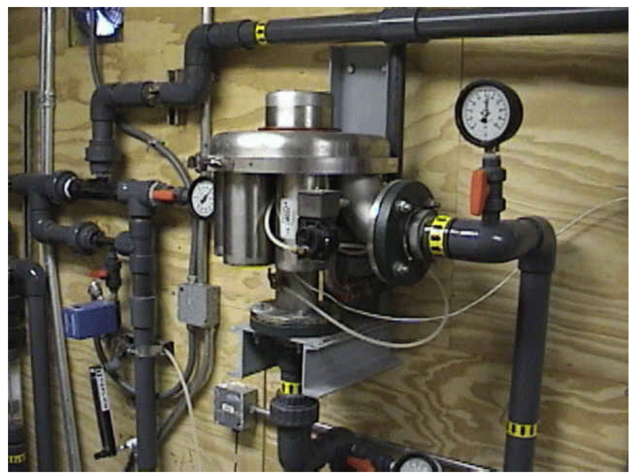
REMEDIATION SYSTEM EVALUATION

MODESTO GROUNDWATER CONTAMINATION SUPERFUND SITE
MODESTO, CALIFORNIA

Report of the Remediation System Evaluation,
Site Visit Conducted at the Modesto Groundwater Contamination Superfund Site
July 19, 2001

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NOTICE

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EXECUTIVE SUMMARY

The Modesto Groundwater Contamination Site is located in a commercial area on McHenry Avenue south of West Fairmont Avenue in the City of Modesto, Stanislaus County, California. The remedy at the site addresses tetrachloroethylene (PCE) contamination primarily from Halford's Cleaners, located at 941 McHenry Avenue. Contamination originally was discovered in municipal water supply Well 11 in 1984. The well was shut down until 1991 when granular activated carbon units were added to treat the water. However, in 1995 uranium concentrations above the maximum contaminant levels (due to naturally occurring uranium) were detected in the extracted water, and the well was shut down. An interim remedy consisting of a soil vapor extraction (SVE) system was installed and operated in 1991 to address the PCE contamination, but shortly after operation, it was determined that the remedy required expansion. An expanded remedy consisting of an SVE system and a pump-and-treat system and was installed in August 2000 but experienced difficulty operating without excessive operator attention. New contractors began work on the system in June 2001, and on the day of the RSE they had completed start up adjustments, and the system was operating continuously.

The SVE system consists of a single vapor extraction well with no currently used monitoring points, and the pump-and-treat system consists of a single groundwater extraction well. Fifteen groundwater monitoring wells are sampled quarterly for volatile organic compounds including PCE.

The RSE team found the site managers and the new contractor committed to system optimization. Recommendations made by the RSE team to improve system effectiveness include the following:

- The subsurface performance of the SVE system should be monitored by installing monitoring points at multiple locations and depths. Such monitoring would help quantify the flow of air through the subsurface, determine capture of the SVE system, and evaluate the progress toward remediation of the unsaturated zone.

- The responsibility of analyzing monitoring and performance data should be delegated to a particular party. Such analysis is currently not included in the scope of work for the contractors, and without clarification of this responsibility and perhaps appropriate modifications to the scope of work, regularly collected data may not be analyzed leaving the site managers questioning the performance and progress of the remedy.

- A capture zone analysis should be conducted to ensure that the appropriate portions of the contaminant plume are contained by the groundwater extraction system. A preliminary analysis was conducted previously, but subsequent data suggest variations in the site water levels and potentiometric surface that were not originally considered. Development of a simple but appropriately calibrated groundwater flow model or modification of the previous groundwater flow model would be useful in evaluating capture and in determining the appropriate final remedy for the site.

- PCE concentrations to the southeast and southwest had extended beyond the outermost monitoring wells as of November 2000. In addition, in August 1999 the concentration in the deeper aquifer had increased by an order of magnitude suggesting downward migration of the contamination. Continued migration may be occurring in these directions, and additional monitoring wells

downgradient of this portion of the plume may be necessary to accurately delineate the plume if concentrations in the present monitoring wells in these areas do not decrease.

These recommendations might require approximately $48,000 in capital costs and might increase annual costs by approximately $30,000 per year.

Recommendations to reduce life-cycle costs include the following:

- The groundwater treatment plant removes PCE and uranium and discharges the treated water to the local sanitary sewer for a monthly POTW charge of approximately $1,500. If alternate discharge locations are available and could be utilized, then the POTW charge, as well as other costs, could be eliminated. The RSE report highlights two potential alternatives.

  - If treated water is discharged to the local storm sewer, the POTW charges and possibly costs associated with liquid phase carbon treatment could be eliminated. This alternative may cost $20,000 to implement but would likely save $20,500 per year.

  - If treated water is reinjected into the subsurface, the POTW charges, and possibly the costs of the liquid phase carbon and the ion exchange treatment could all be eliminated. This alternative may cost $150,000 to implement but would likely save $31,000 per year.

- The equalization tank at the front of the groundwater treatment train does not facilitate operation and requires the use of an additional transfer pump. In addition, the automatic backwash filtration system requires substantial maintenance. The filter system should be simplified and the equalization tank and transfer pump should be removed. Initial costs of $10,000 may be incurred for implementing these changes, but a cost savings of approximately $6,000 per year due to a reduction in electricity would result. If the equalization tank must be left in place a smaller transfer pump should be installed to reduce the usage of electricity.

- Because the uranium concentrations in the extracted groundwater are only slightly higher than the maximum contaminant level of 20 pCi/L, the RSE team recommends regularly evaluating the influent uranium concentrations to determine the necessity of continuing uranium removal via ion exchange. Elimination of the ion exchange units may save approximately $20,000 per year.

Implementing the recommendations to reduce costs would require initial investments, but savings from operations and maintenance could offset these initial investments and the costs associated with recommendations for enhanced system effectiveness and technical improvement.

Recommendations for technical improvement and for gaining site closeout are also discussed. Many of the recommendations geared toward technical improvement include modifications to improve safety, prevent damage, and facilitate operation of the systems, and some of the recommendations reflect suggestions made by the system operator. The recommendations concerning site close out include encouraging the site managers to proceed with the final remedy screening and sampling for parameters that affect subsurface degradation of PCE. Both of these recommendations are geared toward developing a site exit strategy.

A summary of recommendations, including estimated costs and/or savings associated with those recommendations is presented in Section 7.0 of the report.

PREFACE

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

The following organizations are implementing this project.

Organization	Key Contact	Contact Information
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The project team is grateful for the help provided by the following EPA Project Liaisons.

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

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

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1.0 INTRODUCTION

1.1 PURPOSE

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

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

The Modesto Groundwater Contamination Site was chosen based on initial screening of the pump-and-treat systems managed by USEPA Region 9 as well as discussions with the EPA Remedial Project Manager for the site and the Superfund Reform Initiative Project Liaison for that Region. This report provides a brief background on the site and current operations, a summary of the observations made during a site visit, and recommendations for changes and additional studies. The cost impacts of the recommendations are also discussed.

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

1.2 TEAM COMPOSITION

The team conducting the RSE consisted of the following individuals:

Frank Bales, Chemical Engineer, USACE, Kansas City District
Dave Becker, Hydrogeologist, USACE HTRW CX
Peter Rich, Civil and Environmental Engineer, GeoTrans, Inc.
Doug Sutton, Water Resources Engineer, GeoTrans, Inc.

1.3 DOCUMENTS REVIEWED

Author	Date	Title/Description
US EPA	9/26/1997	Interim Record of Decision, Modesto Groundwater Contamination Superfund Site
Ecology & Environment, Inc.	2/9/1998	Memorandum: Soil Vapor Extraction/Pilot Study Report
Ecology & Environment, Inc.	4/17/1998	Memorandum: Modesto Groundwater Flow and Contaminant Transport Model
Ecology & Environment, Inc.	8/14/1998	Contract Documents, Modesto Groundwater Contamination Site, Groundwater Treatment and Soil Vapor Extraction Systems
Ecology & Environment, Inc.	8/17/1998	Modesto Groundwater Contamination Site, Final Design, Interim Remedial Action Draft Interim Design
USACE, Sacramento	2000	Bid Schedule– Modesto Superfund Site O&M
Ecology & Environment, Inc.	11/17/2000	Groundwater Treatment System Operation and Maintenance
Ecology & Environment, Inc.	11/27/2000	Soil Vapor Extraction System Operation and Maintenance
USACE, Sacramento	1/18/2001	Statement of Work
Ecology & Environment, Inc.	April 2001	Modesto Groundwater Contamination Site Interim Remedial Action Report
Ecology & Environment, Inc.	4/5/2001	Modesto Monitoring Report– April 2000, August 2000, November 2000
City of Modesto	6/11/2001	Conditional and Revocable Groundwater Discharge Permit

1.4 PERSONS CONTACTED

The following individuals were present for the site visit:

Chris Goodrich, Field Service Supervisor, Montgomery Watson
Vilay Lee, Associate Engineer, Montgomery Watson
Doug MacKenzie, Project Engineer, USACE, Sacramento District
David Seter, Remedial Project Manager, EPA Region 9

1.5 SITE LOCATION, HISTORY, AND CHARACTERISTICS

1.5.1 LOCATION AND HISTORY

The Modesto Groundwater Contamination Site is located on McHenry Avenue south of West Fairmont Avenue in the City of Modesto, Stanislaus County, California. The remedy at the site addresses tetrachloroethylene (PCE) contamination stemming from Halford's Cleaners, located at 941 McHenry Avenue. Halford's Cleaners is bordered directly to the north by the Elk's Lodge, to west by a parking lot, to the south by an auto repair shop, and to the east by McHenry Avenue. In general, the surrounding area to the north and west is residential and to the south and east is light commercial. Figure 1-1 shows a layout of the site and the surrounding area.

The following items provide a brief history of the site and remedy up to the time of the RSE visit.

- PCE contamination was originally discovered in Municipal Well 11 in September 1984 and the well was deactivated. The Modesto Groundwater Contamination Site was defined to include Well 11 and the potential sources of contamination. Within a few weeks of the discovery of the PCE contamination of Well 11, Halford's Cleaners was identified as a potential source due to its proximity to the well (1,300 ft) and the use of PCE in dry cleaning.

- In April 1985, the Stanislaus County Department of Environmental Resources conducted a groundwater investigation in the immediate vicinity of Halford's Cleaners. Results indicated a PCE concentration of 84.6 ppb in the groundwater sample collected from the Elk Lodge well (just north of Halford's Cleaners) and a PCE concentration of 176,000 ppb in soil samples taken near a dry cleaning machine owned by Halford's Cleaners.

- Continuous monitoring for PCE revealed no detectable levels at Well 11. The well was restarted but was shut down again in 1989 when PCE was detected again. The well then was equipped with granular activated carbon units in 1991 and resumed operation.

- Following several studies to determine the source of the PCE, the EPA issued an order in 1990 to Halford's Cleaners for treatment of the contaminated soil at the Halford site and the removal action commenced with operation of a SVE system in February 1991.

- Shortly after operation of that remedy began, EPA determined that remedy needed to be expanded and began a subsequent remedial investigation in 1991.

- In October 1995 the City of Modesto detected uranium concentrations in water extracted by Well 11 that exceeded the maximum contaminant level (MCL) of 20 pico Curies per liter (pCi/L). Well operation was discontinued, and the well has remained non-operational.

- In September 26, 1997 an interim Record of Decision (ROD) specified groundwater extraction and treatment by air stripping, discharge of treated groundwater, soil vapor extraction, and institutional controls.

- By August 2000 the pump-and-treat and SVE systems were constructed, and a 12-week O&M period ran from mid-August to early November.

- The U.S. Army Corps of Engineers (USACE) now oversees the site and has contracted a new operator who began work in June 2001. The systems had just begun steady-state operation on the day of the RSE visit on July 19, 2001.

1.5.2 POTENTIAL SOURCES

In 1985 a dry cleaning machine at Halford's Cleaners was found to have leaks. In addition, this unit also discharged PCE into the private sanitary sewer line that connected the cleaners to the main sewer line. Thus, PCE entered the subsurface both through a leak in the machine above ground and also through a leak in the sewer line. The machine has since been replaced and PCE is no longer discharged to the sewer. Soil samples collected in 1985 revealed PCE concentrations in soil as high as 176,000 ppb within three feet of the surface. Later sampling conducted in July 1990 revealed soil concentrations of 21,000 ppb within five feet of the surface. Sampling conducted in 1995 revealed lower soil concentrations but groundwater PCE concentrations as high as 74,000 ug/L. This highest PCE concentration was found in MW-8, and groundwater PCE concentrations of 17,300 ug/L and 2,706 ug/L were also found in MW-5 and MW-3, respectively. These three concentrations are all higher than 1% of the solubility for PCE suggesting the presence of freephase PCE in the form of a dense non-aqueous phase liquid (DNAPL). Please refer to Figure 1-1 for the location of these monitoring wells.

1.5.3 HYDROGEOLOGIC SETTING

In the Modesto area groundwater occurs in both an upper semi-confined unit and a lower confined unit that are separated by the Corcoran Clay. The edge of this clay layer, however, is near the Modesto Groundwater Contamination Site; therefore, these two aquifer systems may be interconnected in the vicinity of the site-related contamination. Sediments beneath the site are discontinuous layers or lenses of sands, silts, and clays that are usually less than 10 feet thick. Fine-grained sediments dominate to the south of the site and coarser grained material dominates to the north. Onsite drilling revealed a fine-grained layer from approximately 95 feet below ground surface (bgs) to 145 feet bgs. Observation of subsurface material obtained from soil borings do not concur with previous observations of the Corcoran Clay. The layer does appear to provide at least a partial barrier to site-related contamination.

The regional water-level gradient is approximately 5×10^{-4} feet/foot, and groundwater levels and flow directions are significantly affected by regional pumping. When Well 11 and other municipal wells were operating, groundwater elevations were 20 feet above mean sea level (MSL) or 70 feet bgs, and flow at the site was directed toward Well 11. Recent measurements (without the influence of regional pumping) yielded water levels of approximately 50 feet MSL or 40 feet bgs and suggested groundwater flow to the south or southwest away from Well 11.

A 1997 pump test suggests a hydraulic conductivity ranging from approximately 50 ft/day to 100 ft/day and a storage coefficient of 0.007, which suggests the formation is semi-confined. A hydraulic connection across the fine-grained layer between 95 feet bgs and 145 feet bgs was evident from the pumping test. The non-pumping gradient supports upward flow thereby potentially limiting contamination of the groundwater beneath this layer.

1.5.4 DESCRIPTION OF GROUND WATER PLUME

The highest concentrations of PCE center around Halford's Cleaners and diminish in all directions as the distance from the cleaners increases. PCE concentrations in the monitoring wells adjacent to the site and above 95 feet bgs (MW-3, MW-5, and MW-8) range from 2,200 ppb to 5,500 ppb. Over time, and in the absence of pumping from Well 11, the plume has spread to the south. Approximately 300 feet to the south of the site (MW-4) the November-2000 PCE concentration was 810 ppb and approximately 600 feet south of the site (MW-6) the November-2000 PCE concentration was 270 ppb. PCE concentrations in monitoring wells to the north (upgradient in the absence of pumping from Well 11) are 20 ppb or lower and are likely residuals from periods when Well 11 was operating. PCE contamination has extended below the fine-grained layer that extends from 95 to 145 feet bgs as revealed by samples taken from MW-9. The concentrations, however, are two orders of magnitude lower than those in MW-8 which is adjacent to MW-9 but over 50 feet above it. A plume map is provided in Figure 1-1.

2.0 SYSTEM DESCRIPTION

2.1 SYSTEM OVERVIEW

The interim remedy for the Modesto Groundwater Contamination Site specified in the 1997 interim ROD includes the following items:

- groundwater extraction from one well located on site; above ground treatment (air stripping, carbon adsorption, and ion exchange treatment), and discharge to city sewer;

- soil vapor extraction, above-ground treatment (carbon adsorption), and discharge to the atmosphere; and

- institutional controls that include signs and fencing.

Although a number of test periods for both the pump-and-treat and SVE systems were conducted during 2000, continuous operation of this system did not begin until July 2001 under oversight by USACE and their new operations contractor.

2.2 EXTRACTION SYSTEMS

The groundwater extraction system consists of one extraction well, EW-1, installed in June 2000. It is screened from 65 feet bgs to 95 feet bgs and is designed to pump at 50 gpm. A flush mounted concrete vault has been constructed over the well to prevent damage. The vault also includes a manual winch to facilitate pump maintenance.

The soil vapor extraction system consists of one vapor extraction well, SV-1, installed in May 2000. It replaced the original SVE well from 1991, which was damaged during the excavation of the piping trench in 2000. The new SVE well is screened from 18 to 38 ft bgs, and soil vapor is extracted from the well at 160 standard cubic feet per minute (scfm).

2.3 TREATMENT SYSTEM

The groundwater treatment system was designed to operate at 50 gpm with influent PCE concentrations of 4,500 ppb and effluent PCE concentrations of 0.5 ppb, which translates to removing 2.7 pounds of PCE per day. Maximum design effluent concentrations for uranium and toluene are 20 pCi/L and 150 ppb, respectively. The system consists of the following elements:

- equalization tank

- filters
- anti-scaling system (non-toxic)
- tray aerator (air stripper)
- one vapor phase granular activated carbon (GAC)
- two liquid phase GAC
- two ion exchange units

The entire system, with the exception of one liquid phase GAC unit, is housed in an 8.5' x 8.5' x 40' metal storage container.

The soil vapor treatment system was designed to operate at 160 scfm and remove up to 100 pounds per day of PCE with treated off-gas concentrations of less than 15 ppm total organics. It consists of the following elements:

- knock-out drum
- air filter
- discharge silencers
- vapor phase GAC

The system housed in an 8.5' x 8.5' x 12.5' treatment unit with the exception of the vapor phase GAC unit, which is adjacent to the treatment unit.

2.4 MONITORING SYSTEM

On a quarterly basis, the operations contractors measure water levels and sample for volatile organic compounds from fifteen monitoring wells. All but one of the wells screen above the fine-grained layer from 95 feet bgs to 145 feet bgs. Between November 2000 and August 2001 aquifer samples were not collected and water levels were not measured due to a switch in operations oversight and contractors. There is no subsurface monitoring program for the SVE system.

Monitoring of the process water includes monthly sampling of the influent and effluent and quarterly sampling of two additional points. Monitoring of the soil vapor treatment system includes sampling and analysis for VOCs five times per quarter. All aquifer and process samples, both air and water, are sent to an offsite laboratory for analysis.

3.0 SYSTEM OBJECTIVES, PERFORMANCE AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The current system is an interim remedy until further information can be gathered to determine the appropriate final remedy. The interim ROD signed on September 26, 1997 states the following goals:

- eliminate and contain the highest contaminant levels at the source [source control];
- prevent exposure to contaminated groundwater, above acceptable risk levels, to human health and the environment;
- minimize the impact of interim cleanup measures to the community;
- collect data to determine if federal and state requirements can be met throughout the aquifer; and
- to delineate more clearly the downgradient edges of the plume and to prevent its further migration.

The duration of the interim remedy has not been determined, but it is expected to be at least one year.

3.2 TREATMENT PLANT OPERATION GOALS

The treatment plant goals are consistent with the discharge permit issued by the City of Modesto. The permitted discharge limits include 0.5 ppb for PCE, 150 ppb for toluene, and 20 pCi/L for each isotope of uranium (U 234, U 238, or U 235). Treated air discharged to the atmosphere must meet the requirements of San Joaquin Valley Unified Air Pollution Control District Rule 2201, which states that Best Available Control Technology must be used if groundwater or soil vapor treatment systems that emit more than 2 pounds of contaminants per day.

3.3 ACTION LEVELS

The discharge limits stated above are the action levels for the site. Cleanup standards for the site are yet to be determined. Data from the interim remedy will be used to determine cleanup standards for the final remedy.

4.0 FINDINGS AND OBSERVATIONS FROM THE RSE SITE VISIT

4.1 FINDINGS

The RSE team visited the site within weeks of the new operations contractor commencing work on the pump-and-treat and SVE systems. The RSE team found the oversight managers and the contractors committed to optimizing the system for consistent and reliable operation. The observations and recommendations given below are not intended to imply a deficiency in the work of the designers, operators, or site managers but are offered as constructive suggestions in the best interest of the EPA and the public. These recommendations obviously have the benefit of the operational data unavailable to the original designers.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

4.2.1 WATER LEVELS

Water-level data collected prior to 1997 indicate a hydraulic head gradient of approximately 0.0005 that directs flow south, and the 1997 groundwater modeling study of the site assumes such a gradient. Quarterly measurements of water levels conducted in 2000 from the fifteen monitoring wells also indicate that groundwater generally flows south, but this more recent data suggests more complicated flow patterns with a hydraulic head gradient of closer to 0.001 and flow directions ranging from southeast to southwest. Water levels are approximately 30 feet higher than they were during operation of Well 11.

4.2.2 CAPTURE ZONE

The capture zone of the groundwater extraction well was analyzed in the 1997 modeling study of the site. The study assumed a hydraulic conductivity ranging from approximately 37 to 300 ft/day, a hydraulic gradient ranging from 0.00057 to 0.00065, approximately 50 feet of saturated thickness for the contaminated zone, and pumping at 50 gpm. The resulting capture zone has a width of approximately 1,800 feet (900 feet cross gradient on each side of the extraction well) and a downgradient stagnation point over 600 feet from the extraction well. An overlay of this capture zone and the December 1997 simulated PCE plume map from the same study suggest capture of the most contaminated portions of the plume. Only a small portion of the plume with concentrations up to 50 ppb extended downgradient beyond the simulated capture zone. No capture zone analysis has been conducted with water level and concentration data since 1997, and water level data from 2000 may suggest a higher and variable hydraulic gradient, which could result in a smaller capture zone.

4.2.3 CONTAMINANT LEVELS

Although a capture zone analysis has not been performed since the modeling study conducted in 1997, a comparison of the plume maps from 1997 and April 2000 suggests no appreciable horizontal spreading of the PCE plume or increases in the sampled concentrations of the shallow monitoring wells. Rather, the PCE concentrations in the monitoring wells near the source area decreased, suggesting limited dilution of the source area. The PCE concentrations in the deeper well (MW-9), however, did increase by an order of magnitude between April and August 1999. It should be noted that before August 2000 the SVE and pump-and-treat systems were not operational. PCE sampling results from November 2000, after a three month test period of the SVE and pump-and-treat systems, are similar to those obtained in April 2000 with the exception that PCE concentrations in the monitoring wells near the source area were higher (more comparable to those obtained in 1997). Thus, it appears that the plume area has not increased appreciably over a three year period even in the absence of pumping. The magnitude of PCE concentrations in the deeper monitoring wells, however, have increased significantly.

The groundwater treatment system is designed for influent concentrations up to 4,500 ppb PCE. Actual influent PCE concentrations measured during the 12-week trial period in the Fall of 2000 ranged from 30 ppb to 12,000 ppb. The influent concentrations for uranium were 23.5 pCi/L for U 234, 19.1 pCi/L for U 238, and less than 15 pCi/L for U 235. PCE concentrations in the extracted groundwater was approximately 3,000 ppb at the time of the RSE visit. In June 2001, the PCE concentration in the air extracted from the SVE system was 522 ppm by volume as determined by laboratory analysis of collected air samples.

4.3 COMPONENT PERFORMANCE

4.3.1 GROUNDWATER EXTRACTION AND TREATMENT SYSTEMS

4.3.1.1 EXTRACTION WELL

The extraction well operates at 48 gpm. The pump is 2 horsepower, and the well is screened from 65 to 95 feet bgs. During the initial operation of the well, sand and silt were drawn from the extraction well into the treatment plant.

4.3.1.2 EQUALIZATION TANK

The 550 gallon equalization tank provides for eleven minutes of storage at the design pump rate of 50 gpm and is equipped with high level alarms which can shut down the system to reduce the threat of overflowing. A metering pump injects scaling agent into the equalization tank to prevent fouling of the other process components. A 7.5 horsepower transfer pump sends the water from the bottom of the equalization tank through a filter system and the rest of the treatment process train.

4.3.1.3 FILTRATION UNIT

Water from the equalization tank flows through an automatic backwash filtering system before entering the tray aerator. The filter system consists of 10 micron filters, associated plumbing, and a clarifying tank.

The system automatically backwashes at a pressure differential of 10 pounds per square inch (psi). Backwashed water is sent through a clarifier and then to the equalization tank. The system cycled 10 times in two days during initial operation in June 2001 and has required substantial maintenance.

4.3.1.4 TRAY AERATOR

The tray aerator (air stripper) consists of three trays and is designed for 99.99% VOC removal efficiency when provided with approximately 900 cfm of air. A 7.5 horsepower blower provides this required air flow. The transfer pump that sends water from the tray aerator through the carbon is the rate-limiting step of the groundwater extraction and treatment system.

4.3.1.5 LIQUID PHASE GAC UNITS

The liquid phase GAC units contain approximately 1,000 lbs of GAC. They were replaced in October of 2000 because the units were not rated at the pressure specified in the design. The pressure drop across the GAC unit is monitored, and the system automatically shuts down if the pressure reaches a predetermined limit. The system was shutting down frequently due to a "water hammer" effect caused by high pressures when the transfer pump from the air stripper activated. The new operators remedied this by placing a five-second delay in the logic that allows the pressure to abate so the system does not shut down.

4.3.1.6 VAPOR PHASE GAC UNIT

The vapor phase GAC unit contains approximately 2,000 lbs of GAC and has not been replaced since it was installed in 2000. According to design influent concentrations, the vapor phase GAC was projected to last 12 weeks assuming continuous operation. At the current flow rates chemical loading to this unit is less than 2 pounds per day. With this loading rate the unit could last up to 30 weeks without requiring replacement.

4.3.1.7 ION EXCHANGE UNITS

Two ion exchange units are placed in series after the liquid phase GAC unit. The resin has not been replaced to date, but based on current influent concentrations, the manufacturer projected that the resin should be changed out after approximately 300 days. The lead vessel has fouled and requires replacement. The vacuum relief valve is currently placed prior to this system. As a result, when the system shuts down, water is siphoned from these units to the discharge point producing a strong vacuum within the units possibly contributing to unnecessary compression of the resin. More importantly, this vacuum could implode these units.

4.3.1.8 CONTROLS

The system has auto dial-out capability when an alarm condition exists and allows remote restart and shutdown. Also, the anti-scaling system does not shut down automatically in the event of an automatic plant shutdown and will continue to pump at approximately one gallon per day until it is manually shut off. This is not a problem as it will not harm downstream units or the tank containing this agent. The cost of this system and its chemicals are minimal.

4.3.2 SVE SYSTEM

The SVE system consists of an extraction well, a 7.5 horsepower blower operating at approximately 160 scfm, a knock out drum to lower the humidity, filters to remove particulates, and a vapor phase GAC unit. The knock out drum has a capacity of 50 gallons and was modified to include a sump that drains the drum to the equalization tank of the groundwater treatment system. The vapor phase GAC unit contains approximately 2,000 lbs of GAC and was replaced after eleven days of continuous operation. Frequent replacement of the carbon in this unit may be required during the initial operation periods until the PCE concentration in the soil vapor decreases. At the time of the RSE visit, discharge from the blower was 200 F, which is above normal operating conditions. Flow rates through the SVE system are currently measured with a hot-wire anemometer because the pitot tube originally installed in the 3-inch line was designed for 2-inch lines.

4.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF MONTHLY COSTS

Costs associated with the operation and maintenance of the pump-and-treat and SVE systems can only be approximated because the systems had only operated for three weeks under the current contract. These costs are provided in the following list and are estimated based on the proposal from the original operator and the bid schedule for the current operator. Quantities for electricity, carbon, and ion exchange resin are estimates based on engineering judgment and may be significantly different during actual operations

O&M labor, management, and reporting	$20,000
Response to autodialer calls and alarms	$1,000
Optimization	$1,250
Reimbursable parts	$1,700
Chemical analysis	$3,500
Chemicals (anti-scaling agent)	$200
Electricity	$5,000
Ion exchange replacement	$1,700
GAC replacement (liquid and vapor phase)	$2,900
POTW fees	$1,500
	$37,750

4.4.1 UTILITIES

Operation of the pumps and blowers for the pump-and-treat and SVE systems require approximately 60 to 70 kilowatts which translates to approximately $5,000. City water and natural gas are not used at site. The average monthly cost for discharging plant effluent to the POTW is approximately $1,500.

4.4.2 NON-UTILITY CONSUMABLES AND DISPOSAL COSTS

Approximately two drums of anti-scaling agent are used each year at a cost of approximately $1,200 per drum. The initial bid schedule filed by the current contractors suggests approximately $32,500 per year for eight replacements of a vapor phase carbon unit (equivalent to the six replacements over nine months as specified in the bid schedule) and $2,500 per year for replacement of a liquid phase carbon unit. At an estimated annual cost of $35,000 per year, this translates to approximate monthly costs of $2,900 for GAC replacement. The bid schedule indicates one change out of the ion exchange units is expected per year at an approximate cost of $22,000 per year.

4.4.3 LABOR

The bid schedule, prior to negotiation, allocated approximately $20,000 per month for the nine months of operation and maintenance occurring after an initial three-month period of startup. These costs presumably include the costs of management and reporting but do not include up to $10,000 over nine months for responding to autodialer calls and meetings.

4.4.4 CHEMICAL ANALYSIS

According to the scope of work, after the initial three-month startup period, quarterly monitoring requirements include the following sampling:

- 5 samples of vapor from the SVE system analyzed for VOCs;
- 10 samples of the process water (including influent and effluent) analyzed for VOCs;
- 7 samples of the process water (including influent and effluent) analyzed for total uranium; and
- 15 groundwater samples analyzed for VOCs.

At costs of approximately $300 per sample for the vapor samples and an average of $200 per sample for the groundwater samples (uranium or VOCs), this program translates to quarterly sampling costs of approximately $8,000 or monthly costs of $2,700. Field blanks and other required additional samples would likely increase these costs to $3,500 per month.

4.5 RECURRING PROBLEMS OR ISSUES

A number of technical problems regarding the initial design have delayed steady-state operation of the system. The following list itemizes a few of these issues or problems highlighted by the current operators during the RSE visit:

- high temperatures in the metal storage containers housing the SVE and groundwater treatment systems;
- difficulty in sampling vapor phase GAC due to the lack of room within the storage containers;

- continuous cycling of the automatic backwash filters;
- fouling of the lead ion exchange unit; and
- siphoning of water from the ion exchange vessels to the system discharge when the system is shut down.

4.6 REGULATORY COMPLIANCE

The groundwater treatment system has had a number of problems that have delayed operation including PCE effluent concentrations exceeding the limit of 0.5 ug/L specified in the discharge permit. According to sampling events in late June and July 2001, the treatment system has met the required discharge criteria.

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

Since steady-state operation of the plant in July 2001, there have been no treatment process excursions or accidental releases of contaminants or reagents.

4.8 SAFETY RECORD

There have been no reported accidents on site.

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

5.1 GROUND WATER

The groundwater underlying Modesto is no longer used for drinking water due to uranium concentrations exceeding the maximum contaminant levels (MCLs). However, according to State Water Resources Control Board Resolution No. 88-63, "Sources of Drinking Water Policy", with some exceptions, all groundwater and surface water are considered suitable, or potentially suitable, for municipal or domestic water supply. Thus, groundwater underlying the Modesto site may be considered a potential source of drinking water in the future. Also, given the prominence of agriculture in the areas surrounding Modesto, the possibility exists that groundwater could be used for agricultural purposes in the future.

The municipal water supply is now provided from the Stanislaus River located approximately 5 miles from the site. Thus, groundwater currently does not represent a direct avenue of exposure to site-related contamination.

5.2 SURFACE WATER

The Stanislaus River is approximately 5 miles upgradient to the north of the site, and the Tuolumne River is approximately 3 miles downgradient to the south of the site. Dry Creek passes within a mile of the site to the southeast and empties into the Tuolumne River. The November 2000 groundwater sampling does suggest transport of PCE from the site toward both the Tuolumne River and Dry Creek suggesting, that without adequate capture of the plume, impacted groundwater could eventually reach these two surface water bodies. In November 2000 MW-13, located approximately 1,000 feet south-southwest of the site, had a PCE concentration of 10 ppb, and MW-12, located approximately 600 feet to the east-southeast of the site, had a PCE concentration of 51 ppb.

5.3 AIR

The SVE system is installed to remove PCE and other VOCs from the unsaturated zone; however, the capture zone of this system is currently unknown due to an insufficient number of monitoring points. The emissions from the pump-and-treat and SVE systems represent the most significant avenue of site-related contamination to the air. However, vapor phase carbon units on both systems keep emissions from the systems well below a pound of PCE per day.

5.4 SOILS

Subsurface soils at the site are impacted by PCE and other VOCs, and these soils are addressed by the SVE system. Asphalt over these soils prevents direct exposure of the public to these impacted subsurface soils.

5.5 WETLANDS AND SEDIMENTS

Wetlands and sediments are not impacted by site-related contamination. If the contaminant plume were to reach the Dry Creek or the Tuolumne River such exposure of the related soils to PCE would be expected.

6.0 RECOMMENDATIONS

6.1 RECOMMENDED STUDIES TO ENSURE EFFECTIVENESS

6.1.1 MONITOR SUBSURFACE PERFORMANCE OF THE SVE SYSTEM

The soil vapor extraction system requires monitoring points to properly evaluate its capture zone and progress toward remediation. Monitoring from approximately four locations with multiple depths should suffice. According to the project team, two monitoring locations with multiple sampling depths are already installed at the site, but sampling them is not part of the operations scope of work. The condition of these existing monitoring wells should be evaluated, and if they are functional they should be included in the proposed monitoring program for the SVE system. Regardless of the condition of the existing wells, additional points are also required. They can be installed using direct-push techniques and should include short screens placed at three depths above the water table (e.g., 15, 25, and 35 feet) and in at least two new locations. Monitoring these points for VOCs and measuring them for vacuums will help evaluate the throughput of air for remediation, progress toward cleanup, and location of significant vadose zone sources. Installation of the new monitoring points should cost approximately $18,000. Sampling for VOCs from twelve sampling points (four locations with three depths each) should be added to the quarterly aquifer monitoring events and should translate to additional labor costs of approximately $12,000 per year and additional analytical costs of approximately $8,000 per year.

6.1.2 ASSIGN RESPONSIBILITY FOR EVALUATING MONITORING AND PERFORMANCE DATA

The aquifer sampling program under the current contractor is scheduled to begin in August 2001. Before the program is underway the responsibility of data analysis should be properly delegated. Data analysis could be conducted by the EPA Remedial Project Manager, EPA technical support staff, the USACE project manager, or the contractor. All of these parties are capable of evaluating the aquifer data and providing adequate data analysis, and all parties should review the data independently. However, one of those parties should take on the primary responsibility of evaluating and analyzing the data to continually evaluate capture of site-related contaminants and remediation progress as well as provide a knowledge base from which an optimal final remedy can be determined. It should be noted that in the scope of work for the contractor, groundwater sampling and reporting of the results is required— the scope of work does not require data analysis, evaluation of plume capture, or evaluation of remedy progress. Thus, without a modification to this scope, adequate data analysis likely will not be performed by the contractor.

6.1.3 ANALYZE CAPTURE ZONE

The capture zone was analyzed in 1997 with the use of a groundwater model calibrated with steady-state and transient water level measurements. Since this original capture zone analysis additional water level and water quality data have been collected showing potential variations in groundwater flow and limited migration of the site-related contaminants. A relatively simplistic groundwater model should be developed and calibrated with historical water level data and continuously updated with new water level data. A capture zone analysis should be conducted based on recent plume maps and model simulations. Such an analysis may show less capture than was originally determined in 1997 suggesting the possible need for additional pumping if pump-and-treat is selected as the final remedy. The recommended capture zone analysis should illustrate which portions of the plume are captured and the approximate concentrations of those portions that are not captured. Development of the model may result in an initial cost of $30,000. Regular updating and calibration of the model as well as simulations for determining capture and experimenting with final remedy scenarios may cost $10,000 per year.

6.1.4 DELINEATE PLUME VERTICALLY AND TO THE SOUTHEAST AND SOUTHWEST

Aquifer sampling in and since August 1999 indicate PCE concentrations over 50 ppb in MW-9 which screens an interval beneath the fine-grained layer that is located between 95 and 145 feet bgs. If concentrations in this well continue to rise or do not decrease after a year of quarterly sampling additional monitoring may be required at depths of more than 145 feet bgs. If contamination is considered extensive, a remediation strategy may be required at these depths. Additional pumping at these depths is not advisable as it may assist in downward migration of the contamination. In-well stripping may be more appropriate.

The November 2000 aquifer sampling also indicates that the plume has extended beyond MW-13 to the south-southwest and beyond MW-12 to east-southeast. Concentrations at these two wells in November 2000 were 10 ppb and 51 ppb, respectively. Given that these are the outermost monitoring wells for the site and they have detectable concentrations of PCE, they cannot be used to adequately determine the outermost extent of the plume. If concentrations in these wells increase or remain the same after a year of quarterly sampling, additional monitoring wells may need to be placed beyond these monitoring wells to help delineate the PCE plume, as these portions of the plume are likely beyond the capture zone and likely will continue to migrate downgradient.

An additional well would require a capital cost of approximately $14,000. This figure would include the costs of a work plan, the design, contracting, and installation. As mentioned above, the need for such wells should be evaluated by evaluating monitoring data from existing wells over a year of continuous system operation. An increase of approximately $1,500 per well per year would be expected if such wells were added to the current sampling program.

6.2 RECOMMENDED CHANGES TO REDUCE COSTS

6.2.1 INVESTIGATE ALTERNATE DISCHARGE OPTIONS

A substantial portion of the remedy costs are associated with discharging to the local sanitary sewer. The POTW charges on average $1,500 per month to accept the treated water with undetectable concentrations of PCE and uranium concentrations of less than 20 pCi/L. A number of alternative discharge options should be considered in an effort to reduce life-cycle costs, especially with potential future increases in extraction rates for the final remedy. The following list provides a few alternatives and the advantages and disadvantages of each one.

Discharge to the local storm sewer:

Advantages:

Discharging the treated water to the local storm sewer in place of the sanitary sewer (POTW) would eliminate the POTW charges of approximately $1,500 per month. In addition, this alternate discharge location may allow the relaxation of the PCE discharge requirements from 0.5 ug/L to the maximum contaminant level (MCL) of 5 ug/L. A relaxed standard would allow removal of the polishing step with liquid phase carbon and could save an additional $2,500 per year.

Disadvantages:

This option would require additional permitting and acceptance by the City of Modesto. Applying for the permit including negotiations, toxicity testing, and piping to the sewer may cost $20,000.

Cost Summary:

This option may cost $20,000 up front to obtain the permit, but an estimated annual potential savings of approximately $20,500 per year could be expected suggesting payoff and potential savings in approximately one year.

Reinjection to the subsurface:

Advantages:

Reinjecting treated water would eliminate the POTW charges of approximately $1,500 per month. In addition, this alternate discharge location may allow the relaxation of the PCE discharge requirements from 0.5 ug/L to the maximum contaminant level (MCL) of 5 ug/L. A relaxed standard would allow removal of the polishing step with liquid phase carbon and could save an additional $2,500 per year. Furthermore, because this option involves returning the treated water to the subsurface that has a background uranium concentration equal to that of the treated water the ion exchange units used for uranium treatment could likely be removed at a cost savings of approximately $1,700 per month.

Disadvantages:

This discharge option would require additional permitting and acceptance of the permit application by the State of California. Furthermore, it would require the construction of a reinjection system capable of reinjecting the water to the subsurface 400 to 500 feet down gradient from the extraction well. Designing, permitting, obtaining easements for, and constructing the system may result in capital costs of approximately $150,000. Continued maintenance of the system would likely require approximately $10,000 per year.

Cost Summary:

This option includes a significant capital cost of approximately $150,000 for design and installation. An estimated annual potential savings of approximately $31,000 could be expected suggesting payoff and savings after approximately 5 years. The savings could be more substantial if pumping rates are increased for the final site remedy.

6.2.2 ELIMINATE EQUALIZATION TANK, SIMPLIFY FILTRATION SYSTEM AND REMOVE TRANSFER PUMP

Influent to the treatment plant currently enters an equalization tank before passing through the treatment process train. The presence of this tank provides no added benefit to the system (well purge water can be added to the system through the SVE knockout drum and scale inhibitor can be added in line) and requires additional transfer pumps to move water through the treatment process train. In addition, the automatic backwash filtering system currently installed between the equalization tank and the tray aerator is overly complicated and requires frequent maintenance.

The 2 horsepower submersible pump in the extraction well is sufficient to transfer the water from the well through a simple filtering system to the top of the tray aerator. Thus, the 7.5 horsepower transfer pump located between the equalization tank and the current filtration system could be eliminated if the equalization tank is removed and the filtration unit is simplified. The simplified filtering system should consist of inline bag filters, with 10 or 25 micron pores, arranged in parallel and located prior to the air stripper. In addition, it should have a differential pressure switch interlocked with the well pump and a bypass or parallel unit to allow bag filter changes without system downtime. If necessary, a second filter could be added after the tray aerator to further limit pressure buildup in the downstream units.

Removal of the equalization tank and the 7.5 horsepower pump in addition to purchasing and installing two bag filter units in parallel would cost approximately $10,000. This change, however, would result in a cost savings of approximately $500 per month ($6,000 per year) assuming electricity costs of $0.10/kilowatt-hour and would greatly reduce the amount of maintenance required by the current automatic backwash filtering system.

It should be noted that if extraction of DNAPL is a concern, the equalization tank may be required to act as a phase separator. However, because the tank drains from the bottom, a baffle would be needed in the tank to prevent transfer of DNAPL to the tray aerator. While aquifer concentrations do suggest DNAPL in the subsurface, influent concentrations do not indicate the DNAPL is being transferred from the well to the treatment system. If the equalization tank is left in place and the filtration system is simplified, a smaller transfer pump could be used to reduce electricity costs.

6.2.3 REGULARLY EVALUATE THE NEED FOR THE ION EXCHANGE UNITS

With continued pumping, the influent uranium concentrations may drop over time, and if this influent concentration drops consistently below 20 pCi/L, treatment for uranium would no longer be required. Given that replacement of the ion exchange resin costs approximately $1,700 per month (over $20,000 per year) significant cost savings could be realized if these units are eliminated. Thus, influent uranium concentrations should be evaluated regularly to determine if the discharge criteria can be met without treatment.

6.3 MODIFICATIONS INTENDED FOR TECHNICAL IMPROVEMENT

6.3.1 RELOCATE VACUUM BREAKER TO HIGH POINT AFTER THE SECOND ION EXCHANGE UNIT

When the groundwater treatment system shuts down, water from the ion exchange units is siphoned to the discharge point creating a strong vacuum within the ion exchange units. Such a vacuum could damage the units and could result in injury to operations personnel if the units collapse. A vacuum breaker is currently located prior to the ion exchange units, and if this breaker is relocated to the high point after the last ion exchange unit, the potential for such vacuums would be eliminated. Due to the potential of injury and serious damage, this recommendation should be implemented immediately. Implementing this recommendation should require a maximum of $2,000 for labor and any necessary materials.

6.3.2 INSTALL VALVING TO ALLOW FOR BACKWASHING OF GAC AND ION EXCHANGE UNITS

Valving should be added to the system to allow removal and backwashing of individual GAC and ion exchange units. The backwash effluent should be directed inline prior to the recommended bag filters that precede the tray aerator. The purchase and installation of the appropriate valves would costs approximately $7,000.

6.3.3 ADD PERFORMANCE OF EXTRACTION WELL TO THE MONITORING PROGRAM

The effectiveness of the extraction system rests solely on a single well and pump. As such, the performance of this well and the pump should be monitored frequently to determine if fouling is becoming an issue. The specific capacity of the well and the production of sand and silt should be noted regularly. Measuring the water level in the extraction well monthly and noting the flow rate will provide the specific capacity. If the water level is decreasing, the specific capacity is decreasing, and well maintenance likely is necessary. It should be noted that monitoring the extraction rate alone may not be sufficient as fouling may occur with a decrease in the water levels and no substantial decrease in the extraction rate. The water level and flow rate in the extraction well should be noted as soon as possible to provide a baseline level for the specific capacity. If the specific capacity drops to less than 70% of that baseline, well maintenance is necessary. More information about well maintenance can be found in USACE Engineering Pamphlet EP 1110-1-27 at **http://www.usace.army.mil/inet/usace-docs**.

Determining the specific capacity each month and assessing the need for maintenance may cost an additional $1,000 per year. As a contingency for well maintenance, an additional $1,000 per year should be budgeted.

6.3.4 MODIFY SVE SYSTEM TO ADDRESS HIGH DISCHARGE TEMPERATURE

At the time of the RSE, the SVE system was operating at 160 scfm and 68 inches of water suction, which is at the high end of the pressure/low flow curve for the installed DR 858. The operating temperature of 200 F is within the max of the 140 C limit for the blower but above the design level for the CPVC pipe. If the temperature cannot be reduced by removing inline restrictions such as a throttling valve or plugged filters, the discharge pipe prior to the increase in diameter should be converted to galvanized steel with a protective screen around it. The blower is probably too large for the one extraction point, but since the system could be altered and may not have a long life span, operating with a slightly open dilution valve to keep adequate flow through the blower is the best option.

6.3.5 REGULARLY EVALUATE NECESSITY OF VAPOR PHASE CARBON UNIT FOR THE GROUNDWATER TREATMENT SYSTEM

An extraction rate of 48 gpm and an influent PCE concentration of 3,000 ug/L translates to a daily loading of approximately 1.8 pounds of PCE per day that is stripped by the tray aerator. Because this loading and the subsequent loading of the tray aerator offgas is less than 2 pounds per day, according to San Joaquin

Valley Unified Air Pollution Control District Rule 2201, treatment of this offgas is not required. Thus, the vapor phase carbon unit could be removed from the groundwater treatment system. The RSE team does not recommend removing this carbon unit until a final remedy is selected and it is verified that the daily loading will consistently remain below 2 pounds per day. Additionally, many sites do maintain vapor treatment even when it is not required by permit to transfer contaminants to another media.

It should also be noted that the vapor phase carbon unit for the groundwater treatment system likely does not require a preheater to improve its overall cost effectiveness. Although such a heater would improve the efficiency, the associated costs savings in carbon replacement likely would fail to offset the capital costs of installing the heater and the increase in costs for the electricity.

6.3.6 APPLY PROPER CONVERSIONS TO PCE CONCENTRATIONS DETERMINED BY PID MEASUREMENTS

A MiniRae Plus Classic PID calibrated with isobutylene is used to determine PCE concentrations associated with the air stripper offgas and extracted and treated soil vapor. Because isobutylene is used for calibration, the readings on the PID should be properly adjusted for PCE concentrations. According to the RAE Systems website (**http://www.raesystems.com**) readings from a PID calibrated with a 100 ppm isobutylene standard should be multiplied by a factor of 0.59 to obtain PCE concentrations.

6.3.7 IMPROVE ACCURACY OF FLOW MEASUREMENT FOR SVE SYSTEM

The flow rate for the SVE system is inaccurate due to an incorrectly sized pitot tube. The pitot tube originally installed into the 3-inch piping is meant for 2-inch piping. A properly sized pitot tube should be installed. This could be accomplished for under $1,000.

6.3.8 ADJUST MEMBRANE SURROUNDING THE BAKER TANK

The membrane surrounding the Baker tank is compromised at the tank drain. The membrane should be draped over the berm frame for the entire tank circumference.

6.3.9 IMPROVE DRAINAGE TO THE SECONDARY CONTAINMENT SUMP

The RSE team concurs with the operators recommendation to add better drainage to the secondary containment sump.

6.3.10 ADD FANS FOR THE CONTROL PANEL

The RSE team concurs with the operators recommendation to add fans to the control panel to reduce temperatures.

6.3.11 RELOCATE VAPOR PHASE GAC UNIT FOR GROUNDWATER TREATMENT SYSTEM

The RSE team concurs with the operators recommendation to relocate the vapor phase GAC unit for the groundwater treatment system to the outside of the metal storage container in an attempt to provide more room for maneuvering around the system.

6.3.12 ADD AN ADDITIONAL PHONE LINE FOR DATA ACQUISITION

The RSE team concurs with the operators recommendation to add a phone line to allow concurrent phone communication and data acquisition.

6.4 MODIFICATIONS INTENDED TO GAIN SITE CLOSE-OUT

6.4.1 PURSUE FINAL REMEDY SCREENING

The RSE team encourages the site managers to pursue a final remedy screening. This is important in developing an exit strategy. The use of a groundwater flow model (Section 6.1.3) would be helpful in determining what part of the concentrated plume would need to be captured to prevent substantial growth of the plume. It is likely that portions of the plume above 100 ug/L would need to be contained. If additional pumping is required for adequate capture, aspects of the groundwater treatment system may require adjustment. For example, increased extraction rates will increase discharge costs paid to the POTW thereby making alternate discharge locations (see Recommendation 6.2.1) more attractive.

The final remedy should also seriously consider the possibility of a continuing source of contamination in the subsurface including PCE in the unsaturated soil and free product PCE below the water table. Depending on results from the monitoring suggested in recommendation 6.1.1, the SVE system may require expansion in order to fully address the PCE in the unsaturated zone. Remediating DNAPL, however, is beyond the capability of the SVE and pump-and-treat systems. If continued operation of the current remedy and monitoring suggest the presence of DNAPL, aggressive source removal strategies should be weighed against a containment remedy. Due to the stratified geologic cross section, air sparging will likely have a low likelihood of success and may even impact effectiveness by spreading PCE vapors through the unsaturated zone beyond the influence of the SVE system. In addition, utilities and active businesses may limit application of thermal or other in situ remedies. Dual phase extraction (reducing the water level through pumping and extracting vapor from the same location) may be preferable if the source area beneath the water table can be delineated and exposed by groundwater extraction.

In-well stripping may prove cost-effective for control of plume migration near the source area as VOCs could be removed from the subsurface without the added requirements of carbon polishing or uranium treatment via the ion exchange units. Consideration of this and other alternate technologies or strategies should be considered, and a comparison of a containment remedy to aggressive source removal should include analysis of life-cycle costs.

6.4.2 ADD DISSOLVED OXYGEN AND REDOX POTENTIAL TO THE SAMPLING PROGRAM

PCE is known to undergo reductive dechlorination in reduced environments, and measurements of oxidation-reduction potential (ORP) and dissolved oxygen (DO) will help determine the potential for reductive dechlorination. These measurements could easily be made during quarterly monitoring events for one year with field test kits and reported for minimal additional costs (less than $1,000). If these ORP and DO measurements indicate a potential for dechlorination of these compounds then measurement of additional parameters such as sulfate, nitrate, and dissolved iron in future sampling events may be beneficial. On the other hand, if the ORP and DO measurements indicate minimal potential for dechlorination then dispersion will be the only likely natural mechanism for reducing concentrations, and such results should be included in final remedy screening for the site.

6.5 SUGGESTED APPROACH TO IMPLEMENTATION OF RECOMMENDATIONS

Relocating the vacuum breaker (Recommendation 6.3.1) should occur immediately due to the possibility for damage and injury. All other recommendations can be implemented immediately and concurrently as there are few dependencies between the recommendations. Recommendation 6.2.1 (considering alternate discharge locations), however, should only proceed with investigation and evaluation of potential alternate discharge locations until further information is gathered about the remedy performance. As data is gathered during a year of continuous operation a more informed decision about the final remedy and the most appropriate discharge location can be made.

7.0 SUMMARY

In general, the RSE team found a well-operated treatment system. The observations and recommendations mentioned are not intended to imply a deficiency in the work of either the designers or operators but are offered as constructive suggestions in the best interest of the EPA and the public. These recommendations have the obvious benefit of the operational data unavailable to the original designers.

Several recommendations are made to enhance system effectiveness, reduce future operations and maintenance costs, improve technical operation, and gain site close out. The recommendations to enhance effectiveness include monitoring the subsurface performance of the SVE system, analyzing the capture zone, further delineating the plume, and delegating responsibility for evaluation of aquifer and process monitoring. Recommendations to reduce costs include investigating alternate discharge options, eliminating the equalization tank and the associated transfer pump, and regularly evaluating the necessity of the ion exchange units and the groundwater treatment system vapor phase carbon unit. The RSE team identified a number of possibilities for technical improvement such as relocation of a vacuum breaker to prevent damage to the ion exchange units and replacement of the current filter system with bag filters that are easier to maintain. In addition, the RSE team concurs with a number of optimization recommendations provided by the operator. Finally, recommendations regarding site closure include proceeding with the final remedy screening and sampling of parameters that would affect degradation of site-related compounds in the subsurface. The table below itemizes all of the recommendations as well as the cost (or cost savings) and reason for each one.

Table 7-1. Cost Summary Table

Recommendation	Reason	Estimated Change in			
		Capital Costs	Annual Costs	Lifecycle Costs *	Lifecycle Costs **
6.1.1 Monitor subsurface performance of SVE system	Effectiveness	$18,000	$20,000	$118,000†	$109,000†
6.1.2 Assign Responsibility for Evaluating Monitoring and Performance Data	Effectiveness	$0	$0	$0	$0
6.1.3 Analyze capture zone	Effectiveness	$30,000	$10,000	$330,000	$191,000
6.1.4 Delineate plume (if necessary)	Effectiveness	$0	$0	$0	$0
6.2.1 Consider alternate discharge locations 1. Discharge to storm sewer or 2. Reinject to subsurface	Cost Reduction	$20,000 or $150,000	($20,500) or ($31,000)	($595,000) or ($780,000)	($310,000) or ($350,000)
6.2.2 Remove equalization tank, simplify filtration system, and remove transfer pump	Cost Reduction	$10,000	($6,000)	($170,000)	($87,000)
6.2.3 Regularly evaluate need for ion exchange units	Cost Reduction	$0	($20,000)	($600,000)	($322,000)
6.3.1 Relocate vacuum breaker	Technical Improvement	$2,000	$0	$2,000	$2,000
6.3.2 Install valving for backwashing carbon and ion exchange units	Technical Improvement	$7,000	$0	$7,000	$7,000
6.3.3 Monitor extraction well performance	Technical Improvement	$0	$2,000	$60,000	($32,000)
6.3.4 Modify SVE system to address high operating temperatures	Technical Improvement	$0	$0	$0	$0

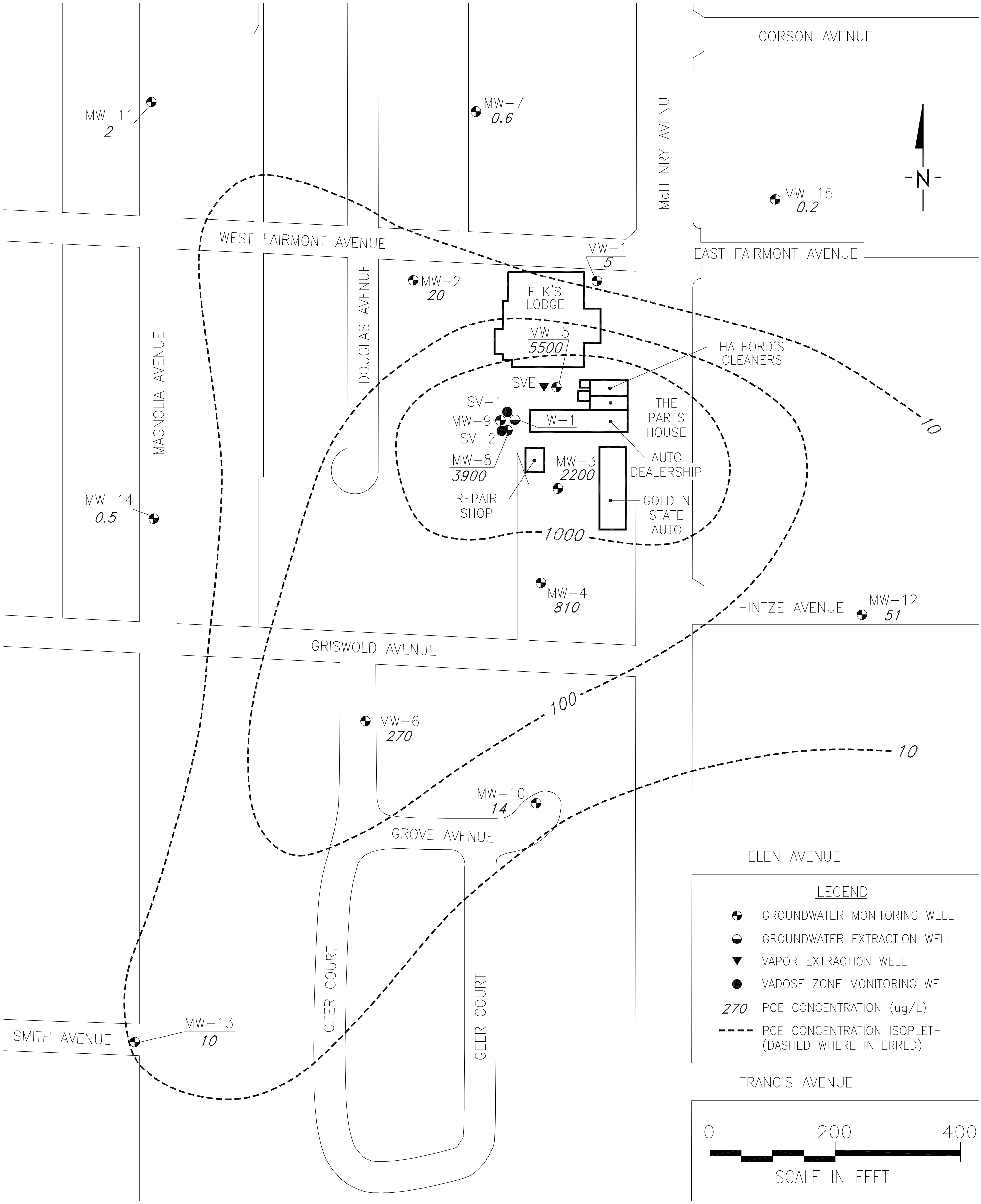
Costs in parentheses imply cost reductions.
* assumes 30 years of operation with a discount rate of 0% (i.e., no discounting)
** assumes 30 years of operation with a discount rate of 5% and no discounting in the first year
† assumes only 5 years of operation rather than 30 years of operation
Note: Costs are “not quantified” for recommendations initiated and begun by operations contractor.

Recommendation	Reason	Estimated Change in Capital Costs	Annual Costs	Lifecycle Costs *	Lifecycle Costs **
6.3.5 Regularly evaluate need for vapor phase carbon	Technical Improvement	$0	$0	$0	$0
6.3.6 Properly convert PID readings to PCE concentrations	Technical Improvement	$0	$0	$0	$0
6.3.7 Improve accuracy of SVE flow	Technical Improvement	<$1,000	$0	<$1,000	<$1,000
6.3.8 Adjust membrane around Baker tank	Technical Improvement	$0	$0	$0	$0
6.3.9 Improve drainage to secondary sump	Technical Improvement	Not quantified	Not quantified	Not quantified	Not quantified
6.3.10Add fans to the control panel	Technical Improvement	Not quantified	Not quantified	Not quantified	Not quantified
6.3.11Relocate vapor phase carbon for the groundwater treatment system	Technical Improvement	Not quantified	Not quantified	Not quantified	Not quantified
6.3.12 Add phone line for data acquisition	Technical Improvement	Not quantified	Not quantified	Not quantified	Not quantified
6.4.1Initiate screening of final remedy	Gain site close-out	$0	$0	$0	$0
6.4.2 Measure DO and ORP in monitoring wells	Gain site close-out	<$1,000	$0	$0	$0

Costs in parentheses imply cost reductions.
* assumes 30 years of operation with a discount rate of 0% (i.e., no discounting)
** assumes 30 years of operation with a discount rate of 5% and no discounting in the first year
† assumes only 5 years of operation rather than 30 years of operation
Note: Costs are “not quantified” for recommendations initiated and begun by operations contractor.

FIGURES

FIGURE 1-1. SITE LAYOUT SHOWING THE WELLS AND THE PCE PLUME AS DETERMINED BY THE NOVEMBER 2000 SAMPLING RESULTS.



(Figure compiled from Figure 3 of the Modesto Groundwater Contamination Site, November 2000 Monitoring Report, Ecology and Environment, April 5, 2001).

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