Health Consultation

Public Health Implications of Contaminated Groundwater

BOULEVARD CLEANERS
HAMPTON, VIRGINIA

EPA FACILITY ID: VAN000306668

Prepared by
Virginia Department of Health

OCTOBER 29, 2012

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

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners 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 or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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SUMMARY

Introduction	The U.S. Environmental Protection Agency (EPA) requested that the Virginia Department of Health (VDH) evaluate whether the levels of dry cleaning solvents in soil, air, and groundwater at the former Boulevard Cleaners site in Hampton, Virginia poses a health risk. The City of Hampton is interested in redeveloping the property and conducted a site assessment. The site assessment revealed the presence of dry cleaning solvents in soil and groundwater as well as containers of chemicals on the property. The City of Hampton then requested that the EPA further evaluate the site. EPA detected the presence of contaminants including tetrachloroethylene, trichloroethylene, and vinyl chloride in the soil onsite and in the groundwater both on and off site. EPA sampled the indoor air in a home nearby to determine if contaminants had migrated from the groundwater into the home. Remediation activities to date have included removing the contaminated soil from the property, and removing the former dry cleaning building.
Conclusion	VDH concludes that the volatile organic compounds in soil will not harm people's health.
Basis for Conclusion	The contaminated soil has been replaced with uncontaminated soil and additional sampling indicated that the level of contaminants were below levels of health concern.
Conclusion	VDH concludes that the volatile organic compounds in groundwater will not harm people's health.
Basis for Conclusion	Nearby homes and businesses use municipal water.
Conclusion	VDH concludes that the potential for vapor intrusion exists for any building constructed on site and for homes and buildings in the direction of the contaminated groundwater plume, but not enough information is known at this time to make a health conclusion.
Basis for Conclusion	The concentrations of volatile organic compounds in groundwater on site are high enough to be a concern. Hypothetical volatile organic compound air concentrations calculated using attenuation factors and Henry's Law Constant support this conclusion. *Actual indoor air concentrations are necessary to make a health conclusion.*
Conclusion	VDH concludes that the volatile organic compounds detected in the indoor air at one home adjacent to the site were not at levels expected to harm people's health.
Basis for Conclusion	No contaminants were present in the indoor air of the home above their respective health comparison values.
Next Steps	Contaminants in the groundwater continue to present a problem on and off site and should be monitored annually until their levels have decreased either naturally or by treatment. Any building constructed on site must have a designed and engineered vapor mitigation system that includes a vapor barrier and active vapor extraction system.

BACKGROUND

Site Description and History

The former Boulevard Cleaners site is located in a residential neighborhood at 2519 Kecoughtan Road, Hampton, Virginia, 23661. Boulevard Cleaners operated as a dry cleaning business from 1941 to 2000. From 2000 to May 2009, the front portion of the facility served as a dry cleaning drop-off and pick-up location. Various dry cleaning solvents, including tetrachloroethylene (PCE) and trichloroethylene (TCE), were routinely used by the dry cleaning business. The City of Hampton conducted Phase I (review of documents regarding past history of the site and a detailed visit to the site) and Phase II (sampling and testing of soil, groundwater and air) studies. The Phase I investigation revealed improperly stored containers and drums on the property. Volatile organic compounds (VOCs), including PCE, TCE, and vinyl chloride (VC) were detected in the soil during Phase II. In July 2009, the City of Hampton requested that the U.S. Environmental Protection Agency (EPA) help determine the extent of environmental contamination on the property and in the surrounding area. The City of Hampton plans to purchase the land and build a fire station on site (EPA 2009). The Boulevard Cleaners building was demolished in the fall of 2011, with EPA Region III staff overseeing the demolishing, removal, monitoring, and clean-up activities (EPA 2011a).

EPA conducted an environmental assessment at the former dry cleaning property and in the surrounding area. EPA performed an inventory of containers and drums that remained on the property, collected sediment samples along the inside drainage of the building, and collected soils along the outside of the building. In the surrounding neighborhood, EPA investigated the extent to which TCE, PCE, and VC contamination exists in the air, shallow groundwater, and subsurface soils (EPA 2010). VDH was asked to evaluate the environmental data to determine if the chemical contamination posed a public health risk to nearby residents and future employees or patrons of the redeveloped property.

Land Use and Demographics

The Boulevard Cleaners site is located on 2519 Kecoughtan Road in a residential neighborhood with an approximate population density equal to 2,968 people per square mile (Figure 1). The site is located in the southeast corner of a residential city block at the intersection of Kecoughtan Road and Powhatan Parkway with adjacent commercial properties to the west along Kecoughtan Road. On the same city block is a hair salon to the west. West of the hair salon is a grass field where a gas station formerly operated. Eight residences are located on the northern half of this city block.

Figure 1: Map of Boulevard Cleaners Site and Surrounding City Blocks

On the adjacent city block to the east along Kecoughtan Road, there are several businesses and places of interest (traveling west to east): a convenience store that provides gasoline, a termite office, a laundry cleaner, a local hardware store, and a church. Also on this city block are nine residences, including one with a below-ground swimming pool. There are approximately 30 homes and less than five small apartment buildings on the city blocks to the south and southeast. On the city block to the west there is a bank, a dollar store, a restaurant, and several residences.

All of the businesses and residences near the site obtain their drinking water from a public waterworks. There are no records of irrigation wells near the site (L. Casillas, personal communication, April 2012). There are no schools, landfills, or public parks identified near the site. The Indian River is less than three blocks away (~260 yards) to the east, and it empties into the confluence of the James River and the Chesapeake Bay. See Appendix A for additional maps.

The Boulevard Cleaners building was demolished in September 2011, and the site is currently vacant. The site is surrounded by a locked eight foot high chain link fence with signs reading "Danger Keep Out" and information signs posted by EPA that describe the ongoing remediation activity at the site. Currently, there are a few fully grown trees, the remains of a concrete parking lot, and the rest of the site is covered with soil. The City of Hampton has expressed interest in buying the former Boulevard Cleaners property to construct a fire station after remediation is complete.

The community consists of 50% African Americans and 43% Caucasians. Less than six percent of the population is under the age of 5 years and approximately twelve percent of the population is over 65 years of age (U.S. Census 2010).

Environmental Activities Timeline

March - May 2009, the City of Hampton conducted Phase I and Phase II studies:

- Phase I study identified improperly stored containers and drums with some containing unknown materials; a potential fill port for an underground storage tank; stains on the floor.
- Phase II study detected TCE, PCE, and VC in the soil.

In *July 2009,* the City of Hampton met with EPA; City of Hampton expressed interest and concern over redeveloping the site and EPA agreed to investigate potential contamination.

In *August 2009*, the property owner granted access for EPA to conduct an assessment of the property.

In *September - October 2009*, EPA began to assess the potential extent of groundwater contamination migrating off site. They began sampling soil and shallow groundwater for VOCs. EPA inventoried containers within the building and found paints and chemicals. EPA analyzed improperly stored waste drums and confirmed the presence of PCE and diesel range organics. They sampled liquids from floor drains inside the building and confirmed the presence of TCE and PCE. EPA sampled sediments along the inside drainage of the building, and sampled soil along the outside of the building. TCE and PCE were found in subsurface soil surrounding the northeast corner of the building and in shallow groundwater (depth between 4.33-5.6 feet) surrounding the northeast corner of the property (EPA 2009).

In *February 2011*, EPA consolidated solvents and chemicals found in the facility. Soil samples were collected in and around the building. Contaminated soil was removed along the alley behind the Boulevard Cleaners building. Five on-site and three off-site monitoring wells were installed to monitor the cleanup progress.

In *March 2011*, EPA collected groundwater samples from underneath the building, in the alley behind the building, and along the street; soil gas samples were collected from underneath the building.

In *May 2011*, EPA conducted air sampling in a home near the site as a precautionary measure. Consolidated wastes and chemical containers were removed (EPA 2011b).

In *September 2011*, EPA demolished the building and removed contaminated soil. Ambient air monitoring was carried out during the demolition process to measure dust and VOCs. The building cinderblocks and bricks had elevated levels of lead. Contaminated soil and debris were removed from the site and disposed at an authorized facility (EPA 2011a).

In *January 2012,* EPA carried out additional soil, groundwater and residential indoor air sampling to evaluate the present concentrations of contaminants.

Environmental Data

Soil and groundwater samples were collected in 2009, 2011 and 2012 to assess the extent of environmental contamination (L. Casillias, personal communication, March 13, 2012). Indoor air and sub-slab vapor samples were collected from a nearby home in 2011 and 2012 (see Appendix A for sampling locations). PCE and TCE were not detected in the indoor air. The concentration of PCE in sub-slab samples taken in 2011 and 2012 was 340 and 290 µg/m^3, respectively.

Chemicals found in the groundwater included those consistent with solvents used at the dry cleaners and their breakdown products (Table 1). The contaminants include *cis*-1,2-dichloroethene, *trans*-1,2-dichloroethene, PCE, TCE, and VC. Groundwater sampling was done in nine locations in 2009, nine locations in 2011 and ten locations in 2012. There was an increase in VOC concentration in groundwater from 2009 to 2011. TCE and PCE groundwater concentrations decreased from 2011 to 2012. This decrease was likely due to the removal of the contaminated soil in September 2011.

Table 1: Multi-year On-site and Off-site Groundwater Sampling Results*

All units in µg/L		**2009**			**2011**			**2012**		
Chemical	**†RL**	**High**	**Freq**	**Avg**	**High**	**Freq**	**Avg**	**High**	**Freq**	**Avg**
cis-1, 2-Dichloroethene	5	100	4/9	12	7,600	5/9	900	8,800	4/10	1,700
trans-1,2-Dichloroethene	5	1.7	1/9	0.2	59	1/9	7	28	2/10	3
Methylene Chloride	5	3	4/9	1				190	10/10	35
Tetrachloroethylene	5	900	6/9	120	7,500	5/9	1,700	3,700	6/10	710
Toluene	5	1	7/9	1				5	6/10	3
Trichloroethylene	5	180	4/9	21	1,500	4/9	210	980	6/10	200
Vinyl Chloride	5	1.2	1/9	0.1	61	2/9	7			

(*Source*: EPA) ***RL**=Reporting Limit. **Freq**=Number of detects/number of samples. **Avg**=Average. †**RL** = 0.5 in 2009. **Shaded Boxes** = data not available.

Soil sampling was done in nine locations in 2009, 17 locations in 2011, and nine locations in 2012 (See Appendix A). Soil sampling results from 2012 show that only methylene chloride was detected in soil on site after contaminated soil was removed and replaced with uncontaminated soil (Table 2).

Table 2: Multi-year Soil Sampling Results*

All units in µg/kg		**2009**			**2011**			**2012**		
Chemical	**RL**	**High**	**Freq**	**Avg**	**High**	**Freq**	**Avg**	**High**	**Freq**	**Avg**
cis-1, 2-Dichloroethene	5	140	2/9	19	75	5/17	0.8			
Methylene Chloride	5	180	4/9	24				10	7/9	5
Tetrachloroethylene	5	61,000	8/9	9,800	490,000	13/17	29,000			
Toluene	5	7	1/9	1						
Trichloroethylene	5	940	5/9	140	160	6/17	22			
Vinyl Chloride		1.1	1/9	0.1						

(*Source*: EPA) ***RL**=Reporting Limit. **Freq**=Number of detects/number of samples. **Avg**=Average; **Shaded Boxes** = data not available.

DISCUSSION

Step 1: Chemical Evaluation

VDH determines if the concentration of chemicals in environmental samples is of potential concern by comparing them to comparison values (CV). CVs are conservative environmental contaminant concentrations calculated from health based values developed by the Agency for Toxic Substances and Disease Registry (ATSDR), EPA, and other federal or state agencies. They are used to screen environmental results and determine if further analysis is needed. If a contaminant's concentration exceeds the comparison value then it is selected for further evaluation. Contaminants found in concentrations below their CV are not evaluated. Additional toxicological information for chemicals exceeding their CV can be found in Appendix C.

Comparison values used to screen contaminants at Boulevard Cleaners are listed below. ATSDR defines the CVs as follows:

- ATSDR's Reference Dose Media Evaluation Guides (RMEGs)

  "ATSDR derives RMEGs from EPA's oral reference doses, which are developed based on EPA evaluations. RMEGs represent the concentration in water or soil at which daily human exposure is unlikely to result in adverse non-carcinogenic effects."

- ATSDR's Environmental Media Evaluation Guides (EMEGs)

  "EMEGs are estimated contaminant concentrations that are not expected to result in adverse non-carcinogenic health effects based on ATSDR evaluation. EMEGs are based on ATSDR MRLs and conservative assumptions about exposure, such as intake rate, exposure frequency and duration, and body weight."

- ATSDR's Cancer Risk Evaluation Guides (CREGs)

  "CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million (10^{-6}) persons exposed during their lifetime (70 years). ATSDR's CREGs are calculated from EPA's cancer slope factors (CSFs) for oral exposures or unit risk values for inhalation exposures. These values are based on EPA evaluations and assumptions about hypothetical cancer risks at low levels of exposure."

  (ATSDR 2005)

Comparing the concentrations of chemicals in on-site monitoring wells (Table 3) to ATSDR CVs showed multiple contaminants exceeded their groundwater CVs. Because these levels are above CVs, these results are evaluated further in Step 2 to determine if there is an impact to public health.

Table 3: Multi-year On-site and Off-site Monitoring Wells Results and Groundwater Comparison Values*

All units in µg/L	2009-2012		Comparison Values						
Contaminant	Avg	High	$EMEG_{(C)}$		CREG	$EMEG_{(I)}$		RMEG	
			Child	Adult		Child	Adult	Child	Adult
cis-1,2-Dichloroethene	900	8,800				**3,000**	11,000	**20**	**70**
trans-1,2-Dichloroethene	3	59				2,000	7,000	200	700
Methylene chloride	19	190	600	2,100	**18**			**60**	**210**
Tetrachloroethene	824	7,500			**17**			**60**	**210**
Toluene	2	5				200	700	800	2,800
Trichloroethene	145	1,500			0.76			5	18
Vinyl Chloride	4	61	**30**	**110**	**0.025**			**30**	110

(*Source*: EPA) ***Bold**=values in bold face are CVs that are exceeded. **RMEG**=Reference Dose Media Evaluation Guide. **CREG**=Cancer Risk Evaluation Guide. **$EMEG_{(IN)}$**=Intermediate Environmental Media Evaluation Guide. **$EMEG_{(C)}$**=Chronic Environmental Media Evaluation Guide. **Shaded boxes**=CV not available.

After remediation of the site and the replacement of soil in September 2011, PCE and TCE were not detected in subsequent sampling conducted in 2012 (Table 4). Methylene chloride was not evaluated further because it is below its soil CV.

Table 4: Multi-year On-site Soil Sampling Results and Soil Comparison Values*

All units in µg/kg	2009-2011†		Comparison Values				
Contaminant	Avg	High	$EMEG_{(C)}$		CREG	RMEG	
			Child	Adult		Child	Adult
cis-1,2-Dichloroethene	11	140				**100**	1,400
Methylene chloride	14	180	3,000	42,000	350	300	4,200
Tetrachloroethene	21,808	490,000			**330**	**300**	**4,200**
Toluene	0.78	7				4,000	56,000
Trichloroethene	58	940			**15**	**25**	**350**
Vinyl Chloride	0.12	1.1	150	2,100	**0.5**	150	2,100

(*Source*: EPA) ***Avg**=Average. **Bold**= values in bold face are CVs that are exceeded. **$EMEG_{(C)}$**=Chronic Environmental Media Evaluation Guide **CREG**=Cancer Risk Evaluation Guide. **RMEG**=Reference Dose Media Evaluation Guide. †2012 on-site soil sampling results were negative. **Shaded area**=CV not available.

To evaluate the potential risk from exposure to VOCs in structures on site VDH compares the indoor air concentration to relevant CVs. Because there is no building on site or air sampling data to compare to air CVs, VDH calculated hypothetical air concentrations by conservatively assuming that a certain percentage of VOCs in groundwater will be present in indoor air. The equation used to calculate the hypothetical indoor air concentration from groundwater is shown below (Equation 1) (ITRC 2007).

Equation for calculating indoor air VOC concentrations from groundwater concentrations

Equation 1

$$C_H = C_{GW} \times \alpha \times H' \times CF$$

Where:

Abbreviations	Parameter name	Value & Units
C_H	Hypothetical indoor air concentration	µg/m^3
C_{GW}	Concentration in groundwater	µg/L
α	Attenuation factor	0.001 (unitless)
H′	Henry's Law Constant	Chemical specific (unitless)
CF	Conversion Factor	1000 L/m^3

An example calculation using the highest measured PCE groundwater concentration is shown below (Equation 2).

Example for calculating the hypothetical indoor air concentration from groundwater using PCE

Equation 2

$$C_H = 7{,}500 \text{ µg/L} \times 0.001 \times 0.754 \times 1{,}000 \text{ L/m}^3 = 5{,}655 \text{ µg/m}^3$$

Various assumptions used in deriving the concentration are described as follows:

Henry's Law Constant dimensionless (H′)

Henry's Law states that the solubility of a gas in a liquid solution at constant temperature is proportional to the partial pressure of the gas above the solution. The dimensionless Henry's Law Constant (H′) can be calculated by dividing Henry's Law Constant (H) (atm-m^3/mol) by the product of the Ideal Gas Law Constant (R), 8.205x10^{-5} atm-m^3/mol-K, and the room temperature in Kelvin (K), 298 K (see below) (EPA 2012a).

$$\boldsymbol{H' = \frac{H}{RT}}$$

Attenuation factor (α)

Attenuation factors are empirically derived and represent the ratio of indoor air concentration to the concentration in subsurface medium such as groundwater. It is the measure of how VOCs entry into a building is limited by the soil and the building itself. EPA uses an attenuation factor of 0.001 for groundwater to indoor air calculations (EPA 2012b) (Folkes et al, 2007).

Conversion Factor

Conversion factor of 1000 L/m^3 is used to convert from µg/L to µg/m^3.

Table 5: Factors Used to Calculate Hypothetical VOCs Indoor Air Concentrations from 2012 On-site Groundwater and Air Comparison Values*

Contaminant	†C_{GW}	H′	α	C_H	CV	Source
cis-1,2-Dichloroethene	8,800	0.167	0.001	1,470		
trans-1,2- Dichloroethene	28	0.385	0.001	11	790	$EMEG_{(I)}$
Methylene chloride	190	0.0898	0.001	17	**100**	CREG
Tetrachloroethene	3,700	0.754	0.001	2,790	**3.8**	CREG
Toluene	5	0.272	0.001	1.4	300	$EMEG_{(C)}$
Trichloroethene	980	0.422	0.001	414	**0.24**	CREG

***Bold**=values in bold are CVs that are exceeded. **$EMEG_{(C)}$** =Chronic Environmental Media Evaluation Guide. **CREG**=Cancer Risk Evaluation Guide. **$EMEG_{(I)}$** =Intermediate Environmental Media Evaluation Guide. **C_{GW}** =Concentration in Groundwater (µg/L) †Highest reported value for 2012 used. **H′**=Henry's Law Constant dimensionless (*source:* see EPA reference cited within text). **α**=Attenuation Factor. **C_H**=Hypothetical Indoor Air Concentrations (µg/m^3). **CV**=Comparison Value. **Shaded area**=CV not available

Comparing the C_H of VOCs to ATSDR CVs showed multiple contaminants exceeded their air CVs (Table 5). Because these levels are above CVs, these results are evaluated further in Step 2 to determine if there is an impact to public health. Please note that hypothetical air concentrations screened against CV may not represent actual indoor air concentrations.

Step 2: Exposure Pathway Evaluation

Chemicals present in the environment above their respective CVs can impact public health only if you are exposed to them. VDH determines if an exposure to environmental contamination occurred in the past, is occurring, or might occur in the future by identifying if a completed or potential exposure pathway exists. A completed exposure pathway consists of 5 elements:

1. A source of contamination
2. An environmental medium
3. A point of exposure
4. A route of exposure
5. A receptor population

A completed pathway exists if all five elements are present. VDH eliminates an exposure pathway if at least one of the five elements is missing and is very unlikely to be present at anytime. A potential pathway exists if information on one of the five elements is missing or is insufficient, but may be present at any time. A table summarizing the pathways identified at Boulevard Cleaners can be found in Appendix B.

Completed Pathway

A complete pathway exists when people are actually exposed to a contaminant through inhalation, ingestion, or by skin contact. *No completed pathways* were identified.

Eliminated Pathways

Ingestion of on-site soil – This pathway is eliminated because the public does not have access to the site. As long as site conditions remain the same this pathway is considered eliminated. EPA has protected the site by installing an 8 foot tall chain link fence; the site is protected by a gate that is locked to prevent any trespassing. EPA has removed the contaminated soil on site and replaced it with clean soil.

Consumption of on-site groundwater – This exposure pathway was eliminated because there is no current use or likely future use of groundwater at this site.

Ingestion of off-site soil – This exposure pathway was eliminated because the surrounding area is capped by an asphalt roads and concrete pathways which limit exposure to off-site soil.

Adjacent resident indoor air – This pathway is considered eliminated because monitoring results did not detect any chemicals in the indoor air in the home adjacent to the site.

Off-site groundwater – There are no private drinking wells nearby or around the area. The surrounding area is developed and all residences and businesses near the site are on municipal water.

Potential Pathway

On-site vapor intrusion - There is a potential for VOCs identified at their current concentration in the shallow groundwater to volatilize into future building constructed on site.

Residential indoor air - The potential for VOCs to migrate into homes and buildings off site is a potential pathway if the contaminated groundwater plume continues to move to the east.

Public Health Implications

Contaminants identified at the Boulevard site were primarily VOCs and their environmental breakdown products. Because VOCs have been identified in shallow groundwater on and off site the potential for vapor intrusion exists. Vapor Intrusion is the migration of volatile chemicals from the subsurface into buildings. Volatile chemicals in groundwater can migrate through soils and into indoor air spaces of buildings. It is possible for the vapors to accumulate in buildings at levels that may present a health problem or safety hazard. Generally, the chemical concentration levels are low or, may not be present at detectable levels. In buildings with low concentrations, the chemicals may pose an unacceptable risk from long-term exposure. PCE, TCE, and VC were the only chemicals identified in groundwater that potentially pose a health risk to any future structure or building built on site.

Child Health Considerations

VDH recognizes that children are at a greater risk of developing illness from exposure to hazardous chemicals given their smaller stature and growing body. Children are likely to breathe more air and consume more food and water per body weight than are adults. Also, children's

bodies are developing and are susceptible to damage if toxic exposures are high enough during critical growth stages. For that reason, VDH 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, TCE, and VC are derived with additional safety factors to account for children.

CONCLUSIONS

- VDH concludes that the VOCs in soil will not harm people's health because contaminated soil has been removed from the former Boulevard Cleaners site and replaced with clean soil.

- VDH concludes that the VOCs in groundwater will not harm people's health because no one is drinking contaminated groundwater.

- VDH concludes that the potential for vapor intrusion exists for any building constructed on site and for homes and buildings in the direction of the contaminated groundwater plume, but not enough information is known at this time to make a health conclusion

- VDH concludes that the VOCs detected in the indoor air at one home adjacent to the site are not at levels expected to harm people's health because they are not above their respective health comparison values.

RECOMMENDATIONS

- VDH recommends that the natural attenuation of the remaining contaminant groundwater plume be monitored on at least an annual basis.

- As a precautionary measure, VDH recommends that any future buildings constructed on the site above the contaminated groundwater plume should include construction practices that minimize the potential for vapor and water intrusion (for example, a designed and engineered vapor mitigation system that includes a vapor barrier and active vapor extraction system).

- VDH recommends EPA to remediate the groundwater to prevent future exposure to VOCs that might occur through vapor intrusion.

- VDH recommends monitoring indoor air in nearby homes and businesses if the contaminated groundwater plume moves off site and the concentration of VOCs remain elevated.

PUBLIC HEALTH ACTION PLAN

Actions Undertaken

On May 24, 2011, EPA spoke with residents and businesses in the area and handed out fact sheets. In September 2011, EPA posted information signs on the fence surrounding the property. In October 2011, a public availability session was conducted by EPA and VDH at the Hampton Public Library, 4207 Victoria Boulevard, Hampton, VA. The focus of this meeting was to discuss the current status of the project and to address health concerns. The Local Health Director and less than five residents from the community attended.

Actions Planned

VDH will evaluate any future environmental sampling data and determine if there is a public health impact.

VDH will participate in any future meetings as requested by EPA and provide health educational material.

REPORT PREPARATION

This Health Consultation for the Former Boulevard Cleaners Site was prepared by the Virginia Department of Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, procedures existing at the date of publication. Editorial review was completed by the cooperative agreement partner. ATSDR has reviewed this document and concurs with its findings based on the information presented.

Author
Dwight Flammia, Ph.D.
State Public Health Toxicologist
Principal Investigator
Virginia Department of Health
109 Governor Street
Richmond, VA 23219

Contributing Author
Vinay Allagadda, M.S.
Health Assessor
Virginia Department of Health
109 Governor Street
Richmond, VA 23219

State Reviewer
Rebecca LePrell, MPH
Division Director
Division of Environmental Epidemiology
Virginia Department of Health
109 Governor Street
Richmond, VA 23219

Technical Project Officer
Jennifer Freed
Cooperative Agreement Team
ATSDR/DHAC/CAPEB

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APPENDIX A

Map of Boulevard Cleaners, Hampton Virginia and Surrounding Area

Indoor air sampling locations in the adjacent home near Boulevard Cleaners

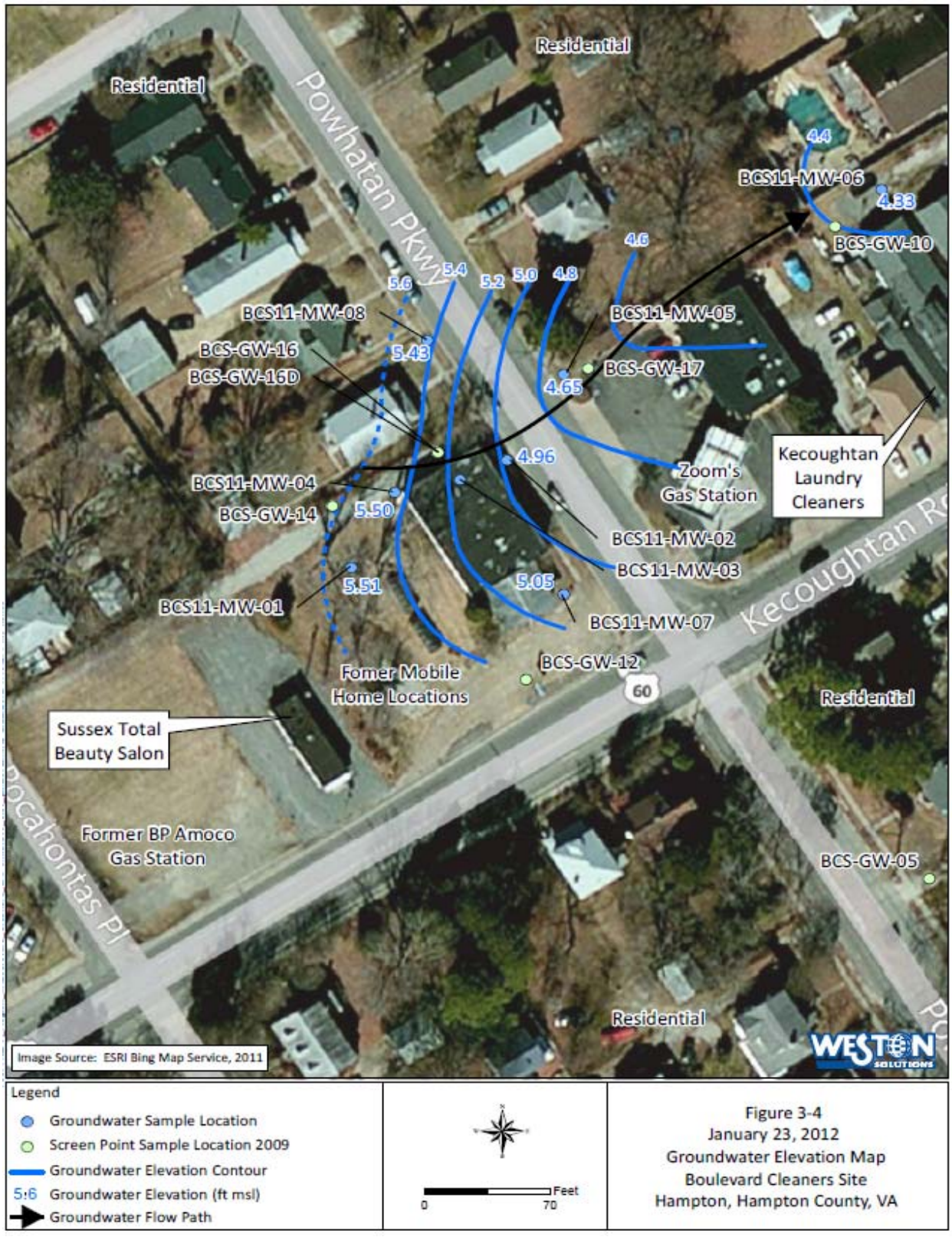
Legend

Soil Gas/Indoor Air Sample Location (Approximate Location)

Feet
0 25

Figure 3-1
Residential Indoor Air/Soil Gas Sample Locations
Boulevard Cleaners Site
Hampton, Hampton County, VA

Groundwater elevation and sampling locations on and near Boulevard Cleaner's



Soil boring sampling locations on and near Boulevard Cleaners

APPENDIX B

Exposure Pathways Summary

Source	Media	Exposure Point	Exposure Route	Receptor Population	Time Frame	Exposure Status
Boulevard Cleaners	Groundwater	On site	Dermal Contact & Ingestion	Workers or people that come on site	Past Present Future	Eliminated
Boulevard Cleaners	Vapor intrusion from groundwater	On-site buildings	Inhalation	Workers or people on site	Past Present Future	Potential Eliminated Potential
Boulevard Cleaners	Soil	On site	Dermal contact & Ingestion	Workers or people that come on site	Past Present Future	Potential Eliminated Eliminated
Boulevard Cleaners	Soil	Off site	Ingestion	People living in nearby homes	Past Present Future	Eliminated
Boulevard Cleaners	Vapor intrusion from groundwater	Off-site residences	Inhalation	People living in homes near the site	Past Present Future	Eliminated Eliminated Potential
Boulevard Cleaners	Groundwater	Off site	Dermal Contact & Ingestion	People living in nearby homes	Past Present Future	Eliminated

APPENDIX C

Dichloroethene

1,2-Dichloroethene is a mixture of *cis*- and *trans*-1,2-dichloroethene. It is a colorless liquid with a sharp odor that is highly flammable. 1,2-Dichloroethene is a break down product of tetrachloroethylene and trichloroethylene. EPA has determined that *cis*-1,2-dichloroethene is not classifiable as to its human carcinogenicity. No EPA cancer classification is available for *trans*-1,2-dichloroethene.[1]

Breathing high concentrations can cause nausea, drowsiness, and headaches. Exposure to extremely high levels of 1,2-dicholorethene in the air can result in death. Long-term human health effects after exposure to low concentrations of 1,2-dichloroethene are not known. 1,2-Dichloroethene has not been shown to affect fertility in people or animals.

Methylene Chloride

Methylene chloride is a colorless liquid that has a mild sweet odor. It evaporates readily and is poorly soluble in water. It is widely used as an industrial solvent and as a paint stripper. The Department of Health and Human Services (DHHS) has determined that methylene chloride can be reasonably anticipated to be a cancer-causing chemical.[2]

If you breathe in large amounts of methylene chloride you may feel dizzy, lightheaded, and have nausea and a tingling sensation in your extremities. Skin contact with methylene chloride may cause burning and redness of the skin.

Tetrachloroethylene

Tetrachloroethylene is a manufactured chemical. It is a liquid that has a sharp sweet odor. It readily evaporates into the air. Tetrachloroethylene is widely used for dry cleaning and as a metal degreaser. DHHS has determined that tetrachloroethylene may reasonably be anticipated to be a carcinogen.[3]

Breathing high concentrations of tetrachloroethylene can cause dizziness, confusion, headaches, and sleepiness. Repeated skin contact can lead to irritation. The health effects of drinking or breathing low levels of tetrachloroethylene are not known. Animals exposed to high levels of tetrachloroethylene can result in kidney and liver damage.

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[1] Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological profile for 1,2-dichloroethene. U.S. Public Health Services, U.S. Department of Health and Human Services, Atlanta, GA, 1996.

[2] Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological profile for methylene chloride. U.S. Public Health Services, U.S. Department of Health and Human Services, Atlanta, GA, 1996.

[3] Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological profile for tetrachloroethylene. U.S. Public Health Services, U.S. Department of Health and Human Services, Atlanta, GA, 1997.

Trichloroethylene

Trichloroethylene is a colorless liquid with a sweet odor and a burning taste. Trichloroethylene is primarily used as a metal degreaser. It is also used in adhesives, paint removers, typewriter correction fluids and spot removers.[4]

Ingesting large amounts may cause liver and kidney damage, nausea, and even death. Drinking small amounts for a long period of time may damage the immune system, kidneys, and liver. Skin exposure may result in rashes. The National Toxicology Program has determined that trichloroethylene is reasonably anticipated to be a human carcinogen.

Vinyl Chloride

Vinyl chloride is a colorless gas. It has a mild, sweet odor. It is a manufactured substance that does not occur naturally. Vinyl chloride is a breakdown product of trichloroethylene and tetrachloroethylene. Most of the vinyl chloride produced in the United States is used to make polyvinyl chloride (PVC), a material used to manufacture a variety of plastic and vinyl products including pipes, wire and cable coatings, and packaging materials. DHHS has determined that vinyl chloride is a known carcinogen.[5]

Breathing high levels of vinyl chloride may cause dizziness and sleepiness. Some people exposed to vinyl chloride for many years developed liver damage. Others experienced nerve damage and immune reactions. Exposure to high levels may affect blood flow to the hands. Skin exposure may result in numbness, redness, and blisters. Animals exposed to vinyl chloride for a long time can develop damaged sperm and testes.

[4] Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological profile for trichloroethylene. U.S. Public Health Services, U.S. Department of Health and Human Services, Atlanta, GA, 1997.

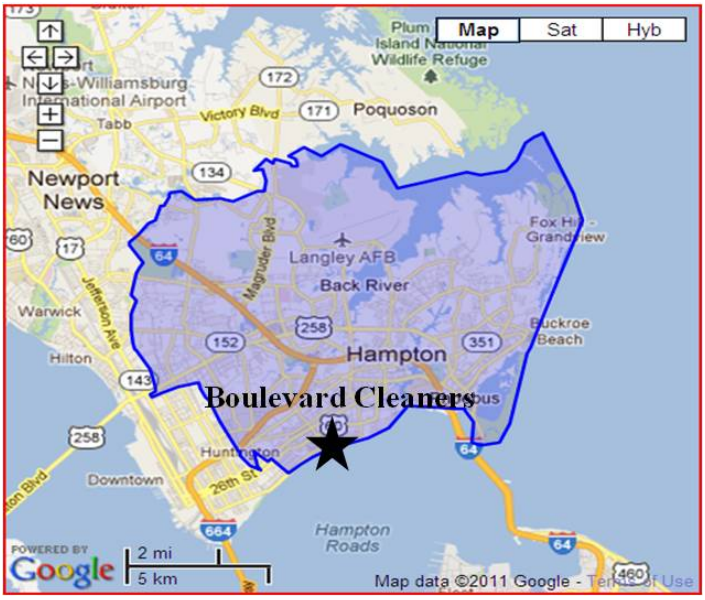
[5] Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological profile for vinyl chloride. U.S. Public Health Services, U.S. Department of Health and Human Services, Atlanta, GA, 2006.

APPENDIX D

Demographics

VDH examines demographic and land use data to identify sensitive populations, such as young children, the elderly, and women of childbearing age, to determine any potential health risks that may result from exposures. Demographic information also provides details on residential history in a particular area. This information helps VDH evaluate how long residents might have been exposed to contaminants.

Map of Boulevard Cleaners Location and Surrounding Zip code 23661



As of the 2010, the total population in Hampton Virginia where Boulevard Cleaners is located was 145,903. The community consists of African Americans and Caucasians, representing approximately 50% and 43% of the population respectively. This area also has a small percentage of Hispanic/Latinos and Asians within the community. Although more than three quarters of the population are between the ages of 18-65, there are sensitive populations of those under 5 years old (6%) and those over 65 years old (12%) in the community.

Demographic Information for Hampton City and Virginia

	Hampton, Virginia	Virginia
Total Population	145,903	8,001,024
Male	48%	49%
Female	52%	51%
Race or Ethnicity		
White/Caucasian	43%	68.6%
Black/African American	50%	19.4%
Age Distribution		
Under 5 years old	6%	6.4%
Over 65 years old	12%	12.2%
Economics		
Unemployment Rate 2010	6.6%	6.5%
Families below poverty level 2009	10.5%	7.2%

(*Source*: U.S. Census, and Bureau of Labor and Statistics)