

# Health Consultation

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PUBLIC HEALTH IMPLICATIONS AND INTERPRETATION OF  
TETRACHLOROETHYLENE (PCE) EXPOSURE IN  
AMBIENT AND RESIDENTIAL INDOOR AIR

DOVER MUNICIPAL WELL NO. 4  
DOVER TOWNSHIP, MORRIS COUNTY, NEW JERSEY

EPA FACILITY ID: NJD980654131

MARCH 18, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service  
Agency for Toxic Substances and Disease Registry  
Division of Health Assessment and Consultation  
Atlanta, Georgia 30333

## **Health Consultation: A Note of Explanation**

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared by:

New Jersey Department of Health and Senior Services  
Consumer and Environmental Health Services  
Under Cooperative Agreement with the  
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# **Health Consultation**

*Public Health Implications and Interpretation of Tetrachloroethylene (PCE)  
Exposure in Ambient and Residential Indoor Air*

**Dover Municipal Well No. 4  
Dover Township Morris County, New Jersey**

**EPA Facility ID: NJD980654131**

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Consumer and Environmental Health Services**

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## Summary

In response to a request by the United States Environmental Protection Agency, the New Jersey Department of Health and Senior Services, in cooperation with the Agency for Toxic Substances and Disease Registry, evaluated whether elevated indoor air concentrations of tetrachloroethylene detected in nine residences located in the vicinity of Joy Cleaners, Dover, Morris County, New Jersey, posed an immediate health threat. Joy Cleaners has been identified as a Potential Responsible Party for groundwater contamination of Dover Municipal Well No. 4. The well served as one of the town's primary drinking water supply wells. It was taken out of service in September 1980 because of groundwater contamination with halogenated organic solvents, including tetrachloroethylene. The Dover Municipal Well No. 4 site was added to the National Priorities List in 1983.

In December 2002, the United States Environmental Protection Agency performed environmental sampling at 10 residences located in the vicinity of Joy Cleaners. In August 2003, additional environmental sampling was conducted at nine of the 10 previously sampled residences. Tetrachloroethylene levels were detected in both sampling rounds, with the highest concentrations detected in ambient and indoor air and soil gas in August 2003. The maximum tetrachloroethylene concentration detected in ambient air was considerably higher than that detected in the indoor air, indicating that ambient air was a major contributing source of contamination to the indoor environment. In addition, elevated tetrachloroethylene soil gas concentrations detected in August 2003 suggest vapor intrusion as a source of indoor tetrachloroethylene levels.

To estimate non-cancer and cancer health effects, the exposure frequency was assumed to be six months of the year at the maximum detected tetrachloroethylene concentration, to account for the variability in the indoor and ambient tetrachloroethylene levels detected in December 2002 and August 2003. Tetrachloroethylene concentrations measured in the indoor air of all sampled residences were below the chronic and acute minimal risk level for non-cancer health effects. As such, adverse non-cancer health effects from tetrachloroethylene exposures in these residences are not expected. For cancer health effects, based on exposures to current residents, lifetime excess cancer risks values calculated for children and adults pose a "low increased risk" at two residences. For possible past and future exposures, tetrachloroethylene concentrations pose a "moderate increased risk" at three residences, based on the highest reported indoor tetrachloroethylene levels. As such, exposures to tetrachloroethylene in indoor air to residents living at the three residences pose a ***Public Health Hazard***.

Recommendations include the implementation of actions to reduce residential tetrachloroethylene exposures, obtaining additional samples under different seasonal conditions, and the consideration of sampling at other residences and/or businesses located above the groundwater contamination plume.

## Statement of Issues

In November 2003, the United States Environmental Protection Agency (USEPA) requested assistance from the Agency for Toxic Substances and Disease Registry (ATSDR) in determining whether elevated indoor air concentrations of tetrachloroethylene (also known as perchloroethylene, or PCE) detected in nine residences located in the vicinity of the suspected source, Joy Cleaners, 272 Route 46, Dover, Morris County, posed an immediate health threat. In response to this request and through a cooperative agreement with the ATSDR, the New Jersey Department of Health and Senior Services (NJDHSS) prepared the following Health Consultation for Joy Cleaners. At the request of the USEPA, this Health Consultation focuses on exposures associated with PCE levels detected during December 2002 and August 2003 sampling events.

## Background

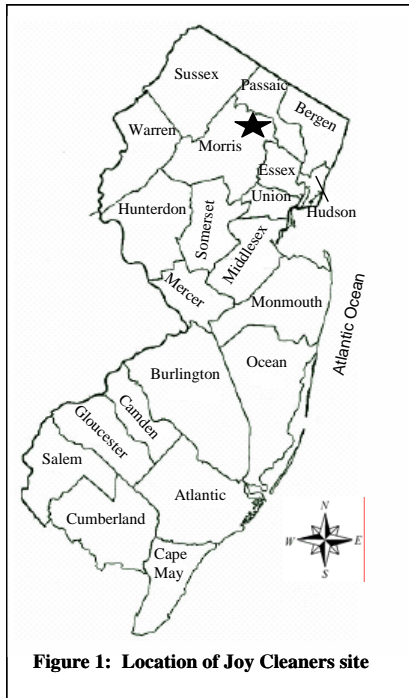


Figure 1: Location of Joy Cleaners site

Joy Cleaners is a retail dry cleaning and laundering establishment located on Route 46 in a residential/commercial zoned area of Dover, Morris County (see Figure 1). The one story building with half basement has been used as a retail dry cleaning facility since the 1970s. The current operator (i.e., Joy Cleaners) purchased the dry cleaning business in December 2000. The use of PCE for dry cleaning predates the current operator.

This dry cleaning facility has been identified as a Potential Responsible Party for groundwater contamination of the Dover Municipal Well No. 4. The well served as one of the town's primary drinking water supply wells. It was taken out of service in September 1980 because of groundwater contamination with halogenated organic solvents (including PCE); the site was added to the National Priorities List (NPL) in 1983. A Remedial Investigation/Feasibility Study (RI/FS) initiated in 1986 included the installation of 17 groundwater monitoring wells. Results of sampling conducted in October

and November 2000, August 2001 and December 2002 showed persistent elevated levels of PCE in the groundwater (USEPA 2002a, 2002b).

On December 4, 2002 the USEPA conducted a Resource Conservation Recovery Act (RCRA)/National Emission Standards for Hazardous Air Pollutants (NESHAP)/Multi-media Compliance Evaluation Inspection of Joy Cleaners pursuant to a Superfund Referral. According to the owner/operator of Joy Cleaners, prior to and at the time of the inspection, PCE-contaminated separator water was routinely collected in an open plastic jug. When full, the residual separator water was transferred to a rice cooker to be "cooked-off" (i.e., volatilized) outside on the landing in the backyard. Additionally, PCE-contaminated steam press water

(generated from the steam pressing of dry cleaned textiles) was poured down an open basement sump, which drained directly into the underlying soil.

In December 2002, the USEPA performed indoor air sampling at 10 residences in the immediate vicinity of the Joy Cleaners site. Ambient air samples were also collected from the exterior of six of the 10 residences. In August 2003, additional environmental sampling was performed. Ambient and indoor air and soil gas samples were collected in nine of the 10 previously sampled residences; one residence was unavailable for resampling. In this sampling round, two indoor air samples (one in the basement, the other on the first floor) were collected over a 24-hour period in each residence. Subsequent to the collection of the indoor air samples, soil gas samples were collected over a 30-minute period by drilling through basement (concrete slab) flooring and driving a sampling device into the ground under the concrete slab. Duplicate samples and trip blanks were also collected. Using a Spanish language interpreter, the USEPA administered a questionnaire to residents comprising topics such as length of residency, number of occupants, number of children less than 13 years of age, basement floor type (e.g., earthen, concrete slab, floating), whether the basement is used as a living space (e.g., sleeping quarters, play area) and the use of solvent-based products. Results of the questionnaire indicated that the majority of the residents are renters with an average residency time of 4.1 years.

### **Site Visit**

On December 17, 2003 staff performed a site visit of the Dover Municipal Well No. 4 site. Additionally, staff viewed the area around Joy Cleaners. Present were Julie Petix, Steven Miller, Tariq Ahmed, Somia Aluwalia and Christa Fontecchio of the NJDHSS; Leah Escobar of the ATSDR; and Diego Garcia of the USEPA. The site visit commenced at 10:30 am. Weather conditions were heavy rain with temperatures in the mid 40s. The Dover Municipal Well No. 4, as shown in Appendix A, Photograph 1, was visited first. The well head is housed within a small brick building located about 1,000 feet southeast of Joy Cleaners. Joy Cleaners is bordered to the north by Route 46; Grecco Auto Body to the west; Walt's Auto Radiator to the east; and residential housing (Richards Avenue) to the south. Strong solvent odors were evident in the neighborhood. According to Mr. Garcia, the residences on Richards Avenue were constructed in the late 1800s or early 1900s. Toys, bicycles and plastic play houses and slides were observed on the porches and backyards of the residences. Joy Cleaners is situated approximately 20 feet from the residence having the highest detected concentration of PCE in both indoor and ambient air (House "C" Richards Avenue). Louvers associated with an exhaust fan were observed in a window located at the rear of the building (see Appendix A, Photograph 3).

Mr. Garcia stated that contamination of the aquifer that supplied Dover Municipal Well No. 4 has not been remediated to date. Dover Municipal Wells Nos. 2 and 3 are currently the primary wells that provide water to the community; well No. 1 is only utilized during peak demand (summer months). According to the USEPA, there are no private potable wells within a one mile radius of Joy Cleaners. Subsequent to the December 2002 USEPA RCRA/NESHAP/Multi-media Compliance Evaluation Inspection, the Joy Cleaners operator has reportedly ceased "cooking off" PCE in a rice cooker.

### **Past ATSDR activities**

In 1990, the NJDHSS, in cooperation with the ATSDR, prepared a Public Health Assessment for the Dover Municipal Well No. 4 that concluded that the site was a “potential public health concern” due to past exposures to halogenated organic volatile compounds at concentrations that may result in adverse health effects. It was recommended that the Dover Municipal Well No. 4 remain closed until the contaminated aquifer was remediated. Periodic monitoring of wells serving Dover was also recommended (ATSDR 1990). A Site Review and Update report prepared in 1994 reiterated the recommendations made in the 1990 Public Health Assessment (ATSDR 1994).

## **Environmental Contamination**

### Groundwater Sampling

In 1992, a Remedial Investigation/Feasibility Study (RI/FS) was completed to evaluate the nature and extent of the groundwater contamination at the Dover Municipal Well No. 4 site. The remedy selected in the Record of Decision (ROD) included a groundwater extraction and treatment system (a.k.a. "pump and treat") to drinking water standards followed by discharge of treated water into the public water supply system and/or reinjection into groundwater (ATSDR 1994). The ROD also called for a subsequent RI/FS in order to: 1) investigate the overall extent of the groundwater contamination; 2) determine the source(s) of the contamination; and 3) propose and evaluate remedial alternatives. Investigative activities carried out in 1998 could not identify sources of the groundwater contamination. A subsequent investigation initiated in the spring of 2000 included the installation and sampling of additional monitoring wells and the use of a groundwater model to assist the USEPA with the design of a groundwater extraction and treatment system. Results of groundwater modeling indicated that the proposed "pump and treat" remedy would not be successful unless the contaminant source(s) was located and controlled (ATSDR 1994, USEPA 2002c). Figure 2 shows the contaminated groundwater plume as it extends south from Joy Cleaners.

### Air and Soil Gas Sampling

In December 2002, the USEPA performed indoor air sampling at 10 residences located in the immediate vicinity of the Joy Cleaners site (Weston 2003a). Ambient air samples were also collected from the exterior of six of the residences. All samples were collected over a 24-hour period using SUMMA<sup>®</sup> canisters and analyzed for volatile organic compounds (VOCs) using USEPA Method TO-15. PCE concentrations detected in indoor air ranged from 0.95 to 39 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ); ambient air concentrations ranged from 0.75 to 25  $\mu\text{g}/\text{m}^3$ .

In August 2003, additional sampling was conducted at nine of the 10 previously sampled residences (see Figure 3) (Weston 2003b). For each of the nine residences sampled, indoor air samples were collected from the basement and the first floor. Ambient air samples were collected from the exterior of four residences. Soil gas samples were collected over a 30-minute period from the basement of seven residences. Soil gas samples were obtained by drilling through basement (concrete slab) flooring. Additionally, exterior soil gas samples were



collected from seven residences. The results of the analysis of these samples are presented in Table 1. Duplicate indoor air samples were collected from the basements of two residences (House “C” and House “G” Richards Avenue) using SUMMA<sup>®</sup> canisters placed side by side. The duplicate air sampling results from the basement of House “C” Richards Avenue varied by two orders of magnitude (i.e., 2.29 versus 279.77  $\mu\text{g}/\text{m}^3$ ). At the request of the USEPA, the higher value of the duplicates was used for the purpose of this Health Consultation.

The USEPA administered a questionnaire to the residents during both the 2002 and 2003 sampling events. Table 1 presents the maximum length of residency reported in either survey. The average residency duration was 4.1 years; one household reported 15 years as the maximum length of residency.

**Table 1: Maximum length of residency and PCE concentrations detected in the indoor and ambient air and soil gas of residences located near the Joy Cleaners Site, August 2003**

Richards Avenue House No.	Max. Length of Residency (years)	PCE Concentration ( $\mu\text{g}/\text{m}^3$ )				
		Basement Air	First Floor Air	Ambient Air	Basement Soil Gas	Exterior Soil Gas
A	1.5	26.92	0.35 (U*)	19.12	9.21	ND
B	8	74.47	203.84	179.68	1,073.88	766.04
C	1	a) (2.29; 2.48) <sup>†</sup> b) (279.77; 286.88) <sup>†</sup>	204.65	517.18	7,471.01	NS
D	2	52.11	21.47	54.13	24.13	3.51
E	4	1.48	1.92	NS	19.42	rejected
F	2.5	c) (3.93; 1.90) <sup>†</sup> d) (1.70, 1.63) <sup>†</sup>	1.09	NS	NS	2.28
G	2	2.69	1.71	NS	5.77	96.58
H	0.5	3.69	1.41	NS	37.39	196.37
I	15	5.18	2.61	NS	NS	706.48 73.84

\*Under detection limit; <sup>†</sup>results of two injections of sample extract; ND = not detected; NS = not sampled  
a) and b) are duplicate samples; c) and d) are duplicate samples

As shown in Table 1, Houses “B” and “C” Richards Avenue, located directly behind Joy Cleaners, had high levels of PCE in the indoor and ambient air, as well as the soil gas (basement and exterior). PCE levels in the basement and exterior soil gas were as high as 7,471 and 766  $\mu\text{g}/\text{m}^3$ , respectively. Since PCE levels detected in the indoor and ambient air in December 2002

were generally lower than those detected in August 2003, this may indicate the potentially episodic nature of PCE levels in the area of Joy Cleaners.

## **Discussion**

### **Assessment Methodology**

The general method for determining whether a public health hazard exists to a receptor is to evaluate the level and extent of human exposure through various exposure pathways. An exposure pathway is the process by which a receptor is exposed to contaminants from a source of contamination and consists of the following elements:

- source of contamination;
- environmental media (e.g., air, soil gas, groundwater, surface water, soil, sediment, biota);
- point of exposure (i.e., location of potential or actual human contact with a contaminated medium);
- route of exposure (e.g., inhalation, dermal contact/absorption, ingestion); and
- receptor population.

Exposure pathways are further classified as: (1) "completed pathways," i.e., those in which exposure is reasonably likely to have occurred, to be occurring, or to occur in the future; (2) "potential pathways," i.e., those in which exposure might have occurred, may be occurring, or may yet occur; and, (3) "eliminated pathways," i.e., those that can be eliminated from further analysis because one of the five elements is missing and will never be present, or in which no contaminants of concern can be identified.

### **Exposure Pathways**

There is a completed exposure pathway from indoor and ambient air to children and adults living in the vicinity of the Joy Cleaners. Other potential exposure pathways (e.g., soil ingestion) were not evaluated as part of this Health Consultation.

### **Health Guideline Comparison: Non-Cancer and Cancer Health Effects**

Typically, as the first step in evaluating health hazards associated with completed exposure pathways, the concentration of each contaminant detected is compared to an established environmental guideline comparison value (CV). For contaminants exceeding these "screening" values, site-specific conditions are evaluated to determine likely exposure scenarios for a given exposure pathway. Since environmental and health-based CVs are the same for indoor air contaminants, PCE levels were compared directly with health-based CVs.

#### *Non-Cancer Health Effects*

To evaluate non-carcinogenic 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-cancerous 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.

The inhalation chronic and acute MRL for PCE are  $271 \mu\text{g}/\text{m}^3$  and  $1,356 \mu\text{g}/\text{m}^3$ , respectively. The maximum PCE concentration detected in either the December 2002 or August 2003 sampling rounds was from the basement of House "C" Richards Avenue ( $286.88 \mu\text{g}/\text{m}^3$ ). The basement of this residence had been used as a living space in the past. The large variation in PCE levels (December 2002 versus August 2003) detected in indoor and ambient air indicates that the ambient contribution to the indoor air is episodic in nature. To estimate non-cancer health effects, the exposure frequency was assumed to be six months of the year at the maximum PCE concentration of  $286.88 \mu\text{g}/\text{m}^3$ , to account for this variability. Since the chronic MRL is based on exposures greater than or equal to 365 days, the maximum concentration of PCE was multiplied by 0.5 to estimate PCE levels for six months of the year (i.e., six months or 183 days divided by 365 days in a year). This concentration was calculated to be  $143.44 \mu\text{g}/\text{m}^3$ , less than the chronic MRL of  $271 \mu\text{g}/\text{m}^3$ . Therefore adverse non-cancer health effects from PCE exposure are not expected.

As previously noted, duplicate air sampling results from House "C" Richards Avenue differed by two orders of magnitude (see Table 1). The large disparity in the results prompted the use of the Johnson and Ettinger model to predict indoor PCE concentrations from soil gas concentrations. This model uses site-specific parameters such as soil gas sampling depth and soil type to predict indoor PCE concentrations. It also utilizes a number of simplifying assumptions regarding contaminant distribution and occurrence, subsurface characteristics, transport mechanisms, and building construction (USEPA 2003a). Using the highest concentration of PCE detected in the basement soil gas of House "C" Richards Avenue ( $7,471 \mu\text{g}/\text{m}^3$ ), the predicted indoor concentration of PCE was  $19 \mu\text{g}/\text{m}^3$ , which is less than that actually detected in the indoor air (i.e.,  $286.88 \mu\text{g}/\text{m}^3$  in the basement and  $204.65 \mu\text{g}/\text{m}^3$  on the first floor). As shown in Figure 4, the maximum PCE concentration detected in ambient air ( $517.18 \mu\text{g}/\text{m}^3$ ) was considerably higher than that detected in the indoor air. As such, ambient levels of PCE (detected in August 2003) were a major contributing source of contamination to the indoor environment. Elevated PCE soil gas concentrations detected in August 2003 also suggest vapor intrusion as a source of indoor PCE levels.

## Cancer Health Effects

The USEPA is currently reviewing its cancer classification for PCE (USEPA 2003b). The United States Department of Health and Human Services, National Toxicology Program (NTP) reviewed available toxicological studies and determined that although there is sufficient evidence that PCE causes cancer in animals, the evidence in humans is inconclusive. For the purpose of this Health Consultation, PCE was considered a probable human carcinogen.

Cancer risk evaluation involves multiplying exposure dose (calculated for cancer health effects) by the cancer slope factor (CSF). This translates to a calculated lifetime excess cancer risk (LECR), usually expressed in terms of excess cancer risk in an exposed population. For example, an estimated cancer risk of  $1 \times 10^{-6}$  is equivalent to one additional cancer case expected among one million persons exposed. In order to provide a qualitative perspective of LECRs associated with contaminant exposures, the NJDHSS refers to the following LECR ranges and corresponding public health designations:

**Table 3: LECR and Public Health Designation**

LECR*	Public Health Designation
$LECR \leq 1 \times 10^{-6}$	No increased risk
$1 \times 10^{-6} < LECR \leq 1 \times 10^{-5}$	No apparent increased risk
$1 \times 10^{-5} < LECR \leq 1 \times 10^{-4}$	Low increased risk
$1 \times 10^{-4} < LECR \leq 1 \times 10^{-3}$	Moderate increased risk
$LECR > 1 \times 10^{-3}$	High increased risk

\* Lifetime Excess Cancer Risk

### Possible Past and Potential Future Exposures

Since complete past residency data is unavailable, USEPA Region 3 Risk Based Concentrations (RBCs) were utilized to assess possible past and potential future excess cancer risks to residents for an approximate 30 year time frame. RBCs are chemical concentrations, adjusted for body weight and inhalation during the first 30 years of life, corresponding to a fixed level of risk (i.e., a Hazard Index of 1 or a lifetime cancer risk of  $1 \times 10^{-6}$ ) in water, air, biota and soil. The Joy Cleaners site has been the location of a retail dry cleaning facility since the 1970s. This estimate was used to evaluate excess cancer risks to those residents who lived in the vicinity of Joy Cleaners in the past but moved prior to the administration of the initial 2002 USEPA survey. Similarly, the RBCs were used to estimate potential future exposures to current residents if PCE exposures continue uninterrupted.

The RBC for PCE is  $0.31 \mu\text{g}/\text{m}^3$ , equivalent to a LECR of  $1 \times 10^{-6}$  (1 in 1,000,000). Therefore, a concentration of  $3.1 \mu\text{g}/\text{m}^3$  (a factor of 10 greater than the RBC) represents a LECR of  $1 \times 10^{-5}$  (1 in 100,000), and a concentration of  $31 \mu\text{g}/\text{m}^3$  represents a LECR of  $1 \times 10^{-4}$  (1 in 10,000). Exposure levels of 3.1 to  $31 \mu\text{g}/\text{m}^3$  represent a “low increased” risk (see Table 3). Table 4 provides the public health interpretations for PCE air concentrations ranges. The LECR values were calculated based on the USEPA draft provisional cancer reassessment of exposure to

PCE by inhalation (USEPA 2003b). This determination was based on a study of liver cancer in female mice, an outcome that is considered by many to be the most appropriate when extrapolating human health effects from rodent studies (Cal/EPA 2001).

**Table 4: Public health interpretation based on PCE air levels (ATSDR 2002)**

Indoor PCE air Concentrations ( $\mu\text{g}/\text{m}^3$ )	Public Health Interpretation*	
Less than 3.1	$\text{LECR}^\dagger \leq 1 \times 10^{-5}$	No apparent increased risk
3.1 to 31	$1 \times 10^{-5} < \text{LECR} \leq 1 \times 10^{-4}$	Low increased risk
31 to 310	$1 \times 10^{-4} < \text{LECR} \leq 1 \times 10^{-3}$	Moderate increased risk
310 and Above	$\text{LECR} > 1 \times 10^{-3}$	High increased risk

\* Refer to Table 3

† Lifetime Excess Cancer Risk

As previously stated, a “worst case” approach was assumed by using the maximum values reported from sampling conducted in December 2002 and August 2003. The PCE concentrations detected in indoor air of three residences located north of Richards Avenue (Houses “B”, “C” and “D”) were within the 31 to 310  $\mu\text{g}/\text{m}^3$  range (see Table 1). This indicates that PCE exposure poses a “moderate increased risk” at this concentration based on a 30-year exposure scenario.

#### Exposures to Current Residents

Based on a review of questionnaire responses on reported length of residency and the maximum detected indoor air concentrations of PCE, children and adults living at House “B” Richards Avenue were exposed to elevated PCE concentrations for the longest duration; residents of House “C” Richards Avenue were exposed to the highest concentration of PCE in indoor air detected (see Table 1). For both residences, exposure doses for cancer health effects were calculated using the following formula:

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

where, C = concentration of contaminant in air ( $\mu\text{g}/\text{m}^3$ )

IR = inhalation rate ( $\text{m}^3/\text{day}$ )

EF = exposure factor

BW = body weight (kg)

whereas,  $EF = \frac{\text{exposure frequency} \times \text{exposure duration}}{\text{averaging time}}$

The LECR for children and adults was calculated using a USEPA Cancer Slope Factor of 0.021 (mg/kg/day)<sup>-1</sup> multiplied by the exposure dose (see Table 5). Since children are typically considered the most sensitive population, the LECRs were also calculated for this population using standard USEPA exposure factors (USEPA 2002d). The maximum values reported from sampling conducted in December 2002 and August 2003 were used to calculate the LECR values for children and adults, assuming a “worst case” scenario. Due to the variation in PCE levels (December 2002 versus August 2003) detected in indoor and ambient air, the exposure frequency was assumed to be six months of the year.

**Table 5: Calculated LECR for Houses “B” and “C” Richards Avenue**

House No.	Max. Length of Residency* (years)	Max. Indoor PCE Conc. (µg/m <sup>3</sup> )	Exposure Dose (mg/kg/day)		Calculated LECR <sup>†</sup>	
			Child	Adult**	Child	Adult
B	8	203.84	4.7 x 10 <sup>-3‡</sup>	3.3 x 10 <sup>-3</sup>	9.9 x 10 <sup>-5</sup>	7.0 x 10 <sup>-5</sup>
C	1	286.88	1.1 x 10 <sup>-3§</sup>	5.8 x 10 <sup>-4</sup>	2.3 x 10 <sup>-5</sup>	1.2 x 10 <sup>-5</sup>

\*residency times of current residents as reported at time of survey

<sup>†</sup> Lifetime Excess Cancer Risk

<sup>‡</sup> Child Exposure Scenario: 7.25 m<sup>3</sup>/day inhalation rate, 183 days a year exposure frequency, 8 years exposure duration, 70 years averaging time, 17.75 kg body weight (USEPA 2002d)

<sup>§</sup> Child Exposure Scenario: 4.5 m<sup>3</sup>/day inhalation rate, 183 days a year exposure frequency, 1 year exposure duration, 70 years averaging time, 8.4 kg body weight (USEPA 2002d)

\*\* Adult Exposure Scenario: 20 m<sup>3</sup>/day, 183 days a year exposure frequency, 70 years averaging time, 70 kg body weight (USEPA 2002d)

The calculated LECR values show that the PCE levels pose a “low increased risk” to children and adults living at Houses “B” and “C” Richards Avenue (see Table 3). The LECR values calculated for the other residences pose a “no” and “no apparent increased” cancer risk to children and adults.

### Child Health Considerations

ATSDR’s Child Health Initiative recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination in their environment. Children are at greater risk than adults from certain kinds of exposures to hazardous substances because they eat and breathe more than adults. They also play outdoors and often bring food into contaminated areas. They are shorter than adults, which mean they breathe dust, soil and heavy vapors closer to the ground. Children are also smaller, resulting in higher doses of chemical exposure per body weight. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most importantly, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care.

The potential health risk from elevated indoor air concentrations of PCE to children living in the vicinity of the Joy Cleaners site was evaluated. The USEPA questionnaire

administered during the December 2002 and August 2003 sampling rounds documented children (< 13 years of age) residing at Houses “A”, “B”, “C”, “G”, “H” and “I” Richards Avenue. As stated in Non-Cancer Health Effects section, indoor PCE levels were less than the chronic MRL in all residences, assuming an exposure frequency of six months a year at the maximum detected concentration. It should be noted that the most sensitive endpoint for non-cancer health effects is increased reaction time, a less serious neurologic effect, as observed in an adult population working in dry cleaning establishments (ATSDR 1997). The MRL, which is based on this endpoint, may not be sufficiently conservative in all cases, especially children with developing nervous systems. For cancer health effects, based on exposures to possible past and for potential future exposures, PCE concentrations pose a “moderate increased risk” to children, based on the highest reported indoor PCE levels. Current exposures constituted a “low increased risk” of cancer to children. If PCE levels remain unchanged in these residences, there is a continued increased risk of cancer proportional to the child’s length of residency.

## Conclusions

In December 2002 and August 2003, environmental sampling was conducted at residences located in the vicinity of the Joy Cleaners. Levels of PCE were detected in both sampling rounds, with the highest concentrations detected in ambient and indoor air and soil gas in August 2003. Based on the maximum detected indoor air concentrations of PCE and reported length of residency, children and adults living at House “B” Richards Avenue were exposed to elevated PCE concentrations for the longest duration; residents of House “C” Richards Avenue were exposed to the highest indoor air concentrations of PCE.

PCE concentrations measured in the indoor air of all residences were below the ATSDR chronic and acute MRL for non-cancer health effects. The exposure frequency was assumed to be six months of the year at the maximum PCE concentration of  $286.88 \mu\text{g}/\text{m}^3$ , to account for the variability in the indoor and ambient PCE levels detected in December 2002 and August 2003. This maximum concentration was calculated to be  $143.44 \mu\text{g}/\text{m}^3$ , less than the chronic MRL of  $271 \mu\text{g}/\text{m}^3$ . Therefore, adverse non-cancer health effects from PCE exposure are not expected under this assumption. The maximum PCE concentration detected in ambient air was considerably higher than that detected in the indoor air, indicating that ambient air was a major contributing source of contamination to the indoor environment. In addition, elevated PCE soil gas concentrations detected in August 2003 suggest vapor intrusion as a source of indoor PCE levels.

For cancer health effects, LECR values were calculated assuming an exposure frequency of six months per year to account for the potentially episodic nature of PCE levels measured at the residences. Based on exposures to current residents, LECR values calculated for children residing at Houses “B” and “C” Richards Avenue pose a “low increased risk” for children and adults. For possible past and potential future exposures, PCE concentrations detected in the indoor air of three residences (Houses “B”, “C” and “D” Richards Avenue) posed a “moderate increased risk” over an assumed 30-year exposure scenario. As such, exposures to PCE in indoor air to residents living at Houses “B”, “C” and “D” Richards Avenue pose a **Public Health Hazard**.

It is important to note that the frequency, duration and pattern of PCE exposure to residents in the vicinity of Joy Cleaners are unknown. As previously stated, the data used in this assessment are limited and may not fully characterize PCE exposures associated with the site.

### **Recommendations**

1. Results from a small number of samples were considered for this Health Consultation and it was noted that the duplicate sample results were disparate. The USEPA should consider obtaining additional samples under different seasonal conditions. In addition, consideration should be given regarding the sampling of other residences and/or businesses located above the groundwater contamination plume.
2. The northern regional office of NJDEP Air Compliance and Enforcement should inspect Joy Cleaners to determine if the facility is in compliance with the General Operating Permit for Perchloroethylene Dry Cleaning Operations.
3. To protect indoor air quality at affected residences on Richards Avenue, the USEPA should take steps to interrupt PCE vapor intrusion.
4. Residents near the Joy Cleaners site should be encouraged to contact the NJDEP through its hotline (1-877-WARNDEP or 1-877-927-6337) to report any environmental incidents, abuses and complaints. Although this hotline is currently not available in the Spanish language, any calls received from Spanish-only speaking individuals are forwarded to a bilingual Spanish-speaking employee.

### **Public Health Action Plan (PHAP)**

The purpose of a PHAP is to ensure that this Health Consultation 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 NJDHSS and ATSDR to follow up on this plan to ensure that it is implemented. The public health actions to be implemented by ATSDR and NJDHSS are as follows:

#### *Public Health Actions Taken*

Indoor air levels of PCE, as measured in December 2002 and August 2003, have been reviewed and evaluated by the NJDHSS to determine human exposure pathways and public health issues.



*Public Health Actions Planned*

1. In February and August 2004, the USEPA performed additional air sampling for PCE at residences located in the vicinity of Joy Cleaners. The NJDHSS and the ATSDR will review and evaluate this data upon the request of the USEPA.
2. A Spanish language Citizen's Guide will be prepared to accompany this Health Consultation and the NJDHSS will be conducting appropriate outreach activities to the community.

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## **CERTIFICATION**

The Health Consultation for the Dover Municipal Well No. #4, Dover Township, Morris County, New Jersey, was prepared by the New Jersey Department of Health and Senior Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated.

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Technical Project Officer, CAT, SPAB, DHAC  
Agency for Toxic Substances and Disease Registry (ATSDR)

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

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Roberta Erlwein  
Team Leader, CAT, SPAB, DHAC, ATSDR

## **APPENDIX A**

**Photograph 1: Backyard of Houses “B”/”C” Richards Avenue**



**Photograph 2: Dover Municipal Well #4 site**





**Photograph 3: View of Joy Cleaners's Landing**



**Photograph 4: Backyard between "B"/"C" Richards Avenue (left) and Joy Cleaners (right)**

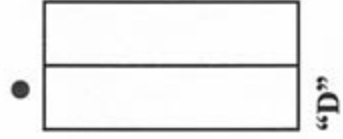
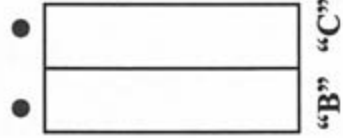
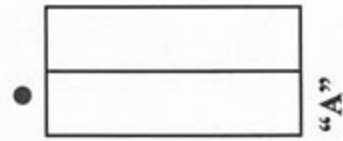




Route 46



Joy Cleaners



Richards Avenue

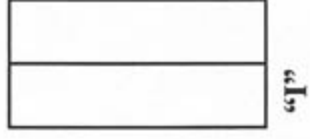
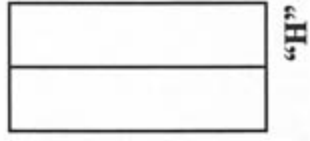
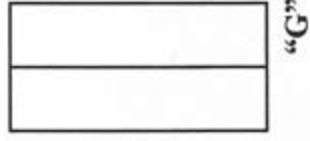
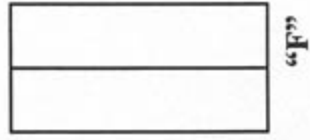
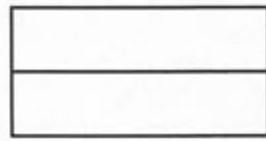
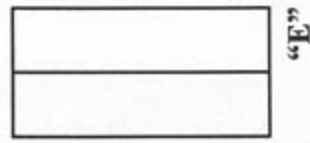


Figure 3: Location of Joy Cleaners and Residences sampled in August 2003

- Ambient air sample
- \* Diagram not to scale

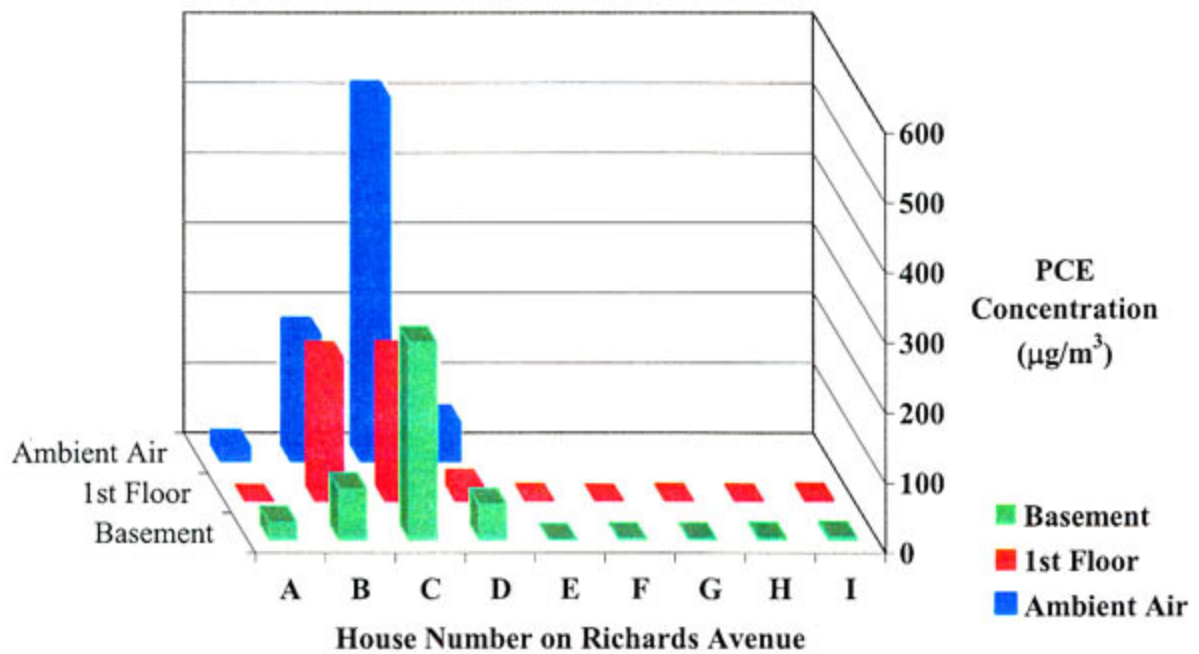


Figure 4: PCE levels in ambient and indoor air in the vicinity of Joy Cleaners as detected in August 2003

## **APPENDIX B**

## **ATSDR's Interim Public Health Hazard Categories**

### **A. Urgent Public Health Hazard**

This category is used for sites where short-term exposures (< 1 yr) to hazardous substances or conditions could result in adverse health effects that require rapid intervention. This determination represents a professional judgment based on critical data which A TSDR has judged sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made. Evaluation of available relevant information\* indicates that site-specific conditions or likely exposures have had, are having, or are likely to have in the future, an adverse impact on human health that requires immediate action or intervention. Such site-specific conditions or exposures may include the presence of serious physical or safety hazards.

### **B. Public Health Hazard**

This category is used for sites that pose a public health hazard due to the existence of long-term exposures (> 1 yr) to hazardous substance or conditions that could result in adverse health effects. This determination represents a professional judgment based on critical data which ATSDR has judged sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made. Evaluation of available relevant information\* suggests that, under site-specific conditions of exposure, long-term exposures to site-specific contaminants (including radio nuclides) have had, are having, or are likely to have in the future, an adverse impact on human health that requires one or more public health interventions. Such site-specific exposures may include the presence of serious physical or safety hazards.

### **C. Indeterminate Public Health Hazard**

This category is used for sites in which "*critical*" data are *insufficient* with regard to extent of exposure and/or toxicological properties at estimated exposure levels. This determination represents a professional judgment that critical data are missing and ATSDR has judged the data are insufficient to support a decision. This does not necessarily imply all data are incomplete; but that some additional data are required to support a decision. The health assessor must determine, using professional judgment, the "*criticality*" of such data and the likelihood that the data can be obtained and will be obtained in a timely manner. Where some data are available, even limited data, the health assessor is encouraged to the extent possible to select other hazard categories and to support their decision with clear narrative that explains the limits of the data and the rationale for the decision.

### **D. No Apparent Public Health Hazard**

This category is used for sites where human exposure to contaminated media may be occurring, may have occurred in the past, and/or may occur in the future, but the exposure is not expected to cause any adverse health effects. This determination represents a professional judgment based on critical data which A TSDR considers

sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made. Evaluation of available relevant information\* indicates that, under site specific conditions of exposure, exposures to site-specific contaminants in the past, present, or future are not likely to result in any adverse impact on human health.

**E: No Public Health Hazard**

This category is used for sites that, because of the absence of exposure, do NOT pose a public health hazard. Sufficient evidence indicates that no human exposures to contaminated media have occurred, none are now occurring, and none are likely to occur in the future.

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