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Surfactant Enhanced Aquifer Remediation (SEAR)

How Surfactant Enhanced Aquifer Remediation Changed the Outlook for Long-Term Groundwater Cleanup

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Underground Storage Tank (UST) Facility

Former gas station and convenience store that operated several USTs - stored gasoline, diesel, and kerosene

Site Layout

- MONITORING WELL
- 1 5,000 gal GAS
- 2 5,000 gal GAS
- 3 2,000 gal GAS
- 4 2,000 gal DIESEL
- 5 280 gal KEROSENE

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Early Cleanup Methods

- Passive Skimmers
  - pneumatic device placed in well - collects free product that passes into well
  - little to no "influence" on area surrounding well
- Mobile High-Vacuum Extraction (HVE)
  - short application times (8- to 12-hour event, typical)
  - very expensive (heavy equipment, special operator, disposal costs)
  - *a.k.a.* EFR®, MEME, HVR

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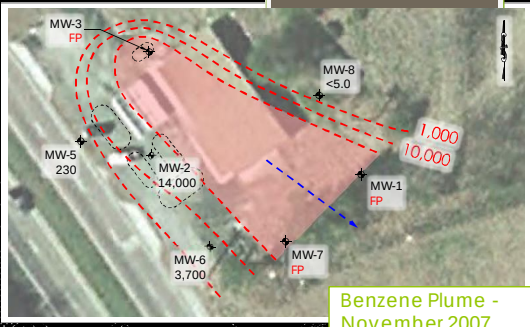

Benzene Plume - November 2007

- MONITORING WELL
- FP FREE PRODUCT
- GROUNDWATER FLOW DIRECTION

CONCENTRATIONS IN µg/L

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Other Cleanup Methods

- Dual-Phase Extraction (DPE)
  - effective technology, but expensive
  - only applied for 30 days (normal 1 to 2 years to finish)
- In-Situ Chemical Oxidation (ISCO)
  - chemically destroys petroleum product in the ground
  - required installation of injection wells
  - moderate results - determined too much chemical required to complete cleanup

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Surfactant Enhanced Aquifer Remediation (SEAR)

- Uses proprietary surfactants (soaps) to flush petroleum from ground
- Solution injected into ground under pressure
- Solution/contaminated groundwater recovered from nearby wells for off-site disposal
- Follow up with injection of microorganisms and nutrients that break down petroleum (bioremediation)

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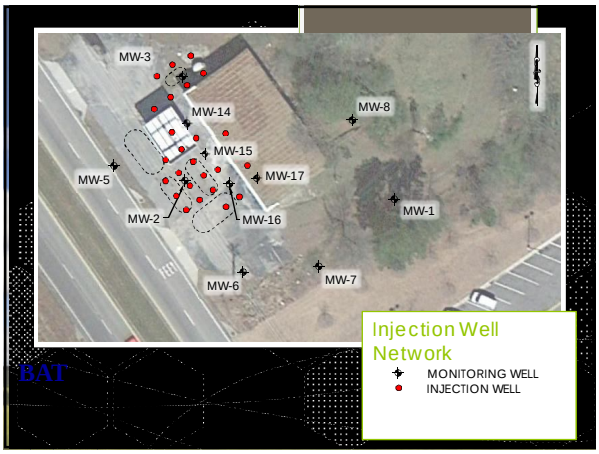

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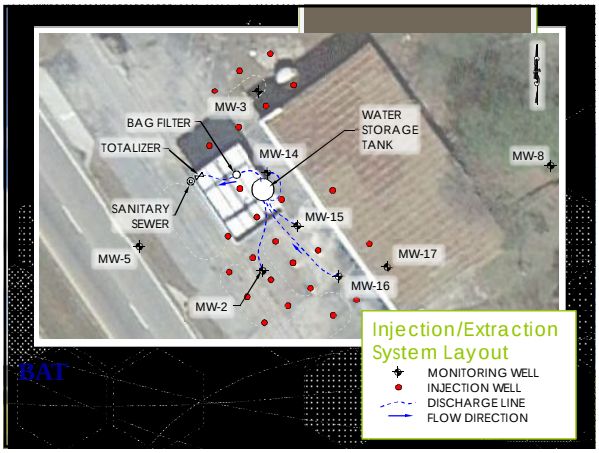

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Injection System Equipment

BAT designed this injection system to accurately deliver the designed quantities of solutions.

Solutions: 3½ to 10%
Flow Rates: <¼ to 8 gpm
Pressures: up to 60 psi

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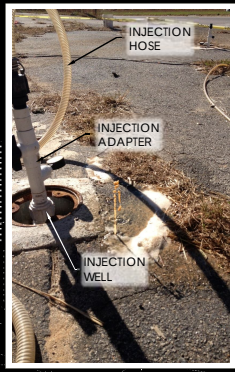
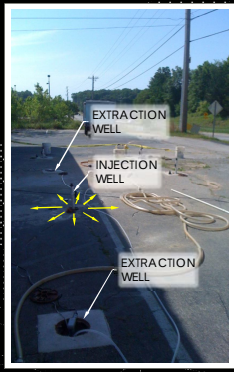


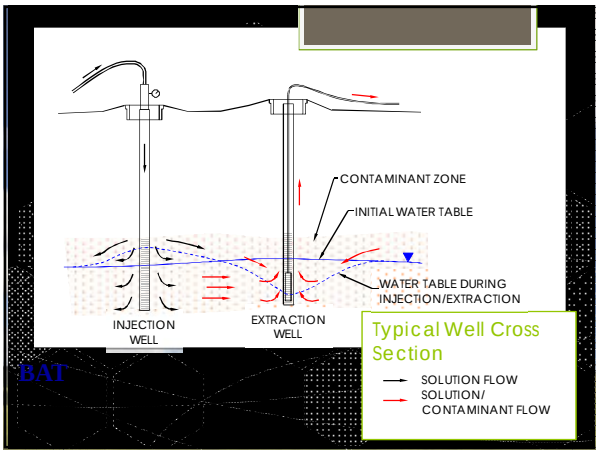
Injection Well Connection

Sometimes the pressure, combined with inconsistencies in the soil type can cause solutions to surface.



Injection and Extraction Wells

SEAR solutions are delivered into the subsurface through injections wells. The solutions travel through the subsurface dissolving the contaminants. The solutions/contaminants travel to the extraction wells for removal.



How does SEAR work?

- Surfactants bond with hydrophobic organic compound.
- The contaminants dissolve into water more readily.
- The surface tension of the mixture is reduced allowing flow through smaller pores

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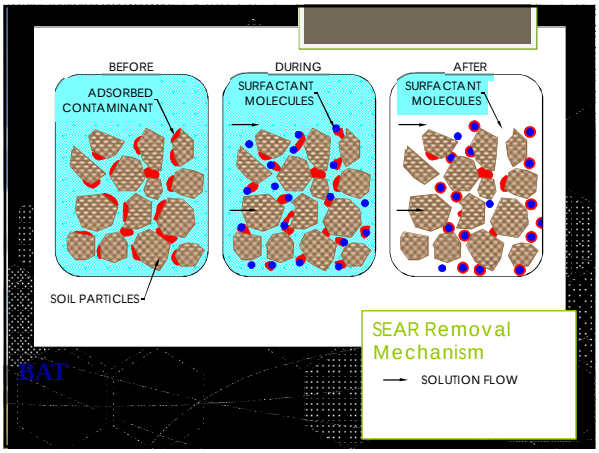
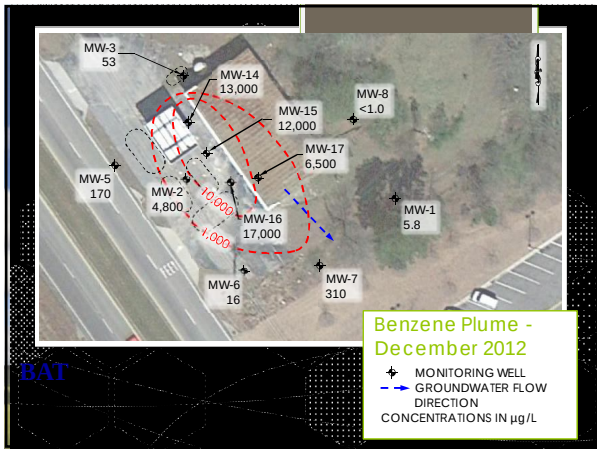
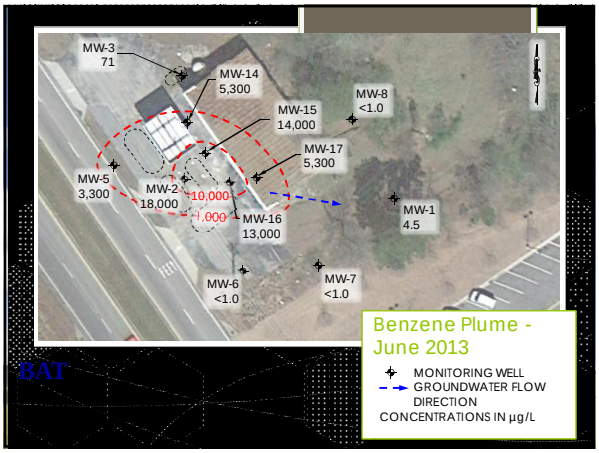
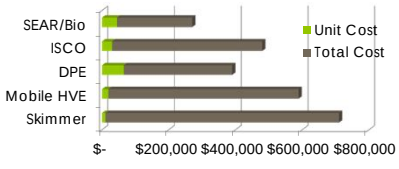






Costs for Various Technologies



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Summary

- Surfactant injection has been shown to decrease the contaminant mass in the subsurface.
- SEAR is more cost effective than other technologies applied at this site.

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Thank you!

- For any further questions, please feel free to contact me at:

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