

COST AND PERFORMANCE REPORT

Pump and Treat of Contaminated Groundwater at the
City Industries Superfund Site
Orlando, Florida

September 1998



Prepared by:

U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
Technology Innovation Office

SITE INFORMATION

Identifying Information:

City Industries Superfund site
Orlando, Florida

CERCLIS #: FLD055945653

ROD Date: March 29, 1990

Treatment Application:

Type of Action: Remedial

Period of operation: 05/94 - Ongoing (Data collected through May 1997)

Quantity of groundwater treated during application: 151.7 million gallons

Background

Historical Activity that Generated

Contamination at the Site: Hazardous waste handling

Corresponding SIC Code: 4953 (Hazardous Waste Material Disposal Sites)

Waste Management Practice That

Contributed to Contamination: Improper disposal practices and unauthorized dumping

Location: Orlando, Florida

Facility Operations [1,2,3]:

- The City Industries site operated as a hazardous waste Treatment, Storage, and Disposal (TSD) facility from 1971 until 1983. From 1981 through 1983, U.S. EPA and Orange County officials cited the facility for multiple RCRA violations. In July 1983, EPA, the Florida Department of Environmental Protection (FDEP), and Orange County ordered the business to close under Resource Conservation and Recovery Act (RCRA) authority.
- In 1983, the owner of the site abandoned the facility. That same year, EPA and FDEP performed source control activities, including the FDEP removing 41 tons of waste drums, sludge, and liquid hazardous waste. EPA also thermally treated 1,670 tons of contaminated soil off site, and returned the clean soil to the site as fill. EPA removing 10 tons of highly contaminated soil and transported it to an off-site hazardous waste landfill. As a result of these activities, the only remaining media of concern at the site was the groundwater.
- In 1984, EPA issued an Administrative Order to City Industries requiring cleanup; however, the company ignored the order. In December 1985, the facility owner was

found guilty on 17 counts of hazardous waste handling violations and other criminal charges.

- FDEP completed a multiphased Remedial Investigation (RI) in May 1986.
- In 1988, FDEP and the City Industries steering committee entered into an agreement to develop viable cleanup options. The Feasibility Study (FS) was conducted by the Potentially Responsible Parties (PRPs) under a consent agreement between the PRPs and FDEP and was completed in December 1989.
- In March 1989, the site was listed on the National Priorities List (NPL), and EPA assumed oversight responsibility from FDEP. A Record of Decision (ROD) for the site was signed on March 29, 1990.
- In 1991, EPA negotiated a consent decree with the PRPs to fund the necessary activities to clean up the site.

Regulatory Context:

- The ROD for the site was signed in 1990.
- An Explanation of Significant Differences (ESD) was signed in February 1994 to revise the selected remedy and to identify two new contaminants. The ROD called for secondary treatment of effluent to meet POTW pretreatment standards; however, the POTW refused to accept the discharge. The ESD revised the remedy to include air stripping with no secondary treatment and discharge to surface water under an NPDES permit.



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SITE INFORMATION (CONT.)

Background (Cont.)

- Site activities are conducted under provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) §121, and the National Contingency Plan (NCP), 40 CFR 300.

Groundwater Remedy Selection: The selected groundwater remedy for the site is pumping and treating the contaminated groundwater through air stripping with discharge to surface water, as specified in the ROD and modified in the ESD.

Site Logistics/Contacts

Site Lead: PRP

Oversight: EPA

Remedial Project Manager:

Pam Scully*
U.S. EPA Region IV
345 Courtland Street, N.E.
Atlanta, GA 30365
(404) 562-8898

State Contact:

Don Harris
Florida Department of Environmental Protection
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32301
(904) 488-0190

Treatment System Vendor:

Jerry Peters
PEER Consultants P.C. (Design)
12300 Twinbrook Parkway, Suite 410
Rockville, MD 20852
(301) 816-0700

Stuart Bills*
ERM-EnviroClean, Inc. (Construction & Operation/Maintenance)
250 Phillips Blvd. #280
Ewing, NJ 08618
(609) 895-0050

* Indicates primary contacts

MATRIX DESCRIPTION

Matrix Identification

Type of Matrix Processed Through the Treatment System: Groundwater

Contaminant Characterization [1,2,3,10]

Primary Contaminant Groups: Halogenated and nonhalogenated volatile organic compounds (VOCs).

- The initial 14 contaminants of concern at the site were acetone, benzene, 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethylene (1,1-DCE), *trans*-1,2-dichloroethylene (*trans*-1,2-DCE),

ethylbenzene, methylene chloride, methyl ethyl ketone (MEK), methyl isobutyl ketone (MIBK), tetrachloroethylene (PCE), toluene, 1,1,1-trichloroethane (1,1,1-TCA), trichloroethylene (TCE), and total phthalates. During construction of the treatment system in 1994, two additional contaminants of concern were identified and added to the list in the ESD: *cis*-1,2-DCE and vinyl chloride.



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MATRIX DESCRIPTION (CONT.)

Contaminant Characterization (Cont.)

- The maximum concentrations of contaminants detected during a 1988 FS sampling event were acetone (146,000 µg/L), benzene (100 µg/L), 1,1-DCA (500 µg/L), 1,1-DCE (6,000 µg/L), methylene chloride (165,000 µg/L), MEK (20,000 µg/L), MIBK (78,000 µg/L), toluene (9,000 µg/L), TCE (27,000 µg/L), 1,2-DCE (24,000 µg/L), 1,1,1-TCA (430 µg/L), ethylbenzene (2,100 µg/L), and PCE (380 µg/L). The maximum concentrations of vinyl chloride and *cis*-1,2-DCE detected during 1994 were 2,400 µg/L and 38,000 µg/L, respectively.
- Based on 1986 RI data, site engineers estimated the initial plume covered approximately eight acres extending from the City Industries site toward the drainage canal east of the site. Based on an area of eight acres, a plume thickness of approximately 50 feet, and a porosity of 0.3, the initial plume volume was estimated for this report to be approximately 39 million gallons.
- Contamination has been detected in the upper aquifer (the Surficial Aquifer). Figures 1 and 2 illustrate plume distribution in the Surficial Aquifer in August 1994. Figure 1 depicts concentration contours detected in intermediate zone wells; Figure 2 depicts concentration contours detected in deep zone wells. Intermediate and deep monitoring wells are screened in the top 40 feet and lower 20 to 30 feet of the Surficial Aquifer, respectively.
- Figures 1 and 2 reveal that the majority of the contamination is in the top 40 feet of the Surficial Aquifer. The plume in the top 40 feet (Figure 1) is more concentrated than the plume in the lower 20 to 30 feet (Figure 2). The plume has migrated east of City Industries, concurrent with groundwater flow direction.

Matrix Characteristics Affecting Treatment Costs or Performance

Hydrogeology: [4]

Two distinct hydrogeologic units have been identified beneath this site.

Unit 1	Surficial Aquifer	Unconfined aquifer of fine to medium-grained quartz sand with limestone, gravel, chert, and coarse-grained sand.
Unit 2	Floridan Aquifer	Interlayered clayey gravel, clayey sand, clay, and limestone.

The hydrogeology at the site consists of two units separated by a 140-foot thick aquitard. Groundwater flows in an easterly direction across the site through the 60- to 70-foot thick Surficial Aquifer. This aquifer is not used as a potable source in the vicinity of the site. Groundwater in the Floridan Aquifer has not been characterized because it is not contaminated at the site; however, the City of Winter Park draws its water from a well supply field in the Floridan Aquifer 1,900 feet west of the site. The Surficial and Floridan Aquifers are not hydraulically connected. Tables 1 and 2 present technical aquifer information and well data, respectively.

Table 1. Technical Aquifer Information

Unit Name	Thickness (ft)	Conductivity (ft/day)	Average Velocity (ft/day)	Flow Direction
Surficial Aquifer	60-70	6.3936	0.064	East
Floridan Aquifer	100	NA	NA	NA

NA - indicates not characterized

Source: [4]



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MATRIX DESCRIPTION (CONT.)

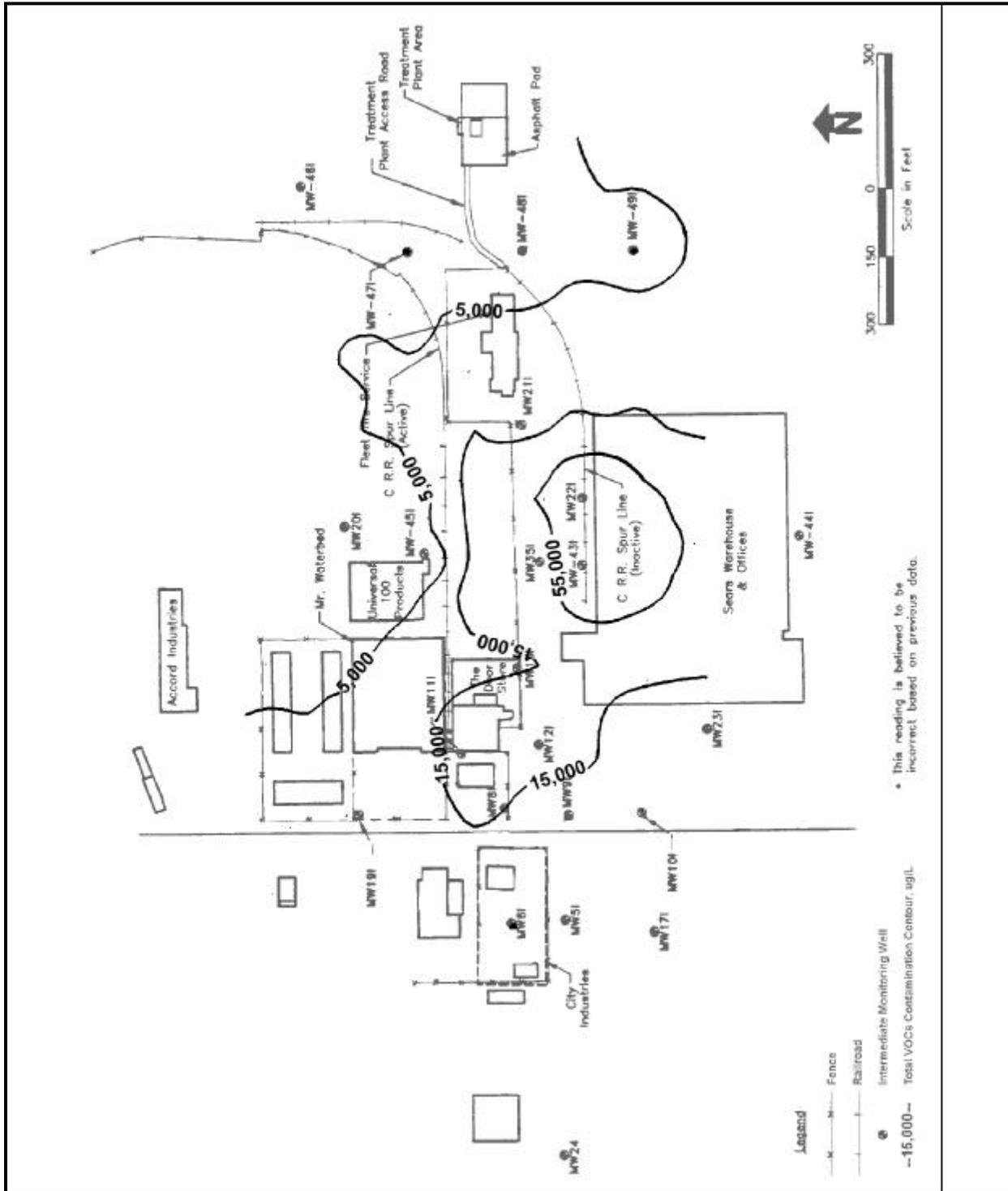


Figure 1. Total VOCs in Intermediate Zone Monitoring Wells, August 1994 [2]

MATRIX DESCRIPTION (CONT.)

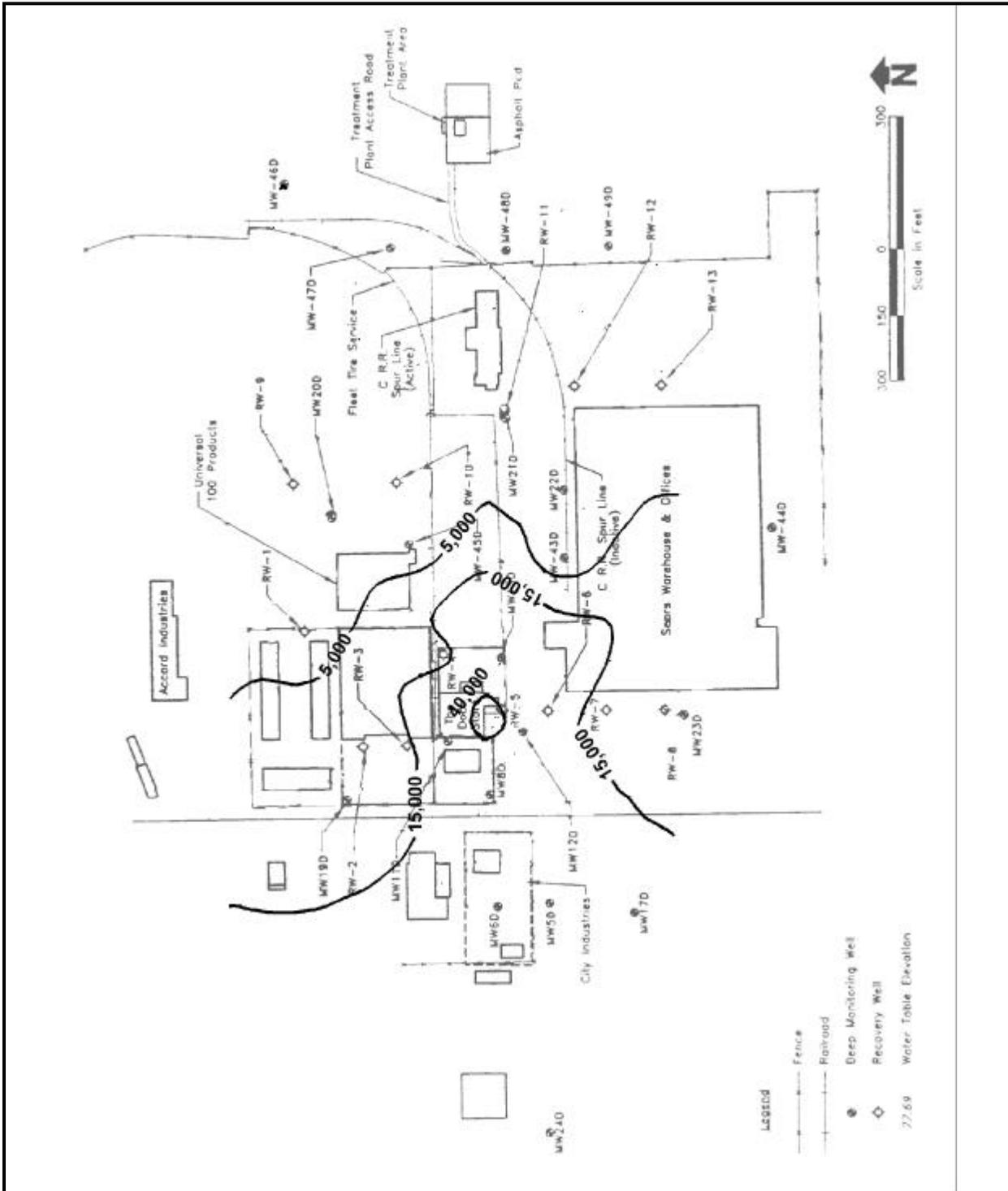


Figure 2. Total VOCs in Deep Zone Monitoring Wells, August 1994 [2]



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TREATMENT SYSTEM DESCRIPTION

Primary Treatment Technology

Pump and treat (P&T) with air stripping

Supplemental Treatment Technology

Equalization/neutralization prior to air stripping

System Description and Operation

Table 2. Extraction Well Data

Well Name	Unit Name	Depth (ft)	Design Yield (gpm)
RW-1 through RW-8	Surficial Aquifer	25-70	10
RW-9 through RW-13	Surficial Aquifer	25-70	5

Source: [2]

System Description [2]

- The groundwater extraction system consists of 13 recovery wells (RW-1 through RW-13) located on five adjacent properties east of the original site, as listed in Table 2. The recovery wells are divided into two groups, which are installed across the width of the initial contaminant plume. The well placement is designed to intercept the plume and to achieve hydraulic containment of the plume as it flows east. The first group consists of eight recovery wells (RW-1 through RW-8) which are located just downgradient from the site, perpendicular to the plume centerline, where most of the contamination has been found. The second group consists of the remaining five recovery wells (RW-9 through RW-13). These wells are located further downgradient, perpendicular to the centerline and are estimated to be at the leading edge of the contaminant plume.
- The treatment system constructed in 1994 consists of an equalization/neutralization tank followed by an air stripping tower. The 1,500-gallon equalization tank serves to settle aggregates and equalize flow to the tower. The air stripper has been designed for a 97% treatment efficiency.
- Treated water from the air stripper is transported via a gravity pipeline approximately 2,250 feet east to a county-maintained drainage canal (Crane Strand) where it is discharged in accordance with NPDES permit limits.

- A network of 41 monitoring wells and 13 recovery wells is used to measure quarterly changes in groundwater levels and concentrations. Twenty additional monitoring wells are sampled on an annual basis. The monitoring wells are screened at various depths and some are in a series of clusters of shallow, intermediate, and/or deep wells.

System Operation [2,10]

- Quantity of groundwater pumped from the aquifer in gallons:

Year	Volume Pumped (gal)
5/94-4/95	48,430,000
5/95-4/96	47,750,000
5/96-5/97	51,524,849
6/97	3,990,000

- System operations began on May 19, 1994. As of June 1997, the P&T system has been operational approximately 90% of the time.
- A primary operational concern is biological growth on pumps in the wells, in the equalization tank, and in the air stripping tower. Biological growth degrades system performance below design and permit requirements. In June 1996, the system was shut down for 24 hours and the pumps and treatment system were shocked with a high dose of chlorine, which alleviated a biological growth problem.



TREATMENT SYSTEM DESCRIPTION (CONT.)

System Description and Operation (Cont.)

- The air stripping tower packing continues to require cleaning approximately every six months. The air stripping media has been removed and washed with a weak acid solution four times to remove scaling: August 1994, March 1995, November 1995, and April 1996. Discharges (liquid and solid) from the cleaning operations are tested and disposed of according to applicable regulations.
- The extraction system has pumped an average of 105 gpm from May 1994 through June 1997, which meets the design requirement for plume containment.
- EPA Region 4 completed an optimization study in December 1996 to maximize plume capture during pumping. The study examined what pumping rates from all the existing wells were best to maximize zones of influence and to minimize stagnation zones. Pumping options were limited in that the total treatment capacity remained at 115 gpm; however, the study found that zones of influence would increase by decreasing pumping from wells located along the upgradient edge of the plume and increasing pumping from those at the leading edge of the plume. The following recommended changes were incorporated in June 1997: increased pumping in three wells at the leading edge of the plume from 5 to 10 gpm and decreased pumping in three other wells at the upgradient edge from 10 to 5 gpm.
- Quarterly sampling data indicates that several recovery wells are showing no contamination now. Wells with increased rates are drawing in more contaminants, but data are being analyzed to determine if stagnant zones are moving.
- In March 1998, four wells were shut down and the rates in the other wells were increased to try to increase recovery. Sampling was reduced to semi-annual. When results are available the EPA will determine if the plume is still contained or if wells need to be restarted.



TREATMENT SYSTEM DESCRIPTION (CONT.)

Operating Parameters Affecting Treatment Cost or Performance

The major operating parameter affecting cost or performance for this technology is the extraction rate. Table 3 presents the design value for this and other performance parameters.

Table 3. Performance Parameters

Parameter	Value																																
Design Pump Rate	115 gpm (actual average = 105 gpm*)																																
Performance Standards (Effluent)	<table style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 80%;">Acetone</td><td style="text-align: right;">88,000 µg/L</td></tr> <tr><td>Benzene</td><td style="text-align: right;">53 µg/L</td></tr> <tr><td>1,1,-Dichloroethane</td><td style="text-align: right;">1160 µg/L</td></tr> <tr><td>1,1-Dichloroethene</td><td style="text-align: right;">303 µg/L</td></tr> <tr><td>c-1,2-Dichloroethene</td><td style="text-align: right;">1160 µg/L</td></tr> <tr><td><i>trans</i>-1,2-Dichloroethene</td><td style="text-align: right;">1160 µg/L</td></tr> <tr><td>Ethyl Benzene</td><td style="text-align: right;">453 µg/L</td></tr> <tr><td>Methylene Chloride</td><td style="text-align: right;">1100 µg/L</td></tr> <tr><td>Methyl Ethyl Ketone</td><td style="text-align: right;">56,400 µg/L</td></tr> <tr><td>Methyl Isobutyl Ketone</td><td style="text-align: right;">42,800 µg/L</td></tr> <tr><td>Tetrachloroethylene</td><td style="text-align: right;">84 µg/L</td></tr> <tr><td>Toluene</td><td style="text-align: right;">175 µg/L</td></tr> <tr><td>1,1,1-Trichloroethane</td><td style="text-align: right;">530 µg/L</td></tr> <tr><td>Trichloroethylene</td><td style="text-align: right;">4,500 µg/L</td></tr> <tr><td>Vinyl Chloride</td><td style="text-align: right;">525 µg/L</td></tr> <tr><td>Xylenes, total</td><td style="text-align: right;">260 µg/L</td></tr> </table>	Acetone	88,000 µg/L	Benzene	53 µg/L	1,1,-Dichloroethane	1160 µg/L	1,1-Dichloroethene	303 µg/L	c-1,2-Dichloroethene	1160 µg/L	<i>trans</i> -1,2-Dichloroethene	1160 µg/L	Ethyl Benzene	453 µg/L	Methylene Chloride	1100 µg/L	Methyl Ethyl Ketone	56,400 µg/L	Methyl Isobutyl Ketone	42,800 µg/L	Tetrachloroethylene	84 µg/L	Toluene	175 µg/L	1,1,1-Trichloroethane	530 µg/L	Trichloroethylene	4,500 µg/L	Vinyl Chloride	525 µg/L	Xylenes, total	260 µg/L
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Remedial Goals (Florida MCLs)	<table style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 80%;">Acetone</td><td style="text-align: right;">700 µg/L</td></tr> <tr><td>Benzene</td><td style="text-align: right;">1 µg/L</td></tr> <tr><td>1,1,-Dichloroethane</td><td style="text-align: right;">5 µg/L</td></tr> <tr><td>1,1-Dichloroethene</td><td style="text-align: right;">7 µg/L</td></tr> <tr><td>c-1,2-Dichloroethene</td><td style="text-align: right;">70 µg/L</td></tr> <tr><td>t-1,2-Dichloroethene</td><td style="text-align: right;">70 µg/L</td></tr> <tr><td>Ethyl Benzene</td><td style="text-align: right;">700 µg/L</td></tr> <tr><td>Methylene Chloride</td><td style="text-align: right;">5 µg/L</td></tr> <tr><td>Methyl Ethyl Ketone</td><td style="text-align: right;">200 µg/L</td></tr> <tr><td>Methyl Isobutyl Ketone</td><td style="text-align: right;">350 µg/L</td></tr> <tr><td>Tetrachloroethylene</td><td style="text-align: right;">3 µg/L</td></tr> <tr><td>Toluene</td><td style="text-align: right;">2,000 µg/L</td></tr> <tr><td>1,1,1-Trichloroethane</td><td style="text-align: right;">200 µg/L</td></tr> <tr><td>Trichloroethylene</td><td style="text-align: right;">3 µg/L</td></tr> <tr><td>Total Phthalates</td><td style="text-align: right;">3 µg/L</td></tr> <tr><td>Vinyl Chloride</td><td style="text-align: right;">1 µg/L</td></tr> </table>	Acetone	700 µg/L	Benzene	1 µg/L	1,1,-Dichloroethane	5 µg/L	1,1-Dichloroethene	7 µg/L	c-1,2-Dichloroethene	70 µg/L	t-1,2-Dichloroethene	70 µg/L	Ethyl Benzene	700 µg/L	Methylene Chloride	5 µg/L	Methyl Ethyl Ketone	200 µg/L	Methyl Isobutyl Ketone	350 µg/L	Tetrachloroethylene	3 µg/L	Toluene	2,000 µg/L	1,1,1-Trichloroethane	200 µg/L	Trichloroethylene	3 µg/L	Total Phthalates	3 µg/L	Vinyl Chloride	1 µg/L
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Total Phthalates	3 µg/L																																
Vinyl Chloride	1 µg/L																																

Source: [1, 2]

*The average of 105 gpm was provided in the Interim Long-Term Response Action Report.



TREATMENT SYSTEM DESCRIPTION (CONT.)

Timeline

Table 4 presents a timeline for this remedial project.

Table 4. Project Timeline

Start Date	End Date	Activity
3/90	--	ROD issued
1992	--	Final remedial design completed
2/94	--	ESD issued
5/94	---	Construction of the treatment system and extraction wells completed
5/94	ongoing	System operation begun

Source: [2]

TREATMENT SYSTEM PERFORMANCE

Cleanup Goals/Standards [1, 2]

Cleanup goals are to remediate groundwater to levels set by the Florida Primary Drinking Water Standards (which for this site are the same as Maximum Containment Levels (MCLs) set by the Federal Primary Drinking Water Standards). These standards are listed in Table 3 and are applied throughout the aquifer.

Treatment Performance Goals [1, 2]

- The primary performance goal of the P&T system is to achieve hydraulic containment of the plume.
- The performance goal of the treatment system is to reduce effluent contaminant concentrations to meet NPDES permit requirements listed in Table 3.

Performance Data Assessment [2, 5, 6, 9, 10]

For the purposes of this report, total VOCs consist of acetone, benzene, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, ethylbenzene, methylene chloride, MEK, MIBK, PCE, toluene, 1,1,1-TCA, TCE, total phthalates, and vinyl chloride.

- Figure 3 illustrates the trend of average total VOC concentrations from May 1994 through May 1997. Total concentrations of contaminants have been reduced 86% during this period, from 3,121 µg/L to 444 µg/L. However, concentrations of all VOCs remain above cleanup goals.
- Although concentrations have been reduced significantly, three of the VOCs show persistently elevated concentrations: acetone, 1,1-DCE, and MIBK. Nonetheless, maximum levels of acetone have decreased 84%, from 146,000 µg/L to 23,000 µg/L. Maximum levels of 1,1-DCE have declined 52% from 6,000 µg/L to 2,900 µg/L. Maximum levels of MIBK have declined 93% from 78,000 µg/L to 5,000 µg/L.



TREATMENT SYSTEM PERFORMANCE (CONT.)

Performance Data Assessment (continued) [2, 5, 6, 9, 10]

- Figures 4 and 5 illustrate contours of total VOCs detected during August 1996 sampling events in intermediate and deep monitoring wells, respectively. Compared to the plume of total VOCs detected in August 1994 (illustrated in Figures 1 and 2), the volume of total VOCs in the plume detected in August 1996 has decreased. The 55,000 µg/L contour in the intermediate wells has decreased in size from 1994 to 1996. In addition, the level of maximum VOCs has decreased in the deep wells from 40,000 µg/L in August 1994 to 8,000 µg/L in August 1996.
 - No contaminants have been detected in downgradient monitoring wells since the beginning of remedial operations, and the plume has been contained. In addition, monitoring done since 1997 has shown that the plume has reduced in size. No plume map was available to demonstrate the change in size.
- Figure 6 illustrates total VOC concentrations in wells MW-13D, MW-43I, and MW-22I, where contamination is concentrated. Concentrations have decreased exponentially since operations began. In February 1996, an increase was seen in all three wells; however, concentrations have continued to decrease since 1996.
 - Effluent standards for the treatment system have been met during system operation.
 - From June 1994 through May 1997, the P&T system removed approximately 2,700 pounds of contaminant mass from the groundwater. Figure 7 shows mass flux rate and total contaminant removal from June 1994 through May 1997. The mass flux rate spiked in April 1996, but the spike is attributed to a high concentration of acetone detected during that sampling event.

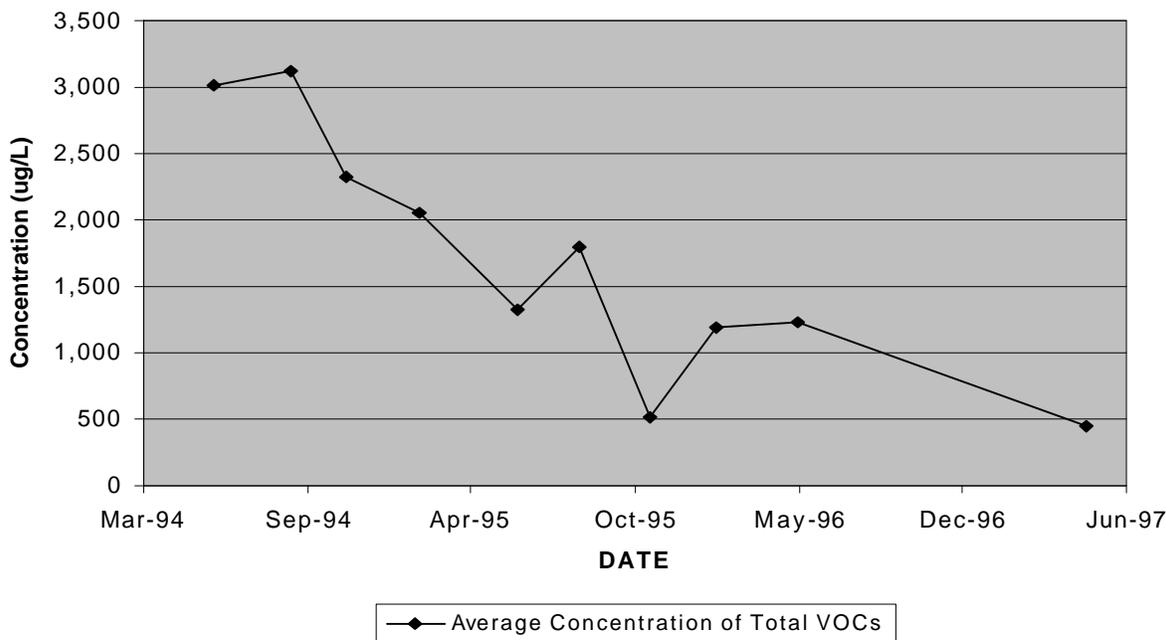


Figure 3. Average of Total VOCs in all Monitoring Wells from May 1994 through May 1997 [2,5,6,9]



TREATMENT SYSTEM PERFORMANCE (CONT.)

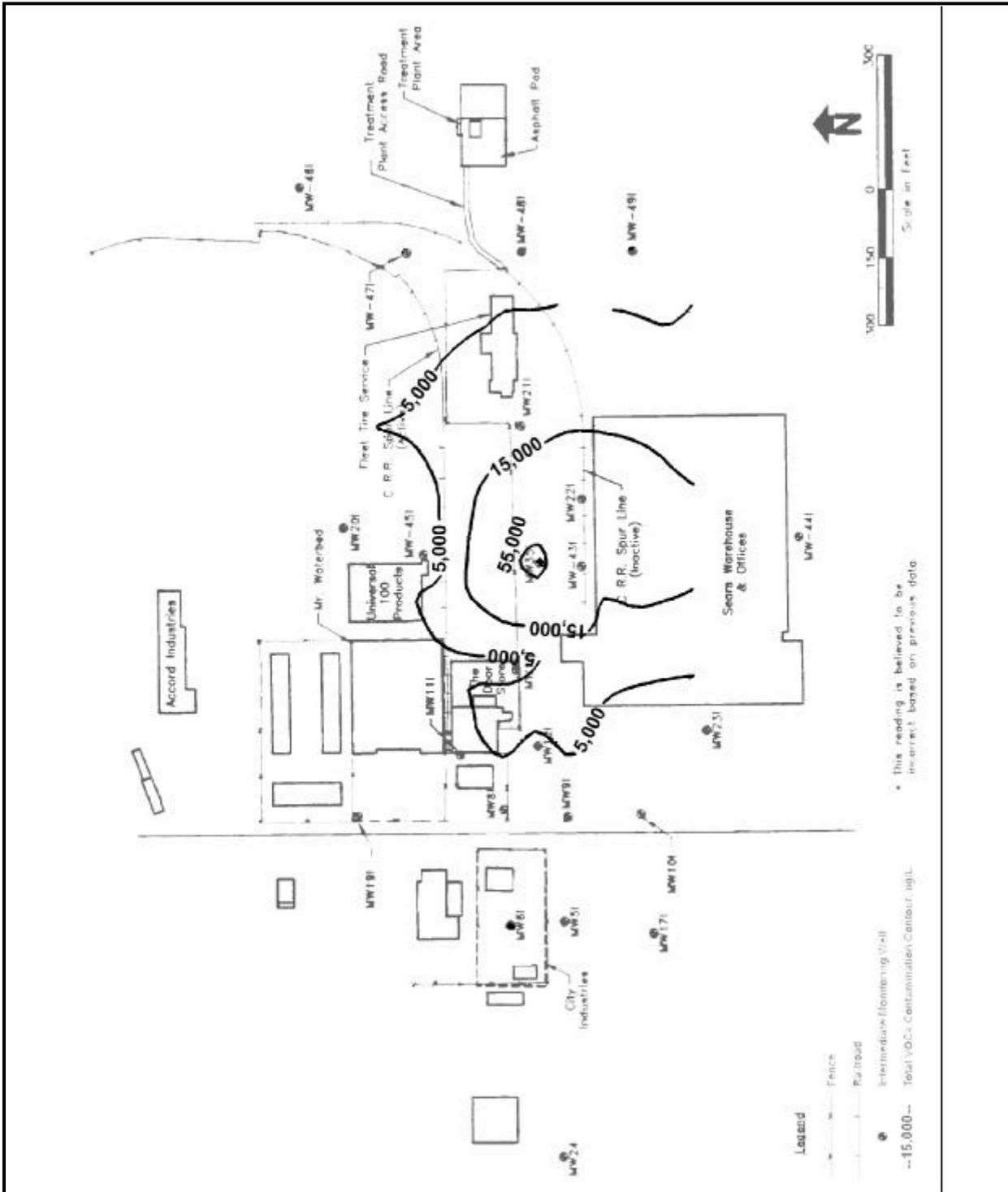


Figure 4. Total VOCs in Intermediate Zone Monitoring Wells, August 1996 [2]

TREATMENT SYSTEM PERFORMANCE (CONT.)

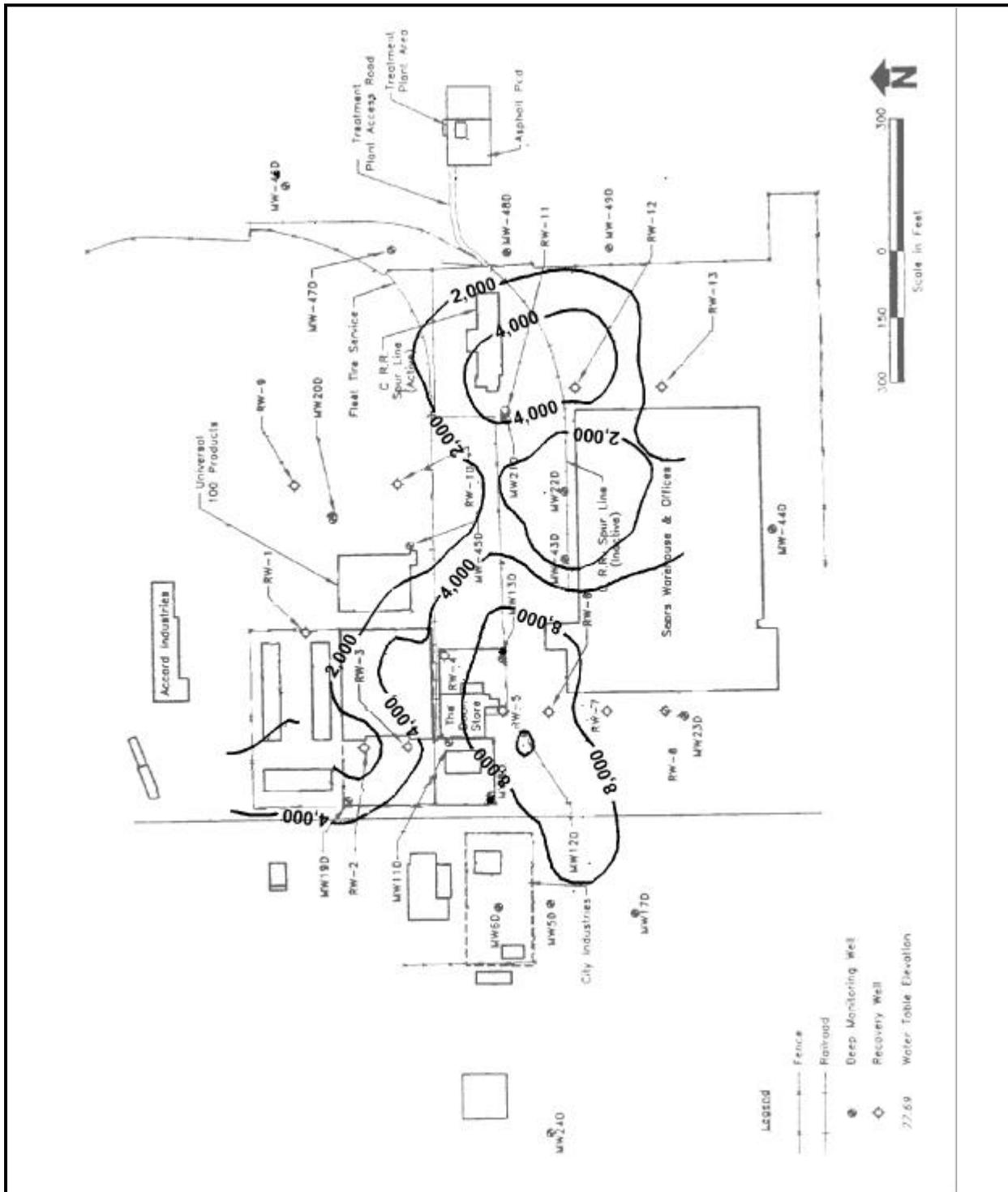


Figure 5. Total VOCs in Deep Zone Monitoring Wells, August 1996 [2]

TREATMENT SYSTEM PERFORMANCE (CONT.)

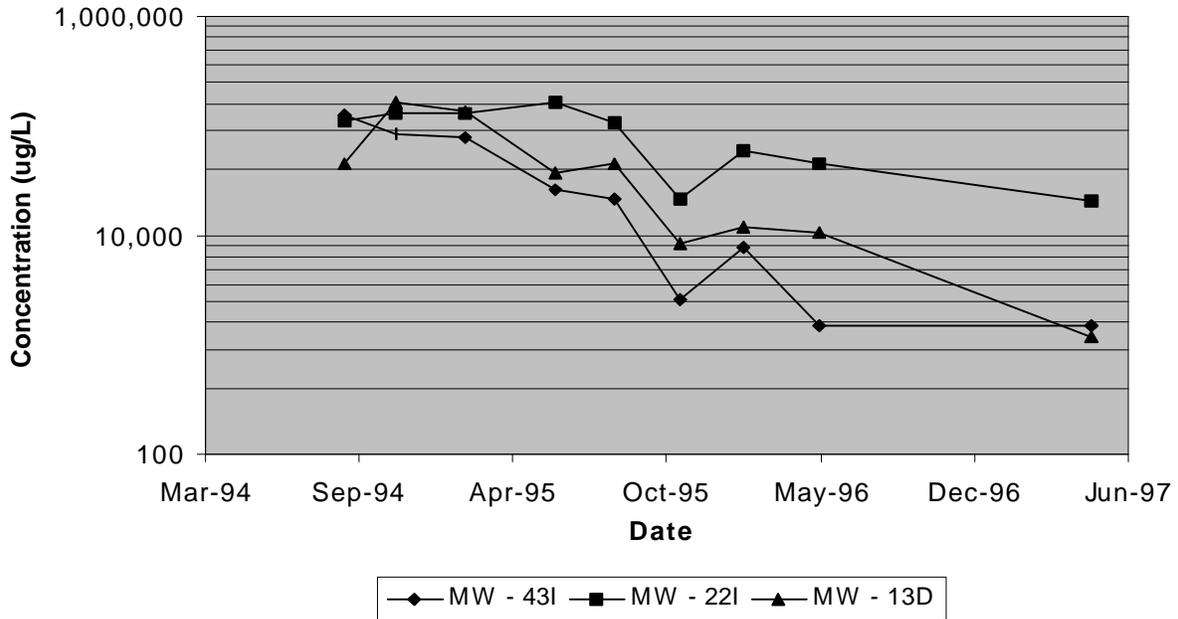


Figure 6. Total VOCs Concentrations in Highly Contaminated Wells, May 1994 through May 1997 [2,5,6,9]

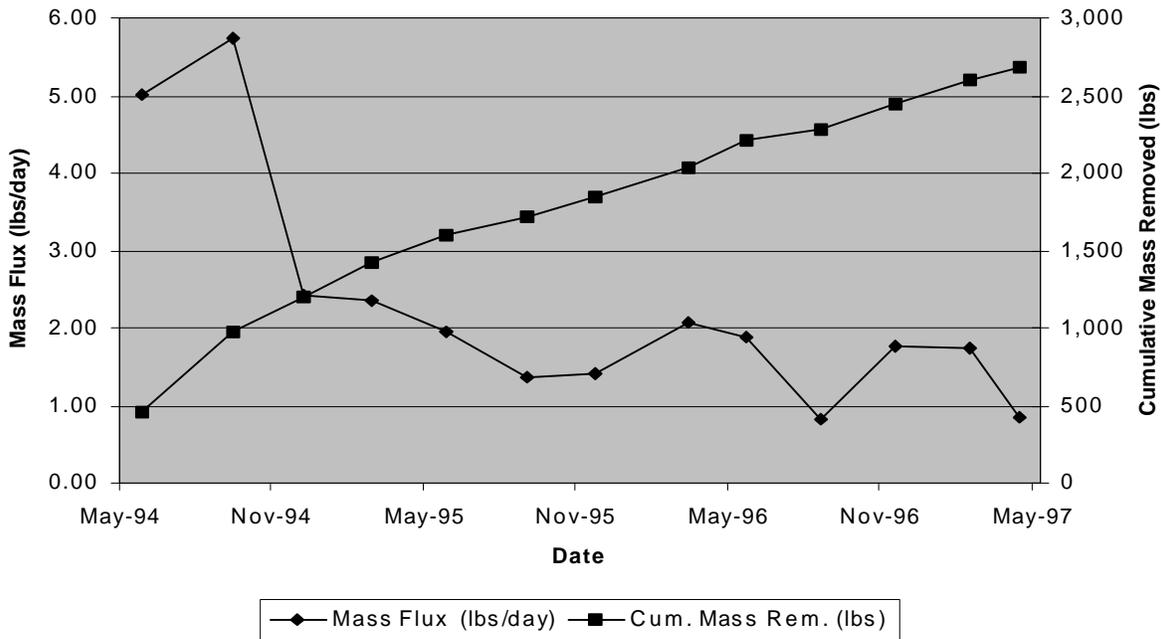


Figure 7. Mass Flux and Cumulative Mass Removal, June 1994 through May 1997 [2,6,9]



TREATMENT SYSTEM PERFORMANCE (CONT.)

Performance Data Completeness

- Monthly data for contaminant concentrations in monitoring and recovery wells are available for June 1994 through May 1996 in the Interim Long-Term Remedial Action Report. Quarterly data for contaminant concentrations in monitoring and recovery wells are available in monthly reports from the site operators for September 1996 through September 1997. At the time of preparation of this report, the site contact (the EPA RPM) had not received reports past May 1997. For the analyses in this report, including the average concentrations of total VOCs shown in Figures 3 and 6, quarterly data were used from June 1994 through May 1996 and annual data were used from May 1996 through May 1997.
- For Figure 3 analyses, the average concentration of total VOCs was calculated using a geometric mean of contaminant concentrations in wells within the initial contaminant plume. A geometric mean was used to show the trend of contaminant levels across the site. Where contaminant levels were below detection limits, half of the detection limit was used.
- Monthly data regarding contaminant removal through the treatment system are available for June 1994 through May 1997 in the Monthly Operations and Maintenance Reports. For the mass removal analyses in Figure 7 of this report, quarterly data were used from June 1994 through May 1997.

Performance Data Quality

The QA/QC program used throughout the remedial action met the EPA and the State of Florida requirements. All monitoring was performed using EPA-approved methods, and the site contact did not note any exceptions to the QA/QC protocols.

TREATMENT SYSTEM COST

Procurement Process

EPA contracted with Peer Consultants, P.C. to design the groundwater extraction and treatment system. EPA awarded the construction, startup and O&M (2-year base period) contract to ERM-EnviroClean, Inc. FDEP was the lead agency until 1989, at which time EPA took over the lead and maintained responsibility for operation and maintenance of the treatment system.

Cost Analysis

All costs incurred for remedial activities at this site were borne by Potentially Responsible Parties (PRPs).



TREATMENT SYSTEM COST (CONT.)

Capital Costs [4]

<u>Remedial Construction</u>	
Mobilization and Preparatory Work	\$174,700
Site Work	\$68,100
Well Installation, Instrumentation, and Piping	\$559,140
Install Well Manholes	\$13,700
Air Stripper	\$202,060
Effluent Pipeline	\$27,100
Demobilization	\$50,000
Total Construction	\$1,094,800

Operating and Maintenance Costs [4,5]

5/94 - 4/95	\$186,250
5/95-4/96	\$186,250
5/96-5/97	\$133,295
Total O&M	\$505,795

Other Costs [4]

<u>Remedial Design</u>	
Remedial Design	\$190,234
Preparatory Work	\$90,494
Tank Removal	\$74,377
Field Data Development	\$147,922
Treatability Studies	\$38,979
Closeout	\$5,619
Remedial Oversight	\$34,913
Total Design	\$582,538
EPA Personnel	\$99,675

Cost Data Quality

Capital and operations and maintenance cost data were supplied in a 1994 Cost Study of the site, originated from the treatment vendor, and were updated by the RPM.

OBSERVATIONS AND LESSONS LEARNED

- Approximate costs for the P&T system at this site were \$1,674,800, consisting of \$1,094,800 in capital costs and \$580,000 in cumulative operating and maintenance costs through May 1997, which corresponds to \$590 per pound of contaminants removed and \$10.60 per 1,000 gallons of groundwater treated.
- Total concentrations of VOCs have declined 86% at this site, but remain above cleanup goals.
- The mass flux rate illustrated in Figure 6 is more constant over time than at many P&T sites. The hydrogeology at the site is relatively simple and hydraulic conductivity is relatively high compared to typical hydraulic conductivities [7]. In addition, no pure phase, or nonaqueous phase liquid (NAPL), has been detected at the site [5].
- Given the matrix of contaminants at this site, there is potential for cometabolic degradation. Cometabolic degradation of TCE, DCE, and vinyl chloride is supported in the presence of aromatic compounds, such as toluene [8].
- Based on conversations with the RPM for the site, contaminant levels in late 1997 and 1998 at the site are lower than the May 1997 monitoring data.



OBSERVATIONS AND LESSONS LEARNED (CONT.)

- The site contractor did not anticipate biofouling in the air stripper in the design. According to the contractor, design specifications assumed a different temperature and alkalinity for the groundwater from actual conditions. Chlorine treatment was found to alleviate biofouling and the system has been operational 90% of the time.
- The RPM also indicated that the P&T system has lowered contaminant concentrations in extracted water to levels below effluent NPDES requirements. Thus, in the near future, the extracted water may be discharged directly to the POTW and treatment will not be necessary.

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Analysis Preparation

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