

Four-Year Monitoring Shows Source-Area VOC Reductions After ERH/SVE at Naval Station-Annapolis

The U.S. Navy applied electrical resistance heating (ERH) and soil vapor extraction (SVE) in 2006 as an interim action to remove 1,1,2,2-tetrachloroethane (TeCA) and trichloroethene (TCE) from source areas at Site 1 of the Naval Support Activity installation in Annapolis, MD (former Naval Station-Annapolis) [see September 2007 TNT]. Analysis of soil samples collected upon complete cooling of the subsurface in January 2009 indicated an average 99.6% reduction in TeCA concentrations and 99.9% reduction in TCE concentrations. Sampling results since then show concentrations in soil remain below the corresponding U.S. EPA industrial standards of 2,900 µg/kg and 14,000 µg/kg. In groundwater of wells adjacent to the treatment area, TeCA and TCE concentrations have decreased an average 98% and 74%, respectively, as a result of ERH/SVE application in the source areas.

Three-phase ERH technology was implemented at Site 1 by way of steam stripping and in situ hydrolysis to convert TeCA to the more volatile TCE and subsequently remove the TCE. Integrated ERH/SVE system components included 24 steel electrodes, a steam condenser, one blower, and a granular-activated carbon filtration (GAC) system. The subsurface soil was heated to temperatures averaging 99°C (210°F) over 116 days, from February to May 2006.

As anticipated, TCE concentrations in the treatment-area groundwater monitoring wells significantly increased immediately after ERH/SVE treatment, which indicated hydrolysis had occurred. Concentrations then dropped to below pre-treatment levels over following months. For example, one treatment-area monitoring well with a TCE concentration of 2,800 µg/L prior to treatment exhibited a concentration of 27,000 µg/L five months later, followed by a concentration below 2,000 µg/L in subsequent monitoring events (Figure 3). The most recent data collected during biannual sampling of wells adjacent to the treatment area show that TeCA and TCE concentrations have decreased to an average of 35 µg/L and 475 µg/L, respectively.

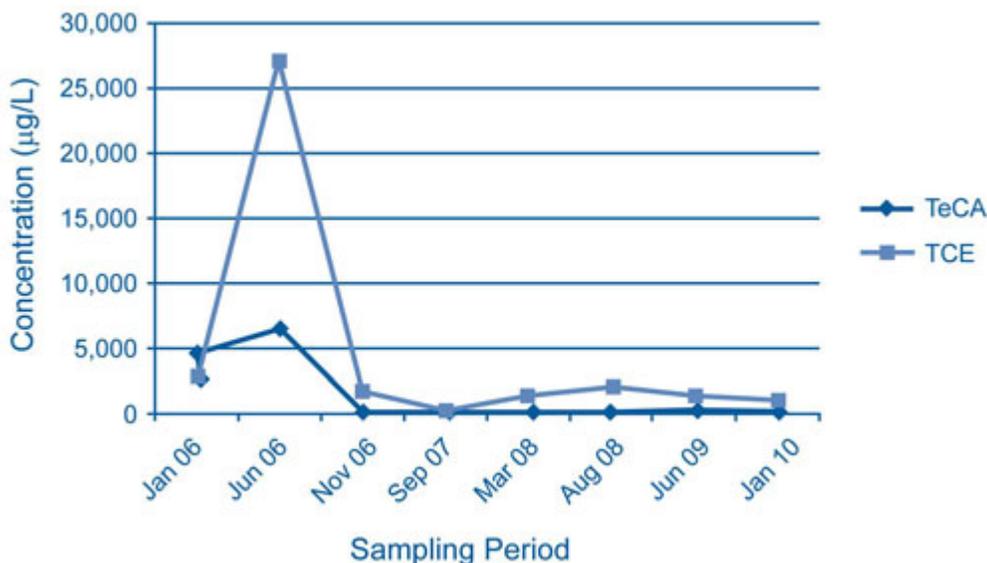


Figure 3. TCE concentrations in one monitoring well at the downgradient perimeter of the Site 1 treatment area decreased to 940 µg/L within four years of ERH/SVE implementation, after an initial spike caused by rapid breakdown of TeCA to TCE.

Monitoring downgradient of the source areas indicates that a plume of TCE was released to groundwater during heating of the source areas. Four wells located 250-800 feet downgradient exhibited a peak average increase of 2,060% in volatile organic compound (VOC) concentrations approximately two years after system shutdown. All four wells exhibited a decline of TeCA and TCE concentrations after the second-year sampling event, which suggested that VOC mobilization was temporary. One well approximately 250 feet downgradient, for example, showed a 1,200% and 1,100% increase in TeCA and TCE, respectively, followed by notably lower concentrations seven months later (Figure 4).

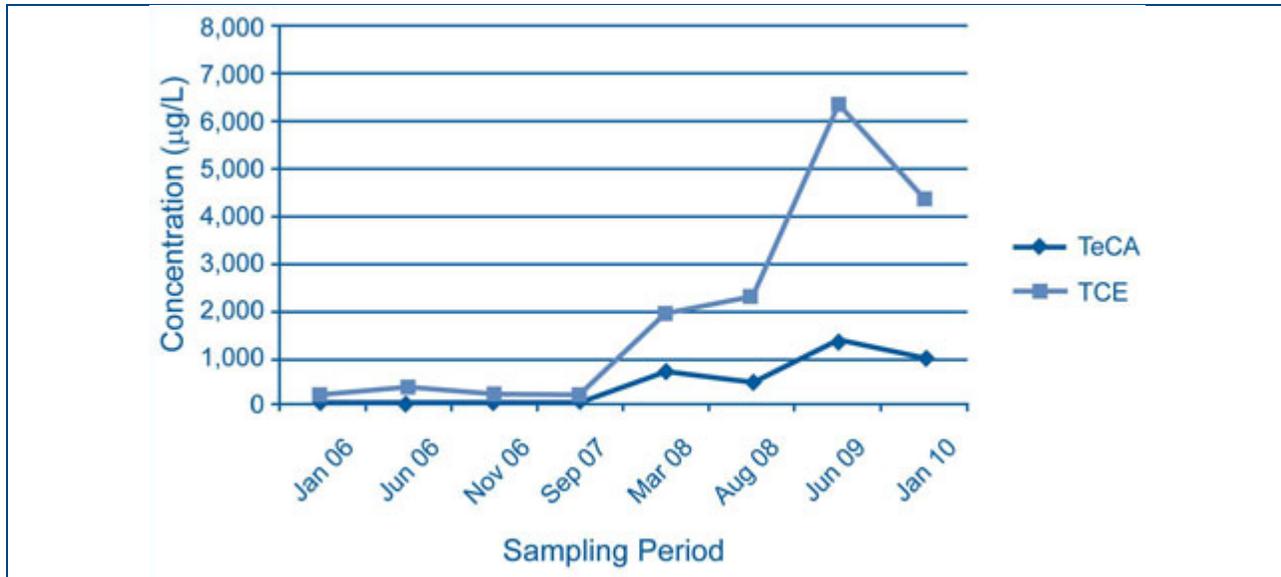


Figure 4. With an an estimated groundwater flow rate below 1 ft/day, impacts from Site 1 source-area ERH/SVE implementation were observed at one well approximately 21 months later.

The Navy continues to monitor VOCs at Site 1 to evaluate groundwater concentration trends associated with this interim action. Groundwater monitoring costs since the 2006 shutdown have averaged less than \$20,000/year.

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