Letter Health Consultation

SANDSTON PCE SITE

SANDSTON, HENRICO COUNTY, VIRGINIA

Prepared by
Virginia Department of Health

SEPTEMBER 30, 2015

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

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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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LETTER HEALTH CONSULTATION

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Ms. Christine Wagner
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Dear Ms. Wagner,

On March 28, 2014, the Virginia Department of Health (VDH) participated in a conference call with the U.S. Environmental Protection Agency's (EPA) Region 3 On-Scene Coordinator and the Henrico County Health Department regarding the potential public health implications of exposure to trichloroethylene (TCE) and tetrachloroethylene (PCE) through vapor intrusion from contaminated groundwater at the Sandston PCE site in Sandston, Henrico County, Virginia. Individuals potentially impacted at this site are occupants of buildings constructed over the contaminated groundwater. EPA requested that VDH review *the February, June, and July 2014 air sampling results* for new locations associated with the Sandston site *and determine if the detected concentrations of PCE and TCE pose a public health risk*. The dataset includes indoor air samples from a children's daycare center, elementary school, and public library, and crawlspace air samples from eight different residences. Very different results were obtained from the duplicate canisters used for air sampling each time at the public library. To be protective of human health, the highest concentration detected in the public library was evaluated further for the potential to cause harmful effects. VDH concludes that the reviewed indoor and crawlspace air levels of TCE and PCE in the sampled locations are not expected to harm people's health, because the concentrations of TCE and PCE are below health based comparison values and the increased cancer risk from exposure to these chemicals is extremely low. Limitations to these conclusions include: The air sampling results that were provided to VDH are a snapshot of concentrations of these chemicals at a single point in time; VDH is not able to determine seasonal effects on PCE and TCE concentrations in air without samples from the same location during different seasons; and, multiple results were reported as "J" values (approximate concentrations). VDH recommends additional air sampling be conducted during warm and cold seasons for each respective location to confirm harmful effects are not expected if further groundwater investigations in this area show contamination of PCE and TCE.

BACKGROUND AND STATEMENT OF ISSUE

In August 2013, a private contractor performed a Phase I Environmental Site Assessment and Limited Site Investigation in the area near East Williamsburg Road and Garland Avenue in Sandston, VA (see Attachment for site map). The site investigation was performed in preparation for a potential real estate transaction. The investigation report revealed elevated levels of PCE in the groundwater at several borehole locations. This information was forwarded to the Virginia Department of Environmental Quality (DEQ) who requested EPA's assistance to perform further investigations. In January 2014, EPA sampled private water wells in the site area, and at the request of the Henrico County Health District, VDH published a letter health consultation document reviewing these results. The results indicated that VOCs were detected in two of three tested private wells.[1] VDH concluded that exposure to the reported concentrations were not a health hazard for residents using these private wells for household use, and recommended that further groundwater and vapor intrusion sampling be conducted to characterize potential seasonal variation. After subsequent groundwater investigations, EPA determined there was not a pattern of PCE and/or TCE contamination in the groundwater in the site area.[2]

Community Demographics

Sandston, VA is a small town with approximately 7,571 residents. Caucasians represent the majority of the population at 60.6%, followed by African-Americans and Hispanics at 32.9% and 4.7%, respectively. Sandston has a higher percentage of females (54%) compared to the state average of 50.9% (U.S. Census Bureau, 2010).[3]

Environmental Sampling

February 2014

- Crawlspace air samples were collected from six residences on the block extending from Naglee Avenue to Williamsburg Road, east to Garland Avenue, north to Federal Street, and west to Naglee Avenue.
- One indoor air sample was collected at the children's day care center.

June 2014

- One indoor air sample was collected at Sandston Elementary School.
- One indoor air sample was collected at Sandston Public Library.
- Crawlspace air samples were collected from three residences (two properties on Garland Avenue and one property on Federal Street). The crawlspace of one these three residences was also sampled earlier in February 2014.

[1] VDH. Letter Health Consultation, Review of Volatile Organic Compounds Detected in Private Drinking Water Wells in Sandston, Virginia. January 27, 2014.
[2] U.S. EPA, OSC C. Wagner, personal communication, ATSDR Region 3 L. Werner, 9/22/15.
[3] US Census Bureau. 2010. www.census.gov/2010census/

July 2014

- Repeat indoor air sample was collected at the Sandston Public Library.

The February, June, and July 2014 indoor air and crawlspace air samples were collected over a 24-hour period using a summa vacuum canister. Sampling was performed using the EPA Vapor Intrusion guidance[4] and collected samples were sent to an approved EPA laboratory for analyses. The air samples were analyzed in accordance with EPA Method TO-15 for volatile organic compounds (VOCs) such as PCE, TCE, vinyl chloride, cis-1,2-dichloroethene, and trans-1,2-dichloroethene. These compounds and their methods detection limits are shown in Table 1 of the Attachment.

Results

February 2014

- Trichloroethylene (1.4 $\mu g/m^3$) was detected in one residential crawlspace. VOCs in five other residential crawl space samples were either not detected or not quantifiable.
- VOCs were either not detected or not quantifiable in children's day care center.

June 2014

- VOCs were either not detected or not quantifiable at Sandston Elementary School.
- PCE (71.4 $\mu g/m^3$) was detected in one canister at Sandston Public Library and not the other canister.
- VOCs were either not detected or not quantifiable at the three residential properties sampled.

July 2014

- PCE (55.6 $\mu g/m^3$) was detected in one canister at Sandston Public Library and not the other canister.

DISCUSSION

Vapor intrusion (VI) is the pathway of concern for the Sandston site. VI is the migration of contaminant vapors from groundwater, soil, or non-aqueous phase liquid through the subsurface into the indoor air of a building. The vapor intrusion pathway is a challenging pathway to evaluate especially in residential homes; however, to adequately characterize people's exposure to indoor air contaminants from vapor intrusion, when possible, VDH prefers:

- Concurrently collected indoor air, ambient air, and subsurface air (crawlspace or subslab) data;
- Samples should be obtained over and appropriated exposure time, such as 24 hours for residents or 8 hours for workers; and

[4] EPA November 2002. www.epa.gov/osw/hazard/correctiveaction/eis/vapor/complete.pdf

- Sample collection during multiple seasons, including at least one sample in the winter, is recommended to characterize seasonal variability.

For the evaluation of air samples, ATSDR comparison values (CVs) were used. CVs are media-specific concentrations used to identify contaminants that require additional evaluation. They are derived using standard default exposure assumptions and are not site-specific. For contaminants detected below their respective CVs, exposure is not anticipated to result in adverse health effects. It should be noted that contaminants detected at concentrations that exceed their respective CVs, do not necessarily represent a health threat. For inhalation exposure, non-cancer health effects are evaluated with Minimal Risk Levels (MRLs). MRLs are estimates of the daily human exposure to a substance that is likely to be without appreciable risk of adverse health effects during a specified duration of exposure. MRLs are based only on non-carcinogenic effects. Inhalation exposure cancer health effects are evaluated with Cancer Risk Evaluation Guides (CREGs). CREGs are estimated contaminant concentrations that would be expected to cause no more than one additional excess cancer in one million persons exposed over a lifetime.

Non-cancer health effects evaluation

The contaminants of concern in the air samples are TCE and PCE (See Attachment for toxicological discussion of each). The MRL established by the ATSDR for chronic duration inhalation for TCE and PCE are 2 $\mu g/m^3$ and 270 $\mu g/m^3$, respectively. The MRL for PCE is highly conservative given that it assumes breathing 270 $\mu g/m^3$ 24-hours a day, seven days a week for a lifetime which is not occurring at the library. The highest air sample concentration of TCE detected in the crawlspace was 1.4$\mu g/m^3$, while the highest indoor air concentration of PCE detected in the public library was 71.4$\mu g/m^3$. The detected concentrations were below the MRLs for chronic exposure and are not expected to harm people's health.

Cancer risk evaluation

The concentrations exceed the CREG of 0.24 $\mu g/m^3$ and 3.8 for TCE and PCE, respectively. Since TCE and PCE detected in air samples exceeded the CREG value, the cancer risk was calculated using standard exposure assumptions for exposure. Estimates of cancer risk are expressed as a proportion of the population that may be affected by a carcinogen during a lifetime of exposure. For example, an estimated risk of 1×10^{-6} predicts the probability of one additional cancer, in a population of 1 million. Additional cancer risk for TCE was estimated using the equation below:

$$\text{Cancer risk} = C_{air} \times IUR$$

where,

C_{air} = contaminant concentration in air ($\mu g/m^3$)

IUR = EPA's Inhalation Unit Risk [chemical specific $(\mu g/m^3)^{-1}$]

The Inhalation Unit Risk (IUR) for TCE is modified with age-dependent adjustment factors (ADAFs), as necessary, to account for early life exposures to compounds with a mutagenic mode of action.[5] Using the spreadsheet provided on EPA's IRIS summary for TCE (modified to account for a 78-year lifetime exposure) a 78-year exposure, beginning at birth, to 1.4 $\mu g/m^3$ of TCE would result in an increased cancer risk of about 0.0000066 or about 7 excess cancers in out of one million people exposed.

This estimate assumes that the concentration of TCE in the crawlspace is the same as in the home and that the person is continuously exposed to 1.4 $\mu g/m^3$ of TCE. The estimate of cancer risk calculated above is considered extremely low.

The highest concentration of PCE (71.4 $\mu g/m^3$) detected in the two sampling events at the public library was used in the calculation below. Since exposure to PCE in air at the public library was assumed not to be continuous, it was adjusted by applying an exposure duration (ED), averaging time (AT), and exposure factor (EF) to the cancer risk equation:

$$\text{Cancer risk (PCE)} = (C_{air} \times ED/AT) \times IUR \times EF$$

where,

ED = exposure duration (30 years)

AT = averaging time for carcinogenic effects (78 years)

EF = exposure factor (8hr/day x 5days/week x 50weeks/year) / (24hr/day x 7days/week x 52weeks/year) = 0.228

Cancer risk (PCE) = (71.4 $\mu g/m^3$ x 30 years / 78 years) x $(2.6 \times 10^{-7} \mu g/m^3)^{-1}$ x 0.228 = 0.0000016 or less than 2 in a million.

This estimate assumes that a person is exposed to 71.4 $\mu g/m^3$ (the highest concentration detected) of PCE at the public library for eight hours a day, five days a week, and 50 weeks a year, over the course of 30 years. The estimate of cancer risk calculated above is considered extremely low.

CONCLUSIONS

VDH concludes that the concentration of TCE in the crawlspace at one home in February is not at levels expected to harm people's health because its concentrations in air is less than its non-cancer comparison values, and the estimated increased cancer risk from exposure to TCE is extremely low.

VDH concludes that the highest concentration of PCE detected in the public library in June and July is not at levels expected to harm people's health because the concentration in air is less than

[5] U.S. Environmental Protection Agency. IRIS Summary for Trichloroethylene. http://www.epa.gov/iris/subst/0199.htm

the non-cancer comparison values, and the estimated increased cancer risk from exposure to PCE is extremely low.

VDH concludes that there is insufficient data to determine if a future health risk exists because sampling at this site was performed at all but one location during only one season and volatile organic compounds concentration in indoor air may vary seasonally.

RECOMMENDATIONS

If any further groundwater investigations show contamination of PCE and TCE, VDH recommends collecting air samples during different seasons from the same locations (sampled residences, elementary school, and public library) to characterize seasonal variability in VOC concentrations to confirm that harmful effects are not expected.

I trust that the above information will be of help to you. Should you have any additional questions or sampling results to be considered please contact Dwight Flammia by phone at (804) 864-8127 or by email: dwight.flammia@vdh.virginia.gov.

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ATTACHMENTS

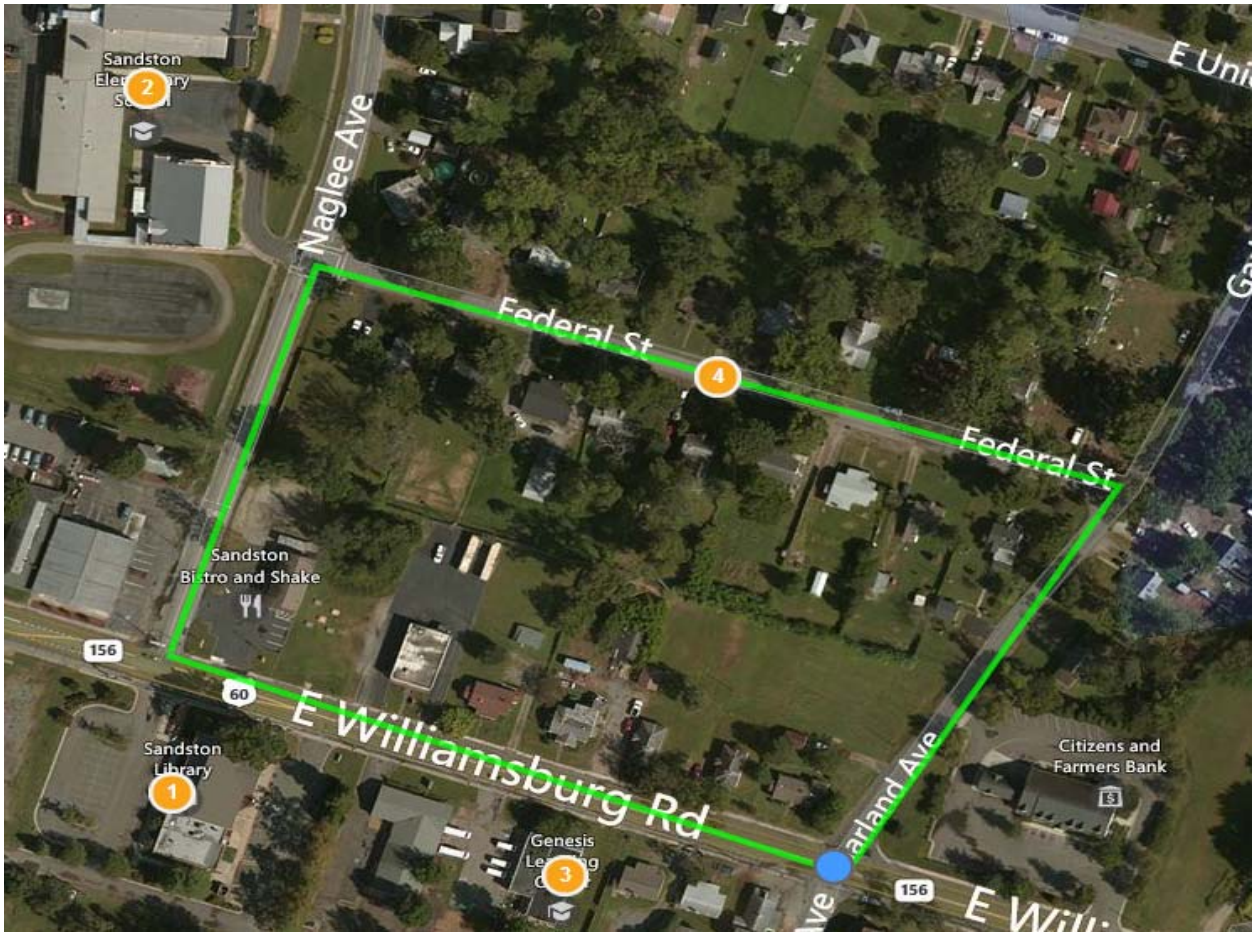

Figure 1. Area map of Sandston site. The green rectangle (4) indicates the approximate area where groundwater plume was first identified. 1=Sandston Public Library, 2=Sandston Elementary School, 3=Genesis Learning Center. (*Source:* Bing Maps, 2014)

Table 1. Volatile organic compounds analyzed and methods detection limits (µg/m^3).

Volatile Organic Compound	Method Detection Limit
1,1-Dichloroethane	0.15
1,1-Dichloroethene	0.095
1,2-Dichloroethane	0.069
cis-1,2-Dichloroethene	0.15
trans-1,2-Dichloroethene	0.11
Tetrachloroethylene (PCE)	0.11
1,1,1-Trichloroethane	0.11
Trichloroethylene (TCE)	0.13
Vinyl Chloride	0.097

Trichloroethylene

Trichloroethylene (TCE) is a chlorinated hydrocarbon mainly used in industries for degreasing metal parts.[6] As a solvent, it is used for removing greases, oils, fats, waxes, and tars. It is also used in the production of adhesives, paint removers, typewriter correction fluids, rug-cleaning fluids, and spot removers.[4] TCE has become an environmental contaminant of concern because of its increased uses in anthropogenic activities. It's industrial usage and disposal is its main route of entering the environment.

TCE is ubiquitous; it is commonly present in ambient air, surface water, and ground water. High levels of TCE have been detected in industrial areas, homes undergoing renovation, and in homes with private wells located close to TCE disposal or contamination sites. TCE is slightly soluble in water and it can remain in ground water for a long period of time. In sand and gravel aquifers, TCE vaporizes rapidly into the air spaces between adjacent soil grains where it is either reabsorbed in ground water or it diffuses into the atmosphere.

The EPA has stated that TCE is "carcinogenic to humans" by all routes of exposure.[7] This conclusion was based on substantial evidence, which associates TCE exposure and kidney cancer in humans. In addition, strong epidemiologic evidence has also linked TCE to non-Hodgkin lymphoma and liver cancer.[8] Studies of pregnant women exposed to TCE-contaminated drinking water have suggested an association between TCE exposure, and cardiac defects, oral clefts, neural tube defects, and choanal atresia.[9] Animal studies have shown that exposure to trichloroethylene can induce cancer of the kidney, liver, lung, testis, and lymph nodes.[10] Furthermore, research in chick embryos revealed consistent effects on cardiogenesis (septal and valvular alterations) when exposed to TCE during critical stages of heart development.[11] The International Agency for Research on Cancer has classifies TCE as carcinogenic to humans,[12] and the National Toxicology Program classifies it as a compound that is "reasonably anticipated" to be a human carcinogen.

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[6] ATSDR Public Health Statement for Trichloroethylene. www.atsdr.cdc.gov/phs/phs.asp?id=171&tid=30

[7] EPA (U.S. Environmental Protection Agency). 2011. Toxicological Review of Tricloroethylene. http://www.epa.gov/iris/toxreviews/0199tr/0199tr.pdf

[8] NTP (National Toxicology Program). 2011. Report on Carcinogens, Twelfth Edition; U.S. DHHS, Public Health Service,.

[9] Bove FJ, Fulcomer MC, Klotz JB, Esmart J, Dufficy EM, Savrin JE., 1995. Public drinking water contamination and birth outcomes. Am J Epidemiol. 141(9):850-62.

[10] Lavin AL, Jacobson CF, DeSesso JM. 2000. An assessment of the carcinogenic potential of trichloroethylene in humans. Hum Ecol Risk Assess. 6:575–641.

[11] Rufer ES, Hacker TA, Flentke GR, Drake VJ, Brody MJ, Lough J, Smith SM. 2010. Altered cardiac function and ventricular septal defect in avian embryos exposed to low-dose trichloroethylene. Toxicol Sci. 113(2):444-52.

[12] International Agency for Research on Cancer. Agents Classified by the *IARC Monographs*, 2014 Volumes 1–10 http://monographs.iarc.fr/ENG/Classification/ClassificationsAlphaOrder.pdf

Tetrachloroethylene

Tetrachloroethylene (PCE) is an important occupational chemical used in metal degreasing and dry cleaning. PCE is one of the most frequently detected solvents in groundwater[13] and at Superfund sites.[14]

PCE is a recognized human and animal neurotoxicant; it readily crosses both the placental and blood brain barriers.[15] Research has indicated that exposure to low level PCE can induce adverse neurological effects such as decreases in attention, cognitive function, and memory.[16] Results from studies of animals exposed to high PCE concentrations indicate that tetrachloroethylene can cause liver and kidney damage as well as liver and kidney cancers. Although it has not been shown to cause cancer in humans, the U.S. Department of Health and Human Services has determined that tetrachloroethylene may reasonably be anticipated to be a human carcinogen. The International Agency for Research on Cancer (IARC) has also determined that tetrachloroethylene is probably carcinogenic to humans.[17]

[13] Moran MJ, Zogorski JS, Squillace PJ. 2007. Chlorinated solvents in groundwater of the United States. Environ Sci Technol.41:74–81.
[14] EPA (U.S. Environmental Protection Agency). 2012. Toxicological Review of Tetrachloroethylene (Perchloroethylene). http://www.epa.gov/iris/toxreviews/0106tr.pdf
[15] Klaassen CD. 2001. Casarett and Doull's Toxicology: The basic science of poisons. New York: McGraw-Hill. Medical Publishing Division.
[16] Schreiber JS, Hudnell HK, Geller AM, House DE, Aldous KM, Force MS, et al. 2002. Apartment residents' and day care workers' exposures to tetrachloroethylene and deficits in visual contrast sensitivity. Environ Health Perspect. 110:655–664.
[17] ATSDR 1997. Public Health Statement for Tetrachloroethylene (PERC) http://www.atsdr.cdc.gov/phs/phs.asp?id=263&tid=48

Greetings,

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Completing the survey should take less than 5 minutes of your time. If possible, please provide your responses within the next two weeks. All information that you provide will remain confidential.

The responses to the survey will help ATSDR determine if we are providing useful and meaningful information to you. ATSDR greatly appreciates your assistance as it is vital to our ability to provide optimal public health information.

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