ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

HOPEWELL PRECISION AREA CONTAMINATION
HAMLET OF HOPEWELL JUNCTION
TOWN OF EAST FISHKILL, DUTCHESS COUNTY, NEW YORK
EPA FACILITY ID: NYD066813064

SEPTEMBER 28, 2007

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

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EPA FACILITY ID: NYD066813064

Prepared by:

New York State Department of Health
Center for Environmental Health
Under a Cooperative Agreement with
The U.S. Department of Health & Human Services
Agency for Toxic Substances and Disease Registry
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SUMMARY

The Hopewell Precision Area Contamination site is located in a semi-rural residential area of Dutchess County, New York. Hopewell Precision is an active manufacturer that fabricates and paints sheet metal. The facility, which opened in 1977, originally operated at 15 Ryan Drive but moved its operations to 19 Ryan Drive in 1981. Wastes generated from the Hopewell Precision site include paint thinners and degreasing solvents. Mishandling of these waste products, including dumping 5-gallon buckets containing these wastes on the ground outside the back door, allegedly occurred at the original location (15 Ryan Drive). As a result, area groundwater is contaminated with volatile organic compounds (VOCs), primarily trichloroethene (TCE) and 1,1,1-trichloroethane (1,1,1-TCA). Area soil vapor has also been impacted as a result of the VOC groundwater plume. Exposures to TCE and 1,1,1-TCA have occurred via private drinking water supplies and breathing contaminated indoor air as a result of soil vapor intrusion. For this public health assessment, a maximum exposure duration of 29 years was used to correspond with the start of industrial activity at the Hopewell Precision facility. However, the movement of the contamination to groundwater, private drinking water wells, and soil vapor likely took a significant amount of time, resulting in shorter exposure duration than assumed for this public health assessment. The data presented in this public health assessment were current as of the spring of 2006, prior to the start of the Remedial Investigation being conducted by the US EPA.

Dutchess County Health Department (DCHD) staff initially sampled four nearby private wells in June 1985. None of these wells showed any VOC contamination at that time. New York State Department of Environmental Conservation (NYS DEC) staff sampled two private wells in April 1993. No VOC contamination was identified in private drinking water wells during this sampling round. In February 2003, the United States Environmental Protection Agency (US EPA) conducted an assessment of the site. As part of this assessment, US EPA sampled 75 nearby residential wells. Results of the sampling revealed five residential wells, south and southwest of the site, that were contaminated with TCE. Subsequently, US EPA sampled approximately 450 private drinking water wells to delineate the contaminated area. TCE was detected above the state and federal drinking water standards, referred to as Maximum Contaminant Levels (MCLs) of 5 micrograms per liter (mcg/L) in 36 wells of the approximately 450 wells sampled, or about 8 percent. TCE was detected below the state MCL in 22 of the wells sampled or about 5 percent. 1,1,1-TCA was detected above the state MCL of 5 mcg/L in 15 of the wells sampled, or about 3 percent. 1,1,1-TCA was detected below the state MCL in 47 of the wells sampled, or about 10 percent. Two wells had methyl-*tert*-butyl-ether (MTBE) at levels above the state MCL. However, this contaminant is not related to the Hopewell Precision site. US EPA and NYS DEC provided water treatment systems, also known as point of entry treatment (POET) systems, for private wells to reduce exposures to TCE and 1,1,1-TCA through drinking water. As of the spring of 2006, 51 treatment systems (37 by US EPA and 14 by NYS DEC) had been installed to address the TCE contamination, 1,1,1-TCA contamination, or both. US EPA and NYS DEC monitor these treatment systems on a quarterly basis to ensure that they are working effectively.

From February 2004 through the spring of 2006, US EPA collected sub-slab soil vapor samples from 206 buildings and indoor air samples from 103 buildings, mainly residential, located over the plume. TCE was detected in the sub-slab soil vapor of 66 buildings and in the indoor air of 70 buildings. 1,1,1-TCA was detected in the sub-slab soil vapor samples of 141 buildings and in the indoor air of 71 buildings. Tetrachloroethene, also known as PCE, was detected in the sub-slab soil vapor of 81 buildings and in the indoor air of 61 buildings. Although PCE is a common degreaser, it is not known to be associated with the Hopewell Precision site and has not been consistently detected in the groundwater. The source of the PCE in soil vapor is unknown. Methyl-*tert*-butyl ether (MTBE), which is unrelated to the Hopewell Precision site, was detected in the sub-slab vapor of 56 buildings and in the indoor air of 77 buildings.

US EPA installed sub-slab depressurization systems (SSDS) at 46 buildings that were determined by US EPA to currently be impacted or that have the potential to be impacted by vapor intrusion of TCE, thereby minimizing exposures to TCE in indoor air. US EPA chose to use TCE as the determining contaminant when making decisions regarding the need for SSDS.

Public health actions were needed in the past and are still being conducted at the Hopewell Precision Area Contamination site to reduce exposures to site-related VOCs, primarily TCE and 1,1,1-TCA, and the non-site related VOCs, PCE and MTBE. Exposure to TCE, 1,1,1-TCA, and MTBE were occurring via contaminated private well water and via indoor air. Exposure to PCE was occurring via indoor air. Many wells were contaminated with TCE and 1,1,1-TCA at or above the state or federal MCLs; two wells had MTBE at levels above the NYS MCL (promulgated in December 2003) of 10 mcg/L. Long-term exposure of residents to the highest levels of TCE detected in private water supplies is estimated to pose a low increased risk for cancer; the risks for noncancer effects is low to moderate. Long-term exposure to the highest level of MTBE in private wells (which is not related to the Hopewell Precision facility) is estimated to pose a low increased risk for cancer. These exposures have been addressed by installation of treatment systems.

Indoor air of some buildings, mostly residential, was contaminated with TCE and PCE above the US EPA remedial goal of less than 0.38 microgram per cubic meter (mcg/m^3) TCE in indoor air and NYS DOH air guidelines of 5 mcg/m^3 for TCE and 100 mcg/m^3 for PCE. Some residents could have been exposed to TCE in their indoor air for as long as 29 years; however, the movement of contamination to groundwater and soil vapor could have taken a significant period of time, resulting in a shorter exposure duration. The estimated increased cancer risk for exposure to the levels of TCE in indoor air at properties within the contamination area is low, with the exception of one property, where the estimated cancer risk is moderate. The risks for TCE noncancer effects for indoor air are minimal to low. PCE indoor air levels, which are not related to the Hopewell Precision facility, are estimated to pose a low increased risk for cancer and minimal to low risk for noncancer health effects, except for two properties where the estimated noncancer risk is moderate. A single property had significantly elevated PCE levels corresponding to a moderate increased theoretical cancer risk and a high risk for noncancer health effects. These exposures have been addressed by installation of mitigation systems.

The drinking water affected by the site currently poses an indeterminate public health hazard. Although treatment systems have been installed on affected wells and regular monitoring is being implemented, the extent of the groundwater plume is still being defined. In those impacted homes already identified, contaminants in private drinking water wells have been reduced to levels below state MCLs, thereby reducing exposures. Therefore, the site currently poses no apparent public health hazard for the residents in homes with drinking water treatment systems.

Similarly, indoor air affected by the site poses an indeterminate public health hazard. Although mitigation systems have been installed and inhalation exposures have been minimized in those impacted homes already identified, the extent of the soil vapor plume still needs to be defined. The site currently poses no apparent public health hazard for residents in homes with soil vapor mitigation systems, also known as a sub-slab depressurization system (SSDS).

Residents affected by the groundwater and soil vapor contamination have voiced concerns about several issues, including when remediation of the contaminated groundwater will take place, the feasibility and cost of bringing public water to the community, and concerns over the safety of using the carbon filters on their wells, and the sub-slab vapor depressurization systems installed on their homes. Residents exposed to TCE and 1,1,1-TCA in their drinking water and indoor air also have questions concerning the short- and long-term health effects of their exposure. NYS DOH, in conjunction with Agency for Toxic Substances and Disease Registry (ATSDR) and US EPA, held four public meetings and one informational community meeting to address residents' health concerns.

ATSDR and NYS DOH have also provided physician education and training materials on exposures associated with the Hopewell Precision Area Contamination. NYS DOH and ATSDR placed an advertisement in the Dutchess County Medical Associations newsletter, The Decatur, in October of 2004, acknowledging the availability for physicians to obtain educational packets that include information on health effects associated with exposures, how to take a patient's environmental exposure history, and case studies in environmental medicine. These resources are also available at the US EPA information repository in the East Fishkill Community Library for other interested health care providers. NYS DOH and ATSDR have also provided the community several opportunities to have these packets sent to their physicians by having patients provide the names of their physician to NYS DOH or ATSDR representatives.

NYS DOH and ATSDR have recommended actions to protect residents from the contaminated groundwater and indoor air. Recommended actions include proper maintenance and monitoring of the installed treatment systems for both drinking water and indoor air, a permanent, long-term remedy for groundwater users, and VOC exposure education for residents and physicians by ATSDR and NYS DOH. Additional investigation of the source of the contamination and the extent of the contaminant plumes is needed and is currently being conducted by the US EPA as part of the Remedial Investigation. As needed, NYS DOH and ATSDR will evaluate new exposure related information in a future public health assessment document.

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 additional data to define the extent of the VOC contaminated groundwater plume and soil vapor plume. NYS DOH and US EPA will evaluate the potential for exposures to TCE and 1,1,1-TCA in groundwater and soil vapor based on these data and perform any follow-up sampling that may be necessary.

Persons known to have been exposed to site-related contaminants in either groundwater or soil vapor at this site are being offered enrollment in the NYS VOC Exposure Registry established by NYS DOH. The VOC Exposure Registry is a tool for long-term follow-up for communities with documented exposures to VOCs. Future analysis of VOC Exposure Registry information will involve combining information from multiple sites with similar exposures into a multi-site study, increasing our ability to detect effects. People who are enrolled in the Registry will be kept informed of any research results that come from the Registry data.

NYS DOH is conducting a health statistics review for the Hopewell Junction Contamination Area. The review will use existing data from statewide databases on cancer diagnoses, congenital malformations, and low birth weight births to determine whether these outcomes are occurring at a higher, lower, or about the same level in the Hopewell Junction study area compared to the rest of New York State. The results of the review will be discussed in a future public health assessment document.

This public health assessment was distributed for public comment from November 17th 2006 until January 19th 2007. A public meeting was held on January 22nd 2007 to discuss the document with the community and the deadline was extended until February 23rd 2007. NYS DOH received multiple written comments, and verbal comments from the meeting. A summary of these comments and NYS DOH's responses are included in Appendix E.

In addition to those educational materials distributed thus far, NYS DOH and ATSDR will distribute a draft of this public health assessment to concerned residents and local physicians in the area who expressed an interest in the site.

PURPOSE AND HEALTH ISSUES

The purpose of this public health assessment (PHA) is to evaluate human exposure pathways for contaminants related to the Hopewell Precision Area Contamination site. This PHA also fulfills the congressional mandate for public health assessment activities for each site being proposed to the National Priorities List (NPL). The Hopewell Precision Area Contamination site was proposed to the NPL on September 23, 2004 and added on April 27, 2005. In addition, this public health assessment responds to a petition for a public health assessment that ATSDR received from a local resident. This public health assessment will focus on exposure to volatile organic compounds (VOCs), mainly trichloroethene (TCE) and 1,1,1-trichloroethane (1,1,1-TCA) in private wells and soil vapor, which are the only known site-related exposure pathways in the contamination area. The public health actions taken to date include identifying exposed and potentially exposed residents and providing treatment and mitigation systems to homeowners with private drinking water wells contaminated with TCE and 1,1,1-TCA above New York State (NYS) public drinking water standard of 5 micrograms per liter (mcg/L), or with TCE sub-slab vapor concentration of greater than US EPA action and screening levels. In addition, evaluation of contaminants not related to the Hopewell Precision Area Contamination site have been included in this report to provide a thorough evaluation of the potential risks and hazards from environmental contamination in the community. The United States Environmental Protection Agency (US EPA), New York State Department of Health (NYS DOH), and Agency for Toxic Substances and Disease Registry (ATSDR) conducted four public meetings to address public health concerns.

BACKGROUND

A. Site Description and History

The Hopewell Precision Area Contamination site is in the Hamlet of Hopewell Junction, Dutchess County, New York. The source of contamination is believed to be the Hopewell Precision facility, an active sheet metal fabrication and painting business. The facility, which opened in 1977, originally operated at 15 Ryan Drive but moved to its current location, 19 Ryan Drive, in 1981. Since 1981, a moving company has occupied the property at 15 Ryan drive. The combined size of these two adjacent properties is 5.7 acres. The facility and the associated groundwater and soil vapor contamination plumes are in a semi-rural mostly residential area. The area impacted by the groundwater and soil vapor contamination extends approximately 1.4 miles in a southwestern direction from the Hopewell Precision site, generally following NYS Route 82. The streets with one or more impacted private wells include NYS Route 82, Oakridge Road, Lenart Drive, Creamery Road, Hamilton Road, Clove Branch Road, Baris Lane, Cavelo Road, and West Old Farm Road (Appendix A, Figure 1). About 670 people live in the affected area. All residents in the affected area rely on private wells as their primary source of potable water. Impacted wells in the study area are contaminated with VOCs, primarily TCE and to a lesser extent 1,1,1-TCA. The streets with one or more soil vapor impacted buildings include Ryan Drive, NYS Route 82, Lenart Drive, Creamery Road, Hamilton Road, Oakridge Road, Maple Place, Baris Lane, and Canterberry Court. TCE is the primary site-related soil vapor contaminant.

Waste products associated with the Hopewell Precision Facility include paints, thinners, and degreasing solvents. Allegedly, these waste products were dumped directly to the ground outside of the building at 15 Ryan Drive. Waste paints and thinners were allegedly dumped outside the backdoor on a daily basis and waste degreasing solvents were dumped on a biweekly basis. US EPA first investigated this site in response to a letter written by a concerned citizen. US EPA confirmed the allegations of dumping during a site inspection in November 1979. At this time, several punctured and leaking 55-gallon drums of various chemicals, empty paint, and solvent cans were identified on-site. Proper disposal of the TCE used in site operations could not be documented due to missing waste manifest documents. In March of 1980, US EPA sampled the on-site process well and found low level VOC contamination. The site was subsequently referred to NYS DEC for further investigation.

NYS DEC completed an investigation of the site in 1984 and again in 1987 (NYS DEC, 1987). As part of these investigations, NYS DEC installed three on-site groundwater monitoring wells in May of 1985. Subsequent sampling of these wells identified one with 1,1,1-TCA at 23 mcg/L and trace levels of other VOCs. In June 1985, the Dutchess County Health Department (DCHD) sampled four private wells (2 residential and 2 business, including the on-site well). No VOCs were detected in any of the samples.

In April 1993, the site owners completed a limited site investigation which included sampling of the three previously installed groundwater monitoring wells and two residential private wells. NYS DEC collected samples at the same time during this investigation. TCE was only detected in one on-site monitoring well at levels below state MCL. In 1994, based on the results of these investigations, NYS DEC decided to remove the Hopewell Precision site from the New York State Registry of Inactive Hazardous Disposal Waste Sites.

In February 2003, as part of US EPA's effort to make decisions on historic sites, US EPA sampled 75 residential wells near the Hopewell Precision site. Analyses of the samples revealed that five residential wells were contaminated with TCE ranging from 1.2 mcg/L to 250 mcg/L. At that time, NYS DEC, on behalf of the NYS DOH, requested US EPA conduct a removal action at the site (i.e., installation of carbon filter systems on residential wells). A removal action is a short-term measure taken to reduce human exposures.

US EPA initiated a removal action at the site in March 2003. Since the time of initiation, US EPA has expanded the scope of their investigation to include additional drinking water wells and sub-slab soil vapor and indoor air sampling. The results of the expanded investigation have confirmed that some homes were impacted by contaminated drinking water and contaminated soil vapor intrusion as a result of the site-related TCE and 1,1,1-TCA groundwater plume.

B. Actions Implemented During the Public Health Assessment Process

US EPA installed point of entry treatment systems (referred to as POETS) on those private drinking water wells that had VOC contamination that exceeded or approached the federal and state Maximum Contaminant Level (MCL) for TCE of 5 mcg/L. NYS DEC installed carbon filters at those locations where 1,1,1-TCA was detected at levels below the federal MCL of 200 mcg/L but above the state MCL of 5 mcg/L. US EPA and NYS DEC will continue to provide regular sampling and maintenance for these carbon filters until such time that they are no longer needed (i.e., analysis shows that groundwater is consistently below the federal and state MCLs) or an alternative water source for the area is secured.

US EPA has also installed active sub-slab depressurization systems (SSDS) in those buildings found to be impacted or have the potential to be impacted by soil vapor intrusion. US EPA's action level (i.e., a SSDS is automatically installed) for TCE in sub-slab soil vapor is 50 mcg/m^3. US EPA's screening level for soil vapor (i.e., indoor air sampling will be conducted) is a concentration greater than 2.7 mcg/m^3, and the US EPA post-mitigation goal for TCE in indoor air is less than 0.38 mcg/m^3. Outdoor air was not considered in the establishment of US EPA action levels. US EPA is providing post-installation indoor air sampling to confirm the effectiveness of the systems in minimizing vapor intrusion of TCE contaminated soil vapor. US EPA will provide monitoring and maintenance of each of the SSDS until such time that they are no longer needed.

US EPA, NYS DOH, ATSDR, and NYS DEC conducted four public meetings (July 10, 2003, May 5, 2004, December 1, 2005, and January 22, 2007) to answer health concerns, to explain in greater detail the VOC registry, and to discuss the current activities taking place at the site. NYS DOH and ATSDR also requested resident assistance in identifying their health care providers so that educational outreach to the health care providers could be targeted. US EPA has mailed out six update newsletters to the community.

NYS DOH and ATSDR physician outreach activities included the placement of an advertisement in the Dutchess County Medical Society Newsletter, The Decatur, informing area physicians of the availability of a "Physician Outreach Packet" which contains several ATSDR documents including ATSDR's 2004 Toxicological Profiles CD, "Case Studies in Environmental Medicine," and other reference information. NYS DOH and ATSDR also included a notice in the October 2004 US EPA community update newsletter informing the public of the opportunity to request that a packet be sent to their physician.

C. Site Visit

The initial site visit by NYS DOH was completed on January 16, 1986. Since that time, NYS DOH, NYS DEC, and US EPA have completed multiple visits to this area. US EPA's work at the site is on-going. Access is restricted to the Hopewell Precision property. NYS DOH, NYS DEC, DCHD, and US EPA have all sampled private well water in homes in the area. NYS DOH last visited the site on December 1, 2005.
A public meeting was held on January 22, 2007 and no changes in site characteristics were noted. In addition, the US EPA project manager visits the site periodically, and no significant changes in site conditions have been reported.

D. Demographics.

NYS DOH estimated, from the 2000 Census (US Bureau of the Census, 2001; 2002), that approximately 670 people live above the area of the plumes. The age distribution of the area is similar to that of the rest of Dutchess County as well as New York State, excluding New York City (NYC). There were approximately 130 females of reproductive age (ages 15-44) in the area. The area is somewhat less racially diverse than the rest of the county or state (excluding NYC) with 97% of the population reported as white. Based on the 2000 Census, less than 1% of people in the area are living below the poverty level compared to 10% in New York State, while the median household income is almost 60% higher than the rest of the state (excluding NYC). These comparisons are provided in the following table. In addition, there are no schools or nursing homes within the area.

2000 Census Demographics	New York State excluding NYC	Dutchess County	Area above plume
Age Distribution			
<6	8%	8%	8%
6-19	20%	21%	22%
20-64	58%	60%	58%
>64	14%	12%	12%
Race Distribution			
White	85%	84%	97%
Black	8%	9%	<1%
Native American	<1%	<1%	<1%
Asian	2%	3%	<1%
Pacific Islander	<1%	0%	0%
Other	2%	2%	<1%
Multi-Racial	2%	6%	1%
Percent Minority*	18%	20%	8%
Ethnicity Distribution			
Percent Hispanic	6%	2%	6%
1999 Median Income	$47,517	$53,086	$74,547
% Below Poverty Level	10%	8%	<1%

- 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 NYS DOH, NYS DEC, and US EPA. The data discussed here were acquired before US EPA began its remedial investigation of the Hopewell Precision Area under the Superfund Program in 2006. That investigation is ongoing. US EPA expects to report on the results of the remedial investigation in mid-2008. The following sections summarize the results of the investigations of groundwater, surface water, sediment, soil, soil vapor, and indoor air contamination in and around the study area prior to the US EPA's remedial investigation.

Groundwater / Private Drinking Water

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 5 feet to 355 feet below ground surface. All of the wells in the area, including wells that contain site-related contamination are drilled into and screened in glacial outwash or bedrock. These two water bearing units are hydraulically interconnected and are considered to be one aquifer. TCE and 1,1,1-TCA were detected in some of the samples collected from wells and were the only site-related VOCs detected consistently above the state MCL of 5 mcg/L. Approximately 450 private drinking water wells were sampled by US EPA to delineate the contamination area (See Table 1 for data summary). TCE was present above state public drinking water standard in 8 percent or 36 of the approximately 450 wells sampled. TCE was detected below the state and federal MCLs in about 5 percent or 22 of the wells sampled. 1,1,1-TCA was present above state MCL in about 3 percent or 15 of the approximately 450 wells sampled. 1,1,1-TCA was detected below the state MCL in about 10 percent or 47 wells of the wells sampled. 1,1,1-TCA was not detected in any well above the federal MCL of 200 mcg/L. In some cases, individual wells showed no contamination in areas where neighbors had elevated levels of TCE or 1,1,1-TCA. Such differences may be the result of differences in depth and construction of individual wells and well water usage per household. Also, contamination from the source area could be following a complicated course through glacial outwash and fractures in the bedrock.

To detect any future migration of the plume and reduce potential exposures, US EPA has been testing private wells beyond the edge of the known plume area. These wells will be sampled regularly as part of a long-term monitoring program. In addition, US EPA has proposed installing additional groundwater monitoring wells as part of the on-going remedial investigation of the Hopewell Precision Area Contamination site.

Two VOCs unrelated to the Hopewell Precision Area Contamination site were detected in several residential wells. Methyl-*tert*-butyl ether (MTBE), which was a common gasoline additive in NYS prior to January 2004, was detected in drinking water wells at levels below the state MCL of 10 mcg/L with the exception of two wells (up to 28 mcg/L). MTBE was detected in 42 of the approximately 450 wells sampled or about 9 percent. The average concentration of MTBE in wells sampled was 0.37 mcg/L. The detection of MTBE in area wells is most likely the result of gasoline spills in the area. Information on local gasoline spills is available from the NYS DEC Region 3 office at (845) 256-3052 or visit the NYS DEC website at http://www.dec.state.ny.us/website/der/spills/index.html.

In addition, styrene was detected at a level (5.3 mcg/L) just slightly above the state MCL in one private drinking water well. The presence of styrene in this sample is not site-related and may be due to the use of styrene in some plumbing adhesives. Therefore, no further evaluation of styrene will be completed in this PHA.

Surface Water and Sediment

In April 2003, US EPA collected surface water samples and sediment samples from two small ponds, Pond 1 and Pond 2 (Appendix A, Figure 2) located approximately 300 feet south-southwest (i.e., downgradient) of Hopewell Precision, the alleged source area. TCE was detected in the surface water at concentrations of 4 mcg/L and 3.4 mcg/L in these two ponds respectively. TCE was detected at a concentration of 88 micrograms per kilogram (mcg/kg) in the sediment sample collected from Pond 1. No TCE was detected in the Pond 2 sediment sample. 1,1,1-TCA was not detected in either surface water or sediment sample. To the best of our knowledge, which is based on site visits and discussions with federal and local agency staff and residents, these ponds are not used for recreation.

In May 2003, US EPA collected additional surface water samples from two ponds located approximately 900 feet (Pond 3) and 4,500 feet southwest of Hopewell Precision (Pond 4). No TCE or 1,1,1-TCA was detected in either surface water sample from the two ponds**.** TCE was detected in only one sediment sample from Pond 3 at a concentration 3.6 mcg/kg. To the best of our knowledge, which is based on site visits and discussion with federal and local agency staff and residents, these ponds are not used for recreation.

Surface water samples were collected by the Village of Fishkill (May 2004) and DCHD (June 2004) from the nearby Red Wing Park permitted bathing (swimming) facility. Neither TCE nor 1,1,1-TCA were detected in any of the surface water samples collected.

Soil

Although NYS DEC conducted a Phase II investigation at the site in 1986, no soil samples were collected at that time.

In July 2003, US EPA collected 13 on-site and five off-site soil samples. Analysis of these samples indicated that TCE was present in two on-site samples and 1,1,1-TCA was present in one of the on-site samples. Neither contaminant was detected in any of the off-site soil samples.

US EPA collected additional soil samples at the site in December 2003. US EPA focused its investigation between the boundaries of the current and former Hopewell Precision Facilities (15 and 19 Ryan Drive). US EPA installed 14 soil borings down to 12 feet below the ground surface in the suspected source areas and two soil borings to be used as background samples for comparison purposes (i.e., samples collected from upgradient areas not known or expected to be contaminated). US EPA collected 26 soil samples from the 16 soil borings. Low levels of TCE (up to 3.9 mcg/kg) were detected in five of the 26 soil samples collected. TCE was not detected in the background samples. US EPA concluded that the coarse-grained soils at the site have very

little ability to hold the organic chemicals. The vertical groundwater recharge through the shallow soils (i.e., precipitation in the form of rain or snow) may have flushed away any contamination remaining in the soils on the Hopewell Precision site.

Soil Vapor / Indoor Air

From February 2004 to the spring of 2006, US EPA collected sub-slab soil vapor samples from 206 buildings and indoor air samples from 103 buildings, mainly residential, located over the plume. The reason for the decreased number of buildings sampled for indoor air compared to the number of buildings sampled for soil vapor is that some homes were eliminated from further investigation since there was minimal potential for vapor intrusion (i.e., the sub-slab concentrations were below the US EPA TCE screening level of greater than 2.7 mcg/m^3). In those locations where indoor air was sampled, samples were collected from basement levels (if present) and the first floor living space. Since the amount of exposure can vary based on whether the basement is finished and occupied frequently or a non-occupied area used for storage, laundry, or other infrequent uses, the data for both the basement and first floor are separated as presented in Table 2.

TCE
TCE was detected in the sub-slab vapor samples of 66 buildings or approximately 32% with a range of 2.7 mcg/m^3 to 7518 mcg/m^3. TCE was detected in the basement air of 51 buildings with an average of 3.6 mcg/m^3 and the first floor of 54 buildings with an average of 2.2 mcg/m^3. The TCE concentrations in the 70 buildings where the contaminant was detected ranged from 0.37 mcg/m^3 to 172 mcg/m^3.

1,1,1-TCA
1,1,1-TCA was detected in the sub-slab vapor samples of 141 buildings or approximately 69% with a range of 2.7 mcg/m^3 to 486 mcg/m^3. 1,1,1-TCA was detected in the basement of 55 buildings with an average of 1.2 mcg/m^3 and the first floor of 43 buildings with an average of 0.9 mcg/m^3. TCA concentrations in the 71 buildings where the contaminant was detected ranged from 0.36 mcg/m^3 to 17 mcg/m^3.

PCE
Tetrachloroethene, also known as PCE, was detected in the sub-slab soil vapor of 81 buildings or 39% with a range of greater than 2.7 mcg/m^3 to 4500 mcg/m^3. Although PCE is a common degreaser, it is not known to be associated with the Hopewell Precision site. In addition, PCE has not been consistently detected in the groundwater. In the approximately 450 private drinking water wells sampled, PCE was only detected twice at concentrations of 0.22 mcg/L and 0.28 mcg/L, which are below NYS public drinking water standard of 5 mcg/L. The source of the PCE in soil vapor is unknown. Additional investigation is being conducted during the on-going remedial investigation by US EPA. PCE was detected in the basement air of 48 buildings with an average of 7.5 mcg/m^3 and the first floor of 40 buildings with an average of 7.6 mcg/m^3. PCE concentrations in the 61 buildings where the contaminant was detected ranged from 0.45 mcg/m^3 to 2000 mcg/m^3. The detection of PCE in indoor air may be the result of vapor intrusion or possibly the presence of products stored or used in the buildings (e.g., dry-cleaned clothes, automotive brake cleaner, etc.). Due to the prevalence of PCE detected in soil vapor and the

levels at which PCE was present in indoor air, further evaluation of PCE is included in the Public Health Implications section of this PHA.

MTBE
Methyl-*tert*-butyl ether (MTBE), which is unrelated to the Hopewell Precision Area Contamination site, was detected in the sub-slab vapor of 56 out of 206 buildings or 27% with a range of 2.7 mcg/m^3 to 76.0 mcg/m^3. MTBE was detected in the basement of 75 buildings with an average of 7.6 mcg/m^3 and the first floor of 60 buildings with an average of 5.6 mcg/m^3. MTBE concentrations in the 77 buildings where the contaminant was detected ranged from 0.36 mcg/m^3 to 610 mcg/m^3. The increased percentage of MTBE detected in the indoor air compared to that detected in the soil vapor suggests that in many situations there is likely an indoor source, such as gasoline, used or stored within a building. However, the possibility of vapor intrusion of MTBE can not be eliminated as a potential exposure pathway. Therefore, due to the prevalence of MTBE detections in soil vapor and the levels at which MTBE was present in indoor air, further evaluation of MTBE is included in the Public Health Implications section of this PHA.

Common Household Contaminants
Several volatile organic compounds such as acetone, 1,1-dichlorobenzene and methylene chloride were detected at levels above background in the indoor air of some buildings. The presence of these compounds in indoor air is most likely the result of products stored and used in the building such as nail polish remover, craft/hobby supplies, mothballs, cleaning/disinfectants, rug cleaners, hairspray, etc. These compounds are not site-related contaminants and, therefore, will not be further evaluated in this public health assessment.

Sub-slab Depressurization Systems
As of early 2006, US EPA had installed sub-slab depressurization systems (SSDS) at 46 buildings (or approximately 70% of buildings where TCE was detected in sub-slab soil vapor) that were determined by US EPA to be impacted or to have the potential to be impacted by vapor intrusion. US EPA has chosen to use TCE as the determining contaminant when making decisions regarding the need for SSDS. US EPA expects that additional systems may be warranted based on the results of the soil vapor investigations being conducted during the Remedial Investigation.

B. Pathways Analysis

This section of the PHA identifies completed exposure pathways associated with past, present, and future uses of the site. An exposure pathway is how an individual could be exposed to

contaminants originating from a site. An exposure pathway is comprised of five elements including:

(1) a contaminant source,
(2) 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 place where contaminant release to the environment occurred (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 potentially become exposed to contaminants at a point of exposure.

Completed Exposure Pathways:

For the Hopewell Precision Area Contamination site, there are two known completed site-related exposure pathways, exposure to primarily TCE and 1,1,1-TCA in private drinking water and contaminated soil vapor intruding into indoor air. Exposure to contaminants in drinking water supplies can occur through ingestion, dermal contact, and absorption during showering, bathing or other household water uses, and through inhalation of aerosols and vapors from water used in the household. Exposure to soil vapor contaminated with VOCs can occur when the vapors beneath a building are drawn through cracks and openings in the foundation and mix with indoor air. Inhalation is the route of exposure, or the manner in which the VOCs actually enter the body, once in the indoor air. For an undetermined period of time, some residents were exposed to VOCs in their drinking water supply and/or indoor air. Prior to February 2003, we do not know how long or at what concentration residents were exposed to site-related contaminants in their drinking water. However, limited sampling of private wells in 1985 showed no contamination. Prior to February 2004, we do not know how long or at what concentration residents were exposed to site-related contaminants in their indoor air. The maximum duration for both the drinking water and vapor intrusion exposure pathways could be as long as 29 years for some of the homes in the contamination area, since some of these homes were built and the potential source facility was operational as early as 1977. However, it is quite likely that the movement of the contamination to groundwater, private drinking water wells and soil vapor could have taken a significant period of time, resulting in shorter exposure duration. Although these pathways were complete in the past, most exposures were eliminated or minimized as contamination was identified through the installation of treatment systems on drinking water wells where VOCs were detected at or above the NYS public drinking water standard of 5 mcg/L and installation of sub-slab depressurization systems on homes where soil vapor intrusion was occurring or has the potential to occur. One property owner has refused the installation of the treatment systems on the property and therefore, exposures may be currently

occurring. If treatment systems are not maintained or if TCE or 1,1,1-TCA is detected at or above the state MCL in any wells where contamination was not previously identified or TCE is detected in sub-slab vapor in any additional buildings, additional exposures to these contaminants above standards or guidelines could occur.

C. Public Health Implications

An analysis of the toxicological implications of the human exposure pathways of concern is presented below. To evaluate the potential health risks from contaminants of concern associated with the exposure pathways identified for the Hopewell Precision Area Contamination site, NYS DOH assessed the risks for cancer and noncancer health effects. The risks for health effects depend primarily on contaminant concentration, exposure route, exposure frequency and exposure duration. For additional information on how NYS DOH determined and qualified health risks applicable to this public health assessment, please refer to Appendix C.

1) Past ingestion, dermal and inhalation exposure to volatile organic contaminants in private water supply wells

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. Although actual 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. Several investigations (e.g., Maxwell et. al., 1991; Weisel and Jo, 1996) have indicated that for VOCs in drinking water, exposures by the inhalation or dermal routes may approach the same level as exposure by ingestion. Therefore, the NYS DOH doubled the exposure from ingesting two liters of water per day in the risk calculations to account for non-ingestion VOC exposures from drinking water.

For an undetermined period of time, possibly for up to 29 years, some of the private water supply wells near the Hopewell Precision facility have been contaminated with VOCs, primarily TCE and 1,1,1-TCA. The estimated exposure duration of 29 years is based on the beginning of industrial activity at the Hopewell Precision facility in 1977, although the movement of contamination to groundwater and private drinking water wells could have taken a significant period of time, resulting in a shorter exposure duration. Some private wells also contained MTBE, which is not considered related to the Hopewell Precision facility. Some concentrations of TCE, 1,1,1-TCA
and MTBE detected in private wells exceed the state MCL and/or public health assessment comparison values (see Table 3). Therefore, these chemicals have been selected for further evaluation.

Trichloroethene (TCE)

In humans, long-term exposure in the workplace to high levels of TCE in air is linked to effects on the central nervous system and irritation of the mucous membranes. Some studies of people exposed to high levels of TCE in workplace air or in drinking water show an association between exposure to TCE and increased risks for certain types of cancer, including cancers of the kidney,

liver, esophagus, and non-Hodgkin's lymphoma. Other studies suggest an association between workplace TCE exposure and reproductive effects (alterations in sperm counts) in men.

Studies of women exposed to mixtures of chlorinated solvents (including TCE) in drinking water during pregnancy also suggest that TCE may increase the risk of birth defects (e.g., neural tube defects, oral cleft defects, and congenital heart defects) and/or childhood leukemia (ATSDR, 1997b). In each of the drinking water studies, however, there are uncertainties about how much contaminated water the women drank during pregnancy and about how much TCE was in the water the women drank while pregnant. In addition, we do not know if the health effects observed in the studies of human exposure to TCE in workplace air and in drinking water are due to TCE or other factors, including exposure to other chemicals, smoking, alcohol consumption, and lifestyle choices. Since these potential confounding factors were not well controlled, and because there were uncertainties about actual exposures, the studies in humans suggest, but do not prove, that exposure to TCE can cause cancer, developmental effects and reproductive effects in humans.

In animal studies, exposure to high levels of TCE caused adverse effects on the central nervous system, liver and kidneys. Lifetime exposure to high levels of TCE has caused cancer in laboratory animals. When pregnant animals were exposed by ingestion to large amounts of TCE, adverse effects on the normal development of the offspring were observed (ATSDR 1997b). In most, but not all of these studies, the high amounts of the chemicals also caused adverse health effects on the parent animals. In one set of studies, effects on fetal heart development were observed in the offspring of rats exposed to TCE in drinking water before and during pregnancy (Dawson et al., 1993, Johnson et al., 1998, Johnson et al., 2003).

Based on the available sampling information and data from animal and human studies, long-term exposure (i.e., 29 years) to the highest level of TCE detected in private water supplies (250 mcg/L) is estimated to pose a low increased risk for cancer (i.e., the estimated risk is between one-in-one million and one-in-ten thousand). The available information suggests the risk for noncancer health effects would be moderate for people drinking water from private wells containing TCE levels higher than 130 mcg/L (seven of the 58 wells where TCE was detected) and low for wells containing TCE between about 25 mcg/L and 130 mcg/L (19 of the 58 TCE-containing wells). The noncancer risk for people drinking water from private wells containing less than about 25 mcg/L TCE is estimated to be minimal. Overall, the increase in the health risks for 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 chemicals were detected in private water supplies.

1,1,1-Trichloroethane (1,1,1-TCA)

1,1,1-TCA was present above the state MCL of 5 mcg/L in 15 of the approximately 450 wells sampled (about 3%), and none of the levels exceeded the health comparison value for 1,1,1-TCA based on noncancer effects (Table 3). Exposure to high levels of 1,1,1-TCA can cause adverse effects on the nervous system, liver and cardiovascular system (ATSDR, 1995). The available data suggest the risks for noncancer health effects from past exposure in drinking water are

minimal for exposure to the highest detected level of 1,1,1-TCA detected in private wells (12 mcg/L). Available toxicological data are inadequate to assess the carcinogenic potential of 1,1,1-TCA (US EPA IRIS, 2004).

Methyl-tert-Butyl Ether (MTBE)

MTBE was detected in 42 of approximately 450 wells sampled (about 9%). It was detected above the state MCL for MTBE in only two wells. MTBE caused cancer in laboratory animals exposed to high levels for most or all of their life (Bird et al., 1997; Belpoggi et al., 1995; 1998). Whether or not MTBE causes cancer in humans is unknown. Chemicals that cause cancer in laboratory animals may also increase the risk of cancer in humans who are exposed to lower levels over long periods of time. Long-term exposure to the highest detected level of MTBE in private wells (28 mcg/L) is estimated to pose a low increased risk for cancer; it would be very low for exposure to the levels detected in other private wells (all below the state MCL of 10 mcg/L). The risk for noncancer health effects would be minimal.

Summary

The following table summarizes the evaluation of potential health risks for contaminants detected in private drinking water supplies:

Summary of Cancer and Noncancer Risk Descriptors for Contaminants Detected in Private Wells Near the Hopewell Precision Site[a]

Chemical	Drinking Water Concentration in Micrograms per Liter	Qualitative Risk Descriptor
Cancer Risk Evaluation		
trichloroethene (TCE)	250[b]	low
1,1,1-trichloroethane (1,1,1-TCA)	---[c]	---[c]
methyl-*tert*-butyl ether (MTBE)	28[b]	low
Noncancer Risk Evaluation		
trichloroethene (TCE)	> 130 ≥ 25 to 130 < 25	moderate low minimal
1,1,1-trichloroethane (1,1,1-TCA)	12[b]	minimal
methyl-*tert*-butyl ether (MTBE)	28[b]	minimal

[a]Additional information on evaluating the health risks for the contaminants is found in Appendix C. MTBE contamination is not considered related to the Hopewell Precision facility.
[b]Highest level detected.
[c]Toxicological data are inadequate to assess the carcinogenic potential of 1,1,1-TCA.

2) Past inhalation exposure to volatile organic contaminants in indoor air.

Several VOCs were detected in indoor air in buildings within the Hopewell Precision contamination area. The primary indoor air contaminants associated with the Hopewell Precision facility are TCE and 1,1,1-TCA. Since operations at the Hopewell Precision facility began in 1977, people could potentially have been exposed to these contaminants for up to 29 years, although this is unlikely considering that migration of contaminants to groundwater, to soil vapor,

and then to indoor air could have taken a significant length of time. Tetrachloroethene (PCE) and MTBE, which are not considered related to the Hopewell Precision facility, were also detected in indoor air. Some of the measured indoor air levels of these four contaminants exceed indoor background levels and/or public health assessment comparison values (Table 4). Therefore, these chemicals have been selected for further evaluation.

Trichloroethene (TCE)

TCE was detected in the indoor air of 70 homes. The cancer and noncancer health effects for exposure to TCE have been discussed previously. Long-term exposure (29 years) to TCE detected in indoor air near the Hopewell Precision site is estimated to pose a low increased risk for cancer (i.e., the increase cancer risk is between one-in-one million and one-in-ten thousand) for air levels ranging from about 1 mcg/m³ to 72 mcg/m³. One of the 359 samples taken had TCE at an air concentration greater than 72 mcg/m³ (172 mcg/m³). Long-term exposure to this level is estimated to pose a moderate increased risk for cancer (i.e., the increased risk is between one-in-ten thousand and one-in-one thousand). The available information suggests the risks for noncancer health effects for exposure to TCE in air are low for air levels ranging from greater than 10 mcg/m³ to equal to or below 50 mcg/m³, and minimal for air levels equal to or below 10 mcg/m³. Only two locations had TCE air levels greater than 50 mcg/m³. Long-term exposure to the levels at these properties is estimated to pose a moderate risk for noncancer health effects. As noted previously, the increase in health risk is difficult to estimate because we have no information on how long or to what levels people were exposed to prior to the time the contamination was discovered.

1,1,1-Trichloroethane (1,1,1-TCA)

1,1,1-TCA was detected in some buildings near the Hopewell Precision facility above indoor air background levels, but none of the air levels (the highest being 17 mcg/m^3) exceeded its inhalation public health comparison value based on noncancer health effects (Table 4). The health effects of 1,1,1-TCA have already been discussed. The available information suggests the risks for noncancer health effects for 1,1,1-TCA in indoor air are minimal.

Tetrachloroethene (PCE)

PCE was detected in indoor air in 61 of the buildings tested, and some of the highest detected levels exceed indoor air background levels and inhalation public health assessment comparison values (Table 4). The PCE indoor air levels are not considered related to the Hopewell Precision facility.

Exposure to elevated levels of PCE for short or long periods of time can cause effects on the central nervous system. Very high exposures (700,000 mcg/m³ or more) have caused symptoms such as dizziness, headaches, sleepiness, lightheadedness and poor balance, while lower exposures (350,000 mcg/m³ for short-term exposure and 1400 mcg/m³ to 5000 mcg/m³ for long-term exposure) have resulted in lower scores on tests that evaluate central nervous system (CNS) function.

Studies of workers exposed to PCE and other chemicals and studies of people living in communities with drinking water supplies contaminated with mixtures of VOCs (including PCE) show an association between exposure to high levels of these chemicals and increased risks of cancer (ATSDR 1997a). The role of other factors (e.g., exposure to other chemicals) in causing these cancers is not completely understood; and therefore the studies suggest, but do not prove, that exposure to PCE causes cancer in humans. Studies of people exposed to PCE in the workplace suggest that long-term inhalation exposure may increase the risk of effects on reproduction (reduced fertility, changes in semen quality, increased incidences of menstrual disorders and increased rates of spontaneous abortion), but the studies are not strong enough to conclude that these effects were due solely to PCE. Long-term exposure to high levels of PCE has caused cancer and adverse effects on the central nervous system, kidney and liver in laboratory animals. Based on information from animal and human studies, long-term exposure to levels from 2 mcg/m³ to 190 mcg/m^3 of PCE measured in the indoor air (the highest level detected, with the exception of one property) is estimated to pose a low increased risk for cancer. The available information suggests the risks for noncancer effects from exposure to PCE in indoor air would be low for PCE levels from greater than 100 mcg/m^3 to 190 mcg/m^3, and minimal for PCE levels equal to or below 100 mcg/m^3.

One property contained PCE indoor air levels as high as 2000 mcg/m³. Long-term exposure to this level is estimated to pose a moderate increased risk for cancer and a high risk for noncancer health effects. The measured level of 2000 mcg/m³ is within the range of PCE air concentrations associated with slightly lower scores on nervous system function tests in people who lived in apartments above dry cleaning shops (1400 mcg/m³ to 5000 mcg/m³) (Altmann et al., 1995).

Methyl-tert-Butyl Ether (MTBE)

In some buildings, MTBE was detected in the indoor air above background levels and its public health assessment comparison values based on carcinogenic effects (Table 4). As with PCE, the MTBE levels in the buildings are not considered related to the Hopewell Precision facility. The health effects for exposure to MTBE have been discussed previously. Long-term exposure to the highest level of MTBE detected in the indoor air (610 mcg/m³) is estimated to pose a low increased risk for cancer and a minimal risk for noncancer health effects.

Summary

The following table summarizes the evaluation of potential health risks for contaminants detected in indoor air:

Summary of Cancer and Noncancer Risk Descriptors for Contaminants Detected in Indoor Air Near the Hopewell Precision Site[a]

Chemical	Air Concentration in Micrograms per Cubic Meter	Qualitative Risk Descriptor
Cancer Risk Evaluation		
trichloroethene (TCE)	1 to 72[b]	low
1,1,1-trichloroethane (1,1,1-TCA)	---[c]	---[c]
tetrachloroethene (PCE)	2 to 190[d]	low
methyl-*tert*-butyl ether (MTBE)	610[e]	low
Noncancer Risk Evaluation		
trichloroethene (TCE)	> 10 to ≤50 ≤ 10	low minimal
1,1,1-trichloroethane (1,1,1-TCA)	17[e]	minimal
tetrachloroethene (PCE)	> 100 to 190[d] ≤ 100	low minimal
methyl-*tert*-butyl ether (MTBE)	610[e]	minimal

[a]Additional information on evaluating the health risks for the contaminants is found in Appendix C. MTBE and PCE contamination is not considered related to the Hopewell Precision facility.
[b]One building had a level of 172 mcg/m^3, which is estimated to pose a moderate increased cancer risk.
[c]Toxicological data are inadequate to assess the carcinogenic potential of 1,1,1-TCA.
[d]One building had a level of 2000 mcg/m^3, which is estimated to pose a moderate increased risk for cancer and a high risk for noncancer effects.
[e]Highest level detected.

D. Consideration of Interactions among Environmental Chemicals

Most hazardous waste sites contain multiple chemical contaminants. Therefore, the possibility for interactions among the chemicals detected at the Hopewell Precision contamination area was considered when evaluating the potential health risks. The three types of interactions among chemicals that can take place are additivity, synergy and antagonism. Additivity means that the combined effect of the chemicals of a mixture acting together is equal to the sum of the effects of the chemicals acting alone. Synergy takes place when the combined effect of the chemicals acting together is greater than the sum of the effects of the chemicals acting alone. Antagonism refers to the combined effect of the chemicals acting together being less than the sum of the effects of the chemicals acting alone.

Studies that directly evaluate dose-response relationships for exposure to mixtures containing all four of the chemicals that were selected for further evaluation in the Hopewell Precision contamination area (trichloroethene, 1,1,1-trichloroethane, tetrachloroethene, MTBE) are not available. However, in 2004, ATSDR published a document called an Interaction Profile (ATSDR, 2004a), which summarizes the available information on chemical interactions in various mixtures of three of the four chemicals (trichloroethene, 1,1,1-trichloroethane and tetrachloroethene). According to ATSDR's evaluation, trichloroethene, 1,1,1-trichloroethane and

tetrachloroethene can all cause CNS effects, and while no studies are available that directly examine the joint toxic action of mixtures of these three chemicals on the nervous system, additivity for CNS effects is plausible.

Studies in laboratory animals show that all three chemicals cause effects on the liver and kidney, and trichloroethene and tetrachloroethene both cause carcinogenic responses (via reactive metabolites) in these organs. In addition, limited studies of interactions of binary (two chemicals) or trinary (three chemicals) mixtures of these chemicals on the liver and kidney provide no evidence of greater than additive effects. According to ATSDR, additive action on the liver and kidney is plausible for binary combinations of each of the components, with the exception of limited evidence that tetrachloroethene may inhibit the toxic action of trichloroethene on the liver and kidney. Therefore, assuming there is general similarity among the four chemicals of concern with respect to toxic endpoints and mode of action, we considered the non-cancer and cancer health effects and health risks to be additive. Based on the ATSDR guidance for evaluating the health risks of mixtures (ATSDR, 2004b), significant interactive effects among these chemicals are unlikely to result in a health hazard, because for most of these properties, the individual chemical exposures are less than one-tenth of each chemicals' reference concentration or reference dose. This means that most of the exposures at the site are well below exposure levels associated with adverse health effects. Significant interactions among carcinogens in mixtures of the chemicals chosen for further evaluation are considered unlikely at low environmental exposure levels (ATSDR, 2004b; NRC, 1989).

E. ATSDR Child Health Considerations

ATSDR emphasizes examining child health issues in all of the agency's activities, including evaluating child-focused concerns through its mandated public health assessment activities. ATSDR and NYS DOH consider children when evaluating 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 the effects of hazardous chemicals, but whether there is a difference depends on the chemical. Children may be more or less susceptible than adults to health effects from a chemical and the relationship may change with developmental age.

The possibility that children or the developing fetus may have increased sensitivity to TCE (the primary contaminant associated in the Hopewell Precision contamination area) was taken into account when evaluating the potential health risks associated with the contamination of private water supply wells and indoor air.

Human studies suggest that exposure to mixtures of chlorinated solvents (including 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 1997b). As stated previously in this document, the amount of exposure to TCE, the exposure duration, and the role of other factors (e.g., exposure to other chemicals in the water) in causing these effects is

not fully known. The studies therefore suggest, but do not prove, that the developing fetus may have increased sensitivity to the effects of trichloroethene.

When pregnant animals were exposed by ingestion and/or inhalation to large amounts of TCE, adverse effects on the normal development of the offspring were observed (ATSDR 1997b). In most, but not all of these studies, the high amounts of the chemicals also caused adverse health effects on the parent animal. One study reported abnormal fetal heart development in the offspring of rats exposed to TCE in drinking water before and during pregnancy (Dawson et al., 1993). Another study in rats reported that exposure to TCE in drinking water before mating, during gestation, and throughout lactation was associated with a significant decrease in the number of myelinated fibers in 21 day old offspring (Isaacson and Taylor, 1989).

The likelihood for site-related TCE exposures to cause developmental health effects (e.g., those on the fetus, infants or children) was evaluated by comparing TCE exposure estimates for the site to levels of exposures known to cause developmental toxicity in the studies described above. The estimated exposures to the highest levels of TCE in drinking water from private wells or in indoor air near the Hopewell Precision facility are about 700 times lower than the lowest TCE exposure levels reported to cause developmental effects in the offspring of animals. It therefore appears unlikely that site-related exposures to TCE will result in developmental effects, although there is some uncertainty associated with this evaluation because of the limitations in the available information on the developmental toxicity of TCE.

F. Health Outcome Evaluation

NYS DOH has not completed an evaluation of health outcome data specifically for the Hopewell Precision site. The number of people known to have been exposed to VOCs is too small to conduct a health study that could successfully detect an unusual disease pattern. However, Hopewell Precision is a site selected for inclusion in the New York State VOC Exposure Registry and NYS DOH will conduct a health statistics review for the Hopewell Junction Contamination Area.

A health statistics review uses existing data from sources such as birth certificates and health registries to determine whether health outcomes in a particular community are occurring at higher, lower, or about the same level compared to statewide levels. A health statistics review takes risk factors commonly found on health records into account such as age and sex. A health statistics review may not be able to take into account certain individual risk factors for health outcomes such as medical history, smoking, genetics and occupational exposures. A health statistics review does not tell us why elevations or deficits in health outcomes exist and cannot prove whether there is a cause and effect relationship between exposures and health outcomes. Rather, a health statistics review may suggest hypotheses and could indicate whether a more rigorous study should be considered.

For the Hopewell Precision Area Contamination site, the review will use existing data from statewide databases on cancer diagnoses, congenital malformations, and low birth weight births to determine whether these outcomes are occurring at a higher, lower, or about the same level in

the Hopewell Junction study area compared to the rest of New York State. Diagnoses that occurred in the study area identified from the New York State Cancer Registry from 1980, Congenital Malformations registry from 1983, and birth records from 1978 through the most recent year of available data will be included in the health statistics review even if the person no longer lives in the area.

NYS DOH established the New York State VOC Exposure Registry (Registry) in 1999 as a tool for health status assessment and long-term follow-up for communities and individuals with documented exposures to VOCs. The Registry is currently evaluating exposures and health status of New York State residents at locations where drinking water or indoor air was contaminated with chemicals such as industrial solvents or petroleum products from landfills, industrial sites, spills, or other sources. Individuals and communities are considered for inclusion in the Registry if potential exposures from the contamination of private wells, public water supplies, or indoor air have been verified by sampling results.

For eligible residents in the Hopewell Precision area, enrollment in the Registry currently involves completion of a mailed questionnaire seeking information about exposures during the time period before the contamination was detected and before intervention occurred to prevent exposure. Information about other risk factors such as tobacco and alcohol use, detailed information about registrant health status before and after the potential exposure, and basic demographic information such as age, education and occupation, is also collected. Health status questions seek information about cancer as well as respiratory, neurological, cardiovascular, gastrointestinal, musculo-skeletal, endocrine, and reproductive symptoms and diseases.

The Registry enrollment process for homes with private wells impacted by Hopewell Precision has been underway since 2003. Since that time, additional investigation of groundwater and soil vapor intrusion into the indoor air of residences overlying the groundwater contamination has been ongoing. Residents will be contacted about the Registry as the on-going investigations document exposures to site-related contaminants in either private drinking water wells or indoor air.

Enrollment in the Registry has provided NYS DOH researchers with identifying information for exposed individuals. This information will be maintained to help NYS DOH researchers stay in contact with registrants so that information from any studies resulting from the Registry can be provided to enrollees.

In addition to following people over time, the exposure registry is a tool for combining information from sites with similar exposures so that larger numbers of individuals can be evaluated. The method used to collect data for the VOC Exposure Registry is being changed to maximize this use of the Registry. Statewide comprehensive data from a variety of databases will be used to evaluate health outcomes for groups of individuals from sites with similar VOC

exposures. The databases that are currently being used to develop follow-up health outcome data are the Cancer Registry, the Congenital Malformations Registry, and Vital Records (birth and death certificates). Hospital discharge information may also be used in the future.

People who are enrolled in the Registry will be kept informed of any research results that come from the Registry data. Information gathered for the Registry is strictly confidential. This means that information that could reveal specific enrollees or any information about their health status can not be provided to anyone other than NYS DOH researchers evaluating the data. In addition, privacy of individual health information is protected in all reports that use Registry data. Reports provide information that is grouped so that no individual information is revealed.

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. The major concerns and responses to those concerns are summarized below. This public health assessment was distributed for public comment from November 17th 2006 until January 19th 2007. A public meeting was held on January 22nd 2007 to discuss the document with the community and the deadline was extended until February 23rd 2007. NYS DOH received multiple written comments, and verbal comments from the meeting. A summary of these comments and NYS DOH's responses is included in Appendix E.

Concern: The primary concern expressed is about the possible health effects in exposed individuals. Part of this concern is the uncertainty about the length of time people 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 accurately estimate people's potential duration of exposure. Initial contamination of the groundwater may have occurred 29 years ago**.** Therefore, in the public health assessment, we used an exposure duration of 29 years to evaluate risks for site-related chemicals. As described elsewhere in this document, this is likely an over-estimate.

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 TCE and 1,1,1-TCA that were detected in drinking water near the Hopewell Precision Area Contamination 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 Hopewell Precision Area Contamination 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 a person's gender 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 NYS DOH at 1-800-458-1158, extension 27950.

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

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

Concern: Some residents have requested that NYS DOH and ATSDR conduct a health study of the people in Hopewell Junction who were exposed to contaminants from the Hopewell Precision site.

Answer: Hopewell Precision is a site selected for inclusion in the VOC Exposure Registry, and NYS DOH will conduct a health statistics review for the Hopewell Precision Contamination Area.
The Registry and health statistics review are discussed more fully in the *Health Outcome Evaluation* Section.

Concern: Some residents are worried about the reliability of the water treatment systems and sub-slab depressurization systems installed at their homes.

Answer: Both types of system use well-established, reliable technologies to reduce exposures to contamination. Similar systems have been used successfully at many other sites. The US EPA and NYS DEC are currently responsible for maintaining the systems they have installed. If these systems become part of the final remedy for the site, a formal maintenance and monitoring plan would ensure that the systems are maintained until they are no longer needed.

Concern: Some residents have asked when the groundwater contamination will be remediated, and whether it would be feasible to provide a public water supply to the community.
Answer: The US EPA estimates that they will propose a remedy for this site in 2008. The proposed remedy will be based on a feasibility study, which will examine a number of possible ways to clean up and reduce the potential for exposure to the contamination. The provision of a public water supply would be one of the measures considered in the study. The proposed remedy will include an approximate timetable for remediation.

CONCLUSIONS

Public health actions were needed in the past and may be needed in the future at the Hopewell Precision Area Contamination site to reduce exposures to site-related VOCs, primarily TCE and 1,1,1-TCA and the non-site related VOCs, PCE, and MTBE. Exposure to TCE, 1,1,1-TCA and MTBE were occurring via contaminated private well water and via soil vapor intrusion impacts to indoor air. Exposure to PCE was occurring via soil vapor intrusion impacts to indoor air. Several wells were contaminated with TCE and 1,1,1-TCA at or above the state or federal MCLs; one well had MTBE at levels above the state MCL. Long-term exposure (up to 29 years) of residents to the highest levels of TCE detected in private water supplies is estimated to pose a low increased risk for cancer; the risks for noncancer effects is low to moderate. Long-term exposure to the highest level of MTBE in private wells (which is not related to the Hopewell Precision facility) is estimated to pose a low increased risk for cancer. These exposures have been addressed by installation of treatment systems.

Indoor air of some buildings, mostly residential, was contaminated with TCE and PCE above US EPA screening levels and New York State air guidelines. Some residents could have been exposed to TCE in their indoor air for as long as 29 years. With the exception of measured levels at one property, (for which the estimated cancer risk was moderate), the estimated increased cancer risk for exposure to the levels of TCE measured in indoor air is low. The risks for TCE noncancer effects for indoor air are minimal to low. PCE air levels, which were not related to the Hopewell Precision facility, are estimated to pose a low increased risk for cancer and minimal to low risk for noncancer health effects. A single property had significantly elevated PCE levels corresponding to a moderate increased cancer risk and a high risk for noncancer health effects. These exposures have been addressed by installation of mitigation systems.

The drinking water affected by the site currently poses an indeterminate public health hazard. Although treatment systems have been installed and regular monitoring is being implemented in those impacted homes already identified, the extent of the groundwater plume still needs to be defined. Exposures to contaminants have been reduced to levels below state and federal MCLs in those wells already identified. However, if treatment systems are not maintained, or if TCE or 1,1,1-TCA are detected in any potentially threatened wells, or if new wells are installed in the contaminated plume, exposures could be occurring or occur in the future.

Similarly, soil vapor and indoor air affected by the site poses an indeterminate public health hazard. Although mitigation systems have been installed and exposures have been reduced to levels below US EPA screening levels and NYS DOH air guidelines in those impacted homes already identified, the extent of the soil vapor plume still needs to be defined. Also, if the treatment systems are not maintained, or if TCE or 1,1,1-TCA is detected in the soil vapor in additional buildings overlying the contaminated plume, exposures could be occurring or occur in the future.

Sampling data indicate that the contamination plume has moved primarily to the southwest, underneath and beyond Route 82. The extent of the plume will be delineated as part of US EPA's on-going Remedial Investigation of the site. The source of contamination is believed to be the former Hopewell Precision facility located at 15 Ryan Drive, that was used to manufacture and

paint sheet metal, and the current Hopewell Precision facility at 19 Ryan Drive that continues these activities.

RECOMMENDATIONS

1. Continue actions to minimize human exposure to the contaminated water.
2. Maintain installed treatment systems and monitor the quality of the treated water until contamination levels are below federal and state MCLs or until an alternative water supply is provided.
3. Maintain installed soil vapor mitigation systems until the contamination levels are below US EPA site-specific target levels.
4. Through the US EPA's ongoing remedial investigation, define the nature and extent of the groundwater and soil-vapor contamination from the Hopewell Precision site.
5. Continue monitoring of potentially affected private wells, soil vapor and indoor air in the area, with treatment systems/mitigation systems added as appropriate.
6. Consider a permanent, long-term remedy for groundwater users.
7. Undertake additional investigation of the source(s) of MTBE in groundwater, although not site-related. Information on local gasoline spills can be obtained from the NYS DEC Region 3 office at (845) 256-3052 or visit the NYS DEC website at http://www.dec.state.ny.us/website/der/spills/index.html
8. Complete additional investigation of the source(s) of PCE found in soil vapor, although not site-related. This should be done by the US EPA during the on-going Remedial Investigation.
9. Complete additional investigations of the source of the contamination and the extent of the contamination.

PUBLIC HEALTH ACTION PLAN

The Public Health Action Plan (PHAP) for the Hopewell Precision Area Contamination site describes actions to be taken by ATSDR and/or NYS DOH following completion of this PHA. For those actions already taken at the site, please refer to the Background section of this PHA. The purpose of the PHAP is to provide a plan of action designed to outline measures to be taken to mitigate exposures and minimize the potential for 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 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 NYS DOH are as follows:

1. NYS DOH will coordinate with the appropriate environmental agencies to develop a plan to implement the recommendations contained in this PHA.

2. NYS DOH will review all data generated from the US EPA Remedial Investigation of the site to evaluate potential public health implications and implement necessary measures to protect public health. The evaluation of additional information about exposures will be the subject of a future public health assessment document.

3. ATSDR will provide a follow-up report on this PHAP, as needed, outlining the actions completed and those in progress. This report will be placed in repositories that contain copies of this PHA and will be provided to people who request it.

4. NYS DOH will continue to distribute information on the NYS VOC Exposure Registry to residents with exposures documented by sampling results. Results of any new research that become available will be shared with Registry participants.

5. NYS DOH will proceed with a health statistics review for the area. Any follow-up activities will take into consideration the findings of the health statistics review, the feasibility of additional action, and input from community members. The findings of the review will be the subject of a future public health assessment document.

6. ATSDR and NYS DOH will provide future updates of the PHA to local physicians and concerned residents who expressed an interest in the draft PHA. They will be encouraged to contact the agencies if they have additional questions or concerns.

ATSDR and NYS DOH will reevaluate and expand the PHAP when needed. New environmental, toxicological, or 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 Hopewell Precision Site 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. Editorial review was completed by the cooperative agreement partner.

Technical Project Officer, CAT, CAPEB, DHAC

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

Team Leader, CAT, CAPEB, DHAC, ATSDR

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APPENDIX A

Figures

Figure 1. Site Location Map
Hopewell Precision Area Contamination Site,
Hopewell Junction, Dutchess County, New York

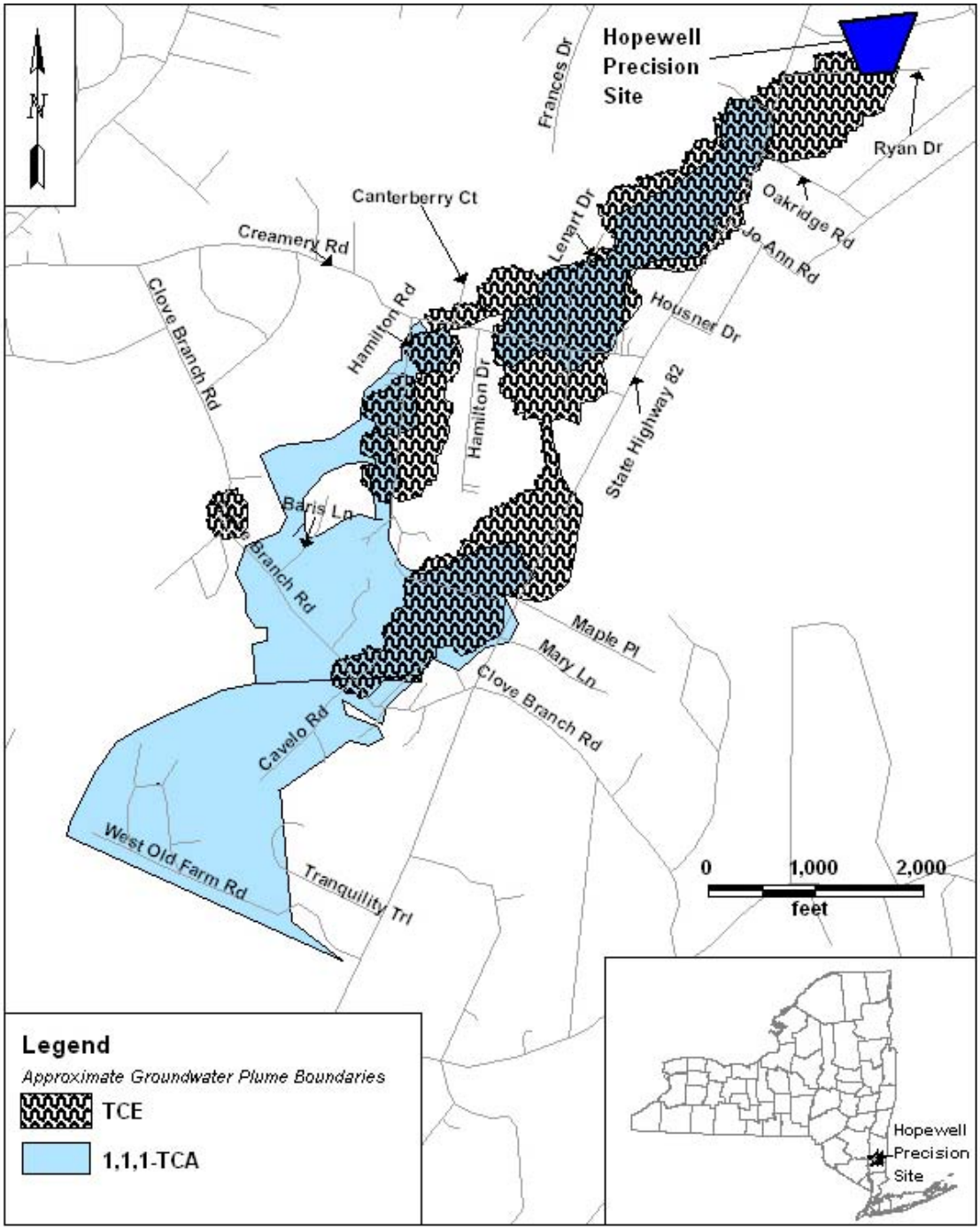
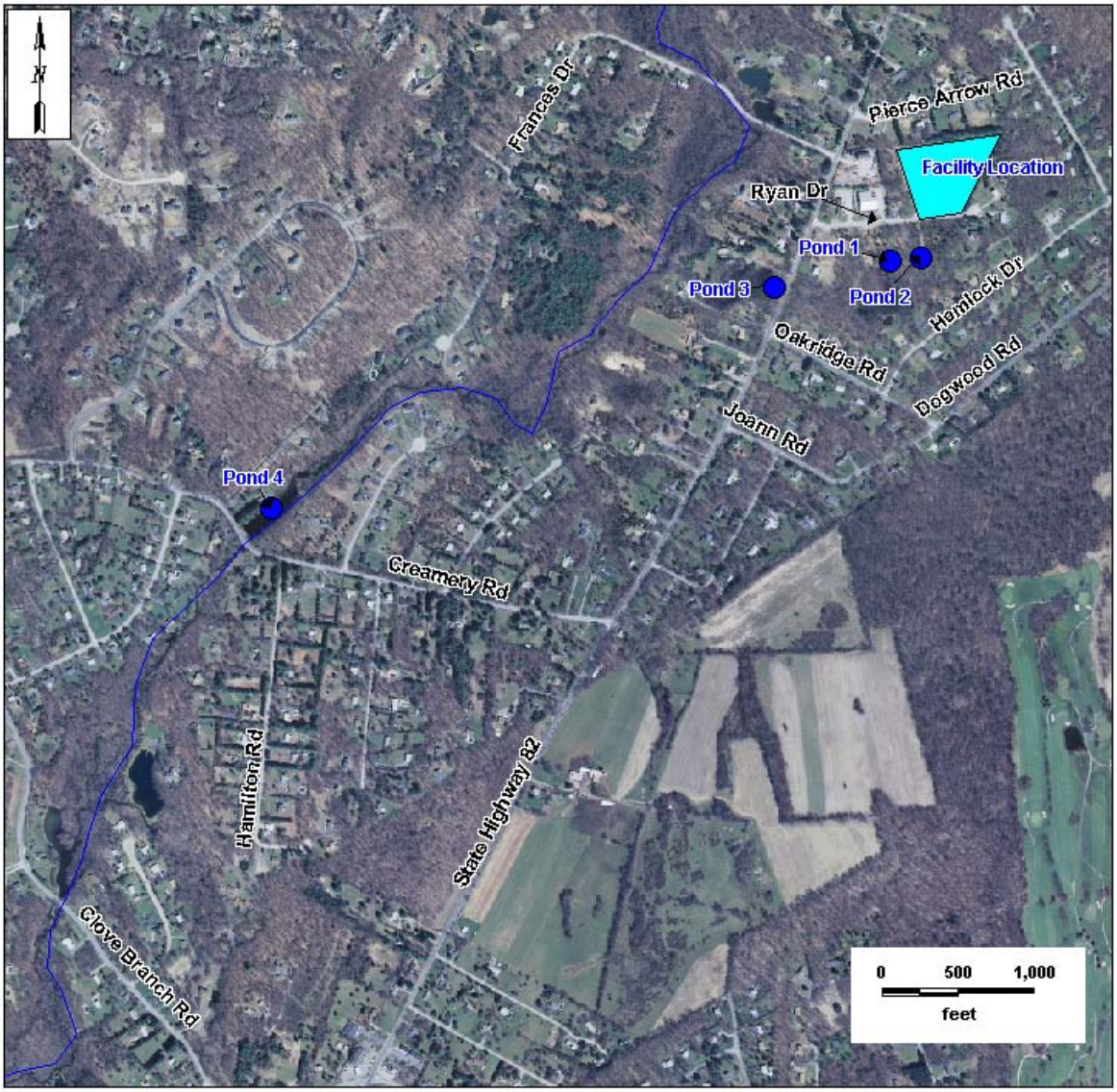


Figure 2. Hopewell Precision Area Contamination Site
Locations of Ponds



APPENDIX B

Tables

Table 1

Contaminants in Groundwater
Near the Hopewell Precision Area Contamination Site
All values in micrograms per liter (mcg/L)

Analyte:	Trichloroethene	1,1,1-Trichloroethane	Methyl-*tert*-butyl ether
Max	250	12	28
Min	0.17	0.22	0.07
Arithmetic Mean	2.0	0.62	0.37
50th Percentile	0.25	0.25	0.25
75th Percentile	0.25	0.25	0.25
95th Percentile	12	2.5	0.68
Number of Detects	58	62	42
Number of Wells Sampled	447	451	450
Percent Detect	13	14	9.3

Table 2

Contaminants in Indoor Air
Near the Hopewell Precision Area Contamination Site
All values in micrograms per cubic meter (mcg/m^3)

		Trichloroethene (TCE)	1,1,1-Trichloroethane (1,1,1-TCA)	Methyl tert-Butyl Ether (MTBE)	Tetrachloroethene (PCE)
Basement	Max	172	17	610	2000
	Min	0.39	0.36	0.36	0.47
	Arithmetic Mean	3.6	1.2	7.6	7.5
	50th Percentile	0.54	0.43	0.58	0.45
	75th Percentile	2.4	1.1	2.3	0.68
	95th Percentile	17	4.6	23.5	3.4
	Number of Homes with Detects	51	55	75	48
	Number of Homes Sampled	87	94	97	91
	Percent of Homes with Detects	59	59	77	53
First Floor	Max	48	12	140	1200
	Min	0.37	0.37	0.36	0.45
	Arithmetic Mean	2.2	0.9	5.6	7.6
	50th Percentile	0.45	0.36	0.69	0.45
	75th Percentile	1.7	0.64	3.24	0.68
	95th Percentile	10.2	3.2	28.8	3.2
	Number of Homes with Detects	54	43	60	40
	Number of Homes Sampled	87	94	97	91
	Percent of Homes with Detects	62	45	61	44

Table 3

Water Quality Standards/Guidelines and Public Health Assessment Comparison Values Exceeded by Contaminant Levels Found in Private Water Supply Wells in the Hopewell Precision Contamination Area

All values in micrograms per liter (mcg/L)

		Water Quality Standards/Guidelines							
		New York State			US EPA	Comparison Values*			
Contaminant	Maximum Detection	Ground Water	Surface Water	Drinking Water	Drinking Water	Cancer	Basis**	Noncancer	Basis**
methyl-*tert*-butyl ether	28	10[a]	[a]	10		10	NYS CPF	230	NYS RfD
1,1,1-trichloroethane	12	5	5	5	5	--	--	1960	US EPA RfD
trichloroethene	250	5	5	5	5	6.1	NYS CPF	10	Health Canada RfD

* Comparison values determined for a 70-kilogram adult who drinks 2 liters of water per day. The cancer comparison value is the water concentration that provides an intake corresponding to an increased lifetime cancer risk of one-in-one million. Non-cancer comparison values assume a relative source contribution of 20%.

** Health Canada RfD: Health Canada Reference Dose
NYS CPF: New York State Department of Health Cancer Potency Factor
NYS RfD: New York State Department of Health Reference Dose
US EPA RfD: U.S. Environmental Protection Agency Reference Dose (Region 3)

[a]Under Review

Table 4

Maximum Detected Air Levels, Indoor Air Background Levels and Public Health Assessment Comparison Values Exceeded by Contaminant Levels Found in Indoor Air Within the Hopewell Precision Contamination Area

All values in microgram per cubic meter (mcg/m^3)

			Comparison Values*				
Contaminant	**Maximum Detection**	**Indoor Air Background Level****	**New York State Air Guidelines**	**Cancer**	**Basis*****	**Noncancer**	**Basis*****
methyl-*tert*-butyl ether	610	14	--	3.8	CA EPA UR	8000	CA EPA REL
tetrachloroethene	2000	2.5	100	1	NYS DOH UR	100	NYS DOH RfC
1,1,1-trichloroethane	17	2.5	--	--	--	2200	US EPA RfC
trichloroethene	172	0.46	5	0.3 to 7.8	NYS DOH UR	10	NYS DOH RfC

*The cancer comparison value is the air concentration that provides an intake corresponding to an increased lifetime cancer risk of one-in-one million.

**Based on upper fence air levels obtained from *Summary of Indoor and Outdoor Levels of Volatile Organic Compounds from Fuel Oil Heated Homes in New York State 1997-2003* (available at *http://www.health.state.ny.us/nysdoh/indoor/fuel_oil.htm*). The upper fence is calculated as 1.5 times the interquartile range (difference between the 25^{th} and 75^{th} percentile values) above the 75^{th} percentile value. The upper fence is a boundary used for identifying the presence of outliers in the data. Since these data were collected, methyl-*tert*-butyl ether was prohibited from use as an additive to gasoline in New York State.

*** CA EPA UR: California Environmental Protection Agency Unit Risk
CA EPA REL California Environmental Protection Agency Reference Exposure Limit
NYS DOH UR: New York State Department of Health Unit Risk
NYS DOH RfC: New York State Department of Health Reference Concentration
US EPA RfC: U.S. Environmental Protection Agency Reference Concentration (Region 3)

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 Hopewell Precision Area 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 authoritative health agencies, such as the US EPA, NYSDOH, Cal EPA and others. 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:

Qualitative Descriptors for Excess Lifetime Cancer Risk

Excess Lifetime Cancer Risk	Qualitative Descriptor
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 authoritative health agencies such as the US EPA, ATSDR, NYS DOH, Cal EPA, and others. The resulting ratio was then compared to the following qualitative scale of health risk:

Qualitative Descriptions for
Noncarcinogenic Health Risks

Ratio of Estimated Contaminant Intake to Risk Reference Dose	Qualitative Descriptor
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 that 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. The level of concern also 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

Public Health Hazard Categories

PUBLIC HEALTH HAZARD CATEGORIES

CATEGORY / DEFINITION	DATA SUFFICIENCY	CRITERIA
A. Urgent Public Health Hazard 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.	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.	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.
B. Public Health Hazard 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.	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.	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.
C. Indeterminate Public Health Hazard This category is used for sites in which "*critical*" data are *insufficient* with regard to extent of exposure and/or toxicologic properties at estimated exposure levels.	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.	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.
D. No Apparent Public Health Hazard 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.	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.	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.
E: No Public Health Hazard This category is used for sites that, because of the absence of exposure, do NOT pose a public health hazard.	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	

∗ *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

Appendix E
Summary of Public Comments and Responses

This summary was prepared to address comments and questions on the public comment draft of the Hopewell Precision Area Contamination Public Health Assessment. The public was invited to review the draft during the public comment period, which ran from November 17th 2006 until January 19th 2007. A public meeting was held on January 22nd 2007 to discuss the document with the community and the deadline was extended until February 23rd 2007. NYS DOH received multiple written comments, and verbal comments from the meeting. A summary of these comments and NYS DOH's responses is included below:

Environmental Data

Comment #1: The report lacks details, for example, about methods used to collect samples. Data are summarized but there are no references to the reports that provide details on how data were generated.

Response #1: It is beyond the scope of this document to provide details about sample collection and analysis methods; however, it is appropriate to include references for the information presented in the report and used in the assessment. The Reference section of this document includes all of the published or publicly available material used in preparing the assessment.

The US EPA expects to issue a Remedial Investigation Report next year. That report will include detailed descriptions of collection and analysis methods for all samples collected in support of the Remedial Investigation, including many of the samples discussed in this document.

Comment #2: The information in the report is two years old.

Response #2: The information in the report was current as of the spring of 2006, when the US EPA began their Remedial Investigation. The investigation will provide more information on the extent of the groundwater contamination, but such information is unlikely to change the basic conclusions and recommendations of the public health assessment. When the investigation is complete, ATSDR and NYS DOH will revisit the Public Health Assessment to determine whether the Public Health Action Plan should be changed or expanded.

Comment #3: The public health assessment says that the tetrachloroethene (PCE) found in soil vapor and indoor air and the methyl-tert-butyl ether (MTBE) found in private wells are not related to Hopewell Precision. Have the parties responsible for this contamination been found?

Response #3: No, they have not. We have recommended to the US EPA that additional investigation into the sources of these chemicals be undertaken.

General Investigation/Remediation

Comment #4: How long will the US EPA's investigation of the Hopewell Precision Contamination site go on?

Response #4: The US EPA expects to finish field work for the investigation by the end of 2007. They estimate that the remedial investigation report would be issued early in 2008 and that a remedy would be proposed sometime in 2008.

Comment #5: Will the sub-slab depressurization systems and water treatment systems be the final remedy for this site?

Response #5: The remedy may include these systems at least as an interim measure, but it will probably also include other components designed to actively contain or remediate contaminated groundwater and sources of contamination. After the remedial investigation is complete, the US EPA will conduct a feasibility study, also in 2008, to evaluate potential remedies for the contamination. Based on that study, they will propose a remedy for the site. The public will have an opportunity to review and comment on the proposal before a final remedy is determined.

Comment #6: Water treatment and vapor mitigation systems should be maintained as long as necessary, and a permanent long-term remedy is needed for groundwater users.

Response #6: We have made these recommendations to the US EPA. At this time, the NYS DEC and US EPA plan to continue maintaining the treatment and mitigation systems. We have recommended that the US EPA consider a permanent, long-term remedy for groundwater users when evaluating potential remedies for the contamination.

Exposure-Related Sampling

Comment #7: How do I request to have my private well or air tested or retested?

Response #7: You may contact Lorenzo Thantu, the US EPA's project manager for the remedial investigation, at (212) 637-4240 to find out if your home is within the boundaries of US EPA's investigation and whether there are plans to collect additional samples at your home.

You may also wish to have water from your private well tested by an independent laboratory. For a list of approved laboratories in your area, as well as for other information about drinking water and private wells, you can contact the Dutchess County Department of Health's Environmental Health Services Division at 845-486-3404, 9 a.m. to 5 p.m., Monday through Friday.

Long-Term Monitoring

Comment # 8: Wells outside the defined TCE plume should be tested as part of long-term monitoring plan, and wells that have already been tested that did not exceed state drinking water standards should be retested at least twice a year. The Hopewell Junction Citizens for Clean Water should be notified when these wells are tested and should be given the results.

Response # 8: The NYS DOH has shared this comment with the US EPA for their consideration in developing a long-term monitoring plan for the site. The details of that plan will be determined as part of the design of the overall remedy for the contamination, which is expected to begin sometime next year.

The US EPA will continue to monitor private wells in the area. The US EPA will notify property owners and tenants of the results of private well sampling.

Comment # 9: Homes where sub-slab vapor was tested but where sub-slab depressurization systems were not installed should be retested at least twice a year as part of a long-term monitoring plan. This includes homes eliminated from further vapor testing because sub-slab vapor concentrations of TCE were below the US EPA screening level of 2.7 micrograms per cubic meter, as well as homes with sub-slab vapor concentrations greater than 2.7 but less than 50 micrograms per cubic meter. Also, homes with sub-slab vapor concentrations greater than 50 micrograms per cubic meter, which were given sub-slab depressurization systems, should be tested to ensure that the indoor air meets the "post-remediation standard" of 0.38 micrograms per cubic meter.

Response # 9: The NYS DOH has shared this comment with the US EPA for their consideration in developing a long-term monitoring plan for the site. The details of that plan will be determined as part of the design of the overall remedy for the contamination, which is expected to begin sometime next year.

The US EPA will collect additional sub-slab vapor and indoor air samples at some homes in the area, depending on the results of previous sampling (if any) and the location of the homes relative to the known contamination. Once a sub-slab depressurization system is installed at a home, and its proper operation has been verified, additional vapor and air samples are not typically needed as long as the system is inspected periodically to ensure that it continues to operate as designed.

Comment # 10: Was the air sampled in the building at Red Wing Park?

Response # 10: No. To date, the vapor investigation has not gone south of Clove Branch Rd. At this time, the US EPA does not have evidence that the contamination extends that far.

Comment # 11: Does the soil vapor contamination pose an exposure concern for children playing on the ground?

Response # 11: No. Outdoor air has been sampled, and it has not shown evidence of site-related contamination. Soil vapor contamination is seldomly a significant source of outdoor air contamination, even at ground level, because vapors are quickly diluted by outdoor air.

Surface Water

Comment # 12: What action will be taken to address the contamination in surface water and sediment in small ponds? You may wish to consider fencing off or posting signs until contamination is cleaned up.

Response # 12: After the investigation is completed, the US EPA will consider potential remedies for all of the site-related contamination, including contamination in sediment and surface water. No actions have been taken at this time to address the contamination in the small ponds. These ponds are not used to supply water for drinking or other purposes, nor are they used for recreation, to the best of our knowledge. Transient exposure to the levels of contamination detected in the ponds does not pose a health concern.

Health Effects, Physician Information

Comment # 13: How can I get a packet of information regarding TCE exposure for my doctor?

Response # 13: A packet of information regarding TCE exposure has been provided to the person asking this question. Any other community members who wish to have such a packet sent to their physician or would like there own copy, should call 1-800-458-1158, extension 27880, and ask to speak with Rebecca Mitchell. NYS DOH would also like the name and address of your physician. The packets include the following materials:

- An ATSDR Compact Disc (CD) of Case Studies in Environmental Medicine (CSEMs), with opportunities for earning many free CME credits through the Centers for Disease Control and Prevention. * Go to the CSEM specifically entitled "Trichloroethylene (TCE) Toxicity".
  http://www.atsdr.cdc.gov/HEC/CSEM/tce/docs/tce.pdf
- A hard copy of both the "TCE Trichloroethylene (TCE) Toxicity" and "Taking an Environmental Exposure History" Case Studies
  http://www.atsdr.cdc.gov/HEC/CSEM/exphistory/docs/exposure_history.pdf
- A NYS DOH fact sheet on Trichloroethene (TCE) in Indoor and Outdoor Air
  http://www.health.state.ny.us/environmental/investigations/soil_gas/svi_guidance/fs_tce.htm
- ATSDR fact sheet on Trichloroethylene (TCE)
  http://www.atsdr.cdc.gov/tfacts19.pdf
- A NYS DOH fact sheet on Tetrachloroethene (PERC) widely used in dry-cleaning.
  http://www.health.state.ny.us/environmental/chemicals/tetrachloroethene/index.htm

- An ATSDR fact sheet on Tetrachloroethylene (PERC) http://www.atsdr.cdc.gov/tfacts18.pdf
- An ATSDR fact sheet on 1,1,1-Trichloroethane (1,1,1-TCA) http://www.atsdr.cdc.gov/tfacts70.pdf

Comment # 14: Residents should have access to "doctors trained in this field" who "know what types of testing need to be done because of our exposure."

Response # 14: Environmental medicine is not a common specialty among physicians. Those who specialize in Public Health and Preventive Medicine and/or Occupational Medicine are generally the most knowledgeable about chemical exposures and toxicology. In trying to identify an environmental health physician nearby, you can try the following methods:

1. You or your personal physician may want to contact one of the clinics in the New York State Occupational Health Clinic Network. The New York State Occupational Health Clinics are recognized centers of excellence, providing a unique blend of diagnostic and prevention services for occupational disease. The clinics in this network offer specialized medical diagnoses, high-quality care and support services for workers with occupational and environmental disease. They can medically evaluate patients who have experienced environmental exposures and they will accept most health insurances and Medicaid. The two following clinics have satellite offices in areas within a moderate distance of the East Fishkill area:

    - The Occupational and Environmental Health Center of Eastern New York has an office in New Paltz. To contact this clinic for an appointment, call 518-690-4420 or 1-800-419-1230.
    - The Mt. Sinai IJ Selikoff Center for Occupational and Environmental Medicine of Mt. Sinai School of Medicine has an office in Yonkers. To contact this clinic for an appointment, call 914-964-4737.

2. You may Ask your primary care physician if he or she can provide a referral, or
3. Call your local or a nearby County Medical Society or the Medical Society of the State of New York for a list of appropriate physicians, or
4. Search for the above mentioned specialties in your county or nearby on the NYS Department of Health web site at http://www.nydoctorprofile.com/search_parameters.jsp.

Comment # 15: The synergistic effects of exposure to multiple chemicals, including TCE, PCE,

and MTBE, should be considered in this assessment.

Response # 15: Our evaluation of potential chemical interactions, including synergy, is discussed under "Consideration of Interactions among Environmental Chemicals." It is found in Part D of the Discussion section of the document.

Comment # 16: "Kidney cancer from TCE carries a unique toxic fingerprint. Residents should be informed of this, and educated on this mutation. Those who agree to genetic testing should be accommodated. This would be very much in line with what CDC is doing for Fallon and Sierra Vista, as well as the beryllium testing in Ohio at Brush Wellman Plant."

Response # 16: Somatic mutations leading to an inactivation of the Von Hippel-Lindau (VHL) tumor suppressor gene are considered a risk factor for kidney cancer. They are only considered risk factors because it remains debatable whether mutations in the VHL gene alone are sufficient to trigger the cancer response in the kidney (NAS, 2006).

Studies have shown increased mutations in the VHL gene of kidney cancer patients exposed to high concentrations of TCE, and evidence suggests an association between TCE exposure and a unique genetic signature (i.e., a pattern of mutations). Genetic testing of people with kidney cancer could determine whether the mutations have taken place, but would not provide conclusive evidence that the changes were caused by TCE exposure rather than some other factor that can induce genetic signatures similar to that of TCE. Given these uncertainties, we consider it premature to test residents for mutations in the VHL gene as a means of identifying those at risk for kidney cancer related to TCE exposure. Individuals wishing to learn more about the VHL gene and the merits of genetic testing are advised to consult a physician or genetic counselor familiar with genetic testing.

VOC Exposure Registry

Comment # 17: At some point, NYSDOH should share information from the VOC Exposure Registry with other state health agencies so that a more cohesive picture of the adverse health effects of TCE and other contaminants in our water, soil and air can be realized sooner than later.

Response # 17: Information from any summaries of VOC Exposure Registry data and/or results of studies which use VOC Exposure Registry data will be shared with all stakeholders including residents of Registry communities, interested members of the general public, as well as local, county, state or federal agencies. In addition, if positive findings result from studies using VOC Exposure Registry data, these results will be communicated through the scientific literature and the information will be made available to other states through our federal partner ATSDR. All

personal identifying information about individual VOC Registry participants is

strictly confidential. No individual-level information will ever be provided in reports or summaries.

Comment # 18: "Epigenetics is proving that toxicants can tweak the function of our genes without mutating. We are learning such exposures have multi-generational effects beginning in the womb. This is an opportunity to learn from the community through real life exposure cases what health effects can manifest as disease in the future. It is my understanding that the TCE sub registry from the past was found to be lacking. Has this resource been updated and improved?"

Response # 18: Although NYS DOH does not have a statewide registry specifically for TCE exposure, the VOC Exposure Registry does include a number of sites where TCE was the primary contaminant. ATSDR established a National Exposure Registry that contains four subregistries, one of which is the TCE Subregistry. More information is available about the National Exposure Registry and the TCE Subregistry on ATSDR's website at: http://www.atsdr.cdc.gov/NER/index.html

Health Statistics Review

Comment # 19: A health statistics review (like the one done near the IBM site in Endicott, NY) should be done to determine whether the people living near this plume have elevated rates of health effects.

Response # 19: NYS DOH will conduct a health statistics review of cancer and birth outcomes for the Hopewell Precision area. NYS DOH scientists met with residents in March 2007 to define the appropriate study area boundaries to be used in the review. While the review may show an elevation in certain cancer or birth outcomes among Hopewell residents, this type of study is not capable of determining whether exposure to contamination from the Hopewell Precision site caused any particular adverse health effect.

Comment # 20: Would a health statistics review include everyone living over the plume or only select residents, like those who have enrolled in the VOC registry?

Response # 20: Once the appropriate study area boundaries have been determined, the health statistics review will include all individuals within the study area.

Comment # 21: Will NYSDOH track down past residents?

Response # 21: The health statistics review will include cancer and adverse birth outcomes diagnosed among Hopewell area residents who lived in the study area during the study time period (roughly 1980-2004). If past residents of the Hopewell area do not meet these criteria, but are interested in the results of the review or have any

questions, comments or concerns regarding the VOC Exposure Registry, they are

encouraged to contact Ms. Megan Meldrum of the NYS DOH at 1-800-458-1158 ext. 27950.

Comment # 22: What disease would be an indicator of exposure?

Response # 22: Certain health outcomes have been shown in the scientific literature to be associated with TCE exposure. However, it is important to keep in mind that there are several risk factors for all of these health outcomes, including lifestyle and genetic factors. Therefore the occurrence of these outcomes does not necessarily indicate exposure to TCE or other environmental contaminants. Epidemiologic studies of women living in areas where drinking water has been contaminated with TCE or PCE or women occupationally exposed to TCE and other solvents have suggested an increased risk of several types of birth defects as well as several other adverse birth outcomes including cardiac defects, oral clefts, neural tube defects, spontaneous abortion, low or very low birth weight and small for gestational age. Available epidemiologic studies provide evidence for a positive association between occupational TCE exposures and several types of cancer in humans, most notably liver/biliary cancer, kidney cancer, non-Hodgkin's lymphoma, esophageal cancer, and to a lesser extent Hodgkin's disease and cervical cancer. Human epidemiologic studies do not provide evidence to support the identification of TCE as a risk factor for lung cancer and testicular tumors. Nonetheless, potential TCE air criteria are derived from animal studies showing that TCE caused liver cancer, kidney cancer, lung cancer, testicular tumors, and malignant lymphoma in animals.

TCE Action Levels/Standards

Comment # 23: Did the NYSDOH use the most current information on TCE exposure when they drafted this public health assessment?

Response # 23: We used the most recent available information on exposure (e.g., the sampling results for indoor air and private wells), toxicity, and used currently accepted risk assessment practices to evaluate the health risks associated with contaminants at the Hopewell Contamination area.

Comment # 24: New York State's action levels are higher than those of California or Oregon. Those states have adopted the maximum contaminant levels suggested by the 2002 EPA draft review of TCE's toxicity: 1 ppb for drinking water and 0.020 mcg/cu.m. for indoor air in Oregon and 0.017 mcg/cu.m. in California. NYSDOH should err on the side of caution and use these levels.

Response # 24: The air values cited for California and Oregon are based on the 2001 (not 2002, as is stated in the comment) US EPA Draft Health Assessment Document entitled "Trichloroethylene Health Risk Assessment: Synthesis and Characterization" (US EPA, 2001). This draft assessment was review by the US EPA's Scientific Advisory

Board (SAB), which made extensive and detailed comments on the methods used to evaluate the toxic potency of TCE. Following the SAB review, an expert panel was convened by the National Academy of Sciences (NAS) Board on Environmental Studies and Toxicology, which identified critical scientific issues that should be addressed in any health risk assessment of TCE. The draft US EPA Health Assessment is undergoing revision. The final document is expected to address the SAB's comments and incorporate the findings of the NAS report (NAS, 2006).

Therefore, the values presented in the original report (US EPA, 2001) are subject to change, including the estimate of cancer potency on which the air values cited in the comment (0.02 and 0.017 micrograms per cubic meter (mcg/m3)) are based. This cancer potency estimate comes from a single study on the association between cancer rates (e.g., non-Hodgkin's lymphoma) in New Jersey towns and drinking-water levels of volatile organic chemicals (VOCs), including TCE, in the same towns. The use of this study to derive an air level for TCE is not supported by the information in the study for several reasons. First, it is a drinking water study, and inhalation studies should be used to derive an air guideline when such studies are available, as they are for TCE. Second, the study lacks vital information on the level and duration of exposure to TCE, and therefore does not meet criteria for using an epidemiology study for quantitative risk assessment. Third, chemicals other than TCE were in the drinking water supplies, and therefore whether the observed increases in risk are due to TCE or one of the other chemicals is not known. We therefore did not use this study to derive a cancer potency factor to quantify the cancer risks of TCE exposures. This conclusion is supported by the expert NAS (2006) panel on TCE, which stated, "None of the existing epidemiologic data is suitable as a primary means of quantifying cancer risks."

The New York State air guideline for TCE (5 mcg/m^3) was derived using standard and accepted risk assessment procedures and was peer reviewed by a panel of independent experts (NYS DOH, 2006a). The TCE air guideline is set at a level lower than those that cause health effects and assumes people (including sensitive individuals such as infants and children) are exposed 24 hours per day and seven days per week for a lifetime. The TCE air guideline is one aspect of the Soil Vapor/Indoor Air Matrix 1, which is New York State's decision-making tool for remediation of TCE contamination resulting from soil vapor intrusion. The matrix recommends actions based on background, sub-slab and indoor air levels of TCE, and does not rely solely on the air guideline. For example, the matrix recommends mitigation of TCE exposures when TCE is present in sub-slab vapor at 250 mcg/m3 or higher even when TCE is not detected in indoor air. Our soil vapor intrusion guidance document (NYS DOH, 2006b) also recommends that reasonable and practical measures should be taken to reduce TCE exposure when indoor air levels are above background, even when they are below the guideline of 5 mcg/m3. Thus, the TCE air guideline is not a threshold below which no action is taken.

As per New York State's approach to mitigating soil vapor intrusion into indoor air, Soil Vapor/Indoor Air Matrix 1 was used to make decisions about remediation at the Hopewell Precision site. This included an evaluation of TCE indoor air levels that are above and below the air guideline of 5 mcg/m3.

Cancer Risk Language:

Comment # 25: "The determination that a concentration of 250 mcg/L of TCE in well water poses a "low" cancer risk for residents consuming this water is not based on any scientific analysis. It is simply a subjective judgment, an opinion, offered as "fact" when it clearly is not. The US EPA drinking water standard that defines a safe and acceptable concentration for consuming drinking water is set at 5 mcg/L. How can a value that is 50 times higher than this standard, that is also based on the risk of developing cancer, be defined as having a "low increased risk for cancer (i.e., the estimated risk is between one-in-one million and one-in-ten thousand)" (PHA, p. 15)? It appears that DOH is trying to assure the public that everything is "OK," regardless of the scientific evidence, various uncertainties, and the presence of clearly identified risks. This classification contradicts the findings made last year by a committee of the National Academies that concluded in part that the "evidence on carcinogenic risk and other health hazards from exposure to trichloroethylene has strengthened since 2001" and that "there is strong evidence that exposure to high doses of trichloroethylene is associated with increased rates of kidney cancer." Defining 250 mcg/L TCE in drinking as a "low increased risk" is misleading and a disservice to the public."

Response # 25: The use of the term "low" does not refer to the qualitative weight-of-evidence that TCE is a human carcinogen, but to our standard qualitative descriptor for levels of estimated excess lifetime cancer risk (see Appendix C of the Public Health Assessment). Based on our procedure for evaluating health risks and assigning qualitative descriptors, increased lifetime cancer risks between 1 per 1,000,000 and 1 per 10,000 are given the qualitative descriptor of "low." The estimated increased cancer risk for exposure to 250 mcg/L TCE (3.4 per 100,000) is within this range. Because of the uncertainties associated with these cancer risk estimates, these estimates cannot be used in an actuarial sense to predict the number of actual cancer cases. Rather they are used to help make decisions about the need and urgency of action to reduce exposures. The exact degree of risk at low levels may never be known because the risk is generally too small or too confounded by other factors to measure in the general population, particularly given the large background rates of cancer (1 in 2 for men and 1 in 3 for women) in the general population.

Characterization of the increased cancer risk as "low" does not mean that there is no risk, or that measures to reduce exposure are not needed. In fact, the estimated risk is in the range of excess cancer risks that are generally used by regulatory agencies

for taking actions (1 per 1,000,000 to 1 per 10,000), and as stated before, measures to reduce exposure were initiated at the site. The characterization of the risk associated with exposure to 250 mcg/L TCE as "low" means that the estimated increased cancer risk is relatively small, and that the level of exposure, although above the drinking water standard, is still well below the TCE exposure levels that have been shown to cause cancer in laboratory animals. A step-by-step calculation of the estimated increase cancer risk from exposure to 250 mcg/L TCE in drinking water is presented in Attachment 1 of these responses to comments.

Comment # 26: " I am also concerned that the wording in the TCE section of the Public Health Implications on pages 14 – 15 is misleading to those effected by this contamination. The families that lived on top of this contamination plume were most likely exposed to unhealthful levels of TCE for years in their homes. Potentially, this means that people without jobs, such as older retired residents, homemakers and small children, were exposed to these levels 24 hours a day, 7 days a week. Studies that I have read noted that two of the three groups of people I just mentioned are more likely to be susceptible to TCE exposure: the elderly and children. Although a dose – response continuum has not been established (because of uncertainties in exposure levels, duration of time exposed, and confounding factors such as smoking or alcohol consumption), this should not minimize concern for residents.

"I think the wording of the last paragraph of the TCE section is the most concerning. The health implications for being exposed to the TCE levels in the drinking water were described as "posing a low increased risk for cancer". However, on page 47 The NYS DOH "Qualitative Descriptors for Excess Lifetime Cancer Risk" describes the excess cancer risks associated with the exposure of the Hopewell Precision Site. It would be better to write in that section that the residents have a low increase of excess risk for cancer. The excess risk measurement is what is important. The general public is told everyday that if they don't do this or do that then they risk an increase in developing cancer of one sort or another. For example, public service announcements on television advise that if you don't eat enough fiber, you may increase your risks for colon cancer. Other announcements say if you breathe second-hand smoke you increase your risk of developing lung cancer. Eating fiber and staying out of smoky rooms are then factors people have the power to control. I have never seen a public service announcement by a celebrity telling the public not to drink contaminated water with TCE let alone other chemicals or not to breathe the vapors of TCE. Most of the general public is unaware of the adverse health effects associated with VOC exposure. Therefore, exposure to undetected toxic contamination is not within a person's power to control and is appropriately termed "excess" risk. This is the terminology that should be used in the public health implications to accurately depict the increased health risks that the exposed citizens of the Hopewell Precision Site may face."

Response # 26: The first portion of the comment expresses concern that the health risks for TCE be evaluated for continuous exposure and for people who may be especially sensitive to TCE. In the public health assessment, we evaluated health risks at the Hopewell Precision site assuming that residents were exposed to site-related contaminants in indoor air and drinking water on a continuous basis for 29 years (corresponding with the start of industrial activity at the Hopewell Precision facility). For contaminants in indoor air, we assumed the exposure was without interruption for 24 hours per day, 7 days per week. For contaminants in drinking water, we assumed that a person drinks 2 liters of water per day containing the chemicals and also is exposed through nondrinking uses of the water, such as showering or bathing. In our risk characterization, we also considered the possibility that infants and children may be especially sensitive to TCE exposure in light of the fact that their nervous systems are rapidly developing. Thus, our exposure estimates are inclusive of people who may be especially sensitive to the effects of TCE and who may have spent a significant portion of their time in their homes. In reality, residents are unlikely to have stayed in their homes continuously, and their exposure to site-related contaminants was probably intermittent (i.e. discontinuous). In addition, the exposure duration is likely to have been shorter than 29 years because the movement of contamination to groundwater, private drinking water wells, soil gas and indoor air could have taken a significant amount of time. Therefore, the exposure assumptions used in the public health assessment probably result in an overestimation of actual exposures at the site.

The second issue raised in the comment concerns the terminology used in the public health assessment to describe the estimated cancer risks resulting from exposure to site contaminants. The term "increased risk for cancer" refers to the extra (or excess) risk (probability) of developing cancer over the lifetime of an individual resulting from exposure to site-related contaminants. The risk for cancer associated with site-related exposures is termed increased (or excess) because it is in addition to pre-existing background cancer rates which are attributable to other risk factors unrelated to the contamination area.

ATTACHMENT 1

METHOD USED TO ESTIMATE CANCER RISK
FOR EXPOSURE TO TCE IN DRINKING WATER

The purpose of the public health assessment is to estimate and characterize the potential health risks resulting from the contamination. The public drinking water standard was used as one of several comparison values to select chemicals for further evaluation. Since several private wells had TCE levels that exceeded the standard, TCE was selected as one of the chemicals for which the health risks would be characterized. To characterize the health risks, we assumed a person drinks 2 liters of water every day containing the highest measured level of TCE found in a private well (250 mcg/L) for 29 years, averaged over a 70 year lifetime. We also assumed that a person receives additional exposure to TCE through non-ingestion exposure pathways such as cooking, showering and bathing. We assumed that this exposure was equal to the exposure from ingestion pathways, and doubled the drinking water concentration to account for it. The estimated increase in cancer risk is calculated from the exposure in drinking water (expressed as a TCE dose in milligrams per kilogram body weight per day (mg/kg/day)) and the cancer potency factor (0.00572 per mg/kg/day (NYS DEC, 1997)). A cancer potency factor is a number (usually derived by health agencies) that is based on toxicological studies of the chemical, and represents a measure of the chemical's ability to cause cancer. The calculation for the estimated increased cancer risk for someone exposed to 250 mcg/L TCE in drinking water is as follows:

Calculation of Contaminant Dose from Drinking Water:

250 mcg/L x 2 x 2 L/day x 1/70 kg x 1 mg/1000 mcg x 29 years/70 years = 0.0059 mg/kg/day

where:

250 mcg/L = highest detected level of TCE

2 = factor to account for non-ingestion exposure to TCE

2 L/day = drinking water ingestion rate (US EPA, 1989)

70 kg = body weight (US EPA, 1989)

1 mg/1000 mcg = conversion factor to convert micrograms to milligrams

29 years/70 years = fraction of lifetime exposure

Calculation of Increased Lifetime Cancer Risk from Contaminant Dose:

0.0059 mg/kg/day x 0.00572/mg/kg/day = 0.000034 or 3.4 per 100,000

where:

0.0059 mg/kg/day = estimated contaminant dose for TCE

0.00572/mg/kg/day = cancer potency factor for TCE (NYS DEC, 1997)

References for Summary of Public Comments and Responses

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APPENDIX E

ATSDR Glossary of Terms

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, 1-888-422-8737.

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).

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.

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 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 ($t_{½}$) - 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 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 (e.g., 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.

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/cm^2 - Milligram per square centimeter (of a surface).

mg/m^3 - 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, 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.

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

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