Groundwater Extraction & Treatment

By Beth Thomas & Greg Gilles

Groundwater project demonstrates successful arsenic remediation

Strong housing demand and a limited supply of land in Florida has increased residential development of former agricultural lands. At a former 14-acre ornamental nursery site in Delray Beach, Fla., the use of arsenical herbicides and pesticides contaminated soil and groundwater to levels exceeding cleanup goals.

The site is surrounded by residential communities and is being developed as an apartment community. A site assessment identified the extent of soil and groundwater with arsenic concentrations greater than regulatory limits.

LFR, an environmental firm under contract to Blackstone Consultants, LLC, was responsible for specifying and selecting a cleanup remedy in accordance with the state of Florida Department of Environmental Protection (DEP) cleanup standards. The objective was to complete an assessment of the soil and groundwater in order to prepare and implement a remedial action plan to achieve regulatory closure.

Analysis of soil samples collected from more than 300 locations indicated that arsenic concentrations were above the residential cleanup goal (2.1 mg/kg), arsenic leached to the groundwater at concentrations above the arsenic groundwater cleanup goal (0.05 mg/L), and the contaminated soil was non-hazardous based on TCLP tests. A leachability study established a site-specific leachability soil cleanup goal of 13 mg/kg. A soil management plan was prepared and implemented beginning in 2006, and during implementation, 43,000 tons of soil were excavated and disposed offsite as nonhazardous waste.

Arsenic concentrations in the groundwater ranged up to 4,000 mg/L. Because of the quantity, oxidation state and distribution of the arsenic in the groundwater above the groundwater cleanup goal, the most viable method of groundwater remediation was identified as groundwater extraction and treatment. To treat arsenic in extracted groundwater, several technologies were reviewed. After LFF and Blackstone completed the site characterization and demonstrated that the groundwater contained high arsenic concentrations, LFR contacted AdEdge Technologies to assist in developing a treatment remedy. Given the combination of high levels of iron and arsenic in the groundwater, a two-stage treatment approach was selected using oxidation and filtration followed by adsorption. This approach was selected based on successful bench and field-scale treatability studies. The primary two components of the selected treatment technology is a manganese-dioxide-based media for iron removal and a granular ferric oxide adsorbent media that has a high capacity for arsenic adsorption and has been used commercially in many drinking water installations.

The groundwater recovery system consisted of five extraction wells, submersible pumps, associated piping and appurtenances. A pilot program for arsenic removal was conducted with AdEdge prior to the full-scale design and utilized a small-scale version of the proposed treatment train (AD26 plus AdEdge's granular ferric oxide adsorption technology).

The pilot program involved two small arsenic treatment units in a series configuration containing the adsorption media. A groundwater flow of 2 gpm was pumped through the arsenic

WEBresources ➤➤➤

Related search terms from www.waterinfolink.com: groundwater, arsenic

For more information related to this article, visit www.wqpmag.com/lm.cfm/wq110904

pilot units for a threemonth period. Influent concentrations exceeded 2,000 parts per billion (ppb) total arsenic and 1,000 ppb iron. The pilot unit performed well and the system design was implemented to full scale upon review and approval of the corrective action plan by the Florida DEP.

Groundwater remediation began in December 2004 and stopped in October 2006 prior to implementation of the soil management plan. During this period, approximately 12 million gal of groundwater were extracted and 55 lb of arsenic removed from the groundwater. In 2008, the groundwater remediation system was reconstructed during the site development activity. The expected duration of the project and cost is five years and $3,000,000.

A Technical Approach

The full-scale arsenic treatment system currently in place consists of three skid-mounted modules, each rated for 30 gpm and capable of removing the contaminants of concern. Groundwater is pumped from the extraction wells into a 2,000-gal equalization (EQ) tank. From the EQ tank the groundwater flows through bag filters and then enters the dual vessels AD26 (oxidation/filtration) skid containing manganese dioxide media. In this step, iron is oxidized and removed via filtration. Treated effluent flows into two Adsorption Package Units (APU) in series containing Bayoxide E33 adsorption media to remove the remaining arsenic.

Each skid-mounted system is equipped with automatic controls, backwashing features, switches, gauges and sample ports for complete, functioning packaged units. Instrumentation is provided on a control panel to measure critical operating parameters. Total gallon throughput and flow rate for each unit is measured continuously with a dedicated flow totalizing meter. The adsorption system does not require any chemicals or regeneration, and the process does not generate liquid or hazardous waste. Spent media is discarded as a nonhazardous waste. The new remedial system construction was completed in May 2008 and has continued to meet all discharge requirements. The expected duration of groundwater remediation is two additional years.

The cost analysis for the project includes approximate assessment costs of $250,000, soil excavation costs for the 24,467 cu yd of soil removed of $2,000,000 and groundwater remediation for three years of $750,000. The estimated undeveloped property value is $13,000,000. The site has been approved for 120 apartment units.

A site-specific study of arsenic leachability from soil is important to identify the source. An analysis of groundwater geochemistry improves the understanding of arsenic mobility and the remedial approach. Adsorption treatment systems have been primarily designed for use in drinking water systems; therefore, it is important to study the affect of the groundwater geochemistry and competing cations and anions on arsenic removal effectiveness. Groundwater extraction and treatment is an effective approach for arsenic removal, and the use of granular ferric oxide arsenic adsorption media is a viable and cost-effective treatment option. *wqp*

Greg Gilles is vice president of AdEdge Technologies. Gilles can be reached by e-mail at greg@adedgetechnologies.com. Beth Thomas is project manager for AdEdge Technologies. Thomas can be reached by e-mail at beth@adedgetechnologies.com.

For more information on this subject write in 1004 on the reader service card.