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REMEDIATION SYSTEM EVALUATION (RSE)

GCL TIE AND TREATING SUPERFUND SITE
SIDNEY, NEW YORK

Report of the Remediation System Evaluation
Site Visit Conducted July 13, 2006

Final Report
December 2006

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 EPA contract 68-C-02-092 to Dynamac Corporation, Ada, Oklahoma. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

EXECUTIVE SUMMARY

A Remediation System Evaluation (RSE) involves a team of expert hydrogeologists and engineers, independent of the site, conducting a third-party evaluation of site operations. It is a broad evaluation that considers the goals of the remedy, site conceptual model, above-ground and subsurface performance, and site closure strategy. The evaluation includes reviewing site documents, visiting the site for up to 1.5 days, and compiling a report that includes recommendations to improve the system. Recommendations with cost and cost savings estimates are provided in the following four categories:

- Improvements in remedy effectiveness
- Reductions in operation and maintenance costs
- Technical improvements
- Gaining site closeout

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 by the RSE team, and represent the opinions of the RSE team. These recommendations do not constitute requirements for future action, but rather are provided for the consideration of all stakeholders.

The GCL Tie and Treating Superfund Site is located along the outskirts of Sidney in Delaware County, New York. The site is a former wood treating facility that was operated between the early 1950s and 1988 when the property was abandoned by the owners. The site soils and ground water were impacted by creosote-related compounds as a result of these historical activities. The site contamination has been divided into two Operable Units (OUs). The OU1 remedy, which was completed in 2001, addressed contaminated soils. The OU2 remedy addressed ground water contamination with a pump and treat (P&T) system. This RSE focuses on the OU2 remedy, which is now completing the first year of a 10-year Long-Term Remedial Action before being transferred to the State of New York for operation and maintenance.

In general, the RSE team found a well-operated system. The observations and recommendations contained in this report are not intended to imply a deficiency in the work of either the system designers or operators, but are offered as constructive suggestions in the best interest of the EPA, the public, and the facility. These recommendations have the benefit of being formulated based on operational data unavailable to the original designers.

Recommendations are provided in three of the four of the categories: effectiveness, cost reduction, and technical improvement. No recommendations are provided regarding site closure. The recommendations for improving system effectiveness are as follows:

- A routine ground water monitoring program that consists primarily of annual sampling from site monitoring wells should be established.

- An additional monitoring well could be added downgradient of MW-11B to horizontally delineate the naphthalene plume in the bedrock aquifer. The plume is currently not delineated in this area; however, the naphthalene concentrations at MW-11B are only a factor of two above the cleanup standard, and conservative transport modeling suggests that the contamination likely degrades within a few hundred feet of MW-11B. Therefore, the additional monitoring well may or may not be necessary depending on how rigorously EPA would like to demonstrate plume delineation.

- The Five-Year Review suggested that soil vapor intrusion be evaluated for buildings in the area. It is suggested that this evaluation begin with an investigation of shallow ground water in the vicinity of the Meadwestvaco building.

Implementing these recommendations might require $50,000 in capital costs. The ground water monitoring program suggested by the RSE team would cost less than the monitoring event conducted in Spring 2006, and the savings associated with this suggested program are considered in the cost reduction recommendations. Recommendations for cost reduction include the following:

- Historical ground water sampling in the intermediate (overburden) zone suggests that the plume is stable without pumping from the overburden. Given that the overburden contributes high levels of natural manganese that complicate operation of the treatment plant, the site team could substantially simplify plant operations without sacrificing effectiveness by eliminating pumping from the intermediate zone. The RSE team estimates that this change could save approximately $104,000 in operator labor per year without any increase in capital costs.

- In addition to eliminating pumping from the intermediate zone, the site team could consider automating the backwashing of the greensand filters. Approximately $28,000 per year might be saved by implementing this recommendation, but implementation might cost as much as $100,000 in capital costs. The incremental cost-effectiveness of this recommendation depends on the cost savings realized by eliminating the extraction from the overburden.

- Suggestions are provided for a long-term ground water monitoring program so that monitoring can be provided cost-effectively. The suggestions include competitive bidding of the ground water sampling, reducing the number of wells sampled compared to the Spring 2006 event, and contracting the ground water sampling directly through the U.S. Army Corps of Engineers. Implementing these suggestions could save approximately $54,000 per year.

- The air stripper was included in the design because substantially higher concentrations of volatile organic compounds (VOCs) were expected in the treatment plant influent. The liquid phase GAC alone should be able to provide cost-effective removal of the low-level VOCs that are actually present in the influent. A net savings of approximately $14,000 per year is expected if the air stripper is bypassed.

- The current contract has negotiated fixed-price terms, and several of the items in this fixed-price contract are uncertain. As a result, EPA is likely paying for items whether or not they are used. It is suggested that future contracts consider a hybrid of time & materials (T&M) terms and fixed-price terms so that EPA only pays for those materials that are needed rather than those materials that the contractor estimates might be expected under reasonable worst case scenarios. This change in contracting approach could likely save approximately $35,500 per year or more.

- Project management costs (including USACE oversight) have been relatively high at this site, but this is likely explained by the operational difficulties with the system. Once system operation is streamlined the RSE team suggests reducing project management costs so that they are in line with other cost-effectively operated systems. This might result in a savings of approximately $84,000 per year.

In total, the RSE team identifies approximately $319,500 per year in potential savings. The RSE team also provides a recommendation for technical improvement based on the input from the plant operator. The recommendation involves approximately $12,000 in modifications to the plant that include changing the location of a high-high level switch and installing isolation valves on the sight glasses. No recommendations are provided with regard to site closure, especially given that this is the first year of long-term operation.

A table summarizing the recommendations, including estimated costs and/or savings associated with those recommendations, is presented in Section 7.0 of this report.

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) in support of the "Action Plan for Ground Water Remedy Optimization" (OSWER 9283.1-25, August 25, 2004). The objective of this project is to conduct Remediation System Evaluations (RSEs) at selected pump and treat (P&T) systems that are jointly funded by EPA and the associated State agency. The project contacts are as follows:

Organization	Key Contact	Contact Information
U.S. EPA Office of Superfund Remediation and Technology Innovation (OSRTI)	Jennifer Hovis	2777 South Crystal Drive 5th Floor Mail Code 5204P Arlington, VA 22202 phone: 703-603-8888 hovis.jennifer@epa.gov
Dynamac Corporation (Contractor to U.S. EPA)	Daniel F. Pope	Dynamac Corporation 3601 Oakridge Boulevard Ada, OK 74820 phone: 580-436-5740 fax: 580-436-6496 dpope@dynamac.com
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1.0 INTRODUCTION

1.1 PURPOSE

During fiscal years 2000 and 2001 Remediation System Evaluations (RSEs) were conducted at 20 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*. OSRTI has since commissioned RSEs at 10 additional Fund-lead sites with P&T systems. An independent EPA contractor is conducting these RSEs, and representatives from EPA OSRTI are participating as observers.

The RSE process was developed by the US Army Corps of Engineers (USACE) and is documented on the following website:

http://www.environmental.usace.army.mil/library/guide/rsechk/rsechk.html

An RSE involves a team of expert hydrogeologists and engineers, independent of the site, conducting a third-party evaluation of site operations. It is a broad evaluation that considers the goals of the remedy, site conceptual model, above-ground and subsurface performance, and site closure strategy. The evaluation includes reviewing site documents, visiting the site for up to 1.5 days, and compiling a report that includes recommendations to improve the system. Recommendations with cost and cost savings estimates are provided in the following four categories:

- Improvements in remedy effectiveness
- Reductions in operation and maintenance costs
- Technical improvements
- Gaining site closeout

The recommendations are intended to help the site team (the responsible party and the regulators) 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 by the RSE team, and represent the opinions of the RSE team. These recommendations do not constitute requirements for future action, but rather are provided for the consideration of all site stakeholders.

The GCL Tie and Treating Superfund Site (the Site) was selected by EPA OSRTI based on a recommendation from EPA Region 2. In particular, the treatment system has required more attention than originally planned, and the site team is looking for cost-reduction strategies that will allow the system to more cost-effectively maintain its designed level of protectiveness. This report provides a brief background on the site and current operations, a summary of observations made during a site visit, and recommendations regarding the remedial approach. The cost impacts of the recommendations are also discussed.

1.2 TEAM COMPOSITION

The team conducting the RSE consisted of the following individuals:

Peter Rich, Civil and Environmental Engineer, GeoTrans, Inc.
Doug Sutton, Water Resources Engineer, GeoTrans, Inc.

The RSE team was also accompanied by the following observers:

Sherri Clark from EPA OSRTI

1.3 DOCUMENTS REVIEWED

Author	Date	Title
U.S. EPA	3/1995	Record of Decision
U.S. EPA	9/2003	Five-Year Review Report
U.S. EPA	4/2005	Remedial Action Report
CDM	7/2001	Pre-Design Investigation Report
CDM	7/2006	Ground Water Sampling Report, Spring 2006
CDM	10/2001	Final Design Package
Conti	1/2006 – present	Treatment plant monthly process sampling results
Conti	6-7/2006	Weekly O&M Reports, 6/12/2006, 6/19/2006, 6/26/2006, and 7/03/2006
Carbonair	2004	Relevant Sections of Treatment Plan O&M Manual
Conti	11/2005	Negotiated contract
Various	Various	Various site maps and historical data

1.4 PERSONS CONTACTED

The following individuals associated with the site were present for the visit:

Monica Baussan, Remedial Project Manager, EPA Region 2
Rob Alvey, Hydrogeologist and Regional Optimization Liaison, EPA Region 2
Ed Modica, Hydrogeologist, EPA Region 2
Gary Morin, Project Manager, U.S. Army Corps of Engineers
Darrell Moore, Engineer, U.S. Army Corps of Engineers
Ray Smith, Project Manager, Conti Environment and Infrastructure
Rick Vogel, Plant Operator, Conti Environment and Infrastructure

1.5 SITE LOCATION, HISTORY, AND CHARACTERISTICS

1.5.1 LOCATION

The GCL Tie and Treating Superfund Site is a 26-acre site located in a commercial/industrial section of the Village of Sidney, Delaware County, New York. The site is bordered to the north by a rail line owned by the Delaware and Hudson Railroad. Meadwestvaco, Inc., a calendar manufacturer, and the Sidney

Municipal Airport are located to the north of the rail line. Unalam, Inc., a laminated wood manufacturer, is located east of the property and Delaware Avenue runs along the southern border of the site in a northeast to southwest direction. An undeveloped scrub/shrub area with wetlands lies west of the site.

Historically, the Site has been considered to be approximately 60 acres of land comprised of the GCL property (26 acres) and two adjacent properties to the east (34 acres), referred to as the non-GCL property. The two properties to the east are now a vacated sawmill operation and Unalam. For the purpose of this RSE report, the Site refers to the 26-acre GCL property unless otherwise noted.

Site characterization and remediation has been divided into two operable units (OUs): OU1 to address contaminated soils and OU2 to address remaining contaminated soils (if any) and contaminated ground water. The OU1 remedy was completed in August 2000 (six years prior to the RSE), and successfully addressed the soil contamination such that no soil contamination needs to be addressed as part of OU2. This RSE focuses on the OU2 ground water remedy, which consists of an operating P&T system and associated monitoring. A site map with well locations is provided on Figure 1-1.

1.5.2 HISTORICAL PERSPECTIVE

The GCL property was operated as a railroad tie manufacturing and treating plant since at least the early 1950s. The business was sold to GCL Tie and Treating in 1983. The owners filed for bankruptcy in 1987 and abandoned the property in 1988. During operation, logs were brought on-site, cut, and treated with creosote in pressurized tanks inside the process building. After treatment, the logs were allowed to drip dry in open areas west and east of the process building with no containment. In addition to this potential source of contamination, one of the pressurized treatment vessels inside the process building malfunctioned and released an estimated 9,000 to 10,000 gallons of creosote. The owners excavated some of the contaminated soil and stored it on site for later disposal. However, only a small portion of the contaminated soil was excavated.

- The site was proposed for inclusion on the National Priorities List in February 1994 and was added in May 1994
- The OU1 Record of Decision was issued in 1994
- The OU2 Record of Decision was issued in 1995
- The OU1 Remedial Design was completed in 1997
- The OU1 Remedial Action was completed in 2000
- The OU2 Remedial Design was completed in 2001
- The construction of the OU2 P&T system began in 2002 and was completed in July 2004.
- The OU2 remedy operated for several months beginning in August 2004 before it was temporarily shut down due to lack of funding and negotiations of the State Superfund Contract.
- Long-Term Remedial Action (LTRA) officially beginning in October 2005.
- The system was restarted in January 2006.

1.5.3 POTENTIAL SOURCES

OU1 addressed contaminated unsaturated soil, but creosote-related contamination persists in the saturated zone as soil contamination, dense non-aqueous phase liquid (DNAPL), and as dissolved ground water contamination. DNAPL has been observed as free product in several monitoring wells; however, the DNAPL contamination is apparently relatively discontinuous with relatively isolated areas of both free product and residual product. The soil contamination and DNAPL contamination provide an ongoing source of ground water contamination. Primary site-related compounds of concern are as follows:

- benzene, toluene, ethylbenzene and xylenes (collectively BTEX)
- naphthalene
- 2-methyl-naphthalene
- other polyaromatic hydrocarbons (PAHs)

Volatile organic compounds (VOCs) attributed to other contaminated sites (the Route 8 Landfill and the Hill Site upgradient of the GCL Site) are also present in ground water underlying the Site. The Route 8 Landfill Site is located across Delaware Avenue near the intersection of Route 8 and Delaware Avenue, and the ground water remedy at that site includes P&T with extraction from the Unalam well, an on-site recovery well, and an on-site recovery trench. Contaminants associated with the Route 8 Landfill Site include toluene; ethylbenzene; 1,1-dichloroethane (1,1-DCA); trans-1,2-dichloroethene (trans-1,2-DCE); trichloroethene (TCE); vinyl chloride; and 1,1,1-trichloroethane (1,1,1-TCA). The Hill Site is located across Route 8 from the GCL Tie and Treating Superfund Site approximately 1,400 feet south of the Route 8 Landfill Site. The contaminants associated with the Hill Site include TCE, 1,2-DCE, and 1,1-DCA. The Hill Site has been capped and closed under the oversight of U.S. EPA.

1.5.4 HYDROGEOLOGIC SETTING

The Site is underlain by fill, some of which is associated with the original property use and some of which is associated with the OU1 remediation. In some areas of the site the fill is approximately 2 to 3 feet thick. In other portions of the site the thickness of the fill is approximately 20 feet deep.

Underlying the fill are glacial sediments that are mainly silts with variable proportions of clay and sand. The sediments are poorly sorted. Clay lenses approximately 4 to 6 inches in thickness are common throughout the sediments as are sand and gravel lenses. Thicker clay units (up to 25 feet thick) are also present. These thicker units are also discontinuous and limited in horizontal extent. There is a general coarsening of sediments downward in some locations. The sediments range from 0 to 125 feet in thickness. The shallow monitoring wells at the site screen perched water in the upper portion of these glacial sediments. The intermediate monitoring and extraction wells at the site screen regional ground water in the middle or lower portion of these sediments, which is referred to as the “intermediate zone” in this report.

Underlying the glacial sediments is glacial till that is primarily sand and gravel in a dense and occasionally dry clayey matrix. The till ranges from 0 to 35 feet in thickness.

Bedrock from the Devonian Oneonta Formation underlies the glacial sediments. The formation is comprised of medium to fine grained sandstones and interbedded mudstones. The bedrock surface slopes to the northwest in the direction of the Susquehanna River. The bedrock surface is highly weathered and significantly fractured in the upper 20 feet. The bedrock at MW-03B contains DNAPL at 30 to 40 feet below the bedrock surface. The deep/bedrock monitoring and extraction wells at the site screen the upper portion of the bedrock, which is referred to as the “deep zone” in this report.

The depth to the regional water table is approximately 20 to 30 feet below ground surface (bgs), but perched water is present in some locations at a depth of 5 to 10 feet bgs. In the absence of pumping, the potentiometric surface prepared from measurements in the shallow wells depicts a convergence zone near the MW-3 cluster suggesting that shallow (perched) ground water is migrating vertically to the regional water table. Flow in the intermediate and deep zones indicates flow to the north or northwest toward the Susquehanna River in the absence of pumping. The hydraulic gradient in the intermediate zone is approximately 0.015 to 0.020 feet per foot, and the hydraulic gradient in the deep zone is approximately 0.010 feet per foot. Hydraulic conductivity has been calculated to be approximately 0.1 feet per day for the intermediate zone and 0.5 feet per day for the deep zone based on pump tests conducted during the pre-design phase.

1.5.5 POTENTIAL RECEPTORS

The primary receptors for the site are the Susquehanna River and two public water supply wells located along the Susquehanna River. The supply wells are located approximately 4,500 feet north of the GCL site and approximately 115 feet south of the southern bank of the river. The primary water supply well is reportedly 100 feet deep, and the secondary water supply well is approximately 250 feet.

The 2003 Five Year Review states that the soil vapor intrusion exposure pathway was evaluated. The maximum detected concentrations for several VOCs (including those not associated with the site) were found to exceed the most protective screening level of a 10^{-6} incremental cancer risk or a non-cancer hazard factor of 0.1. The Five Year Review suggested that additional evaluation would likely be necessary for the existing Meadwestvaco building or any other buildings that might be erected over the plume.

1.5.6 DESCRIPTION OF GROUND WATER PLUME

The site team tracks concentrations and migration of BTEX, naphathelene, 2-methyl naphthalene, and the sum of the remaining heavier PAHs (a total of 15 other PAHs with higher molecular weights than naphthalene). Concentrations are highest in the area immediately downgradient of the original soil source area. DNAPL has historically been identified in MW-3B, MW-7B, and MW-7D. The June 2004 baseline sampling event provides information regarding contaminant transport after the soil contamination had been addressed by the OU1 remedy but before the P&T system began operation. In the intermediate zone, the June 2004 results indicated that concentrations above cleanup standards for all compounds had remained within approximately 200 to 300 feet of the source area, indicating relatively little potential for migration.

In the bedrock zone, the June 2004 sampling suggested that contaminant migration was more extensive. BTEX concentrations above cleanup standards were detected in MW-11B, and naphthalene was found above standards in MW-11B and MW-13B. The following table summarizes the sampling results for MW-11B and MW-13B between March 2000 and December 2005. Note that December 2005 is also indicative of pre-pumping concentrations because the system had previously only operated for several months and that had occurred more than a year before the sampling event.

Compound	ROD Cleanup Standard (ug/L)	MW-11B[1] (ug/L)			MW-13B[1] (ug/L)	
		Mar. 2000	**Jun. 2004**	**Dec. 2005**	**Jun. 2004**	**Dec. 2005**
Benzene	5	ND <5.0	ND <1.0	ND <1.0	1.3	2.6
Toluene	5	2J	3.7	1J	ND <2.0	ND < 2.0
Ethylbenzene	5	ND < 5.0	**5.9**	1J	ND <2.0	ND < 2.0
Xylenes	5[2]	**12**	**12**	3	ND <2.0	ND < 2.0
Naphthalene	50	**130**[3]	**580**[3]	**95**	**200**	3.4
2-methyl naphthalene	50	ND < 1.0	39	3.6	7.8	0.13
Sum of heavier PAHs[4]	50[5]	4.25	10.6	4.15J	21.9	14.3J

*Notes: Concentrations above standards are indicated in **bold**.*

1 *MW-11B is approximately 500 feet downgradient of a former source area, and MW-13B is approximately 600 to 700 feet downgradient of a former source area.*

2 *The m+p-xylenes have a standard of 5 ug/L and o-xylenes have a standard of 5 ug/L but xylene sampling is reported as total xylenes*

3 *The March 2000 naphthalene concentration is the average of two samples. The June 2004 naphthalene concentration is from method 8270C rather than 8260B.*

4 *The sum of the concentrations for 15 other PAHs with molecular weights that are higher than naphthalene.*

5 *Each individual PAH in this category that has a standard has a standard of 50 ug/L.*

With respect to vertical plume delineation, it appears that the bedrock monitoring wells intercept the bottom of the local flow regime. Bedrock monitoring wells were generally drilled in 10-foot zones with yield in each zone tested. The results routinely showed that the boreholes yielded little or no water below the depth interval that was selected for long term sampling. Deeper portions of the boreholes were backfilled and sealed before installing the screen for the monitoring interval.

2.0 SYSTEM DESCRIPTION

2.1 SYSTEM OVERVIEW

The P&T system has an Operational and Functional date of October 2005 and consists of an extraction system, a treatment plant, and discharge to a local creek. The system is designed to contain site-related contamination and remove contaminant mass.

2.2 EXTRACTION SYSTEM

The extraction system includes four extraction wells in the intermediate zone and three extraction wells in the deep (e.g., bedrock) zone. Each extraction well is piped independently to the treatment plant through HDPE pipe. The following table summarizes the extraction rates and contaminant concentrations for each of those wells based on sampling data collected between May 15, 2006 and May 17, 2006 and based on flow rate measurements between July 3, 2006 and July 9, 2006.

Extraction Well	Flow Rate (gpm)	BTEX Concentration (ug/L)	Naphthalene Concentration (ug/L)	Total BTEX and Naphthalene Mass Removal (lbs/year)
EW-1I	1.4	158	570	4.4
EW-2I	11.8	64	220	14.7
EW-3I	3.2	5	1.8	0.1
EW-4I	2.1	93	33	1.2
EW-1B	14.4	18	250	16.9
EW-2B	13.3	48	1000	61.0
EW-4B	31.5	4	110	15.7
Total	**~78**			**114.0**

Note: Total BTEX and naphthalene mass removed from each extraction well is calculated by multiplying the flow rate by the sum of the BTEX and naphthalene concentrations and then by several conversion factors to obtain mass removed in pounds per year.

2.3 TREATMENT SYSTEM

The treatment system consists of the following treatment components:

- 6,000-gallon DNAPL settling tank
- 150-gpm capacity coalescing oil/water separator
- 4,500-gallon equalization tank
- Potassium permanganate addition
- Two (2) green sand filters arranged in parallel using Carbonair MPC-13 tanks
- Two (2) 50 micron bag filters arranged in parallel
- Sulphuric acid addition
- 6-tray Carbonair STAT 180 low profile air stripper with a 15-horsepower blower
- Two (2) 10 micron bag filters arranged in parallel

- Two (2) 2,500-lb liquid phase granular activated carbon (GAC) units arranged in series
- 6,000 gallon effluent discharge tank
- Two (2) 2,000-lb vapor phase GAC units arranged in series to treat air stripper off-gas
- 12-kW electric in-line duct heater
- 3,000-gallon dirty backwash storage tank
- Associated gauges, meters, mixers, pumps, and controls

The system was designed to treat influent concentrations of organic compounds as summarized in the following table:

Compound in Influent	Design Influent Concentration (ug/L)
Benzene	500
Toluene	430
Ethylbenzene	650
Xylenes	3000
2-methyl naphthalene	850
Naphthalene	8,800
Other PAHs	1,978
Non site-related compounds	2,819
Total	**19,027**

2.4 MONITORING PROGRAM

Ground Water Monitoring

A regular ground water monitoring program has not been established for the site because most of the site funding has been diverted to maintain operation of the P&T system. The most recent sampling event occurred in May 2006 and consisted of sampling 19 monitoring wells, one piezometer, and eight extraction wells (one not operating) for VOCs, PAHs, iron, and manganese. Wells were sampled using low-flow sampling, and wells with NAPL were not sampled. Prior to sampling, the site team included a list of contingency wells that could be sampled in place of those wells with NAPL so that a total of 20 wells would be sampled. Laboratory analyses are provided by an independent laboratory contracted through Conti Environment and Infrastructure, the site contractor. Ground water elevations were measured in 39 wells, including the seven extraction wells. The results of the event were summarized in a concise report that provided potentiometric surface maps for the intermediate and deep zones and contaminant concentration maps for both BTEX and PAHs (including naphthalene). The site team has not decided on a time frame for the next sampling event.

Process Monitoring

Process monitoring is conducted on a monthly basis. Samples are collected for the blended plant influent, between the two liquid phase GAC vessels, and for the plant effluent. Influent and effluent samples are analyzed for 23 metals, hardness, biochemical oxygen demand, total dissolved solids, total suspended solids, alkalinity, nitrogen, chloride, sulfate, VOCs, and PAHs. The sample from between the liquid phase GAC units is analyzed for VOCs.

3.0 SYSTEM OBJECTIVES, PERFORMANCE, AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The ROD stated the following language regarding the goals for the ground water remedy.

- Prevent public and biotic exposure to contaminant sources that present a significant threat.
- Reduce the concentrations of contaminants in the ground water to levels that are protective of human health and the environment.
- Prevent further migration of ground water contamination.

The ROD further states the following:

> The goal of the groundwater portion of the remedy is to restore groundwater to drinking water quality. However, due to the characteristics of creosote (e.g., extremely viscous and difficult to pump) and the complex hydrogeological setting, it is unlikely that this goal will be achieved within a reasonable time frame for areas containing the creosote layer (e.g., shallow groundwater). Current estimates of shallow groundwater remediation are on the order of several hundred years. As such, it is likely that chemical-specific ARARs will be waived for those portions of the aquifer based on the technical impracticability of achieving further contamination reduction within a reasonable time frame. If groundwater restoration is not feasible or practical, the alternative may then focus on containing the extent of groundwater contamination within the site boundaries. Restoration of the groundwater outside of the DNAPL source areas (e.g., intermediate groundwater) is likely to be feasible, since it is mostly contaminated with mobile organic contaminants (e.g., benzene).

The ROD also suggested the potential use of natural attenuation or enhanced biodegradation to reduce contaminant concentrations if cost-effective. The decision to implement this additional remedial approach or to focus on containment instead of restoration would be made either during design or during the LTRA period.

It is noted that DNAPL is actually observable in the bedrock and that residual DNAPL is likely also present in the intermediate zone. Therefore, the RSE team assumes that the discussion related to technical impracticability also extends to the intermediate and deep zones. It is also noted that DNAPL is present both on the former GCL property (MW-3B) and off-property (e.g., MW-7B and MW-7D). Therefore, the RSE team assumes efforts to contain ground water are based on the location of DNAPL rather than an attempt to contain contamination within the GCL property boundaries.

The cleanup criteria established by the ROD for several site-related contaminants are summarized in the following table.

Contaminant of Concern	Cleanup Criteria (ug/L)
Benzene	5
Toluene	5
Ethylbenzene	5
m+p-Xylenes	5
o-Xylenes	5
Naphthalene	50
2-methyl naphthalene	50
Acenaphthylene	50
Fluorene	50
Fluoranthene	50
Benzo(a) anthracene	50
Chrysene	50
Benzo(b) fluoranthene	50

3.2 TREATMENT PLANT OPERATION STANDARDS

Treated ground water is discharged to the stream alongside Delaware Avenue. The discharge is governed by a National Pollutant Discharge Elimination System (NPDES) permit equivalent administered by the NYSDEC. Selected discharge criteria are provided in the table on the following page.

Constituent	Discharge Criteria (ug/L)
VOCs	
Benzene	5
Toluene	5
Ethylbenzene	5
Xylenes	5
1,1-Dichloroethane	5
1,1-Dichloroethene	7
Cis-1,2-Dichlorothene	10
Styrene	10
1,1,1-Trichloroethane	10
Trichloroethene	5
1,3,5-Trimethylbenzene	10
1,2,4-Trimethylbenzene	10
PAHs	
Naphthalene	13
2-methyl naphthalene	4.7
Acenaphthene	5.3
Anthracene	3.8
Benzo(a) anthracene	0.05
Benzo(a) pyrene	0.09
Benzo(b) fluoranthene	0.2
Benzo(k) fluoranthene	0.2
Chrysene	0.2
Fluoranthene	10
Fluorene	4.8
Indeno(1,2,3-cd) pyrene	0.4
Phenanthrene	5
Pyrene	4.6
Inorganics	
Iron	300*
Manganese	300*
Total dissolved solids	500

** Iron and manganese each have a limit of 300 ug/L and a combined limit of 500 ug/L*

4.0 FINDINGS AND OBSERVATIONS FROM THE RSE SITE VISIT

4.1 FINDINGS

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 ground water remediation have changed over time.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

4.2.1 WATER LEVELS

The potentiometric surface maps presented in the July 2006 Sampling Report include water levels from operating extraction wells. Because water levels in operating extraction wells are affected by well losses and other factors that substantially lower the water level in the well compared to the surrounding aquifer, they may bias the development of potentiometric surface maps in favor of capture. As is the case at many sites, there are not enough monitoring wells at the site to develop a reliable potentiometric surface map that clearly indicates capture. However, several monitoring wells show significant reductions in water levels from pumping. The following table provides the water levels expected based on a uniform gradient under non-pumping conditions for several monitoring wells in the intermediate zone and their actual water levels under continuous pumping conditions. This alone does not provide a basis for delineating the actual capture zone, but as discussed the following section, the relatively substantial drawdown is an additional line of evidence for capture that can be considered along with other analyses.

Monitoring Well	Expected Water Level Without Pumping (ft MSL)	Actual Water Level Under Continuous Pumping (ft MSL)
PZ-1I*	986	986.03
PZ-2I	~982	972.89
EW-5I (not operational)	~982	971.72
MW-3I	~982	969.90
MW-12I	~980	970.08
MW-07I	~978	971.24
MW-08I	~977	971.40
MW-11I	~974	969.78
MW-10I	~974	970.72

** PZ-1I is used as a reference point from which the other expected water levels are calculated based on a presumed hydraulic gradient of 0.017 feet per foot (e.g., consistent with the hydraulic gradient of 0.015 to 0.020 feet per foot noted in Section 1.5.4).*

As is evident from the above table, the pumping has a significant effect on the water levels in monitoring wells. Similar effects from pumping are also identified in the deep zone.

4.2.2 CAPTURE ZONES

Drawdown alone is not sufficient for interpreting a capture zone because the extent of capture is the result of drawdown superimposed on the regional hydraulic gradient, and observable drawdown is commonly present in wells that are downgradient of the capture zone. However, there are other lines of evidence that suggest capture is adequate in both the intermediate and deep zones. For example, a capture zone width calculation in both the intermediate and deep zones suggests that the capture zone might be several times the plume width in each zone. The calculations are as follows:

Intermediate Zone

W – Width of capture zone – to be calculated
B – Saturated depth – assume 125 feet based on information in Section 1.5.4
K – Hydraulic conductivity – assume 0.1 feet per day based on information in Section 1.5.4
i – Hydraulic gradient – 0.02 feet per day based on the upper limit noted in Section 1.5.4
f – Safety factor – 2 to account for heterogeneity and other factors
C – Conversion factor – 0.00518 gpm/ft^3/day
Q – Intermediate zone well yield of approximately 18.5 gpm

$$W = \frac{Q}{C \times B \times K \times i \times f}$$

$$\sim 7{,}100\text{ feet} = \frac{18.5\text{ gpm}}{\frac{0.00518\text{ gpm}}{\text{ft}^3/\text{day}} \times 125\text{ feet} \times \frac{0.1\text{ feet}}{\text{day}} \times \frac{0.02\text{ feet}}{\text{foot}} \times 2}$$

Deep Zone

W – Width of capture zone – to be calculated
B – Saturated depth –100 feet assuming upper portion of bedrock is targeted for capture
K – Hydraulic conductivity – assume 0.5 feet per day based on information in Section 1.5.4
i – Hydraulic gradient – 0.01 feet per day based on information in Section 1.5.4
f – Safety factor – 2 to account for heterogeneity and other factors
C – Conversion factor – 0.00518 gpm/ft^3/day
Q – Deep zone well yield of approximately 59.2 gpm

$$W = \frac{Q}{C \times B \times K \times i \times f}$$

$$\sim 11{,}400\text{ feet} = \frac{59.2\text{ gpm}}{\frac{0.00518\text{ gpm}}{\text{ft}^3/\text{day}} \times 100\text{ feet} \times \frac{0.5\text{ feet}}{\text{day}} \times \frac{0.01\text{ feet}}{\text{foot}} \times 2}$$

The plume widths in both zones are approximately 700 feet wide or less. Therefore, the above calculations indicate that interpreted capture zone widths are approximately one order of magnitude greater than the plume widths. Assuming the data used as input to these water budget calculations is accurate, the current extraction rates result in a very conservative capture zone. These favorable calculations coupled with the significant drawdown in monitoring wells as a result of pumping suggest that capture is likely adequate. Such simple calculations require simplifying assumptions such as homogeneous, isotropic, confined aquifer with infinite extent, uniform aquifer thickness, fully penetrating wells, uniform regional horizontal hydraulic gradient, steady-state flow, negligible vertical gradient, no net recharge, and no other water sources introduced to aquifer due to extraction. Most of the assumptions are not satisfied at this site. However, based on the much greater calculated capture widths compared to the actual plume widths, it appears that the analysis is conservative and error associated with the assumptions would likely not change the conclusions.

Concentration for BTEX and naphthalene trends in downgradient wells can also provide useful information regarding capture. Low or undetectable concentrations in the MW-10, MW-13, MW-14, and MW-15 clusters suggest that contamination is not reaching these locations. If concentrations in these wells continue to be low or undetectable, then this is supporting evidence that contaminants are either not migrating in this direction or are adequately captured. On the other hand, the concentrations at MW-11B have remained relatively consistent around 100 ug/L. The absence of a decrease in concentrations at this well might be explained by one of the following:

- The monitoring well is near the stagnation point of the capture zone such that contamination in this area is not migrating substantially away from or toward the extraction network.

- The monitoring well is within the capture zone such that contaminated water passes by MW-11B on its way to one of the extraction wells (perhaps EW-4B).

- There is a gap in the capture zone that results in continued contaminant migration in this area.

EW-2B is directly upgradient of MW-11B and pumps at a rate of greater than 13 gpm. Using the capture zone calculations presented earlier, this translates to an estimated capture width of approximately 2,600 feet. As a result, the RSE team believes that source area contamination is adequately contained and that one of the first two possibilities noted above is the explanation for these relatively consistent concentrations at MW-11B. Continued ground water monitoring may help confirm adequate capture or indicate potential deficiencies in the extraction network.

4.2.3 CONTAMINANT LEVELS

The contaminant concentrations in downgradient wells have generally decreased since 2000, with the exception of MW-11B. However, concentrations in the source area remain elevated and NAPL is present in multiple wells. These contaminant levels indicate potential to remediate the fringes of the plume but also indicate that contamination in the source area is persistent and that restoration of this area might be technically impracticable in a reasonable time frame with a P&T system. Continued ground water monitoring will provide more information to evaluate this conceptual model.

4.3 COMPONENT PERFORMANCE

4.3.1 EXTRACTION SYSTEM

The extraction wells have electric submersible pumps that pump water through separate HDPE pipes to a common manifold inside the treatment plant. The submersible pumps are controlled by level sensors. Each extraction well and 25 monitoring wells have pressure transducers to monitor changes in drawdown. The pumps in the intermediate wells cycle on and off due to a well yield that is relatively low compared to the pump capacity. The bedrock wells run continuously.

4.3.2 NAPL PHASE SEPARATION

NAPL phase separation is theoretically provided by a 6,000-gallon DNAPL tank and a 150-gpm capacity coalescing oil/water separator (COWS). No DNAPL has been collected in the DNAPL tank and no LNAPL has been collected in the COWS. However, some DNAPL has been collected in the COWS. The plant operator changed the COWS media prior to restarting the plant in January 2006. Additional cleaning may be appropriate on a regular basis, perhaps every six months.

4.3.3 EQUALIZATION TANKS

Equalization of flow is provided by a 4,500-gallon HDPE equalization tank with high and low level controls to control pumping and a high-high level control that results in plant shut down if triggered. The plant operator reports that the high-high level control and the high level control are too close to each other (separated by only 3 inches), such that the high-high level control is needlessly triggered in several instances when influent flow rates are temporarily higher than the process flow rates.

4.3.4 GREENSAND FILTERS

The greensand filters are comprised of two Carbonair MPC-13 tanks with greensand and other media arranged in parallel. Each tank has a 4-foot diameter bed providing 12.5 square feet of area, equating to an acceptable loading rate of approximately 3.2 gpm per square foot (e.g., up to 80 gpm divided by a total of 25 square feet of area). The influent manganese concentration is approximately 1,500 mg/L, and the influent iron concentration is approximately 0.1 mg/L. This should translate to a potassium permanganate dosing of approximately 3 mg/L, but the actual dosing level is not known.

The filters are manually backwashed at least twice a day. The O&M manual suggests that backwashing of each tank should occur for 20 minutes. A greensand backwash should typically expand the bed by 35% to 40%, and typically requires a backwashing loading rate of 10 to 12 gpm per square foot. These flow rates translate to 3,000 gallons of backwash water per filter; however, the tank that receives the backwash from the filters only has a 3,000-gallon capacity. Therefore, both filters cannot receive a complete backwash during one event. The plant operator chooses either to backwash each filter for half the specified time or backwashes one filter at a time (which would require four separate backwashing events per day). Greensand filter backwashing and the associated solids handling contributes substantially to operator level of effort.

4.3.5 BAG FILTERS

Bag filters are provided in three locations. The plant was originally designed with bag filters between the greensand filters and air stripper and then again between the air stripper and GAC units. The site team has determined that 50 micron bag filters are most appropriate for the first set of bag filters and 10 micron bag filters are most appropriate for the second set. Since operation resumed in January 2006, the site team added a set of 50 micron bag filters between the dirty backwash tank and the equalization tank. Prior to adding this set of filters, filter changeouts on the original two units were required multiple times per day. Since adding this set of filters, filter changeouts in the original two units are typically required once a week. The new set of bag filters requires changeouts once every two to three days.

4.3.6 AIR STRIPPER AND VAPOR PHASE GAC UNITS

The six-tray Carbonair STAT 180 low-profile air stripper was included in the design because concentrations of VOCs were anticipated at over 7,000 ug/L. The actual VOC influent, however, is under 500 ug/L (including naphthalene), and continued operation of the air stripper is not a cost-effective means of treating the VOCs.

4.3.7 LIQUID PHASE GAC UNITS

There are two Carbonair MPC 20 liquid phase GAC adsorbers arranged in series. Each unit has 2,500 pounds of GAC. Neither unit has been changed since the plant began operating. Sampling is conducted monthly between the two units to detect breakthrough. The GAC is manually backwashed monthly based on the differential pressure. Backwashing the units takes approximately 15 to 20 minutes.

4.3.8 SOLIDS HANDLING

The solids handling procedures for the plant are labor intensive. For each backwash event, the operator lets the solids in the backwash water settle, decants cleaner water to the equalization tank, empties the solids into a 250-gallon tote, lets solids settle in the tote, and decants from the tote. When the tote is filled (with about 1 to 2% solids) the solids are removed by a vacuum truck and sent off-site for disposal. Disposal of 250 gallons occurs approximately once every three months. The process is relatively slow such that given the frequent backwashes, the plant operator is continually conducting backwashes and dealing with the associated solids.

4.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF ANNUAL COSTS

The site has an annual budget of $700,000 per year as summarized below.

Item Description	Estimated Annual Cost*
Labor: USACE oversight and project management	$60,000
Labor: Contractor project management and travel	$96,000
Labor: System operation (1.5+ full time equivalents)	$209,000
Ground water sampling and reporting	$109,000
Utilities: Electricity	$57,000
Non-electric utilities and other services	$20,000
Non-utility consumables, disposal, and small repairs	$105,000
Treatment plant analytical costs	$28,000
Ground water sampling analytical	$12,000
Total Estimated Annual Cost	**$696,000**

** extrapolated from negotiated proposal for 3 months of operation during 2006*

Historically, the site team has eliminated ground water sampling events to preserve funding to keep the plant operating. Actual and projected expenditures for the limited ground water sampling in December 2005, the comprehensive ground water sampling event May 2006, and the nine months of operation from January 2006 through the end of September 2006 are approximately $606,000. All contractor costs are under a negotiated fixed-price contract. The remaining $94,000 for this time period is available to cover oversight for USACE or other issues that arise. O&M costs will need to decrease in the future if the site team is to operate the system for a full year under the $700,000 annual budget. The RPM has filed a request to increase the budget to $900,000 per year over a five year period.

4.4.1 UTILITIES

Utilities costs are divided between electricity and non-electricity services. The electricity cost from the utility is estimated by the site contractor as $48,000 per year. An additional $9,000 per year consists of the contractor's G&A and profit. GeoTrans estimates that the fixed-price of $48,000 per year reasonably represents the costs for site electric; however, the negotiated cost was only based on a three month period. If a contract were to be negotiated for a longer term, the escalation in electric costs would be difficult to estimate, and the contractor will likely increase their bid to cover the risk of escalation.

Non-electric utilities and other services include potable water, garbage collection, cell phones, telephone, portable toilets, cable internet service, and shipping. The direct costs for these non-electric utilities are approximately $17,000 per year. An additional $3,000 per year represents site contractor G&A and profit.

4.4.2 NON-UTILITY CONSUMABLES AND DISPOSAL COSTS

For a flow rate of 70 gpm, the contractor estimates a direct cost of $7,400 per month for consumables, disposal, and small repairs. This translates to a direct cost of $88,800 per year. Including markups, the cost for this category is $105,000 per year. The consumables category includes potassium permanganate, sulfuric acid, bag filters, GAC, disposal of miscellaneous items, and disposal of solids. The site contractor reports that the solids are treated as hazardous wastes due to the F027 listing associated with wood treating facilities. The negotiated proposal indicated that the direct costs for GAC replacement and disposal are $9,000 per event. Chemical usage was not reported to the RSE team, but it was described as very low. The RSE team estimates that chemicals, bag filters, and solids disposal are likely under $20,000 per year. Assuming the liquid GAC is changed twice per year and the estimated cost for other items is correct, then this cost category should be closer to $38,000 per year in direct costs. Repairs may also add to the cost, but the contract specifically states that the budget is limited to small repairs and that motor replacements and similar items are not covered. The fixed-price of $88,800 per year likely includes a significant hedge against material needs and costs. EPA is also paying for the G&A and profit markups on the consumables cost, which totals approximately $16,000 per year.

4.4.3 LABOR

There are four general areas involving labor: USACE oversight, contractor project management, operator labor, and ground water sampling. The USACE oversight of $60,000 is reasonable for this first year of operation; however, in future years as O&M issues are resolved, it is likely that these costs will decrease as a result of fewer technical issues, streamlined contract administration, and fewer site visits. The contractor project management is approximately $84,000 per year plus $12,000 per year in travel costs. The $84,000 per year includes approximately 1,120 hours of labor, which translates to over 0.5 full time equivalent employees for managing site issues and vendors. While this may be appropriate during the first six months to a year of operation, it is likely that these costs will decrease substantially over time, particularly, since this project management category does not include any reporting. The operator labor is approximately $209,000 per year for just over 1.5 full time equivalent employees with the assumption that response to an alarm is needed each night. The ground water sampling labor (and associated equipment) is approximately $109,000 per year, of which $92,000 per year represents direct costs.

4.4.4 CHEMICAL ANALYSIS

The chemical analysis costs represent costs for analyzing treatment plant compliance samples, waste characterization samples, and ground water monitoring samples. The unit rates provided in the negotiated contract appear to be reasonable and competitive.

4.5 RECURRING PROBLEMS OR ISSUES

The site team reported that maintenance of the greensand filters and solids handling have been more labor intensive than originally planned. The site team also reported the unnecessary alarms associated with the close proximity of the high level switch and the high-high level switch in the equalization tank.

4.6 REGULATORY COMPLIANCE

The treatment plant has routinely met discharge standards since resuming operation in January 2006.

4.7 TREATMENT PROCESS EXCURSIONS AND UPSETS, ACCIDENTAL CONTAMINANT/REAGENT RELEASES

There have been no reported major upsets or accidents since the plant resumed operation in January 2006.

4.8 SAFETY RECORD

The site team reports no health and safety reportable incidents for the treatment plant. The site team does note the inconvenience and potential safety issues associated with one person performing some of the tasks and the absence of a door directly between the office and treatment plant area.

5.0 EFFECTIVENESS OF THE SYSTEM TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

5.1 GROUND WATER

The ground water points of exposure are the supply wells located along the banks of the Susquehanna River, approximately 4,000 feet downgradient of the site. Data to date suggest that the contamination is far from reaching these wells. The naphthalene in MW-11B represents the most significant downgradient migration of site-related contamination. Although this contamination may extend further, the properties of naphthalene suggest it will degrade before reaching these supply wells. The naphthalene concentrations in the source area have been as high as 1,600 ug/L, and NAPL has been observed at MW-7B. Therefore, concentrations are an order of magnitude lower at MW-11B than in the source area. Relatively simplistic contaminant fate and transport modeling performed by the RSE team using the BIOSCREEN modeling package and conservative input values that reproduce this attenuation between the source area and MW-11B confirms that contamination would attenuate below the standard of 50 ug/L within 200 feet of MW-11B (see Appendix A). As a result, the RSE team believes that the current remedy is likely protective of human health with respect to preventing contamination of the identified public supply wells.

5.2 SURFACE WATER

The Susquehanna River is the primary ecological receptor of site-related ground water contamination. The Susquehanna River is near the public supply wells. As stated above, conservative fate and transport modeling suggests that the contamination at MW-11B above standards (e.g., naphthalene) would degrade to below standards within 200 feet of MW-11B, which is several thousand feet from the River. As a result, the RSE team believes that the current remedy is likely protective of human health and the environment with respect to preventing contamination of the Susquehanna River.

5.3 AIR

The Five-Year Review for the site indicated that risks associated with soil vapor intrusion should be evaluated at the site. Other than the treatment plant, the primary building of concern would be the large industrial two-story building on the Meadwestvaco property to the north of the site. The depth to ground water near the building is approximately 12 to 15 feet below ground surface. Concentrations of site-related VOCs at MW-8I (approximately 55 feet deep) were not detectable in the 2006 sampling event. Relatively high levels of site-related VOC contamination are present at MW-12I, which is also near the building, but no samples have been collected from a shallow well in this location (e.g., PZ-3) since 1998, which is before the OU1 and OU2 remedies. The RSE team does not recommend indoor sampling for this building due to its industrial nature. Rather, if the site team proceeds with an evaluation, the initial steps should focus on water quality in the shallow ground water.

If the site team can demonstrate low (e.g., at or below standards) or undetectable VOC concentrations at the water table, then this clean water overlying the contamination would eliminate the potential for VOCs to enter the vadose zone and the indoor air space. If the site team wishes to proceed with this evaluation, shallow ground water concentrations could be evaluated from grab samples taken from a direct push sampling event. Sampling PZ-3 and locating direct push samples between PZ-3 and the Meadwestvaco building, the site team can also determine if contamination adjacent or beneath the building is attributable to the GCL site. If the sampling suggests little or no VOC contamination in the shallow ground water on the GCL side of the building, then any soil vapor contamination that might be detected in or beneath the Meadwestvaco building could potentially derive from non-GCL-related sources. Therefore, before proceeding with sub-slab sampling or other sampling associated with the Meadwestvaco building, the RSE team suggests a limited shallow ground water investigation.

The site team could also consider modeling with conservative assumptions. As an industrial building, there are several features that would limit the potential for vapor intrusion relative to private residences (which are often the focus of vapor intrusion evaluations). With modeling, ventilation and building construction should be considered. The ventilation rate for industrial buildings generally involves several air exchanges per hour such that the VOC concentrations would generally not accumulate in indoor air as they would in a residence where there is typically much less than one air exchange per hour. In addition, it is possible that the building is maintained at a positive pressure relative to ambient air. Finally, the building may not have working space below the ground surface (e.g., a basement).

5.4 SOIL

Surface soil and subsurface soil above the water table has been addressed as part of OU1. Potential routes of exposure to contaminated soil have therefore been eliminated.

5.5 WETLANDS AND SEDIMENTS

As discussed above for ground water and surface water, the RSE team believes that the current remedy is likely protective of human health and the environment with respect to the wetlands and sediments associated with the Susquehanna River. The wetlands and sediments associated with the discharge point are upgradient of the site. They are not impacted by the site but may be impacted by upgradient non-site-related sources.

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.

6.1 RECOMMENDATIONS TO IMPROVE EFFECTIVENESS

6.1.1 INSTITUTE A ROUTINE GROUND WATER MONITORING PROGRAM

The site team has previously reduced ground water monitoring efforts to preserve funding to keep the system operating. The RSE team recommends that the site team institute a routine ground water monitoring program that consists of annual sampling. The scope and costs of the recommended program are discussed in Section 6.2.3 because the recommended scope and costs should result in substantial savings relative to the ground water sampling conducted in 2006.

6.1.2 OPTIONAL PLUME DELINEATION

Naphthalene concentrations at MW-11B are above standards, and as a result, the plume is not fully delineated in this area. However, the naphthalene concentrations at MW-11B are over an order of magnitude lower than they are approximately 300 feet upgradient near the source area. Given this attenuation and that naphthalene only exceeds the ROD cleanup standards by a factor of approximately 2.0, the RSE team believes it is reasonable to extrapolate the downgradient edge of the naphthalene plume in this area. The RSE team believes that the naphthalene concentrations are likely below standards within 200 to 500 feet downgradient of MW-11B and that no further investigation is required. However, if the site manager feels a need to provide more concrete evidence of plume delineation, an additional bedrock well could be installed approximately 200 feet downgradient of MW-11B. The cost for this monitoring well might be $35,000, including work plans, oversight, and one round of sampling in addition to the next upcoming site-wide sampling event.

6.1.3 SOIL VAPOR INTRUSION EVALUATION

The Five-Year Review indicated the need to evaluate soil vapor intrusion for the site. The primary building of interest is the Meadwestvaco building. The RSE team provides an initial approach for evaluating the potential for soil vapor intrusion. The RSE team suggests evaluating shallow ground water with ground water samples collected from PZ-3 and from a direct-push event. Given that most of the contamination at the site is at depth, the previously executed soil remedy, and continued infiltration of rain water, the RSE team believes that the water at the water table likely has undetectable or very low concentrations of VOCs, effectively isolating the vadose zone from the deeper contamination. This type of shallow ground water investigation could also be used to determine if there is a direct link between shallow VOC contamination at the site, and immediately adjacent, to the Meadwestvaco building. If no shallow VOC contamination is found in shallow groundwater adjacent to the Meadwestvaco building, the RSE team would not advise further investigation of the indoor or sub-slab air at the Meadwestvaco building due to the potential influence from other possible sources. The RSE team estimates the shallow ground water evaluation could likely be conducted for $15,000, including work plans, sample collection, analysis, and reporting.

6.2 RECOMMENDATIONS TO REDUCE COSTS

6.2.1 DISCONTINUE PUMPING FROM THE INTERMEDIATE ZONE

Ground water sampling indicates that pumping for plume containment is not necessary in the intermediate zone. Although ground water data from March 2000 (during the OU1 remedy) indicated naphthalene and BTEX contamination migrating beyond MW-8I at concentrations above ROD standards, concentrations decreased substantially prior to P&T system operation in August 2004. Over this more than four year period without pumping, naphthalene concentrations at MW-8I decreased from as high as 1,900 ug/L to 41 ug/L and benzene concentrations decreased from 12 ug/L to less than 1 ug/L. These decreases can likely be attributed to the success of the OU1 remedy in removing source area contamination that was migrating toward MW-8I and natural attenuation that occurred over the four year period following source removal. In addition, sampling from other downgradient monitoring wells in June 2004 and December 2005 indicated either undetectable concentrations or concentrations far below standards for all contaminants of concern.

The intermediate zone wells provide approximately 20% of the total system mass removal. Given the presence of NAPL at the site (predominantly in the deep zone), the absence of pumping in the intermediate zone would not appreciably delay aquifer restoration.

Although the intermediate zone pumping provides little benefit in terms of plume control and mass removal, it contributes heavily to the annual costs for system operation because it provides the majority of the manganese loading. The blended influent manganese concentration to the treatment plant is approximately 1,530 ug/L at a flow rate of approximately 78 gpm. This translates to a daily load of 1.42 pounds of manganese per day.

$$\frac{78\text{ gal}}{\text{min}} \times \frac{1{,}530\text{ ug}}{\text{L}} \times \frac{1{,}440\text{ min}}{\text{day}} \times \frac{3.785\text{ L}}{\text{gal}} \times \frac{\text{kg}}{10^9\text{ ug}} \times \frac{2.2\text{ lbs}}{\text{kg}} = \frac{1.42\text{ lbs}}{\text{day}}$$

The blended iron concentration and mass loading are approximately 100 ug/L and 0.1 pounds per day, respectively. The intermediate zone extraction wells, which are screened in the overburden, have significantly higher manganese concentrations than the bedrock wells. Therefore, if pumping can be discontinued from the intermediate zone without sacrificing remedy protectiveness, the manganese loading to the treatment plant can be reduced. The following table summarizes manganese data from each of the intermediate zone extraction wells and bedrock zone extraction wells and calculates the mass loading contributed by each well and from each zone.

Extraction Well	Flow Rate (gpm)	Manganese Concentration* (ug/L)	Manganese Mass Loading (lbs/day)
EW-1I	1.4	11,100	0.19
EW-2I	11.8	4,330	0.61
EW-3I	3.2	1,870	0.07
EW-4I	2.1	7,280	0.18
Intermediate Zone Subtotal	**18.5**		**1.05**
EW-1B	14.4	600	0.10
EW-2B	13.3	706	0.11
EW-4B	31.5	417	0.16
Bedrock Zone Subtotal	**59.2**		**0.37**
Total	**77.7**		**1.42**

** The higher value of the total and dissolved concentrations from the May 2006 sampling. Some of the dissolved manganese values were higher than the total values, suggesting that the two values may have been swapped.*

As demonstrated in the above table, the mass loading of manganese can be reduced by approximately 1.05 pounds per day (or by approximately 74%). Because the backwash requirements are directly related to solids removal, a reduction of 74% mass loading should substantially reduce the backwashing requirements. It may be possible to reduce backwashing to three times per week, effectively reducing operator labor from five to three days per week.

In addition, in the absence of extraction from the intermediate zone extraction wells, the blended manganese influent concentration will be approximately 500 ug/L, which is much closer to the discharge limit of 300 ug/L. The site team may be able to negotiate with the State to relax the manganese standard to 600 ug/L, allowing the plant to operate without the greensand filters. If this is feasible, operator labor could likely be reduced to one or two days per week because greensand backwashing and solids handling would no longer be required.

If such a change to the discharge permit is not feasible, the site team should consider relaxing its internal standards for manganese removal. At present, the site team is maintaining manganese concentrations below 15 ug/L in the plant effluent. The site team could further reduce the need for backwashing by either bypassing some flow around the greensand filters or by reducing the permanganate dosing such that the manganese concentration in the plant effluent is approximately 200 ug/L (i.e., 100 ug/L below the discharge criteria). The site team will need to confirm that the treatment plant can still meet the criteria for total dissolved solids.

The RSE team recommends immediately discontinuing pumping from the intermediate zone wells on a trial basis. Continued influent monitoring should show a significant decrease in manganese loading, and after operating for several weeks at this decreased loading, the site team should notice a substantial decrease in the need to backwash the greensand filters. With a reduction in the backwash frequency, the site team could consider providing the recommended full 20-minute backwash for each unit.

There should be no additional engineering or treatment plant costs associated with discontinuing pumping from the intermediate wells, and the RSE team estimates a potential reduction in operator labor from approximately 60 hours per week to 30 hours per week (including response to alarms up to three times per week). This would represent a decrease in operator labor costs from approximately $209,000 per year to approximately $105,000 per year. If the site team is concerned about potential contaminant migration that is occurring deeper than MW-8I but above the deep zone, the site team could consider installing another monitoring well in the same location as MW-8I but approximately 30 feet deeper. The cost for this well might be $15,000 (including work plans and oversight) if the well is the only well being installed.

6.2.2 CONSIDER MODIFICATIONS TO THE BACKWASHING AND SOLIDS HANDLING PROCEDURES (CONTINGENT ON OUTCOME OF 6.2.1)

Depending on the outcome of the above recommendation, the site team may consider additional measures to reduce operator labor and other costs associated with backwashing and solids handling. The investment in these additional measures depends on how much additional money may be saved after Recommendation 6.2.1 is fully implemented. Potential measures to consider include the following:

- The site team could convert the existing DNAPL recovery tank (6,000 gallon capacity with a cone-shaped bottom and bottom drain) into a supplementary dirty backwash tank. This would involve bypassing the plant influent around the DNAPL recovery tank and directly into the COWS. Since operation began, it has been the COWS, not the DNAPL recovery tank, that has recovered DNAPL from the influent. The DNAPL recovery tank does not currently play any other beneficial role in the treatment plant. In addition, the DNAPL recovery tank has an appropriate capacity and construction to serve as a dirty-backwash tank. This conversion would allow the plant operator to provide both greensand filters a full 20-minute backwash per event. If, after further evaluation, the site team does not believe the DNAPL recovery tank is appropriately configured to serve as a dirty backwash tank, a second 3,000-gallon tank could be added for a slightly higher cost. This modification should improve the performance of the greensand filters and further reduce the backwash frequency without significantly increasing operator level of effort. The cost for using the DNAPL recovery tank is plumbing labor, which should be less than $2,500 in direct costs.

- The site team could also consider adding a small (about 2 cubic feet) filter press to the treatment plant for solids handing and automating the backwashing function by adding control equipment or replacing the vessels with a packaged automated system that can be tied into the main control system. This would substantially reduce operator time for solids handling, and it would also decrease disposal costs. The capital investment for this measure might be on the order of $100,000 total, including approximately $40,000 for the filter press, compressor, air lines and controls, double diaphragm sludge feed pump and filtrate piping to the equalization tank and $60,000 for replacing or modifying the greensand filters to provide automated backwashing and tying the controls into the main operating system. The site team will want to carefully evaluate the potential additional cost savings of implementing this after Recommendation 6.2.1 is implemented.

The RSE team estimates that both of these modifications will be cost-effective if the greensand filters require an operator to be on site three or more times per week for backwashing and solids handling. This will not be determined until after Recommendation 6.2.1 is implemented. The modifications should reduce operator labor to approximately 22 hours per week (including response to three alarms per week), which might further reduce operator labor costs from the $105,000 noted in Recommendation 6.2.1 to approximately $77,000 (e.g., additional savings of approximately $28,000 per year).

6.2.3 Suggestions for Long-Term Ground Water Monitoring

The 2006 ground water monitoring event cost approximately $121,000 to sample 21 non-pumping wells and 7 operating extraction wells, analyze the samples (iron, manganese, VOCs, and PAHs), and prepare a report. The direct costs for this event were surprisingly high to the RSE team, and the RSE team believes that much lower costs can be obtained by competitively bidding this ground water sampling or through stronger negotiations between USACE and the contractor. For example, the RSE team believes that a reasonable/conservative direct cost for the ground water sampling itself should be approximately $30,000 rather than $65,000. USACE should directly contract the ground water sampling to the appropriate contractor to avoid the mark-up by the prime contractor. Although this will require some labor from USACE, the added cost should be substantially lower than the cost of the prime contractor's markup. The costs and savings associated with these suggestions are summarized in the following table.

Item	Reported Direct Costs*	Reported Costs to EPA*	RSE Team Suggested Direct Costs	RSE Team Suggested Cost to EPA**
Sampling • Labor • Materials & Equipment • Travel • Project Management	$65,400	$77,200	$30,000	$30,000
Office Work • Work Plans • Data Management • Data Validation • Reporting	$23,800	$28,100	$23,800	$23,800
Analysis	$9,900	$11,700	$9,900	$9,900
Prime Contractor Oversight	$2,800	$4,000	$3,000***	$3,000***
Total	**$101,900**	**$121,000**	**$66,700**	**$66,700**

** The difference between the direct costs and the costs to U.S. EPA is the markup from the site contractor of 18%*
*** Costs reflect USACE directly contracting with the sampling firm*
**** Costs reflect added time from USACE (instead of the prime contractor) to manage the sampling contractor*

The RSE team also suggests modifying the sampling program as follows to focus on demonstrating plume containment:

- Annual monitoring of the following non-pumping wells in the intermediate zone: MW-7I, MW-8I, MW-10I, MW-11I, MW-13I, MW-14I, MW-15I, EW-1I, EW-2I, EW-5I, EW-4I. Note that this assumes pumping in the intermediate zone has been discontinued. Samples should be analyzed for VOCs and PAHs only (i.e., not iron or manganese).

- Annual monitoring of the following non-pumping wells in the deep zone: MW-10B, MW-11B, MW-7D, MW-12B, MW-13B, MW-14B, MW-15B. Samples should be analyzed for VOCs and PAHs only (i.e., not iron or manganese).

- Quarterly monitoring of the three operating extraction wells should be conducted with samples analyzed for VOCs, PAHs, iron, and manganese. This sampling could be conducted by the treatment plant operator from within the treatment plant, and samples could be submitted for analysis along with other process water samples.

- Sampling select additional site monitoring wells every five years in conjunction with the Five-Year Reviews.

The above changes should not result in a significant change in costs compared to the suggested costs in the above table. Fewer non-pumping wells will be sampled and several iron and manganese samples will not be collected and/or analyzed. However, these savings will likely be offset by the quarterly sampling and analysis of the three operating extraction wells, which might have otherwise been done on an annual basis.

In summary, the RSE team believes that the above changes will result in an effective monitoring program that saves EPA approximately $54,000 per year (rounded down from $54,300 per year).

6.2.4 PILOT TEST BYPASSING THE AIR STRIPPER

The air stripper was included in the design due to substantially higher expected concentrations of VOCs in the influent. Because those VOCs are not present at the expected concentrations in the system influent and the GAC is capable of providing the necessary VOC removal, the value of the air stripping step is questionable. The air stripper blower costs approximately $13,000 in electricity per year to operate, and the in-line heater (assuming it operates 75% of the time) costs another $8,000 in electricity per year to operate. Bypassing the air stripper should save approximately $21,000 per year in direct costs or $24,800 including G&A and contractor fee. Recognizing that the GAC may need one additional change out per year, the net savings may be on the order of $12,000 per year in direct costs or $14,000 including G&A and contractor fee.

Bypassing the air stripper could be done immediately by discontinuing the operation of the blower and the in-line heater. The site team will continue to monitor the GAC performance through the monthly sample collected between the GAC units. If the site team determines that more than two GAC changes are required per year while the air stripper is bypassed, then the site team should consider using the air stripper again.

Despite a potential increase in GAC usage, the RSE team estimates that the site team will be able to realize savings of at least $10,000 per year by bypassing the air stripper. Additional minor savings may be realized if fewer bag filter changeouts are needed for the bag filter units located downstream of the air stripper.

6.2.5 CONSIDER A HYBRID TIME & MATERIALS AND FIXED-PRICE CONTRACT

The current contract for system O&M is fixed-price, which means that the contractor must provide the stated services for a fixed cost. To cover the risk of potential unknowns, a contractor will often add in substantial contingency into a fixed-price contract to cover those unknowns. In this case, the client (EPA) pays for the reasonable worst-case cost scenario even if that reasonable worst-case does not happen. As an example, the contract for three month period includes $7,400 per month for consumables and disposal costs. This translates to $88,800 per year in direct costs or $105,000 per year including the markup. This direct cost of $88,800 per year in direct costs appears to include substantial contingency. The following table summarizes conservative costs that the RSE team assumes would fall under this category. The actual costs are likely lower than these estimated by the RSE team.

Item	Conservative RSE Estimated Cost
Two liquid phase GAC changeouts per year	$18,000*
Chemicals • Potassium permanganate • Sulfuric acid	$5,000
Bag filters	$10,000**
Disposal	$15,000
Minor repairs (including parts)	$18,000
Total	**$66,000**

* *based on costs provided in the negotiated contract*
** *actual costs are much lower (likely under $5,000)*

The above table suggests that the fixed-price contract includes an additional $22,800 in direct costs beyond those that the RSE team conservatively estimates would be needed. With the markups included, this translates to approximately $27,000 in extra costs to EPA.

In future contacts, the RSE team recommends bidding O&M for one year with two to four option years. The contract should include a fixed-price for operator labor, project management, and other labor (e.g., health and safety coordinator and procurement), and the contract should be time and materials for chemicals, disposal, GAC replacement, and minor utilities. Electricity should be billed directly to USACE or EPA to save the markup of approximately $8,500. If, for whatever reason, the electricity cannot be direct billed, the electricity should also be billed time and materials due to the uncertainty of electricity rate escalation and electricity demand for building heat.

In summary, the RSE team believes that implementing this recommendation will save at least $35,500 ($27,000 plus $8,500) and possibly more. If the GAC and waste disposal can be contracted directly by the USACE rather than by the site contractor, the cost of the markup on those items could also be eliminated.

6.2.6 REDUCTIONS IN PROJECT MANAGEMENT CONSISTENT WITH STEADY STATE SYSTEM OPERATION

The current project management costs ($96,000 including travel for the contractor and $60,000 for USACE) are very high for an operating P&T system and are likely the result of the problems associated with the first several months of startup. Appropriate project management costs from the site contractor during steady-state operation of the treatment plant (including procurement, health and safety, etc.) could be provided for approximately $3,000 per month ($36,000 per year). By comparison, several Fund-lead P&T systems in Region 3 have project management costs of under $36,000 per year. Only the much more complicated systems have project management as high as $60,000 per year. In addition, the oversight provided by USACE could also be likely reduced during future steady-state operation to approximately $3,000 per month ($36,000 per year). In summary, the reduction of project management costs as the system operation becomes smoother should result in savings of approximately $84,000 ($96,000+$60,000 - $36,000 - $36,000 = $84,000) per year compared to those currently incurred at the site.

6.3 RECOMMENDATIONS FOR TECHNICAL IMPROVEMENT

6.3.1 RE-LOCATE EQUALIZATION TANK HIGH-LEVEL SWITCH

The equalization tank high level switch should be lowered to increase the distance between the high level switch and the high-high level switch. This should reduce unnecessary alarms and associated labor. This change will require additional plumbing with system operation temporarily discontinued because the sight glass does not have an isolation valve. While this change is being made and the system is shut down, isolation valves should be added to all sight glasses to facilitate future maintenance. The RSE team estimates that these modifications should be made for under $10,000 in direct costs or approximately $12,000 including markups.

6.3.2 DISCONTINUE USE AND SERVICE TO GENERATOR

The site team maintains a diesel generator to operate the treatment system in case of a power outage. The RSE team does not believe that such a protective measure is necessary. Typical power outages last less than a day, and a severe power outage may last for up to a week. Given that ground water flow at the site is relatively slow (typically less than 0.02 feet per day), even a week long shutdown would only allow ground water to migrate a fraction of a foot. As such, the RSE team recommends that resources (time and funding) be allocated to more important aspects of site O&M. Other EPA facilities may be in much greater need of the diesel generator.

6.3.3 Modify Use of Water Levels from Operating Extraction Wells When Developing Potentiometric Surface Maps

Because water levels in operating extraction wells are affected by well losses and well inefficiencies that substantially lower the water level in the well compared to the surrounding aquifer, they may bias the development of potentiometric surface maps in favor of capture. As such, it is more appropriate to either discontinue their use in developing potentiometric surface maps or to correct the water levels to account for these factors. For extraction wells EW-1B and EW-4B there are monitoring wells sufficiently close to the extraction wells such that the water levels from EW-1B and EW-4B can be excluded when preparing the potentiometric surface map. However, for EW-2B, it is more appropriate to correct the measured water level to better represent the water level in the aquifer in the vicinity of the extraction well. Appendix B of this report provides a methodology for partially correcting the water levels by accounting for the effects of well losses. Ideally, the drawdown in the extraction well should scale linearly with the extraction rate, but well losses will cause the drawdown to increase non-linearly with the extraction rate. Once they are determined as discussed in Appendix B, effects of well losses can be added to the water level from the operating extraction well and the potentiometric surface map can be prepared. Although other aspects of well inefficiency may still be present, this will nevertheless represent an improved estimate of the water level in the aquifer adjacent to the extraction well. The additional cost associated with this task should be less than $5,000. This cost includes planning by a senior scientist plus travel to the site by a technician to measure water levels in the extraction well while the treatment plant operator varies the flow. The data can be easily interpreted and explained within the current estimated budget for preparing the ground water monitoring report.

6.4 Considerations for Gaining Site Close Out

The RSE team does not have any recommendations for this category. The RSE team believes that complete aquifer restoration will not occur within a reasonable time frame due to the presence of DNAPL in relatively tight unconsolidated material and bedrock. As such, the above recommendations are geared toward long-term cost-effective P&T operation. During the next Five-Year Review, the site team might begin considering a Technical Impracticability waiver for the site.

7.0 SUMMARY

The observations and recommendations contained in this report are not intended to imply a deficiency in the work of either the system designers or operators, but are offered as constructive suggestions in the best interest of the EPA and the public. These recommendations have the obvious benefit of being formulated based upon operational data unavailable to the original designers.

Recommendations are provided in the following three of the four categories: effectiveness, cost reduction, and technical improvement. The effectiveness recommendations include instituting a routine ground water monitoring program and providing options to EPA for additional plume delineation in ground water and for evaluating soil vapor intrusion. The recommendations for cost reduction offer potential cost savings of over $300,000 per year including projected savings for ground water monitoring. Recommendations include changes to ground water extraction that will facilitate plant operation and reduce operator labor. The recommendations also include suggested changes in contracting, potentially bypassing the air stripper, and reducing project management costs as system operation becomes more routine. The recommendations for technical improvement include general maintenance to sight glasses and level switches, including relocation of the high-level switch in the equalization tank to reduce the likelihood of unnecessarily tripping the high-high level switch. The site is in its first year of a Long-Term Remedial Action, and no recommendations are provided for gaining site closure.

Table 7-1 summarizes the costs and cost savings associated with each recommendation. Both capital and annual costs are presented. Also presented is the expected change in life-cycle costs over a 30-year period for each recommendation both with discounting (i.e., net present value) and without it.

Table 7-1. Cost Summary Table

Recommendation	Reason	Additional Capital Costs ($)	Estimated Change in Annual Costs ($/yr)	Estimated Change in Life-cycle Costs ($)*	Estimated Change in Life-cycle Costs ($)**
6.1.1 Institute a Routine Ground Water Monitoring Program	Effectiveness	$0	See 6.2.3	See 6.2.3	See 6.2.3
6.1.2 Optional Plume Delineation	Effectiveness	$35,000	$0	$35,000	$35,000
6.1.3 Soil Vapor Intrusion Evaluation	Effectiveness	$15,000	$0	$15,000	$15,000
6.2.1 Discontinue Pumping From the Intermediate Zone	Cost Reduction	$15,000	($104,000)	($3,105,000)	($1,664,000)
6.2.2 Consider Modifications to the Backwashing and Solids Handling Procedures (Contingent on Outcome Of 6.2.1)	Cost Reduction	$100,000	($28,000)	($740,000)	($352,000)
6.2.3 Suggestions for Long-Term Ground Water Monitoring	Cost Reduction	$0	($54,000)	($1,620,000)	($872,000)
6.2.4 Pilot Test Bypassing the Air Stripper	Cost Reduction	$0	($14,000)	($420,000)	($226,000)
6.2.5 Consider a Hybrid Time & Materials and Fixed-Price Contract	Cost Reduction	$0	($35,500)	($1,065,000)	($573,000)
6.2.6 Reductions in Project Management Consistent with Steady State System Operation	Cost Reduction	$0	($84,000)	($2,520,000)	($1,356,000)
6.3.1Re-Locate Equalization Tank High-Level Switch	Technical Improvement	$12,000	$0	$12,000	$12,000
6.3.2 Discontinue Use and Service to Generator	Technical Improvement	$0	$0	$0	$0
6.3.3 Modify Use of Water Levels from Operating Extraction Wells when Developing Potentiometric Surface Maps	Technical Improvement	$5,000	$0	$5,000	$5,000
Total		**$182,000**	**($319,500)**	**($9,403,000)**	**($4,976,000)**

Costs in parentheses imply cost reductions
* assumes 30 years of operation with a discount rate of 0% (i.e., no discounting)
** assumes 30 years of operation with a discount rate of 5% and no discounting in the first year

FIGURES

FIGURE 1-1. SITE MAP WITH WELL LOCATIONS

GCL Tie and Treating Site
Operable Unit 2
Sidney, New York

Figure 1
Well Location Map

CDM

(Note: This figure was prepared by CDM as part of the Groundwater Sampling Report for the Spring 2006 Event.)

APPENDIX A:
BIOSCREEN ANALYSIS

SELECTION OF BIOSCREEN INPUT PARAMETERS
NAPHTHALENE ATTENUATION
GCL TIE & TREATING SUPERFUND SITE

BIOSCREEN was run to simulate the attenuation of naphthalene between the source area located near MW-7B and downgradient well MW-11B. The results were also used to estimate the distance downgradient of MW-11B that would be required for the naphthalene concentrations to attenuate below the cleanup criteria of 50 ug/L. The following values were used for input parameters:

Parameter	Value	Explanation
Hydraulic conductivity	0.5 feet per day (1.8×10^{-4} cm/sec)	Measured with pump test
Hydraulic gradient	0.01 feet per foot	Interpreted from potentiometric surface maps
Effective porosity	0.2	Conservatively estimated
Longitudinal dispersivity	17.9	Calculated using BIOSCREEN manual
Transverse dispersivity	1.8	Calculated using BIOSCREEN manual
Vertical dispersivity	0	Conservatively estimated
Retardation factor	1	Conservatively estimated
Degradation half-life	4.5	Conservatively estimated at more than 6 times upper end value from Michalenko, E.M., *Handbook of Environmental Degradation Rates*, Lewis Publishers, 1991
Source area concentration	7,000 ug/L	Consistent with values from MW-7B

The simulation with this set of parameters results in a naphthalene concentration of 112 ug/L 300 feet downgradient of the source area. This agrees with the measured concentration of 110 ug/L of naphthalene at MW-11B, which is approximately 300 feet downgradient of MW-7B. It is further noted that the simulated naphthalene concentration decreases to 27 ug/L (i.e., below the standard of 50 ug/L) within 400 feet of the source area.

Print outs of the input and output screens for the above simulation are provided on the following pages.

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence

Version 1.4

GCL Tie & Treating

Run Name

Data Input Instructions:

115	1. Enter value directly....or
or	2. Calculate by filling in grey cells below. (To restore formulas, hit button below).
0.02	
Variable*	Data used directly in model.
20	Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	9.1	(ft/yr)
or		or	
Hydraulic Conductivity	K	1.8E-04	(cm/sec)
Hydraulic Gradient	i	0.01	(ft/ft)
Porosity	n	0.2	(-)

2. DISPERSION

Longitudinal Dispersivity	alpha x	17.9	(ft)
Transverse Dispersivity*	alpha y	1.8	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp	500	(ft)

3. ADSORPTION

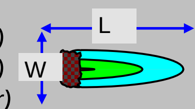
Retardation Factor*	R	1.0	(-)
or		or	
Soil Bulk Density	rho	1.4	(kg/l)
Partition Coefficient	Koc	2000	(L/kg)
FractionOrganicCarbon	foc	0.0E+0	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	1.5E-1	(per yr)
or		or	
Solute Half-Life	t-half	4.50	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	0	(mg/L)
Delta Nitrate*	NO3	0	(mg/L)
Observed Ferrous Iron*	Fe2+	0	(mg/L)
Delta Sulfate*	SO4	0	(mg/L)
Observed Methane*	CH4	0	(mg/L)

5. GENERAL

Modeled Area Length*	1000	(ft)
Modeled Area Width*	500	(ft)
Simulation Time*	200	(yr)



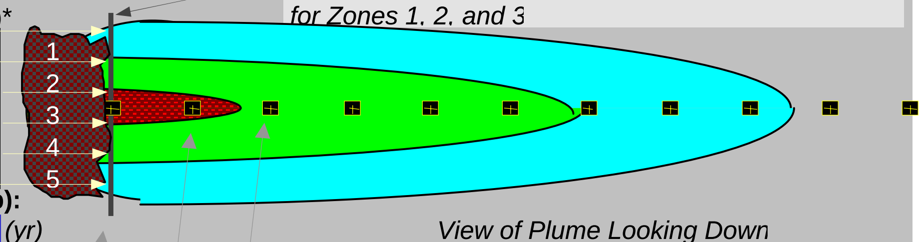
6. SOURCE DATA

Source Thickness in Sat.Zone* 100 (ft)

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3

Source Zones:

Width* (ft)	Conc. (mg/L)*
25	7
25	7
25	7
25	7
25	7



View of Plume Looking Down

Source Halflife (see Help):

Infinite	Infinite	(yr)
Inst. React.	1st Order	
Soluble Mass	infinite	(Kg)
In Source NAPL, Soil		

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)											
Dist. from Source (ft)	0	100	200	300	400	500	600	700	800	900	1000

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE

View Output

RUN ARRAY

View Output

Help

Recalculate This Sheet

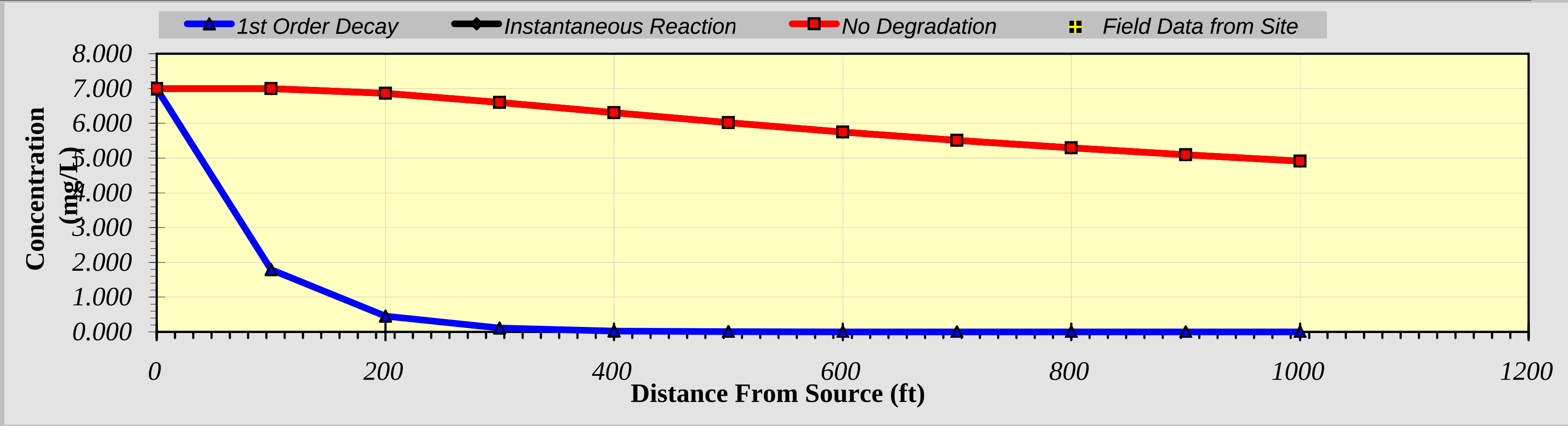
Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	100	200	300	400	500	600	700	800	900	1000
No Degradation	7.000	6.993	6.861	6.600	6.303	6.015	5.749	5.508	5.291	5.094	4.914
1st Order Decay	7.000	1.794	0.452	0.112	0.027	0.007	0.002	0.000	0.000	0.000	0.000
Inst. Reaction	7.000	6.993	6.861	6.600	6.303	6.015	5.749	5.508	5.291	5.094	4.914
Field Data from Site											



Calculate Animation

Time:

200 Years

Return to Input

Recalculate This Sheet

APPENDIX B:
CALCULATION OF WELL LOSSES

USING SPECIFIC CAPACITIES FROM A STEP-DRAWDOWN TEST TO ESTIMATE WELL LOSSES AT EXTRACTION WELLS DUE TO TURBULENT FLOW

Ground water flow across the well screen is turbulent due to large hydraulic gradients. For this case Jacob (1950) proposed the following expression for drawdown inside the well casing, s_w:

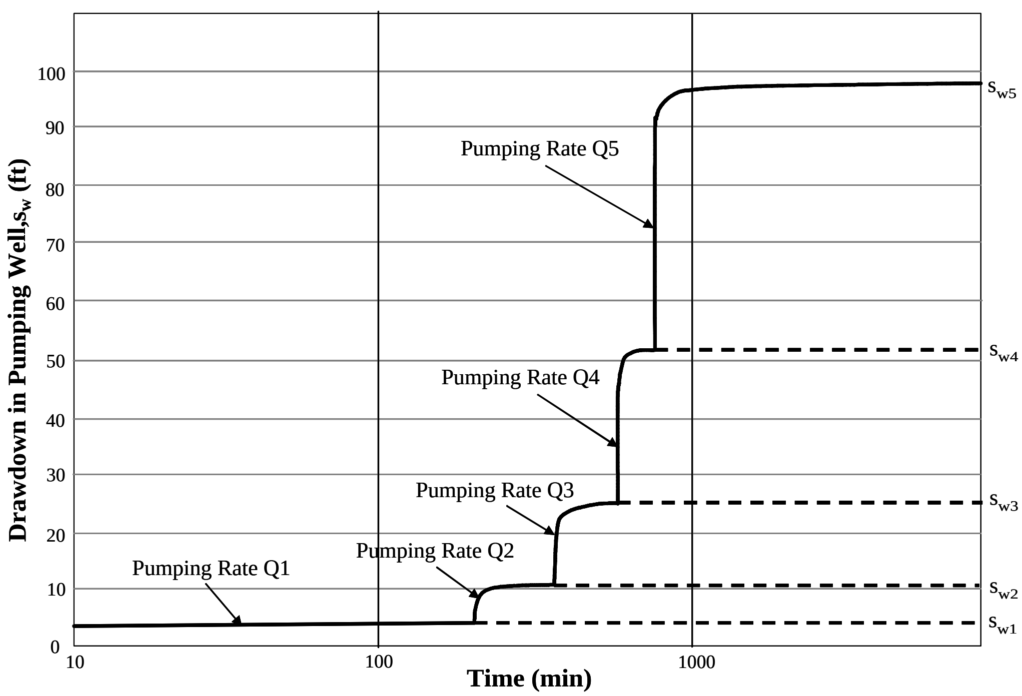
$$s_w = BQ + CQ^2$$
$$s_L = CQ^2$$

Where

- s_w = drawdown inside the well casing
- s_L = well loss
- C = a "well coefficient", a measure of the head loss due to turbulent flow in the well screen and pump inlet
- B = an "aquifer coefficient", a measure of the head loss due to laminar (Darcy) flow in the aquifer
- Q = pumping rate

Bierschenk (1964) developed a graphical method for determining coefficients B and C. It is based on a plot of specific capacity versus pumping rate from a step-drawdown test, which assumes that an equilibrium drawdown in the pumping well will be established during the step-drawdown test for several pumping rates.

$$\mathbf{s_w/Q = CQ + B}$$



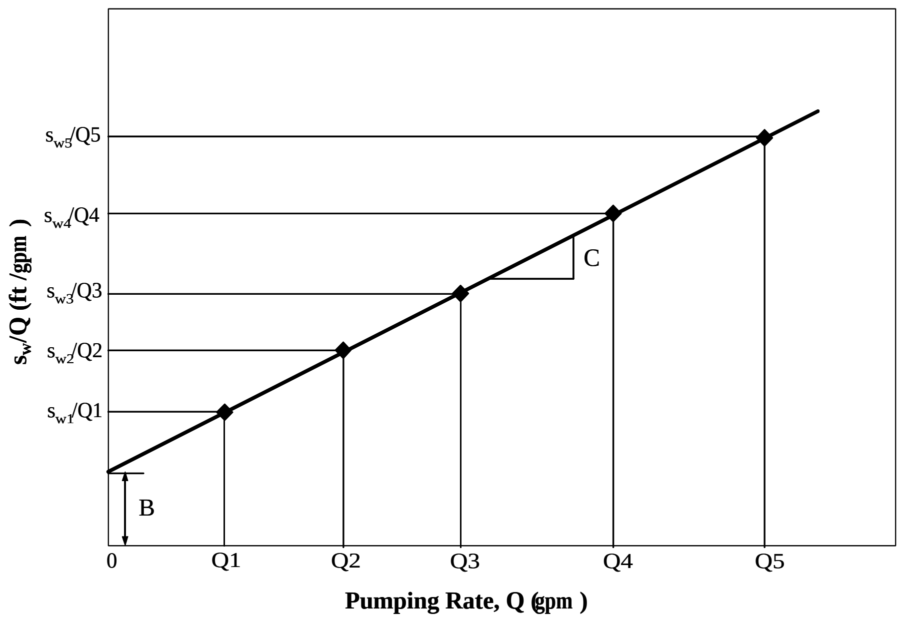
The step-by-step description of the procedure is as follows:

1. Plot drawdown s_w versus log(time) as shown in the upper figure

2. For each pumping rate, record the equilibrium drawdown at the pumping well (s_w)

3. Plot s_w/Q versus Q on arithmetic scale as shown in the lower figure. Fit a straight line through the data and extend the fitted line to a zero pumping rate. The slope of the line is C and the y-intercept is B.

4. Calculate the well loss associated with a specific pumping rate, $s_L = CQ^2$



References

Bierschenk, W.H. 1964. Determining Well Efficiency by Multiple Step-Drawdown Tests. International Association of Scientific Hydrology, Publication 64, pp. 494-505.

Jacob, C.E. 1950. Flow of groundwater, in *Engineering Hydraulics* (H. Rouse, Ed.), Chap. 5, pp. 321-386, Wiley, New York.