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WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Shelton Laundry and Cleaners November 2003 and April 2004 Groundwater Monitoring Results

Abstract

Groundwater samples for volatile organic analysis were collected from four monitoring wells in November 2003 and April 2004 at Shelton Laundry and Cleaners in Shelton, Washington. Samples were collected to monitor concentrations and distribution of tetrachloroethylene (PCE).

PCE contamination of the shallow groundwater was discovered in 1997 during an environmental site assessment of a nearby property. The source of contamination was assumed to be a spill that occurred in 1993 at the dry cleaning facility occupied by Shelton Laundry and Cleaners. Monitoring of four shallow wells installed in 1998 detected PCE contamination in well 4W, located where the spill was reported to have occurred, with concentrations ranging from 280 ug/L in July 1998 to 25 ug/L in September 2000. In 2002 four additional deeper wells were installed. Results from the 2002 monitoring indicated that PCE contamination occured at well 4W with an average concentration of 13 ug/L. PCE was not detected in the four deep wells.

Results from the most recent monitoring concur with previous results. PCE was detected in well 4W with concentrations of 15 to 26 ug/L. Trichloroethylene and cis-1,2-dichloroethylene also were detected in well 4W but at concentrations near or below the practical quantitation limit of 1 ug/L. PCE was not detected in the two deeper wells.

Although contaminant concentrations have decreased since 1998, PCE concentrations in well 4W exceeded the Model Toxic Control Act cleanup standard of 5.0 ug/L. Because PCE concentrations continue to exceed the cleanup standards in this well, some level of monitoring should continue. Additional investigation or possible remedial action also could be considered to further reduce PCE concentrations at this site.

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This report was prepared by a licensed hydrogeologist. A signed and stamped copy of the report is available upon request.

Background

Tetrachloroethylene (PCE) contamination of the shallow groundwater was discovered in 1997 during an environmental site assessment/subsurface investigation (Building Analytics, 1997) of a property in Shelton, Washington (Figure 1). PCE was detected at a concentration of 130 ug/L in groundwater collected from a shallow boring. The Model Toxic Control Act (MTCA) cleanup level for PCE in groundwater is 5 µg/L.

The Washington State Department of Ecology (Ecology) was notified of the contamination when it received copies of the Environmental Site Assessment Reports in June 1997. Based on these reports, Shelton Laundry and Cleaners was listed on Ecology's Confirmed and Suspected Contaminated Sites List in December 1997, and ranked under the Washington Ranking System.

The most likely source of the contamination was identified as the dry cleaning facility occupied by Shelton Laundry and Cleaners which is located adjacent to the property where the site assessment was conducted. The commerical laundry and dry cleaning facility has been in operation since 1935. In 1993, a new dry cleaning machine was installed. As the old cleaning machine was being removed, an unknown quantity of dry cleaning solvent, assumed to be PCE, was reportedly spilled and infiltrated through the broken asphalt in the alley behind the building. This spill event is assumed to be the source of groundwater contamination.

Several investigations were conducted at the Shelton Laundry and Cleaners site during 1997 and 1998. During these investigations, several shallow borings were drilled to collect both soil and groundwater samples. In July 1998, four shallow (15 feet deep) monitoring wells were installed to sample the groundwater. Four rounds of groundwater monitoring were conducted at the site between July 1998 and September 2000. PCE contamination was primarily detected in well 4W located where the spill was reported to have occurred, with concentrations ranging from 280 ug/L (July 1998) to 25 ug/L (September 2000).

Ecology conducted an investigation in 2002 to determine the current concentration and distribution of PCE. As part of the invesitgation, four additional wells (MW-5 through MW-8) were installed to gain a better understanding of contaminant concentrations at deeper depths. Three of the wells were installed to a depth of 45 feet beside existing shallow wells. The fourth well was installed to a depth of 60 feet downgradient of the site. PCE was not detected in any of the deeper wells during the 2002 monitoring (Marti, 2003).

Well logs from the deeper monitoring wells indicate that the project area is covered with up to two feet of fill and pavement material, which is underlain by an undetermined thickness of sandy gravel with some sand interbeds. The depth to the water table ranged from about four to six feet over the study period. The sandy gravel in which all the monitoring wells are screened is part of the Vashon recessional outwash deposits which underlay the western outwash plain between Shelton and the Skokomish Valley to the north. Deeper production well logs near the site indicate that the recessional deposits can attain a thickness of more than 100 feet in the area of Oakland Bay. Regionally, groundwater flow is described as being southward in the loose sand and gravel toward the Shelton Valley and Oakland Bay (Molenaar and Noble, 1970).

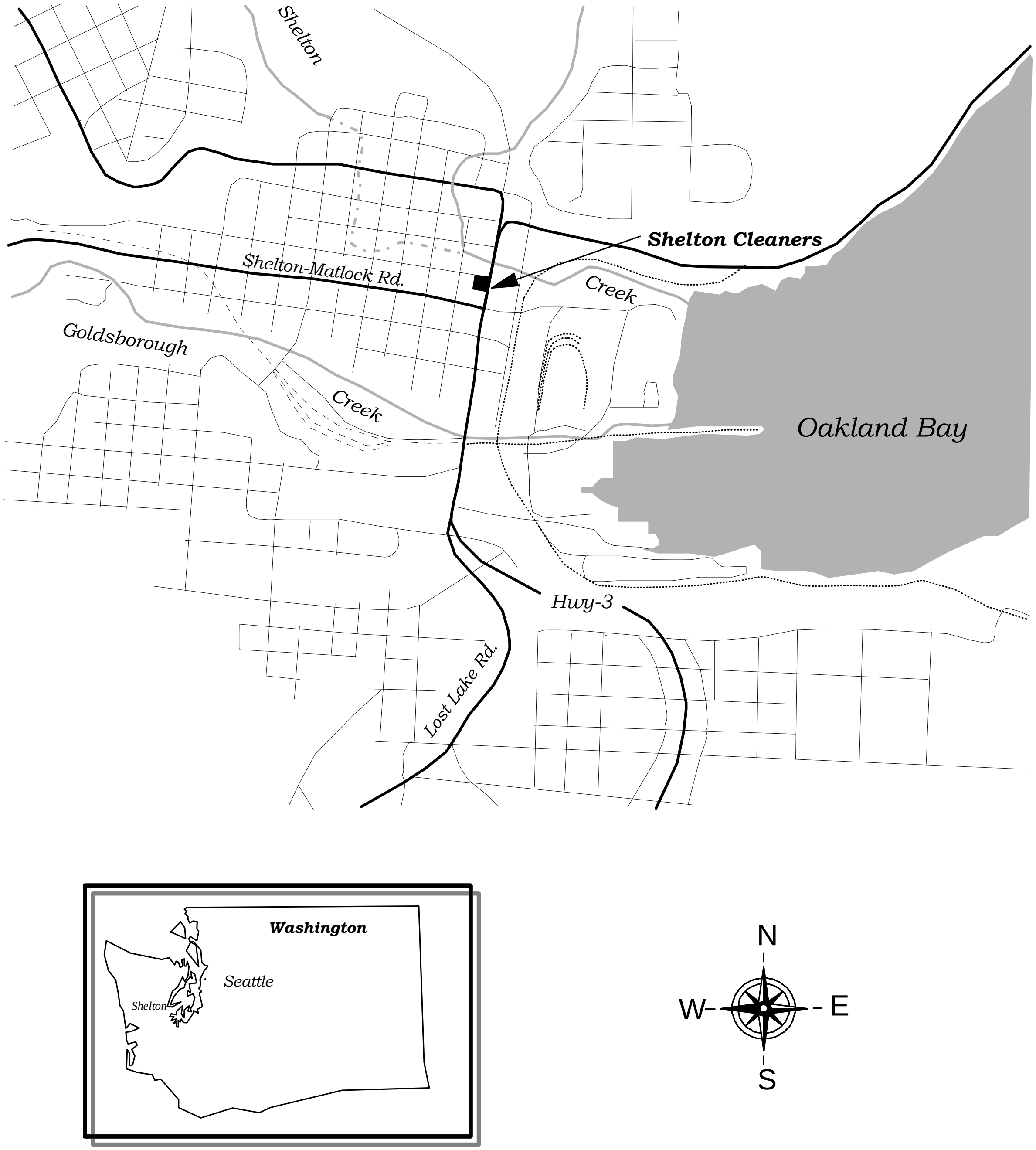


Figure 1: Shelton Laundry & Cleaners Site Location

Methods

Groundwater Sampling

Groundwater samples for volatile organic analysis (VOAs) were collected in November 2003 and April 2004 from two shallow and two deep monitoring wells to monitor concentrations and distribution of PCE (Figure 2).

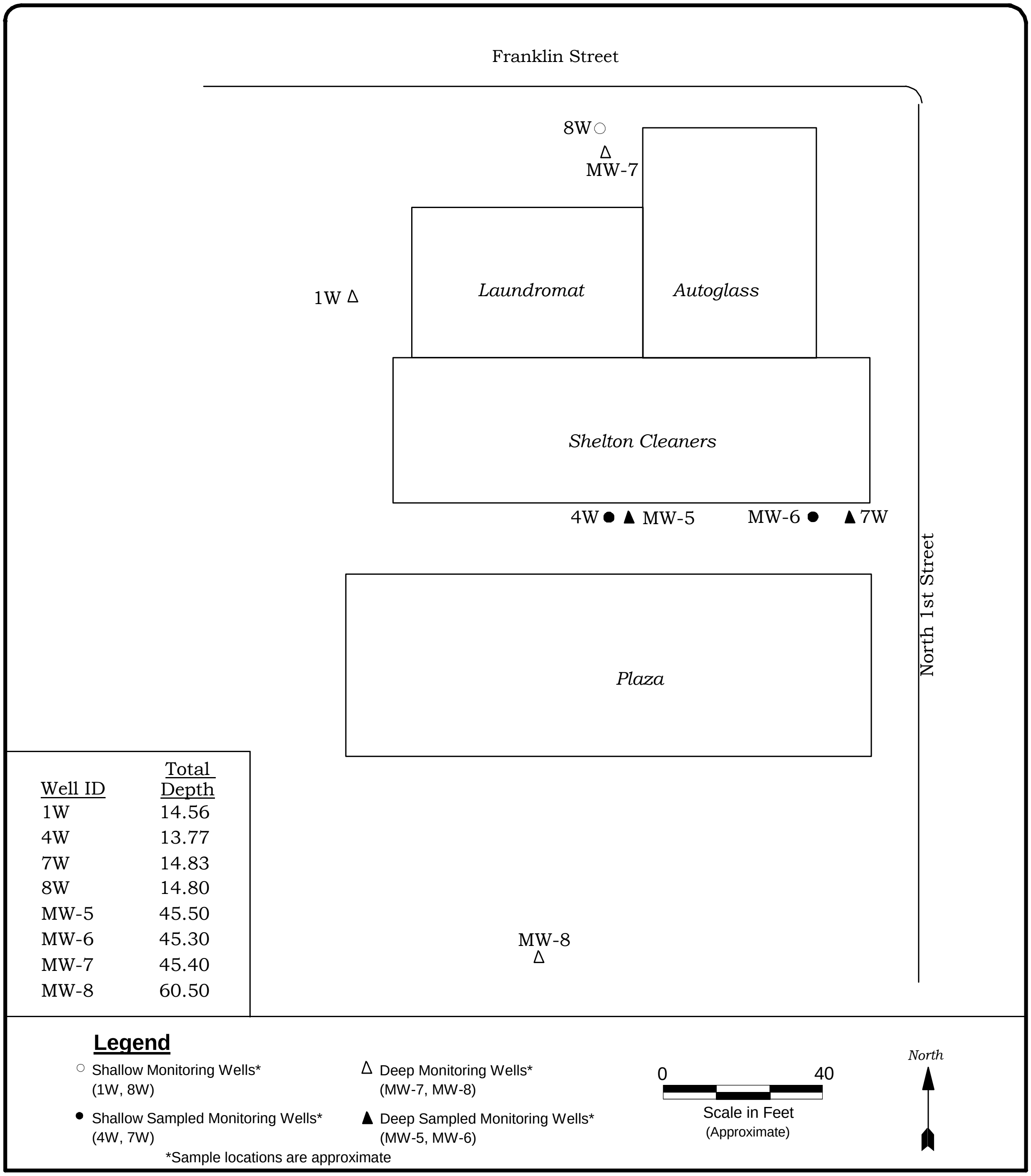
The two shallow wells installed in 1998 (4W and 7W) were constructed of 1-inch diameter PVC to a depth of about 15 feet with 10-foot screens. The two deep wells (MW-5 and MW-6) were constructed of 2-inch diameter PVC to a depth of about 45 feet with the screened interval from 35-45 feet below ground surface (bgs).

Static water levels were measured in all wells using a Solinst water level meter with a ¼-inch diameter probe prior to well purging and sampling. Measurements were recorded to 0.01 foot and are accurate to 0.03 foot. The probe was rinsed with deionized water between measurements. Wells were purged through a continuous flow cell until pH, specific conductivity, and temperature readings stabilized. Purge water from all the wells was collected and stored on-site in a 55-gallon drum. The purge water was transported and disposed of in accordance with Washington State regulations (Chapter 173-340-400 WAC).

Monitoring wells MW-5 and MW-6 (2-inch diameter wells) were purged and sampled using a stainless steel submersible pump, with a pump rate of less than 1-liter/minute. Samples were collected from the wells screened interval into pre-cleaned vials using the submersible pump. The pump was decontaminated between each well by circulating laboratory grade detergent/water though the pump followed by a clean water rinse, with each cycle lasting five minutes.

Because of their small diameter (1 inch), wells 4W and 7W were purged and sampled with a peristaltic pump. Although studies have shown that there can be a loss of volatile analytes in samples collected with suction lift devices such as a peristaltic pump, in some situations the loss may be small if the sample lift is small and a slow pump rate is used in conjunction with less sorptive tubing material (Parker, 1994). To minimize the loss of volatile analytes in wells 4W and 7W, dedicated polyethylene tubing was used in each well and pumped at a rate of less than 1-liter/minute. The sample lift was less than six-feet. At the completion of purging, the tubing was disconnected from the pump, plugged, and the entire tubing removed from the well. Water collected in the tubing was allowed to drain into pre-cleaned sample vials.

VOA samples were collected free of headspace in three 40-mL glass vials with Teflon lined septa lids and preserved with 1:1 hydrochloric acid. Upon sample collection and proper labeling, all samples were stored in an ice-filled cooler. Samples were transported to the Ecology headquarters building in Lacey. Samples were kept in the walk-in cooler until picked up by the courier to Ecology/EPA Manchester Environmental Laboratory in Manchester, Washington. Chain-of-custody procedures were followed according to Manchester Environmental Laboratory protocol (Ecology, 2003).



Well ID	Total Depth
1W	14.56
4W	13.77
7W	14.83
8W	14.80
MW-5	45.50
MW-6	45.30
MW-7	45.40
MW-8	60.50

Figure 2: Shelton Laundry & Cleaners Sample Locations

Analysis

Analytes, analytical methods, and detection limits for both field and laboratory parameters are listed in Table 1. All groundwater samples were analyzed for volatile organics.

Table 1: Field and Laboratory Methods

Analytes	Method	Reference	Reporting Limit
Field			
Water Level	Solinst Water Level Meter	NA	0.03 feet
pH	Orion 25A Field Meter	NA	0.1 std. units
Temperature	YSI 3510 Temperature Probe	NA	0.1 C
Specific Conductance	YSI 3520 Conductivity Cell	NA	10 umhos/cm
Laboratory			
VOAs	EPA SW-846 Method 8260B	U.S. EPA 1996	1-5 ug/L

In general, the quality of the data is acceptable. Quality control samples collected in the field consisted of blind field duplicate samples, which were obtained from well 4W during both rounds of sampling. The numeric comparison of duplicate results is expressed as the relative percent difference (RPD). The RPD for PCE was 14% in November and 43% in April. Due to the high RPD for the April results, average concentrations of the duplicate samples for PCE and trichloroethylene (TCE) will be used in the remainder of this report. In addition to field quality control samples, duplicate matrix spikes and surrogate compound recoveries were performed in the laboratory. Overall, matrix spikes and surrogate recoveries were within acceptable limits. Quality assurance case narratives and laboratory reporting sheets, with the complete list of volatile organics analyzed, are available upon request.

Results

Field Observations

Total depth and depth-to-water of each monitoring well were determined before sampling began. Temperature, pH, and specific conductivity readings measured at the time of sampling are listed in Table 2.

Table 2: Summary of Field Parameter Results for November 2003 and April 2004

Monitoring Well	Total Depth (feet)[1]	Depth to Water (feet)[1]		Temperature (°C)		pH (standard units)		Specific Conductivity (umhos/cm)		Purge Volume (gallons)	
		11/03	4/04	11/03	4/04	11/03	4/04	11/03	4/04	11/03	4/04
Shallow											
1W	14.56	4.91	4.63	--	--	--	--	--	--	--	--
4W	13.77	4.88	4.59	12.5	10.5	6.9	7.1	218	211	8	7
7W	14.83	4.52	4.22	11.7	10.3	7.2	7.0	216	215	4	6
8W	14.80	4.19	3.90	--	--	--	--	--	--	--	--
Deep											
MW-5	45.5	4.87	4.57	12.7	10.4	7.2	7.0	215	213	9	14
MW-6	45.3	4.50	4.22	11.5	10.4	7.4	7.2	219	214	10	18
MW-7	45.4	4.27	--	--	--	--	--	--	--	--	--
MW-8	60.5	5.46	5.18	--	--	--	--	--	--	--	--

[1] Measured from top of PVC casing.
-- Not Sampled

Completion depths for the eight monitoring wells ranged from 13.77 to 60.5 with depth-to-water ranging from 3.90 to 5.46 feet below the measuring point. Overall, water levels fluctuated less than 1/2-foot during the monitoring period. Hydrographs showing water-level elevations for each well from May 2002 to April 2004 are shown in Figure 3. Data for the hydrographs is presented in Appendix A. The hydrographs show that the seasonal fluctuation is small throughout the year, less than one foot, and the groundwater gradient is fairly flat.

A typical groundwater flow pattern for the site is shown in Figure 4. This figure is based on water levels obtained on November 2003. The location of the water-table contours was determined using a kriging algorithm in the Surfer software program. The groundwater flow direction is approximately perpendicular to the contours. The overall flow direction appears to be southward, which corresponds to the regional flow direction with flow toward the southwest and southeast.

Field parameters were within expected ranges for the sampled monitoring wells. Groundwater temperatures ranged from 10.3ºC to 12.7ºC. The pH of groundwater ranged from 6.9 to 7.4, and the specific conductivity measurements ranged from 211 to 219 umhos/cm.

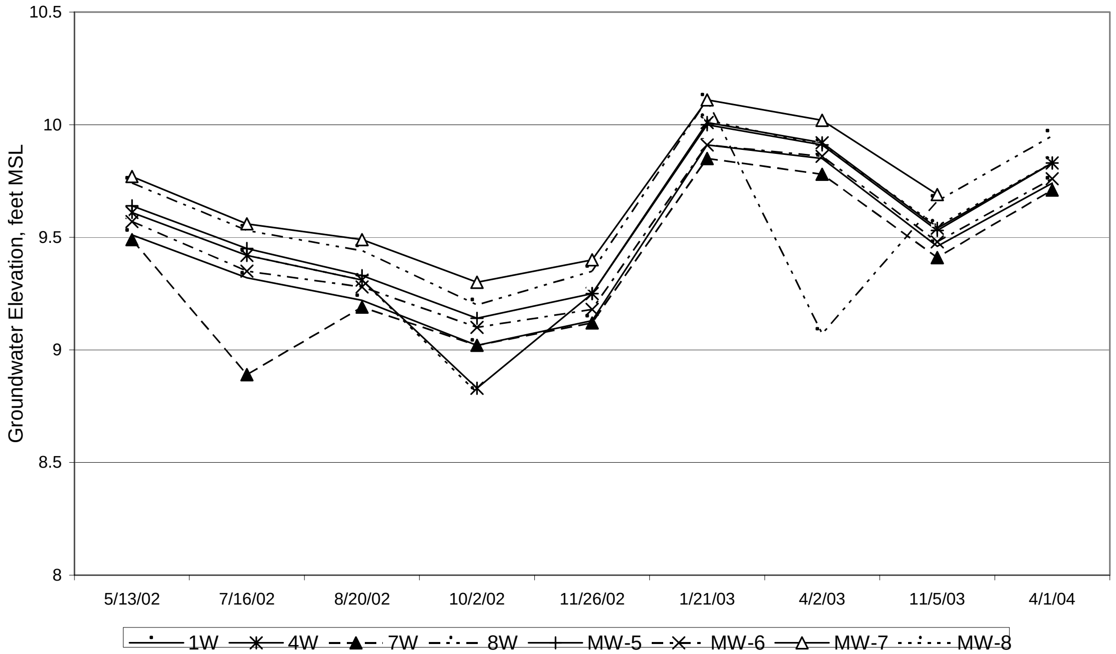


Figure 3: Shelton Laundry and Cleaners - Hydrographs May 2002 to April 2004

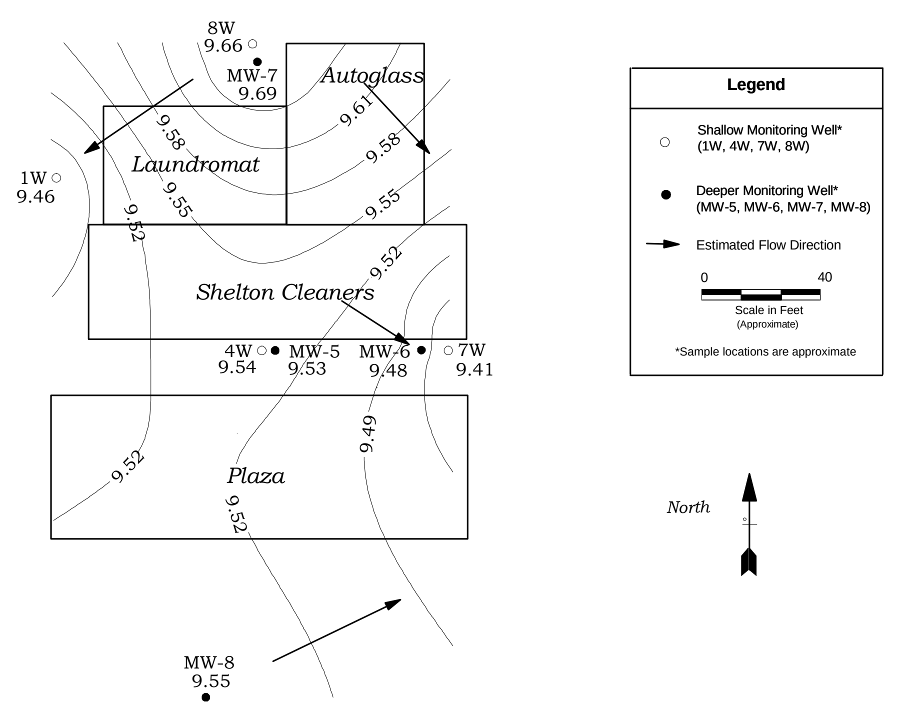


Figure 4: Shelton Laundry and Cleaners - Water Table Elevation November 2003

Analytical Results

Analytical results for volatile organics (VOAs) are summarized in Table 3. For comparison, a summary of historical data for this project is presented in Appendix B.

Table 3: Summary of Analytical Results (ug/L) for November 2003 and April 2004

Well	Tetrachloroethylene (PCE)		Trichloroethylene (TCE)		Cis-1,2-Dichloroethylene (DCE)	
	11/03	4/04	11/03	4/04	11/03	4/04
4W	**15**	**26***	**2**	**2.8***	**0.60J**	**1.4**
7W	1 U	**1.7**	1 U	1 U	1 U	1 U
MW-5	1 U	1 UJ	1 U	1 U	1 U	1 UJ
MW-6	1 U	1 UJ	1 U	1 U	1 U	1 UJ

* – Average concentration of duplicate samples.
U – Analyte was not detected at or above the reported value.
UJ – Analyte was not detected at or above the reported estimated result.
Bold – Analyte was detected.

PCE, TCE, and cis-1,2-dichloroethylene (DCE) were detected in well 4W during both rounds of sampling. PCE concentrations in this well ranged from 15 to an average of 26 ug/L. Average concentrations for the April 2004 PCE and TCE results are listed in Table 3 due to the high RPD between the duplicate samples. TCE and DCE concentrations in well 4W were near or below the practical quantitation limit of 1 ug/L. In April 2004, PCE was detected in well 7W at a concentration of 1.7 ug/L. Low concentrations of PCE have been detected in this well in the past. PCE, TCE, and DCE have not been detected in the four deep wells since they were installed in July 2002.

Conclusions

PCE concentrations have decreased in the two wells where it has been detected since the groundwater contamination was discovered in May 1997. During May 1997, PCE concentration from a temporary boring in the vicinity of well 4W was reported as 130 ppb. PCE concentrations in well 4W have decreased from 280 ppb in July 1998 to an average of 21 ppb in 2004.

Although contaminant concentrations have decreased since 1998, PCE concentrations detected in well 4W during November 2003 and April 2004 continue to exceed the Model Toxic Control Act (MTCA) cleanup standard of 5.0 ug/L. TCE and DCE, typically associated with the breakdown of PCE, also were detected in well 4W at concentrations below their respective cleanup standards of 5 ug/L.

Results of this study indicate that the site continues to be impacted in the area of well 4W but not at the other sampling locations. Because PCE concentrations continue to exceed MTCA cleanup standards in well 4W, some level of monitoring should continue. Additional investigation or possible remedial action also could be considered to further reduce PCE concentrations at this site.

References

Building Analytics, 1997. Phase II Subsurface Investigation of Wells Fargo Bank Property, Shelton, Washington. File No. 197415, June 1997.

Ecology, 2003. Manchester Environmental Laboratory - Laboratory Users' Manual. 7th edition. Washington State Department of Ecology, Manchester, WA.

GeoEngineers, 1998. Subsurface Investigation, Shelton Cleaners and Laundry, Shelton, Washington. File No. 6539-001-00. August 10, 1998.

GeoEngineers, 2000. Ground Water Monitoring, Shelton Cleaners and Laundry, Shelton, Washington. File No. 6539-002-00/100200. October 2, 2000.

Marti, Pamela, 2002. Quality Assurance Project Plan: Shelton Cleaners and Laundry. Washington State Department of Ecology, Olympia, WA. Publication No. 02-03-078. http://www.ecy.wa.gov/biblio/0203078.html

Marti, Pamela, 2003. Shelton Laundry and Cleaners, July 2002 through April 2003 Groundwater Monitoring Results. Washington State Department of Ecology, Olympia, WA. Publication No. 03-03-038. http://www.ecy.wa.gov/biblio/0303038.html

Molenaar, D. and J. Noble, 1970. Geology and Related Ground-Water Occurrence, Southeastern Mason County, Washington. Water-Supply Bulletin No. 29.

Parker, Louise, 1994. The Effects of Groundwater Sampling Devices on Water Quality: A Literature Review. Groundwater Monitoring Review, Spring 1994. p. 130-141.

U.S. EPA, 1996. Test Methods for Evaluating Solid Waste, SW-846. Office of Emergency Response, U.S. Environmental Protection Agency, Washington D.C.

Appendix A. Hydrograph Data

Table A-1. Groundwater Elevations (feet above mean sea level), May 2002 to April 2004

Well ID	1W	4W	7W	8W	MW-5	MW-6	MW-7	MW-8
5/13/02	9.51	9.61	9.49	9.74	9.64	9.57	9.77	--
7/16/02	9.32	9.42	8.89	9.53	9.45	9.35	9.56	9.42
8/20/02	9.22	9.31	9.19	9.44	9.33	9.28	9.49	9.31
10/2/02	9.02	8.83	9.02	9.2	9.14	9.1	9.3	8.81
11/26/02	9.13	9.25	9.12	9.35	9.25	9.18	9.5	--
1/21/03	9.91	10.01	9.85	10.11	10	9.91	10.11	10.02
4/2/03	9.85	9.92	9.78	9.07	9.91	9.86	10.02	9.91
11/5/03	9.46	9.54	9.41	9.66	9.53	9.48	9.69	9.55
4/1/04	9.74	9.83	9.71	9.95	9.83	9.76	--	9.83

Depth-to-water measured from top of PVC casing.
-- Not measured

Appendix B. Historical Data

Table B-1. PCE, TCE, and DCE Results (ug/L) from May 1997 to April 2004

Well ID	Building Analytics	AA Enviro Assess-ment	GeoEngineers				Ecology					
	5/21/97	3/3/98	7/24/98	11/18/98	7/12/99	9/6/00	7/17/02	10/3/02	1/22/03	4/3/03	11/5/03	4/1/04
1W												
PCE	--	--	<1.0	<1.0	<1.0	NS	1 U	1 U	1 U	1 U	--	--
TCE	--	--	<1.0	<1.0	<1.0	NS	1 U	2 U	1 U	1 U	--	--
4W												
PCE	**130**[1]	**1510**[2]	**280**	**130**	**39**	**25**	**9.3**	**15**	**17**	**12**	**15**	**26***
TCE	NR	NR	**4.7**	<1.0	<1.0	<1.0	**0.84 J**	**1.9 J**	**0.25 J**	**1.3**	**2**	**2.8***
DCE	NR	NR	**33**	<1.0	<1.0	<1.0	**0.26 J**	**0.64 J**	**0.31 J**	**0.49 J**	**0.60 J**	**1.4**
7W												
PCE	--	--	**4.3**	**3**	<1.0	**1.2**	1 U	**0.19 J**	1 U	1 U	1 U	**1.7**
TCE	--	--	<1.0	<1.0	<1.0	<1.0	1 U	2 U	1 U	1 U	1 U	1 U
DCE	--	--	**6.4**	<1.0	<1.0	<1.0	1 U	1 U	1 U	1 U	1 U	1 U
8W												
PCE	--	--	<1.0	<1.0	<1.0	NS	1 U	1 U	1 U	1 U	--	--
TCE	--	--	<1.0	<1.0	<1.0	NS	1 U	2 U	1 U	1 U	--	--
MW-5												
PCE	--	--	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 UJ
TCE	--	--	--	--	--	--	1 U	2 U	1 U	1 U	1 U	1 U
MW-6												
PCE	--	--	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 UJ
TCE	--	--	--	--	--	--	1 U	2 U	1 U	1 U	1 U	1 U
MW-7												
PCE	--	--	--	--	--	--	1 U	1 U	1 U	1 U	--	--
TCE	--	--	--	--	--	--	1 U	2 U	1 U	1 U	--	--
MW-8												
PCE	--	--	--	--	--	--	1 U	1 U	1 U	1 U	--	--
TCE	--	--	--	--	--	--	1 U	2 U	1 U	1 U	--	--

PCE = tetrachloroethylene TCE = trichloroethylene DCE = cis-1,2-dichloroethylene
NS = not sampled NR = not reported
<1.0 = Analyte was not detected at a concentration above the value shown.
U = Analyte was not detected at or above the reported value.
J = Analyte was positively identified. The associated numerical result is an estimate.
UJ = Analyte was not detected at or above the reported estimated result.
[1] = Concentration reported by Building Analytics is in approximate location of well 4W.
[2] = Concentration reported by AA Environ Assessment is in approximate location of well 4W.
* = Average concentration of duplicate samples.
Bold = Analyte was detected.