Public Health Assessment

Final Release

Public Health Implications of Site-Related Exposures
to Trichloroethylene

Mansfield Trail Dump Superfund Site
Sussex County, New Jersey

EPA FACILITY ID: NJN000206345

Prepared by
New Jersey Department of Health

SEPTEMBER 4, 2013

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR's Cooperative Agreement Partner 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's Cooperative Agreement Partner 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.

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Summary

Introduction

On October 21, 2010, the United States Environmental Protection Agency (USEPA) proposed to add the Mansfield Trail Dump site, Sussex County, New Jersey, to the National Priorities List (NPL). On March 10, 2011, USEPA listed the site as final on the NPL. The New Jersey Department of Health (NJDOH), in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), prepared the following public health assessment to review environmental data obtained from the site, to evaluate potential human exposure to contaminants, and to determine whether the exposures are of public health concern.

The top priority of ATSDR and NJDOH is to ensure that the community around the site has the best information possible to safeguard its health.

Conclusions

The NJDOH and ATSDR have reached four conclusions in this public health assessment on the Mansfield Trail Dump site:

Conclusion 1

NJDOH and ATSDR conclude that, from 2005 to the present, drinking water from the domestic potable wells will not harm people's health. Drinking water from domestic (private) wells that have Point-of-Entry Treatment (POET) systems installed will not harm people's health, as long as the POET systems are properly designed and maintained.

Basis for Conclusion

Exposures were interrupted for residents when POET systems were installed in 2005.

Next Steps

Until residents are given a more permanent solution to address their contaminated domestic potable wells, it is recommended that the New Jersey Department of Environmental Protection (NJDEP) continue to ensure proper operation/maintenance of the installed POET systems at affected residences which are Spill Fund eligible. Additionally, it is recommended that for residences that are not eligible for state funding due to changes in ownership, the property owners look to the NJDEP for guidance ensuring proper operation/maintenance of pre-existing POET systems.

Conclusion 2	*NJDOH and ATSDR conclude that past exposures (prior to 2005) to trichloroethylene (TCE) in domestic potable water could have harmed people's health.*
Basis for Conclusion	The conclusion is based on the maximum detected levels of TCE in domestic wells as occupants of several residences were exposed to levels of TCE in the past that could result in potential fetal heart malformations as indicated by toxicological studies. Other non-cancer health effects are not expected and the conclusion of possible harmful effects to the fetus only applies to the occupants of those few residences with the highest concentration of TCE in their domestic wells. Ingestion of TCE contaminated water was determined to pose no apparent increase in cancer risk compared to background levels.
Next Steps	The USEPA should implement removal and/or remedial actions to provide a permanent solution to address contaminated drinking water for residents.
Conclusion 3	*At this time the NJDOH and ATSDR cannot conclude whether past, current and future exposures to trichloroethylene (TCE) in indoor air could have harmed people's health.*
Basis for Conclusion	From 2006-2008, NJDEP collected indoor air and sub-slab soil gas samples in and below 15 residences. Although these samples indicated volatile organic compounds were not present at harmful levels at most of the sampled homes, more extensive indoor air sampling is needed to assess whether volatile organic compounds may be building up in homes yet to be tested (vapor intrusion). Current and future exposures are considered interrupted in five residences with systems as remedial measures have been taken to mitigate vapor intrusion.
Next Steps	USEPA is scheduled to conduct additional sampling of more residences to verify that residents are not being exposed to groundwater contaminants from vapor intrusion. Once data becomes available, an evaluation to assess adverse health effects from past, current and future chronic exposures to TCE in indoor air will be made.

Conclusion 4	*NJDOH and ATSDR conclude that incidental ingestion of surface soil and surface water will not harm people's health.*
Basis for Conclusion	Small children are not expected to have contact with contaminated on-site soil present in the trenches. The likelihood of appreciable exposures to recreational users of a public pedestrian/bike path present on-site is low as the trenches are not readily accessible. As analytical results indicated non-detect values for all volatile organic compounds in surface water, in the unnamed tributary to Lubbers Run, it can be concluded that exposures associated with this pathway will not result in adverse health effects.
For More Information	Copies of this report will be provided to concerned residents in the vicinity of the site via the township libraries and the internet. NJDOH will notify area residents that this report is available for their review and provide a copy upon request. Questions about this public health assessment should be directed to the NJDOH at (609) 826-4984.

Statement of Issues

On October 21, 2010, the United States Environmental Protection Agency (USEPA) proposed to add the Mansfield Trail Dump site, Sussex County, New Jersey, to the National Priorities List (NPL). On March 10, 2011, USEPA listed the site as final on the NPL. Pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA) of 1986, the federal Agency for Toxic Substances and Disease Registry (ATSDR) is required to conduct public health assessment activities for sites listed or proposed to be added to the NPL. The New Jersey Department of Health (NJDOH), in cooperation with the ATSDR, prepared the following public health assessment to review environmental data obtained from the site, evaluate potential human exposure to contaminants, and to determine whether the exposures are of public health concern.

Background

Site Description and Operational History

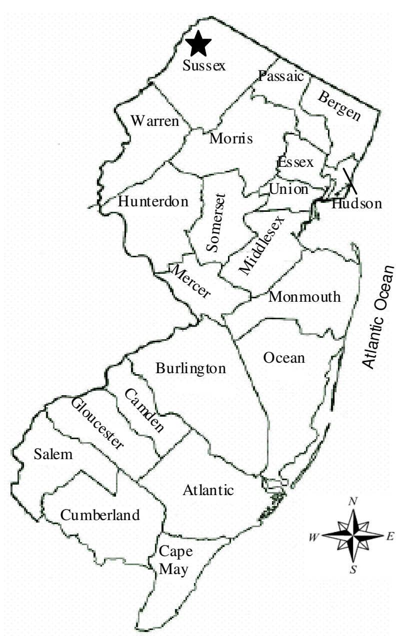

Figure 1: Location of Mansfield Trail Dump

The Mansfield Trail Dump site, which consists of several waste disposal trenches in a wooded area near the Mansfield Bike Path, is located in rural Sussex County in Byram Township in northwestern New Jersey (see Figure 1). The site is located near the intersection of the Mansfield Bike Path and Stanhope-Sparta Road. There are five discrete areas of concern that have been designated as Dump Areas A, B, C, D, and E (USEPA 2010). Dump Area A lies directly upslope of residential properties along Brookwood Road; three residential properties lie within 200 feet of Dump Area A. In addition, a public pedestrian/bike path is located down slope of Dump Area D (see Figures 2, 3).

The waste disposal trenches at the Mansfield Trail Dump site were first identified in 2009 by the New Jersey Department of Environmental Protection (NJDEP) during an effort to identify the source of the contamination detected in the nearby domestic potable wells along Brookwood and Ross Roads.

Dump Areas A, B, and D consist of one or more trenches in which waste material (resembling sludge) of unknown origin has been deposited. Dump Area C consists of a disturbed area adjacent to Dump Area B. Dump Area E consists of four parallel mounds in a wooded area between Dump Areas B and D (USEPA 2010b). A public pedestrian/bicycle path runs north to south along the east side of Dump Areas C, D, and E (see Figure 2). No secondary containment such as liner, maintained engineered cover, or other containment features were observed during the Geoprobe™ investigation as done by the USEPA.

There is currently no fencing or other measures present that could prevent access to the site by the public, and trespassers have been observed using a network of wooded trails near Dump Area B for off-road motorcycles (USEPA 2010b). Historical aerial photos indicate that site operation began in the late 1950s and ran through the early 1970s. The residential properties impacted and potentially impacted by this site were built in the mid-1980s.

Regulatory and Remedial History

In May 2005, the Sussex County Department of Health and Human Services (SCDOH) and NJDEP became aware of trichloroethylene (TCE) contamination in domestic wells serving homes on Brookwood and Ross Roads, and notified residents in the neighborhood of the contamination. As of June 2005, thirteen domestic wells were known to be contaminated with TCE at concentrations in excess of New Jersey Drinking Water Standards (1 part per billion) (USEPA 2010b). Further sampling of the domestic wells in the Brookwood and Ross Roads neighborhood was conducted by NJDEP in March 2006 and in May 2008 to establish the number of impacted residences. Currently, 18 homes utilize a point of entry treatment (POET) system to remove the contamination (USEPA 2010b). The NJDEP ensures proper operation/maintenance of the installed POET systems at affected residences which are Spill Fund eligible. It should be noted that as of March 2, 2009, due to an amendment modifying the New Jersey Spill Fund claim rules and regulations, the purchaser of a property on which a POET system was installed and maintained at the expense of the Spill Fund is not eligible for compensation for ongoing maintenance and monitoring costs (NJDEP 2012).

From 2006-2008, NJDEP collected indoor air and sub-slab soil gas samples from homes throughout the affected neighborhood. Many of the homes showed the presence of volatile organic compounds, such as TCE, benzene and methyl tert-butyl ether, in the indoor air but not in the sub-slab samples (USEPA 2010b).

In May 2009, NJDEP installed two monitoring wells between Dump Areas B and D. In July and October 2009, NJDEP collected samples from these wells and total concentrations of TCE, 1,2-dichloroethylene (DCE), and vinyl chloride in one monitoring well ranged from 1.61 micrograms per liter (µg/L) to 9.48 µg/L; concentrations in the other well ranged from 771 µg/L to 835 µg/L (USEPA 2010b).

In September 2009, NJDEP collected soil samples (depth unknown) from Dump Areas A, B, and D. Analytical results indicated the presence of TCE in Dump Area A at a concentration over 20,000 milligrams per kilogram (mg/kg) (USEPA 2010b). Soil from Dump Area B was found to contain benzene, ethylbenzene, toluene, and xylene, as well as various chlorinated benzene compounds. TCE, cis-1,2-dichloroethylene (cis-1,2-DCE), and chlorinated benzene compounds were detected in soil from Dump Area D.

As part of the pre-remedial phase of the Mansfield Trail Dump site Integrated Assessment, waste source (soil and waste), groundwater (on-site monitoring wells), and domestic well samples were collected from February-May 2010 (USEPA 2010b). Sample analytical results of waste samples (collected from Dump Area A in April 2010) and domestic well samples (collected from private wells serving homes in the Brookwood and Ross Roads neighborhood in February-March 2010) document an observed release of TCE from the site and contamination of 15 domestic wells serving 56 residents.

From May 10-18 and June 7-16, 2010, in support of the USEPA Region 2 Removal Program, waste source delineation phase was conducted and soil, groundwater, and composite waste samples were collected throughout the site using Geoprobe™ direct-push technology (USEPA 2010b). Analytical results of soil and waste samples collected during the waste source delineation phase indicated the presence of volatile organic compounds (VOCs), such as TCE, cis-1,2-DCE, and various chlorinated benzene compounds, throughout the site.

The detailed sampling results from these investigations are summarized in the Environmental Contamination section.

Site Geology and Hydrogeology

Site-specific information indicates that ground water flow beneath the eastern portion of the site is south to north. The hydrogeology beneath the site indicates a downward migration of hazardous substances from Dump Area A into the bedrock aquifer to nearby domestic wells. Based on the topography and the detections of volatile organics in the domestic wells, it is likely that shallow ground water flow beneath Dump Area A, which lies on the west side of the ridge, is to the west-northwest toward the Brookwood and Ross Roads neighborhood. It is noted that localized pumping of the private wells in the area affects ground water flow and contaminant transport. Due to insufficient mapping, the lateral extent of the aquifer of concern and therefore the complete extent of the 15-mile target distance limit is currently unknown. The USEPA considers that there is still a threat of contaminant migration further than what is currently documented (USEPA 2010b).

USEPA determined that contaminants from the on-site trenches were migrating to the groundwater under the neighboring residences by sampling domestic wells in the Brookwood and Ross Roads neighborhood. Sampling and analysis of domestic well samples (pre-treatment samples) collected by USEPA in February and March 2010 indicated that 56 people are served by fifteen private wells contaminated with TCE at concentrations significantly above background (USEPA 2010b). There are three public supply wells located within one mile of Dump Area A and 15 public supply wells within two miles of Dump Area A (USEPA 2010). Currently, 18 homes utilize a point of entry treatment (POET) system to remove the contamination.

Prior ATSDR/NJDOH Involvement

There has not been any prior ATSDR/NJDOH involvement at this site.

Land Use and Demographics

The land use in this rural area is mixed residential and recreational. Based upon the 2000 United States Census, population demographics indicate that there are approximately 4,000 individuals residing within a one-mile radius of the site (see Figure 4).

Site Visit

Representatives from NJDOH and ATSDR met with USEPA representatives on April 6, 2011 for a site visit of the dump areas. Trenches A, B, C, D and E were observed from a distance. It was noted at the time that there were not any signs marking this area as a Superfund site and public access was not restricted. A public pedestrian/bicycle path runs north to south along the east side of Dump Areas C, D, and E and is used routinely by people in the area. Of particular interest is that the path is used by the local high school as part of its school cross-country running practice route. It was mentioned that the path is used by children residing in houses on Brookwood Road and neighboring streets as a shortcut to the high school. Pictures from the site visit are attached in Appendix A.

Community Concerns

The USEPA held an initial environmental Community Advisory Group meeting on May 26, 2011. ATSDR and NJDOH were invited to this meeting and were in attendance. No specific site-related health concerns were raised by the community at this meeting.

Environmental Contamination

An evaluation of site-related environmental contamination consists of a two-tiered approach: 1) a screening analysis; and 2) a more in-depth analysis to determine public health implications of site-specific exposures (ATSDR 2005). First, maximum concentrations of detected substances are compared to media-specific environmental guideline comparison values (CVs). If concentrations exceed the environmental guideline CVs, these substances, referred to as Contaminants of Potential Concern (COPCs), are selected for further evaluation. If contaminant levels are found above environmental guideline CVs, it does not mean that adverse health effects are likely, but that a health guideline comparison is necessary to evaluate site-specific exposures. Once exposure doses are estimated, they are compared with health guideline CVs to determine the likelihood of adverse health effects.

Environmental Guideline Comparison

There are a number of CVs available for screening environmental contaminants to identify COPCs (ATSDR 2005). These include ATSDR Environmental Media Evaluation Guides (EMEGs) and Reference Media Evaluation Guides (RMEGs). EMEGs are estimated contaminant concentrations that are not expected to result in adverse noncarcinogenic health effects. RMEGs represent the concentration in water or soil at which daily human exposure is unlikely to result in adverse noncarcinogenic effects. If the substance is a known or a probable carcinogen, ATSDR's Cancer Risk Evaluation Guides (CREGs) were considered as CVs. CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million persons exposed during their lifetimes (78 years).

In the absence of an ATSDR CV, CVs from other sources may be used to evaluate contaminant levels in environmental media. These include New Jersey Maximum Contaminant Levels (NJMCLs) for drinking water, USEPA MCLs for drinking water and USEPA Regional Screening Levels (RSLs). RSLs are contaminant concentrations corresponding to a fixed level of risk (i.e., a Hazard Quotient[1] of 1, or lifetime excess cancer risk of one in one million, or 10^{-6}, whichever results in a lower contaminant concentration) in water, air, biota, and soil (USEPA 2011a). For soils and sediments, CVs also include the NJDEP Residential Direct Contact Soil Remediation Standards (RDCSRS), Ingestion-Dermal Health Based Criterion (IDHBC) and Inhalation Health Based Criterion (IHBC). Based primarily on human health impacts, these criteria also take into account natural background concentrations, analytical detection limits, and ecological effects (NJDEP 2011).

Substances exceeding applicable environmental guideline CVs were identified as COPCs and evaluated further to determine whether these contaminants pose a health threat to exposed or potentially exposed receptor populations. In instances where an environmental guideline CV or toxicologic information is unavailable, the substance may be retained for further evaluation.

On-site sampling

Soil

In September 2009, NJDEP collected soil samples from Dump Areas A, B, and D. Analytical results indicated the presence of TCE in Dump Area A at a concentration over 20,000 milligrams per kilogram (mg/kg) (USEPA 2010b). Soil from Dump Area B was found to contain benzene, ethylbenzene, toluene, and xylene as well as various chlorinated benzene compounds. TCE, cis-1,2-dichloroethylene (cis-1,2-DCE), and chlorinated benzene compounds were detected in soil from Dump Area D. The depth of these soil samples was not indicated.

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[1]The ratio of estimated site-specific exposure to a single chemical from a site over a specified period to the estimated daily exposure level at which no adverse health effects are likely to occur.

As part of the pre-remedial phase of the Mansfield Trail Dump Integrated Assessment, waste soil samples were collected from February-May 2010 (USEPA 2010b). Sample analytical results indicated the presence of TCE at a depth of 5-8 inches at concentrations of 0.63 J[2] mg/kg, 15 mg/kg and 170 mg/kg. Cis-1,2-DCE was detected at concentrations of 2 mg/kg, 56 mg/kg and 81 mg/kg.

From May 10-18 and June 7-16, 2010, test borings were advanced throughout the site and grab soil and composite waste samples at various depths were collected from each of the dump area trenches. Dump Area C was observed to be littered with tires and miscellaneous trash and no evidence of the same type and method of waste deposition as the other dump areas (e.g., excavated trenches and sludge-like waste material) were observed (USEPA 2010b). Therefore, Dump Area C was not evaluated during the waste source delineation phase of the integrated assessment by the USEPA. The results from the other dump areas are summarized below and in Table 1.

It should be noted that the ATSDR considers 0-3 inches to be the surface soil (the soil to which people are most likely to be exposed)

Grab Soil Sampling Results

Dump Area A: The maximum concentrations of TCE (2,900 mg/kg) and cis-1,2-DCE (340 mg/kg) were detected in subsurface soil sample (6.6-6.8 feet) collected from the upper trench. Soil samples collected from outside the trenches indicated non-detect values for site contaminants (see Table 1).

Dump Area B: Grab soil sample VOC analytical results indicated the presence of TCE (200 J[2] mg/kg), cis-1,2-DCE (45 mg/kg) and chlorinated benzene compounds in surface soil samples (0 -2 feet). One soil sample (200 J[2] mg/kg at depth: 1.6-1.8 feet) was elevated above the CV for TCE (see Table 1).

Dump Area D: Analytical results of the soil samples (0-2 feet) indicated the presence of acetone, cis-1,2-DCE, TCE, toluene, chlorobenzene, ethylbenzene, o-xylene, m,p-xylene, 1,4-dichlorobenzene, 1,2-dichlorobenzene, 1,2,4-trichlorobenzene. None of these were elevated above CVs (see Table 1).

Dump Area E: VOC analytical results indicated the presence of cis-1,2-DCE (120 mg/kg), TCE (220 mg/kg) in samples collected at 1.7-1.8 feet depth. Chlorinated benzene compounds, such as 1,2,4-trichlorobenzene and 1,2,3-trichlorobenzene were detected at a maximum concentration of 1,800 and 840 mg/kg, respectively collected at a depth of 1.7-1.9 feet. These VOCs are elevated above their respective CVs (see Table 1).

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[2]J = The analyte was positively identified and the J-value is the approximate concentration of the analyte in the sample.

Composite Waste Sampling Results

Composite samples from the dump areas indicated the presence of TCE (3,600 mg/kg, depth: 0-8 feet), 1,2-dichlorobenzene (2,500 mg/kg, depth: 2-12 feet), polycyclic aromatic hydrocarbons (PAHs), phthalate, phenol compounds, Aroclor-1254 (8 J[3] mg/kg, depth: 1-11 feet), mercury (18.2 mg/kg, depth: 0-4 feet) and lead (401 J[3] mg/kg, depth: 0-4 feet). .Therefore, the results from composite waste sampling were not considered representative of surface soil samples and will not be included in further analysis.

Based on maximum concentrations detected in surface soil samples, the following VOCs were classified as COPCs: cis-1,2-DCE, TCE, 1,2,4-trichlorobenzene and 1,2,3-trichlorobenzene (see Table 1).

Off-site sampling

Domestic (private) Potable Wells

In June 2005, NJDEP collected fourteen groundwater samples from private wells in the Brookwood and Ross Roads neighborhood. TCE was detected in two samples at concentrations of 13 and 27 µg/L. In March 2006, SCDOH and NJDEP collected sixteen groundwater samples from private wells in the same area (USEPA 2010b). TCE was detected in ten raw (or untreated) samples, at concentrations ranging from 3.9 to 70 µg/L in homes which had installed point of entry treatment systems. In May 2008, NJDEP re-sampled six wells along the border of the area of impacted residences (which were non-detect for VOCs). These were found to be non-detect again for VOCs.

From February 22-24 and March 1-5, 2010, twenty-three domestic well samples were collected by USEPA from 21 residences along Brookwood and Ross Roads and from the Byram Intermediate School well. Seventeen of the domestic well samples (including an environmental duplicate sample) were collected from private wells in which previous sampling by NJDEP indicated TCE contamination and which currently use point of entry treatment (POET) systems. The residential well samples were collected directly into sample jars, and prior to POET systems where applicable. There was no sampling point available prior to the chlorine treatment system at the Byram Intermediate School as the school does not use a POET system (USEPA 2010b). Analysis of the domestic well samples indicated the presence of TCE in the raw (untreated) water from 12 private wells using POET systems at concentrations significantly above the federal Maximum Contaminant Level (MCL) of 5 µg/L. Cis-1,2-DCE was detected above the CV in four out of 16 sampled wells. The sample from the Byram Intermediate School was non-detect for VOCs.

Summary of the domestic well sampling results from sampling events in March 2006 through March 2010 is presented in Table 2. Maximum concentrations of TCE and cis-1,2-DCE exceeded environmental guideline CVs and therefore are considered as the COPCs for the domestic potable wells (see Table 2).

Indoor Air

From 2006-2008, NJDEP collected indoor air and sub-slab soil gas samples from fifteen homes throughout the Brookwood and Ross Roads neighborhood. The results varied with some homes showing TCE concentrations above NJDEP screening levels in just the sub-slab samples and some homes showing TCE concentrations above screening levels in both the sub-slab and indoor air samples. Many of the homes showed the presence of other VOCs, such as benzene and MTBE, in the indoor air but not in the sub-slab samples. The presence of these other compounds was attributed to indoor air background sources, such as environmental tobacco smoke, emissions from carpets and cleaning products. NJDEP installed or enhanced existing sub-slab depressurization systems in five residences in 2007-2008, where the sub-slab sampling revealed TCE concentrations above screening levels (USEPA 2010b).

Table 3 summarizes the indoor air results from the NJDEP sampling. Based on maximum concentrations detected in indoor air samples, TCE was classified as a COPC. Although benzene was elevated above the screening level in 14 out of 15 samples, it is not considered a site-related contaminant as it was not detected in the groundwater. There are indoor and ambient sources for benzene (ATSDR 2007). Outdoor air contains low levels of benzene from tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions. Indoor air generally contains higher levels of benzene from products such as glues, paints, furniture wax, gas cans stored in garages and detergents. Since benzene is a known human carcinogen, efforts should be made to reduce exposure to this contaminant. Appendix D has information on how to address exposures from indoor contaminants.

Surface Water

In October 2009, NJDEP collected 12 surface water samples from the unnamed tributary of Lubbers Run (USEPA 2010b). The tributary flows north along the abandoned railroad bed that runs south to north just east of the site. Analytical results indicated non-detect values for all VOC parameters for all samples collected downstream of the two probable points of entry for Dump Areas B, C, and D.

As analytical results indicated non-detect values for all VOCs, surface water will not be included in further analysis.

Listed below are the COPCs for the Mansfield Trail Dump site:

Media	VOCs
On-site Soil	cis-1,2-DCE TCE 1,2,4-trichlorobenzene 1,2,3-trichlorobenzene
Domestic Potable (private) Wells	cis-1,2-DCE TCE
Indoor Air	TCE

Discussion

The method for assessing whether a health hazard exists to a community is to determine whether there is a completed exposure pathway from a contaminant source to a receptor population and whether exposures to contamination are high enough to be of health concern. Site-specific exposure doses can be calculated and compared with health guideline CVs.

Assessment Methodology

An exposure pathway is a series of steps starting with the release of a contaminant in environmental media and ending at the interface with the human body. A completed exposure pathway consists of five elements:

1. source of contamination;
2. environmental media and transport mechanisms;
3. point of exposure;
4. route of exposure; and
5. receptor population.

Generally, the ATSDR considers three exposure categories: 1) completed exposure pathways, that is, all five elements of a pathway are present; 2) potential exposure pathways, that is, one or more of the elements may not be present, but information is insufficient to eliminate or exclude the element; and 3) eliminated exposure pathways, that is, a receptor population does not come into contact with contaminated media. Exposure pathways are used to evaluate specific ways in which people were, are, or will be exposed to environmental contamination in the past, present, and future.

The exposed populations for identified areas of concern include children and adults associated with residences identified through the investigation efforts conducted by the USEPA and the NJDEP.

The evaluated exposure pathways for site-related contaminants are presented in Table 4.

Completed Exposure Pathways

Ingestion, Inhalation and Skin Absorption of TCE and cis-1,2-DCE from Private Wells Used for Domestic Purposes (past)

VOC exposure could have occurred in several ways:

- Ingestion: People could have drunk the water or eaten food prepared using the water.
- Inhalation: People could have breathed in VOCs that volatilized (moved into the air) from well water during showering, bathing, or other household use.
- Dermal Exposure: People could have absorbed VOCs through their skin during showering, bathing, or other use.

Often, ingestion exposure is the most significant source of exposure to hazardous substances from a site. In the case of VOC contamination, however, inhalation and dermal exposures can make a significant contribution to the total exposure dose (that is, the total amount of contaminant that enters and can affect a person's body). A precise estimate of these non-ingestion exposures is seldom achievable. A common estimation is that non-ingestion exposures yield a contaminant dose comparable to the ingestion dose (ATSDR 2005). This estimation may underestimate exposures to people who may be exposed to TCE from shower water for periods of 30 minutes or more per day.

For the purposes of this evaluation, ingestion exposure doses were doubled using measured water VOC concentrations and default assumptions for the amount of water consumed per day and other exposure parameters to account for additional exposure from inhalation and dermal exposures.

For the past, there was an exposure pathway to TCE and cis-1,2-DCE from contaminated domestic potable wells. Current and future ingestion, inhalation (via showering) and dermal (via bathing) exposures to TCE and cis-1,2-DCE in domestic potable wells are considered interrupted since 2005 for residents who have POET systems installed. It is noted that exposures at residences where POET systems are installed are only considered interrupted if these systems are properly designed and maintained to reduce contaminants to levels safe for potable use. Improper design or maintenance of these systems may cause contaminants in groundwater to pass through and enter the household delivery system resulting in exposures.

Inhalation of TCE in Indoor Air (Past, Present and Future)

From 2006-2008, NJDEP collected indoor air and sub-slab soil gas samples from fifteen homes throughout the affected neighborhood. The results varied with some homes showing TCE concentrations above State screening levels in just the sub-slab samples and some homes showing TCE concentrations above screening levels in both the sub-slab and indoor air samples. Many of the homes showed the presence of other VOCs, such as benzene and MTBE, in the indoor air but not in the sub-slab samples. The presence of these other compounds was attributed to background sources. NJDEP installed or enhanced existing sub-slab depressurization systems in five of the affected homes with sub-slab TCE elevations. The completed exposure pathway involves these contaminant vapors migrating upwards through contaminated subsurface media, groundwater and soil, and entering the interior of the residences in the past.

Current and future exposures are considered interrupted for five residences with systems as remedial measures have been taken to mitigate vapor intrusion.

Potential Exposure Pathway

Incidental Ingestion of Surface Soil (Past, Present and Future)

With the exception of Dump Area C, soil and composite waste samples collected during both the pre-remedial and waste source delineation phases of the Integrated Assessment indicated or suggested the presence of VOCs, semi-volatile organic compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs) in all four dump areas, especially in the sub-surface soil. There is currently no fencing or other measures present that could prevent access to the site by the public, and trespassers have been observed using a network of wooded trails near Dump Area B for off-road motorcycles. The property boundaries of three residences lie within 200 feet of Dump Area A, but the properties are not known to be contaminated and the houses are located more than 200 feet from the area of observed contamination. A public pedestrian/bicycle path runs north to south along the east side of Dump Areas D and E. The path is reportedly used by the local high school as part of its school cross country track practice route. Additionally, it is used by children residing in houses on Brookwood Road and neighboring streets as a shortcut to the high school.

Assuming contaminant levels at the soil surface are similar to those collected (0-2 ft in depth), individuals, including children, may be exposed to contaminants while on the site. Surface soils may be incidentally ingested through hand-to-mouth activity by individuals accessing the site.

The soil screening levels are based on the assumptions that exposure occur 24 hours a day for 350 days of the year. However, this assumption is not representative of actual site exposures to residents and users of the bike/pedestrian path. Also, these people are not expected to have contact with contaminated soil present in the trenches (Dump Areas A-E). The likelihood of appreciable exposures is low given the lack of ready accessibility to the trenches under the current use scenario.

Eliminated Exposure Pathway

Ingestion and Absorption of contaminants from Surface Water (past, present, future)

As analytical results indicated non-detect values for all VOCs, it can be concluded that there are no exposures associated with this pathway at the present time.

Exposure Point Concentration

The exposure point concentration (EPC), or the concentration term in the exposure equation, is derived to reflect a representative concentration at the exposure point or points over the exposure period (EPA 1989; 2007). Consistent with guidance from ATSDR, the 95% upper confidence limit (UCL) of the mean was used to estimate the EPC. An EPC is considered to be the concentration of a contaminant at the point of human exposure. The 95% UCL is considered a 'conservative estimate' of average contaminant concentrations in an environmental medium to represent the EPC. Where the 95% UCL[3] was greater than the maximum value, the maximum concentration was applied. The EPC analysis was not performed for the indoor air data as the TCE was only detected in four out of 15 samples.

Public Health Implications of Completed Pathways

Health Guideline Comparison – Non-Cancer Health Effects

To assess non-cancer health effects, ATSDR has developed Minimal Risk Levels (MRLs) for contaminants that are commonly found at hazardous waste sites. An MRL is an estimate of the daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of adverse, non-cancer health effects. MRLs are developed for a route of exposure, i.e., ingestion or inhalation, over a specified time period, e.g., acute (less than 14 days); intermediate (15-364 days); and chronic (365 days or more). MRLs are based largely on toxicological studies in animals and on reports of human occupational (workplace) exposures. MRLs are usually extrapolated doses from observed effect levels in animal toxicological studies or occupational studies, and are adjusted by a series of uncertainty (or safety) factors or through the use of statistical models. In toxicological literature, observed effect levels include:

- no-observed-adverse-effect level (NOAEL); and
- lowest-observed-adverse-effect level (LOAEL).

A NOAEL is the highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals. LOAEL is the lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals. In order to provide additional perspective on these health effects, the calculated exposure doses were then compared to observed effect levels (e.g., NOAEL,

[3]EPC calculations were conducted using EPA's ProUCL software (EPA 2007).

LOAEL). As the exposure dose increases beyond the MRL to the level of the NOAEL and/or LOAEL, the likelihood of adverse health effects increases.

If the NOAEL or LOAEL is not available, the BMDL (benchmark dose level) or BMCL (benchmark concentration level) can be used. The BMD or BMC is a dose or concentration that produces a predetermined change in response rate of an adverse effect (called the benchmark response or BMR) compared to background. The BMD or BMC can be used as an alternative to the NOAEL/LOAEL in dose-response assessment. The lower limit of the BMDL or BMCL is a characterization of the dose or concentration corresponding to a specified increase in the probability of a specified response. For example, a $BMDL_{10}$ or $BMCL_{10}$ is the lower confidence limit of the estimated dose corresponding to an increase of 0.10 in the probability of the specified response relative to the probability of that same response at dose zero.

When MRLs for specific contaminants are unavailable, other health based comparison values such as the USEPA's Reference Dose (RfD) are used. The RfD is an estimate of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime of exposure.

<u>Ingestion of TCE and cis-1,2-DCE in Domestic (Private) Potable Wells</u>

Past exposures are based on ingestion of well water contaminated with TCE and cis-1,2-DCE under the following scenario: residents within the area using domestic wells prior to the installation of the POET systems in 2005.

Non-cancer exposure doses were calculated using the following formula:

$$\textit{Exposure Dose (mg/kg/day)} = \frac{C \times IR}{BW}$$

where, mg/kg/day = milligrams of contaminant per kilogram of body weight per day;
C = concentration of contaminant in groundwater (µg/L);
IR = groundwater ingestion rate (L/day);
BW = body weight (kg)

For the purposes of this evaluation, ingestion exposure doses were doubled using measured water VOC concentrations and default assumptions for the amount of water consumed per day and other exposure parameters to account for additional exposure from inhalation and dermal exposures.

The following site-specific exposure assumptions (USEPA 2011a) were used to calculate past contaminant doses to area residents. The exposure duration of 20 years was selected as the houses in this neighborhood were constructed starting in 1985 and the POET systems were installed in 2005.

Exposed Population	Body Weight	Ingestion Rate	Exposure Assumptions	Number of Years Exposed
Child (birth through 6 years old)	15 kg	0.32 liters/day	365 days per year	6
Adult	80 kg	1 liter/day		20

As an example, the calculation of exposure of a child weighing 15 kg drinking 0.32 liter per day of water containing 33 µg/L TCE follows. Multiplying by a factor of 2 to account for additional exposure from breathing in TCE from water and getting it on skin during bathing, the daily dose of TCE in milligrams TCE per kg of body weight per day (mg/kg/day) is estimated as:

$$2 \text{ x } \frac{33 \frac{\mu g}{L} \times 0.32 \frac{L}{day} \times \frac{1 mg}{1000 \mu g}}{15\ kg} = 0.0014\ mg/kg - day$$

Table 5 presents calculated doses for children and adults for the two COPCs. Based on EPC and/or maximum levels of TCE and cis-1,2-DCE in domestic wells, chronic exposure doses calculated for children and adults were higher than the corresponding health guideline CVs. A brief evaluation of non-cancer health implications for the COPCs is presented below.

TCE. The RfD for chronic oral exposure to TCE is 0.0005 mg/kg/day and reflects the midpoint among RfDs from three studies that noted adult immunological effects in mice, developmental immunotoxicity in mice and fetal heart malformations in rats (USEPA 2011b). These three studies derived the RfDs using the following uncertainty factors:

- *Study 1 (Kiel et al. 2009)*: Immunological effects in mice exposed for 30 weeks by drinking water. An uncertainty factor of 100 was applied to the LOAEL of 0.048 mg/kg/day to calculate the oral RfD equaling 0.00048 mg/kg/day.

- *Study 2 (Peden-Adams et al. 2006)*: Immunological effects in mice exposed from 0 until 3 or 8 weeks of age through drinking water. An uncertainty factor of 1,000 was applied to the LOAEL of 0.37 mg/kg/day to calculate the oral RfD equaling 0.00037 mg/kg/day.

- *Study 3 (Johnson et al. 2003)*: Fetal heart malformations in rats exposed from 1 until 22 weeks of age through drinking water. An uncertainty factor of 10 was applied to the LOAEL of 0.0051 mg/kg/day to calculate the oral RfD equaling 0.00051 mg/kg/day.

The following table summarizes the toxicological information and the calculated exposure doses:

TCE Toxicological Health Effect	RfD (mg/kg/day)	LOAEL (mg/kg/day)	EPC dose (mg/kg/day)		Maximum Dose (mg/kg/day)	
			Child	Adult	Child	Adult
Study 1: Adult Immunological Effects	0.00048	0.048	0.001	0.0008	0.005	0.003
Study 2: Developmental Immunotoxicity	0.00037	0.37				
Study 3: Fetal Heart Malformations	0.00051	0.0051				

Based on the EPC of TCE (33 µg/L) detected in the domestic wells, the exposure doses calculated for children (0.001 mg/kg/day) and adults (0.0008 mg/kg/day) exceeded the RfDs (see table above). The child and adult exposure doses were approximately 48 and 60 times, respectively lower than the LOAEL from Study 1. It is concluded that adult immunological effects (decreased thymus weights) are unlikely. Based on the maximum concentration of TCE (110 µg/L) detected in the domestic wells, the exposure doses calculated for children (0.005 mg/kg/day) and adults (0.003 mg/kg/day) exceeded the RfDs (see Table above). The child and adult exposure doses were 10 and 16 times lower than the LOAEL from Study 1. It is concluded that the possibility of adult immunological effects (decreased thymus weights) is low.

Comparison of EPC exposure doses to the LOAEL from Study 2 indicates that the doses are 370 and 460 times lower for children and adults, respectively. It is concluded that developmental immunological effects are unlikely. Comparison of exposure doses based on the maximum concentration of TCE to the LOAEL from Study 2 indicates that the doses are 74 and 120 times lower for children and adults, respectively. It is similarly concluded that the possibility of developmental immunological effects is low.

The adult EPC exposure dose was approximately 6 times lower than the LOAEL from Study 3. The adult exposure dose based on the maximum concentration of TCE was approximately the same as the LOAEL from Study 3. In this instance, there is a possibility of potential fetal heart malformations from ingestion of well water containing this level of TCE. For this site, the public health implications from past exposure to TCE in domestic wells will be based on the maximum detected concentration of TCE, rather than the EPC. This is because there were several domestic wells in the neighborhood known to have TCE levels that were at or very close to the LOAEL. There is a possibility of fetal heart malformations resulting from past exposures to domestic well water contaminated with the maximum detected value for TCE.

Cis-1,2-DCE. A chronic oral MRL is unavailable for cis-1,2-DCE. The chronic oral RfD (0.002 mg/kg/day) is based on increased relative kidney weight in male rats (USEPA 2010c). An uncertainty factor of 3,000 was applied to the $BMDL_{10}$ of 5.1 mg/kg/day to derive the chronic oral RfD. Based on the EPC of cis-1,2-DCE detected in the domestic wells, the exposure doses calculated for children (0.001 mg/kg/day) and adults (0.0008 mg/kg/day) were lower than the RfD (see Table 5). The maximum exposure dose calculated for children (0.003 mg/kg/day) exceeded the RfD; however, the dose was about 1,700 times lower than the $BMDL_{10}$ (5.1 mg/kg/day). The maximum adult dose was the same as the RfD and is therefore lower than the $BMDL_{10}$. As such, the potential for non-cancer adverse health effects in children and adults from exposures to cis-1,2-DCE is considered unlikely.

Inhalation of TCE in Indoor Air via Vapor Intrusion

There were no detected concentrations exceeding the intermediate MRL (500 $\mu g/m^3$) for TCE (see Table 6). The current MRLfor chronic inhalation exposure to TCE is 2 $\mu g/m^3$ and is adopted from the EPA RfC (USEPA 2011). The chronic MRLreflects the midpoint between RfC estimates for two critical effects (1.9 $\mu g/m^3$ for adult immunological effects in mice and 2.1 $\mu g/m^3$ for fetal heart malformations in rats).

The maximum detected level of TCE in indoor air was for evaluating public health implication of TCE levels in indoor air as this would provide the most conservative estimate. This is prudent to use the maximum in this scenario as the indoor air sampling of homes was not as extensive as the domestic well water investigations. As Table 7 indicates, the maximum concentration of TCE in indoor air (13 $\mu g/m^3$) is above the chronic MRL. The LOAELs for the two RfC studies are 190 $\mu g/m^3$ and 21 $\mu g/m^3$ (USEPA 2011). The maximum concentration (13 $\mu g/m^3$) is close to the LOAEL (21 $\mu g/m^3$); therefore, based on this comparison, there is a possibility of potential fetal heart malformations from exposure to indoor air containing this level of TCE.

The possibility of adult immunological effects is low as the maximum TCE concentration is approximately 15 times lower than the LOAEL (190 $\mu g/m^3$). If the effects of combined inhalation and ingestion exposures to TCE are evaluated, the risk of adult immunological effects would increase; however the dose would be still 10-fold below the LOAEL[4].

It should be noted that the evaluation of adverse health effects is made on the basis of current measurements of contaminants in indoor air, which only provides a snapshot estimate, i.e., concentration levels at a single point in time. It is unknown if past levels of TCE could have been higher or lower in the residences; therefore, the health effects may be either underestimated or overestimated for past exposures.

[4] Calculation of max adult inhalation dose = C*(1/BW)*(IR): $(13\mu g/m^3)*(1mg/1000\mu g)*(1/80\ kg)*(15m^3/day)$ = 0.002 mg/kg-day. Max adult ingestion dose = 0.003 mg/kg-day (from Table 5)
Combined Dose from Inhalation and Ingestion = 0.005 mg/kg-day.
The LOAEL for adult immunological effect = 0.048 mg/kg-day (from Table on page 14)

Health Guideline Comparison – Cancer Health Effects

The site-specific lifetime excess cancer risk (LECR) indicates the cancer potential of contaminants. LECR estimates are usually expressed in terms of excess cancer cases in an exposed population in addition to the background rate of cancer. For perspective, the lifetime risk of being diagnosed with cancer in the United States is 44 per 100 individuals for males, and 38 per 100 for females; the lifetime risk of being diagnosed with any of several common types of cancer ranges between approximately 1 in 6 and 1 in 100 (ACS 2011). Typically, health guideline CVs developed for carcinogens are based on one excess cancer case per 1,000,000 exposed individuals. The NJDOH considers estimated cancer risks of less than one additional cancer case among one million persons exposed as insignificant or no increased risk (expressed exponentially as 10^{-6}).

The NJDOH use the following cancer risk descriptions for health assessments:

Public Health Assessment/Health Consultation
Risk Description for New Jersey

LECR	Risk Description
$\geq 10^{-1}$	Increase
10^{-2} to $<10^{-1}$	
10^{-3} to $<10^{-2}$	
10^{-4} to $<10^{-3}$	Low increase
10^{-5} to $<10^{-4}$	No apparent increase
10^{-6} to $<10^{-5}$	
$< 10^{-6}$	No expected increase

Following USEPA Guidelines for Carcinogen Risk Assessment, TCE is characterized as "carcinogenic to humans" by all routes of exposure (USEPA 2011). There is "inadequate information to assess the carcinogenic potential" of cis-1,2-DCE (USEPA 2010c). This cancer descriptor is based on the absence of epidemiological studies in humans and lack of animal studies designed to evaluate the carcinogenic potential of cis-1,2-DCE. The following section details the cancer health effects from exposure to TCE.

Ingestion of TCE in Domestic (Private) Potable Wells

The risk of cancer from ingestion, inhalation and skin absorption of TCE from domestic potable wells in the past was calculated using the following formula:

$$\textit{Cancer Exposure Dose (mg/kg/day)} = \frac{C \times IR \times ED}{BW \times AT}$$

where C = concentration of contaminant in groundwater (µg/L);
IR = groundwater ingestion rate (L/day);
ED = exposure duration representing the site-specific exposure scenario (years);
BW = body weight (kg); and
AT = averaging time (years).

$$LECR = CED \times CSF$$

where *CED* = cancer exposure dose (mg/kg/day); and
CSF = cancer slope factor $(mg/kg/day)^{-1}$

The LECR for adults was calculated by multiplying the cancer exposure dose by the cancer slope factor (CSF). The CSF is defined as the slope of the dose-response curve obtained from animal and/or human cancer studies and is expressed as the inverse of the daily exposure dose, i.e., $(mg/kg/day)^{-1}$.

Based on the USEPA Exposure Factors and site-specific conditions, the following assumptions were used to calculate the exposure doses and the corresponding LECRs (USEPA 2011a). The exposure duration of 20 years was selected as the houses in this neighborhood were constructed starting in 1985 and the POET systems were installed in 2005.

Exposed Population	**Body Weight**	**Ingestion Rate**	**Exposure Assumptions**	**Number of Years Exposed**
Adult	80 kg	1 liter/day	365 days per year	20

As an example, the calculation of exposure dose of an adult weighing 80 kg drinking one liter per day of water for 20 years containing 33 µg/L TCE follows. Multiplying by a factor of 2 to account for additional exposure from breathing in TCE from water and getting it on skin during bathing, the dose of TCE in milligrams TCE per kg of body weight per day (mg/kg/day) over a lifetime of 78 years is estimated as:

Cancer Exposure Dose (mg/kg/day):

$$2 \text{ x } \frac{33\frac{\mu g}{L} \times \frac{1L}{day} \times \frac{1mg}{1000\mu g} \times \frac{20\,yr}{78\,yr}}{80\,kg} = 0.00021\, mg/kg - day$$

The lifetime excess cancer risk was calculated to be:

LECR = 0.00021 mg/kg/day x 0.05 $(mg/kg/day)^{-1}$ = 1 x 10^{-5}

Using the USEPA oral cancer slope factor of 0.05 $(mg/kg/day)^{-1}$ and assuming people were exposed to the EPC of TCE (33 µg/L) for 20 years, the predicted increased theoretical cancer risk is approximately one in 100,000 (see Table 7), classifying the cancer risk as no apparent increase when compared to the excess background risk of all or specific cancers. At present, no one at the site is drinking water containing TCE at levels that would measurably increase the theoretical risk of cancer. For the maximum concentration detected (110 µg/L), the LECR was estimated to be four in 100,000 which is considered no apparent increased risk when compared to the excess background risk of all or specific cancers.

Inhalation of TCE in Indoor Air via Vapor Intrusion

The exposure concentration resulting from indoor air concentration of TCE was calculated using the following formulas:

$$EC = \frac{EPC \times ET \times EF \times ED}{AT}$$

where EC = exposure concentration ($\mu g/m^3$);
EPC = exposure point concentration of contaminant in air ($\mu g/m^3$);
ET = exposure time (hours/day);
EF = exposure frequency (days/year);
ED = exposure duration (years); and
AT = averaging time (years).

$$LECR = EC \times IUR$$

where EC = exposure concentration ($\mu g/m^3$); and
IUR = inhalation unit risk of contaminant in air $(\mu g/m^3)^{-1}$

The LECR for residents was calculated by multiplying the cancer exposure concentration in indoor air by the inhalation unit risk (IUR). The IUR is defined by the USEPA as the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 $\mu g/m^3$ in air (USEPA 2008b).

The risk of cancer for past exposures from the inhalation of indoor air contaminated with TCE was evaluated for adults in residences identified from the April 2006 through July 2008 indoor air investigations. The LECR was estimated using the highest detected concentration of TCE (13 $\mu g/m^3$) and it was assumed that an adult was exposed to this concentration for 16 hours a day for 20 years.

$$\text{LECR} = \quad 13\,\frac{\mu g}{m^3} \times \frac{16\,hrs}{24\,hrs} \times \frac{20\,yrs}{78\,yrs} \times 4{\times}10^{-6}\left(\frac{\mu g}{m^3}\right)^{-1} = 9{\times}10^{-6}$$

Based on the highest detected concentration of TCE in indoor air, the LECR was estimated to be nine in 1,000,000 which is considered no apparent increased risk when compared to the excess background risk of all or specific cancers (see Table 8).

The fact that VOCs present in the sub-slab soil gas were not detected in indoor air in these homes supports the hypothesis that vapor intrusion issues may not be a significant concern at the site (see Completed Exposure Pathway section). However, further sampling at more residences would be needed to ensure that this is the case.

As measures of probability, individual LECRs can be added. Cumulative ingestion and inhalation exposures (using the maximum detected level of TCE in domestic wells and in indoor air) indicated a cancer risk of approximately five excess cancer cases per 100,000 individuals. This represents no apparent increased risk when compared to the background risk for all or specific cancers.

Child Health Considerations

ATSDR recognizes that infants and children might be more vulnerable than adults to exposures in communities with contaminated air, water, soil, or food. This potential vulnerability results from the following factors: 1) children are more likely to play outdoors and bring food into contaminated areas; 2) children are shorter and therefore more likely to contact dust and soil; 3) children's small size results in higher doses of chemical exposure per kg of body weight; and 4) developing body systems can sustain permanent damage if toxic exposures occur during critical growth stages. Because children depend completely on adults for risk identification and management decisions, ATSDR is committed to evaluating their special interests at the site.

The NJDOH and ATSDR evaluated the potential risk for children residing in the Mansfield Trail Dump site who were previously exposed to contaminants in their drinking water. Based on the EPC of TCE in drinking water and the highest detected concentration of TCE in indoor air over a 20-year exposure duration, it was determined that there was a no apparent increase in cancer when compared to the excess background risk of all or specific cancers.

TCE is a known contaminant detected in domestic wells in the neighborhood near the Mansfield Trail dump site necessitating residents to have POET systems installed. A study conducted in Woburn, Massachusetts concluded that the elevated incidence of childhood leukemia was associated with the mother's potential for exposure to drinking water contaminated with TCE, PCE, chloroform and other organic compounds, particularly during pregnancy (MDPH 1997). The study also suggested that exposures to these contaminants, whether individual or mixtures, might have had an effect on blood-forming organs during fetal development, but not during childhood. Similarly, a New

Jersey study found a statistically elevated rate of childhood leukemia in towns served by community water supplies contaminated with TCE and PCE (NJDOH 1993). A literature review of drinking water contaminants and adverse pregnancy outcomes was conducted (Bove et al. 2002). Results of studies on chlorination disinfection byproducts indicated moderate evidence for associations with certain birth defects, although this evidence was less clear for chlorinated solvents including TCE and PCE.

Health Outcome Data

Health outcome data can give a more thorough evaluation of the public health implications of a given exposure. Health outcome data can include mortality information (e.g., the number of people dying from a certain disease) or morbidity information (e.g., the number of people in an area getting a certain disease or illness). The review is most effective when (1) a completed human exposure pathway exists, (2) potential contaminant exposures are high enough to result in measurable health effects, (3) enough people are affected for the health effect to be measured, and (4) a database is available to identify rates of diseases plausibly associated with the exposure for populations of concern.

A review of health outcome data was not performed for this site at this time. People are not currently being exposed to contaminants because homes found to have TCE-contaminated water were provided with POET systems soon after discovery of the contamination. Although potential exposures in the past could have occurred, we do not have specific information about how long the contamination was present for each residence or the actual exposure levels at each residence. At the present time, NJDOH and ATSDR are not planning to review health outcome data. This is because a statistical evaluation of available health data for a relatively small potentially exposed population is unlikely to produce interpretable results.

Public Comment

The public comment period for this public health assessment was from July 18, 2012 through September 28, 2012. The comments and responses are given in Appendix C.

Conclusions

The Mansfield Trail Dump site consists of waste disposal trenches in a wooded area and groundwater contamination extending into an adjacent residential neighborhood. There were completed exposure pathways via the ingestion of contaminated domestic well water and inhalation of indoor air (via vapor intrusion pathway) in the past. Contaminants of concerns are TCE and cis-1,2-DCE in domestic wells and TCE in indoor air. The exposed populations are the area residents. Based on the results of NJDOH evaluation of the USEPA and NJDEP sampling results, NJDOH and ATSDR reached the following conclusions:

NJDOH and ATSDR conclude that, from 2005 to the present, drinking water from the domestic potable wells will not harm people's health. Drinking water from domestic (private) wells that have Point-of-Entry Treatment (POET) systems installed will not harm people's health, as long as the POET systems are properly designed and maintained. Since 2005, residents who had the POET installed are no longer exposed to contaminants in drinking water. It should be noted that these exposures are only considered eliminated if POET systems are properly designed and maintained.

NJDOH and ATSDR conclude that past exposures (prior to 2005) to TCE in domestic potable water could have harmed people's health. Adult and developmental immunological effects are unlikely from ingestion of well water, and the possibility of fetal heart malformations is considered low based on the exposure point concentration of TCE. However, for this site, the conclusion is based on the maximum detected levels of TCE in domestic wells as several residences were exposed to levels of TCE in the past that could result in potential fetal heart malformations as indicated by toxicological studies. Other non-cancer health effects are not expected and the conclusion of possible harmful effects to the fetus only applies to those few residences with the highest concentration of TCE in their domestic wells. Ingestion of TCE contaminated water was determined to pose no apparent increase in cancer risk compared to background levels.

At this time the NJDOH and ATSDR cannot conclude whether past, current and future exposures to TCE in indoor air could have harmed people's health. The NJDEP collected indoor air samples in 15 residences to identify whether vapors from underground contaminated water could be building up inside the residences. Although these samples indicated volatile organic compounds were not present at harmful levels at most of the sampled homes, sampling of additional residences is needed to assess whether VOCs may be building up in residences (vapor intrusion). For the 15 sampled residences, the possibility of adult immunological effects is low assuming exposures to the maximum levels of TCE in indoor air. For fetal heart malformations, there is a possibility of potential fetal heart malformations from exposure to indoor air containing the maximum detected level of TCE. The lifetime excess cancer risk, based on the highest detected indoor TCE level, was determined to pose no apparent increased risk when compared to the excess background risk of all or specific cancers. This is the case even when calculated TCE doses from indoor air and from past use of contaminated well water were combined. Current and future exposures are considered interrupted for five residences with systems as remedial measures have been taken to mitigate vapor intrusion.

NJDOH and ATSDR conclude that incidental ingestion of surface soil and surface water will not harm people's health. Small children are not expected to have contact with contaminated on-site soil present in the trenches. The likelihood of appreciable exposures to recreational users of a public pedestrian/bike path present on-site is low as the trenches are not readily accessible. It can be concluded that adverse health effects are not expected to occur under the current use scenario. As analytical results indicated non-detect values for all volatile organic compounds in surface water, in the unnamed tributary to Lubbers Run, it can be concluded that exposures associated with this pathway will not result in adverse health effects.

Recommendations

1. The NJDEP should continue to ensure the POET systems installed at eligible affected residences are properly operated and maintained to protect residents from unnecessary exposures to site-related contaminants. The NJDEP should provide guidance on proper operation and maintenance for residences that are not eligible for state funding due to changes in ownership.

2. The USEPA should implement removal and/or remedial actions to provide a permanent solution to address contaminated drinking water for residences. The USEPA should also continue remedial investigations, including vapor intrusion, and evaluate feasibility studies to implement necessary actions to address contaminated groundwater and to eliminate any potential exposure pathways to residents.

3. The USEPA should conduct additional indoor air and/or sub-slab soil gas sampling to verify that area residents are not being exposed to groundwater contaminants from vapor intrusion.

4. The USEPA should take measures to limit access to the areas of concern (Dump areas A-E) at the Mansfield Trail Dump site. This can include signage marking the site as a Superfund site. Trespassers have been observed using a network of wooded trails near Dump Area B for off-road motorcycles. Individuals, including children who use the bike/pedestrian path, may be exposed to contaminants while on the site. Although the possibility of these individuals contacting contaminated surface soil is low, it is prudent to limit access.

5. Residents are encouraged to contact their primary health care physician to discuss health concerns regarding exposure to site-related contaminants. Additionally, as the USEPA is actively addressing site contamination through remedial measures, residents are encouraged to follow their recommendations and allow them to take the measures necessary to reduce or prevent exposures.

Public Health Action Plan

The purpose of a Public Health Action Plan is to ensure that this Public Health Assessment not only identifies public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of the

ATSDR and the NJDOH to follow-up on this plan to ensure that it is implemented. The public health actions to be implemented by the ATSDR and NJDOH are as follows:

Public Health Actions Taken

1. The ATSDR and NJDOH reviewed information and relevant data to evaluate the potential health implications for TCE in drinking water and indoor air for affected residences near the Mansfield Trail Dump site.

2. On May 26 and September 8, 2011, the NJDOH and ATSDR attended the initial and second meeting of USEPA Community Advisory Group (CAG), respectively.

Public Health Actions Planned

1. Copies of this public health assessment will be made available to concerned residents in the vicinity of the site in the township libraries and the Internet.

2. The NJDOH will attend the USEPA Community Advisory Group (CAG) meetings as and when requested.

3. In cooperation with the USEPA, public meetings can be scheduled, if needed, to discuss the findings of this report and to determine and address any additional community concerns.

4. The NJDOH and the ATSDR will continue to review data as it is made available.

5. The NJDOH will make available to residents any materials on site-related contaminants and provide assistance concerning the findings of this report.

6. The NJDOH and ATSDR will assist residents in identifying non-site related sources of contaminants such as benzene, upon request. In addition, Appendix E of this report provides information on potential sources.

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REPORT PREPARATION

This Public Health Assessment for the Mansfield Trail Dump Site was prepared by the New Jersey Department of Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, procedures existing at the date of publication. Editorial review was completed by the cooperative agreement partner. ATSDR has reviewed this document and concurs with its findings based on the information presented. ATSDR's approval of this document has been captured in an electronic database, and the approving agency reviewers are listed below.

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Table 1: Surface Soil sampling (0-2 feet) results as collected by USEPA from February-June 2010 for Mansfield Trail Dump site

Contaminant	Highest Concentration Detected in Any Sample (milligram per kilogram or mg/kg)	No. of Detections	No. of Samples With Contaminant Concentration Above the CV	CV (mg/kg)[1]	COPC[2]
Dump A					
Acetone	0.072	2 out of 17	0 out of 17	50,000 (RMEG)	No
cis-1,2-Dichloroethylene	3.2	2 out of 17	0 out of 17	100 (RMEG)	No
Trichloroethylene (TCE)	1	2 out of 17	0 out of 17	100 (CREG)	No
Dump B					
Acetone	0.43	1 out of 6	0 out of 6	50,000 (RMEG)	No
cis-1,2-Dichloroethylene	45	1 out of 6	0 out of 6	100 (RMEG)	No
2-Butanone	0.054	1 out of 6	0 out of 6	30,000 (RMEG)	No
Trichloroethylene (TCE)	200 J[3]	1 out of 6	1 out of 6	100 (CREG)	**Yes**
Toluene	37	1 out of 6	0 out of 6	1,000 (EMEG)	No
Chlorobenzene	0.0045	1 out of 6	0 out of 6	1,000 (RMEG)	No
1,4-Dichlorobenzene	180	1 out of 6	0 out of 6	4,000 (EMEG)	No
1,2-Dichlorobenzene	1,100	2 out of 6	0 out of 6	5,000 (RMEG)	No
Dump D					
Acetone	0.19	5 out of 33	0 out of 33	50,000 (RMEG)	No
cis-1,2-Dichloroethylene	42	4 out of 33	0 out of 33	100 (RMEG)	No
Trichloroethylene (TCE)	81	3 out of 33	0 out of 33	100 (CREG)	No
Toluene	37	4 out of 33	0 out of 33	1,000 (EMEG)	No
Chlorobenzene	100	4 out of 33	0 out of 33	1,000 (RMEG)	No
Ethylbenzene	100	1 out of 33	0 out of 33	5,000 (RMEG)	No
o-Xylene	37	1 out of 33	0 out of 33	690 (SL)	No
m,p-Xylene	150	1 out of 33	0 out of 33	600 (SL)	No
1,4-Dichlorobenzene	190	4 out of 33	0 out of 33	4,000 (EMEG)	No
1,2-Dichlorobenzene	1,000	4 out of 33	0 out of 33	5,000 (RMEG)	No
1,2,4-Trichlorobenzene	5	2 out of 33	0 out of 33	22 (SL)	No
Dump E					
cis-1,2-Dichloroethylene	120	2 out of 3	0 out of 3	100 (RMEG)	**Yes**
Trichloroethylene (TCE)	220	2 out of 3	1 out of 3	100 (CREG)	**Yes**
Toluene	310	3 out of 3	0 out of 3	1,000 (EMEG)	No
Chlorobenzene	97	1 out of 3	0 out of 3	1,000 (RMEG)	No
o-Xylene	130	1 out of 3	0 out of 3	690 (SL)	No
m,p-Xylene	140	1 out of 3	0 out of 3	600 (SL)	No

Table 1: (Cont'd.) Surface Soil Sampling (0-2 feet) results as collected by USEPA from February-June 2010 for Mansfield Trail Dump site

Contaminant	Highest Concentration Detected in Any Sample, (mg/kg)	No. of Detections	No. of Samples With Contaminant Concentration Above the CV	CV (mg/kg)[1]	COPC[2]
1,3-Dichlorobenzene	750	1 out of 3	0 out of 3	1,000 (EMEG)	No
1,4-Dichlorobenzene	3,700	3 out of 3	0 out of 3	4,000 (EMEG)	No
1,2-Dichlorobenzene	4,900	3 out of 3	0 out of 3	5,000 (RMEG)	No
1,2,4-Trichlorobenzene	1,800	3 out of 3	3 out of 3	22 (SL)	**Yes**
1,2,3-Trichlorobenzene	840	2 out of 3	2 out of 3	49 (SL)	**Yes**

[1]CREG = Cancer Risk Evaluation Level (ATSDR Comparison Value or CV);
NJDEP SL = New Jersey Department of Environmental Protection Screening Level;
EMEG = Environmental Media Evaluation Guide (ATSDR Comparison Value);
[2]Contaminants of Potential Concern;
[3]J: Estimated value.

Table 2: Contaminants Detected Above Comparison Values (CVs) in Domestic Potable Wells as sampled by SCDOH and NJDEP in March 2006 and USEPA in February-March 2010 for Mansfield Trail Dump site

Contaminant	Highest Concentration Detected in Any Domestic Well Sample, (microgram per liter or µg/L)	No. of Detections	No. of Wells With Contaminant Concentration Above the CV	CV (µg/L)	COPC[1]
Trichloroethylene (TCE)	110	18 out of 27	15 out of 27	5 (MCL)[2] 6 (CREG)[3]	**Yes**
cis-1,2-Dichloroethylene (DCE)	78	16 out of 16	4 out of 16	70 (MCL) 20 (RMEG)[4]	**Yes**

[1]Contaminants of Potential Concern;
[2]MCL = Maximum Contaminant Level (USEPA Comparison Value);
[3]CREG = Cancer Risk Evaluation Level (ATSDR Comparison Value);
[4]RMEG = Reference Media Evaluation Guide (ATSDR Comparison Value).

Table 3: Contaminants Detected Above Comparison Values (CVs) in Indoor Air samples (basement and first floor) for Mansfield Trail Dump site during 2006-2008 sampling by NJDEP

Contaminant	Highest Concentration Detected in Any Sample, (microgram per cubic meter or $\mu g/m^3$)	No. of Detections	No. of Samples With Contaminant Concentration Above the CV	CV ($\mu g/m^3$)	COPC[1]
Trichloroethylene (TCE)	13[2]	4 out of 15	4 out of 15	0.2 (CREG)[3] 1 (NJDEP SL)[4]	**Yes**
Benzene	35	14 out of 15	14 out of 15	0.1 (CREG) 0.6 (NJDEP SL)	No[5]
Methy tert-butyl ether	72	6 out of 15	6 out of 15	2,000 (EMEG)[6] 2 (NJDEP SL)	No
Methylene Chloride	33	6 out of 15	6 out of 15	2 (CREG) 4 (NJDEP SL)	No
Total Xylenes	220	3 out of 15	3 out of 15	200 (EMEG) 110 (NJDEP SL)	No
Tetrachloroethylene	6	1 out of 15	1 out of 15	0.2 (CREG) 1 (NJDEP SL)	No
1,4-Dichlorobenzene	4.3	1 out of 15	1 out of 15	60 (EMEG) 1 (NJDEP SL)	No

[1]Contaminants of Potential Concern;
[2]Sample collected in basement of residence;
[3]CREG = Cancer Risk Evaluation Level (ATSDR Comparison Value);
[4]NJDEP SL = New Jersey Department of Environmental Protection Screening Level;
[5]Not selected as this contaminant was not detected in monitoring wells and therefore not regarded as being site-related;
[6]EMEG = Environmental Media Evaluation Guide (ATSDR Comparison Value).

Table 4 – Evaluated Exposure Pathways

Pathway	Pathway Exposure Pathway Elements				Pathway Classification
	Environmental Medium	Route of Exposure	Location	Exposed Population	
Groundwater	Domestic Wells	Ingestion, Inhalation, Dermal	Residences	Adults & Children	Past – Completed Present & Future – Interrupted [(a)]
Indoor Air	Indoor Air	Inhalation			Past, Current and Future – Completed [(b)]
Surface Soil	Surface Soil	Incidental Ingestion	On-site at Mansfield Trail Dump	Adults & Children	Past, Current and Future – Potential
Surface Water	Surface Water	Ingestion, Dermal	Unnamed Tributary of Lubbers Run	Adults & Children	Past, Current and Future – Eliminated

(a) Considered interrupted with Point of Entry Treatment (POET) systems;

(b) Remedial systems have been installed at five residences to mitigate vapor intrusion and reduce or prevent further exposures; for these residences this pathway is considered interrupted.

Table 5: Comparison of Calculated Exposure Doses with Non-Cancer Health Guideline CV based on contaminant concentrations in Domestic Potable Well samples for Mansfield Trail Dump site

Contaminant	Exposure Point Concentration (µg/L)[1]	Exposure Dose (mg/kg-day)		Health Guideline CV (mg/kg-day)	Potential for Non-cancer Effects
		Child[2]	Adult[3]		
Trichloroethylene (TCE)	33 (110)[4]	0.001 (0.005)[5]	0.0008 (0.003)[5]	0.0005 (RfD)	**Yes**
Cis-1,2-dichloroethylene (DCE)	32 (78)[4]	0.001 (0.003)[5]	0.0008 (0.002)[5]	0.002 (RfD)	**Yes**

[1]Exposure Point Concentrations (micrograms per liter) derived using Pro UCL Version 4.00.02 (USEPA 2007);
[2]Child ingestion exposure assumptions: exposure through 6 years old; 0.32 liter/day; 15 kg mean body weight. Dose was multiplied by two to account for inhalation and dermal exposures from potable well usage;
[3]Adult ingestion exposure assumptions: 1 liter/day; 80 kg mean body weight. Dose was multiplied by two to account for inhalation and dermal exposures from potable well usage;
[4]Maximum concentration detected in parenthesis;
[5]Maximum Exposure dose calculation based on maximum concentration.

Table 6: Comparison of Calculated Exposure Doses with Non-Cancer Health Guideline Comparison Value based on contaminant concentrations in Indoor Air samples for Mansfield Trail Dump site

Contaminant	Exposure Point Concentration (microgram per cubic meter or $\mu g/m^3$)[1]	Health Guideline CV ($\mu g/m^3$)	Potential for Non-cancer Effects
Trichloroethylene (TCE)	13	2[2] (MRL)	**Yes**

[1]Maximum concentration used as there was only four detections of TCE in samples;
[2]ATSDR Chronic Minimum Risk Level.

Table 7: Calculated Lifetime Excess Cancer Risk (LECR) associated with TCE detected in Domestic Potable Well samples for Mansfield Trail Dump site

Contaminant of Concern	Exposure Point Concentration (µg/L)[1]	Exposure Dose (mg/kg-day)[2]	CSF[3] (mg/kg-day)$^{-1}$	Lifetime Excess Cancer Risk
Trichloroethylene (TCE)	33 (110)[4]	0.0002 (0.0007)[5]	0.05	0.00001 or 1 x 10^{-5} (0.00004 or 4 x 10^{-5})

[1]Exposure Point Concentrations (micrograms per liter) derived using Pro UCL Version 4.00.02;
[2]Exposure scenario: 365 days/year, 1liter/day ingestion rate, 20 yrs exposure duration and 80 kg body weight. Dose was multiplied by two to account for inhalation and dermal exposures from potable well usage;
[3]Cancer Slope Factor;
[4]Maximum concentration detected in parenthesis;
[5]Maximum Exposure dose calculation based on maximum concentration.

Table 8: Calculated Lifetime Excess Cancer Risk (LECR) associated with TCE detected in Indoor Air samples for Mansfield Trail Dump site

Contaminant of Concern	Exposure Point Concentration ($\mu g/m^3$)[1]	IUR[2] $(\mu g/m^3)^{-1}$	LECR[3]
Trichloroethylene (TCE)	13	0.000004 (4×10^{-6})	0.000009 (9×10^{-6})

[1]Maximum concentration used as there was only four detections of TCE in samples;
[2]Inhalation Unit Risk;
[3]Lifetime Excess Cancer Risk estimate using exposure scenario: 16 hrs/day, 20 yrs exposure duration over lifetime exposure of 78 yrs.

.

Appendix A

Figure 1: ATV tire tracks on-site at Mansfield Trail Dump site

Figure 2: Motorbike tire tracks on-site at Mansfield Trail Dump site

Figure 3: Bike path at Mansfield Trail Dump site

Figure 4: Pedestrian path at Mansfield Trail Dump site

Figure 5: Homes near Dump Area A at Mansfield Trail Dump site

Figure 6: Dump Area B at Mansfield Trail Dump site

Figure 7: Dump Area B at Mansfield Trail Dump site

Appendix B

The toxicological summaries provided in this appendix are based on ATSDR's ToxFAQs (http://www.atsdr.cdc.gov/toxfaq.html). Health effects are summarized in this section for the chemicals of concern found off-site in area private wells. The health effects described in the section are typically known to occur at levels of exposure much higher than those that occur from environmental contamination. The chance that a health effect will occur is dependent on the amount, frequency and duration of exposure, and the individual susceptibility of exposed persons.

Cis-1,2-dichloroethene 1,2-Dichloroethene, also called 1,2-dichloroethylene, is a highly flammable, colorless liquid with a sharp, harsh odor. It is used to produce solvents and in chemical mixtures. There are two forms of 1,2-dichloroethene; one is called cis-1,2-dichloroethene and the other is called trans-1,2-di-chloroethene. Sometimes both forms are present as a mixture.

Breathing high levels of 1,2-dichloroethene can make you feel nauseous, drowsy, and tired; breathing very high levels can kill you. When animals breathed high levels of *trans*-1,2-dichloroethene for short or longer periods of time, their livers and lungs were damaged and the effects were more severe with longer exposure times. Animals that breathed very high levels of *trans*-1,2-dichloroethene had damaged hearts. Animals that ingested extremely high doses of *cis*- or *trans*-1,2-dichloroethene died. Lower doses of *cis*-1,2-dichloroethene caused effects on the blood, such as decreased numbers of red blood cells, and also effects on the liver. The long-term (365 days or longer) human health effects after exposure to low concentrations of 1,2-dichloroethene aren't known. One animal study suggested that an exposed fetus may not grow as quickly as one that hasn't been exposed. Exposure to 1,2-dichloroethene hasn't been shown to affect fertility in people or animals.

The EPA has determined that *cis*-1,2-dichloroethene is not classifiable as to its human carcinogenicity.

Trichloroethylene (TCE). TCE is a nonflammable, colorless liquid with a somewhat sweet odor and a sweet, burning taste. It is used mainly as a solvent to remove grease from metal parts, but it is also an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers. TCE dissolves a little in water, and can remain in groundwater for a long time. It quickly evaporates from water, so it is commonly found as a vapor in the air. People can be exposed to TCE by breathing air in and around the home which has been contaminated with TCE vapors from shower water or household products, or by drinking, swimming, or showering in water that has been contaminated with TCE. Breathing small amounts of TCE may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating. Breathing large amounts of TCE may cause impaired heart function, unconsciousness, and death. Breathing it for long periods may cause nerve, kidney, and liver damage. Drinking large amounts of TCE may cause nausea, liver damage, unconsciousness, impaired heart function, or death. Drinking small amounts of TCE for long periods may cause liver and kidney damage, impaired immune system function, and impaired fetal development in pregnant women, although the extent of some of these effects is not yet clear. Skin contact with TCE for short periods may cause skin rashes.

Following U.S. EPA (2005b) Guidelines for Carcinogen Risk Assessment, TCE is characterized as “carcinogenic to humans” by all routes of exposure. This conclusion is based on convincing evidence of a causal association between TCE exposure in humans and kidney cancer. The kidney cancer association cannot be reasonably attributed to chance, bias, or confounding. The human evidence of carcinogenicity from epidemiologic studies of TCE exposure is strong for non-Hodgkin lymphoma (NHL), but less convincing than for kidney cancer, and more limited for liver and biliary tract cancer. In addition to the body of evidence pertaining to kidney cancer, NHL, and liver cancer, the available epidemiologic studies also provide more limited evidence of an association between TCE exposure and other types of cancer, including bladder, esophageal, prostate, cervical, breast, and childhood leukemia.

Appendix C

Summary of Public Comments and Responses
Mansfield Trail Dump Site Public Health Assessment

The NJDOH held a public comment period from July 18, 2012 through September 28, 2012 to provide an opportunity for interested parties to comment on the draft Public Health Assessment prepared for the Mansfield Trail Dump Site. Written comments were received by the NJDHSS during the public comment period.

The NJDOH and ATSDR followed the following steps in preparing responses to all significant public comments received during the public comment period: (1) all comment documents were reviewed and catalogued, (2) the material was organized for content (Comments addressing similar issues may have been considered, and (3) a response was prepared for each comment.

Questions regarding this summary or any aspect of this Public Health Assessment may be addressed to the NJDOH at (609) 826-4984.

***Comment**: "…. it is entirely possible that TCE was in drinking water before 1980s and in higher concentrations. This means residents that lived within the area from the 1950s to 1980s could have potentially had TCE in their drinking water. "…. it is therefore reasonable to attempt to evaluate what the potential health risks to those residents were during that time frame."*

Response: It is not possible to evaluate past contaminant concentrations in wells from the 1950s in the absence of analytical data. The impacted neighborhood was determined by contaminant detections in area potable and monitoring wells in a sampling effort conducted by the NJDEP and USEPA. The highest detected trichloroethylene concentration was used to estimate public health effects from inhaling and ingesting the TCE in water over a 20-year period (1985-2005). This time period was specifically chosen as the residences in this impacted neighborhood were constructed in the mid-1980s and exposures for these residents could not have preceded prior to this time period.

***Comment**: "I would also suggest that any test data (specifically for TCE and related chemicals) that the NJDEP may have for community wells be included in your report. A potential list might include wells from East Brookwood Estates Property Owners Association, Lenape Valley Regional High School, Byram Intermediate School, etc. This would at least establish that TCE was not present for certain periods of time in community wells which surround the dump site."*

Response: Wells from distances up to 4 miles were evaluated by the USEPA in the Integrated Assessment report. The impacted neighborhood and the private wells that were affected were delineated by sampling monitoring wells installed in the area following initial presence of contaminants in a private well in 2005. Most of the public well systems within 4 miles consist of blended groundwater supplies. Monitoring data from some of these wells and wells from East Brookwood Estates Property Owners Association do not indicate trichloroethylene exceedences above 1 part per billion with data dating back to 1993.

Comment*: "Since the geology around the dump site is complicated and the aquifer is not completely mapped and the PHA report states there is a concern for contamination spreading further than the current area (now and in the past), a suggestion should be made to the EPA that steps be taken to not inadvertently cause any groundwater contamination to spread."*

Response: This suggestion will be communicated to the USEPA.

Comment*: "Would the PHA consider it to be worthwhile to attempt to notify former residents of this area of the TCE contamination?"*

Response: The report is available to the public on the New Jersey Department of Health (NJDOH) website and copies of the final report will be placed in local repositories such as local public libraries. There are no present plans for NJDOH to conduct outreach to former residents of the impacted neighborhood. In addition, NJDOH will continue to be available to attend the Community Advisory Group meeting to discuss and health concerns as related to the site.

Comment*: "I think that at a minimum the CAG should be provided with information on how current and past residents could "register" any severe illnesses they had into a database that would allow for further studies that might shed more light on the health consequences of exposure to TCE."*

Response: If residents have health concerns, they are encouraged to speak to their healthcare provider. There are no mechanisms that exist to support a health registry. Epidemiological studies are conducted to assess disease in a population; however, these are feasible when a large population has been exposed and/or is at risk. In this instance, any epidemiological study will be unlikely to yield outcomes that can be easily interpreted given the size of the exposed population.

Appendix D

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency in Atlanta, Georgia, with 10 regional offices in the United States. ATSDR serves the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases from 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 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. For additional questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

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].

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

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.

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

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]

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. The Superfund Amendments and Reauthorization Act (SARA) later amended this law.

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.

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].

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

Dose
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.

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

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

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 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.

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

Health outcome data
Information from private and public institutions on the health status of populations. Health outcome data can include morbidity and mortality statistics, birth statistics, tumor and disease registries, or public health surveillance data.

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].

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

Metabolic byproduct
Any product of metabolism.

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

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

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

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.

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).

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

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.

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.

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.

Risk
The probability that something will cause injury or harm.

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].

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.

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.

Substance
A chemical.

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.

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.

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.

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)

For more information on the work of ATSDR, please contact: Office of Policy, Planning and Evaluation Agency for Toxic Substances and Disease Registry 1600 Clifton Road, N.E. (Mail Stop F-61) Atlanta, GA 30333 Telephone: (770) 488-0680

Appendix E

Uses and Typical U.S. Background Concentration of Selected Chemicals Detected in Residential and Commercial Indoor Air Samples

Chemical	Usage[a]	Sources of Common Exposure[b]	Background Concentrations ($\mu g/m^3$)[c]
Acetone	Solvent; paint strippers; rubber cement; cleaning fluids; nail polish remover.	See Usage.	2 - 80[d]; 16[g]; 19 (indoor)[g]
Benzene	Solvents, gasoline, resins and plastics; nylon; paints; adhesives (especially carpet); printing; pesticides;	Gasoline emissions; cigarette smoke; paints and adhesives; particle board and wood composites; wood smoke	1 (average outdoor – Monmouth County, New Jersey)[h]
1,3-Butadiene	Intermediate (potential impurity) in many plastics and polymers; fungicides; latex paint; acrylics; fuel	Vehicle emissions; tobacco smoke; wood fires; waste incinerators; electric wire coatings; thermal degradation of plastics	0.38 (indoor) 14 (cigarette smoke)[d]
Chloroform	Refrigerant manufacturing; raw material for polytetrafluoroethylene plastics; insecticidal fumigant; solvent; cleansing agent in fire extinguishers; by-product in chlorination of potable water; former use in cough syrup, toothpastes, and toothache compounds..	Bathroom showers using chlorinated water; see Usage.	10-500 (10 min shower)[d]; 0.5 - 4 [d]; 0.1 - 2 [g]
1,4 - Dichlorobenzene	Deodorant; pesticide; resins and plastics; solvent; dyes; degreaser; wood preservative; motor oils; paint	Mothballs; toilet deodorants; air fresheners; tobacco smoke; pesticide application	3.45 (indoor non-smoker)[d]; 10.22(indoor smoker)[d]; 1 - 4 (average outdoor)[d] 0.08-240 (indoor - study)[g]
1,2 - Dichloroethane	Manufacture of vinyl chloride; formerly used in varnish, paints, finish removers, adhesives, soaps, degreasing agent	Fugitive emissions from industries, treatment plants, hazardous waste sites; landfills; occupational settings; ambient air	0.3 (indoor non-smoker avg)[f]; 0.03 (indoor non-smoker avg)[f]; 0.04-0.4 (outdoor - study)[f]

Chemical	Usage[a]	Sources of Common Exposure[b]	Background Concentrations ($\mu g/m^3$)[c]
Ethylbenzene	Production of synthetic rubber; general and resin solvent; gasoline additive.	Self-serve gasoline fill-ups; vehicle emissions; painting; new or remodel construction.	1 - 12 (outdoor - average) [d]
n-Hexane	Gasoline; rubber cement; typing correction fluid; perfume aerosols; cleaning agent; paint diluent; alcohol denaturant; solvent in extraction of soybean oil, cottonseed oil and other seed oils. Constituent in natural gas.	Combustion of motor fuels, heating oil fuels or other petroleum products; natural gas; glues, stains, paints, varnishes, adhesives, and cleaning agents.	14 (average outdoor) [d]; 7 [g]
Methylene Chloride	Industrial solvent; hairspray; paint strippers; spray paint; rug cleaners; insecticides; furniture polish.	See Usage	Less than 10[d]; 0.17 (average)[g]
Methyl t-Butyl Ether (MTBE)	Used as an octane booster in gasoline (gasoline refinement)	Automobile gasoline refueling; inside automobiles when driving; refueling lawn mowers; chain-saws; or other gasoline-powered equipment	3.6 (median) [d]; Less than 1 (estimated average)[f]
Tetrachloroethylene (PCE)	Solvent; degreaser; dry cleaning and textile production; water repellants; pharmaceuticals; pesticides; refrigerants; insulating fluids; correction fluid (e.g., white out) and inks; adhesives	Dry cleaned garments; paint removers; fabric cleaning products (e.g., stain removers, etc.); lubricants; wood products	1-4 (average)[d]; 7 (average)[g]
1,2,4- Trimethylbenzene	Dyes, fragrances, and plastics; solvent and paint thinner; sterilizing agent; degreaser; gasoline additive; synthetic wood products.	Self-serve gasoline fill-ups; indoor painting or printing	10-12 (indoor)[d] 2.8 - 5.9 (outdoor)[f]

Chemical	Usage[a]	Sources of Common Exposure[b]	Background Concentrations ($\mu g/m^3$)[c]
1,3,5- Trimethylbenzene	Building materials; Dyes; UV inhibitor in plastics; solvent and paint thinner; gasoline additive.	Self-serve gasoline fill-ups; indoor painting or printing; new or remodel construction.	3-8 (indoor)[d] 3-15 (outdoor) [d]
Toluene	Manufacture of benzoic acid, explosives, dyes, artificial leather, perfumes; solvent for paints, lacquers, gums, and resins; printing inks; gasoline additive; spot removers; cosmetics; antifreeze; adhesive solvent in plastic toys and model airplanes.	Self-serve gasoline fill-ups; vehicle emissions; cigarette smoke; consumer products; nail polish; indoor painting; new or remodel construction (carpets).	3 - 140 (outdoor) [d] 42 (outdoor - average) [d] 20 – 60 µg/cigarette [d]
Xylenes (Total)	Manufacture of benzoic acid; dyes, hydrogen peroxide, perfumes, insect repellants, epoxy resins, pharmaceuticals, paints, varnishes, general solvent for adhesives and paints; gasoline additive; used in leather industry.	Self-serve gasoline fill-ups; vehicle emissions; indoor painting; new or remodel construction.	17 (outdoor - average) [d]

[a]National Library of Medicine's (NLM) Hazardous Substances Data Bank (HSDB)
[b]ATSDR Toxicological Profile
[c]The background concentrations presented are not specific to the Sal's Auto Repair site in particular, but are presented to provide the homeowner some perspective as to levels typically found in U.S. homes
[d]HSDB, 2002, at www.toxnet.nlm.nih.gov
[e]Chemical profiles at www.scorecard.org
[f]EPA, 1988
[g]Tox Profile at www.atsdr.cdc.gov
[h]EPA, 1999

Information Sources for Indoor Air Quality

The following sources of information are provided as a reference to homeowners and business owners regarding actions and preventative measures on how to help improve the quality of indoor air within their homes or workplace.

“Healthy Indoor Air for America’s Homes – Indoor Air Hazards Every Homeowner Should Know About.” USEPA. EPA 402-K-98-002. June 2002 available at:
http://www.montana.edu/wwwcxair/

“The Inside Story – A Guide to Indoor Air Quality.” USEPA. EPA 402-K-93-007. April 1995 available at:
http://www.epa.gov/iaq/pubs/index.html
“Health Buildings, Health People: A Vision for the 21st Century.” USEPA. EPA 402-K-01-003. October 2001 available at:
http://www.epa.gov/iaq/pubs/index.html

“Indoor Air Pollution: An Introduction for Health Professionals.” USEPA. EPA 402-R- 94-007. 1994 available at:
http://www.epa.gov/iaq/pubs/index.html

“What You Should Know About Using Paint Strippers.” Consumer Product Safety Commission. CPSC Publication # F-747-F-95-002. February, 1995 available at:
www.cpsc.gov/cpscpub/pubs/423.html

“Healthy Indoor Painting Practices.” USEPA. EPA 744-F-00-001. May 2000 available at:
www.cpsc.gov/cpscpub/pubs/456.pdf

Many of these sources are available in print through the website contact or through:

New Jersey Department of Health and Senior Services
Indoor Environments Program PO Box 369 Trenton, NJ 08625-0369
609-826-4950
Access on line at: http://nj.gov/health/iep/iaq_links.shtml