REMEDIATION SYSTEM EVALUATION

MIDLAND PRODUCTS SUPERFUND SITE
YELL COUNTY, ARKANSAS

Report of the Remediation System Evaluation,
Site Visit Conducted at the Midland Products Site
February 27, 2001

Final Report Submitted to Region 6
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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 37-acre Midland Products Site, located in Yell County, Arkansas addresses creosote contamination from a wood-treating plant that operated between 1969 and1979. State highways border the site to the north (downgradient) and to the south while private property borders the site to the east and west. The town of Ola, Arkansas with a population of approximately 1,000 is located one half mile to the west. Source control excavation and onsite treatment costing approximately $20 million was completed in May 1993. A pump-and-treat system, initially installed in October 1993 remains at the site in an effort to reduce concentrations of pentachlorophenol (PCP) and polynuclear aromatic hydrocarbons (PAHs) to below cleanup levels set in the ROD of 0.2 mg/L for PCP and 28 ng/L for PAHs. This long-term remediation action is led by the State with 90% of the approximate $223,000 annual operating costs provided by Superfund. Despite an initial cleanup time estimate in the ROD of 1 to 5 years for groundwater, the current system likely will operate indefinitely without a change in the ROD or the remedy.

This pump-and-treat system, consisting of 8 wells that collectively extract approximately 10 gallons per minute, collects an unmeasured (but small) amount of free product per year in addition to dissolved phase PCP and PAHs. In January 1999, after approximately four years of operation (one year left according to the ROD estimate), the site was shutdown, and in July 1999 a monitoring program began to determine if significant rebounding of PCPs and PAHs would occur in the recovery wells. The system was restarted in September 2000.

This RSE report describes the following recommendations to improve effectiveness:

- To more accurately delineate the contaminant plume and ensure it is fully captured by the pump-and-treat system, approximately five monitoring wells should be added to the north (downgradient) and to the west of the plume.

- Oil has been detected at the bottom of some of the monitoring wells and most of the recovery wells. Quantitative sampling for carrier oils should be conducted quarterly for one year.

These recommendations might require approximately $30,000 in capital costs and might increase annual costs by approximately $3,000 per year.

Recommendations to reduce life-cycle costs include the following:

- The current operations contract is broad and includes unnecessary financial risk for the contractors. As a result, the lump-sum bids to operate the system are higher than necessary. The scope of future bids should be reduced to be focused only on plant operation, and risks such as equipment replacement and carbon changeout should be handled as priced options in the contract. This will reduce the overall cost of the site by approximately $32,000 per year.

- The current sampling program for the treatment plant effluent can be reduced by approximately $32,000 per year without sacrificing effectiveness.

These savings could offset the extra costs associated with recommendations to improve system effectiveness.

Numerous other recommendations are included that focus on safety at the site and technical improvement. Chief among these recommendations are further training of the plant operator and the installation of a phone.

Finally, the RSE revealed that the ROD provides no feasible exit strategy. Reducing concentrations to the documented cleanup levels will not be achieved with the current pump-and-treat system. Consequently, this report suggests a change in the exit criteria and possibly an alternative remediation strategy. Three alternative strategies are provided.

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.

Region 1	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 pump-and-treat 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 exit strategy, and verify adequate maintenance of Government-owned equipment.

The Midland Products Site was chosen based on initial screening of the pump-and-treat systems managed by USEPA Region 6 and discussions with the Project Liaison for that Region. 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 at Midland Products and other Fund-lead pump-and-treat systems throughout the nation 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. (EPA TIO’s contractor)
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, Old Midland Products, Yell County, AR, March 31, 1987
IT Corporation	2/1990	Old Midland Products Site, Remedial Action Volumes I, II, and III
M.C. Anthon Waterwell Contractor	1990	Well installation logs, Wells SM-1 through SM-9
Chemical Waste Management	8/25/1992	Old Midland Water Treatment Plant, Operations and Maintenance Manual
Chemical Waste Management	11/1993	Ground Water Recovery System, Operational and Maintenance Manual and Well Performance Analysis
Rust Environmental & Infrastructure	4/1994	Monthly Well Report #2
OHM Remediation Services Corp.	9/1994 - 9/1998	Monthly Well Reports #8, 14, 21, 26, 32, 38, 44, 50, 56
US EPA	5/1999	5 year review
IT Corporation	10/2000	Arkansas Department of Environmental Quality, Former Old Midland Products Site, Monthly O&M Report, September 2000
Arkansas Dept. of Environmental Quality	2/2001	Old Midland Products - Groundwater Recovery Data
Arkansas Dept. of Environmental Quality		Discharge criteria

1.4 PERSONS CONTACTED

The following individuals were present for the site visit:

Clark McWilliams, State Regulator, Arkansas Department of Environmental Quality
Jerry Neill, State Regulator, Arkansas Department of Environmental Quality
Chet Reynolds, Plant Operator, IT Corporation
Vincent Malott, RSE Project Liaison, EPA Region VI

1.5 Site Location, History, and Characteristics

1.5.1 Location

The site is located on the abandoned Midland Products wood-preserving plant on Arkansas Highway 10 in Yell County a half mile east of Ola, Arkansas, approximate population 1,000. The site occupies about 37 acres and is bounded by Arkansas Highway 10 to the south, Old State Highway 10 to the north and private property to the west and east. Petit Jean Wildlife Management Area is located approximately three-quarters of a mile to the north (down gradient) but is not affected by contamination from the site. Both free and dissolved phase polynuclear aromatic hydrocarbons (PAHs) and pentachlorophenol (PCP) have been observed in the subsurface directly beneath old processing lagoons from the wood- treatment plant. The site layout is shown on Figure 1-1 showing estimated zone of contamination.

1.5.2 Potential Sources

The Midland Products Superfund Site addresses PCP and PAH contamination resulting from a wood preserving facility that operated from 1969 to 1979. Effluent from the treatment process including PCP and PAHs were released and stored in onsite lagoons. Over time, these constituents seeped into the subsurface. The site remedy has included excavation and onsite incineration of the contaminated surface soil and extraction and treatment of the contaminated groundwater. The excavation and incineration was completed in May 1993. Freephase pockets of these constituents located between 20 and 40 feet below land surface act as continuing sources of dissolved contamination. While the Remedial Investigation, ROD, and Remedial Action describe the freephase as an LNAPL, oil removed during operation of the pump-and-treat system and the report in semi-annual updates of oil detected in the bottom of some recovery and monitoring wells indicate the presence of DNAPL.

1.5.3 Hydrogeologic Setting

The geology of Yell County is dominated by the lower and middle Atoka Formation which consists of shale and sandstone. At the Old Midland Products Site, the top 15 feet of the subsurface consists of silt and clay, the next 20 feet is weathered bedrock, and below that is unweathered, but fractured bedrock. The topography and water table slope down to the north. Groundwater in this area flows to the north (downgradient) through joints and fractures in the weathered and unweathered bedrock but may also migrate to the west along bedding planes as suggested by the initial characterization of the plume.

1.5.4 Description of Ground Water Plume

Groundwater contamination consists of free and dissolved phase product located in weathered and unweathered bedrock between approximately 20 and 40 feet below land surface with an estimated affected area of 24,000 square feet. Relatively immobile DNAPL provides a continuing source of dissolved PCP and PAHs that may be capable of migrating in the absence of hydraulic containment. However, since its installation in October 1993, the pump-and-treat system has likely maintained containment of a majority of the contamination. During the Remedial Investigation, significant concentrations of contaminants were found mostly in the upper 20 feet of the soil and rock. Contamination at a depth of 40 feet may have also existed at the time of the Remedial Investigation or may have been caused by disturbance of the subsurface during excavation. No evidence of contamination at these deeper depths was identified during the Remedial Investigation.

2.0 SYSTEM DESCRIPTION

2.1 SYSTEM OVERVIEW

The original water treatment plant was designed to accommodate 100 gallons per minute (gpm) of contaminated water that needed treatment during the excavation and incineration of onsite soils (i.e., storm water runoff and excavation dewatering). Since October 1993, however, the plant has treated only contaminated water recovered by the current extraction system. That system currently extracts approximately 10 gpm and the associated treatment system averages around 15 gpm on a batch basis. The current system consists of eight recovery wells, double walled piping to the plant, a groundwater treatment plant (GWTP), and an outfall.

Because the ROD originally estimated a groundwater cleanup time of 1 to 5 years with an aggressive pump-and-treat system, the system was shut down in January 1999 under the condition that it would restart if contamination significantly rebounded or migrated. Thus, in July 1999 a monitoring program began at the site in both the monitoring wells and the recovery wells. While no migration was detected, the plant was restarted in September 2000 (months after shutdown) due to increasing concentrations in the recovery wells.

2.2 EXTRACTION SYSTEM

Eight recovery wells, with depths ranging from 26 to 33 feet, were installed in 1993. The depth to water in these wells during pumping ranges from approximately 19 feet in RW-8 to approximately 25 feet in RW-5.

The wells were installed in below grade vaults. Vaults are constructed of concrete reinforced steel. The wells are constructed of stainless steel risers and screens. The pump system at each recovery well vault consists of an Ejector System "total fluids ejector" (pump), controller, control line, air supply line and liquid discharge line. A totalizing meter was installed on the liquid discharge line within each vault. In addition, all extraction pumps are connected to cables allowing them to be set at various depths.

A dual containment system was constructed to carry recovered groundwater and oils to the GWTP. The dual containment system cosists of a 2-inch Driscopipe high-density polyethylene carrier pipeline inside of a 6-inch HDPE containment pipeline. The 6"/2" HDPE system consists of eight lateral lines extending from each recovery well, a secondary header system, and a main header. The main header extends approximately 430 feet from the vicinity of the recovery wells to the GWTP.

2.3 TREATMENT SYSTEM

The GWTP consists of the following items:

- an oil/water separator for removing light oils,
- pumps,

- bag filters,
- granular activated carbon filters,
- effuent holding tanks, and
- a control system.

The dual containment pipe from the extraction system delivers groundwater to the oil/water separator. Because the system was designed to remove LNAPL, but DNAPL prevails at the site, the oil/water separator functions more as a settling tank and as an influent/equalization tank. When the oil/water separator is full, the plant pumps turn on, sending the stored water through the treatment plant. The influent pumps send the raw water to the bag filters for solids removal. The water is then processed through two granular activated carbon filters for dissolved organics removal and then sent to the effluent holding tank. The ultimate disposal of the treated water is to the on-site creek.

2.4 MONITORING SYSTEM

The monitoring system consists of the following:

- eight monitoring-well couplets that each consist of a shallow well (approximately 20 feet deep) and a deep well (approximately 40 feet deep), both with screened intervals of 5 to 10 feet;

- four additional shallow monitoring wells 20 to 30 feet deep with screened intervals of 5 to 10 feet;

- five piezometer couplets that each consist of a shallow piezometer (approximately 20 feet deep) and a deep piezometer (approximately 40 feet deep); and

- two additional shallow piezometers (approximately 20 feet deep).

Potentiometric surfaces are generated and included in reports semi-annually. The contaminants of concern are sampled from the monitoring wells on a semi-annual basis and from each of the eight recovery wells on a monthly basis. In addition, two nearby wells previously used for private water supply are sampled semi-annually for the contaminants of concern.

3.0 SYSTEM OBJECTIVES, PERFORMANCE AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The goal of the pump-and-treat system, as documented in the ROD, is to achieve cleanup levels of 0.2 mg/l for PCP, established from the Safe Drinking Water Act, and 28 ng/l for PAHs (unclear if this is for individual or total PAHs), the 10^{-5} cancer risk level established from the EPA's Ambient Water Quality Criteria. The ROD provided an initial estimate of 1 to 5 years to achieve these goals.

3.2 TREATMENT PLANT OPERATION GOALS

The current contract for operations calls for the plant to operate 24 hours per day, seven days a week while treating water from all designated active extraction wells. A newly hired plant operator currently attends the facility two days per week to inspect the facility and, when necessary, obtain regularly scheduled samples and change filters.

3.3 ACTION LEVELS

The aquifer cleanup levels are mentioned in Section 3.1. The discharge criteria in effect since March 18, 1992 are provided in Table 3-1. It should be noted that the aquifer cleanup level of 28 ng/L for PAHs as specified in the ROD is orders of magnitude lower than discharge criteria of approximately 1 to 10 mg/L.

Table 3-1: Discharge criteria as of March 18, 1992.

Contaminant	Effluent (daily maximum)	Effluent (monthly average)
Pentachlorophenol*	Exp[1.005(pH) - 5.290] ug/L	Exp[1.005(pH) - 5.290] ug/L
Pentachlorophenol**	Exp[1.005(pH) - 4.830] ug/L	Exp[1.005(pH) - 4.830] ug/L
Napthalene	2.30 mg/L	0.62 mg/L
Acenapthene	1.70 mg/L	0.52 mg/L
Fluoranthene	3.98 mg/L	
Oil and grease (free phase)	15 mg/L	10 mg/L
Total phenols	10.2 mg/L	2.56 mg/L
BOD	20 mg/L	15 mg/L
COD or TOC	75 mg/L	50 mg/L
NH_3	6 mg/L	4 mg/L
TSS	40 mg/L	30 mg/L
pH	6 - 9	6 - 9
Chlorides	250 mg/L	250 mg/L

* Chronic toxicity (4-day average)
** Acute toxicity (never to exceed)

4.0 FINDINGS AND OBSERVATIONS FROM THE RSE SITE VISIT

4.1 FINDINGS

In general, the RSE team found the system to be operational with a high level of involvement by the state regulator. The following observations and recommendations are not intended to imply a deficiency in the work of either the designers, operators, or managers; rather, they are offered as constructive suggestions in the best interest of the EPA and the public. The recommendations obviously have the benefit of the operational data unavailable to the original designers.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

Approximately 10 gallons per minute are extracted through the eight recovery wells. Of these eight wells, four (RW-2, RW-3, RW-7, and RW-8) penetrate a gravel layer placed at approximately 20 feet below land surface during the excavation phase of the remediation. These wells pump approximately 66% of the extracted groundwater. RW-6, which does not penetrate the gravel layer, pumps an additional 26%. The three other wells (RW-1, RW-4, and RW-5) extract water from relatively tight fractures and therefore account for only 8% of the flow.

4.2.1 WATER LEVELS

At the time of the Remedial Investigation, water in the subsurface occurred in the weathered and unweathered rock under artesian conditions. Background water levels (approximately 10 feet below land surface) range from 345 feet in elevation to the south of the recovery zone to 330 feet in elevation to the north of the recovery zone. Water levels determined from piezometers and monitoring wells at the same locations, but at depths of 40 feet, are similar. This suggests minimal vertical flow. Within the recovery zone, water levels are as low as 328 feet in both shallow and deep monitoring wells (MW-3s) and 321 feet in the recovery wells (RW-5). The potentiometric surface generated with monitoring well data from 40 feet below land surface is shown in Figure 1-1.

4.2.2 CAPTURE ZONES

The water levels obtained from the shallow and deep monitoring wells in the recovery zone and from the recovery wells confirm converging flow toward the pumps in both the horizontal and vertical directions. This does not, however, confirm capture of the plume. The oily condition of the bottom of monitoring wells MW-20s and MW-20d suggest the presence of contaminants on the outer border of the capture zone (see Figure 1-1) or out potentially outside of the capture zone (see Monthly Well Reports 50 and 56, 4/1994 and 10/1994).

4.2.3 CONTAMINANT LEVELS

Contaminant levels in the monitoring wells do not suggest a trend toward or away from cleanup. Since operation in January 1994, only monitoring wells MW-3s and MW-3d suggest PCP concentrations significantly above the cleanup levels. In addition, PAHs have been found in concentrations significantly above the cleanup levels in all recovery wells and in MW-3s, MW-3d, MW-17s, MW-20s, and MW-20d. PAH concentrations in other wells may or may not be above cleanup levels. The ambiguity arises due to a laboratory detection limit of 2×10^{-2} to 2×10^{-3} mg/L that is higher than the cleanup level (28 ng/L or 2.8×10^{-5} mg/L). MW-3s, MW-3d, MW-17s, MW-19s, MW-19d, MW-20s, and MW-20d also have oil near the bottom that may contain the contaminants of concern. As mentioned in 4.2.2, it is unclear if free and dissolved phase contaminants are completely contained by the pump-and-treat system. It is also unclear if the dense freephase product is seeping to greater depths.

4.3 COMPONENT PERFORMANCE

The pump-and-treat system operates with infrequent shutdowns. As mentioned earlier, one extended period of shutdown occurred between January 1999 and September 2000 to determine the magnitude of the rebounding and migration of the contaminants. No change in concentration was found in the monitoring wells, but significant rebounding did occur in the recovery wells. The system restarted in September 2000.

4.3.1 WELL PUMPS

The existing pumps are old and replacement parts are hard to find. The flow controllers on recovery wells RW-4 and RW-5 are inoperable and are in need of maintenance.

4.3.2 AIR COMPRESSORS

Two compressors maintain process air and compressed air for the pumps and controllers. The site uses ABS air lines rated at 105 psi. The compressors operates at 125 psi. A section of line was replaced adjacent to the GAC vessels near the compressor. Lines are subject to damage from walking, dropping tools, and other physical hazards.

4.3.3 OIL/WATER SEPARATOR

The oil/water separator was designed/baffled to remove floating product; however, the on-site oils are sinking oils. Therefore, no skimmed oil has ever been recovered. The recovered oils have been of small quantity and are only recovered by shutting the system down and manually removing oils from the bottom of the tank. The oil/water separator has only required cleaning to remove these heavy oils twice in the past five years.

4.3.4 BAG FILTERS

Down stream of the influent pumps are four bag filter housings, two parallel systems each consisting of a 5-micron filter and a 3-micron filter in series. Waste water travels through one of the parallel systems at a time, and flow through these systems is alternated each week. As mentioned in Recommendation 6.3.1, the automated mechanism for routing the flow from one parallel system to the other is broken, and this routing must be done manually.

These bags foul from iron and emulsified oils and are replaced every week with the used bags containerized and held on site for off-site disposal as a hazardous waste. To switch the bag filters, which is done on a weekly basis, the filter housings are drained. The valves that stop flow between the bag housings and the carbon units are faulty allowing water from the carbon units to flow back through the housings when the filters are changed. This extends the time required to change the filters and increases the amount of water overflowing onto the floor, into the drain, through the sump, and back into the treatment system.

4.3.5 GRANULAR ACTIVATED CARBON UNITS

Two GAC units are operated in series. The units each contain about 10,000 pounds of GAC. Though they were replaced twice during excavation of the site, they have not been replaced during the past five years of pump-and-treat operation. The piping is designed to allow series or parallel operation. For the duration of the pump-and-treat operation they have been operating in series, and there has been no sampling done for breakthrough from the first unit.

4.3.6 EFFLUENT STORAGE TANKS

Two large effluent storage tanks are available for effluent holding. During normal operation the tanks are not used. However, if the pH of the system goes out of range then the system automatically sends effluent to these tanks. Once the tanks fill the entire system is shutdown. Operation can not resume until the operator resets the system. If the water in the effluent tanks meet discharge criteria, it can be discharge; otherwise, it is rerun through the treatment plant.

4.3.7 BACKWASH SYSTEM

Current plant operations do not utilize the installed backwashing capabilities.

4.3.8 RECOVERED AND SKIMMED OIL TANK

Since no appreciable amount of oils are recovered there is not a regular schedule for disposal of recovered oils.

4.3.9 STORMWATER SUMP

The sump in the building is utilized to contain spills or collected rainwater in the process building. The sump has a level controlled pump which activates to empty sump contents into the oil/water separator.

4.3.10 CONTROLS

The system utilizes several level controls and a pH controller. Automatic sampling for compliance purposes is also maintained. Level controllers are on the oil/water separator, effluent tanks, and sump. The pH meter controls the valve that allows discharge to the creek or filling of the effluent tanks. This is due to a pH-dependent relationship of PCP toxicity listed in the discharge criteria. There is an automatic sampler that collects 24 hour samples in a refrigerator. These samples are collected as part of the permit for discharge.

4.4 Components or Processes that Account for Majority of Costs

In January 1999 a contract change order was issued to temporarily shutdown the system and maintain it for potential future use. The change order had a total cost of $438,565.64 broken down as follows:

Treatment System Shutdown	$59,937.82
Groundwater Sampling and Analysis	$137,674.05
Conditional Extract and Treatment System Restart	$17,923.86
Conditional Extraction and Treatment System O&M	$223,029.91
	$438,565.64

The listed $223,029.91 is the lump-sum cost of operation for September 2000 to September 2001. This cost covers such items as labor, travel, equipment, materials, supplies, waste transport and disposal, laboratory costs, and utilities. It does not include site maintenance such as mowing the lawn, repairing the fence and maintaining the buildings. The lump-sum cost of $223,029.91 for a year corresponds to an average monthly cost of approximately $18,600.

4.4.1 Utilities

The primary consumer of power is the air compressor, and electrical costs for the plant are approximately $700 per month.

4.4.2 Non-utility Consumables and Disposal Costs

Replacement of the bag filters on a weekly basis, occasional disposal of collected oil, and change-out of the carbon are the main costs associated with this category. During the first 5 years of operation (including excavation activities), the oil/water separator was cleaned twice to remove and dispose of waste oils that had collected in the bottom six inches of the tank. GAC replacement has not occurred during the current operation of the pump-and-treat system. It was, however, replaced twice during the excavation phase of the remedation. GAC replacement (if required) would be the most significant consumable cost at approximately $40,000.

4.4.3 Labor

While it is difficult to determine the cost of labor associated with the operation and maintenance of the system, the change order specified, among other labor categories, 4290 hours for a field technician, which equates to full time for one technician for two years or full time for two technicians for one year. Currently, the plant is operated by a single operator for 16 hours per week (i.e., much less than the change order estimates). At the labor rates specified in the change order (including markup and profit), the actual labor corresponds to a monthly cost of approximately $2,000, plus any project management.

4.4.4 Chemical Analysis

Chemical analysis of water for the following constituents is conducted in each of the eight recovery wells:

- TOC
- PCP
- Carbazol,
- PAHs

In addition, semi-annually, the monitoring wells and the wells at the Barnes and Neiley residences are sampled.

Chemical analysis of the plant effluent is accomplished according to the following schedule:

weekly	**biweekly**	**monthly**	**quarterly**
pH	weekly items	weekly items	weekly items
BOD	phenols	biweekly items	biweekly items
TSS	PCP	acenapthene	monthly items
Chlorides		fluoranthene	toxicity testing
TOC		napthalene	
NH_3			
Oil and Grease			

Because of the lump-sum nature of the contract, the costs of this sampling schedule is not known in detail. However, the state regulator estimates it between $5,000 and $8,000 monthly.

4.5 RECURRING PROBLEMS OR ISSUES

A number of operations and maintenance items are required, as follows:

- replacement of the influent totalizer which is inoperable or out of calibration
- calibration of the pH meter on a regular basis
- replacement of the faulty check valves between the bag filters and carbon units
- replacement of the sheared bolts on the bladder pumps
- removal of piping in traffic areas to eliminate a tripping hazard
- installment or replacement of the missing or broken hinges on the well vaults
- operation of the compressor within the specified range
- compilation of an updated O&M manual.

4.6 REGULATORY COMPLIANCE

Discharge standards are routinely met and no issues regarding compliance are noted. The state regulator, however, mentioned the infeasibility of achieving the cleanup levels for PAHs (28 ng/L) with the current system and the potential need for changing the ROD if close-out is to be attained.

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

Once a week, the bag filters must be changed. This involves draining the bag filter housings and usually involves additional water flowing back from the carbon units. During this draining, the water spills on the floor and travels to drain in the floor where a sump pump sends the water back through the system. While this spilling has not resulted in releases of contaminants to the environment, it is a slipping hazard for the operator. There have been no accidental releases since plant startup in September 2000.

4.8 SAFETY RECORD

The site has no phone or listed address. If an accident occurred it could take several hours or days to find the operator. No accidents have been reported to date.

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

At the time of the RSE visit, the school district owned the property occupied by the site. The district's plans for the use of the site are unknown.

5.1 GROUND WATER

Dissolved and freephase PCP and PAHs exist within the fractures of the weathered shale and possibly in the underlying unweathered shale. The vertical and horizontal extent of this contamination is not entirely known. The deepest (approximately 40 feet) and outermost monitoring wells in the recovery zone (MW-20s and MW-20d) have evidence of DNAPL at the bottom. The next monitoring well is over 200 feet downgradient of the MW-19 or MW-20 well pairs.

At the time of the Remedial Investigation, there were two wells used for private water supply that were issues of concern for the State regulators, the Nieley well located approximately 400 feet to the west of the plume and the Barnes well approximately 1900 ft northwest of the plume. These wells draw water from 80 feet or deeper, approximately 40 feet lower than the known extent of the plume. As a precaution both of these residences were attached to the public water supply. As of yet, however, public water has not been used at the Barnes residence. Both of these wells are currently used for monitoring PAH and PCP concentrations, and at the time of the RSE visit, samples from these wells reportedly yielded non-detectable concentrations. Four other wells are located within 1,500 feet of the Old Midland Products Site, and none of them showed any signs of site-related contamination when the ROD was signed.

A wildlife management area is located approximately three-quarters of a mile to the north. At the time of the Remedial Investigation, an overland, intermittent stream was the most significant pathway for the contaminants of concern to reach this area. Site excavation, however, removed the surface contamination. Given estimated water velocities at the Old Midland Site (20 to 40 feet per year), the transport time for dissolved phase contaminants to travel from the site to the management area would be approximately 100 to 200 years, and this does not account for retardation due to partitioning of these contaminants to subsurface material.

5.2 SURFACE WATER

According to a public comment, years before the ROD was signed hard rain led to flooding of the Old Midland Products Site. Overflow from the site reached Keeland Creek, and trees along the creek died. Excavation of the site has removed the contaminants at the surface, and there has been no additional comment regarding contamination of surface waters.

5.3 AIR

Air is an unlikely exposure avenue of PCP and PAHs at the site.

5.4 SOILS

It appears the sources identified in the ROD that have been removed under the previous operable units have effectively removed the source of the contamination near the surface.

5.5 WETLANDS

The wildlife management area to the north and Keeland Creek represent the only nearby natural receptors for the contaminants of concern. Previous excavation, however, has since removed the PCPs and PAHs at the surface.

6.0 RECOMMENDATIONS

6.1 RECOMMENDED STUDIES TO ENSURE EFFECTIVENESS

6.1.1 INSTALL NEW WELLS FOR IMPROVED PLUME DELINEATION

Samples from monitoring and recovery wells within the capture zone have detectable concentrations of PCP and PAHs. However, downgradient of the capture zone there are only three pairs of monitoring wells, the closest of which is 100 to 150 feet from that zone. As a result, plume delineation is somewhat vague. Furthermore, while capture zones are plotted each month as part of the sampling report, the lack of plume delineation prevents a clear understanding of the containment offered by the pump-and-treat system and the possibility of contaminant migration.

The RSE team, therefore, recommends adding five new monitoring wells down gradient of the plume. Referring to Figure 1-1,

- one deep well (approximately 40 feet deep) with a screened interval of 5 to 10 feet should be added near MW-16s in order to sample the unweathered bedrock in this area,
- two wells, one shallow well (approximately 20 feet deep and screening 5 to 10 feet of the weathered bedrock) and one deep well (approximately 40 feet and screening 5 to 10 feet of the unweathered bedrock) should be added 50 feet due north of MW-20s and MW-20d, and
- two wells, one shallow well (approximately 20 feet deep and screening 5 to 10 feet of the weathered bedrock) and one deep well (approximately 40 feet and screening 5 to 10 feet of the unweathered bedrock) should be added midway between the MW-10 and MW-20 monitoring well couplets.

These wells should be sampled quarterly for PCP and PAHs for one year, and semi-annually with the other monitoring wells thereafter. This would significantly improve plume delineation down gradient of the original source area. Over the lifetime of the pump-and-treat system, these wells would ensure containment, and upon potential shut down of the system, they would signal whether or not the remaining contaminants would migrate off site. Installation of these wells is estimated to cost less than $5,000 each for a total capital cost of $25,000. Laboratory analysis for the semi-annual sampling would cost approximately $3,000 per year. If PCP and PAHs are detected during drilling of these wells or subsequent sampling, additional wells and sampling may be required.

6.1.2 SAMPLE WELLS FOR CARRIER OILS

The September 2000 Monthly Update reports that seven of the monitoring wells and seven of the eight recovery wells have oil at the bottom. However, the site has not been monitored for carrier oils. Because these oils (TPH-DRO) may act as a reservoir for PCP and PAHs, including the oils in the monitoring program would improve the understanding of remaining contamination sources within the subsurface. These oils should be sampled quarterly for one year in all wells with oil at the bottom as reported in the September 2000 O&M report (MW-3s, MW-3d, MW-17s, MW-19s, MW-19d, MW-20s, MW-20d, and all recovery wells except for RW-5). Laboratory analysis for this one year of sampling would cost approximately $5,600.

6.2 RECOMMENDED CHANGES TO REDUCE COSTS

6.2.1 SIMPLIFY CONTRACT TO REDUCE RISK AND AMOUNT OF LUMP-SUM BIDS

The current contract for operating the site, which started in September 2000 and ends in September 2001, is a lump sum payment of approximately $223,000 ($18,600 monthly). Under this contract the operators are responsible for replacing of any equipment or materials, including the carbon which may cost up to $40,000. Therefore, this contract is likely higher to accommodate the risk associated with equipment failure or carbon change out. This contract will end in September 2001, and the state will announce acceptance of bids for future operation. This next contract should identify some of the high dollar items to be priced separately and only awarded in the event the need arises. The primary item to be omitted from the contract is the carbon change out, but other items to be included are well-pump replacement and cleaning of the oil/water separator. Reducing the financial risk will make lower lump-sum bids feasible for contractors. Given that $40,000 dollars of carbon lasts at least five years at the site, annual carbon costs are approximately $8,000. Removing the risk of changing carbon during a year of operation, however, should reduce a year-long contract by at least $40,000 suggesting a savings to the overall project of $32,000 per year ($40,000 in savings minus $8,000 for the actual cost of the carbon).

6.2.2 REDUCE SAMPLING OF EFFLUENT

The current sampling program includes frequent monitoring of the effluent from the water treatment plant. This sampling could be significantly reduced without compromising effectiveness. Weekly samples of BOD, TSS, chlorides, TOC, and NH_3 could be changed to monthly (if permitted by the discharge criteria) resulting in a cost savings of approximately $6,000 per year. Sampling of the recovery wells can be changed from a monthly to a semiannual or annual basis resulting in a cost savings of approximately $26,000 per year.

6.3 MODIFICATIONS INTENDED FOR TECHNICAL IMPROVEMENT

6.3.1 PROVIDE ADDITIONAL TRAINING FOR PLANT OPERATOR AND UPDATE O&M MANUAL

At the time of the RSE visit, the plant operator had been working at the site for approximately one month. He had completed 40 hours of HAZWOPER training and one week of on-the-job training but had no prior experience with treatment operations. Coupled with the recent upstart of the system and aging equipment, this minimal training resulted in a number of maintenance issues including:

- broken or missing hinges on the recovery-well vaults,
- a broken or uncalibrated flow meter for the plant influent,
- a diaphragm pump that had sheered two of four bolts holding it in place,
- a nonfunctional controller to automatically route water through alternate bag filter housings,
- faulty check valves between the bag filters and the carbon units,
- an uncalibrated pH meter, and
- the operator's limited knowledge of the well-sampling procedure.

To further complicate the operation of the system, the plant and O&M manual were designed for 100-gpm for treatment during excavation of the site. The plant now runs at 15 gpm and operation parameters are now different. A week of additional training of the operator would likely cost approximately $5,000, and compiling an updated O&M manual could be done for $15,000 assuming excerpts were taken from the current manual.

6.3.2 INSTALLATION OF A PHONE AND FAX

The plant does not have an installed phone or FAX and does not have a registered address. The lack of a phone and address is a safety hazard given that the operator visits and maintains the plant alone. While he does carry a "bag" phone (a cell phone does not supply enough power to reach the nearest towers), such a phone is not connected directly to 911 or emergency lines. If there were an emergency and he could not, for whatever reason, communicate his exact location, emergency dispatchers would not be able to locate him. Thus, the plant should have a phone line installed and a registered address. The addition of a FAX machine would also allow for facilitated communication of data between the operator, project manager, and state regulator. If a telephone line needs to be extended to the site, installation of a phone and fax would likely cost $2,000. Annual costs of a phone would be approximately $600 or $50 per month.

6.3.3 INSTALL AN AUTODIALER

There is no autodialer currently installed. Nor is there any monitoring within the plant to reveal potential problems or leaks. Such a monitoring system and autodialer should be installed given that the operator is still familiarizing himself with the site and only visits it twice a week. An autodialer could be purchased and installed to a plant sensor for $500.

6.3.4 REPLACE CHECK VALVES BETWEEN BAG FILTERS AND CARBON UNITS

Because the oil/water separator was designed for floating rather than sinking oils and now only works as a settling tank for some of the sinking oils that are recovered, the bag filters represent a significant removal process for oil within the system. There are four bag filter housings, two parallel systems each consisting of one 5 micron and one 3 micron filter. Waste water travels through one of the parallel systems at a time, and flow through these systems is alternated each week. As mentioned in Recommendation 6.3.1, the automated mechanism for routing the flow from one parallel system to the other is broken, and this routing must be done manually. To switch the bag filters, which is done on a weekly basis, the filter housings are drained. The two valves that stop flow between the bag housings and the carbon units are faulty allowing water from the carbon units to flow back through the housings when the filters are changed. This extends the time required to change the filters and increases the amount of water overflowing onto the floor, into the drain, through the sump, and back into the treatment system. The two check valves can be replaced for $200 each.

6.3.5 ANNUAL OR BIANNUAL CLEANING OF THE OIL/WATER SEPARATOR AND DISPOSAL OF RECOVERED OIL AND SLUDGE

The oil/water separator was designed to remove floating oils. While no floating oils are recovered, periodic inspection and cleaning of the oil/water separator has shown that it is collecting small amounts of sinking oils. The oil/water separator should be cleaned annually or biannually to remove these recovered oils. A single cleaning and disposal would cost approximately $2,000.

6.3.6 MONITOR EFFLUENT FROM FIRST CARBON UNIT

Carbon was changed twice during the excavation of the site but has not been changed since then, a period of over 5 years. While the effluent from the plant is monitored, no samples have been taken from the effluent of the first carbon unit. Therefore, it is unknown whether or not the carbon in this unit has been spent. The effluent of this carbon should be sampled once to determine if breakthrough has occurred. Based on the results of this sampling, new carbon may be required. If no breakthrough has occurred, the first-unit effluent should be sampled, perhaps semi-annually, until breakthrough is achieved. At this point, it is probable that only the carbon in the first unit would need to be replaced.

The integrity of the carbon units is significant to the effectiveness of the treatment plant as there is no early warning system for determining a rise in contaminant concentrations in the effluent. Although sampled weekly, results may take weeks, and by then water with elevated concentrations may have been discharged. Semi-annual sampling of the first carbon unit would cost approximately $1,000 per year.

6.3.7 REPLACE FLOWMETER BEFORE OIL/WATER SEPARATOR

The total flow of water into the treatment plant is calculated by summing the extraction rates from each of the recovery wells. The flowmeter that measures the blended influent into the plant is broken and does not provide an accurate flow rate. This flowmeter can be purchased and installed for $500.

6.3.8 REPLACE AIRLINES TO ACCOMMODATE OPERATING AIR PRESSURE

The airlines connecting the compressors to the pumps in the extraction wells are rated at 105 psi, but the compressors are operating at 125 psi. In addition, these lines are subject to being kicked or sustaining other damage that would result in failure of those lines and the pumps. Lines subject to damage should be replaced with galvanized piping. This at-risk piping could be purchased and installed for under $2,000.

6.3.9 ANALYSIS OF MONTHLY MONITORING DATA

Current monthly updates do not involve data analysis to reflect trends in recovery and monitoring well concentrations or blended plant influent, nor do they provide analysis of water levels and the capture zone. The operations contract should be modified to include this data analysis and a brief summary of it in the monthly updates as such analysis would improve the understanding of system operation and progress. The addition of this analysis to the contract could potentially result in a minor cost increase (e.g., $1,000 or less).

6.4 MODIFICATIONS INTENDED TO GAIN SITE CLOSE-OUT

The cleanup levels required by the ROD, 0.2 mg/L for PCP and 28 ng/L for PAHs, likely cannot be achieved with the current pump-and-treat system despite the initial estimate in the ROD that cleanup with pump-and-treat would occur in 1 to 5 years. Furthermore, the discharge levels for PAHs are approximately three orders of magnitude higher than the cleanup level for PAHs. Given that the plant is permitted to discharge water with PAH concentrations of approximately 1 mg/L (refer to Table 3-1), it is reasonable to assign a similar levels for aquifer cleanup, especially given that residences in the area are provided with public water.

Due to technical impracticability, a change to the ROD and/or a change to the current system is required for site closure. These changes to the ROD should incorporate sampling from the additional monitoring wells suggested in Recommendation 6.1.1. Below is a recommended change in the ROD and three independent potential remediation strategies. The first strategy (6.4.2.1) has the highest recommendation due to its low cost and clear exit strategy.

6.4.1 CHANGE THE ROD

Given that complete cleanup of PCP and PAHs is infeasible with the current system, the RSE team suggests a remedy update in which the cleanup standards and cleanup area are changed. Specifically, the team suggests that the system to be allowed to shut down if it can be demonstrated that the contaminants of concern will not migrate off site at levels above the current discharge levels (see Table 3-1). Region 6 considers all remedy review requests, and proposed alternative remedies must be at least as cost-effective and protective as the current remedy. Any proposed change in the selected remedy would be consistent with the National Contingency Plan (NCP) and applicable guidance. Given that there are no receptors of contaminants on the site, this change would be as protective as the current pump-and-treat system. Due to the potential for earlier shutdown, this change would also be cost effective. To demonstrate that the contaminants will not migrate in significant concentrations, the additional monitoring wells in Recommendation 6.1.1 must be installed and sampled regularly. Furthermore, the data from these samples must be analyzed carefully.

6.4.2 REMEDIATION STRATEGIES

6.4.2.1 STRATEGY 1: MONITORED NATURAL ATTENUATION

This is the most passive and cost-effective approach. With the installation of the additional monitoring wells mentioned in Recommendation 6.1.1, site managers will have ample data to determine the threat of contaminant migration. Shutdown of the current pump-and-treat system will eliminate hydraulic containment provided by pumping, but ample effectiveness still may be provided due to the nature of the contaminant/subsurface interaction and the relatively tight formation. In such a case, natural processes may have ample time to prevent significant migration of PCP off site, approximately 250 feet to the west (across gradient) and over 1,000 feet to the north/northwest (downgradient). Although natural biodegradation of PAHs is not likely at the site, partitioning of PAHs to subsurface material, and the associated immobility, may limit migration of PAHs through the subsurface, especially given the low groundwater velocities. Thus, PAHs may not decrease significantly in the source area, but their potential for migration is reduced. According to the change order from the previous plant shutdown, shutting the system down would cost approximately $60,000. In addition, as mentioned in Recommendations 6.1.1, 6.1.2, and 6.3.2, installing the new monitoring wells, sampling for carrier oils, and installing a phone would cost approximately $32,600. However, if the pump-and-treat system is discontinued and semi-annual sampling continues in 17 monitoring wells (MW-5s, MW-8s, MW-8d, MW-9s, MW-9d, MW-10s, MW-10d, MW-16s, MW-19s, MW-19d, MW-20s, MW-20d, and the five recommended wells), annual costs will be less than $30,000 per year (approximately $10,000 of for analytical costs and $20,000 for supplies, labor, and management) compared to the current annual costs of approximately $223,000. Thus, an annual savings of approximately $193,000 could be realized.

While the pump-and-treat system was formerly shutdown for over a year, the site managers focused on contaminant rebounding in the recovery wells and not on natural limits to plume migration. Furthermore, they did not have the benefit of water samples from the recommended monitoring wells immediately downgradient of the contaminated area. This recommended strategy has the benefit of maximizing cost savings over the long term if the contaminants do not migrate and offers concrete evidence for continuing the pump-and-treat system or instituting another remediation strategy if the contaminants do migrate. On the other hand, if the current system is shut down for more than a couple of years, and the plume begins to spread, the system would likely need to be overhauled, and new extraction wells may be required to contain the now larger plume.

The exit strategy for this approach is straightforward:

- Discontinue the existing pump-and-treat system, but continue to monitor with the additional recommended wells. If the plume does not migrate significantly over the next five-year period pump and treat is not required.

- If the plume does migrate significantly over the next five-year period, then the site managers have significant evidence that pump and treat, or a more aggressive approach, is necessary to reduce the hazard of PCP and PAH contamination.

This strategy will require

- $92,600 in capital costs ($60,000 for plant shutdown and $32,600 for implementing Recommendations 6.1.1, 6.1.2, and 6.3.2), and

- $30,000 in annual costs.

6.4.2.2 STRATEGY 2: PUMPING AND TREATING WITH REDUCED ANNUAL COSTS

This is the intermediate of the three proposed approaches and the closest to current operations. This strategy involves continued operation of the current pump-and-treat system, but at a reduced annual cost. Additional upfront costs are required for the installation of the wells in Recommendation 6.1.1, but annual cost savings would be realized due to reduced sampling of the effluent and reducing the scope of the next operations contract.

With the installation of the recommended wells, this approach has the benefits of ensuring containment of the plume at a reduced cost (compared to the current costs). However, with this strategy, there is no clear point at which system close out can occur. PCP and PAH concentrations will likely continue to be above the current cleanup levels for an indefinite period of time, but there is little evidence suggesting that these same contaminants will migrate off site and pose a threat to human or ecological health. The cost savings of operating a pump-and-treat system with above-mentioned recommendations compared to operating the current system is approximately $61,000 per year ($64,000 from cost reductions but $3,000 for sampling of new wells).

As mentioned, the exit strategy for this approach is unclear.

This strategy will require

- $56,000 in capital costs for implementing all of the recommendations except for a feasibility study, and

- $164,600 in annual costs (current annual costs of $223,000 minus $58,400 associated with implementing the recommendations).

6.4.2.3 STRATEGY 3: SOURCE REMOVAL ACTION

This approach has the highest upfront costs of the three approaches, but has the benefit of removing a large amount of freephase contamination, which is a continuing source of dissolved phase PCP and PAHs. The RSE team recommends funding a feasibility study investigating the use of chemical oxidation, steam injection, or facilitating in situ bioremediation to maximize the removal of contaminants (perhaps more than 50% of the effected area) for a cost of implementation not exceeding $1,000,000. Oxidation would have to use Fenton's Reagent or another strong oxidant, and bioremediation would likely focus on cometabolism of the constituents. An initial feasibility study of these processes, without bench or pilot tests, could be done for under $25,000.

If one of these approaches were chosen, the pump-and-treat system would likely be shut down, thereby offsetting the capital cost within approximately 5 to 10 years. Monitoring from the wells mentioned in Recommendation 6.1.1 would need to continue to verify a reduction in contaminant concentrations or to warn site managers if the remaining contaminants are migrating.

The benefit of an aggressive, short-term strategy is that with a significant reduction in the amount of freephase contamination, the probability is reduced for the remaining contamination to migrate off site in sufficiently high concentrations. The downside to this type of strategy is the risk due to handling chemicals, including pH reducers for Fenton's Reagent and the possibility of increased subsurface pressure that can lead to increased mobility of the contaminants.

The exit strategy for this approach is straightforward:

- After aggressive remediation is implemented, if concentrations are reduced and significant migration is not evident (without containment offered by pumping), then monitoring is required but additional remediation is not.

- If after aggressive remediation, significant concentrations and migration is evident, then containment offered by pumping is required.

This strategy will require

- approximately $1,000,000 in capital costs for the in situ remediation and installation of monitoring wells and

- $30,000 in annual costs for continued monitoring (see section 6.4.2.1)

7.0 SUMMARY

The observations and recommendations given below 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 obviously have the benefit of the operational data unavailable to the original designers.

Several recommendations are made to assure system effectiveness, reduce future operations and maintenance costs, improve technical operation, and gain site close out. The recommendations include improving plume delineation with additional monitoring wells, altering the upcoming operations contract to reduce risk to the contractor and therefore reduce the amount of a lump-sum bid, decreasing the amount of sampling from the plant effluent, providing additional training for the plant operator, and installing a phone for safety in emergency situations. A remedy update is also suggested due to absence of a clear and feasible exit strategy. Finally, three potential remediation strategies and accompanying exit strategies are recommended.

Tables 7-1 summarizes the costs and cost savings associated with each recommendation, and Table 7-2 summarizes the costs and cost savings for each remediation strategy. In each table, both capital and annual costs are presented. In addition, Table 7-1 presents the expected change in life-cycle costs over a 30-year period for each recommendation, and Table 7-2 presents the total expected life-cycle cost over a 30-year period of each strategy. Life-cycle costs are calculated both with discounting (i.e., net present value) and without it.

Table 7-1. Cost summary table for individual recommendations

Recommendation	Reason	Estimated Change in			
		Capital Costs	Annual Costs	Life-cycle Costs*	Life-cycle Costs **
6.1.1 Install and sample new wells for plume delineation	Effectiveness / Site close-out	$25,000	$3,000	$115,000	$73,400
6.1.2 Sample for carrier oils	Effectiveness	$5,600	$0	$5,600	$5,600
6.2.1 Reduce risk in O&M contract	Cost reduction	$0	($32,000)	($960,000)	($516,500)
6.2.2 Reduce sampling of effluent	Cost reduction	$0	($32,000)	($960,000)	($516,500)
6.3.1 Provide additional training for plant operator and update O&M manual	Technical Improvement	$20,000	$0	$20,000	$20,000

Table 7-1. Cost summary table for individual recommendations (cont.)

Recommendation	Reason	Estimated Change in			
		Capital Costs	Annual Costs	Life-cycle Costs*	Life-cycle Costs **
6.3.2 Install a phone and FAX (with wiring)	Technical Improvement/ Safety	$2,000	$600	$20,000	$11,700
6.3.3 Install an autodialer	Technical Improvement / Effectiveness	$500	$0	$500	$500
6.3.4 Replace check valves between bag filters and carbon units	Technical Improvement	$400	$0	$400	$400
6.3.5 Clean oil/water separator	Technical Improvement	$0	$1,000	$30,000	$16,100
6.3.6 Monitor effluent from first carbon unit	Technical Improvement	$0	$1,000	$30,000	$16,100
6.3.7 Repair influent flowmeter	Technical Improvement	$500	$0	$500	$500
6.3.8 Replace at-risk airlines	Technical Improvement / Safety	$2,000	$0	$2,000	$2,000
6.3.9 Analyze and summarize monthly data	Technical Improvement	$0	$0	$0	$0
6.4.1 Change cleanup standards in ROD	Site Close Out	$0	$0	$0	$0
6.4.2 Initial feasibility study for aggressive source removal	Site Close Out	$25,000	$0	$25,000	$25,000

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

Table 7-2. Cost Summary Table for Remediation Strategies

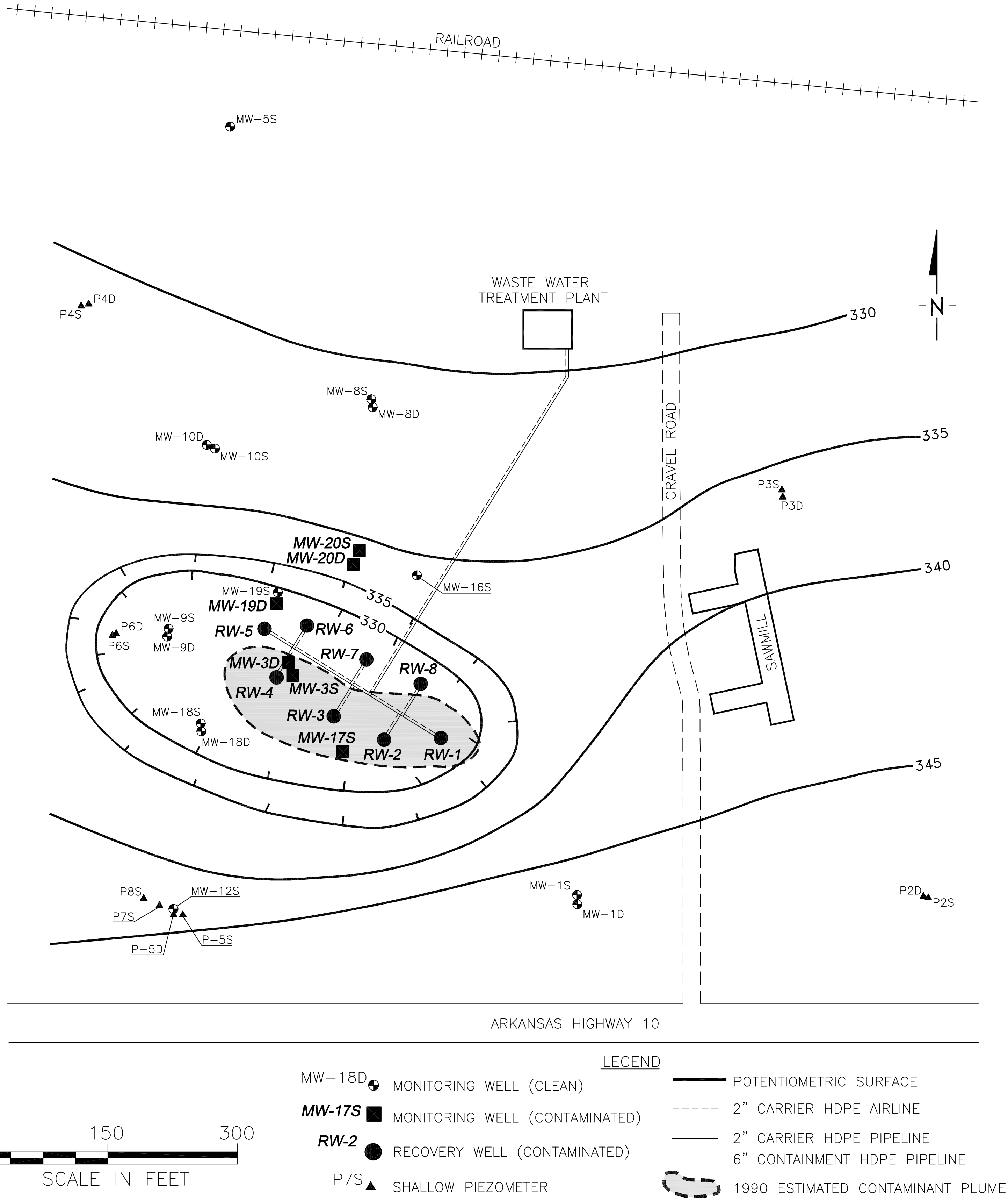
	Description	Capital Costs Required	Annual O&M Costs	Estimated Life-cycle Costs*	Estimated Life-cycle Costs**
Current P&T system	Current	$0	$223,000	$6,690,000	$3,599,500
Remediation strategies					
1. Monitored Natural Attenuation	Passive	$92,600	$30,000	$992,600	$576,800
2. Continued pump-and-treat	Moderate	$56,000	$164,600	$4,994,000	$2,712,800
3. *In situ* remediation	Aggressive	$1,000,000	$30,000	$1,900,000	$1,484,200

* assumes 30 years of operation with a discount rate of 0% (i.e., no discount).

** assumes 30 years of operation with a discount rate of 5% and no discounting in the first year.

FIGURES

FIGURE 1-1. SITE LAYOUT SHOWING THE POTENTIOMETRIC SURFACE FROM SEPTEMBER 2000, 1990 ESTIMATED CONTAMINANT PLUME, AND WELLS WITH AND WITHOUT CONTAMINATION BETWEEN SEPTEMBER 1994 AND SEPTEMBER 2000.



NOTE: Potentiometric surface taken from the September 2000 O&M Report, IT Corporation. 1990 estimated contaminant plume taken from the Old Midland Products Remedial Action, Vol. III, IT Corporation, 1990. Well sampling data taken from September 1994 through September 2000 O&M Reports, IT Corporation.

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