

Health Consultation

**Public Health Implications and Interpretation of Tetrachloroethylene (PCE)
Exposure in Ambient and Residential Indoor Air – No. 2**

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

EPA FACILITY ID: NJD980654131

MARCH 21, 2006

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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*Public Health Implications and Interpretation of Tetrachloroethylene (PCE)
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Summary

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 residences located in the vicinity of Joy Cleaners, Dover, Morris County, New Jersey, posed a continuing 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 and August 2003, the United States Environmental Protection Agency performed environmental sampling at residences located in the vicinity of Joy Cleaners. These results showed that there were potential cancer risks to individuals at three residences from past and future tetrachloroethylene exposures. In February and August 2004, additional indoor and ambient sampling was conducted at nine area residences. Tetrachloroethylene levels detected in the indoor and ambient air in the winter months were generally lower than those detected in the summer months. In June 2005, dry cleaning operations at the Joy Cleaners ceased, and the building is scheduled for demolition.

Results from the four rounds of air sampling indicate that adverse non-cancer health effects from tetrachloroethylene exposures in all sampled residences are not expected. For cancer health effects, sampling results from February 2004 and August 2004 support previous conclusions. For past exposures, the site represents a ***Public Health Hazard*** to individuals at two residences. Operations ceased at the dry cleaning facility on June 17, 2005, thereby eliminating ambient contributions to indoor PCE levels. Elevated tetrachloroethylene soil gas concentrations detected in August 2003 suggest vapor intrusion as a continued source of indoor tetrachloroethylene levels. The United States Environmental Protection Agency is planning another round of ambient and indoor air sampling following the cessation of operation at Joy Cleaners. As this data is currently unavailable, the site currently represents an ***Indeterminate Public Health Hazard***.

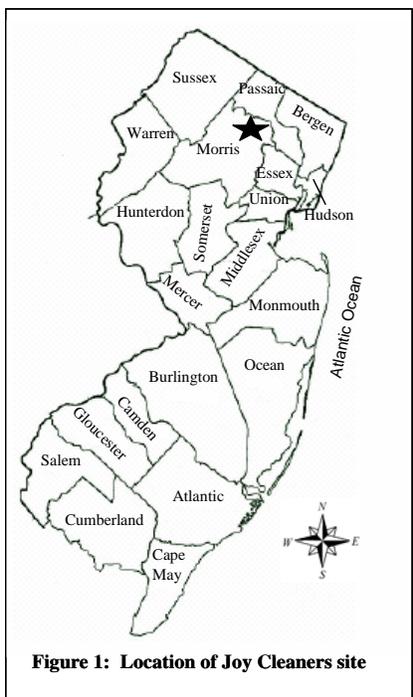
It is recommended that environmental monitoring be continued at residences situated above the groundwater plume. The United States Environmental Protection Agency is proposing to conduct another round of environmental sampling in the residences directly behind the dry cleaners in 2006. The New Jersey Department of Health and Senior Services will review this data and reevaluate the public health implications.

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 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 a health consultation for the Joy Cleaners site which evaluated PCE concentrations from two sampling events (December 2002 and August 2003) (ATSDR 2005). Based on the highest reported indoor concentrations of PCE, the results indicated that past and future tetrachloroethylene exposures posed potential cancer risks to individuals living at three residences.

This health consultation evaluates exposures associated with PCE levels detected during the two ensuing sampling events conducted by the USEPA in February and August 2004. In June 2005, dry cleaning operations at the Joy Cleaners ceased, and the building is scheduled for demolition. As such, present and future exposures associated with site emissions to ambient air have been eliminated.

Background



Joy Cleaners was a retail dry cleaning and laundering establishment located on Route 46 in a residential/commercial zoned area of Dover, Morris County, New Jersey (see Figure 1). The one story building with half basement had been used as a retail dry cleaning facility since the 1970s. The most recent operator (i.e., Joy Cleaners) purchased the dry cleaning business in December 2000. On June 17, 2005, Joy Cleaners ceased operations at the site and vacated the property. The building is scheduled to be demolished.

The dry cleaning facility has been identified as the 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).

A previous health consultation details December 2002 and August 2003 environmental sampling of residences located in the vicinity of the dry cleaners (ATSDR 2005). In February 2004, the USEPA performed additional ambient and indoor air sampling at nine residences, eight of which had been previously sampled in December 2002 and August 2003. In August 2004, ambient and indoor air samples were collected in the same nine residences sampled in February 2004.

Site Visit

A site visit of Dover Municipal Well No. 4 and the area around Joy Cleaners was performed on December 17, 2003 (ATSDR 2005).

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).

A health consultation previously prepared for the Joy Cleaners site evaluated public health implications of PCE concentrations detected both in ambient air and nearby residential indoor air (ATSDR 2005). The report concluded that although non-cancer adverse health effects were unlikely, PCE exposures to individuals at three residences posed an excess cancer risk. It was additionally noted that the fluctuating PCE levels detected in two sampling rounds were indicative of an episodic or seasonal pattern.

Environmental Contamination

Typically, 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 the public health implications of site-specific exposures. First, maximum concentrations of detected substances are compared to media specific environmental guideline comparison values (CV). If substance concentrations exceed the environmental guideline CV, these substances, referred to as Contaminants of Concern (COC), are selected for further evaluation. This subsequent evaluation is conducted by comparing estimated exposure doses, derived from site-specific exposure conditions, to dose-based health guideline CVs. Since environmental and health-based CVs are the same for indoor air contaminants, PCE levels were compared directly with health-based CVs.

For the evaluation of PCE in air, both the acute and chronic ATSDR Minimal Risk Levels (MRLs) were used. 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). Since PCE is a possible human carcinogen, the ATSDR Cancer Risk Evaluation Guide (CREG) was also considered as a comparison value. CREGs are estimated contaminant concentrations expected to result in no more than one excess cancer in one million people exposed during a 70 year lifetime.

Indoor and Ambient Air Sampling

In February 2004, the USEPA performed indoor air sampling at nine residences located in the immediate vicinity of the Joy Cleaners site (Weston 2004a). Eight of these residences had been previously sampled in December 2002 and August 2003. For each of the nine residences, indoor air samples were collected from the basement and first floor. Ambient air samples were also collected from the exterior of seven of these residences as well as the exterior of the dry cleaners. All samples were collected over a 24-hour period using SUMMA[®] canisters and analyzed for volatile organic compounds (VOCs) using USEPA Method TO-15. PCE concentrations detected in indoor air ranged from non-detect to 5.0 micrograms per cubic meter of air ($\mu\text{g}/\text{m}^3$); ambient air concentrations ranged from non-detect to 6.3 $\mu\text{g}/\text{m}^3$ as presented below:

| February 2004 PCE Sampling Results | | | | | |
|------------------------------------|----------------------------------|-------------|---------|--------------------------------------|---------|
| House ID | PCE ($\mu\text{g}/\text{m}^3$) | | | PCE MRL ($\mu\text{g}/\text{m}^3$) | |
| | Basement | First Floor | Ambient | Acute | Chronic |
| A | 2.2 | 1.5 | 1.6 | 1,356 | 271 |
| X | 1.1 | 1.2 | NS | | |
| B | 2.9 | 4.6 | 2.6 | | |
| C | 5.0 | 4.1 | 4.8 | | |
| D | 4.8 | 3.2 | 5.25 | | |
| F | ND | ND | ND | | |
| Y | NS | 0.65 | NS | | |
| G | 1.5 | 0.98 | 0.9 | | |
| H | NS | NS | ND | | |
| Joy Cleaners | NS | NS | 6.3 | | |

MRL = minimal risk level; NS = not sampled; ND = not detected

In August 2004, additional sampling was conducted at these nine residences (Weston 2004b). PCE concentrations detected in indoor air (i.e., basement and first floor) ranged from non-detect to 290 $\mu\text{g}/\text{m}^3$; ambient air concentrations ranged from 1.0 to 190 $\mu\text{g}/\text{m}^3$ as presented below:

| August 2004 PCE Sampling Results | | | | | |
|----------------------------------|----------------------------------|-------------|---------|--------------------------------------|---------|
| House ID | PCE ($\mu\text{g}/\text{m}^3$) | | | PCE MRL ($\mu\text{g}/\text{m}^3$) | |
| | Basement | First Floor | Ambient | Acute | Chronic |
| A | 11.0 | 7.7 | 17 | 1,356 | 271 |
| X | 1.6 | 17 | 20 | | |
| B | 140 | 220 | 190 | | |
| C | 140 | 290 | 180 | | |
| D | 15 | 16.5 | 44 | | |
| F | 1.1 | 1.1 | 1.5 | | |
| Y | NS | NS | 1.0 | | |
| G | 2.1 | 1.7 | 1.3 | | |
| H | NS | 1.8 | 1.7 | | |
| Joy Cleaners | NS | NS | 52 | | |

MRL = minimal risk level; NS = not sampled; ND = not detected

Figure 2 depicts the residences in the vicinity of Joy Cleaners where sampling occurred in December 2002, August 2003, February 2004 and August 2004. Discussion regarding comparisons to the MRLs is provided in the Public Health Implication section of this report.

When compared with PCE sample results from December 2002 and August 2003 (see Table 1), it appears that PCE levels detected in the winter months (December 2002, February 2004) were generally lower than those detected during the summer season (August 2003 and 2004). Indoor and ambient PCE concentrations detected in February 2004 were lower than those measured in December 2002. The highest indoor PCE levels detected in August 2003 ($287 \mu\text{g}/\text{m}^3$) and August 2004 ($290 \mu\text{g}/\text{m}^3$) indicated a seasonal nature of PCE levels in the area of Joy Cleaners.

Discussion

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, one or more of the elements is absent. 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.

Completed Exposure Pathways

In the past, there was a completed PCE exposure pathway via indoor and ambient air to household members (including children) living in the vicinity of the Joy Cleaners. Based on the results of questionnaires administered by the USEPA, the majority of tenants in the sampled residences did not change from the August 2003 through August 2004 sampling rounds, with the following exceptions. There were new tenants in Houses "A" and "F"; therefore, new questionnaires were distributed and collected by the USEPA from these houses in February 2004. Additionally, questionnaires were distributed to Houses "X" and "Y" which were not sampled in August 2003, but were sampled in February and August 2004. This information is important as it provides the information necessary for determining the duration of exposure to the population at risk.

Potential Exposure Pathways

Since June 17, 2005, operations have ceased at the dry cleaning facility thereby eliminating the ambient PCE contribution. However, elevated PCE soil gas concentrations detected in August 2003 may continue to be a source of indoor PCE levels via vapor intrusion. These levels would be much lower and there may not be an appreciable risk without the ambient air contribution. Since there was no data available to evaluate the residual PCE contribution to indoor air via vapor intrusion, this remains a potential pathway of exposure.

Eliminated Exposure Pathways

In June 2005, dry cleaning operations at the Joy Cleaners ceased, and the building is scheduled for demolition. As such, present and future exposures associated with PCE site emissions to ambient air have been eliminated.

Public Health Implications of Completed Exposure Pathways

Non-Cancer Health Effects

Measured PCE levels were compared with acute and chronic MRLs for PCE, which are $1,356 \mu\text{g}/\text{m}^3$ and $271 \mu\text{g}/\text{m}^3$, respectively. The exposure frequency was assumed to be six months of the year at the maximum PCE concentration, to account for the variability in the indoor and ambient PCE levels detected in December 2002 and February 2004 (winter months) and August 2003 and August 2004 (summer months).

The maximum indoor PCE concentration detected in the four sampling rounds (December 2002, August 2003, February 2004 and August 2004) was from the first floor of House "C" ($290 \mu\text{g}/\text{m}^3$) (see Table 1). The basement of this residence was used as a living space in the past. PCE air levels detected in the two additional sampling rounds in February and August 2004 are consistent with previous measurements taken in December 2002 and August 2003. The seasonal variation in PCE levels (December 2002/February 2004 versus August 2003/August 2004) detected in indoor and ambient air indicates that the ambient contribution to the indoor air was episodic in nature. As such, the residents were not exposed to the highest PCE level year-round and the single day results were well below the acute MRL. Adverse non-cancer health effects from PCE exposures are not expected, in concurrence with exposure dose calculations performed in the previous health consultation (ATSDR 2005).

Cancer Health Effects

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 1×10^{-6} is equivalent to one additional cancer case expected among one million persons exposed.

The maximum reported values in February 2004 were lower than the levels in December 2002. Sampling results from August 2004 were similar to the levels detected in August 2003 (see Table 2). Maximum PCE concentrations were evaluated for estimating cancer risks. The maximum PCE concentrations detected in indoor air of two residences located north of Richards Avenue (Houses "B" and "C") were similar to what was detected in previous sampling rounds. Therefore, for past exposures to these residents, the LECR estimates represent the same cancer risk as reported in the previous health consultation (ATSDR 2005).

Child Health Considerations

ATSDR 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, per pound of body weight, 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 in the previous health consultation (ATSDR 2005). The USEPA questionnaires administered during February and August 2004 sampling rounds documented children (< 13 years of age) residing in eight residences. The

current indoor PCE levels are unknown, following the cessation of operations at Joy Cleaners. These levels can be assumed to be lower, without the ambient air contribution.

Conclusions

Environmental sampling (conducted on December 2002 and August 2003) at residences located in the vicinity of the Joy Cleaners had shown that there were potential cancer risks to individuals at three residences from past and future PCE exposures based on the highest reported indoor PCE levels. Additional ambient and indoor air sampling was conducted in February and August 2004. Levels of PCE were detected in August 2004 are similar to the levels detected in August 2003, while PCE levels detected in February 2004 were lower than December 2002 levels. Since PCE levels detected in the indoor and ambient air in the winter months were generally lower than those detected in the summer months, this may indicate the seasonal nature of PCE levels in the area of Joy Cleaners.

Based on the results of PCE samples collected in February and August 2004, adverse non-cancer health effects from PCE exposures are not expected, in concurrence with exposure dose calculations performed in the previous health consultation (ATSDR 2005). Based on PCE levels detected in February and August 2004, cancer risks remain the same for children and adults living at Houses "B" and "C", as reported in the previous health consultation. As such Joy Cleaners remains a ***Public Health Hazard*** for past exposures to these residents.

Since June 17, 2005, operations have ceased at the dry cleaning facility therefore thereby eliminating ambient contributions to indoor PCE levels. Soil gas data available from August 2003 indicate that vapor intrusion pathway presents a continuing source of PCE contamination to the indoor air of nearby residences. The current indoor PCE levels, caused solely by vapor intrusion, are unknown. The USEPA is planning another round of ambient and indoor air sampling following the cessation of operation at Joy Cleaners. As this data is currently unavailable, the site currently represents an ***Indeterminate Public Health Hazard***. To protect indoor air quality at affected residences on Richards Avenue, actions may need to be taken to interrupt PCE vapor intrusion.

Recommendations

Environmental monitoring, as conducted by the USEPA, should continue at residences situated above the groundwater plume.

Public Health Action Plan (PHAP)

The Public Health Action Plan (PHAP) for the Joy Cleaners site contains a description of the actions to be taken by the NJDHSS and/or ATSDR at or in the vicinity of the site subsequent to the completion of this health consultation. The purpose of the PHAP is to ensure that this health consultation not only identifies public health hazards, but 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 NJDHSS and ATSDR are as follows:

Public Health Actions Taken

1. Indoor air levels of PCE, as measured in February 2004 and August 2004, have been reviewed and evaluated by the NJDHSS to determine human exposure pathways and public health issues.
2. A site visit was conducted to gather information to assess exposures to the community.

Public Health Actions Planned

In 2006, the USEPA is proposing to conduct another round of environmental sampling in the residences directly behind the dry cleaners following the Record of Decision (ROD) issued September 30, 2005. When available, the NJDHSS will review this data and reevaluate the public health implications.

References

[ATSDR] Agency for Toxic Substances and Disease Registry. 1990. Public health assessment for Dover Municipal Well 4, Dover New Jersey. Atlanta: US Department of Health and Human Services.

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[USEPA] US Environmental Protection Agency. 2002a. Addendum to the May 2002, final Operable Unit One Preliminary Design Report, May.

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Weston 2004a. Sampling Trip Report - Dover Municipal Well #4, Dover, Morris County, New Jersey. USEPA Contract 68-W-00-113. March 17, 2004.

Weston 2004b. Data Validation Assessment - Dover Municipal Well Site, Dover, Morris County, New Jersey. USEPA Contract 68-W-00-113. October 8, 2004.

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CERTIFICATION

The health consultation for the Dover Municipal Well No. #4 site, 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. It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated. Editorial review of this health consultation was provided by the cooperative agreement partner.

Gregory V. Ulirsch
Technical Project Officer, CAT, SPAB, DHAC
Agency for Toxic Substances and Disease Registry

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

Alan Yarbrough
Team Leader, CAT, SPAB, DHAC
Agency for Toxic Substances and Disease Registry

Table 1: PCE concentrations detected in indoor and ambient air of residences located near the Joy Cleaners Site

| House ID | PCE Concentration in Air ($\mu\text{g}/\text{m}^3$) | | | | | | | | | | |
|-------------|---|---------|-------------------|-------------|---------|------------------|-------------------|-------------------|-------------|-------------------|------------------|
| | December 2002 | | August 2003 | | | February 2004 | | | August 2004 | | |
| | First Floor | Ambient | Basement | First Floor | Ambient | Basement | First Floor | Ambient | Basement | First Floor | Ambient |
| A | 3.86 | 1.76 | 26.9 | 0.35 | 19.1 | 2.2 | 1.5 | 1.6 | 11 | 7.7 | 17 |
| X* | 3.32 | NS | NS | NS | NS | 1.1 | 1.2 | NS | 1.6 | 17 | 20 |
| B | 39.2 | 25.0 | 74.5 | 204 | 180 | 2.9 | 4.6 | 2.6 | 140 | 220 [†] | 190 [†] |
| C | 10.7 | NS | 287 ^{**} | 205 | 517 | 5.0 | 4.1 | 4.8 | 140 | 290 [†] | 180 [†] |
| D | 14.6 | 7.46 | 52.1 | 21.5 | 54.1 | 4.8 | 3.2 [‡] | 5.25 [‡] | 15 | 16.5 [‡] | 44 |
| E | 0.95 | NS | 1.48 | 1.92 | NS | NS | NS | NS | NS | NS | NS |
| F | 1.56 | 2.03 | 3.9 ^{**} | 1.09 | NS | ND | ND | ND | 1.1 | 1.1 | 1.5 |
| Y* | NS | NS | NS | NS | NS | NS | 0.65 [‡] | NS | NS | NS | 1 |
| G | 2.31 | 0.79 | 2.69 | 1.71 | NS | 1.5 [‡] | 0.98 | 0.9 | 2.1 | 1.7 | 1.3 |
| H | 3.73 | NS | 3.69 | 1.41 | NS | NS | NS | ND | NS | 1.8 | 1.7 |
| I | NS | NS | 5.18 | 2.61 | NS | NS | NS | NS | NS | NS | NS |
| Z* | 7.25 | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| Dry Cleaner | | | | | | | | 6.3 | | | 52 |

* residences not sampled in August 2003

** highest reported value

[†] estimated sample result

[‡] average of two samples

ND - not detected

NS - not sampled

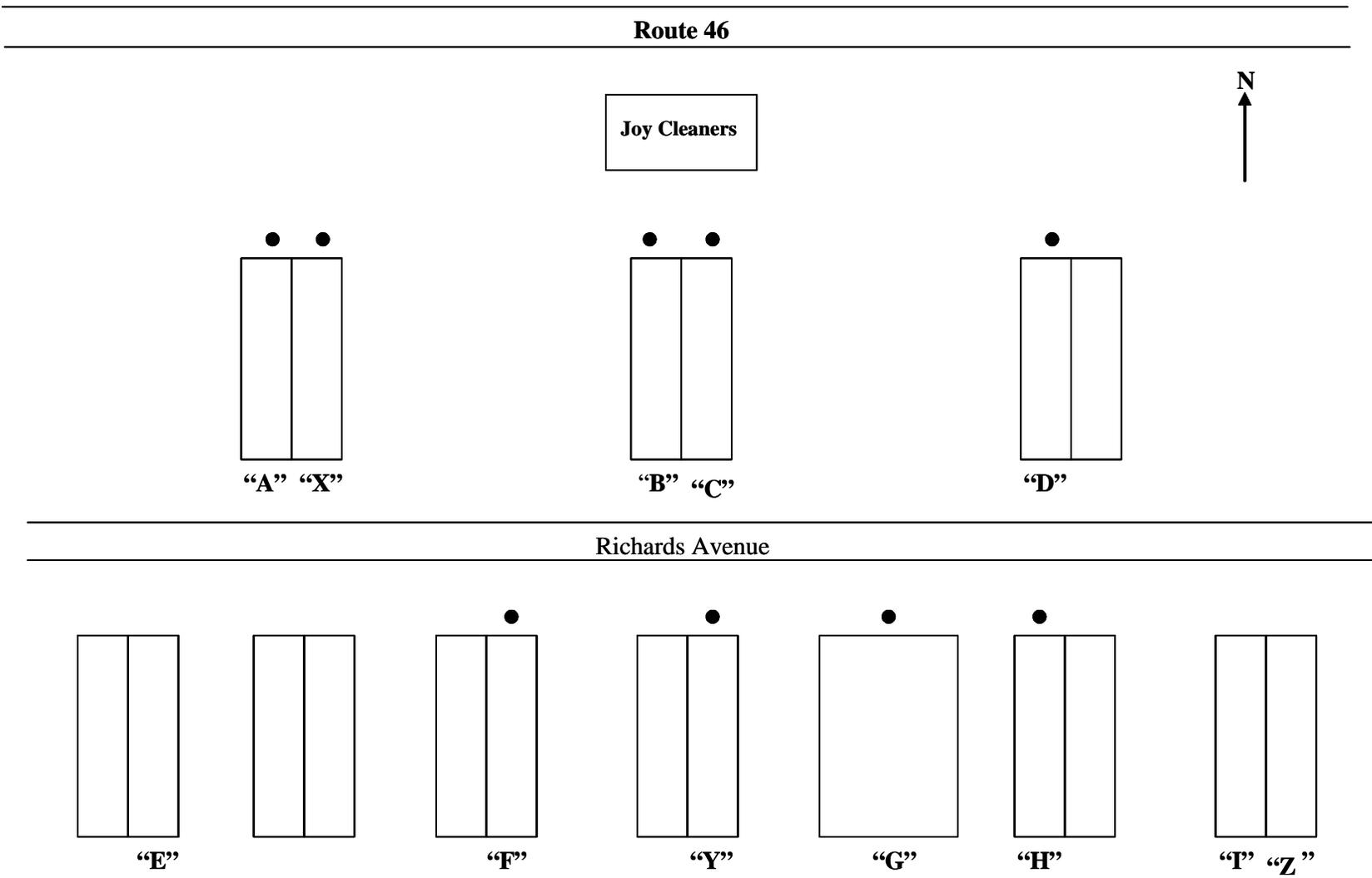


Figure 2: Location of Joy Cleaners and residences sampled in four sampling rounds (December 2002, August 2003, February 2004 and August 2004)

● Ambient air sample
 Note: Diagram not to scale