



Groundwater Cleanup: Overview of Operating Experience at 28 Sites

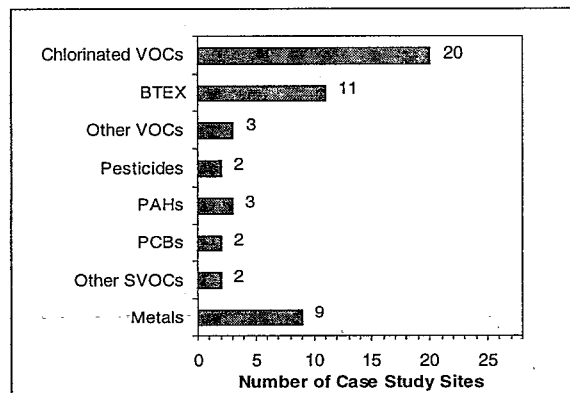
Fact Sheet and Order Information

Introduction

Groundwater contamination is present at most hazardous waste sites across the country. U.S. EPA compiled data on groundwater remediation in a new report, *Groundwater Cleanup: Overview of Operating Experience at 28 Sites (EPA 542-R-99-006)* to provide site managers with information that may be helpful in remedy evaluation and selection. The study examines operating experiences at 28 sites with completed or ongoing groundwater cleanup programs. The sites present a range of the types of cleanups typically performed at sites with contaminated groundwater, and were selected based on length of cleanup operations, type of cleanup goals, and availability of data.

At 21 of the sites, pump-and-treat (P&T) systems were used as the sole groundwater cleanup technology. *In situ* permeable reactive barriers (PRBs) were used alone at two of the sites as the groundwater technology, and followed P&T at one site. In addition, *in situ* bioremediation and air sparging were used in conjunction with P&T at five sites. The bar chart shows the categories of contaminants treated at the sites. (Some sites have more than one type of contaminant.) The Federal Remediation Technology Roundtable has published individual reports for each of the 28 sites available at www.frttr.gov/cost.

Categories of Contaminants Treated at 28 Sites



Contents of Report

For each of the 28 sites, the report summarizes and discusses the following types of data:

- Site conditions, such as contaminants, hydrogeology, presence of non-aqueous phase liquid (NAPL), and type and dates of cleanup
- Design and operation of the remedial system, such as system components, *in situ* technologies used, operational parameters, and system optimization and modification efforts
- Performance of the remedial system, such as progress towards meeting cleanup goals, removal of contaminant mass, and average reduction in the concentrations of contaminants
- Cost for the remedial system, such as capital costs, average annual operating costs, and unit costs

Summary of Findings

Most of the case studies (26 of the 28) examine sites at which remediation is ongoing; data on performance and cost are current as of late 1997 or early 1998. Performance data compiled for the report show that the total amount of contaminant removed at the sites ranged from 7 pounds to >510,000 pounds, with a median contaminant mass removal of 2,000 pounds. The average annual volume of groundwater treated at P&T sites ranged from 1.7 million to 550 million gallons. Changes in contaminant concentrations in the aquifer varied widely.

For the 26 systems in which P&T was used alone or with another technology, the median capital cost was \$1.9 million; the median average annual operating cost was \$190,000; the median unit costs were \$96 of capital cost per average 1,000 gallons of groundwater treated per year and average annual operating cost of \$18 per average 1,000 gallons of groundwater treated per year. For the three PRB systems, the median capital cost was \$500,000; the median average annual operating cost was \$85,000; the median unit costs was \$520 of capital cost per average 1,000 gallons of groundwater treated per year and average annual operating cost of \$84 per average 1,000 gallons of groundwater treated per year.

The factors that affect cost and performance and the extent of the effect of those factors varied from site to site. However, the information provided for the 28 case study sites, as well as general observations of groundwater cleanup as a whole, indicate that the following factors have a significant effect on the cost and performance of groundwater remediation systems:

- **Source control** - Method, timing, and success of controls that mitigate continuing sources of groundwater contamination, such as NAPLs or highly contaminated soil
- **Hydrogeologic conditions** - Aquifer properties that affect transport of the contaminant and design of the extraction system, including hydraulic connection of aquifers, aquifer flow parameters, and influences of adjacent surface water bodies and production wells
- **Properties of the contaminants** - Physical/chemical properties of contaminants that affect the relative ease of removing contaminants from the aquifer, such as solubility and vapor pressure
- **Extent of contamination** - The extent of the contaminated groundwater plume, including area and depth of the plume and the concentrations of contaminants within the plume
- **Remedial goal** - Regulatory factors that affect the design of a remedial system or the period of time for which it must be operated, including containment of the plume, restoration of the aquifer, and stringency of the cleanup levels
- **System design and operation** - Different configurations of a system, system downtime, system optimization efforts, amount and type of monitoring performed, and use of *in situ* technology to replace or supplement a P&T system



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