

Health Consultation

ECONOCARE CLEANERS VAPOR INTRUSION INVESTIGATION
GREEN BAY, BROWN COUNTY, WISCONSIN

EPA FACILITY ID: WID065453730

SEPTEMBER 30, 2006

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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HEALTH CONSULTATION

ECONOCARE CLEANERS VAPOR INTRUSION INVESTIGATION
GREEN BAY, BROWN COUNTY, WISCONSIN

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Prepared by:

Wisconsin Department of Health and Family Services
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Summary

The Wisconsin Department of Health and Family Services (DHFS) evaluated public health implications of soil and groundwater contaminated with dry cleaning solvents from Econocare Cleaners, a former dry cleaning facility located in Green Bay, Wisconsin. The evaluation was requested in the context of an environmental investigation of the property for the purposes of remediation. Environmental data indicate conditions favoring low levels of tetrachloroethylene (PCE) vapor migration and intrusion into the indoor air of two neighboring residences. This is an indeterminate health hazard, since more information would be needed to quantitatively assess PCE exposure at these residences. Exposures at two other residences cannot be excluded based upon the evidence provided. DNR is considering whether to request that vapor mitigation systems be installed at two residences. DHFS advises that this measure would be protective of public health.

BACKGROUND and STATEMENT OF ISSUES

Purpose

The Wisconsin Department of Health and Family Services (DHFS), was asked by the Wisconsin Department of Natural Resources (DNR), to evaluate the public health implications of soil and groundwater contaminated with dry cleaning solvents from Econocare Cleaners, a former dry cleaning facility, and the potential for vapor migration and intrusion to the indoor air nearby homes. The evaluation was requested in the context of an environmental investigation of the property for the purposes of remediation.

Site Description

The former Econocare property is located at 719 South Fisk Street, Green Bay, Brown County, in a mixed residential and industrial neighborhood. The dry cleaning building has been removed and the Econocare property, as well as the property immediately to the east, is presently a vacant lot. Industrial properties border 719 Fisk to the north; to the west across Fisk Street and parking lots serving other industrial facilities. Immediately to the south across Shirley Street is a small residential neighborhood consisting of single-family dwellings. Four of these residences and a park within 100 yards of 719 Fisk are evaluated here for vapor intrusion impacts. The depth to groundwater in the area varies. Measurements made by consultants for the property owner between 2004 and 2006 show groundwater approximately 3.5-6.5 feet below surface beneath both 719 Fisk and nearby residences. Residences and businesses in this urban area obtain their water supplies from municipal sources that are not affected by this source of contamination.

Data Summary

Environmental consultants for the property owner provided measurements of volatile organic compounds from soil and groundwater on the Econocare property, and from groundwater and indoor air from off-site locations (Giles Engineering, Waukesha Wisc., project 1E-0405001). The environmental investigation data indicate that

tetrachloroethylene (PCE) and trichloroethylene (TCE) are contaminants of concern both on and off the Econocare property. This health consultation primarily considers off-site measurements relevant to the vapor intrusion exposure pathway to residences (Table 1). Shallow groundwater contaminated with PCE and TCE flows generally southward from the 719 Fisk Street property (at the corner of Fisk and Shirley Streets) and beneath a residential neighborhood directly to the south across Shirley Street (Figure 1). Several residences along Fisk and Shirley Streets to the south of the Econocare property are potentially affected by PCE contaminants in soil and groundwater that may migrate through building foundations and into indoor air.

Table 1. Summary of off-site groundwater and indoor air concentrations of tetrachloroethylene and trichloroethylene near 719 Fisk Street, Green Bay, Wisconsin.¹

Location	Location code ¹	Sample medium	PCE ²	PCE CV ⁴	TCE ³	TCE CV ⁴
Residence A	na	Indoor air, basement	ND	0.12ppbv (indoor air)	ND	0.0041 ppbv (indoor air)
Residence A	MW8	Groundwater, NW corner of property	6.4 ppb	5ppb	0.23 ppb (j)	5 ppv
Residence B	na	Indoor air, sump headspace	18.3 ppbv	1.2ppbv (shallow soil gas)	ND	0.041 ppbv (shallow soil gas)
Residence B	MW10	Groundwater NE corner of property	<0.5 ppb	5 ppb	<0.2 ppb	5 ppb
Undeveloped property between residences A and B	MW7	Groundwater, NW corner of property	5900 ppb	5 ppb	130 ppb	5 ppb
NW corner Colburn Park	MW11	Groundwater	<0.5 ppb	5 ppb	<0.2 ppb	5 ppb

¹Environmental data from Giles Engineering, Waukesha, WI. Project 1E-0405001. 2004-2006.

²PCE: tetrachloroethylene

³TCE: trichloroethylene

⁴CV: health-based comparison value, from EPA 2002. Generic screening levels corresponding to 1x 10⁻⁶ lifetime excess cancer risk.

ND: not detected

na: not applicable

j: chemical was detected, but reported value is an estimate that is below the laboratory's quantitation limit.

In consultation with DNR and DHFS, private consultants for the property owner investigated the two nearest residences (Residence A and Residence B; Figure 1) and adjacent vacant and recreational properties for environmental impacts that might affect public health. A maximum PCE measurement of 5900 ppb in groundwater (19 October 2005) was found within 30 feet of these two residences. Groundwater is high around these residences, although measurements made on 15 June 2006 were much lower (data not shown). High groundwater around these residences is at least intermittently in contact with the foundation, suggesting a potential for vapor intrusion of volatile organic chemicals directly into basements from contaminated groundwater. Residence B has an operating sump which the consultant sealed and then withdrew samples from the air headspace in the sump after the air had equilibrated for 8 hours. From residence A, which has an intermittently wet basement but no operating sump, an 8-hour air sample was taken from the basement. Analytical results of these samples provided to DHFS show 18.3 parts per billion – volume (ppbv) PCE in the sump headspace of residence B. No PCE or breakdown chemicals were reported from the basement air of Residence A (Table 1).

DISCUSSION

Environmental Data

Wide variations in the PCE and TCE concentrations detected in groundwater present some difficulty in assessing exposure risks, via vapor intrusion, to nearby residents. The field experience of DNR project managers and DHFS staff suggests wide variation in a single monitoring well is not unusual where there is shallow groundwater, and may be due to intermittent migration from the soil source area following heavy rainfalls or a high water table. At the time of this writing, there is not enough information to accurately assess long-term exposure to nearby residents. However, the levels of PCE found in groundwater near residences and in the sump headspace of one residence (Table 1) are sufficient to suggest *some* level of vapor intrusion into nearby residences.

Exposure pathways evaluation

The completed exposure pathway in this case is inhalation of PCE via vapor intrusion from contaminated soil and groundwater beneath residential properties south of Econocare into the indoor air of houses on the residential properties. In assessing the potential for vapor intrusion, several approaches are available. A common approach has been to estimate indoor air concentrations from environmental data using the Johnson and Ettinger (1991) model for vapor intrusion. DHFS (2003) uses an application of the Johnson and Ettinger model developed by the U.S. Environmental Protection Agency, which includes environmental assessment tools and model-based exposure tables using the comparison values presented in Table 1 (EPA 2002). More recently, attempts have been made to simplify the decision-making process in vapor intrusion cases where subsurface contamination is high, but where there is little evidence of actual vapor

migration into indoor air. The draft guidelines published by the New York State Department of Health (NYSDOH 2005) condense decisions to either “mitigate, monitor, or take no further action,” based on the relative amounts of volatile contaminants in soil, groundwater, and indoor air. Based on matrix 1 and 2 of the New York guidelines, combined with a known maximum PCE measurement of 5,900 ppbv in groundwater within 30 feet of two residences with wet basements, vapor intrusion cannot be excluded in at least residences A and B (Table 1), and mitigation of potential exposures is indicated for at least those two residences. Preventing those exposures should involve a combination of removing the contaminant source and of interrupting vapor intrusion into nearby homes. The most common method of interrupting vapor intrusion is to seal preferential pathways, combined with installation of a relatively inexpensive sub-slab vapor mitigation system of the type used in buildings where radon gas is a problem.

The periodically high (shallow) water table presents extra concerns for the mitigation of vapor intrusion into residences. Periodic high groundwater (approximately 3.5 feet below surface can, 1) enhance contaminant migration from the source to nearby residences, 2) bring contaminated groundwater into contact with residential building foundations, and 3) temporarily compromise the function of any vapor mitigation systems that might be installed in these residences, since they require dry subslab soils to operate properly. Therefore, if vapor mitigation systems are installed at residences near Econocare, those residences should also be evaluated for the need to accommodate periodic high groundwater. This might be limited to existing sumps, but might also require supplementary dewatering systems or diverting rainfall away from the residence.

Public Health implications

Of the chemicals detected in soil, air, and groundwater at off-site locations near the Econocare property, PCE is the major contaminant of concern. TCE is present in some off-site groundwater samples, but the much higher concentrations of PCE contamination allow this case to be discussed primarily in terms of PCE. The indoor air of four residences on the south side of Shirley Street that are nearest to the former Econocare property are possibly affected by PCE-contaminated soil and groundwater. Of these, PCE in the headspace of a sump indicates vapor intrusion into residence B (Table 1, Figure 1), and a need for vapor mitigation there. The PCE levels suggested from the limited sampling information are not high enough to cause acute effects to the occupants, and local information indicates this is a rental property, suggesting past exposures PCE have not been long-term. PCE was not detected in basement air of residence A (detection limit = 3.7 ppbv), but high PCE levels in groundwater near residence A indicates a high probability of a complete exposure pathway, suggesting past exposures to low levels of PCE, and a need for vapor mitigation at that property to prevent future exposure (NYSDOH 2005). Vapor intrusion exposures at residences C and D (Figure 1) appears less likely, but cannot be excluded based on available evidence (NYSDOH 2005). These houses should be further monitored.

The concentration of PCE in air that the EPA conservatively considers safe for long-term exposure to the most sensitive people (based on their cancer slope factor) is $0.31\mu\text{g}/\text{m}^3$, or 0.05 ppbv. The level of PCE measured in the sump headspace on one occasion was 18.3 ppbv. If this measurement is taken to represent shallow soil gas beneath the building foundation, combined with a vapor migration attenuation factor of 10, then a corresponding indoor air concentration might be 1.8 ppbv. This estimate exceeds the EPA value of 0.05 ppbv, and is therefore higher than DHFS recommends for long-term residential exposure. It must also be noted that the indoor measurements were made when the depth to groundwater was relatively deep, and when PCE in groundwater near residences A and B (MW7, Giles Engineering June 2006 sample) was 200 ppb, rather than 5900 ppb as was measured in October 2005. This suggests that PCE levels within residences A and B may sometimes exceed what has been estimated with currently available information.

Toxicology of tetrachloroethylene and trichloroethylene. PCE and TCE are examples of substances that affect the body by more than one chemical mechanism. High levels of acute exposure directly affect the nervous system. In contrast, low level, long term exposure has no immediate effect. Instead, some of the PCE or TCE molecules, in the course of their metabolism and elimination, are transformed into reactive forms that are harmful. Most of these reactive intermediates are further metabolized to less toxic forms, but a percentage of the reactive molecules damage large cellular molecules, such as proteins or DNA. Although the body is routinely able to repair most of this damage, some level of exposure leads to cell death, tissue damage, or an increased risk of tumor formation. Some whole-body effects reported from exposure to these chemicals include immune suppression, liver damage, and kidney damage. The Agency for Toxic Substances and Disease Registry (ATSDR) lists TCE as a probable human carcinogen with an intermediate minimal risk level (MRL) in air of 100 parts per billion, and an acute MRL of 2000 parts per billion (ATSDR 2003). In contrast, the carcinogenicity of PCE is under review as of August 2006. PCE was formerly an EPA class B2 chemical (Probable Human Carcinogen). In 1990, U.S. EPA withdrew their PCE assessment for further review, although DHFS currently relies on EPA's pre-1990 cancer slope factor when estimating increased human cancer risk due to PCE exposures. The National Toxicological Program has classified PCE as "reasonably anticipated to be a carcinogen" based on sufficient evidence of carcinogenicity in experimental animals (NTP 2005). Similarly, the International Agency for Research on Cancer classified PCE as "Probably Carcinogenic to Humans" (IARC 1995). The acute MRL of this chemical in air is 200 parts per billion (ATSDR 1997). In controlled human and lab animal studies reviewed by ATSDR (1997), PCE caused minor cognitive effects in people exposed for eight hours at somewhere between 10 and 50 parts per million (ppm). Animals that inhaled PCE over periods of days to months displayed a variety of toxic effects to PCE, including respiratory, liver, blood, and cancer effects. These effects were seen at inhaled concentrations ranging from 10 to 500 ppm. Minimal Risk Levels are derived from these studies by ATSDR. ATSDR (1997) "selects the most sensitive endpoint which, in its best judgment, represents the most sensitive human health effect for a given exposure route and duration." The exposures causing these toxic endpoints are then multiplied by one or more uncertainty factors that take into account human and inter-species variability.

Child Health Considerations

The evaluations and recommendations in this health consultation assume that children presently, or will in the future, live at the residences near the Econocare property. Children are often at greater risk than adults to certain kinds of exposure from hazardous chemicals in the environment. Children have a lower body weight, but a higher intake rate which results in a greater dose to hazardous substances per unit body weight. Also, children's bodies are developing and are susceptible to damage if toxic exposures are high enough during critical growth stages. For that reason, DHFS considers children as one of the most sensitive population evaluated in this health consultation, and always takes into account children when evaluating exposures to contaminants. The health-based comparison values for PCE and TCE discussed above are designed to be low enough to protect children living near the Econocare property.

CONCLUSIONS

- PCE detected in the sealed sump headspace of residence B indicates at least a low level of vapor intrusion into indoor air. This is an indeterminate health hazard, as more information is needed to confidently determine the amount of exposure.
- PCE vapor intrusion into residence A was not detected, but cannot be excluded based on groundwater monitoring well data, and is therefore an indeterminate health hazard.
- PCE in groundwater beneath the vacant lot between residences A and B is presently at high enough levels to be a future health hazard via the vapor intrusion route, if residences are placed on the property.
- The vapor intrusion potential at residences C and residence D appear marginal based on current evidence, but more information is needed to conclusively exclude these properties.
- There is no public health hazard from PCE in groundwater beneath park land adjacent to residential areas, as PCE is not at high enough levels to be an inhalation health hazard in outdoor air to people using those areas.

RECOMMENDATIONS

- As part of prudent public health practice, and as a short-term measure, the basement of residence B should be ventilated with open windows to avoid the accumulation of PCE vapors in the home.
- Consider placing soil vapor extraction systems beneath the foundations of Residence A and Residence B. Proper operation of the vapor system may require additional management of groundwater beneath the building foundation.
- Perform additional monitoring of well MW10 to conclusively exclude effects on Residence D and C.

- Consider monitoring or vapor mitigation at Residence A. Proper operation of a vapor system may require additional management of groundwater beneath the building foundation.
- If current impacts to soil and groundwater persist, any future construction on the vacant property between residences A and B should be designed to mitigate organic vapor intrusion.

PUBLIC HEALTH ACTION PLAN

- DHFS will meet with occupants of residences A and B to explain the findings of this health consultation
- DNR will direct the Econocare property owner to perform additional monitoring of residences C and D.

REFERENCES

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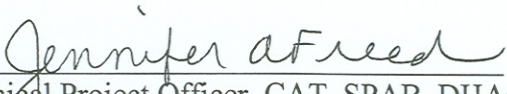
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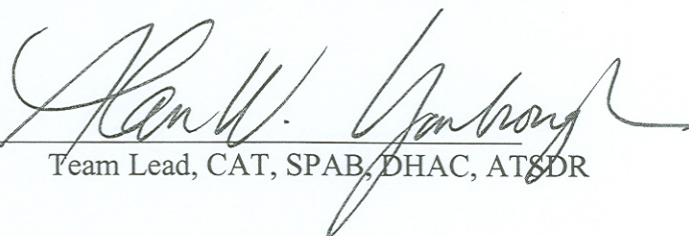
Certification

This health consultation for Econocare Cleaners in Green Bay, WI 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 procedure existing at the time the Health Consultation was begun. Editorial review was completed by the Cooperative Agreement partner.



Technical Project Officer, CAT, SPAB, DHAC

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



Team Lead, CAT, SPAB, DHAC, ATSDR

Figure 1. Aerial view of neighborhood surrounding the former Econocare cleaners, 719 S. Fisk Street, Green Bay, Wisconsin.

