Case Study: Former PEC Industries Site, Orlando, Florida, USA

Site Overview	The former PEC Industries property is a 9-acre parcel of commercial land in Orlando, Florida. Chlorinated solvents, previously used in printed circuit board production, had been stored in drums on an unlined and uncovered storage area, causing solvents to be released into the environment and leach into the groundwater. Site assessment revealed groundwater contamination well beyond previous findings, including methylene chloride at up to 2,000,000 parts per billion (ppb).
GSR Project Outcome	A significant reduction in total VOC mass demonstrates the effectiveness of the systems. Based on the most recent sampling results, estimated total VOC mass has been reduced from 2,897 pounds (prior to system start-up) to less than 9 pounds VOC mass (greater than 99% mass reduction). Site is being considered for a conditional site closure, and planned for redevelopment into a hotel.
Background & Drivers	Property is being remediated in accordance with a Florida Department of Environmental Protection (FDEP) consent order.
Regulatory Program	Property is being remediated in accordance with FDEP Chapter 62-780 Florida Administrative Code (FAC), risk-based corrective action (RBCA).
Site End Use	Site is located in a high-traffic tourism area of Orlando, Florida, and is currently planned for redevelopment into a hotel.
Contaminants of Concern and Impacted Media	Primary chemicals of concern in groundwater: - 1,1-DCE, vinyl chloride - 1,1,1-TCA, 1,1-DCA - Methylene chloride
Key Stakeholders in Project	- FDEP - Rockwell Automation
Cleanup Objectives	Risk-based objectives: - Protect the public against unsafe levels of chlorinated solvent contaminated groundwater - Protect the Floridan Aquifer System from contamination (primary drinking water supply) - Eliminate off-site contamination.

Remediation Strategy	- Hydraulic control at property boundaries to capture offsite contamination, and eliminate further offsite flow of contaminated groundwater. - Reduction of VOC mass in groundwater using enhanced anaerobic bioremediation (EAB). In situ bioremediation enhanced through the use of groundwater circulation. - Hot spot treatment using excavation and in situ chemical oxidation (ISCO) to expedite overall cleanup timeframe.
GSR Strategy/Best Management Practices (BMPs)	BMPs used: - EAB maximizes the naturally occurring bacteria, Dehalococcoides spp. Because it is an in situ technology, EAB destroys the contamination in the ground, mitigating the risks typically associated with extraction technologies, such as accidental release to the environment or worker exposure. - Used water from rainwater collection system for lavatory and onsite chemical mixing. - Ex-situ treatment system is operated at higher treatment rates for shorter durations. The cycling of the treatment system significantly reduces the electrical usage and costs. - Energy efficient pumps (variable frequency drives). - Robust well cleaning program to optimize system function and injection rates. - Used horizontal wells to recover groundwater, which used less electricity and is more efficient for general O&M than traditional vertical extraction wells. Also, used unique one-pass trenching technology to install horizontal wells, which required less energy than traditional drilling technologies, reduced the amount of air emissions released during the process, reduced costs, and improved safety.
GSR Metrics and/or Footprinting Tool(s)	- Energy usage - Water usage - Fate and transport modeling completed to optimize the system design. Continual evaluation of current data is used to optimize the system

Lessons Learned [Optional]	As the project proceeded it was determined that the amount of O&M associated with infrastructure was underestimated. While the addition of groundwater circulation significantly expedited the bioremediation, it also contributed to excess bioaccumulation and fouling in the well screens and pumps. To overcome the biofouling, a regular well screen and pump cleaning program was implemented which combined chemical treatment with physical brushing. While long-term O&M was necessary, the use of the horizontal wells, which significantly reduced the number of well screens, pumps, and associated piping, reduced the amount of O&M compared to the use of a traditional vertical extraction well network.
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