REMEDIATION SYSTEM EVALUATION

SHORCO SOUTH
MAHWAH, NEW JERSEY

Report of the Remediation System Evaluation
Site Visit Conducted
July 29, 2003

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Remediation System Evaluation
Shorco South
Mahwah, New Jersey

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NOTICE AND DISCLAIMER

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This report has undergone review by the state site manager and EPA headquarters staff. For more infomation about this project, contact: Joe Vescio (703-603-0003 or vescio.joseph@epa.gov) or Kathy Yager (617-918-8362 or yager.kathleen@epa.gov).

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 exit 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 site stakeholders.

The Shorco South site is located on the southbound side of Route 17 in the Township of Mahwah, New Jersey. The Shorco South site is downgradient of the Shorco North site, which also has ground water impacted with petroleum constituents. This RSE focuses on the Shorco South site, and the Shorco North site is discussed only in relation to its impact on Shorco South. The Shorco South site remediation is currently being run by NJDEP under the publicly funded cleanup program, while the Shorco North remediation is still being operated by the responsible party. Ground water flows in a south to southwest direction across the Shorco South site, towards the Ramapo River.

Dissolved benzene, methyl tertiary butyl ether (MTBE), and tertiary butyl alcohol (TBA) levels are present in many wells above ground water criteria and are good “indicator parameters” for continuing impacts at the site. Toluene, ethylbenzene, xylene, and lead only sporadically exceed the criteria, and occur at wells within the plumes associated with the three indicator parameters (benzene, MTBE, and TBA). On-site wells located upgradient of on-site sources (“upgradient” wells) are impacted, but at lower concentrations than the “mid-plume” wells. Impacts at these “upgradient wells” are most likely due to Shorco North, and concentrations at these wells are decreasing over time. At the “mid-plume” wells (impacted primarily by sources at Shorco South) the concentrations also appear to be decreasing over time, though in some cases concentrations still remain several orders of magnitude above cleanup criteria. Trends at the “downgradient” wells are not as clear.

A ground water pump and treat system was completed during 1991 which included 6 recovery wells. Nine well points were added to the system in 1996 to improve containment at the downgradient south corner of the site. The well points were not effective due to iron fouling problems. In the June 10, 1997 “Evaluation of Existing Remedial Systems” Dan Raviv Associates (Raviv) recommended modifying the recovery and treatment system because the system was operating below design capacity and below the rate needed to create hydraulic control. The current pump and treat system consists of an approximately 200 foot long trench 14 to 16 feet deep that was installed in late 2001, but has not operated except for testing.

The RSE team observed a system that is not currently operating. Recommendations to improve the effectiveness of the system once it is operating include the following:

- addition of short-term extraction events from select monitoring wells using a vacuum truck

- consideration of indoor air sampling

- evaluation of capture effectiveness

Recommendations to reduce costs include the following:

- a suggestion to reduce the frequency of proposed ground water sampling in the first two years from quarterly to annual at 10 wells (keeping quarterly sampling at 10 other wells)

- give priority be given to negotiating criteria with the POTW that preclude a need for on-site treatment of TBA

Recommendations for technical improvement include repairing and labeling vaults and well covers, and repairing the treatment shed roof. All of these recommendations can be easily implemented, and no prioritization of the recommendations is needed. After several years of operation, the RSE team suggests that a switch to air sparging or biosparging be considered in lieu of ground water extraction.

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 pilot project conducted by the United States Environmental Protection Agency (U.S. EPA) Office of Underground Storage Tanks (OUST) and Office of Superfund Remediation and Technology Innovation(OSRTI). The objective of this project is to conduct Remediation System Evaluations (RSEs) of pump and treat systems managed by State UST programs. The following organizations are implementing this project.

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TABLE OF CONTENTS

List of Tables

List of Figures

1.0 INTRODUCTION

1.1 PURPOSE

During fiscal years 2000, 2001, and 2002 Remediation System Evaluations (RSEs) were conducted at 24 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 and OUST are performing a pilot study of conducting RSEs at UST sites. During fiscal year 2003, RSEs at 3 State-managed UST sites were conducted in an effort to evaluate the effectiveness of this optimization tool for this class of sites. GeoTrans, Inc., a Dynamac contractor, is conducting these evaluations, and representatives from EPA OUST are attending the RSEs as observers.

The Remediation System Evaluation (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

A 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 exit strategy. The evaluation includes reviewing site documents, visiting the site for 1 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, if one exists, and the regulators) identify opportunities for improvements. In many cases, further analysis of a recommendation, beyond that provided in this report, might 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. This RSE report pertains to conditions that existed at the time of the RSE site visit, and any site activities that have occurred subsequent to the RSE site visit are not reflected in this RSE report (unless otherwise noted).

The Shorco South site was selected by EPA OUST, in coordination with State agencies. 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.

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.
Rob Greenwald, Hydrogeologist, GeoTrans, Inc.

The RSE team was also accompanied by the following observers:

- Joe Vescio, EPA OUST
- Judy Barrows, EPA OUST
- Rebecca Jamison (EPA Region II)
- Jeanette Daduse (EPA Region II)

EPA-OUST is jointly conducting this RSE Pilot Study for UST sites with EPA-OSRTI.

1.3 DOCUMENTS REVIEWED

Author	Date	Title
H2M Associates	December 2002	Recommendations Report
EWMA	December 2001	Remedial Action Progress report (Shorco North)
Dan Raviv Associates	October 6, 1999	Underground Storage Tank Closure Site Investigation report (Shorco South)
Dan Raviv Associates	April 30, 1998	Groundwater Remedial Action Workplan
Dan Raviv Associates	January 20, 1998	Proposed Remedial Action Workplan Schedule and Groundwater Monitoring Proposal
Dan Raviv Associates	June 10, 1997	Evaluation of Existing Remedial Systems
Sadat Associates	October 1994	Second and Third Quarterly Progress Report for 1994
Sadat Associates	July 7, 1994	Response to the NJDEP Comments on the Soil Remedial Action Report
Sadat Associates	May 1994	Soil Remedial Action Report
Sadat Associates	September 1992	Phase II Remedial Investigation/Feasibility Study
Burde Inc. / Sadat Associates	June 26, 1991	Groundwater Treatment System O&M Manual
Sadat Associates	July 1990	Remedial Investigation/Feasibility Study

All reports are for both Shorco North and South sites unless noted.

1.4 PERSONS CONTACTED

Tom Ferrara, the site manager from NJDEP, provided site related information and led the RSE team and observers on a site tour on July 29, 2003. The completion of this report has been delayed due to a contractual problem that arose in August 2003 and was resolved in May 2004. Due to the delay, additional information about the site was obtained from Tom Ferraro and Tom O'Neill of NJDEP during a conference call on June 9, 2004.

1.5 SITE LOCATION, HISTORY, AND CHARACTERISTICS

1.5.1 LOCATION

The Shorco South site is located on the southbound side of Route 17 in the Township of Mahwah, New Jersey. The site location is shown on Figure 1-1. The Shorco North site is located northeast of the Shorco South site across Route 17. The Shorco South site remediation is currently being run by NJDEP under the publicly funded cleanup program while the Shorco North remediation is still being operated by the responsible party. This RSE focuses on the Shorco South site, and the Shorco North site is discussed only in relation to its impact on Shorco South.

1.5.2 POTENTIAL SOURCES

Petroleum impacts at the Shorco South site were discovered in 1986. Observations from several inspections that year included leaks from the eight above ground storage tanks (ASTs), soil staining, sheens and vapors in the site restaurant basement, product in excavations for septic system installation, and perforations in USTs. The eight ASTs were removed from the southern corner of the site in April 1987, and 344 cubic yards of contaminated soils were removed at that time. During June and July 1987 the USTs and piping at the pump islands in the middle of the site were replaced. Holes were noted in the removed USTs and product was seen on the ground water. The RI/FS dated 1990 noted that two previous USTs were located east of the pump islands. These USTs were apparently removed prior to 1990. A 2000 gallon UST was removed from adjacent to the tire room on the northern portion of the site in 1992. A small amount (<50 cubic yards) of contaminated soil was removed from two areas on the western portion of the site in 1993.

Impacted soil within the water table fluctuation zone and possibly shallower soil likely provides a continuing source to on-site dissolved ground water contamination. In addition, spills, overfills, or leakage from the existing UST system could potentially be providing continuing source of soil and ground water contamination. Shorco North, which is hydraulically upgradient of Shorco South, appears to be a source of ground water impacts to Shorco South.

1.5.3 HYDROGEOLOGIC SETTING

Depth to ground water at the site typically ranges from about 5 to 10 feet below ground surface. The shallow ground water occurs in a surficial sand and gravel layer that extends to 12 to 23 feet deep at the site. A silty clay layer has been encountered in all deep site boreholes and is 35 and 50 feet thick at the two boreholes advanced through the unit. This silty clay layer overlies the deeper aquifer used for local ground water supply. The most recent analysis of deep ground water (in 1998) indicated no detections of impacts in downgradient wells located in the deeper aquifer (JOSMW-19D and JOSMW-21D).

Ground water flows in a south to southwest direction across the site. The site is downgradient of the Shorco North site, which also has ground water impacted with petroleum constituents. From the Shorco South site ground water flows towards the Ramapo River (see Figure 1-2). A reported sanitary sewer installed south of the site in South Houvenkopf Road may provide a preferential shallow ground water flow path from the southern corner of the site towards well JOSMW-17S (see Figure 1-2).

The hydraulic gradient as measured in 1998 was about 0.01 ft/ft under non-pumping conditions. Hydraulic conductivity based on pumping test results ranges from 28 to 85 ft/day.

1.5.4 RECEPTORS

The primary potential receptor is the surface water of the Ramapo River about 400 feet southwest of the site. MTBE and TBA impacts are present in JOSMW-19S about 100 feet from the river.
In addition, Mahwah water supply wells are located about 2,300 feet southwest of the site. A Leggette, Brashears and Graham (LBG) report dated 1987 evaluated the threat of the Shorco sites to the well field. The report concluded that the well field is in more direct hydraulic connection with the deeper aquifer than with the shallow aquifer. The lack of impacts in the deep wells at Shorco South and the fact that no contaminants had reached the well field indicated that the threat is minimal. The 150 foot deep Shorco South production well was abandoned to prevent any cross contamination of the deeper aquifer.

1.5.5 DESCRIPTION OF GROUND WATER PLUME

Contaminants of primary concern include benzene, toluene, ethylbenzene and xylene (BTEX), MTBE, and TBA. Based on the H2M Report (2002) lead concentrations above ground water criteria were also detected in some wells in 1997 when traditional sampling methods were employed, but not in 1998 when low-flow techniques were utilized. This suggests the lead impacts in 1997 were likely due to suspended solids associated with the purging. Benzene, MTBE and TBA are the best indicators of remediation progress due to the low cleanup criteria for benzene and the high solubility and lack of adsorption of MTBE and TBA. Figure 1-2 depicts the site monitoring wells and the extent of benzene (1 ug/L contour), MTBE (70 ug/L contour), and TBA (100 ug/L) dissolved phase plumes in February 2002.

Based on the February 2002 sampling results, ground water impacts are observed at wells located at the upgradient portion of the Shorco South site (e.g., wells JOSMW-5, RWS-1, MW-9 and RWS-2). These impacts are likely caused by the Shorco North site, and the impacts are relatively low compared to the higher concentrations elsewhere on the Shorco South property that likely result from Shorco South sources. In the central portion of the Shorco South site, liquid petroleum hydrocarbon (LPH) has been observed in MW-8, and high dissolved concentrations are observed in MW-6. Dissolved levels of benzene over 100 ug/L and MTBE over 1,000 ug/L extend downgradient to the southern corner of the site where well points were installed in 1996. Detectable concentrations of MTBE and TBA extend at least 300 feet off-site to the south and southwest. JOSMW-19S had an MTBE concentration of 300 ug/L about 100 feet from the Ramapo River.

A review of historical data indicates that MTBE concentrations in ground water in the vicinity of the Shorco South USTs and pump islands spiked in the1994, 1995, and 1997 sampling events in comparison to earlier results (see Section 4.2.2). Maximum dissolved benzene and MTBE concentrations have subsequently decreased significantly in comparison to the November 1995 and January 1997 sampling events. The extent of the dissolved benzene and MTBE plumes are similar to the 1995 configurations except for a substantial MTBE decrease in JOSMW-17S (from 1,500 ug/L in November 1995 to 8 ug/L in February 2002). The TBA plume is offset slightly south of the benzene and MTBE plumes.

2.0 SYSTEM DESCRIPTION

2.1 SYSTEM OVERVIEW

A ground water pump and treat system was completed during 1991 which included six recovery wells, an oil/water separator, bag filters, a packed tower air stripper, and GAC, with discharge to surface water. Nine well points were added to the system in 1996 to improve containment at the downgradient south corner of the site. The well points were not effective due to iron fouling problems. In the June 10, 1997 “Evaluation of Existing Remedial Systems” Dan Raviv Associates (Raviv) recommended modifying the recovery and treatment system because the system was operating below design capacity and below the rate needed to create hydraulic control. The system recovery wells capable of yields over 1 gpm were located mainly upgradient of the greatest site impacts. The treatment system also had significant iron fouling problems. Based on the Second and Third Quarterly Progress Report for 1994 the system was typically treating about 3-5 gallons per minute. Raviv stated that the existing treatment system did not have adequate capacity to handle the anticipated recovery flow rate of a modified recovery system.

The current pump and treat extraction system consists of an approximately 200 foot long trench 14 to 16 feet deep that was installed in late 2001. The trench has a northwest to southeast alignment on the west side of the Shorco South site from near JOSMW-1 to near PWS-9 (see Figure 1-2). Raviv predicts a pumping rate of 5 to 10 gpm to maintain a drawdown of six feet within the trench and intercept the width of the ground water plume. A submersible pump operated with level controls will pump water from the trench sump to an underground oil/water separator (reported to be a Highland Tank Model HTC-J 350™). From the separator the water will be pumped to a bag filter (to be installed) and then a “Breeze” Aeromix™ diffusion air stripper with a 3 HP regenerative blower. Emissions from the air stripper will be discharged through a stack directly to the atmosphere and treated water will be discharged to the North Bergen Municipal Utility Authority (MUA) publicly owned treatment works (POTW). The NJDEP and Handex are currently working to obtain a permit. The treatment system is proposed to have treatment capacity to 25 gpm. The system will also have failsafes, alarms, and an autodialer to allow unattended operation. The system has undergone some initial test operation and appears capable of sustaining at least 5 gpm yield, but continuous operation has been delayed since a discharge agreement has not been finalized.

This current trench-based system will allow the downgradient plume to go untreated. In the April 30, 1998 “Ground Water Remedial Action Workplan” Dan Raviv Associates proposes “natural remediation” for the parcels downgradient of the site. Raviv states the “worst-case” Classification Exception Area (CEA) calculations for MTBE indicate that the plume will not reach the Ramapo River. The Ramapo River is the nearest sensitive receptor to the site. Based on 2002 sampling data, it is possible that low concentrations of MTBE and TBA may be discharging to the river. Even if some discharge is occurring it is likely to have negligible or minimal impact due to dilution.

Ground water upgradient of the trench is not being actively treated, and even if no new contamination is being introduced into the subsurface, it will take a substantial time period (many years) for existing impacts to be flushed out.

2.2 MONITORING PROGRAM

The monitoring program has historically consisted of periodic sampling and analysis at select wells for BTEX and MTBE. Approximately nine well sampling events have been conducted since 1992. Raviv proposed in the 4/30/98 Work Plan that 20 Shorco South wells be sampled quarterly with analysis for BTEX, MTBE and TBA, with 12 additional wells sampled annually. NJDEP is considering that general approach, with the potential for the quarterly ground water sampling to be reduced to semiannual after two years. In addition a post-remediation (after system shut-down) sampling plan is proposed that includes 11 wells to be sampled quarterly for two years. Short-term monthly sampling is also proposed at system start up.

3.0 SYSTEM OBJECTIVES, PERFORMANCE AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The NJDEP ground water cleanup criteria that serve as remediation goals for the site are as follows:.

Contaminant	NJDEP Standard
Benzene	1 ug/L
MTBE	70 ug/L
TBA	100 ug/L
Toluene	1,000 ug/L
Ethylbenzene	700 ug/L
Xylenes	1,000 ug/L
Lead	10 ug/L

Dissolved benzene, MTBE, and TBA levels are still present in many wells above these criteria and are good “indicator parameters” for continuing impacts at the site. Toluene, ethylbenzene, xylene, and lead only sporadically exceed the criteria, and occur at wells within the plumes associated with the three indicator parameters (benzene, MTBE, and TBA). When the three indicator parameters are successfully remediated, it is likely that the other parameters will also be remediated.

Natural remediation is planned for the area downgradient of the trench capture zone, where MTBE and TBA are present at levels above NJDEP standards. A Classification Exception Area (CEA) was proposed for this downgradient area by Raviv and NJDEP has apparently agreed to this approach. Raviv also proposes a CEA for the area within the proposed capture zone after a “significant reduction” in ground water contamination has occurred, but specific concentration levels and a specific time period have not been established.

3.2 TREATMENT PLANT OPERATION STANDARDS

Initial operational tests of the system accomplished after the RSE visit indicate that the trench will likely be able to recover about 10 gpm, based on qualitative drawdown observations in the trench sump. Continuous operation of the system has been delayed due to discharge permitting difficulties, and therefore standards for the system effluent have not been finalized. System effluent concentrations during the testing were reported to be 18 ug/L benzene, 525 ug/L MTBE and 16,500 ug/L TBA. NJDEP reported that the TBA level may be above POTW pretreatment standards.

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, NJDEP, and the public. These observations obviously 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 PLUME CAPTURE

The original ground water extraction system consisted of six recovery wells. Pumping from these wells did not provide adequate plume capture. Nine well points were placed in the downgradient corner of the site to augment plume capture, but they were not effective due to solids production and low yields. The original recovery system has been replaced with a 200 foot long, 14 to 16 foot deep trench located on the southwest side of the site. Based on calculations by Raviv that utilize previous hydraulic conductivity estimates, this trench should be effective in maintaining a capture zone across the target area if pumping of 5 to 10 gallons per minute is achieved (as discussed in Section 3.2, approximately 10 gpm was achieved in testing done subsequent to the RSE visit). A similar calculation is provided below using representative parameters that are discussed in Section 1.0 of this report:

$$Q \;=\; C \times W \times B \times K \times i \;=\; C \times 200 \text{ ft} \times 15 \text{ ft} \times 50 \text{ ft/day} \times 0.01 \;=\; 7.8 \text{ gpm}$$

where

Q	is the pumping rate (gpm)	*B*	is the saturated thickness
C	is a conversion factor (0.00518 gal/ft^3 min/day)	*K*	is the hydraulic conductivity (ft/day)
W	is the width of the trench(ft)	*i*	is the hydraulic gradient (ft/foot)

This simple calculation, which is sensitive to the parameters used and a number of simplifying assumptions, indicates that a pumping rate of 7.8 gpm is required to intercept ground water flowing to the trench. When evaluating capture, it is often preferable to have a factor of safety of 1.5 to 2.0. Therefore, although effective capture is possible at 7.8 gpm, based on the parameters used, it would be preferable to achieve an extraction rate of 10 to 15 gpm.

4.2.2 AQUIFER RESTORATION

Concentration data (benzene, MTBE, and TBA) at selected monitoring wells are presented on the following page. These wells were selected to illustrate concentration trends in three portions of the site:

- on-site wells located upgradient of the on-site sources (“upgradient”)
- on-site wells located near current and historic USTs and pump islands (“mid-plume”)
- downgradient of the “mid-plume” wells, both on-site and off-site (“downgradient”)

The locations of the selected wells are presented in Figure 1-2, and dissolved concentrations for February 2002 are also presented in Figure 1-2.

Monitoring Well	**Date**	**MTBE (ug/L)**	**Benzene (ug/L)**	**TBA (ug/L)**
NJDEP Standard		**70**	**1**	**100**
		Upgradient Wells		
RWS-1	Apr. 1992	260	520	ND
	Aug. 1993	2,400	940	ND
	Sep. 1994	15,000	1,100	1,400J
	Nov. 1995	12,000	67	
	Jan. 1997	19,000	45	
	Feb. 1998	550	142	
	May 1998	1,300	97	
	Feb. 2002	28	ND	30
JOSMW-5	Apr. 1992	150	590	ND
	Aug. 1993	ND	400	ND
	Sep. 1994	ND	340	ND
	Nov. 1995	ND	400	
	Jan. 1997	30	190	
	Feb. 1998	1,200	15	
	May 1998	293	22	
	Feb. 2002	91	5	7
		Mid-Plume Wells		
MW-6	Apr. 1992	1,100	510	ND
	Jul. 1993	5,100	980	ND
	Sep. 1994	86,000	ND	ND
	Nov. 1995	140,000	3,200	
	Jan. 1997	50,000	2,200	
	Feb. 1998	15,500	1,160	
	May 1998	16,300	1,280	
	Feb. 2002	1,600	900	36,000
	Aug. 2003	97	10	
MW-7	Aug. 1993	95	320	ND
	Sep. 1994	ND	11	ND
	Nov. 1995	19,000	1,900	
	Jan. 1997	860	980	
	Feb. 1998	8,300	661	
	May 1998	13,500	644	
	Feb. 2002	570	36	24
	Aug. 2003	3,500	60	

Monitoring Well	Date	MTBE (ug/L)	Benzene (ug/L)	TBA (ug/L)
NJDEP Standard		**70**	**1**	**100**
Downgradient Wells				
PWS-4	Nov. 1995	2,300	380	
	Jan. 1997	1,500	8	
	Feb. 1998	3,960	110	
	May 1998	4,550	89	
	Feb. 2002	2,200	280	15,000
	Aug. 2003	580	5	
JOSMW-17S	Apr. 1992	270	ND	ND
	Jul. 1993	143	ND	ND
	Aug. 1994	39	ND	ND
	Nov. 1995	1,500	ND	
	Jan. 1997	800	ND	
	Feb. 1998	109	ND	
	May 1998	270	ND	
	Feb. 2002	8	ND	260
JOSMW-19S	Apr. 1992	ND	ND	110
	Jul. 1993	ND	ND	152
	Aug. 1994	39	ND	73
	Nov. 1995	250	ND	
	Jan. 1997	174	ND	
	Feb. 1998	77	ND	
	May 1998	97	ND	
	Feb. 2002	300	ND	9.3

Sampling results since 1992

On-site wells located upgradient of on-site sources ("upgradient" wells) are impacted, but at lower concentrations than the "mid-plume" wells. Impacts at these "upgradient wells" are most likely due to Shorco North, and concentrations at these wells are decreasing over time. At the "mid-plume" wells (impacted primarily by sources at Shorco South) the concentrations also appear to be decreasing over time, though in some cases concentrations still remain several orders of magnitude above cleanup criteria. Trends at the "downgradient" wells are not as clear.

MW-8 was the only remaining well with free product in 2002. In the August 2003 sampling round no free product was found in the well.

4.3 COMPONENT PERFORMANCE

The new treatment system has only operated for short term tests, so performance information is based on design estimates and test data provided by NJDEP. System effluent concentrations during the testing were reported to be 18 ug/L benzene, 525 ug/L MTBE and 16,500 ug/L TBA. Although these effluent levels are in excess of ground water criteria, these concentrations may meet POTW pretreatment standards (which have not yet been finalized). If not, more effective treatment will be required.

4.3.1 EXTRACTION SYSTEM TRENCH, PUMPS, AND HEADER

Initial tests indicate that the extraction trench will yield about 10 gpm. No problems with the submersible extraction pump or level controls were noted.

4.3.2 SEPARATOR AND FILTER

Extracted ground water is transferred to an underground oil/water separator. The separator model is reported to be a Highland Tank HTC-350™. This is a 350 gallon volume unit rated for up to 35 gallons per minute. Given that free product is not accumulating in monitoring wells at the site, little or no product should be expected to be collected in the separator.

The current plan is to pump the water from the separator to a bag filter system to remove suspended solids prior to the air stripper. The bag filter system had not been installed at the time of the RSE site visit. An appropriate bag filter opening size will be determined to minimize solid loading to the air stripper while not requiring excessive operator attention to change-out bags.

4.3.3 AIR STRIPPER

The air stripper is a "Breeze" Aeromix™ unit with a three horsepower regenerative blower. The H2M report states that at the 25 gpm design capacity, about 90% removal of BTEX compounds and 70% removal of MTBE is predicted with this stripper. Removal efficiency increases with the lower flow rates anticipated at Shorco South. For example, at 10 gpm, the removal rate of MTBE may be 90%. Information was not available for removal of TBA.

The Aeromix™ air stripper is relatively inefficient for volatiles removal due to its use of diffusers in a water column. However, this type of air stripper is less prone to fouling than more efficient packed tower and tray stripper units. If the Aeromix™ stripper effluent meets POTW pretreatment standards, then it is very appropriate for use at this site.

The system test effluent analysis reported by NJDEP indicated effluent concentrations of 18 ug/L benzene, 525 ug/L MTBE and 16,500 ug/L TBA. Based on the predicted system efficiencies (90% for BTEX and 70% for MTBE), system influent levels are estimated at >180 ug/L benzene and >1,750 ug/L MTBE. These estimated influent levels are consistent with the high end of the monitoring well analytical results from the August 2003 sampling event for wells in the vicinity of the trench. Influent concentrations (and therefore mass removal) are expected to decrease once continuous pumping begins.

At the estimated influent concentrations and an average flow rate of 10 gpm, 0.02 pounds/day of benzene and 0.21 pounds/day of MTBE will be removed from the site ground water and discharged to the atmosphere or the POTW.

$$\frac{10\text{ gal.}}{\text{min.}} \times \frac{180\text{ ug benzene}}{\text{L}} \times \frac{3.785\text{ L}}{\text{gal.}} \times \frac{1440\text{ min.}}{\text{day}} \times \frac{2.2\text{ lbs}}{10^9\text{ ug}} = \frac{0.02\text{ lbs benzene}}{\text{day}}$$

$$\frac{10\text{ gal.}}{\text{min.}} \times \frac{1{,}750\text{ ug MTBE}}{\text{L}} \times \frac{3.785\text{ L}}{\text{gal.}} \times \frac{1440\text{ min.}}{\text{day}} \times \frac{2.2\text{ lbs}}{10^9\text{ ug}} = \frac{0.21\text{ lbs MTBE}}{\text{day}}$$

4.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF ANNUAL COSTS

The treatment system is not currently being operated, so the cost breakdown provided below is based on estimates for the proposed scope and information provided by NJDEP. NJDEP plans to contract with Handex to run the new treatment system. The total cost for the system O&M is planned at about $100,000 per year, including sampling costs and POTW fees. Electrical costs are not included since the service station pays the electrical bills.

Item Description	Estimated Cost per Year
System operation and maintenance	$30,000
PM and Reporting	$12,000
Sampling and well gauging	$23,000
Electricity	Paid by others
POTW (reported to decrease to $21K/yr after 1st year)	$26,000
Laboratory analysis	$12,000
Total Estimated Cost	**$103,000**

4.4.1 UTILITIES

The main site utility paid by NJDEP is for POTW discharge. NJDEP reports that fees during the first year will be $26,000 and for additional years fees will be $21,000. A per gallon cost rate was not provided but it appears to be less than $0.01 per gallon, which is reasonable compared to other rates we have seen in New Jersey.

4.4.2 NON-UTILITY CONSUMABLES AND DISPOSAL COSTS

Disposal costs will consist mainly of the disposal of filter bags (assuming GAC is not used), and those costs will be minimal (not quantified).

4.4.3 LABOR

Operator labor will consist of periodic site visits to clean the air stripper and other system components, and to replace bag filters. We assume 50 hours per month at $50 per hour for the cost estimate. Project management and reporting costs are expected to be about $1,000 per month. Well sampling costs are estimated at $250 per sample with 92 total samples per year.

4.4.4 CHEMICAL ANALYSIS

Chemical analysis costs are assumed to be $100 per well sample, plus $700 per quarter for POTW required analysis.

4.5 REGULATORY COMPLIANCE

The Second and Third Quarterly Progress report for 1994 noted NPDES permit exceedances for TOC, TPHC and toluene. Iron fouling of the packed tower air stripper media was the reported cause of the elevated effluent values. Because the POTW (proposed for future discharge) has less stringent standards, these issues should not be a problem with the new system, although the POTW criteria have not been finalized.

4.6 SAFETY RECORD

The site team did not indicate any reportable incidents.

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

5.1 GROUND WATER

Based on the current site conceptual model, site contamination in ground water will likely not impact the Mahwah Well Field. There are no other potable supply wells in the vicinity of the site. The on-site supply well was apparently abandoned in the mid 1990s.

5.2 SURFACE WATER

Calculations in the Raviv Groundwater Remedial Action Workplan indicate that the ground water impacts will not reach the Ramapo River. Even if low levels of MTBE or TBA were to reach the river, dilution and volatilization would likely render these constituents undetectable.

5.3 AIR

The on-site service station related buildings are the only structures over the site ground water plume. Indoor air impacts were considered qualitatively in site inspections in the late 1980s. Our review did not find any analysis of indoor air, discussion of ongoing building venting, or recent complaints regarding indoor air quality. Given that service station tank and piping conditions have improved, and ground water contaminant concentrations are declining over time, it is likely that any indoor air impacts (if any) are reduced from previous levels. However, it may be prudent for NJDEP to analyze indoor air quality and/or inspect any venting systems, to determine if any additional remediation efforts are warranted.

5.4 SOILS

Varying amounts of contaminated soils have been removed in several efforts at the site. Contaminated soil may be a continuing source of ground water contamination at the site but the site is covered with paving and buildings so that any exposure to impacted soils is limited except during excavating.

5.5 WETLANDS AND SEDIMENTS

MTBE and TBA are the constituents most likely to migrate to surface water. We did not specifically evaluate these media, but the concentrations reaching surface water in wetlands would likely be quite low and subject to subsequent volatization. The constituents of concern at the site do not typically sorb to sediments.

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 VACUUM ENHANCED EXTRACTION EVENTS AT MW-8 AND OTHER HOT SPOT WELLS

Aquifer restoration with the current system may take a considerable amount of time, considering that the trench is located about 100 feet from wells that have high levels of dissolved contamination (e.g. MW-8) and vadose zone soil impacts may continue to serve as a source of dissolved ground water impacts. One approach to speed restoration might be sparging, but introducing air into the subsurface by sparging while the ground water recovery system is operating may cause significant iron fouling. A more conservative approach that may succeed is short-term extraction (about 2-4 hours per well) of liquid and vapor from hot-spot wells with a vacuum truck. We recommend considering such events quarterly for one year at 2-4 monitoring wells on the site with the greatest concentrations. This should require about $2,000 per one day event, or approximately $8,000 for one year. In addition to speeding site restoration, this approach may reduce influent concentrations to the treatment system, which might make it easier to meet effluent standards required by the POTW.

6.1.2 INDOOR AIR ANALYSIS OR CONFIRMATION OF CONTROLS

NJDEP should consider verifying that indoor air ventilation is adequate or analyze indoor air within occupied structures at the site. Assuming four samples are taken and analyzed, this effort would require about $5,000 for a one time event.

6.1.3 REVIEW CAPTURE EFFECTIVENESS AFTER CONSISTENT OPERATION IS ESTABLISHED

The water budget analysis suggests that the trench extraction rate is comparable to the rate at which ground water flows through the target capture zone. However, given uncertainties in the parameters used to conduct the water budget analysis, results are not sufficiently conservative to conclude that capture is provided. Additional lines of evidence such as the use of potentiometric surface maps and concentration trends in downgradient wells should also be used.

There may be a sufficient number of wells and piezometers to collect enough information to provide an informative potentiometric surface. A potentiometric surface map developed with water levels from each available well/piezometer on the Shorco South site should be used to generate a potentiometric surface map and interpret ground water flow directions. Such analyses would be helpful on a quarterly basis for one to two years and annually thereafter.

In general, the concentrations in wells that are downgradient of the trench and trench capture zone should decrease over time if capture is sufficient. However, substantial contamination remains in place downgradient of the trench. Concentrations in the more contaminated downgradient wells should decrease over time; however, concentrations in some of the less contaminated downgradient wells may increase over time if the contamination that is already downgradient of the trench migrates over time.

Analysis of capture effectiveness based on trench yield, water level measurements, and concentration trends in monitoring wells downgradient of the trench should be routinely conducted as part of the O&M contract. Assuming the necessary field work is already included in the contract, this review could cost about $5,000 in the first year. In subsequent years, the capture zone analyses would be done as part of preparing the annual reports, and the cost would be included in the cost of preparing those annual reports.

6.2 RECOMMENDATIONS TO REDUCE COSTS

It is difficult to make recommendations for costs savings because system operations have yet to begin and the RSE team has not reviewed the contractor's scope and cost breakdown. In addition, the level of total annual cost reported by NJDEP is relatively low. NJDEP should consider reviewing system operational data after one year of continuous operation to determine if the system is achieving containment and treatment goals and if progress is seen towards aquifer restoration. Costs should also be reviewed at that time to determine if any unexpected operational changes or difficulties have increased cost components. If any cost items are significantly different than those estimated in Section 4.4, NJDEP may want to determine the reason for the differences.

6.2.1 REDUCE WELL SAMPLING

The proposed monitoring well sampling program (Raviv, 1998) includes 20 wells sampled quarterly plus 12 additional wells sampled annually for the first two years of system operation, with the quarterly sampling frequency reduced to semiannual thereafter. NJDEP should consider reducing the number of wells sampled quarterly to about 10 key wells (for example, those included in the table in Section 4.2.2) with the remainder sampled annually for the first two years of system operation. Thereafter a semiannual sampling frequency is reasonable. With over 15 years of ground water monitoring trends available, collecting a large quantity of quarterly data is unlikely to be productive for decision making. Brief quarterly reports should be produced to note monitoring data, and system operation including POTW discharge compliance. Annual reports should be produced describing ground water concentration trends, recovery and treatment system operational details such as volume pumped, mass removed, and system effectiveness as indicated by water level measurements, influent and effluent analysis, and uptime percentage. This would reduce the total number of well samples by 30 for the first two years and by 10 thereafter for an assumed eight additional years of system operation. Based on our estimates this represents a potential savings of $10,500 for the first two years and $3,500 per year thereafter.

6.2.2 AVOID TBA TREATMENT

Separate TBA treatment costs are not currently included in system cost estimates. However TBA levels in the system influent may require treatment depending on the final agreement with the POTW. TBA concentrations at the high levels seen in the system tests should be readily treated by the typical biological treatment at a POTW, and we recommend that NJDEP pursue further negotiations perhaps to include paying additional fees to the POTW, rather than using GAC or another technology to attempt to remove TBA on-site. While GAC systems often remove TBA due to biological growth within the vessel, filtering prior to the GAC to prevent fouling may require considerable capital and/or operating expense for additional bag filters and changeouts or iron precipitation. NJDEP may need to evaluate potential treatment options if further TBA treatment is required and GAC does not provide the desired results. Other possible alternatives include more efficient air stripping, UV/Oxidation, and fluidized bed bioreactors (using GAC as the fixed growth media). Any of these options would have associated capital costs and iron fouling issues to consider.

It should also be noted that TBA concentrations should decline over time due to the remedy (particularly if remediation is accelerated by the actions recommended in Section 6.1.1), and the need for treatment of TBA (if any) may only be for the short-term.

6.3 MODIFICATIONS INTENDED FOR TECHNICAL IMPROVEMENT

6.3.1 HOUSEKEEPING

The remediation system is in generally poor condition (including the investigation and remediation related construction). NJDEP should consider making the effort to repair and label vaults and well covers. More importantly, the treatment system shed roof needs to be repaired. These improvements may already be planned. The RSE estimates that approximately $5,000 could significantly improve site conditions.

6.4 CONSIDERATIONS FOR GAINING SITE CLOSE OUT

The system will likely provide capture of the plume upgradient and slightly downgradient of the trench. However, the contaminant mass removed by the trench will likely have a minimal impact on cleaning up the site. Based on the concentration trends from 1995 to 2002 it is likely that natural remediation processes are the most significant factor in cleaning up the site. As discussed in Section 6.1.1, if NJDEP desires to accelerate the site cleanup beyond what will occur with natural processes, short-term extraction (about 2-4 hours per well) of liquid and vapor from hot-spot wells with a vacuum truck is suggested. An air sparging or biosparging approach could also be considered in lieu of ground water extraction after it is determined that hydraulic containment of site ground water is no longer necessary (sparging would likely cause fouling of an operating extraction system).

6.5 SUGGESTED APPROACH TO IMPLEMENTATION

The recommendations included in Section 6.1 to 6.3 are straightforward and could be implemented in the first year of system operation. We recommend the consideration of a sparging approach as discussed in Section 6.4 after several years, as a possible alternative in lieu of continued extraction.

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.

The RSE team observed a system that is not currently operating. Recommendations to improve the effectiveness of the system once it is operating include the addition of short-term extraction events from select monitoring wells using a vacuum truck, consideration of indoor air sampling, and making sure that capture effectiveness is evaluated. Recommendations to reduce costs include a suggestion to reduce the frequency of proposed ground water sampling in the first two years from quarterly to annual at 10 wells (keeping quarterly sampling at 10 other wells). It is also suggested that priority be given to negotiating criteria with the POTW that preclude a need for on-site treatment of TBA. Recommendations for technical improvement include repairing and labeling vaults and well covers, and repairing the treatment shed roof. All of these recommendations can be easily implemented, and no prioritization of the recommendations is needed. After several years of operation, the RSE team suggests that a switch to air sparging or biosparging be considered in lieu of ground water extraction.

Table 7-1 summarizes the costs and cost savings associated with each recommendation in Sections 6.1 through 6.4. Both capital and annual cost estimates are presented. Also presented is the expected change in life-cycle costs over a 10-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 ($) [1]	Estimated Change In Life-cycle Costs ($) [2]
6.1.1 Vacuum-enhanced extraction events for one year	Effectiveness	$8,000		$8,000	$8,000
6.1.2 Indoor air analysis	Effectiveness	$5,000		$5,000	$5,000
6.1.3 Initial capture evaluation	Effectiveness	$5,000		$5,000	$5,000
6.2.1 Reduce well sampling	Reduce Costs		($10,500) yr 1-2 ($3,500) yr 3-10	($49,000)	($42,000)
6.2.2 Avoid TBA treatment	Reduce Costs	not quantified	not quantified	not quantified	not quantified
6.3.1 Housekeeping	Technical Improvement	$5,000		$5,000	$5,000
6.4.1 Recommendations for site closeout	Gain Site/System Closeout	not quantified	not quantified	not quantified	not quantified

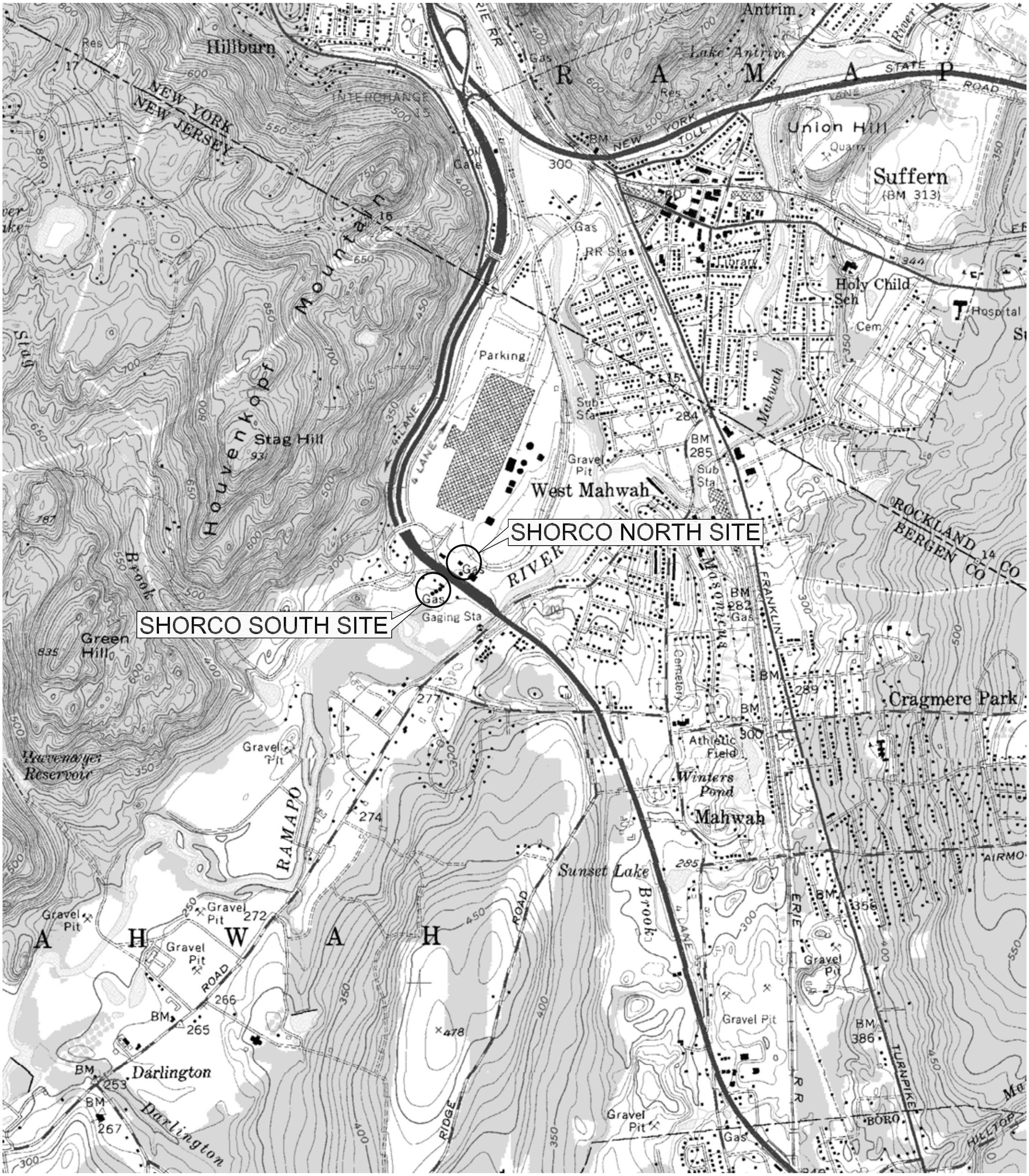
Costs in parentheses imply cost reductions.

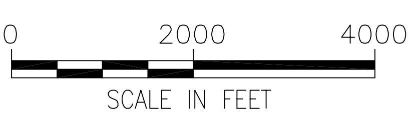
[1] assumes 10 years of operation with a discount rate of 0% (i.e., no discounting)

[2] assumes 10 years of operation with a discount rate of 5% and no discounting in the first year

FIGURES

FIGURE 1. SITE LOCATION MAP





Quadrangle Location

(Note: This figure is taken from Ramsey, NJ-NY U.S.G.S. Quadrangle, 1955.

FIGURE 2. SHORCO SOUTH SITE RESULTS OF ANALYSES OF GROUNDWATER SAMPLES FEBRUARY 2002 SAMPLING PROGRAM.