Figure 21 Nitrate Concentrations in Medium-Depth Wells

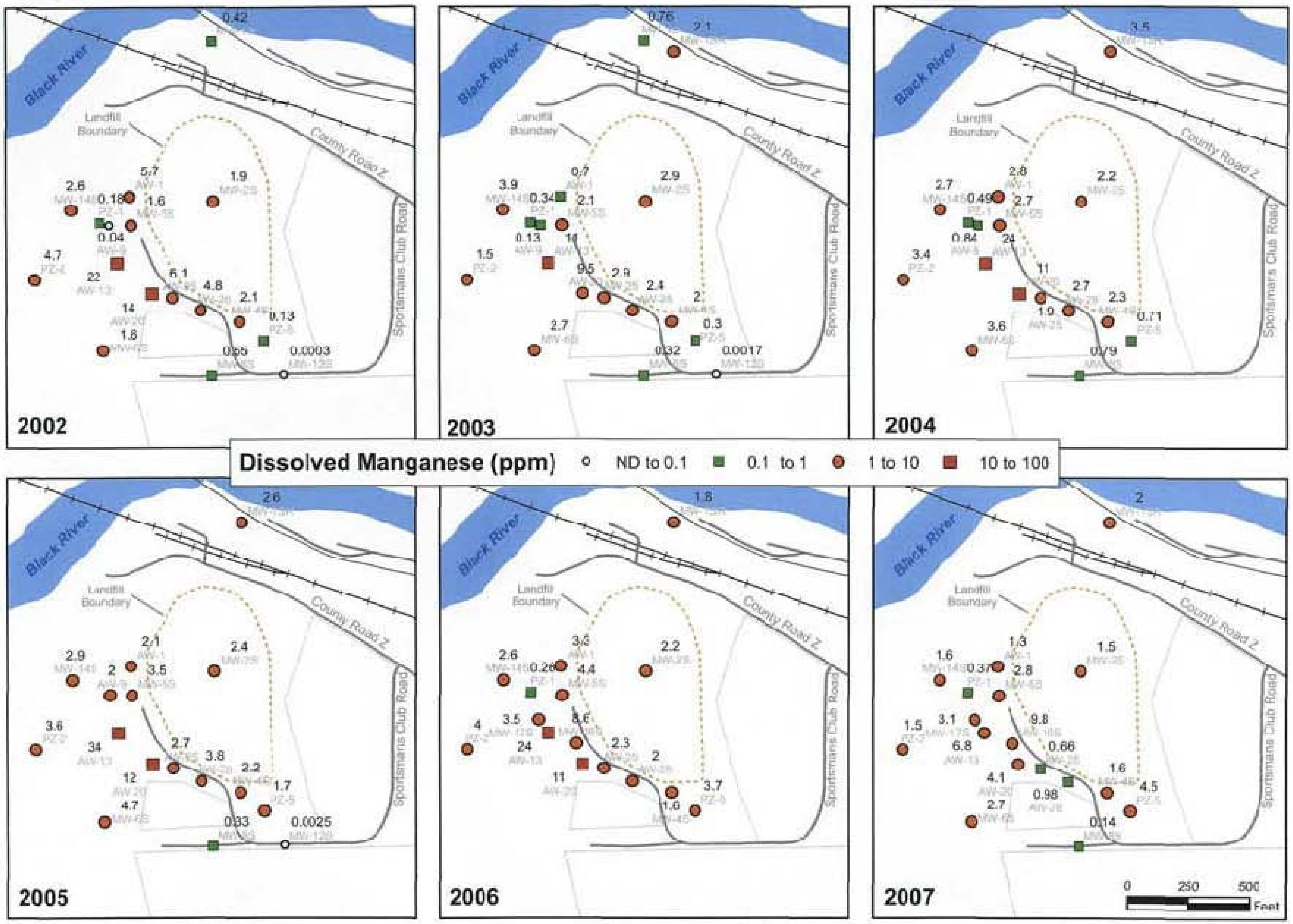


Figure 22 Dissolved Manganese Concentrations in Shallow Wells

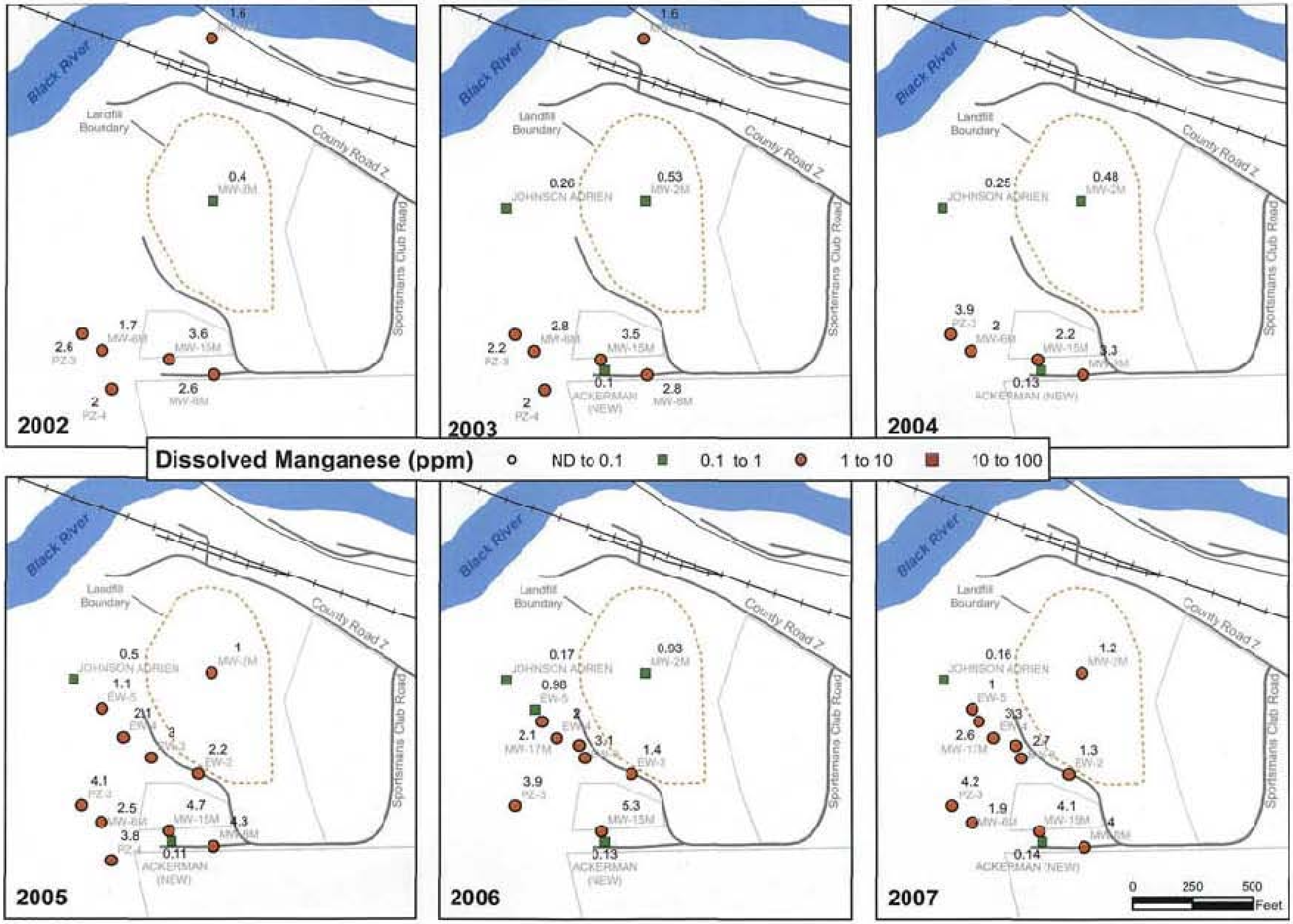


Figure 23 Dissolved Manganese Concentrations in Medium-Depth Wells

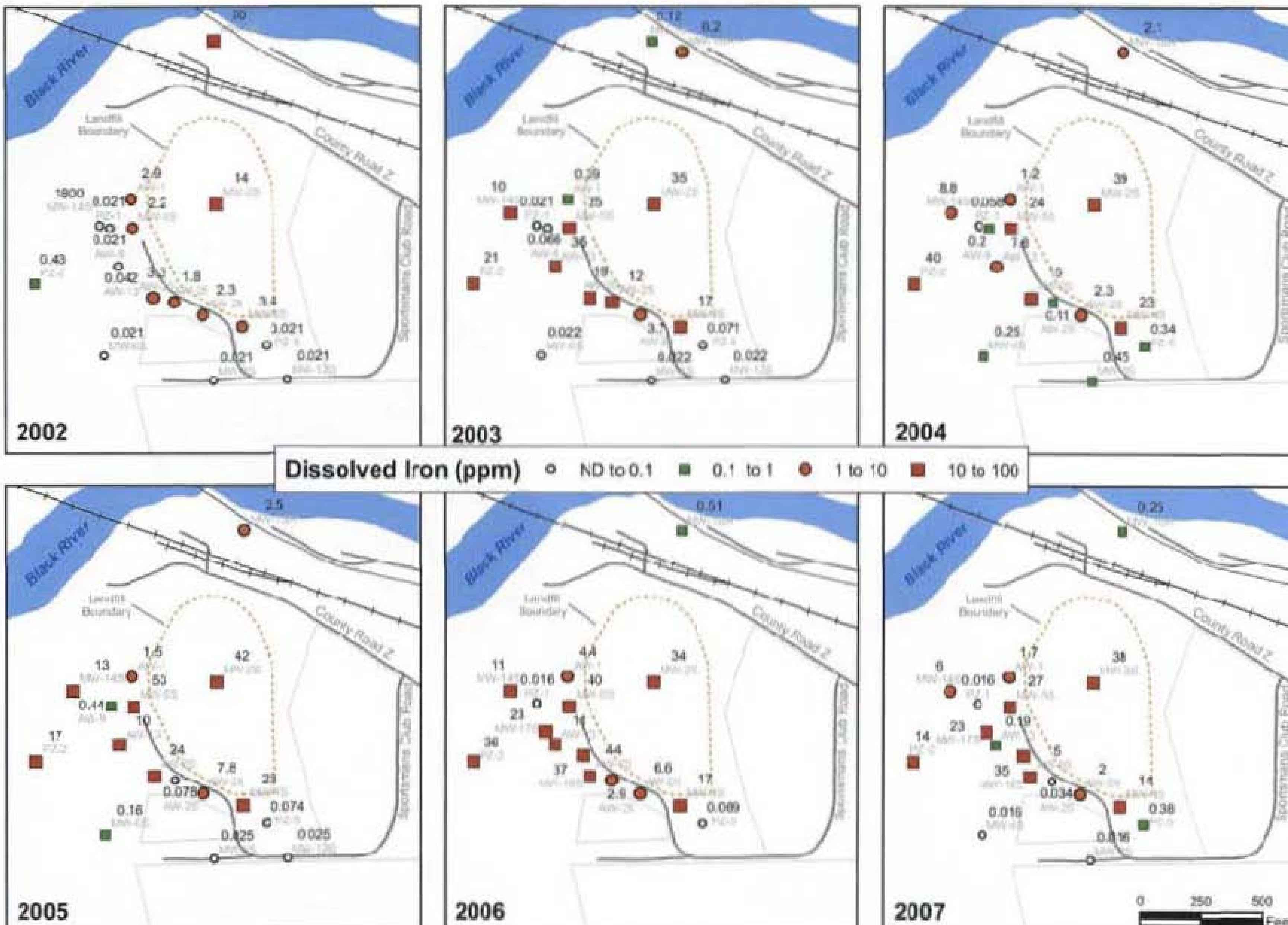


Figure 24 Dissolved Iron Concentrations in Shallow Wells

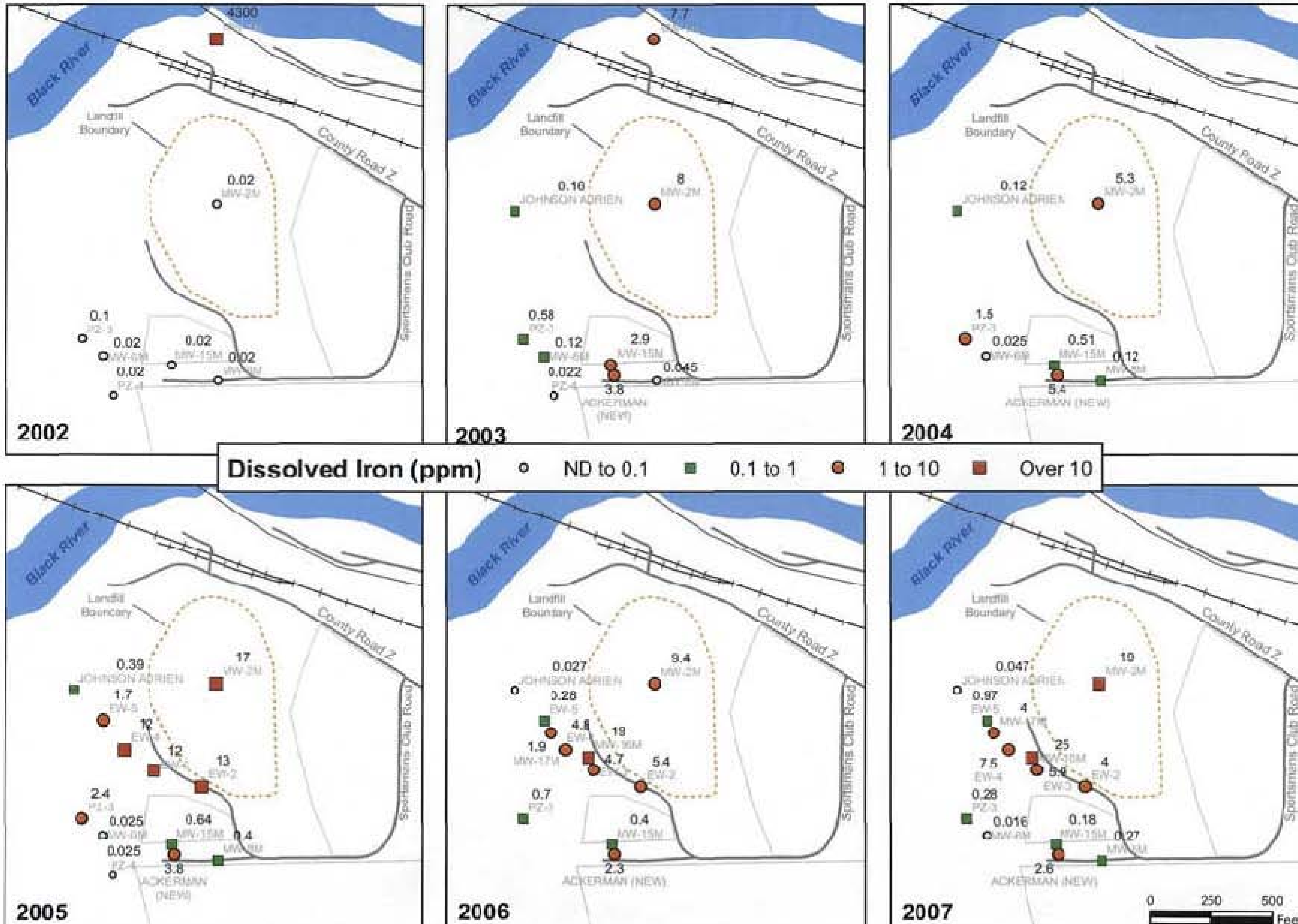


Figure 25 Dissolved Iron Concentrations in Medium-Depth Wells

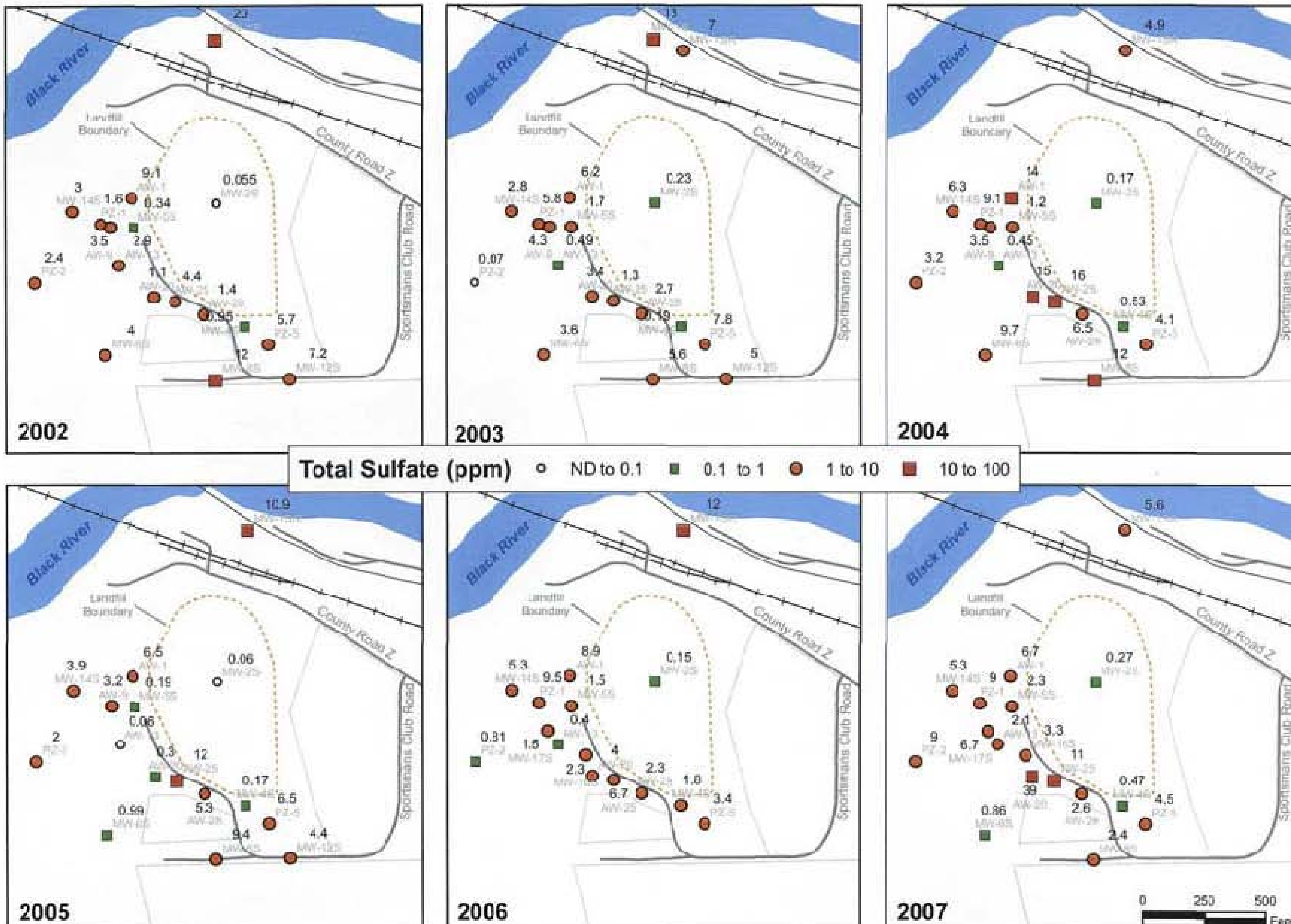


Figure 26 Sulfate Concentrations in Shallow Wells

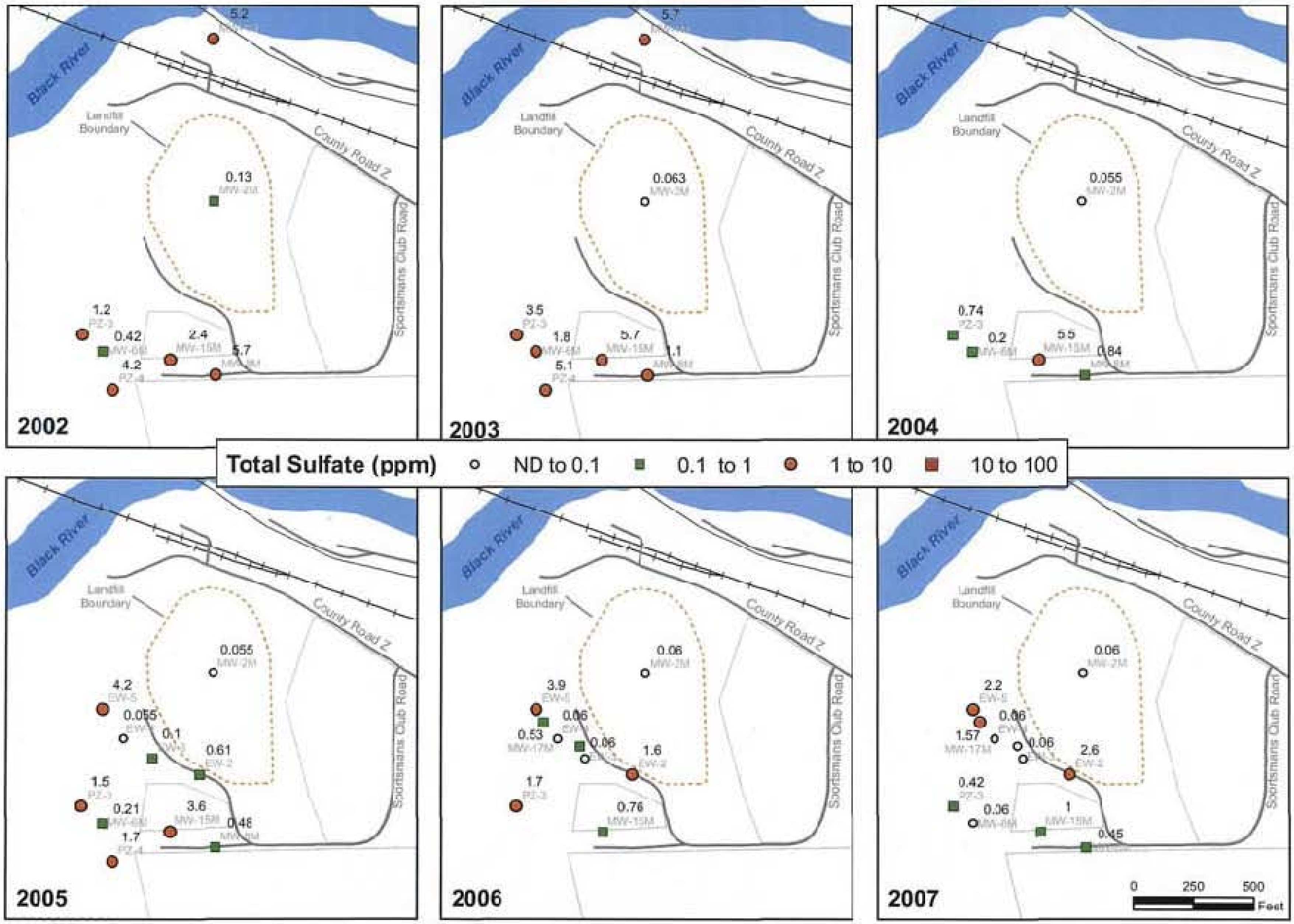


Figure 27 Sulfate Concentrations in Medium-Depth Wells

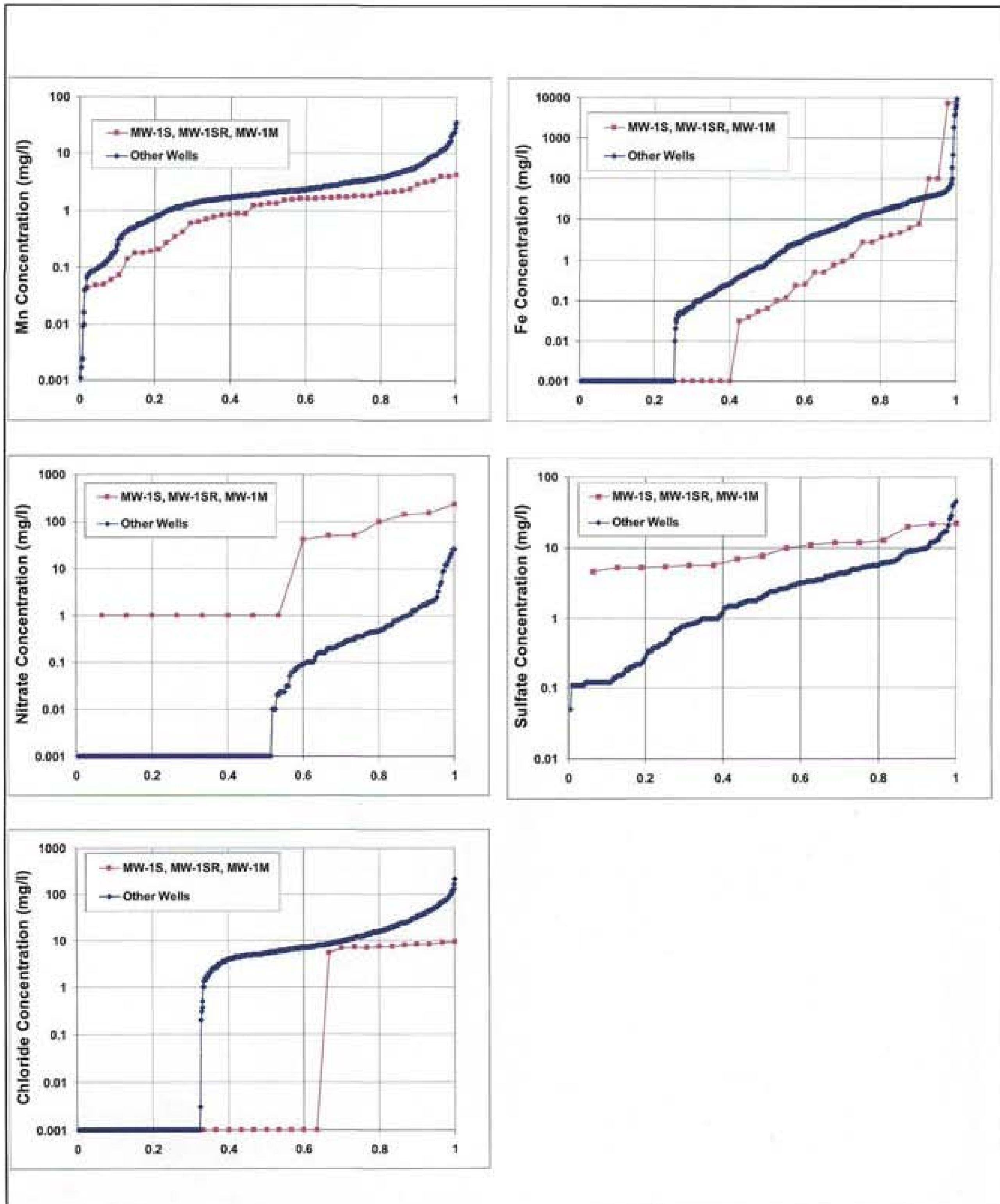


Figure 28 Cumulative Frequency Diagrams for MNA Parameters

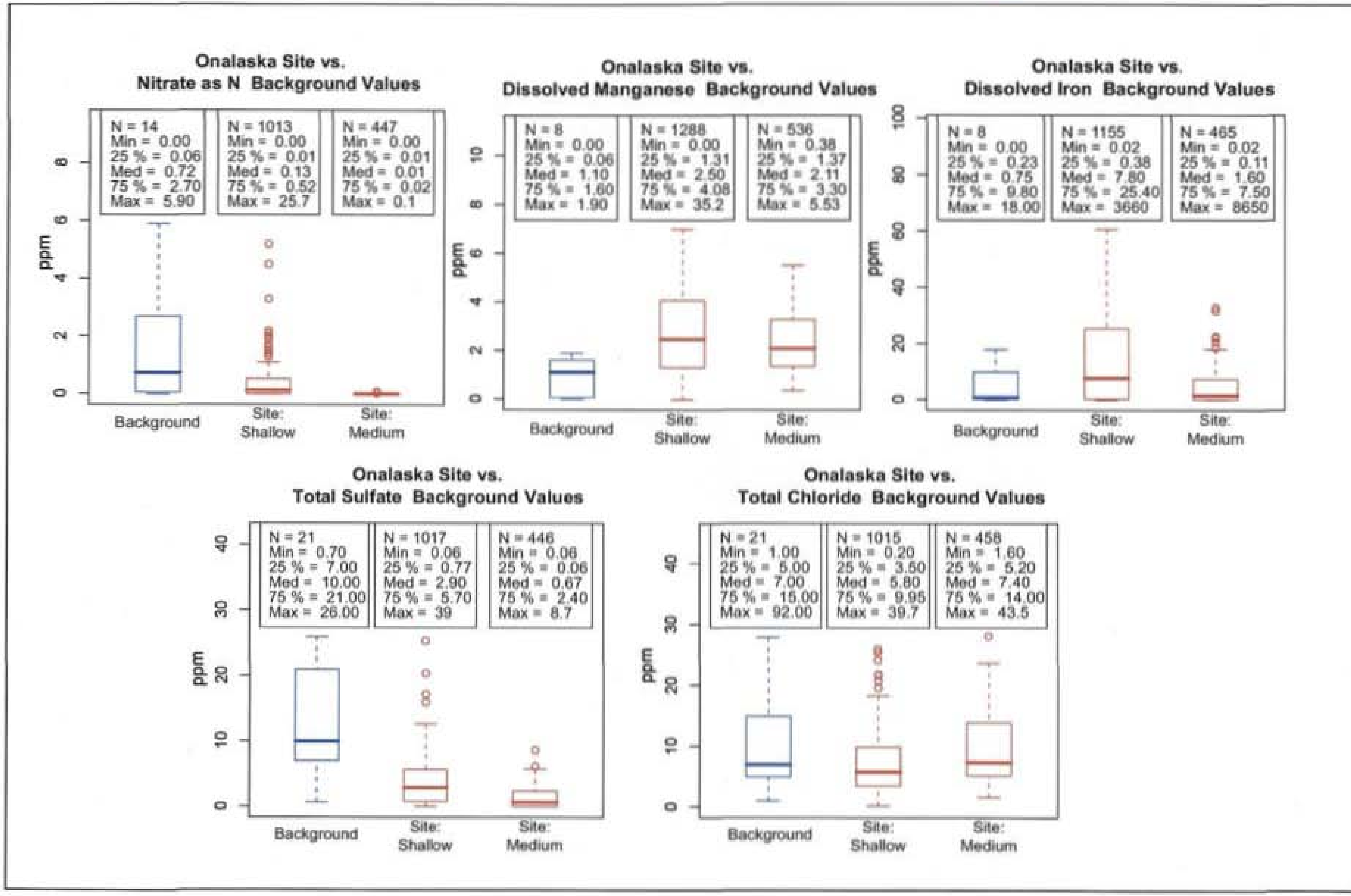


Figure 29 Comparison of Site Data to background Values in the Black River Watershed, Sand and Gravel Aquifer

TABLES

Table 1 Contaminants of Concern and Cleanup Standards

Contaminants	Wisconsin NR140 PAL [ug/L][1]	Wisconsin NR140 ES [ug/L]	Federal MCL [ug/L]
Organic Contaminants			
BTEX			
Benzene	0.5	5	5
Ethylbenzene	140	700	700
Toluene	200	1,000	1,000
Total Xylenes	1000	10,000	10,000
Chlorinated VOC[2]			
1,1-Dichloroethane	85	850	N.A.[3]
1,1-Dichloroethene	0.7	7	7
1,1,1-Trichloroethane	40	200	200
Cis-1,2-Dichloroethene	7	70	70
Trans-1,2-Dichloroethene	20	100	100
Trichloroethene	0.5	5	5
Tetrachloroethene	0.5	5	5
Methylene Chloride	0.5	5	N.A.
Vinyl Chloride (Chloroethene)	0.02	0.2	2
Other VOC			
Sum of 1,2,4-and1,3,5-Trimethylbenzene	96	480	N.A.
Naphthalene	8	40	N.A.
Metal Contaminants			
Arsenic	1	10	10
Barium	400	2,000	2,000
Iron	150	300	N.A.
Lead	1.5	15	15
Manganese	25	50	N.A.
Cadmium	0.5	5	5
Cobalt	8	40	N.A.
Mercury	0.2	2	2
Vanadium	6	30	N.A.

Source: Table 1-1, ENSR Corporation (2007). Annual Monitored Natural Attenuation Report for the Onalaska Municipal Landfill Site, Onalaska, Wisconsin, Wisconsin Department of Natural Resources.

Notes:

1. ug/L= micrograms per liter, equivalent to parts to billion
2. VOC = Volatile Organic Compounds
3. N A.= Not applicable

Table 2 Wells with Increasing and Decreasing Concentration Trends of VOCs

Well	1,2,4 - Trimethylbenzene	1,3,5 - Trimethylbenzene	Total Trimethylbenzenes	Naphthalene
AW-20		decreasing		
AW-25	decreasing			
AW-28		decreasing	decreasing	
MW-4S	increasing	increasing	increasing	increasing
MW-5S	increasing		increasing	increasing
MW-8M	increasing		increasing	
MW-14S	increasing		increasing	increasing
MW-16S		decreasing		
MW-17S	increasing	decreasing		

Table 3 Partial List of Wastes Deposited at Onalaska Landfill

Waste	Sources
High Flash Naphtha (metal cleaning waste)	Outers/Metallics
Mineral Spirits	Outers/Metallics
Gun Oil	Outers
Gun Cleaning Solvents	Outers
Paint Residues	Outers/Metallics
Asphaltum	Outers/Metallics
Water Soluble Solvents (Okite Materials)	Outers/Metallics
Lubricating Oils	Outers/Metallics
Synthetic Lubricant (PTL-1009) (amine soap)	Continental Can
Cannery wash (99 percent water)	Continental Can
Septic Tank Sludges	Septic Tank Sludge Haulers
Animal Carcasses, Hides, Intestines	Bly Rendering Works
Animal Manure	Bly Rendering Works
Transformers	Trempealeau Electric
Entire Rendering Works Building (4 stories)	Bly Rendering Works
Insecticides (DOT, etc.)	Unknown
Beer Cooling Units	Heileman's Brewing
Beer Cans (partially full and empty)	Heileman's Brewing
Cardboard, Wood, Paper Waste	St. Francis Hospital Outers/Metallics
Plastic Waste	St. Francis Hospital
Empty Drums	Outers/Metallics
Full Drums (Naphtha and Paint Wastes)	Outers/Metallics
Tank Truck (paint wastes) (500 gal)	Outers/Metallics
Municipal Rubbish	Town or City of: Onalaska, Medary, Campbell, French Island, West Salem
Tires	Tire Haulers

Source: Table 1-2, CH2M Hill, (1989). Remedial Investigation (RI) Report. Vol 1. (SDMS# 233292)

Table 4 Exceedances of Standards, 2007 Average Concentrations

Wells Outside DMZ (Regulatory Standard is PAL)					Wells Inside DMZ (Regulatory Standard is MCL/ES)				
Analyte	Location	Depth	2007 Average* (ug/l)	PAL Std (ug/l)	Analyte	Location	Depth	2007 Average* (ug/l)	MCL/ES Std (ug/l)
Arsenic, Dissolved	PRETASKY	D	6.60	1	Arsenic, Dissolved	EW-2	M	24.20	10
Arsenic, Dissolved	MW-8M	M	5.80	1	Arsenic, Dissolved	EW-3	M	21.40	10
Arsenic, Dissolved	MILLER-JOEL		5.18	1	Arsenic, Dissolved	EW-4	M	27.20	10
Barium, Dissolved	MW-8M	M	874.00	400	Arsenic, Dissolved	EW-5	M	16.80	10
Barium, Dissolved	MW-15M	M	756.50	400	Arsenic, Dissolved	MW-16M	M	22.43	10
Barium, Dissolved	MW-6M	M	744.00	400	Arsenic, Dissolved	MW-16S	S	11.57	10
Barium, Dissolved	MILLER-JOEL		416.00	400	Arsenic, Dissolved	MW-2M	M	22.60	10
Iron, Dissolved	PZ-2	S	13,500.00	150	Arsenic, Dissolved	MW-2S	S	12.80	10
Iron, Dissolved	MILLER-JOEL		9,550.00	150	Arsenic, Dissolved	MW-17S	S	11.65	10
Iron, Dissolved	MW-14S	S	5,950.00	150	Dichloromethane	MW-16S	S	25.41	5
Iron, Dissolved	PZ-3	M	280.00	150	Dichloromethane	MW-17S	S	46.94	5
Iron, Dissolved	MW-8M	M	270.00	150	Iron, Dissolved	ACKERMAN (NEW)	D	2,640.00	300
Iron, Dissolved	MW-1SR	S	250.00	150	Iron, Dissolved	AW-1	S	1,700.00	300
Iron, Dissolved	MW-15M	M	184.50	150	Iron, Dissolved	AW-20	S	15,100.00	300
Iron, Dissolved	PRETASKY	D	170.00	150	Iron, Dissolved	AW-28	S	2,000.00	300
Manganese, Dissolved	MILLER-JOEL		6,655.00	25	Iron, Dissolved	EW-2	M	4,000.00	300
Manganese, Dissolved	PZ-3	M	4,200.00	25	Iron, Dissolved	EW-3	M	5,900.00	300
Manganese, Dissolved	MW-15M	M	4,075.00	25	Iron, Dissolved	EW-4	M	7,500.00	300
Manganese, Dissolved	MW-8M	M	3,970.00	25	Iron, Dissolved	EW-5	M	970.00	300
Manganese, Dissolved	MW-6S	S	2,720.00	25	Iron, Dissolved	MW-16M	M	25,200.00	300
Manganese, Dissolved	MW-1SR	S	2,050.00	25	Iron, Dissolved	MW-16S	S	35,066.67	300
Manganese, Dissolved	MW-6M	M	1,900.00	25	Iron, Dissolved	MW-17M	M	3,966.67	300
Manganese, Dissolved	MW-14S	S	1,625.00	25	Iron, Dissolved	MW-17S	S	23,233.33	300
Manganese, Dissolved	MW-10M	M	1,520.00	25	Iron, Dissolved	MW-2M	M	18,700.00	300
Manganese, Dissolved	PZ-2	S	1,510.00	25	Iron, Dissolved	MW-2S	S	37,900.00	300
Manganese, Dissolved	PRETASKY	D	1,490.00	25	Iron, Dissolved	MW-4S	S	14,100.00	300
Manganese, Dissolved	JOHNSON ADRIEN		157.40	25	Iron, Dissolved	MW-5S	S	26,850.00	300
Manganese, Dissolved	MW-8S	S	135.00	25	Iron, Dissolved	PZ-5	S	380.00	300
Naphthalene	MW-14S	S	11.75	8	Manganese, Dissolved	ACKERMAN (NEW)	D	140.00	50
					Manganese, Dissolved	AW-1	S	1,320.00	50
					Manganese, Dissolved	AW-13	S	6,850.00	50
					Manganese, Dissolved	AW-20	S	4,080.00	50
					Manganese, Dissolved	AW-25	S	656.50	50
					Manganese, Dissolved	AW-28	S	977.00	50
					Manganese, Dissolved	EW-2	M	1,270.00	50
					Manganese, Dissolved	EW-3	M	2,670.00	50
					Manganese, Dissolved	EW-4	M	3,310.00	50
					Manganese, Dissolved	EW-5	M	1,030.00	50
					Manganese, Dissolved	MW-16M	M	1,495.00	50
					Manganese, Dissolved	MW-16S	S	9,796.67	50
					Manganese, Dissolved	MW-17M	M	2,603.33	50
					Manganese, Dissolved	MW-17S	S	3,093.33	50
					Manganese, Dissolved	MW-2M	M	1,170.00	50
					Manganese, Dissolved	MW-2S	S	1,490.00	50
					Manganese, Dissolved	MW-4S	S	1,560.00	50
					Manganese, Dissolved	MW-5S	S	2,820.00	50
					Manganese, Dissolved	PZ-1	S	371.00	50
					Manganese, Dissolved	PZ-5	S	4,460.00	50
					Trimethylbenzenes - Combined	MW-17S	S	907.00	480
					Trimethylbenzenes - Combined	MW-4S	S	1,125.00	480
					Trimethylbenzenes - Combined	MW-5S	S	1,290.00	480
					Vinyl Chloride	MW-5S	S	2.10	2

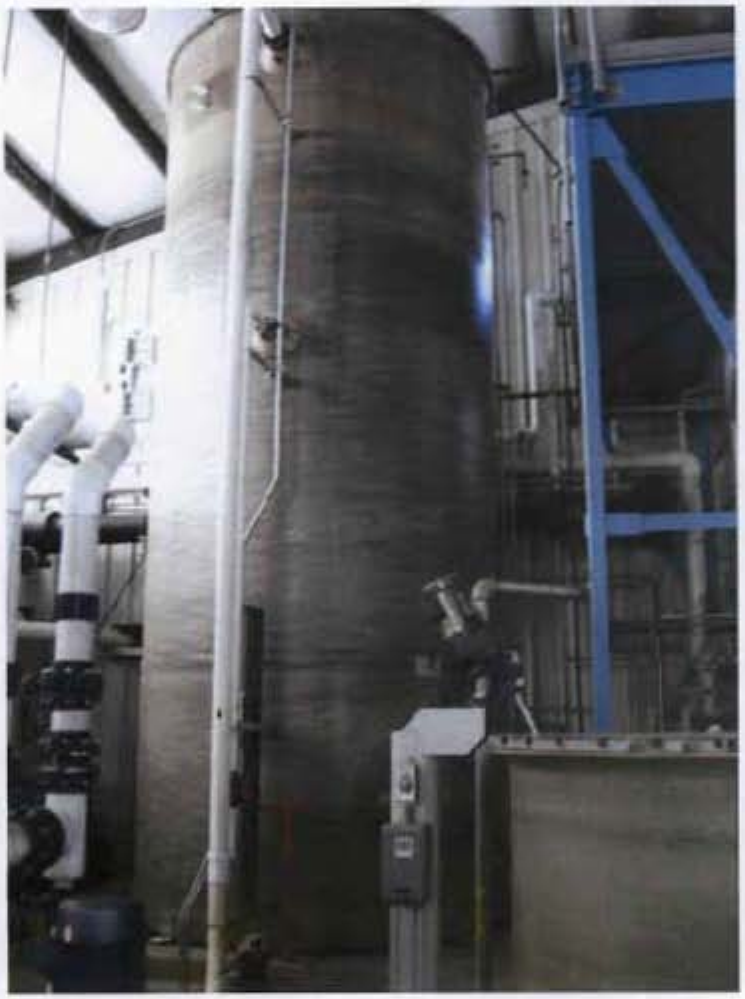
* Average calculated based upon detected value or half detection limit

ATTACHMENT 10

Photographs

Entrance to fenced remediation facility

Process Building



Sludge Holding Tank.

Diatomaceous earth filter tank

Caustic Tank

Compressor that produces air flow for the air stripping tower.

Alarm Panel

Part of electrical panel awaiting replacement of surge protector fuse. (Part on order)

One of two circuit breaker boxes.

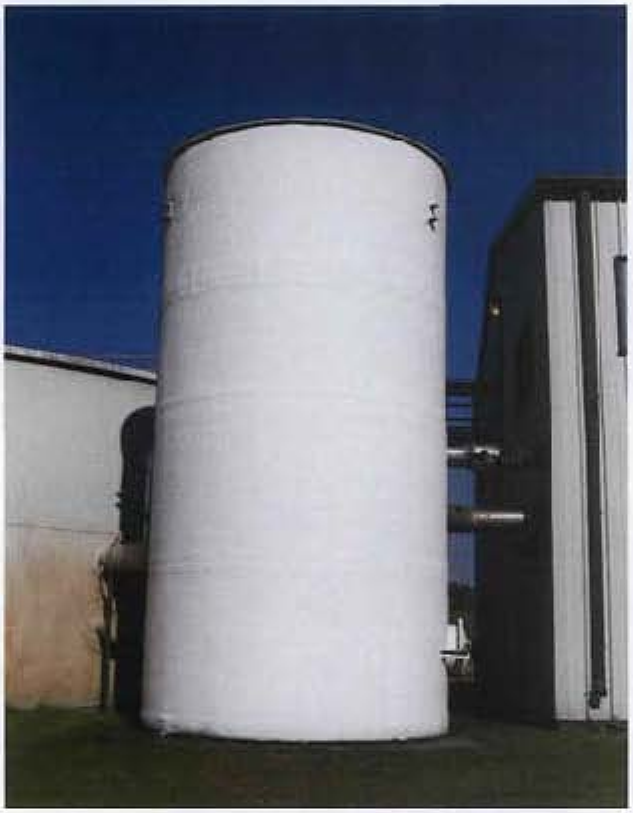
MW-5 – Protective top and new surface seal required.

Extraction Well EW-5

Back (west side) of treatment building. Clarifier tank at left and aerator tank at center.

Monitoring wells MW-17S and MW-17M.

Air Stripping Tower



Aerator Tank where air is injected prior to the water being pumped to the clarifier .

Groundwater Extraction Well EW-4

Air Injection Well

Passive Gas Vent Well
on Landfill Cap

Edge of Landfill Cap

MW-4S

Markings for desired easement for driveway to Prinsen Property at southern part of site.

Monitoring Well PZ-5

Monitoring Well
MW-12S

Monitoring Well Nest
MW-8S, MW-8M &
MW-8D

Monitoring Well Nest
MW-6S & MW-6M

Johnson Supply Well

Landfill Cap, Facing North, Monitoring Well Nest MW-2S, MW-2M and MW-2D in Center
Cap was recently mowed to facilitate inspection.

Sampling Port of
Landfill Passive Gas
Vent

Landfill Cap, Facing North, slight depression with no signs of water ponding.

Case Study of Monitored Natural Attenuation of Dissolved Chlorinated Hydrocarbons at a Former Railroad Maintenance Facility, Sanford, Florida

Locomotive and wheel maintenance activities resulted in the release of chlorinated solvents to soil and groundwater. An interim remedial action was performed, including the removal of 6,700 gallons of liquid and sludge from the maintenance pits, and the excavation of 6,000 tons of impacted soil. Twenty-five monitoring wells were sampled in the shallow water-bearing unit and analyzed for volatile organic compounds (VOCs). The primary chlorinated hydrocarbons detected were perchloroethene (PCE), trichloroethene (TCE), cis-1,2- dichloroethene (cis-1,2-DCE) and vinyl chloride (VC). Total chlorinated VOC concentrations ranged from <1 microgram per liter (μg/L) to 64 μg/L, and the maximum concentration of vinyl chloride (64 μg/L) indicated natural attenuation was occurring. A total of six wells in the upgradient, downgradient, lateral and source-area locations were also analyzed for natural attenuation parameters (general chemistry and hydrocarbon gases). The results indicate that PCE, TCE, cis-1,2-DCE and VC are naturally attenuating, and VC is degrading to ethane and ethene under reducing conditions. Anaerobic conditions for reductive dechlorination are evident in the affected area through denitrification, methanogenesis, sulfanogenesis, and ferric iron reduction. Natural attenuation is further being enhanced by relatively high alkalinity and a suitable pH range. Subsequent monitoring has been reduced to the six wells and monitoring results confirm that natural attenuation is continuing.

Historical locomotive and wheel maintenance activities using limited amounts of chlorinated solvents resulted in the release of contaminants to soil and groundwater. The source of contamination was determined to be in an area where locomotives were repaired, and spent solvents, water and sludges collected in concrete lined maintenance pits. The site is underlain by approximately 15 feet of fine-grained sand with small amounts of silt. A five-foot clayey sand aquitard separates the upper surficial water bearing zone from an intermediate water bearing zone. The depth to groundwater is approximately five feet. The shallow groundwater flows to the south.

In 1995, an interim remedial action was performed, including the removal of 6,700 gallons of liquid and 825 gallons of sludge from the maintenance pits, and the excavation of 6,000 tons of impacted soil. The concentrations of PCE in the soil ranged from <5.0 micrograms per kilogram (μg/Kg) to 1,000 μg/kg, concentrations of TCE ranged from <5.0 μg/Kg to 60 μg/Kg, concentrations of cis-1,2-DCE ranged from <5.0 μg/Kg to 5,400 μg/Kg, and VC was not detected in any soil sample.

In 1994, 15 monitoring wells were sampled to determine the shallow groundwater quality. The initial concentration of PCE ranged from <1.0 μg/L to 160 μg/L, TCE ranged from <1.0 μg/L to 23 μg/L, cis-1,2-DCE ranged from <1.0 μg/L to 19 μg/L, and VC ranged from <1.0 μg/L to 7.2 μg/L. Further assessment and monitoring of VOCs continued to evaluate shallow groundwater quality continued over the next several years. In general, the VOCs appeared to be naturally attenuating and compounds were only detected in a limited number of wells.

In December 1999, VOCs were only detected in groundwater samples from six of the 25 shallow monitoring wells when sampling for monitored natural attenuation parameters began. Detectable concentrations of PCE ranged from 2.1 μg/L to 47 μg/L, TCE ranged from 1.2 μg/L to 6.9 μg/L, cis-1,2-DCE ranged from 1.2 μg/L to 8.3 μg/L, and VC ranged from 1.7 μg/L to 64 μg/L.

A total of six wells in the upgradient (MW-29), downgradient (MW-32), lateral (MW-28) source-area (MW-25 and MW-27R) and flow path (MW-33) locations were also analyzed for natural attenuation parameters including permanent gases (oxygen, carbon dioxide, hydrogen chloride, and nitrogen), light hydrocarbon gases (methane, ethane and ethylene), and anion and cations (alkalinity, ferrous iron II, nitrate, nitrite, sulfate, sulfide, soluable organic carbon and iron). Field measurements of dissolved oxygen, redox potential, pH and temperature were also obtained. The wells were subsequently sampled in May and December 2000.

The results of the three sampling events indicate that PCE, TCE, cis-1,2-DCE and VC are naturally attenuating and VC is degrading to ethane and ethene under reducing conditions. Anaerobic conditions for reductive dechlorination are evident in the affected area through denitrification, methanogenesis, sulfanogenesis and ferric iron reduction. Natural attenuation is further being enhanced by relatively high natural alkalinity and a suitable natural pH range.

<u>December 1999 Groundwater Quality Results</u>

The process of reductive dechlorination requires an appropriate source of carbon for microbial growth to occur. Sufficient concentrations [>20 milligrams per liter (mg/L)] of anthropogenic carbon compounds have historically been detected in samples collected from MW-25R, MW-22R, MW-29, MW-32, and MW-33.

Field measurements of dissolved oxygen (DO) indicate that the area of affected groundwater was oxygen deficient at concentrations that allow reductive chlorination or oxidation of VC. The DO concentration in upgradient monitoring well MW-29 was measured at 1.4 mg/L. DO concentrations in samples from monitoring wells within (MW-25R) and downgradient (MW-32) of the area of the highest total dissolved degradation product concentrations were less than 1.1 mg/L. The DO concentration at lateral monitoring well MW-28 was 1.62 mg/L. The depletion of DO within the affected area indicated that aerobic degradation was occurring and that the anaerobic conditions needed for reductive dechlorination were present. There were corresponding elevated carbon dioxide (CO_2) concentrations within the area of affected groundwater. The CO_2 concentration at MW-25R (affected area) was 204.2 mg/L and the CO_2 concentration at MW-28 (lateral well) was 16.47 mg/L.

Sulfate was detected in samples from all monitoring wells in concentrations less than 20 mg/L and decreased along the flow path. Nitrate was detected in lateral well MW-28 at a concentration of 52 mg/L, but was not detected in MW-25R, MW-27, MW-29, MW-32, or MW-33. The depletion of sulfate and nitrate along the flow path, and in the area of highest total dissolved degradation products concentrations, is indicative of the microbially mediated processes of denitrification and sulfanogenisis occurring in the area of affected groundwater anaerobically degrading the chlorinated solvents.

Dissolved iron was detected in all samples collected at the site ranging from 0.3034 mg/L (MW-28) to 19.61 mg/L (MW-25R - affected well). Dissolved iron was detected at a concentration of 19.61 mg/L in the sample collected from MW-25R (the area of highest total dissolved degradation product concentrations). Samples from MW-27 (11.68 mg/L), MW-29 (14.04 mg/L), and MW-33 (13.0

mg/L) (potentially impacted wells) also had elevated iron concentrations in comparison to MW-28 (0.3034 mg/L) and MW-32 (1.219 mg/L), the lateral and downgradient wells, respectively. Elevated concentrations of ferrous iron II were detected in groundwater samples from MW-25R (8 mg/L), MW-27R (11 mg/L), MW-29 (13 mg/L), and MW-33 (13 mg/L). The samples from the lateral and downgradient wells, MW-28 and MW-33, respectively, were <1.0 mg/L. These data indicate that ferric iron is being reduced to ferrous iron as a result of the same anaerobic (electron rich) conditions that facilitate the reductive dechlorination of chlorinated solvents in the aquifer.

The alkalinity at the site is relatively high (66 mg/L to 160 mg/L) which is sufficient to buffer the potential changes of pH caused by biologically mediated oxidation reactions. The pH of the groundwater at the site ranges from 5.25 to 7.16. This range of pH is conducive to chlorinated hydrocarbon degrading microbes.

Methane was detected in MW-25R (the sample of the highest total dissolved degradation product concentrations) at a concentration of 4.173 mg/L and in the sample from upgradient well MW-29 (4.823 mg/L). In comparison, methane concentrations were 0.121 mg/L and 0.152 mg/L in groundwater samples from MW-28 and MW-32, the lateral and upgradient wells, respectively. Methane was also detected at MW-27R (1.801 mg/L) and MW-33 (1.995 mg/L), potentially impacted wells. Methane is produced under strongly anaerobic conditions, the same conditions that allow the reductive dechlorination of degradation products to occur.

Ethane and ethylene were detected in the sample collected from monitoring well MW-25R at concentrations of 6.719 μg/L and 27.877 μg/L. These concentrations are elevated relative to the samples collected from MW-27R, MW-28, MW-29, MW-32 and MW-33 which did not exceed 0.5 μg/L. This indicates that VC (detected at 64 μg/L in MW-25R), a daughter product of PCE and TCE, is naturally degrading.

Dissolved hydrogen concentrations ranged from 0.81 nanomolar (nM) to 3.38 nM. Concentrations ranging from 1 to 4 indicate sulfate reduction and concentrations greater than 1 nM indicate reductive dechlorination. If hydrogen concentrations are greater than 1 nM, rates of reductive dechlorination should have environmental significance and Type 1 and Type 2 behavior would be expected.

Summary

The changes in the properties of various halogenated compounds and the presence of anthropogenic carbon in groundwater strongly indicates that natural attenuation is occurring via a combined "Type 1 and Type 2 Behavior" as described in the USEPA's Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action and Underground Storage Tank Sites. The recent groundwater sampling was designed to confirm whether there is a sufficient supply of electron donors, the role of competing electron acceptors and whether VC is oxidized or reduced. Subsequent monitoring has confirmed that natural attenuation is continuing.

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FINAL INTERIM REMEDIAL ACTION REPORT FOR PREFERRED REMEDIAL ACTION AT THE SOMERSWORTH SANITARY LANDFILL SUPERFUND SITE

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GeoSyntec Project Number TR0057.46
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This document is a DRAFT document prepared by the Work Settling Defendants under a government Consent Decree. This document has not undergone formal review by the U.S. Environmental Protection Agency or the New Hampshire Department of Environmental Services. The opinions, findings, and conclusions expressed are those of the author and not those of the U.S. Environmental Protection Agency or the New Hampshire Department of Environmental Services.

NOTE

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REMEDIAL ACTION REPORT
CERTIFICATIONS

We certify that the components of the Preferred Source Control Remedy (except the final landfill cover), the Management of Migration Remedy, and the Landfill Gas Venting Trench that entail construction have been constructed as described in this Remedial Action Report and are operational and functional.

Thomas A Krug

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

BP	Bio-Polymer
BRW	Bedrock Well
CD	Consent Decree
CE	chlorinated ethene
CTW	Chemical Treatment Wall
DCA	dichloroethane
DCE	dichloroethene
EPA	United States Environmental Protection Agency
ft	feet
GMZ	Groundwater Management Zone
ICL	Interim Cleanup Levels
ICP	Instrument Control Panel
in	inch
LFG	Landfill Gas
LFGVS	Landfill Gas Venting System
MITC	methyl isothiocyanate
MSDS	Material Safety Data Sheet
NHDES	New Hampshire Department of Environmental Services
O&M	Operation and Maintenance
PCB	polychlorinated biphenyls
PCE	tetrachloroethene
PID	photoionization detector
PLC	permeable landfill cover
POC	point of compliance
ppb	parts per billion
ppm	parts per million
PRA	Preferred Remedial Action
PRB	permeable reactive barrier
RA	Remedial Action
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SOW	Statement of Work
TCE	trichloroethene

LIST OF ABBREVIATIONS (continued)

µg/L	micrograms per liter
VC	vinyl chloride
VOC	volatile organic compound
WSD	Work Settling Defendants
ZVI	zero-valent iron

1. INTRODUCTION

This Final Interim Remedial Action Report (RA Report) for the Preferred Remedial Action (PRA) at the Somersworth Sanitary Landfill Superfund Site (the "Site") has been prepared by GeoSyntec Consultants, Inc. (GeoSyntec) on behalf of the City of Somersworth and General Electric Company, the Work Settling Defendants (WSDs) for the Site. This draft RA Report describes the construction activities conducted to implement the Chemical Treatment Wall (CTW), permeable cover, and bedrock groundwater extractions components of the PRA. This RA Report also describes the construction activities conducted in 2003 to install the landfill gas (LFG) venting trench on the east side of the Site. This RA Report is submitted to the United States Environmental Protection Agency (EPA) and New Hampshire Department of Environmental Services (NHDES) to fulfill the requirements of the Consent Decree (CD) (EPA, 1995) for Remedial Design (RD) and Remedial Action (RA) to prepare and submit for review and comment a RA Report. The RA Report requirements are listed in Section VI (A)(5) of Appendix B of the CD.

1.1 Summary of Site Characteristics

The Site is located on the north side of Blackwater Road approximately one mile southwest of the center of the City of Somersworth (the City) in Strafford County, New Hampshire as shown in **Figure 1**. The Site layout is shown in **Figure 2**. The dominant Site feature is a former sanitary landfill that extends over an area of approximately 26 acres. The extent of the property currently owned by the City at and around the landfill is shown on **Figure 1**.

This section presents a summary of site history and conditions that was developed using information contained in the Record of Decision (ROD) for the Site (EPA, 1994) and in the Design Investigation Report for the Pilot Study that was submitted to the EPA and NHDES as part of the RD activities (Beak, 1998).

The landfill accepted municipal and industrial wastes from the mid-1930's to 1981. Initially the wastes were burned, but in 1958, the burning was stopped and the wastes were landfilled after excavating the natural soils. Soils were used to cover the wastes daily and the landfill expanded westward. The approximate extent of buried landfill wastes is shown on **Figure 2**. Approximately 10 acres of the eastern portion of the Site have been reclaimed by the City for use as recreational facilities, tennis and basketball courts, ball fields, and a playground. Residential properties are present to the east, west and south of the Site and a wooded area and former quarry are located to the north. A National Guard Armory and fire station are also located to the east of the Site. A cemetery is located to the northeast of the Site.

The landfill is located entirely within the Peters Marsh Brook surface water drainage basin. The brook flows northwesterly through the wetlands at the Site into Tate's Brook, which in turn flows into the Salmon Falls River which is located about one mile east of the Site (see **Figure 1**).

The Site is relatively flat and low lying (see **Figure 2**) except that the quarrying activities immediately to the north of the landfill have resulted in the presence of a 15 to 20-foot vertical escarpment which runs parallel to the northern edge of the waste. The western edge of the waste slopes downward toward the wetland.

The Site is underlain by an unconfined sand and gravel aquifer ranging from about 15 to 75 feet thick. Metamorphic bedrock occurs beneath the sand and gravel overburden deposits. A peat layer is present at ground surface in and near the wetland. Groundwater flows through the overburden in a northwesterly direction. The bedrock is fractured, with flow in the shallow bedrock appearing to be slightly north of west. Groundwater from both the bedrock and overburden discharges to Peters Marsh Brook and the wetland.

Groundwater sampling conducted at the Site during the Remedial Investigation and Feasibility Study (RI/FS) between 1985 and 1992 indicated the presence of low concentrations (parts per billion to about a part per million) of the following VOCs:

- trichloroethene (also know as trichloroethylene; TCE);
- tetrachloroethene (also known as tetrachloroethylene or perchloroethylene; PCE);
- 1,1-dichloroethene (1,1-DCE);
- cis and trans isomers of 1,2-dichloroethene (cis-1,2-DCE and trans-1,2-DCE, respectively);
- 1,2-dichloroethane (1,2-DCA);
- vinyl chloride (VC);
- benzene; and

- methylene chloride (also known as dichloromethane).

Metals (specifically chromium and arsenic) were detected in the groundwater samples during the RI/FS but their concentrations were similar to background levels. Polychlorinated biphenyls (PCBs) and pesticides were not detected in the groundwater samples. Soils sampled during the RI/FS had low concentrations of VOCs and semi-volatile organic compounds. VOCs were detected in sediment and surface water samples from the wetland in 1985 and 1986; no VOCs were detected during subsequent sampling of the surface water in 1992 (sediments were not re-sampled).

The ROD (EPA, 1994; page 5, 2nd paragraph) reports that the groundwater VOC distribution downgradient of the buried waste appears to have reached a steady-state condition and that VOCs extended to approximately 1,700 feet downgradient of the waste at the time of the RI/FS. Groundwater sampling conducted during RD indicates that by 1998, the extent and overall concentration of VOCs in groundwater was significantly less than this (about 1,200 feet downgradient of the waste) and that significant natural attenuation of the VOCs in groundwater was occurring (Beak, 1998). There are VOC impacts in the bedrock groundwater to the south of Blackwater Rd however, the bedrock groundwater from this area is flowing to the northwest and discharging to the wetland area downgradient of the landfill (EPA, 1994; page 4, 4th paragraph). More recent sampling (GeoSyntec, 2003 and GeoSyntec, 2004) provides additional evidence that natural attenuation is ongoing.

1.2 Summary of Remedial Action Implementation

The Preferred Remedial Action (PRA) for the Site is described in detail in the 100% Design (Beak and GeoSyntec, 1999) that was approved by EPA and NHDES in April 1999. An update to the design was prepared in July 2000 (GeoSyntec, 2000). In summary, the PRA is comprised of:

1) a Preferred Source Control Remedy including a CTW and permeable landfill cover (PLC);
2) a Management of Migration Remedy;
3) Institutional Controls; and
4) a Groundwater Monitoring Program.

The PRA described in the Consent Decree does not include a landfill gas (LFG) venting trench, but based on soil gas monitoring conducted in 2001 and 2002 the EPA and NHDES believed that actions, such as the LFG venting trench, were necessary to mitigate methane in landfill gas near the perimeter of the landfill.

The various components of the PRA and the landfill gas (LFG) venting trench described in this report were installed between July 2000 and May 2004. **Table 1** presents the major construction milestones for Remedial Action. The Chemical Treatment Wall (CTW) was installed in 2000, the permeable cover and bedrock groundwater extractions components of the PRA were installed in 2001, and the landfill gas (LFG) venting trench on the east side of the Site was installed substantially in 2003 and was completed in the spring of 2004.

The Pre-Final Inspection Meeting was held at the Site on 15 June 2004. The meeting was attended by:

- Roger Duwart (EPA)
- Andrew Hoffman, Richard Pease, and Carl Baxter (NHDES)
- Norm Leclerc (City of Somersworth)
- Tom Krug and David Bonnett (GeoSyntec Consultants)

There were no outstanding construction items that impact the implementation of the Preferred Remedy Action (PRA) or the Landfill Gas Venting Trench identified during the meeting.

Sections 2 of this RA Report present a general description of the components of the PRA and the Landfill Gas Venting Trench. Sections 3 through 5 present additional information on the three phases of construction: 1) the CTW in 2000; 2) the permeable landfill cover and bedrock groundwater extraction system in 2001; and 3) the Landfill Gas Venting Trench in 2003. As built drawings for the components of the PRA and the Landfill Gas Venting Trench are presented in Appendix A, B and C.

2. PREFERRED REMEDIAL ACTION DESCRIPTION

The components of the PRA and the LFG venting trench are described in the following subsections.

2.1 Preferred Source Control Remedy

The Preferred Source Control Remedy includes installation of a CTW to provide in-situ, flow-through treatment of groundwater containing chlorinated ethenes (CEs) at the downgradient edge of the waste management area of the landfill. The CTW was constructed during the summer of 2000 at the location shown in **Figure 2**. The construction of the CTW is described in Section 3 and in the Draft Chemical Treatment Wall Construction Completion Report (GeoSyntec 2001b). According to the Statement of Work in the Consent Decree (EPA, 1995), the CTW must prevent all untreated overburden groundwater that contains CEs at concentrations greater than Interim Cleanup Levels (ICLs) from migrating from the landfill to areas beyond the Point of Compliance (POC), except for insubstantial amounts of such groundwater. The POC is the edge of the waste management area, except where the CTW has been constructed, in which case it is the outer edge of the CTW. The groundwater passing through the CTW must achieve ICLs for the CEs within 18 months after the Preferred Remedial Action Prefinal Inspection Meeting and must maintain such levels thereafter.

The Preferred Source Control Remedy also includes placement of a permeable landfill cover (PLC) and additional source control measures to remediate benzene and methylene chloride in groundwater migrating from the landfill, if necessary. The PLC covers the portion of the landfill not currently used for recreational activities. The PLC consists of approximately six inches of coarse backfill material and six inches of topsoil seeded with native grass. The purpose of the PLC is to prevent direct contact with the underlying waste material, allow for infiltration of precipitation through the landfill and control erosion.

The Preferred Source Control Remedy must also assure that groundwater migrating from the landfill to areas beyond the POC does not contain >ICL concentrations of benzene or methylene chloride 18 months after CTW construction. No additional source control measures have been identified as necessary for implementation at the Site given their absence or very low concentrations in groundwater (Beak and GeoSyntec, 1999); however, the Groundwater Monitoring Plan (Sampling and Analysis

Plan (SAP), GeoSyntec 2001a) has been developed to collect the data to address this compliance requirement.

2.2 Management of Migration Remedy

The Management of Migration Remedy is required to reduce the concentrations of VOCs in groundwater to ICLs at and beyond the POC. It includes bedrock groundwater pumping at extraction well BRW-1 located adjacent to bedrock monitoring well B-12R (located approximately 80 feet south of the edge of the waste) and natural attenuation of VOCs in groundwater downgradient of the CTW. Extracted bedrock groundwater is discharged to the infiltration gallery located on the landfill upgradient of the CTW, and treated by the CTW. The need for additional bedrock groundwater extraction must be evaluated as part of the PRA implementation.

2.3 Institutional Controls

The PRA also includes institutional controls. The 100% Design includes fencing, other physical barriers and access controls, and land and groundwater use restrictions.

2.3.1 Fencing and Other Physical Barriers

Fencing and other physical barriers have been installed around active and accessible components of the PRA to discourage vandalism and tampering and provide protection to the components as listed below.

- An 8-foot high chain link fence has been installed around the control box and the underground vault for the extraction system. The infiltration gallery and extraction well have been protected by flushmount locking protective covers.
- Protective steel casings have been installed over all monitoring wells and will be locked using heavy gauge padlocks (i.e., to withstand unauthorized access using bolt cutters).
- Dense shrubs have been planted around the soil gas vent pipes of the LFG venting system.

2.3.2 Groundwater and Land Use Restrictions

Pursuant to its zoning and land use authority, The City of Somersworth, a WSD under the CD, has established a Groundwater Management Zone (GMZ) by legislative enactment. The boundaries of the GMZ are the same boundaries as presented on the Groundwater Management Zone Overlay Map included in the Preferred Remedial Action 100% Design and Demonstration of Compliance Plan prepared by Beak International and GeoSyntec Consultants International, Inc. (Beak and GeoSyntec, 1999). The withdrawal of groundwater within the GMZ for any purpose is prohibited. The City of Somersworth has notified its residents of the groundwater use restrictions by publishing legal notices in area newspapers which described the restrictions and by posting these same notices at City Hall. In addition, the Somersworth City Council and Planning Board held separate and distinct public hearings prior to the adoption of the groundwater zoning restrictions. A list of all properties and owners located within the GMZ IS included in Appendix D.

If the zoning ordinance is repealed or amended so that it no longer prohibits the withdrawal of groundwater within the GMZ, then other types of institutional controls will be implemented in accordance with the SOW. A copy of Section 10 of the City of Somersworth Zoning Ordinance and a Certificate of City Clerk are included in this Report in Appendix D along with a copy of the Groundwater Management Zone Overlay Map included in the Preferred Remedial Action 100% Design and Demonstration of Compliance Plan.

Where access to land is required for monitoring, remedy construction or other response actions, land easements or access agreements will be used to the extent necessary. An easement has been obtained for extraction well BRW-1. Existing agreements obtained from the property owners to access existing wells are being used during RA.

2.3.3 Access

Where access to land is required for monitoring, remedy construction or other response actions necessary, land easements or access agreements will be used to the extent necessary and possible. An easement has been obtained for extraction well BRW-1. Existing agreements obtained from the property owners to access existing wells are being used during RA.

2.4 Groundwater Monitoring

The Groundwater Monitoring Plan is provided in Section 2 of the SAP to address the monitoring requirements identified in the Statement of Work (SOW) appended to the CD. The groundwater monitoring network is shown in **Figure 2**.

2.5 Landfill Gas Venting Trench

The PRA described in the Consent Decree does not include a landfill gas (LFG) venting trench but based on soil gas monitoring conducted in 2001 and 2002 the EPA and NHDES believe that certain actions, such a LFG venting trench, are necessary to mitigate methane in landfill gas near the perimeter of the landfill. A LFG venting trench was installed along the southern and eastern perimeter of the landfill as shown in **Figure 2** during 2003. The LFG venting trench is a passive system that prevents landfill gas from moving away from the landfill and allows for methane gas to escape from the subsurface.

The LFG venting trench includes two segments of a gravel filled trench with vertical vent pipes to the surface at regular intervals. The passive LFG venting system relies upon advective flow of LFG generated in the landfill and barometric pumping to convey LFG into the gravel filled trench and out through vertical vent pipes to the atmosphere. The venting trench also serves as a barrier to soil gas migration through the use of a geomembrane liner which prevents LFG from migrating past the venting trench and force the LFG out the vent pipes. The locations of the two segments of trench are shown in **Figure 2**.

The soil gas venting trench extends down to the seasonal low groundwater level. The trench is 3 feet wide with a total depth between approximately 15 feet in the southern segment to approximately 27 feet in the northern segment.

The venting trench contains gravel (#57 stone) placed from the seasonal low groundwater table to a depth of 3 feet below ground surface. A vertical geomembrane extends down the outside wall of the trench (the wall located farthest from the landfill) to act as a barrier to soil gas migration. Above the gravel, a geotextile fabric separator, a 2.5 feet layer of compacted clay and a 0.5 foot layer of topsoil have been installed.

The compacted clay is intended to limit infiltration of surface water while the geotextile separator prevents migration of sediment into the gravel filled portion of the trench.

The vent pipes are embedded vertically within the gravel and are 4 inches in diameter. The pipe in the gravel is slotted with 1/8-inch slots. The vent pipes extend 8 feet above ground surface and terminate with a wind driven turbine vent at the outlet.

3. CHEMICAL TREATMENT WALL CONSTRUCTION

3.1 Overview

Construction of the CTW involved excavation of trench panels, backfilling with granular iron or a granular iron/sand mixture, placing a geotextile fabric, installing a compacted clay layer, and then installing cover soil to the ground surface. The main activities conducted for the construction of the CTW were as follows:

- mobilized equipment, facilities, and personnel;
- installed silt fence downgradient of the construction area and placed construction warning fence around the perimeter of the site;
- created a workpad approximately 50 ft wide, 915 ft long, and 5 ft above the groundwater table and relocated landfill waste encountered during workpad construction to the top of the landfill;
- excavated various lengths of trench “panels” to bedrock surface refusal and stockpiled trench spoils on the top of the landfill;
- prepared various mixtures of granular iron and sand as per the specifications;
- backfilled panels with required concentrations of granular iron or granular iron/sand mixtures;
- graded the surface of the granular iron backfill to required elevations (based on groundwater surface elevation data);
- covered the granular iron surface with a filter geotextile and a low-permeability compacted clay layer;
- covered the compacted clay layer with a cover soil layer;
- placed topsoil and grass seed on required areas of the workpad;
- graded the relocated waste and trench spoils on the top of the landfill and covered with a layer of clean soil;

- improved the integrity of the silt fence and placed additional silt fence where required; and

- demobilized from the site.

Landfill waste encountered during the construction of the workpad and spoil material from trench excavation was graded and covered on the top of the landfill. These materials (waste and spoils) were incorporated into the top of the landfill. Also, excess slurry that was stored in an impoundment and sediment which dropped out of the slurry in the impoundment area, was placed in temporary storage tank on site pending the natural degradation of a biocide used in the slurry as a preservative.

Geo-Con began initial site preparation and workpad construction on 8 July 2000. CTW excavation and backfilling operations began on 1 August 2000 and were completed on 11 September 2000. The compacted clay layer was constructed between 14 and 21 September 2000. Grading and covering of relocated waste and trench spoils was completed on 18 September 2000. Remedial Contractor activities of the CTW construction phase were completed at the site by 28 September 2000.

3.2 CTW Construction

The CTW was constructed by excavating and backfilling a trench using a guar based bio-polymer (BP) slurry to maintain the stability of the trench prior to backfilling as shown in **Figure 3**. The excavation was performed through a workpad constructed to a minimum of 5 feet (ft) above the water table to provide stability for heavy equipment and to allow the level of the BP slurry to be maintained above the water table. Following excavation, each of the panels of the CTW was backfilled with granular iron or a mixture of granular iron and inert sand.

A compacted clay layer was constructed on top of the granular iron to prevent groundwater from flowing over the granular iron in the CTW. The clay layer was separated from the granular iron surface by a non-woven filter geotextile. A cover soil layer was then placed over the clay layer to the elevation of the surface of the workpad.

The remainder of this section describes the CTW construction in more detail.

3.2.1 Workpad Construction

A workpad was constructed along the entire length of the CTW to allow easy access of equipment to and from the trench and staging areas and to allow the level of the PB slurry to be maintained above the water table. The workpad was approximately 50 ft wide and was aligned to contain the CTW centerline approximately 10 ft from the wetland edge of the workpad. Native soils and material from an on-site borrow source located near the Blackwater Road Site entrance were used to construct the workpad. Excavation of materials and slope grading were performed with Daewoo 130, 220, and 330 trackhoes. A John Deere 750 bulldozer was also utilized for blading and grading the workpad. Wood debris (trees and roots) cleared for construction of the workpad was stockpiled on top of the landfill.

Some landfill waste was encountered during workpad construction. This waste was relocated and stockpiled in an area located in the northwest corner of the top of the landfill, and was covered with a plastic sheet. This material was eventually spread out over the top of the landfill and covered with clean fill, as discussed later in this section.

3.2.2 CTW Panel Alignment

The original alignment of the CTW was modified slightly after a pre-construction site walk in order to minimize the impact of construction activities on the adjacent wetlands. Approximately 300 ft of the southernmost length of the CTW was moved closer than originally planned to the waste area of the landfill. The CTW alignment was also modified slightly in the vicinity of the high-pressure gas pipeline located near the mid-point of the CTW. This adjustment allowed for the construction of the CTW to occur without the gas pipeline being submerged within the slurry during panel excavation and backfilling.

The CTW was divided into eight different sections along the length of the alignment, each section requiring a specific granular iron concentration based on the concentrations of VOCs in groundwater and groundwater flow in the area of each section. Each of these sections was subdivided into separate panels each approximately 33 ft to 50 ft in length. **Figure 4** shows the approximate locations of the 8 sections of the CTW.

Panels within each section were designated as being either primary or secondary. Primary panels were excavated and backfilled first without adjacent panels having been excavated. Steel I-beams were placed at both ends of the primary panels to provide a defined end to the panels. Typically, a primary panel was excavated in one day and backfilled with granular iron or a mixture of granular iron and sand on the following day. Often, the next primary panel was excavated while the previous panel was being backfilled.

After the majority of the primary panels were excavated and backfilled, construction of the secondary panels was conducted. Secondary panels were excavated down to the bedrock between the I-beams defining the ends of the adjacent primary panels. **Table 2** presents information on each of the 23 separate panels of the CTW.

3.2.3 CTW Panel Excavation

The CTW panels were excavated using a LinkBelt 7400 trackhoe equipped with a 30 inch wide "rock-ripper" bucket. Containment berms were erected around the area of the trench to form a temporary containment area with the initial soil material excavated from the initial few feet of the trench. A BP slurry (Rantec G-150 from Rantec Corporation) was added to support the trench walls during the remaining excavation. Excavated material was placed within the temporary containment area and excess slurry was allowed to drain and flow back into the trench. The drained soil material (trench spoil) was then loaded with the Daewoo 220 trackhoe into a Caterpillar 350 tri-axial dump truck and hauled to a designated area on top of the landfill.

Panel excavation continued down to the bedrock surface. Several scrapes of the bedrock surface were made with the excavator bucket to remove rock from the surface of the bedrock. For primary panels, the trench bottom was scraped across the length of the panel to locations outside where I-beam panel dividers would be placed. The 30 in wide I-beams were then lowered into the trench onto scraped areas of bedrock. For secondary panels, a metal flat-plate attachment was affixed to the hoe bucket to remove material between the flanges of the I-beams and at the corners made by I-beams and the bedrock surface.

PVC development wells were installed in each panel following completion of the excavation. The wells were custom-made based on the depth of the panel, with the bottom 20 ft of each well being slotted. A metal weight was affixed to the bottom of each well to allow the well to sink to the bottom of the excavated trench. The top of each well was held in place by securing the well with wire to two 6 inch by 6 inch wooden beams placed perpendicular to the trench. The wells were installed to allow for removal of some of the PB slurry and to allow for the addition of chemicals to enhance the breakdown of the remaining BP slurry following construction

3.2.4 Granular Iron/Sand Preparation

The granular iron filings for the CTW were supplied by Connelly-GPM, Inc. (Connelly) of Chicago, Illinois. The granular iron was shipped to Site in closed trucks transported via railway flat bed cars. The granular iron was shipped in 3,000 pound (1.5 ton) bags, each on a wooden pallet. Each bag was equipped with straps for lifting. Most of the granular iron had been delivered to the Site and stored before Geo-Con mobilized to Site. Off-loading and storage of granular iron was performed by Turgeon Construction Co. of Somersworth, New Hampshire (Turgeon), under subcontract to Geo-Con. The bags of granular iron were stored in an area north of the Site access road near the Maple Street entrance. The bags were stored in rows three bags high and covered with plastic sheet for moisture protection.

The sand used in the granular iron/sand mixture was delivered from Ossipee Aggregates (Ossipee), in Ossipee, New Hampshire. Sand was delivered by truck and was stockpiled in a storage area located near the site entrance on Maple St., east of the granular iron staging area. The sand used in the granular iron/sand mixtures was "double washed" to remove excess fine sand material.

A mixing truck, referred to as the "Elkin" mixer, was used to mix the granular iron and sand to obtain the appropriate mixtures for each of the CTW Sections. The Elkin mixer had separate granular iron and sand hoppers, each with an adjustable gate to feed variable amounts of material onto a single conveyor. The conveyor emptied both materials simultaneously into an auger mixing system, which dispensed the mixed material onto a concrete pad for loading. A front-end loader was used to transport the sand from the sand stockpile into the sand hopper of the Elkin mixer. Granular iron was loaded into the second hopper of the Elkin mixer using a Lull 844 all terrain forklift to suspend the granular iron bags over the granular iron hopper while a worker slit the bottom of the bag to allow the granular iron to empty into the hopper.

3.2.5 CTW Panel Backfill

A tremie pipe was used to deliver the granular iron or granular iron and sand mixture to the bottom of the trench to minimize contact of the granular iron with PB slurry and to minimize the turbulence in the open trench. The tremie was constructed of a 10 ft length of 24 inch diameter metal pipe with a hopper on the top, and three additional removable 10 ft lengths of 24 inch pipe. The tremie was moved into place and supported in the trench during backfill operations using a large crane. A "Screen Machine" conveyor system was used to deliver the granular iron backfill material to the hopper of the tremie pipe. Front-end loaders were used to transport the granular iron/sand mix from the concrete loading pad near the Elkin mixer and dump the mix into the screened hopper of the conveyor system. The conveyor belt transported the granular iron mixture directly into the hopper of the tremie. A water pipe and water sprayer were attached to the top of the conveyor system to saturate the granular iron with water as it was poured into the hopper of the tremie. This water was added to fill void spaces of the granular iron mixture to reduce the contact of slurry with the surface of the granular iron.

As backfill operations were conducted and the level of the granular iron in the trench increased, sections of the tremie pipe were removed so the hopper of the tremie was maintained at a suitable height for the conveyor system. As the tremie was lifted out of the trench it was moved along the length of the trench to distribute the granular iron inside tremie along the trench. Backfilling operations were suspended for short periods of time while the sections of the tremie were removed. The slurry displaced during the backfilling operation was allowed to flow by gravity through a shallow trench to a lined slurry impoundment were the PB slurry was allowed to degrade and suspended material was allowed to settle out.

Once the level of granular iron in the trench reached the required height, addition of granular iron ceased. The slurry remaining over the surface of the backfilled material was removed either by pumping with a 6 inch diameter Godwin pump or by bailing with the bucket of the Daewoo 130 or 220 trackhoe. Once the granular iron surface was exposed, a sacrificial geotextile was placed over the granular iron surface and the panel was backfilled with temporary fill material while the remaining panels were excavated and backfilled and the compacted clay layer could be installed.

3.2.6 Compacted Clay Layer

After all the individual panels of the CTW were backfilled, a 3 foot thick layer of compacted clay layer was placed above the granular iron to prevent groundwater from passing over the top of the CTW untreated. The compacted clay layer was constructed by first removing temporary fill and the sacrificial geotextile in the panels and exposing a clean granular iron surface. The granular iron surface was graded to the required elevations as per the 100% Design. This elevation corresponded to the lowest observed water level at the location of the section. Material excavated from the trench was stockpiled adjacent to the trench. A permanent filter geotextile was then placed over the granular iron surface. A bridge lift of low-permeability clay was then placed over the geotextile to a level slightly above the observed water table. This bridge lift was graded and tamped with the bucket of the Daewoo 130 trackhoe. Additional 8-inch layers of clay were then placed on top of the bridge lift until the required 3 foot thick layer of clay was in place. A “Wacker Packer” walk-behind, padfoot compactor was utilized to compact each lift of clay. Soil for the compacted clay layer was supplied by Turgeon.

3.2.7 Cover Soil

After construction of the compacted clay layer was completed, cover soil was placed over the clay layer. The cover soil was obtained from fill material excavated and stockpiled adjacent to the CTW during clay capping operations and from material obtained from the surface of the workpad. At least 2 ft of cover soil was placed over the compacted clay layer.

3.2.8 Topsoil

Topsoil was placed on the northernmost 400 ft of the workpad. The soil was placed from the centerline of the CTW to the toe of the outboard slope of the workpad. The topsoil was manually seeded with grass, utilizing a hand-held seed broadcaster, and was then covered with straw. Grass seed was also placed on the northernmost 400 ft of the workpad that was not covered with topsoil. No topsoil was placed over the remainder of the workpad, which was incorporated into the final cover system constructed in 2001.

3.2.9 Repairs

Some difficulties were encountered during construction of several of the CTW panels and repairs to these panels were required. Repairs were performed either by adding more granular iron to a panel to attain the required elevation or by replacing material with suspect granular iron concentrations within a panel. The following panel repairs were completed after all panels of the CTW were installed.

- After backfill operations were completed in Panel 8B, it was found that the granular iron surface was approximately 3 ft below the required elevation on the side nearest to the end of CTW. The panel was repaired by excavating an open cut to the surface of granular iron in the panel with the Daewoo 220 excavator and then adding granular iron/sand mix until the required grade was attained.

- Part of Panel 1A (the first panel constructed) was also not backfilled to the required elevations during initial construction. Attempts to expose the surface of the granular iron during repair proved difficult because the surface of the granular iron was approximately 4 ft below the water table. As groundwater was pumped out to allow for visual observation of the granular iron surface, several cave-ins occurred as trench walls became unstable. In order to overcome these difficulties, a trench box was used to support the sides of the trench while repairs were made. A 6-inch diameter Godwin pump was used to pump out the groundwater, and the Daewoo 220 hoe was used to expose the granular iron surface within the trench box. The Daewoo 130 hoe was then used to obtain granular iron/sand mix from the bucket of a front-end loader and to place the mix in the trench box onto the exposed granular iron surface.

- During initial construction, Panel 8A was not completed by the end of the day it was started. A trench profile, surveyed at the end of the day of backfill, indicated that the backfill was approximately 10 ft below the required final elevation at the time backfilling was discontinued. The next morning, trench soundings revealed that approximately 10 ft of material had settled out of the slurry and/or sloughed in from the sidewalls overnight. Magnetic separation testing on samples obtained from the material suggested that although granular iron was present, samples were not of acceptable concentrations. Repair to the top 10 ft of the panel was made by excavating an 18 inch wide panel under a PB slurry and then backfilling with 100% granular iron (a minimum 88% granular iron mixture was required for an 18 in. wide trench in this panel).

The granular iron required to perform repairs was shipped directly from Connelly to the site by truck on the weekend prior to repair operations. Fifty-four bags, each containing 3,000 pounds of granular iron, were used to complete the repairs.

Difficulties were also encountered during the excavation and backfilling of secondary panels 1B and 1D that are adjacent to the CTW Test Section (Panel 1C) that was installed in the fall of 1999. Panels 1B and 1D were the first of the secondary panels to be installed. During construction of panels 1B and 1D, the viscosity of the slurry decreased significantly overnight and excess material either dropped out of suspension or sloughed in from the sides of the trench. The rapid degradation of the PB slurry is believed to be due to active biodegradation enhanced by the presence of significant biological activity in the subsurface in the vicinity of the primary panel. Some of the excess material was removed from the bottom of the panels and the panels were backfilled with the required amount of iron. Some question, however, remained about the iron content of the bottom few feet of these panels and additional monitoring was conducted to confirm that the difficulties with these sections did not impact the performance of the CTW in any significant way (GeoSyntec, 2001c and GeoSyntec, 2003). As a result of the difficulties with the stability of the PB slurry in Panels 1B and 1D, the construction sequence for the remaining secondary panels was modified such that secondary panels were excavated and backfilled on the same day before the slurry had time to degrade.

3.3 Relocated Waste and Trench Spoil Management

During construction of the workpad, some landfill waste was encountered and was relocated and stockpiled in a low-lying area on the top of the landfill. The relocated waste was covered with plastic sheet for the duration of CTW construction. Also, trench spoils from the CTW excavation were stockpiled daily on top of the landfill adjacent to the waste stockpiles.

Upon the completion of CTW construction, the waste and spoils were moved to the lowest elevation areas on the top of the landfill. The waste was relocated first by excavating with the Daewoo 220 hoe, loading into the Caterpillar 350 dump truck, and hauling to the designated low areas. The trench spoils were then pushed over the top of the waste with the John Deere 750 dozer, leaving only the trench spoils exposed. The spoils were then covered with a layer of clean soil. The clean soil was obtained from sand that was intended for, but not used in, granular iron/sand mixing, and from high areas of soil on the top of the landfill.

3.4 Slurry Fluid and Sediment Management

Special management of the fluid and sediment from the slurry impoundment was required as a result of the use of a slurry preservative or Biostat, Troysan 142, which was added to increase the working life of the BP slurry. Troysan 142 contains a biocide that degrades into methyl isothiocyanate (MITC), which can be toxic to fish according to the Troysan 142 Material Safety Data Sheet (MSDS). MITC degrades through natural processes into non-toxic substances.

Samples of fluid and sediment from the slurry impound were collected on 14 September 2000 and sent to a laboratory specializing in pesticide analysis, Anresco, Inc. (Anresco) in San Francisco, CA. Anresco reported that the sediment contained 1.1 part per billion (ppb) of Dazomet and 727 ppb of MITC, while the water contained 2.0 micrograms per liter (µg/L) of Dazomet and 1,110 µg/L of MITC. Based on these test results a 100,000 gallon capacity "Modu-Tank" modular tank was ordered and shipped to the Site by truck to store the slurry. The modular tank was erected in an area near the Maple Street Site entrance. Approximately 35,000 gallons of slurry fluid in the impoundment was transferred to the modular tank using a 6-inch diameter Godwin pump and stored until tests indicated that the MITC had naturally degraded to acceptable levels. A lined basin was constructed on the top of the landfill adjacent to the spoils area to contain the sediment from the impoundment. The 60-foot by 60-foot basin was constructed with the relocated waste and spoils making one side of the basin and 2 ft high earthen berms forming the remaining 3 sides. The basin was then lined with a modular tank plastic liner, ordered and shipped to Site with the Modu-Tank used to hold the slurry from the impoundment.

After the fluid in the impoundment was pumped to the modular tank, the sediment was loaded with the Daewoo 220 excavator into the Caterpillar 350 dump truck and hauled to the lined basin. The John Deere 750 bulldozer was used to compile the sediment as it was excavated. Once all the sediment was hauled to the lined basin, the basin was covered with plastic sheet. Soil was used to anchor the plastic sheet over the sediment. The sediment was left in the basin and allowed to degrade naturally and covered by the final cover system.

The fluid slurry in the modular tank was sampled on 23 October 2000 and subjected to analysis for MITC. Two samples of fluid were collected and found to contain 7.6 and 5.8 ug/L of MITC. The contents of the modular tank were sampled again on 2 February 2001 and found to contain 6.8 ug/L of MITC. Based on the results of sampling the EPA provided approved to discharge the water. By the time plans were made to discharge the water from the tank, the water in the tank had frozen. The wood supports for the tank were removed and the solid block of ice was allowed to melt and discharge slowly into the groundwater.

4. PERMEABLE LANDFILL COVER AND BEDROCK GROUNDWATER EXTRACTION SYSTEM CONSTRUCTION

4.1 Overview

Construction of the permeable landfill cover and the bedrock groundwater extraction and re-injection system was conducted during June, July and August of 2001 by Sevenson Environmental Services, Inc. (Sevenson). A project Kick-Off meeting was held at the Site on 6 June 2001 and a final site inspection meeting was held on 29 August 2001. The main activities conducted for the construction of these components of the remedy were as follows:

- mobilized equipment, facilities, and personnel to the Site;
- installed silt fence around construction areas and temporary fencing around construction areas;
- constructed temporary access roads;
- removed concrete rubble debris and relocated to the bank north of the landfill;
- removed asphalt piles for off-site asphalt recycling;
- removed exposed tires from landfill for off-site recycling;
- removed wood waste from top of landfill and chipped wood material in an area to the north of the landfill;
- removed existing road on the east side of the landfill;
- re-graded waste material to achieve design grading and drainage of site;
- installed a minimum of six inches of fill material and six inches of topsoil over waste disposal area;

- installed subsurface piping beneath Blackwater Road from Extraction Well BRW-1 to the north side the road;
- installed a subsurface vault for the piping and flowmeter for the extraction well;
- installed the infiltration gallery on the top of the landfill and piping from the subsurface vault to the infiltration gallery;
- installed power supply and controls for bedrock groundwater extraction pump;
- removed temporary access roads and regraded disturbed areas;
- installed access road from Blackwater Road to infiltration gallery as per design drawings;
- hydroseeded cover area;
- demobilized equipment from the Site.

4.2 Site Preparation and Cover Installation Activities

Site preparation activities were initiated at the beginning of June 2001. Sevenson mobilized equipment, facilities, and personnel to the Site during the first week of June 2001. They installed silt fence around the construction areas and temporary fencing around construction areas and constructed temporary access roads and parking areas. They removed concrete rubble debris from areas on the top of the landfill and relocated this material to the bank north of the landfill. They removed asphalt piles from the Site for off-site asphalt recycling. They removed exposed tires from landfill and stored these tires in the former quarry area to the north of the landfill pending transport off-site for recycling. They removed wood waste from top of landfill and stored this wood in the former quarry area to the north of the landfill pending chipping of wood material on-site. They removed existing road on the east side of the landfill and replaced it with a gravel road. They re-graded waste material to achieve design grading and drainage of the site and installed a minimum of six inches of fill material and six inches of topsoil over waste disposal area.

4.3 Bedrock Groundwater Extraction System Construction

The groundwater extraction well BRW-1 was installed in April 1996 to a depth of 51 feet below ground surface. A copy of the boring log for BRW-1 is included in Appendix E. Sevenson installed subsurface piping and power supply for the pump beneath Blackwater Road from extraction well BRW-1 to the north side the road. They installed a subsurface vault for the piping and flowmeter on the north side of Blackwater Road. They installed the infiltration gallery on the top of the landfill and piping from the subsurface vault to the infiltration gallery. They installed the power supply to the extraction well pump and pump controls. They installed level switches in the extraction well to control the operation of the pump. They installed a manual flow control valve to control the flowrate of groundwater from the extraction well pump in the subsurface vault. They installed an above ground Instrument Control Panel (ICP) in a lockable weather proof box located adjacent to the underground vault. They installed a flowmeter / flow totalizer to monitor the flow from the extraction well pump in the vault with a display on the Instrument Control Panel (ICP) located in the control cabinet adjacent to the vault. The subsurface vault and the control cabinet are surrounded by an 8-foot high chain link fence.

Sevenson also installed the groundwater injection system consisting of: 1) double-walled underground piping to convey groundwater from the underground vault up the hill to the infiltration gallery; 2) perforated distribution piping in the infiltration gallery; 3) an infiltration gallery filled with stone to allow groundwater to percolate into the landfill; and 4) a clean-out access point to allow access to distribution piping in the infiltration gallery.

4.4 Site Restoration

Sevenson arranged for off-site recycling of tires removed from the landfill and chipping of the wood debris. Wood debris was placed against the sand bank of the sand quarry north of the landfill. Sevenson hydroseeded the cover and demobilized equipment from the Site.

5. LANDFILL GAS VENTING TRENCH CONSTRUCTION

This section describes the construction of the LFG venting trench at the Site.

5.1 Overview

Construction of the landfill gas venting system LFGVS involved excavation of two trench segments along the eastern side of the landfill, backfilling the trench with gravel, and capping with a clay layer. The main elements of the LFGVS construction were as follows:

- mobilized equipment, facilities, and personnel;
- installed silt fence around the construction areas and placed temporary security (6-ft chain link) fence around the trench excavation areas;
- stripped the existing 1-ft thick permeable cap at the southwest corner of the landfill to serve as a contaminated soil (waste) disposal area;
- constructed temporary access roads adjacent to both sections of trench;
- excavated two trench segments to September 2001 groundwater levels (historic low), or to existing groundwater level and stockpiled spoils in clean or waste disposal areas depending on visual and photoionization detector (PID) screening results;
- placed geomembrane panels with geotextile overlay on the side of the trench furthest from the landfill;
- installed 4-in. diameter slotted vent pipes at 200-ft intervals along trench (the vents were later extended using solid pipe, approximately 10 to 12-ft above ground and had turbine ventilators installed on the top and sample ports at approximately 3 to 4-ft above ground);
- backfilled trench with gravel and graded the surface of the gravel backfill to approximately 3 ft below ground surface;

- deployed a non-woven geotextile over the gravel surface the placed/compacted a low-permeability cap;

- replaced topsoil over disturbed trench areas and hydroseeded or placed sand and gravel on areas of the trench formerly used as parking areas and roads;

- removed temporary access roads adjacent to trenches and regarded disturbed areas;

- graded the contaminated (waste) spoils at the southwest corner of the landfill to blend with adjacent grades and covered with two 6-in. thick layer of clean soil;

- planted shrubs around each of the seven vent stacks; and

- demobilized from the Site.

Panther was issued a Notice to Proceed on 11 September 2003, provided submittals starting 16 October 2003 (including a Quality Control Plan, Remedial Action Work Plan, and Erosion Control, Dust Control, and Clearing & Grubbing Plan), and began initial site preparation on 28 October 2003. A pre-construction meeting was held on 30 October 2003. LFGVS excavation and backfilling operations began on 1 November 2003 and were substantially completed on 12 December 2003. The compacted clay layer was constructed between 1 and 5 December 2003 for the southeast trench segment and between 14 and 18 December 2003 for the northeast trench segment. Grading and covering of the contaminated soil disposal area was completed on 8 January 2004. The majority of the restoration activities of the LFGVS was completed by 11 June 2004, following a winter demobilization period. A pre-final inspection was conducted on 15 June 2004.

5.2 LFGVS Construction

The proposed LFGS centerline was realigned after a pre-construction site walk-through in an effort to minimize excavation through waste. Several test pits were excavated initially along the proposed trench alignment, which indicated the limits of waste extended towards Blackwater Road. The south east portion of the trench, starting at Station 0+00, was gradually adjusted to be located at the base on an existing embankment along Blackwater Road. Between Stations 4+25 and 6+25, the alignment was moved inward toward the landfill to avoid an existing embankment. Between Stations 15+75 and 13+25, along the northern portion of the northeast trench, a 2 to 3-ft bench was initially cut to allow for the excavator to reach target depths. Test pits also indicated waste deeper than 5 feet to the south of the existing concession stand, therefore the LFGS was moved as close to the concession stand as possible to minimize the amount of waste encountered during trench excavation.

The LFGVS was constructed by excavating and backfilling a trench using a bio-polymer slurry (guar based). Trench excavation was performed with various pieces of equipment as follows:

- Station 0+00 to 1+50 of Southeast trench – John Deere 160LC and Komatsu PC220 with 42-inch wide bucket.
- Station 1+50 to 1+90 of southeast trench – Volvo EC290BLC with 36-inch wide bucket.
- Station 1+90 to 7+25 of southeast trench – Volvo EC290BLC with 30-inch wide bucket.
- Northeast trench – Komatsu PC400LC with 30-inch wide rock bucket.

After initial soil material had been excavated from the trench, a bio-polymer slurry, a mixture of Ultra-Guar with water, was added to support the trench walls during the remaining excavation. Excavated material was transported to one of two disposal areas. Spoils containing visual waste or giving PID readings above 5 ppm were placed within the contaminated soil disposal area at the southwest corner of the landfill. Excavated soils with no visual refuse or PID readings above 5 ppm were stockpiled to the northwest of landfill in the former quarry area.

When a sufficient length of trench had been excavated and the depth was verified manually with a tape measure, 40-mil thick textured geomembrane panel with a 4 ounce per square yard non-woven geotextile cushion was lowered into the trench on the side furthest from the landfill. The geomembrane/geotextile panels were ballasted with four or five sandbags tied to the bottom of the panels. The geomembrane and geotextile were supplied by The Liner Company of Colts Neck, NJ and was manufactured by

Solmax International Inc., Varennes, Quebec, and SKAPs Inc., Pendergrass, GA, respectively.

At seven locations on approximately 200-ft intervals, prior to trench backfilling operations, a 4-inch diameter schedule 40 PVC vent pipes were installed. Each vent pipe included a slotted section of pipe extending from the bottom of trench to 3-ft below ground surface. The remainder of the vent pipe was solid PVC extending to a height of 10 to 12-ft above ground surface. The pipe was supplied by Johnson Screens, Forked River, NJ. A 16-in. diameter externally braced galvanized turbine ventilators (manufactured by Empire Ventilation Equipment Co., Inc., Long Island City, NY) were installed on each vent as well as a ¼-in diameter brass McMaster Carr sampling port.

When the geomembrane/geotextile panels and vent pipes (at selected locations) had been lowered into place, a front-end loader and excavator were then used to backfill the trench with gravel. The ¾-in. diameter gravel was supplied by Pike Industries, from their Wells, ME quarry.

A compacted clay layer was placed over the gravel backfill to limit surface water infiltration into the trench. This soil barrier layer was constructed to be 2.5 ft. high above the surface of the gravel. The compacted clay layer was constructed by first placing a separation geotextile over the gravel surface. Five lifts, each 6 inches thick (compacted), were then placed on top of the geotextile. A trench compactor, a Bomag BMP 851 padfoot compactor, was utilized to compact each lift of clay. Soil for the compacted clay layer was supplied by STS Construction of East Lebanon, ME.

Topsoil or a sand and gravel mixture was used to backfill the upper 6-inches of trench. Topsoil was placed in areas that were originally grassed. A sand and gravel mixture was used in the parking area along the eastern-most 50-ft of the southeast trench and in the road and parking area to the north of the concession stand along the northeast trench. The topsoil was then hydroseeded. Grass seed was placed on the areas adjacent to both trench sections that were used for temporary access roads. Around each gas vent, a ring of native shrubs were planted. The topsoil and shrubs were supplied by Leaver's Landscaping, Somersworth, NH. The sand and gravel mixture was composed of on-site clean trench spoils and gravel used for trench backfill.

Repairs to an existing concrete slab (adjacent to an existing canteen building) were performed by Panther prior to demobilizing from the Site. A subcontractor, DQ

Concrete Foundation and Floor, assisted with placement of concrete, supplied by Seacoast Redimix Concrete, LCC.

5.3 Relocated Waste and Trench Spoil Management

During LFGVS excavation, landfill waste was encountered and was required to be relocated in a selected area on the top of the landfill. The relocated waste was covered with a temporary plastic film for the duration of LFGVS construction. Clean trench spoils were stockpiled to the northwest of landfill in the former quarry area.

Upon the completion of LFGVS construction, the waste stockpile was compacted with a dozer and blended into the adjacent grades on top of the landfill. The graded waste was then covered with a 6-inch layer of clean soil that had been previously stripped. Some additional cover soil was required and clean trench spoils were used. A 6-inch thick layer of topsoil was then placed on top of the layer of clean cover soil. The topsoil was then hydroseeded by the City of Somersworth.

5.4 Slurry Fluid Management

Bio-slurry was mixed in a stand-alone mixing tank that transferred the mix into two 20,000 gallon storage tanks (i.e., Baker tanks) where it was mixed via recirculation until being pumped into the trench excavation, Slurry levels within the trench were typically maintained between two to three feet below grade. Due to slurry consumption rate within both the northeast and southeast trench segments, no slurry was pumped out of either trench.

The General Contractor took measures to limit the quantity of slurry excavated from the trench by cutting holes in the excavator’s bucket. Trench spoils were also drained directly from the end dumps spoils by raising the end dump’s bed to an angle to allow for liquids to drain out of the bed and back into the trench. Any slurry spilled from the tank or delivery hose was collected and placed directly into an open section of trench.

6. SUMMARY OF PROJECT COSTS

Table 3 provides a comparison of the actual project costs with the ROD estimate of project costs.

7. CONTACTS

This section includes the relevant contact information for the project.

The PRPs used the following contractor for the RA:

Thomas Krug, Project Manager
GeoSyntec Consultants
130 Research Lane, Suite 2
Guelph ON, Canada, N1H 3E9
519 822-2230 ext 242

The following companies analyzed samples:

Columbia Analytical Services
1 Mustard St., Suite 250
Rochester, NY, USA 14609
585-288-5380 ext. 134

The project manager for the PRPs was:
Norm Leclerc
City of Somersworth

603-692-4262 x314

The project managerS for the EPA were:

Roger Duwart (prior to December 2004) and
Michael Jasinski (after December 2004)
EPA Remedial Project Manager / New England Chief, NH/RI Superfund Section
United States Environmental Protection Agency
New England (Region 1)
1 Congress Street Suite 1100 (HBO)
Boston, MA
USA 02114-2023
(617) 918-1352 (for Mike Jasinski)

8. REFERENCES

Beak International Incorporated (Beak). 1998. Design Investigation Report for the Pilot Study and Site Groundwater Monitoring Program. Remedial Design for Preferred Remedial Action at the Somersworth Sanitary Landfill Superfund Site, New Hampshire. Draft Report. July 1998.

Beak International Incorporated and GeoSyntec Consultants International, Inc. (Beak and GeoSyntec). 1999. Preferred Remedial Action 100% Design and Demonstration of Compliance Plan. Somersworth Sanitary Landfill Superfund Site, New Hampshire. Final Report. 23 April 1999.

GeoSyntec Consultants International, Inc. (GeoSyntec). 2000. 100% Design Update #1, Preferred Remedial Action 100% Design and Demonstration of Compliance Plan. Somersworth Sanitary Landfill Superfund Site, New Hampshire. 17 July 2000.

GeoSyntec Consultants International, Inc. (GeoSyntec) 2001a. Sampling and Analysis Plan (SAP) for Groundwater Monitoring During Preferred Remedial Action; Part 1 of 2, Field Sampling Plan. 19 March 2001.

GeoSyntec Consultants International, Inc. (GeoSyntec) 2001b. Chemical Treatment Wall Construction Completion Report. Draft. 30 May 2001.

GeoSyntec Consultants International, Inc. (GeoSyntec). 2001c. Letter to Roger Duwart of EPA Re: Updated Proposal for Monitoring of Suspect Panels of the Chemical Treatment Wall at the Somersworth Sanitary Landfill Superfund Site, New Hampshire. 29 October 2001.

GeoSyntec Consultants International, Inc. (GeoSyntec) 2003. Annual Monitoring and Demonstration of Compliance Report for 2002. DRAFT, 31 January 2003.

GeoSyntec Consultants International, Inc. (GeoSyntec) 2004. Annual Monitoring and Demonstration of Compliance Report for 2003. DRAFT, 2 March 2004.

United States Environmental Protection Agency New England (Region I) (EPA). 1994. Record of Decision, Somersworth Sanitary Landfill Superfund Site.

United States Environmental Protection Agency New England (Region I) (EPA). 1995. Consent Decree for Remedial Design/Remedial Action at the Somersworth Sanitary Landfill Superfund Site, Somersworth, New Hampshire.

Table 1: Major Construction Milestones for Remedial Action

Major Activity	Date	Milestone
Bedrock Extraction Well Installation	April-1996	Installation of BRW-1
Remedial Action Design	April-1999	100% Design Approved by EPA and NHDES
	July-2000	Updated 100% Design Completed
Construction of Chemical Treatment Wall (CTW)	8-Jul-2000	Initiation of CTW Workpad Construction
	1-Aug-2000	Excavation of First CTW Panel
	11-Sep-2000	Backfilling of Final CTW Panel
	28-Sep-2000	Completion of CTW Construction Activities
Construction of Landfill Cover and Bedrock Extraction System	6-Jun-2001	Project Kick-Off Meeting and Initiation of Construction
	29-Aug-2001	Final Inspection Meeting for Cover and Bedrock Extraction
Construction of Landfill Gas (LFG) Venting System	30-Oct-2003	Pre-Construction Meeting on Site
	1-Nov-2003	Initiation of Excavation Activities for LFG Venting Trench
	12-Dec-2003	Completion of Excavation for LFG Venting Trench
	18-Dec-2003	Completion of Backfilling of LFG Venting Trench
	8-Jan-2004	Completion of Site Grading for LFG Venting Trench
	11-Jun-2004	Completion of Site Restoration for LFG Venting Trench
Pre-Final Inspection	15-Jun-2004	Pre-Final Inspection Meeting

Table 2: Summary of CTW Panels and Iron Usage

Panel	Start Location (feet)	End Location (feet)	Length of Panel (feet)	Excavation Date	Backfill Date	Number of Bags of Iron Used
1-A	0	40.96	40.96	1-Aug-00	3-Aug-00	111
1-B	40.96	79.00	38.04	14-Aug-00	15-Aug-00	122
1-C	79.00	99.22	20.22	Nov-99	Nov-99	0
1-D	99.22	134.09	34.87	15-Aug-00	16-Aug-00	78
1-E	134.09	177.22	43.13	8-Aug-00	9-Aug-00	99
2-A	177.22	211.64	34.42	17-Aug-00	17-Aug-00	99
2-B	211.64	245.16	33.52	29-Aug-00	29-Aug-00	65
2-C	245.16	278.59	33.43	30-Aug-00	30-Aug-00	72
3-A	278.59	327.9	49.31	9-Aug-00	10-Aug-00	148
3-B	327.9	377.84	49.94	18-Aug-00	18-Aug-00	182
4-A	377.84	421.95	44.11	10-Aug-00	11-Aug-00	213
4-B	421.95	460.09	38.14	21-Aug-00	22-Aug-00	152
4-C	460.09	497.97	37.88	11-Sep-00	11-Sep-00	145
5-A	497.97	529.51	31.54	23-Aug-00	24-Aug-00	88
5-B	529.51	578.53	49.02	8-Sep-00	9-Sep-00	93
5-C	578.53	614.58	36.05	24-Aug-00	25-Aug-00	82
6-A	614.98	658.39	43.41	8-Sep-00	8-Sep-00	59
6-B	658.39	695.9	37.51	25-Aug-00	26-Aug-00	81
6-C	695.9	733.28	37.38	7-Sep-00	7-Sep-00	60
7-A	733.28	774.55	41.27	26-Aug-00	27-Aug-00	65
7-B	774.55	814.06	39.51	6-Sep-00	6-Sep-00	52
8-A	814.06	863.65	49.59	28-Aug-00	28-Aug-00	126
8-B	863.65	916.35	52.7	30-Aug-00	31-Aug-00	141
TOTAL CTW LENGTH			915.95			2333

Table 3: Comparison of ROD Estimated and Actual Costs Costs

Cost Item	ROD Estimate (in 1993 $)	ROD Estimate (in 2000 $**)	Actual Cost without LFG Trench (costs to the end of 2004)	Actual Cost with LFG Trench (costs to the end of 2004) ***
Pre-Design Investigation Cost	NA	NA	$1,720,000	$1,720,000
RA Capital Cost	$12,744,700	$15,089,725	$4,034,000	$4,770,000
RA OM&M Cost	$2,240,100	$2,652,278	$896,000	$946,000
Total RA Cost (without Pre-Design Investigations)	$14,984,800	$17,742,003	$4,930,000	$5,716,000
Total Cost (RA and Pre-Design Investigations)	NA	NA	$6,650,000	$7,436,000
Difference between Actual Total RA Cost Spent to Date and ROD Estimate of Total RA Cost (Capital plus OM&M Spent to Date) *	--	--	($12,812,003)	($12,026,003)

Notes:

* The difference between the Actual Total RA Cost Spent to Date and ROD Total RA Cost Estimate is due to the fact that the Actual Total RA Cost Spent to Date does not include OM&M costs past the year end of 2004 and that the ROD estimate includes the cost for a RCRA C landfill cover as the "final" cover for the site. Both the ROD and Final RD/RA Statement of Work (SOW) recognize that the final landfill cover may be something other than a costly RCRA C cover. As stated in the ROD (page 39) "after cleanup levels have been achieved and can be maintained without use of the chemical treatment 'wall', EPA will evaluate an appropriate cover to be installed to close the landfill. A significant cost reduction could be realized." The SOW provides (page26) that "the Work Settling Defendants shall submit an evaluation and proposal to EPA and NHDES, based on the data collected in the monitoring programs, of an appropriate landfill cover to be installed to close the landfill that is consistent with the ROD....the types of landfill cover that may be determined to be appropriate ... range from continued maintenance of the permeable cover to installation of a RCRA Subtitle C or D cap.

** ROD Cost was adjusted from 1993 $ to 2000 $ using U.S. Department of Labor Consumer Price Index factor of 1.184

*** ROD Cost Estimate did not include costs for the LFG Trench

Actual OM&M costs include money spent to the end of 2004 and do not include an adjustment for the year the money was spent.

LFG - Landfill Gas

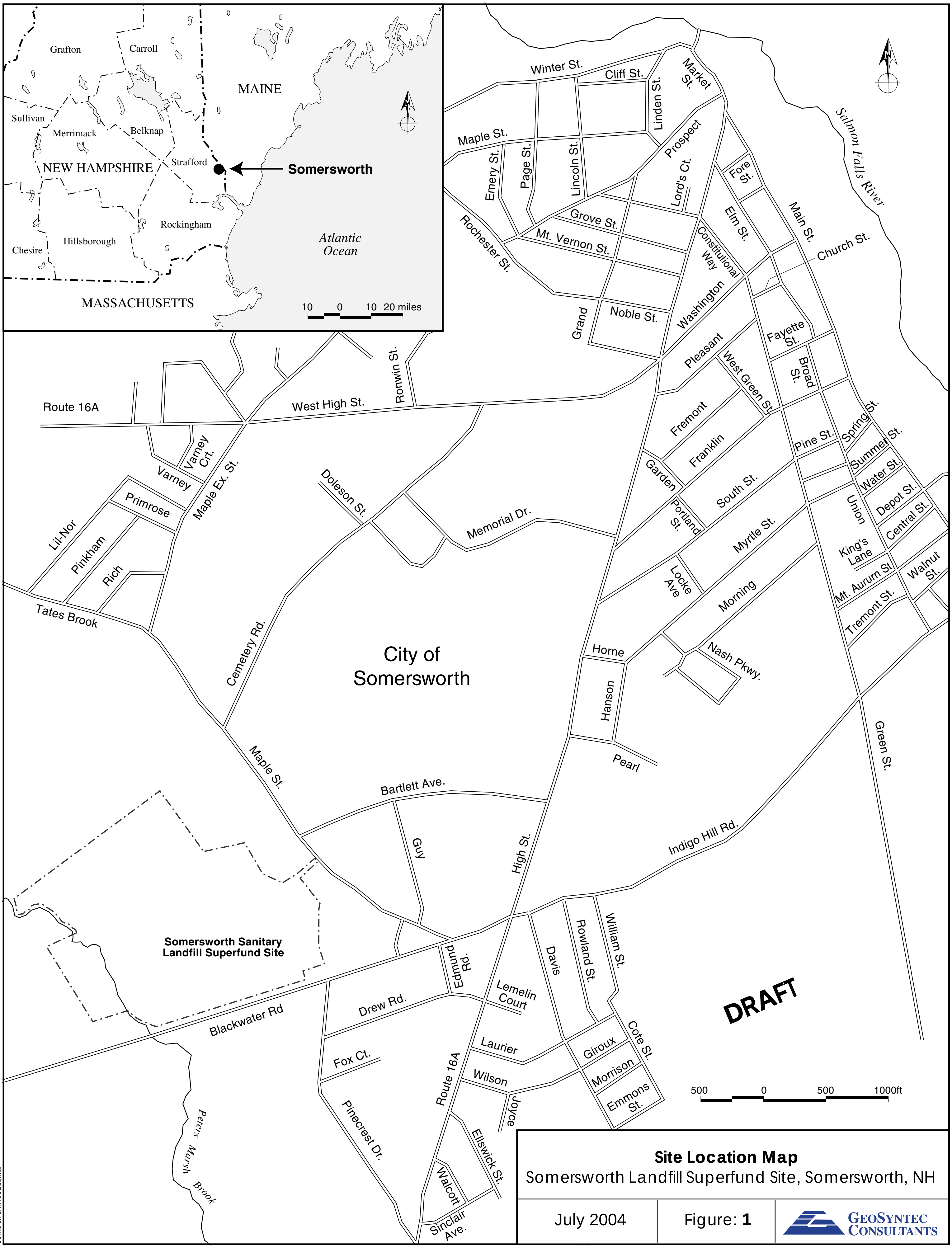
NPV - Net Present Value

NA - Not Available

OM&M - Operations, Maintenance and Monitoring

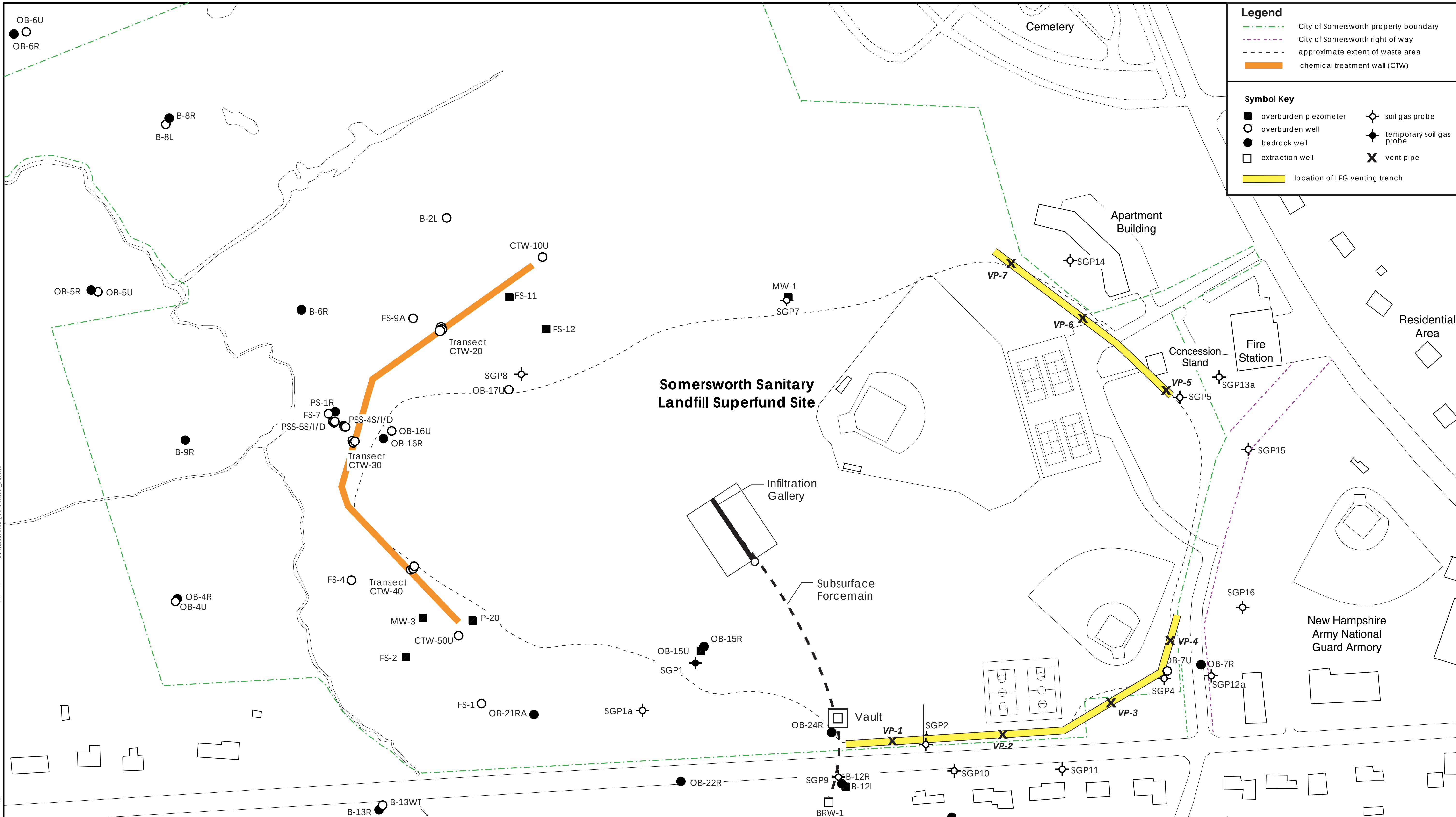
RA - Remedial Action

ROD - Record of Decision



Site Location Map
Somersworth Landfill Superfund Site, Somersworth, NH

July 2004	Figure: **1**	GeoSyntec Consultants

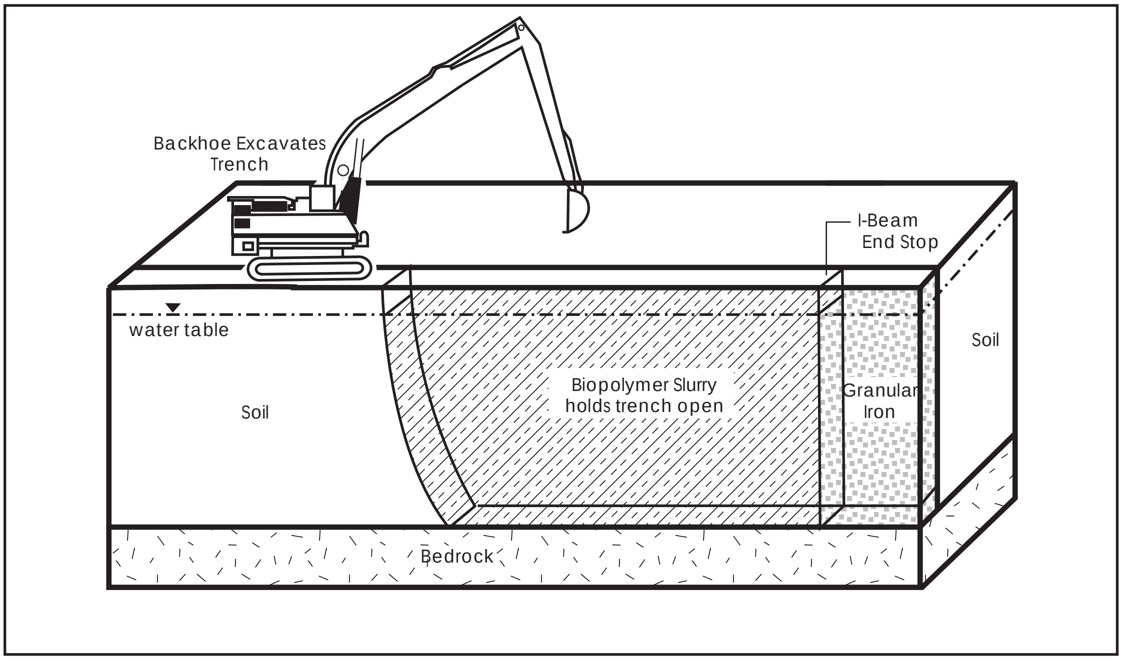


New Landfill Gas Sampling Locations
Somersworth Landfill Superfund Site, Somersworth, NH

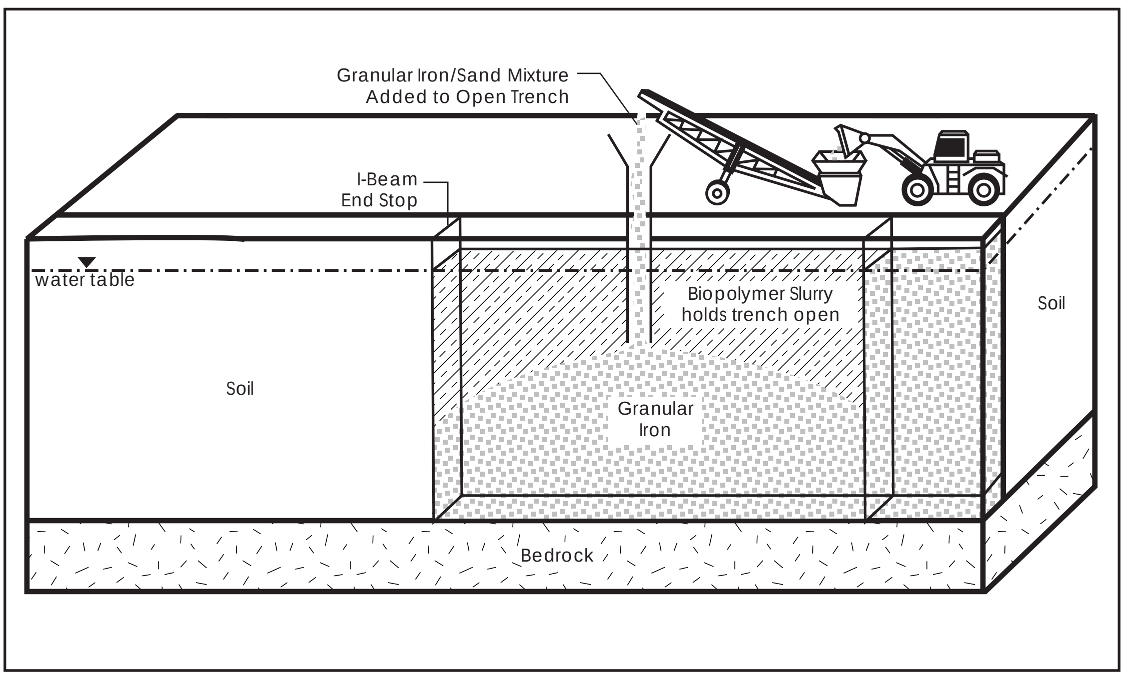
Nov. 2001 | Figure: 2 | GeoSyntec Consultants

File Name: Enlarged Contour_Base.ai

A) Step 1 - Excavation



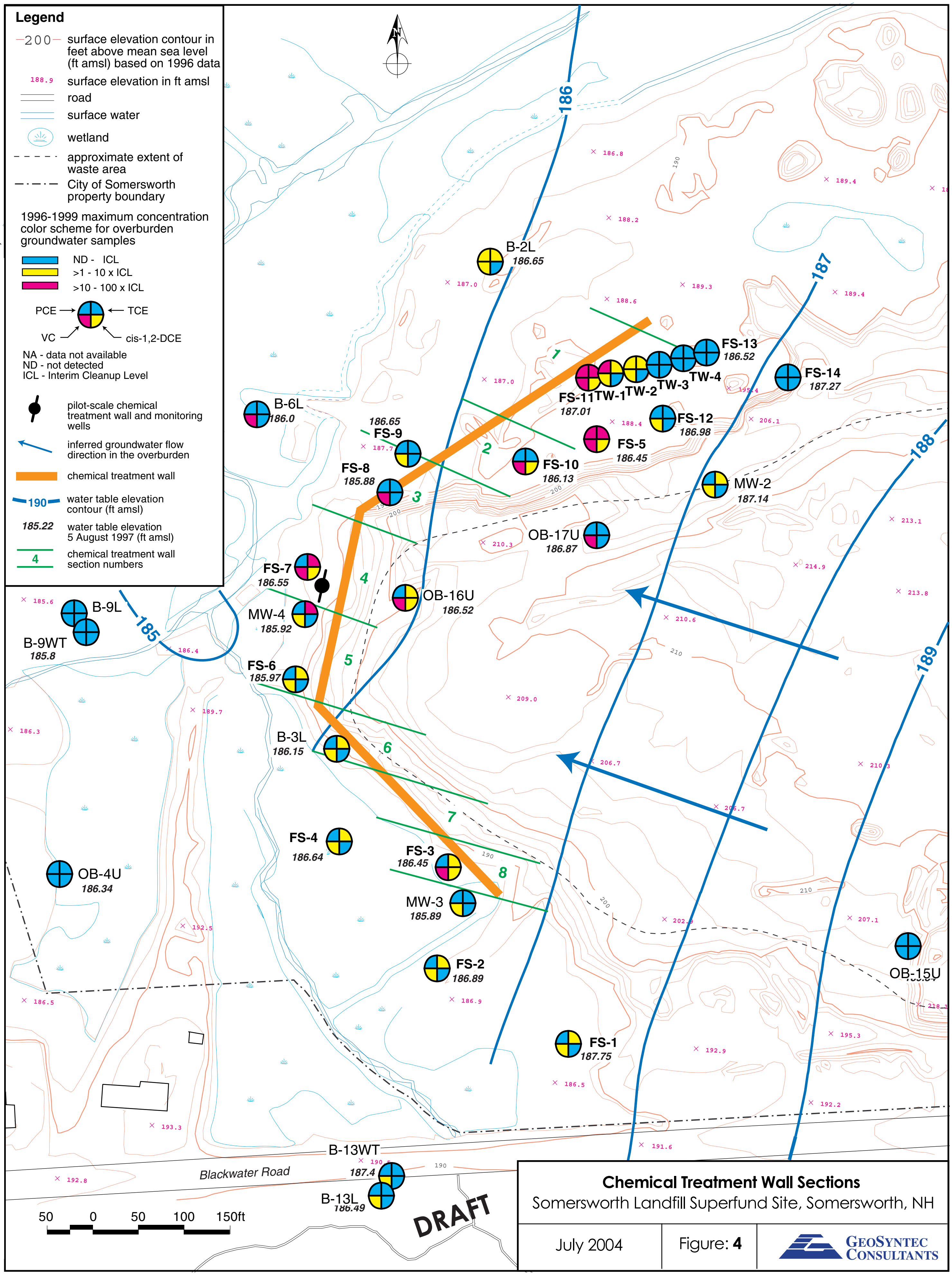
B) Step 2 - Backfilling



DRAFT

schematic.ai

Construction Sequence for Chemical Treatment Wall		
July 2004	Figure: **3**	GeoSyntec Consultants



Chemical Treatment Wall Sections

Somersworth Landfill Superfund Site, Somersworth, NH

July 2004 | Figure: 4

GeoSyntec Consultants

APPENDIX A

AS BUILT DRAWINGS FOR CTW

CONSTRUCTION DRAWINGS

SOMERSWORTH SANITARY LANDFILL SUPERFUND SITE

SOMERSWORTH, NEW HAMPSHIRE

PREFERRED REMEDIAL ACTION
CHEMICAL TREATMENT WALL COMPONENT
AS-BUILT DRAWINGS

JULY, 2004

DETAIL IDENTIFICATION LEGEND

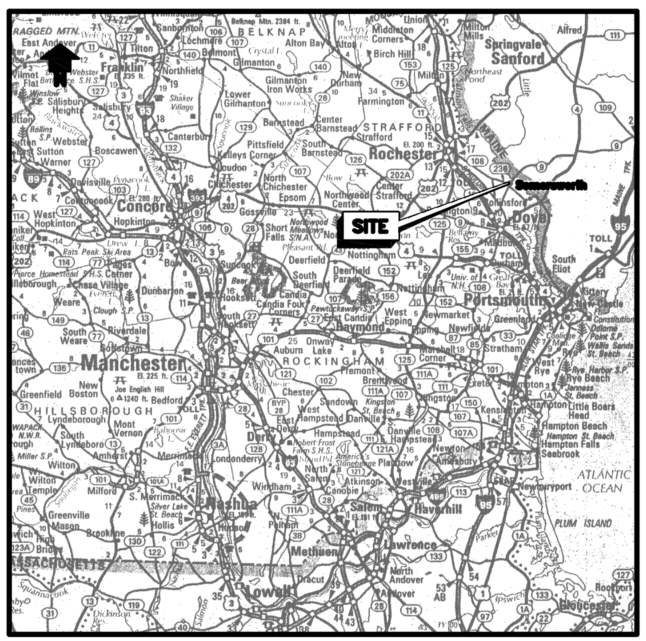
2 / 6 — Detail Number; Sheet on which above detail is presented

Detail Number — 2 / 5 — Sheet on which above detail was first referenced

DETAIL
TITLE OF DETAIL
SCALE: 1" = 1'

Example: Detail Number 2 presented on Sheet No. 6 was referenced for the first time from Sheet No. 5.

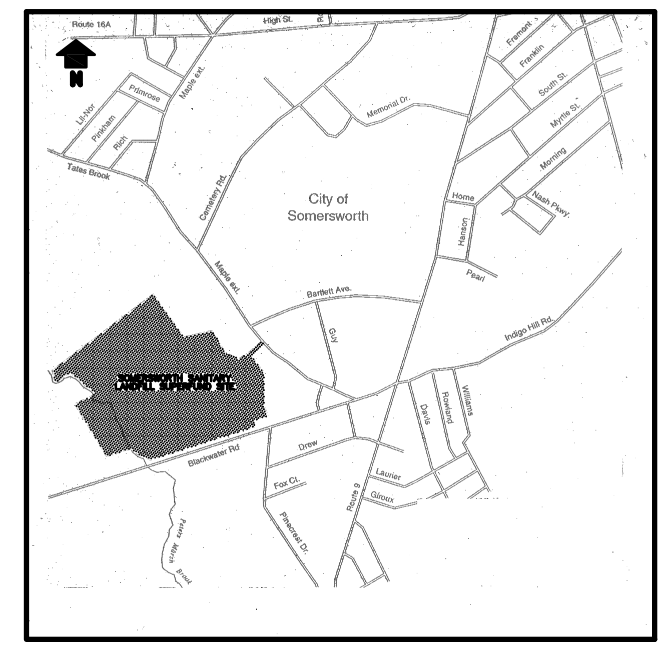
Note: Above system also applies to section identifications.



LOCATION MAP
0 10 MILES
SCALE

LIST OF DRAWINGS

DRAWING	DESCRIPTION
1	TITLE SHEET
2	PRE-CONSTRUCTION SITE CONDITIONS
3	SITE PLAN
4	COVER GRADING PLAN
5	AS-BUILT CTW PLAN AND PROFILE
6	CTW DETAILS
7	SURFACE-WATER MANAGEMENT DETAILS
8	GROUNDWATER EXTRACTION/RE-INJECTION SYSTEM DETAILS
9	GENERAL DETAILS



VICINITY MAP
0 1000 FT.
SCALE

100% DESIGN

PREPARED FOR:

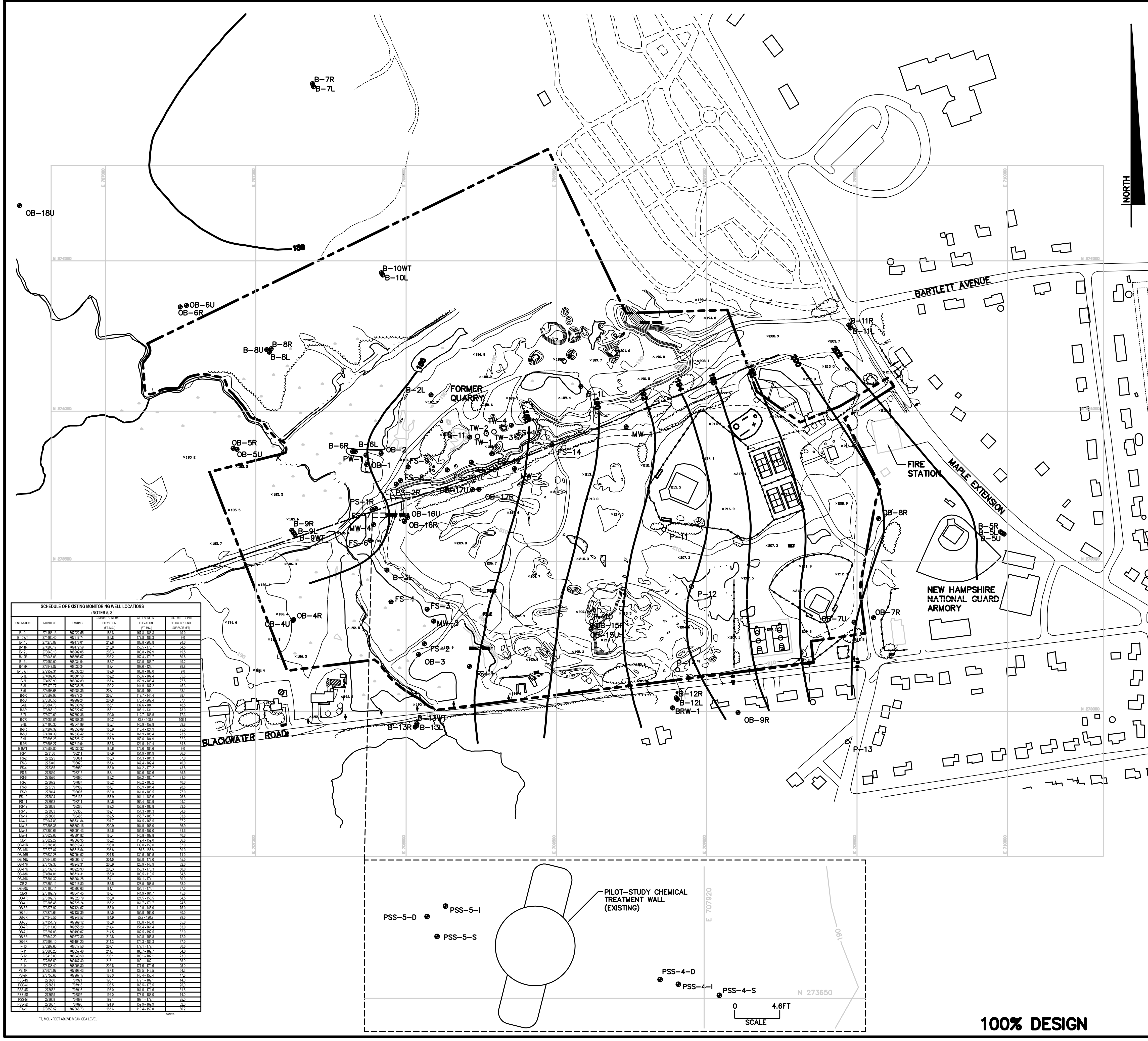
THE SOMERSWORTH LANDFILL SITE GROUP

PREPARED BY:

GEOSYNTEC CONSULTANTS

130 RESEARCH LANE, SUITE 2
GUELPH, ONTARIO, CANADA N1G 5G3
(519) 822-2230

PROJECT NUMBER TR0001-01
FILE NUMBER 0001A001
DRAWING NUMBER 1 OF 9
REVISION D



SCHEDULE OF EXISTING MONITORING WELL LOCATIONS (NOTES 5, 8)					
DESIGNATION	NORTHING	EASTING	GROUND SURFACE ELEVATION (FT, MSL)	WELL SCREEN ELEVATION (FT, MSL)	TOTAL WELL DEPTH BELOW GROUND SURFACE (FT)
B-10L	274453.13	707922.55	186.8	167.8 - 186.3	19.0
B-10WT	274460.40	707917.74	186.8	177.8 - 186.3	9.0
B-11L	274276.87	709478.01	212.8	188.8 - 203.8	24.0
B-11R	274286.17	709472.59	213.0	158.5 - 178.7	54.5
B-12L	273040.13	708902.05	203.3	183.8 - 192.9	19.5
B-12R	273045.03	708898.67	203.2	152.4 - 171.7	50.8
B-13L	272952.00	708034.94	188.7	139.5 - 186.7	49.2
B-13R	272947.87	708030.34	188.4	108.6 - 123.1	79.8
B-13WT	272959.31	708036.23	189.0	180.0 - 188.0	9.0
B-1L	274082.08	708581.50	189.2	153.6 - 187.4	35.6
B-2L	274053.99	708082.89	187.4	159.9 - 185.4	27.5
B-3L	273470.77	707936.28	190.2	144.9 - 187.2	45.3
B-5L	273593.68	709983.35	208.1	150.0 - 163.1	58.1
B-5R	273597.93	709977.24	208.1	119.7 - 144.4	88.4
B-5U	273590.55	709989.24	207.8	170.4 - 202.4	37.4
B-6L	273864.76	707830.92	186.1	137.6 - 184.1	48.5
B-6R	273865.10	707822.07	186.1	108.1 - 131.1	78.0
B-7L	275079.69	707692.36	190.0	112.7 - 185.5	77.3
B-7R	275089.55	707688.35	190.2	83.8 - 108.3	106.4
B-8L	274196.30	707544.89	185.7	145.9 - 157.9	39.8
B-8R	274207.32	707550.89	185.9	110.4 - 124.9	75.5
B-8U	274204.39	707536.42	185.4	161.9 - 185.4	23.5
B-9L	273595.28	707625.17	185.9	153.6 - 184.9	32.3
B-9R	273603.27	707619.94	185.8	121.0 - 140.4	64.8
B-9WT	273588.80	707630.32	185.6	176.6 - 184.6	9.0
FS-1	273150	708211	187.9	151.9 - 181.9	36.0
FS-2	273225	708061	188.3	151.3 - 181.3	37.0
FS-3	273340	708070	187.4	147.4 - 182.4	40.0
FS-4	273365	707950	188.0	144.2 - 179.2	43.8
FS-5	273830	708217	188.1	152.6 - 182.6	35.5
FS-6	273570	707880	189.2	158.2 - 180.7	31.0
FS-7	273672	707887	188.2	148.2 - 183.2	40.0
FS-8	273769	707982	187.7	158.9 - 181.4	28.8
FS-9	273814	708007	188.0	161.0 - 183.5	27.0
FS-10	273804	708137	187.9	161.1 - 183.6	26.8
FS-11	273913	708211	189.6	165.4 - 182.9	24.2
FS-12	273858	708285	189.3	155.8 - 185.8	33.5
FS-13	273953	708350	189.1	154.3 - 184.3	34.8
FS-14	273888	708485	189.5	155.7 - 185.7	33.8
MW-1	273947.83	708731.84	201.7	164.5 - 166.5	37.2
MW-2	273808.36	708360.16	200.9	164.0 - 166.0	36.9
MW-3	273300.66	708091.43	186.6	155.0 - 157.0	31.6
MW-4	273622.03	707891.82	186.4	145.8 - 187.8	40.6
OB-1	273822.27	707868.95	186.2	119.4 - 159.0	66.8
OB-15R	273285.88	708619.43	206.0	139.0 - 159.0	67.0
OB-15U	273273.87	708615.54	205.8	166.8- 186.8	39.0
OB-16R	273632.28	707994.02	201.5	130.5 - 150.5	71.0
OB-16U	273646.05	708005.17	201.0	156.0 - 176.0	45.0
OB-17R	273739.33	708242.31	205.9	123.9 - 143.9	82.0
OB-17U	273739.15	708220.93	206.3	156.3 - 176.3	50.0
OB-18U	274684.01	706714.31	185.0	100.5 - 110.5	84.5
OB-19U	275301.32	706264.28	184.1	154.1 - 174.1	30.0
OB-2	273859.11	707916.80	186.5	128.5 - 158.5	58.0
OB-20U	276160.11	705892.63	181.1	154.1 - 174.1	27.0
OB-3	273189.79	708041.45	187.7	141.9 - 161.7	45.8
OB-4R	273302.77	707623.79	186.0	121.5 - 156.5	64.5
OB-4U	273305.45	707626.24	186.2	161.7 - 171.7	24.5
OB-5R	273875.92	707424.67	185.0	110.0 - 145.0	75.0
OB-5U	273872.64	707437.39	185.0	155.0 - 165.0	30.0
OB-6R	274346.55	707248.57	184.9	85.9 - 120.9	99.0
OB-6U	274351.79	707269.12	185.0	130.0 - 140.0	55.0
OB-7R	273311.80	709555.20	214.4	151.4 - 161.4	63.0
OB-7U	273297.03	709490.07	214.5	182.5 - 192.5	32.0
OB-8R	273642.20	709572.30	212.8	140.8 - 155.8	72.0
OB-9R	272996.10	709104.20	211.3	174.3 - 189.3	37.0
P-10	273299.60	708617.50	207.1	177.1 - 179.1	30.0
P-11	**273606.20**	**708857.40**	**214.7**	**180.7 - 182.7**	**34.0**
P-12	273416.00	708949.50	203.1	180.1 - 182.1	23.0
P-13	272898.50	709467.40	215.1	180.1 - 182.1	35.0
P-14	273138.40	708903.80	202.6	177.6 - 179.6	25.0
PS-1R	273675.97	707898.43	187.8	133.5 - 143.5	54.3
PS-2R	273756.66	707967.17	188.0	140.4 - 150.4	47.6
PSS-4S	273650	707921	193.1	179.1 - 189.1	14.0
PSS-4I	273651	707918	193.5	168.5 - 178.5	25.0
PSS-4D	273652	707916	193.0	161.5 - 171.5	31.5
PSS-5S	273655	707897	192.0	178.0 - 188.0	14.0
PSS-5I	273658	707898	192.1	167.1 - 177.1	25.0
PSS-5D	273657	707896	191.9	159.9 - 169.9	32.0
PW-1	273853.52	707866.73	185.6	119.4 - 159.0	66.2

som.xls

FT, MSL - FEET ABOVE MEAN SEA LEVEL

LEGEND

- 200 — OVERBURDEN PIEZOMETRIC SURFACE (FEET)
- 210 — EXISTING GROUND ELEVATION (FEET)
- ×213.1 — EXISTING SPOT ELEVATION (FEET)
- APPROXIMATE PROPERTY BOUNDARY (NOTE 3)
- PAVED ROAD
- UNPAVED ROAD
- WATER LINE
- TREELINE
- APPROXIMATE EXTENT OF WASTE (NOTE 3)
- FENCE
- NATURAL GAS PIPELINE (NOTES 3,4)
- UTILITY POLE
- MONITORING WELL (NOTE 5)
- WETLANDS

NOTES:

1. TOPOGRAPHIC MAP AND RELATED SITE FEATURES COMPILED BY EASTERN TOPOGRAPHICS, INC. WOLFBORO, NEW HAMPSHIRE, BASED ON AERIAL PHOTOGRAPHY TAKEN IN FALL 1996.
2. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL (MSL), NGVD 1929. GRID COORDINATES CORRESPOND TO THE MAINE STATE PLANE COORDINATE SYSTEM, WEST ZONE, NAD 1927.
3. LOCATIONS OF PROPERTY BOUNDARY, NATURAL GAS PIPELINE, AND EXTENT OF WASTE BOUNDARY ARE APPROXIMATE, AND WERE TAKEN FROM FIGURE 1.2 OF THE SEPTEMBER 1998 CONCEPTUAL DESIGN REPORT, PREPARED BY BEAK INTERNATIONAL, INC., GUELPH, ONTARIO.
4. GAS PIPELINE OWNER, NORTHERN UTILITIES, INC., HAS INDICATED THAT AN ACTIVE GAS PIPELINE AND ABANDONED GAS PIPELINE EXIST SIDE-BY-SIDE ALONG THE APPROXIMATE LOCATION SHOWN ON THIS DRAWING. CONTRACTOR IS RESPONSIBLE FOR CONTACTING NORTHERN UTILITIES AT (603)436-0310 TO LOCATE THESE GAS PIPELINES.
5. GROUNDWATER MONITORING WELL LOCATIONS TABULATED TO THE NEAREST 0.01-FT LOCATION AND SHOWN ON THIS DRAWING WERE TAKEN FROM JULY 1998 DESIGN INVESTIGATION REPORT FOR THE PILOT STUDY AND SITE GROUNDWATER MONITORING PROGRAM, REMEDIAL DESIGN FOR PREFERRED REMEDIAL ACTION AT THE SOMERSWORTH SANTORY LANDFILL SUPERFUND SITE, PREPARED BY BEAK INTERNATIONAL, INC.
6. OVERBURDEN PIEZOMETRIC SURFACE (I.E., WATER TABLE) IS APPROXIMATE AND SHOWS CONTOURS FROM 28 APRIL 1996. SURFACE WAS TAKEN FROM FIGURE 5.4 OF THE JUNE 1996 DESIGN INVESTIGATION REPORT FOR THE PRE-PILOT HYDROGEOLOGICAL AND GEOTECHNICAL INVESTIGATION, PREPARED BY BEAK INTERNATIONAL, INC. ADDITIONAL INFORMATION ON THE SITE HYDROGEOLOGY (E.G., WATER TABLE ELEVATIONS, TOP OF BEDROCK ELEVATIONS, ETC.) IS INCLUDED WITH THE CONTRACT DOCUMENTS. CONTRACTOR MAY PERFORM SITE INVESTIGATION AT THEIR OWN EXPENSE TO FURTHER DEFINE THE HYDROGEOLOGIC CONDITIONS THAT MAY BE ENCOUNTERED.
7. CONTRACTOR IS RESPONSIBLE FOR VERIFICATION OF EXISTING CONDITIONS SHOWN ON THIS DRAWING.
8. WELLS OB-19U AND OB-20U ARE LOCATED BEYOND THE MAPPING LIMITS SHOWN ON THIS DRAWING.

150 75 0 150 300
SCALE IN FEET

GEOSYNTEC CONSULTANTS
130 RESEARCH LANE, SUITE 2
GUELPH, ONTARIO, CANADA N1G 5G3

THE SOMERSWORTH LANDFILL SITE GROUP

PROJECT: CONSTRUCTION DRAWINGS
DESIGN FOR PREFERRED REMEDIAL ACTION

WORK: **SOMERSWORTH SANITARY LANDFILL SUPERFUND SITE**

TITLE:
PRE-CONSTRUCTION SITE CONDITIONS

MARK	DATE	REVISION	BY	APPROVED
D	JULY 2004	TITLE BLOCK CHANGE	MR	TK
B	APRIL 2000	CHANGED LOCATION OF FS-11	WDB	TK
A	APRIL 1999	NO CHANGES TO THIS DRAWING	SMG	JFB

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

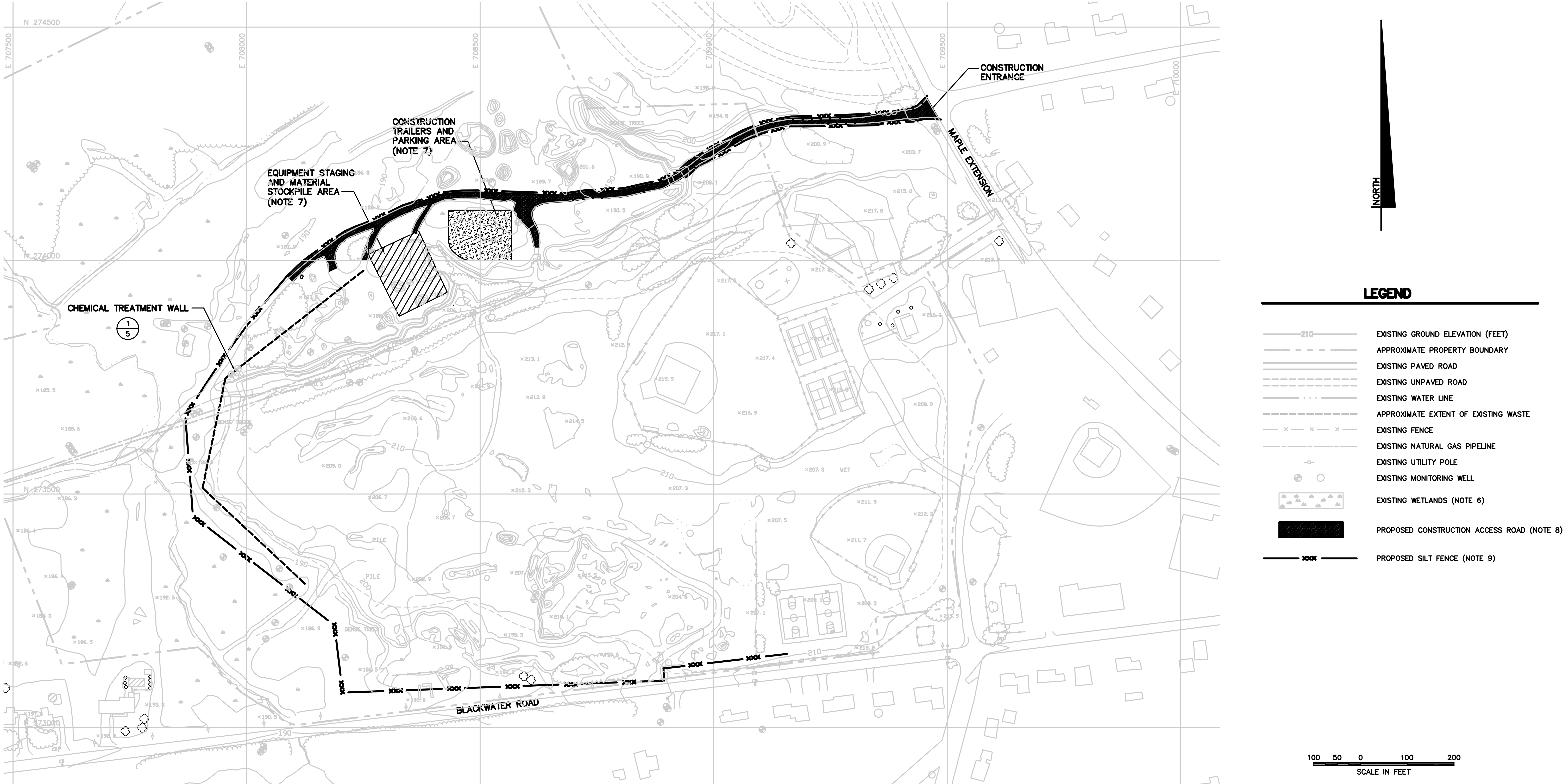
SIGNATURE

DATE

SEAL

DATE:	APRIL 1999	SCALE:	1" = 150'
DESIGN BY:	SMG	JOB NO.:	TR0001-01
DRAWN BY:	JW	FILE NO:	0001B002
CHECKED BY:	MJM	REVISION:	D
REVIEWED BY:	TK	DRAWING NO:	2 OF 9
APPROVED BY:	JFB		

100% DESIGN



NOTES:

1. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL (MSL), NGVD 1929. GRID COORDINATES CORRESPOND TO THE MAINE STATE PLANE COORDINATE SYSTEM, WEST ZONE, NAD 1927.
2. EXISTING CONDITIONS TAKEN FROM DRAWING 2.
3. CONTRACTOR IS RESPONSIBLE FOR ESTABLISHING SURVEY CONTROL AT THE SITE PRIOR TO CONSTRUCTION.
4. CONTRACTOR IS RESPONSIBLE FOR VERIFICATION OF EXISTING SITE CONDITIONS, AND SHALL PERFORM PRE-CONSTRUCTION SURVEY AS FURTHER DESCRIBED IN THE SPECIFICATIONS. CONTRACTOR SHALL LOCATE AND PROVIDE CLEARANCE FOR ALL ABOVE-GROUND AND UNDERGROUND UTILITIES PRIOR TO CONSTRUCTION. THE GAS PIPELINE OWNER, NORTHERN UTILITIES, INC., MAY BE REACHED AT (603)436-0310.
5. ANY EXISTING FACILITY OR SITE FEATURE, (E.G., NATURAL GAS PIPELINE, GROUNDWATER WELLS, FENCING, ETC.), DAMAGED BY THE CONTRACTOR SHALL BE RESTORED OR REPLACED TO THE SATISFACTION OF THE SITE GROUP. THE CONTRACTOR SHALL BEAR THE ENTIRE COST OF RESTORATION AND/OR REPLACEMENT. CONSTRUCTION ACTIVITIES ADJACENT TO THESE FEATURES SHALL BE AS DESCRIBED IN THE SPECIFICATIONS.
6. WETLAND DELINEATION TO BE PERFORMED BY THE SITE GROUP PRIOR TO CONSTRUCTION. BASED ON THE FINDINGS OF THE WETLAND DELINEATION, THE SITE GROUP WILL UPDATE THE DRAWINGS AND SPECIFICATIONS TO ADDRESS WETLANDS MITIGATION/RESTORATION (IF APPLICABLE), AND SUBMIT THE PLANS TO THE NEW HAMPSHIRE WETLANDS BUREAU. CONTRACTOR WILL BE PROVIDED WITH WETLAND DELINEATION PRIOR TO CONSTRUCTION. PRIOR TO CONSTRUCTION THE CONTRACTOR SHALL MARK THE WETLAND LIMITS WITH WARNING TAPE, AND MARKING SHALL BE MAINTAINED THROUGHOUT CONSTRUCTION.
7. CONTRACTOR'S FACILITIES, MATERIAL STOCKPILES, STAGING AREAS, AND STORAGE AREAS SHALL BE LOCATED AS SHOWN ON THIS DRAWING AND DESCRIBED IN THE CONTRACT DOCUMENTS, UNLESS PRIOR APPROVAL IS OBTAINED BY THE SITE GROUP. CONTRACTOR IS RESPONSIBLE FOR MAINTAINING ALL SUCH AREAS DURING CONSTRUCTION AND FOR CLEANUP/RESTORATION OF SUCH AREAS AFTER CONSTRUCTION.
8. CONTRUCTION TRAFFIC ACCESS TO THE SITE SHALL BE RESTRICTED TO THE SITE ENTRANCE ON MAPLE EXTENSION AS SHOWN ON THIS DRAWING, UNLESS OTHERWISE APPROVED BY THE SITE GROUP. CONTRACTOR SHALL BE RESPONSIBLE FOR CONSTRUCTION/MAINTENANCE OF THE CONSTRUCTION ACCESS ROAD AND ANY OTHER TEMPORARY ACCESS ROADS NECESSARY FOR CONSTRUCTION. LOCATIONS OF TEMPORARY ACCESS ROADS SHALL BE ONLY AS APPROVED BY THE SITE GROUP.
9. STORM-WATER MANAGEMENT AND EROSION AND SEDIMENT CONTROL FEATURES SHALL BE ESTABLISHED BY THE CONTRACTOR IN ACCORDANCE WITH APPLICABLE STATE AND LOCAL REQUIREMENTS AND THE SPECIFICATIONS. THE FEATURES SHALL BE INSTALLED BY THE CONTRACTOR AROUND AND DOWN-GRADIENT OF AREAS TO BE DISTURBED PRIOR TO CONSTRUCTION AND SHALL BE MAINTAINED BY THE CONTRACTOR AS NEEDED DURING AND AFTER CONSTRUCTION IN ACCORDANCE WITH THE SPECIFICATIONS.

100% DESIGN

GEOSYNTEC CONSULTANTS
130 RESEARCH LANE, SUITE 2
GUELPH, ONTARIO, CANADA N1G 5G3

THE SOMERSWORTH LANDFILL SITE GROUP

PROJECT: CONSTRUCTION DRAWINGS
DESIGN FOR PREFERRED REMEDIAL ACTION

WORK: **SOMERSWORTH SANITARY LANDFILL SUPERFUND SITE**

TITLE: **SITE PLAN**

MARK	DATE	REVISION	BY	APPROVED
D	JULY 2004	TITLE BLOCK CHANGE	MR	TK
B	APRIL 2000	CTW EXTENDED 75 FT. NE	WDB	TK
A	APRIL 1999	NO CHANGES TO THIS DRAWING	SMG	JFB

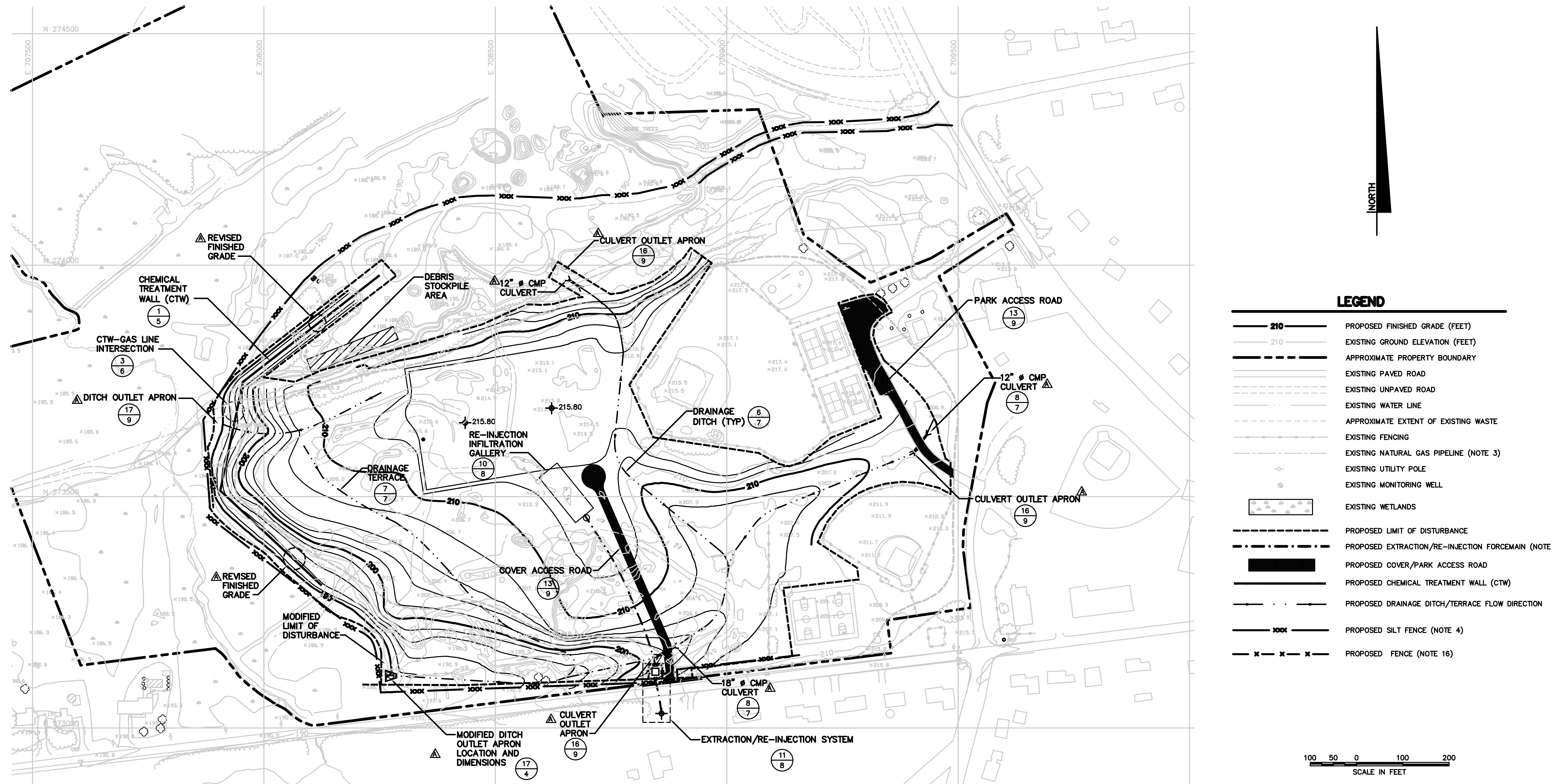
THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

SEAL

DATE:	APRIL 1999	SCALE:	1" = 100'
DESIGN BY:	SMG	JOB NO.:	TR0001-01
DRAWN BY:	JW	FILE NO:	0001B003
CHECKED BY:	MJM	REVISION:	D
REVIEWED BY:	TK	DRAWING NO:	3 OF 9
APPROVED BY:	JFB		



NOTES:

1. ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL (MSL), NGVD 1929. GRID COORDINATES CORRESPOND TO THE MAINE STATE PLANE COORDINATE SYSTEM, WEST ZONE, NAD 1927.
2. ANY EXISTING FACILITY OR SITE FEATURE, (E.G., NATURAL GAS PIPELINE, GROUNDWATER WELLS, FENCING, ETC.), DAMAGED BY THE CONTRACTOR SHALL BE RESTORED OR REPLACED TO THE SATISFACTION OF THE SITE GROUP. THE CONTRACTOR SHALL BEAR THE ENTIRE COST OF RESTORATION AND/OR REPLACEMENT. CONSTRUCTION ACTIVITIES ADJACENT TO THESE FEATURES SHALL BE AS DESCRIBED IN THE SPECIFICATIONS.
3. CONTRACTOR SHALL NOTIFY NORTHERN UTILITIES, INC., AT (603)436-0310 AND THE ENGINEER 3-DAYS PRIOR TO PERFORMING ANY EXCAVATION WITHIN 10-FT OF THE NATURAL GAS PIPELINE. ALL SUCH WORK SHALL BE CONDUCTED ONLY UNDER THE SUPERVISION OF A NORTHERN UTILITIES, INC. REPRESENTATIVE.
4. STORM-WATER MANAGEMENT AND EROSION AND SEDIMENT CONTROL FEATURES SHALL BE ESTABLISHED BY THE CONTRACTOR IN ACCORDANCE WITH APPLICABLE STATE AND LOCAL REQUIREMENTS AND THE SPECIFICATIONS. THE FEATURES SHALL BE INSTALLED BY THE CONTRACTOR AROUND AND DOWN-GRADIENT OF AREAS TO BE DISTURBED PRIOR TO CONSTRUCTION AND SHALL BE MAINTAINED BY THE CONTRACTOR AS NEEDED DURING AND AFTER CONSTRUCTION IN ACCORDANCE WITH THE SPECIFICATIONS.
5. PROPOSED CONTOURS AND CONSTRUCTION CONTROL POINTS SHOWN ON THIS DRAWING REPRESENT FINISHED GRADE (I.E., TOP OF TOPSOIL LAYER). THE CONTRACTOR SHALL ALSO USE THE INFORMATION PRESENTED ON THIS DRAWING TO ACHIEVE THE REQUIRED SUBGRADE GRADES (I.E., BOTTOM OF COVER SYSTEM GRANULAR LAYER) UPON WHICH THE COVER SYSTEM WILL BE CONSTRUCTED.
6. CONSTRUCTION CONTROL POINTS ARE PROVIDED TO ASSIST THE CONTRACTOR AND FOR AS-BUILT VERIFICATION PURPOSES. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ACHIEVE THE FINISHED GRADES AS REPRESENTED BY THE CONTOURS SHOWN ON THIS DRAWING, BETWEEN ALL CONSTRUCTION CONTROL POINTS.
7. LIMIT OF DISTURBANCE SHOWN ON THIS DRAWING SHOULD BE CONSIDERED APPROXIMATE AND SHALL BE FIELD-LOCATED BY THE CONTRACTOR AS APPROVED BY SITE GROUP AND ENGINEER DURING CONSTRUCTION.
8. CLEARED TREES, STUMPS, AND VEGETATION SHALL BE CHIPPED AND PLACED AS MULCH ON-SITE AS DIRECTED BY THE SITE GROUP. UNDER NO CIRCUMSTANCES SHALL TREES, STUMPS, BRANCHES, OR OTHER ORGANIC MATERIAL BE PLACED WITHIN THE COVER SYSTEM LIMITS.
9. SURFACIAL CONSTRUCTION/DEMOLITION DEBRIS (E.G., CONCRETE, ASPHALT, BRICKS, ETC.) SHALL BE MOVED AND GRADED AS NECESSARY TO ACHIEVE THE REQUIRED COVER GRADES. DEBRIS MAY BE PLACED IN FILL AREAS PROVIDED THAT IT MEETS OR IS MODIFIED TO MEET THE MATERIAL REQUIREMENTS GIVEN IN THE SPECIFICATIONS. DEBRIS NOT MEETING THE FILL MATERIAL REQUIREMENTS, SUCH AS LARGE CHUNKS, SHALL BE STOCKPILED BY THE CONTRACTOR IN THE DESIGNATED AREA SHOWN ON THE DRAWINGS UNLESS OTHERWISE APPROVED BY THE SITE GROUP.
10. CONTRACTOR SHALL REMOVE PAVED ROAD AND PARKING LOT (PARK ACCESS ROAD) WITHIN THE LIMIT OF DISTURBANCE AS SHOWN ABOVE. PAVEMENT SHALL BECOME THE CONTRACTOR'S PROPERTY FOR OFF-SITE RECYCLING IN ACCORDANCE WITH NHDES REGULATIONS. PAVEMENT SHALL NOT BE DISPOSED OF ON-SITE.
11. EXISTING FENCE WITHIN THE LIMIT OF DISTURBANCE SHALL BE REMOVED AND DISPOSED OF BY THE CONTRACTOR. CONTRACTOR SHALL NOT DISTURB OR DAMAGE EXISTING FENCING OUTSIDE THE LIMIT OF DISTURBANCE.
12. AREAS REQUIRING CUT TO ACHIEVE THE REQUIRED SUBGRADE ELEVATIONS SHALL BE PROOF-ROLLED PRIOR TO CONSTRUCTION OF THE COVER SYSTEM. AREAS REQUIRING FILL TO ACHIEVE THE REQUIRED SUBGRADE ELEVATIONS SHALL BE FILLED WITH STRUCTURAL FILL IN ACCORDANCE WITH THE SPECIFICATIONS.
13. ALIGNMENT OF PROPOSED FORCEMAIN IS APPROXIMATE, AND MAY BE MODIFIED SLIGHTLY BASED ON FIELD CONDITIONS WITH PRIOR APPROVAL OF THE SITE GROUP. CONTRACTOR SHALL PRESSURE TEST FORCEMAIN IN ACCORDANCE WITH THE SPECIFICATIONS PRIOR TO BACKFILLING. TRENCHING SHALL COMPLY WITH ALL NHDOT AND OSHA REQUIREMENTS.
14. RIPRAP OUTLET APRONS SHALL BE AS SHOWN ON DRAWING 9. (A)
15. CONTRACTOR IS RESPONSIBLE FOR LOCATING UTILITIES AND COORDINATING TRAFFIC CONTROL FOR FORCEMAIN INSTALLATION ACROSS BLACKWATER ROAD. CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS NEEDED TO PERFORM THIS WORK.
16. CHAIN LINK FENCE AROUND CONCRETE VAULT AND EXTRACTION/RE-INJECTION CONTROL SYSTEM SHALL BE 7-FT HIGH FENCING WITH BARBED WIRE, AND SHALL CONFORM TO NHDOT SECTION 607. FENCING SHALL INCLUDE A 12-FT WIDE GATE ALONG EAST SIDE.

100% DESIGN

GEOSYNTEC CONSULTANTS
130 RESEARCH LANE, SUITE 2
GUELPH, ONTARIO, CANADA N1G 5G3

THE SOMERSWORTH LANDFILL SITE GROUP

PROJECT: CONSTRUCTION DRAWINGS
DESIGN FOR PREFERRED REMEDIAL ACTION

WORK: **SOMERSWORTH SANITARY LANDFILL SUPERFUND SITE**

TITLE: **COVER GRADING PLAN**

MARK	DATE	REVISION	BY	APPROVED
D	JULY 2004	TITLE BLOCK CHANGE	MR	TK
B	APRIL 2000	CTW EXTENDED 75 FT. NE	WDB	TK
A	APRIL 1999	RESPONSE TO MARCH 1999 USEPA COMMENT NO'S 19, 20, 21, 23 AND 24.	SMG	JFB

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

SEAL

DATE:	APRIL 1999	SCALE:	1" = 100'
DESIGN BY:	SMG	JOB NO.:	TR0001-01
DRAWN BY:	JW	FILE NO:	0001B004
CHECKED BY:	MJM	REVISION:	D
REVIEWED BY:	TK	DRAWING NO:	4 OF 9
APPROVED BY:	JFB		