



Public Health Assessment for

**SHENANDOAH ROAD GROUNDWATER CONTAMINATION
EAST FISHKILL, DUTCHESS COUNTY, NEW YORK
EPA FACILITY ID: NYSFN0204269
SEPTEMBER 8, 2003**

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE**

Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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PUBLIC HEALTH ASSESSMENT

SHENANDOAH ROAD GROUNDWATER CONTAMINATION

EAST FISHKILL, DUTCHESS COUNTY, NEW YORK

EPA FACILITY ID: NYSFN0204269

Prepared by:

New York State Department of Health
Center for Environmental Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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SUMMARY

The Shenandoah Road Groundwater Contamination site is in a rural area of homes, farmland and undeveloped parcels. Past industrial activities at a facility located at 7 East Hook Cross Road (which cleaned and restored computer parts) contaminated groundwater in the area with volatile organic compounds (VOCs), primarily tetrachloroethene also known as perchloroethylene, perc or PCE. Activities at the facility were allegedly performed by a contractor for International Business Machines Corporation (IBM), East Fishkill, Dutchess County, New York. The IBM Corporation is cooperating with the United States Environmental Protection Agency (US EPA) and assisting in the investigation, remediation, operation and maintenance of the site-related activities.

The site posed a public health hazard in the past to residents due to exposure to VOCs in their private wells. All residents in the area use private wells for their potable water supply. Residents with contaminated private wells have been exposed to VOCs in their water for an unknown amount of time, some possibly as long as thirty years. Exposures to VOCs occurred through inhalation, ingestion and dermal absorption. Private wells were initially sampled between April and October 2000. Of the VOCs detected, PCE is the most commonly detected contaminant and has the highest concentrations. However, trichloroethene, (TCE) is also detected in many wells at or above the State and Federal drinking water standard. PCE contamination was detected in 60 private wells at levels equal to and above the state and federal drinking water standard of five micrograms per liter (mcg/L), which is about 5 parts per billion (ppb) for water. The levels of PCE found in the contaminated residential wells ranged from non-detect to the highest level of 1600 mcg/L. However, only exposures to levels as high as 1100 mcg/L were measured, because the 1600 mcg/l was detected in a sample that was collected before the carbon filter, which removed the contaminant before it reached the household system. Twenty homes had PCE levels above 70 mcg/L, the US EPA Removal Action (Emergency Response) level. On June 8, 2000, the US EPA initiated an Emergency Response action by providing 57 of the 60 affected residences with bottled water and subsequently with granular activated carbon (GAC) filtration systems. Three homeowners installed GAC filtration systems at their own expense prior to US EPA's involvement in the site.

People drinking water containing PCE over a period of up to 30 years at levels between 0.78 mcg/L to 78 mcg/L (about 28% of the all the samples) are estimated to have a low increased risk of getting cancer. People drinking water containing PCE at levels from 78 mcg/L to 780 mcg/L (about 10% of all the samples) for 30 years are estimated to have a moderate increased risk for cancer. One sample contained 1100 mcg/L PCE and was the highest level of PCE to which people were known to have been exposed. Exposure to this level for 20 years (based on the ages of the homes where this sample was taken) is estimated to pose a moderate increased risk of getting cancer. Although the risks of noncarcinogenic effects from potential exposures to these contaminants are not completely understood, the existing data suggest they could be minimal for PCE levels below 175 mcg/L (over 95% of all the samples) and low for PCE levels between 175 and 875 mcg/L (4% of all the samples). One sample contained 1100 mcg/L PCE and could pose a moderate risk for noncancer health effects.

People exposed to TCE at levels from 3.7 mcg/L to 40 mcg/L (the highest level detected) for 30 years are estimated to have a low increased risk of getting cancer (about 15% of all the samples). The noncancer risks for TCE would be minimal at detected concentrations.

Exposures to PCE through drinking water are presently minimized since GAC filtration systems were installed; therefore, the drinking water affected by the site currently is no apparent public health hazard. In summer/fall 2001, the IBM Corporation placed filters on all homes with PCE detections less than 5 mcg/L or in "threatened" homes, homes with no contamination detected, but adjacent to homes with filters; therefore, no future exposures are expected. The IBM Corporation is currently monitoring all homes with filtration systems under US EPA oversight.

Residents affected by the groundwater contamination have voiced concerns about several issues, including when remediation of the contaminated groundwater will take place, the feasibility and cost of public water to the community and concerns over the safety of the GAC filtration systems placed on their wells. Residents exposed to PCE in their drinking water also have questions concerning the short and long term effects of their exposure and a possible need for biological testing.

The New York State Department of Health (NYS DOH) in conjunction with the Agency for Toxic Substances and Disease Registry (ATSDR) and the US EPA held two availability sessions to address residents' health concerns. ATSDR conducted an additional public availability session to address residential exposure-related health concern. Public comments were also gathered during the comment period for the draft public health assessment, which ran from September 25 to December 18, 2002, and during the public availability session and public meeting held on December 9, 2002.

ATSDR and NYS DOH also held physician education training on exposures associated with the Shenandoah Road site. ATSDR held a physician education training session on September 27, 2002 at the Mid-Hudson Family Practice Program in Kingston, New York. Speakers included specialists in occupational health from the New York State Occupational Health Clinic Network. This educational activity was video-taped and videos were mailed to the physicians that serve the community. Additionally, ATSDR mailed health educational packets to the physicians, including information on health effects associated with exposures and how to take a patient's environmental exposure history. These resources, along with the video tape, are available at the US EPA information repository in the East Fishkill Community Library for other interested health care providers.

The NYS DOH is currently evaluating the feasibility of reviewing health outcome data specific to the Shenandoah Road Site. The NYS DOH has also added residents whose wells were contaminated with PCE to the New York State Volatile Organic Compounds Registry to help evaluate site-related VOC exposures and maintain an ongoing health status for the affected individuals.

The NYS DOH and ATSDR have recommended actions to protect residents from the contaminated groundwater. Recommended actions include proper maintenance and monitoring of the installing treatment systems, a permanent, long-term remedy for groundwater users and VOC exposure education for residents and physicians by ATSDR and NYS DOH.

The NYS DOH and ATSDR will coordinate with the appropriate environmental agencies to implement the recommendations and provide follow-up to the Public Health Action Plan. Included in these recommendations is the need to collect data on volatile organic compounds in soil vapor over the groundwater plume. The NYS DOH will evaluate the potential for exposures from possible soil vapor intrusion into indoor air, based on these data and any follow-up indoor sampling that may be indicated.

Follow-up also includes enrollment of residents with contaminated wells in the NYS Volatile Organics Exposure Registry (VOC Registry) with contact every two years to update their medical histories and evaluation by the NYS DOH and ATSDR as to whether additional health studies of people exposed to VOCs at the site are warranted. In addition to those educational materials distributed thus far, the NYS DOH and ATSDR will distribute this final public health assessment to concerned residents and local physicians in the area who expressed an interest in the draft public health assessment.

PURPOSE AND HEALTH ISSUES

The purpose of this public health assessment (PHA) is to evaluate human exposure pathways for contaminants related to the site. This PHA also fulfills the congressional mandate for a public health assessment for each site within one year of being proposed to the National Priorities List (NPL). The Shenandoah Road Site was proposed to the NPL January 11, 2001 and added on June 14, 2001. This public health assessment will focus on exposure to tetrachloroethene (PCE) in private wells, the only known exposure pathway at the site. Past exposures to volatile organic compounds (VOCs) from contamination at potential source areas, such as those associated with contaminated soils or vapors, cannot be evaluated because sampling data are not available. The public health actions taken to date include identifying potentially exposed residents and providing an alternative source of drinking water to homeowners with wells contaminated above the New York State (NYS) drinking water standard of 5 micrograms per liter (mcg/L). In addition, the New York State Department of Health (NYS DOH) and the Agency for Toxic Substances and Disease Registry (ATSDR) conducted three public availability sessions to address public health concerns.

BACKGROUND

A. Site Description and History

The Shenandoah Road Groundwater Contamination study area (site) is in the Town of East Fishkill in Dutchess County, New York in the Hamlet of Hopewell Junction. The source of contamination is believed to be the former facility located at 7 East Hook Cross Road that was used to clean and restore computer parts. The area impacted by the groundwater contamination is on the southern portion of Shenandoah Road approximately one mile in length, and is just north of Interstate 84 and one half mile west of the Taconic State Parkway. The streets with one or more impacted private wells include Shenandoah Road, Old Shenandoah Road, Seymour Lane, Burbank Road, Jackson Road, Townsend Road, Jaycox Lane, Stone Ridge Lane, Griffen Lane and East Hook Cross Road (See Figure 1). The site is in a rural area consisting of residential homes, farms and undeveloped property. About 325 people live in the affected area. All residents in the affected area rely on private wells as their sole source of potable water. Impacted wells in the study area are contaminated with VOCs, primarily PCE and to a lesser extent trichloroethene (TCE).

Between April and October of 2000, the NYS DOH collected approximately 144 private well samples and the US EPA collected approximately 230 private well samples throughout the potentially affected area (see Figure 2). Sixty wells were contaminated with PCE at concentrations exceeding the NYS DOH and US EPA drinking water standard of 5 mcg/L (see Figure 3). Twenty-one of the 60 residences had PCE concentrations exceeding the US EPA Removal Action Level (RAL) of 70 mcg/L.

The levels of PCE found in the contaminated residential wells ranged from non-detect to the highest level of 1600 mcg/L. However, only exposures to levels as high as 1100 mcg/L were measured, because the 1600 mcg/l was detected in a sample that was collected before the carbon filter, which removed the contaminant before it reached the household system. Concentrations of PCE below the NYS DOH drinking water standard of 5 mcg/L were also detected in many of the homes throughout the study area. In addition to PCE, three other contaminants were detected, trichloroethene (TCE), *cis*-1,2-dichloroethene (*cis*-1,2-DCE) and methyl *tert*-butyl ether (MTBE) (see Table 1). TCE was detected, in some cases, above the NYS DOH and US EPA drinking water standard, but less frequently and at levels much less than those of PCE. The other volatile organic compounds, *cis*-1,2-DCE and MTBE, were detected below the NYS DOH drinking water standard for each contaminant.

The New York State Department of Environmental Conservation (NYS DEC), who originally investigated the possible source areas with the NYS DOH, submitted a request to the US EPA in June 2000 for assistance in finding alternative water supplies for the affected residents. The NYS DEC and the NYS DOH were unable to undertake actions to eliminate the threat posed by this site prior to the source being identified. To address the immediate health concerns associated with exposure to PCE in drinking water, the US EPA began an Initial Removal Action in June 2000 which consisted of supplying bottled water and subsequently GAC filtration systems (also referred to as point of entry treatment (POET) systems) in homes where well contamination was at or above the US EPA maximum contaminant level (MCL) of 5 mcg/L. This is equal to the NYS DOH drinking water standard of 5 mcg/L. The US EPA installed an air stripper in one home on Burbank Road where levels of PCE (1100 mcg/L) in the private well required additional treatment prior to the GAC filtration system. To date, the US EPA installed 57 GAC filtration systems since the initiation of the removal action. Three homeowners installed GAC filtration systems at their own expense prior to US EPA's involvement in the site. The US EPA installed ultraviolet (UV) lights and particulate filters on the homeowner-installed treatment systems and assumed the full system maintenance.

The site was proposed for placement on the National Priorities List (NPL) on January 11, 2001. The IBM Corporation, in cooperation with the US EPA, signed an Administrative Order on Consent (AOC) on May 16, 2001, requiring IBM Corporation to complete the removal actions authorized by the Action Memoranda issued by the US EPA for the site. The AOC also requires the IBM Corporation to assume maintenance responsibilities for the treatment systems installed by the US EPA. The site was officially placed on the NPL on June 14, 2001. In June 2001, the IBM Corporation put GAC filtration systems on about 18 homes with PCE detections less than 5 mcg/L. In July 2001, the three homeowners who purchased their own treatment systems prior to US EPA involvement were reimbursed by the IBM Corporation. In September 2001, the IBM Corporation put treatment systems on about 19 homes considered "threatened" by the approaching contaminant plume. None of the "threatened" homes placed on treatment had PCE detected in their wells. Currently, the 97 homes with treatment systems are monitored by IBM with US EPA oversight.

The origin of the contaminant plume appears to be a former commercial facility at 7 East Hook Cross Road on Shenandoah Mountain, topographically higher in elevation than the contaminated residential wells. Because the presence of hazardous substances in groundwater is documented and the US EPA RALs were exceeded in private wells, a removal action to disassociate residents from the contaminated water was authorized and undertaken. In October 2000, the septic system at 7 East Hook Cross Road, which contained high levels of PCE, was identified by the US EPA and the NYS DEC as the probable source of groundwater contamination. Because the PCE remaining in the septic tank was leaking into the soil, the septic tank was considered a continuing source of groundwater contamination. More detail about the contamination can be found in the Environmental Contamination section. In September 2001, the US EPA and the IBM Corporation discovered disposal pits for site-related solvents and acid wastes behind the former building. The waste pits are believed to be the primary source of VOC contamination in the downgradient private wells. Contaminated soil removal actions, conducted by IBM Corporation under US EPA oversight, were completed in February 2002.

B. Actions Implemented During the Public Health Assessment Process

The US EPA arranged for regular sampling and maintenance of each residential GAC filtration system for the duration of the removal action, including the three systems installed by homeowners. The IBM Corporation, with US EPA oversight, is presently performing the quarterly monitoring of all homes with GAC filtration systems. In June 2001, the IBM Corporation also placed GAC filtration systems on homes with PCE detected below the NYS drinking water standard of 5 mcg/L. In September 2001, the IBM Corporation placed GAC filtration systems on homes considered threatened by the PCE contamination plume. If PCE should be detected at or above the NYS drinking water standard or US EPA MCLs in any additional wells that do not currently have treatment systems, the US EPA will direct the IBM Corporation to provide the home with bottled water and GAC filtration.

The NYS DOH and ATSDR conducted two availability sessions, one on December 14, 2000 and the other on May 15, 2001 to answer outstanding health questions, to explain in greater detail the VOC registry and to assist the residents completing the VOC registry questionnaire. On June 15, 2001 the US EPA and ATSDR held a meeting with residents affected by the groundwater contamination. ATSDR held an open house for residents and their physicians prior to the public meeting. The US EPA discussed the current activities taking place at the site. On November 15, 2001, ATSDR conducted an additional availability session for the residents. ATSDR addressed resident health concerns and distributed educational materials on site-related conditions, site-specific chemicals and exposure to those chemicals. ATSDR also requested assistance in identifying resident health care providers so that educational outreach could be targeted.

ATSDR held a health care provider workshop in September 2002. It was held to assist local physicians in evaluating their patients' exposure and health issues associated with exposure to tetrachloroethene.

The public was invited to review a draft public health assessment during the public comment period which ran from September 25 to December 18, 2002. The NYS DOH and ATSDR held a public availability session and public meeting on December 9, 2002 to review the public health assessment and discuss health concerns and physician education activities.

C. Site Visit

Both the NYS DOH and US EPA sampled private well water in homes, to delineate the extent of contamination. The NYS DOH sampled between April and May 2000 and the NYS DOH and the US EPA sampled from June to October 2000. The NYS DOH, US EPA and the NYS DEC visited the Shenandoah Road Groundwater Contamination area and the 7 East Hook Cross Road property on several occasions during the spring and summer of 2000 until the NYS DEC and the US EPA identified the property as the probable source of the VOC contamination. The site is privately owned and access is restricted.

D. Demographics

The NYS DOH estimated, from the 2000 Census (US Bureau of the Census 2001), that 1,258 people live within one mile of the Shenandoah Road site. The age distribution of the area is similar to the rest of Dutchess County as well as New York State excluding New York City, with a slightly lower percentage of individuals over 64 years old living in the area. There were 257 females of reproductive age (ages 15-44) within one mile of the site. The area within one mile of the site has a higher proportion of whites compared to the rest of the county and state. Based on the 2000 Census (US Bureau of the Census 2002), a lower percentage of the population is living below the poverty level while the median household income is higher than the rest of the county and state. These comparisons are provided in the following table. In addition, there are no schools or nursing homes within a mile of the site.

Demographic Data Table

2000 Census Demographics	New York State excluding NYC	Dutchess County	Area within 1 mile of Shenandoah Rd site
Age Distribution			
<6	8%	8%	10%
6-19	20%	21%	21%
20-64	58%	60%	60%
>64	14%	12%	9%
Race Distribution			
White	85%	84%	92%
Black	8%	9%	3%
Native American	<1%	<1%	0%
Asian	2%	3%	2%
Pacific Islander	<1%	0%	0%
Other	2%	2%	1%
Multi-Racial	2%	2%	1%
Percent Minority*	18%	20%	13%
Ethnicity Distribution¹			
Percent Hispanic	6%	6%	7%
1999 Median Income²	\$47,517	\$53,086	\$80,843
% Below Poverty Level²	10%	8%	5%

* Minority includes Hispanics, African-Americans, Asian-Americans, Pacific Islanders and Native Americans

DISCUSSION

A. Environmental Contamination

The environmental data presented in this section were gathered during investigations conducted by the NYS DOH, NYS DEC and the US EPA. The following sections summarize the results of the investigations of groundwater and soil contamination in and around the study area.

Groundwater

Groundwater is known to be contaminated in the investigation area, encompassing approximately one square mile; however, not all private wells within the area are contaminated. The depths of wells in the contaminated area are between 30 to 480 feet. The VOCs PCE, TCE and *cis*-1,2-DCE were detected in many of the samples collected from contaminated wells. PCE, however, was the only VOC detected consistently above the NYS DOH drinking water standard. Approximately 144 private well samples were collected by the NYS DOH to delineate the contamination area (See Figure 2). PCE was present in about one-half (64/144) of the samples collected; TCE was present in approximately one-fourth (42/144) of the samples, but at a lower concentration than PCE. Subsequently, the US EPA collected an additional 230 private well water samples. In some cases, individual wells showed no contamination in areas where neighbors had elevated levels of PCE. Such differences may be the result of differences in depth and construction of individual wells and well water usage per household. Also, the potential source of the VOC contamination is in an area of fractured bedrock, topographically higher in elevation than the contaminated residential areas. Contamination from the source area could be following a complicated course through fractures in the bedrock.

The IBM Corporation, under US EPA oversight, installed groundwater monitoring wells to determine the depth to groundwater and establish an accurate direction of groundwater flow. To detect any future migration of the plume, the wells were installed beyond the plume to serve as early detection or “sentinel” wells and will be sampled regularly as part of the long-term monitoring program.

Surface Water

No surface water sampling has been done by any state or federal agency or by the IBM Corporation. The contamination is in deep groundwater, greater than 70 feet deep. The US EPA will evaluate potential surface water impacts during the remedial investigation phase, expected to begin in fall 2003.

Sediment/Soil

In October 2000, the NYS DEC and the US EPA identified a 1200-gallon septic tank at 7 East Hook Cross Road as the possible source of the PCE groundwater contamination at the Shenandoah Road site. High levels of PCE were removed from the septic tank (800 gallons of liquid, 250 gallons of sludge), placed in drums and disposed off-site. From December 4 - 15, 2000, approximately 750 tons of contaminated soil were removed from the area surrounding the tank. In April 2001 the US EPA directed the demolition of the building where the PCE contamination originated and removed the remainder of the soil contamination beneath the building. Excavated soils and debris were covered and stored on-site until an appropriate off-site disposal facility could receive it. In September 2001 the US EPA and the IBM Corporation discovered disposal pits which received acid and solvent wastes behind the former building.

These pits are believed to be the source of the VOC contamination in the downgradient private wells.

Air/Soil Vapor

The VOC contamination associated with the site is in subsurface soil and groundwater. No indoor/outdoor air samples or soil vapor samples were collected by either agency or by the IBM Corporation. Soil vapor samples will be collected as part of the remedial investigation (RI) for the site.

B. Pathways Analysis

This section of the public health assessment (PHA) identifies completed exposure pathways associated with past, present and future uses of the site. An exposure pathway is the process by which an individual may be exposed to contaminants originating from a site. An exposure pathway is comprised of five elements including:

- (1) a contaminant source,
- (2) an environmental media and transport mechanisms,
- (3) a point of exposure,
- (4) a route of exposure,
- (5) a receptor population.

The source of contamination is the source of contaminant release to the environment (any waste disposal area or point of discharge); if the original source is unknown, it is the environmental media, (soil, air, water, biota) which are contaminated at the point of exposure. Environmental media and transport mechanisms carry contaminants from the source area to points where human exposures may occur. The exposure point is a location where actual or potential human contact with a contaminated medium may occur. The route of exposure is the manner in which a contaminant actually enters or contacts the body (ingestion, inhalation, and dermal absorption). The receptors are the people who are exposed or may become exposed to contaminants at a point of exposure.

Completed Exposure Pathways:

For the Shenandoah Road Groundwater Contamination site, there is one known completed exposure pathway, exposure to VOCs, primarily PCE, in private drinking water. Exposure to contaminants in drinking water supplies can occur through ingestion, dermal contact and absorption during showering, bathing or other household uses and through inhalation of aerosols and vapors from water used in the household. For an undetermined period of time, residents using private wells were exposed to VOCs in their drinking water supply. Prior to spring/summer 2000, we do not know how long or at what concentration residents were exposed to site-related contaminants. The maximum exposure duration could be as long as 30 years for some of the homes on the site, since some of these homes were built and the source facility was

operational as early as 1969. The developments on Burbank Road began in the late 1970's and developments on Seymour Lane began in the 1980's; therefore, exposure duration for these people could be as long as 20 years.

Although this pathway was completed in the past, residents are not likely exposed at the present time. Exposures were eliminated or significantly reduced through the placement of water treatment systems on wells where VOCs were detected at or above the NYS drinking water standard of 5 mcg/L. However, if treatment systems are not maintained or if PCE is detected at or above the NYS drinking water standard in any future wells, exposures could occur.

Potential Exposure Pathways:

Potential pathways of exposure may have existed for employees working in the source area building. Surface and subsurface soils in and around the septic system and in the disposal pit area were heavily contaminated with VOCs. Employees who worked in the past in the suspected source building (not associated with the computer parts cleaning and restoring business) may have been exposed to residual VOC vapors in indoor air. Soil vapors from heavily contaminated subsurface soils may have entered the multi-use building. Since indoor air samples were never collected within the source building, the potential concentration of VOCs in indoor air is unknown. Workers may have had dermal contact with surface soils in the source area. Potential exposures, including inhalation, most likely occurred during disposal activities. These exposure pathways no longer exist since the former facility was removed in April 2001. Remediation of the source area is ongoing and was completed in February 2002. Because no information is available about the extent of these potential exposure pathways, they will not be discussed further in this Public Health Assessment.

Soil vapor may be present in the areas underlain by the groundwater contamination plume. Where soil vapor is present underneath homes, the volatile organic compounds in soil vapor could intrude into homes. This pathway cannot be further evaluated until soil vapor is measured as part of the RI.

C. Public Health Implications

To evaluate the potential health risks from contaminants associated with the human exposure pathways identified for the Shenandoah Road groundwater contamination area, the NYS DOH assessed the risks for cancer and noncancer health effects. The health effects are related primarily to contaminant concentration, exposure pathway, exposure frequency and exposure duration. Chronic exposure to chemicals in drinking water is possible by ingestion, and also by dermal contact and inhalation from water uses such as showering, bathing and cooking. Accordingly, the NYS DOH doubled the concentrations of the VOCs detected in drinking water to account for possible additional exposures via the inhalation and dermal routes. Although exposure varies depending on an individual's lifestyle, each of these exposure routes can contribute to the overall daily intake of contaminants and, thus, may increase the risk for chronic

health effects. For additional information on how the NYS DOH determined and qualified health risks applicable to this health consultation, refer to Appendix C.

For an undetermined period of time, possibly for up to 30 years, private water supply wells in the Shenandoah Road area have been contaminated with volatile organic chemicals, primarily PCE and TCE. The concentrations of PCE and TCE measured in some of the private wells exceed New York State public drinking water standards and/or public health assessment comparison values (see Table 1). Therefore, these chemicals have been selected for further evaluation.

Studies of workers exposed to PCE and/or TCE and other chemicals show an association between exposure to high levels of these chemicals and increased risks of certain forms of cancer, including kidney, cervical, esophageal, liver and non-Hodgkin's lymphoma (ATSDR 1997a, b). These associations are unlikely to be due to chance; however, the role of other factors in causing these cancers, including exposures to other potential cancer-causing chemicals, is not fully known. Thus, these data suggest, but do not prove, that PCE and TCE cause cancer in humans. Other studies show that people living in communities with drinking water supplies contaminated by mixtures of chemicals including PCE and TCE have higher risks of certain types of cancer (e.g., non-Hodgkin's lymphoma) than do people living in communities with uncontaminated drinking water. These studies are weaker than those of workers largely because we do not know for certain whether the people who got cancer actually drank the contaminated water for long periods of time before they got cancer. PCE and TCE cause cancer in laboratory animals exposed to high levels over their lifetimes (ATSDR 1997a, b). Chemicals that cause cancer in laboratory animals may also cause cancer in humans who are exposed to lower levels over long periods of time.

A total of 144 samples from private wells were analyzed for PCE and TCE. More than half of these samples (about 57%) did not detect PCE, and most (over 76% of the samples) did not detect TCE. Based on the results of epidemiology and animal studies, people drinking water containing PCE over a period of up to 30 years at levels between 0.78 mcg/L to 78 mcg/L (about 28% of the all the samples) are estimated to have a low increased risk of getting cancer. The estimated risk for residents to develop cancer from drinking water contaminated with PCE at levels from 78 mcg/L to 780 mcg/L (about 10% of all the samples) for 30 years is considered to be moderate. One sample contained 1100 mcg/L PCE and was the highest level of PCE to which people were known to be exposed. Exposure at this level for 20 years (based on the ages of the homes where this sample was taken) is estimated to pose a moderate increased risk of getting cancer (i.e., the estimated risk is between one in ten thousand and one in one thousand). People exposed to TCE at levels from 3.7 mcg/L to 40 mcg/L (the highest level detected) for 30 years are estimated to have a low increased risk of getting cancer (about 15% of all the samples). The actual increase in cancer risk for PCE and TCE in drinking water is difficult to estimate because we have no information on how long or to what levels people were exposed prior to the time the contamination was discovered.

Exposure to high levels of PCE and TCE is also known to produce a variety of noncarcinogenic health effects, primarily on the liver, kidney and nervous system (ATSDR 1997a,b). In humans,

the potential health effects for PCE exposure include changes in electrical measurements of nervous system activity, mild and reversible effects on nervous system performance, and central nervous system symptoms such as dizziness (Stewart, et al., 1970; Hake et al., 1977; Altman et al., 1990, 1992, 1995; Cavalleri, 1994). Although the risks of noncarcinogenic effects from potential exposures to these contaminants are not completely understood, the existing data suggest they could be minimal for PCE levels below 175 mcg/L (over 95% of all the samples) and low for PCE levels between 175 and 875 mcg/L (4% of all the samples). One sample contained 1100 mcg/L PCE and could pose a moderate risk for noncancer health effects. In this case, the estimated exposure is about two times lower than an estimated exposure level associated with slight reductions in central nervous system performance in people who lived at least one year and, on average 10 years, in apartments with indoor air contaminated with PCE (Altman et al 1995). The noncancer risks for TCE would be minimal.

D. ATSDR Child Health Considerations

The ATSDR Child Health Initiative emphasizes the on-going examination of relevant child health issues in all of the Agency's activities, including evaluating child-focused concerns through its mandated public health assessment activities. The ATSDR and New York State Department of Health consider children when we evaluate exposure pathways and potential health effects from environmental contaminants. We recognize that children are of special concern because of their greater potential for exposure from play and other behavior patterns. Children sometimes differ from adults in their susceptibility to hazardous chemicals, but whether there is a difference depends on the chemical. Children may be more or less susceptible than adults to health effects, and the relationship may change with developmental age.

The possibility that children or the developing fetus may have increased sensitivity to PCE and TCE (two of the primary contaminants at the Shenandoah Road groundwater contamination site) was taken into account when evaluating the potential health risks associated with the groundwater contamination. Human studies suggest that exposure to mixtures of chlorinated solvents (including PCE and TCE) in drinking water during pregnancy may increase the risk of birth defects (e.g., neural tube defects, oral cleft defects, and congenital heart defects) and/or childhood leukemia (ATSDR 1997a,b). In each of these studies, however, there are uncertainties about how much contaminated water the women drank during pregnancy and about how much PCE and TCE was in the water the women drank during pregnancy. Moreover, the role of other factors in causing these effects is not fully known. The most important of the factors was the potential exposure during pregnancy to other chemicals in drinking water. These studies suggest, but do not prove, that the developing fetus may have increased sensitivity to the effects of PCE and TCE. When pregnant animals are exposed by ingestion and/or inhalation to large amounts of PCE and TCE, adverse effects on the normal development of the offspring are observed (ATSDR 1997a,b). In most, but not all of these studies, the high amounts of the chemicals also caused adverse health effects on the parent animal. A study in young mice suggests effects on the central nervous system after transient exposure to PCE by ingestion 10 to 16 days after birth (Fredriksson et al., 1993). In another study, abnormal fetal heart development was observed in the offspring of rats exposed to TCE in drinking water before and during

pregnancy (Dawson et al., 1993). The estimated exposures to PCE and TCE in drinking water in the private wells (based on the highest detected levels) are both about 80 times lower than the lowest exposure levels that cause developmental effects in the offspring of animals.

E. Health Outcome Evaluation

The NYS DOH has not previously evaluated health outcome data specifically for the Shenandoah Road site. On May 21, 2001 the NYS DOH, Center for Environmental Health requested that the Bureau of Chronic Diseases and Epidemiological Surveillance (BCDES) do an address-specific cancer review of residents in the affected area. BCDES is currently assessing the feasibility of such a review. The NYS DOH maintains several health outcome databases, which could be used to generate site-specific data, if warranted. These databases include the cancer registry, the congenital malformations registry, vital records (birth and death certificates) and hospital discharge information.

The NYS DOH will include residents near the Shenandoah Rd. site, whose wells were contaminated with PCE and other VOCs, in the New York State Volatile Organic Compounds Registry. The registry will be used to help evaluate exposures and health status for people whose drinking water was found to contain PCE and other VOCs. Enrollment in the registry involves completing a survey about possible exposures to VOCs, the health status of each member of the household, and other factors related to health, such as smoking. Residents will then be contacted approximately every two years to update address information and monitor changes in health status.

The registry allows long-term follow-up on the health status of persons with documented exposures to VOCs at selected sites in New York State. An exposure registry, such as this one, is a resource for research that may help us learn whether exposures to VOCs are related to health effects. People who are enrolled in the Registry will be kept informed of any research results that come from the Registry data. Data gathered for the registry will be kept confidential.

As part of the NYS DOH Cancer Surveillance Improvement Initiative, age-adjusted incidence rates for specific sites of cancer are being tabulated and mapped at the ZIP code for the entire state for the years 1993-1997. Areas of the state having higher than expected rates of cancer are highlighted on the maps using statistical methods to evaluate the disease pattern. NYS DOH has evaluated four sites of cancer at the ZIP code level; breast, prostate, lung and colorectal. Additional follow-up for some geographic areas for these four types of cancer is being undertaken using a protocol developed for selecting and prioritizing follow-up areas. Additional information on this project can be found at the NYS DOH Cancer Surveillance Improvement Initiative web site at <http://www.health.state.ny.us/nysdoh/cancer/csii/nyscsii.htm> or by calling 1-800-458-1158.

The Shenandoah Rode site falls within ZIP code 12533. Of the cancers investigated for the years 1993-1997 in the Cancer Surveillance Improvement Project, none were found at levels significantly higher than expected in this portion of Dutchess County.

COMMUNITY HEALTH CONCERNS

Community health concerns have been expressed at public meetings and meetings with local elected officials, through correspondence to government agencies and telephone calls to the county and state health departments. Additional public health concerns are discussed in the attached Appendix E, which is a summary of public comments and responses. These comments were gathered during the comment period for the draft public health assessment, which ran from September 25 to December 18, 2002 and during the public availability session and public meeting held on December 9, 2002.

Concern: The primary concern expressed is about the possible health effects the exposed individuals may have suffered. Part of this concern is the uncertainty about the length of time they may have been exposed and whether the levels of contaminants have varied (increased or decreased) during that time.

Answer: Potential health effects from past exposure to contaminants in drinking water are evaluated and discussed in the Public Health Implications section. We do not have enough information to closely estimate people's potential duration of exposure. Initial contamination of the groundwater may have occurred 30 years ago. For this public health assessment, we assumed the maximum time period, 20 - 30 years, depending on location.

Concern: People who were exposed to the contaminated water in the past are interested in what, if any, medical monitoring would be recommended for themselves and their families.

Answer: Volatile organic compounds, such as PCE, TCE and *cis*-1,2-DCE that were detected in drinking water at the Shenandoah Road site, do not persist in the body for very long after the exposure stops. Because people are no longer exposed to these chemicals from the Shenandoah Road site, biological monitoring for these VOCs or their metabolites is not useful.

Research studies have not identified specific medical tests to look for effects from these chemicals. However, biological tests such as urinalysis or blood chemistry analyses are useful tools for finding health problems early. An individual's physician may have already used these routine tests when giving periodic checkups in the past. Physicians evaluate test results by comparing them to normal ranges for your sex and age. A wide range of medical conditions can cause abnormal findings in these tests. Each physician also interprets an individual's results in relation to individual medical histories. Residents may wish to tell their physician about their exposure to VOCs because the physician will consider their patient's personal health history when deciding the types of tests needed and how frequently their patients need to be seen. If your physician would like to talk with a NYS DOH environmental health nurse or physician, they should contact the NYS DOH at 1-800-458-1158, extension 27950.

The NYS DOH and ATSDR conducted two availability sessions, one on December 14, 2000 and the other on May 15, 2001 to answer health questions, explain in greater detail the VOC registry and assist completion of the VOC registry questionnaire for residents. On November 15, 2001,

ATSDR conducted an additional availability session to the residents affected by the groundwater contamination. ATSDR addressed resident's health concerns and distributed prepared educational materials on site-related conditions, site-specific chemicals and exposure to those chemicals. ATSDR also requested assistance identifying resident health care providers so that educational outreach to health care workers could be targeted.

Concern: Some residents suspect that illnesses in the family were caused by exposure to the contaminated groundwater (e.g., cancer, headaches, dizziness, etc.).

Answer: Potential cancer health effects are discussed in the Public Health Implications section. Whether these contaminants or some other factor caused the additional symptoms or illnesses mentioned is not known.

CONCLUSIONS

The site posed a public health hazard in the past due to exposures to VOCs, primarily PCE, in private water supplies. Several wells were contaminated with PCE at or above the federal removal action level and many others were contaminated with PCE and or TCE at or above the state and federal drinking water standard. Exposures occurred through inhalation, ingestion and dermal absorption. Some residents drinking contaminated groundwater within the contamination area may have been exposed for as long as 30 years. Because there is evidence from studies in animals and humans that exposure to elevated levels of tetrachloroethene and trichloroethene can increase the risk of adverse cancer and noncancer health effects in humans, we evaluated the potential health risk for exposure to these chemicals at the Shenandoah Road site.

People drinking water containing PCE over a period of up to 30 years at levels between 0.78 mcg/L to 78 mcg/L (about 28% of the all the samples) are estimated to have a low increased risk of getting cancer. People drinking water containing PCE at levels from 78 mcg/L to 780 mcg/L (about 10% of all the samples) for 30 years are estimated to have a moderate increased risk for cancer. One sample contained 1100 mcg/L PCE and was the highest level of PCE to which people were known to have been exposed. Exposure to this level for 20 years (based on the ages of the homes where this sample was taken) is estimated to pose a moderate increased risk of getting cancer. People exposed to TCE at levels from 3.7 mcg/L to 40 mcg/L (the highest level detected) for 30 years are estimated to have a low increased risk of getting cancer (about 15% of all the samples). Although the risks of noncarcinogenic effects from potential exposures to these contaminants are not completely understood, the existing data suggest they could be minimal for PCE levels below 175 mcg/L (over 95% of all the samples) and low for PCE levels between 175 and 875 mcg/L (4% of all the samples). One sample contained 1100 mcg/L PCE and could pose a moderate risk for noncancer health effects. The noncancer risks for TCE would be minimal.

The drinking water affected by the site currently poses no apparent public health hazard since treatment systems have been installed and regular monitoring is being implemented. Therefore, exposures have been reduced to levels below drinking water standards. However, if treatment

systems are not maintained, if PCE is detected in any potentially threatened wells, or if new wells are installed in the contaminated plume, future exposures could occur.

However, data on volatile organic compounds in soil vapor over the groundwater plume have not been collected. The potential for exposures from possible soil vapor intrusion into indoor air will need to be evaluated in the future, based on these data.

Sampling data indicate that the contamination plume has moved primarily to the north, underneath and beyond Interstate 84. The plume has also migrated, to a lesser extent, to the east and southeast. The source of contamination is believed to be the former facility located at 7 East Hook Cross Road that was used to clean and restore computer parts.

RECOMMENDATIONS

1. Actions taken to disassociate people from the contaminated water should continue.
2. Installed treatment systems must be properly maintained and the quality of the treated water should be monitored until contamination levels are below NYS drinking water standards or an alternative water supply is provided.
3. Monitoring of potentially affected private wells in the area should continue, with treatment systems added if contaminant levels exceed the NYS drinking water standard.
4. A permanent, long-term remedy for groundwater users should be considered.
5. Local physicians and concerned residents who expressed an interest in the draft public health assessment should be provided with a copy of this final public health assessment and be encouraged to contact ATSDR or NYS DOH for more information.
6. Data on volatile organic compounds in soil vapor over the groundwater plume should be collected. The potential for exposures from possible soil vapor intrusion into indoor air should be evaluated, based on these data and other data that may need to be collected.

PUBLIC HEALTH ACTION PLAN

The Public Health Action Plan (PHAP) for the Shenandoah Road Groundwater Contamination site contains a description of actions to be taken by ATSDR and/or the NYS DOH following completion of this health assessment. For those actions already taken at the site, please refer to the Background section of this public health assessment. The purpose of the PHAP is to ensure that this public health assessment identifies public health hazards and provides a plan of action designed to mitigate and prevent adverse human health effects resulting from the past, present and/or future exposures to hazardous substances at or near the site. Included is a commitment on

the part of ATSDR and/or the NYS DOH to follow up on this plan to ensure that it is implemented. The public health actions to be implemented by ATSDR and/or the NYS DOH are as follows:

1. The NYS DOH will coordinate with the appropriate environmental agencies to develop a plan to implement the recommendations contained in this public health assessment.
2. The NYS DOH and ATSDR will review data on volatile organic compounds in soil vapor over the groundwater plume and evaluate the potential for exposures from possible soil vapor intrusion into indoor air.
3. ATSDR will provide follow-up to this PHAP, as needed, outlining the actions completed and those in progress. This report will be placed in repositories that contain copies of this public health assessment and will be provided to people who request it.
4. The NYS DOH has distributed information and enrollment forms for the NYS Volatile Organics Exposure Registry to residents with contaminated wells. Enrollees will be contacted every two years to update their medical histories. Results of any new research that become available will be shared with Registry program participants. The NYS DOH and ATSDR will evaluate whether additional health studies of people exposed to VOCs at the site are warranted.
5. ATSDR and NYS DOH will provide this public health assessment to local physicians and concerned residents who expressed an interest in the draft public health assessment. They will be encouraged to contact the agencies if they have additional questions or concerns.

ATSDR will reevaluate and expand the PHAP when needed. New environmental, toxicological, health outcome data or the results of implementing the proposed actions may determine the need for additional actions at this site.

CERTIFICATION

The Public Health Assessment for the Shenandoah Road Groundwater Contamination was prepared by the New York State Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the Public Health Assessment was initiated.

Technical Project Officer, SPS, SSAB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this Public Health Assessment and concurs with its findings.

Chief, SPS, SSAB, DHAC, ATSDR

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APPENDIX A
FIGURES

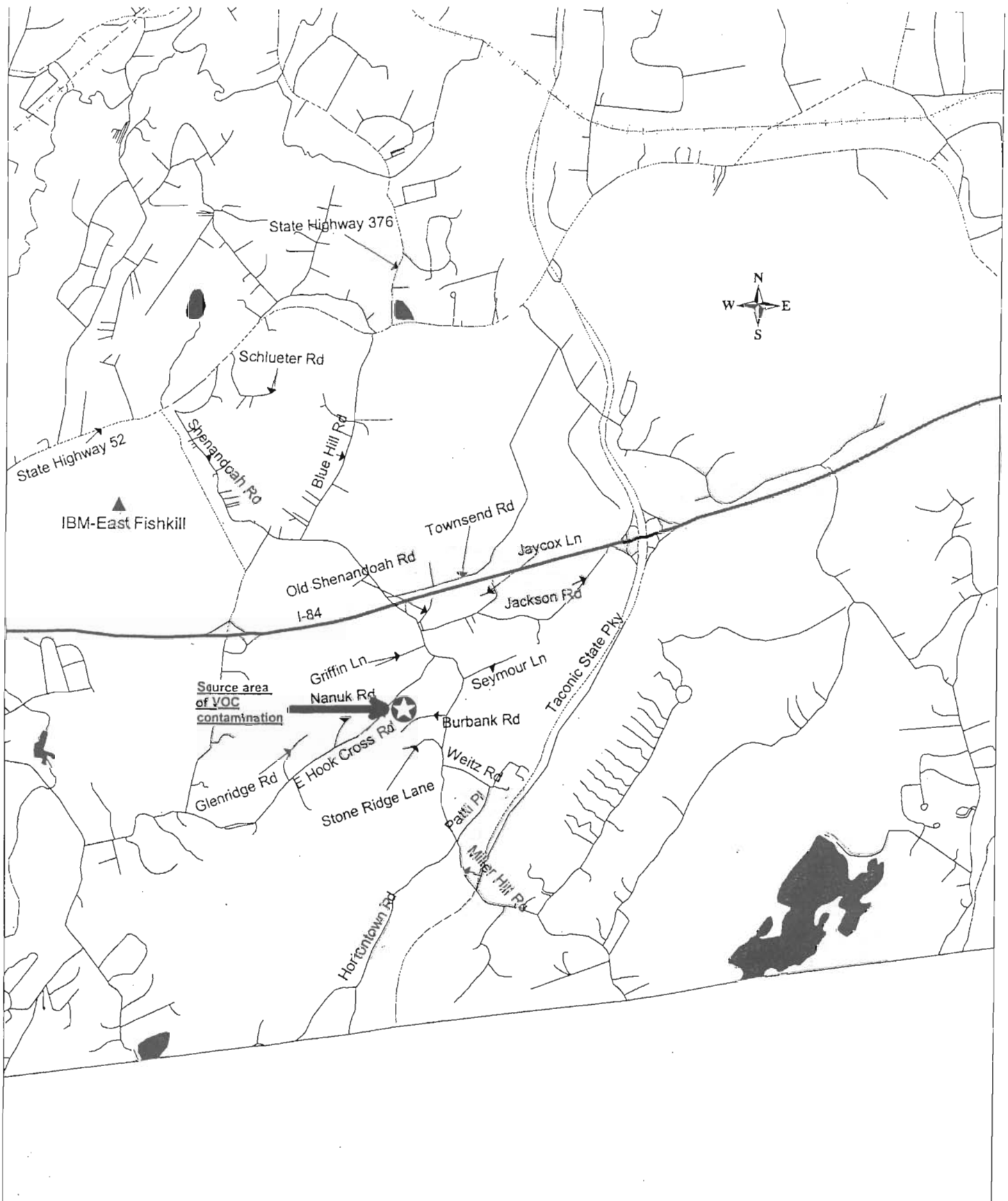
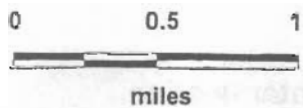


Figure 1



**Shenandoah Rd. Groundwater
Contamination Area
Town of East Fishkill, Dutchess County**

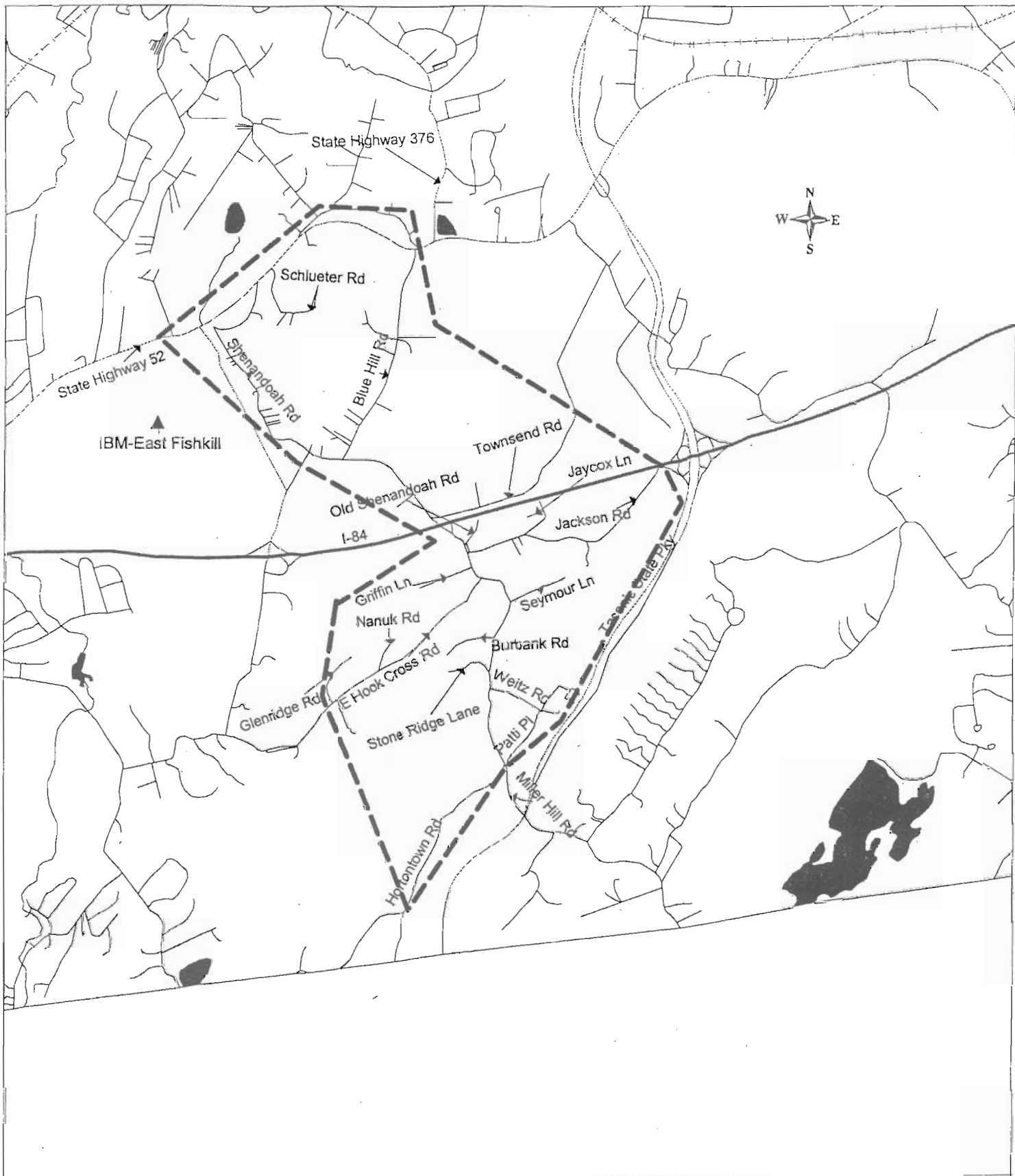


Figure 2

**Total Sampling Area for PCE Contamination
Associated with the Shenandoah Rd. Site
Town of East Fishkill, Dutchess County**

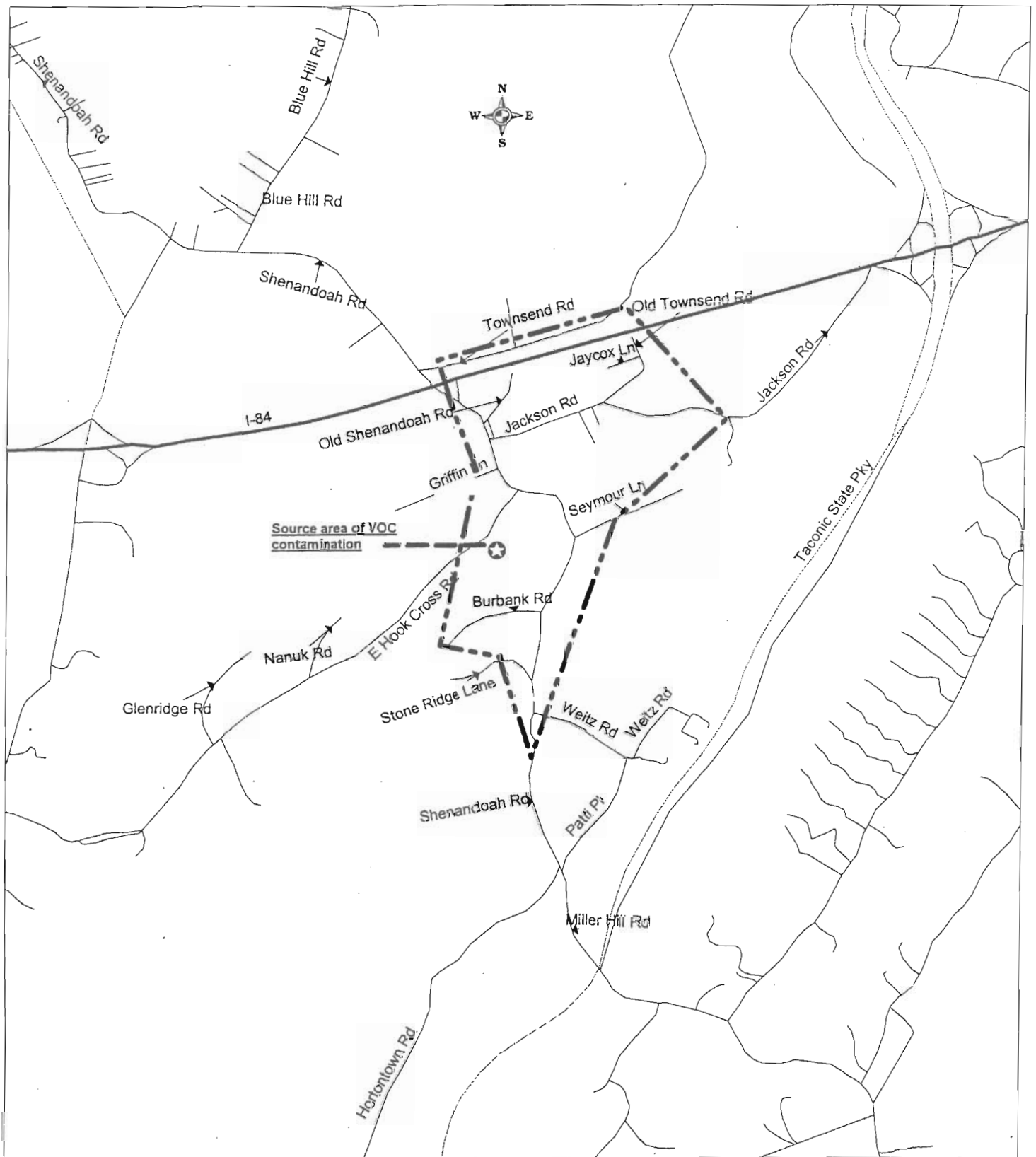


Figure 3

**Area of PCE Contamination Associated
with the Shenandoah Rd. Site
Town of East Fishkill, Dutchess County**

APPENDIX B

TABLE

Table 1
 Water Quality Standards/Guidelines and /or Public Health Assessment
 Comparison Values for Contaminants Found in Private Wells Near Shenandoah Road
 [All values in micrograms per liter (mcg/L)]

Contaminant	Water Quality Standards/ Guidelines	Water Quality Standards/ Guidelines	Water Quality Standards/ Guidelines	US EPA Drinking Water	Comparison Values*			
	New York State Ground Water	Surface Water	Drinking Water		Cancer	Basis**	Noncancer	Basis**
<i>cis</i> -1,2-dichloroethene	5	5	5	70	--	--	70	EPA HEAST
methyl <i>tert</i> -butyl ether	10 ^a	10 ^a	50	--	10	NYS DOH	230	NYS DOH
tetrachloroethene (perc)	5	0.7 ^a	5	5	0.67	EPA RBC	10	EPA LTHA
trichloroethene	5	5	5	5 ^b	3.2	EPA RBC	42	EPA RBC

* Comparison values determined for a 70 kilogram adult who drinks 2 liters of water per day.

** EPA HEAST: Environmental Protection Agency Health Effects Assessment Summary Tables.
 Environmental Protection Agency Lifetime Health Advisory.

EPA RBC: U.S. Environmental Protection Agency Region 3 Risk-Based Concentration Table (April 2001).

EPA LTHA.
 NYS DOH: New York State Department of Health.

^a Guidance value.

^b Under review.

APPENDIX C

**NYS DOH PROCEDURE FOR EVALUATING POTENTIAL HEALTH RISKS
FOR CONTAMINANTS OF CONCERN**

**NYS DOH PROCEDURE FOR EVALUATING POTENTIAL HEALTH RISKS
FOR CONTAMINANTS OF CONCERN**

To evaluate the potential health risks from contaminants of concern associated with the Shenandoah Road Groundwater Contamination site, the New York State Department of Health assessed the risks for cancer and noncancer health effects.

Increased cancer risks were estimated by using site-specific information on exposure levels for the contaminant of concern and interpreting them using cancer potency estimates derived for that contaminant by the US EPA or, in some cases, by the NYS DOH. The following qualitative ranking of cancer risk estimates, developed by the NYS DOH, was then used to rank the risk from very low to very high. For example, if the qualitative descriptor was "low", then the excess lifetime cancer risk from that exposure is in the range of greater than one per million to less than one per ten thousand. Other qualitative descriptors are listed below:

Excess Lifetime Cancer Risk

<u>Risk Ratio</u>	<u>Qualitative Descriptor</u>
equal to or less than one per million	very low
greater than one per million to less than one per ten thousand	low
one per ten thousand to less than one per thousand	moderate
one per thousand to less than one per ten	high
equal to or greater than one per ten	very high

An estimated increased excess lifetime cancer risk is not a specific estimate of expected cancers. Rather, it is a plausible upper bound estimate of the probability that a person may develop cancer sometime in his or her lifetime following exposure to that contaminant.

There is insufficient knowledge of cancer mechanisms to decide if there exists a level of exposure to a cancer-causing agent below which there is no risk of getting cancer, namely, a threshold level. Therefore, every exposure, no matter how low, to a cancer-causing compound is assumed to be associated with some increased risk. As the dose of a carcinogen decreases, the chance of developing cancer decreases, but each exposure is accompanied by some increased risk.

There is general consensus among the scientific and regulatory communities on what level of estimated excess cancer risk is acceptable. An increased lifetime cancer risk of one in one million or less is generally not considered a significant public health concern.

For noncarcinogenic health risks, the contaminant intake was estimated using exposure assumptions for the site conditions. This dose was then compared to a risk reference dose (estimated daily intake of a chemical that is likely to be without an appreciable risk of health effects) developed by the US EPA, ATSDR and/or NYS DOH. The resulting ratio was then compared to the following qualitative scale of health risk:

Qualitative Descriptions for
Noncarcinogenic Health Risks

<u>Ratio of Estimated Contaminant Intake to Risk Reference Dose</u>	<u>Qualitative Descriptor</u>
equal to or less than the risk reference dose	minimal
greater than one to five times the risk reference dose	low
greater than five to ten times the risk reference dose	moderate
greater than ten times the risk reference dose	high

Noncarcinogenic effects unlike carcinogenic effects are believed to have a threshold, that is, a dose below which adverse effects will not occur. As a result, the current practice is to identify, usually from animal toxicology experiments, a no-observed-effect-level (NOEL). This is the experimental exposure level in animals at which no adverse toxic effect is observed. The NOEL is then divided by an uncertainty factor to yield the risk reference dose. The uncertainty factor is a number which reflects the degree of uncertainty that exists when experimental animal data are extrapolated to the general human population. The magnitude of the uncertainty factor takes into consideration various factors such as sensitive subpopulations (for example, children or the elderly), extrapolation from animals to humans, and the incompleteness of available data. Thus, the risk reference dose is not expected to cause health effects because it is selected to be much lower than dosages that do not cause adverse health effects in laboratory animals.

The measure used to describe the potential for noncancer health effects to occur in an individual is expressed as a ratio of estimated contaminant intake to the risk reference dose. A ratio equal to or less than one is generally not considered a significant public health concern. If exposure to the contaminant exceeds the risk reference dose, there may be concern for potential noncancer health effects because the margin of protection is less than that afforded by the reference dose. As a rule, the greater the ratio of the estimated contaminant intake to the risk reference dose, the greater the level of concern. This level of concern depends upon an evaluation of a number of factors such as the actual potential for exposure, background exposure, and the strength of the toxicologic data.

APPENDIX D
INTERIM PUBLIC HEALTH HAZARD CATEGORIES

INTERIM PUBLIC HEALTH HAZARD CATEGORIES

CATEGORY / DEFINITION	DATA SUFFICIENCY	CRITERIA
<p>A. Urgent Public Health Hazard</p> <p>This category is used for sites where short-term exposures (< 1 yr) to hazardous substances or conditions could result in adverse health effects that require rapid intervention.</p>	<p>This determination represents a professional judgement based on critical data which ATSDR has judged sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.</p>	<p>Evaluation of available relevant information* indicates that site-specific conditions or likely exposures have had, are having, or are likely to have in the future, an adverse impact on human health that requires immediate action or intervention. Such site-specific conditions or exposures may include the presence of serious physical or safety hazards.</p>
<p>B. Public Health Hazard</p> <p>This category is used for sites that pose a public health hazard due to the existence of long-term exposures (> 1 yr) to hazardous substance or conditions that could result in adverse health effects.</p>	<p>This determination represents a professional judgement based on critical data which ATSDR has judged sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.</p>	<p>Evaluation of available relevant information* suggests that, under site-specific conditions of exposure, long-term exposures to site-specific contaminants (including radionuclides) have had, are having, or are likely to have in the future, an adverse impact on human health that requires one or more public health interventions. Such site-specific exposures may include the presence of serious physical or safety hazards.</p>
<p>C. Indeterminate Public Health Hazard</p> <p>This category is used for sites in which “critical” data are <i>insufficient</i> with regard to extent of exposure and/or toxicologic properties at estimated exposure levels.</p>	<p>This determination represents a professional judgement that critical data are missing and ATSDR has judged the data are insufficient to support a decision. This does not necessarily imply all data are incomplete; but that some additional data are required to support a decision.</p>	<p>The health assessor must determine, using professional judgement, the “criticality” of such data and the likelihood that the data can be obtained and will be obtained in a timely manner. Where some data are available, even limited data, the health assessor is encouraged to the extent possible to select other hazard categories and to support their decision with clear narrative that explains the limits of the data and the rationale for the decision.</p>
<p>D. No Apparent Public Health Hazard</p> <p>This category is used for sites where human exposure to contaminated media may be occurring, may have occurred in the past, and/or may occur in the future, but the exposure is not expected to cause any adverse health effects.</p>	<p>This determination represents a professional judgement based on critical data which ATSDR considers sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.</p>	<p>Evaluation of available relevant information* indicates that, under site-specific conditions of exposure, exposures to site-specific contaminants in the past, present, or future are not likely to result in any adverse impact on human health.</p>
<p>E: No Public Health Hazard</p> <p>This category is used for sites that, because of the absence of exposure, do NOT pose a public health hazard.</p>	<p>Sufficient evidence indicates that no human exposures to contaminated media have occurred, none are now occurring, and none are likely to occur in the future</p>	

*Such as environmental and demographic data; health outcome data; exposure data; community health concerns information; toxicologic, medical, and epidemiologic data; monitoring and management plans.

APPENDIX E

Summary Of Public Comments and Responses

Summary Of Public Comments and Responses

Shenandoah Road Groundwater Contamination Public Health Assessment

This summary was prepared to address comments and questions on the public comment draft of the Shenandoah Road Groundwater Contamination Public Health Assessment. The public was invited to review the draft during the public comment period which ran from September 25 to December 18, 2002. We received three written comments from residents. Oral comments from the public availability session and public meeting held on December 9, 2002 are also included. Similar comments may be consolidated or grouped together and some statements reworded to clarify the comment. If you have any questions about this summary, you may contact Mr. Daniel Geraghty of the New York State Department of Health (NYS DOH) at the toll-free number: 1-800-458-1158, extension 27890.

Comment #1 - A resident reported family members having constant runny noses and fungus on their finger nails. Could these health effects be related to site contamination?

Response - We know of no scientific studies that link exposure to tetrachloroethene to these conditions. If you or your family are concerned about these conditions, we suggest that you consider seeing your personal physician.

Comment #2 - A resident reported that friends and relatives took thousands of gallons of water from the neighborhood in jugs for drinking water. What are the possible health effects for these people?

Response - If the water contained tetrachloroethene, the risks for adverse health effects would depend on the amount of tetrachloroethene in the water and how much exposure there was through drinking and other uses of the water. Without this information we are unable to estimate the potential risks for adverse health effects. However, we would expect exposures to be lower because the people using water from jugs would not be using water from jugs for all household uses that result in exposures, such as showering and bathing.

Comment #3 - A resident requested clarification on what is meant by acceptable levels.

Response - In the Shenandoah Road Groundwater Contamination Public Health Assessment we only used the phrase “acceptable levels” of contaminants except in Appendix C. Contamination of drinking water above naturally occurring levels can increase people’s exposure to the contaminant, and, depending on the contaminant, increase their risk of health effects. We do discuss, for cancer health effects, what is generally considered an acceptable increased risk of health effects. From Appendix C, “There is general consensus among the scientific and regulatory communities on what level of estimated excess cancer risk is acceptable. An increased lifetime cancer risk of one in one million or less is generally not considered a significant public health concern.” Acceptable

in this case means that standards or guidelines are set equal to the concentration corresponding to this risk level.

Comment #4 - A resident requested comprehensive health screening and medical monitoring beyond blood tests and urinalysis for all known health effects of tetrachloroethene and trichloroethene.

Response - Currently there are no tests that identify specific effects from exposure to tetrachloroethene or trichloroethene or that can link specific health problems with this chemical exposure. Much of what we know about how tetrachloroethene might affect humans comes from studies with volunteers exposed to very high levels in air for short periods of time (8 hours or less) and studies of dry-cleaning workers exposed to high levels in air. The studies with volunteers show that tetrachloroethene causes central nervous system symptoms, ranging from dizziness and headache to reduced scores on certain behavioral tests. Studies of dry-cleaning workers show that long-term exposure (9 - 20 years, for example) to high levels in workplace air reduces scores on behavioral tests and causes mild biochemical changes in blood and urine that indicate liver and kidney damage. Overall, both the short-term and dry-cleaner studies show that the central nervous system is the most sensitive target for tetrachloroethene exposure. The studies of dry-cleaning workers also suggest a link between high-level tetrachloroethene exposures and increased risk for cancer, specifically non-Hodgkin's lymphoma, esophageal cancer, and bladder cancer. Knowledge of exactly how tetrachloroethene affects the central nervous system, or possibly increases cancer risk, is limited. As a result, medical research has not developed a test that can look for long-lasting effects of exposure to tetrachloroethene. However, routine biological tests (urinalysis and blood chemistries) are useful for finding a wide range of health problems early, so these tests are important even if they do not tell us whether tetrachloroethene exposure caused the problem. The Agency for Toxic Substances and Disease Registry (ATSDR) and NYS DOH met with and mailed written materials to local physicians to assist them in evaluating their patients' exposure and health issues associated with tetrachloroethene.

Comment #5 - A resident requested a health study for all health effects of tetrachloroethene and trichloroethene exposure and that the study be limited to just the exposed population.

Response - Residents of Shenandoah Road area households whose wells showed VOC contamination have been contacted and invited to participate in the VOC Exposure Registry. To enroll in the Registry, household members complete a questionnaire that asks about possible exposures, past and current health status of each household member, and other factors related to health such as smoking history. Questions about current and past cancer diagnoses, as well as respiratory, neurological, cardiovascular, gastrointestinal, musculo-skeletal, endocrine, and reproductive symptoms and diseases are included. Contact with participants will be maintained for a minimum of ten years and health status updates will be sought from participants every two to three years.

If sufficient information is collected over time from Registry participants from the Shenandoah Road area and other areas where similar exposures occurred, numbers and types of health problems reported can be compared with state and national data to see if Registry participants are experiencing unusually high rates of disease. Data from the VOC Registry can also be linked to health outcome databases such as the Cancer Registry, Congenital Malformations Registry and vital records to assess additional health outcomes among resident in households with VOC contamination and who participate in the Registry.

Comment #6 - A resident requested sharing VOC registry results.

Response - Participants in the Registry will be kept informed of any research results from the VOC Exposure Registry. Information will be shared with VOC registrants and, if they wish, their health care providers if new information becomes available that points to potential health problems associated with these types of exposures. By the end of 2003, follow-up health status questionnaires will be mailed to Registry participants in the Shenandoah Road area. This mailing will also include a status report on the success of enrollment efforts and a general summary of health information provided in the initial questionnaires. Once this progress report and summary are provided to participants, they will also be made available to other interested parties, upon request. All information provided by Registry participants is strictly confidential, and no individual information is provided in reports.

Comment #7 - A resident requested that the video tape of the NYS DOH and the ATSDR information session for physicians be made available to local doctors.

Response - ATSDR and NYS DOH held physician education training on exposures associated with the Shenandoah Road site. ATSDR held a physician education training session on September 27, 2002 at the Mid-Hudson Family Practice Program in Kingston, New York. Speakers included specialists in occupational health from the New York State Occupational Health Clinic Network. This educational activity was video-taped and videos were mailed to the physicians that serve the community. Additionally, ATSDR mailed health educational packets to the physicians, including information on health effects associated with exposures and how to take a patient's environmental exposure history. These resources, along with the video tape, are available at the United States Environmental Protection Agency (US EPA) information repository in the East Fishkill Community Library for other interested health care providers.

Comment #8 - A resident requested additional information regarding the possible link between site contaminants and Alzheimer disease, depression, oral damage, immune system damage, and genetic damage.

Response - Tetrachloroethene primarily affects the central nervous system, kidney, liver and possibly the reproductive system. Information on the toxicity of tetrachloroethene to the immune system is limited. One study of people exposed to tetrachloroethene and other chemicals in a public water supply reported increases in immunological abnormalities (increases in blood cells

that fight infections and changes in the ratio of different infection- fighting cells in the blood). This study is limited since we do not know how much of the contaminated water the people actually drank, how long they drank it, and what the actual contaminant levels were. Consequently it is not possible to determine if these effects are due to tetrachloroethene, the other contaminants, or some other factor (e.g., predisposal for infection or greater exposure to infectious agents). In animals, one study of rats given high levels of tetrachloroethene for 5 days reported damage to the thymus and spleen (two indicators of immune system toxicity), while another study of rats exposed to similar levels for 14 days did not show any damage to these organs. A long term study in rats and mice exposed to tetrachloroethene levels high enough to increase mortality in the animals did not show any adverse effects on the spleen, lymph nodes, or thymus. Based on the available information thus far, the immune system has not been identified as a major target system for tetrachloroethene.

Concerning genetic damage, the overall information indicates that tetrachloroethene is not mutagenic (i.e., it does not cause changes in DNA), although some of its metabolites (i.e., substances tetrachloroethene is changed to in the body) are mutagenic. These metabolites may play a role in the ability of tetrachloroethene to cause cancer in animals.

We know of no scientific information that directly links tetrachloroethene exposure to Alzheimer's disease, oral damage, or depression.

Comment #9 - Residents are concerned about possible exposures to tetrachloroethene and related contaminants in residences near the IBM East Fishkill plant, or in the facility itself, particularly around 1981.

Response - IBM completed an initial investigation of groundwater contamination at their East Fishkill facility in 1978. IBM placed a treatment system on their water supply in 1981. The suspected source of the contamination, an on-site landfill, was excavated in 1982 and additional remedial measures were performed in 1984. Groundwater near the contamination is pumped and treated so that off-site migration of contaminants is reduced or prevented.

In 1979, several nearby residential wells were found to be contaminated with volatile organic chemicals. We do not know how long these wells were contaminated prior to 1979. The residential wells were replaced with deeper wells to avoid the contamination in the affected aquifer. Some of these homes were on the northern most portion of Shenandoah Road, but are separate from the homes on Shenandoah Road that are currently affected by tetrachloroethene and trichloroethene contamination (primarily south of I-84). In 2000, these wells were sampled again and none of the chemicals were detected.

Because tetrachloroethene was used at the IBM facility, workers handling the chemical or involved in the use of tetrachloroethene at the plant may have been exposed to tetrachloroethene in the workplace. Workplace exposures to chemicals are regulated by the United States Occupational, Safety and Health Administration.

See response to comment 10 for information about air releases of tetrachloroethene.

Comment #10 - One resident expressed concern about emissions to air from the IBM East Fishkill facility and the possible impact of those emissions on the surrounding community. The resident specifically referred to Toxic Release Inventory (TRI) reports on the emissions of tetrachloroethene and *N*-methyl-2-pyrrolidone from the IBM facility.

Response: TRI data reflect information, submitted to the US EPA by industries, on the amounts of certain chemicals released to the environment and the amounts transferred from a facility to other locations. While these data can be useful, TRI data alone (e.g., the amount of a certain chemical released to the air by a facility) present challenges in accurately describing human exposure to chemicals. Measurements or estimates of the levels of chemicals in the air in a community usually are more useful for characterizing possible human exposure to chemicals. Monitoring (measured) data for tetrachloroethene and *N*-methyl-2-pyrrolidone are not available for any of the communities near IBM's East Fishkill facility. However, estimated outdoor air concentrations of tetrachloroethene are available. These concentration estimates were developed by the US EPA as part of the National-scale Air Toxics Assessment (NATA)

For NATA, EPA used 1996 emissions data for many different types of emission sources (including point (stack) sources such as the IBM facility), meteorological data (e.g., data on wind speed and wind direction) and a computer model, to estimate concentrations of numerous hazardous air pollutants in each census tract in the contiguous United States. Census tracts are land areas defined by the U.S. Bureau of the Census and typically contain about 4,000 residents each.

Tetrachloroethene is included in NATA. To estimate an air concentration for this chemical EPA assumed that 62,480 pounds were emitted from the stack(s) at the IBM facility in 1996. This emission estimate is somewhat higher than the maximum reported TRI emissions from the facility (56,820 pounds in 1995). The estimated concentration of tetrachloroethene in the census tract that includes the IBM facility and the residential and other land use areas near the Shenandoah Road Groundwater Contamination site (census tract 027/502.01) is 0.99 micrograms per cubic meter (mcg/m³). Additional information on EPA's National-scale Air Toxics Assessment is available on EPA's webpage at <http://www.epa.gov/ttn/atw/nata/>.

NYS DOH staff reviewed EPA's NATA data and found that the IBM facility is the primary source for the estimated tetrachloroethene concentration in this census tract. TRI reporting began in 1987, for which the facility reported stack emissions of 35,000 pounds of tetrachloroethene. Reported emissions peaked in 1995 and for each year since then, TRI-reported stack emissions of tetrachloroethene from the IBM facility have declined. TRI-reported emissions are 4,500 pounds for 1999. In 2000, IBM reported no emissions of tetrachloroethene. We have not been able to determine if the 2000 TRI report is accurate or if it contains a reporting error. Assuming that no

new major sources of tetrachloroethene began operating near the IBM facility, estimated air concentrations of this chemical would decrease every year following 1995.

US EPA did not include *N*-methyl-2-pyrrolidone in NATA. NYS DOH staff reviewed the 1996 TRI files and found two facilities with reported releases of *N*-methyl-2-pyrrolidone in the area of the Shenandoah Road Groundwater Contamination site. The two facilities, IBM and Philips Semiconductor, are located in the same complex. TRI-reported stack releases of the chemical from these facilities in 1996 are 6100 and 4300 pounds, respectively. To estimate an air concentration for *N*-methyl-2-pyrrolidone we combined the releases of *N*-methyl-2-pyrrolidone for the two facilities. Because the two facilities are about a tenth of a mile apart, we assumed that all of these releases are emitted from the IBM facility, and used information that relates the estimated air concentration of tetrachloroethene to the emissions of tetrachloroethene from the IBM facility. Based on this approach, we estimated an air concentration of 0.13 mcg/m³ for *N*-methyl-2-pyrrolidone in census tract 027/502.01.

The estimated air concentration for tetrachloroethene (0.99 mcg/m³) is below the NYS DOH residential air guideline of 100 mcg/m³ (NYS DOH 1997), and is below levels that cause health effects.

Toxicological information on *N*-methyl-2-pyrrolidone is limited. Exposure to high levels of *N*-methyl-2-pyrrolidone causes adverse effects on the blood of laboratory animals and on their ability to bear healthy offspring. Based on a limited number of studies, the *N*-methyl-2-pyrrolidone exposure levels that cause health effects in laboratory animals correspond to air levels more than 500,000 times higher than the estimated air concentration for *N*-methyl-2-pyrrolidone. Therefore exposure to the estimated *N*-methyl-2-pyrrolidone air level (0.13 mcg/m³) is unlikely to result in adverse health effects.

Comment #11: The US EPA has recently released a draft health assessment on trichloroethene, which concludes that it is more toxic than previous thought. Since the Shenandoah Groundwater Contamination Site has trichloroethene as one of the contaminants of concern, how does this draft health assessment affect the conclusions of the public health assessment?

Response: In 2001, the US EPA released an external review draft health assessment document on trichloroethene. The new health assessment document, which was peer-reviewed, is the agency's updated evaluation of the potential health risks from exposure to trichloroethene, and uses several animal and epidemiological studies published since US EPA's last evaluation, which was released in 1985. In 2002, US EPA's Science Advisory Board (SAB) reviewed the draft health assessment and made extensive comments on US EPA's methods and evaluations of cancer and noncancer risks. We anticipate that US EPA will review and respond to the SAB's comments. The NYS DOH is currently reviewing and evaluating both the US EPA external review draft document and the SAB comments. The information in US EPA's draft health assessment would not change the overall conclusions of the public health assessment nor our recommendations for measures to reduce and minimize exposure to chemicals in drinking water.

Comment #12:- Is the NYS DOH and ATSDR concerned about vapor intrusion into homes?

Response - In addition to groundwater, volatile organic chemicals (VOCs) may be present in the air spaces between soil particles; this is sometimes called soil gas. Tetrachloroethene could migrate into indoor air through soil gas. It must be present in a vapor phase in soil gas beneath a building to migrate into indoor air of the building. To determine if these vapors are present, the US EPA will oversee collecting of samples of soil gas in the area around and near the groundwater contamination during late 2003 to early 2004. The results of the soil gas sampling will be evaluated to determine the need for indoor air sampling.

Reference:

NYS DOH (New York State Department of Health). 1997. Tetrachloroethene Ambient Air Criteria Document. Final Report. Center for Environmental Health. Bureau of Toxic Substance Assessment.

APPENDIX F

ATSDR Glossary of Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health. This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

General Terms

Absorption

The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute

Occurring over a short time [compare with chronic].

Acute exposure

Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Additive effect

A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with antagonistic effect and synergistic effect].

Adverse health effect

A change in body function or cell structure that might lead to disease or health problems

Aerobic

Requiring oxygen [compare with anaerobic].

Ambient

Surrounding (for example, ambient air).

Anaerobic

Requiring the absence of oxygen [compare with aerobic].

Analyte

A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study

A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect

A biologic response to exposure to multiple substances that is less than would be expected if the known effects of the individual substances were added together [compare with additive effect and synergistic effect].

Background level

An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation

Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study

A study that uses (a) biomedical testing or (b) the measurement of a substance [an analyte], its metabolite, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see exposure investigation].

Biologic monitoring

Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake

The transfer of substances from the environment to plants, animals, and humans.

Biomedical testing

Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

Biota

Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden

The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

CAP [see Community Assistance Panel.]

Cancer

Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk

A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen

A substance that causes cancer.

Case study

A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study

A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number

A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

Central nervous system

The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]

Chronic

Occurring over a long time [compare with acute].

Chronic exposure

Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

Cluster investigation

A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP)

A group of people from a community and from health and environmental agencies who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV)

Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see exposure pathway].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

Concentration

The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant

A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Delayed health effect

A disease or an injury that happens as a result of exposures that might have occurred in the past.

Dermal

Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact

Contact with (touching) the skin [see route of exposure].

Descriptive epidemiology

The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit

The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention

Measures used to prevent a disease or reduce its severity.

Disease registry

A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD

United States Department of Defense.

DOE

United States Department of Energy.

Dose (for chemicals that are not radioactive)

The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)

The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship

The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

Environmental media

Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism

Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA

United States Environmental Protection Agency.

Epidemiologic surveillance [see Public health surveillance].

Epidemiology

The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure

Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure assessment

The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction

A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation

The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway

The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Exposure registry

A system of ongoing followup of people who have had documented environmental exposures.

Feasibility study

A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS)

A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds

Training sessions for physicians and other health care providers about health topics.

Groundwater

Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Half-life ($t_{1/2}$)

The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard

A source of potential harm from past, current, or future exposures.

Hazardous Substance Release and Health Effects Database (HazDat)

The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste

Potentially harmful substances that have been released or discarded into the environment.

Health consultation

A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with public health assessment].

Health education

Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation

The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

Health promotion

The process of enabling people to increase control over, and to improve, their health.

Health statistics review

The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Indeterminate public health hazard

The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence

The number of new cases of disease in a defined population over a specific time period [contrast with prevalence].

Ingestion

The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation

The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure

Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

In vitro

In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with in vivo].

In vivo

Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with in vitro].

Lowest-observed-adverse-effect level (LOAEL)

The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring

A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism

The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite

Any product of metabolism.

mg/kg

Milligram per kilogram.

mg/cm²

Milligram per square centimeter (of a surface).

mg/m³

Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration

Moving from one location to another.

Minimal risk level (MRL)

An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

Morbidity

State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

Mortality

Death. Usually the cause (a specific disease, a condition, or an injury) is stated.

Mutagen

A substance that causes mutations (genetic damage).

Mutation

A change (damage) to the DNA, genes, or chromosomes of living organisms.

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)

EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

National Toxicology Program (NTP)

Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

No apparent public health hazard

A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)

The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard

A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see National Priorities List for Uncontrolled Hazardous Waste Sites]

Physiologically based pharmacokinetic model (PBPK model)

A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

Pica

A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume

A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure

The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population

A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP)

A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb

Parts per billion.

ppm

Parts per million.

Prevalence

The number of existing disease cases in a defined population during a specific time period [contrast with incidence].

Prevalence survey

The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention

Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public availability session

An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public comment period

An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action

A list of steps to protect public health.

Public health advisory

A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)

An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].

Public health hazard

A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Public health hazard categories

Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Public health statement

The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public health surveillance

The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Public meeting

A public forum with community members for communication about a site.

Radioisotope

An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide

Any radioactive isotope (form) of any element.

RCRA [see Resource Conservation and Recovery Act (1976, 1984)]

Receptor population

People who could come into contact with hazardous substances [see exposure pathway].

Reference dose (RfD)

An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry

A systematic collection of information on persons exposed to a specific substance or having specific diseases [see exposure registry and disease registry].

Remedial investigation

The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)

This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA

RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD [see reference dose]

Risk

The probability that something will cause injury or harm.

Risk reduction

Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication

The exchange of information to increase understanding of health risks.

Route of exposure

The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Safety factor [see uncertainty factor]

SARA [see Superfund Amendments and Reauthorization Act]

Sample

A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size

The number of units chosen from a population or an environment.

Solvent

A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination

The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Special populations

People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder

A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics

A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance

A chemical.

Substance-specific applied research

A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's toxicological profiles. Filling these data needs would allow more accurate

assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)]

Superfund Amendments and Reauthorization Act (SARA)

In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water

Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Surveillance [see public health surveillance]

Survey

A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].

Synergistic effect

A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see additive effect and antagonistic effect].

Teratogen

A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent

Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile

An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology

The study of the harmful effects of substances on humans or animals.

Tumor

An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor

Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

Urgent public health hazard

A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)

Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other glossaries and dictionaries:

Environmental Protection Agency (<http://www.epa.gov/OCEPATERMS/>)

National Center for Environmental Health (CDC)
(<http://www.cdc.gov/nceh/dls/report/glossary.htm>)

National Library of Medicine (NIH) (<http://www.nlm.nih.gov/medlineplus/mplusdictionary.html>)

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