

# Innovative Deep Horizontal Injection Well Near Full-Scale Pilot Study for Hexavalent Chromium Groundwater Plume – Applications and Lessons Learned

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**Background/Objectives:** As contaminated sites increasingly shift toward utilization of in-situ remedies logistical challenges have arisen (i.e., access and lack of open space). One solution for this is horizontal wells. This presentation focuses on the design, installation, operation, and lessons learned for an innovative approach to inject lactate in a deep aquifer using horizontal well technology to promote hexavalent chromium [Cr(VI)] reduction. The Puchack Well Field Superfund Site is located in Pennsauken Township, NJ. Metal plating operations resulted in Cr(VI) groundwater contamination in three aquifer units at depths ranging from 90 to 200 feet bgs and resulted in closure of a public water supply well field. A 2008 Record of Decision to address contamination selected geochemical fixation through reducing agent injection to treat groundwater with total chromium concentrations exceeding 70 ppb. The reducing agent (lactate) changes the aquifer's geochemistry to reducing conditions and causes the Cr(VI) to form an immobile trivalent chromium precipitate. The remedy is being implemented in two phases. Phase I was completed in an industrial area and included installation of 166 vertical wells in parking lots and on public roads. Phase II will occur in a residential neighborhood where access limitations including small lots, narrow streets, and numerous overhead and underground utility lines make the installation of vertical wells extremely difficult. To overcome these limitations, horizontal injection wells were considered. While horizontal injection wells are being used more frequently at remediation sites, they haven't been attempted at the depths required for this Site's work. In 2014 a significant scale pilot study was run to test the feasibility of using horizontal injection wells at greater depths.

**Approach/Activities:** The goals of the pilot study were to determine the effectiveness and implementability of horizontal injection wells for treatment of the Cr(VI) contaminated groundwater plume and to provide design parameters for full scale design. One 4-inch diameter horizontal injection well was installed at a depth of 90 feet bgs. The well was approximately 830 feet long, with the last 450 feet having variable slots to deliver the lactate solution into the aquifer. Approximately 260,000 lbs of 60% sodium lactate was mixed with extracted groundwater to form a 16,100 mg/L solution and injected into the horizontal well at a rate of 150 gpm.

**Results/Lessons Learned:** This pilot study is an innovative application of lactate injection via horizontal wells. Review of available case studies yielded limited information for use of horizontal injection wells at depths encountered at this site or for the injection of reducing agents. The pilot study demonstrated that a horizontal injection well could successfully be installed and used to inject and distribute lactate. Specific lessons learned throughout the pilot study include:

- limitations of horizontal well design and application
- well screen design for distribution of lactate throughout the screen
- staging areas for various drilling completion techniques
- use and limitations of bit tracking technologies (gyroscopic steering tool and walk-over tracking tools)
- use of vertical wells to monitor lactate distribution, changes in chromium concentrations over time (through 2017), and changes in aquifer geochemistry.