Deployment Support Leading to Implementation

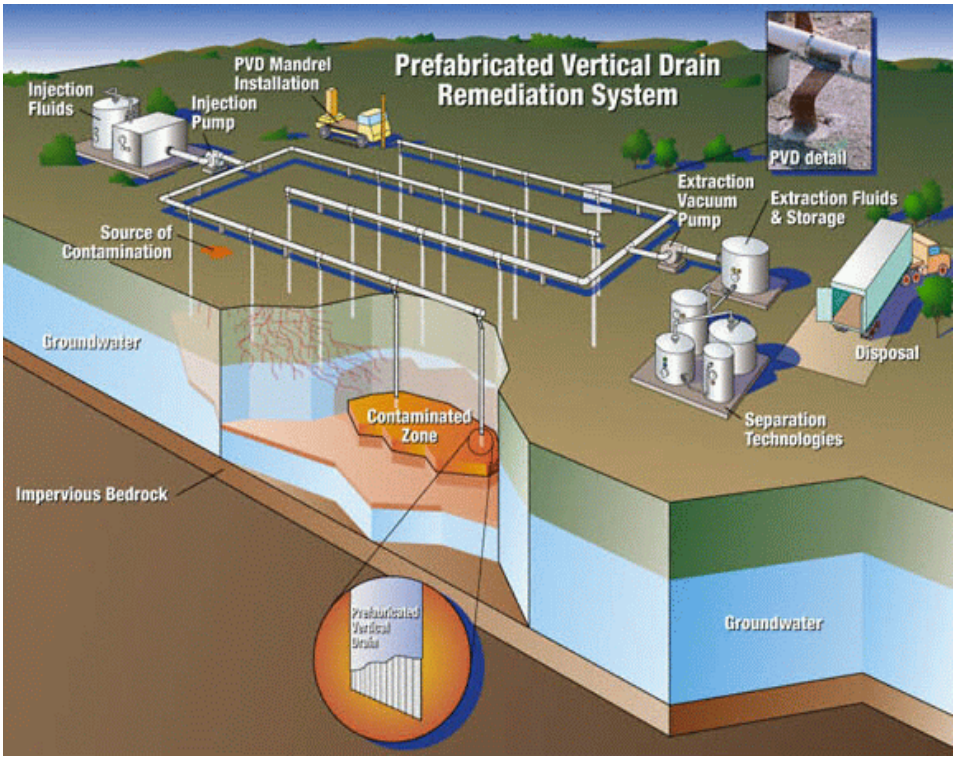
Developer: West Virginia University Research Corporation
Contract Number: DE-FC26-98FT40396
Crosscutting Area: N/A

Technical Integration

Problem:

Deployment Support Leading to Implementation at West Virginia University (WVU) is a Cooperative Agreement that focuses on research and development associated with hazardous waste remediation problems existing at the Department of Energy (DOE) and at private sector sites. The agreement builds on a unique combination of resources coupling university and other researchers with DOE funded small businesses, leading toward field tests and large-scale technology demonstrations.

The RMI Titanium Plant (RMI) in Ashtabula, Ohio is a former uranium processing facility whose operations resulted in significant contamination of the soil and groundwater. The contaminants of chief concern are trichloroethylene (TCE), uranium, and technetium-99 (^{99}Tc), and the site soils contain regions of low permeability. Groundwater contamination is an offsite concern because of potential migration. In situ remediation techniques are preferred as they are generally lower in cost and more effective. A problem common to the in situ remediation of contaminated aquifers by any approach is the need to deliver and/or recover solutions/agents to the subsurface efficiently. This problem is even more challenging in soils with low permeability, such as those at RMI.



Solution:

To address the problem, a novel, versatile technology for the delivery and withdrawal of solutions using Prefabricated Vertical Drains (PVDs) was developed. PVDs have been used for decades in the construction industry to dewater soil. They consist of corrugated plastic wicks encased in permeable fabric. Water movement through the soil is facilitated by the extremely high hydraulic conductivity of the PVD material. The PVDs are typically installed by hydraulic rams and are often spaced only a few feet apart. Fluids can be extracted by applying a vacuum through the PVDs or chemical solutions/agents can be injected and recovered through adjacent drains. The extracted fluids can then be treated above ground.

The explicit goal for the first year is to prove the application of the Prefabricated Vertical Drain (PVD) technology in soil flushing operations. A centrifugal membrane system will also be deployed for separating surfactants from the extracted groundwater.

Benefits:

▸Preliminary results suggest that typical remediation times in excess of 20 years may be reduced to 3-5 years using the PVD approach.

▸By extracting fluids from the PVDs, the location of the contaminants can be delineated and extraction can be limited to PVDs containing contaminants. This greatly reduces the volume of extracted liquids and minimizes potential cross contamination.

▸Using the SpinTek Centrifugal Membrane System to recover and concentrate the surfactant from the extracted fluids allows surfactant recycling and reduces the volume of concentrate to be treated.

Technology:

The PVD technology was first tested and proven successful by WVU at an Ashland Oil and Refining Company abandoned gasoline station site in Weston, WV that was underlain by a fine grain soil (hydraulic conductivity $K = 10^{-6}$ cm/s).

The PVDs can be placed on 2-3 foot centers, 20-30 feet deep (or deeper), allowing a site to be completely matrixed. An acre can be installed in a few days. With this close spacing, the resulting short flow path (1.5-3.0 feet) for travel of the contaminant, very low permeability soils (like clays) can be remediated as well as granular soils. Surfactants and other cleaning agents can be injected in selected drains and extracted from adjacent drains.

RMI is providing a TCE contaminated site to prove the PVD technology on a large scale. The project is a joint effort between WVU, FETC-Morgantown, DOE-Ashtabula, RMI Environmental Services (RMIES), the Institute of Gas Technology (IGT), Nilex Corporation, North Carolina State University (NCSU), SpinTek, and possibly the 3M Corporation. The set up will consist of approximately 600-800 PVDs arranged in a 27 x 27 matrix of rows and columns. Nilex Corporation will supply the materials and install the PVDs.

A surfactant will be added to the flush water to enhance mobilization and solubilization of the TCE from the soil matrix. The contaminant will be tied up in the micelles of the surfactant as it is flushed through the contaminated soil. IGT is performing studies to determine the surfactant and other chemicals required to release and tie up the TCE from the contaminated soil matrix. IGT is also providing the expertise on mixing and injecting the various chemicals through the PVDs and is addressing all Quality Assurance and Quality Control (QA/QC) issues. They will develop an integrated process flow scheme of the system including material and energy balances and cost estimates for full-scale implementation.

RMIES is designing the treatment train for extracted fluids. The SpinTek Centrifugal Membrane System will be applied to extracted liquids so that the surfactant can be recovered for re-injection. The SpinTek system uses a series of flat, round membrane disk packs, set on a hollow rotating shaft inside a cylindrical housing. The waste stream enters the membrane chamber under pressure and is distributed across the membrane surfaces by centrifugal and hydraulic action. Permeate is forced through the membrane and is collected in the hollow shaft and discharged.

The 3M Corporation has developed, through FETC-Morgantown, an adsorbent particle membrane fabricated into small 10-inch high cartridges capable of removing ^{99}Tc. Negotiations are occurring to bring this innovative technology to the RMI site for removal of ^{99}Tc from the extracted groundwater. RMIES plans to use conventional techniques to address the small quantities of Uranium.

Contacts:

West Virginia University develops innovative approaches to environmentally safe energy technologies and environmental restoration technologies. The Department of Civil and Environmental Engineering serves as program coordinator for FETC and helps develop partnerships with industry and government to further enhance eventual application of developed technologies. For information on this project, the contractor contact is:

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