Health Consultation

BISHOP TUBE SITE

EAST WHITELAND TOWNSHIP, CHESTER COUNTY, PENNSYLVANIA

JULY 16, 2008

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.

HEALTH CONSULTATION

BISHOP TUBE SITE

EAST WHITELAND TOWNSHIP, CHESTER COUNTY, PENNSYLVANIA

Prepared By:

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Division of Regional Operations
Atlanta, Georgia 30333

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1.0 STATEMENT OF ISSUES

On June 11, 2007, ATSDR received a petition to conduct “public health assessment activities” for the community surrounding the former Bishop Tube manufacturing facility in East Whiteland Township, Pennsylvania. Following receipt of this request, ATSDR worked closely with the Pennsylvania Department of Health (PADOH) and the Pennsylvania Department of Environmental Protection (PADEP) to identify and evaluate potential sources of environmental sampling data. The results of an on-site investigation in 1987 indicated the presence of volatile organic compounds (VOCs), primarily TCE and 1,1,1-trichloroethane (1,1,1-TCA) in the groundwater underlying the site. Heavy metals were also detected in the soil and groundwater samples collected during the investigation (PADEP 2002b). After identifying that limited off-site environmental data was available, on September 7, 2007, ATSDR agreed to evaluate potential exposures of adults and children in contact with creek and spring water near the Bishop Tube facility. ATSDR will determine if it is possible to evaluate and make recommendations regarding other potential exposure pathways of concern, such as vapors from groundwater contamination affecting indoor air in buildings above the chlorinated solvent plume. This document (1) summarizes and evaluates the environmental sampling data available for offsite areas, (2) evaluates the public’s potential for exposure to environmental contaminants, (3) discusses toxicological and health implications for exposure to contaminants, (4) provides conclusions regarding the public’s exposure or potential for exposure to contaminants identified, and (5) provides recommendations for reducing exposures, and for further assessment activities to characterize current and future environmental conditions surrounding the Bishop Tube site. Additionally, ATSDR agrees to review additional data as it becomes available for areas surrounding this site.

2.0 BACKGROUND

The following section provides a description of the area, including the site layout, areas of concern, and the site history.

2.1 DESCRIPTION OF SITE AND AREAS OF CONCERN

The 13.7 acre Bishop Tube site (Site) is located on the east side of Malin Road, south of US Route 30, in Frazier, East Whiteland Township, Chester County, Pennsylvania. The site is surrounded primarily by industry, although residential communities are located north and east of the site. The site is bordered to the north by the Norfolk Southern railroad, commercial properties along US Route 30 (Lancaster Avenue), and a residential community to the north of US Route 30; to the east, by Little Valley Creek and the General Warren Village (GWV) residential community; to the south, by the Amtrak railroad and wooded, sloped areas where the Little Valley Creek originates; and to the west, by Malin Road and the Mobil Oil Corporation’s bulk fuel oil terminal. Figure 1 provides the site location.

The site is comprised of (1) wooded areas, (2) asphalt-, concrete- and gravel-covered parking and storage areas, and (3) buildings where former manufacturing of seamless

FIGURE 1
SITE LOCATION MAP
BISHOP TUBE SITE

SOURCE: U.S.G.S QUADRANGLE
MALVERN, PENNSYLVANIA.

SCALE:	1" = 2000'	DATE:	MAR 2001
S.O. NO.:	24300-116	FILE:	FIGURE1
DSN/DWN:	MBI/JJR	CHK:	

Baker

MICHAEL BAKER JR, INC.
HARRISBURG, PENNSYLVANIA

metal tubes took place. Two large, out-of-service, rectangular-shaped, one-story, concrete block buildings that cover approximately 3.2 acres of the site were used for manufacturing. The two buildings are connected to one another and are referred to as Building #5 and Building #8. A considerable amount of cutting and filling occurred at the site to construct the buildings and parking areas. Building #5 was constructed in 1950 and Building #8 was built in 1959. The remainder of the property consists primarily of paved and gravel-covered storage/parking areas, with a smaller amount of undeveloped grassy areas. An 8-foot high chain-link fence currently surrounds the northern, eastern, and southern edges of the property, although evidence of trespassing is present (i.e. graffiti and vandalism).

The site is heavily contaminated with chlorinated solvents, acids and heavy metals which were used during manufacturing activities. These contaminants, including (1) TCE and its breakdown products; (2) nitric and hydrofluoric acids; (3) various oils; and (4) other hazardous materials were not properly handled and disposed at this site. As a result, the on-site soils are heavily contaminated (up to 15,000 milligrams per kilogram [mg/kg] TCE) and a substantial chlorinated solvent plume has been identified in the shallow and deep aquifers both on-site and down gradient of the site (PADEP 2002a). Recent groundwater samples collected from under the site in May 2007 showed TCE concentrations up to 780,000 micrograms per liter (µg/L) (PADEP 2007). Extensive subsurface studies and tests of the site and surroundings by PADEP have resulted in a well-defined geology and hydrogeology for both the site and the down gradient off-site residential area of concern (AOC1), where a large chlorinated solvent plume has been identified through sampling and mapped via groundwater modeling.

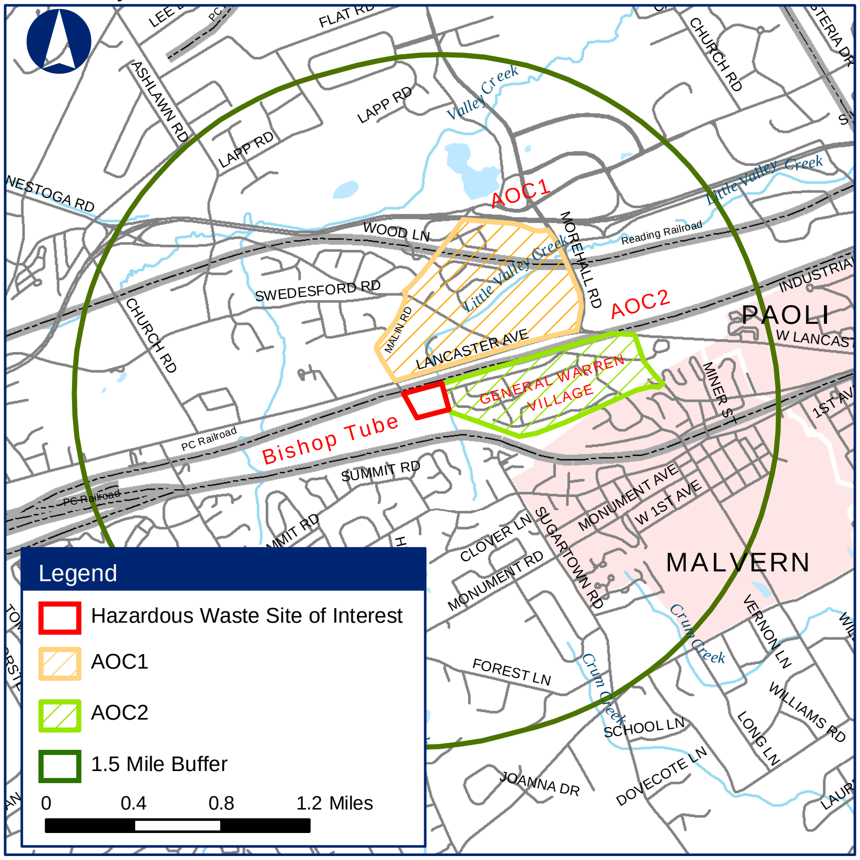
AOC1 is bordered by Malin Road and Swedesford Road to the west, Route 202 to the north, Morehall Road to the east, and U.S Route 30 (Lancaster Avenue) to the south. ATSDR has identified AOC1 as an area for further investigation because it is located down gradient and northeast of the site, the direction for which PADEP has identified for groundwater and surface water flow. Additionally, ATSDR has identified AOC1 for further investigation because PADEP has environmental data which indicate TCE contamination has been present within this residential community at levels above the state's water quality standards for more than 10 years. Figure 2 provides current demographics for this area. Figure 3 provides the locations of primary off-site features.

An additional residential area of concern (AOC2), the General Warren Village, is located directly east of the site and on grade. Due to its close proximity to the site, ATSDR has identified this area as an additional area for further discussion in this health consultation.

The Bishop Tube site and both AOC1 and AOC2 are situated within a southwest to northeast trending valley locally referred to as the Chester Valley area (PADEP 2002a). Surface water and groundwater follows this southwest to northeast geologic trend, which flows from the site directly towards AOC1 (PADEP 2002a). The Chester Valley area is mainly underlain by easily eroded rocks comprised of limestone and dolomite (Sloto 1984). Based on subsurface studies, PADEP has reported that the aquifer in the Chester Valley area has the characteristics of a fractured bedrock system (PADEP 2002a).

Bishop Tube Company
Frazer, PA

EPA Facility ID: PAD081868309



Base Map Source: Geographic Data Technology, May 2005.
Site Boundary Data Source: ATSDR Geospatial Research, Analysis, and Services Program, Current as of Generate Date (bottom left-hand corner).
Coordinate System (All Panels): NAD 1983 StatePlane Pennsylvania South FIPS 3702 Feet

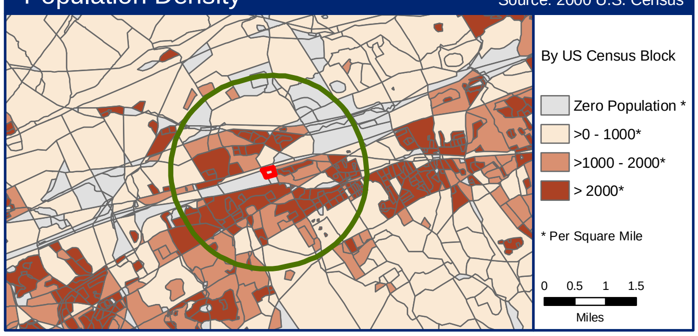
Site Location: Chester County, PA

Demographic Statistics
Within Area of Concern*

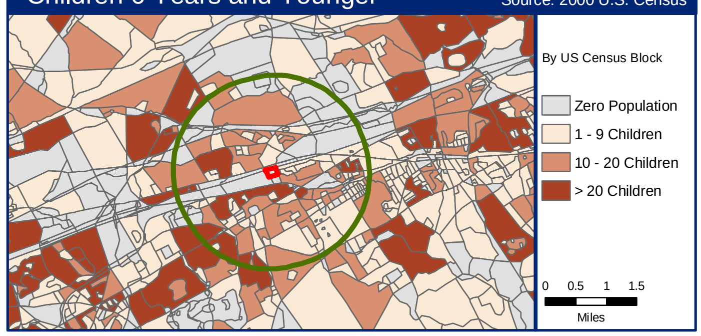
	1.5 mi
Total Population	10,518
White Alone	9,529
Black Alone	361
Am. Indian & Alaska Native Alone	11
Asian Alone	411
Native Hawaiian & Other Pacific Islander Alone	11
Some Other Race Alone	59
Two or More Races	135
Hispanic or Latino**	183
Children Aged 6 and Younger	931
Adults Aged 65 and Older	1,578
Females Aged 15 to 44	2,122
Total Housing Units	4,189

Demographics Statistics Source: 2000 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.

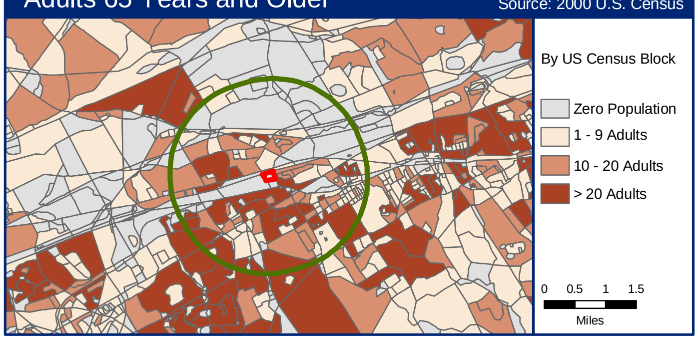
Population Density
Source: 2000 U.S. Census



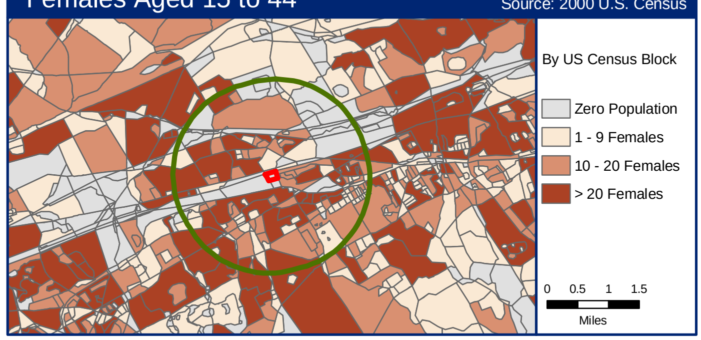
Children 6 Years and Younger
Source: 2000 U.S. Census



Adults 65 Years and Older
Source: 2000 U.S. Census



Females Aged 15 to 44
Source: 2000 U.S. Census



<project=3195><userid=JXA0><geo=Chester County, PA><keywords=PAD081868309, Bishop, Tube>

Figure 3

Offsite Features Map

Bishop Tube Site

East Whiteland Township, Chester County, Pennsylvania

Map created by Robert Helverson, Agency for Toxic Substances and Disease Registry

Last Modified on March 12, 2008

Fractured bedrock characteristics can result in preferential pathways for organic vapors to travel from contaminated groundwater to structures above or near the contamination. Additionally these geologic characteristics can result in an enhanced liquid phase migration that can surface in artesian springs at quite a distance from the source area (i.e. site).

From its headwater immediately south of the Bishop Tube site, Little Valley Creek flows north past the east perimeter of the site, then northeast, crossing under the Norfolk Southern railroad and Route 30 into AOC1. The creek meanders through AOC1 for approximately one river mile before entering back into industrial areas further east. Within AOC1, a number of tributaries and springs feed into Little Valley Creek. Malin and Morehall tributaries have confluences within AOC1 and the Worthington tributary merges with Little Valley Creek just east of Morehall Rd. Springs have also been identified within AOC1 and just east of Morehall Road that contribute to the Little Valley Creek. Spring waters in this area appear to have been impacted by the Bishop Tube site, with both tetrachloroethene (PCE) and TCE detected in samples collected from these springs. PCE was detected from a spring located just south of Winding Way at a concentration of 5.8 µg/L (PADEP 2002b). Spring samples collected just east of Morehall Road have had TCE concentrations ranging from 6.5 µg/L to 130 µg/L (PADEP 2002b). These springs are located between a quarter mile and one mile north and northeast of the site/source area.

2.2 SITE HISTORY

The Bishop Tube site was formerly used to process precious metals and to fabricate stainless steel specialty items, namely tubing and piping products (PADEP 2002a). Manufacturing operations began at the site under the name of the "J. Bishop and Company, Platinum Works" in 1951. Facility activities included the use of a wide variety of materials, including nitric acid, hydrofluoric acid, caustic materials for water treatment, motor oil (20W40), gear oils, specialty drawing lubricants, degreasing solvents (TCE), anhydrous ammonia, coolants, polishing compounds, metal alloys, and paints (PADEP 2002a).

Currently, the Site is characterized by a large chlorinated solvent groundwater plume with three specific areas of very highly concentrated chlorinated solvents: (1) the plant #8 degreaser area, which includes the vapor degreaser area (554,100 µg/L TCE), the solvent distillery area (260,000 µg/L TCE), and the above-ground storage tank area (264,750 µg/L); (2) the Plant #5 degreaser area (121 µg/L TCE); and, (3) the former drum storage area (160,600 µg/L TCE). Currently, the PADEP has been constructing a source mitigation system at the Bishop Tube site to address the contaminated soils and groundwater. By using air sparge and soil vapor extraction (AS/SVE), the PADEP hopes to collect and properly treat a large proportion of the chlorinated solvents located in the shallow aquifer and soils at the site. Currently, the plant #8 degreaser area is being mitigated with an AS/SVE system. The additional two areas will also be addressed with AS/SVE systems. This action will help to reduce the source materials which continue to contribute to the chlorinated solvent plume which has been migrating northeast. In addition to chlorinated solvents, additional hazardous materials have been detected on and off the Bishop Tube site, including hydrofluoric and nitric acids, various waste oils, and heavy metals.

TCE and its breakdown products (1,1,1-trichloroethane [1,1,1,-TCA]; 1,1-dichloroethane [1,1-DCA]; 1,1-dichloroethene [1,1-DCE]; vinyl chloride) are of particular concern offsite since it has been detected in groundwater collected from offsite wells and springs. Contaminants related to the site have been detected in a residential well (which has a whole house carbon-filtration system), most of the down gradient springs, and in Little Valley Creek surface waters for up to a mile from the site.

2.3 COMMUNITY CONCERNS

In March 2007, citizens from the East Whiteland Township area raised concerns about lymphomas, pancreatic cancer, and neuroblastomas. ATSDR spoke with a long term resident near the site who wanted to see a statistical review of the cancer data for this site. The resident said that there are several incidents of cancer in his family and stated that “across the railroad tracks, every household has cancer." The resident’s wife died of pancreatic cancer 3 years ago. Another resident of the area voiced his cancer concerns directly to ATSDR in early 2007. Specifically, the resident is concerned about lymphoma, which he has, and concerns that many other neighbors have cancer as well. This resident wanted to know what it takes to have a cancer cluster. ATSDR discussed the difficulties and challenges surrounding cancer cluster investigations. This resident again said he is concerned about a host of blood cancers and breast cancers in people in their 40's and younger, and worried about the exposures to TCE and chromium from the facility. The resident said "East Whiteland has a whole neighborhood loaded with cancer; every house has 1-2 cancers."

In June 2007, East Whiteland Township petitioned ATSDR requesting that the agency perform a “public health assessment” to gauge the impact the former Bishop Tube manufacturing facility has had on the health of former employees and residents who live in the neighborhood surrounding the facility. ATSDR spoke with a former Bishop Tube employee that worked at the facility as a mill wright and in plant maintenance. He reported experiencing acute TCE toxicity symptoms, including a "drunk feeling" and a tingly feeling on his skin. He worked directly with the degreasers. This former employee is now being treated for asthma which he never suffered from before. ATSDR did refer the former employee and an additional former employee to the regional Association of Occupational and Environmental Clinics (AOEC) at the University of Pennsylvania for expertise in environmental and occupational health medicine. This former employee also informed ATSDR that (1) many employees from the facility have nueromuscular conditions and cancer, (2) his father worked at the facility and has Parkinson's disease and respiratory problems, and, (3) hydrofluoric acid and nitric acid fumes were a problem at the site, in addition to asbestos in piping and the poor ventilation at the facility.

This health consultation will provide an evaluation of the chemicals released from the site and their estimated impact on public health in past, currently and in the future. Additionally, this document will discuss the steps ATSDR has taken and recommendations for additional activities to be taken to characterize this site's impact on the community in East Whiteland Township. Specific responses to community concerns are provided in Section 3.5.

2.4 SUMMARY OF AVAILABLE DATA

The PADEP has compiled data from a number of on site groundwater and soil assessments. These data sets have been used by the PADEP to design an on site treatment system which is currently being built at the site. These data sets characterize on-site contamination and have limited utility for evaluating off-site (i.e. residential) exposures. The onsite data will not be fully discussed in this document, but a summary of this data is presented to show the high concentrations of contaminants at the source. It is important to note however, that the high concentrations of chlorinated solvents in the site surface soils and groundwater underlying the site will continue to contribute to the groundwater plume until the source material has been sufficiently extracted by the ongoing cleanup activities.

Environmental investigations have been conducted at the site since 1972. Major investigations have been conducted by contractors for both the property owners and the PADEP for over 20 years. Analytical data presented below were compiled from investigations conducted in 1981, 1987, 1996, and 2001 through 2007. Although none of these investigations were comprehensive, the overall data set provides a sufficient representation of the environmental contamination resulting from operations at the Bishop Tube site. Although additional data are needed for some exposure pathways, the data presented here can be used by ATSDR to estimate exposures to surface and spring water and groundwater. Additional assessment efforts are needed in order to complete an evaluation of some exposure pathways, including inhalation of organic vapors offsite, which is discussed later in this document. This section will summarize data from the most relevant environmental assessments which characterize on site and offsite areas impacted by site contaminants.

2.4.1 ON SITE CONTAMINATION

In 1987, BCM/Smith, Inc., on behalf of Christiana Metals Corporation, conducted an investigation to update a 1981 groundwater study and to evaluate potential impacts from degreasing agents (i.e., chlorinated solvents) historically used at the plant (PADEP 2002b). The results of this investigation indicated the presence of volatile organic compounds (VOCs), primarily TCE and 1,1,1-trichloroethane (1,1,1-TCA) in the groundwater underlying the site. Heavy metals were also detected in the soil and groundwater samples collected during the investigation (PADEP 2002b).

In 1996, Smith Environmental (formerly BCM) collected surface water samples from Little Valley Creek in the vicinity of the Bishop Tube site for fluoride and VOC analysis (PADEP 2002b). In addition to fluoride, the analytical results showed that TCE was detected in the surface water of Little Valley Creek adjacent to the site at concentrations of 75 µg/l and 10 µg/l (PADEP 2002b).

During the period of June through October 2001, a Site Characterization was performed by Baker on behalf of the PADEP to determine the concentrations of organic and inorganic compounds in soils, sediments, surface water, and shallow groundwater at the Bishop Tube site (PADEP 2002b). A total of 87 soil borings were drilled inside and around the perimeter of the plant building to evaluate the horizontal and vertical extent of organic and inorganic compounds in soil (PADEP 2002b). To assess potential impacts resulting from the past disposal of waste materials at the site, eight sets of surface water and sediment samples were collected from selected locations along Little Valley Creek as well as the drainage swale situated north of Building #8 (PADEP 2002b). Elevated concentrations (i.e. exceeding the PADEP health-based standards) of chlorinated solvents (TCE; PCE; 1,1-DCE, 1,2-DCE, 1,1,1-TCA, 1,1,2-trichloroethane [1,1,2-TCA], 1,2-dichloropropane, and vinyl chloride); hydrocarbon compounds (MTBE, benzene, toluene); polynuclear aromatic hydrocarbon compounds (anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and pyrene); polychlorinated biphenyls (Aroclor 1260); and heavy metals (antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, silver, thallium, vanadium and zinc) were detected in soil, sediment, surface water, and shallow groundwater at the site (PADEP 2002b).

2.4.2 OFF SITE CONTAMINATION

Off site sampling data includes groundwater samples collected from residential wells and monitoring wells. The depth to screening intervals for these wells is not known. Spring samples and surface water samples were collected from a number of locations, including creeks, tributaries, standing pools of water, and intermittent and perennial springs and analyzed for a number of contaminants including VOCs, general chemistry parameters, and other analyses. The data presented below is only a summary identifying the contaminants of interest for the areas surrounding the site. One round of indoor air quality sampling was conducted and this data is also provided below.

2.4.2.1 GROUNDWATER

One residential drinking water well located on Conestoga Road (CH1985) was identified by the PADEP in AOC1. This well has been sampled periodically since 1996 after the first round of sampling detected chlorinated solvents (O’Brien and Gere 1998). Samples collected from CH1985 in January of 1996 were found to contain the following VOCs: TCE at 53 µg/l; 1,1,1-TCA at 8.1 µg/l; and, 1,1-DCA at 1.1 µg/l (O’Brien and Gere 1998). In 1999, a whole-house carbon filtration system was installed in this home at the expense of the Christiana Metals Corporation (PADEP 2002b). In 2002, groundwater samples were collected by Baker on behalf of the PADEP from well CH1985. These groundwater samples were found to contain the following concentrations of VOCs: TCE at 37 µg/l; 1,1,1-TCA at 6 µg/l; and 1,2-dichloroethene (1,2-DCE total) at 9.9 µg/l (PADEP 2002b). This residential well was sampled again in April and then October 2003 with similar results. Table 1 provides a summary of the results obtained from PADEP’s sampling of the untreated water from residential well CH1985.

In addition to residential well CH1985, the PADEP has been monitoring groundwater within AOC1 at an additional well located very close and to the south along Conestoga

Road, known as 30CR (PADEP 2004). Both well 30CR and CH1985 are approximately the same distance from the site, but it is not known whether the well screening intervals access the same groundwater aquifer. When well 30CR was initially drilled in 2002 for residential use, TCE was immediately detected at 10,000 ug/L (PADEP 2004).

TABLE 1
CH1985 Untreated Residential Well VOC Results Summary

VOC	TCE	1,1,1-TCA	1,1-DCA	1,2-DCE (total)	1,1-DCE
Date	Result	Result	Result	Result	Result
January 1996	53	8.1	1.1	ND	ND
January 2002	37	6	1.7 J	9.9	1.2 J
April 2003	19	2	1	5	1 J
October 2003	24	2	1	7	0.9

Notes: All results in micrograms per liter (µg/L)
J = Indicates that the compound was detected below the quantitation limit (estimated value).
ND = Not detected

Residential well use for 30CR was immediately abandoned and instead this well is used for groundwater monitoring purposes only. Chlorinated solvent concentrations detected in monitoring well 30CR are significantly higher than those found at CH1985. Table 2 provides a summary of the 30CR results obtained during quarterly sampling events between March 2003 and February 2004. The most recent sampling data for this location, collected in May 2007, show that elevated levels of chlorinated solvents remain in the groundwater under AOC1 (see Table 2).

TABLE 2
30CR Monitoring Well VOC Results Summary

VOC	TCE	1,1,1-TCA	1,1-DCA	1,2-DCE (total)	1,1-DCE
Date	Result	Result	Result	Result	Result
March 2003	8,700	1,300	150 J	130 J	340
July 2003	13,000	2,700	340 J	250 J	590
October 2003	8,800	1,300	200	180 J	380
February 2004	10,000	1,600	230 J	150 J	430 J
May 2007	5,700 Q	1,150	U	NA	U

Notes: All results in micrograms per liter (µg/L)
J = Indicates that the compound was detected below the quantitation limit (estimated value).
Q = Average of multiple results from multiple analyses, or average of the averages of dual column analyses methods
NA = Not available
U = Not detected

In January 2002, an offsite groundwater investigation was conducted at residential properties located down gradient of the site. Two springs (one on Winding Way and one on Malin Station Road) and two private drinking water supply wells (CR1985 and on E. Lancaster Avenue) were sampled for VOCs. VOCs were not detected at the E. Lancaster

Avenue or Malin Station Road locations, but TCE was detected in the spring water at Winding Way (also known as SP-49) at 5.8 µg/L and at CH1985 at 37 µg/L (PADEP 2002b).

In May 2007, PADEP conducted additional groundwater sampling of monitoring wells located on and off site. Elevated concentrations of chlorinated solvents were detected in wells located inside and outside the northeast perimeter of the site (PADEP 2007). One well, MW-28, located less than 300 feet northeast of the site had elevated levels of chlorinated solvents in the deepest aquifer screened, including TCE at 17,600 µg/L (PADEP 2007). Additionally, one offsite monitoring well, 30CR, was sampled in May 2007 (located approximately 1,400' northeast of the site and within AOC1). Chlorinated solvents were detected in 30CR, including 1,1,1-TCA at 1,150 ug/L and TCE at 5,700 ug/L (PADEP 2007). Table 3 provides a summary of this most recent groundwater data.

TABLE 3
2007 Offsite Groundwater Results from Down Gradient Monitoring Wells

Location	**MW-28A**	**MW-28B**	**MW-28C**	**30CR**
Location Description	**<300' northeast of site (102' to 112' bgs)**	**<300' northeast of site (173' to 183' bgs)**	**<300' northeast of site (222' to 232' bgs)**	**Conestoga Road, <1,400' northeast of site, in AOC1**
Compound	**Result**	**Result**	**Result**	**Result**
1,1,1-Trichloroethane (1,1,1-TCA)	1020 Q	6,700 Q	1,140	1,150
1,1-Dichloroethane (1,1 DCA)	394	ND	3,310	ND
1,1-Dichloroethene (1,1-DCE)	247	ND	865	ND
Tetrachloroethene (PCE)	73.4	ND	ND	ND
Trichloroethylene (TCE)	14,200	16,200 Q	17,600 Q	5,700 Q

Notes:
All result in micrograms per liter (µg/L)
AOC1 = Residential Area of Concern 1, bordered by Malin Road and Swedesford Road to the west, Route 202 to the north, Morehall Road to the east, and U.S Route 30 to the south
Bgs = Below ground surface
E = Concentration exceeds the calibration range of the instrument for the specific analysis
ND = Not detected
Q = Average of multiple results from multiple analyses, or the average of the averages of dual column analysis methods

2.4.2.2 SURFACE WATER

On May 19 and 20, 2003, samples were collected from 21 locations including springs and surface waters along the Little Valley Creek and its tributaries (Malin, Morehall, and Worthington) (PADEP 2003). Sampling was conducted to further characterize chlorinated solvent impacts. Sampling locations included points along the perimeter of the site (SW-1 and SW-2), down stream through AOC1 (SW-4 to SW-6, SW-8 to SW-10 and SW-12 to SW-14), and beyond AOC1 (SW-15 to SW-20, SP-3, SP-4A, SP-4B) in an industrial area east of Morehall Road (PADEP 2003). Sample identifiers, sampling date, matrices, a sampling location description, PADEP's human health criteria, ATSDR's comparison values, and the compounds detected at elevated levels are provided in Appendix A, Table 1 at the end of this document.

In June and August 2004, the PADEP conducted additional sampling events to follow up the 2003 investigation and to close data gaps regarding offsite releases of site contaminants. These sampling events included collection of additional surface water samples from areas within AOC1. In addition to sampling at the Bishop Tube site and near the site perimeter, the PADEP collected samples from a drainage swale located on a commercial property (to the east of Route 401) where standing water was not draining to the Little Valley Creek. Sampling results revealed that this location appeared to be a groundwater seep with TCE concentrations of 160 µg/L (PADEP 2005a). Additional samples collected from Little Valley Creek in the vicinity of this commercial property in June 2004 had TCE concentrations of 8.4 µg/L, 9.2 µg/L, and 9.7 µg/L (PADEP 2005a). Table 4 provides maximum and median values of select compounds detected in surface water and springs within AOC1, and in surface and spring water down stream of AOC1.

2.4.2.3 VAPOR INTRUSION

In addition to collecting groundwater, surface water, and spring samples offsite, PADEP has conducted one round of vapor intrusion sampling from the basement of one home in the General Warren Village (AOC2) (PADEP 2005b). The residential location was selected by PADEP because it is situated on the perimeter of the site, potentially in the path of the chlorinated solvent plume, and closest to the northeastern corner of the site where chlorinated solvent contamination in the shallow aquifer was detected in previous assessments (PADEP 2005b). Table 5 provides a summary of selected volatile organic compounds (VOC) detected in indoor air. A number of chemicals commonly found in gasoline/oil products, paints and other chemicals (toluene, xylenes, propene, benzene, ethylbenzene, methyl ethyl ketone) were detected in the basement air, but these vapors may be attributable to storage of paint and other chemicals in the basement, some of which were known to be present at the time of sampling. Due to potential interferences by stored chemicals in the residence during indoor air sampling, the presence of these VOCs and those presented in Table 5 could not be attributed specifically to vapor intrusion or site related contamination following the January 2005 sampling event. Given the local geology and the preferential groundwater flow pathways in this area, the sampling of one home can not sufficiently characterize vapor intrusion potential in this area.

TABLE 4
Surface Water Sample Results Summary for AOC1

		Sample Collection Area **Number of samples**	**AOC1** **(9)**	**Downstream of AOC1[1]** **(9)**
Compound	**PADEP Human Health Criteria**	**ATSDR Comparison Value**	**Result Max/ mean^**	**Result Max/ mean^**
1,1,1-Trichloroethane (1,1,1-TCA)	NA	200,000/700,000 (child/adult Inter EMEG); 200 (MCL)	11/1.9	24/5.4
1,1-Dichloroethane (1,1 DCA)	NA	NA	0.66/0.3	1.6/0.5
1,1-Dichloroethene (1,1 DCE)	0.057	90/300 (child/adult chronic EMEG); 7 (MCL)	ND/0.3	8.2/1.8
1,2-Dichloroethene (1,2 DCE)	700 (trans-)	2,000/7,000 (child/adult Inter EMEG); 100 (MCL)	8.9/0.3	6.3/1.5
Bromodichloromethane	NA	200/700 (child/adult chronic EMEG); 80 (MCL); 0.6 (CREG)	ND/0.3	ND/0.3
Chloroform	5.7	100/400 (child/adult chronic EMEG); 80 (MCL)	ND/0.3	ND/0.3
Methyl-tert-butyl ether MTBE)	NA	3,000/10,000 (child/adult Inter EMEG)	18/3.3	0.31/0.26
Tetrachloroethene (PCE)	0.8	100/400 (child/adult Inter RMEG); 5 (MCL)	5.4/0.9	5.1/1.3
Trichloroethylene (TCE)	2.7	2,000/7,000 (child/adult acute EMEG); 5 (MCL)	160*/18.3	150/36.6
Vinyl chloride (VC)	2	30/100 (child/adult chronic EMEG); 2 (MCL); 0.03 (CREG)	ND/0.3	ND/0.3

Notes:
All results, human health criteria and comparison values reported in micrograms per liter (µg/L).
Results reported as not detected in original results have been given a value of half the current EPA contract-required quantitation limit for trace compound results in order to calculate the median value (0.25 µg/L for all compounds).
1 = Area is defined as downstream/east of Morehall Road (industrial area)
^ = Mean value obtained by sum of all results divided by total number of locations (9 locations in AOC1 and 9 locations downstream of AOC1)
* = 160 µg/L TCE detected in drainage swale in AOC1. The maximum TCE detected in Little Valley Creek within AOC1 was 18 µg/L
ATSDR = Agency for Toxic Substances and Disease Registry
Acute = Exposure criteria defined by ATSDR as less than or equal to 14 days
AOC1 = Residential Area of Concern 1, bordered by Malin Road and Swedesford Road to the west, Route 202 to the north, Morehall Road to the east, and U.S Route 30 to the south
Chronic = Exposure criteria defined by ATSDR as 365 days or more
CREG = ATSDR Cancer Risk Evaluation Guideline
EMEG = ATSDR Environmental Media Evaluation Guide
Inter = Exposure criteria defined by ATSDR as 15 days to 364 days
Max = Maximum result detected within the area defined during the 2003 sampling event
MCL = EPA's Maximum Contaminant Level for public drinking water supplies
NA = Not available
ND = Not detected
PADEP = Pennsylvania Department of Environmental Protection
RMEG = ATSDR Remedial Media Evaluation Guide

TABLE 5
2005 Indoor Air Quality Sampling Event Results Summary

	Location	97 Village Way (Basement)
Compound	**CV**	**Result**
1,1,1-Trichloroethane (1,1,1-TCA)	720 (Inter EMEG)	0.060 J
Tetrachloroethene (PCE)	43.4 (chronic EMEG)	0.087 J
Trichloroethylene (TCE)	91.34 (Inter EMEG)	0.099 J
Carbon tetrachloride	31.2 (chronic EMEG)	0.087 J
Carbon disulfide	283.7 (chronic EMEG)	0.82
Methyl-tert-butyl-ether (MTBE)	545 (chronic EMEG)	3.5

Notes:
All results and comparison values in parts per billion by volume (ppbv)
Chronic = Exposure criteria defined as 365 days or longer
CV = ATSDR comparison value
EMEG = Environmental media evaluation guide
Inter = Intermediate exposure duration criteria (15 days to 364 days)

2.5 DATA QUALITY

In preparing this health consultation, ATSDR relied on information provided in the referenced documents. The analyses, conclusions, and recommendations in this health consultation are valid only if the referenced documents are complete and reliable. Although ATSDR staff did not review quality assurance/quality control (QA/QC) information with regard to the collection of environmental data, such as whether measures were followed regarding chain-of-custody, laboratory procedures, and data reporting, all samples were analyzed by certified laboratories. As such, ATSDR considers these environmental data adequate for public health evaluation purposes.

2.6 CONTAMINANTS OF CONCERN

ATSDR, as well as other agencies, has developed health-based comparison values (CV) for chemicals in various environmental media (air, soil, drinking water). These values specify the concentration at or below which carcinogenic and/or noncarcinogenic health effects are not likely to result following exposure. Contaminant concentrations exceeding these values will not necessarily result in adverse health effects, but require further evaluation to determine the potential for adverse health effects.

ATSDR compared environmental sampling data provided by the PADEP for the areas surrounding the Bishop Tube site to each contaminant's CV. Although ATSDR does not have a CV for surface water, drinking water CVs were applied as the screening level for surface and spring water, as well as groundwater data. After identifying which contaminants exceed CVs for particular environmental media, ATSDR then determined if these contaminants come into contact with humans or could come into contact with humans in the future.

By comparing the contaminants identified by PADEP sampling to ATSDR's comparison values, a list of site-related chemicals has been identified for further evaluation for public health purposes. Concentrations of these chemicals in these media were reported by PADEP and summaries of these chemical concentrations have been presented. After comparing the concentrations of these chemicals to ATSDR's CVs, trichloroethylene (TCE) and tetrachloroethene (PCE) were identified as the contaminants requiring further evaluation. The following sections will discuss the exposure pathways and the estimated TCE and PCE exposure doses for each specific pathway identified.

2.7 EXPOSURE PATHWAYS

ATSDR evaluates the environmental and human components that lead to contaminant exposures. Human contact (exposure) with environmental contamination is only possible when a completed pathway exists. A completed exposure pathway exists when all of the five elements are present: (1) source of the contamination; (2) transport through an environmental medium; (3) a point of exposure; (4) a route of human exposure; and (5) an exposed population. ATSDR categorizes an exposure pathway as completed when all five elements exist and exposure to a contaminant has occurred in the past, is currently occurring, or will occur in the future. Potential pathways, however, require that at least one of the five elements is missing, but could exist. Potential pathways indicate that exposure to a contaminant could have occurred in the past, could be occurring now, or could occur in the future. An exposure pathway could be eliminated if at least one of the five elements is missing and will never be present. As an additional note, even though an exposure pathway might be complete or potentially complete, it does not necessarily mean there is a public health risk. For a public health risk to occur, a substantial exposure dose must be present in a completed or potentially completed exposure pathway.

The Bishop Tube site, a source of chlorinated solvent contamination, has been assessed for at least two decades by former site owners and, ultimately, by the PADEP. Site contaminants have been identified in a number of environmental pathways including soil, surface water and groundwater. Springs which have been sampled down gradient of the site show that chlorinated solvents have migrated well over a mile through the groundwater from the site. This plume has been sampled and modeled by the PADEP and they have determined that the likely source of the contaminant plume underlying AOC1 is the Bishop Tube site. Chlorinated solvents are present in monitoring wells, a residential well, springs and surface waters of Little Valley Creek throughout AOC1. Additional exposure points include springs, the surface waters of Little Valley Creek, and residences/buildings where chemical vapors migrating through the subsurface may enter homes/structures. A number of routes of human exposure are present in the areas bordering the Bishop Tube Site, including:

- Incidental ingestion of contaminated water from Little Valley Creek;
- Incidental ingestion of contaminated spring waters;
- Incidental ingestion of untreated groundwater from a private well;
- Inhalation of ambient air near Little Valley Creek or near contaminated springs;
- Inhalation of chlorinated solvent vapors within residences overlying or near the contaminant plume; and,
- Inhalation of chlorinated solvent vapors within dwellings or spring houses where contaminated spring water exists.

Two residential areas are located down gradient (AOC1) or in very close proximity and on grade with (AOC2) the site. An additional residential area is located to the south. The residential area to the south is not expected to be impacted with site contaminants due primarily to local geologic conditions (i.e. rock type and slope), but also because of surface and groundwater flow information, and its proximity to the site (approximately ¼ mile). AOC1 has completed or potential pathways for all the routes of exposure listed above, except exposure due to vapor intrusion. Additional data would be needed to determine whether the potential pathways of exposure are actually completed pathways. AOC2, the General Warren Village, has a potential pathway for inhalation of vapors from groundwater in dwellings, but additional sampling would be required to determine if other pathways of exposure are present in AOC2. It should be noted that due to extensive groundwater studies by PADEP, a chlorinated solvent plume is not expected to be underlying AOC2, although preferential pathways for vapor migration may be present due to the underlying geology of the region.

Based on the exposure pathways presented above and the concentrations of contaminants in environmental media (air, groundwater and surface water/springs), ATSDR has identified the following completed exposure pathways for further evaluation to determine if the potential for adverse health effects exist:

- Incidental ingestion of surface and spring water in AOC1;
- Ingestion of contaminated groundwater; and,
- Inhalation of and dermal exposure to chemicals from contaminated groundwater used at a residence prior to 1999.

In addition to these completed pathways of exposure which will be discussed in the following subsections, ATSDR has identified potential pathways of exposure for further discussion. The potential pathways of exposure include:

- Incidental ingestion of untreated groundwater from a residential tap in AOC1
- Inhalation of vapors from contaminated spring water inside structures, including dwellings and spring houses; and,
- Inhalation of vapors migrating into dwellings from underlying contaminated groundwater or soils.

Table 6 summarizes the components for each pathway of exposure for the areas surrounding the Bishop Tube Site.

2.8 EXPOSURES AND DOSE ESTIMATES

Three completed pathways have been identified for past exposures: (1) ingestion of surface water (including creek and spring waters), (2) ingestion of groundwater, and (3) inhalation of and dermal exposure to chemicals from contaminated groundwater used at a residence. One completed pathway has been identified for present exposures: ingestion of surface water, including the Little Valley Creek surface waters and local spring waters. By applying the standard conservative inputs for daily ingestion rates (i.e. 1 liter of water per day for a child weighing 16 kilograms and 2 liters of water per day for an adult

TABLE 6
Exposure Pathways Summary

Source	Media	Exposure Point	Exposure Route	Exposed Population	Period of Exposure	Exposure Status
Bishop Tube Site	Surface water and springs	Little Valley Creek and springs	Incidental ingestion	AOC1 residents and community	Past	**Completed**
					Present	**Completed**
					Future	Potential
Bishop Tube Site	Untreated Groundwater	Residential taps	Ingestion	AOC1 residents	Past	**Completed** (Prior to 1999)
					Present	Potential
					Future	Potential
Bishop Tube Site	Untreated Groundwater	Indoor air and water	Inhalation and dermal absorption	AOC1 residents	Past	**Completed** (1996-1999)
					Present	Potential
					Future	Potential
Bishop Tube Site	Vapors from groundwater	Interior air in structures over springs (dwellings and springhouses)	Inhalation	AOC1 and AOC2 residents	Past	Potential
					Present	Potential
					Future	Potential
Bishop Tube Site	Vapor intrusion from subsurface (groundwater and/or soil)	Interior air in dwellings	Inhalation	AOC1 and AOC2 residents	Past	Potential
					Present	Potential
					Future	Potential

Notes:
AOC1 = Residential Area of Concern 1, bordered by Malin Road and Swedesford Road to the west, Route 202 to the north, Morehall Road to the east, and U.S Route 30 to the south
AOC2 = Residential Area of Concern 2, the General Warren Village residential development

weighing 70 kilograms), and using the maximum concentrations detected in environmental media, the maximum exposure dose can be calculated. Table 7 provides the estimated exposure doses for the completed pathways of exposure for children and adults, respectively. A discussion of the toxicological implications from these estimated exposure doses will be discussed in the following section.

TABLE 7
Estimated Children's and Adult's Exposure Doses for Completed Pathways

Exposed Population	Contaminant	Pathway Status	Maximum concentration (ug/L)	Media	Estimated Exposure Dose mg/kg/day	NOAEL mg/kg/day	NOAEL with protection factor applied* mg/kg/day
Children	TCE	Present; completed	18	LVC surface water	0.0011	50**	0.5
Children	TCE	Present; completed	5.8	Spring water	0.00036	50**	0.5
Children	TCE	Past; completed	53	Groundwater	0.0033	50**	0.5
Children	PCE	Present; completed	5.4	Spring water	0.00034	14**	0.01
Children	TCE	Past; completed	(53)	Indoor air and water***	0.0033	50**	0.5
Adults	TCE	Present; completed	18	LVC surface water	0.00051	50**	0.5
Adults	TCE	Present; completed	5.8	Spring water	0.00017	50**	0.5
Adults	TCE	Past; completed	53	Groundwater	0.0015	50**	0.5
Adults	PCE	Present; completed	5.4	Spring water	0.00015	14**	0.01
Adults	TCE	Past; completed	(53)	Indoor air and water***	0.0015	50**	0.5

Notes:
* = The NOAEL, when converted from animal to human, is multiplied by a protection factor. This number is provided in the table after multiplying by the protection factor for the chemical
** = The lowest NOAEL dose found in animal studies
*** = A method for determining overall exposure (i.e. inhalation and ingestion) inside a home for a resident with contaminated groundwater in use is to double the ingestion exposure dose (OEHHA 1998)
NOAEL = No observed adverse effect level
µg/L = Micrograms per liter
kg = Kilograms
L/day = Liters per day
LVC = Little Valley Creek
mg/kg/day = Milligrams of contaminant per kilogram body weight per day
NOAEL = No observed adverse effect level
PCE = Tetrachloroethene
TCE = Trichloroethylene

3.0 DISCUSSION

Health effects due to exposure to toxic chemicals in the environment depend on several factors, including route of exposure, dose, frequency, age, and bioavailability. By identifying completed and potential exposure pathways, estimating exposure doses for these pathways, and comparing this information to the most relevant and current toxicological research, ATSDR can estimate whether adverse health effects may or may not occur. After evaluating site specific data, ATSDR categorizes each pathway for its expected public health consequence. The five public health categories are defined as follows:

- Urgent Public Health Hazard - Sites that pose a serious risk to the public's health as the result of short-term exposures to hazardous substances;
- Public Health Hazard - Sites that pose a public health hazard as the result of long-term exposures to hazardous substances;
- Indeterminate Public Health Hazard - Sites for which no conclusions about public health hazard can be made because data are lacking;
- No Apparent Public Health Hazard - Sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard;
- No Public Health Hazard - Sites for which data indicate no current or past exposure or no potential for exposure and therefore no health hazard.

The remainder of this section evaluates the exposure pathways and doses presented in section 2, and discusses the toxicological implications for these estimated exposure doses. Each pathway is then categorized into one of the five public health categories. Following discussions on specific exposure pathways and their toxicological implications, responses to specific community concerns, including (1) TCE and cancer and (2) former worker's health, will be presented.

3.1 TOXICOLOGICAL IMPLICATIONS

This section will evaluate the estimated exposure doses by comparing them to relevant toxicological research. After determining whether adverse health effects are likely for each exposure pathway, ATSDR will categorize each of the exposure pathways as defined above.

3.2 COMPLETED PATHWAYS OF EXPOSURE

Three completed exposure pathways were identified for the Bishop Tube Site. The following section will discuss the completed exposure pathways and specifically the contaminants of concern.

3.2.1 INCIDENTAL INGESTION OF SURFACE AND SPRING WATER IN AOC1

ATSDR evaluated this completed exposure pathway in AOC1 based on environmental sampling data sets collected by PADEP in 2002 (2 spring samples), 2003 (21 surface and spring water samples), and 2004 (7 surface water and spring samples). No data collected prior to 2002 was available for evaluation by ATSDR. By comparing each of the maximum and mean concentrations for each of three geographic areas (from site perimeter to AOC1, AOC1, and down gradient of AOC1) to CVs, ATSDR was able to determine that PCE and TCE in surface and spring water required further evaluation in

AOC1. Due to man-made culverts, underground culverts and the creek passing under Route 30, there is minimal access to the creek located up gradient of AOC1 and down gradient of the site. Areas located down gradient of AOC1 are industrial. Based on the use characteristics (access to water, industrial versus recreational) of these two areas, only data for AOC1 was further evaluated for this exposure pathway. It should be noted, however, that areas down gradient of AOC1 have higher concentrations of chlorinated solvents, including TCE, in surface and spring waters than up gradient and upstream areas (including AOC1 and areas upstream of AOC1). These down gradient and currently industrial-use areas might require further assessment to determine public health implications should accessibility or land uses change.

3.2.1.1 PCE

With incidental surface water ingestion expected to occur only during seasonal recreation activities (spring/summer/fall) in Little Valley Creek, and exposure dose concentrations well below health effects levels, ATSDR has categorized the present PCE exposure pathway in surface water as "**no apparent public health hazard**." Although limited data is available for evaluation of past exposure pathways, exposure point contaminant concentrations prior to 2002 are unknown. With a limited data set, ATSDR concludes that this past exposure pathway is an "**indeterminate public health hazard**." Without additional environmental data reporting contaminant concentrations and limited data regarding the migration of the site's contaminant plume, future exposures via this pathway are also categorized by ATSDR as an "**indeterminate public health hazard**."

Maximum (5.4 µg/L) and mean (1.44 µg/L) concentrations of PCE in surface waters in AOC1 exceeded the PADEP Human Health Criteria (0.8 µg/L). The PADEP Human Health Criteria is based primarily on EPA's reference doses (RfD) published in the Integrated Risk Information System (IRIS), but also applies additional criteria that accounts for carcinogenic effects, primary use of the waterway, and consumption (which assumes 2 liters of drinking water and 6.5 grams of fish per day) (Pennsylvania Code 2007). EPA's maximum contaminant level (MCL) for PCE in public water supplies is 5 µg/L. MCLs are set for public drinking water supplies and assume that an exposed individual will be using the water as their primary source for ingestion (2 liters per day for adults and 1 liter per day for children). The residential community within AOC1 is served by public water and ATSDR is not aware of any residents using Little Valley Creek or any of the natural springs in the area as a primary drinking water source. PCE concentrations do not exceed ATSDR drinking water CVs (intermediate remedial media evaluation guide [RMEG]) for children (100 µg/L) or adults (400 µg/L). Estimated doses are over 30 times lower than the no-adverse effect level (NOAEL) after applying a safety factor of 1000 to the NOAEL. Given the limited amount of water that children and trespassers might incidentally consume while recreating in the creek, ATSDR does not expect any adverse non-cancer health effects from exposure to the PCE in surface water and springs in AOC1.

Although the concentrations of PCE detected are not anticipated to cause any non-cancer health effects, the Department of Health and Human Services (DHHS) has determined that PCE may reasonably be anticipated to be a carcinogen (ATSDR 1997a). Oral exposure to PCE at high levels has been shown to cause liver tumors in mice (ATSDR 1997a). Again, it should be noted that ATSDR is not aware of any residents in the area that are using the creek or the springs in the area as a drinking water supply and only intermittent exposures are expected.

3.2.1.2 TCE

Surface and spring waters in this area are not known to be used for drinking water and residents in the area are supplied with public water. Estimated exposure doses for spring and surface water in AOC1 are below acute MRLs and pose a low to moderate increased risk of cancer following 30 years of exposure to these contaminated water supplies (spring or Little Valley Creek) when used as the primary drinking water source, which it is not. Therefore, ATSDR has categorized this present exposure pathway as "**no apparent public health hazard**." Due to limited environmental data, past and future exposures have been categorized as an "**indeterminate public health hazard**."

NON-CANCER EFFECTS

ATSDR has not derived a chronic or intermediate CV for TCE exposure by ingestion, and instead uses the EPA MCL of 5 µg/L for identifying contaminants that require further evaluation. ATSDR has derived an acute oral (ingestion) minimal risk level (MRL) for TCE of 0.2 milligrams of TCE per kilogram of body weight per day (0.2 mg/kg/day) for non-cancer effects, and acute CVs for drinking water of 2,000 µg/L for children and 14,000 µg/L for adults. The maximum TCE concentration in surface or spring water within AOC1, was 18 µg/L (the maximum TCE concentration in spring water was 5.8 µg/L).

Eight of 14 locations in AOC1, including both surface water and springs, had levels of TCE that exceeded the MCL, as did the mean value (18.3 µg/L) for AOC1. Locations with the highest TCE concentrations include a drainage swale (160 µg/L) at a commercial property and in Little Valley Creek just downstream of Winding Way (18 µg/L). The maximum TCE concentration detected in springs within AOC1 was 5.8 µg/L at SP-49. ATSDR is not aware of any spring water use in this area. Theoretically, spring water could be used as drinking water, so ATSDR evaluated exposures via ingestion using the maximum concentrations of TCE, which were found in spring SP-49, and the standard exposure inputs. Estimated children's (0.0004 mg/kg/day) and adult's (0.00017 mg/kg/day) exposure doses from the maximum TCE in spring water would not exceed ATSDR CVs, the MRL, or the safety-factor-adjusted NOAEL for TCE (0.5 mg/kg/day).

CANCER EFFECTS

The National Toxicology Program (NTP) determined that TCE is "reasonably anticipated to be a human carcinogen" (ATSDR 2003). The International Agency for Research on Cancer (IARC) has determined that TCE is "probably carcinogenic to humans" (ATSDR 2003). TCE cancer effects levels (CELs), which were derived from lowest observed adverse effects levels (LOAELs) in chronic-duration studies on rats and mice, ranged from 100,000 parts per billion (ppb, equal to µg/L) to 600,000 ppb. The levels of TCE measured in Little Valley Creek and the spring water of this area are from 10,000 to 100,000 times lower than these CELs.

For cancer-causing substances, EPA established a cancer slope factor (CSF) for health guidance criteria. A CSF is used to estimate the number of excess cancers expected from exposure to a specific chemical for a specific timeframe (i.e. 30 years of exposure to TCE). The range of CSFs for TCE recommended by the U.S. EPA is 0.02 to 0.4 (mg/kg/day)-1 (EPA 2001). By multiplying the maximum adult exposure dose (0.00017 mg/kg/day) by the CSF, the number of excess cancers can be estimated.

If the local spring water (maximum TCE concentration of 5.8 µg/L) was used as the primary source of drinking water over a lifetime (30 years), a low increased cancer risk could be estimated ($6.8x10^{-5}$). Should surface water be consumed daily for 30 years from Little Valley Creek (with maximum TCE concentration of 18 µg/L) at normal drinking water consumption rates of 2 liters per day, the estimated dose (0.00051 mg/kg/day) would pose a moderate increased risk for cancer ($2x10^{-4}$). These two calculations are based on EPA risk methodologies and assume the water is the primary source of drinking water.

The estimated doses from exposure to spring and Little Valley Creek water (0.00051 mg/kg/day and 0.0018 mg/kg/day for adults and children, respectively) are below the levels where cancer and non-cancer effects were observed in animal and human toxicological studies of TCE exposure. Actual exposure doses to spring and creek water at this site are expected to be lower than doses used to estimate exposures in this document since these water sources are not used as primary drinking water supplies.

3.2.2 INGESTION OF CONTAMINATED GROUNDWATER AT A RESIDENCE

Residents at a home located within AOC1 had been exposed to TCE and other site related contaminants in their drinking water prior to 1999, the year a whole-house carbon filtration system was installed. The first round of data available for this exposure pathway was collected in 1996. Exposure to these compounds may have occurred since the initiation of manufacturing operations in 1951 at the Bishop Tube site, although the actual date when VOCs began to enter the residential well (CH1985) is expected to be more recent. With no data available from 1951 to 1999, ATSDR categorizes this past exposure pathway as an "**indeterminate public health hazard**". Since a whole-house carbon filter had been installed in 1999, present and future exposures via the ingestion pathway have been categorized as "**no apparent public health hazard**."

PADEP has provided groundwater sampling data for well CH1985, a residential drinking water well. The first round of samples, collected in January 1996, showed TCE at 53 µg/L; 1,1,1-TCA at 8.1 µg/L; and, 1,1-DCA at 1.1 µg/L (O'Brien and Gere 1998). In 1999, a whole-house carbon filtration system was installed under the supervision of the PADEP. ATSDR is unaware of any additional sample data from 1996 to 1999 for well CH1985 and PADEP has informed ATSDR that the residents were exposed to the untreated groundwater during this three year period. Since exposures occurred for at least three years and possibly longer (if contamination was present prior to the first round of sampling in 1996), it is appropriate to compare daily exposure doses to chronic exposure values in order to evaluate the potential for adverse cancer and non-cancer effects.

The maximum 1,1,1-TCA concentration detected in the drinking water is below the EPA maximum contaminant level goal (MCLG) of 200 ug/L and no adverse health effects are expected from exposure to this contaminant at this concentration. The EPA and ATSDR have not identified MCLGs, CVs or MRLs for 1,1-DCA, but animal studies on chronic exposure to 1,1-DCA showed no adverse effects when much higher concentrations were ingested by the subjects. Therefore, ATSDR does not expect adverse health effects from chronic exposure to 1,1-DCA at 1.1 µg/L.

TCE concentrations detected in groundwater from this residence in 1996 were approximately ten times the MCL. Exposure doses calculated for adults (70 kilograms body weight) consuming 2 liters of water per day, and children (16 kilograms body weight) consuming 1 liter of water per day contaminated with 53 µg/L of TCE, the maximum concentration detected, were 0.0015 mg/kg/day and 0.0033 mg/kg/day, respectively.

Due to insufficient data, ATSDR has not derived intermediate and chronic ingestion guidelines for TCE. In reviewing the available literature on chronic exposure (greater than 365 days) to TCE through ingestion, all the animal studies reviewed had used much higher doses than the exposure dose calculated for this site. The lowest No Observed Adverse Effect Levels (NOAELs) dose found in chronic animal studies (50 mg/kg/day) was over 3,300 times greater than the adult dose and over 1,500 times greater than the child dose calculated for this pathway at this site. A NOAEL is a chemical-specific dose at which no adverse health effects were observed in the study subjects (ATSDR 1997b). The calculated exposure doses for adults and children are well below the NOAEL; therefore adverse health effects are unlikely.

The ability of TCE to cause cancer is presently under review by EPA, is classified as reasonably anticipated to be carcinogenic by the National Toxicology Program (NTP), and is classified as probably carcinogenic to humans (limited human evidence, sufficient evidence in animals) by the International Agency for Research on Cancer (IARC). Available studies indicate people exposed to TCE for chronic periods via the inhalation and dermal route in the workplace do not experience an increased incidence of cancer. Exposure to TCE via ingestion and cancer in humans is controversial, with a number of studies indicating an association and a number of studies not indicating an association (ATSDR 1997b). Results from the ATSDR TCE Subregistry exposure study did not report an excessive rate of cancer when compared with the general population (ATSDR 1994).

Ingestion of TCE from drinking water well CH1985 is known to have occurred from 1996 through 1999, when a whole-house filtration system was installed. No data is available prior to 1996 to determine if TCE was present in the drinking water at this residence, but TCE ingestion at this residence may have occurred for as long as the Bishop Tube site was in operation (since 1951), although this scenario is unlikely, and TCE contamination at this residential well is expected to have occurred more recently than 1951. Given the worst case scenario for exposure to TCE (1951 to 1999) and using the maximum level detected in this well (53 ug/L), there may be a slightly increased risk of developing cancer from exposure to contaminated groundwater from the site.

There may also be an increased risk for some fetal effects if mothers were exposed to TCE at these levels during pregnancy. Studies are not conclusive, but some do suggest an association (CaEPA, 1999 and Khattak et al, 1999).

Due to the lack of environmental data for extended periods of time (e.g. prior to 1996), this pathway has been categorized as an "**indeterminate public health hazard**" prior to 1999, when a whole-house carbon filter was installed. Since 1999, this exposure pathway has been categorized as "**no apparent public health hazard**."

3.2.3 INHALATION OF AND DERMAL EXPOSURE TO CHEMICALS FROM CONTAMINATED GROUNDWATER USED AT A RESIDENCE

Inhalation and dermal absorption exposure pathways were present at the residence which used contaminated groundwater from well CH1985. Evaluation of these additional exposure pathways is necessary when estimating overall exposures to residents where VOCs have contaminated the water supply. Many methods have been employed to estimate exposure to individuals while showering with contaminated water, and this specific short-term period of exposure can result in the highest levels of exposure for an individual in the home. But, exposure while showering plus exposure from ingestion only accounts for a portion of the overall exposure to a resident using VOC-contaminated groundwater in their home. Additional inhalation exposures occur throughout the house from ambient contaminant concentrations and while using the contaminated water for various common household activities. Dishwashers and washing machines can release VOCs into the indoor air. Using contaminated water in the kitchen sink or for other common activities can also result in dermal and inhalation exposures.

One method to estimate all exposures while in the home (i.e. whole-house exposure) is to double the estimated ingestion dose (OEHHA 1998). By using the estimated ingestion dose at this residence (0.0015 and 0.033 mg/kg/day for adults and children, respectively) to account for inhalation and dermal absorption, and combining this dose with the ingestion dose, a total exposure dose can be estimated (i.e. doubling the ingestion dose to account for all exposure pathways, including ingestion, dermal absorption and inhalation). Based on this method, the estimated dose for one route of exposure (inhalation or dermal) is 0.0015 for adults and 0.0033 mg/kg/day for children.

The estimated combined exposure dose, which includes dermal, inhalation and ingestion exposure pathways, for residents using water from well CH1985 is 0.0030 and 0.0066 mg/kg/day for adults and children, respectively. The estimated overall exposure doses are below the lowest NOAEL reported from toxicological studies. But, insufficient environmental data and site specific house data are available for this residence regarding exposure. Due to the lack of environmental data for extended periods of time (e.g. prior to 1996) and no indoor air monitoring data, this past exposure pathway has been categorized as an "**indeterminate public health hazard**". Since a whole-house carbon filter has been installed in 1999, present and future exposures are categorized as "no apparent public health hazard." It should also be noted that vapor intrusion from the underlying groundwater contaminant plume may lead to unhealthy exposures in this home. More environmental data is needed to evaluate this pathway, which is discussed further in Section 3.4.3.

3.3 POTENTIAL PATHWAYS OF EXPOSURE

The following sections will discuss potential exposure pathways and the associated contaminants of concern.

3.3.1 INCIDENTAL INGESTION OF UNTREATED GROUNDWATER FROM RESIDENTIAL TAPS IN AOC1

The groundwater underlying AOC1 contains a chlorinated solvent plume. Local authorities and PADEP have reported that, except for the one residence on Conestoga Road, no additional residential wells are known to be in use in this area. The Conestoga Road residential well (CH1985) has been identified and sampled by the PADEP. Based on these sampling results, we know that the occupants were exposed to chlorinated VOCs prior to 1999, when a whole-house carbon filter was installed, thus eliminating exposures via groundwater pathway. Unfortunately we do not know when exposures to chlorinated VOCs began prior to 1996 or at what levels exposures occurred. PADEP has continued to monitor CH1985 (see Table 1) and has installed and maintains a whole-house carbon filtration system at the residence. The property owner has limited access to the untreated water, and PADEP has informed ATSDR that the untreated water is not intentionally consumed or used by the resident. Concentrations of TCE in the untreated groundwater collected from this residential well have fluctuated from 53 µg/L in 1996 to 24 µg/L in 2003. TCE concentrations in carbon-filtered water at this residence are below the federal drinking water standard of 5 µg/L for TCE.   Although levels detected in this residential well have remained relatively stable (24 to 53 µg/L), a monitoring well (30CR) located within a few hundred yards south of this well has reported TCE concentrations up to 13,000 µg/L during the same timeframe.

Should someone consume the untreated water for a short period of time (less than 14 days), the exposure dose by ingestion would be below the acute MRL of 0.2 mg/kg/day. At the maximum TCE concentration detected in this well (53 µg/L), the exposure dose by ingestion for a child would be 0.0053 mg/kg/day, well below the acute MRL. Based on the concentrations detected in the untreated groundwater and the limited current exposure to this water, incidental ingestion of untreated groundwater at this residence is not expected to cause adverse non-cancer health effects, but due to limited environmental data, ATSDR has categorized this pathway as an "**indeterminate public health hazard**".

3.3.2 INHALATION OF VAPORS FROM CONTAMINATED SPRING WATER IN STRUCTURES (DWELLING AND SPRING HOUSE) AND AMBIENT AIR

The PADEP has identified a number of springs in the area, but only two locations where impacted springs are enclosed in a structure: SP-49, located at a residence on Winding Way in AOC1, and SP-4, located down gradient of AOC1 in an industrial area. ATSDR evaluated the enclosed exposure pathways under the assumption that VOC levels would be higher inside structures such as spring houses and residential dwellings, than ambient levels in outdoor air. As such, if these exposure scenarios are determined to not be of public health concern, then VOC exposures in ambient air would not be of concern as well.

3.3.2.1 WINDING WAY SPRING

A spring located on Winding Way is reported to be directly under the first floor at the residential dwelling, where it collects in a pool under the house before a pipe redirects this pooled water to the “springhouse”, where sampling point SP-49 is located (PADEP 2008). An opening in the floor at this residence allows for direct access to the pooled spring water. This floor opening also creates a conduit for vapors to migrate from the spring water into the living spaces at the residence. Sample results reported for this spring (SP-49) were collected from a location down gradient of the original spring location, the spring water pool and the conduit pipe which transports the spring water from under the dwelling to the “spring house.” The maximum TCE reported from SP-49 was 5.8 µg/L, however, it is expected that spring water TCE concentrations would be higher upgradient of this sampling point, specifically at the spring and collecting pool located under the dwelling.

ATSDR does not have the necessary environmental information required to evaluate TCE vapor concentrations emanating from the pooled water under this residence. Second, the sampling results reported for SP-49 were collected down gradient of the dwelling itself and are most likely lower than the levels nearer the dwelling due to vaporization from the surface water. With continuous spring water flow under the house and a collecting pool under the house, TCE vapor concentrations could potentially accumulate and migrate into living spaces through the access hole in the floor. With no environmental sampling data to evaluate this exposure pathway, ATSDR can only report this as a data gap which would require additional sampling for evaluation. As such, ATSDR categorizes this exposure pathway as an “**indeterminate public health hazard**” and recommends additional sampling to determine whether a public health hazard is present at this residence.

3.3.2.2 SP-4 SPRING HOUSE

Although outside of AOC1, but within close proximity to the residential area, the spring located within a spring house (SP-4) has a very high flow rate (up to 300 liters per minute) and a maximum TCE concentration of 130 ug/L (McGinty 2003 and PADEP 2003). The PADEP has reported that the roof of the spring house is considerably deteriorated (PADEP 2008). With the dilapidated structure conditions, indoor air turnover rates are expected to be high and TCE or other chlorinated solvent vapors can be expected to dissipate rapidly. Although, given the very high flow rate and TCE concentration, the potential for chlorinated solvent vapor exposures inside this structure is possible. Since no data has been provided regarding vapor concentrations within this structure, ATSDR can only report this as a data gap and that the potential remains for exposures at this location. As such, ATSDR categorizes this exposure pathway as an "**indeterminate public health hazard**."

3.3.3 INHALATION OF VAPORS MIGRATING INTO DWELLINGS FROM UNDERLYING CONTAMINATED GROUNDWATER OR SOILS

Environmental data is limited to indoor air sampling conducted in 2005 and 2008 from three residences located in AOC2. The 2005 sample was collected from the basement of the nearest residence to the site, although this basement did not have a sump and the building slab appeared to be intact with no apparent cracks or openings. The 2008 samples were also collected from the same area, including the residence sampled in 2005 and two neighboring residences within AOC2. With this limited environmental data set, ATSDR has categorized this exposure pathway as an "**indeterminate public health hazard**".

In January 2005, the PADEP collected one indoor air sample in the General Warren Village (AOC2) to determine whether chlorinated solvent vapors from contaminated groundwater and soil were migrating into a home. Due to a number of factors, this assessment did not provide enough data to draw any general conclusions regarding vapor intrusion. The PADEP chose to sample this residence located within AOC2 due to (1) its close proximity to the northeast portion of the site where the highest levels of contamination were detected, (2) the northeasterly surface and groundwater flow direction, (3) the shallow groundwater (approximately 5-feet below ground surface) in this area, and (4) a groundwater TCE concentration of 700 ug/L near this residence.

An indoor-air TCE concentration of 0.099 ppb was detected in the basement, but a number of chemicals were stored in the dwelling during sample activities making a determination of the source of this TCE vapor and the other volatile organic vapors impossible. Other volatile organic vapors were detected in the sample, but none were above levels known to cause adverse health effects. Additionally, the basement slab appeared to be in good condition and no openings, such as a sump, were present in the floor.

One residential indoor air sample was collected and analyzed for organic compounds in 2005. The location selected by the PADEP for this indoor air sampling event is the closest residence to the site, but the groundwater contaminant plume and the maximum contaminant concentrations appear to have migrated northeasterly and possibly to the west of this residence, based on various PADEP assessment documents. The actual extent of the plume has not been fully characterized.

In March 2008, additional samples were collected by PADEP in AOC2. Specifically, indoor air and outdoor ambient air samples were collected for volatile organic compounds analyses. None of these results indicated a vapor intrusion concern for residential properties within AOC2.

A number of factors, including sample results, geologic studies, and the presence of springs contaminated with site contaminants suggests a need for further assessment and evaluation of the vapor intrusion pathway for the site. AOC1 and portions of AOC2, as defined by the PADEP in its comprehensive site characterization report is underlain with limestone and dolomite which shows characteristics of fractured bedrock (PADEP 2002a). Contaminated spring water located in AOC1 and down gradient of AOC1 suggests that groundwater is migrating from the site towards AOC1, then either surfacing in AOC1 or migrating in the aquifer past AOC1. Much higher concentrations of TCE have been detected under AOC1 than at the location the PADEP sampled for indoor air in 2005. Results from a more recent groundwater sampling event in 2007 from within AOC1 showed a TCE concentration of 5,700 ug/L in well 30CR. Past groundwater sampling results from the well 30CR showed TCE results up to 13,000 ug/L. With a known chlorinated solvent contaminant plume migrating through the groundwater underlying AOC1, additional indoor air, sub-slab or soil vapor sampling in AOC1 is recommended to characterize this exposure pathway.

3.4 COMMUNITY CONCERNS

This section will discuss specific concerns raised by the local residents which were presented in Section 2.3.

3.4.1 TCE AND CANCER

ATSDR reviewed relevant literature regarding TCE and cancer. Some studies with mice and rats have suggested that high levels of TCE may cause liver, kidney, or lung cancer (ATSDR 2003). A review of the available literature on TCE carcinogenicity has not shown a relationship to TCE exposure and pancreatic cancer in animals or human studies. Some studies of people exposed over long periods to high levels of TCE in drinking water or in workplace air have found evidence of increased cancers (ATSDR 2003). Although, there are some concerns about the studies of people who were exposed to TCE, some of the effects found in people were similar to the effects in animals (ATSDR 2003).

In the National Academy of Sciences (NAS) TCE report in 2006, several findings regarding the likelihood of human cancers from TCE exposure were reported (NAS 2006). For kidney cancer, there is agreement between animal and human studies which support the conclusion that TCE is a potential human kidney carcinogen (NAS 2006). The toxic effects on the nephron tubule (kidney) appear to have a role in cancer development, functioning as a promoter (NAS 2006). However the magnitude of exposure necessary to produce kidney damage (leading to cancer) in humans is not clear but appears to be at levels higher than typically found in the environment (NAS 2006). Exposure to TCE concentrations relevant to the general public is not likely to induce liver cancer in humans (NAS 2006). Also, humans appear to be far less susceptible to liver cancer than mice (NAS 2006). Lung cancer does not appear to result from exposures to TCE while lymphatic cancers (particularly non-Hodgkin's lymphoma and childhood leukemia) need to be further investigated as the data is not conclusive (NAS 2006).

In addition to reviewing the relevant literature on TCE and carcinogenicity, ATSDR contacted the PADOH epidemiology program. The PADOH epidemiology program provided the ZIP code cancer incidence rate area analysis (1996-2004) for the area within a 3 mile radius of the site. In summary, by screening this data for the overall area, the state epidemiologists did not find increased cancer rates in areas surrounding the site as compared to overall state cancer rates.

3.4.2 WORKER CONCERNS

Serious health effects were reported by a former Bishop Tube employee, including tingling sensations, a drunken feeling and, more recently the development of asthma which the former employee has never had before. Tingling sensations are consistent with exposure to moderate to high concentrations of TCE which can have effects on the nervous system. A drunken feeling, as reported by the former employee is consistent with the known effects of acute exposures to high concentrations of TCE, which include dizziness, drowsiness, headache, and unconsciousness. Although no specific environmental or occupational data is available for specific time period of this worker’s exposure, the highly contaminated soils identified in these specific work areas indicate heavy contamination in the work area when the facility was in operation, which most likely resulted in very unhealthy TCE exposures for workers.

Due to this former employee’s prolonged exposure to TCE and other chlorinated solvents while working at the facility, ATSDR suggests this employee and other employees who have experienced these health effects and have a similar work history at the site (i.e. stationed at degreasers or other areas where high concentrations of chlorinated solvents were identified) seek a medical evaluation. Periodic medical examination is also recommended for individuals that have experienced acute health effects from occupational exposures to TCE.

4.0 CHILD HEALTH CONSIDERATIONS

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than adults; this means they breathe the dust, soil, and vapors that are closer to the ground. A child’s lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus, adults need as much information as possible to make informed decisions regarding their children's health. Therefore, a major focus of ATSDR's evaluation is children's exposure to hazardous chemicals and the potential health effects associated with their exposure. Based on the levels detected and the exposure pathways identified, we do not expect adverse health effects to result from children's exposure to TCE and other VOCs based on current environmental data. Due to a lack of environmental sampling data, no conclusions can be made regarding past exposures. Because chlorinated solvents continue to contaminate the groundwater under AOC1, a potential for future exposures exists. Additional sampling data would be needed to determine whether unhealthy exposures may occur in the future.

5.0 CONCLUSIONS

ATSDR has evaluated environmental sampling data for areas surrounding the Bishop Tube site, including residential areas located on grade (AOC2) and down gradient (AOC1) of the site. AOC1, as described by the PADEP, is impacted by a chlorinated solvent plume in the underlying aquifer which is most likely due to former industrial activities at the Bishop Tube site. Additionally, surface waters of the Little Valley Creek appear to have been impacted by contaminated surface water runoff from the site and from contaminated springs which feed the creek throughout AOC1 and down gradient of AOC1.

Three completed exposure pathways, and 3 potential exposure pathways were identified and evaluated by ATSDR for this site. ATSDR evaluated environmental media concentrations, identified completed and potential exposure pathways, calculated exposure doses, and conducted literature reviews and data evaluations. Table 8 and the following bullets summarize ATSDR's conclusions for the specific exposure pathways, contaminants of concern, and the timeframes of exposure for the Bishop Tube Site.

- Although a number of contaminants, including heavy metals, nitric and hydrofluoric acids, and chlorinated solvent breakdown products (1,1,1-TCA; 1,1-DCA; 1,1-DCE; 1,2-DCE) were detected in on-site samples at concentrations that may present a public health concern in a residential setting, these high concentrations were not identified off site. Off-site exposures to high concentrations of these contaminants are not expected at this time. ATSDR does not expect adverse effects due to current or past exposures to these chemicals.
- Exposure dose estimates for incidental ingestion of untreated water at the residence on Conestoga Road are below the acute MRL for TCE when using the maximum concentration detected (53 µg/L). No adverse health effects are expected due to incidental exposures at this residence based on current data. ATSDR has identified this current potential exposure pathway as "**no apparent public health hazard**".
- Workers exposures to chlorinated solvents at specific areas of the Bishop Tube Site, including the degreaser area, appear to have resulted in adverse health effects. These past exposures are a health hazard to the exposed workers.

Table 8
Exposure Pathway and Public Health Category Summary

Exposure Pathway	Completed or Potential Pathway?	Time period	Public Health Category
Incidental ingestion of surface and spring water in AOC1	Completed	Past	Indeterminate public health hazard
		Present	No apparent public health hazard
		Future	Indeterminate public health hazard
Ingestion of contaminated groundwater at a residence	Completed	Past	Indeterminate public health hazard
		Present	No apparent public health hazard
		Future	
Inhalation and dermal absorption of chemical vapors from contaminated groundwater used at a residence	Completed	Past	Indeterminate public health hazard
		Present	No apparent public health hazard
		Future	
Incidental ingestion of groundwater from residential taps in AOC1	Potential	Past	Indeterminate public health hazard
		Present	
		Future	
Inhalation of vapors from contaminated spring water inside a residential dwelling and a spring house	Potential	Past	Indeterminate public health hazard
		Present	
		Future	
Inhalation of vapors migrating into dwellings from underlying contaminated groundwater or soils in both AOC1 and AOC2	Potential	Past	Indeterminate public health hazard
		Present	
		Future	

6.0 RECOMMENDATIONS

- Area residents and local authorities should be informed of this health consultation.
- Residents and local authorities in areas down gradient of the site (AOC1) should be informed of the groundwater contaminant plume, and surface and spring water contamination**.**

- For residents using groundwater at the Conestoga Road property, ATSDR recommends continued use of the treated water for consumption and other indoor uses. Due to the extreme variability of TCE concentrations in groundwater in this area, continued monitoring of the groundwater from this residential well is recommended.
- Residents at the Conestoga Road property should be advised of the potential for inhalation, dermal, and incidental ingestion exposures if untreated groundwater is used.
- Indoor air sampling should be conducted in AOC1, particularly in (1) the Winding Way and Conestoga Road residences, (2) spring houses, (3) the commercial property along Conestoga Road, and (4) at other locations where geology, contaminant plume conditions, and surface and/or spring water contamination suggest potential vapor intrusion.

7.0 PUBLIC HEALTH ACTION PLAN

The purpose of the public health action plan (PHAP) is to ensure that this evaluation not only identifies potential and ongoing public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. The public health actions that are completed, ongoing and planned are listed below.

7.1 Completed Actions

PADEP began hazardous site cleanup activities at the Bishop Tube site in the 1990s. Comprehensive site assessment activities, which are ongoing, resulted in (1) a well-defined geology of the area and (2) a general understanding of the site conditions, the contaminant concentrations in various environmental media, the groundwater contaminant plume trends and concentrations, and some understanding of the off site contaminants and preferential pathways of contaminant migration. The assessments previously conducted by PADEP and its contractors have provided the PADEP with enough information to begin a source-area cleanup in order to reduce plume contaminant concentrations in the future. Offsite assessment activities have resulted in identifying an impacted residential well leading to PADEP's installation of a whole-house filter system to remove the site related contaminants from the residential water supply. Intermittent sampling of this residential well since 1996 when it was identified by PADEP has continued and is planned to continue indefinitely.

7.2 Ongoing Actions

PADEP has entered into an agreement with a current site purchaser for the installation and maintenance of a source-reduction, engineering system which uses air sparge and soil vapor extraction techniques to actively mobilize and collect chlorinated solvent contaminants from the most heavily impacted soils on the site. This activity will reduce the contaminant volume at the source, which, over time should result in reduced concentrations of contaminants in the groundwater plume. PADEP has agreed to continue to characterize and address groundwater contamination related to this site. PADEP continues to investigate offsite contamination, including intermittent sampling of residential well CH1985, and is in the planning phase for additional assessment activities which will further characterize the Little Valley Creek and indoor air quality in the site area, including residences in the General Warren Village (AOC2).

7.3 Planned Actions

ATSDR will make recommendations as listed in section 7.0 above and will directly contact PADEP and individual residents to inform them of these recommendations. ATSDR will mail this health consultation to the appropriate personnel at PADEP, East Whiteland Township, and Chester County Health Department to ensure they are made aware of ATSDR's recommendations to further investigate potential exposure pathways and to determine the contaminant concentrations for each of these pathways. ATSDR will work closely with PADEP in the future to help evaluate the available data and to make recommendations regarding assessment and cleanup of off site areas of concern.

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ATTACHMENT A

Water and Spring Volatile Organic Compounds Data Collected May 2003
(4 pages)

ATTACHMENT
TABLE A
Summary Table of Surface Water and Spring Volatile Organic Compounds Data
Collected May 2003

		Sampling Location	SW-1	SW-2	SW-3	SW-4	SW-5
		Date Sampled	May-03	May-03	May-03	May-03	May-03
		Matrix	SW	SW	SW	SW	SW
		Location Description	LVC south of site	LVC southeast edge of site	LVC northeast of site and south of railroad	LVC north of Rt. 30	Malin Tributary east of Malin Road
		Unit	ug/L	ug/L	ug/L	ug/L	ug/L
Compound	Human Health Criteria*	Comparison Value (CV)**	Result	Result	Result	Result	Result
1,1,1-Trichloroethane (1,1,1-TCA)	NA	200,000/700,000 (child/adult Inter EMEG); 200 (LTHA)	ND	ND	17	11	ND
1,1-Dichloroethane (1,1 DCA)	NA	NA	ND	ND	ND	ND	ND
1,1-Dichloroethene (1,1 DCE)	0.057	9/300 (child/adult chronic EMEG); 7 (MCL)	ND	ND	0.64	0.23	ND
1,2-Dichloroethene (1,2 DCE)	700 (trans-)	2,000/7,000 (child/adult Inter EMEG); 100 (MCL)	ND	ND	14	8.9	1.4
Bromodichloromethane	NA	200/700 (child/adult chronic EMEG); 80 (MCL)	ND	ND	ND	ND	ND
Chloroform	5.7	100/400 (child/adult chronic EMEG); 80 (MCL)	ND	ND	ND	ND	ND
Methyl-tert-butyl Ether (MTBE)	NA	3,000/10,000 (child/adult Inter EMEG)	ND	ND	6	4.4	18
Tetrachloroethene (PCE)	0.8	100/400 (child/adult Inter RMEG); 5 (MCL)	ND	ND	0.57	ND	5.4
Trichloroethylene (TCE)	2.7	2,000/7,000 (child/adult acute EMEG); 5 (MCL)	ND	ND	55	44	0.73
Vinyl chloride (VC)	2	30/100 (child/adult chronic EMEG); 2 (MCL)	ND	ND	0.23	ND	ND

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TABLE A

Summary Table of Surface Water and Spring Volatile Organic Compounds Data

Collected May 2003

		Sampling Location	SW-6	SW-8	SW-9	SW-10	SW-12
		Date Sampled	May-03	May-03	May-03	May-03	May-03
		Matrix	SW	SW	SW	SW	SW
		Location Description	LVC midway between Rt. 30 and Rt 401	LVC east of Rt. 401	LVC upstream of 10 Winding Way spring confluence	LVC 80 yards downstream of bridge at end of Winding Way	Morehall Tributary downstream of Rt. 30 and above waterfall
		Unit	ug/L	ug/L	ug/L	ug/L	ug/L
Compound	Human Health Criteria*	Comparison Value (CV)**	Result	Result	Result	Result	Result
1,1,1-Trichloroethane (1,1,1-TCA)	NA	200,000/700,000 (child/adult Inter EMEG); 200 (LTHA)	1	ND	1.6	2.4	ND
1,1-Dichloroethane (1,1 DCA)	NA	NA	ND	ND	ND	ND	ND
1,1-Dichloroethene (1,1 DCE)	0.057	9/300 (child/adult chronic EMEG); 7 (MCL)	ND	ND	ND	0.66	ND
1,2-Dichloroethene (1,2 DCE)	700 (trans-)	2,000/7,000 (child/adult Inter EMEG); 100 (MCL)	1.6	0.82	2.3	1.3	ND
Bromodichloromethane	NA	200/700 (child/adult chronic EMEG); 80 (MCL)	ND	ND	ND	ND	ND
Chloroform	5.7	100/400 (child/adult chronic EMEG); 80 (MCL)	ND	ND	ND	ND	ND
Methyl-tert-butyl Ether (MTBE)	NA	3,000/10,000 (child/adult Inter EMEG)	3.1	1.6	1.1	0.45	ND
Tetrachloroethene (PCE)	0.8	100/400 (child/adult Inter RMEG); 5 (MCL)	ND	ND	ND	0.81	ND
Trichloroethylene (TCE)	2.7	2,000/7,000 (child/adult acute EMEG); 5 (MCL)	5	2.7	9.5	18	ND
Vinyl chloride (VC)	2	30/100 (child/adult chronic EMEG); 2 (MCL)	ND	ND	ND	ND	ND

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TABLE A
Summary Table of Surface Water and Spring Volatile Organic Compounds Data
Collected May 2003

		Sampling Location	SP-3	SW-13	SW-14	SW-15	SP-4A
		Date Sampled	May-03	May-03	May-03	May-03	May-03
		Matrix	Spring water	SW	SW	SW	Spring water
		Location Description	Spring/ wetland area feeding Morehall tributary near Norwood Industries	Morehall tributary downstream of culvert, under power lines	Morehall tributary above confluence with LVC	LVC upstream of confluence with NI spring	Spring from springhouse north of NI downstream of Morehall bridge
		Unit	ug/L	ug/L	ug/L	ug/L	ug/L
Compound	Human Health Criteria*	Comparison Value (CV)**	Result	Result	Result	Result	Result
1,1,1-Trichloroethane (1,1,1-TCA)	NA	200,000/700,000 (child/adult Inter EMEG); 200 (LTHA)	1.1	ND	ND	1.4	24
1,1-Dichloroethane (1,1 DCA)	NA	NA	ND	ND	ND	ND	1.6
1,1-Dichloroethene (1,1 DCE)	0.057	9/300 (child/adult chronic EMEG); 7 (MCL)	ND	ND	ND	0.35	8.2
1,2-Dichloroethene (1,2 DCE)	700 (trans-)	2,000/7,000 (child/adult Inter EMEG); 100 (MCL)	ND	ND	ND	ND	5.5
Bromodichloromethane	NA	200/700 (child/adult chronic EMEG); 80 (MCL)	0.9	ND	ND	ND	ND
Chloroform	5.7	100/400 (child/adult chronic EMEG); 80 (MCL)	3.8	ND	ND	ND	ND
Methyl-tert-butyl Ether (MTBE)	NA	3,000/10,000 (child/adult Inter EMEG)	ND	ND	ND	ND	ND
Tetrachloroethene (PCE)	0.8	100/400 (child/adult Inter RMEG); 5 (MCL)	ND	ND	ND	ND	5.1
Trichloroethylene (TCE)	2.7	2,000/7,000 (child/adult acute EMEG); 5 (MCL)	6.5	ND	ND	9.8	130
Vinyl chloride (VC)	2	30/100 (child/adult chronic EMEG); 2 (MCL)	ND	ND	ND	ND	ND

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TABLE A
Summary Table of Surface Water and Spring Volatile Organic Compounds Data
Collected May 2003

		Sampling Location	SP-4B	SW-16	SW-17	SW-18	SW-19	SW-20
		Date Sampled	May-03	May-03	May-03	May-03	May-03	May-03
		Matrix	SW	SW	SW	SW	SW	SW
		Location Description	Spring (north of NI and downstream of Morehall bridge) tributary sample upstream of LVC confluence	LVC sample just downstream of confluence with spring north of NI and downstream of Morehall bridge	LVC upstream of WS and Worthington tributary confluence	Worthington tributary between rail line and "84 Lumber"	Worthington tributary above LVC confluence	LVC at downstream end of WS site culvert
		Unit	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Compound	Human Health Criteria*	Comparison Value (CV)**	Result	Result	Result	Result	Result	Result
1,1,1-Trichloroethane (1,1,1-TCA)	NA	200,000/700,000 (child/adult Inter EMEG); 200 (LTHA)	18	2.1	0.98	ND	ND	0.91
1,1-Dichloroethane (1,1 DCA)	NA	NA	1.2	0.37	ND	ND	ND	ND
1,1-Dichloroethene (1,1 DCE)	0.057	9/300 (child/adult chronic EMEG); 7 (MCL)	5.9	0.27	ND	ND	ND	0.25
1,2-Dichloroethene (1,2 DCE)	700 (trans-)	2,000/7,000 (child/adult Inter EMEG); 100 (MCL)	6.3	0.39	ND	ND	ND	0.44
Bromodichloromethane	NA	200/700 (child/adult chronic EMEG); 80 (MCL)	ND	ND	ND	ND	ND	ND
Chloroform	5.7	100/400 (child/adult chronic EMEG); 80 (MCL)	ND	ND	ND	ND	ND	ND
Methyl-tert-butyl Ether (MTBE)	NA	3,000/10,000 (child/adult Inter EMEG)	ND	ND	ND	ND	ND	0.31
Tetrachloroethene (PCE)	0.8	100/400 (child/adult Inter RMEG); 5 (MCL)	4.2	0.49	ND	ND	ND	ND
Trichloroethylene (TCE)	2.7	2,000/7,000 (child/adult acute EMEG); 5 (MCL)	150	18	7.2	ND	ND	7.2
Vinyl chloride (VC)	2	30/100 (child/adult chronic EMEG); 2 (MCL)	ND	ND	ND	ND	ND	ND

Notes:
* = PADEP water quality standard in micrograms per liter
** = Comparison values for Drinking Water reported in micrograms per liter
EMEG = Environmental Media Evaluation Guides
LTHA = Lifetime health advisory
LVC = Little Valley Creek
MCL = EPA's maximum contaminant level
NA = Not assigned
ND = Not detected above detection limit
NI = Norwood Industries
RMEG = Remedial Media Evaluation Guides, based on EPA Reference Dose (RfD)
SP = Spring
SW = Surface water
ug/L = Micrograms per liter
WS = Worthington Steel