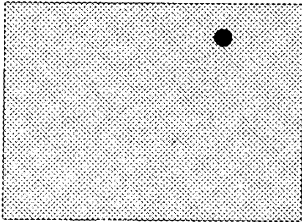




SITE FACTS



Location: Denver, Colorado

Laboratories/Agencies: U.S. EPA National Risk Management Research Laboratory (NRMRL), U.S. EPA Region 8

Media and Contaminants: BTEX in ground water

Treatment: In situ bioremediation of ground water with nutrient and hydrogen peroxide addition

Date of Initiative Selection: Spring 1991

Objective: To evaluate the effectiveness of in situ bioremediation of used oil and the potential for future environmental impact from residual contaminants

Bioremediation Field Initiative Contact: John Wilson, U.S. EPA NRMRL, P.O. Box 1198, Ada, OK 74820

Regional Contact: Suzanne Stevenson, U.S. EPA Region 8, 999 18th Street, Denver, CO 80202-2466

Bioremediation Field Initiative Site Profile: Public Service Company of Colorado

Background

In 1987, Public Service Company of Colorado (PSC), an electric utility, determined that used oil had leaked from a 75-gallon catch basin at the company's facility at 2701 West 7th Avenue in Denver, Colorado. The catch basin served as a temporary storage container for used automotive oil in the facility's garage. A discrepancy between the volume of oil deposited in the tank and the volume pumped out for disposal led PSC to suspect the leak. Though it is unclear when the leak first occurred, the basin had been in service for approximately 29 years before the leak was discovered.

Characterization

PSC found soil concentrations of oil and grease beneath the tank ranging up to 9,600 mg/kg. Soil samples also showed BTEX compounds in the following concentrations: toluene, 3,200 µg/kg; ethyl benzene, 820 µg/kg; and xylenes, 29,600 µg/kg. Ground water sampling detected low levels of BTEX compounds, though levels of xylenes exceeded EPA's proposed drinking water standards.

Field Evaluation

An in situ bioremediation system was operated at the site from October 1989 to March 1992. Ground water was pumped from a recovery well downgradient of the spill at the rate of 11 gallons per minute. The recovered water was treated by carbon adsorption to remove dissolved hydrocarbons and reinjected into the aquifer upgradient of the spill through two injection galleries. Ground water amended with ammonium, phosphate, and hydrogen peroxide was injected through the first gallery. Unamended ground water was injected through the second gallery, upgradient of the first, to sweep the amended ground water through the spill to the recovery well. Injection rates were adjusted periodically to optimize the delivery of nutrients and oxygen to the spill. Figure 1 shows the plan view of the site.

A total of 10 to 15 pore volumes of ground water were exchanged over the course of the treatment, which reduced BTEX levels in the ground-water monitoring wells to below cleanup level goals. In March 1992, PSC submitted an application for closure to the State of Colorado and the site entered a period of postremediation monitoring.



In July 1992, the Robert S. Kerr Environmental Research Laboratory (RSKERL) (now part of the National Risk Management Research Laboratory) and the University of Colorado at Boulder (UCB), with support from the Bioremediation Field Initiative, began a retrospective evaluation of bioremediation at the PSC site. The evaluation consisted of aquifer sampling to assess the hydrocarbon contamination remaining at the site after treatment, and modeling to predict whether a plume of contamination would return after active remediation was discontinued.

Status

RSKERL collected aquifer core samples to determine the quantity and distribution of hydrocarbons remaining at the site. Significant hydrocarbons were found to remain in a narrow, approximately 2-ft

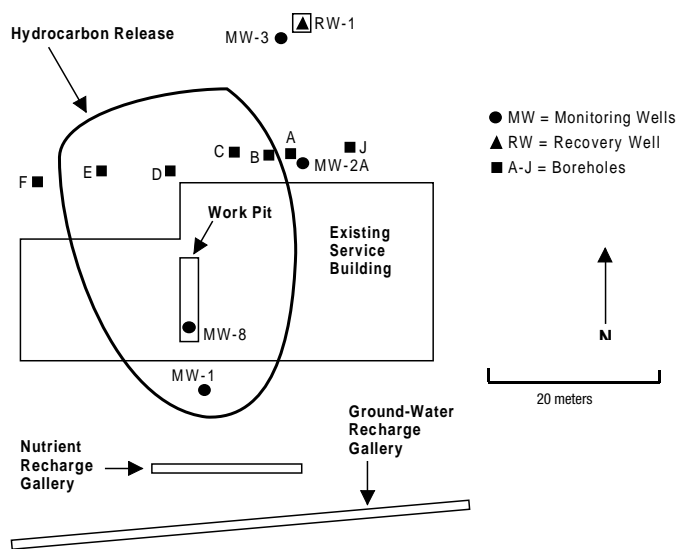


Figure 1. Plan view of the PSC site, showing the location of the work pit, recovery and monitoring wells, and reinjection galleries and the approximate area of the spill.

Table 1

Vertical Distribution of TPHs, Total BTEX Compounds, and Benzene Found in Borehole D				
Elevation (feet above MSL ^a)	TPHs (mg/kg)	BTEX (mg/kg)	Benzene (mg/kg)	Color and Texture
1609.711 to 1609.458	<44	<1	<0.2	Brown sand
1609.458 to 1609.354	227	5.1	<0.2	Brown sand
1609.354 to 1609.230	860	101	<0.2	Black sand
1609.230 to 1609.101	1,176	206	4.3	Black sand
1609.101 to 1609.050	294	27	0.68	Black sand
1609.050 to 1608.949	273	7.4	0.26	Black sand
1608.949 to 1608.821	<34	<1	<0.2	Black sand
1608.821 to 1608.492	<24	<1	<0.2	Brown to yellow sand

^aMean sea level.

thick interval just below the water table. Table 1 shows the contaminant concentrations found at eight different sampling depths in the borehole closest to the source of the spill. These data suggest that active remediation physically and biologically weathered the spill, creating a cortex of material with reduced levels of hydrocarbons surrounding a core of material in which hydrocarbons were not degraded significantly.

Following RSKERL's investigation of the residual contamination, researchers at UCB conducted hydraulic conductivity tests and three-dimensional ground-water flow modeling to determine the velocity and trajectory of potential contaminant plumes. The research team recommended that compliance monitoring be continued until all of the subplumes have reached steady-state conditions, and that compliance wells be designed to minimize contaminant dilution.

The Bioremediation Field Initiative was established in 1990 to expand the nation's field experience in bioremediation technologies. The Initiative's objectives are to more fully document the performance of full-scale applications of bioremediation; provide technical assistance to regional and state site managers; and provide information on treatability studies, design, and operation of bioremediation projects. The Initiative currently is performing field evaluations of bioremediation at eight other hazardous waste sites: Libby Ground Water Superfund site, Libby, MT; Park City Pipeline, Park City, KS; Bendix Corporation/Allied Automotive Superfund site, St. Joseph, MI; West KL Avenue Landfill Superfund site, Kalamazoo, MI; Eielson Air Force Base Superfund site, Fairbanks, AK; Hill Air Force Base Superfund site, Salt Lake City, UT; Escambia Wood Preserving Site, Brookhaven, MS; and Reilly Tar and Chemical Corporation Superfund site, St. Louis Park, MN. To obtain profiles on these additional sites or to be added to the Initiative's mailing list, call 513-569-7562. For further information on the Bioremediation Field Initiative, contact Fran Kremer, Coordinator, Bioremediation Field Initiative, U.S. EPA, Office of Research and Development, 26 West Martin Luther King Drive, Cincinnati, OH 45268; or Michael Forlini, U.S. EPA, Technology Innovation Office, Office of Solid Waste and Emergency Response, 401 M Street, SW., Washington, DC 20460.