

Remediating Megaplumes

Arcadis

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Introduction

The design and implementation of remedial technologies for groundwater plumes have rapidly evolved in the last few years. Scientists and engineers are implementing innovative remediation alternatives to sites with a degree of complexity and scale not seen before. The need to investigate and remediate these *megaplumes* is a challenge faced by the Remediation Industry.

What is a *megaplume*? The scale is the most defining feature (foot prints larger than 1 mile long and 0.5 mile wide) in combination with the existence of multiple sources, multiple remedies and ultimately, the cost.

For *in-situ* remedies, this change in scale called for the scaling up of the remediation system components, specifically the reagent delivery systems. The in-situ reactive zone (IRZ) technology required that the injected amendments were well distributed within the desired area of treatment. The challenge of effectively delivering substrates over large treatment areas has driven ARCADIS to capture all scientific and engineering principles necessary to design efficient delivery systems at larger scales in a successful manner.

We will discuss the approach of an injection-based remedy implemented at a Megaplume located in the Ogallala aquifer.

The Challenge: A megaplume in the Ogallala aquifer

The site was used as a training base for pilots during World War II. Aircraft maintenance activities, which included cleaning engine parts with trichloroethene (TCE), eventually leaked into the surrounding groundwater and formed a 3- by 0.5-mile plume in the Ogallala aquifer, the sole source of water for the surrounding community. ARCADIS was contracted to remediate the site to EPA standards.

The contaminated water-bearing zones at the site were about 120 feet bgs and the saturated thickness was approximately 40 feet. The formation sediments are alluvial fan and braided stream deposits. These sediments represent a complex distribution of lithologies that create a very heterogeneous saturated zone.

The Approach: Remediation Hydraulics

Understanding groundwater movement through these soils required a new paradigm, Remediation Hydraulics, which recognized that water movement would be as complex as the soil. The scale of the problem required the division of the plume into five different areas based on the contaminant distribution patterns. A conceptual site model was constructed for each area to adequately customize remediation strategies to smaller scale characteristics that are crucial to the design.

The design of Area 3 was based on the continuous delivery of reagents into the reactive zone to provide treatment via controlled partial dechlorination of TCE to cis-1,2-dichloroethene (DCE). The TCE concentrations are low enough for the DCE to be less than the cleanup standards of 70 ppb. Recirculation was used to facilitate this continuous delivery. Forty-six remediation wells were installed in Area 3 during June 2006. The wells were installed along six transects running perpendicular to groundwater flow along the axis of the TCE plume. Within each transect, six injection wells were installed at 200 foot intervals and two extraction wells were installed at the north and south end of each transect. The extraction wells provided the necessary makeup water to be amended and delivered to the injection wells located within the transect so hydraulic capture was maintained and amendment recovery is minimized at the extraction wells.

Results

The large-scale IRZ at Area 3 has been operating since April 2007. During a 12-month period, a total of 18 million gallons of amended water have been delivered to the aquifer and more than a 40% reduction in plume mass has been achieved. Significant progress has also been made in other areas of the plume using other remedial alternatives. Full-scale remediation and closure of this 3 mile long TCE plume should be achieved by 2014.

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TCE in Area 3 - pre remediation (April 2006).



TCE in Area 3 - after 11 months of remediation (February 2007).

Legend:

 Concentration limits - 10 ppb  Concentration limits - 50ppb