TECHNOLOGY NEWS AND TRENDS

Combined Treatment Technologies for TCE Removal Approach Cleanup Closure

Use of soil vapor extraction (SVE) partially enhanced by electrical resistance heating (ERH) at the Air Force Plant 4 (AFP4) in Forth Worth, TX, over the past 13 years has resulted in successful removal of volatile and semi-volatile contaminants in the site's vadose and saturated zones. Treatment of the contaminated soil and ground water posed unique challenges due to the presence of TCE in the vadose zone directly below the plant's "Building 181." In one of the building's monitoring wells, TCE concentrations were as high as 1,400 mg/L.

The area under Building 181 is the primary source of the AFP4's operable unit 1 (OU1) ground-water contaminant plume. As part of the OU1 source-area remediation plan, vadose-zone treatment was needed to prevent TCE migration into the alluvial ground-water system, which in turn threatened the regional aquifer. The vadose-zone TCE under the building serves as a source of ground-water contamination under an adjacent parking lot. Alluvium in this area consists of clayey fill and gravelly clay with low permeability, conditions shown in the past to be amenable to SVE applications.

In 1993, the U.S. Air Force (USAF) constructed an SVE pilot system. The system employed eight extraction wells, seven of which extended up to five feet bgs and one which extended 35 feet bgs into the alluvial terrace. It also included 19 soil-gas monitoring probes, a 7.5-horsepower blower for vapor extraction, and two 3,000-pound carbon vessels for TCE removal. The first 90 days of SVE operations resulted in removal of 4,400 pounds of TCE.

Following three years of successful pilot operations, SVE was selected as the final remedy for AFP4 and major system upgrades were initiated. The full-scale system included 36 soil-gas extraction wells, three dual-phase extraction wells, and numerous soil-gas probes and piezometers to measure system performance. An additional vacuum blower, expanded piping network, and a new semi-permanent operations building also were added. Instead of the vapor-phase carbon adsorption used during the pilot, catalytic oxidation vapor treatment technology (COVTS) was installed to treat recovered TCE vapors.

The full-scale SVE system began operating on a continuous basis in March 2000. During its six-month startup, the system removed 1,521 pounds of TCE. As influent concentrations declined, the COVTS equipment became uneconomical to operate and

was replaced in May 2002 with activated carbon adsorbers. At that time, analytical sampling indicated TCE concentrations in source-area soil were slightly above the 11.5-mg/kg cleanup goal, and higher TCE concentrations were detected at some locations near the original release area. A review of the system's long-term performance indicated that the application of an additional treatment technology in the source area would likely accelerate cleanup and achieve the remedial action objectives.

Based on the site characteristics, technology screening, and pilot-test results, a full-scale ERH system was installed in 2002 to enhance source-area treatment efficiency. ERH technology employs electrical resistance to heat contaminated soil, thereby helping to vaporize residual contaminants, ground water, vadose-zone moisture, and perched water. The system targeted 27,000 cubic yards of contaminated soil in a 0.5-acrea area under the floor of the building. A total of 63 ERH electrodes and co-located vapor and steam recovery wells operated continuously over nine months. [See the December 2004 *Technology News and Trends* for details on this application.] Existing SVE pipes, wells, and auxiliary equipment were used for ERH implementation.

The combined SVE-ERH treatment approach removed 1,743 pounds of TCE. The ERH system was shut down in December 2002 when cleanup goals for both soil and ground water in the target area were met at 11.5 mg/kg and 10 mg/L, respectively. (One well (MV-10) could not be heated due to equipment failure and still contained elevated TCE concentrations; the USAF will apply a localized treatment if monitoring does not indicate a trend of decreasing TCE concentrations in the well.) The aboveground ERH system and ancillary equipment were removed in 2003, while the SVE and monitoring systems continued to operate. Temporary shutdowns of the SVE system occurred periodically to evaluate soil-vapor rebound, and only minimal rebound was detected.

Monitoring throughout 2004-2005 showed an average mean TCE concentration in soil of 0.184 mg/kg, significantly below the 11.5-mg/kg target for OU1. The mean TCE concentration in ground water also was far below its 10-mg/L target, and averaged 4.1 mg/L. Downgradient dual-phase extraction wells with concentrations exceeding 20 mg/L before SVE-ERH treatment now exhibit TCE concentrations below 1 mg/L, well below the remediation target (Figure 1). As a result, the USAF currently is shutting down the SVE system, evaluating the MW-10 well area, and conducting any final remedial actions in preparation for OU1 clean-up closure later this year.

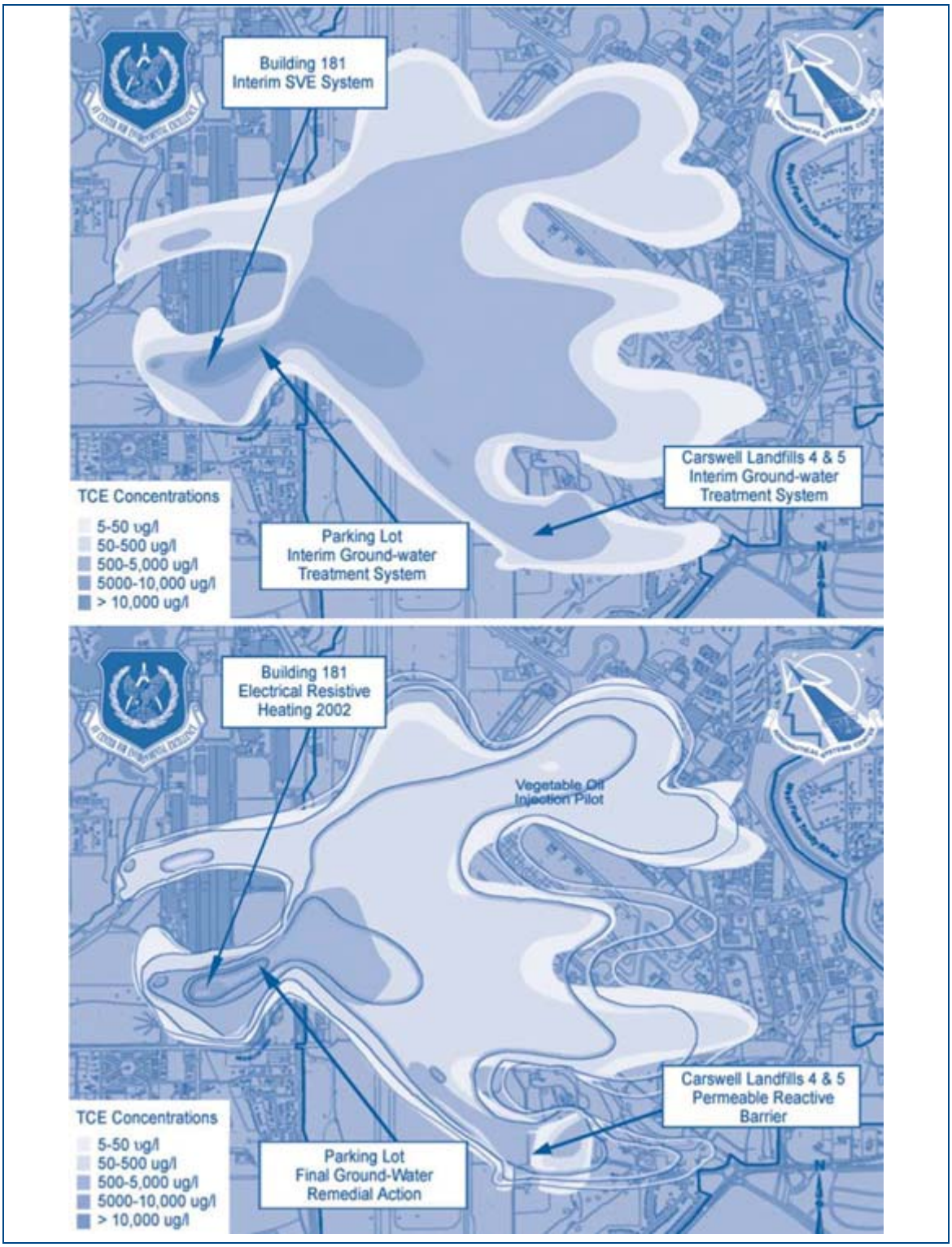

Figure 1. Mapping of TCE distributions in ground water before and after SVE-ERH treatment illustrate significant progress toward cleanup closure at Air Force Plant 4.

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