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Remediation System Evaluation (RSE)

Alaric, Inc. Superfund Site

Tampa, Florida

REMEDIATION SYSTEM EVALUATION

ALARIC, INC. SUPERFUND SITE
TAMPA, HILLSBOROUGH COUNTY, FLORIDA

Report of the Remediation System Evaluation
Site Visit Conducted at the Alaric, Inc. Superfund Site
April 29, 2009

Revised Report
January 27, 2010

NOTICE

Work described herein was performed by GeoTrans, Inc. (GeoTrans) for the U.S. Environmental Protection Agency (U.S. E.P.A). Work conducted by GeoTrans, including preparation of this report, was performed under Work Assignment #48 of EPA contract EP-W-07-078 with Tetra Tech EM, Inc., Chicago, Illinois. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

EXECUTIVE SUMMARY

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

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

Another category related to sustainability and integrating renewable energy has also been added.

The recommendations are intended to help the site team identify opportunities for improvements. In many cases, further analysis of a recommendation, beyond that provided in this report, may be needed prior to implementation of the recommendation. Note that the recommendations are based on an independent evaluation by the RSE team, and represent the opinions of the RSE team. These recommendations do not constitute requirements for future action, but rather are provided for the consideration of all stakeholders.

The Alaric Site is located in the Orient Park neighborhood at 2110 North 71st Street in Tampa, Hillsborough County, Florida. The Site was undeveloped prior to 1973 and, thereafter, operated as a number of businesses. Tetrachloroethene (PCE), trichlorothene (TCE), and other chlorinated hydrocarbons were detected in soil and ground water in 1986. An Interim Action Record of Decision (IA ROD) was signed in July 2002 specifying excavation, in-situ treatment with chemical oxidation, and pump and treat (P&T). Despite these soil and source zone remediation activities, contamination remains. At the time of the RSE site visit, the only operating remedy was the P&T system in the intermediate zone. Additional investigation and feasibility analyses are underway for selection of the final site-wide remedy. This RSE focuses on the effectiveness of previously conducted shallow zone remediation and implications for potential additional shallow zone remediation, the effectiveness and efficiency of the IZ P&T system, and an analysis of the October 2008 Technical Memorandum regarding final remedy selection.

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

Recommendations are provided in all four primary categories: effectiveness, cost reduction, and technical improvement and analysis is provided related to integrating renewable energy. The recommendations for improving system effectiveness are as follows:

- Conservatively establish a buffer zone when communicating the extent of ground water contamination to the State, so that the State uses this conservative extent when placing ground restrictions in the area.

- Periodically analyze the P&T process water for constituents from the plume emanating from the neighboring Helena Chemical Site.

- Simplify the process controls to facilitate repairs and reduce downtime.

- Monitor the specific capacity in the recovery wells to forecast potential problems with well fouling.

- Interpret the capture zone of the P&T system.

Recommendations for cost reduction include the following:

- Modify the VOC treatment to reduce electrical usage and fouling of the injection well.

- Consider discharging treated water to the shallow zone to facilitate addressing fouling issues and to eliminate potential concerns of discharging contaminants to the Floridan aquifer.

- Characterize the GAC again in the future to confirm that the detected radioactivity is a one-time occurrence so that the GAC can be regenerated rather than disposed of as hazardous waste.

- Track routine O&M costs separately from non-routine costs so that routine costs can be better controlled.

The cost savings from these recommendations are modest, resulting in approximately $14,000 per year in savings.

The recommendation for technical improvement is focused on evaluating potential repairs that have been suggested by the site contractor. The recommendations for site closure are a compilation of considerations for selecting the final remedy. Cost and environmental footprint analysis is provided for several remedial options.

Tables summarizing the recommendations, including estimated costs, savings, and effects on sustainability associated with those recommendations, are presented in Section 6.0 of this report.

PREFACE

This report was prepared as part of a project conducted by the United States Environmental Protection Agency Office of Superfund Remediation and Technology Innovation (U.S. EPA OSRTI) in support of the "Action Plan for Ground Water Remedy Optimization" (OSWER 9283.1-25, August 25, 2004). The objective of this project is to conduct Remediation System Evaluations (RSEs) at selected pump and treat (P&T) systems that are jointly funded by EPA and the associated State agency. The project contacts are as follows:

Organization	Key Contact	Contact Information
U.S. EPA Office of Superfund Remediation and Technology Innovation (OSRTI)	Jennifer Hovis	USEPA Headquarters – Potomac Yard 2777 Crystal Drive Arlington, VA 22202 phone: 703-603-8888 hovis.jennifer@epa.gov
Tetra Tech EM, Inc. (Contractor to EPA)	Elizabeth Powell	Tetra Tech EM Inc. 1881 Campus Commons Drive, Suite 200 Reston, VA 20191 phone: 703-390-0616 Elizabeth.Powell@ttemi.com
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1.0 INTRODUCTION

1.1 PURPOSE

During fiscal years 2000 and 2001 independent reviews called Remediation System Evaluations (RSEs) were conducted at 20 operating Fund-lead pump and treat (P&T) sites (i.e., those sites with pump and treat systems funded and managed by Superfund and the States). Due to the opportunities for system optimization that arose from those RSEs, EPA OSRTI has incorporated RSEs into a larger post-construction complete strategy for Fund-lead remedies as documented in *OSWER Directive No. 9283.1-25, Action Plan for Ground Water Remedy Optimization*. A strong interest in sustainability has also developed in the private sector and within Federal, State, and Municipal governments. Consistent with this interest, OSRTI has developed a Green Remediation Primer (http://cluin.org/greenremediation/) and as a pilot effort now considers green remediation during independent evaluations.

The RSE process involves a team of expert hydrogeologists and engineers that are independent of the site, conducting a third-party evaluation of the operating remedy. It is a broad evaluation that considers the goals of the remedy, site conceptual model, available site data, performance considerations, protectiveness, cost-effectiveness, closure strategy, and sustainability. The evaluation includes reviewing site documents, potentially visiting the site for one day, and compiling a report that includes recommendations in the following categories:

- Protectiveness
- Cost-effectiveness
- Technical improvement
- Site closure
- Sustainability

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

The Alaric, Inc. Superfund Site was selected by EPA OSRTI based on a nomination from EPA Region 4. The Site is located in Tampa, Florida. The P&T system is an interim remedy implemented in accordance with a 2002 Interim Action Record of Decision. The interim remedy was initiated in 2004. The site team requested an RSE to evaluate the costs associated with the interim remedy and to provide an analysis of the Technical Memorandum Remedial Alternative Screening that was recently prepared in association with developing a final remedy for the Site.

1.2 TEAM COMPOSITION

The RSE team consists of the following individuals:

Name	Affiliation	Phone	Email
Doug Sutton	GeoTrans, Inc.	732-409-0344	dsutton@geotransinc.com
Peter Rich	GeoTrans, Inc.	410-990-4607	prich@geotransinc.com

In addition, the following individuals from EPA Headquarters participated in the RSE site visit.

- Jennifer Hovis
- Jennifer Edwards
- Chip Love

1.3 DOCUMENTS REVIEWED

The following documents were reviewed. The reader is directed to these documents for additional site information that is not provided in this report.

- Interim Action Record of Decision – July 2002
- Remedial Design Report, Shaw Environmental – September 2003
- Helena Chemical Five Year Review – January 2006
- Remedial Action Report – March 2006
- Technical Proposal, Air Emissions Modifications, GR&T Systems, Shaw Environmental – June 2007
- Optimization Report, Fouling Issues, Shaw Environmental – July 2007
- Monthly Operating Reports, Shaw Environmental – May 2007 to September 2008
- Alaric Five Year Review – May 2008
- Remedial System Performance Evaluation, EPA ORD – June 2008
- Phase II Remedial Investigation Report, Revision 0, Intermediate Water Bearing Zone, Black & Veatch – October 2008
- Technical Memorandum, Remedial Alternative Screening, Revision 0, Black & Veatch – October 2008
- Tampa Electric Company 2006 – 2008
- Alaric Feasibility Study Remedy Review Meeting – April 2009
- Equipment Inspection and Photo Documentation – May 2009
- Process and Instrumentation Diagrams

1.4 PERSONS CONTACTED

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

Name	Affiliation	Phone	Email
Galo Jackson	U.S. EPA Region 4 (RPM)	404-562-8937	jackson.galo@epamail.epa.gov
Chris Strzempka	Shaw Environmental		

1.5 BASIC SITE INFORMATION AND SCOPE OF REVIEW

1.5.1 LOCATION

The Alaric Site is located in the Orient Park neighborhood at 2110 North 71st Street in Tampa, Hillsborough County, Florida. Figure 2-1 of the October 2008 Remedial Alternative Screening Technical Memorandum (October 2008 Technical Memorandum), which is provided in Attachment A of this report, is an aerial photograph of the area and indicates the Site location along with other notable features in the area. Figure 2-3 of the same report (see Attachment A) is an aerial photograph of the Site and the neighboring properties. The Alaric Site is accessed by 71st Street along the eastern property edge. The property includes a rectangular building (Alaric building) approximately 50-foot by 100-foot and an abutting 40-foot by 25-foot remedial equipment building for the interim remedy. An asphalt covered parking area is located north of the building. A limestone gravel surface covers the area northwest and west of the building. The ground surface south of the Site building is grass covered soil. Utilities servicing the property include overhead electric and communications, and underground municipal water. Industrial properties surround the Site towards the east, west, and north. A sparsely wooded lot owned by Helena Chemical is located south of the Site, followed by a CSX railroad easement trending towards the east and west.

1.5.2 SITE HISTORY, POTENTIAL SOURCES, AND RSE SCOPE

According to the October 2008 Technical Memorandum, the Site was undeveloped prior to 1973 and, thereafter, operated as a number of businesses. Operations between 1978 and 1981 included manufacturing, repairing, and refinishing concrete mixing equipment. Degreasing agents were reportedly used, and the west and south sides of the property reportedly included spray-down areas (e.g., suspected solvent source areas). From 1981 until 1992, Alaric, Inc. operated a plastics recycling business at this location. The exact nature of the Alaric operation is unknown, but it has been reported that PCE was stored in a bulk tank on-site for the purpose of removing paints from plastics prior to recycling. Other businesses with different operations occupied the facility after this period.

Tetrachloroethene (PCE) and trichloroethene (TCE) were detected in ground water in an on-site private well (MW008) in 1986. The Florida Department of Environmental Protection (FDEP) initiated assessment and investigation activities in 1988, and EPA began a Remedial Investigation in 1997. An Interim Action Record of Decision (IA ROD) was signed in July 2002 specifying the following interim action remedy components:

- Excavation, removal, and off-site disposal of the shallow subsurface soil contamination, septic tank and drain field
- Treatment of the deeper contaminated soils below the water table using in-situ chemical oxidation (ISCO)
- Treatment of contaminated ground water from the surficial and intermediate aquifers by pumping and treating (P&T)

Additional investigations were conducted in late 2002 to support the design basis of the interim remedy.

According to the 2008 Five-Year Review, approximately 562 tons of solvent-contaminated soils were excavated, categorized as non-hazardous, and disposed of at a permitted landfill. Consistent with the IA ROD, the maximum depth of contaminated soil excavation was to the depth of the water table (approximately 3 feet below ground surface). During this period, the septic tank and related drain field components were replaced. Soil contamination identified under the building during the septic tank replacement was left in place for treatment during the ISCO applications.

ISCO treatment occurred in two separate phases. The first phase included injection of potassium permanganate through a surficial aquifer P&T system. The extracted water was treated and used for make-up water for the potassium permanganate, which was injected into the reinjection wells. The system operated for a total of 377 days between September 2003 and October 2004. Over 220,000 pounds of potassium permanganate was injected, substantially reducing soil concentrations in the surficial aquifer. The second phase of ISCO was conducted with sodium permanganate in two rounds, one from December 2006 through January 2007 and another in late February 2007. The sodium permanganate solution, mixed with potable water, was gravity fed to the surficial aquifer through two PVC galleries. Approximately 6,000 pounds of sodium permanganate was added in the source area to the southeast of the Alaric building. Due to concern regarding the effectiveness of the second phase of ISCO, limited soil excavation (under 30 cubic yards of soil) was conducted in Spring 2008 with the excavated material disposed of off-site.

Despite soil and source zone remediation in the surficial aquifer, the site conceptual model continues to include dense non-aqueous phase liquid (DNAPL) in the intermediate zone between the surficial aquifer and the Floridan aquifer, which will provide an ongoing source of dissolved ground water contamination.

P&T in the surficial aquifer operated into July 2008, and a intermediate zone (IZ) P&T system continues to operate. This RSE focuses on the following items:

- The effectiveness of previously conducted shallow zone remediation and implications for potential additional shallow zone remediation
- The effectiveness and efficiency of the IZ P&T system
- An analysis of the October 2008 Technical Memorandum

1.5.3 HYDROGEOLOGIC SETTING

The hydrogeologic setting for the Site contains two separate aquifers: the surficial aquifer and the Floridan aquifer. The surficial aquifer consists of undifferentiated sand and silt and is an unconfined aquifer of variable thickness and lateral discontinuity throughout the region. The surficial and Floridan aquifers are separated by the semi-confining Hawthorn Group (identified at the Site as the Intermediate Zone or IZ), and are locally interconnected by sinkholes and leaky and discontinuous portions of the IZ. Descriptions of these formations and ground water flow within them are as follows:

Shallow Zone: The shallow zone corresponds to the unconfined surficial aquifer, which is recognized by undifferentiated sand and silty sand from the land surface to the top of an underlying semi-confining zone. At Alaric, the surficial aquifer is 10 to 20 feet thick. The undifferentiated silty sands of the surficial aquifer lie unconformably on the top of the undulatory surface of the semi-confining clay. Regionally, the surficial aquifer is not considered an important water supply but can sustain yields under 10 gpm for domestic, commercial, and community water supplies. A potentiometric surface map generated from water levels collected in December 2002 under non-pumping conditions indicate semi-radial flow in the shallow zone from a locally high ground water elevation in the northeastern corner of the former Alaric property (Figure 3-4 of the October 2008 Technical Memorandum, see Attachment A). Based on this potentiometric surface map, ground water along the eastern portion of the former Alaric property flows to the south, ground water in along the northern portion of the property flows to the west, and areas in between indicate a transition from southerly to westerly flow.

Upper Intermediate Semi-Confining Zone (UIZ): The top of the semi-confining zone immediately beneath the surficial aquifer consists of clay-rich deposits of the Bone Valley Member, which is included within the Hawthorn Group (primarily mixtures of clay, sand, and limestone). At the Site, the Bone Valley Member is approximately 10 to 25 feet thick (e.g., from approximately 12 to 35 feet below ground surface) and is easily recognized by its characteristic greenish-gray and occasional bluish-gray to brownish-gray color. Insufficient consistent information for the UIZ is available to develop a useable potentiometric surface map for this interval. The 2008 Technical Memorandum concluded that the UIZ presumably does not have sufficient soil moisture and connected porosity to function by definition as an aquifer. The hydraulic conductivity for the UIZ is considered to be generally less than 1 foot per day.

Middle and Lower Intermediate Semi-Confining Zone (MIZ and LIZ): The Tampa Member of the Hawthorn Group underlies the Bone Valley Member clay in the Tampa area. At the Site, the Tampa Member is primarily a mixture of gray gravelly calcareous clay with some competent limestone/dolomite. At least some of the gray clay also has properties of a semi-confining unit (similar to the overlying greenish-gray clay). The Tampa Member exists from approximately 35 to 80 feet below ground surface, although the unit may extend another 20 feet or so because of the lack of data between 80 and 100 feet below ground surface. The bulk of the clay-rich soil in the IZ contains little moisture, although discrete thin zones of saturation (0.1 to 2.0-ft thick) with sand and/or gravel in the clay. Within the lower portion of the IZ, limestone interbedded in the clay is believed to contain localized solution channels that also contribute to the distribution of ground water. Potentiometric surface maps from May and September 2007 indicate that ground water flow in the MIZ and LIZ are southeast and south-southeast, respectively, with an approximate hydraulic gradient of 0.007 feet per foot. This is in the direction of the Tampa Bypass Canal, the location of which is depicted in Figure 2-1 of the October 2008 Technical Memorandum (see Attachment A). The results of pumping tests in 2002 and 2008 reportedly indicate hydraulic conductivities of 1.5 to 6.1 feet per day for the MIZ and 3.0 to 7.1 feet per day for the LIZ.

Upper Floridan Aquifer: Consists of any ground water in competent limestone units within the upper Floridan aquifer, as monitored by the five wells screened below 110 feet below ground surface. Based on regional studies, this interval is comprised of Suwannee Limestone (poorly to well-cemented limestone, with clay zones and thin chert beds). This boundary is imprecise, and has been designated to occur at approximately 85 feet below ground surface at the Site. Regionally, the Floridan aquifer is a highly productive aquifer and is the principal water supply source for the Tampa area. The aquifer is over 3,000 feet thick in the Tampa area and has a transmissivity ranging from 250,000 to over 1,000,000 square feet per day.

Figure 3-2 from the October 2008 Technical Memorandum (see Attachment A) provides an indication of Site stratigraphy, and the following table from the same document summarizes key hydrogeological information for the shallow zone (SA in the table) and the intervals of the IZ.

Property		**Hydrogeologic Zone**				**Comment**
		SA	**UIZ**	**MIZ**	**LIZ**	
Hydraulic Conductivity, K (average)		20 to 30 ft/day	-	~1.5 to 3.0 ft/day	~3.0 to 6.1 ft/day	Injection tests (SA); aquifer pumping tests (MIZ + LIZ)
Potentiometric Surface		~0.5 to 5 ft bls	~3 to 14 ft bls	~6 to 14 ft bls	~7 to 18 ft bls	2002 - 2007
Storage Coefficient (dimensionless)		-	-	~0.0002-0.0019	~0.0004-0.0062	Pumping Tests
Assumed Porosity		0.25	0.35-0.45			Based on Driscoll (1986); IZ porosity is variable with lithology
Horizontal Gradient		0.0005-0.003 W to SW	-	0.003-0.01 SE	0.004-0.011 SSE	ft/ft
Vertical Gradient		-0.13 to -0.22 (ft/ft) (SA to MIZ)	-	-0.005 to -0.027 (ft/ft, down)		-0.06 to -0.11 ft/ft gradient from LIZ to Deep Zone
Average Linear Velocity	ft/day	0.04 to 0.36	-	0.01 to 0.17		Assuming average porosity
	ft/year	14 to 131	-	4 to 62		Assuming average porosity
2008 Pumping Test						
Hydraulic Conductivity, K (average)		-	-	5.1 to 6.1	7.1	RW-I3 pumping test
Transmissivity (ft2/day)		-	-	128 to 154	143	Two MIZ wells and one LIZ well
Storage Coefficient (dimensionless)		-	-	0.001	0.0003	Two MIZ wells and one LIZ well

** bls = below land surface*

1.5.4 Potential Receptors

According to the October 2008 Technical Memorandum, appreciable ecological risks were not identified for the Site. Rather, the focus is on protecting human health. The Floridan aquifer is a primary source for drinking water in the Tampa area; therefore, protection of the Floridan aquifer is a high priority. Contaminated ground water poses a potential risk due to the potential for direct contact by construction workers, for vapor intrusion in surrounding businesses and homes, and to potential domestic supply wells in the vicinity of the Site. No specific reference to local ground water use was mentioned during the RSE process. A well survey was conducted in 1986 and reportedly found that all water in the area was provided by the public water supply system.

1.5.5 Description of Ground water Plume

The ground water plumes for PCE, TCE, *cis* 1,2-dichlorothene (*cis*1,2-DCE), and vinyl chloride in the shallow zone (April 2007) and the IZ (2007/2008) are illustrated in Figures 2-6 of the 2008 Remedial Investigation and Figures 3-11, 3-12, and 3-13 of the October 2008 Technical Memorandum (see Attachment A). Additional shallow zone sampling was conducted in Spring 2009. The results and the implication of these results are discussed in Section 4.2.2 of this report along with interpretations of contaminant distribution in the IZ.

The October 2008 Technical Memorandum states that the preponderance of evidence supports the occurrence of DNAPL at the Alaric Site, although it is restricted to a twenty foot radius. The highest PCE soil concentration (3,010 mg/kg) in the entire IZ occurred in clay-rich soil in SB-56 at 11.8 feet below ground surface in 2003 corresponding to approximately 0.5 feet beneath the top of the UIZ. SB-137 had a concentration of 810 mg/kg at 49 feet below ground surface. In addition, prior to the ISCO treatment of the surficial aquifer, actual DNAPL ganglia were reportedly observed in the overlying silty sand within this same boring. Finally, DNAPL is also evidenced by high PCE ground water concentrations in the MIZ/LIZ. For example, PCE has been detected at 100 mg/L in MIZ well MW069 (about 66% of PCE’s solubility of 150 mg/L), and at 36 mg/L in LIZ well MW068 (about 24% of solubility). The October 2008 Technical Memorandum estimates that the total mass of PCE, TCE, cis 1,2-DCE, and vinyl chloride in soil and ground water is just under 1,400 pounds as summarized in the following table from the October 2008 Technical Memorandum.

Combined Mass Estimate				
Contaminated Media Zone	Source Zone A (SZA)	Source Zone B (SZB)	High Concentration Plume (HCP)	Dilute Plume (DP)
Intermediate Zone Impacted	UIZ MIZ	MIZ	UIZ MIZ LIZ	UIZ MIZ LIZ
Depth Interval (ft bls)	~12 to 35	~35 to 60	~12 to 75	>12 to 80
Estimated Soil Volume (yd^3)	~2,140	~820	~2,200	~35,720
Estimated Ground water Volume (gals)	~151,600	~58,100	~2,175,500	~7,215,600
DNAPL	Yes[1]	Yes[1]	No	No
Defining Soil Concentration Range (µg/kg)	>5,000	>5,000	300 – 5,000	30 – 3,000
Defining Ground water Concentration Range (µg/L)	-	-	3,000 – 10,000	<300
Soil Analytical Mass (lbs)[2]	192	43	16 (>1,000 µg/kg)	NE
Soil Equilibrium Partitioning Mass (lbs)	NE	NE	485	378
Ground water Analytical Mass (lbs)	13	70	125	60
Total Mass (lbs)	**205**	**113**	**626**	**438**
Percent total Mass	14.8%	8.2%	45.3%	31.7%

[1]DNAPL presumed or inferred
[2] Soil analytical mass contains DNAPL mass in theory, but could be underreported.
NE = not evaluated
ft bls = feet below land surface; yd^3 = cubic yards; gals = gallons; lbs=pounds; µg/kg = micrograms per kilogram; µg/L = micrograms per liter

2.0 SYSTEM DESCRIPTION

Two P&T systems are currently installed at the Site as part of the interim remedy specified in the 2002 IA ROD. The shallow zone P&T system was activated in September 2003 and was used for the first phase of ISCO injections. ISCO injections were discontinued in October 2004. The system continued to operate until it was shut down in July 2008 to observe plume behavior after the limited source excavation conducted during Spring 2008. The IZ P&T system was also activated in September 2003 and operation continues.

2.1 EXTRACTION SYSTEM

2.1.1 SHALLOW ZONE EXTRACTION AND REINJECTION SYSTEMS

The shallow zone extraction system (which no longer operates) addressed two plumes, one emanating from the northwestern portion of the property and one emanating from the southeastern portion of the property. Four recovery wells are located near the northwestern plume. For the southeastern plume, the extraction system is a series of three rows/trenches of well points oriented perpendicular to ground water flow along the length of the shallow zone plume as depicted in Figure 2-6 of the October 2008 Remedial Investigation (see Attachment A). The reinjection system (which also no longer operates) is comprised of two rows/trenches of well points located between the extraction "trenches" to inject/mobilize permanganate and to separate "exfiltration" galleries to otherwise discharge treated water. Extraction is performed via an eductor system comprised of the following components:

- Feed tank
- Two 15 HP pumps (that alternately operate)
- Drop tubes with valves and pressure gauges in each well point
- Eductor for each well point
- Piping and manifold vaults

In addition to the injection points and "exfiltration" galleries, the reinjection system consists of a 10 HP effluent pump, valves, and piping.

During operation, the average extraction/discharge rate was approximately 10 gpm.

2.1.2 IZ EXTRACTION AND REINJECTION SYSTEMS

The IZ extraction system consists of four recovery wells each fitted with a 0.5 HP variable speed submersible pump. The design basis suggested a total recovery rate of 11 gpm from the wells; however, pumping from one of the recovery wells has been discontinued to prevent drawing in the plume from the neighboring Helena Chemical Site and/or pulling contamination down from overlying zones. Reinjection is accomplished through a 6-inch injection well installed into the Floridan aquifer. The system has typically operated at approximately 8 gpm but at the time of the RSE site visit the extraction rate was approximately 4 gpm.

2.2 TREATMENT SYSTEM

2.2.1 SHALLOW ZONE SYSTEM

The shallow zone treatment system (not currently operating) consists of the following components:

- 1.5 HP feed pump
- Two bag filter units arranged in parallel
- Two 1500-pound granular activated carbon (GAC) units arranged in series
- four-tray ShallowTray 2641 tray stripper with a 7.5 HP blower
- 10 HP effluent pump

2.2.2 IZ SYSTEM

The IZ treatment system consists of the following components:

- Three 1,000-pound granular activated carbon (GAC) units arranged in series
- QED EZ Stacker 2.3P three-tray air stripper rated for 1 to 25 gpm with a 2 HP blower
- 1.5 HP feed pump
- Two bag filter units arranged in parallel

2.3 MONITORING PROGRAM

Ground Water Monitoring

There is no formal ground water monitoring program with a set number of wells and set frequency. Most recent sampling has been conducted to either evaluate the effects of source remediation in the shallow zone or as part of the final Remedial Investigation for the Site initiated in 2007.

Process Monitoring

Process monitoring for the shallow zone system was discontinued when system operation was discontinued in July 2008. Intermediate process monitoring includes VOC analysis for samples collected from each of the three operating recovery wells, influent to each of the GAC units, air stripper influent, air stripper effluent, and bag filter (system) effluent on a quarterly basis.

3.0 SYSTEM OBJECTIVES, PERFORMANCE, AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The IA ROD for the Alaric Site identified the following Remedial Action Objectives (RAOs):

- Treat and-reduce concentrated source materials (in soil) below the water table to a total chlorinated VOC concentration ranging from 100 ug/kg to 1,000 ug/kg.
- Remove VOC contaminated soils in the unsaturated zone in the vicinity of the septic system drain field and other related areas for off-site disposal.
- Contain, collect, treat, and dispose of VOC-contaminated ground water.
- Perform this work in a manner that is compatible with the ground water remediation planned for the Helena Chemical Superfund Site.

The IA ROD stated "that implementation of this IRA should reduce the amount of future loading of contaminants from the source materials to the ground water, contain the horizontal and vertical migration of the ground water plume, and reduce the total mass of contaminants in the ground water. Remedial components specified in the IA ROD were not intended to restore the aquifer nor to attain the MCLs.

A Final Remedial Investigation has been completed and the October 2008 Technical Memorandum has screened potential remedial options for the Site. The table on the following page, from the October 2008 Technical Memorandum, summarizes cleanup standards that would apply to the Site and also includes standards for co-mingled contaminants from the neighboring Helena Chemical Superfund Site that are not specific chemicals of concern for the Alaric Site.

3.2 TREATMENT PLANT OPERATION STANDARDS

The treatment standards for discharging the treated water to the Floridan aquifer reinjection well are the FDEP Groundwater Cleanup Target Levels indicated in the table on the following page.

Chemicals of Concern – Alaric Site						
Chemical	Maximum Value[1] (µg/L)	EPA MCL (µg/L)	FDEP Soil Leaching SCTL (µg/kg)	FDEP Soil Residential Direct Exposure SCTL (mg/kg)	FDEP Ground Water GCTL (µg/L)	FDEP Natural Attenuation Default Concentration (µg/L)
PCE	100,000	5	30	8.8	3	300
TCE	6,700	5	30	6.4	3	300
cis-1,2-DCE	14,000	70	400	33	70	700
Vinyl chloride	1,000	2	7	0.2	1	100
Manganese	860	none	SPLP	3,500	50	500
Co-Mingled COCs from Helena Chemical						
Sulfate	1,300,000	-	-	-	250,000*	-
Iron	15,000	-	SPLP	53,000	300*	3,000
Arsenic		10	SPLP	2.1	10	500
Chromium (total)	7	100	38,000	210	100	1,000
Nickel	29	-	130,000	340	100	1,000
Alpha - BHC	0.550	-	0.3	0.1	0.006	0.6
Beta - BHC	0.31	-	1	0.5	0.02	2
Delta - BHC	0.28	-	200	24	2.1	21
Gamma - BHC	0.014	-	9	0.7	0.2	20
MCPP	62	-	0.03	64	7	700

1 Maximum value detected in IZ or Floridan aquifer
MCL = Maximum contaminant level (EPA, 2003)
* = Secondary drinking water standard
FDEP = Florida Department of Environmental Protection
SCTL = Soil Cleanup Target Level (FDEP, 2005)
GCTL = Groundwater Cleanup Target Level (FDEP, 2005)
SPLP = Synthetic Precipitation Leaching Procedure
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
BHC = hexachlorocyclohexane
MCPP = potassium salt of propionic acid

4.0 FINDINGS

4.1 GENERAL FINDINGS

The observations provided below are not intended to imply a deficiency in the work of the system designers, system operators, or site managers but are offered as constructive suggestions in the best interest of the EPA and the public. These observations have the benefit of being formulated based upon operational data unavailable to the original designers. Furthermore, it is likely that Site conditions and general knowledge of ground water remediation have changed over time.

The findings in this section are limited to the results of the shallow zone interim remediation efforts and the ongoing IZ P&T system. The performance of the shallow zone system when it operated is not discussed.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

4.2.1 PLUME CAPTURE

Plume capture in the shallow zone is not discussed because there is no active remediation occurring in this zone since the discontinuation of pumping in July 2008.

The design basis for the IZ system included ground water modeling that suggested 11 gpm would be required for plume capture. Figure K-18 from the Remedial Design (see Attachment A) suggests capture of the 1,000 ug/L plume but not necessarily complete capture of the 100 ug/L plume. A target capture zone was not specified, but given that the depicted pumping scenario was selected as the design basis, the illustrated degree of capture is apparently sufficient to meet objectives. The model calibration upon which this simulation was conducted is questionable for the IZ (referred to as the Floridan at the time of the Remedial Design). Figure K-7 from the Remedial Design (see Attachment A) plots the simulated heads against observed heads, and it is clear that the plot does not follow the intended 1:1 trend. Rather, the simulated heads are low relative to the observed heads, and simulated capture may not be accurate. Additional model development and calibration incorporating actual pumping scenarios from the recovery wells (such as comparing observed versus simulated drawdown) has not occurred since this initial effort conducted as part of the design basis.

Plume capture was evaluated by EPA Office of Research and Development (ORD) in June 2008 but did not include a review of the design basis. The average extraction rate considered during this evaluation was 8.1 gpm. The evaluation concluded that insufficient coverage of water level measurements was available to accurately interpret capture and a sufficient record of observed VOC trends in downgradient monitoring wells was not available to accurately interpret capture. Using a transmissivity of 100 ft^2/day, a hydraulic gradient of 0.01 feet per foot, and a pumping rate of 2.7 gpm, the evaluation included sample capture zone width calculations that suggested that capture in the vicinity of RW-I2 might be sufficient. The RSE team would have used the following parameters for the analysis based on the information provided in the October 2008 Technical Memorandum:

- Transmissivity - 145 ft^2/day (average of four similar values from the PS001 pumping test during design)
- Hydraulic gradient – 0.007 ft/ft
- Pumping rate (for one well) – 2.7 gpm (equal to one third of the 8.1 gpm)
- Factor to account for heterogeneity and contributions from above and below – 2.0

Based on these values and an assumed flow direction to the southeast, the estimated capture zone width using the simplified capture zone width calculation would be approximately 250 feet wide for one well, which would be sufficient to capture the portion of the 3,000 ug/L contour that is upgradient of RW-I2 and much of the 300 ug/L contour shown in Figures 3-12 and 3-13 of the October 2008 Technical Memorandum (see Attachment A). Similar extraction rates from RW-I1 and RW-I3 would likely provide capture of the 300 ug/L contour that is upgradient of the recovery wells. Some portion of the 300 ug/L contour that has already migrated downgradient of the recovery wells might not be captured. This is only one line of evidence based on a calculation that relies on many simplifying assumptions (e.g., homogeneous aquifer). Given the heterogeneity at the Site and the contributions of water to the IZ from the shallow zone, additional lines of evidence should likely be considered if capture of a specific target capture zone is stipulated.

Other potential lines of evidence include interpreting ground water flow directions from potentiometric surface maps, observing concentration trends in wells downgradient of the extraction system, and utilizing an appropriately calibrated ground water flow model. The potentiometric surface map and capture zone interpretation presented in Figure 7-10 of the October 2008 Technical Memorandum (see Attachment A) may not be a reliable line of evidence. Contrary to recent guidance (*A Systematic Approach to Evaluating Capture Zones at Pump and Treat Systems*, EPA 600-R-08-003), Figure 7-10 utilizes water levels from active extraction wells to assist in developing the potentiometric surface map. Because water levels are often substantially lower in active extraction wells than in the surrounding aquifer, using water levels from active extraction wells can lead to substantially overestimating drawdown associated with pumping. In Figure 7-10, this overestimation appears to have lead to extrapolating the 15.50-foot contour to the downgradient side of the extraction wells and establishing a ground water divide that is over 100 feet downgradient of the wells. Therefore, as it currently stands, this line of evidence is not reliable. As stated by ORD, there is also not enough of a historical ground water quality record to evaluate capture zone effectiveness based on concentration trends in downgradient wells.

The RSE team is confident that the extraction rate of 4 gpm at the time of the RSE site visit provides substantially reduced plume capture compared to that provided by an extraction rate of 8 gpm. In addition, although 8 gpm may provide adequate capture if this flow rate is maintained, it may not provide adequate capture if the flow rates are unequally distributed among the wells (RW-2 is expected to only pump 2 gpm vs. 3 gpm from RW-1 and RW-3), if the plume is not necessarily migrating to the southeast (see discussion below), if there is substantial downtime such that the average flow rate over time is much lower, or if a continuing source of dissolved phase contamination is entering the aquifer beyond the extent of the capture zone (see discussion below).

4.2.2 GROUND WATER CONTAMINANT CONCENTRATIONS

<u>*Shallow Zone*</u>

VOC data collected from shallow zone monitoring wells in Spring 2009 indicate substantial contamination remains in the shallow zone. The following results are noteworthy.

Well	PCE (ug/L)	TCE (ug/L)	*cis* 1,2-DCE (ug/L)	Vinyl Chloride (ug/L)
MW28R	14,000	3,600	1,200	38
MW047	3,200	130	190	11
MW048	15,000	350	290	<100
MW056	0.16	12	38	30
MW057	12,000	150	220	74

In addition, MW056 had total VOC concentrations over 20,000 ug/L in April 2007. Based on the location of this well approximately 120 feet from the source area, high concentrations (noted in the table above) continue to exist between the source area and this well, and given the absence of ground water remediation in the vicinity of MW056 since April 2007, the RSE team believes it is unlikely that the observed contamination has been remediated to the degree suggested in the table above. A more plausible scenario is that discontinuing pumping in the shallow zone has redirected ground water flow in the vicinity of this well and that the contamination now follows a flow path that is not intercepted by this well. Consistent with this hypothesis is an increase in the concentrations at MW027 (albeit not as large as the decrease observed at MW056), suggesting that some of the high-level contamination that previously migrated toward MW056 has been shifted toward MW027.

MW28R, MW048, and MW057 are all located in the immediate vicinity of the source area where remedial activities were previously performed. Given that VOC concentrations in these wells are comparable to the concentrations detected in 2007 and concentrations in these wells and are still in excess of 10,000 ug/L suggests that source area was not completely remediated. MW047 is located approximately 60 feet downgradient of the source area and concentrations have decreased to the above values from a total VOC concentration of 19,170 ug/L in April 2007. Given the observed 2009 concentrations in the other wells noted above, the RSE team believes that the decrease in observed concentrations between April 2007 and Spring 2009 are also potentially the result of a change in ground water flow patterns as described above for MW056.

Despite the relatively high density of wells in the shallow zone to the southwest, it does not appear that the extent of contamination in the shallow zone has been thoroughly delineated to the southwest. Prior to remediation, total VOC concentrations over 50,000 ug/L were detected as far downgradient as MW009 (over 200 feet from the source area). The concentrations in the two wells immediately side gradient of MW009 (MW051 and MW058) were substantially lower, suggesting a narrow plume. Total VOCs in MW058 did not exceed 3 ug/L and total VOCs in MW051 did not exceed 151 ug/L. RW-29, which is approximately 75 feet downgradient of MW009 had a total VOC concentration of over 9,000 ug/L before remediation, but MW052 and MW055 which are only 50 feet apart and straddle the flow path between MW009 and RW029 had historical total VOC concentrations that did not exceed 100 ug/L, confirming that the plume remains highly concentrated and narrow. MW015 and MW016, which are southwest of RW029 are also likely sidegradient of the plume core in the shallow zone. Based on the total VOC concentration of over 1,000 ug/L at MW015 in 2003 and undetectable values at MW016, it is likely that the plume migrated closer to MW015 than to MW016, but it is also likely that MW015 is not necessarily within the plume core.

Access downgradient of MW-15 is severely restricted due to industrial buildings and an active railroad. Although wells MW038, MW039, and MW040 have been installed downgradient of MW015, it is unlikely that the required density of points could reasonably be installed to find and delineate the plume in this area. Therefore, continuing uncertainty may remain about the magnitude and extent of contamination in this area and its potential to migrate downward into the IZ.

IZ

As indicated in Figures 3-6, 3-7, and 3-11 through 3-13 from the October 2008 Technical Memorandum (see Attachment A), the VOC plume in the IZ does not have a shape that would be expected based on the observed potentiometric surface. Ground water flow is to the southeast (MIZ) or south-southeast (LIZ), but total VOC concentrations exceeding 300 ug/L have been detected over 200 feet side-gradient to the southwest. The plume extent to the southwest (sidegradient to ground water flow) is greater than the plume extent in the direction of ground water flow. In addition, the plume extends to the east-southeast toward (and past) the Helena Chemical property further than it extends to the southeast or south-southeast.

The plume extent to the southwest in the IZ appears to be related to downward migration of contamination from the shallow zone. Similar to the above findings for the shallow zone, plume delineation to the southwest in the IZ also appears to be incomplete but access is difficult for a comprehensive delineation effort. The plume extent to the southeast toward the Helena Chemical property is not easily explained by the interpreted hydraulic gradient or Alaric-related contamination migrating downward from the shallow zone. One possible explanation is the orientation for the plume extent in this area is a combination of the hydraulic gradient and the orientation of the permeable zones that are present within the generally lower permeable material of the IZ. Another possible explanation is that there may be insufficient water level measurement points to the east in the shallow zone or IZ to accurately interpret the ground water flow direction. It is possible that additional water level measurements to the east of the Alaric property could result in interpreting a flow component in this direction.

Contamination exceeding the FDEP GCTL and natural attenuation criteria is also present in MW059, located in the northwest portion of the property. This contamination is presumably related to secondary source area and shallow zone contamination in this portion of the property. As of the April 2007 sampling, the VOC concentrations in the shallow zone in this area appear to have been significantly reduced to below the FDEP natural attenuation levels.

4.3 COMPONENT PERFORMANCE

The performance of the primary treatment components are discussed below. As a general note, major process equipment appears to be functioning as intended, but process instrumentation (such as flowmeters, pressure gages, etc.) and various fittings are in general disrepair and/or are missing.

4.3.1 EXTRACTION SYSTEM

The extraction system has historically maintained the design value of 8 gpm for RW-I1, RW-I2, and RW-I3 until recently. At the time of the RSE site visit, the low flow of 4 gpm was reportedly due to problems with a recovery pump fitting and the flow meters. These problems are likely easily addressed, but had not been addressed.

RW-I4 has not been operated due to concerns of pulling in contamination from the Helena Chemical Superfund Site and due to concerns of pulling contamination down from overlying formations. This reasoning is unclear. The treatment system can address the VOCs and pesticides from the Helena Chemical Site with GAC, and based on figures provided in Appendix E of the Alaric Remedial Design (see Attachment A), the Helena sulfate plume in the surficial aquifer is above the FDEP GCTL as far as RW-I1 such that it would be extracted by RW-I1, RW-I2, and RW-I3 just as easily as it would be by RW-

I4. Metals concentrations in the vicinity of the RW-I4 (see Attachment A) are low enough that they would likely not result in an exceedance of the discharge criteria if extraction was maintained at all four recovery wells. More thorough evaluation of the Helena Chemical plume in both the shallow zone and IZ is merited. Process sampling of the Alaric IZ system indicates low levels of pesticides from the Helena Chemical plume that are present in the influent but removed by the GAC. In addition, sampling associated with the reinjection well fouling analysis indicated influent sulfate concentrations of approximately 240 mg/L, which is consistent with intercepting some of the plume from the Helena Chemical Site. With regard to pulling VOC contamination down, the PCE concentrations in the LIZ are lower but comparable to those of the UIZ and MIZ in the area of RW-I4. RW-I4 screens both the MIZ and the LIZ. The concentrations in the LIZ, albeit lower than those of the MIZ and UIZ are comparable (e.g., 80,000 ug/L and 88,000 ug/L in the UIZ in 2005 and 2007, and 37,000 ug/L and 100,000 ug/L in the MIZ in 2005 and 2007 compared to 22,000 ug/L and 36,000 ug/L in the LIZ in 2005 and 2007). These concentrations in all three zones are close to the solubility of PCE (approximately 150,000 ug/L, *Groundwater Chemicals Desk Reference,* Lewis Publishers, 1989), suggesting that product and high dissolved contaminant concentrations are present in all three zones.

4.3.2 GRANULAR ACTIVATED CARBON AND AIR STRIPPER

GAC was originally included in the treatment train because it would be able to address the VOC contamination at the Alaric facility but also the pesticides and VOCs associated with the Helena Chemical plume, if those constituents were present in the process water. An air stripper was not included in the original treatment system, but was added after system operation began when influent concentrations were higher than expected. The air stripper was originally placed in front of the GAC units, which is the common approach. Although air permit conditions were met, complaints from a resident regarding potential impacts to local air quality led to moving the air stripper behind the GAC so that air emissions would be substantially reduced. The air stripper currently is able to provide polishing to the GAC effluent, especially for those compounds, such as vinyl chloride, that breakthrough quickly.

The current process is to change the GAC when there is breakthrough of any one target compound, including vinyl chloride, which breaks through significantly faster than the other target compounds. This measure of conservatism is reportedly used due to concern that the air stripper may fail and that treated water is discharged directly to the Floridan aquifer. The influent to each of the GAC units and the influent to the air stripper (i.e., the effluent from the final GAC unit) are sampled monthly to evaluate breakthrough.

Due to prior concerns regarding air quality, the emissions of VOCs from the air stripper off-gas are also calculated monthly.

No pressure gauges are currently provided on the GAC units to evaluate the pressure drop across each of the units.

The GAC and air stripper have functioned as intended; however, the GAC from a previous changeout tested positive for radioactivity, which precluded it from being regenerated. The GAC was disposed of as a hazardous waste to the EQ facility in Michigan. The radioactivity is not believed to be a site-related contaminant of concern, and is not expected to recur.

4.3.3 Bag Filters

The bag filters are intended to remove solids to prevent the reinjection well from fouling. The bag filters are changed on a weekly basis. The pressure gauges on the bag filter units do not read accurately.

4.3.4 Reinjection Well

The reinjection well has fouled repeatedly as a result of carbonate precipitation from the aeration of the process water in the air stripper. The reduced performance of the well has led to substantial system downtime, including from January 2008 to June 2008. Previous rehabilitation efforts have included acid injections and overdrilling the well.

4.3.5 System Controls

The system is controlled by a PLC with a human machine interface that allows for remote system operation and records system data every 10 minutes. Many features that are easily controlled manually are automated, and this automation (though intended to provide efficient operation) has led to many operational problems. For example, the variable frequency drives on the influent pumps have not been able to maintain a set point, and the flow rates from the wells have been controlled by throttling. The variable speed drives appeared to be off during the RSE site visit. Problems with the flow meters on each of the influent lines have further complicated recording flow rates and controlling extraction rates since extraction is controlled by a set point with feedback from the flow meters.

4.4 Components Or Processes That Account For Majority of Annual Costs

O&M costs are approximately $186,000 per year on a move forward basis for operating the IZ system. An assumed breakdown of the operational costs is provided below based on the general cost information provided by the site team (which also included other activities) and professional judgment by the RSE team.

Item Description	Approximate Annual Cost
USACE oversight	$36,000
Routine project management, quarterly system reporting	$36,000
O&M labor	$40,000
Electricity	$7,000
GAC purchase and regeneration	$5,000
Supplies/services for routine maintenance	$12,000
Non-routine maintenance (e.g., well rehabilitation)	$15,000
Ground water sampling (assume annual event with 45 wells)	$20,000*
Annual ground water report	$15,000*
Total Estimated Annual Cost	**$186,000**

** These items are not specifically included in the O&M program to date but would likely be included in future years of operation.*

4.4.1 UTILITIES

The utility costs have varied over the past several years due to previous operation of the shallow zone treatment system and extensive shutdown periods due to reinjection well fouling. The estimated cost for electricity is based on average electricity usage of approximately 60,000 kWh per year at approximately $0.12 per kWh, including demand charges, fees, and taxes. The estimated usage of 60,000 kWh is based on the total 2008 electrical usage and is comparable to what would be expected for operation of the specified motors, plus lighting, and air conditioning (for the electronics in the control room).

4.4.2 NON-UTILITY CONSUMABLES AND DISPOSAL COSTS

The GAC cost is based on two 1,000-pound change outs per year on a cost of approximately $1,000 per mobilization and $1.50 per pound of material (including regeneration). This translates to a yearly cost of approximately $5,000 per year.

The RSE team has estimated the routine and non-routine maintenance costs based on professional judgment and experience with similar systems.

4.4.3 LABOR

Labor costs, including USACE oversight, are estimated based on the specified level of effort for operator labor for the IZ system (8 hours per week at a rate of $75 per hour estimated by the RSE team plus approximately 25% additional time for maintenance), approximate historical annual costs for USACE, and an estimate by the RSE team of reasonable costs for project management and monthly reporting for the IZ system only. These estimated costs, along with the costs for the other fields appear to generally agree with the historical costs for the Site, when extracting other site activities, including operation of the Shallow system.

The cost for ground water sampling is based on sampling 4 to 5 wells per day and an average cost of $2,000 per day for field labor, equipment, and supplies.

4.4.4 CHEMICAL ANALYSIS

Chemical analysis is not included in the above table because analyses are provided by the Contract Laboratory Program and are not billed to the Site. If the costs were billed to the Site, it is estimated that the analytical costs would be on the order of $4,000 per year for the current process monitoring program and approximately $5,000 per year for annual sampling of 45 wells for VOCs.

4.5 APPROXIMATE ENVIRONMENTAL FOOTPRINTS ASSOCIATED WITH REMEDY

4.5.1 ENERGY, AIR EMISSIONS, AND GREENHOUSE GASES

The annual emissions for carbon dioxide for the current system are presented in Table 4-1. Energy usage and emissions for sulfur dioxide, nitrogen oxides, and particulate matter are not calculated because they are assumed to generally scale with carbon dioxide emissions because, like carbon dioxide, the primary source is the combustion of fossil fuels. Fossil fuels are the primary source of energy used at this site;

therefore, carbon dioxide emissions are an indication of the energy footprint. Efforts to reduce the carbon footprint would be assumed to reduce the footprints for energy and these other pollutants. The emissions of hazardous air pollutants associated with the site would primarily result from air stripper off-gas or vapor intrusion. These items are discussed in section 5 of this report in the context of protecting human health and the environment.

Item	**Carbon Footprint (lbs CO_2e/yr)**	**Percent Contribution of Carbon Footprint**
Energy		
Electricity	76200	71%
Diesel (GAC disposal)	616	1%
Gasoline	2166	2%
Energy subtotal	**78982**	**74%**
Materials		
GAC	4000	4%
Other materials (bag filters, disposables)	5000	5%
Materials subtotal	**9000**	**9%**
Waste Disposal		
Hazardous waste disposal for GAC	27.5	0%
Disposal subtotal	**27.5**	**0%**
Other Services		
Well rehabilitation	10000	9%
Laboratory analysis	9000	8%
Other services subtotal	**19000**	**17%**
Treatment Process Emissions		
Air stripper off-gas	0	0
Process emissions subtotal	**0**	**0**
P&T System Total	**107009**	**100%**

CO_2e/yr = carbon dioxide equivalents per year

4.5.2 WATER RESOURCES

The remedy operations have a limited effect on water resources beyond the attempts to remediate the aquifers. Water that is extracted and treated (approximately 4 million gallons annually if the system is operating continuously) is reinjected into the Floridan aquifer for beneficial use. However, preserving this discharge option comes at significant effort and resources to maintain the injection well.

4.5.3 Land and Ecosystems

Remedy activities have a limited affect on the surrounding land and ecosystems. The area surrounding the Site is industrial in nature with the exception of the wooded lot to the south of the Site. Although wells and piping have been installed in this area, the area has been largely left unaffected since remedy construction in 2003. The wells are only occasionally accessed by foot for system checks, minor repairs, and ground water sampling.

4.5.4 Materials Usage and Waste Disposal

GAC represents the principal material that is used on-site and disposed of off-site. A historic GAC characterization sample indicated radioactivity and precluded the GAC from being disposed of locally as a non-hazardous waste or from being regenerated. As a result, the GAC is hauled approximately 1,200 miles to Belleville, Michigan and is handled as a hazardous waste. On a move-forward basis with the existing system, the RSE team would expect two GAC changeouts per year with used GAC being regenerated.

4.6 Recurring Problems or Issues

The primary recurring issues with the Site are the disrepair of process instrumentation and the fouling of the reinjection well. The site team has recently made an inventory of problematic instrumentation and appears to have identified a successful method for well rehabilitation. It is likely that continued use of the reinjection well will require continued maintenance and/or frequent (e.g., once per year) rehabilitation efforts.

4.7 Regulatory Compliance

The system has complied with its discharge requirements. There is no air permit for the air stripper off-gas.

4.8 Safety Record

No health and safety issues were identified during the RSE site visit, and the site visit began with an appropriate health and safety tailgate meeting.

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

5.1 GROUND WATER

Ground water is impacted at the Site in the shallow zone and in the IZ but does not appear to pose an immediate risk to human health. Site-related contamination has not been found above FDEP GCTL standards in the Upper Floridan Aquifer. A historic well survey suggests no wells are used in the vicinity of the Site, but these findings have apparently not been confirmed since 1986.

5.2 SURFACE WATER

The Tampa Bypass Canal is the closest surface water body to the Site, and it is located sufficiently far downgradient that it is unlikely to be affected by site-related contamination.

5.3 AIR

Air quality could potentially be affected by site-related contamination through either the air stripper off-gas if breakthrough occurs through all three GAC units or through soil vapor intrusion. As the system currently operates, VOC emissions from air stripper off-gas would not typically be measureable. During GAC breakthrough, VOC emissions would be several orders of magnitude lower than the emission rates that would require an air permit. With regard to soil vapor intrusion, the site team reports evaluating this potential exposure pathway during the Human Health Risk Assessment using the Johnson-Ettinger Model and concluding that the non-cancer hazards and cancer risks for the current industrial worker exposed to surface soil and indoor air were below the threshold of concern. The total HI was reportedly less than 1 and the total cancer risk was reportedly less than 1E-4. Under future land-use scenarios, the risk was above the level of concern.

5.4 SOIL

Unsaturated soil remediation has generally been conducted to the FDEP standards, and that soil which has not been remediated would be addressed as part of the final remedy. In the interim, contaminated soil is not readily accessible for direct exposure by those working above ground. Residual contamination appears to be present in soil beneath the water table that contributes to an ongoing source of dissolved ground water contamination.

5.5 WETLANDS AND SEDIMENTS

These media are not affected or potentially affected by Site contamination.

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. The costs and sustainability impacts of these recommendations are summarized in Tables 6-1 and 6-2.

Many of the recommendations provided below assume that the system will continue to operate for several years as an interim remedy or may become part of the final remedy for the Site. If the final remedy does not include P&T and the final remedy is expected to occur within a few years, then the following recommendations should be evaluated to determine if the costs and resources of implementing them are worthwhile given the short-term nature of the P&T system.

6.1 RECOMMENDATIONS TO IMPROVE EFFECTIVENESS

6.1.1 CAREFULLY DETERMINE AN APPROPRIATELY CONSERVATIVE BUFFER WHEN INFORMING THE STATE OF PLUME EXTENT RELATED TO ESTABLISHING GROUND WATER RESTRICTIONS

Remediation of the plume between the southwest injection trench (200 feet downgradient of the source area) and the southwest recovery trench (300 feet downgradient of the source area) appears to have been effective. However, it is possible that total VOC concentrations exceeding 10,000 ug/L had already migrated beyond this target area of remediation. This contamination could continue to migrate horizontally within the shallow zone or could migrate downward into the IZ. The RSE team believes that the current extent of contamination in the IZ is the result of contamination that had migrated horizontally in the shallow zone before migrating downward to the IZ. The VOC contamination in the IZ also appears to not be fully delineated to the southwest. RW-I1 appears to be the furthest well from the source area to the southwest and has total VOC concentrations over 500 ug/L.

Based on the limited access due to the active railroad, it is likely that these plumes to the southwest will not be fully delineated or remediated. Given the current and projected land use as a rail yard, it is unlikely that ground water in this area will be used. EPA is reportedly negotiated a Memorandum of Agreement (MOA) with the Southwest Florida Water Management District (SFWMD) to provide an institutional control that restricts the use of contaminated ground water at "off-site" (off source property), non-liable properties. The MOA was signed by EPA in September 2008. In the MOA, EPA agrees to provide the SWFMD information on the extent of ground water contamination and the SFWMD agrees to use their authority to deny any well construction permit application that will cause harm to public health or degradation of the aquifer.

The RSE team suggests that EPA provide carefully determine a buffer zone that extends beyond the known extent of ground water contamination to include the unknown extent and expected future extent of ground water contamination. This may involve some analytical transport modeling with BIOSCREEN, BIOCHLOR, or a similar program. Using a very simplistic analysis, the RSE team observes that a concentration of 2,400 ug/L of total VOCs was present in LIZ well MW-18 as early as 2000 (and perhaps earlier). If the release of PCE occurred at the beginning of the Alaric occupation of the property in 1981, then the average transport would have been approximately 20 years. MW-18 is located approximately

300 feet or more from the source area, suggesting and average transport rate of 15 feet per year in the IZ. If the release from Alaric occurred later during their occupation, then the average transport rate in the IZ would be faster. Transport velocities in the shallow zone are much higher than the IZ, and PCE concentrations exceeding 3,000 ug/L likely exist in the shallow zone beyond the area of historic remedial activities. The hydraulic properties summarized in Section 1.5 of this report suggest an unretarded seepage velocity as high as 131 feet per year in the shallow zone. The contamination observed at existing monitoring wells in 2000 has had an additional nine years of transport, suggesting that it may have migrated another 135 feet (9 years times 15 feet per year) in the IZ and 1,179 feet (9 years times 131 feet per year) in the shallow zone. As important, the observed concentrations of 2,400 ug/L in MW-18 or similarly high concentrations in the shallow zone are substantially higher than the FDEP GCTL for the respect constituents. Concentrations above the FDEP GCTL have likely migrated much further than these estimated distances, especially when considering dispersion. Migration will likely continue into the future because some of this contamination that migrated this far from the source area may not be addressed by the remedy. A more thorough analysis of contaminant transport may provide a better estimate of an appropriate buffer zone. In conducting this analysis, the hydraulic and contaminant transport properties of the shallow zone and IZ should also be considered.

The cost of this effort should be less than $10,000 and could be included as part of other documents being prepared as part of the final remedy selection.

6.1.2 ANALYZE PROCESS WATER PERIODICALLY FOR CONSTITUENTS OF CONCERN FROM THE HELENA CHEMICAL SITE

Concern has been documented by the Alaric Site team regarding potential impacts to the Alaric P&T system from the Helena Chemical plume. This concern is partially responsible for not operating one of the Alaric recovery wells. Conditions at both sites have changed over the past several years, and some remedial activities have occurred at the Helena Chemical property. Process sampling of the Alaric system for the Helena Chemical constituents as late as 2004 suggested that the system extracts low levels of pesticides that are treated by the GAC. In addition, analysis of samples from MW011 and MW019 indicated low levels of pesticides above the FDEP GCTL. RW-I3, which continues to operate, extracts ground water from this vicinity.

Given changing site conditions and the current discharge of treated water to the Floridan aquifer, the RSE team recommends continuing to sample the process water for pesticides and other constituents (perhaps arsenic and chromium) from the Helena Chemical plume to confirm they are appropriately treated prior to discharge. Initially, this monitoring should include sampling the influent, between the various GAC vessels, and the effluent. Once influent concentrations and treatment performance is documented, the sampling could be reduced to after the second GAC vessel and the effluent to document when breakthrough occurs and the quality of the water entering the Floridan aquifer.

The additional analyses would likely be analyzed by the CLP program and not charged to the site. The RSE team notes; however, that the typical cost of analyzing for pesticides plus two metals is approximately $100 per sample. The cost of implementing this recommendation will vary on the ultimate frequency that the samples are collected. If three samples are collected and analyzed monthly for the first 6 months, this would translate to an approximately cost of $1,800. Thereafter, if two samples are collected and analyzed quarterly, then the annual cost would be approximately $800 per year. The RSE team would not expect the GAC changeout frequency to increase.

6.1.3 SIMPLIFY SYSTEM CONTROLS

The main system components consisting of submersible well pumps, three 1000-pound GAC vessels in series, a small tray type air stripper, bag filters and an injection well are very simple and should be straightforward to operate with minimal downtime. However, system downtime has been relatively high, reducing the overall effectiveness of the system. Part of the problem is that the system has relatively complex electronic control and monitoring equipment, and when the equipment malfunctions it requires excessive time to fix or the equipment is allowed to remain non-functioning.

In particular, the controls for the well pumps should be simplified. The electronic flow meters should be replaced with mechanical totalizers that can be monitored during weekly site visits, and the pump control should be provided by simpler means such as the Pumpsaver® pump control or Warrick-type conductivity control sensors that allow the pumps to cycle on and off periodically. Cycling can be minimized by throttling the valves or by using small variable frequency drives that are manually set rather than adjusted automatically by the PLC. Due to the fairly small motors, the cost savings from using the variable frequency drives would be fairly low (less than $1,000 per year), but the carbon dioxide emissions from reduced electricity usage might be on the order of 5,000 to 10,000 pounds per year. Making these changes might cost $5,000 in materials and up to $10,000 in labor and/or subcontractors for planning, wiring, and reworking the PLC programming.

6.1.4 MONITOR SPECIFIC CAPACITY IN RECOVERY AND REINEJCTION WELLS

Well fouling can occur and get progressively worse without operator knowledge if the specific capacity of a well is not regularly monitored. Specific capacity (gallons per minute extracted/reinjected per foot of drawdown) should be monitored quarterly to determine if more drawdown is required to achieve the same extraction rate. If the specific capacity decreases, it is an indication of well fouling, and well maintenance or rehabilitation will likely be more successful during the early stages of fouling than in the later stages. The additional level of effort and time for this measurement is negligible relative to existing site activities and costs, and can be performed within the existing O&M budget.

6.1.5 INTERPRET CAPTURE

Assuming that this remedy may continue to operate for some time, perhaps to contain and remediate the dilute portion of the VOC plume as a component of the site-wide final remedy, the capture zone interpretation should be revisited and the extraction rates modified accordingly. A target capture zone would presumably be developed as part of remedy selection. This will likely require additional delineation efforts to the east (on the far side of the Helena Chemical Site).

A thorough capture zone has not been conducted to date. Potentiometric surface maps have been developed based on water levels, and these potentiometric surface maps indicate capture. However, the maps were developed using water levels from active recovery wells, which biases the potentiometric surface in favor of capture. A more comprehensive capture zone analysis would include developing potentiometric surface maps without this source of bias and potentially also using a recalibrated site model.

The ground water model used during design appeared to have a shortcoming in the model calibration for the intermediate zone. There is now infrastructure available (i.e., recovery wells) that can be used to provide more information for model calibration. Prior to collecting this information, however, the site team should invest in new piezometers in the shallow zone, MIZ, and LIZ near RW-I1, RW-I2, and RW-I3 (there are already wells close enough to RW-I4). These piezometers can be used to develop informative potentiometric surface maps that are free from the bias of using water levels from active recovery wells and help understand the contributions of water from the various intervals. In addition, these piezometers will be located sufficiently close to the recovery wells to provide useful information during pumping tests. Without these piezometers, it is unclear if the drawdown from pumping at the recovery wells will be sufficiently large to see in existing monitoring wells given the distance of these monitoring wells from the recovery wells. With the piezometers installed, aquifer testing with the existing extraction system is suggested according to the following general procedure:

- Increase extraction rate back to the intended value of 8 gpm (if using RW-I1 through RW-I3) or 11 gpm (if using RW-I-1 through RW-I4).
- Operate at the intended extraction rate for a period of one month to achieve steady conditions
- Shutdown all operating extraction wells for one week and record water levels with pressure transducers in MW011, MW060, MW063, MW061, MW019, MW023, MW024, MW017, and MW018
- Restart RW-I3 at its intended rate while continuing to record water levels
- Restart RW-I2 several days later at its intended rate while continuing to record water levels
- Restart RW-I1 several days later at its intended rate while continuing to record water levels
- Recalibrate the model using the transient drawdown results from the above testing. The model should be used to simulate the results of the transient pumping, and a defensible calibration should be achieved.
- Create a steady-state version of the model that can be used to simulate the intended pumping rates and use forward particle tracking (with particles released from all cells within the capture zone) to observe capture
- Use the steady-state model to simulate other potential flow rates for either achieving capture at a lower flow rate or to improve capture.

The above analysis, including piezometer installation (3 in the shallow zone, 3 in the MIZ, and 3 in the LIZ), collecting the data (but not including additional monitoring wells that might be needed for delineation), model calibration, simulations, and reporting should cost under $100,000 (e.g., $45,000 for the piezometers, $15,000 for the hydraulic testing, $20,000 for model calibration, and $20,000 for simulations and reporting). The model would also be available to simulate capture or other hydraulic performance criteria for various pumping and reinjection scenarios.

6.2 Recommendations to Reduce Costs

6.2.1 Modify VOC Treatment

The treatment system currently includes two treatment technologies for removing VOCs from extracted water: air stripping and adsorption with liquid phase GAC. It is common to include GAC as a polishing step to air stripping, and GAC was originally selected as the primary treatment technology because it also would remove pesticides from the Helena Chemical plume if they were present in the extracted water. The use of air stripping and liquid phase GAC at the Site is counter to typical practice (i.e., the GAC is placed before the air stripper at this Site), but complaints resulting from the potential VOC off-gas from the air stripper has resulted in the site team placing the GAC before the air stripper so that the GAC provides the majority of mass removal and the air stripper provides redundancy to remove contaminants (especially vinyl chloride) when they breakthrough the GAC. This redundancy is preferred because the treated water is discharged directly to the Floridan aquifer.

Air stripping at this site has a caused a number of problems within fouling as indicated in the July 24, 2007 optimization report on fouling issues. The aeration of the water increases the pH and causes calcium carbonate scale to form. This scaling reportedly fouled the GAC when GAC treated the air stripper effluent, and now that the water from the air stripper directly discharges to the injection well, the scaling has reportedly been fouling the injection well. The RSE team believes that regardless of the treatment or discharge component that follows the air stripper, fouling will occur unless that water is softened or otherwise treated prior to air stripping.

Due to the concerns regarding VOC emissions and the problems with scaling, the site team if could consider using GAC as the only treatment technology for contaminant removal. However, data from June 2007 through October 2007 suggests that each GAC unit might only last approximately 30 days until vinyl chloride breakthrough if the system is operating at approximately 8 gpm. The GAC needs to remain a component of the treatment process to address the constituents from the Helena Chemical plume. As a result, one of two modifications could be made:

- One option is to continue to operate the system in its current arrangement, but make two modifications. First, the site team could reduce the air flow rate of the air stripper blower so that it only provides the air to water ratio needed to address the vinyl chloride that breaks through. Second, the site team could add an acid drip (before or after the air stripper) to maintain a pH below 7 (but above 6) to prevent the scaling from occurring. This option would likely require two liquid phase GAC changeouts per year, some acid usage, and slightly reduced electricity usage than is presently used. This option would result in minimal air emissions (orders of magnitude lower than those that would cause a human health concern or that would require an air permit) and reduced or eliminated scaling of the bag filters and injection well.

- The second option is to move the air stripper prior to the GAC, pre-heat the air stripper off-gas, treat the air stripper off-gas with vapor phase GAC, add an acid drip to reduce scaling, and polish the air stripper effluent with liquid phase GAC to address the contamination from the Helena Chemical plume. This option would likely require increased electricity usage compared to the present system, one or two vapor GAC changeouts per year, and likely one liquid GAC changeout per year. The liquid GAC changeouts would likely result from fouling rather than chemical loading, because although scaling would be reduced, it likely would be sufficient to decrease GAC performance and increase the pressure across the GAC unit over the course of a year. This option would result in similar air emissions to the current system or the above option because the vinyl chloride would not be well addressed by the GAC. It would also result in less scaling of the reinjection well relative to the current system.

The cost for implementing the first option would be approximately $10,000. This cost includes a chemical feed pump with controller, 500 gallon HDPE tank for acid, pH probe and transmitter, variable frequency drive for the blower, installation costs, and design costs. The acid addition might cost $1,000 to $2,000 per year but is difficult to estimate. The RSE team estimates that this option might save approximately $1,000 per year in electricity costs (which should offset the acid addition costs) and should either eliminate or greatly reduce the frequency of injection well rehabilitation, which would be a savings of approximately $10,000 per year. Regarding the environmental footprint, the RSE team expects that the acid usage and electricity reductions might offset each other, and that the overall footprint may be reduced by the footprint for the well rehabilitation.

6.2.2 CONSIDER DISCHARGING TO THE SHALLOW ZONE

The fouling of the reinjection well has caused a number of problems with regard to extended system shutdown and with regard to costly rehabilitation efforts. In addition, discharge to the Floridan aquifer raises concern within the site team regarding water quality. The concern regarding discharging the water to Floridan aquifer could be avoided if the treated water is discharged to the shallow aquifer. Reinjection galleries and piping is already present. The concerns regarding scaling of the injection well will also apply to the shallow zone injection, but should be addressed if Recommendation 6.2.1 is implemented. Furthermore, if scaling of the shallow zone reinjection system does occur, it would likely be less costly to rehabilitate than the reinjection well. This option has previously been considered, but uncertainty regarding the shallow zone remedy prevented further consideration.

Based on the most recent sampling results, it appears that active remediation will likely be needed for the shallow zone source during the final remedy, but there should be enough capacity in the "exfiltration" galleries and in the downgradient reinjection trenches to accommodate the treated water from the IZ. Because the piping and trenches are already in place, the cost for making this change should be under $5,000. If Recommendation 6.2.1 is not implemented, the RSE team estimates that the cost savings might be on the order of $5,000 per year, assuming that some form or reduced reinjection system maintenance is required instead of the more costly injection well rehabilitation. In the absence of implementing Recommendation 6.2.1, this should also reduce the environmental footprint associated with well rehabilitation by, perhaps 5,000 pounds of carbon dioxide per year (based on the emission factor in Table 4-1).

6.2.3 CHARACTERIZE GAC AGAIN AND INVESTIGATE SOURCE OF RADIOACTIVITY IN AN ATTEMPT TO DISPOSE OF GAC AS NON-HAZARDOUS WASTE OR TO REGENERATE IT

The spent GAC is being disposed of as hazardous waste due to the presence of radioactivity. Based on the discussions at the site visit, this was an unexpected finding given site conditions. If repeated characterization samples suggest radioactivity is present, then the site team should consider what the causes might be. They could be site-related (e.g., naturally occurring), which may lead to a consideration during final remedy selection, or they might be vendor related, which may lead to using another vendor. If the detection of radioactivity was a one-time anomalous event, then efforts should be made to either regenerate the spent GAC or dispose of it locally as a non-hazardous waste. This could reduce cost and improve remedy sustainability by reducing materials and the emissions footprints associated with the materials. The benefits could be significantly multiplied if the remedy operates long-term and/or focuses on more aggressive mass removal. The sustainability benefits are not calculated because the footprint associated with GAC disposal (including diesel for transportation) is apparently minor according to the results Section 4.5.1 that are included in Table 4-1. The cost savings (assuming current GAC usage) might be on the order of $4,000 per year (e.g., approximately $2,000 per changeout).

6.2.4 TRACK ROUTINE O&M COSTS SEPARATELY FROM NON-ROUTINE COSTS

Tracking routine O&M costs regularly can help provide cost control, identify cost increases, and potentially address cost increases. However, if the routine costs are masked or obscured by additional items such as additional remedial activities, pilot tests, additional investigation, or technology screening, it is difficult to reliably track the O&M costs. The RPM should track the O&M costs separately and preferably track O&M labor costs separately from O&M materials costs. Contractor invoices or cover letters can be requested to provide information in this format so that it is easy to track. This cost for making this change should be negligible relative to other project management activities.

6.3 RECOMMENDATIONS FOR TECHNICAL IMPROVEMENT

6.3.1 CONSIDER THE FOLLOWING COMMENTS TO THE MAY 2009 TECHNICAL REVIEW BY THE SITE CONTRACTOR

The May 2009 Technical Review by the contractor included photographs of current equipment, an inventory of equipment in need of replacement, and suggestions for simplifying system operation. In general we agree with the recommendations presented in the referenced letter. However, we consider this a relatively simple system with clear issues and we believe many of the recommendations listed in the letter could be resolved immediately based on existing information rather than as part of future work products. More specific comments are as follows:

- We agree that an O&M manual with monitoring log(s) and maintenance procedures for the operators should be developed. The monitoring log sheet should include depth to water (could be checked manually), discharge pressure and flow rate at each well, total system flow rate, pressure at GAC units and bag filters, air pressure and flow at the air stripper (if it continues to operate) and pressure at the reinjection point.

- We agree that the PLC and HMI should be updated to reflect the operating system and as-built documents as listed in Section 4.2 of the 5/27/2009 Shaw letter should be compiled and maintained at the Site.

- The existing treatment equipment is functioning and fit for continued use. Multiple minor components should be added, fixed, replaced, or possibly removed if no longer needed (such as the pressure transducers in the wells if the pump control options discussed in Section 6.1.5 are adopted). This type of maintenance, such as adding or replacing pressure gages, should be occurring on an ongoing as-needed basis by the system operator and should be noted in the quarterly reports.

- Treated water discharge requirements are known and it is clear that the current GAC with or without air stripping treatment units can meet these requirements at design flow rates. We do not believe that a final design document and work plan are needed for re-configuration activities. Any re-configuration activities could be adequately documented in the regular quarterly reports.

- Problems such as the "flow problem" noted at RWI3 should be addressed on an immediate as-needed basis by the system operator/site team. The site team should pull the pump from the well and clean and replace any damaged/leaking fittings or pipe.

- Although mixing Schedule 40 and Schedule 80 PVC is not standard, there is no reason based on the system pressure to replace all of the pipe with Schedule 80 PVC. The mixed schedule piping would have the Schedule 40 rating. Schedule 40 PVC has a minimum pressure rating of >200 psi for diameters less than 4 inches and the maximum system pressure is less than 125 psi based on the maximum head of the Grundfos 5SQE03A-180-NE currently utilized.

- If the hose and camlock fittings used for connecting to the GAC units and bag filters are rated for over 75 psi (GAC vessel rating) and are not leaking, we recommend maintaining them and supporting them properly instead of replacing them with Schedule 80 PVC. The hose and camlocks are preferable for ease of changeouts, flexibility of GAC location and durability. If the hose is not rated for 75 psi, other flexible hose with that pressure rating is available and could easily replace the current hose.

- We agree that the bag filters should be kept in parallel configuration.

6.4 CONSIDERATIONS FOR GAINING SITE CLOSE OUT

The October 2008 Technical Memorandum provides a reasonable site conceptual model and an estimate of contaminant mass in the subsurface. It also provides a comprehensive review of many potential remedial options. We have the following general comments that apply.

- The high sulfate (approximately 250 mg/L) and its impact on in-situ bioremediation is not as significant a concern as noted in the document. Although sulfate is a competing electron acceptor to the chlorinated ethenes, the predominant factor controlling the mass of electron donor (nutrients) added is the adsorptive capacity of the soil. The stoichiometry, including the sulfate, contributes insignificantly to the overall mass that would need to be added. The RSE team recently evaluated the Grants Chlorinated Solvents Site where in-situ bioremediation was pilot tested and will be used in the final remedy. The sulfate concentrations at that Site are over 2,000 mg/L and in-situ bioremediation performed well where the microbe population was sufficient and donor was effectively added.

- The RSE team favors mass removal and hydraulic containment type approaches to the source zone remedy, compared to physical isolation with slurry walls and caps, particularly given the relatively small size of the source zone and the amount of mass that has already migrated from the source zone to the high concentration and dilute portions of the plume.

- The calculated treatment volumes (e.g., source zone A, source zone B, the high concentration plume, and the dilute plume) do not appear to add up based on the areal extent of the zones, the maximum depths of contamination, and the estimated number of injection points, etc. for remediation. Specific examples are provided below:

    - The source zone A and B are reported to have a total volume of approximately 3,000 cubic yards of soil and a volume of ground water (in gallons) that is consistent with this soil volume and a porosity of 0.35. However, the areal extent multiplied by only 20 feet of thickness (which is less than the maximum thickness of source zone A only, yields a volume of 4,600 cubic yards. More importantly, the large diameter auger remedy assumes 370 locations assuming a 6-foot diameter auger. Again assuming a thickness of 20 feet, this volume is over 7,500 cubic yards. The injection-related remedies assume 70 injection locations, each with a diameter of 12.5 feet. Once again, assuming a thickness of 20 feet (which does not account for any of source zone B), the volume is over 6,500 cubic yards.

- The reported volume for the high concentration plume is also questionable. The areal extent appears to be approximately 20,000 square feet, and the thickness based on most assumptions in the document is approximately 45 feet. This resulting volume minus approximately 5,000 cubic yards for the source zone would correspond to a volume of 28,000 cubic yards compared to the 2,200 cubic yards reported in the Technical Memorandum. Furthermore, the reported ground water volume (1,927,300 gallons) does not correlate to the soil volume (2,200 cubic yards) the same way it did for the source zones. Converting 1,927,300 gallons into cubic yards and then accounting for porosity would yield approximately 27,000 cubic yards not 2,200 cubic yards.

- The volume calculation for the dilute plume is also questionable because of how the soil volume and ground water volumes compare. Converting the reported gallons in the dilute plume (7,215,600 gallons) directly to cubic yards (35,720) using 27 cubic feet per cubic yard yields 35,720 cubic yards, but porosity has not been accounted for. Based on a preliminary review of Figure 3-12 from the Technical Memorandum, the total area of the dilute plume (excluding the source zone and high concentration plume) appears to be approximately 92,000 square feet. Assuming an average thickness of 20 feet (which is a fraction of the total thickness of the MIZ and LIZ) is impacted above target levels for active remediation, the total volume for the dilute plume (excluding the source zone and high concentration plume) would be approximately 68,000 cubic yards.

It is suggested that these volumes be revisited and that if they are deemed to be correct that more transparency be provided in how the volumes were calculated. Contaminant mass estimates may also need to be revisited.

- Cost information is not provided in the feasibility study, but it is unclear if the synergy between continued pumping for plume containment purposes and source zone pumping for mass removal has been considered. If the P&T system continues to operate to hydraulically contain the plume and remediate the dilute portion of the plume, there are relatively small incremental costs to annual operations to remove substantially more mass from the source zone. Consider the $186,000 per year cost described earlier for operating the P&T system with the current configuration and the current influent concentrations (approximately 2,000 ug/L of PCE, 2,000 ug/L of TCE, 250 ug/L of cis 1,2-DCE, and 25 ug/L of vinyl chloride). The additional cost to operate three more extraction wells (e.g., RW-I4 and another well located in the high concentration portion of the plume), increase the extraction rate to 16 gpm, double the influent concentration, and treat the water with a GAC-only treatment process would likely cost under $30,000 per year more than the current O&M costs for four times the amount of GAC and an increase in electricity for pumping. It is unclear how long the higher influent concentrations would be maintained, but if they were maintained for six months, the mass removal over the course of the year would be approximately 600 pounds. Therefore, assuming that P&T continues to be utilized for hydraulic containment and remediation of the dilute plume, substantial source zone mass removal via P&T with added wells can occur for an incremental cost of less than $30,000 per year. A capital cost of $300,000 should be adequate to install addition wells, piping, and treatment plant modifications.

- The following very approximate cost and sustainability comparison compares the relative costs of remediation over a 30-year period using P&T to address the dilute plume and various remedial technologies to address the source zone and high concentration plume. Note that these are estimated costs for up to 30 years and do not necessarily represent the estimated costs to achieve closure for some of the remedial options. Some remedies would be expected to remove contaminant mass and reach site closure in less than 30 years and some of the options, particularly the P&T containment option, may involve remediation for substantially longer than 30 years. The costs do are not discounted to represent net present value. For the purpose of this evaluation, the following basic, simplifying assumptions are made:

  - The total source zone (referred to as source zones A and B in the October 2008 Technical Memorandum) is approximately 5,000 cubic yards.

  - The high concentration plume (total VOC concentrations over 3,000 ug/L) comprises an additional 27,000 cubic yards.

  - The dilute plume (total VOC concentrations between 300 ug/L and 3,000 ug/L) comprises an additional 68,000 cubic yards of volume to the above volumes for the source zone and high concentration plume.

  - The cost for operating the P&T system to contain the dilute plume or the source zone, high concentration plume, and dilute plume at an estimated extraction rate of 8 gpm is approximately $186,000 per year for 30 years.

  - The for operating the P&T system to both contain the dilute plume and aggressively extract mass from the source zone as described above is $216,000 per year for the first 10 years, $210,000 per year for years 11 through 20, and $204,000 per year for years 21 through 30.

  - Under either P&T scenario, an additional cost of $150,000 would be more than adequate for replacing P&T system equipment over the 30-year period.

  - The approximate unit cost for thermal remediation is $500,000 for design and mobilization plus $100 per cubic yard.

  - The approximate unit cost for in-situ bioremediation is approximately $60 per cubic yard for three injections.

  The following table summarizes costs for implementing various combinations of the above remedies, without any discounting:

Approximate Cost Comparison of Various Remedial Options

Source Zone Remedy	High Concentration Plume Remedy	Dilute Plume Remedy	Total Cost
P&T only to contain the source zone, HCP, and dilute plume for 30 years (operation at current capacity, ~8 gpm)			$5.7 million
P&T only to address the source zone and contain the HCP and dilute plumes for 30 years (operation at increased capacity, ~16 gpm)			$6.8 million
In-situ thermal remediation	P&T at 8 gpm to contain the HCP and dilute plume for 30 years		$6.7 million
In-situ thermal remediation	In-situ thermal remediation	P&T at 8 gpm for 30 years	$9.4 million
In-situ thermal remediation	Bioremediation	P&T at 8 gpm for 30 years	$8.3 million
Bioremediation	Bioremediation	P&T at 8 gpm for 30 years	$7.6 million
In-situ thermal remediation	In-situ thermal remediation	In-situ thermal remediation	$10.5 million
In-situ thermal remediation	Bioremediation	Bioremediation	$6.7 million
Bioremediation	Bioremediation	Bioremediation	$6.0 million

Note: The above table analyzes cost only over a 30-year time frame and does not consider which approach would remove the most mass or remedy performance. The P&T option for 16 gpm includes $300,000 in capital costs for system modifications and well installations. All P&T options include an additional $150,000 for equipment replacement over the course of the 30-year period.

The above table indicates that P&T is a viable remedial option that might provide a means of cost-effective remediation and should be further considered as part of the remedy selection process. In addition, the above table suggests that if in-situ thermal remediation or bioremediation is used to address that high concentration plume that it would be more cost-effective to expand the bioremediation area to include the dilute plume rather than contain the dilute plume with a P&T system. Continuing to operate the P&T system appears to be cost-effective if bioremediation or in-situ thermal remediation is not used to address the high concentration plume.

A similar analysis can be done with respect to the carbon footprint. The table below summarizes a "very approximate" estimate of the carbon footprint for the same scenarios. The assumptions and calculations for the footprint estimates are presented in Attachment B.

Estimated Approximate Carbon Footprints of Various Remedial Options

Source Zone Remedy	High Concentration Plume Remedy	Dilute Plume Remedy	Estimated Total CO2e Footprint (tons CO2e)
P&T only to contain the source zone, HCP, and dilute plume for 30 years (operation at current capacity, ~8 gpm)			970
P&T only to address the source zone and contain the HCP and dilute plumes for 30 years (operation at increased capacity, ~16 gpm)			1,861
In-situ thermal remediation	P&T at 8 gpm to contain the HCP and dilute plume for 30 years		1,655
In-situ thermal remediation	In-situ thermal remediation	P&T at 8 gpm for 30 years	5,355
In-situ thermal remediation	Bioremediation	P&T at 8 gpm for 30 years	2,855
Bioremediation	Bioremediation	P&T at 8 gpm for 30 years	2,396
In-situ thermal remediation	In-situ thermal remediation	In-situ thermal remediation	13,685
In-situ thermal remediation	Bioremediation	Bioremediation	4,985
Bioremediation	Bioremediation	Bioremediation	4,526

Note: The above table analyzes cost only over a 30-year time frame and does not consider which approach would remove the most mass or remedy performance. Assumptions made in deriving these estimated footprints are provided in Attachment B.

The footprint for containing the plume over 30 years is the smallest of the various options considered, but it is likely containment would need to occur for substantially longer than 30 years without source zone remediation. Evaluating the above options, it appears that thermal remediation should be limited to the source zone. It also appears that some combination of source zone and high concentration plume remediation coupled with P&T to contain the dilute plume results in a comparatively small footprint and a reasonable chance of closing the site within 30 years. The option using an enhanced P&T system to address the source zone, high concentration plume, and dilute plume offers one of the lowest cost and lowest environmental footprints, but it is unclear if 30 years of enhanced P&T would be sufficient to achieve the same mass removal or chance for closure as options that involve more aggressive source zone remediation.

The remedy options with the lowest cost are not necessarily the remedy options with the lowest carbon footprints. However, it is apparent that options that involve P&T, including the option to extract ground water from the source zone and high concentration plume, are competitive with the other remedial options with respect to cost and environmental footprint (as measured by the carbon footprint). As such, it seems appropriate to retain some form of P&T as a remedial option during remedy selection.

6.5 Recommendations for Improved Sustainability

No specific recommendations are made with respect to further incorporating sustainability into the remedy. The above recommendations, which are made for other primary reasons, consider and may enhance remedy sustainability as noted in the discussion of each recommendation.

6.5.1 Considerations for Renewable Energy at the Site

Cost Analysis for Solar Energy

Florida has abundant sunshine and incentives for photovoltaic (PV) systems. Therefore, consideration of renewable energy at the Site should include an analysis of the usage and costs, and the costs associated with installing a PV system. Assuming the roof of the Alaric building is available for solar panels, approximately 20kW of solar panels could fit on the southern facing portion of the roof. A system this size in Florida, assuming limited or no obstruction of sunlight by the surrounding trees, could provide slightly less than half of the electricity used by the extraction system and treatment plant. A cost analysis is presented in Attachment C. The analysis uses local solar intensity (Tampa, FL) from PVWATTs (operated by the National Renewable Energy Labortory), commonly used photovoltaic efficiency parameters, and local electrical rates. After rebates, the system would cost approximately $90,000. The payback period, assuming rebates from the Florida Solar Energy System Incentives Program operated by Florida are available, is almost 20 years.

The cost analysis does not consider selling the renewable energy credits (“green tags”) generated by the system because it is assumed that the renewable energy credits would be retained by the Site so that the generated renewable energy is credited to the Site rather than sold to another entity. If renewable energy was generated on-site but the renewable energy credits were sold to another party, the “ownership” of the renewable energy would be transferred to the party purchasing the renewable energy credits.

Cost Analysis and Rationale for Green Tags

Renewable energy can also be used to power the P&T system by purchasing “green tags” or renewable energy certificates. The market price is approximately $0.025 per kWh. It would therefore cost approximately $1,500 additional per year to power the P&T system with renewable energy that is generated elsewhere in the country. Comparing this option to the solar option described above, this option would have no upfront capital costs but would cost approximately $15,000 additional over the next 10 years (assuming green tag prices do not increase) to address all of the system electricity usage. By comparison, the solar option described above (including the rebates but excluding benefits of tax credits and depreciation) would still be approximately $50,000 from breaking even after 10 years and would have only addressed approximately 50% of the system’s electricity usage. As a result, over a 10-year time frame, the purchase of renewable energy certificates may make more financial sense. If the planning horizon is a 20-year period, then the renewable energy certificate option would cost over $72,000 where as the solar option would break even.

Table 4.1 Energy and Atmosphere Footprint Analysis

	Quantity	Unit	CO2 equiv (lbs)	
			emission factor (lbs/unit)	total
Energy				
Electricity	60,000	kWh	1.27	76200
Diesel (GAC disposal)	28	gallons	22	616
Gasoline	114	gallons	19	2166
Energy subtotal				**78982**
Materials				
GAC	2,000	pounds	2	4000
Other materials (bag filters, disposables)	$5,000	dollars	1	5000
Materials subtotal				**9000**
Waste Disposal				
Hazardous waste diposal for GAC	1	tons	27.5	27.5
Disposal subtotal				**27.5**
Other Services				
Well rehabilitation	$10,000	dollars	1	10000
Laboratory analysis	$9,000	dollars	1	9000
Other services subtotal				**19000**
P&T System Total				**107009.5**

Usage and Emission Factor Notes for Table 4-1.

Except where otherwise noted, information regarding emission factors was obtained from eGRID, EPA Climate Leaders Program, the National Renewable Energy Laboratory life-cycle inventory at www.nrel.gov/lci, or the EUROPA Reference Life-Cycle Database. Costs used in deriving emission factors are consistent with costs during Spring 2009. The emissions factors developed here are rough approximations based on simplifying assumptions. They are intended to provide only approximate environmental footprints to help understand the affects potential changes to the remedy may have on the footprint of the remedy.

Electricity

Quantity – 60,000 kWh, see report text for additional information

Emission Factor – Based on eGRID2007 for FRCC output emission rate for base-load using equivalency ratios of 21:1 methane to carbon dioxide and 310:1 nitrous oxide to carbon dioxide from http://www.epa.gov/solar/energy-resources/calculator.html

Diesel

Quantity – 0.023 gallons per ton-mile of transport in a single-unit truck, for 0.5 tons of waste transported 1,200 miles to Belleville, MI two times per year (NREL)

Emission Factor – 22 pounds of carbon dioxide per gallon of diesel (Climate Leaders)

Gasoline

Quantity – 2 gallons of gasoline per trip, once per week, 52 weeks per year for operator labor, plus an additional 10 trips once per year for ground water sampling.

Emission Factor – 19 pounds of carbon dioxide per gallon of gasoline (Climate Leaders)

Granular Activated Carbon

Quantity – 2,000 pounds per year

Emission Factor – 2 pounds of carbon dioxide per pound of regenerated GAC, see Attachment B.

Other Materials

Quantity – Usages were not directly quantified. The emission factor used is based on a percentage of material cost directed toward energy from fossil fuels. Approximately $5,000 of materials (bag filters, disposable personal protective equipment, etc.) is assumed.

Emission Factor – 1 pounds of carbon dioxide per dollar of materials, based on 10% of the cost of the materials resulting from the direct use of fossil fuels or electricity derived from fossil-fuels, and approximately 10 pounds of carbon dioxide emitted per $1 of fossil fuels consumed. 10 pounds would represent a blend of natural gas, diesel, gasoline, and coal.

Hazardous Landfill Disposal

Quantity – 1 ton per year based on 0.5 tons (1,000 pounds) disposed of 2 times per year

Emission Factor – 27.5 pounds of carbon dioxide per ton, based at 10% premium on the carbon emissions from EUROPA file location: Inert waste disposal. Inert waste used so that methane and carbon dioxide from decomposing waste is not included.

Other Services

Quantity – A breakdown of materials and energy are not directly quantified. The emission factor used is based on a percentage of service cost directed toward energy from fossil fuels. Approximately $10,000 for well-rehabilitation service is assumed and likely includes diesel for transport and on-site energy generation, chemicals and/or pressurized nitrogen, and delivery activities. Approximately $15,000 in laboratory analysis is assumed and likely includes fuel for transport, electricity for operating the laboratory and equipment, chemicals and disposables associated with sample preparation and analysis, and disposal.

Emission Factor – 1 pound of carbon dioxide per dollar spent on the service, based on 10% of the cost resulting from direct use of fossil fuels and approximately 10 pounds of carbon dioxide per $1 of fossil fuels consumed. 10 pounds of carbon dioxide would represent a blend of natural gas, diesel, gasoline, and coal.

References

Climate Leader GHG Inventory EPA-430--K-08-004, May 2008

EGRID 2007 v1.1

(EUROPA) European Reference Life Cycle Database (ELCD core database), version II compiled under contract on behalf of the European Commission - DG Joint Research Centre - Institute for Environment and Sustainability with technical and scientific support by JRC-IES from early 2008 to early 2009. (http://lca.jrc.ec.europa.eu/lcainfohub/datasetArea.vm)

National Renewable Energy Laboratory (NREL), Life-Cycle Inventory Database (www.nrel.gov/lci) maintained by the Alliance for Sustainable Energy, LLC.

Table 6-1. Cost Summary Table

Recommendation	Reason	Additional Capital Costs ($)	Estimated Change in Annual Costs ($/yr)	Estimated Change in Life-Cycle Costs $*	Estimated Change in Life-Cycle Costs (net present value) $**
6.1.1 Carefully Determine an Appropriately Conservative Buffer when Informing the State of Plume Extent Related to Establishing Ground Water Restrictions	Effectiveness	$10,000	$0	$10,000	$10,000
6.1.2 Analyze Process Water Periodically for Constituents Of Concern from the Helena Chemical Site	Effectiveness	$0	$0	$0	$0
6.1.3 Simplify System Controls	Effectiveness	$15,000	$0	$15,000	$15,000
6.1.4 Monitor Specific Capacity in Recovery And Reinjection Wells	Effectiveness	Negligible			
6.1.5 Interpret Capture	Effectiveness	$100,000	$0	$100,000	$100,000
6.2.1 Modify VOC Treatment	Cost Effectiveness	$0	($10,000)	($300,000)	($196,000)
6.2.2 Consider Discharging to the Shallow Zone	Cost Effectiveness	$5,000	($5,000)	($150,000)	($93,000)
6.2.3 Characterize GAC Again and Investigate Source of Radioactivity in an Attempt to Dispose of GAC as Non-Hazardous Waste or to Regenerate It	Cost Effectiveness	$0	($2,000)	($60,000)	($39,200)
6.2.4 Track Routine O&M Costs Separately from Non-Routine Costs	Cost Effectiveness	Not Specified			

Recommendation	Reason	Additional Capital Costs ($)	Estimated Change in Annual Costs ($/yr)	Estimated Change in Life-Cycle Costs $*	Estimated Change in Life-Cycle Costs (net present value) $**
6.3.1 Consider the Following Comments to the May 2009 Technical Review by the Site Contractor	Technical Improvement	Not Specified			
6.4 Considerations Regarding Site Closure – Consider P&T for Final Remedy	Site Closure	Not Specified			
6.5 Sustainability and Renewable Energy	Cost Analysis Provided for Solar Energy and Renewable Energy Certificates				

Costs in parentheses imply cost reductions
* assumes 30 years of operation with a discount rate of 0% (i.e., no discounting)
** assumes 30 years of operation with a discount rate of 3% and no discounting in the first year

Table 6-2. Sustainability Summary Table for Recommendations

Recommendation	Reason	Effects on Sustainability
6.1.1 Carefully Determine an Appropriately Conservative Buffer when Informing the State of Plume Extent Related to Establishing Ground Water Restrictions	Effectiveness	None beyond the remedial objectives of the remedy to protect human health and the environment.
6.1.2 Analyze Process Water Periodically for Constituents Of Concern from the Helena Chemical Site	Effectiveness	Additional minor footprint associated with laboratory analysis, but review will help protect the water resource of the Floridan aquifer
6.1.3 Simplify System Controls	Effectiveness	None beyond the remedial objectives of the remedy to protect human health and the environment.
6.1.4 Monitor Specific Capacity in Recovery And Reinjection Wells	Effectiveness	None beyond the remedial objectives of the remedy to protect human health and the environment.
6.1.5 Interpret Capture	Effectiveness	Potentially identify opportunities to reduce overall extraction rate necessary to provide capture or demonstrate need to increase extraction rate. The environmental footprints would tend to scale with the extraction rate.
6.2.1 Modify VOC Treatment	Cost Effectiveness	Reduced carbon footprint by approximately 10,000 pounds of carbon dioxide per year. Reductions associated with other footprints are also likely.
6.2.2 Consider Discharging to the Shallow Zone	Cost Effectiveness	Reduced carbon footprint by approximately 5,000 pounds of carbon dioxide per year (if 6.2.1 is not implemented). Reductions associated with other footprints are also likely.
6.2.3 Characterize GAC Again and Investigate Source of Radioactivity in an Attempt to Dispose of GAC as Non-Hazardous Waste or to Regenerate It	Cost Effectiveness	Potentially avoid long-distance transportation and potentially allow GAC to be regenerated rather than disposed of in landfill.
6.2.4 Track Routine O&M Costs Separately from Non-Routine Costs	Cost Effectiveness	None.

Recommendation	Reason	Effects on Sustainability
6.3.1 Consider the Following Comments to the May 2009 Technical Review by the Site Contractor	Cost Effectiveness	None.
6.4 Considerations Regarding Site Closure – Consider P&T for Final Remedy	Technical Improvement	Effects are unclear, but analysis provides perspective on the footprints of several remedial approaches.
6.5 Sustainability and Renewable Energy	Site Closure	A photovoltaic system could provide almost 50% of the electricity required by the system. Purchase of renewable energy certificates could allow entire site to be powered by renewable energy.

ATTACHMENT A

	Figure Not To Scale Source: Google Earth (by license)	Client: U.S. EPA Region 4, RAC		Project #: 048706	Title: Regional Aerial Photograph of the Site Alaric Site, Tampa, Florida	Figure 2-1
		File: Alaric Tech Memorandum Figures 10-02-08	Rev: 1.0	Date: 10/02/08		
		Drawn By/Checked By: EMS				

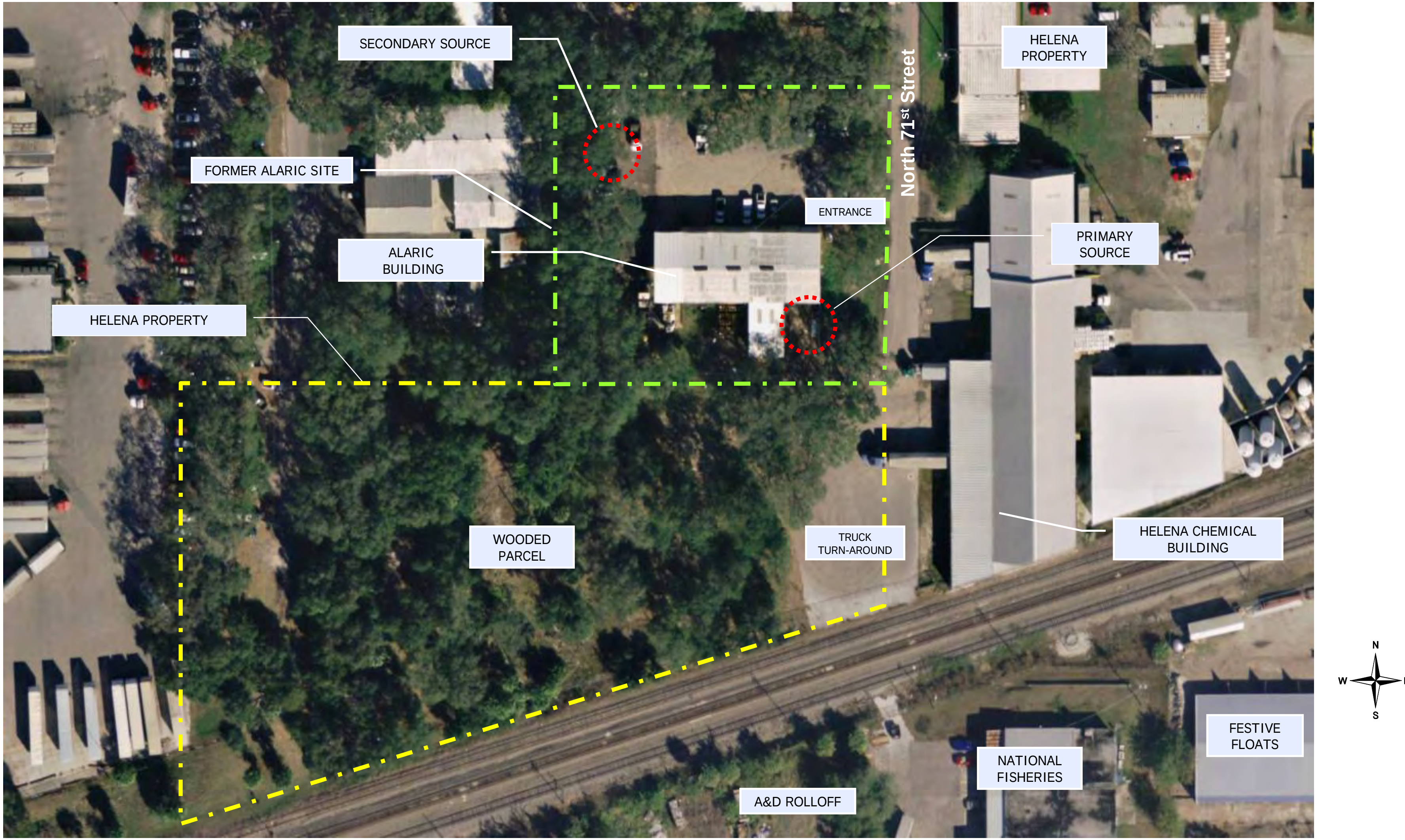
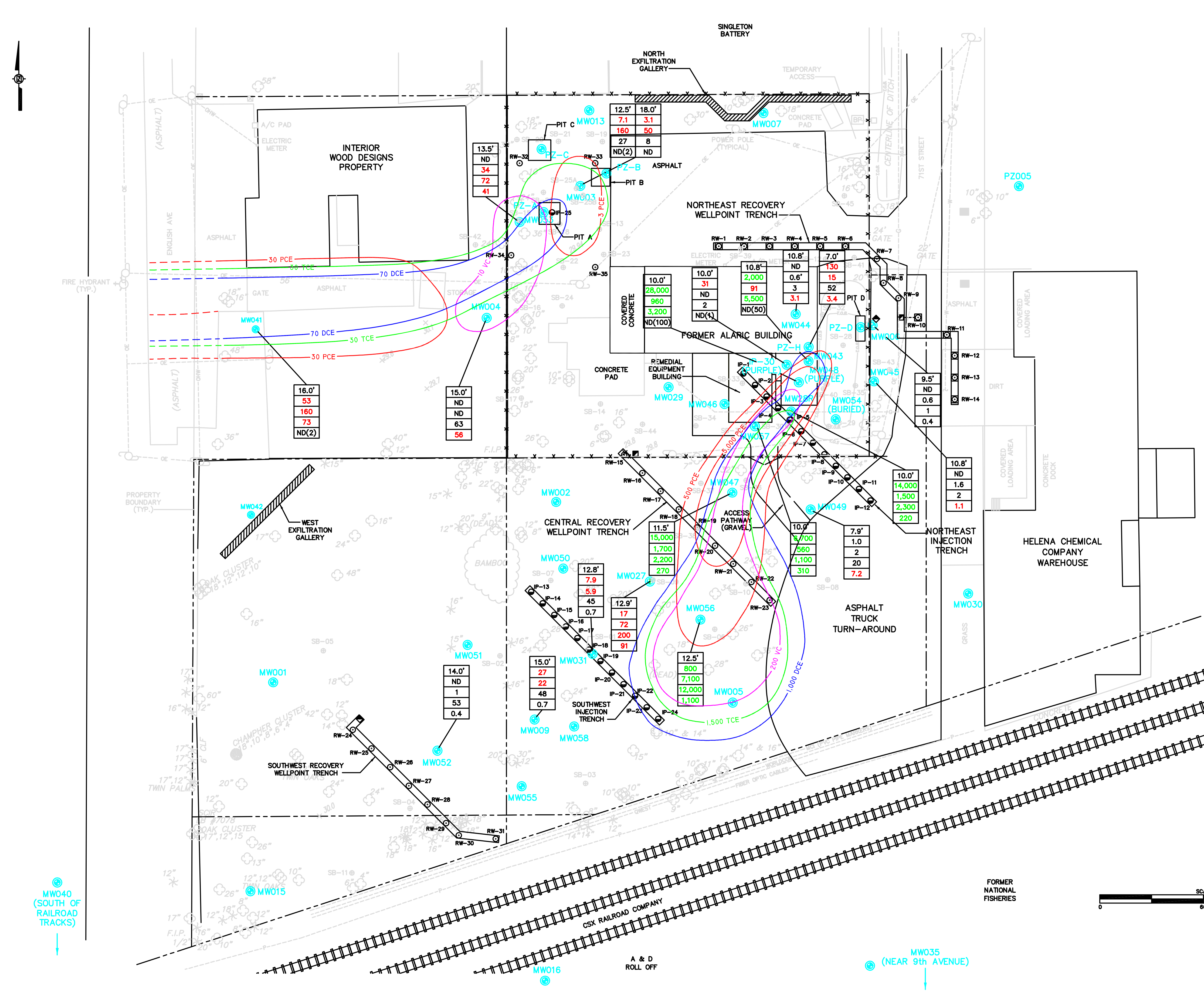


Figure Not To Scale Source: Hillsborough County Property Appraiser Website	**Client:** U.S. EPA Region 4, RAC		**Project #:** 048706	Title: **Site Aerial Photograph Alaric Site, Tampa, Florida**	**Figure 2-3**
	File: Alaric Tech Memorandum Figures 10-02-08	**Rev:** 1.0	**Date:** 10/02/08		
	Drawn By/Checked By: EMS				



LEGEND:

- EXISTING SHALLOW MONITORING WELL LOCATION (2 to 20')
- RECOVERY WELL MANIFOLD VAULT LOCATION
- SHALLOW INJECTION WELLPOINT LOCATION
- SHALLOW RECOVERY WELLPOINT LOCATION
- RECOVERY WELLPOINT LOCATION (HEAVY TRAFFIC)
- PCE — PCE ISOCONCENTRATION CONTOUR OF 3, 30, 500 or 5,000 ug/L
- TCE — TCE ISOCONCENTRATION CONTOUR OF 30 or 1,500 ug/L
- DCE — CIS-DCE ISOCONCENTRATION CONTOUR OF 70 or 1,000 ug/L
- VC — VINYL CHLORIDE ISOCONCENTRATION CONTOUR OF 10 or 200 ug/L

10.8'	SAMPLE DEPTH (FEET BLS)
ND	PCE CONCENTRATION (ug/L)
1.6	TCE CONCENTRATION (ug/L)
2	CIS-DCE CONCENTRATION (ug/L)
1.1	VINYL CHLORIDE CONC. (ug/L)

NOTES:

1. GROUNDWATER SAMPLES COLLECTED BY THE MICROPURGE TECHNIQUE IN JULY 2005.
2. ANALYTICAL RESULTS IN RED EXCEED THE FDEP CTL.
3. ANALYTICAL RESULTS IN GREEN EXCEED THE FDEP NADC.
4. THE 18-FOOT SAMPLE FROM MW003 IS WITHIN THE UPPER INTERMEDIATE ZONE.
5. MW28R WAS SAMPLED IN MAY 2007.

Symbol	Description	Date	Approved
EG	BV BORDAR ADDED	7/17/08	—

Revisions

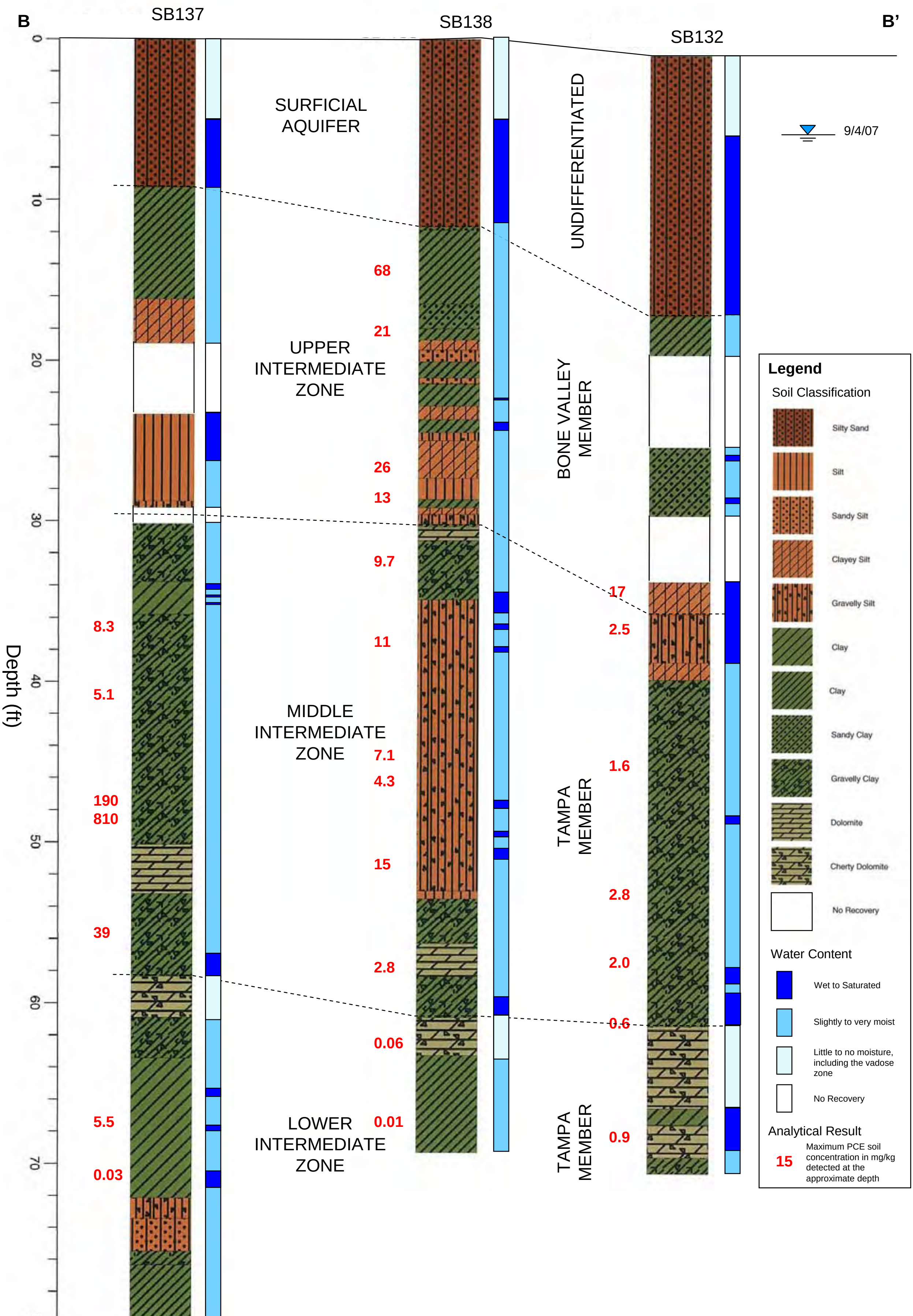
ALARIC SUPERFUND SITE
2110 NORTH 71st STREET
TAMPA, FLORIDA

BLACK & VEATCH *Special Projects Corp.*

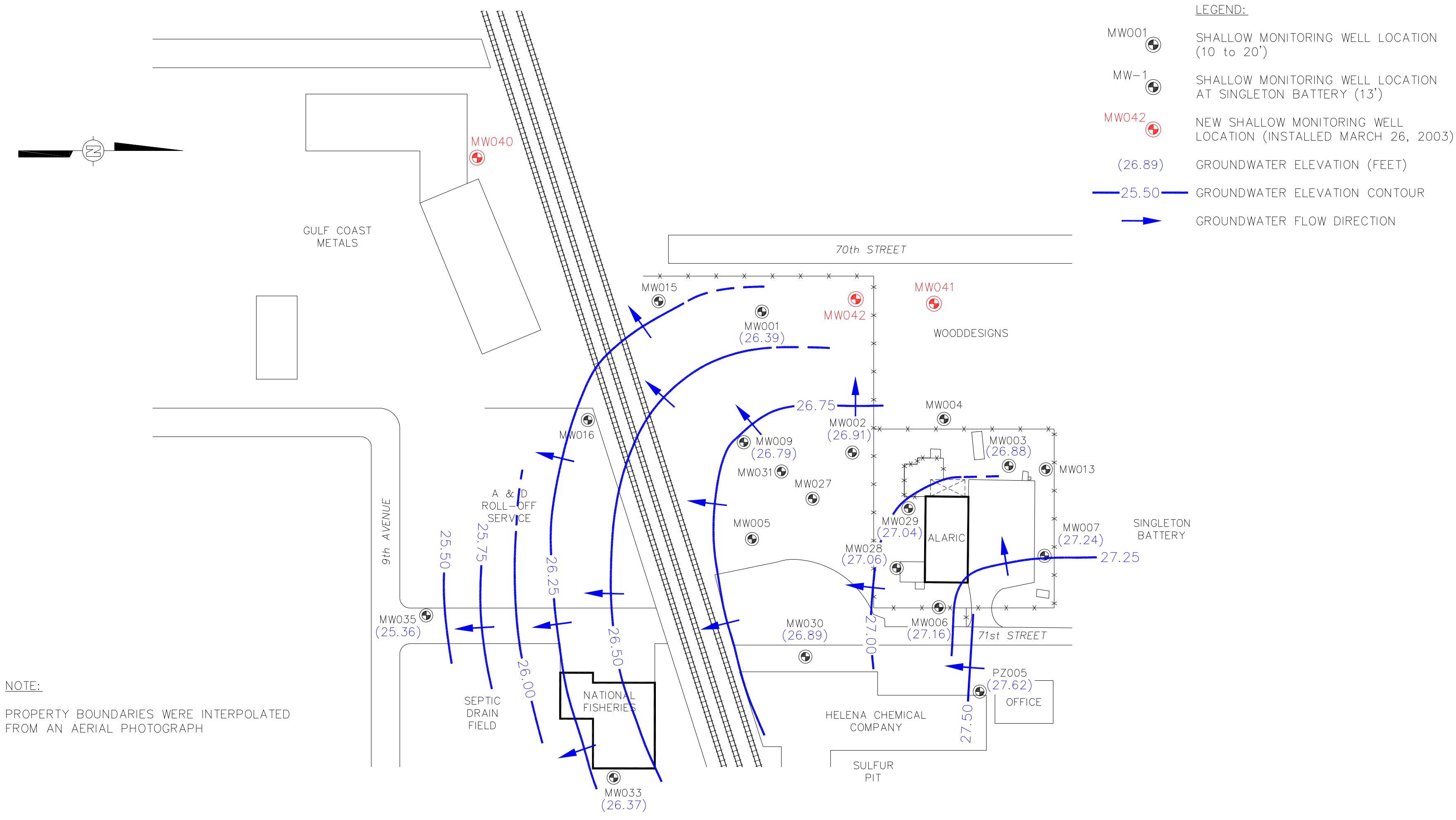
Designed By: CB	Date: 7/17/08
Drawn By: EG	File No.
Checked By: CB	Drawing Name: D-7A
Reviewed By:	Project Number: 048706.01.10

CHLORINATED COMPOUNDS IN GROUNDWATER FROM THE SURFICIAL AQUIFER APRIL 2007

FIGURE 2-6

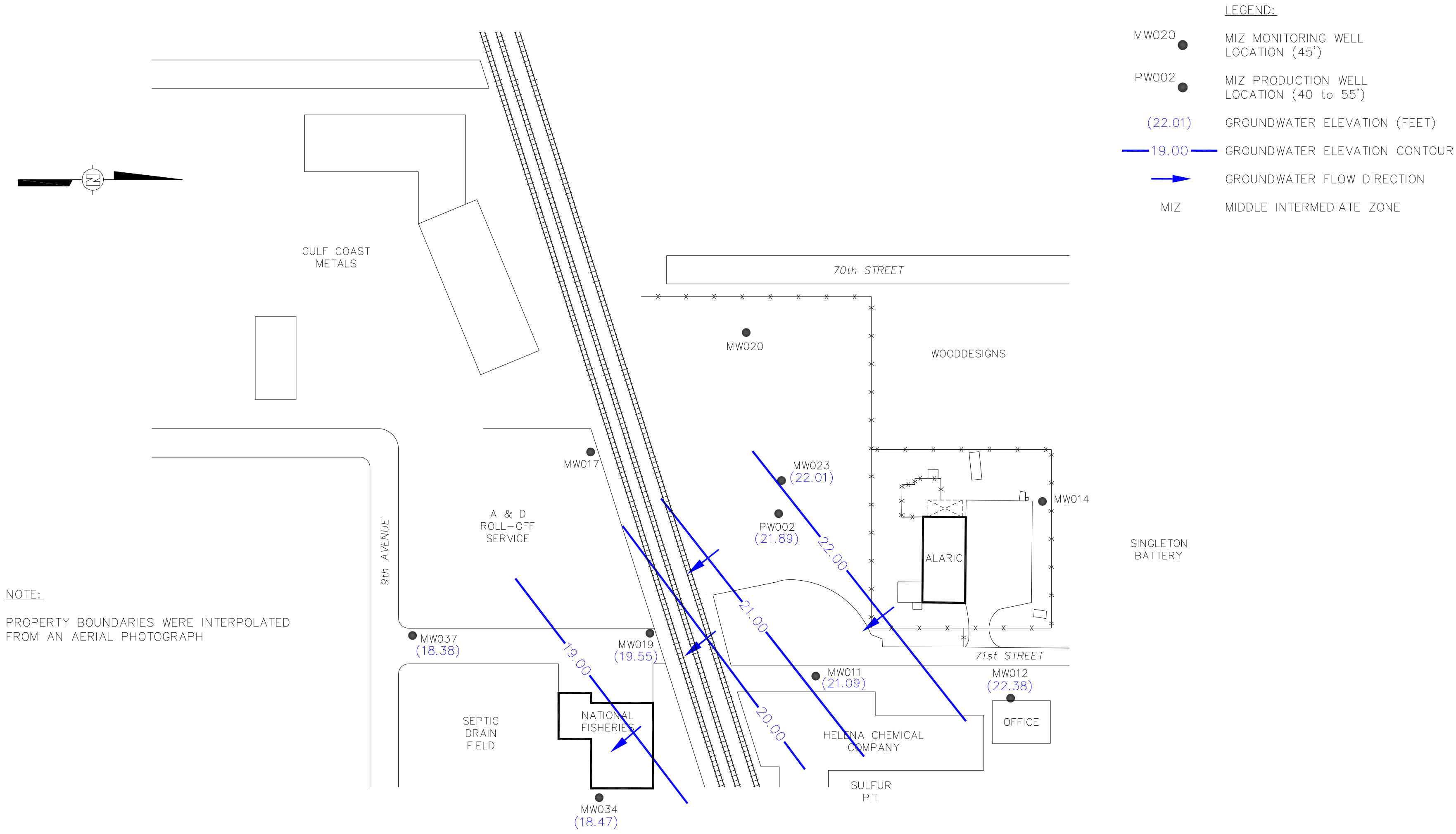


	Project #: 048706 **Date:** 09/08	Title: **Cross-Section of the Primary Source Area Technical Memorandum Former Alaric Site, Tampa**	**Figure 3-2**



Client: U.S. EPA Region 4, RAC	**Project #:** 048706	Title:	**Figure 3-4**
File: Alaric Tech Memorandum Figures 10-02-08	**Rev:** 1.0	**Date:** 10/02/08	
Drawn By/Checked By: SF/EMS			

Groundwater Elevations
In Shallow Wells (Non-Pumping)
December 15, 2002
Alaric Site, Tampa, Florida



SCALE
0 120 240

Client: U.S. EPA Region 4, RAC

Project #: 048706

File: Alaric Tech Memorandum Figures 10-02-08

Rev: 1.0

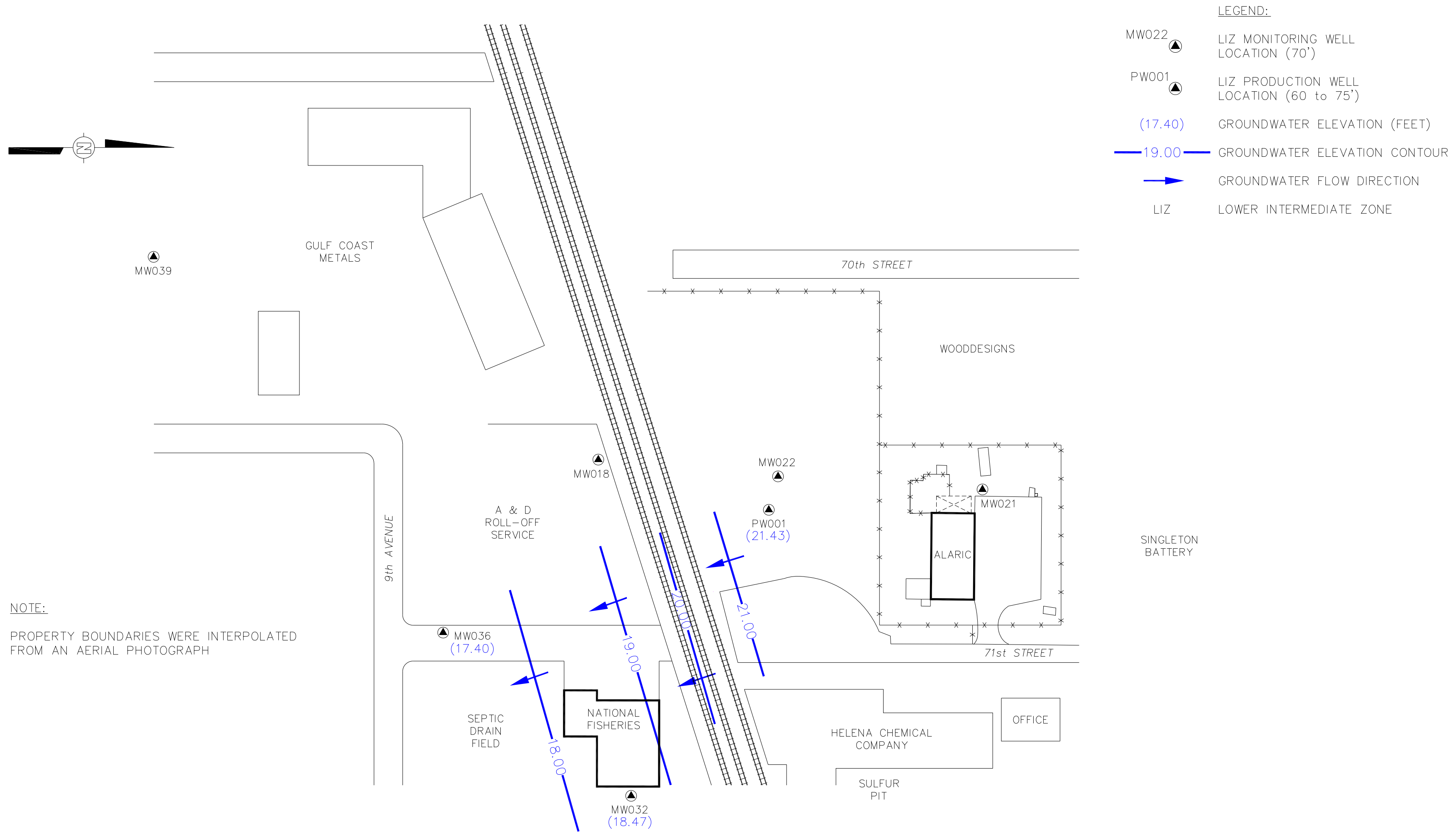
Date: 10/02/08

Drawn By/Checked By: EMS

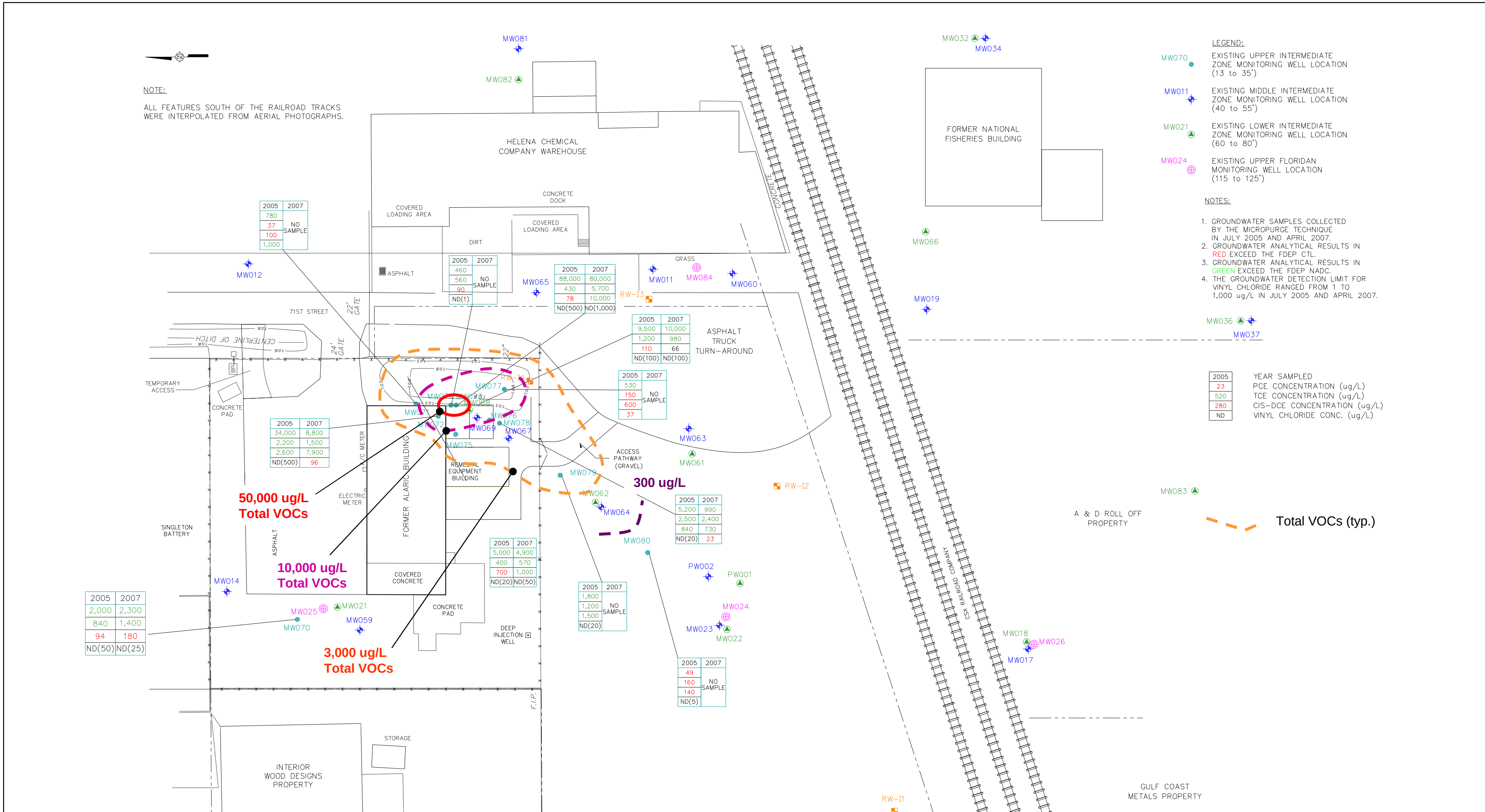
Title:

Groundwater Elevations
In MIZ Wells (Non-Pumping)
December 15, 2002
Alaric Site, Tampa, Florida

Figure 3-6



SCALE 0 120 240	**Client:** U.S. EPA Region 4, RAC	**Project #:** 048706	Title: **Groundwater Elevations In LIZ Wells (Non-Pumping) December 15, 2002 Alaric Site, Tampa, Florida**	**Figure 3-7**
	File: Alaric Tech Memorandum Figures 10-02-08	**Rev:** 1.0	**Date:** 10/02/08	
	Drawn By/Checked By: SF/EMS			



Client:	Project #:	Title:	
U.S. EPA Region 4, RAC	048706	2007/2008 VOC Distribution in the UIZ Alaric Site, Tampa, Florida	Figure 3-11

File: Alaric Tech Memorandum Figures 10-02-08

Rev: 1.0

Date: 10/02/08

Drawn By / Checked By: RC/EMS

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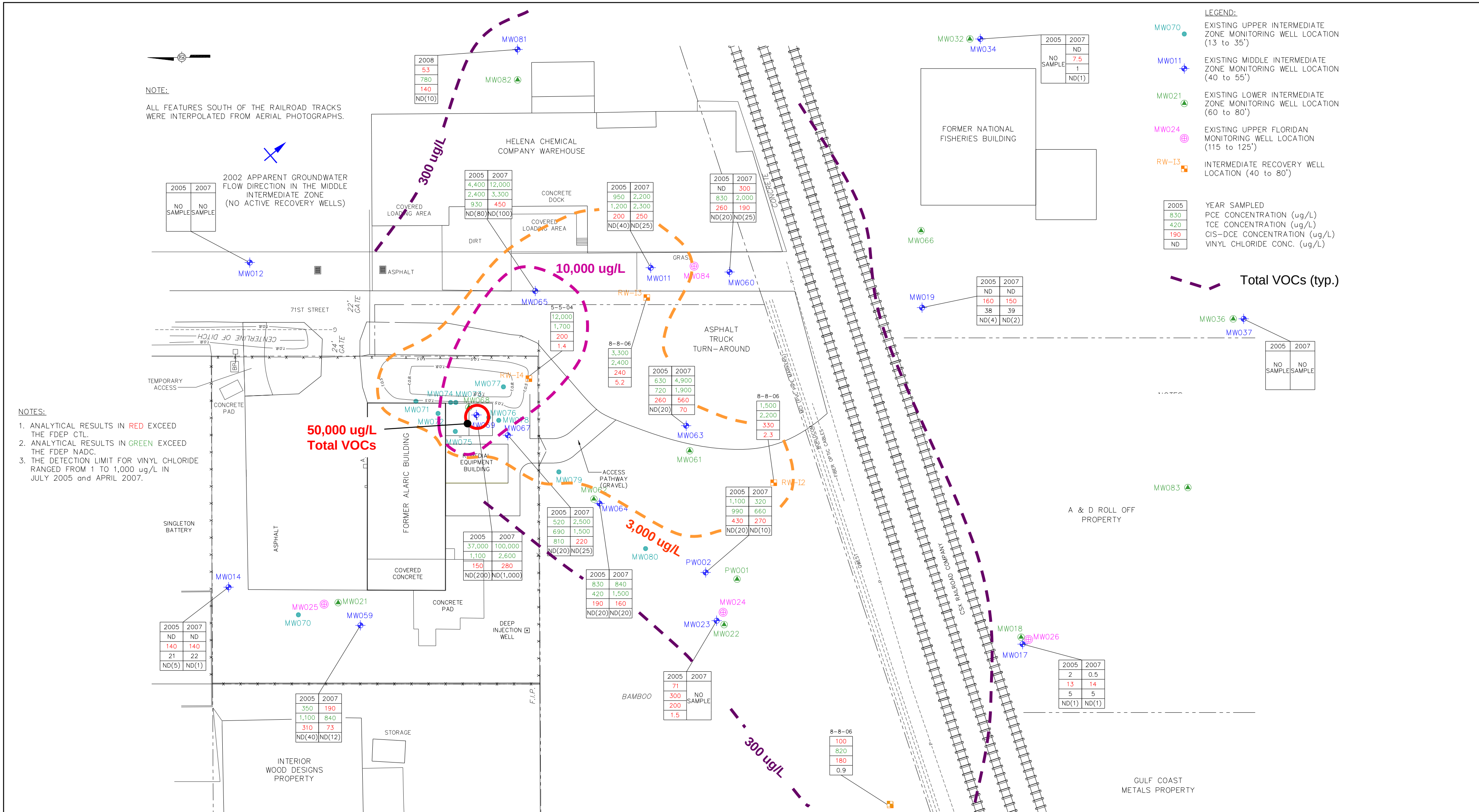
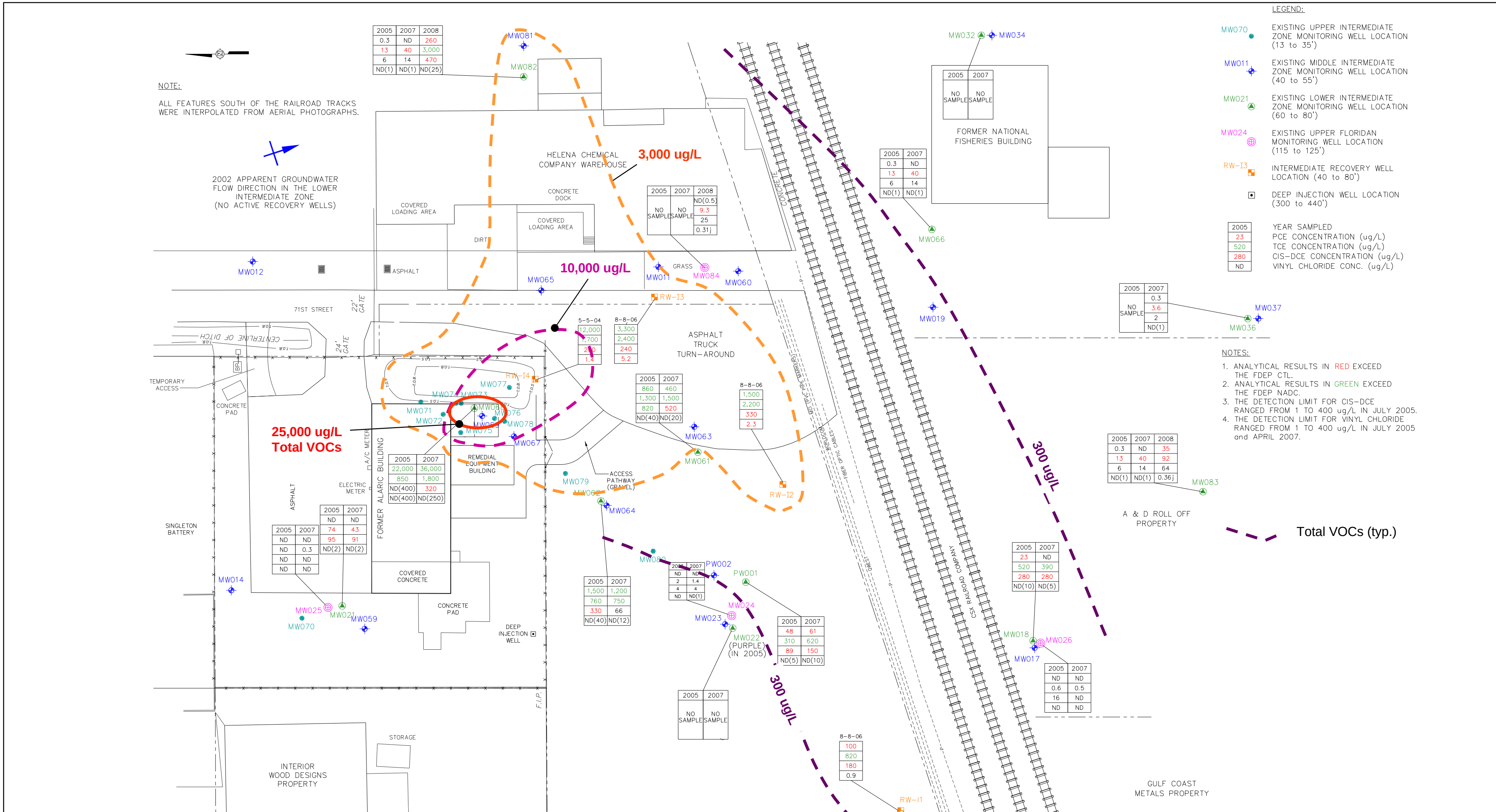


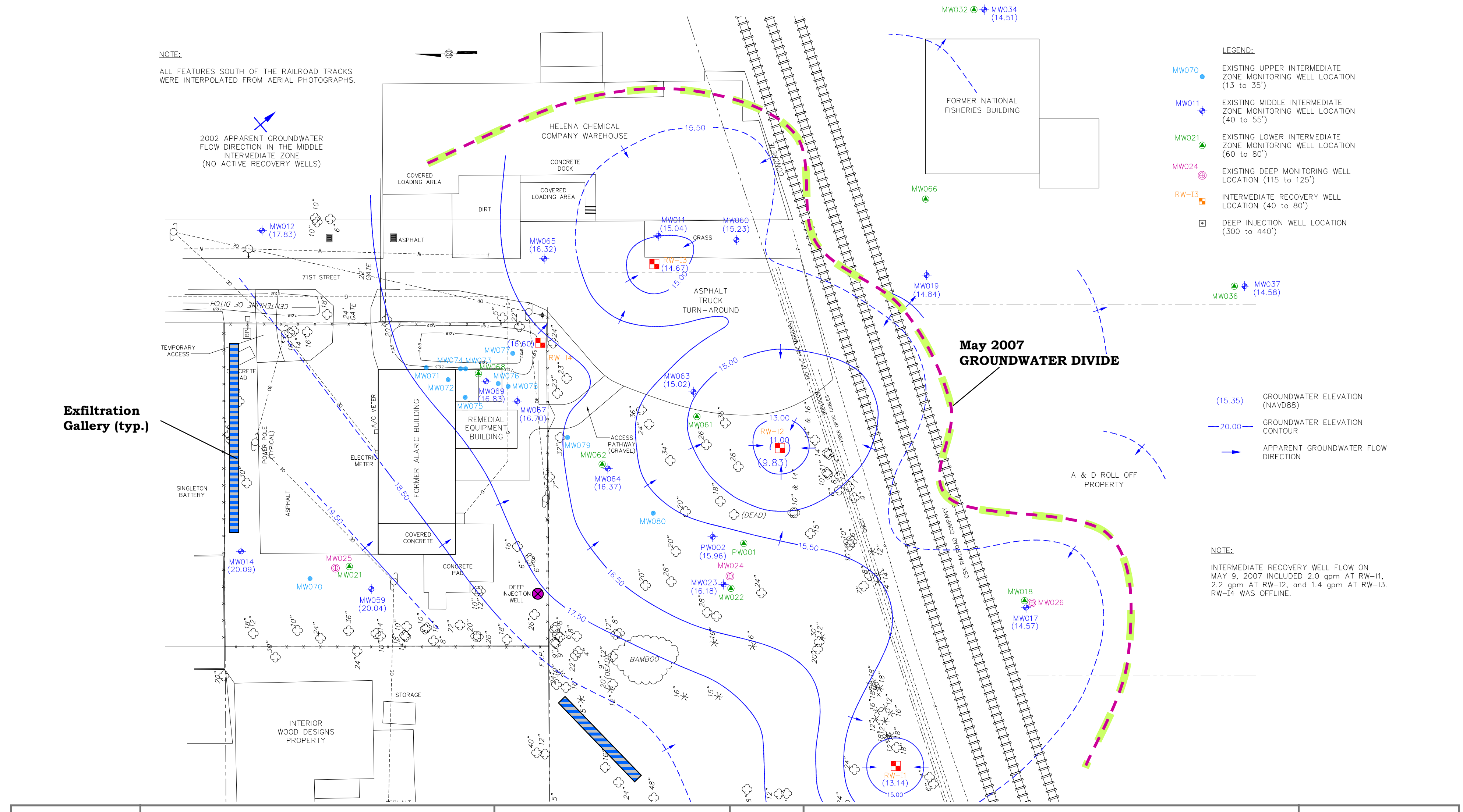
Client: U.S. EPA Region 4, RAC	Project #: 048706	Title:
File: Alaric Tech Memorandum Figures 10-02-08	Rev: 1.0	Date: 10/02/08
Drawn By/Checked By: RC/EMS		

2007/2008 VOC Distribution in the MIZ
Alaric Site, Tampa, Florida

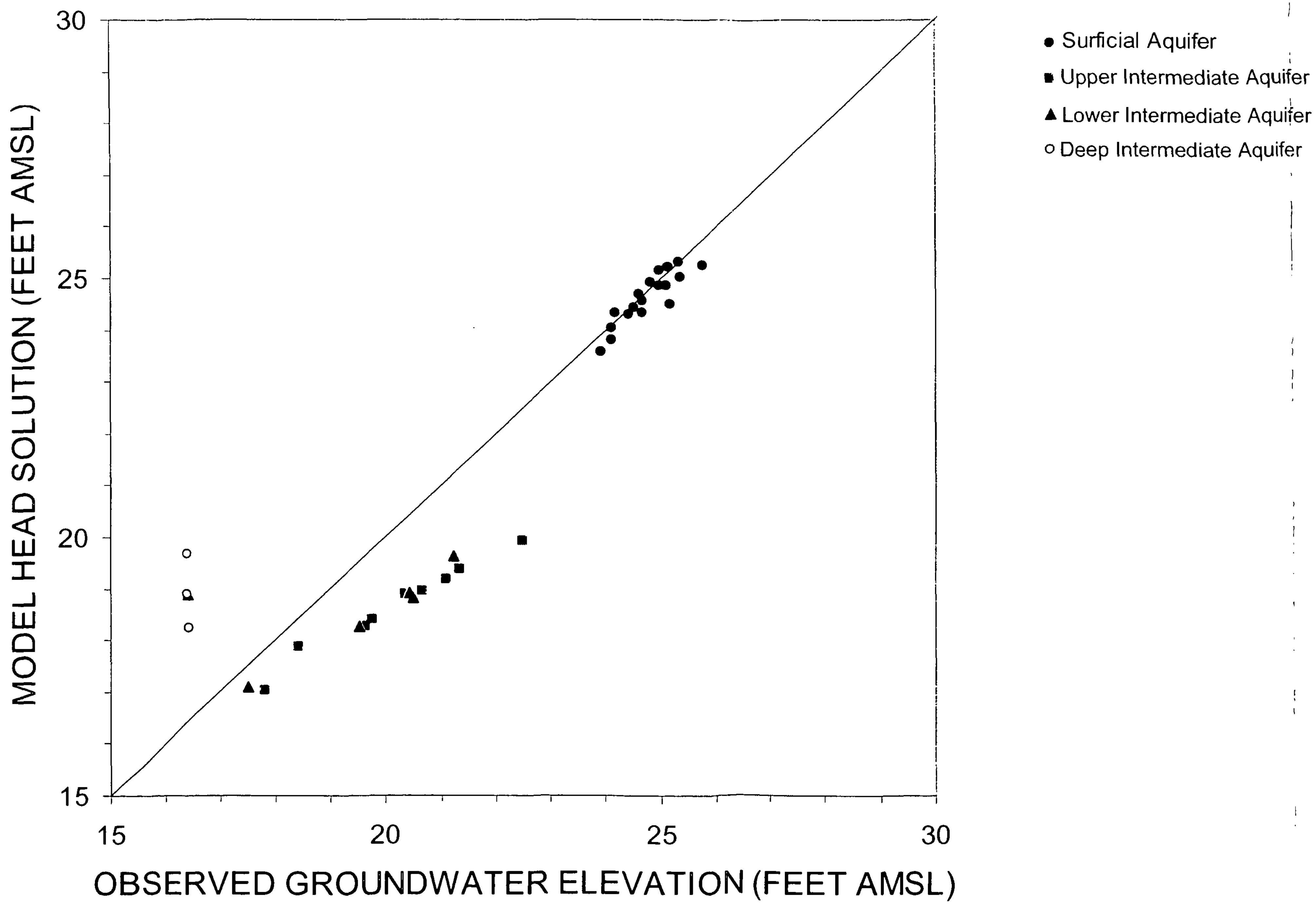
Figure 3-12



Client:	Project #:	Title:	
U.S. EPA Region 4, RAC	048706	**2007/2008 VOC Distribution in the LIZ** **Alaric Site, Tampa, Florida**	**Figure 3-13**
File: Alaric Tech Memorandum Figures 10-02-08	Rev: 1.0	Date: 10/02/08	
Drawn By/Checked By: RC/EMS			



Client: U.S. EPA Region 4, RAC	**Project #:** 048706	Title: **Remedial Alternative SZB-2B, HCP-3B, DP-2B Layout:** ***Groundwater Containment*** **Alaric Site, Tampa, Florida**	**Figure 7-10**
File: Alaric Tech Memorandum Figures 10-02-08	**Rev:** 1.0	**Date:** 10/02/08	
Drawn By/Checked By: RC/EMS			



Shaw

725 U.S. Highway 301 South
Tampa, FL 33619

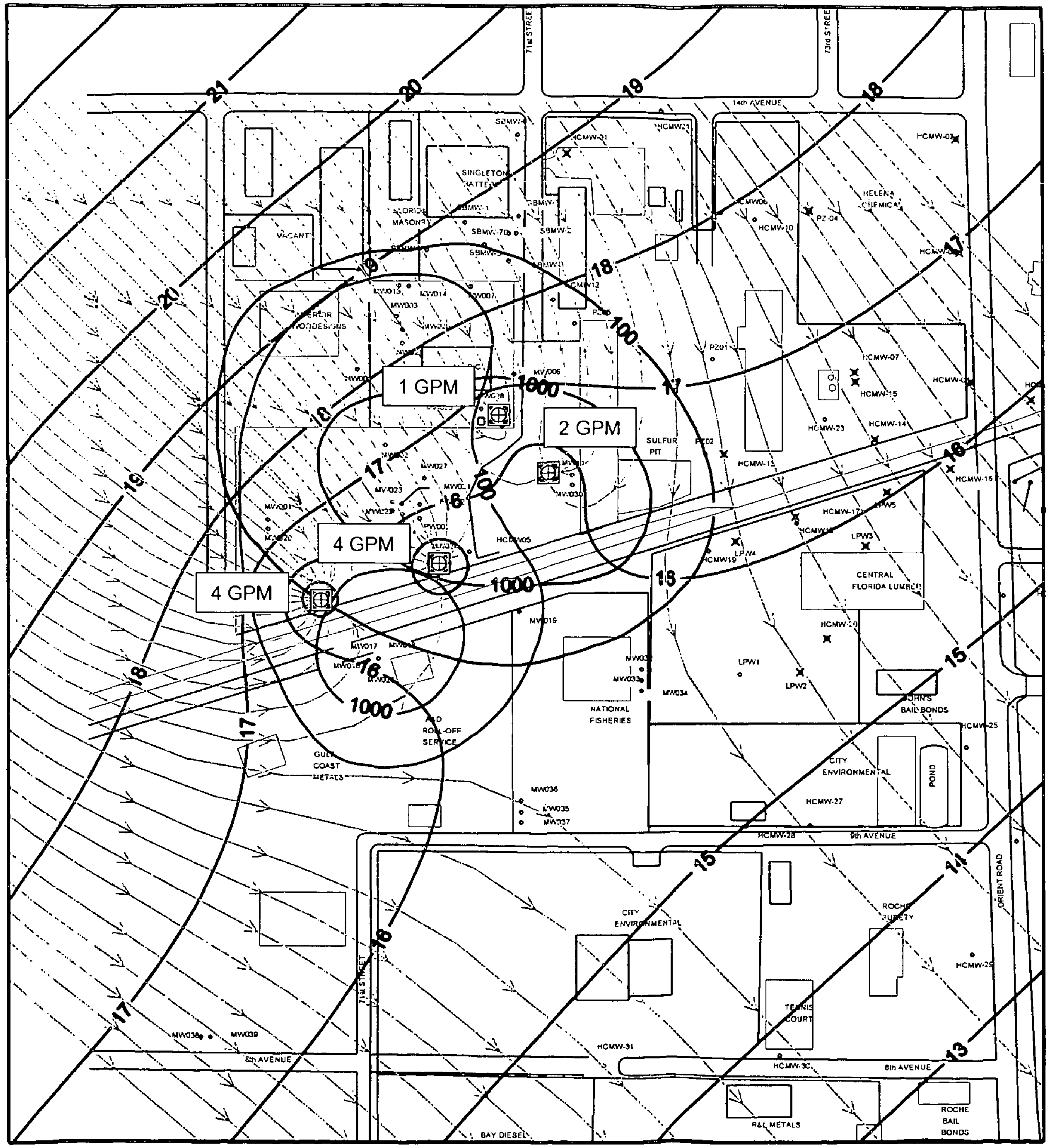
4/28/03

Figure K-7

Comparison of Steady-State Model and Observed Groundwater Elevations

Alaric, Inc. HWC-114
210 North 71st Street, Tampa, FL

Project # 804408 | PM: TW | PE: EMS



0 100 200 300 400

Scale in Feet

Groundwater Capture Zone

25 — Head Elevation Contour (Feet NAVD 88)

Groundwater Flow Path

100 — Total VOC Concentration Upper Intermediate (ug/L)

100 — Total VOC Concentration Lower Intermediate (ug/L)

Proposed Intermediate Aquifer Groundwater Recovery Well

N
W E
S

Shaw

725 U.S. Highway 301 South
Tampa, FL 33619

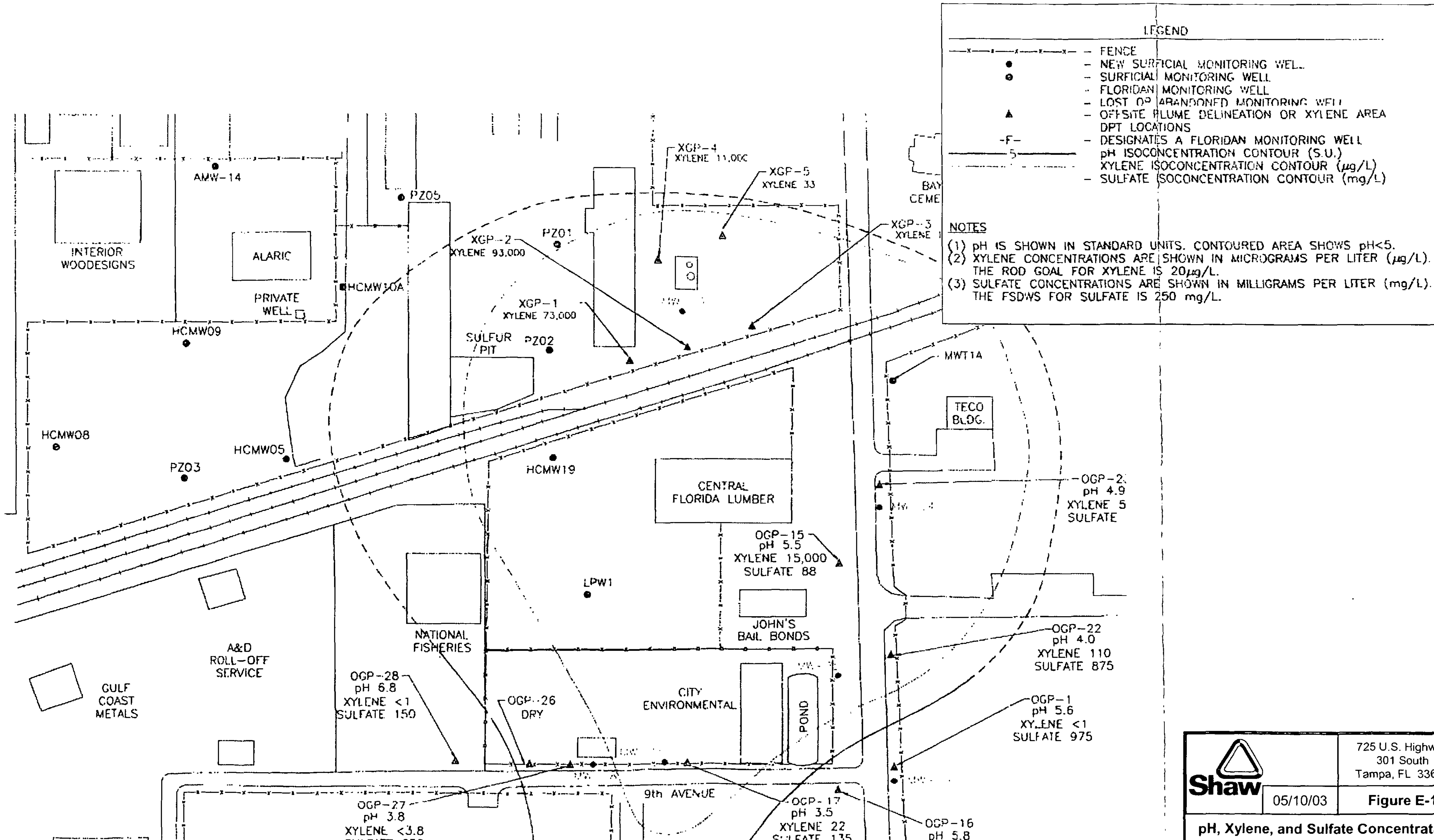
4/28/03

Figure K-18

Groundwater Flow Path Solution
Layer 3 (Upper Intermediate Aquifer)

Alaric, Inc. HWC-114
210 North 71st Street, Tampa, FL

Project # 804408	PM: TW	PE: EMS



Maps Prepared by Ensafe (2002)

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725 U.S. Highway 301 South
Tampa, FL 33619

05/10/03

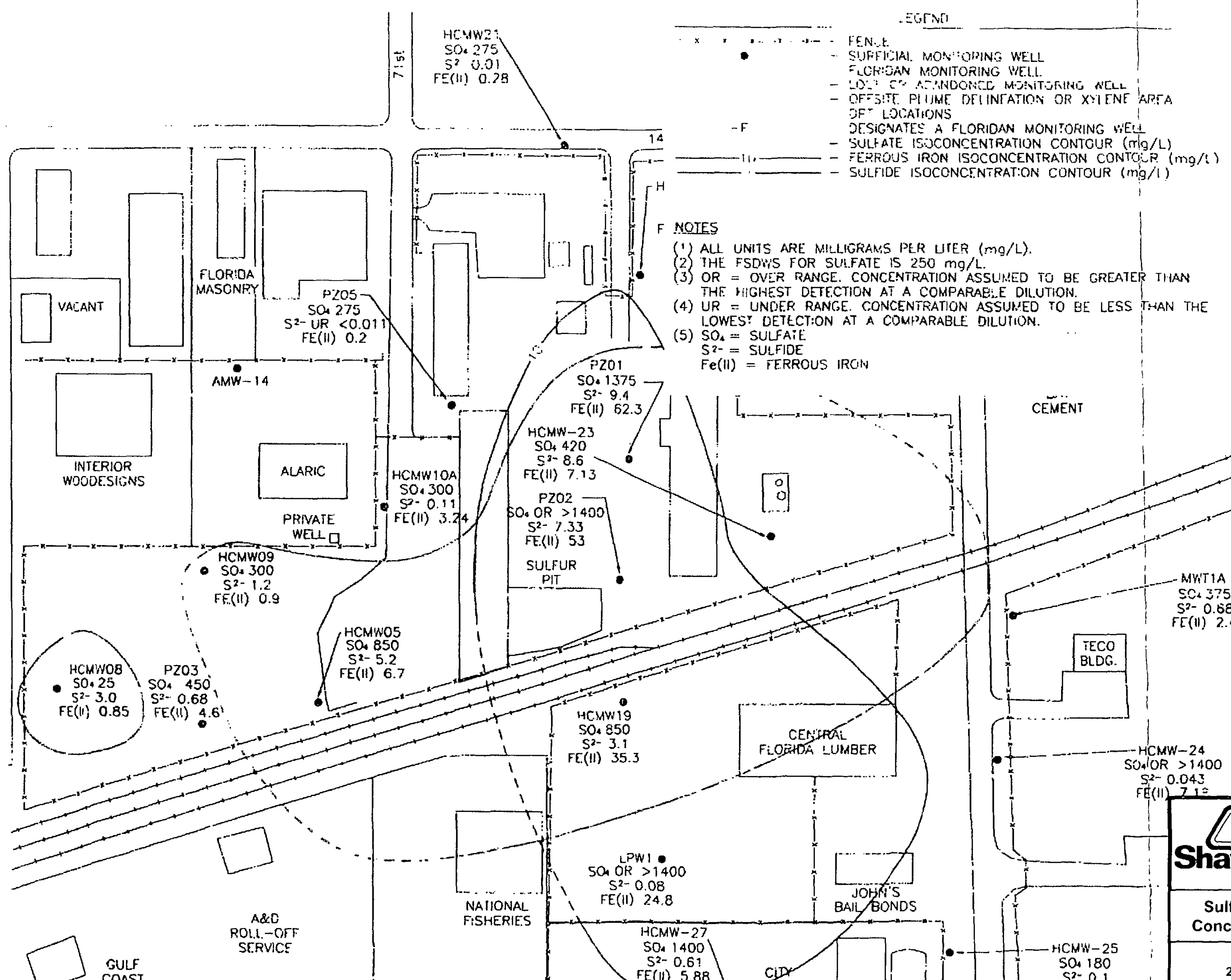
Figure E-1

pH, Xylene, and Sulfate Concentration Maps From Helena RI

Alaric, Inc. HWC-114
2110 North 71st Street, Tampa, FL

Project # 804378	PM: TW	PE: EMS

Maps Prepared by Ensafe (2002)



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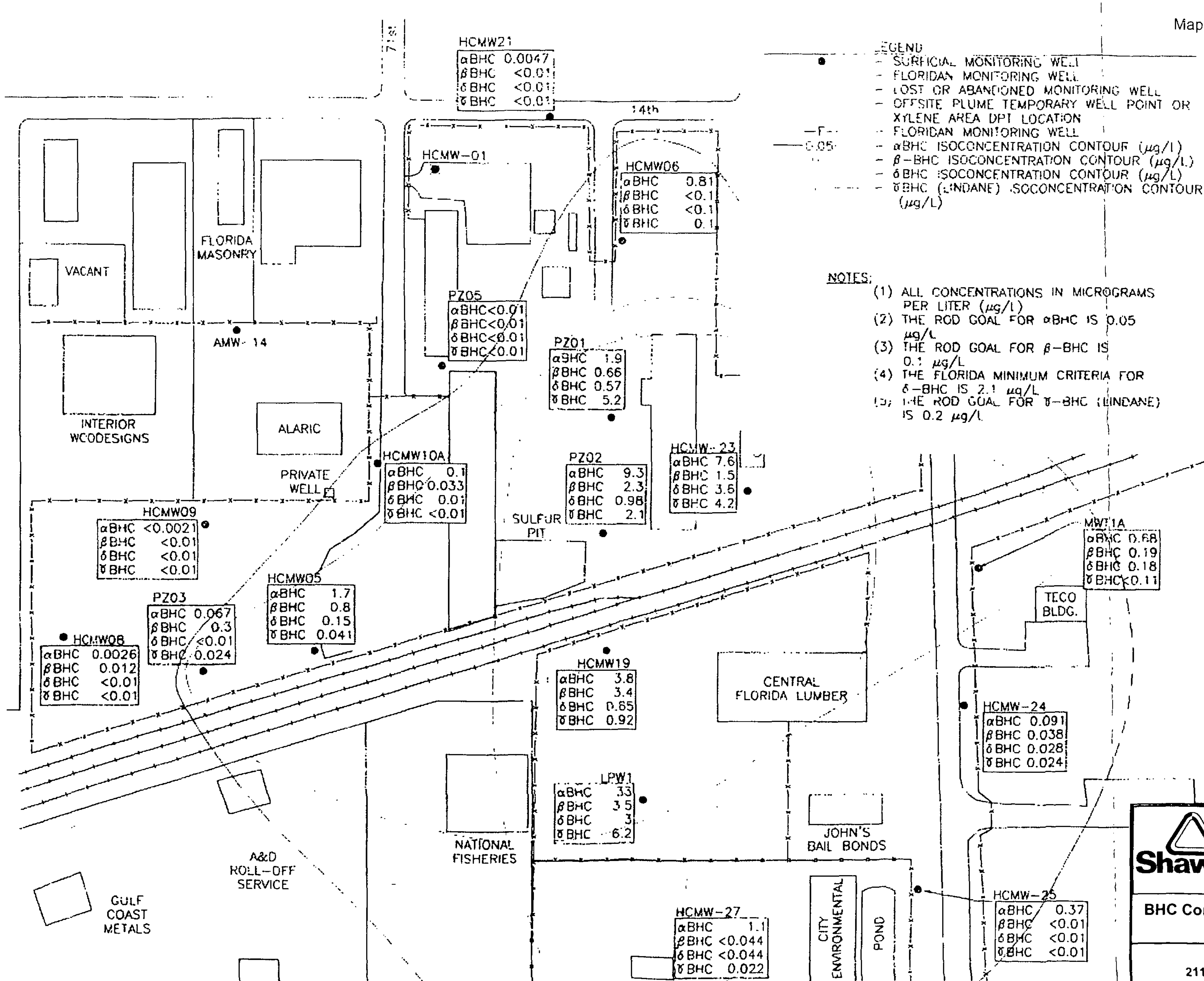
Tampa, FL 33619

05/10/03 — **Figure E-2**

Sulfate, Ferrous Iron, and Sulfide Concentration Maps From Helena RI

Alaric, Inc. HWC-114
2110 North 71st Street, Tampa, FL

Project # 804378	PM: TW	PE: EMS



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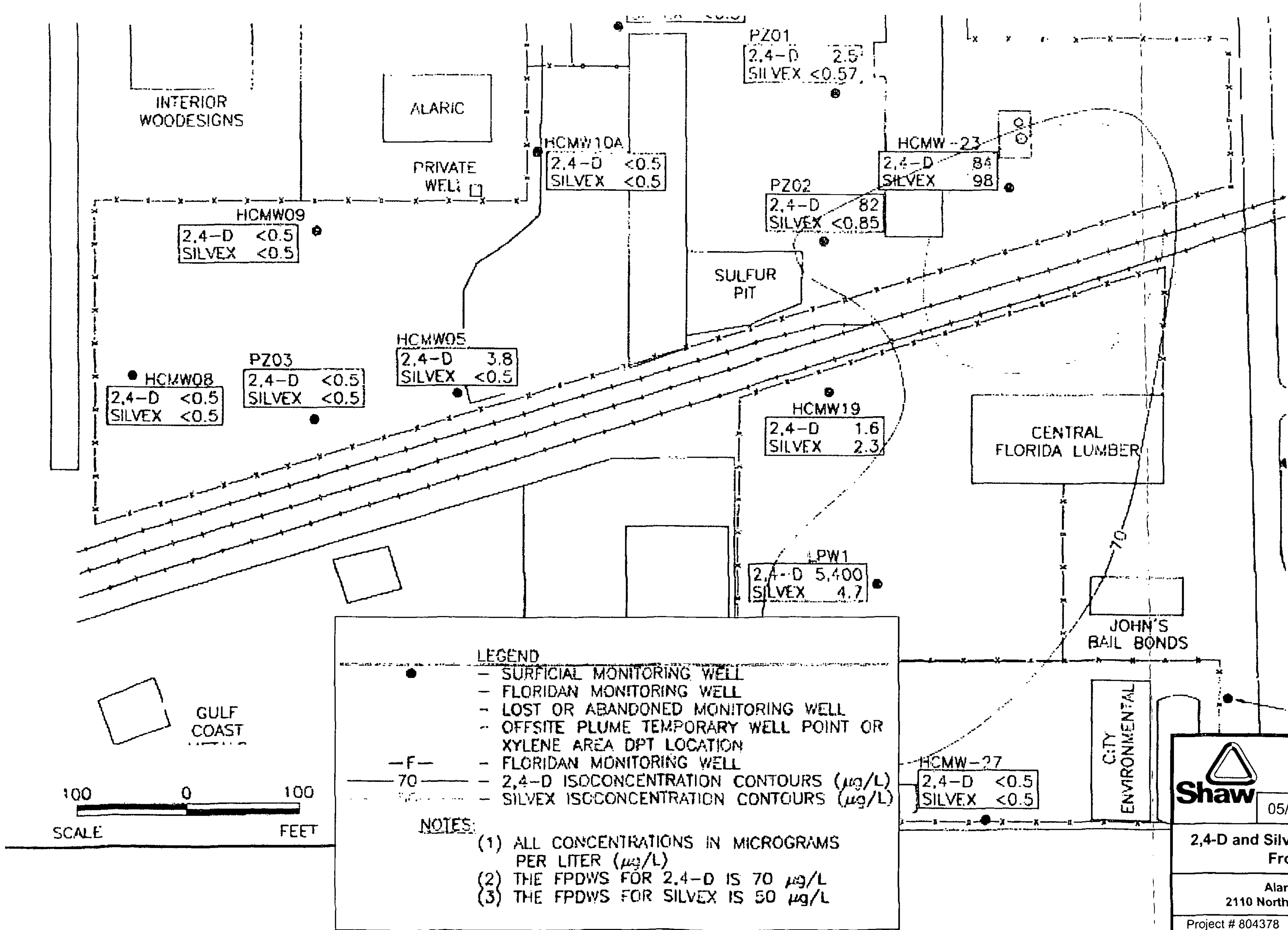
Tampa, FL 33619
05/10/03
Figure E-3
BHC Concentration Maps From Helena RI
Alaric, Inc. HWC-114
2110 North 71st Street, Tampa, FL
Project # 804378 | PM: TW | PE: EMS

Maps Prepared by Ensafe (2002)



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Tampa, FL 33619

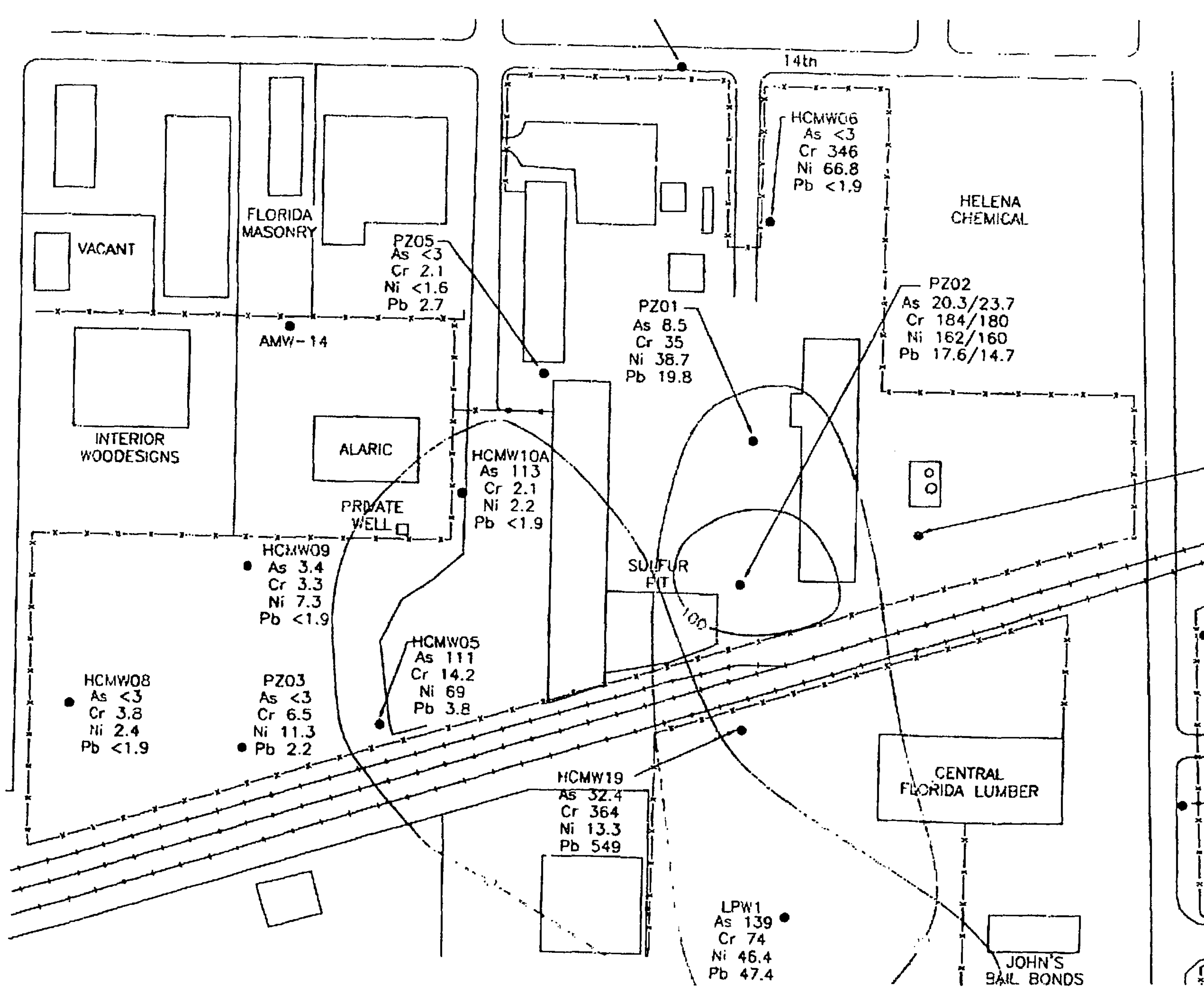
05/10/03

Figure E-4

2,4-D and Silvex Concentration Maps From Helena RI

Alaric, Inc. HWC-114
2110 North 71st Street, Tampa, FL

Project # 804378	PM: TW	PE: EMS



LEGEND

- FENCE
- SURFICIAL MONITORING WELL
- FLORIDAN MONITORING WELL
- LOST OR ABANDONED MONITORING WELL
- OFFSITE PLUME INVESTIGATION OR XYLENE AREA DPT LOCATIONS
- –F– DESIGNATES A FLORIDAN MONITORING WELL
- 100 NICKEL ISOCONCENTRATION CONTOUR (μg/L)
- ARSENIC ISOCONCENTRATION CONTOUR (μg/L)
- CHROMIUM ISOCONCENTRATION CONTOUR (μg/L)
- 15 LEAD ISOCONCENTRATION CONTOUR (μg/L)

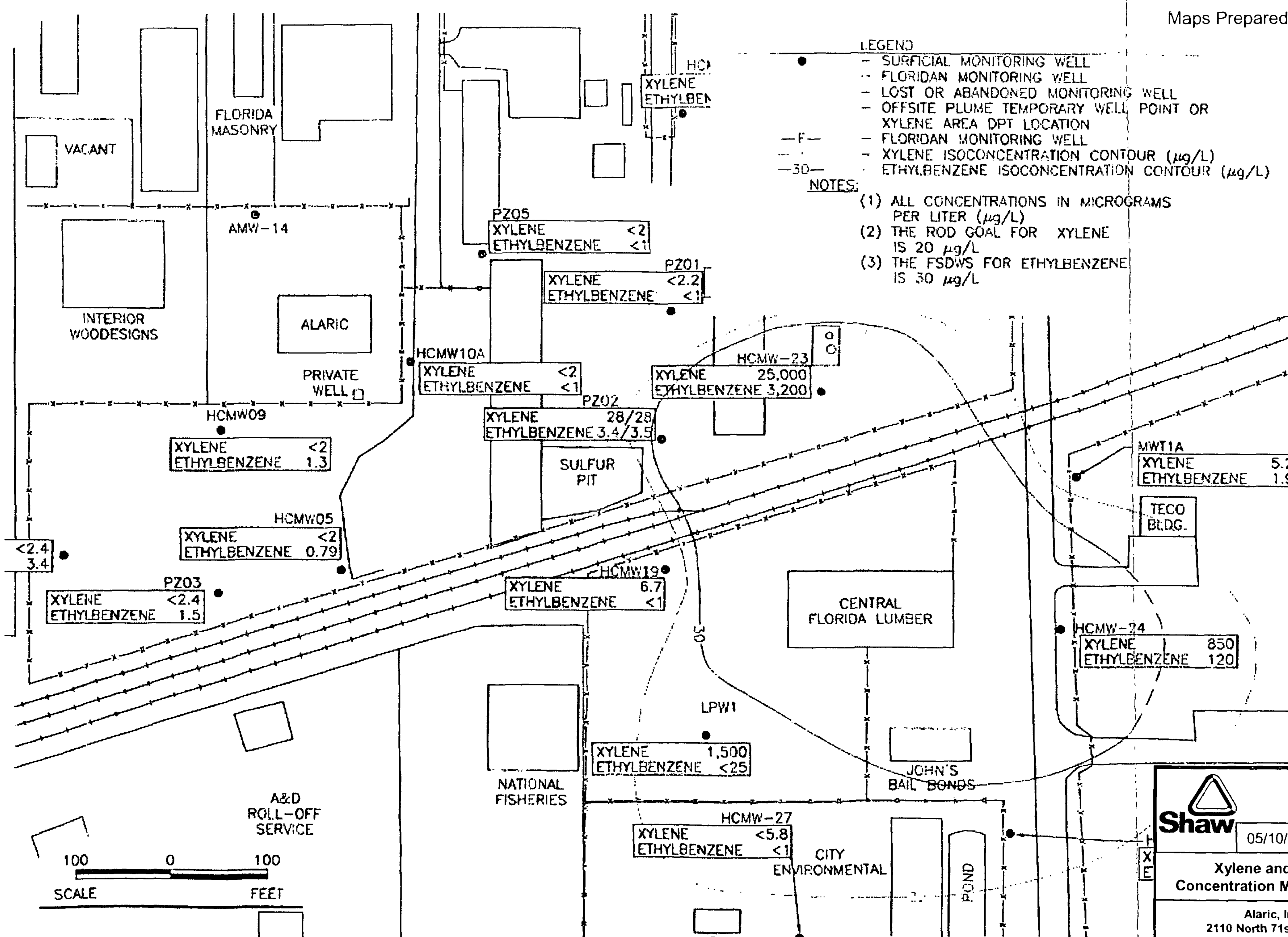
NOTES

(1) ALL UNITS ARE MICROGRAMS PER LITER (μg/L).
(2) THE FPDWS FOR NICKEL IS 100 μg/L.
(3) THE FPDWS FOR ARSENIC IS 50 μg/L.
(4) THE FPDWS FOR CHROMIUM IS 100 μg/L.
(5) THE FPDWS FOR LEAD IS 15 μg/L.

Maps Prepared by Ensafe (2002)

Shaw		725 U.S. Highway 301 South Tampa, FL 33619
	05/10/03	**Figure E-5**
Metals Concentration Maps From Helena RI		
Alaric, Inc. HWC-114 2110 North 71st Street, Tampa, FL		
Project # 804378	PM: TW	PE: EMS

Maps Prepared by Ensafe (2002)



Shaw

725 U.S. Highway 301 South Tampa, FL 33619

05/10/03

Figure E-6

Xylene and Ethylbenzene Concentration Maps From Helena RI

Alaric, Inc. HWC-114
2110 North 71st Street, Tampa, FL

Project # 804378 | PM: TW | PE: EMS

ATTACHMENT B

Approximate Carbon Footprint Calculations

These only consider those activities or components that are expected to be the primary contributors to the overall footprint. As such, the calculated footprints are approximations.

Baseline P&T System Operating at 8 gpm for Plume Capture

Electricity usage – 1,051,000 kWh total as follows
- 1.5 HP total for all three extraction wells, operating 100% of the time
- 1 HP for blower operating 100% of the time
- 1.5 HP feed pump operating 33% of the time
- 1 kW operating 100% of the time for miscellaneous usage (e.g., lighting, controls)
- All motors assumed to operate a 75% efficiency
- Remedy duration of 30 years

GAC usage – 60,000 pounds total as follows
- 2,000 pounds per year
- Remedy duration of 30 years

Acid usage – 126,000 pounds total as follows
- 4,200 pounds per year based on neutralizing 100 mg/L ($CaCO_3$) of alkalinity at 8 gpm
- Remedy duration of 30 years

Laboratory Analysis - $180,000 in laboratory analysis as follows:
- Monthly analysis of 5 samples (including QA) for VOCs only
- Analytical cost of $100 per sample
- Remedy duration of 30 years

Item	**Quantity**	**CO2e Emission Factor**	**CO2e Emission (lbs)**
Electricity (kWh)	1,051,000	1.27	1,335,000
GAC (lbs)	60,000	2	120,000
Acid (lbs)	126,000	2.4*	302,000
Laboratory analysis ($)	$180,000	1	180,000
		Total (lbs)	**1,937,000 lbs**
		Total (tons)	**970 tons**

** Emission factor for acid from European Reference Life Cycle Database (ELCD core database), version II compiled under contract on behalf of the European Commission - DG Joint Research Centre - Institute for Environment and Sustainability with technical and scientific support by JRC-IES from early 2008 to early 2009. (http://lca.jrc.ec.europa.eu/lcainfohub/datasetArea.vm)*

Enhanced P&T System Operating at 16 gpm for Remediation and Plume Capture

Electricity usage – 1,840,000 kWh total as follows

- 3 HP total for all six extraction wells, operating 100% of the time
- 2 HP for blower operating 100% of the time
- 1.5 HP feed pump operating 67% of the time
- 1 kW operating 100% of the time for miscellaneous usage (e.g., lighting, controls)
- All motors assumed to operate a 75% efficiency
- Remedy duration of 30 years

GAC usage – 180,000 pounds total as follows

- 8,000 pounds per year for first 10 years
- 6,000 pounds per year for next 10 years
- 4,000 pounds per year for last 10 years

Acid usage – 352,000 pounds total as follows

- 8,400 pounds per year based on neutralizing 100 mg/L (CaCO3) of alkalinity at 16 gpm
- Remedy duration of 30 years

Laboratory Analysis - $180,000 in laboratory analysis as follows:

- Monthly analysis of 5 samples (including QA) for VOCs only
- Analytical cost of $100 per sample
- Remedy duration of 30 years

Construction – excluded because footprint is negligible compared with other components.

Item	Quantity	CO2e Emission Factor	CO2e Emission (lbs)
Electricity (kWh)	1,840,000	1.27	2,337,000
GAC (lbs)	180,000	2	360,000
Acid (lbs)	352,000	2.4*	845,000
Laboratory analysis ($)	$180,000	1	180,000
		Total (lbs)	**3,7622,000 lbs**
		Total (tons)	**1,861 tons**
		Total (tons)	**970 tons**

** Emission factor for acid from European Reference Life Cycle Database (ELCD core database), version II compiled under contract on behalf of the European Commission - DG Joint Research Centre - Institute for Environment and Sustainability with technical and scientific support by JRC-IES from early 2008 to early 2009. (http://lca.jrc.ec.europa.eu/lcainfohub/datasetArea.vm)*

Thermal Remediation for Source Zone

Electricity usage – 835,000 kWh total as follows

- 20,000 btus of energy per cubic foot (approximately 15,000 btus of heat to heat water and soil 150 F plus additional 5,000 btus to account for some heat loss and limited water vaporization)
- 3,413 btus of heat per kWh for electrical resistive heating
- 27 cubic feet per cubic yard and source zone volume of 5,000 cubic yards
- 5 HP blower operating for 12 months (motor operates at 75% efficiency

Steel for electrode installation – 280,000 total pounds as follows

- 56 electrodes to average depth of 50 feet
- 4-inch steel casing at approximately 10.8 pounds per foot
- 730 cubic feet of steel shot (342 pounds/cubic foot) to backfill boreholes to increase electrical conductivity
- Other construction materials and activities are negligible

GAC usage – 600 pounds total as follows (negligible)

- 2 pounds of GAC per pound of contaminant
- Approximately 300 pounds of contaminants

Construction is excluded, but is anticipated to have a small footprint relative to footprint from electricity usage

Item	**Quantity**	**CO2e Emission Factor**	**CO2e Emission (lbs)**
Electricity (kWh)	835,000	1.27	1,060,000
Steel (lbs)	280,000	1.1*	308,000
GAC (lbs)	600	2	1,200
		Total (lbs)	**1,369,000 lbs**
		Total (tons)	**685 tons**

** Emission factor for steel from European Reference Life Cycle Database (ELCD core database), version II compiled under contract on behalf of the European Commission - DG Joint Research Centre - Institute for Environment and Sustainability with technical and scientific support by JRC-IES from early 2008 to early 2009. (http://lca.jrc.ec.europa.eu/lcainfohub/datasetArea.vm)*

Thermal Remediation for High Concentration Plume

Scaling the footprint for source zone from 5,000 cubic yards (source zone) to 27,000 cubic yards (high concentration plume) yields a footprint of 3,700 tons of CO_2e for remediating the HCP with thermal remediation.

Thermal Remediation for Dilute Plume

Scaling the footprint for source zone from 5,000 cubic yards (source zone) to 68,000 cubic yards (dilute plume) yields a footprint of 9,300 tons of CO_2e for remediating the dilute plume with thermal remediation.

Bioremediation for Source Zone

Primary footprint components

On-site diesel usage – 5,150 total gallons as follows

- 70 locations for pneumatic fracturing and injection at one location per day
- 12 gallons of diesel per day for direct-push rig
- 70 8-hour days of 70 HP air compressor operating at 40% duty and 0.056 gallons of diesel per HP-hr
- 3 injection/fracturing events using the above parameters

Emulsified vegetable oil – 90,000 pounds as follows

- 0.002 pounds per pound of soil adsorptive capacity
- 5,000 cubic yards of treatment area
- 1.5 tons per cubic yard of soil and 2,000 pounds per ton
- 3 injections made at soil adsorptive capacity

Off-site diesel usage – 1,035 total gallons as follows

- 30,000 pounds of vegetable oil hauled 1,000 miles for each event
- 3 events
- 0.023 gallons per ton-mile of transport

Item	Quantity	CO_2e Emission Factor	CO_2e Emission (lbs)
Diesel	6,185	22	136,000
Vegetable oil	90,000	3.51	316,000
		Total (lbs)	**452,000 lbs**
		Total (tons)	**226 tons**

** Footprint for vegetable oil obtained from Nielsen PH, Nielsen AM, Weidema BP, Dalgaard R and Halberg N (2003). LCA food data base. www.lcafood.dk*

Bioremediation for High Concentration Plume

Scaling the footprint for source zone from 5,000 cubic yards (source zone) to 27,000 cubic yards (high concentration plume) yields a footprint of 1,200 tons of CO2e for remediating the HCP with bioremediation.

Bioremediation for Dilute Plume

Scaling the footprint for source zone from 5,000 cubic yards (source zone) to 68,000 cubic yards (dilute plume) yields a footprint of 3,100 tons of CO2e for remediating the dilute plume with bioremediation.

Derivation of Estimated Carbon Footprint for GAC

Information from Literature

Use of Adsorbents for the Removal of Pollutants from Wastewaters, by Gordon McKay, published by CRC Press, 1995, ISBN 0849369207

Table 8.1

Granular Carbon Regeneration Process Energy Requirements (15,000 kg/day Regeneration Rate)			
System	**Fuel, kJ/kg**	**Electricity, kWh/kg**	**Steam, kg/kg**
Electric infrared furnace	0	0.36	0
Multiple-hearth furnace	18,600	0.10	1.0
Rotary Kiln	23,300	0.07	1.0
Fluid bed furnace	11,700	0.11	0.8

1.2		Specific gravity of coal (www.engineeringtoolbox.com)
0.5		Specific gravity of GAC (Westates/Siemens)
0.7		Fraction of coal that is carbon (http://www.eia.doe.gov/cneaf/coal/quarterly/co2_article/co2.html)
0.27	lb CO2e/lb	Carbon footprint of extracting and delivering 1 lb of coal to a plant (EUROPA ELCD - Hard Coal)
14	lb CO2e	Carbon footprint of natural gas, including natural gas production (per therm) (NREL)
1.34	lb CO2e	Carbon footprint of electricity (per kWh) (EGRID, US Average)

Assumptions:

- Use fuel and electricity requirements for multiple hearth furnace to estimate energy required for regeneration

- Assume energy requirements for regeneration is the same as they are for initial activation

Calculations for Virgin Coal:

Carbon Footprint

2.4		Pounds of coal required to produce one pound of GAC
1.68		Pounds of that coal that is carbon
1		Pounds of carbon in one pound of GAC
0.68		Pounds of carbon from coal emitted to atmosphere
2.5	lb CO2e	Pounds of carbon dioxide emitted for burning off coal (measured as pounds of CO2)
0.65	lb CO2e	Pounds of CO2e emitted during coal extraction
8,920	Btus	Fuel required to activate one pound of GAC (2.2 pounds per kg and 1.055 kJ/btu)
1.2	lb CO2e	Pounds of CO2e emitted for combustion of natural gas during activation (100,000 btus per therm)
0.045	kWh	Electricity required to activate one pound of GAC (2.2 pounds per kg)
0.061	lb CO2e	Pounds of CO2e emitted for electricity generation
4.5	lb CO2e	Total CO2e emitted for carbon activation

Energy Footprint

2.4		Pounds of coal required to produce one pound of GAC
1440	Btus	Energy required during coal extraction
8,920	Btus	Fuel required to activate one pound of GAC (2.2 pounds per kg and 1.055 kJ/btu)
0.045	kWh	Electricity required to activate one pound of GAC
470	Btus	Energy required to generate that electricity (3,413 btus/kWh and 33% thermal efficiency)
10,800	Btus	Total energy required for virgin carbon activation

Calculations for Regenerated Coal

Footprint per Regeneration Cycle (including 10% virgin GAC to make-up for loss)

Energy	CO2e
8,920 + 10% x 10,800 = 10,000	1.2 + 0.061 + 10% x 4.5 = 1.7

Footprints over 10 Regeneration Cycles

Cycle	Energy	CO2e
1	10,800	4.5
2	10,400	3.1
3	10,300	2.6
4	10,200	2.4
5	10,200	2.2
6	10,100	2.1
7	10,100	2.1
8	10,100	2
9	10,100	2
10	10,100	1.9

ATTACHMENT C

Financial Analysis
Photovoltaic System - Alaric Superfund Site, Tampa, Florida

System Power (DC, STC)	20	kW	**Solar Capital Cost**	**$170,000**	
System Efficiency	77%		Rebate	$80,000	at $4 per installed watt
System Power (AC)	15.4	kW			
Installed Unit Cost	$8,500	$/kW DC	**Total MTC Grant**	**$80,000**	
			Solar Grant %	47.06%	
Annual Production	27,260	kWh/yr	**Cost After Grants**	**$90,000**	
Electricity Rate	$0.1200	$/kWh	**Net Upfront Cost**	**$90,000**	
			30% fed tax credit	$0	not applicable to military
			max taken in 1st year	$0	not applicable to military
Demand Charge	$0.0000	$/kW	amount remaining	$0	not applicable to military
			Loan Amount	$0	
			Loan Term	0	years
Escalation	5.00%	{annual rate increase}	Interest Rate	0.00%	per year
			Annual Payment	$0	
Estimated SREC value	$0.0000	$/kWh			
			Tax Rate	0.0%	not applicable to military

Year	Cash/Loan	Federal Tax Credit and Depreciation	Tax Deduction on Loan Interest	Avoided Energy Cost Photovoltaic System	Other Federal Credit (per kWh)	REC	Cash Flow	Cumulative Cash Flow
1	($90,000)	$0	$0	$3,271	$0	$0	($86,729)	($86,729)
2	$0	$0	$0	$3,400	$0	$0	$3,400	($83,328)
3	$0	$0	$0	$3,535	$0	$0	$3,535	($79,794)
4	$0	$0	$0	$3,674	$0	$0	$3,674	($76,119)
5	$0	$0	$0	$3,819	$0	$0	$3,819	($72,300)
6	$0	$0	$0	$3,970	$0	$0	$3,970	($68,329)
7	$0	$0	$0	$4,127	$0	$0	$4,127	($64,202)
8	$0	$0	$0	$4,290	$0	$0	$4,290	($59,912)
9	$0	$0	$0	$4,460	$0	$0	$4,460	($55,452)
10	$0	$0	$0	$4,636	$0	$0	$4,636	($50,817)
11	$0	$0	$0	$4,819	$0	$0	$4,819	($45,998)
12	$0	$0	$0	$5,009	$0	$0	$5,009	($40,988)
13	$0	$0	$0	$5,207	$0	$0	$5,207	($35,781)
14	$0	$0	$0	$5,413	$0	$0	$5,413	($30,368)
15	$0	$0	$0	$5,627	$0	$0	$5,627	($24,742)
16	$0	$0	$0	$5,849	$0	$0	$5,849	($18,893)
17	$0	$0	$0	$6,080	$0	$0	$6,080	($12,813)
18	$0	$0	$0	$6,320	$0	$0	$6,320	($6,493)
19	$0	$0	$0	$6,570	$0	$0	$6,570	$77
20	$0	$0	$0	$6,829	$0	$0	$6,829	$6,906
21	$0	$0	$0	$7,099	$0	$0	$7,099	$14,005
22	$0	$0	$0	$7,379	$0	$0	$7,379	$21,385
23	$0	$0	$0	$7,671	$0	$0	$7,671	$29,056
24	$0	$0	$0	$7,974	$0	$0	$7,974	$37,029
25	$0	$0	$0	$8,289	$0	$0	$8,289	$45,318

Notes:
Avoided energy cost from the photovoltaic system assumes a decay in panel efficiency by 1% per year

DISCLAIMER

Energy demand, usage, and utility costs are estimated. Solar output is estimated based on default/optimal parameters using PVWATTs for Tampa, FL. Actual values may vary depending on facility activities or other factors. No value is assigned to the Renewable Energy Certificates (RECs) because it is assumed that RECs will be retained to apply renewable energy to the facility rather than to sell it to another party. Net metering up to the full capacity of the photovolataic system is assumed but should be confirmed with the inidividual utility.