Former Big B Cleaners

Pump and Treat—Soil Vapor Extraction—Dual Phase Extraction—In Situ Chemical Oxidation—Monitored Natural Attenuation

Site Name: Former Big B Cleaners
Site Location: Warrington, Florida
Technology Used:

- Pump and Treat (P&T)
- Soil Vapor Extraction (SVE)
- Dual Phase Extraction (DPE)
- In Situ Chemical Oxidation (ISCO) (Fenton's Reagent and Sodium Persulfate)
- Monitored Natural Attenuation (MNA)

Regulatory Program: Florida EPA─Drycleaning Solvent Cleanup Program
Remediation Scale: Full
Project Duration: 1993 to present

Site Information: Big B Cleaners operated between 1972 and 1978 in a 27-acre strip mall complex at 501 North Navy Boulevard in Warrington, Florida. Commercial properties abut Navy Boulevard to the east and northeast of the site. Residential areas are present to the south and southwest, and a vacant and wooded property exists to the north and west of the site. Among the two public drinking water well fields near the site, the People's Water Service Company well number 3 (PWS3) is only about 300 ft southwest and downgradient of the drycleaners. The second well field (Corry Field) is about one mile north of the site.

Contaminants: A release of 275 gallons of tetrachloroethene (PCE) at the site was reported in 1977. In 1983, public supply well PWS3 was contaminated with PCE from the site. PCE has been detected in the groundwater and at levels up to 76,000 µg/L and 5,600 mg/kg, respectively. In the shallow groundwater zone, two plumes exist at the site and extend about 900 ft to the northeast and 400 ft to the southwest. In the intermediate zone, the plumes extend over 1,000 ft from the source area. Contamination in the southwest plume is over 200 ft deep. Only minimal degradation of PCE has occurred in the aerobic aquifer.

Hydrogeology: A very fine- to medium-grained sand underlies the site in the shallow zone from 0 to 77 ft below ground surface (bgs). This unit overlies the shallow-intermediate zone, which is about a 118-ft thick, very fine- to fine-grained sand interbedded with clay and sandy clay. The producing zone (deep zone) of the aquifer, which lies between 195 to 228 ft bgs, consists of fine to coarse sand with some clay lenses. The average depth to groundwater varies from 5 to 19 ft bgs depending upon rainfall and season. Groundwater flow in the shallow zones appears to be radial. In the deeper aquifer the two public water supply well fields dominate the hydraulic gradient.

Project Goals: The following Site Rehabilitation Level (SRL) cleanup goals (Table 1) were identified for PCE. The levels varied by the media PCE was in and the location of the contaminated plume:

Table 1. SRL Goals for PCE	
Unsaturated Soil Zone	50 µg/kg
Source Area Groundwater (Shallow and Intermediate Zone)	30 µg/L
Plume Area Groundwater (Shallow and Intermediate Zone)	300 µg/L
Deep Drinking Water Aquifer	3 µg/L

These goals were intended as cutoff points for active remediation. After reaching these goals, MNA and long-term monitoring will begin. The eventual goal of the cleanup is to reach state maximum contaminant levels.

Cleanup Approach: The initial installation of a P&T containment system in the shallow and intermediate zones was normal operating procedure. A P&T system in the deep zone was not seen as practicable as it could hardly compete with the nearby production well which was, with the addition of the carbon treatment system, acting as a containment system itself. The P&T system was shut down in 1995 due to maintenance problems and because it was drawing shallow contamination into the deeper zone

A free dense non-aqueous phase liquid (DNAPL) was found in the soil immediately under the building slab Two SVE wells were constructed to address the this source zone. Without treatment, the DNAPL source zone in the unsaturated soil beneath the site would remain a source of contamination as the water table seasonally fluctuated up to very shallow depths. Shallow monitoring well data downgradient from this source area reflected increasing and decreasing concentrations of PCE caused by these fluctuations. One SVE well was very shallow and had a 10 ft long lateral screen set at 3 ft bgs (Figure 1). The other SVE well was a 35 ft deep dual-phase well (DPW). The DPW was used to partially dewater the nearby saturated zone and allow access by the SVE system to potential residuals in the saturated zone. The system operated from March to August 2000 and November 2000 to January 2001.

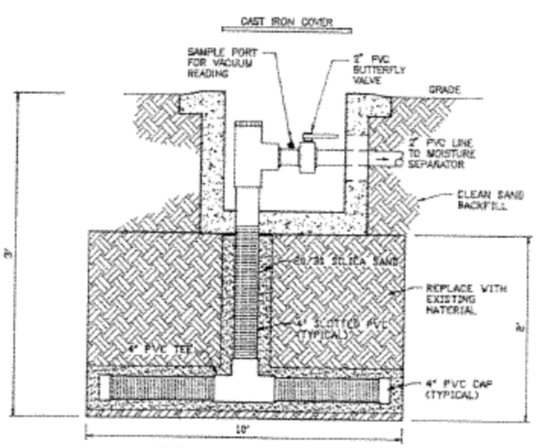

Figure 1. Shallow Lateral SVE Well

Source: HSA 1999

An ISCO pilot study was conducted in 2002 to determine the effectiveness of a modified Fenton's Reagent solution on PCE under site-specific conditions and to determine the approximate radius of influence an injection well would have. Thermo-couples were also set near the injection screen to measure near-screen temperatures during the injection to determine if PVC pipe could be used to construct the injection wells. The study showed that the modified Fenton's Reagent was appropriate, and subsurface temperatures remained under 150ºF, indicating that PVC could be used.

As part of the pilot study effort, 30 diffusion bags were distributed among six wells. They were placed at about 4 ft intervals across the well screens with one well receiving six bags, four wells three bags, and a recovery well 12 bags. The analytical results showed variability within the well screens with concentrations generally increasing with depth.

After SVE remediation of the shallow source zone, a study was undertaken to determine the best location for the full-scale ISCO injection zones. Groundwater was sampled in one boring near the source area at five ft intervals from 10 to 120 ft bgs. The groundwater samples were taken using a 5-ft stainless steel screen attached to a 5-ft casing that was equipped with a packer. At each sampling interval the packer was inflated and the "well" purged. At several other downgradient borings samples were taken at 20-ft intervals. The sampling results revealed hotspot horizons in the subsurface and these were specifically targeted for ISCO treatment.

The ISCO treatment system consisted of 15 injection wells and 20 injection intervals (Figure 3). Five of the wells had 10 ft screens set at 85 to 95 ft and 105 to 115 ft bgs. Baseline chemical measurements were made in the monitoring wells before injection, and downgradient wells were also monitored using downhole instrumentation for water quality parameters (pH, temperature, dissolved oxygen, specific conductance, and redox).

Twenty-four hours before injecting approximately 12,000 gallons of hydrogen peroxide, 100 gallons of a ferrous sulfate, sodium persulfate, and hydrochloric acid solution was injected into each screened interval. The initial injection of hydrogen peroxide and its subsequent reaction resulted in water flowing out of nearby monitoring wells and the injection was delayed while these wells were firmly capped. In general, sampling results after the injection indicated initial increases in PCE concentrations over baseline values with significant decreases over time. The injection activity lasted from June 18 to July 12, 2004.

After examining the results of the first ISCO treatment, a second injection of 12,167 gallons of hydrogen peroxide was performed July 18 to August 4, 2005 in the same fashion as the first.

The site is currently undergoing MNA and long-term monitoring.

The SVE/DPW cost to design and implement was $141,000. The pilot ISCO design cost $27,900. Implementation of the ISCO (injection well installation & 2 injection events cost $479,700 (SCRD 2009).

Project Results: The P&T system that was installed in 1993 and operated for two years treated approximately 7.8 million gallons of water and recovered about 2.6 gallons of PCE. However, since it was designed as a containment system, it did very little to change onsite contaminant concentrations, and it may have contributed to increased PCE concentrations in the public supply well.

The SVE system effectively cleaned up the source zone contamination in the unsaturated and near-surface saturated areas underneath the facility. The system operated for about eight months and recovered approximately 215 lbs of contaminants. It was shut down to accommodate redevelopment at the site. At the time of shutdown, concentrations of PCE in the influent had fallen from 3,100 mg/m^3 to 2.8 mg/m^3.

The dewatering well associated with the SVE system was taken offline at the same time as the SVE system. At the time of shut down, the dewatering well had extracted 889,795 gallons of water and recovered 1.15 lbs of PCE. The PCE concentrations in the pumped water over time became asymptotic, indicating that the significant source under the facility in the shallow zone was no longer present. Rebound was not expected because soil in the area being pumped had low total organic carbon and consisted primarily of sand.

An evaluation of PCE concentrations in the groundwater following the first ISCO injection concluded that a second ISCO injection, conducted about a year later, would be necessary. PCE concentrations from the comprehensive groundwater sampling event that occurred in late November and early December 2005 after the second injection ranged from non-detect (1 µg/L) to 408 µg/L. The 408 µg/L and a 357 µg/L value were from a double-screened source area injection well. All other wells on site had PCE values that were below the 300 µg/L goal and, in many cases, substantially below. A comparison of before and after ISCO applications for contaminated wells is found in Table 2.

The 2012 Groundwater Monitoring Report states that the plume is stable while noting that PCE groundwater concentrations range up to 420 µg/L (which is above the Natural Attenuation Default Source Concentration of 300 µg/L). The site remains in a long term monitoring mode.

Sources:

HSA Engineers and Scientists. 1994. Remedial Alternatives Analysis Warrington Village Shopping Center. Florida Department of Environmental Protection, 17 pp.

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HSA Engineers and Scientists. 2012. Groundwater Monitoring Report Former Big B Cleaners, Warrington Village Shopping Center. Florida Department of Environmental Protection, 890 pp. http://dwmedms.dep.state.fl.us/Oculus/servlet/preview?Action=ViewDoc&DocGUID=5.187777.1&SearchTerm=

State Coalition for Remediation of Drycleaners (SCRD). Former Big B Cleaners . 2009 http://www.drycleancoalition.org/profiles/display.cfm?id=29

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Table 2. Comparison of PCE and TCE Concentrations Before and After ISCO (µg/L)

Well	**PCE Before**	**PCE After**	**TCE Before**	**TCE After**	**Sample Depth**
IW007	970	408	2.9	2	102-114
IW008	718	24.7	1.6	<1.0	100
IW009	86	47.4	2.0	<1.0	100
IW011	17.9	<1.0	<1.0	<1.0	100
IW012	330	1	1.9	<1.0	100
IW013	530	5.9	2.4	<1.0	100
IW014	1,500	184	7.0	<1.0	100
IW015	7.0	7.1	<1.0	<1.0	100
1W016	234	109	<1.0	<1.0	100
IW017	40.2	49.3	1.3	<1.0	100
IW018	114	29.9	<1.0	<1.0	90-115
IW019	286	122	5.4	<1.0	105-115
IW020	101	14.6	1.0	<1.0	100
IW021	44.8	8.6	<1.0	<1.0	85-95
IW022	61.5	15.9	<1.0	<1.0	105-115
MW004	8.0	<1.0	<1.0	<1.0	33
MW006	27	22.9	<1.0	<1.0	102
MW024	6.4	3.3	<1.0	<1.0	35
MW029	98.6	14.9	<1.0	<1.0	35
MW031	2.3	16.7	<1.0	<1.0	35
MW032	2.2	19.4	<1.0	<1.0	37.5
MW033	8.1	1.5	<1.0	<1.0	35
MW039	2.7	1.1	<1.0	<1.0	110
MW040	46.4	21.3	<1.0	<1.0	110
MW042	24.6	39.2	<1.0	<1.0	115
MW043	462	254	2.4	2.0	110
MW044	538	243	3.1	<1.0	112
MW047	1,090	79.6	<1.0	<1.0	107
MW052	20.0	20.2	<1.0	<1.0	106
MW053	54.4	15.1	<1.0	<1.0	106
MW065	25.6	36.7	2.0	2.7	155
MW066	6.7	8.8	<1.0	<1.0	235
MW072	442	270	134	11.1	110
RW002	223	137	5.1	6.4	105

IW=Injection Well, MW=Monitoring Well, RW=Recovery Well

Source: Adapted from HSA 2006.