

# Letter Health Consultation

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Vapor Intrusion Investigation

SPORLAN VALVE SITE

WASHINGTON, MISSOURI

**Prepared by**  
**Missouri Department of Health and Senior Services**

JUNE 6, 2016

Prepared under a Cooperative Agreement with the  
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Agency for Toxic Substances and Disease Registry  
Division of Community Health Investigations  
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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LETTER HEALTH CONSULTATION

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May 27, 2016

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Missouri Department of Natural Resources  
P.O. Box 176  
Jefferson City, MO 65102-0176

Re: Letter Health Consultation, Sporlan Valve site – Vapor Intrusion Investigation

Dear Ms. Wilder:

The Missouri Department of Health and Senior Services (DHSS), in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), has developed this health consultation to document evaluation of the results of the July 2015 vapor intrusion sampling conducted by the Missouri Department of Natural Resources (DNR) at 12 residences near the former Sporlan Valve factory property in Washington, Missouri. Specifically, DHSS has evaluated the health risks of inhalation exposure to trichloroethylene (TCE), dichloroethylene (DCE), and vinyl chloride (VC), which have been found in groundwater at the site and could accumulate in indoor air in residences by the vapor intrusion pathway.

DHSS concludes that TCE vapor intrusion poses a public health hazard at some residences near the factory property. DHSS recommends prompt mitigation action at residences 153 and 176, where TCE vapor intrusion presents a completed pathway and where short-term health effects are of potential health concern. In addition, DHSS recommends prompt investigation and/or mitigation action at residence 193, where TCE vapor intrusion presents a potential pathway and short-term health effects are of potential concern. DHSS recommends additional site-wide sampling to better understand the extent of contaminant migration at the site and potential seasonal variations in vapor intrusion.

### **Basis for Decision**

To determine the potential for vapor intrusion and health risks to residents near the Sporlan Valve factory, DHSS compared the July 2015 sampling results to chemical-specific, health-based screening levels developed by ATSDR and EPA for cancer and noncancer effects [ATSDR's minimal risk levels (MRLs), EPA's reference concentrations (RfCs), and ATSDR's cancer risk evaluation guides (CREGs)].

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DHSS evaluated indoor air, crawl space air, and subslab soil gas sampling results. Indoor air and crawl space air contaminant results were compared directly to indoor air screening levels. Subslab soil gas screening levels were derived from indoor air screening levels<sup>1</sup>, using EPA's recommended subslab soil gas vapor intrusion attenuation factor (AF) [EPA 2015].

As shown in Table 1, TCE and VC concentrations in indoor air and/or subslab soil gas exceeded screening levels<sup>2</sup> at the following locations:

Residence 153, where the maximum TCE concentration in indoor air exceeded a level of concern for cancer and short-term (noncancer) health effects. Evidence of TCE vapor intrusion at that location includes the concurrent detection of DCE and VC (i.e., groundwater degradation products of TCE) in the indoor air, as well as the previous detection of TCE in subslab soil gas (February 2015) and nearby shallow groundwater (January 2014) that exceeded health-based screening levels. VC in indoor air slightly exceeded ATSDR's cancer screening level.

Residence 176, where the maximum TCE concentration exceeded a level of concern for cancer, and where TCE may potentially accumulate in indoor air to levels of concern for short-term (noncancer) health effects, as TCE concentrations in subslab soil gas exceeded a health-based screening level by an order of magnitude.

Residence 193, where the maximum TCE concentration in indoor air exceeded a level of concern for cancer and short-term (noncancer) health effects. While subslab soil gas samples collected at that location did not provide reliable results, evidence of TCE vapor intrusion at that residence includes the concurrent detection of VC in the indoor air. VC in indoor air slightly exceeded ATSDR's cancer screening level.

Residences 150 and 151, where TCE in indoor air did not exceed screening levels, but where TCE concentrations in subslab soil gas slightly exceeded the cancer screening level.

In summary, DHSS identified the following lines of evidence indicating TCE accumulated in indoor air in some residences by the vapor intrusion pathway:

- At residence 153, TCE and its degradation products (i.e., cis-DCE and VC) were concurrently detected in indoor air. TCE, cis-DCE, and VC are off-site groundwater contaminants.
- At residence 153, DNR was not able to collect subslab soil gas samples. However, in February 2015, subslab soil gas samples contained elevated TCE concentrations (Table 1).
- Shallow groundwater collected within 100 feet of residence 153 has contained elevated TCE concentrations. In January 2014, the groundwater TCE concentration (1,560 µg/L) exceeded

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<sup>1</sup> Subslab soil gas screening level (µg/m<sup>3</sup>) = Indoor air screening level (µg/m<sup>3</sup>) ÷ AF, where AF = 0.03

<sup>2</sup> TCE and VC concentrations in crawl space air did not exceed screening levels. At residences listed, DCE was either below screening levels or was not detected. At residences not listed, TCE, DCE, and VC concentrations were either below screening levels or were not detected.

screening levels<sup>3</sup> [5.25 µg/L (noncancer); 0.6 µg/L (cancer)] by several orders of magnitude [ENVIRON 2014].

- At residence 176, TCE was detected in indoor air and subslab soil gas in concentrations that exceeded screening levels (Table 1).
- At residence 193, TCE and VC were concurrently detected in indoor air (Table 1).

**Table 1. Elevated Concentrations in Residential Indoor Air and Subslab Soil Gas  
 Sporlan Valve Site, 2015<sup>a</sup>**

Locations where Detections Exceeded Health-Based Screening Levels <sup>b</sup>	Maximum Concentration in Indoor Air (µg/m <sup>3</sup> )	Maximum Concentration in Subslab Soil Gas (µg/m <sup>3</sup> )	Health-Based Screening Levels (µg/m <sup>3</sup> )	
			Indoor Air	Subslab Soil Gas <sup>c</sup>
TCE				
150	ND	<b>21</b>	2.1 (noncancer) <sup>d</sup> 0.24 (cancer) <sup>e</sup>	70 (noncancer) 8 (cancer)
151	0.21	<b>12</b>		
153	<b>3.9</b>	<b>120</b>		
176	<b>0.25</b>	<b>820</b>		
193	<b>2.4</b>	ND <sup>f</sup>		
VC				
153	<b>0.47</b>	ND	100 (noncancer) <sup>d</sup> 0.11 (cancer) <sup>e</sup>	3,333 (noncancer) 3.7 (cancer)
193	<b>0.17</b>	ND <sup>f</sup>		

<sup>a</sup>All samples collected by the Missouri Department of Natural Resources in July 2015, except subslab soil gas samples at location 153, which were collected by Environ, Corp. in February 2015; values in **bold** and highlighted exceeded screening levels.

<sup>b</sup>12 residences sampled

<sup>c</sup>Subslab soil gas screening levels derived from indoor air screening levels using a factor of 0.03, EPA's recommended subslab soil gas attenuation factor (AF) [EPA 2015].

<sup>d</sup>ATSDR's intermediate and chronic MRL (TCE); EPA's RfC (VC).

<sup>e</sup>ATSDR's CREGs

<sup>f</sup>ND= not detected; technical difficulties

## Public Health Implications

### Non-Cancer Health Effects

EPA's RfC for inhalation of TCE (2.0 µg/m<sup>3</sup>) is based on studies showing cardiac malformations in rats after approximately three weeks of gestational exposure and immunological effects in mice after 30 weeks of exposure [EPA 2011a]. In their review of those studies, EPA derived TCE concentrations that might be expected to have the same effects in humans. The 99<sup>th</sup> percentile of those human equivalent

<sup>3</sup>Groundwater screening level (µg/L) = Indoor air screening level (µg/m<sup>3</sup>) ÷ AF ÷ Henry's Constant (HC) ÷ Conversion Factor (CF), where AF<sub>groundwater</sub> = 0.001 [EPA 2015], HC<sub>TCE</sub> = 0.4, and CF = 1000 L/m<sup>3</sup>.

concentrations (HECs) are  $21 \mu\text{g}/\text{m}^3$  TCE for short-term exposures potentially associated with cardiac malformations and  $190 \mu\text{g}/\text{m}^3$  TCE for chronic exposures potentially associated with immunological effects [EPA 2011a]. In October 2014, ATSDR published an MRL of  $2.1 \mu\text{g}/\text{m}^3$  for both chronic (more than 365 days) and intermediate (2 weeks to 365 days) inhalation exposure to TCE [ATSDR 2014].

At residences where TCE concentrations in indoor air exceeded noncancer screening levels, the maximum TCE concentrations detected in indoor air ( $2.4 \mu\text{g}/\text{m}^3$  at residence 193;  $3.9 \mu\text{g}/\text{m}^3$  at residence 153) were below the estimated HEC for fetal cardiac malformations ( $21 \mu\text{g}/\text{m}^3$ ). However, they fell within a range of uncertainty applied to the HEC (i.e., from  $2.1 \mu\text{g}/\text{m}^3$  to  $21 \mu\text{g}/\text{m}^3$ ). If rates of TCE vapor intrusion and accumulation increase, indoor air TCE levels could quickly approach or exceed the HEC. Of particular concern are short-term exposures in a pregnant woman resulting in increased risks of fetal cardiac malformations during the first trimester of pregnancy.

At residences where TCE concentrations exceeded screening levels, maximum TCE concentrations in indoor air were also below the concentration associated with adverse kidney effects ( $30 \mu\text{g}/\text{m}^3$ ), which was used to support establishment of the RfC [EPA 2011a]. Maximum TCE concentrations were also far below the HEC for immunological effects ( $190 \mu\text{g}/\text{m}^3$ ) [EPA 2011a]. If TCE concentrations fluctuate, long-term indoor air TCE concentrations could approach or exceed those levels. Potential long-term exposure concerns include adverse effects on the kidneys and immune system in adults and children.

Interpretation of scientific data supporting an association between TCE and cardiac malformations has been controversial. Some animal toxicity and epidemiological studies have reported no significant increases in congenital cardiac malformations following maternal exposure to TCE [Chiu et al. 2012]. However, while there are limitations to the animal study used in developing the RfC, the results of that study are believed to be supported by the general weight of evidence from multiple epidemiological and other studies that TCE exposure in humans may cause a variety of cardiac defects [Chiu et al. 2012].

There is substantial evidence that, at sufficient dose and exposure duration, TCE is toxic to the nervous system, kidney, liver, and male reproductive system and is associated with other developmental effects [ATSDR 2014]. The most sensitive effects of TCE exposure appear to be developmental effects (including fetal cardiac malformations), kidney toxicity, and immunological effects [EPA 2011a]. Immunological studies, including epidemiological studies, indicate that chronic exposure to a sufficient dose of TCE may increase the risk of development of autoimmune diseases and hypersensitivity skin disorder, as well as possible suppression of the immune system [Chiu et al. 2012]. These include inflammatory diseases and scleroderma, a hardening of the skin.

### Cancer Risks

EPA classifies TCE and VC as carcinogenic to humans. The National Toxicology Program (NTP) has determined that TCE is reasonably anticipated to be a human carcinogen based on evidence from animal studies and limited evidence from human studies [NTP 2011]. Long-term TCE exposure is associated with liver and kidney cancers and non-Hodgkins lymphoma by multiple routes, including inhalation exposure [EPA 2011a; ATSDR 2014]. Because kidney cancer may develop by a mutagenic mode of action of TCE, there is increased risk of kidney cancer from exposure to TCE during childhood [EPA

2011a; ATSDR 2014]. VC is associated with liver cancer and possibly brain, nervous system, blood, and lymphatic system cancers by multiple routes of exposure [EPA 2000].

Table 2 shows maximum estimated increased cancer risks determined from the highest concentrations of TCE and VC detected in indoor air. The risk values were calculated using EPA's inhalation unit risk factors and, for TCE, EPA's Age-Dependent Adjustment Factors (ADAFs) to account for increased early-life susceptibility to kidney cancer [EPA 2011a]:

$$\text{Cancer Risk}_{\text{TCE}} = \text{Air Concentration} \times \text{Inhalation Unit Risk Factor (IUR)} \times \text{ADAFs}$$

where,  $\text{IUR} = 4.1 \times 10^{-6} (\mu\text{g} / \text{m}^3)^{-1}$

$$\text{Cancer Risk}_{\text{VC}} = \text{Air Concentration} \times \text{Inhalation Unit Risk Factor (IUR)}$$

where,  $\text{IUR} = 4.4 \times 10^{-6} (\mu\text{g} / \text{m}^3)^{-1}$

**Table 2. Estimated Cancer Risks from Potential Long-Term Exposure to TCE and VC in Residential Indoor Air Sporlan Valve Site, 2015**

	Highest Estimated Cancer Risk Value	Highest Increase in Incidents of Cancer
TCE	$1.9 \times 10^{-5}$	2 cases in 100,000 people
VC	$2.1 \times 10^{-6}$	2 cases in 1,000,000 people

These estimated cancer risk values from lifetime exposure to TCE and VC in the indoor air are very low and fall within EPA's target cancer risk range. The values represent increased cancer risks of, at most, 2 excess cases in a population of 100,000 exposed to the same concentration over a lifetime. The values represent maximum estimated risks from constant inhalation exposures over individuals' lifetimes. They are roughly estimated risk values because exposures have likely not lasted a lifetime and, when exposures have occurred, the amount of exposure has likely varied over time due to changes in the rates of vapor intrusion. Also, exposures are likely intermittent, rather than 24 hours per day/7 days per week. Because long-term exposure levels are not known, DHSS cannot draw definitive conclusions about cancer risks at the Sporlan Valve site.

## Recommendations

To protect the current and future health of individuals living near former Sporlan Valve property, DHSS recommends the following:

- Prompt mitigation action at residences 153 and 176, where TCE vapor intrusion was found to pose potential short-term health risks.
- Prompt investigation and/or mitigation action at residence 193, where TCE vapor intrusion is a potential exposure pathway and may pose short-term health risks.
- Expansion of the residential vapor intrusion sampling in a systematic effort to swiftly determine the extent of TCE vapor migration and intrusion in residences in the neighborhood surrounding the site.



- Sampling of residences in multiple seasons, including the winter season. Vapor intrusion rates can fluctuate with changes in season and use of heating and cooling systems.
- Full characterization of the site to determine the extent of migration of TCE and its degradation products from the source zone and to identify any neighboring commercial and/or residential buildings at risk of vapor intrusion.

To assist the community:

1. DHSS in collaboration with DNR has spoken with residents and provided residents with fact sheets about vapor intrusion and TCE exposure. DHSS is available to answer people's questions about their health and the health of their children as they arise.
2. DHSS is available to review additional sampling data and site information as they become available and, if necessary, provide guidance regarding possible health risks.
3. DHSS is available to provide health education and literature when requested.

We appreciate the opportunity to be of assistance. If you have any questions, please contact Elizabeth Semkiw at (573) 751-6102.

Sincerely,

Jonathan Garoutte, Chief  
Bureau of Environmental Epidemiology

JG:DW:ES:mp

## References

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## **Report Preparation**

This Health Consultation for the Sporlan Valve site was prepared by the Missouri Department of Health and Senior Services under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). Editorial review was completed by the cooperative agreement partner.

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