Cost and Performance Summary Report
Soil Vapor Extraction at Defense Supply Center Richmond, OU 5
Chesterfield County, Virginia

Summary Information [1, 2, 5]

The Defense Supply Center Richmond (DSCR) is a 565-acre installation located in Chesterfield County, Virginia, on property owned by the Department of the Army. The installation, built in 1941 and 1942, originally included two separate facilities: the Richmond General Depot and Richmond Holding and Reconsignment Point. In the early 1990's, the installation became known as DSCR. The mission of DSCR was to organize, direct, and manage supplies, and to operate a storage facility of the Defense Supply Agency. Today, DSCR's main function is to manage and furnish general military supplies to the Armed Forces and several civilian federal agencies.

In August 1987, the site was placed on the National Priorities List (NPL). A remedial investigation (RI), conducted in November 1988, identified volatile organic compounds (VOCs) in the soil and groundwater in the vicinity of a pit area. While solvents or other organics were not used in these metal cleaning operations, the pits were open and may have been used for undocumented disposal of organics from other operations at DSCR.

In September 1990, DSCR entered into a federal facilities agreement (FFA) with EPA and the Commonwealth of Virginia. Under that agreement, DSCR was divided into eight operable units (OU). OU 5, the Acid Neutralization Pits source area, is the focus of this report.

OU 5 is the site of two former concrete settling pits that received wastewater from the metal cleaning operations conducted in Warehouse 65. The metal cleaning operations, which included a boiling bath of sodium hydroxide followed by a hot water dip rinse, were conducted from 1958 until the early 1980s. The pits were closed in 1985 and filled with soil. During closure, cracks and holes were observed in the concrete, indicating the potential for leaks to the subsurface.

The primary contaminants of concern were tetrachloroethene (PCE) and trichloroethene (TCE) in the groundwater, and VOCs in the soil. The maximum concentrations measured for soil during the RI were PCE - 1.5 mg/kg and TCE - 0.036 mg/kg.

Because the contaminated soil in the vicinity of the pit area was determined to be the source of groundwater contamination, the record of decision (ROD), signed on March 25, 1992, specified soil vapor extraction (SVE) as the remedy for OU 5. The ROD specified operation of the SVE system until concentrations for the contaminants of concern in the soil were reduced to below specified action levels. The ROD also indicated an estimated time of four years for the system to reduce concentrations to the action levels.

The estimated quantity of soil treated during this application was 1,000 cubic yards (yd^3). The SVE system reduced the concentrations for the contaminants of concern sooner than anticipated, and EPA issued an Explanation of Significant Differences (ESD) in March 1996 to describe how the remedial action completed at this site differed from that identified in the ROD.

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Lead:	Defense Logistics Agency and U.S. Army Corps of Engineers

Timeline [1, 2, 5]

March 25, 1992	ROD signed
December 1 - 11, 1992	Pilot study of SVE conducted
March 8, 1996	ESD signed

Factors That Affected Cost or Performance of Treatment [6, 8]

Listed below are the key matrix characteristics for this technology and the values measured for each during site characterization. According to the draft RI, soils underlying this area consist of 72% Tetotum, 18% Bourne, and 10% other soils (Aquults, Atlee, Dunbar, Faceville, Gitney, Norfolk and Vaucluse soils). Additional data showed that soils at this site consist of approximately 50% clay.

Matrix Characteristics

Parameter	Value
Soil Classification:	Clean to silty sand and silty clay
Clay Content and/or Particle Size Distribution:	Approximately 50% clay
Moisture Content:	Soil characterized as ranging from slightly damp to moist
Air Permeability:	3.49×10^{-8} cm^2 to 7.5×10^{-7} cm^2 (calculated range using three methods)
Porosity:	30% (assumed by EPA based on general knowledge of site area)
Total Organic Carbon:	Not available
Nonaqueous Phase Liquids:	Not identified

Treatment Technology Description [1, 2, 4, 5, 6, 7]

A pilot study of SVE was conducted from December 1 to December 11, 1992, to identify additional design parameters for a full-scale system. The study consisted of two tests, a hydraulic influence test conducted over a 24-hour period, followed by a 10-day hydrocarbon removal test. For the hydrocarbon removal test, one extraction well was used along with a carbon adsorption unit for the treatment of the off-gas. The well was installed at a depth of 12 feet (ft) below ground surface (bgs), and was screened from 6.5 ft bgs to 11.5 ft bgs. It was operated at a vacuum of 35 inches of water and at an air flow rate of 40 standard cubic feet per minute (scfm). The maximum removal rate for total volatile hydrocarbons was 0.00021 lb/hr.

Listed below are the key operating parameters for this technology and the values measured for each.

Operating Parameters

Parameter	Value
Air Flow Rate:	40 scfm
Operating Vacuum:	35 inches of water

Performance Information [1, 2, 5]

The ROD identified the following risk-based soil action levels for OU 5 developed based on the protection of groundwater at the site:

- PCE - 0.58 mg/kg
- TCE - 0.20 mg/kg

Following completion of the pilot study, 19 soil samples from the area beneath six pits were collected and analyzed for PCE and TCE. The results showed that the soil action levels had been achieved during the pilot study. Samples from three of the six pits were below detection levels for PCE and TCE. The maximum concentrations reported for PCE (0.18 mg/kg) and for TCE (0.11 mg/kg) were below the soil action levels. In addition, the areal extent of the contaminated soil was determined to be limited to a small area under one pit. An ESD was signed in March 1996 indicating that a full-scale system was not required. Covers were installed on the pits, as required in the ROD.

During the first day of the hydrocarbon removal test, high levels of toluene were detected. It was determined that the source of the toluene was a sealant used to make air-tight connections with the wellhead. All components of the flow system that had come into contact with the sealant were replaced, and rubber couplings were used to create an air-tight seal. The toluene levels dropped below detection limits by the fourth day of testing.

Performance Data Quality

No information was provided on the quality assurance/quality control activities performed for this application.

Cost Information [2, 3, 7]

Cost data obtained from the U.S. Army Corps of Engineers (USACE) indicated that the total actual cost of the pilot study was $76,099, consisting of $18,225 for capital equipment and $57,874 for operation and maintenance. The unit cost of the pilot study treatment activities was $76/yd^3 (1,000 yd^3 treated). Information was not provided on the mass of contaminant removed, and therefore a unit cost per pound of contaminant removed was not calculated for this application.

Actual Project Costs

Cost Element	Cost ($ in 1992)
Capital	
Site Work and Preparation	
- Electrician	1,300
- Driller	8,500
Equipment and Appurtenances	
- Vacuum extraction pilot unit rental ($1,250/wk x 3 wks)	3,750
- Vapor extraction well ($575/well x 2 wells)	1,150
- Vapor probes ($60/probe x 8 probes)	480
- Flexible hose, SS hose, clamps, vacuum pressure gauges	800
- Data logger, transducer ($610/wk x 2 wks)	1,220
- Additional transducers ($125/wk x 8 wks)	1,000
- Camera ($25/wk x 1 wk)	25
Capital Subtotal	**18,225**
Operation and Maintenance	
Direct Labor	20,904
Travel	
- Airfare	550
- Subsistence	2,075
- Auto Rental	1,500
Direct Materials	
- Carbon canisters and disposal ($2,300/can x 2 cans)	4,600
- Field sampling materials	300
- Field notebook	14
Equipment Overhead	
- Telephone	100
- PC Rental	231
- Facsimile	106
- Overnight express	684
- Photocopier	25
Health and Safety	
- Draeger bellow/tube ($90/wk x 3 wks)	270
- Microtip ($300/wk x 3 wks)	900
- Eye Wash ($35/wk x 2 wks)	70
Analytical (related to technology performance, not compliance monitoring)	
- On-site GC services	18,625
- Soil VOC (method 8240) ($280/analysis x 20 analyses)	5,600
O&M Subtotal	**57,874**
Disposal of Residuals	**Included in total**
Analytical (related to compliance monitoring, not technology performance)	
Soil TCLP ($1,300/analysis x 1 analysis)	1,300
Total Project Cost	**76,099**

Observations and Lessons Learned [2, 5]

Since implementation of a full-scale system was not required, the cost for remediation of OU 5 was lower than the $116,000 ROD estimate.

The cleanup goals were achieved during a 10-day pilot test involving one extraction well. According to the ESD, several factors contributed to the success of the pilot test, including:

- The actual area of contamination was smaller than originally estimated
- Natural attenuation may have contributed to decreased contaminant levels
- PCE concentrations in the untreated soil were only slightly higher than the action levels.

According to the EPA RPM, rubber couplings were determined to be better sealants than solvent-based materials because the solvent-based materials were found to cause toluene contamination in the off-gas stream.

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