Health Consultation

Philip Services Corporation – Georgetown Site
City of Seattle, King County, Washington State

March 11, 2005

Prepared by

The Washington State Department of Health
Under Cooperative Agreement with the
Agency for Toxic Substance and Disease Registry

Washington State Department of Health

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Foreword

The Washington State Department of Health (DOH) has prepared this health consultation in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for health issues related to hazardous wastes. This health consultation was prepared in accordance with methodologies and guidelines developed by ATSDR.

The purpose of this health consultation is to identify and prevent harmful human health effects resulting from exposure to hazardous substances in the environment. Health consultations focus on specific health issues so that DOH can respond to requests from concerned residents or agencies for health information on hazardous substances. DOH evaluates sampling data collected from a hazardous waste site, determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health. The findings in this report are relevant to conditions at the site during the time of this health consultation, and should not necessarily be relied upon if site conditions or land use changes in the future.

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Summary and Statement of Issues

The Washington State Department of Health (DOH) conducted this health consultation at the request of a residential property owner whose property is underlain by a plume of contaminated groundwater associated with the former Philip Services Corporation (PSC) Georgetown facility. The purpose of the health consultation is to evaluate whether the chemicals found in the shallow groundwater below the property pose an indoor air health concern to occupants of the residence. DOH prepares health consultations under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

Background

The residential property is located near the former PSC facility in Seattle's Georgetown community, King County, Washington. A one-story wood frame residence with a basement occupies most of the property. The building is divided into two residential rental units. One unit is located in the basement; the other unit is located on the first floor of the residence. Currently, one adult occupies the first floor unit. The basement unit, which was leased to PSC from November 2000 to November 2003, has been unoccupied since August 2000. (Property owner, communication during visit to residence, August 26, 2004).

The residential property is approximately one-half block west and hydraulically downgradient of the former PSC facility. The facility, where hazardous wastes were received, packaged, occasionally treated, and shipped off-site for treatment or disposal, is at 734 South Lucile Street. Leaking underground storage tanks and other past releases appear to be the source of contaminants detected in groundwater at and down gradient of the PSC facility. These contaminants include volatile organic compounds (VOCs) such as trichloroethylene (TCE), vinyl chloride, and petroleum.

In early 2004, PSC installed a subsurface hydraulic barrier wall and well system designed to contain contaminant sources found at the PSC facility and prevent contaminated groundwater from moving off the facility property. PSC is currently monitoring this system to confirm that it is working as designed. However, some contaminants associated with the former PSC facility beyond the PSC property and barrier wall could be entering the groundwater. These additional contaminants will be addressed by PSC and the Washington State Department of Ecology (Ecology) as part of a feasibility study in the near future if the concentrations are above cleanup levels (Ed Jones, Ecology, e-mail messages, August 31, 2004, and September 16, 2004).

The subject residential property, like other properties to the west of the former PSC facility, continues to be underlain by contaminated groundwater that has migrated from the PSC property. PSC began installing depressurization systems in some residential and commercial buildings downgradient of the former PSC facility in 2003 because of the potential for VOCs to volatilize from the groundwater and move up through the soil into indoor air where they could pose a potential health concern. These depressurization systems were designed to be consistent with the American Society for Testing and Materials (ASTM) radon standard (E2121-03) and the U.S. Environmental Protection Agency's (EPA's) radon mitigation standards.[1] The systems, approved by Ecology prior to installation, were installed below basement floors or on the bottom of crawlspaces. The systems are designed to capture VOCs before they enter the building, thereby reducing or preventing exposure to groundwater contaminants through the inhalation pathway.[1, 2] The depressurization systems will continue to operate and be maintained until groundwater cleanup levels protective of human health have been achieved (Ed Jones, Ecology, e-mail message, August 26, 2004).

PSC installed a depressurization system in the basement and a crawlspace area at the subject residence in March 2004. PSC provided the current tenant with directions on how to read the gauge installed with the system, which is used to indicate whether the system is operating as designed. The tenant was also provided with contact information in case the tenant had any concerns about the depressurization system.[3]

PSC conducted indoor air sampling at the residence in June 2004 to determine how effective the depressurization system is in restricting the flow of contaminants from groundwater into indoor air. PSC collected three indoor air samples. One indoor air sample was collected from the living room in the basement unit as samples had been during previous indoor air sampling rounds at the residence. PSC tried to collect another indoor air sample from the north bedroom of the basement unit, which was selected because a small door that allows access to the bathtub drainpipe is in the bedroom closet. However, a problem occurred with the bedroom sampler during the June sampling and no sample was obtained.[4] DOH does not consider this a significant problem because the living room is adjacent to the bedroom and the air quality between the two rooms is unlikely to be substantially different. In addition, PSC has determined that concrete underlies the bathtub and that only the drainpipe from the bathtub penetrates into the underlying soil. When PSC installed the depressurization system, the area around the drainpipe was sealed to prevent the potential movement of contaminants into indoor air (Ed Jones, Ecology, e-mail message, May 25, 2004). One indoor air sample was also collected from the living room in the first floor unit.[4]

In addition to the indoor air samples, one soil gas sample was collected from below the concrete sub-slab in the north bedroom closet of the basement unit to estimate contaminant levels in the soil gas; one ambient air sample was collected approximately 30 feet northeast of the building at a height of 10 feet to determine background levels of chemicals in outdoor air; and, to estimate contaminant levels in groundwater at the residence, one groundwater sample was collected from a permanent monitoring well (CG-124-WT) located near the residence.[4]

Discussion

Groundwater underlying the Georgetown community, where the subject residence is located, is not used as a drinking water source. Therefore, the VOC contaminated groundwater only poses a health concern if the VOCs evaporate from the groundwater, move through the soil, and enter an occupied building. To evaluate whether the chemicals found in the shallow groundwater pose an indoor air health concern to occupants of the residence, DOH used a two-step evaluation process. DOH first compared indoor air sampling results obtained from the basement unit in 2000, 2001, 2002, and 2004 to see if an obvious change in indoor contaminant concentrations took place after the depressurization system was installed in March 2004. The basement unit, the most vulnerable unit because of its proximity to the subsurface, was the only unit sampled until

June 2004. Secondly, DOH compared the June 2004 indoor air results from the basement and first floor units to outdoor ambient air levels and indoor air literature values to see if the levels detected at the residence were similar.

Table 1 summarizes the indoor air sampling results collected from the basement unit in August 2000; March 2001; August 19, 2002; August 27, 2002, and June 2004.[5, 6, 7] The data from these sampling rounds indicate a general drop in contaminant concentrations in June 2004, which suggests that the depressurization system is working as designed.

Table 1: Indoor Air Sampling Results from 2000 to 2004 for the Basement Unit

	Indoor Air Sampling Results (ug/m^3)									
Analyte	**08/00**	**Q**	**03/01***	**Q**	**08/02†**	**Q**	**08/02‡**	**Q**	**06/04**	**Q**
1,1,1-Trichloroethane	1.48	U	4.1		1.6		1.9		0.56	
1,1-Dichloroethane	1.24	U	0.4		0.14	U	0.2	U	0.14	U
1,1-Dichloroethylene	2.06	U	0.4	U	0.07	U	0.38		0.069	U
1,2,4-Trimethylbenzene	--		--		0.94		2.2		0.57	
1,2-Dichloroethane	2.84	U	0.4	U	0.14	U	0.35		0.17	
1,3,5-Trimethylbenzene	--		--		0.44		0.85		0.22	
2-Hexanone	--		--		0.73	U	1.2	U	0.71	U
Benzene	1.3	U	1.9		1.2		11		0.74	
Chloroethane	--		--		0.23	U	0.38		0.23	U
Chloroform	2.2		0.6		0.4		0.31		0.68	
Ethylbenzene	2.7	U	1.2		1.8		5.9		0.7	
Naphthalene	--		--		93	U	120	U	4.6	U
Propylbenzene	--		--		17	U	22	U	8.5	U
Tetrachloroethylene	2.64	U	0.5		0.24	U	0.52		0.24	U
Toluene	9.42		11.7		7		39		3.9	
Trichloroethylene	2.84	U	0.3		0.55		1.4		0.29	
Vinyl chloride	1.48	U	0.4	U	0.045	U	0.062	U	0.044	U
cis-1,2-Dichloroethylene	1.14	U	0.4	U	0.14	U	0.19	U	0.14	U
p-Isopropyltoluene	--		--		--		--		4.8	U
sec-Butylbenzene	--		--		20	U	25	U	9.5	U
trans-1,2-Dichloroethylene	2.54	U	0.4	U	0.7	U	0.96	U	0.69	U

Q - Qualifier
U - Not detected at the reporting limit
-- Not Analyzed
* Duplicate samples collected in March 2001-table includes highest concentration of each chemical
† Duplicate samples collected on August 19, 2002- table includes highest concentration of each chemical
‡ Duplicate samples collected on August 27, 2002- table includes highest concentration of each chemical
μg/m^3: micrograms per cubic meter

The presence of VOCs in urban air, including some of the chemicals detected in indoor air at the subject residence, has been well established. These chemicals can migrate into indoor air and could account for their presence at the residence. In addition, indoor sources of these VOCs, including cleaning products, paints, solvents, and glues, can be found in most homes.

DOH compared the June 2004 indoor air results from the basement and first floor units to the background ambient air sample results collected near the residence to determine whether ambient air was a possible source of the contaminants. As shown in Table 2, in indoor air in the first floor unit only chloroform was detected above ambient air levels. Chloroform, 1,1,1-trichloroethane, and 1,2–dichloroethane were detected above ambient air levels in the basement unit. The other chemicals were below or slightly below ambient levels indicating that indoor air quality at the residence was generally better than outdoor air.

Table 2: June 2004 Indoor Air Sampling Results for the Residence vs. Ambient Air

Analyte	Indoor Air Results (ug/m3)				Ambient Air Results (ug/m3)	Q
	Basement	Q	1st Floor	Q		
1,1,1-Trichloroethane	0.56		0.19	U	0.49	
1,1-Dichloroethane	0.14	U	0.14	U	0.15	U
1,1-Dichloroethylene	0.069	U	0.069	U	0.075	U
1,2,4-Trimethylbenzene	0.57		0.36		8.9	
1,2-Dichloroethane	0.17		0.07	U	0.077	U
1,3,5-Trimethylbenzene	0.22		0.17	U	2.6	
2-Hexanone	0.71	U	0.71	U	1.4	
Benzene	0.74		0.63		12	
Chloroethane	0.23	U	0.23	U	0.25	U
Chloroform	0.68		0.33		0.18	
Ethylbenzene	0.7		0.51		8.6	
Naphthalene	4.6	U	4.6	U	5	U
Propylbenzene	8.5	U	8.5	U	9.3	U
Tetrachloroethylene	0.24	U	0.24	U	8.1	
Toluene	3.9		5		96	
Trichloroethylene	0.29		0.072		0.37	
Vinyl chloride	0.044	U	0.044	U	0.048	U
cis-1,2-Dichloroethylene	0.14	U	0.14	U	0.15	U
p-Isopropyltoluene	4.8	U	4.8	U	5.2	U
sec-Butylbenzene	9.5	U	9.5	U	10	U
trans-1,2-Dichloroethylene	0.69	U	0.69	U	0.75	U

Q - Qualifier
U - Undetected at the reporting limit
Concentration greater than ambient air concentration
$\mu g/m^{3}$: micrograms per cubic meter

The chloroform, 1,2-dichloroethane, and 1,1,1-trichloroethane levels detected in indoor air at the residence were then compared to indoor air literature values to determine if the detected levels were similar to levels expected to be found in a typical homes. As shown in Table 3, the levels of these three chemicals detected in indoor air at the residence are well below levels expected for a typical home suggesting that contaminated groundwater is not likely the source of these chemicals.

Table 3: June 2004 Indoor Air Sampling Results for 1,1,1 Trichloroethane, 1,2-Dichloroethane, and Chloroform at the Residence vs. Indoor Air Literature Values.

Analyte	Indoor Air Results (ug/m3)				Indoor Air Literature Values [8] (ug/m3)	
	Basement	Q	1st Floor	Q	Average Concentration	Maximum Concentration
1,1,1-Trichloroethane	0.56		0.19	U	19	880
1,2-Dichloroethane	0.17		0.07	U	20	140
Chloroform	0.68		0.33		3	220

Q - Qualifier
U - Undetected at the reporting limit
μg/m^3: micrograms per cubic meter

Chloroform is a common indoor air contaminant and is found in tap water to which chlorine has been added. When chlorine is added to water, small amounts of chloroform form as an unwanted by-product. Chloroform can evaporate from the tap water then enter the air. One of the most significant indoor sources of chloroform is chlorinated tap water. Taking showers is expected to contribute a substantial amount to the indoor chloroform levels.[9] The most common use of 1,2-dichloroethane today is in making vinyl chloride, which is used to make a variety of plastic and vinyl products including polyvinyl chloride (PVC). In the past, 1,2-dichloroethane was a component of some cleaning solutions; pesticides; some adhesives, such as those used to glue wallpaper or carpeting; and some paint, varnish, and finish removers.[10] 1,1,1-trichloroethane is often used as a solvent and can be found as an ingredient in household products such as spot cleaners, glues, and aerosol sprays.[11]

Although the June 2004 indoor air data provide good information to help evaluate whether the depressurization system at the subject residence is effective, additional indoor air data will be needed in the future to confirm that system continues to operate as designed. Such retesting is consistent with ASTM radon standard (E2121-03) and EPA's radon mitigation standards (Section 17.5), which were used by PSC when designing the depressurization system installed at the residence.[1, 12, 13]

Children's Health Concern

Children could potentially be exposed to contaminants migrating from contaminated groundwater into indoor air if measures are not taken to reduce such exposures. Children can be uniquely vulnerable to the hazardous effects of environmental contaminants. When compared to adults, pound for pound of body weight, children drink more water, eat more food, and breathe more air. These facts lead to an increased exposure to contaminants. Additionally, the fetus is highly sensitive to many chemicals, particularly with respect to potential impacts on childhood development. For these reasons, DOH considers the specific impacts that cleanup options such as depressurization systems might have on children, as well as other sensitive populations, when evaluating indoor air quality in homes.

Conclusions

The levels of VOCs detected in indoor air at the residence are similar or less than the levels in background ambient air except for 1,1,1-trichloroethane, 1,2-dichloroethane, and chloroform. The levels of these three chemicals, however, are less than indoor air literature values. This evidence suggests that contaminated groundwater is not the likely source of the VOCs detected in June 2004 in indoor air at the subject residence. A soil depressurization system to prevent the migration of VOCs from contaminated groundwater into indoor air has been installed at the residence. Therefore, VOC contaminated groundwater below the residence poses *no apparent public health hazard* to indoor air.

Recommendations

1. Only one post depressurization system sampling event has been conducted. Additional indoor air samples should be collected to ensure that the depressurization system at the subject residence continues to effectively reduce indoor air contaminant levels associated with VOC contaminated groundwater. Ecology should consider a sampling frequency that will take into account protection of human health.

2. PSC should provide the property owner with an easily understood fact sheet describing the potential vapor intrusion situation below the subject residence and the reasons why the depressurization system was installed. The fact sheet should describe the basic design of the system, operation information, required system monitoring, and PSC contact information that the owner can provide to the tenants.

Public Health Action Plan

1. Copies of this health consultation will be provided to the property owner, Ecology, EPA, and PSC.

2. DOH will review and evaluate any future air sampling plans and results for the subject residence.

3. DOH is available to review draft and final versions of the fact sheet recommended above.

4. DOH has notified the property owner that tenants should ensure that indoor sources of VOCs (e.g., paints, glues, spot cleaners) are stored in sealed containers, preferably outside the residence (e.g., shed) and that good ventilation is necessary to maintain good indoor air quality (e.g., running bathroom fans or opening a window while showering). DOH also provided the property owner with a link to its Web page, which contains information about maintaining good indoor air quality (http://www.doh.wa.gov/ehp/ts/IAQ/IAQPrimer.HTM).

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Certification

This Health Consultation was prepared by the Washington State Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.

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