Drycleaner Site Profiles

Building 25, Morale, Welfare and Recreation (MWR) Dry Cleaners, Camp Lejeune Marine Corps Base, Camp Lejeune, NC

Site Description

Active perchloroethylene (PCE) drycleaner facility that has been in operation since the 1940s. The drycleaner used petroleum drycleaning solvent (Varsol™) until the 1970s when it was replaced by PCE. The facility is located in the industrial portion of the installation.

Site Hydrogeology

Depth to groundwater: 10-16 ft. bgs.

Lithology/subsurface geology: Very fine-grained quartz sand with lenses and discontinuous layers of clay, silt, and peat in upper surficial aquifer, 20-60 ft.
Clay, 0-14 ft.
Fine-grained quartz sand with varying amounts of silt, 0-30 ft. in lower surficial aquifer. When clay layer is absent, upper and lower surficial aquifer are hydraulically one unit.
Fine-grained quartz sand and silt with shell fragments, greater than 50 ft. in upper Castle Hayne aquifer. This is a drinking-water aquifer for the installation with most production from limestone beds not intersected by the monitoring wells at the site.

Conductivity: 1.4 ft/day (upper surficial aquifer); 65 ft/day (lower surficial aquifer); 5.1 ft/day (upper Castle Hayne aquifer)

Gradient: 0.02 ft/ft (upper surficial aquifer); 0.003 ft/ft (lower surficial aquifer); 0.0005 ft/ft (upper Castle Hayne aquifer)

Groundwater Contamination

Contaminants present: PCE, trichloroethylene (TCE), cis 1,2 dichloroethylene (cis 1,2-DCE), trans 1,2-DCE, vinyl chloride (VC), Varsol™

Highest contaminant concentrations: 170,000 µg/L (PCE), 3,030 µg/L (TCE), 3,725 µg/L (cis 1,2-DCE), 38 µg/L (trans 1,2-DCE), 4 µg/L (VC), 7,100 µg/L Varsol™

Deepest contamination: 85 ft. bgs.

Contaminant plume size: 1,500 ft. long by up to 500 ft. wide (as defined by North Carolina groundwater standards)

DNAPLS present: free-phase DNAPL present

Soil Contamination

None reported

Description of Remediation Scenario

Technologies Used:
Surfactant-Enhanced Aquifer Remediation (SEAR)
Cosolvent/Surfactant Flushing

Cleanup goals:

Remediation technology or technologies used: Surfactant-Enhanced Aquifer Remediation (SEAR) with surfactant recycling and Partitioning Interwell Tracer Testing (PITT) for technology evaluation and site characterization

Why technology or technologies used:

Final remediation scenario: Treatment Area was 20 x 30 ft. to a maximum depth of 20 ft. Treatment consisted of injecting 9,718 lb of a custom surfactant (Alfoterra 145-4-PO sulfate™), 38,637 lb isopropanol and 427 lb calcium chloride. 19% (1,800 lb) of the total surfactant injected was recycled.

4,800 and 4,200 gal. of water containing partition tracers (alcohols) were injected into the well field before and after the SEAR, respectively. Tracer tests required about 40 days each.

Results

A mass reduction of 72% (74-88 gal) of DNAPL was achieved in the test zone. 23-29 gal remain.

The pre-SEAR PITT did not sweep low permeability zone. Therefore, percent DNAPL removed (above) represents DNAPL removed from permeable zones only. Post-SEAR PITT unusable.

Costs

Assessment Cost:

Design and Implementation:

O&M:

Total Costs: Unknown. Several crews were on-site from March 15 to August 15, 1999. High-cost surfactant used. Technologies require a large number of sample analyses, laboratory bench test, and considerable computer simulation.

Lessons Learned

1. SEAR and PITT technologies are ineffective for sediments with permeability of less than 1.4 ft/day.

2. At this test, permeability reduction associated with a downward-fining depositional sequence kept the tracer and surfactants from reaching all of the DNAPL. The nature and impact of geologic contacts and/or transition zones needs to be evaluated before selecting technology.

3. An estimated 92-96% of the DNAPL swept by the surfactant flood was removed; however, the surfactant flood did not sweep a significant portion of the DNAPL.

4. There is no evidence of aquifer plugging as a result of surfactant injection.

5. Surfactant apparently biodegraded during the SEAR. Biodegradation was a result of the aquifer conditions (sulfate reducing) and the time required moving surfactant through low permeability sediments. The impact of surfactant biodegradation should be considered before applying these technologies.

6. The results of the post-SEAR PITT test were unusable apparently because surfactant degradation products sorbed on the sediment, then reacted with the tracer during the PITT.

7. The SEAR did not reduce Varsol™ contamination. Underground Injection Control regulators were told that there would be a 90% overall reduction in Varsol™. This requirement was necessary for regulatory approval of recycled surfactant re-injection.

8. Detailed borehole data (geotechnical and geologic) are needed to evaluate technologies that rely on aquifer parameters to be effective. Relying on pump and/or tracer tests without an adequate geologic model can lead to erroneous interpretations.

9. Expensive, custom-made surfactant was selected to test recycling. New surfactant had to be mixed with recycled surfactant before it could be injected. The cost-effectiveness of using recycled surfactant was not shown.

Site Specific References

Not Provided

Contacts

Dave Lown
North Carolina Division of Waste Management
(919) 733-2801

Rick Raines
Camp Lejeune Installation Restoration Program
(910) 451-9461

This profile last updated: November 16, 2001

Drycleaner Site Profiles

Cedarburg Drycleaners, Cedarburg, WI

Site Description

The Cedarburg Dry Cleaners is an active facility that has operated in a mixed commercial and residential area since about 1968. The drycleaner has used perchloroethylene (PCE), and investigations revealed the presence of PCE in soil and PCE and its breakdown products in groundwater. One source of contamination was the illegal disposal of solvents on-site. The investigation results also suggest that a one-time spill inside the facility, the release of PCE through floor drains, and the temporary placement of filters in the grass behind the facility also contributed to soil and groundwater contamination. Contamination has migrated off-site, but has not impacted drinking water wells.

Site Hydrogeology

Depth to ground water: 3-5 ft. bgs. (shallow, perched)

Lithology/subsurface geology: Entire site: Somewhat poorly drained, dark brown silty clay topsoil and fill with occasional sand and gravel, 1-4 ft. bgs.
Brown and gray silty clays and clayey silts, 4-16 ft. bgs.
Grey silty clay with a trace of sand and gravel and some discontinuous seams, 15-39 ft. bgs.
Silty fine sands, 39 ft. bgs., encountered on the Western portion of the site

Conductivity: 28 ft/day (clean or silty sand) to 0.03 ft/day (silt or silty clay)

Gradient: 0.03-0.06 ft/ft

Groundwater Contamination

Contaminants present: PCE, trichloroethylene (TCE), 1,1 dichloroethylene (1,1-DCE), 1,2-dichloroethylene (1,2-DCE).

Highest contaminant concentrations: 6,800 μg/L (PCE), 810 μg/L (TCE), 1,000 μg/L (1,1-DCE), 1,000 μg/L (1,2-DCE)

Deepest groundwater contamination: About 30 ft. bgs.

Plume size: About 165 ft. long and 70 ft. wide (PCE contamination of 100 μg/L or greater)

DNAPLs present: N/A

Soil Contamination

Contaminants present: PCE, TCE

Highest contaminant concentrations: 21,000 µg/kg (PCE), 300 µg/kg (TCE)

Description of Remediation Scenario

Technologies Used:
Bioremediation
Natural Attenuation
Soil Vapor Extraction (SVE)
Reductive Dechlorination

Cleanup goals: Restore the contaminated soil and groundwater, to the extent practicable, and minimize the potential risks associated with the contamination in accordance with WI state spill law, Chapter NR 700. Treated soils returned to the excavation site must contain PCE concentrations below the WI Admin. Code, Chapter NR 600 Land Disposal Restriction limit of 6 mg/kg.

Remediation technology or technologies used: Mobile injection treatment unit with hot air injection with vacuum hood and trenching (soil)
Reductive dechlorination, natural attenuation, Molasses injection (groundwater)

Why technology or technologies selected:

Final remediation design: Contractors used a Mobile Injection Treatment Unit (MITU) to treat about 3,000 cubic yards of VOC-contaminated soil in two source areas. The MITU process uses a chain trencher to break up and pulverize the soil matrix, At the same time, hot air at temperatures up to 700°F is forced into the trench and across the fine soil particles. The combination of soil agitation and pulverization with forced hot air movement across soil particles results in an efficient, thermally-enhanced volatilization of VOCs present. To treat contaminated groundwater, contractors injected dilute molasses solution using three different methods (*in situ* forced air desorption process, temporary Geoprobe injection wells, and an infiltration gallery) to create an in-situ reaction zone. This organic carbon source creates anaerobic and strong reducing conditions within the zone, enhancing reductive dechlorination of chlorinated contaminants.

Results

Soil: Synthetic Precipitation Leaching Procedure (SPLP) test results indicated that PCE concentrations were within the site-specific residual contaminant level (RCL) of 390 µg/kg.

Groundwater: Contractors are monitoring the groundwater for VOCs and natural attenuation parameters on a semiannual basis for a total of two years. These results will determine the next steps at the site.

Costs

Site assessment: Soil: $14,805.68; Groundwater: $54,250.55
Design and implementation: Soil: $47,708.50; Groundwater: $43,979.98

O&M:

Total costs:

Lessons Learned

1. The size of the equipment limited the success of the MITU. The technology itself was successful, but the trencher could not penetrate deep enough. The machine size was not suited to the site.
2.
3.
4.
5.
6.
7.
8.

Site Specific References

--

Contacts

Scott Ferguson
Hydrogeologist Remediation and Redevelopment, Milwaukee Service Center
WI Department of Natural Resources
2300 N. Martin Luther King Jr. Dr.
PO Box 12436
Milwaukee, WI 53212
414-263-8685
Fergus@dnr.state.wi.us

Contractors:
Key Environmental Services
W66 N215 Commerce Court
Cedarburg, WI
414-375-4750

Jim Drought
ARCADIS Geraghty & Miller, Inc.
126 North Jefferson Street, Suite 400
Milwaukee, WI 53202
414-276-7742

This profile last updated: November 26, 2001

Drycleaner Site Profiles

Former Nu Look One Hour Cleaners, Coral Springs, FL

Site Description

This is an inactive drycleaner facility that utilized perchloroethylene (PCE) and operated from 1991 - 1999. The facility is in a strip shopping center in a mixed commercial/residential setting.

Site Hydrogeology

Depth to groundwater: 4 ft. bgs. (unconfined aquifer)

Lithology/subsurface geology: Organic rich, fine-grained sand and peat, surface-7 ft. bgs.; limestone interbedded with shell hash and fine-grained sand, 7-19 ft. bgs.; silty fine-grained sand with minor clay, 19-30 ft. bgs.; fine-grained sand, 30-55 ft. bgs.; dense fine-grained sandstone, 55-58 ft. bgs.

Conductivity: 12.6 ft/day

Gradient: 0.00095 ft/ft

Groundwater Contamination

Contaminants present: PCE, trichloroethylene (TCE), cis 1,2 dichloroethylene (cis 1,2-DCE), trans 1,2-DCE, vinyl chloride (VC)

Highest contaminant concentrations: 1,990 µg/L (PCE), 11,700 µg/L (TCE), 10,200 µg/L (cis 1,2-DCE), 5.5 µg/L (trans 1,2-DCE), 1,000 µg/L (VC)

Deepest contamination: 56 ft. bgs.

Contaminant plume size: 1.25 acres

DNAPLS present:

Soil Contamination

None reported

Description of Remediation Scenario

Technologies Used:

Air Sparging
Recirculating Wells
In-well Stripping

Cleanup goals:

Remediation technology or technologies used: Air sparging using recirculating wells (in-well stripping)

Why technology or technologies used:

Final remediation design: A single pilot recirculating well using in-well airlift through a 12-ft stripping column was operated for a period of 30 days. Air was introduced through a diffuser at an average rate of 35 cfm. and 5 psig. This correlated to a theoretical groundwater flow rate of approximately 5 gpm.

System was operated in "closed loop" configuration, i.e. the air/vapor stream extracted from the wellhead is recycled through a carbon treatment system for reuse in airlift stripping column. This minimized the re-injection of oxygen into the recirculation loop and allowed *in situ* contaminants to continue natural degradation in an anaerobic environment.

Results

The single pilot well achieved an average radius of influence of 62 ft. in the surficial aquifer based upon a 75% reduction of total VOHs based on groundwater sampling from monitor wells. Tracer tests indicated groundwater particles traveled approximately 20 ft. down-gradient in 130 minutes, 20 ft. up-gradient in approximately 180 minutes and approximately 30 ft. cross-gradient in 360 minutes. The estimated average radius of influence based upon tracer testing was 25 ft.

99% reduction of VOHs was achieved in source area after 30 days treatment.

Elimination of 1,000 µg/L contour of dissolved contamination and slight downgradient shift of 100 µg/L contour of dissolved contamination. No shift in 1 µg/L contour of dissolved contaminants.

Slight rebound of PCE concentrations at source well six months after completion of pilot test. Also slight rebound of cis 1,2-DCE and VC concentrations at downgradient wells 6-12 months following completion of pilot tests.

Costs

Site Assessment:

Design and Implementation:

O&M:

Total Costs: $ 193,000, including $16,000 for well installation

Lessons Learned

1. No water use permit required since contaminated water is neither pumped nor treated above ground.

2. Vertical gradients induced in recirculation zone appear to enhance physical removal of contaminants from low permeability zones.

3. Presence of organic rich sand and peat possibly enhanced remediation by circulating naturally occurring organic carbon (food source) into treatment zone.

4. Iron bacteria fouling of well screens necessitated the incorporation of additional measures aimed at eliminating biofouling at discharge zone. Biofouling resulted in major operational and maintenance problems. Assessing the impact of groundwater geochemistry upon the system is important.

Site Specific References

Not Provided

Contacts

Brent Hartsfield
Florida Dept. of Environmental Protection
(850) 488-0190

Contractors:
Bruce Koenig
Metcalf & Eddy
(954) 450-5201

This profile last updated: November 26, 2001

Drycleaner Site Profiles

Former Sages Drycleaners, Jacksonville, FL

Site Description

This is an inactive drycleaning facility that used perchloroethylene (PCE) and operated intermittently from 1968 to 1989. From 1953 to the mid to late 1960s, the site was occupied by a service station. The site is located in a mixed commercial/residential setting.

Site Hydrogeology

Depth to groundwater: 8 ft. bgs. (unconfined aquifer)

Lithology/subsurface geology:
Silty fine to very fine-grained predominantly quartz sand, surface-60 ft. bgs.
Thin discontinuous clay, ~ 35 ft. bgs.
Clay and sandy, silty clay, 60-119 ft. bgs.
Clayey silt, 119-152 ft. bgs.

Conductivity: 10.35 ft/day

Gradient: 0.002 ft/ft

Groundwater Contamination

Contaminants present: PCE, trichloroethylene (TCE), cis 1,2 dichloroethylene (cis 1,2-DCE), trans 1,2-DCE

Highest contaminant concentrations: 34,000 µg/L (TCE), 19,000 µg/L (cis 1,2-DCE), 400 µg/L (trans 1,2-DCE)

Deepest contamination: 92 ft. bgs.

Contaminant plume size: 0.35 acre (as defined to regulatory MCLs)

DNAPLs present: free-phase PCE was recovered

Soil Contamination

None reported

Description of Remediation Scenario

Technologies Used:
Cosolvent/Surfactant Flushing
Bioremediation

Ethanol Cosolvent Flushing
Reductive Dechlorination
Natural Attenuation

Cleanup goals:

Remediation technology or technologies used: Ethanol Cosolvent Flushing

Why technology or technologies used:

Final remediation design: Treatment Area was 24 ft x 9 ft elliptical DNAPL source area with a targeted depth interval of 26-31 ft. bgs. Maximum depth of pilot test was 35 ft. bgs. A total of 9,000 gal 95% ethanol and 5% water) co-solvent were injected. The 3 injection wells were surrounded by 6 extraction wells with 7 multi-level samplers located between injection and extraction wells. Cosolvent was injected at a rate of 4 gpm; extraction rate was 8 gpm over four days. Ternary mixture of PCE/ethanol/water was treated with Akzo Nobel Macro Porous Polymer (MPP) system for removal of PCE. Approximately 160,000 gal of ethanol/water mixture was disposed of off-site.

Results

Demonstrated successful enhancement of dissolution and solubilization of DNAPL PCE. Recovered approximately 42 liters of DNAPL PCE representing approximately 63% of the estimated DNAPL PCE mass located within the source area.

Costs

Site Assessment:

Design and Implementation: About $440,000

O&M:

Total Costs:

Lessons Learned

1. Efficiency of the cosolvent flushing could be optimized through detailed tracer test evaluation and appropriate adjustments to the injection/extraction system.

2. Cost savings could be realized through alcohol re-use by limiting the total amount of alcohol necessary to complete flushing activities and decreasing disposal costs for wastewater with high alcohol concentration.

3. Residual ethanol remaining after cosolvent flushing has significantly enhanced in-situ biological dechlorination processes for natural attenuation of contaminant mass.

<u>*Cosolvent Flushing Pilot Test Report: Former Sages Dry Cleaner*</u>

Site Specific References

Not Provided

Contacts

Doug Fitton
Florida Dept. of Environmental Protection
(850) 488-0190

Contractors:
Kevin Warner, P.E.
LFR Levine-Fricke
(850) 422-2555

This profile last updated: November 26, 2001