Health Consultation

WINONA SOIL AND GROUNDWATER SITE
(CLARKS LANE/GILMORE AVENUE)

CITY OF WINONA, WINONA COUNTY, MINNESOTA

EPA FACILITY ID: MND981091465

MARCH 16, 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

WINONA SOIL AND GROUNDWATER SITE
(CLARKS LANE/GILMORE AVENUE)

CITY OF WINONA, WINONA COUNTY, MINNESOTA

EPA FACILITY ID: MND981091465

Prepared by:

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

FOREWORD

This document summarizes public health concerns at a hazardous waste site in Minnesota. It is based on a formal site evaluation prepared by the Minnesota Department of Health (MDH). A number of steps are necessary to do such an evaluation:

- Evaluating exposure: MDH scientists begin by reviewing available information about environmental conditions at the site. The first task is to find out how much contamination is present, where it's found on the site, and how people might be exposed to it. Usually, MDH does not collect its own environmental sampling data. We rely on information provided by the Minnesota Pollution Control Agency (MPCA), the U.S. Environmental Protection Agency (EPA), and other government agencies, businesses, and the general public.

- Evaluating health effects: If there is evidence that people are being exposed - or could be exposed - to hazardous substances, MDH scientists will take steps to determine whether that exposure could be harmful to human health. The report focuses on public health - the health impact on the community as a whole - and is based on existing scientific information.

- Developing recommendations: In the evaluation report, MDH outlines its conclusions regarding any potential health threat posed by a site, and offers recommendations for reducing or eliminating human exposure to contaminants. The role of MDH in dealing with hazardous waste sites is primarily advisory. For that reason, the evaluation report will typically recommend actions to be taken by other agencies including EPA and MPCA. However, if there is an immediate health threat, MDH will issue a public health advisory warning people of the danger, and will work to resolve the problem.

- Soliciting community input: The evaluation process is interactive. MDH starts by soliciting and evaluating information from various government agencies, the organizations responsible for cleaning up the site, and the community surrounding the site. Any conclusions about the site are shared with the groups and organizations that provided the information. Once an evaluation report has been prepared, MDH seeks feedback from the public. *If you have questions or comments about this report, we encourage you to contact us*.

Please write to: Community Relations Coordinator
Site Assessment and Consultation Unit
Minnesota Department of Health
121 East Seventh Place/Suite 220
Box 64975
St. Paul, MN 55164-0975

OR call us at: (651) 215-0916 *or* 1-800-657-3904
(toll free call - press "4" on your touch tone phone)

I. Summary of Background and History

The Leaf Dry Cleaner site is located at 1405 Gilmore Avenue in the City of Winona, Minnesota approximately 110 miles southeast of St. Paul along the Mississippi River. The site contains soil and groundwater contaminated with tetrachloroethylene, also known as perchloroethylene (PCE), its breakdown products, and petroleum chemicals. PCE is a common dry cleaning solvent.

Prior to January 2003, the Leaf property consisted of two buildings: a main building used for the dry cleaning business plus storage, and an unattached two-stall garage. Before being occupied by a dry cleaner, the property was used as an auto service station. The Leaf property is bordered on the north by Gilmore Avenue, to the east by Clarks Lane and the Gilmore Avenue carwash, to the south by a garage and a single-family residence, and to the west by a motel. The surrounding area consists of a mix of residential and commercial properties, and St. Mary's University with associated athletic fields. The site location is depicted in Figures 1, and 2.

A release at the site was first identified in 1989, when Minnesota Pollution Control Agency (MPCA) staff sampled potable wells in the area of the site in response to complaints about petroleum odors in the water. Water sample analyses detected petroleum constituents in one well and chlorinated solvents in several other area wells. Subsequent investigations of the site indicated that soil at the site and a large area of groundwater were contaminated with PCE and petroleum products. The MPCA issued a Declaration of Emergency in 1989, and conducted additional water well sampling. Contaminated private wells in the area of the site were subsequently abandoned and sealed at the request of the Winona County, and the residents were connected to the municipal water supply. Two underground storage tank (UST) leak sites were also identified during investigations. One is located on the site (related to the former service station), and the other is located across the street to the east at a separate auto service station that is currently used as the Rub-a Dub car wash. Three additional USTs were once located on the Leaf property; two were removed in 1993; the third was removed in 2003 when petroleum contamination related to the USTs was excavated during the removal action at the Leaf property.

The primary source of the PCE contamination at the site appears to be a floor drain that was connected to a dry well (see Figure 1, southwest corner of the Leaf building). The floor drain was allegedly used for the disposal of spent dry cleaning fluid and sludge (Terracon 2000). The spillage of dry cleaning solvents and the use of a dumpster for disposal of spent fluid and sludge may also have contributed to the PCE contamination. The dry well was reportedly excavated, and the owner removed the soil from the site in 1990.

Due to the extent of PCE contamination remaining in soil and groundwater at the site, and due to inadequate response, the MPCA directed the investigation and cleanup activities through the Superfund program under the Minnesota Environmental Response and Liability Act (MERLA). The MPCA staff requested that MDH review site documents prepared to date along with the results of recent indoor air monitoring in order to develop recommendations regarding potential public health impacts from the site. Several investigations have been conducted in and around the site to identify the extent of the PCE contamination in soil and groundwater.

Investigations have found that site soils and groundwater have been contaminated with drycleaner solvent and gasoline. The contaminants of concern are PCE, its decay products, trichloroethylene

(TCE), and gasoline constituents, benzene, toluene, ethyl-benzene, and xylene (BTEX). There are no current exposures to the groundwater at the site because private drinking water wells near the site have been sealed. By 1990, the MPCA had identified at least 25 private wells in the area of the site and provided those homes with access to the municipal water supply. These wells were typically screened at a depth of 20 to 40 feet below grade (see MDH (2000) for a detailed discussion of the drinking water pathway). The remaining exposure pathway of concern is inhalation of the volatilized COCs migrating into homes near the site from source areas in the soil and/or groundwater.

Geology/Hydrogeology

The city of Winona is located on the Mississippi River 110 miles southeast of St. Paul; and the site is located inland approximately 1 mile south of the river bank. The surficial geology in the area of the site is believed to consist of approximately 150 feet of unconsolidated river sediments overlying the Mount Simon Sandstone. Regional groundwater flow in the Mount Simon Sandstone is expected to be toward the Mississippi River.

Investigations conducted at the site have shown that soils consist of approximately 5 feet of fill materials overlying a clay and sandy clay layer that extend to roughly 15 feet below grade. Sand lenses or stringers are also present in the clay/sandy clay unit from 8 to 14 feet below grade. Beneath the clay is a sand and gravel unit that constitutes the water table aquifer. Groundwater is typically encountered at a depth of approximately 10 feet below grade, thus indicating that the clay and sand/gravel formations are interconnected.

Soil Contamination

To determine the extent of contamination in soils on and immediately adjacent to the site, fifteen soil borings were advanced at the site in 1999, and an additional seven soil borings were advanced in 2000. Soil borings were generally advanced to a depth of approximately 15 feet below grade. Soil samples were screened for the presence of organic vapors using a photoionization detector (PID). Organic vapor concentrations were as high as 775 parts per million (ppm) in the clay layer, and as high as 375 ppm at the top of the sand and gravel unit at a depth of 15 feet below grade. The highest organic vapor concentrations were found in borings nearest the suspected source areas, and overall concentrations tended to be higher at depth. Concentrations of PCE as high as 1,600 milligrams per kilogram (mg/kg) were found in the soil at a depth of 11 feet below the ground surface in the area of the former dry well at the rear of the dry cleaner building. For detailed description of the 1999 soil data and groundwater results see *Winona Groundwater Contamination (MDH Health Consultation 2000).*

More recently, in 2000-2003 soil contamination (see figure 1) was found on the adjacent residential property (605 Clarks Lane) at low levels in shallow soil and higher levels at depth. Low levels of petroleum related VOCs (benzene, toluene, ethylbenzene, and xylene (BTEX)) were detected on the east side of the Leaf property, and on the adjacent residential property. Borings were advanced near underground storage tanks associated with the former service station on the site. The locations of soil borings conducted at the site, and their respective PCE concentrations are depicted in Figure 1.

The soil PCE concentrations detected in 2000-2003 were highest in the southwest corner near the floor drain of the Leaf Dry Cleaner building. The PCE concentrations increased with depth (see borings TBS 3, 4, and 16 in Figure 1). The highest PCE soils concentration were found 8 - 11 feet below ground surface on the south side of the building and very near to the 605 Clarks Lane home foundation. Many of the site soil PCE concentrations exceeded the MPCA PCE Residential Soil Reference Value (PCE SRV = 72 mg/kg). The SRVs are soil evaluation criteria based on the protection of human health from direct contact with contaminated soil through ingestion, skin contact, and inhalation of vapors and/or dust particles. Concentrations at or below SRVs are not considered by MPCA or MDH to be of health concern.

Maximum levels of PCE in soil found onsite were approximately 200 times higher than the MPCA residential SRV of 72 mg/kg. The TCE soil concentrations were also consistently above the MPCA residential SRV of 29 mg/kg. The contaminated soil is a contaminant source impacting groundwater and is the suspected source of vapors impacting indoor air in adjacent structures.

Evaluating Indoor Air Quality

MDH recognizes that many environmental exposures to chemicals are at low doses and involve multiple compounds (mixtures). In an effort to assess the potential hazards associated with exposures to chemical mixtures, MDH utilizes an "exposure-based assessment of joint toxic action". This general approach is consistent with ATSDR and similar to the approach used by EPA (ATSDR 2000). This approach involves the use of exposure and toxicological information on the mixture of concern or a similar mixture in conjunction with site-specific data. If toxicological data do not exist for the mixture of concern, studies from a similar mixture may substitute. When mixture data are not available, an assessment based on the components of the mixture is utilized. This is the approach utilized in this health consultation because many of the site contaminants are present at very low levels, and mixture studies of site-specific compounds were not available. MDH has identified the site-specific contaminants and implemented the appropriate health guideline values in this health consultation.

MDH utilizes promulgated Health Risk Values (HRVs) for evaluating ambient air and indoor air quality for excess cancer risk and non-cancer effects. HRVs are concentrations of contaminants in air that MDH considers to be safe for the general public, including sensitive sub-populations. For site related carcinogenic compounds that do not have HRVs, MDH staff have developed a set of screening criterion known as Interim Screening Concentrations (ISC). The ISCs were developed using common risk assessment parameters including adult body weight (70kg), adult inhalation rate (20 m^3/day) and cancer slope factors. HRVs and ISCs for carcinogens are air concentrations that are expected to be associated with an incremental cancer risk of no more than 1 case per 100,000 people exposed for a lifetime. Estimated cancer risks below this level are considered to be negligible. Toxicological data for the VOCs of concern were obtained from standard reference sources, including the U.S. Environmental Protection Agency (EPA) Superfund Technical Support Center, and EPA's Integrated Risk Information System (IRIS) and Health Effects Summary Tables (HEAST). Oral slope factors were used in the calculation of the ISCs due to a lack of available inhalation toxicity values. Their use, therefore, should be limited to simple screening for the identification of potential problem situations and not for determining an actual, long-term air standard (see Appendix A).

The ISCs and associated risk estimates are developed using conservative exposure assumptions. The assumptions used may therefore not reflect the actual exposures that may have occurred at the site, and in fact may likely overestimate them.

The exposure of residents in the home to VOCs in and of itself may not represent a significant risk.

However, given the likely total exposure to these compounds by an individual on a daily basis, the additional involuntary exposure to the levels observed at the site could result in an individual's overall exposure exceeding the negligible excess lifetime cancer risk level. For these reasons, MDH recommends minimizing exposure to potential cancer-causing agents wherever possible.

Common Sources of Indoor Air Contaminants

The use of many common household products can introduce BTEX, TCE, PCE, or other VOCs into the home. The following is a list of common sources of VOC emissions in homes:

- Paints
- Varnishes
- Moth balls
- Solvents
- Gasoline
- Newspaper
- Cooking
- Cleaning Chemicals
- Vinyl floors
- Carpets
- Burning Candles
- Upholstery Fabrics
- Adhesives
- Sealing Caulks
- Air Fresheners
- Fuel Oil
- Vehicle Exhaust
- Pressed wood furniture
- Dry Cleaned items
- Pesticides
- Tobacco Smoke

Indoor air in most homes will contain measurable levels of VOCs. However, each home will have varying VOC levels based upon the homeowner's use of these and other products in the home. The construction date of the house and the type of building materials used can also contribute to indoor air VOCs levels. Newer homes tend to have more VOCs than older ones because VOCs in aged construction materials would already evaporated. It is also possible that environmental media (groundwater, soil and air) contaminated with BTEX, TCE, and PCE can influence indoor air quality as vapors migrate into homes.

Weathering of Contaminants

When contaminants are released into environmental media (soil, water, and air) they sometimes partition into other media. For example when dry cleaner solvent and gasoline are released to the soil, individual compounds found in the mixture can partition into the air and water. This partitioning is partly based upon chemical properties such as water solubility, and volatility (Henry's constant). Compounds that have a high water solubility will dissolve into, and migrate with water. If the compound has a low water solubility, it will tend to stay in the soil.

Other environmental factors such as oxygen levels, moisture, and pH can play an important role in establishing an environment for microorganisms to metabolize/degrade contaminants in the soil or water. For example, PCE is relatively water-soluble and will often leach from soils into groundwater. If the environmental conditions are favorable in the soil, microorganisms will degrade PCE in a step-by-step process (de-chlorination) removing one chlorine atom at a time. This is one reason why weathered PCE plumes may have decay products such as TCE. Gasoline can also leach from the soil and dissolve into groundwater. Gasoline consists of potentially hundreds of different compounds including BTEX. If the environmental conditions are right microorganisms will selectively metabolize/degrade only certain gasoline constituents such as BTEX while other chemical constituents will remain in the plume.

Indoor Air Samples

Because they migrate through soil in the vapor phase, especially in permeable soil or fill such as gravel, VOCs can migrate off-site into nearby structures. PCE in particular has been found to travel longer distances through soil gas relative to other VOCs (Hodgson et al 1992). Of potential concern for vapor migrations were the homes directly to the south and east of the Leaf property, the motel to the west, and the Leaf building itself. Several sewer and utility lines run beneath the streets surrounding the site, to which the homes are likely connected. Gravel or other permeable fill is often used as a base beneath and around utility lines to facilitate drainage and avoid frost damage. VOCs in the vapor state can migrate along utility lines and enter building basements through foundation cracks, pipe entries, sumps, or floor drains. Unsealed foundation drain systems or sumps may also provide a route for VOCs to volatilize from contaminated groundwater into buildings. Therefore, the MPCA performed additional evaluations of nearby structures including 3 homes and one business during 2000-2003.

1) 605 Clarks Lane

Due to the presence of high levels of VOCs in soil and groundwater and the close proximity of the drycleaner to the 605 Clarks Lane foundation, indoor air screening samples were conducted at the 605 Clarks Lane home. Air samples were collected to determine if site contamination was impacting the residence. The following text describes the sample results and compares the indoor air concentrations to health screening criteria.

The 24-hour ambient air samples were collected in SUMMA canisters. These are non-reactive, coated stainless steel canisters placed under a vacuum in order to pull air from the room into the canister. During nine sample events a total of 17 samples were collected. Samples were collected in the basement and main floor living room. The air samples were analyzed using approved EPA analytical methods (EPA Method TO-14 and/or TO-15). Very low detection limits, detection of generally less than 10 micrograms per cubic meter ($\mu g/m^3$) for most compounds are possible using this method. However, even at these low detection limits, a non-detect can be above health based screening levels.

The analysis of the SUMMA canister air samples indicated detectable levels of VOCs in ambient air of the basement and first floor. VOCs detected include PCE, TCE, benzene, ethylbenzene, toluene, and xylenes. These samples were reportedly collected both with windows open during the sample collection and during the winter months with the home sealed up (worse-case). Generally the VOC concentrations were slightly higher during the winter months and higher in the basement. The results of the indoor air sampling are summarized in Table 1. The PCE, TCE, and benzene indoor air concentrations exceeded screening criteria. PCE concentrations were above the PCE Interim Screening Criterion (3.33 $\mu g/m^3$) in all 17 samples collected (see Table 1). PCE concentrations ranged from 9 - 386 $\mu g/m^3$. The TCE ISC concentration (TCE ISC is 0.43 $\mu g/m^3$) was exceeded in 9 samples. The TCE concentrations ranged from non-detect (< 3.0) to 23 $\mu g/m^3$. The lower end of the benzene chronic Health Risk Value (HRV= 1.3 - 4.5 $\mu g/m^3$) was exceeded in 11 of 14 sampling events. The upper end of the range was exceeded in 4 samples. Benzene concentrations ranged from non-detect (<1.9) to 11.38 $\mu g/m^3$.

The levels of indoor air VOCs were cause for concern. To determine if the open sump was a possible source of the VOC vapors in the basement, a sample of the standing water in the bottom of the sump was collected and analyzed for VOCs. PCE, and TCE were detected in the water sample at concentrations of 770, and 14 µg/L respectively (MDH, 2000).

In July of 2000 the MPCA installed a commercial grade, portable air filter designed to remove VOCs (MDH 2000). The unit filtered air through 16 pounds of granular activated carbon 24 hours per day. As the indoor air passed through the activated carbon the VOCs were captured and clean air re-circulated. However, as shown in the table, PCE remained consistently above the PCE ISC of 3.33 µg/m^3 in both the main floor and basement areas. The TCE air concentrations were below detection limits during the last 4 sampling events. In the past 5 sampling events the benzene air concentrations had consistently remained near the upper end of the chronic benzene HRV range of 1.3 - 4.5 µg/m^3 except in the March sample when it was below the detection limit.

Because the air filter did not adequately reduce contaminant levels, MPCA and MDH wanted other more permanent solutions. The MPCA's consultant evaluated various remediation options for the contaminated soil (source areas for the indoor air contaminants), and concluded that excavation and removal of the residual contaminated soil at the site was warranted (Terracon 2000). In effort to remove all the source areas, the 605 Clarks Lane house and the Leaf Drycleaner buildings were demolished in January 2003. Figure 3 shows the demolition and excavation footprint of the 605 Clarks Lane house. (See section titled Soil Removal Action for a summary of the remedial activities.)

2) 611 Clarks Lane (Residence 2)

In an effort to characterize off-site indoor air impacts the 611 Clarks Lane residence was sampled. Analyses of SUMMA canister air samples indicated detectable levels of VOCs present in ambient air of the basement and first floors at 611 Clarks Lane. VOCs detected include benzene, ethylbenzene, toluene, and xylenes. A total of 6 indoor air samples were collected from of September 2000 through March 2001. The results of the indoor air samples are summarized in Table 2. All the PCE, and TCE, air concentrations were below the analytical detection limits. However, the detection levels were slightly above the health screening levels. The detection limit is the lowest concentration which can be quantitated. In other words, when the measurement of a compound is below the detection limit, it may still be present (but at very low levels). The PCE detection levels ranged from < 3.23 - <15.15 µg/m^3. The PCE Interim Screening Criteria is 3.33 µg/m^3 (see Appendix A). The TCE analytical detection levels ranged from < 3.33 - <9.82 µg/m^3. The TCE ISC is 0.43 µg/m^3. Benzene concentrations ranged from <6.18 - 18.5 µg/m^3. The Benzene Chronic Health Based Value range is 1.3 - 4.5 µg/m^3. It is important to note that nearly every home will have minute levels of these compounds in the air. Many common household products and building materials contain these compounds. The air samples may be measuring of VOCs from floor adhesives, paints, tobacco smoke, or other household products. The use of these products can lead to elevated background levels of VOCs in the home.

The low levels of benzene (and possibly other VOCs) occurring in this home are not expected to result in elevated health risks. Exposure calculations used to determine health criteria assume a lifetime of exposure 24 hours/day and therefore likely over-estimate risk.

Additionally, the VOC levels detected do not appear to be site related, and are common in indoor and outdoor environments. Typically if VOCs are migrating into a house from soil, basement VOC concentrations are higher than first floor concentrations and this is not the case at 611 Clarks Lane. Another factor suggesting that the indoor air VOCs are not site related, is that the soil vapor samples collected near the house contain very little VOCs. Soil borings TSB-18, 20, and 22, were collected approximately 45, 20, and 70 feet from the house foundation in the direction of the known source areas (see figure 1 and table 5).
The BTEX vapor samples were collected in the borings at the 6 - 8 foot interval, and 12 -13 foot interval for soil borings TSB-18 and TSB-20. Only TSB-22 tested positive for BTEX constituents 8 to 10 feet

below ground surface. Ethylbenzene, and xylene concentrations were 2.8 and 59.3 mg/kg respectively. The Residential Soil Reference Values (SRVs) for ethylbenzene and xylene are 200 and 110 mg/kg respectively. Only Soil borings TSB-18, and TSB-20 had detectable PCE and TCE. Soil boring TSB-18 had PCE concentrations ranging from 0.034 – 0.062 mg/kg, and a TCE concentration of 0.081 mg/kg. Soil boring TSB-20 had PCE concentrations ranging from 0.5 – 0.051 mg/kg, and a TCE detection of 0.07 mg/kg. The Residential SRV for PCE and TCE are 72 and 29 mg/kg respectively. As an added precaution MDH has requested that MPCA collect additional soil gas probe data closer to the home's foundation to determine if elevated BTEX, TCE, and PCE are found in the soil.

3) El Rancho (1429 Gilmore Ave.)

Nineteen indoor air samples were collected from September 2000 through May 2004 at the El Rancho Motel (See Table 3 for summary results). Ten samples were collected on the main floor living room/office and 9 were collected in the very small basement room.

The samples were analyzed for the following compounds:

tetrachloroethene (PCE)	vinyl chloride
trichlorotheylene (TCE)	cis-1,2-dichloroethene (DCE)

There were no chemicals detected in the May 2004 samples. However the PCE, and TCE detection limits were above their Interim Screening Concentrations (ISC). When this is the case, MDH considers other factors such as the compound concentrations in prior sampling rounds, and how much higher the detection limit is than the ISC. In November 2003, PCE was detected in the main floor (9.6 $\mu g/m^3$). However, both the main floor and basement PCE concentrations were below detection limits in the last two sampling events (January, and May 2004). In the two sample events the PCE detection limit ranged from 4.9-9.6 $\mu g/m^3$. The PCE ICS concentration is 3.33 $\mu g/m^3$. The basement air sample is where the highest concentration of vapors are expected if they are entering a basement foundation. The basement VOC levels have been below detection limits in the last 3 sample events. The indoor air VOC concentrations have generally been decreasing since June 2002. It is important to note that low levels of VOCs are expected to inside a home and are often attributable to dry cleaned garments, construction materials, and household cleaning products.

Two factors contributing to decreasing indoor VOC concentrations in the El Rancho are the removal of the
source areas during remedial activities in December 2002, and the installation of Soil Vapor Collection (SVC) system January 2004 (see Figure 4). During the installation of the SVC system the exposed basement wall was coated with a vapor barrier. The SVC system consists of perforated collection tubes that are laid horizontally next to the basement wall and above the foundation footings. The SVC collection tubes are connected to a fan that creates a vacuum in the tubes, which draws vapors from the ground into the SVC system that vents from the El Rancho office roof to the atmosphere. Three samples collected from the SVC exhaust containing elevated VOC concentrations demonstrate that the system is working.

4) 608 Clarks Lane

Air samples were collected at the 608 Clarks Lane residence in February 2003, June 2003, and January 2004. The air samples were collected to determine if vapors from the Leaf Dry Cleaner, and/or Rub-a-Dub Carwash groundwater plumes had impacted the basement of the residence. During each sampling event the first floor and basement were sampled.

The February air samples were collected in the first floor living room and basement. The living room sample contained the following compounds:

acetone	1,2,4-trimethylbenzene
chloromethane	m,p,o-xylenes
1,3,5-trimethylbenzene	benzene
toluene	ethylbenzene
2-butanone	

There were no compounds detected in the February basement air sample.

On June, 2003 additional air samples were collected in the living room, basement, and back porch. The living room sample contained very low concentrations of the following compounds:

acetone	toluene
chloromethane	2-butanone
dichlorodifluoromethane (Freon)	

The June basement sample contained low concentrations of the following compounds:

dichlorodifluoromethane (Freon)	n-hexane
benzene	n-heptane
styrene	propylene
tetrahydrofuran	trichlorofluoromethane
acetone	
2-butanone	

The January sample had very low concentrations of the following compounds in the first floor living room:

acetone	toluene
methylethylketone (MEK)	dichlorofluoromethane
propylene	n-hexane

The January basement sample contained low concentrations of the following compounds:

acetone	n-hexane
methylethylketone (MEK)	toluene
propylene	o-xylene

The compound concentrations found in the 608 Clarks Lane home are not of health concern. Table 4 is a summary of VOC concentrations related to dry cleaning solvents and gasoline found in the 608 Clarks Lane residence. Some of these compounds are commonly introduced in homes in low concentrations because they are found in cigarette smoke, petroleum products, car exhaust, paint, construction materials, and household cleaning products.

It is important to note that when vapors migrate from contaminated groundwater into a basement, the air contaminant concentrations are usually higher in the basement when compared to other locations in the house. This pattern is not observed at the 608 Clarkson Lane property. As an added precaution MDH has asked the PCA to collect additional soil vapor samples near the foundation of the home.

Soil Removal Action

Remediation conducted in the winter 2002 involved complete demolition of the commercial building on the Leaf property and the residence directly south of Leaf property (605 Clarks Lane). Figure 1 illustrates the structures that were demolished. A total of 11,000 tons of contaminated soils were excavated to 15 feet below ground surface. A challenge associated with the removal was the close proximity of many houses and a daycare facility with approximately 200 pre-school aged children.

The MPCA and MDH distributed letters to local residents informing them of the impending removal action on the site. Several residents and parents of children attending the childcare facility expressed great concern about exposures during the excavation. MDH and MPCA developed a site safety plan that ensured offsite vapors did not pose a health concern.

A site exclusion zone was established around the demolished buildings. The air quality was continuously monitored downwind of the exclusion zone, and in the breathing zone immediately adjacent to the ongoing excavation with a portable organic vapor analyzer. Air samples were periodically collected using Tedlar bags and analyzed for VOCs in an onsite mobile laboratory. Field organic vapor concentrations at sampling locations along the exclusion zone boundaries typically ranged from less than one to one part per million (ppm). The highest reading recorded was 4.5 ppm on the west-side exclusion boundary. This value represents total organic vapors in air and is not convertible to $\mu g/m^3$. PCE concentrations collected during excavation activities typically ranged from 400 to 1000 $\mu g/m^3$. The highest PCE measurement collected from the exclusion zone boundary was 13000 $\mu g/m^3$ at the northeast corner of the site. The MDH PCE Acute Health Risk Value is 20,000 $\mu g/m^3$, and the site PCE action level was 15,000 $\mu g/m^3$ (2.0 ppm). Residents located near the site were notified of the pending remedial activities and a system was developed to alert residents to air quality conditions. The site remained at Alert Level 0 throughout the excavation activities.

Air Quality Alerts

Level 0 Alert (blue): Immediately prior to excavation activities, residents were notified by MPCA and MDH officials to close their windows and avoid outdoor activities. A Level 0 Alert was signaled by posting a blue sign at a location readily visible to nearby residents (see Figure 5).

Level 1 Alert (yellow): A Level 1 Alert was defined as PCE vapor concentrations in the exclusion zone, *but not at the nearest residential property* in excess of 2.0 ppm PCE. For a Level 1 Alert, the consultant was instructed to post an yellow sign at a location readily visible to nearby residents. For this alert, MPCA and MDH officials would have notified residents to stay in their houses, close their windows, not engage in outdoor activities, and quickly move to and from their vehicles.

Level 2 Alert (red): A Level 2 Alert was defined as PCE vapor concentrations at the edge of the nearest residential property in excess of 2.0 ppm. For a Level 2 Alert, the contractor was instructed to post a red sign at the same location as the one used for Level 0 and Level 1 alerts. For this alert MPCA and MDH officials would have notified residents of the elevated PCE vapor concentration, and advised them to remain indoors until the Level 2 Alert had been downgraded to a Level 1 Alert. Residents received either visual or verbal notification of the alert level throughout the excavation phase of the project. The site remained at Level 0 throughout the soil removal action. It is believed cold weather reduced potential VOC volatilization during excavation activities and thereby reducing VOC ambient air concentrations. Another added benefit was the cold weather encouraged individuals to remain indoors with the windows and doors shut. Figures 5, and 6 depict the soil removal action and alert level signage.

II. Discussion

The site contaminants of concern are a mixture of dry-cleaning solvent and gasoline. There are no toxicological data available for this site-specific mixture. Many of the identified chemical constituents were present at very low levels and have not been toxicologically studied individually or as a mixture. However, MDH has identified the chemical constituents in the mixture for which there are health guideline values and utilized these values in its assessment.

Tetrachloroethylene (PCE) is a synthetic solvent widely used for fabric cleaning and degreasing of metal. It has been the solvent of choice for dry cleaning operators because it is nonflammable and volatilizes (evaporates) quickly. In dry cleaning operations, PCE is used as a scouring solvent to remove oils, greases, waxes, and fats from both natural and man-made fabrics (ATSDR 1997). PCE is also used in water repellents, silicone lubricants, spot removers, adhesives, and wood cleaners.

Although it has not been demonstrated to cause cancer in people, the U.S. Department of Health and Human Services has determined that PCE may reasonably be considered a potential human carcinogen, or cancer causing agent, based on animal studies (ATSDR 1997). Once it enters the body, PCE is metabolized by the liver (Bogen and McKone 1988). PCE is rapidly metabolized and eliminated from the body.

Trichloroethylene (TCE) is also a widely used solvent, and is as a breakdown product of PCE. TCE is a nonflammable, colorless liquid with a slightly sweet odor and taste (ATSDR 1997). TCE is extremely volatile, and most TCE released into the environment will evaporate into the air. Exposure to high concentrations of TCE in air can affect the central nervous system, producing headaches, dizziness or even unconsciousness. These concentrations have only been found in occupational settings, or cases of intentional exposure (i.e. intoxication or suicide attempts).

Benzene, toluene, ethylbenzene, and xylene (BTEX) are only a few of the potentially hundreds of chemical constituents found in gasoline. Although it is possible to chemically characterize most of the chemical constituents found in a gasoline plume, it is very expensive and of little use because most of the chemical constituents will not have sufficient toxicological data to aid in assessing health implications of exposure. The MDH have developed health criterion for the BTEX constituents individually, but not as a mixture.

Inhalation is the primary route of exposure to benzene due to its high volatility (ATSDR 1993). Inhalation exposure to benzene can result in noncancer health effects that impact the tissues involved in the formation of the blood cells and the immune system (EPA 2004). Studies involving chronic human occupational or environmental inhalation exposures have established benzene to be a human carcinogen (class A). Human pre-cancer and cancer effects have been reported in the literature from exposures (1- 40 years) to high benzene concentrations ranging from 1 – 479.0 mg/m^3 (ATSDR 1993). The MDH chronic benzene HRV is 0.0013 – 0.0045 mg/m^3.

Chronic inhalation exposure to moderate to high concentrations of toluene is associated with central nervous system disturbances involving subtle behavioral and neurological effects at concentrations >376.8 mg/m^3 (ATSDR 1994). The MDH chronic toluene HRV is 0.4 mg/m^3.

Individuals exposed to high levels of ethylbenzene for short periods of time have complained of eye and throat irritation, and dizziness (ATSDR 1999). It is not known if long term exposure to low levels of ethyl-benzene affects human (ATSDR 1999). Acute exposures to high levels (> 615 mg/m^3) in animal studies resulted in reproductive and developmental effects (ATSDR 1999). The MDH acute ethylbenzene HRV is 10 mg/m^3.

Studies involving human acute exposures to xylene (868.4 mg/m^3) resulted in eye, nose, and throat irritation (ATSDR 1995). Neurological effects (dizziness) were reported at 2995.9 mg/m^3 (ASTDR 1995). Occupational studies have reported irritant effects of xylene at concentrations as low as 60.8 mg/m^3 (ATSDR 1995). The MDH acute xylene HRV is 43 mg/m^3.

Once released into the environment, PCE, TCE, and gasoline constituents readily volatilize from soil and water. Factors that affect the rate of volatilization from soil include the soil type, organic matter content of the soil, moisture content of the soil, and the nature of the release. Volatilization will tend to be higher in sandy soils and lower in denser, more organic soils such as clays where VOCs may be adsorbed onto organic carbon particles. PCE, TCE, and gasoline readily leach through soil, contaminating shallow groundwater. PCE, and TCE are denser than water, and if present in sufficient concentrations in groundwater, they sink to form a pool at the base of the groundwater aquifer. This pool of dense, non-aqueous phase liquid (or DNAPL) can serve as a continuing source of groundwater contamination. Gasoline consists of numerous compounds with varying chemical properties; some of the chemical constituents will dissolve into the groundwater (BTEX) and others (naphthalene) will have more of an affinity for soil.

It is challenging to determine if indoor air VOC impacts are site related because the ubiquitous use of petroleum products has lead to their increased detection in environmental media (soil, water, and air). Further, the environmental fate of the petroleum chemical constituents is dependent on physical, chemical and biological forces encountered in the environment. Gasoline's BTEX constituents are the first to attenuate due to volatilization and microbial degradation while other constituents can potentially remain unchanged for years. Thus the primary reliance on BTEX as indicators of gasoline impacts to indoor air without considering other residual constituents is questionable for weathered gasoline plumes.

Agency for Toxic Substance and Disease Registry (ATSDR) Child Health Initiative

ATSDR's Child Health Initiative recognizes that the unique vulnerabilities of infants and children make them of special concern to communities faced with contamination of their water, soil, air, or food. Children are at greater risk than adults from certain kinds of exposures to hazardous substances at waste disposal sites. They are more likely to be exposed because they play outdoors and they often bring food into contaminated areas. Because they are shorter than adults, they breathe dust, soil, and heavy vapors closer to the ground. Children also weigh less, 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.

III. Conclusions

- Indoor air levels of VOCs measured at the 611 and 608 Clarks Lane residents are very low and are likely not site-related. Inhalation exposures to the VOC levels found in the homes are not a health concern.
- The soil removal action and the demolition of the 605 Clarks Lane home and the Leaf drycleaner building have eliminated the health risks associated with the properties.
- The installation of the soil vapor collection system at El Rancho Motel and removal of the PCE source areas next to the building have reduced indoor air VOCs to levels that are not of health concern.
- For the reasons stated above, the site currently does not represent a public health hazard.

IV. Recommendations

1. Additional soil VOC vapor samples should be collected near the foundation of the 611 Clarks Lane property to help provide additional assurance that the indoor air VOCs are not site related.

2. MDH and the PCA should continue to discuss the technical challenges of addressing risks associated with weathered gasoline vapor impacts to indoor air.

V. Public Health Action Plan

MDH's Public Health Action Plan for the site consists of continued consultation with MPCA staff on any additional soil and indoor air data collected.

References

Agency for Toxic Substance and Disease Registry (ATSDR). Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures. May 2004.

Agency for Toxic Substance and Disease Registry (ATSDR). Toxicological Profile for Tetrachloroethylene. September 1997.

Agency for Toxic Substance and Disease Registry (ATSDR). Toxicological Profile for Benzene. April 1993.

Agency for Toxic Substance and Disease Registry (ATSDR). Toxicological Profile for Toluene. May 1994.

Agency for Toxic Substance and Disease Registry (ATSDR). Toxicological Profile for Ethylbenzene. July 1999.

Agency for Toxic Substance and Disease Registry (ATSDR). Toxicological Profile for Xylenes. August 1995.

Becher, R., Hongslo, J.K., Jantunen, M.J., Dybing, E. (1996). Environmental chemicals relevant for respiratory hypersensitivity: the indoor environment. Toxicology Letters 86: 155-162.

Bogen, K.T., McKone, T.E. (1988). Linking indoor air and pharmacokinetic models to assess tetrachloroethylene risk. Risk Analysis 8: 509-520.

Brymer, D.A., Ogle, L.D., Jones, C.J., Lewis, D.L. (1996). Viability of using SUMMA polished canisters for the collection and storage of parts per billion by volume level volatile organics. Environmental Science & Technology 30: 188-195.

Hodgson, A.T., Garbesi, K., Sextro, R.G., Daisey, J.M. (1992). Soil-gas contamination and entry of volatile organic compounds into a house near a landfill. Journal of Air and Waste Management Association 42: 277-283.

MDH 2000, Health Consultation: Groundwater Contamination (Clarks Lane / Gilmore Avenue) City of Winona, Winona County, Minnesota. November 22, 2000.

McKone, T.E., Daniels, J.I. (1991). Estimating human exposure through multiple pathways from air, water, and soil. Regulatory Toxicology and Pharmacology 13: 36-61.

Stroebel, C., Pellizzari, E., Quackenboss, J.J. (1997). Sources and concentrations of volatile organic chemicals in homes with children. Unpublished.

Tancrede, M., Wilson, R., Zeise, L., Crouch, E.A.C. (1987). The carcinogenic risk of some organic vapors indoors: a theoretical survey. Atmospheric Environment 21: 2187-2205.

References Continued

Terracon 2000. Additional Assessment and Feasibility Study, Leaf Dry Cleaners. Terracon, June 30, 2000.

Terracon 2003. Operation and Monitoring / Source Area Response Action Implementation – July 2002 to March 2003 Winona Groundwater Contamination Superfund Site, Leaf Dry Cleaners. Terracon, March 29, 2003.

Terracon 2004. Operation and Monitoring – April 2003 to December 2003 Winona Groundwater Contamination Superfund Site, Leaf Dry Cleaners. Terracon, March 24, 2004.

EPA Integrated Risk Information System (IRIS) 2004. http://www.epa.gov/iris/

Preparer of Report:

Daniel Peña, M.S.
Health Assessor
Site Assessment and Consultation Unit
Minnesota Department of Health
tel: (651) 215-0774

CERTIFICATION

This Winona Groundwater Contamination Site Health Consultation was prepared by the Minnesota Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

Jeff Kellam
Technical Project Officer, SAB, DHAC
ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.

Roberta Erlwein
Chief, State Program Section, SAB, DHAC, ATSDR

Tables

Indoor Air Sample and Soil Boring Data

TABLE 1 - INDOOR AIR MONITORING RESULTS
605 Clarks Lane
WINONA, MINNESOTA

Sample Location	Sample Date	Sample Duration	Trichloroethylene (TCE) ug/m3	Tetrachloroethene (PCE) ug/m3	Benzene ug/m3	Toluene ug/m3	Ethyl Benzene ug/m3	o, m-& p-Xylene ug/m3
			ISC = 0.43 ug/m3	ISC = 3.33 ug/m3	Chronic HRV = 1.3 - 4.5 ug/m3	Chronic HRV = 400 ug/m3	Acute HRV = 10,000 ug/m3	Acute HRV = 43,000 ug/m3
Basement - Family Rm (SUMA 1)	06/07/00	24 hours	<3.0*	**145**				
Basement - NW Corner (SUMA 2)	05/17/00	24 hours	**4**	**145**				
Basement - NW Corner (SUMA 2)	06/07/00	24 hours	<3.1*	**138**				
Basement - NW Corner (SUMA 2)	08/24/00	24 hours	**19**	**386**	**11.38**	72.77	15.88	59.02
Basement - NW Corner (SUMA 2)	09/14/00	24 hours	**17**	**269**	**2.50**	65.11	4.06	12.46
Basement - NW Corner (SUMA 2)	10/24/00	24 hours	**23**	**241**	**6.83**	36.00	3.40	14.32
Basement - NW Corner (SUMA 2)	12/19/00	24 hours	**6**	**96**	**3.58**	18.00	4.01	17.36
Basement - NW Corner (SUMA 2)	03/29/01	24 hours	<3.4*	**33**	**4.23**	14.17	<2.89	
Basement - NW Corner (SUMA 2)	12/11/01	24 hours	**3**	**193**	**5.85**	27.19	4.37	17.97
Basement - NW Corner (SUMA 2)	03/14/02	24 hours	<4.6*	**59**	<2.8*	13.02		<10.81
Upstairs - Living Rm West Wall	08/24/00	24 hours	**11**	**207**	**8.13**	45.96	7.50	28.64
Upstairs - Living Rm West Wall	09/14/00	24 hours	**9**	**179**	<2.1*	9.58		
Upstairs - Living Rm West Wall	10/24/00	24 hours	**14**	**131**	**4.23**	22.21	<2.5	7.38
Upstairs - Living Rm West Wall	12/19/00	24 hours	<4.5*	**9**	**3.58**	8.04		
Upstairs - Living Rm West Wall	03/29/01	24 hours	<5.1*	**22**	**3.58**	13.41		
Upstairs - Living Rm West Wall	12/11/01	24 hours	<4.0*	**172**	**4.23**	14.94		<6.07
Upstairs - Living Rm West Wall	03/14/02	24 hours	<3.1*	**40**	<1.92*	10.72		
1 - Floor Drain - NW	06/07/00	Instantaneous						
2 - Basement - NW Corner	06/07/00	Instantaneous						
3 - Shower - NW	06/07/00	Instantaneous						
4 - Sump / Stand Pipe - W	06/07/00	Instantaneous						
4 - Sump / Stand Pipe - W (sealed)	10/23/00	Instantaneous		**12**				

ISC= Interim Screening Concentration
< = Not detected above laboratory practical reporting limits (PRL)
- = Not Analyzed
* = Detection limit above the health criterion
Bold = concentration above health criterion
HRV = MDH Health Risk Value
Adapted from Terracon (2004)

TABLE 2 - AIR MONITORING ANAYTICAL RESULTS
611 Clarks Lane
WINONA, MINNESOTA

Sample Location	Sample Date	Sample Duration	Trichloroethylene (TCE) ug/m3	Tetrachloroethene (PCE) ug/m3	Benzene ug/m3	Toluene ug/m3	Ethyl Benzene ug/m3	o, m-& p-Xylene ug/m3
			ISC = 0.43 ug/m3	ISC = 3.33 ug/m3	Chronic HRV = 1.3 - 4.5 ug/m3	Chronic HRV = 400 ug/m3	Acute HRV = 10,000 ug/m3	Acute HRV = 43,000 ug/m3
Basement - East Wall	09/14/00	24 hours	<3.87*	<5.72*	**16.90**	137.88	15.44	85.06
Basement - East Wall	10/24/00	24 hours	<21.84*	<3.23	**18.53**	137.88		
Basement - East Wall	12/19/00	24 hours	<7.1*	<10.34*	**5.85**	61.28		21.27
Basement - East Wall	03/14/01	29 hours	<4.0*	<5.92*	**9.43**	114.90	10.58	54.68
Upstairs - Living Rm on Hutch	10/24/00	24 hours	<9.82	<15.15*	<6.18*	118.73		
Upstairs - Living Rm on Hutch	12/19/00	24 hours	<3.33	<4.89*	**5.53**	72.77	4.23	14.32

ISC= Interim Screening Concentration

< = Not detected above laboratory practical reporting limits (PRL)

- = Not Analyzed

* = Detection limit above the health criterion

Bold = concentration above health criterion

HRV = MDH Health Risk Value

Adapted from Terracon (2004)

TABLE 3 - INDOOR AIR MONITORING RESULTS
EL RANCHO MOTEL
WINONA, MINNESOTA

Sample Location	Sample Date	Sample Duration	Trichloroethylene (TCE) ug/m3	Tetrachloroethene (PCE) ug/m3	Benzene ug/m3	Toluene ug/m3	Ethyl Benzene ug/m3	o, m-& p-Xylene ug/m3
			ISC = 0.43 ug/m3	ISC = 3.33 ug/m3	Chronic HRV = 1.3 - 4.5 ug/m3	Chronic HRV = 400 ug/m3	Acute HRV = 10,000 ug/m3	Acute HRV = 43,000 ug/m3
Basement - East Wall	9/14/00	24 hours	**4.0**	**151.6**	<2.21*	8.8		
Basement - East Wall	10/24/00	24 hours	**3.9**	**75.8**	**2.0**	28.3		7.5
Basement - East Wall	12/19/00	24 hours	<10.9*	**89.6**	<6.82*	68.9		29.9
Basement - East Wall	3/29/01	29 hours	<3.11*	**24.1**	**2.2**	11.5		<4.64
Basement - East Wall	12/12/01	24 hours	**7.1**	**151.6**	<2.5*	8.0		
Basement - East Wall	3/14/02	24 hours	<6.0*	**82.7**	<3.5*	5.4		
Basement - East Wall	6/29/02	24 hours	**0.4**	**46.2**	**2.8**	36.0		
Basement - East Wall	8/7/03	24 hours	<3.4*	<5.09*				
Basement - East Wall	1/30/04	24 hours	<3.3*	<4.96*				
Basement - East Wall	5/20/04	24 hours	<6.5*	<9.6*				
Upstairs - Living Rm Behind Office	10/24/00	24 hours	**4.0**	**151.6**	<2.21*	8.8		<5.38
Upstairs - Living Rm Behind Office	12/19/00	24 hours	<3.33*	**44.1**	**6.8**	25.7	4.2	20.8
Upstairs - Living Rm Behind Office	3/29/01	29 hours	<5.1*	**16.5**	**5.2**	18.4		
Upstairs - Living Rm Behind Office	12/12/01	24 hours	**7.6**	**117.1**	**2.1**	9.2		
Upstairs - Living Rm Behind Office	3/14/02	24 hours	<4.0*	**22.7**	<2.5*	11.5		
Upstairs - Living Rm Behind Office	6/29/02	24 hours	**3.9**	<5.5*	**5.5**	13.0		
Upstairs - Living Rm Behind Office	8/7/03	24 hours	<3.9*	**9.6**				
Upstairs - Living Rm Behind Office	1/30/04	24 hours	<3.4*	<4.96*				
Upstairs - Living Rm Behind Office	5/20/04	24 hours	<7.6*	<8.96*				
Soil Vapor Collector Off-Gas	6/23/03	Grab	**344.0**	**19981.0** [4]		7.3		
Soil Vapor Collector Off-Gas	8/6/03	Grab	**152.9**	**5718.7**				
Soil Vapor Collector Off-Gas	5/20/04	Grab	**92.8**	**2135.9**				

ISC= Interim Screening Concentration

< = Not detected above laboratory practical reporting limits (PRL)

- = Not Analyzed

* = Detection limit above the health criterion

Bold = concentration above health criterion

[4] = compound concentrations exceeded calibration range. Result considered an estimate

HRV = MDH Health Risk Value

Adapted from Terracon (2004)

TABLE 4 - AIR MONITORING RESULTS
608 Clarks Lane
WINONA, MINNESOTA

Sample Location	Sample Date	Sample Duration	Trichloroethylene (TCE) ug/m3	Tetrachloroethene (PCE) ug/m3	Benzene ug/m3	Toluene ug/m3	Ethyl Benzene ug/m3	o, m-& p-Xylene ug/m3
			ISC = 0.43 ug/m3	ISC = 3.33 ug/m3	Chronic HRV = 1.3 - 4.5 ug/m3	Chronic HRV = 400 ug/m3	Acute HRV = 10,000 ug/m3	Acute HRV = 43,000 ug/m3
Upstairs	02/10/03	24 hours	<7.64*	<11.02*	**5.85**	38.30	15.44	107.63
Upstairs	06/23/03	24 hours	<3.82*	<4.82*	<2.27*	10.34		
Main floor Upstairs (living room)	01/29/04	24 hours	<3.82*	<4.82*	<2.27*	4.60		
Basement	02/10/03	24 hours	<3.33*	<4.87*	<2.08*			
Basement	06/23/03	24 hours	<3.82*	<4.82*	**6.83**	61.28		
Basement	01/29/04	24 hours	<4.31*	<5.44*	<2.56*	6.13		6.51
Back Porch (ambient)	02/23/03	24 hours	<4.7*	<5.90*	<2.79*			
Front Porch (ambient)	01/29/04	24 hours	<3.82*	<4.82*	<2.27*			

ISC= Interim Screening Concentration
< = Not detected above laboratory practical reporting limits (PRL)
- = Not Analyzed
* = Detection limit above the health criterion
Bold = concentration above health criterion
HRV = MDH Health Risk Value
Adapted from Terracon (2004)

Table 5 Tetrachloroethylene (PCE) Soil Boring Concentrations

Sample ID #	Soil Depth (feet below ground surface)	PCE Concentration (mg/Kg)	Benzene (mg/Kg)	Toluene (mg/Kg)	Ethyl Benzene (mg/Kg)	o,m, & p-Xylene (mg/Kg)
HA-1						
	6	3400*	<13	<13	<13	<26
TSB-1	4	42	ND	ND	ND	ND
	16	80*	ND	ND	ND	ND
TSB-2	8	59	ND	ND	ND	ND
	16	<25	ND	ND	ND	ND
TSB-3	13	18	<0.07	<0.07	<0.07	<0.14
	16	230*	ND	ND	ND	ND
TSB-4	8	822*	ND	ND	ND	ND
	12	600*	<1.4	<1.4	<1.4	<1.4
	16	1100*	ND	ND	ND	ND
TSB-7	4	49	ND	ND	ND	ND
	16	44	<0.03	<0.03	<0.03	<0.06
TSB-9	10	3.5	ND	ND	ND	ND
	15	27	<0.03	<0.03	<0.03	<0.06
TSB-16	1	0.25	<0.03	<0.03	<0.03	<0.06
	5	0.54	<0.03	<0.03	<0.03	<0.06
	11	16000*	<7.9	<7.9	<7.9	<15.9
TSB-17	1	0.43	<0.03	<0.03	<0.03	<0.06
	7	0.26	<0.03	<0.03	<0.03	<0.06
	12	2.7	<0.03	<0.03	<0.03	<0.06
TSB-18	6-8	0.03	<0.03	<0.03	<0.03	<0.06
	12-13	0.06	<0.03	<0.03	<0.03	<0.06
TSB-19	1	0.6	<0.03	<0.03	<0.03	<0.06
	7	0.2	<0.03	<0.03	<0.03	<0.06
	15	2.4	<0.03	<0.03	<0.03	<0.06
TSB-20	6-8	0.05	<0.03	<0.03	<0.03	<0.06
	12-13	0.5	<0.03	<0.03	<0.03	<0.06
TSB-22	8-10	<0.26	<0.26	<0.26	2.8	59.3
	12-13	<0.03	<0.03	<0.03	<0.03	<0.06

* = Exceeds Minnesota Pollution Control Agency's Residential Soil Reference Value (70 mg/Kg)

ND = Not detected
Adapted from Terracon (2004)