REMEDIATION SYSTEM EVALUATION

RAYMARK SUPERFUND SITE
HATBORO, PENNSYLVANIA

Report of the Remediation System Evaluation,
Site Visit Conducted at the Raymark Superfund Site
June 7-8, 2001

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NOTICE

Work described herein was performed by GeoTrans, Inc. (GeoTrans) and the United States Army Corps of Engineers (USACE) for the U.S. Environmental Protection Agency (U.S. EPA). Work conducted by GeoTrans, including preparation of this report, was performed under Dynamac Contract No. 68-C-99-256, Subcontract No. 91517. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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EXECUTIVE SUMMARY

The Raymark site occupies 7 acres off Jacksonville Road in an industrial part of Hatboro, Pennsylvania. The pump-and-treat system addresses groundwater contamination, primarily trichloroethylene (TCE), associated with the operations of various manufacturers of rivets and other metal manufacturers, including the Penn Rivet and Machine Company that occupied the site from 1947 through 1954. The site has been divided into the following three operable units:

- OU1, completed in October 1995, addressed the soil contamination with excavation of a former storage tank location, an asphalt cap, a multi-layer synthetic cap, and soil vapor extraction;

- OU2 addressed the local drinking water supply by installing air strippers on select public wells to treat contaminated groundwater and vapor phase carbon to treat the off gas from the air strippers; and

- OU3 continues to address the onsite groundwater contamination by extracting groundwater, treating it with an air stripper (equipped with vapor phase carbon to treat the off gas), and discharging the treated water through a storm drain to nearby Pennypack Creek.

Hatboro water supply wells H-14 and H-17 are the only two remaining public water supply wells to operate. The only costs associated with operation of these wells and treatment of the extracted water that are associated with the Raymark site are for regular replacement of the vapor phase carbon.

The RSE team focused on OU3 and found a well-operated treatment system. However, possibly due to the high turnover rate among EPA Remedial Project Managers for this site and changes in contractors, site information and background, especially related to system design, is difficult to access or is unavailable. In addition the recent sampling event in April and May 2000, was the only aquifer monitoring conducted onsite in over half a decade. Recommendations to improve system effectiveness include the following:

- The site-related wells require surveying and downhole camera work to determine the elevations of the tops of the well casings and the screened intervals of the wells. Without this information reliable potentiometric surfaces indicating groundwater flow cannot be generated. In addition, this information is necessary for plume delineation and evaluation of the capture zone.

- Once this information is obtained for the site-related wells, water level elevations should be measured and potentiometric surfaces should be generated for pumping and non-pumping scenarios. This may require the installation of piezometers in each of the underlying stratigraphic units. In addition, previously collected depth-to-water measurements can be converted to water elevations for further evaluation.

- The plume should also be better delineated. This can be accomplished through continuing with the new annual sampling program and adding additional monitoring points in each of the underlying stratigraphic units.

- Once the potentiometric surfaces are generated and the plume is better delineated, the capture zones for the extraction wells should be analyzed. This is especially pertinent given the discrepancy between the extraction rate of 285 gpm suggested in the 1990 Feasibility Study, which was based on a preliminary capture zone analysis, and the current average extraction rate of 48 gpm. If onsite TCE contamination is not captured by the current pumping program, increased pumping rates and additional extraction wells will be required.

- Wells associated with the site, including a former extraction well, screen multiple stratigraphic units, but are no longer used for pumping. These wells should be properly sealed to prevent cross contamination of the stratigraphic units.

- Samples should be taken of the sediments and surface water of Pennypack Creek, which is located within a mile downgradient of the Raymark site. Figures in the 1990 Feasibility Study indicate that the groundwater plume may impact the creek. In addition, the creek is the discharge location for the treatment plant effluent which, according to a consent decree, may have TCE concentrations as high as 73 ppb.

- Finally, TCE concentrations in the shallow subsurface underlying the eastern portion of the site indicate that soil gas may have significant concentrations of TCE. This could adversely impact onsite and nearby buildings. Air sampling in these buildings should be conducted.

These recommendations will likely require approximately $120,000 in capital costs and might increase annual costs by more than $12,000.

The RSE team also found that site-related costs are reasonable, and the team has no current recommendations for cost reduction. Rather, the focus of the site activities should address the above-mentioned effectiveness concerns and the continued operation of the treatment plant. In addition, site-related data and documents should be organized and made easily accessible to the site managers. Current efforts to develop new site documents, compile existing documents, and organizing current information will likely cost $30,000.

PREFACE

This report was prepared as part of a project conducted by the United States Environmental Protection Agency (USEPA) Technology Innovation Office (TIO) and Office of Emergency and Remedial Response (OERR). The objective of this project is to conduct Remediation System Evaluations (RSEs) of pump-and-treat systems at Superfund sites that are "Fund-lead" (i.e., financed by USEPA). RSEs are to be conducted for up to two systems in each EPA Region with the exception of Regions 4 and 5, which already had similar evaluations in a pilot project.

The following organizations are implementing this project.

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The project team is grateful for the help provided by the following EPA Project Liaisons.

Region1	Darryl Luce and Larry Brill	**Region 6**	Vincent Malott
Region 2	Diana Cutt	**Region 7**	Mary Peterson
Region 3	Kathy Davies	**Region 8**	Armando Saenz and Richard Muza
Region 4	Kay Wischkaemper	**Region 9**	Herb Levine
Region 5	Dion Novak	**Region 10**	Bernie Zavala

They were vital in selecting the Fund-lead P&T systems to be evaluated and facilitating communication between the project team and the Remedial Project Managers (RPM's).

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1.0 INTRODUCTION

1.1 PURPOSE

In the *OSWER Directive No. 9200.0-33, Transmittal of Final FY00 - FY01 Superfund Reforms Strategy, dated July 7,2000*, the Office of Solid Waste and Emergency Response outlined a commitment to optimize Fund-lead pump-and-treat systems. To fulfill this commitment, the US Environmental Protection Agency (USEPA) Technology Innovation Office (TIO) and Office of Emergency and Remedial Response (OERR), through a nationwide project, is assisting the ten EPA Regions in evaluating their Fund-lead operating pump-and-treat systems. This nationwide project is a continuation of a demonstration project in which the Fund-lead pump-and-treat systems in Regions 4 and 5 were screened and two sites from each of the two Regions were evaluated. It is also part of a larger effort by TIO to provide USEPA Regions with various means for optimization, including screening tools for identifying sites likely to benefit from optimization and computer modeling optimization tools for pump and treat systems.

This nationwide project identifies all Fund-lead pump-and-treat systems in EPA Regions 1 through 3 and 6 through 10, collects and reports baseline cost and performance data, and evaluates up to two sites per Region. The site evaluations are conducted by EPA-TIO contractors, GeoTrans, Inc. and the United States Army Corps of Engineers (USACE), using a process called a Remediation System Evaluation (RSE), which was developed by USACE. The RSE process is meant to evaluate performance and effectiveness (as required under the NCP, i.e., and “five-year" review), identify cost savings through changes in operation and technology, assure clear and realistic remediation goals and an exit strategy, and verify adequate maintenance of Government owned equipment.

The Raymark Superfund Site was chosen based on initial screening of the pump-and-treat systems managed by USEPA Region 3 as well as discussions with the EPA Remedal Project Manager for the site and the Superfund Reform Initiative Project Liaison for that Region. This site has a long projected operating life and complicated hydrogeology. This report provides a brief background on the site and current operations, a summary of the observations made during a site visit, and recommendations for changes and additional studies. The cost impacts of the recommendations are also discussed.

A report on the overall results from the RSEs conducted for this system and other Fund-lead P&T systems nationwide will also be prepared and will identify lessons learned and typical costs savings.

1.2 TEAM COMPOSITION

The team conducting the RSE consisted of the following individuals:

Frank Bales, Chemical Engineer, USACE, Kansas City District
Rob Greenwald, Hydrogeologist, GeoTrans, Inc.
Lindsey Lien, Environmental Engineer,USACE, HTRW CX
Doug Sutton, Water Resources Engineer, GeoTrans, Inc.

1.3 DOCUMENTS REVIEWED

Author	Date	Title/Description
US EPA	3/24/1988	Record of Decision, Raymark Site, Hatboro Borough, Montgomery County, Pennsylvania, AR, Sept. 28, 1990
CH2M Hill, Inc.	9/1990	Draft Final Focused Feasibility Study for Ground Water Remediation, Raymark Site
CH2M Hill, Inc.	7/1991	Raymark Site RI/FS Final Soil/Source Area Remedial Investigation Report, Operable Unit No. 1
ERM-Enviroclean, Inc.	6/28/1993	Request for Determination of Requirement for Plan Approval/Operating Permit Application for Groundwater Treatment/Soil Vapor Extraction
CH2M Hill, Inc.	9/14/1993	Remedial Action Report, Raymark Superfund Site, Hatboro, Pennsylvania, Operable Unit 2.
CH2M Hill, Inc.	9/30/1994	Raymark Remedial Action, Operable Units 1 and 3
US EPA	9/12/1995	Superfund Preliminary Site Close Out Report, Raymark Superfund Site, Hatboro, Pennsylvania
US EPA	4/16/1996	Amended Work Plan for Hatboro Well H16 and the Raymark Site
Philadelphia Suburban	1997 - 2000	Hatboro Well Monitoring Report, 1997, 1^{st} & 2^{nd} Quarter 1998, 3^{rd} Quarter 1998, 2^{nd} Quarter 1999, 3^{rd} Quarter 1999, 4^{th} Quarter 1999, 1^{st} Quarter 2000, 2^{nd} Quarter 2000, 3^{rd} Quarter 2000
Gilmore & Associates, Inc.	2/5/1997 - 7/17/2000	Raymark Site Groundwater Treatment System Quarterly Progress Report for November-December 1996, January-March 1997, April-June 1997, July-September 1997, January-March 1998, April-June 1998, July-September 1998, October-December 1998, January-March 1999, April-June 1999, July-September 1999, October-December 1999, January-March 2000, April-June 2000
Gilmore & Associates, Inc.	2/18/1999	Communication: TCE concentrations in Wells H14 and H17 from 1983 through September 1996
CDM Federal Programs Corporation	5/21/1999	Groundwater Data Trend Analysis Report for Raymark Site, Hatboro, Montgomery County, Pennsylvania

Author	Date	Title/Description
CDM Federal Programs Corporation	6/8/1999	Well Survey Letter Report, Raymark Superfund Site, Hatboro, PA
CDM Federal Programs Corporation	10/10/2000	Sampling Summary Report for Raymark Superfund Site, Hatboro, Pennsylvania
CDM Federal Programs Corporation	12/22/2000	Quarterly Cleanup Status Report, Raymark Site - Operation and Maintenance, November-December 1999, July-October 2000,

1.4 PERSONS CONTACTED

The following individuals were present for the site visit:

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Bob Smauck (Gilmore Engineering, 215-345-4330) was contacted by phone after the RSE visit.

1.5 SITE LOCATION, HISTORY, AND CHARACTERISTICS

1.5.1 LOCATION

The Raymark Superfund Site, located on Jacksonville Road in Hatboro, Montgomery County, Pennsylvania, occupies 7 acres. Between 1947 and 1954 the Penn Rivet and Machine Company owned and operated a plant for manufacturing rivets. Various businesses have occupied the area since 1954, and the site is currently owned and operated by Penn Fasteners, Inc., manufacturers of rivets and other fasteners. Remedies at the site now address contamination from trichloroethylene (TCE) and other solvents resulting from waste disposal associated with degreasing and electroplating activities. The area surrounding the Raymark Site is shown in Figure 1-1 and the site layout is shown in Figure 1-2.

TCE contamination of the groundwater in the Stockton formation, which supplies Hatboro with drinking water, was first discovered in 1979, and investigations of groundwater contamination began in 1981. In 1985 the EPA and the Borough of Hatboro filed suit against the owners and operators (former and current as of 1985) associated with the Raymark Site. A resulting Consent Decree was issued in 1989. The site was divided into three operable units— OU1 to address soil contamination, OU2 to address the drinking water supply, and OU3 to address groundwater contamination.

The 1990 Record of Decision (ROD) specified both onsite and offsite extraction and treatment of groundwater. Onsite extraction and treatment would require the installation of an extraction system and a treatment system that includes treatment of the water by air stripping and treatment of the offgas with vapor phase carbon. Offsite extraction would be achieved by pumping from local water supply wells H-14, H-16, and H-17. Treatment of water extracted from these wells would be accomplished via air stripping with vapor phase carbon used to treat the offgas. Wells H-14 and H-17 were outfitted with air strippers in 1984 and 1986 as part of a settlement with the Fischer and Porter Company located to the northwest of the Raymark Site. As part of the Raymark remedy H-16 was to be outfitted with an air stripper and the offgas from treatment at all three wells would be addressed with vapor phase carbon. Currently, only wells H-14 and H-17 are operating.

A separate ROD required a soil vapor extraction (SVE) system and two caps to address soil contamination. The SVE system began operation in March 1994 and was shut off in October 1995 when soil cleanup levels were reportedly met. A multilayer low permeability cap covers a soil pile over the former lagoon area. The soil pile, resulting from spoils from drilling and excavations for site piping, and cap rise to a height of approximately 10 to 15 feet over the rest of the site. An asphalt cap, which currently serves as a parking lot, covers the remainder of the site not occupied by building.

1.5.2 POTENTIAL SOURCES

From 1948 to 1972 wastes, including TCE, from degreasing and electroplating activities were discharged into four onsite, unlined lagoons. Other potential sources of contamination included possible leaks from aboveground storage tanks and possible discharges through building drains. Sludge from the lagoons was removed in 1972 and the lagoons were backfilled with clean soil. Soil contamination was addressed by the SVE system in from March 1994 to October 1995 and the multilayer and asphalt caps.

TCE concentrations in groundwater during the initial investigations were as high as 47,000 parts per billion (ug/L). Samples of the surface soils during the Remedial Investigation yielded only 18 ug/kg of TCE, however, subsurface soil samples taken near the former lagoons yielded concentrations of TCE as high as 7,000 ug/kg. Soil gas concentrations for TCE were highest in the soils underlying former storage-tank area. Freephase solvents were not discovered during the Remedial Investigation, but discussions during the RSE visit indicated anecdotes of freephase being discovered during the installation of a well in 1992 by the USGS.

It is important to note that other industrial sources of groundwater contamination exist in the area and may have contributed to the regional groundwater plume including the Fisher and Porter Company located to the northwest of the Raymark site that financed the installation of the air strippers on wells H-14 and H-17.

1.5.3 HYDROGEOLOGIC SETTING

Soil thickness at the site varies from 4 to 10 feet and consists of fine sands and silts. Beneath this soil lies bedrock from the Stockton formation consisting of various layers of sandstone and siltstone which are depicted in Figure 1-3. According to the Remedial Investigation, the bedding of these units shows no particular pattern or order. The 1990 Feasibility Study considers the following four stratigraphic zones based on the logs of well PF-1 and a packer test conducted in that well.

- Zone 1 above 75 feet below ground surface (bgs) is poorly transmissive and yields 0.1 gpm per foot of drawdown.
- Zone 2 extends from 75 to 95 feet bgs and is also poorly transmissive, yielding 0.36 gpm per foot of drawdown.
- Zone 3 extends from 95 to 125 feet, and was described, as a result of the packer test (USGS report dated July 20, 1989), as a zone that does not contribute water to the well.
- Zone 4 extends below 125 feet, is highly transmissive, and yields 5.4 gpm per foot of drawdown.

The site hydrogeology is otherwise not well documented or understood based on the documents reviewed by the RSE team. Groundwater depths have been recorded as part of the site activities, but with the absence of elevations for the tops of the well casings, these depths could not be converted to water elevations. Thus, no potentiometric surface of groundwater at the site is available. In general, water elevations are estimated to vary from 205 to 225 feet above mean sea level (MSL) with the highest levels occurring in the winter and early spring. Given a site elevation of 265 feet MSL, this translates to water depths of 40 to 60 feet below ground surface, depending on the season.

Pennypack Creek passes within a mile of the site to the west and southwest. While regional groundwater flow is expected to flow in this direction, the large number operating wells in the area could significantly affect the speed and direction of groundwater. Actual groundwater flow directions are not known. The average yield for a well in the area is approximately 130 gpm.

1.5.4 DESCRIPTION OF GROUND WATER PLUME

The Feasibility Study conducted in 1990 depicts the TCE groundwater contamination as extending nearly a mile west of the site toward Pennypack Creek as well as 2,000 or more feet to the north of the site. Sampling conducted in April and May 2000 show TCE concentrations onsite as high as 2,300 ppb. In addition, offsite wells have TCE concentrations as high as 1,000 ppb and Hatboro well H-14, over a half mile to the west of the site, has a TCE concentration of approximately 150 ppb. Likely due to the complex nature of the fractured bedrock subsurface, concentrations vary significantly with location. For example, offsite wells R-3 and R-4 are 400 feet apart horizontally and 10 feet apart vertically, but R-3 (located closer to the site than R-4) has a TCE concentration of 7 ppb while R-4 has a concentration of 680 ppb.

The TCE concentration data from the 21 monitoring wells sampled in April and May 2000 and from the two public wells (H-14 and H-17) that are sampled quarterly are insufficient to completely delineate the plume and insufficient information is available to determine the directions in which the plume may be spreading.

2.0 SYSTEM DESCRIPTION

2.1 SYSTEM OVERVIEW

The current onsite system began extracting and treating groundwater in November 1996. Extracted groundwater is pumped directly from two extraction wells into two tray aerators located in the treatment building and is then discharged via below grade piping and a storm sewer to a creek approximately one half mile southwest of the plant. The exhaust from the tray aerators is vented through a single GAC unit.

Two of the Hatboro water supply wells, H-14 and H-17, have continued to operate both as a groundwater remedy (independent of the Raymark site) and for water supply, especially during peak usage. H-14 is located approximately 3,500 feet to the west of the site and H-17 is located approximately 2,000 feet to the northwest of the site. Air strippers are used to treat the water and the Raymark remedy funds the replacement of vapor phase carbon used to treat the off gas.

2.2 EXTRACTION SYSTEM

The extraction system is comprised of two wells (RW-1R and MW-3D). RW-1R was reconstructed in 1999 to replace RW-1 that collapsed. The pump size is 2 horsepower (hp) and pumps at a constant rate of 37 gallons per minute (gpm). The extraction well MW-3D uses a 1 hp pump to extract water on 90-second cycles at a rate of approximately 23 gpm. During the RSE, this pumping rate and cycling corresponded to maintaining water levels between set points of 41 and 60 feet below ground surface. Given these extraction rates, on average the extraction systems pumps approximately 48 gpm.

2.3 TREATMENT SYSTEM

The treatment system includes two tray aerators in series with air supplied by up to five blowers. In an effort to reduce energy consumption, the use of four blowers (one spare) was cut to two blowers in November 1998. While this increased the plant effluent concentrations from less than 5 ppb to 30 or 40 ppb, these concentrations are still below the discharge concentration of 73 ppb. A blower is used to feed the off gas from the air strippers to a single vapor phase carbon unit. The treated water is discharged through a storm drain to Pennypack Creek approximately a half mile from the site.

2.4 MONITORING SYSTEM

The monitoring system consists of 23 sampling points, including 12 offsite wells and 11 onsite wells. The offsite wells include five of the Hatboro wells (H-2, H-7, H-10, H-14, and H-17). While concentrations had been measured regularly from H-14, H-17, and the two onsite extraction wells, samples from the other wells had not been taken in approximately 8 years until the April and May 2000 sampling which was the first event of a new annual sampling program. Another event is planned for June or July of 2001.

Water levels were also measured during the April and May 2000 sampling event; however, because the elevations for the tops of the well casings are unknown, a water level map cannot be constructed.

3.0 SYSTEM OBJECTIVES, PERFORMANCE AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The ROD specifies the following site-specific remedial objectives for OU2 and OU3:

- Protect public health and the environment
- Reduce further migration of contaminated groundwater from the site towards public supply wells
- Contain the contamination within the currently affected area
- Reduce the risk resulting from release of contaminants into the air from treatment devices
- Contribute to the restoration of the aquifer to its beneficial use, and further to background quality, if practicable

3.2 TREATMENT PLANT OPERATION GOALS

As specified in the consent decree, the discharge criteria for the treatment plant is 73 ug/L (ppb) of TCE and 7.3 ug/L (ppb) of carbon tetrachloride. Given plant influent concentrations of TCE, this requires approximately 93% removal efficiency of the plant. Historically, the treatment plant has operated well below this 73 ug/L discharge limit. With four of five blowers operating for the air strippers, effluent concentrations are typically less than 5 ug/L, and with two of five blowers operating, effluent concentrations are typically around 30 ug/L. The system currently operates with two blowers. The remaining TCE in the effluent is likely transferred to the atmosphere as the effluent travels from the site to Pennypack Creek through the storm drain.

3.3 ACTION LEVELS

Concurrent with remedial objective #5, the ROD specifies a cleanup level of 5 ug/L or background if practicable. However, the main objectives of the site pertain to containment of onsite groundwater contamination.

4.0 FINDINGS AND OBSERVATIONS FROM THE RSE SITE VISIT

4.1 FINDINGS

In general, the RSE team found the treatment system well operated and well maintained. However, possibly due to the high turnover rate among EPA Remedial Project Managers for this site and changes in contractors, site information and background, especially related to system design, is difficult to access.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

4.2.1 WATER LEVELS

Although water depths have been recorded as recently as April and May 2000, unknown elevations for the tops of the well casings prevent this information from being used to generate a potentiometic surface of groundwater beneath the site. Thus, the hydraulic gradients and groundwater flow remain unknown.

Given the location of Pennypack Creek and several pumping wells to the west as well as the extent of the plume to the west, it is likely that groundwater in the area of the Raymark site flows to the west.

4.2.2 CAPTURE ZONES

Due to a lack of reliable water-level measurements and only one recent sampling of groundwater concentrations the capture zones associated with the two onsite extraction wells cannot be determined.

A preliminary capture zone analysis, however, was conducted as part of the 1990 Feasibility Study. This analysis and the subsequent remedy alternatives described in that report suggested onsite pumping of 285 gpm— five wells in Zone 4 (i.e., below 125 feet bgs) would each extract 50 gpm and seven wells in Zone 1 (i.e., above 75 feet bgs) would each extract 5 gpm. These recommended wells in Zone 1 and Zone 4 were to be aligned along the downgradient boundary of the site. The designed treatment capacity of the treatment plant of 100 gpm as stated in the 1994 Construction Report and the current extraction rate of approximately 48 gpm from two wells differs significantly from this original analysis. As many of the design documents were inaccessible to the site managers and the RSE team, justifications for this decrease in the extraction could not be found.

4.2.3 CONTAMINANT LEVELS

Contaminant levels at the site vary with location and depth. In the April and May 2000, TCE concentrations above 1,000 ppb were measured in onsite wells PF-1s, MW-2I, and MW-3I, which have depths of 69, 146, and 142 feet below ground surface (bgs), respectively. Both MW-2I and MW-3I are located on the western portion of the property where other groundwater samples suggest contamination as deep as 205 feet bgs and as shallow as 56 feet bgs. PF-1s is located on the eastern portion of the site where the former lagoons were located and where the SVE system operated. This location is now occupied by the multilayer low permeability cap covering the pile of excavated soil. The other high TCE concentration recorded on the eastern portion of the site is in MW-1S, which screens the shallow subsurface in the area of the former lagoons.

4.3 COMPONENT PERFORMANCE

4.3.1 WELL PUMPS AND TRANSDUCERS

Well RW-1R replaced the original RW-1 well which had collapsed around the pump. This replacement well is completed to a depth of 200 feet bgs with the transducer placed at 190 bgs. The screened interval currently is unknown. The pump is 2 hp and pumps continuously at 37 gpm. The well and pump have functioned without incident since installation in 1999.

Extraction well MW-3D (which differs from monitoring well MW-3D) is completed to a depth of 145 bgs with the transducer at 135 bgs. The screened interval is not currently know. The pump is 1 hp and cycles on 90-second intervals at a rate of 23 gpm.

The average total pumping rate over time from both wells is approximately 48 gpm.

4.3.2 BLOWERS

There are five blowers capable of providing compressed air to the two tray aerators. The fifth blower has historically been used as a reserve unit and is generally not operated. In November 1998, the number of utilized blowers was decreased from four to two in order to save electricity. This practice still continues and results in TCE effluent concentrations of approximately 30 ppb, which is well below the discharge criteria of 73 ppb. A separate blower is used to move the exhaust from the tray aerator through the vapor phase GAC unit.

4.3.3 VAPOR PHASE GRANULAR ACTIVATED CARBON

A single vapor phase GAC unit is located outside of the treatment building. The unit contains approximately 1,000 pounds of GAC. The air is heated to lower than 40% relative humidity prior to entering the GAC to minimize moisture within the unit. The current operation includes monitoring the exhaust with a PID. If the PID registers a reading of greater than 2 ppm, the GAC is replaced. The site operators estimate that the GAC is replaced three times per year.

4.3.4 CONTROLS

The plant operates remotely. The control system includes an autodialer to warn the plant engineer when the system has shutdown. The operator can reach the site within 45 minutes.

4.3.5 TRAY AERATORS

Two dual tray (i.e., trays on both the top and bottom) aerators manufactured by Lowry Engineering, Inc. of Durham, North Carolina are operated in series and utilize perforated piping to transfer VOCs to the air exhaust stream. The perforated piping with 1/16-inch diameter perforations was clogging; therefore, the piping was replaced with 1/8-inch diameter perforations. Even though this decreases the surface/transfer area of the air that enters the aerators, the plant has continued to meet effluent requirements and the efficiency has increased due to increased air flow. The second aerator must maintain a lid pressure of 5-6 inches of water to achieve treatment goals. Because of delicate balance between the aerator and the 5 hp vacuum blower that feeds the vapor GAC unit, the system requires seasonal adjustments by the operator.

The two aerators, with four blowers operating, are designed to handle 100 gpm with a water temperature of 50 degrees Fahrenheit and TCE concentrations of 3,250 ppb.

4.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF MONTHLY COSTS

Annual costs of the system, excluding those associated with analytical work, are likely less than $100,000 but will increase in the future with additional monitoring and characterization.

4.4.1 UTILITIES

The groundwater treatment building has a phone and electricity but no natural gas. With two of the five blowers feeding air to the tray aerators, the electric bill is approximately $800 per month or $10,000 per year.

4.4.2 NON-UTILITY CONSUMABLES AND DISPOSAL COSTS

Costs for non-utility consumables and disposal associated with the site include materials necessary for sampling and replacement of the onsite vapor phase carbon each year. These costs are approximately $5,000 per year. The costs for replacement of the vapor phase carbon units on wells H-14 and H-17 are not included in this estimate.

4.4.3 LABOR

Labor involves the annual sampling event, project management, and weekly visits to the site by the plant operator. Labor costs are under $50,000 per year.

4.4.4 CHEMICAL ANALYSIS

Analyses are performed under the CLP program, and those costs are not directly assigned to the site.

4.5 RECURRING PROBLEMS OR ISSUES

The operations of the plant have not reported major upsets in plant operations other than occasional weather related power outages.

4.6 REGULATORY COMPLIANCE

The plant has not exceeded the effluent TCE concentration standards of 73 ppb.

4.7 Treatment Process Excursions and Upsets, Accidental Contaminant/Reagent Releases

The system has been operated with no major upsets or releases.

4.8 Safety Record

No accidents have been reported.

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

5.1 GROUND WATER

Groundwater in the region surrounding the Raymark site has historically been used for the public water supply. Figure 1-6 of the 1990 Feasibility Study indicates that nine public wells are within the area or on the border of the estimated TCE plume (H-1, H-2, H-3, H-9, H-12, H-14, H-15, H-16, and H-17). Operation of all of these wells except H-14 and H-17 has been discontinued. Air stripping towers and vapor phase carbon units have been installed on H-14 and H-17 and treat the water that is used for the public.

A lack of monitoring since the Remedial Investigation and the absence of reliable water-level measurements make delineating the plume (horizontally and vertically) and forecasting its transport impossible. Thus, TCE contamination of the groundwater in this area likely continues to pose a hazard for the public water supply if it is not properly treated. In addition, the RSE team and site managers cannot assess whether the primary objectives of the ROD are being satisfied.

5.2 SURFACE WATER

Pennypack Creek to the west and southwest of the site represents the only surface water potentially impacted by the groundwater contamination and the treatment operations. Based on the estimated plume provided in the 1990 Feasibility Study it appears the contamination has reached the creek. In addition, the effluent from the onsite treatment plant, which may reach concentrations as high as 73 ppb, is discharged to the creek. The creek is used for fishing and therefore represents a potential exposure pathway to the public. The RSE team is unaware of any recent sampling of the creek water.

5.3 AIR

Off gas from the onsite tray aerators (and Hatboro water supply wells H-14 and H-17) is treated with vapor phase carbon. Thus, TCE emissions from these treatment operations are negligible. The majority of the contamination associated with the western portion of the Raymark site occurs at a depth of approximately 100 feet; therefore, elevated TCE concentrations in the soil gas in this part of the site are likely low. However, relatively high TCE concentrations in groundwater (in excess of 1,000 ppb) have been found in shallow monitoring wells on the eastern portion of the site. This could lead to elevated soil gas concentrations in this portion of the site and possibly in some of the onsite or nearby buildings.

5.4 SOILS

The contaminated soils have been excavated, piled on site, capped with a synthetic liner, and treated with an SVE system. Operation of the SVE system was discontinued in October 1995 after cleanup levels were reportedly met. The RSE team did not see any data from the operation of the SVE system or any subsequent data regarding soil contamination. The site has been covered with an asphalt cap that now serves as a parking lot; thus, if contaminated soils did remain, access to them would be limited.

5.5 WETLANDS AND SEDIMENTS

The RSE team is not aware of any recent sampling of the Pennypack Creek sediments. As with the creek itself, these sediments could potentially be impacted either by discharge of contaminated groundwater or treated water (with TCE concentrations allowed up to 73 ppb) to the creek.

6.0 RECOMMENDATIONS

Cost estimates provided 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 RECOMMENDED STUDIES TO ENSURE EFFECTIVENESS

6.1.1 SURVEY AND EVALUATE WELL CONSTRUCTION FOR ALL SITE RELATED MONITOR AND EXTRACTION WELLS

Well construction logs and pertinent information from those logs is not readily available to EPA site managers, site contractors, or the RSE team. Therefore, information such as the screened intervals and elevations of the tops of the well casings for the monitoring and extraction wells are not known. Without the screened intervals of the extraction wells it cannot easily be determined from which portions of the aquifer water is being extracted. Also, although the depths of monitoring wells indicate the approximate depth being sampled, without knowledge of the screened interval, it cannot be determined if water is coming from a vertical interval of 10 feet, 20 feet, or more. Thus, it is not known if a given monitoring well is sampling from a single stratigraphic unit or from two separate units. Without the elevations for the tops of the well casings, water levels cannot be determined, and without these water levels, a potentiometric surface cannot be generated to indicate directions and magnitudes of groundwater flow. With unknown screened intervals for the extraction and monitoring wells and without a potentiometric surface the extent of contaminant containment or capture cannot be evaluated. Thus, it cannot be determined if the current remedy is consistent with the ROD in containing contamination and reducing migration of TCE offsite.

The RSE team recommends a thorough investigation of the well construction data. This would involve tracking down and evaluating the well construction logs. However, it is strongly advised that the site managers also hire a survey crew to accurately determine the elevations of the well-casing tops. Downhole camera work should also be conducted to determine the condition of each of the wells, but more importantly to determine the screened intervals of each well.

Accurate, up-to-date information may be available for some of the Hatboro water supply wells within a mile of the Raymark Site. If the screened intervals of the wells are known and a known reference elevation is available for accurate water-level measurements, then surveying and downhole camera work is not needed for these wells.

It appears that 21 wells (including Hatboro wells H-2, H-7, H-10, H-14, and H-17) are available for sampling and measuring water levels. Excluding the Hatboro wells, there are 16 wells. Adding the two extraction wells, the surveying and downhole camera work would need to be done for 18 (excluding the Hatboro wells) to 23 wells. The studies could likely be conducted for approximately $10,000.

6.1.2 CREATE A POTENTIOMETRIC SURFACE MAP FOR GROUNDWATER AND ESTIMATE FLOW DIRECTIONS AND MAGNITUDES

Once the screened intervals and tops of casings are known for each of the 23 wells (including H-14 and H-17), water levels should be measured and used to generate potentiometrics surfaces for groundwater underlying the Raymark site for a variety of pumping conditions including the following scenarios:

- no pumping;
- pumping from the onsite extraction wells at the current average extraction rate of 48 gpm but no pumping from Hatboro wells H-14 and H-17; and
- pumping from the onsite extraction wells at 48 gpm and from Hatboro wells H-14 and H-17.

The potentiometric surfaces generated for the pumping scenarios should not include the water level measurements from the extraction wells as this will bias any analysis in favor of capture. The potentiometric surfaces should have sufficient resolution to determine the likely portions of the site boundary from which contaminants are most likely to migrate offsite and in which stratigraphic units this migration would likely occur. Given the limited number of points for measuring water levels and the vertical variation in the Stockton formation, additional piezometers placed at various locations and depths, are likely required to yield informative potentiometric surfaces. The specific locations of these additional piezometers may be better determined once water levels are measured and analyzed from the current measurement points.

Water levels are currently measured as part of the new annual sampling program; thus, the actual measurements will not add to the annual costs. The analysis of the potentiometric surfaces generated from the water levels (plus from previous depth-to-water measurements) would require an initial cost of approximately $15,000 for initial work (such as developing a CADD site map and creating historical potentiometric surface maps), and approximately $2,000 per year in the future for developing the potentiometric surfaces. Installation of an additional shallow piezometer (less than 100 feet deep) would require approximately two days of drilling and would cost approximately $7,000. Installation of an additional deep piezometer (approximately 200 feet deep) would cost approximately $11,000. The addition of eight piezometers screening various depths would therefore require a one time expenditure of approximately $72,000.

6.1.3 DELINEATE CONTAMINANT PLUME

The extent of groundwater TCE contamination onsite should be further investigated as well, especially along the site boundaries. A cluster of sampling points each independently screening the stratigraphic units shown in Figure 1-3 and located midway between the MW-3 and MW-2 clusters would help delineate the plume on the western boundary of the site. This is significant given that groundwater likely flows to the west toward Pennypack Creek and Hatboro wells H-14 and H-17. Another cluster of sampling points each screening the stratigraphic units shown in Figure 1-3 and located midway between the MW-3 cluster and the rear end of the property (to the east) would help delineate the plume on the southern/western site boundary. This is also significant because Pennypack Creek turns and passes within a mile to the southwest of the site and groundwater could be flowing in that direction. These points should be added to the annual sampling program and analyzed for volatile organic compounds (VOCs).

The locations of some of the piezometers installed to generate potentiometric surfaces may coincide with the locations of these recommended sampling points. In such cases, monitoring wells should be installed in place of the recommended piezometers. The cost of monitoring well would exceed the cost of a piezometer by up to $500 due to a difference in the cost of materials. Sampling and analysis at an independent laboratory of the new wells, assuming one sampling event per year, might cost $4,000 per year.

6.1.4 EVALUATE CAPTURE OF THE ONSITE TCE PLUME

Once the groundwater flow and plume extent onsite is better understood, the capture zones of the onsite extraction wells should be evaluated. This is especially pertinent given the discrepancy between the extraction rate of 285 gpm suggested in the 1990 Feasibility Study, which was based on a preliminary capture zone analysis, and the current average extraction rate of 48 gpm. The first step is to examine the onsite contaminant plume and determine a target capture zone (i.e., a theoretical capture zone that prevents the offsite migration of contamination). The second step is to compare the target capture zone with the actual one as determined by the potentiometric surface interpreted from water levels measured during onsite pumping. Also, site managers should overlay the plume map interpreted from groundwater sampling with the potentiometric surface interpreted from water levels measured during onsite pumping. If the potentiometric surface has sufficient resolution, this will give a general idea as to the portions of the contamination that are and are not captured by these extraction wells. It may be evident from this evaluation that capture of onsite contamination requires increased pumping from the existing wells, or possibly additional wells as suggested in the Feasibility Study.

For capture to be achieved, hydraulic gradients measured from water levels taken from surrounding piezometers and monitoring wells (and not the extraction wells) must indicate groundwater flow in the direction of the extraction well. Due to regional/background groundwater flow, capture is not necessarily achieved when a well or piezometer indicates drawdown from nearby pumping.

Given the complexity of the fractured bedrock and the stratigraphy underlying the site, it may be impracticable to develop a potentiometric surface map that indicates capture with adequate confidence. Thus, downgradient, offsite wells will require continued monitoring to ensure that concentrations downgradient of the site are decreasing. If these concentrations do not decrease over time, then it is likely that contamination is migrating offsite and contributing to contamination in these offsite wells.

The capture zones should be evaluated at least once per year by analyzing the potentiometric surface and the trends in TCE concentration in the downgradient sentinel wells. The extraction rates, and possibly the addition of new extraction wells, should be adjusted accordingly to prevent migration of contaminants offsite. The analysis of the capture zones in the various stratigraphic units and a written summary of the results should result in a cost increase of approximately $4,000 per year.

6.1.5 ENSURE THAT ABANDONED WELLS ARE PROPERLY SEALED

A number of wells near the Raymark site, including the former extraction well (RW-1) that collapsed, are no longer used for pumping. If these wells have not properly been sealed then they may offer avenues of cross contamination between stratigraphic units. Therefore, the RSE team recommends sealing unused wells that have screened intervals intersecting multiple stratigraphic units. This may be problematic for some of the former water supply wells if the Hatboro Water Authority plans on reusing them. Assuming five wells require sealing, this would be a one time cost of approximately $15,000.

6.1.6 EVALUATE IMPACT OF GROUNDWATER AND TREATED WATER DISCHARGE TO PENNYPACK CREEK

The RSE team is unaware of any water quality sampling of Pennypack Creek, especially where the plant effluent is discharged and near H-9 where the plume may be discharging to the creek. Sampling of the stream water and sediments in these two location would indicate the extent of TCE contamination, if any. Such samples could be collected and analyzed annually. Collecting and analyzing these samples as part of the new annual sampling program should cost an additional $1,000 per year.

6.1.7 SAMPLE AIR IN NEARBY BUILDINGS FOR TCE

Due to the relatively high concentrations of TCE in the groundwater, especially at the shallower depths near the MW-1 and PF-1 clusters, the air in onsite and nearby buildings, especially the residence to the north, should be sampled for TCE. This should be done quarterly for one year and annually thereafter. Total cost in the first year would likely be $5,000. If the air sampling is conducted in the future as part of the annual sampling program the additional cost would be approximately $1,000 per year.

6.2 RECOMMENDED CHANGES TO REDUCE COSTS

The onsite extraction and treatment system currently operate at cost of less than $100,000 per year (excluding analytical work), and the extracted water has concentrations similar to those assumed in the design. Therefore, the RSE does not have any recommendations that would result in significant cost reductions.

6.3 MODIFICATIONS INTENDED FOR TECHNICAL IMPROVEMENT

6.3.1 COMPLETE THE O&M MANUAL

The operator that currently visits the site weekly is the only person familiar with plant operations. He works from experience and not from a manual. The practices necessary for operating the plant smoothly should be documented for potential future operators. Discussions during the RSE indicated that this manual is currently being prepared. A one-time cost of $10,000 is possible for this item.

6.3.2 ORGANIZE/COMPILE DOCUMENTS AND DATA ASSOCIATED WITH SITE

Due to the high turnover rate of the EPA Remedial Project Managers for this site and shift away from the contractor that designed and originally operated the plant, much of the original design and operation information is not readily available. This unavailable information includes but is not limited to the screened intervals of the wells, the elevations of the tops of the well casings, monitoring data from the SVE operation, design reports, and the as-built drawings. In addition, the site Remedial Investigation, Feasibility Study, and monitoring results were obtained from the site contractor and may not be easily accessible in the EPA offices. All of these documents should be readily available to the site manager. The Union Library Company of Hatboro located at 243 South York Road in Hatboro, is designated as a location for public files associated with this site. The site managers should visit this location to identify and copy any site-related documents not currently available in the EPA offices. A one-time cost of $5,000 is possible for these activities.

6.3.3 LABEL ALL WELLS AND RENAME WELLS TO AVOID CONFLICTS

The site-related wells should be named with a consistent nomenclature. At the time of the RSE, the names of various wells included MS-1, MW-1S, R-1, RW-1, USGS, MW-3D (monitoring), and MW-3D (extraction). For example, all monitoring wells associated with the site should have the prefix MW and all extraction or recovery wells should have the prefix RW. Each well could then be given a number and a suffix of S, I, or D indicating shallow, intermediate, or deep, respectively. A table should be constructed and included in all future site documents listing the current names of wells and the recommended names so that wells can easily be tracked. This table should also include pertinent well construction data including the depths, screened intervals, and the elevations for the tops of the well casings.

In addition, the wells are not labeled making it difficult to identify each well without a site map. To avoid confusion and possible errors during sampling and measuring water levels, all of the wells should be clearly labeled. Over time, cost of these items is estimated at approximately $10,000.

6.4 MODIFICATIONS INTENDED TO GAIN SITE CLOSE-OUT

The RSE team has no recommendations for gaining site close out; rather, the RSE team suggests that the additional characterization steps outlined in Section 6.1 are of primary importance. However, this characterization is the first step of a detailed exit strategy that should be developed to ensure that the site does not operate after ROD goals have been achieved. Of particular importance is to develop the exit strategy based on the ROD objectives and not on the TCE concentrations found offsite that may have come from other sources within the region. With regard to onsite contamination, if annual sampling events do not indicate declines in TCE concentrations, investigations should be conducted to determine if any existing sources exist either onsite or upgradient. Alternative remedial strategies should be periodically reviewed for potential application at this site.

7.0 SUMMARY

In general, the RSE team found a smoothly running treatment system, but a site that was poorly characterized, possibly due to a high turnover rate of EPA Remedial Project Managers for the site. The observations and recommendations mentioned are not intended to imply a deficiency in the work of either the 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 the operational data unavailable to the original designers.

Several recommendations are made to assure system effectiveness and improve the technical operation of the system. However, recommendations were not made that are pertinent to cost reduction or gaining site close out. The recommendations to improve effectiveness include surveys and downhole camera work of existing wells to determine the elevations of the tops of the well casings and the screened intervals. Once this information is gained, the RSE team recommends collecting 1) water levels and using them to generate potentiometric surfaces of the groundwater and 2) groundwater quality samples and using them to better delineate the onsite plume. Subsequent to these studies, a capture zone analysis should be conducted and groundwater extraction should be adjusted accordingly. With regard to technical improvement, the RSE team agrees with the current effort to develop an operations and maintenance plan and recommends that the site managers compile and organize site related data and documents.

Recommendations, and estimated cost increases/decreases associated with those recommendations, are presented in Table 7-1.

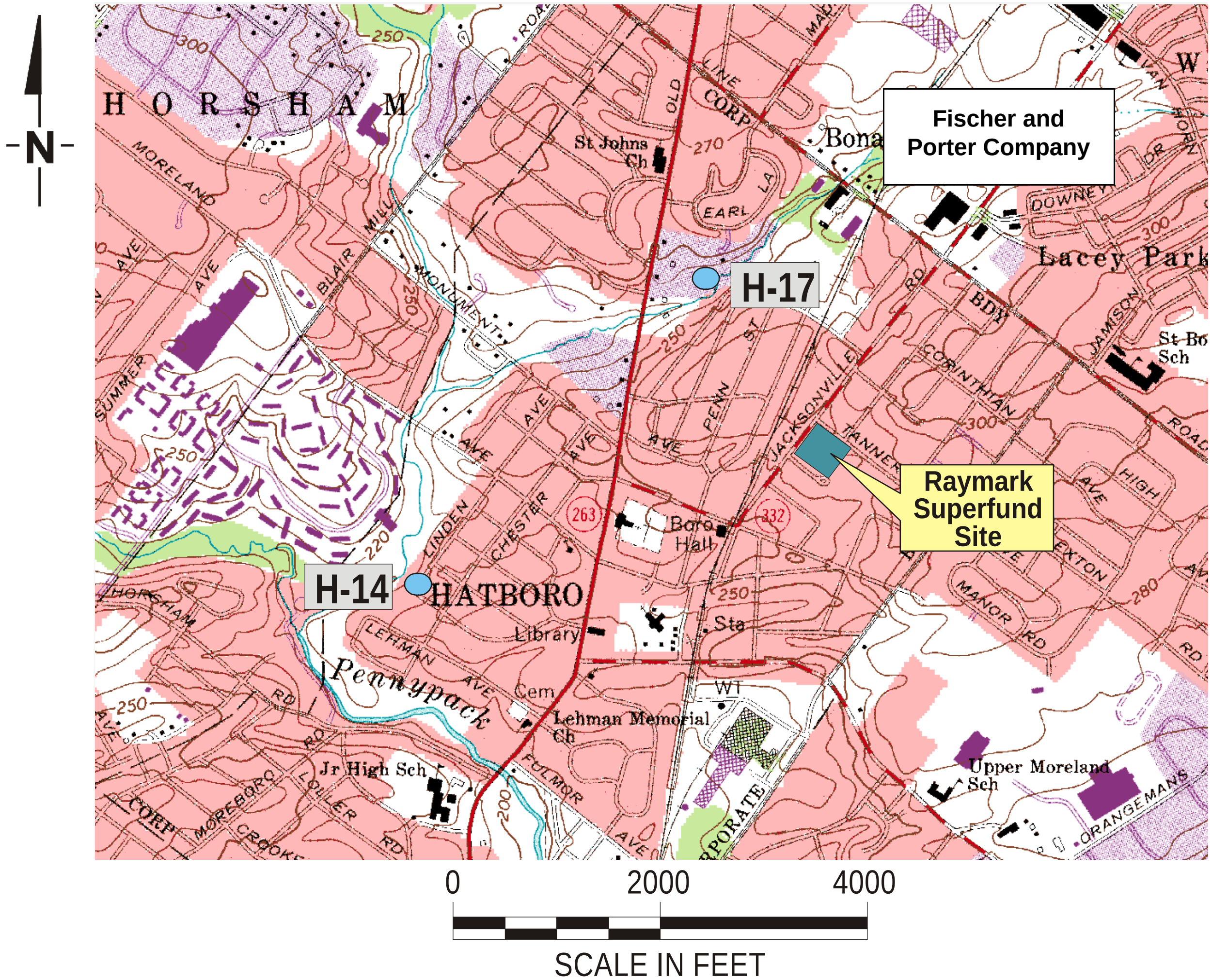
Table 7-1. Cost Summary Table

Recommendation	Reason	Estimated Change in			
		Capital Costs	Annual Costs	Lifecycle Costs*	Lifecycle Costs**
6.1.1 Survey site-related wells	Effectiveness	$10,000	$0	$10,000	$10,000
6.1.2 Measure water levels and develop potentiometric surfaces (costs include the addition of eight piezometers)	Effectiveness	$87,000	$2,000	$147,000	$119,200
6.1.3 Delineate onsite plume (includes extra costs for installing monitoring wells instead of piezometers in 6.1.2)	Effectiveness	$4,000	$4,000	$124,000	$68,500
6.1.4 Analyze capture zone	Effectiveness	$0	$4,000	$120,000	$64,500
6.1.5 Properly seal abandoned wells	Effectiveness	$15,000	$0	$15,000	$15,000
6.1.6 Evaluate TCE impact on Pennypack Creek	Effectiveness	$0	$1,000	$30,000	$16,100
6.1.7 Sample air in buildings for TCE	Effectiveness	$5,000	$1,000	$35,000	$21,100
6.3.1 Complete O&M manual	Technical Improvement	$10,000	$0	$10,000	$10,000
6.3.2 Compile and organize site data and documents	Technical Improvement	$10,000	$0	$10,000	$10,000
6.3.3 Rename and label site wells	Technical Improvement	$10 ,000	$0	$10,000	$10,000

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

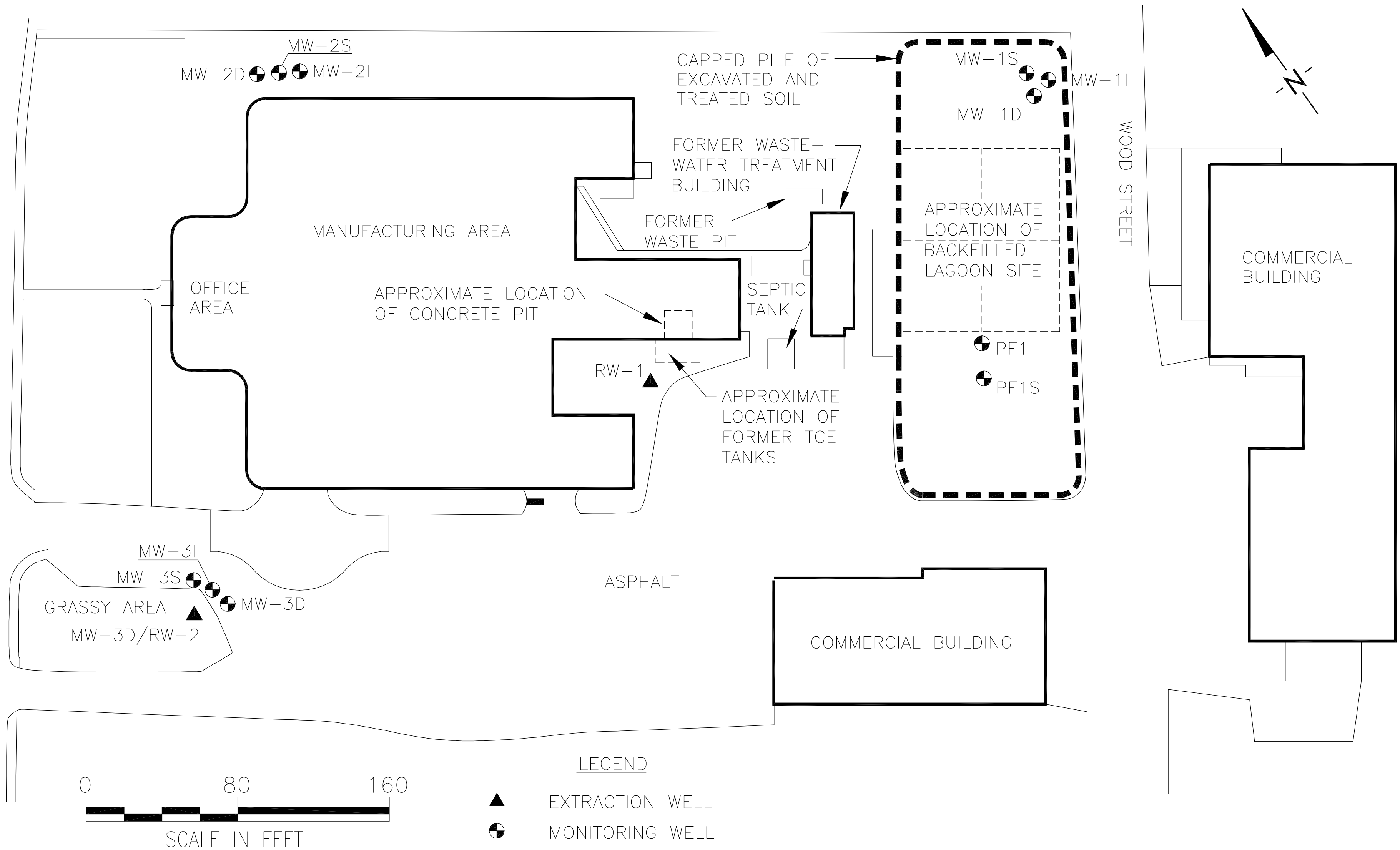
FIGURES

FIGURE 1-1: THE AREA SURROUNDING THE RAYMARK SUPERFUND SITE INCLUDING HATBORO WELLS H-14 AND H-17



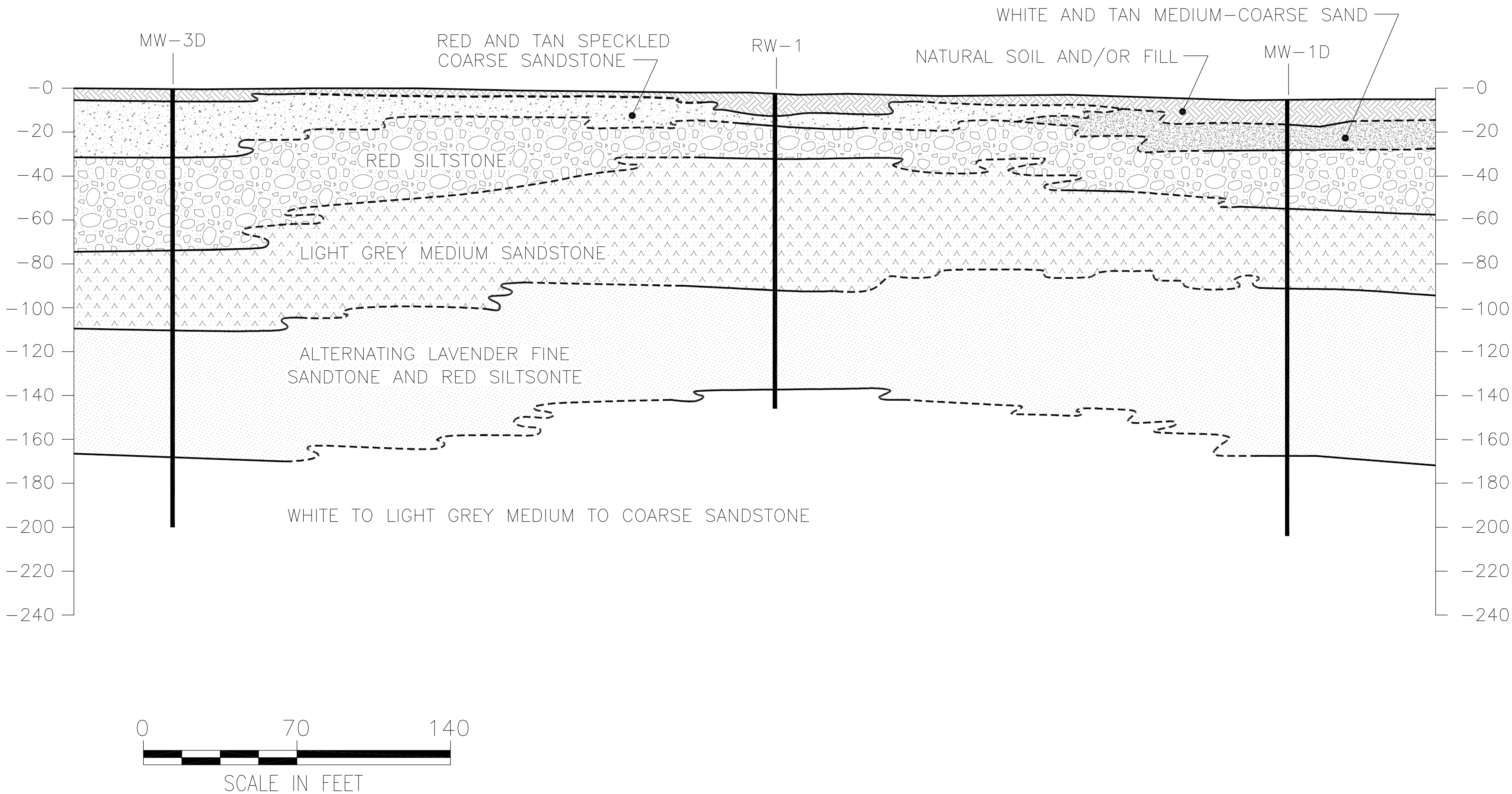
(Note: This figure is adapted from the 1988 USGS topographical map, Hatboro Quadrangle Pennsylvania, 7.5 minute series.)

FIGURE 1-2. SITE LAYOUT SHOWING LOCATIONS OF THE MONITORING WELLS AND THE EXTRACTION WELLS.



(Note: This figure is adapted from Figure 1-2 from the Raymark Site RI/FS Final Soil/Source Area Remedial Investigation Report, Operable Unit No. 1., CH2M Hill, 1991.)

FIGURE 1-3. CROSS SECTION OF THE GEOLOGY UNDERLYING THE RAYMARK SITE.



(Note: This figure is taken from Figure 3-2 from the Raymark Site RI/FS Final Soil/Source Area Remedial Investigation Report, Operable Unit No. 1., CH2M Hill, 1991.)

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