

Health Consultation

FORMER JOHNSON PROPERTY
VAPOR INTRUSION

MILWAUKEE, MILWAUKEE 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

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

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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Prepared by:

Wisconsin Department of Health and Family Services
Bureau of Environmental Health
Under a Cooperative Agreement with
The U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Summary

In May of 2005, Department of Health and Family Services (DHFS) was requested by the USEPA Region V office in Chicago to assist in responding to questions and concerns raised by a Milwaukee resident. This resident lives in a home developed on a property with solvent contamination remaining in the soil and groundwater. DHFS had previous involvement with this project in September of 2000 and May of 2001. In order to address resident questions and to test the effectiveness of actions taken to prevent solvent vapors from entering the homes, DHFS collected air and soil vapor samples in May of 2005. The results of those samples indicate that the existing systems are effectively preventing resident exposure to trichloroethylene (TCE). The residual solvent contamination in soil poses *no public health hazard* to residents in either of the two homes. Additional work is needed to characterize the potential for vapor intrusion in other nearby buildings to the south. Until an indoor air investigation is conducted of these homes, this is an *indeterminate public health hazard*.

Background

The property consists of the city block on the south side of the 1600 block of West Galena Street in the City of Milwaukee. The site includes four residential parcels, each on roughly 0.6 acres. All residences in this neighborhood receive their water supply from Lake Michigan via the City of Milwaukee and receive sanitary sewer services from the Milwaukee Metropolitan Sewerage District. This neighborhood has been primarily residential with small commercial properties intermingled with residential properties. In 1894 this block was residential. In 1910 the block was residential with a fur tannery (S. Nelson & Co. Fur Tanners) on the eastern part of the block. In 1951 the block was residential with a gasoline filling station at the northeast corner and an auto repairing and painting business where the tannery had been (Giles, 2003).

In 2000, the Redevelopment Authority of the City of Milwaukee was working with a developer to construct four residential homes on the south side of the 1600 block of West Galena (referred to as "the property"), when a 550-gallon underground storage tank was discovered on the eastern portion of the property. Following this discovery, the Redevelopment Authority began conducting soil and groundwater investigations on the property. By the time soil and groundwater results were available the base building foundations had already been constructed. Laboratory results identified significant soil and groundwater chlorinated solvent contamination on the eastern portion of the site, potentially beneath two of the foundations. The underground storage tank was not the source of chlorinated solvent contamination found in this area. In September of 2000, the Redevelopment Authority contacted DHFS for technical advice regarding the potential for vapor intrusion. With TCE concentrations in soil as high as 14,500 micrograms per kilogram ($\mu\text{g}/\text{kg}$) and groundwater concentrations as high as 12,000 micrograms per liter ($\mu\text{g}/\text{L}$), DHFS staff recommended against attempting to use a model to rule out the vapor intrusion pathway. Instead DHFS recommended removing as much of the source material in soil as possible and building sub-slab depressurization systems (mitigation system) into the construction of the buildings. From October 12th to November 2nd, 2000, approximately 3,000 tons of TCE impacted soils were removed from the site, including the areas where the highest levels of TCE had been identified (Giles, 2003). A hydrogen

release compound was added to the excavation to encourage further breakdown of residual TCE in the remaining soils and groundwater. A plastic cutoff wall was placed in the south side of the excavation to prevent any remaining residual contamination left in the alley from moving back onto these properties. Because of the aggressive soil removal work, the Redevelopment Authority chose to wait and conduct indoor air monitoring once construction of the homes was complete instead of installing mitigation systems at that time.

On April 20th, 2001, the consultant for the Redevelopment Authority collected a type of air sample in which a container of methanol is opened to the air in the basement and later analyzed for volatile organic compounds (VOCs). TCE and cis 1,2-dichloroethylene were detected in that sample. The method did not enable quantification of indoor air concentrations. The Redevelopment Authority contacted DHFS with the results of this test and asked if additional testing would be recommended. At that time DHFS indicated that these results might be sufficient to confirm the presence of a migration pathway into the home. DHFS recommended mitigation systems be added in the homes as an action to prevent a potential for vapor intrusion, rather than conducting the extensive air monitoring during multiple seasons that would be needed to assure residents that vapor intrusion was not a concern. The Redevelopment Authority hired a radon mitigation contractor to install the mitigation system in the two homes on the eastern half of the block in June of 2001.

Each of the four homes on this block is similarly constructed, two-story buildings with poured basements and attached garages on the alley side of the buildings.

In May of 2005, a resident of one of the two homes that had mitigation systems raised concerns about the apparent lack of progress with the case. Based on the resident's concerns and a request from the Redevelopment Authority, DHFS decided to conduct indoor air testing of these homes. On May 12th, 2005 DHFS and the City of Milwaukee Health Department staff jointly inspected the systems and collected air samples at the two homes with mitigation systems on the eastern half of the block. While at the homes DHFS also provided each homeowner with a radon test kit and recommended that each resident use the kit to check their indoor air radon level.

The manometers for each mitigation system confirmed that they were effectively depressurizing the sub-slab of the building. Each resident indicated that the systems have been in constant operation since their installation. The only exceptions were during storm related power outages for short periods.

DHFS collected a total of four air samples from the two homes. A grab sample was taken from inside the vent stack of the mitigation system at one of the homes on W. Galena Street. This sample was collected from below the fan by installing a sample port into the stack of the piping, and was intended to represent sub-slab vapor concentrations. The sample port was capped but left in place so that follow-up samples could be collected if necessary. Indoor air samples were collected from the basement of each of the homes over a 24 hour period. An outdoor air sample was also collected over an approximate 24

hour period next to one of the homes on W. Galena Street. The results of those samples are summarized in Table 1 and the complete results are at the end of this report.

The results of the radon test conducted at one of the homes on Galena Street were reported by the homeowner as 3 pCi/L (pico Curies per Liter).

Table 1
VOC Air Monitoring Summary, May 12-13, 2005

VOC	Sub-Slab Home 1	Indoor Home 1	Indoor Home 2	Outdoor Home 1	Comparison Values
Benzene	9.31	2.458	1.427	0.094	0.03c
1,3-Butadiene	ND	0.254	ND	0.133	0.014c
Chloroform	ND	0.119	0.256	ND	0.008c
Chloromethane	3.153	ND	ND	0.368	50n
1,4-Dichlorobenzene	ND	0.238	0.131	ND	20n
Ethylbenzene	2.961	1.004	0.284	0.039	1000n
Isopropylbenzene	0.073	0.184	0.028	ND	81n
Methylene chloride	0.323	0.328	ND	0.048	0.86c
n-Octane	0.873	0.42	0.198	ND	NA
Propene	0.098	0.419	0.846	0.326	NA
Styrene	0.33	0.787	0.705	ND	60n
Tetrachloroethylene	ND	0.077	ND	ND	0.1c
Toluene	47.147	16.788	5.431	0.475	80n
Trichloroethylene	19.736	ND	ND	ND	0.1c
m/p-Xylene	11.207	3.458	0.944	0.016	100n
o-Xylene	3.398	1.013	0.349	ND	100n

All units in parts per billion by volume (ppbv).

c – based on potential lifetime cancer risk

n – based on potential for non-cancer health effects

Bolded values exceed the respective comparison values.

The consultant representing the City of Milwaukee provided DHFS with a map containing updated groundwater monitoring results. The summarized results indicate that VOC concentrations in groundwater have decreased or remained low in wells to the north of the cutoff wall. While in the two wells in the alley south of the cutoff wall concentrations went from 0.55 and 2.0 ug/L in September of 2000 to 321 and 945 ug/L in April of 2005 respectively.

Discussion

The air sample from the vent stack of the mitigation system at one of the homes on W. Galena Street contains a detectable level of TCE. This detection indicates that there is still a source of TCE in soil or groundwater contributing to soil vapor. TCE has been identified as the primary contaminant of concern from past and recent groundwater monitoring near the homes. Because the system was operating at the time the sample was collected, DHFS does not believe this result is indicative of area soil vapor concentrations. It is likely that the system is drawing air from within the home and from outdoor air in addition to soil vapor. This would in effect dilute the soil vapor level at the point where the sample was collected. More importantly, neither indoor air result

contained detectable levels of TCE indicating that soil vapor does not appear to be moving into the homes. Several petroleum related VOCs, including styrene, propene, and chloromethane, were also found in this sample. The northeast corner of the block has had a history of petroleum contamination. However, groundwater test results from these properties have not shown detections of petroleum VOCs since February of 2001. It is possible that some residual petroleum contamination remains in soils above the water table on the property. Though DHFS believes the mitigation system is also drawing air from beneath the garage floor and potentially from the air in the garage itself. Other than the petroleum VOCs, the remaining detected chemicals are found in greater concentrations in the indoor air samples, compared to either the mitigation system or the outdoor sample. This indicates that indoor air is being drawn from the home into the subsurface by the system.

The indoor air samples from both homes contain benzene and chloroform above their respective comparison values. DHFS uses comparison values to identify those chemicals that should be evaluated more closely. Chemicals found below their comparison values are unlikely to be of public health significance. The City of Milwaukee has a chlorinated surface water supply system. One byproduct of chlorine disinfection of these systems is the formation of chloroform. Chloroform enters the air as it evaporates from water during showering and other household water uses. Chloroform was not found in soil vapor as measured in the mitigation system vent stack sample. The benzene level found in each home was at a higher level than outdoor air. DHFS believes that homes with attached garages are likely to have higher levels of benzene and other petroleum VOCs than homes without attached garages. The benzene detected in soil vapor may be from small incidental spills from garage sources or air drawn into the mitigation system from the garage air. The sampling conducted did not indicate the specific benzene source (DNR, 1997).

One weakness of the air sampling conducted by DHFS in May of 2005, was that no samples of indoor air in the garages were collected to address this potential source. In addition to the chemicals included in the summary table, the laboratory tentatively identified several other VOCs in the indoor air samples. These chemicals included several additional petroleum VOCs, and chemicals commonly associated with household cleaners and air fresheners such as alcohols, pinene, and limonene.

In Wisconsin, the vapor intrusion pathway is most likely to be completed in the winter months of the year due to the rise of air in heated buildings during cold weather. For this reason, DHFS plans to collect another round of samples during the upcoming winter (DHFS, 2003).

The resident at "Home 1" reported that the result of their radon test was 3 pico Curries per Liter (pCi/L). Though lower than the 4 pCi/L advisory threshold set by EPA, it is not as low as DHFS would like to see or expect in a home with a properly functioning mitigation system (also known as radon mitigation systems). Because the test kits provided to the homeowners were for short term testing, their accuracy is not very high. DHFS will provided a longer term (>90 day) kit to the homeowner to collect a more

accurate sample. The conditions that can influence vapor intrusion into buildings changes from day to day, but particularly from one season to the next in Wisconsin. During winter months the stack effect created by rising warm air in a home increases the potential for vapor intrusion from that of warm weather months. The samples collected in May are not necessarily predictive throughout the year. For this reason DHFS plans to collect another round of samples during the winter months to ensure that the mitigation systems continue to be effective throughout the year.

Groundwater monitoring results indicate that TCE remains the primary contaminant of concern on the property. The increase in TCE concentrations in groundwater beneath the alley south of these homes warrants additional investigation of the degree and extent of contamination to the south. There are additional residential buildings to the south and an additional investigation should be conducted to assess the potential for vapor intrusion impact to those buildings. Until an indoor air investigation is conducted of these homes, this is an *indeterminate public health hazard*. Upon the initial review of the updated results, DHFS and the City of Milwaukee came to this conclusion jointly. The City of Milwaukee began investigating soils and groundwater south of the alley in June of 2005 and will continue to work with the Wisconsin Department of Natural Resources to investigate this potential exposure pathway.

Health Implications

TCE was not detected in the indoor air of either home, and residents are not exposed to this chemical and this poses *no public health hazard*. Residents have asked about the possible health effects associated with TCE exposure should the systems be turned off or fail to function in the future. Based on the single measurement of TCE in the stack of the vent pipe, many years of continual exposure may result in a low increased risk of developing some forms of cancer. Non-cancer health effects are not expected from short or long-term exposures to TCE at this level (ATSDR, 1997c).

The benzene levels in each home are elevated above benzene from outdoor air, but may be normal for homes with attached garages (Morris, 2004). This level of benzene exposure is unlikely to pose a significant increased cancer risk to residents. However, to the extent that this exposure may be unnecessary, steps should be taken to minimize the sources coming from the garage (ATSDR, 1997a).

The testing conducted of indoor air in each home found several VOCs likely related to the use of common household products. DHFS did not specifically identify any of these chemicals as a health concern. DHFS recommends that residents avoid overuse of scented household cleaners and air fresheners in order to reduce the overall level of VOC exposure.

The chloroform levels are in the normal range for homes with a chlorinated surface water supply (ATSDR, 1997b). Exposure to chloroform at these levels is not likely to cause adverse health effects.

Indoor air radon is a source of ionizing radiation that has been found to cause an increased risk of lung cancer. The radon in homes comes from the natural soil and rock around a home's foundation rather than from environmental contamination. The level of radon found in the air of one of the homes on W. Galena (3 pCi/L) is below the threshold set by the U.S. EPA (4pCi/L) for recommending steps for radon reduction. However, there may still be some additional health benefit in making adjustments to the existing mitigation system. These adjustments may also improve the energy efficiency of the system.

Child Health Considerations

Due to their breathing rates and lower body weight, children are generally more highly exposed to air pollutants than the adult population (EPA, 2002). Childhood exposures to the contaminants of concern for indoor air at this site would result in similar levels of increased health risk as discussed in the previous section. However, children are less able to indicate when they are uncomfortable from or experiencing symptoms from chemical exposures. There was concern for the health of a child in one of the homes that led to the concern expressed by the resident in May of 2005. DHFS discussed these concerns and the potential for increased sensitivity of children before samples were collected. When sample results did not indicate a vapor intrusion related exposure, discussion focused on reducing unnecessary exposure to VOCs in the home from other sources.

Conclusions

Air samples collected by DHFS and groundwater monitoring conducted by the City of Milwaukee indicates that low-level TCE continues to be present in groundwater beneath the two homes and is also found in soil vapor, but it is not moving to indoor air. With the mitigation systems in operation, the remaining TCE in soil and groundwater poses *no public health hazard* in either home. Indoor air sample results indicate VOC contributions likely to be from household products and attached garages in both homes. The chloroform levels are in the normal range for homes with a chlorinated surface water supply. Exposure to chloroform at these levels is not likely to cause adverse health effects.

DHFS review of current groundwater monitoring data indicates that the potential for vapor intrusion impacts to indoor air of residents south of the alley cannot be ruled out. Until additional investigation is done to better characterize this potential indoor air exposure pathway in these homes, DHFS considers this *an indeterminate public health hazard*.

Recommendations

- DHFS recommends the collection of another round of air samples to confirm our conclusions during the winter months, when conditions are more conducive to soil vapor entry into homes.
- DHFS recommends that additional investigation south of the alley focus on the potential for vapor intrusion in nearby residential buildings.

Public Health Action Plan

- DHFS will work with the Department of Natural Resources and the City of Milwaukee to inform residents of progress and results of additional investigation.
- DHFS will work with the Department of Natural Resources and the City of Milwaukee to evaluate the vapor intrusion pathway to the south of the alley.
- DHFS will provide long-term radon test kits to residents in order to provide more accurate measurement of current radon levels. Based on the results of these samples, DHFS will work with residents as appropriate to improve the effectiveness of their mitigation systems.

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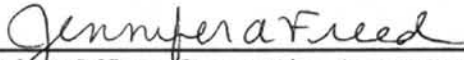
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CERTIFICATION

This health consultation, **Former Johnson Property Vapor Intrusion**, 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). The health consultation is in accordance with ATSDR-approved methodology and procedures existing when the health consultation was begun. Editorial Review was completed by the Cooperative Agreement partner.



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



Team Leader, Cooperative Agreement Team, SPAB, DHAC, ATSDR