Health Consultation

EXPRESS DRY CLEANERS

TETRACHLOROETHENE IN SOIL AT THE RACINE COMMUNITY GARDENS

RACINE, RACINE COUNTY, WISCONSIN

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES Public Health Service Agency for Toxic Substances and Disease Registry Division of Health Assessment and Consultation Atlanta, Georgia 30333

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In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

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RACINE, RACINE COUNTY, WISCONSIN

Prepared By: Wisconsin Department of Health and Family Services Under Cooperative Agreement with the The U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry

BACKGROUND

Purpose. Following the discovery of drycleaner solvents in soil and groundwater on and adjacent to the Express Drycleaner operations in Racine, questions have been raised regarding risks of exposure to the public using the S.C. Johnson Community Gardens. Northern Environmental, Inc. was contracted by the property owner, Ehrlich Family Limited Partnership ("Ehrlich") as the environmental consultant to sample soil and soil gas on the garden property. This work was performed with regulatory oversight by the Wisconsin Department of Natural Resources (WDNR), and with technical input on sampling locations from University of Wisconsin-Racine Extension staff. This health consultation is in response to a request by WDNR to provide a public health perspective on the initial sampling results.

Background and data summary. The Garden of Eatin', or SC Johnson Community Garden, located at 3936 North Bay Drive in Racine, WI, is described as a project developed by community volunteers, the Racine County Food Bank, University of Wisconsin Extension, and the property owner, SC Johnson Company, to grow food for people in need, teach gardening, and establish a community sense of purpose (<u>http://www.racinecountyfoodbank.org/garden.htm</u>). Drycleaner solvents were found on the property in March 2007 during the course of an environmental investigation of the adjacent Express Drycleaner operation on 3941 North Main Street.

Sampling conducted by Northern Environmental Inc. in March 2007 (NEI 2007a) reported significant concentrations of tetrachloroethene (PCE) as the primary contaminant beneath the Ehrlich property. Subsequent sampling reported August 1, 2007 (NEI, 2007b) found soil contamination at 9 locations within the community gardens. Seven of the nine samples were taken in the northwest corner of the gardens, nearest the drycleaner, where the possibility of contamination from surface water runoff was greatest. Two other samples were taken on the eastern side of the gardens in order to partially characterize the entire garden. The samples were taken at the 6 inch soil depth and at 24 inches. These sampling depths were intended to reflect the most common exposures from handling composted soils added to the garden surface, as well as less frequent exposures from the community gardens, in response to the possibility of plant uptake and accumulation of drycleaning solvents.

Prior to completing the 2007 gardening season, the owner of the garden property elected to close the garden. Unharvested crops were consequently destroyed over the property owner's concerns of exposure to PCE in garden plants; there are no plans to continue the garden at this site.

Exposure pathways to drycleaner solvents. During discussions of the work plan proposal for the site, three potential exposure pathways to PCE were identified:

- Incidental hand-to-mouth consumption of soil.
- Inhalation of PCE vapors emitted from contaminated soil.
- Consumption of garden plants grown in contaminated soil.

Contamination of groundwater is a typical environmental concern at drycleaner sites. From a public health perspective, PCE and other drycleaning solvents in groundwater from this site is not a completed or potential exposure pathway, since local residents are served by municipal water supplies.

The consumption of garden plants as an exposure pathway to PCE is discussed below. However, the decision to close and relocate the garden eliminates this pathway regarding exposure to PCE for those previously using this property for growing food.

Analytical results

PCE in soil. The investigation by Northern Environmental reports PCE in soil samples throughout the garden property (Table 1; Appendix 1). The most concentrated sample, 130 mg/kg or ppm, was from a sample taken at 24 inches below surface in a sod area a few feet to the west of the tilled area of the gardens (NEI, 2007). Of the remaining 8 sample locations from within the garden, one sample was 1.3 mg/kg and the others were at or below 1.2 mg/kg.

PCE in soil vapor. PCE in soil vapor reported at the sod area where PCE in soil was most concentrated was 6300 micrograms per liter, or 930 parts per million. PCE in soil gas measured elsewhere was 2 ppm or less.

Sample i.d.	PCE detected in 6'' deep soil (ppm or mg/kg)	PCE detected in 24" deep soil (ppm or mg/kg)	EPA screening value for transfer from soil to air ² (ppm)	EPA Region 3 Risk-based concentration (RBC) for residential soils ³ (ppm or mg/kg)
RA1		130	11	19
DAI DAI		130	11	1.2
DA2	0.05	0.70	11	1.2
BA3	1.20	1.30	11	1.2
BA4	0.69	1.00	11	1.2
BA5	trace	0.04	11	1.2
BA6	0.06	0.07	11	1.2
BA7	0.08	0.38	11	1.2
BA8	trace	trace	11	1.2
BA9	0.03	1.20	11	1.2

Table 1. Tetrachloroethene (PCE) concentrations in soil, S.C. Johnson Racine community gardens¹

¹Results reported by Northern Environmental, Inc. Soil, Soil Vapor, and Vegetable Tissue Sampling Results, Express Cleaners. ECI 01-2300-3057. August 1, 2007.

²US EPA 1999. Region III Risk-based concentration table.

³US EPA. 2007. Region III Risk-based concentration table.

ppm: parts per million, or milligrams per kilogram

DISCUSSION

Environmental data. The analytical results from the 9 sample locations were compared to the EPA Region 3 Risk-Based Concentration (RBC) values for residential soils. The RBCs use standard exposure assumptions to calculate a soil concentration that conservatively reflects a one-in-a-million increased lifetime cancer risk from chronic exposure to the chemical in soil. For PCE, this concentration is 1.2 mg/kg for chronic direct contact and incidental ingestion of residential soil. PCE at 1.2 mg/kg was found at one location in shallow (6 inch below surface) soils, and at concentrations equal to or greater than 1.2 mg/kg at three locations in deeper (24 inch deep) soils. PCE in the deeper soils at or near 1.2 mg/kg is not a contact exposure hazard due to the infrequency of actual exposure compared to the assumptions of the RBC. The one sample location that significantly exceeded this RBC (130 mg/kg, site BA1) was beneath a grass-covered area outside of the tilled garden.

Public health implications. Within the tilled gardens, the exposure frequency and duration is less than would be appropriate for comparison to the RBC. Similarly, PCE concentrations in the tilled soils are much less than would produce any acute effects. It can be concluded that due to the low concentration of PCE in the soil and the limited direct contact, no acute or chronic non-cancer adverse health effects from PCE exposure are expected from contact with soil within the tilled garden area. There is also a very low cancer risk from this exposure.

The area with the highest measured concentration of PCE in soil, BA1, was in an untilled, grass covered area where no regular direct contact would be expected. In the event of contact with soil at this location containing 130 mg/kg PCE, the worst-case exposure was calculated based on a 10 kg child consuming 200 mg/day soil containing 130 mg/kg PCE. This scenario assumes, unrealistically, that none of the PCE evaporates from hands prior to ingestion of soil. Under these conditions, the calculated exposure to PCE is 0.026 mg/kg body weight/day. This is 5-fold less than the corresponding EPA (2007) reference dose of 0.14 mg/kg/day; therefore, we would not expect non-cancer health effects from ingestion of the soil.

No measurements were made of PCE in ambient air at the garden site. In the absence of this information, PCE levels in soil were compared to a screening value of 11 ppm for transfer of PCE from residential soil to air (U.S. EPA 1999 Region III Risk-Based Concentration table). The grass-covered area where soil PCE concentrations are highest (sample BA1) was the only area reporting PCE in soil above 11 ppm. From this area was also reported a concentration of 930 ppm PCE in soil vapor. At this concentration in soil gas, it is possible that PCE would diffuse into air immediately above the soil at this location at concentrations detectable by odor. PCE can be smelled at levels starting at 2-71 ppm (AIHA, 1989). This assumes a 10-fold attenuation in concentration, as might be expected for a chemical diffusing into indoor air through a basement floor (U.S. EPA 2002). In the case of diffusion of PCE from soil to open air, it is not possible to accurately predict PCE concentrations resulting from diffusion from soil to open air, nor any past exposure, given the rapid diffusion of PCE and daily fluctuations in atmospheric

conditions. It is unlikely someone would now or in the past be exposed to level of concern since dispersion would likely reduce the level quickly in the open air. In this case a 10-fold attenuation factor is inappropriate. Applying a less conservative 100-fold concentration reduction from soil to air calculates to 9 ppm, a concentration similar to that expected inside a dry cleaning facility, but still above the ATSDR minimum risk level for acute inhalational exposure to PCE (200 parts per billion (ppb) or 0.2 ppm). Such exposure to PCE might be possible under limited conditions for someone sitting for extended periods over the grass just outside the garden trellis wall. However, within the current usage patterns of the property, such exposures are expected to be brief and intermittent, and therefore, poses no exposure hazard.

The investigation by Northern Environmental did a reasonably thorough job of sampling the variety of vegetables, both root crops and greens, grown throughout the garden. In all 32 samples, no PCE was found above the limit of detection for the analytical method used, which was in the low parts per billion range. The fate of PCE and other chlorinated solvents in plants grown in contaminated soil is still an area of active study, with much of the research being driven by interest in phytoremediation methods. Doucette, *et al.* (2007) report some accumulation of trichloroethylene, a structurally related chlorinated solvent, in tree trunks, but little if any in leaves, fruits, or in vegetable crops. This is supported by Nzengung (2005; 2006) and Dawit et al. (2006) in studies indicating that PCE and chlorinated solvents are rapidly metabolized and transpired from plant tissues rather than accumulating. Overall, the evidence from this site and from related studies does not indicate that people consuming garden plants from this location would have any exposures constituting a health concern.

Child Health Considerations. Children active within the garden area would be expected to have greater actual exposures to PCE than adults, due to higher breathing rates and more hand-to-mouth activity. The risk-based concentration values used in this analysis account for this difference, and are designed to be protective of these sensitive members of the population.

CONCLUSION

- While the garden was operating, there was no apparent health hazard from inhalation of PCE released from soil, or direct contact with and incidental ingestion of PCE in soil, within the tilled areas of the SC Johnson community gardens in Racine, due to the low concentrations and limited exposure to PCE found in garden soil.
- There is a possibility of future PCE odors in air over the grassy area just outside the garden trellis wall. However, within the current usage patterns of the property, such exposures are expected to be brief and intermittent, and therefore, poses no apparent health hazard.
- No PCE was found in any of the fruits and vegetables tested from the garden. Therefore, there is no public health hazard from consumption of plants grown in

or over PCE-containing soils within the SC Johnson community gardens in Racine.

RECOMMENDATIONS

DHFS supports the WDNR effort for cleanup of PCE at the site because existing PCE contamination does not meet WDNR standards for environmental quality of groundwater and soil. This will alleviate concerns from the public and the property owner, remove the potential for future exposures, and gain unrestricted future use of the garden property for the community.

PUBLIC HEALTH ACTION PLAN

- DHFS will continue to provide technical support to the WDNR as they work toward a cleanup and resolution with the responsible party.
- DHFS has extended an invitation to the University of Wisconsin Extension to speak publicly with the gardening public and other interested parties regarding the public health aspects of this case.

CONSULTATION AUTHOR

Robert Thiboldeaux, Ph.D. Toxicologist Health Hazard Evaluation Unit Bureau of Environmental and Occupational Health Division of Public Health Wisconsin Department of Health and Family Services.

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Certification

This Health Consultation on Tetrachloroethene in Soil at the Racine Community Gardens was prepared by the Wisconsin Department of Health and Family Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved methodology and procedures existing at the time the Health Consultation was begun. Editorial review was provided by the cooperative agreement partner.

Jennifer A. Freed

Division of Health Assessment and Consultation (DHAC) ATSDR

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

Alan Yarbrough Team Leader

CAPEB, DHAC, ATSDE

Appendix 1. Diagram of Express Drycleaner and SC Johnson Community Garden properties, Racine Wisconsin. <u>Reprinted From Northern Environmental, Inc. Soil, Soil</u> Vapor, and Vegetable Tissue Sampling Results, Express Cleaners. ECI 01-2300-3057. July 27, 2007.

