Health Consultation

TMC CLEANERS
(a/k/a HOWARD'S CLEANERS AND OLYMPIA CLEANERS)
EVALUATION FOLLOW-UP INDOOR AIR SAMPLING RESULTS AT
THE WASHINGTON TRAFFIC SAFETY COMMISSION OFFICES

CITY OF OLYMPIA, THURSTON COUNTY, WASHINGTON

EPA FACILITY ID: WAH000017277

MARCH 11, 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.

You May Contact ATSDR TOLL FREE at
1-888-42ATSDR
or
Visit our Home Page at: http://www.atsdr.cdc.gov

HEALTH CONSULTATION

TMC CLEANERS
(a/k/a HOWARD'S CLEANERS AND OLYMPIA CLEANERS)
EVALUATION OF FOLLOW-UP INDOOR AIR SAMPLING RESULTS AT THE WASHINGTON TRAFFIC SAFETY COMMISSION OFFICES

CITY OF OLYMPIA, THURSTON COUNTY, WASHINGTON

EPA FACILITY ID: WAH000017277

Prepared by:

Washington State Department of Health
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Foreword

The Washington State Department of Health (DOH) has prepared this health consultation in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for health issues related to hazardous waste. This health consultation was prepared in accordance with methodologies and guidelines developed by ATSDR.

The purpose of this health consultation is to identify and prevent harmful human health effects resulting from exposure to hazardous substances in the environment. Health consultations focus on specific health issues so that DOH can respond to requests from concerned residents or agencies for health information on hazardous substances. DOH evaluates sampling data collected from a hazardous waste site, determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health. The findings in this report are relevant to conditions at the site during the time of this health consultation, and should not necessarily be relied upon if site conditions or land use changes in the future.

For additional information or questions regarding DOH or the contents of this health consultation, please call the health advisor who prepared this document:

Gary Palcisko
Washington State Department of Health
Office of Environmental Health Assessments
P.O. Box 47846
Olympia, WA 98504-7846
(360) 236-3377
FAX (360) 236-3383
1-877-485-7316
Web site: www.doh.wa.gov/ehp/oehas/sashome.htm

For more information about ATSDR, contact the ATSDR Information Center at 1-888-422-8737 or visit the agency's Web site: www.atsdr.cdc.gov/.

Glossary

Acute	Occurring over a short time [compare with **chronic**].
Agency for Toxic Substances and Disease Registry (ATSDR)	The principal federal public health agency involved with hazardous waste issues, responsible for preventing or reducing the harmful effects of exposure to hazardous substances on human health and quality of life. ATSDR is part of the U.S. Department of Health and Human Services.
Aquifer	An underground formation composed of materials such as sand, soil, or gravel that can store and/or supply groundwater to wells and springs.
Cancer Risk Evaluation Guide (CREG)	The concentration of a chemical in air, soil or water that is expected to cause no more than one excess cancer in a million persons exposed over a lifetime. The CREG is a *comparison value* used to select contaminants of potential health concern and is based on the *cancer slope factor* (CSF).
Cancer Slope Factor	A number assigned to a cancer causing chemical that is used to estimate its ability to cause cancer in humans.
Carcinogen	Any substance that causes cancer.
Chronic	Occurring over a long time (more than 1 year) [compare with **acute**].
Comparison value	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.
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.
Dose (for chemicals that are not radioactive)	The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.
Environmental Protection Agency (EPA)	United States Environmental Protection Agency.

Epidemiology	The study of the occurrence and causes of health effects in human populations. An epidemiological study often compares two groups of people who are alike except for one factor, such as exposure to a chemical or the presence of a health effect. The investigators try to determine if any factor (i.e., age, sex, occupation, economic status) is associated with the health effect.
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**].
Groundwater	Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].
Hazardous substance	Any material that poses a threat to public health and/or the environment. Typical hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive.
Inhalation	The act of breathing. A hazardous substance can enter the body this way [see **route of exposure**].
Lowest Observed Adverse Effect Level (LOAEL)	The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.
Media	Soil, water, air, plants, animals, or any other part of the environment that can contain contaminants.
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**].
Model Toxics Control Act (MTCA)	The hazardous waste cleanup law for Washington State.
Monitoring wells	Special wells drilled at locations on or off a hazardous waste site so water can be sampled at selected depths and studied to determine the movement of groundwater and the amount, distribution, and type of contaminant.
No Observed Adverse Effect Level (NOAEL)	The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

Organic	Compounds composed of carbon, including materials such as solvents, oils, and pesticides that are not easily dissolved in water.
Parts per billion (ppb)/Parts per million (ppm)	Units commonly used to express low concentrations of contaminants. For example, 1 ounce of trichloroethylene (TCE) in 1 million ounces of water is 1 ppm. 1 ounce of TCE in 1 billion ounces of water is 1 ppb. If one drop of TCE is mixed in a competition size swimming pool, the water will contain about 1 ppb of TCE.
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].
Volatile organic compound (VOC)	Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Purpose

The purpose of this health consultation is to evaluate health risks from exposure to Volatile Organic Compounds (VOCs), primarily tetrachloroethylene (PCE) and trichloroethylene (TCE), associated with the operation and/or contamination at TMC Cleaners. The Washington State Department of Health prepared this health consultation in response to indoor air quality concerns raised by the some staff at the Washington Traffic Safety Commission (WTSC) and the Thurston County Public Health and Social Services Department (TCHD) regarding potential exposure to PCE and TCE in indoor air. This health consultation is a follow-up to a previous indoor air-sampling event that revealed slightly elevated levels of PCE in indoor air. DOH prepares health consultations under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

Background and Statement of Issues

TMC Cleaners (TMC), formerly known as Howard's Cleaners and Olympia Drycleaners, is located at 606 E. Union Avenue, Olympia, Washington in a mixed residential and commercial area of downtown. It has operated at this location for over 30 years.

Investigations of the dry-cleaning facility in 1995 and 2002-03 revealed, gasoline, heavy oil, xylene, toluene, PCE, TCE, and degradation products of PCE [1,2-dichloroethylene (1,2 DCE), 1,1,1-trichlorethane, vinyl chloride] were found in groundwater and soil in the vicinity of TMC.[1],[2] Exposure to the contaminants in soil and groundwater was evaluated by DOH in a health consultation dated June 1999.[3] This evaluation concluded that VOCs in soil were not a threat to human health, but employees at WTSC, located nearby at 1000 S. Cherry Street (Figure 2), raised concerns about indoor air quality related to the migration of VOCs from groundwater to indoor air.

In July 2002, indoor air samples were taken at WTSC to determine if VOCs migrated from groundwater and impacted workers there.[4] Levels of PCE were above levels typically found in indoor air, but not at levels of concern to public health. These samples, however, were taken in the summer, the season of the year that VOCs are least likely to migrate from groundwater to indoor air. A recommendation to conduct a follow-up sampling in the winter was made in health consultation dated September 8, 2003.[5]

Follow-up air sampling was conducted in January 2004. Four samples were collected from WTSC using 6-liter Summa canisters with preset flow control devices that allowed time-weighted samples to be collected over a 24-hr period. The samples were collected from the reception desk, conference room, south office, and the basement and analyzed for VOCs using EPA method TO-15.

Discussion

Air sampling data were screened using ATSDR, U.S. Environmental Protection Agency (EPA), and Washington State Department of Ecology (Ecology) health-based criteria, or comparison values (Appendix A). Contaminant concentrations below comparison values are unlikely to pose

a health threat, and were not further evaluated. Appendix A, Table A1 shows chemicals that were detected in WTSC air samples in relation to their respective comparisons values. Contaminant concentrations exceeding comparison values do not necessarily pose a health threat, but are further evaluated to determine whether they are at levels that could result in adverse human health effects.

PCE, TCE, and benzene levels in indoor air at WTSC exceeded respective cancer based health comparison values and were evaluated for both cancer and noncancer health effects. Measured concentrations of these chemicals from both 2002 and 2004 sampling events are presented in Table 1. PCE levels show an increase from 2002 to 2004 at the reception desk and the south office, but it cannot be inferred from only two separate sampling events whether these increases are a result of a continuing trend or due to sample variability. A consistent PCE increasing trend is not seen at other locations within WTSC. TCE and Benzene results reveal little change from 2002 to 2004 sampling events.

Table 1. Results of air samples taken 2002 and 2004 from Washington State Traffic Commission near the TMC Drycleaner site Olympia, Washington[6]

Location	Chemical	July 2002 Concentration ($\mu g/m^3$)	January 2004 Concentration ($\mu g/m^3$)	Background Concentration (indoor median ($\mu g/m^3$)[7,8]
Reception Desk	PCE	8.7	20	5
	TCE	<2.5[a]	0.98	0.7
	Benzene	2.1	1.8	10
South Office	PCE	31	39	5
	TCE	3.6	1.3	0.7
	Benzene	1.7	1.8	10
Conference Room	PCE	7.1	3.4	5
	TCE	<1.8[a]	0.22	0.7
	Benzene	1.5	1.6	10
Basement	PCE	3.3	3.7	5
	TCE	<1.8[a]	0.23	0.7
	Benzene	1.5	1.5	10

a- Contaminant was not detected. Reported value is less than the practical quantitation limit.

Background Levels

The wide use of natural and synthetic chemicals is a part of modern life, and as a result, ambient and indoor air always contains low levels of these chemicals. Therefore, background levels of TCE, PCE, and benzene must be examined in order to determine whether or not levels found at WTSC are typical of urban indoor air. Table 1 shows that PCE levels are above background at the reception desk and south office, and at background in the basement and conference room.

TCE levels are only slightly above background at the reception desk and south office, but below background at all other locations. Benzene is below background levels at all locations. This indicates that PCE contamination from TMC may be impacting WTSC at the reception desk and south office. TCE and Benzene levels measured at WTSC may result solely from background sources.

Evaluating noncancer health effects

To evaluate possible noncancer effects from exposure to PCE and TCE in indoor air, measured levels were compared to their respective noncancer comparison value [EPA inhalation reference concentration (RfC) or ATSDR chronic minimal risk level (MRL)]. The MRL and RfC are concentrations in air below which noncancer health effects are not expected.

RfCs and MRLs are set well below toxic effect levels in order to provide an added measure of safety. The higher the chemical concentration is above the RfC or MRL, the closer it will be to an actual toxic effect level.

Because RfCs and MRLs are based on a continuous exposure, an adjustment was made to account for the fact that people working in the businesses are typically exposed for only 8 hours per day 5 days per week. This adjustment is shown in Appendix B.

EPA Reference Concentration (RfC) and ATSDR Chronic Minimal Risk Level (MRL)

Inhalation reference concentrations (RfCs) and chronic minimal risk levels (MRLs) are concentrations of a chemical in air below which adverse noncancer health effects are not expected to occur over a lifetime of continuous (i.e., 24-hour per day) exposure.

Noncancer risk comparisons for PCE and TCE are provided in Appendix B, Table B3. These comparisons assume that a worker is exposed to PCE and TCE for eight hours per day at levels that do not vary. The highest exposures to PCE and TCE occur in the south office, but indoor air PCE levels are still 30 times below the MRL, and TCE levels are about 130 times lower than the RfC. Benzene levels are also more than 70 times lower than the RfC. Benzene, TCE, and PCE exposures at WTSC are not expected to result in adverse noncancer health effects.

Evaluating Cancer Risk

Some chemicals have the ability to cause cancer. Cancer risk is estimated by calculating a dose that a person would receive assuming they breathed PCE and TCE at levels measured in each of the businesses, and multiplying it by a cancer potency factor, also known as the cancer slope factor. Some cancer slope factors are derived from human population data. Others are derived from laboratory animal studies involving doses much higher than are encountered in the environment. Use of animal data requires extrapolation of the cancer potency obtained from these high dose studies down to real-world exposures. This process involves much uncertainty.

Current regulatory practice assumes that there is no “safe dose” of a carcinogen and that a very small dose of a carcinogen will give a very small cancer risk. Cancer risk estimates are not yes/no answers but measures of chance (probability). Such measures, however uncertain, are

useful in estimating the magnitude of a cancer threat. The validity of the "no safe dose" assumption for all cancer-causing chemicals is not clear. Some evidence suggests that certain chemicals considered to be carcinogenic must exceed a threshold of tolerance before initiating cancer. For such chemicals, risk estimates are not appropriate. More recent guidelines on cancer risk from EPA reflect the potential that thresholds for some carcinogenesis exist. However, EPA still assumes no threshold unless sufficient data indicate otherwise.[9]

This document describes cancer risk that is attributable to site-related contaminants in qualitative terms such as low, very low, slight and no significant increase in cancer risk. These terms can be better understood by considering the population size required for such an estimate to result in a single cancer case. For example, a low increase in cancer risk indicates an estimate in the range of one cancer case per ten thousand persons exposed over a lifetime. A very low estimate might result in one cancer case per several tens of thousands exposed over a lifetime and a slight estimate would require an exposed population of several hundreds of thousands to result in a single case. DOH considers cancer risk to be not significant when the estimate results in less than one cancer per one million exposed over a lifetime. The reader should note that these estimates are for excess cancers that might result in addition to those normally expected in an unexposed population. Cancer risks quantified in this document are an upper-bound theoretical estimate. Actual risks are likely to be much lower.

Cancer is a common illness and its occurrence in a population increases with age. Depending on the type of cancer, a population with no known environmental exposure could be expected to have a substantial number of cancer cases. There are many different forms of cancer that result from a variety of causes; not all are fatal. Approximately 25% to 33% of people living in the United States will develop cancer at some point in their lives.[10]

A range of cancer risks was calculated for exposures occurring at WTSC reflecting low and high estimates of cancer slope factors for PCE, TCE, and benzene (see Table B4). Cancer risk ranges from a low-end estimate of 2 excess cancers per 1,000,000 people exposed (2×10^{-6}) to a high-end estimate of 2 excess cancers per 100,000 people exposed (2×10^{-5}) where PCE contributes the most to overall risk. These slight cancer risks are lower than what EPA considers acceptable (1×10^{-4}).

Chemical Specific Toxicity

The use of TCE and PCE are associated with the dry-cleaning industry, and their presence near WTSC may be the result of contamination or operation at TMC. The toxicity of these chemicals is described in the following section. Benzene's toxicity is not described because it was only found below levels typically found in urban air, and is not associated with the dry-cleaning process.

PCE

PCE is a manufactured compound widely used for dry-cleaning fabrics and as a metal degreaser. It is also used as an intermediate in the manufacturing of other products. It is a nonflammable liquid at room temperature, evaporates easily into the air, and has a sharp, sweet odor. Most

people can smell PCE in air at about 1 ppm (~6,800 $\mu g/m^3$). These people may become accustomed to the odor and cease smelling it due to a phenomenon called olfactory fatigue.[11]

Numerous occupational studies have shown that chronic exposures to high levels of PCE in air (higher than levels detected at Eastside businesses) can affect the liver, kidneys, and neurological system, among others. The chronic MRL for PCE is based on neurological effects observed during a 10-year occupational study. Women occupationally exposed to PCE at a median concentration of 15,000 ppb (~102,000 $\mu g/m^3$) for an average of 10 years had prolonged reaction times to a battery of simple reaction tests compared to women who were not exposed.[12]

A number of human studies (primarily epidemiology studies of dry-cleaning workers) suggest the possibility of increased cancer incidences from exposure to PCE, particularly esophageal and bladder cancers, but it has not been shown to definitively cause cancer in humans. Other cancers suspected of being associated with exposures to high levels of PCE (much higher than levels measured in Eastside businesses) include intestinal, pancreatic, lung, kidney, skin, colon, and lymphatic/hematopoietic cancer. Following inhalation exposure to high levels of PCE, mononuclear cell leukemia was observed in rats and hepatic tumors were observed in mice. However, because both mononuclear cell leukemia and hepatic tumors are common in rats and mice, respectively, the relevance of these tumors to humans is not clear.

EPA's Integrated Risk Information System (IRIS) does not provide an inhalation cancer slope factor for PCE, but an estimate of 0.002 mg/kg/day (Unit risk = $5.8x10^{-7}$ per $\mu g/m^3$) was provided by the Superfund Technical Support Center.[13] California EPA uses a slope factor of 0.02 mg/kg/day (Unit risk = $5.9x10^{-6}$ per $\mu g/m^3$), and Ecology recently recommended using this value for cancer - based cleanups for tetrachloroethylene (PCE) under the Model Toxics Control Act (MTCA).[14] These differing values further add to the uncertainty of cancer risk assessment of this chemical. For this reason, this health consultation estimates both a low-end and high-end cancer risk estimate from exposure to PCE based on these differing slope factors.

TCE

TCE is primarily used as a metal degreaser, particularly in the automotive and metals industries. It is also found in some household products, such as typewriter correction fluid, paint removers, adhesives, and spot removers. At room temperature, it is a colorless liquid with a sweet, chloroform-like odor. Most people can smell TCE in air at about 28 ppm (~150,000 $\mu g/m^3$).[15]

The National Center for Environmental Assessment (NCEA) is currently finishing a revised human health risk assessment on TCE. This assessment will present EPA's most current evaluation of the potential health risks from exposure to TCE. The mechanistic information suggests some risk factors may make some populations more sensitive, and that TCE could affect children and adults differently. TCE exposure is associated with a number of health effects, including neurotoxicity, immunotoxicity, developmental, liver, kidney, and endocrine effects. The RfC for TCE is based on critical effects on the central nervous system, liver, and endocrine system.

Recent and extensive review of available data has led EPA to characterize TCE as "highly likely to produce cancer in humans." These findings are consistent with those of the International Agency on Research of Cancer (IARC, 1995) and the National Toxicology Program (NTP, 2000). This classification is based on sufficient evidence in animals and limited evidence in humans. The strongest evidence that TCE can cause cancer in humans comes from occupational studies that have found increases in lung, liver and kidney cancers in workers exposed over several years.[16]

In experimental rodent studies, high doses of TCE administered to mice resulted in tumors of the lungs, liver, and testes. Other possible cancers associated with exposure to high levels of TCE include cancer of the bladder, stomach, prostate, kidney, and pulmonary system.

EPA's TCE Health Risk Assessment: Synthesis and Characterization proposed a cancer slope factor that ranges from 0.02 $mg/kg/day^{-1}$ (derived from an epidemiological study with inhalation as the route of exposure) to 0.4 $mg/kg/day^{-1}$ (derived from a residential drinking water exposure). EPA Region 10 has suggested using a slope factor of 0.4 $mg/kg/day^{-1}$ in assessing risks from exposure to TCE through both oral and inhalation routes of exposure.[17] This health consultation estimates both a low-end and high-end cancer risk estimate from exposure to TCE based on these differing slope factors.

Multiple Chemical Exposure

In almost every situation of environmental exposure, there are multiple contaminants to consider. The potential exists for these chemicals to interact in the body and increase or decrease the potential for adverse health effects. The vast number of chemicals in the environment makes it impossible to measure all of the possible interactions between these chemicals.

Groups of chemicals that have similar noncancer toxic effects can be added such as PCE and TCE, which cause liver toxicity. This is done by summing the hazard quotients associated with exposure to PCE and TCE to produce a hazard index. A hazard index that is greater than one indicates that an exposure is occurring at levels of potential concern. The more the hazard index exceeds one, the more likely an exposure is to result in adverse noncancer health effects. ATSDR's Interaction Profile recommends a hazard index approach for exposure assessments of possible health hazards from exposure to mixtures of PCE and TCE.[18]

Since cancer risk is a measure of probability, cancer risks related to individual chemicals are summed to produce a total cancer risk. A hazard index and cancer risks are reported in Appendix B, Table B2 and B3 respectively. The hazard index is well below one, and cancer risks are very low.

Child Health Considerations

ATSDR's recognizes that the unique vulnerabilities of infants and children deserve special emphasis with regard to exposures to environmental contaminants. Infants, young children, and the unborn may be at greater risk than adults from exposure to particular contaminants. Exposure during key periods of growth and development may lead to malformation of organs

(teratogenesis), disruption of function, and even premature death. In certain instances, maternal exposure, via the placenta, could adversely affect the unborn child.

After birth, children may receive greater exposures to environmental contaminants than adults. Children are often more likely to be exposed to contaminants from playing outdoors, ingesting food that has come into contact with hazardous substances, or breathing soil and dust. Pound for pound of body weight, children drink more water, eat more food, and breathe more air than adults. For example, in the United States, children in the first six months of life drink seven times more water per pound as the average adult. The implication for environmental health is that, by virtue of children's lower body weight, given the same exposures, they can receive significantly higher relative contaminant doses than adults.
Since exposures to infants and young children at the Eastside businesses are expected to be infrequent (i.e., much less than the 8-hours/day, 5 days/week assumptions used for this health consultation), the health risks to children are minimal.

Conclusions

1. No apparent public health hazard exists for workers at WTSC exposed to drycleaning solvents and benzene in indoor air.
    - Although levels of PCE were above background levels in two areas of WTSC, these levels were not likely to cause adverse noncancer health effects in workers there.
    - TCE was found only slightly higher than background levels at two locations within WTSC, and benzene was below levels typically found in urban air. Both chemicals were not found at levels likely to cause noncancer adverse health effects.
    - High-end estimates of cancer risk associated with exposure to PCE, TCE, and benzene at WTSC are very low.

2. PCE levels did not increase dramatically between the summer 2002 and winter 2004 sampling events.
    - Levels of PCE would be expected to be much higher in winter months if vapors were migrating from shallow groundwater into the WTSC building.
    - PCE levels did not increase in the basement where the bulk of vapors would be expected if vapor intrusion were to be a key contributor to PCE levels in the WTSC building.

Recommendations

No recommendations at this time.

Public Health Action Plan

Actions taken

1. DOH has evaluated soil, groundwater, and indoor air data in two prior health consultations.
2. DOH has sampled indoor air at WTSC on two separate occasions to determine the levels of dry-cleaning solvents in indoor air.

Actions Planned

DOH will provide copies of this health consultation to workers at WTSC and the Thurston County Public Health and Social Services Department.

Preparer of Report

Gary Palcisko
Washington State Department of Health
Office of Environmental Health Assessments
Site Assessment Section

Designated Reviewer

Wayne Clifford, Manager
Site Assessment Section
Office of Environmental Health Assessments
Washington State Department of Health

ATSDR Technical Project Officer

Alan Parham
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

Appendix A: Contaminant Screening

Levels of chemicals detected in indoor air at WTSC were compared to health-based comparison values. If a contaminant was found at levels below a comparison value, then it was not evaluated further.

Table A1. Contaminants detected WTSC compared to health-based screening values.

Chemical	**Max Concentration** ($\mu g/m^3$)	**Noncancer Health Comparison Value** ($\mu g/m^3$)	**Cancer Health Comparison Value** ($\mu g/m^3$)	**Contaminant of Concern?**
Trichlorotheylene	1.3	40 [d]	0.5 [c]	Yes
Tetrachloroethylene	39	271 [e]	3.3 [a]	Yes
Benzene	1.8	30 [d]	0.1 [b]	Yes
Chloroform	0.1	3.1 [a]	NA	No
1,1,1-Trichloroethane	0.5	2,300 [a]	NA	No
Vinyl chloride	0.01	100 [d]	0.1 [b]	No
Methylene chloride	1.6	90 [d]	3 [b]	No
Cis-1,2-dichloroethene	0.03	37 [a]	NA	No

a- EPA Region 9 PRG
b- ATSDR CREG
c- MTCA Method B
d- EPA RfC
e- ATSDR chronic MRL

Appendix B: Exposure dose calculations and assumptions

Noncancer health effects were evaluated simply by comparing the measured air concentration to the adjusted MRL or RfD. An adjustment was needed to reflect an intermittent exposure of a worker that spends 8 hours per day, 5 days per week, and 50 weeks per year at their place of employment versus a continuous exposure. The following equation shows the adjustment of both PCE and TCE MRL or RfC.

$$\text{PCE MRL (adjusted)} = \frac{271\ \mu g/m^3 \times 52\ \text{weeks} \times 24\ \text{hours} \times 7\ \text{days}}{50\ \text{weeks} \times 8\ \text{hours} \times 5\ \text{days}} = 1183\ \mu g/m^3$$

$$\text{TCE RfC (adjusted)} = \frac{40\ \mu g/m^3 \times 52\ \text{weeks} \times 24\ \text{hours} \times 7\ \text{days}}{50\ \text{weeks} \times 8\ \text{hours} \times 5\ \text{days}} = 175\ \mu g/m^3$$

$$\text{Benzene RfC (adjusted)} = \frac{30\ \mu g/m^3 \times 52\ \text{weeks} \times 24\ \text{hours} \times 7\ \text{days}}{50\ \text{weeks} \times 8\ \text{hours} \times 5\ \text{days}} = 131\ \mu g/m^3$$

The factor by which a measured air concentration exceeds an MRL or RfC is called a hazard quotient [Hazard Quotient = air concentration ($\mu g/m^3$) / RfC or MRL ($\mu g/m^3$)]. Exceeding a hazard quotient of one does not mean that a person is going to get sick because numerous safety factors are used while deriving RfCs or MRLs, but the more the hazard quotient exceeds one, the more likely adverse noncancer health effect will occur as a result of an exposure.

Cancer risk is evaluated by first calculating an average daily dose over a person's lifetime, and then multiplying the dose by a cancer slope factor to produce the probability, or risk of cancer. These equations and exposure assumptions are shown below and in Table B1:

$$\text{Dose}_{(\text{cancer (mg/kg-day)})} = \frac{C \times CF_1 \times IR \times EF \times ED}{BW \times AT_{cancer}}$$

$$\text{Risk} = \text{Dose}_{(\text{cancer (mg/kg-day)})} \times CSF$$

Table B1. Exposure Assumptions

Parameter	Value	Unit	Comments
Concentration (C)	Variable	ug/kg	Maximum detected value.
Conversion Factor$_1$ (CF_1)	0.001	mg/ug	Converts contaminant concentration from micrograms (ug) to milligrams (mg)
Inhalation Rate (IR)	5	m^3	Volume of air inhaled during 8 hour workday.[a]
Exposure Frequency (EF)	250	days/year	Assumes weekends off and two weeks vacation per year
Exposure Duration (ED)	25	years	Number of years working at one place of employment.
Body Weight (BW) - adult	70	kg	Adult mean body weight
Averaging Time$_{cancer}$ (AT)	25550	days	70 years
Minimal Risk Level (MRL) or Reference Concentration (RfC)	Contaminant-specific	$\mu g/m^3$	Source: ATSDR, EPA
Cancer Slope Factor (CSF)	Contaminant-specific	mg/kg-day^{-1}	Source: EPA

a- Inhalation rate adapted from long-term adult male inhalation rate of 15 m^3/day as presented in EPA's Exposure Factors Handbook.[19] Inhalation rate was divided by a factor of 3 to account for and 8 work day as opposed to a 24 hour breathing rate.

Table B2. Noncancer hazard associated with exposure to PCE and TCE at Washington Traffic Commission near TMC Cleaners site, Olympia, Washington.

Location	Chemical	Maximum Concentration) ($\mu g/m^3$)	Adjusted RfC or MRL ($\mu g/m^3$)	Hazard Quotient
WTSC	PCE	39	1183	0.03
	TCE	1.3	175	0.01
	Benzene	1.8	131	0.01
			[a]Hazard Index	**0.05**

a- Hazard Index is the sum of hazard quotients. This accounts for additive effects of PCE, TCE, and benzene, which can be toxic to similar organs/systems.

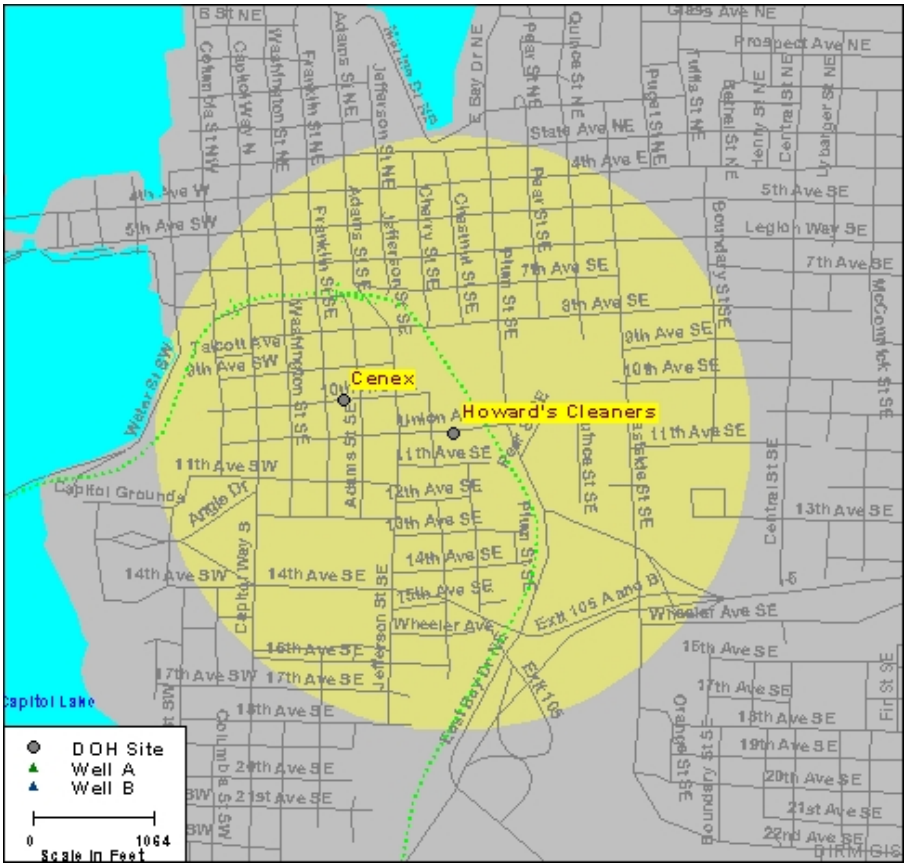
Table B3. Cancer risk associated with exposure to PCE, TCE, and benzene at Washington State Traffic Commission near TMC Cleaners site, Olympia, Washington

Location	**Chemical**	**Concentration** ($\mu g/m^3$)	**Average Daily Dose** (cancer) (mg/kg/day)	**Low-end Cancer Slope Factor** (kg-day/mg) a	**High-end Cancer Slope Factor** (kg-day/mg) a	**Low-end Cancer Risk**	**High-end Cancer Risk**
WSTC	PCE	39	6×10^{-4}	0.002	0.02	1×10^{-6}	1×10^{-5}
	TCE	1.3	2×10^{-5}	0.02	0.4	4×10^{-7}	8×10^{-6}
	Benzene	1.8	3×10^{-5}	0.008	0.03	2×10^{-7}	9×10^{-7}
					Total Cancer Risk	**2×10^{-6}**	**2×10^{-5}**

a TCE cancer slope factor as presented in EPA's TCE Health Risk Assessment: Synthesis and Characterization is a range between 0.02 (derived from an epidemiological study with inhalation as the route of exposure) to 0.4 (derived from a residential drinking water exposure). PCE cancer slope factor ranges from 0.002 (provided by Superfund Technical Support center) to 0.02 as used by Cal EPA and Washington State Department of Ecology. Benzene slope factors adjusted from air unit risk that ranges from 2.2×10^{-6} to 7.8×10^{-6} risk per $\mu g/m^3$

Figure 1. TMC Cleaners (formerly Howard's) site location and demographics. Olympia, Thurston County, Washington

HOWARD'S CLEANERS



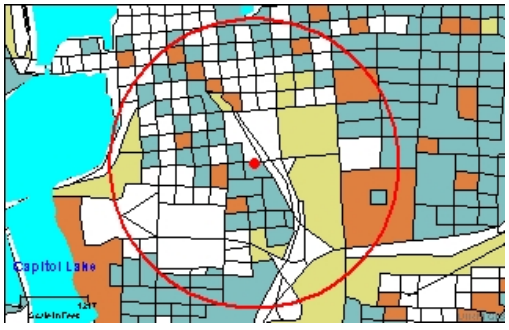
Thurston County

Demographic Statistics Within a Half Mile of the Site*

Total Population	2076
White	1760
Black	66
American Indian, Eskimo, Aleut	48
Asian or Pacific Islander	83
Other Race	28
Hispanic Origin	99
Children Aged 6 and Younger	97
Adults Aged 65 and Older	143
Females Aged 15 - 44	606
Total Aged over 18	1864
Total Aged under 18	211
Total Housing Units	1314

* Calculated using the area proportion technique.
Source: 2000 U.S. CENSUS

Population Density



Children 6 Years and Younger

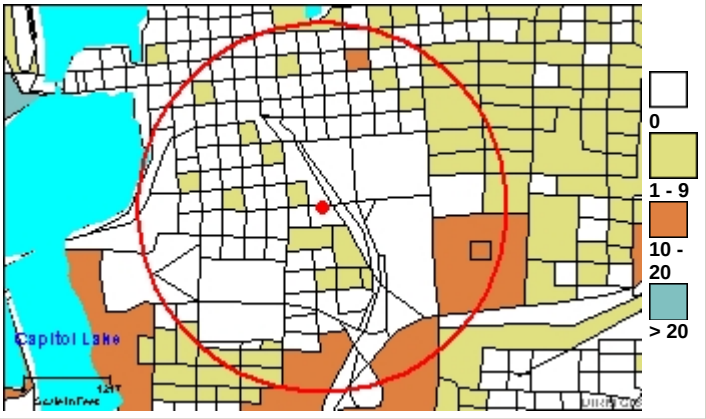
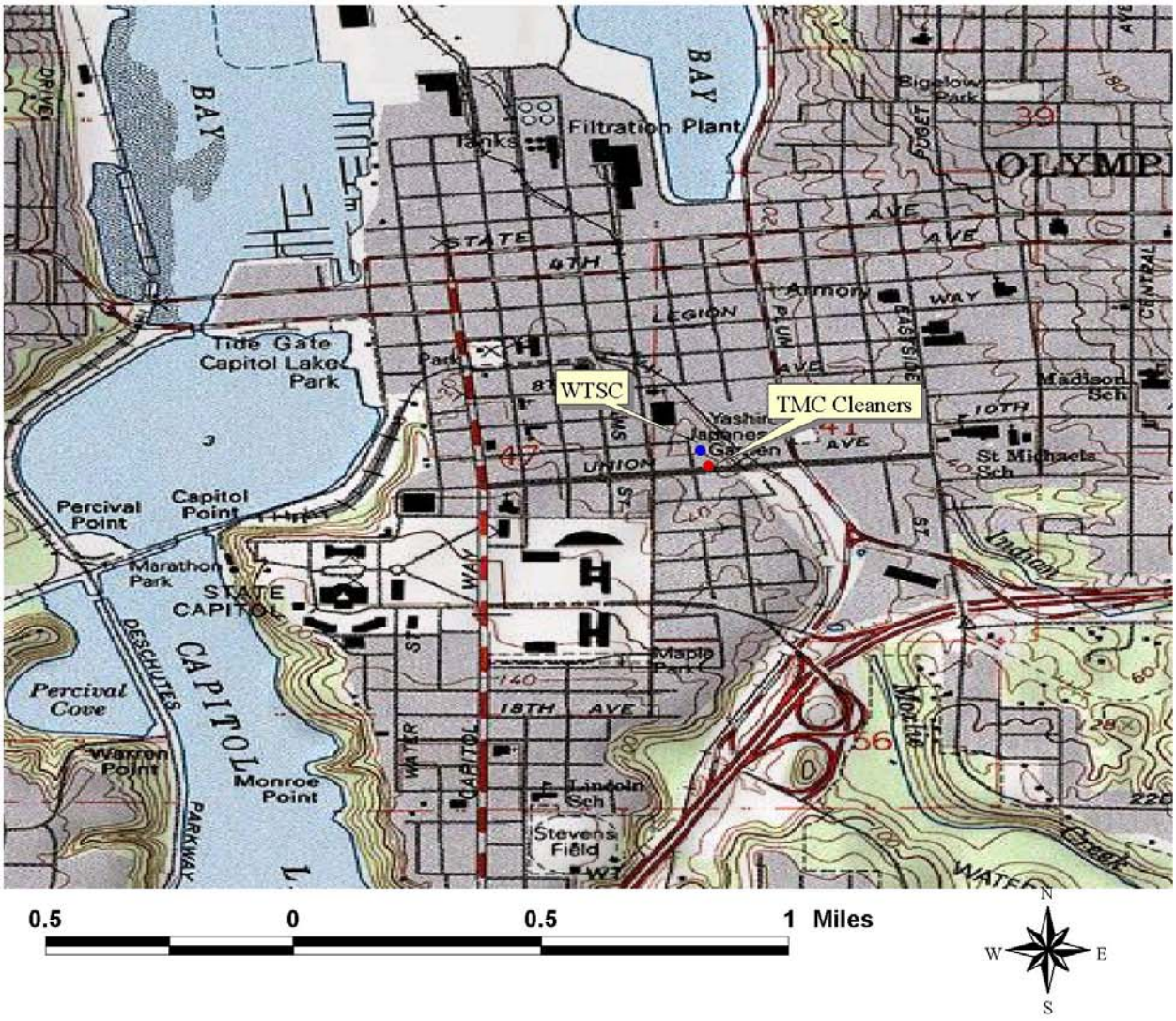


Figure 2. Location of WTSC in relation to TMC Cleaners site. Olympia, Washington.



Certification

This TMC Cleaners Public Health Consultation was prepared by the Washington State Department of Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.

Technical Project Officer, CAT, SPAB, DHAC

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

Team Lead, CAT, SPAB, DHAC, ATSDR

References

[1] Conrex, Inc. Phase II ESA Report of Sampling Activities conducted on the Olympia Drycleaners property, Olympia Washington. June 13, 1995.

[2] Stemen Environmental, Inc. Interim Remedial Activities and Groundwater Monitoring Report: Former Olympia Drycleaners, 606 E. Union Avenue, Olympia, Washington. January 10, 2003.

[3] Washington State Department of Health. Health Consultation: Olympia Drycleaners, Olympia, Thurston County, Washington. June 15, 1999.

[4] Atmospheric Analysis & Consulting, Inc. Laboratory Analysis Report for indoor air samples collected by Gerald Tousley, Thurston County Environmental Health Division. July 31, 2002.

[5] Washington State Department of Health. Health Consultation: Evaluation of Indoor Air Sampling Results (July 16-17, 2002) at the Washington Traffic Safety Commission Offices, Howard's Drycleaners (a/k/a Olympia Drycleaners), Olympia, Thurston County, Washington. September 18, 2003.

[6] Severn Trent Laboratories, Inc. Washington State Indoor Sampling Analytical Report. March 1, 2004.

[7] Shah JJ and Singh HB. Distribution of volatile organic chemicals in outdoor and indoor air. Environmental Science Technology. 1988: 22(12):1381-1388.

[8] Wallace LA. Comparison of risks from outdoor and indoor exposures to toxic chemicals. Environmental Health Perspectives 95:7-13. 1991.

[9] US Environmental Protection Agency. Guidelines for Carcinogen Risk Assessment (Review Draft). NCEA-F-0644 July 19991999 Jul. Web address: Available at http://www.epa.gov/NCEA/raf/cancer.htm.

[10] Agency for Toxic Substances and Disease Registry. ATSDR Fact Sheet: Cancer. Updated August 30, 2002. Atlanta: US Department of Health and Human Services. Available at internet: http://www.atsdr.cdc.gov/COM/cancer-fs.html.

[11] Agency for Toxic Substances and Disease Registry. ToxFAQ for Tetrachloroethylene (PERC). Available at URL http://www.atsdr.cdc.gov/tfacts18.html [cited August 12, 2004].

[12] Agency for Toxic Substances and Disease Registry. Toxicological Profile for Tetrachloroethylene (update). September 1997.

[13] United States Environmental Protection Agency, National Center for Environmental Assessment, Superfund Technical Support Center. Risk Assessment Issue Paper for Carcinogenicity Information for Tetrachloroethylene. Received October 25, 2001.

[14] Email communication from Craig McCormack of Washington State Department of Ecology regarding PCE and TCE information. Sent August 4, 2004.

[15] United States Environmental Protection Agency, Technology Transfer Network Air Toxics Website. Trichloroethylene. Available at URL http://www.epa.gov/ttn/atw/hlthef/tri-ethy.html [cited August 12, 2004].

[16] United States Environmental Protection Agency, Office of Research and Development. Trichloroethylene Health Risk Assessment: Synthesis and Characterization (external review draft). August 2001.

[17] Email communication from Julie Wroble of EPA Region 10 regarding use of varying TCE cancer slope factors. Sent April 5, 2002.

[18] Agency for Toxic Substances and Disease Registry. Interaction Profile for 1,1,1-Trichloroethane, 1,1-Dichloroethane, Trichloroethane, and Tetrachloroethane. May 2004. Atlanta: US Department of Health and Human Services. Available at internet: http://www.atsdr.cdc.gov/interactionprofiles/ip02.html

[19] United States Environmental Protection Agency, Office of Research and Development. Exposure Factors Handbook Volume I: General Factors. EPA/600/P-95/002Fa. August 1997.