Health Consultation

Minnetonka Lakeshore-Advance Machine Superfund Site

SPRING PARK, HENNEPIN COUNTY, MINNESOTA

EPA FACILITY ID: NA

October 22, 2013

Addendum January 29, 2014

Prepared by the

Minnesota Department of Health, Environmental Health Division

Under Cooperative Agreement with the

Agency for Toxic Substances and Disease Registry

U.S. Department of Health and Human Services

This document has not been reviewed and cleared by ATSDR.

Minnesota Department of Health
625 Robert St. N.
St. Paul, MN 55164-0975
www.health.state.mn.us

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This document had a public comment period, which is an opportunity for the public to comment on the information, conclusions, and recommendations contained in the draft document. Comments from the MPCA and Nilfisk-Advance (the company responsible for the historical contamination), were considered prior to the public comment period. The public comment draft Health Consultation was sent to West Arm Townhome residents at the end of June 2013. No public comments were received during the 45- day public comment period. No changes were made to the content of the public comment draft document. The Health Consultation was posted on our website and dated October 22, 2013.

FOREWORD

This document summarizes public health concerns related to a former industrial facility in Minnesota. It is based on a formal site evaluation prepared by the Minnesota Department of Health (MDH). For a formal site evaluation, a number of steps are necessary:

- *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 is found on the site, and how people might be exposed to it. Usually, MDH does not collect its own environmental sampling data. Rather, MDH relies on information provided by the Minnesota Pollution Control Agency (MPCA), the US Environmental Protection Agency (EPA), and other government agencies, private 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. MDH's report focuses on public health— that is, the health impact on the community as a whole. The report 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 pollutants. The role of MDH is primarily advisory. For that reason, the evaluation report will typically recommend actions to be taken by other agencies—including EPA and MPCA. If, however, an immediate health threat exists, MDH will issue a public health advisory to warn 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 individuals or organizations responsible for the site, and community members living near the site. Any conclusions about the site are shared with the individuals, 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 625 North Robert Street, PO Box 64975 St. Paul, MN 55164-0975
OR call us at:	(651) 201-4897 *or* 1-800-657-3908 (toll free call - press "4" on your touch tone phone)
On the web:	http://www.health.state.mn.us/divs/eh/hazardous/index.html

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List of Acronyms

ATSDR	Agency for Toxic Substances and Disease Registry
cis-1,2-DCE	cis-1,2-dichloroethylene
1,1-DCE	1,1-dichloroethylene
CFIG	Franconia-Ironton-Galesville aquifer
CJDN	Jordan sandstone aquifer
CMHS	Mt. Simon-Hinckley aquifer
CMTS	Mt. Simon aquifer
DRO	diesel range organics
EPA	United States Environmental Protection Agency
GAC	granular activated carbon
HBV	Health-Based Value
HCRRA	Hennepin County Regional Railroad Authority
HRL	Health Risk Limit
ISV	Intrusion Screening Value
MCL	Maximum Contaminant Level
MDH	Minnesota Department of Health
MPCA	Minnesota Pollution Control Agency
msl	mean sea level
MW	monitoring well
ND	not detected
PCE	perchloroethylene or tetrachloroethylene
pCi/L	picocuries per liter
ppb	parts per billion
ppm	parts per million
RW	recovery well
SSDS	sub-slab depressurization system
SWDA	Safe Drinking Water Act
TCE	trichloroethylene
trans-1,2-DCE	trans-1,2-dichloroethylene
$\mu g/m^3$	micrograms per cubic meter
VC	vinyl chloride
VIC	Voluntary Investigation and Cleanup
VOC	volatile organic compounds
WATH	West Arm Townhome

I. Summary

INTRODUCTION	The Minnesota Department of Health's (MDH) mission is to protect, maintain, and improve the health of all Minnesotans. For communities living near contaminated sites, MDH's goal is to protect people's health by providing health information the community needs to take actions to protect their health. MDH also evaluates environmental data, and advises state and federal regulatory agencies and local governments on actions that can be taken to protect public health. On December 13, 2012, the MPCA contacted the Minnesota Department of Health Site Assessment and Consultation Unit regarding health risks due to soil and groundwater contaminated with trichloroethylene (TCE) beneath a townhome complex in Spring Park, Minnesota. The site is located in the City of Spring Park, Minnesota, along the south shore of the West Arm of Lake Minnetonka in southwest Hennepin County (see Figure 1). TCE was released to the environment during industrial activities at the former Advance Machine Company, which operated on the property from 1958 to 1987. In the 1990s the property, now referred to as the Minnetonka Lakeshore-Advance Machine site, was redeveloped as privately-owned townhomes. In 2012, the site was transferred from the MPCA Voluntary Investigation and Cleanup Program to the MPCA State Superfund Program to expedite investigations and response actions. The TCE in the soil and groundwater beneath the townhomes poses a potential health concern, due to the possibility of TCE vapors entering the homes from the subsurface, a process known as vapor intrusion. These vapors may accumulate inside the buildings, where they can be inhaled by residents. In addition to vapor intrusion, townhome residents (as well as all Spring Park residents) may be exposed to TCE through their drinking water. Low levels of TCE are present in two of the three Spring Park municipal wells, and therefore intermittently in the drinking water supplied to the residents of Spring Park. As a result, Spring Park residents may be exposed to TCE from ingestion of their drinking water and TCE may also volatilize from the water and into the indoor air, where it can be inhaled. The levels of TCE in the municipal water have never exceeded the federal drinking water standards; however, they are above new MDH health-based drinking water guidance. There currently does not appear to be a hydrologic connection between the affected municipal wells and the groundwater contamination at the Minnetonka Lakeshore-Advance Machine site. TCE is a common contaminant in soil and groundwater, and other sources in the area may be contributing to the concentrations in the City wells. MDH recommends a source investigation be completed to define the source.

	A final potential exposure pathway associated with the Minnetonka Lakeshore-Advance Machine site is through surface water. TCE-contaminated groundwater may be discharging to Lake Minnetonka, possibly at levels that exceed surface water standards. Additional groundwater monitoring is recommended to evaluate this pathway.
OVERVIEW	MDH reached two important conclusions in this Health Consultation.
CONCLUSION 1	There is a potential health risk of breathing TCE vapors in indoor air at the West Arm Townhomes.
BASIS FOR CONCLUSION	Limited soil gas and indoor air quality data from the West Arm Townhomes indicate the potential for vapor intrusion risks from TCE.
NEXT STEPS	To help prevent potential current and future risk of breathing air containing TCE, vapor intrusion at the townhomes should be mitigated, such as by installation of sub-slab depressurization systems.
CONCLUSION 2	Residents of the City of Spring Park may be exposed to TCE from ingestion of their drinking water and inhalation of TCE that may volatilize from the water and into the indoor air.
BASIS FOR CONCLUSION	Two of the three public drinking water wells are completed in aquifers that contain low levels of TCE. The public drinking water supply for Spring Park has intermittently contained TCE at low levels since 2004.
NEXT STEPS	The MPCA has plans to investigate potential sources of the TCE in the City water supply wells. The City of Spring Park is exploring options for reducing or eliminating TCE in the water supply. For households that contain infants and children, women who are pregnant or expecting to become pregnant, and/or people with impaired immune systems, MDH recommends that steps are taken to reduce exposure to TCE in the municipal water. This can include installing a point-of-use filter or using bottled water for drinking water, as well as ventilating the air in the home to remove TCE that may have volatilized into the indoor air during water use, such as while showering.

II. Background and Site History

The Minnetonka Lakeshore-Advance Machine site is located in Spring Park, Minnesota (Figure 1) and was originally developed in the 1930s by Streater Industries, Inc. The company constructed several buildings for manufacturing of kitchen cabinets and store fixtures (Wenck, 2002). The Advance Machine Company (hereafter "Advance") purchased the 2.4 acre site in 1958 and over time acquired surrounding properties and constructed a large building for the manufacture of industrial floor maintenance equipment (Figure 2). In 1985 construction was started on a new Advance headquarters, manufacturing, and distribution center in Plymouth, Minnesota (Advance, 2013). Advance's Spring Park building was decommissioned on July 1, 1987 (Wenck, 2002). In 1994, Advance merged with Nilfisk, a well-known international company, to become Nilfisk-Advance, Inc. (Advance, 2013).

In 1994 the site was purchased for redevelopment. Between 1995 and 2000, 12 townhome units were constructed for a total of 25 residences (4202 through 4250 West Arm Drive, Spring Park, Minnesota)

that became the West Arm Townhome (WATH) Association (Figure 3). The townhomes all have full basements and are a mix of single story and two story structures (Liesch, 2010). A portion of the townhome development was constructed in an area where the soil and groundwater are contaminated with trichloroethylene (TCE) and other chemicals related to past manufacturing activities at the site (Figure 3). The townhomes are bordered by the West Arm of Lake Minnetonka to the north, Rockvam Boat Yards and other businesses to the east, residences to the west, and a paved recreational trail to the south. The site covers approximately 5.6 acres (Wenck, 2002).

A. Geology and Hydrology

The site is located in an area where thick deposits (up to 275 feet) of glacial outwash sediments overlie the bedrock (MDH, 2010). Soil borings drilled at the site encountered a thin (0 to 20 feet), discontinuous layer of silty clay (or upper clay) overlying a continuous layer of silty sand. The clay layer is absent in the area of 4222-4224 West Arm Drive. The underlying silty sand thickens from 15 feet near the south boundary of the site to over 75 feet near the shoreline of Lake Minnetonka (Wenck, 2002). This sand unit is underlain by what appears to be a continuous clay layer (lower clay). The surface of this lower clay layer generally slopes to the north, but is very irregular, with up to 60 feet of topographic relief including a northeast-southwest trending buried valley that is located beneath 4220 – 4224 West Arm Drive (Figure 4; Wenck, 2002).

In the Spring Park area, the thick glacial sediments are underlain by a sequence of sedimentary bedrock layers consisting of, from the bedrock surface: the Prairie du Chien Group (OPDC), the Jordan sandstone (CJDN), the St. Lawrence Formation (CSTL), the Franconia Formation (CFRN), the Ironton and Galesville sandstones (CIGL), the Eau Claire Formation (CECR), the Mt. Simon and the Hinckley sandstones (CMHS; MDH, 2010). However, in the area where the site is located, the OPDC was eroded away before the glacial sediments were deposited, so the uppermost bedrock unit is the CJDN.

Groundwater is encountered beneath the site at depths of 15 to 20 feet below the ground surface, at essentially the same elevation as the water level in Lake Minnetonka. The surface of the groundwater is referred to as the water table and the sedimentary unit in which this surface is encountered is called the water table aquifer. Because the site is located on an isthmus of land between two bays of the lake, groundwater elevations and flow directions are closely linked to lake water levels. Groundwater in the water table aquifer generally flows to the north toward the lake, although the flow direction may vary depending on water levels in various parts of the lake.

There are four other aquifers recognized in the area of the site: the buried Quaternary aquifer (QBAA; this is the saturated sand deposits below the lower clay that underlies the water table aquifer), the Prairie du Chien-Jordan aquifer (OPCJ), the Franconia-Ironton-Galesville aquifer (CFIG), and the Mt. Simon-Hinckley aquifer (CMHS). The regional groundwater flow directions in the QBAA, OPCJ, and CFIG aquifers are to the south-southeast while in the CMHS the groundwater appears to flow to the east-southeast (Kanivetsky, 1989a and 1989b). Each aquifer is separated from the others by low permeability layers called aquitards; these are generally shales and siltstone formations which limit or prevent the downward movement of groundwater and contaminants. However, one or more of these aquitards may be absent in a given area, or their ability to prevent groundwater movement may be compromised by faults, fractures, and other structures, leaving the lower aquifers vulnerable.

A fracture trace analysis and seismic survey completed at the site suggested the presence of a northeast-southwest trending graben (Bison Service Co., 2002). The reported location of this structure is shown on Figure 5. A graben is geologic feature caused by the downward displacement of geologic units that are bounded on two sides by faults, resulting in a depression on the surface of the bedrock and any unconsolidated materials present above the bedrock at the time the movement occurs. The center of the reported graben does coincide with a topographic low on the surface of the clay layer that underlies the sand aquifer, although this feature could have been caused by erosion, rather than faulting. The topographic low appears to form a northeastward dipping buried valley which may influence the direction of groundwater (and contaminant) flow. A geologic cross-section of the area presented in the Spring Park Wellhead Protection Plan (MDH, 2010) does seem to indicate some faults may be present in the deep bedrock units beneath the site (CMHS and CFIG), but the displacement does not appear to carry upwards through the shallower units (CJDN). If faults are present in the area of the site, they could affect groundwater flow directions within the deeper bedrock aquifers.

B. Remedial Investigations

In 1989, during building demolition, four underground fuel storage tanks were removed from the site and petroleum contamination was discovered below one of the tanks (Wenck, 2002). One hundred and twenty cubic yards of petroleum impacted soil was removed from the property; the petroleum leak site was closed by the MPCA in October of 1989 (Wenck, 2002; see Figure 5).

In 1994, a limited soil and groundwater investigation was conducted for the former fuel storage tanks. Diesel range organics (DRO) were found in soil at 17,000 parts per million (ppm) in one soil boring. Groundwater sampling detected TCE at levels up to 3,900 parts per billion (ppb). One water sample also contained diesel range organics (DRO) at 95,900 ppb (Wenck, 2002).

In early 1995, petroleum contaminated soil was encountered while excavating for the construction of townhomes. The contaminated soil was removed and treated and/or disposed. In 1997, following a search of potential responsible parties by the MPCA for the TCE release, Nilfisk-Advance enrolled with the MPCA Voluntary Investigation and Cleanup (VIC) Program to investigate and remediate the groundwater contamination (MPCA, 2010b). The source of the TCE is thought to be from Advance's vapor degreasing operations, storage and other manufacturing uses of TCE (Liesch, 2010).

In 1998 and 1999, groundwater samples were collected at various depths from 26 push-probe borings and analyzed for volatile organic compounds (VOCs) in order to define the TCE plume (Figure 5; Table 1; Wenck, 2002). The maximum results for TCE, perchloroethylene (PCE; also known as tetrachloroethylene), and cis-1,2-dichloroethene (cis-1,2-DCE) were 22,000 ppb, 230 ppb, and 630 ppb, respectively (Wenck, 2002). Trace levels of petroleum-related chemicals (benzene, ethyl benzene and toluene) were detected in three push-probe samples, but none exceeded their drinking water criteria. Two vapor probes were advanced in the vicinity of former storage and use of TCE; VOCs were not detected in the soil gas (Wenck, 2002) but the field instrument used would not have been sensitive enough to measure VOCs in the ppb range.

In 2002, 17 soil borings were drilled at the site and samples were analyzed for VOCs; cis-1,2-DCE, naphthalene, PCE, and TCE were detected (Figure 5; Table 2). Of these VOCs, TCE was detected the most often and at the highest concentrations (up to 10 ppm; Wenck, 2002). Generally, soil samples collected at or just below the water table did not contain TCE; the highest concentrations were detected

in samples collected 20-50 feet below the water table, with the very highest concentrations being found near the base of the sand aquifer within the buried valley (Figure 6).

Five groundwater monitoring wells were also installed in 2002 (Figure 5; Wenck, 2002): shallow wells MW-1, MW-2, MW-3, MW-4, and a deep well, MW-3D. The shallow monitoring wells were screened at depths ranging from 28 to 45 feet below ground surface and 17 to 21 feet below the water table; the deep well was screened from 56 to 66 feet below ground surface, approximately 46 feet below the water table. The wells were screened to coincide with the depth of maximum TCE concentrations as determined from the 1998-1999 push-probe investigation. Analysis of groundwater samples from the wells since 2002 has routinely detected TCE, PCE, cis-1,2-DCE, and trans-1,2-DCE. Monitoring well results are presented in Table 3.

The site investigations identified two areas of TCE contamination: a more contaminated "west area" and a less contaminated "Depot area" (Figure 3; Wenck, 2002). In most of the borings, the maximum soil and groundwater contaminant concentrations levels were detected at elevations between 905 to 925 feet above mean sea level (msl), or about 4 to 24 feet below the top of the water table, although the highest concentrations detected in four of the push-probes and four soil borings were even deeper, at 875 to 905 feet msl, or 24 to 54 feet below the water table. The highest soil and groundwater concentrations were detected in boring B-7 and MW-1, near the base of the northeast trending valley in the lower clay layer. This is consistent with observations at other TCE sites and is likely due to TCE (and other chlorinated VOCs) having a higher density than water. In contrast, the TCE contamination in the "Depot area" is generally present at and just below the water table (Table 2). The "west area" TCE plume widens to the north, toward the lake (Figure 3; Wenck, 2002). The downgradient extent of the VOC plume beneath Lake Minnetonka and the potential discharge points of the plume to the lake are unknown.

The remedial investigation and feasibility study was completed in December of 2002. At that time, the groundwater was not considered to pose a human health risk because all site residents receive municipal water. However, cleanup of the site was determined to be necessary on the basis of the potential for ecological risk (due to groundwater discharging to Lake Minnetonka). As a result, the surface water quality standard for TCE for Lake Minnetonka of 120 ppb was used as the cleanup standard for TCE in groundwater (Wenck, 2002).

C. Groundwater Monitoring and Remediation

1. Remediation

Based on the remedial investigation and feasibility study, a pump-and-treat system was installed to address the groundwater contamination (Wenck, 2002). In 2003, a recovery well, RW-1, was installed on Hennepin County Regional Railroad Authority (HCRRA) property, south of the townhomes (Figure 5; MPCA, 2010b). This well is sampled monthly from April to December of each year (Liesch, 2010; Table 3). Groundwater is pumped from RW-1 into a small treatment building (also on HCRRA property), filtered through granulated activated carbon and the treated water is then discharged to Lake Minnetonka via an underground pipe (Liesch, 2010). The concentrations of site contaminants in the discharge water from the treatment system are shown in Table 4. The groundwater pump-and-treat system has been in operation since April 2004 except during the winter months (operating

approximately May to November). The system is shut off during winter months to avoid creating dangerous thin ice conditions near the treated water discharge point in the lake.

The purpose of the groundwater pump-and-treat system is two-fold: remove dissolved groundwater contaminants and prevent contaminated groundwater from entering Lake Minnetonka. In 2011, it was estimated that the system had removed over 1,100 pounds (or 97 gallons) of TCE from the groundwater (Liesch, 2012). The contaminants are adsorbed onto the GAC filters and then destroyed when the carbon from the filters is thermally regenerated off-site for reuse. It is unclear how effectively the system meets the second objective of preventing groundwater contaminants from entering Lake Minnetonka, due to the intermittent operation of the remedial system. Monitoring data suggests that during the months when the system is active, the recovery well is controlling shallow groundwater flow and preventing the site contaminants from discharging to the lake. However, the monitoring well network is extremely limited and provides insufficient information regarding flow near the base of the upper sand aquifer, where the bulk of the TCE plume is located. Moreover, during periods when the recovery well is not in operation the contaminants may be moving to the lake. The absence of downgradient monitoring points currently makes it impossible to evaluate the concentrations of VOCs moving beneath the townhomes and under the lake. However, when the downgradient monitoring wells (MW-3, MW-3D, and MW-4) were present, they only achieved the site cleanup goal once, in the last samples collected in 2009 before the wells were removed (Table 3). It is also unknown if or where the VOCs discharge to the lake.

2. Groundwater Monitoring

From 2002-2009, groundwater samples were collected twice a year from the five monitoring wells (Table 3; MPCA, 2008b). In 2009, at the request of WATH homeowners, the three downgradient monitoring wells (MW-3, MW-3D, and MW-4) were abandoned (Liesch, 2010). At that time, the TCE concentrations in well MW-3 exceeded the 120 µg/L cleanup goal (Table 3). The current groundwater quality monitoring network consists of the two monitoring wells (MW-1, MW-2) and the recovery well (RW-1), all of which are located on the upgradient, south edge of the site on HCRRA property (Liesch, 2010). MW-1 and MW-2 are currently being sampled once every two years, with the most recent available data being from 2009 (Liesch, 2011; Liesch, 2012).

RW-1 and the treated groundwater are sampled at least once per month during those months when the system is operating. The average TCE concentration for the recovery well influent in 2011 was 1,308 ppb (Liesch, 2012). The treated water that is discharged to the lake has only exceeded the discharge standard once for cis-1,2-DCE (650 ppb in May 2007). TCE concentrations in the treated water are well below the 120 ppb cleanup criteria. Cis-1,2-DCE is the dominant site contaminant detected in the treated discharge water.

As shown in Table 3, TCE and other VOC concentrations in the monitoring wells and RW-1 decreased significantly after the pump-and-treat system began operation in 2004. The more recent data from MW-1, MW-2 and RW-1 suggest the concentrations have “leveled off.” This is typical of pump-and-treat systems; however the groundwater contaminant concentrations at pump-and-treat sites often increase again after the system is shut off. For this reason, sampling of the monitoring wells and the downgradient area during the periods when the system is not operating is a critical missing element in the site monitoring.

As a result of the removal of wells MW-3, MW-3D and MW-4, there are no downgradient monitoring locations to track the TCE plume. In an attempt to evaluate groundwater quality in this area, groundwater sampling was planned for January 2012 using temporary push-probe borings just off-shore near the location of former wells MW-3 and MW-3D (Liesch, 2011). However, thin ice conditions in January 2012 did not permit this work to be completed. Vertical water quality profiling, using a push probe boring, was completed in March 2013 at the 4218 West Arm property to replicate the previous MW-3 and MW-3D sampling locations; the sample results are not yet available (Pers. comm., A. Benker, 2013). Future groundwater monitoring in this area is currently planned to occur every 2 years.

D. Drinking Water

In 1997, a drinking water well survey was conducted to determine if people on the site were being exposed to the groundwater (Wenck, 2002). No groundwater receptors were found. In 2002 it was reported that no wells were located on the site at all, with the exception of the recently installed monitoring wells (Wenck, 2002). A number of wells were found in the vicinity, but none were expected to be impacted by site contamination due to the geology of the area (Wenck, 2002). MDH contacted the City of Spring Park and confirmed that all residents in Spring Park are connected to city water.

The City of Spring Park has three municipal drinking water supply wells located west-southwest of the site (see Figure 7). The municipal water supply wells draw water from much deeper aquifers than the water table aquifer in which the monitoring wells at the site are completed. Spring Park #1 draws water from both the Franconia-Ironton-Galesville (CFIG) aquifer and the top of the Mt. Simon-Hinckley (CMHS) aquifer, Spring Park #2 draws water from the Jordan (CJDN), and Spring Park #3 draws water from the Mt. Simon (CMTS). Based on regional groundwater flow directions in these aquifers, the city wells will draw water primarily from the area located upgradient, or northwest, of the well field. Groundwater modeling by MDH has defined a 10-year capture zone for the three wells, which is shown on Figure 7 (MDH, 2010). The capture zone represents the approximate area from which water in the pumped aquifers will take ten years to travel to the city wells. Although the capture zone includes the westernmost end of the Advance Machine site, the areas where groundwater is known to have been contaminated by site activities are outside of the capture zone.

The water from the three municipal wells is pumped to a treatment plant where excess iron is removed, fluoride is added, and the water is chlorinated to kill bacteria. This treated water is routinely sampled to ensure compliance with the federal Safe Drinking Water Act or SDWA (Table 5). Low levels of TCE (up to 2.4 ppb) and one of its degradation byproducts, cis-1,2-DCE (up to 3.1 ppb), have been detected in water from Spring Park wells #1 and #2 since 2004, but have not exceeded the federal drinking water standards. Trace levels (<1 ppb) of PCE, toluene, and xylenes have also been detected in the city water, but very infrequently. None of the VOCs detected in the city water have ever exceeded their individual federal standards.

TCE is not always detected in the city water samples, likely because some of the samples were collected when well #3 was providing all or most of the water. TCE and cis-1,2-DCE have not been detected in water from Spring Park well #3, which draws water only from the very deep CMTS aquifer. Wells 1 and 2 are the primary water supply wells; well 3 is used during peak demand periods and when wells 1 and 2 need to be serviced. For much of 2012, well #2 was not used because it was pumping sand from the aquifer, so only wells 1 and 3 were being pumped (pers. comm., Isaac Bradlich, MDH, 2013). Although

the concentrations in Table 5 may appear to be trending upward, the variable pumping of different wells at different times makes it difficult to draw any conclusions regarding actual groundwater quality trends. During years when TCE has been detected, the city reported the concentrations to residents in the annual Consumer Confidence Report, as required under the federal Safe Drinking Water Act.

Public water supplies are regulated by the federal government under the SDWA and the EPA establishes enforceable standards, Maximum Contaminant Levels (MCLs). These are legal limits intended to both protect human health and be economically feasible for water systems to achieve through the use of best available technology or treatment techniques. The current MCL of 5 ppb for TCE was established in 1989. The municipal water in Spring Park has never exceeded this standard. Under the Minnesota Groundwater Protection Act, MDH may also establish drinking water standards and guidance values for groundwater contaminants. These standards, known as Health Risk Limits (HRLs), and guidance values, known as Health Based Values (HBVs), are used to evaluate groundwater quality and provide drinking water advice to private well owners, but not municipal systems. HRLs are defined as levels of contaminants that are likely to pose little or no health risk to a population. HBVs are very similar to HRLs; the difference is that HRLs are formally adopted in Minnesota Rules and HBVs have not gone through rulemaking. HRLs/HBVs are not legally enforceable for public water supplies. From 2002 until May 2013, the MDH advice for TCE had been 5 ppb (and formally adopted this value as an HRL in 2007). In 2013, MDH completed a new toxicological review of TCE in drinking water and has replaced the HRL with a new HBV of 0.4 ppb. It is unknown if EPA will re-evaluate the TCE MCL, so the regulatory standard for the Spring Park municipal wells will likely remain at 5 ppb in the near future. For more discussion on the toxicity of TCE, see the *Chemicals of Interest* section below.

The source of the TCE in the city wells has not been identified. A number of current and former businesses in the Spring Park area may have used (or may still use) TCE or compounds that can degrade to TCE, such as PCE. Although the known areas of groundwater contamination associated with the former Advance Machine site are located outside of the city wells capture zone, the full extent of the TCE plume beneath Lake Minnetonka has not been defined and the site cannot yet be ruled out as a possible source. A thorough source investigation is needed to identify the actual source(s).

<u>Inhalation and dermal routes of exposure from drinking water</u>

TCE can also be found in indoor air from the volatilization of contaminated tap water. Contaminants can volatilize from showers, bathtubs, washing machines, dishwashers, toilets, etc. Daily exposure to TCE, for example, may be the highest during showering. Researchers have created many models in attempt to predict inhalation exposures from tap water (Andelman, 1985; McKone, 1989; USEPA, 2000, etc.). Although there is variation in quantifying exposure doses, researchers agree that inhalation of volatile chemicals can be an important exposure route (ATSDR, 2005). A lesser amount of exposure to TCE can also occur by absorption through the skin.

E. Vapor Intrusion

1. What is Vapor Intrusion?

TCE and other chlorinated volatile organic chemicals (VOCs) easily evaporate. VOCs evaporating from polluted soil and groundwater rise towards the ground surface. If these vapors encounter a building as they travel to the surface, they may enter through cracks in the foundation, around pipes, or through a sump or drain system. In this way, the VOC vapors may enter buildings and contaminate the indoor air.

There are potential health effects of long-term exposure to low levels of contaminants in indoor air. Long-term exposure to some of the VOCs that have been found at vapor intrusion sites may be associated with the increased risk to the immune system, nervous system, and to the developing fetus (see TCE section for more information about health effects below). Exposure may also lead to an increased risk of developing certain types of cancer. Even though these risks are usually very low, they are avoidable, and health and environmental officials want to identify and take steps to reduce or eliminate vapor intrusion where possible.

A vapor intrusion investigation usually begins with sampling the soil gas near buildings to determine if soil vapors are present and if they exceed soil gas screening values. If soil vapors near buildings are elevated above screening values, a sample of soil gas beneath the building foundation is collected by drilling a small hole in the building slab and using a sampling device to collect the vapor. This is referred to as a "sub-slab" sample. If the concentrations in a sub-slab sample are high enough to indicate the potential for a vapor intrusion problem, the building's indoor air may be sampled. Indoor air samples are collected in specialized canisters that allow for the collection of air over a 24 hour period. If vapor intrusion risks are indicated based on sub-slab or indoor air results, a mitigation system is recommended to vent the vapors. Often other actions are taken to reduce or eliminate the source of the vapor intrusion, such as groundwater remediation.

Many factors affect vapor intrusion and indoor air quality, such as the weather or season, a change in the elevation of the water table, type of building construction, and ventilation. Vapor intrusion can be the highest during the winter months when air exchange rates are the lowest and heated interior air can cause house depressurization, which tends to draw air up through the home. As a result, vapor intrusion rates and indoor air quality may change significantly over time. If contaminants are found in soil gas beneath a building above levels of concern but they are not detected in indoor air, it lessens the concern that vapor intrusion is occurring, but does not eliminate it. On the other hand, if contaminants are found in indoor air (especially in the basement) of a building situated above where contamination is located, vapor intrusion may be occurring. However, VOCs can come from other sources within the building including household products. As a result of multiple factors that can influence the presence of VOCs in indoor air, more than one sampling event may be necessary to determine the likelihood and extent of vapor intrusion.

Indoor air investigations are difficult to conduct because entering homes can be invasive to the personal lives of individuals and it can be difficult to interpret the results. However, vapor intrusion investigations are important because indoor air contamination can result in significant exposures for individuals. People cannot avoid breathing in their own home, and residential air is what most people breathe for the most hours each day. An investigation may be avoided if a mitigation system is installed without the collection of sub-slab or indoor air samples. These systems are discussed below.

2. Intrusion Screening Values (ISVs) and other Risk-Based Guidance Values

The Intrusion Screening Values were developed by MPCA to evaluate the vapor intrusion pathway. The ISVs are intended to be used to screen for inhalation health risks from indoor air. The MPCA's Remediation Division also uses 10 times the ISVs as residential screening values for sub-slab and soil gas vapor sample results (MPCA, 2008a). These higher screening values are used when soil vapor is sampled because contaminant concentrations in indoor air are typically much lower than the concentrations measured in the surrounding soil (MPCA, 2008a). The selection of soil vapor screening values is based in

part on recommendations from EPA and in part on actual data for the ratios between indoor air concentrations and concentrations measured in soil vapor (MPCA, 2008a).

The ISV for TCE is currently 2 µg/m^3 (micrograms per cubic meter) (MPCA, 2013). This value protects people from immune system effects and effects to the developing fetus, as well as cancer and other health effects (see TCE section below). The resulting screening level for near slab and sub-slab soil gas samples is 20 µg/m^3 (see Table 6 for ISVs for all site-related contaminants).

However, there has been much discussion in the past year regarding appropriate air concentrations that might pose a short-term risk to the developing fetus. At least two state agencies and three EPA regions have developed short-term TCE inhalation levels based on data in the 2011 EPA toxicological assessment. The levels they are using to assess short-term risk to TCE range from 2 - 27 µg/m^3. A description of these guidance values can be found in Appendix A. EPA is expected to officially respond to these different approaches in 2013.

Indoor air samples may have multiple compounds of concern. In such cases, it is also appropriate to consider the cumulative risk of compounds with similar health effects to adequately evaluate health risks posed by the combination of site contaminants.

3. Site Vapor Intrusion Investigations

In fall 2006, with the development of new guidance for evaluating vapor intrusion risks, the MPCA requested a vapor intrusion investigation based on the high concentrations of TCE in groundwater at the site.

Indoor air samples were collected from six townhomes between November 2006 and January 2007. One townhome had TCE in indoor air above the ISV at 17 µg/m^3, while two others had concentrations just below the former TCE ISV (2.6, 2.8 µg/m^3). Typically soil gas samples are taken prior to indoor air sampling to help determine if any vapors found in indoor air are likely to be coming from soil gas, but no soil gas samples were taken at this time.

Low levels of other VOCs that were not detected in the soil or groundwater at the site were found in the indoor air samples. These compounds are likely from consumer products in the home. Only the contaminants found in the soil and groundwater are considered for estimating health risk for indoor air for the purposes of evaluating this site.

Near-slab soil vapor sampling was conducted near eleven townhomes between September 2007 and July 2008. TCE was found in soil vapor at levels that are considered a risk for vapor intrusion at five locations.

To check for the extent of soil vapors to the west, a single soil gas sample was collected on HCRRA property in November 2009 near the westernmost townhomes to the south. No TCE or other chlorinated solvents were detected; however, low levels of petroleum and other compounds were detected (Liesch, 2010).

In November 2011, two townhome sub-slab measurements were taken; one contained high levels of TCE in soil gas beneath the townhome and the other had low levels. One additional soil vapor sample near a townhome was collected in October of 2011 and was found to have elevated TCE.

In August 2010, the consultant for Nilfisk -Advance, Inc. prepared an additional soil vapor sampling plan to more comprehensively address the identification and mitigation of vapor intrusion risks (Liesch, 2010). Based on the data already collected, the plan proposes soil vapor sampling near specific townhomes and beneath the concrete slab floor of other townhomes where sampling has already indicated a potential vapor problem. The plan also proposes indoor air sampling at one residence that exceeded the ISV for TCE during the 2006 sampling. After the additional sampling is conducted, the results are to be evaluated and provided to individual property owners and occupants by the MPCA along with recommendations. Since 2010, only four homeowners provided permission for the proposed sampling to be conducted. Two mitigation systems were installed based on elevated levels of TCE near or below the townhomes. Sub-slab testing at one townhome had results below screening levels, while another had results above screening levels. There are still a number of townhomes that may contain TCE at unhealthy levels in indoor air.

A summary of the indoor air and soil vapor sampling can be found in Table 7 and Figure 8 for data collected from November 2006 to March 2013. The data was limited to those residences where owners granted access for the samples to be taken and as a result, provides an inadequate basis for determining the extent of TCE and other contaminants in the soil gas. Owner cooperation is essential to assessing vapor intrusion and mitigating the risk; to date, lack of owner cooperation has prevented a satisfactory investigation and the installation of mitigation systems. However, it is clear from limited data that TCE was found at substantial quantities in the soil gas in the recent past and is likely to still be present in soil gas and under the slabs of townhomes. A one-time near slab sample isn't always a good predictor of sub-slab concentrations, as indicated by the data collected for the residence at 4210. Two near slab samples in May 2008 indicated TCE in the soil gas at 3.4 and 23 $\mu g/m^3$, while in November 2010 the sub-slab concentration was 691 $\mu g/m^3$.

4. Background TCE in indoor air

Volatile organic compounds are typically found in indoor air from consumer products, building materials, and outdoor air (USEPA, 2011b). TCE is found in items such as adhesives, paint removers, cleaners, and varnishes. These sources of contaminants are commonly referred to as "background" contaminants – those sources that are distinct from contamination due to contaminated soil and groundwater. The presence of background sources can make it difficult to assess the contribution of vapor intrusion to indoor air.

EPA reviewed studies of indoor air collected from 1990-2005 in residences that were not expected or known to be located over contaminated soil or groundwater or have an effective mitigation system in place (USEPA, 2011b). TCE was included as one of the VOCs most commonly detected in indoor air. TCE in indoor air showed a strong decline over the study period (USEPA, 2011b). In 14 studies that measured TCE, 42.6% of the homes had detectable levels. The table below shows the 50th percentile of TCE in homes; the range was from not detected (ND) to 1.1 $\mu g/m^3$. In 11 studies that reported the 90th percentile of TCE in homes, the range was from ND to 2.1 $\mu g/m^3$. It is expected that future "background" TCE indoor air levels will decrease as new, less toxic consumer products and building materials become available.

Ranges of Summary Statistics for Background Indoor Air Concentrations of TCE Measured in North American Residences between 1990 and 2005 (in µg/m^3) (USEPA, 2011b)

Range of 50th% (median)	N	Range of 75th%	N	Range of 90th%	N	Range of 95th %	N
ND-1.1	14	ND-1.2	9	ND-2.1	11	0.56-3.3	5

N = number of studies reporting the percentile.
ND= not detected

More locally, outdoor, indoor, and personal air samples were collected in 1999 and analyzed for TCE from three Twin Cities urban neighborhoods (Sexton et al., 2004). Mean TCE levels were 0.2 µg/m^3 outdoors (*n* = 132), 0.5 µg/m^3 indoors (*n* = 292), and 1.0 µg/m^3 based on participants wearing a personal sampling device (*n* = 288).

These data illustrate that at least a small amount of TCE measured in indoor air in residences is often from sources other than vapor intrusion.

5. Sub-Slab Depressurization Systems (SSDS)

Two townhomes have installed a sub-slab depressurization system (SSDS) to mitigate the risk of vapor intrusion from the site. Systems installed to reduce chemical vapors from the soil gas are the same systems that are installed to reduce radon levels in the home. An SSDS prevents soil gases from entering the home by using a fan to create a slight vacuum beneath the slab relative to the interior air pressure to draw the gases from below the building slab. The soil gases are vented through a pipe to the air above the home where they are quickly diluted and broken down by oxygen and sunlight.

An added benefit of installation of a mitigation system to the homeowner is that it will reduce the level of radon in home. MDH has recently begun collecting a database of radon levels by zip code. Twenty-seven tests have been done in zip code 55384 between 2000-2010 and nine were over the EPA action level for mitigation of 4.0 pCi/L (picocuries per liter) (MDH, 2013). The highest value reported in the zip code was 9.2 pCi/L. These data are similar to the state average data which indicates that forty percent of Minnesota residences are over the EPA action level and should pursue long-term radon testing or mitigation to reduce the risk of developing lung cancer from radon gas. In addition, Minnesota state law now requires a home seller to disclose in writing to the buyer any knowledge the seller has of radon concentrations in the dwelling. The Minnesota Department of Health strongly recommends that all homebuyers have an indoor radon test performed prior to purchase or taking occupancy, and recommends having the radon levels mitigated if elevated radon concentrations are found. Thus, having a mitigation system in place is a positive attribute when selling a home in Minnesota, especially if radon levels are elevated.

Nilfisk-Advance has agreed in the past to provide an SSDS, at no cost to the homeowner, for all of the townhomes along West Arm Drive. The SSDS would be installed by an experienced radon mitigation contractor and the work overseen by Nilfisk-Advance's environmental consultant. As part of the installation the system should be checked to ensure it is working effectively.

III. Chemicals of Interest

A. Trichloroethylene (TCE)

Trichloroethylene (TCE) is a nonflammable, colorless liquid with a chloroform-like odor and slightly sweet, burning taste. TCE is largely known for its use in degreasing metal parts (ATSDR, 2003). Production of TCE began commercially in the 1920s (USEPA, 2011a). It was used for dry cleaning, as a carrier solvent for the active ingredients in pesticides, as an extractant in food products and for decaffeinating coffee, and as an inhalation anesthetic, but such uses have been discontinued (ATSDR, 1997a). In 2004, 73% of TCE use in the U.S. was estimated to be as a feedstock for HRC-134a, a refrigerant that was introduced as a replacement for CFC-12 in the 1990s (ATSDR, 2013). Metal degreasing accounted for approximately 24% of TCE use in 2004 (ATSDR, 2013). TCE is known to be found in wood stains, varnishes, and finishes; adhesives; paint removers, lubricants, and cleaners (ATSDR, 1997a).

TCE is a common environmental contaminant, widespread in ambient air, indoor air, soil, and groundwater (USEPA, 2011a). TCE is extremely volatile, and most TCE released into the environment will evaporate into the air. The mean and median concentration of TCE in ambient air samples between 1991-1998 collected at 25 sites across Minnesota were 0.43 and 0.21 $\mu g/m^3$, respectively (Pratt, et al., 2000). TCE released to soil or leaking from underground storage tanks or landfills can also migrate through the soil into groundwater due to its moderate water solubility. Once in the groundwater, TCE tends to "sink" downward in an aquifer below the water table because it is denser than water. Under the right condition, biodegradation of TCE may occur relatively slowly in soil and groundwater with half-lives on the order of months to years (USEPA, 2011a). Its relatively slow degradation rate means that TCE can persist in groundwater and it is one of the most frequently detected groundwater contaminants.

The EPA recently completed a thorough toxicological review of TCE, compiling available human epidemiologic data and experimental animal data (USEPA, 2011a). EPA concluded that TCE poses a potential human health hazard for non-cancer toxicity to the central nervous system, kidney, liver, immune system, male reproductive system, and developing fetus. The most sensitive effects appear to be developmental, kidney, and immunological (adult and developmental) effects. TCE is also considered a carcinogen by all routes for exposure. High exposures to TCE can cause kidney cancer in humans. There is also evidence of a strong causal association of human TCE exposure at high levels and non-Hodgkin's lymphoma. Less human evidence is found for an association between TCE exposure and other types of cancers (USEPA, 2011a).

MDH's 2013 toxicological review of TCE in drinking water agreed with EPA's conclusions. Immune effects were identified by MDH as the most sensitive health effect caused by exposure to TCE. MDH has developed a Health Based Value (HBV) for TCE in drinking water of 0.4 ppb, which is a safe level, and is protective for immune system effects as well as other health effects. This value is safe for all life stages, including developing fetuses, infants, children, and those with impaired immune systems. MDH determined that 2 ppb is protective for cancer for all individuals, even those exposed for an entire lifetime. A TCE drinking water concentration of 2 ppb is also a safe level for healthy adults who are only exposed after age 18; this level is also safe for pregnant women, to protect the developing fetus from heart defects.

B. Tetrachloroethylene (PCE)

Tetrachloroethylene, (also known as PERC, perchloroethylene, and PCE), is a nonflammable, colorless liquid at room temperature. PCE is a widely used solvent in dry cleaning. It is also used to manufacture other chemicals and for metal cleaning and vapor degreasing (ATSDR, 1997b). It can be found as an impurity in TCE. The majority of drycleaners nationwide use PCE as a solvent. It can be found in consumer products, including some paint and spot removers, water repellents, brake and wood cleaners, glues, and suede protectors.

PCE is similar in chemical structure with TCE and the two contaminants share many properties. PCE is also commonly present in ambient air, indoor air, soil and groundwater. PCE has an ether-like odor, although both PCE and TCE need to be in the air in a relatively large quantity before a person can smell it. PCE may off-gas into the indoor air in a home from garments that have been recently dry-cleaned. PCE has a relatively high mobility in soil and is frequently found in the groundwater as a result of improper disposal or the leaking of underground storage tanks. Like TCE, PCE is denser than water and tends to "sink" downward in an aquifer below the water table. PCE can biodegrade to TCE in the environment under certain conditions.

The primary exposure routes of concern are inhalation of vapor and ingestion of contaminated water. EPA recently concluded in their toxicological review that PCE poses a potential human health hazard for non-cancer toxicity to the central nervous system, kidney, liver, immune and hematologic system, and to development and reproduction (USEPA, 2012). Neurotoxicity appears to be the most sensitive health endpoint. Both animal and human studies, including studies of people who have been exposed to high levels of PCE in the workplace, have provided evidence that PCE exposure results in visual changes, slower reaction time, and impaired mental processes (USEPA, 2012). Other effects of high levels of PCE exposure include eye, nose, and throat irritation, dizziness, headaches, and nausea.

PCE is considered likely to be carcinogenic to humans by all routes of exposure (USEPA, 2012). Human studies of exposures to high levels provide suggestive evidence of a pattern associating PCE exposure and several types of cancer, including bladder cancer, non-Hodgkin lymphoma and multiple myeloma (USEPA, 2012). Animal studies provide conclusive evidence that PCE causes tumors in rodents. Leukemia and liver, testicular, kidney, brain, spleen, and skin tumors have been reported in rodent studies (USEPA, 2012).

C. cis-1,2- and trans-1,2-Dichloroethene (DCE)

1,2-dichloroethene (1,2-DCE) is a highly flammable, colorless liquid, with pungent, chloroform-like odor (ATSDR, 1997c). Historically 1,2-DCE has been used as a solvent for polymers and rubber (USEPA, 2010). It currently is used as a degreasing agent and in the production of other solvents (USEPA, 2010). 1,2-DCE can also appear in the groundwater due to anaerobic degradation of TCE or PCE.

1,2-DCE is volatile, moderately water soluble, and has a greater density than water, which may allow it to "sink" below the water table. Most 1,2-DCE in surface soils or surface water will evaporate into air. It can travel through subsurface soil to the groundwater. There is a slight chance that 1,2-DCE will break down into vinyl chloride, a chemical which is believed to be more toxic than TCE or 1,2-DCE (ATSDR, 1997c).

There are no chronic exposure studies of 1,2-DCE in animals. The most frequently observed effects of 1,2-DCE in subchronic toxicity studies in mice and rats were changes in the liver and kidney weights (USEPA, 2010). EPA determined in 2010 that there is inadequate information to assess the potential of 1,2-DCE to cause cancer.

IV. Discussion

A. Vapor Intrusion and TCE in Indoor Air

Soil gas and indoor air data collected at the site indicate that vapor intrusion may pose a health risk to residents at the West Arm Townhomes. Additional sampling data at properties located above the groundwater plume would indicate the concentrations in the soil gas or indoor air at select townhomes at the time of collection, however may not be able to accurately define the extent or behavior of the soil gas contaminant plume. The current sampling plan may not be adequate to account for potential spatial and temporal variations in vapor concentrations along the length of the groundwater plume and therefore could prematurely conclude some properties are not at risk. Long-term monitoring, which may not be practical at this site due to its invasive nature, would be needed to fully understand the variation of the presence of the contamination.

As discussed above, in addition to vapor intrusion, additional TCE inhalation exposure may be occurring from use of contaminated drinking water, as well as from background air concentrations from consumer products and in ambient air. The appropriate short-term screening values for TCE in indoor air are being widely discussed because of risk to the developing fetus, and it is likely that a relatively low level of TCE will be considered a potential health risk even for exposures that occur over short periods of time. Failure to account for variability in data collected has greater consequences for chemicals like TCE with possible risks from short-term exposures (Dawson, et al. 2013, Inside EPA, 2013). Additional contaminants found in indoor air also add to the health risk.

Soil gas intrusion is a natural process that degrades indoor air quality whether it is chemical vapors from a contaminated site, naturally occurring radon, methane, moisture, etc. (Schuver, 2013). Rather than relying solely on one-time sampling results, MDH recommends mitigation of all homes overlying the groundwater plume. Mitigation is preferred to eliminate the soil gas vapor pathway in the absence of information regarding future site conditions.

B. Drinking Water

In addition to the potential TCE inhalation exposures described above, residents of Spring Park may also be intermittently exposed to TCE by ingestion of their drinking water and inhalation of TCE that may volatilize from the water. MDH recommends that residents take steps to reduce exposure to TCE in drinking water if their household contains infants and children, women who are pregnant or may become pregnant, and/or people with impaired immune systems. The City of Spring Park is in the process of working on a plan in coordination with MDH to improve municipal drinking water quality.

An activated carbon filter is the best way to remove TCE from drinking water. There are two type of filters: those that filter water for one sink or appliance (point-of-use filter) and those that can filter all of the water that enters the home (a whole-house filter). MDH is testing a few point-of-use filters to learn more about their effectiveness. The major benefit of a whole-house filter is prevention of inhalation exposure when TCE evaporates from the water during other uses (e.g. showering and bathing, cooking and washing dishes, etc.). This type of system does cost more, requires regular maintenance, and should be installed by a licensed plumber or water conditioning contractor. Good ventilation (e.g. use of fans, opening windows) can also reduce concentrations of TCE in indoor air.

C. Child Health Considerations

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. They are smaller than adults, which means they breathe dust, soil, and heavy vapors close 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. Children may be at a greater risk from TCE exposure than adults because the primary health concerns associated with TCE exposure are developmental immune system effects, cancer, and heart defects in the developing fetus if the pregnant mother is exposed in the first trimester.

V. Conclusions

- Soil gas levels near eight of the West Arm Townhomes exceed screening levels for TCE and indicate the potential for vapor intrusion, although many townhome owners have not provided access to conduct sampling.
- Based on limited indoor air quality data, three townhomes show the need for mitigation or further evaluation of vapor intrusion risks. It is unknown how many other townhomes contain elevated levels of TCE in indoor air.
- Owner cooperation is essential to assessing vapor intrusion and mitigating the risk; to date, lack of owner cooperation has prevented a satisfactory investigation and the installation of mitigation systems.
- Current sampling plans for vapor intrusion are insufficient to account for variability in site concentrations. More than one sampling event may be necessary to determine the likelihood of vapor intrusion.
- The current MPCA long-term vapor intrusion screening value for TCE is 2 $\mu g/m^3$. The scientific and regulatory community is currently discussing appropriate screening values to use for short-term exposures to TCE.
- It is unknown if the intermittent operation of the groundwater pump-and-treat system allows VOCs to continue to migrate beneath the townhomes and under the lake during the winter periods when the system is not operating.
- The current extent of the VOC groundwater plume and concentrations near the lake shore and beneath the lake are unknown.

- The highest concentrations of soil and groundwater contamination were generally detected several to tens of feet below the water table, which may help to suppress the amount of soil gas being generated by the TCE and other VOCs. However, in areas where site contaminants are present only a few feet below the water table, changing water levels could expose more of the contamination causing soil gas concentrations to change over time.
- TCE can be found in indoor air from sources other than vapor intrusion, such as the ambient air, volatilization from tap water, and products such as adhesives, paint removers, cleaners, varnishes, and building materials inside the home.
- Two of the three public drinking water wells are located in aquifers that contain low levels of TCE. The public drinking water supply for Spring Park has intermittently contained TCE at low levels since 2004 (up to 2.4 ppb). The levels of TCE have never exceeded the federal Maximum Contaminant Level of 5 ppb.
- The source of the TCE in the city supply wells is unknown.
- Residents of Spring Park can be exposed to TCE through the ingestion and inhalation of TCE from the municipal tap water. MDH has conducted a toxicological review of TCE in drinking water and has recommended a Health Based Value (HBV) of 0.4 ppb.
- The federal regulatory drinking water standard for public water supplies will remain the MCL of 5 ppb, regardless of the new MDH HBV.

VI. Recommendations

- Mitigation of vapor intrusion, such as by installation of sub-slab depressurization systems, is recommended for all townhomes to prevent potential current and future risk of breathing indoor air containing TCE.
- Additional groundwater monitoring should be completed to determine the current downgradient concentrations and extent of the VOC plume.
- If warranted by the results of the additional groundwater monitoring, the possibility of continuous operation of the groundwater pump-and-treat system should be revisited, in order to optimize the performance of the system and accelerate the removal of VOCs from the site.
- For households that contain infants and children, women who are pregnant or expecting to become pregnant, and/or people with impaired immune systems, MDH recommends that steps are taken to reduce exposure to TCE in the municipal water. This can include installing a point-of-use filter or using bottled water for your drinking water, as well as ventilating the air in the home to remove TCE that may have volatilized into the indoor air during water use, such as while showering.
- The MPCA should conduct a source investigation to determine the source(s) of TCE in the city water supply wells.

VII. Public Health Action Plan

- MDH will provide information on health risks from exposure to TCE from vapor intrusion and drinking water to the residents of Spring Park.
- MDH will continue to work with the City of Spring Park to discuss options for the improvement of the municipal water quality.

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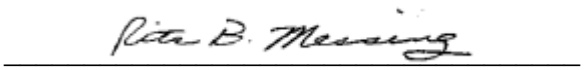
Preparers of the Report:

Emily Hansen, M.P.H
Health Assessor, Site Assessment and Consultation Unit
Minnesota Department of Health

Ginny Yingling, M.S.
Hydrogeologist, Site Assessment and Consultation Unit
Minnesota Department of Health

CERTIFICATION

This Minnetonka Lakeshore – Advance Machine Superfund site Health Consultation was prepared by the Minnesota Department of Health (MDH) with support from 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. This document has not been reviewed and cleared by ATSDR. Editorial review was completed by additional programs of MDH.



Rita B. Messing, PhD, Supervisor
Site Assessment and Consultation Unit, Environmental Assessment and Surveillance Section,
Division of Environmental Health, Minnesota Department of Health

Figures

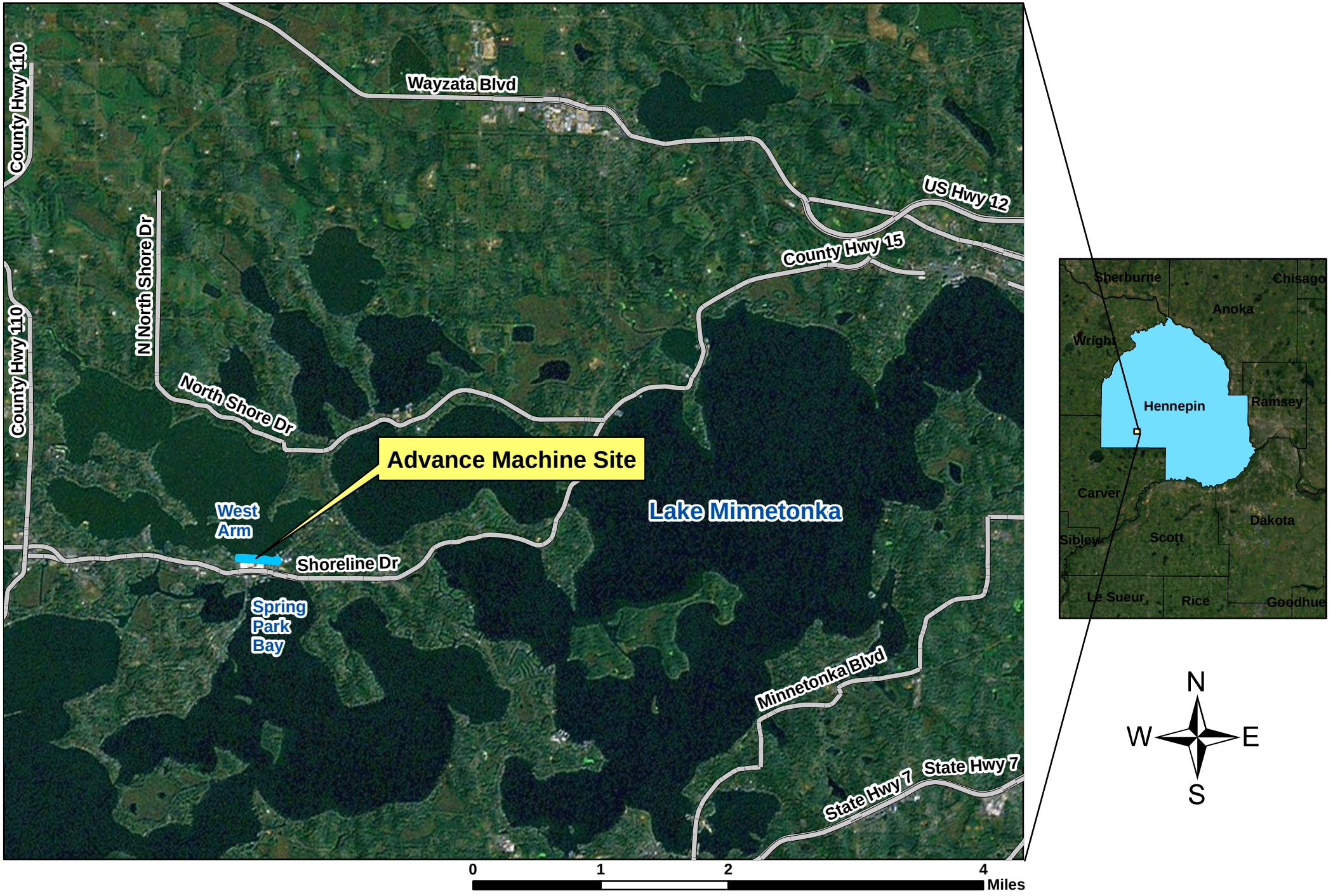


Figure 1 - Site Location Map

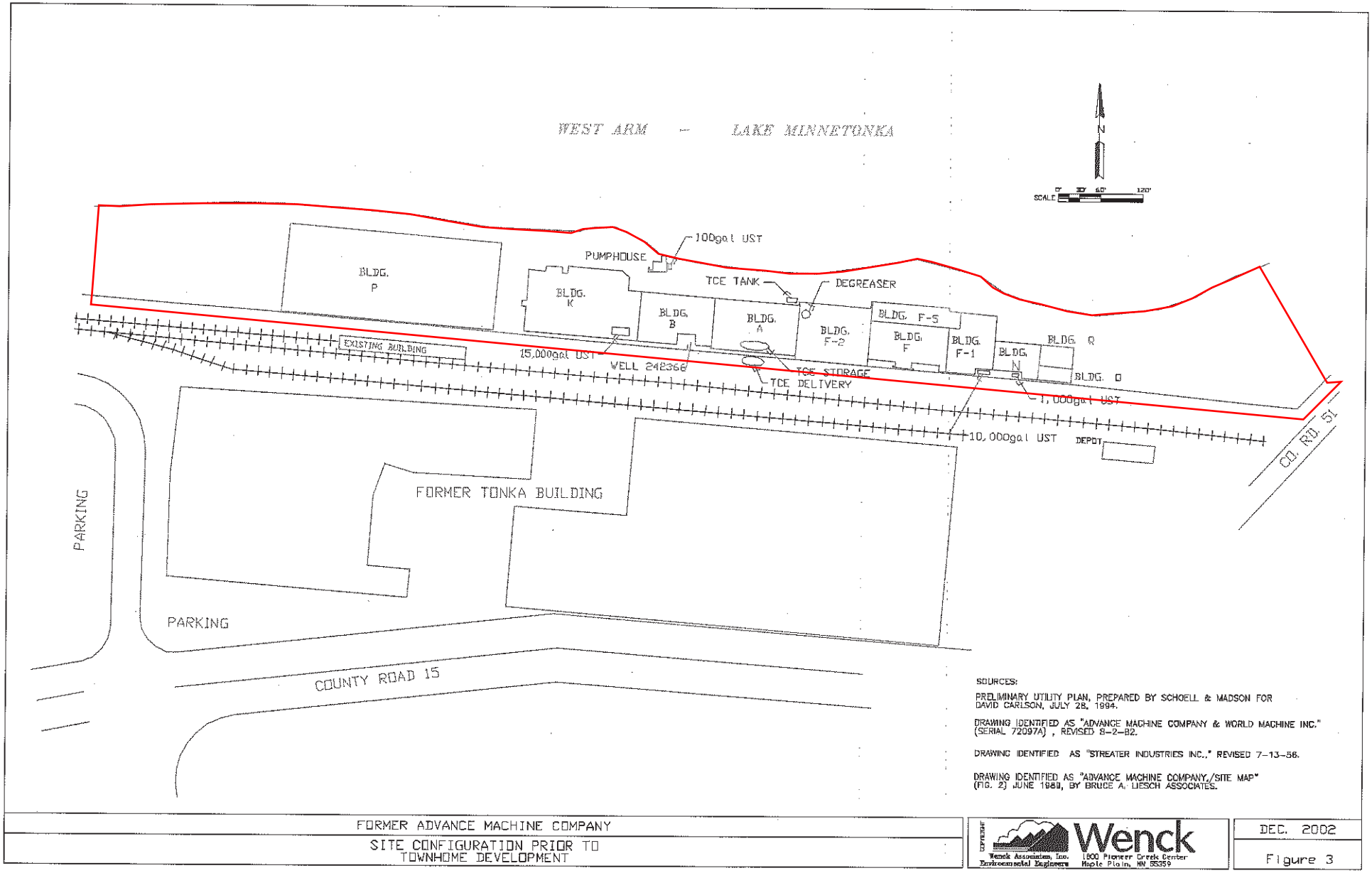


Figure 2 - Advance Machine Site Prior to Re-Development

Modified from: Wenck, 2002

Figure 3 - Current Site Map With Groundwater TCE Concentration Contours

Legend

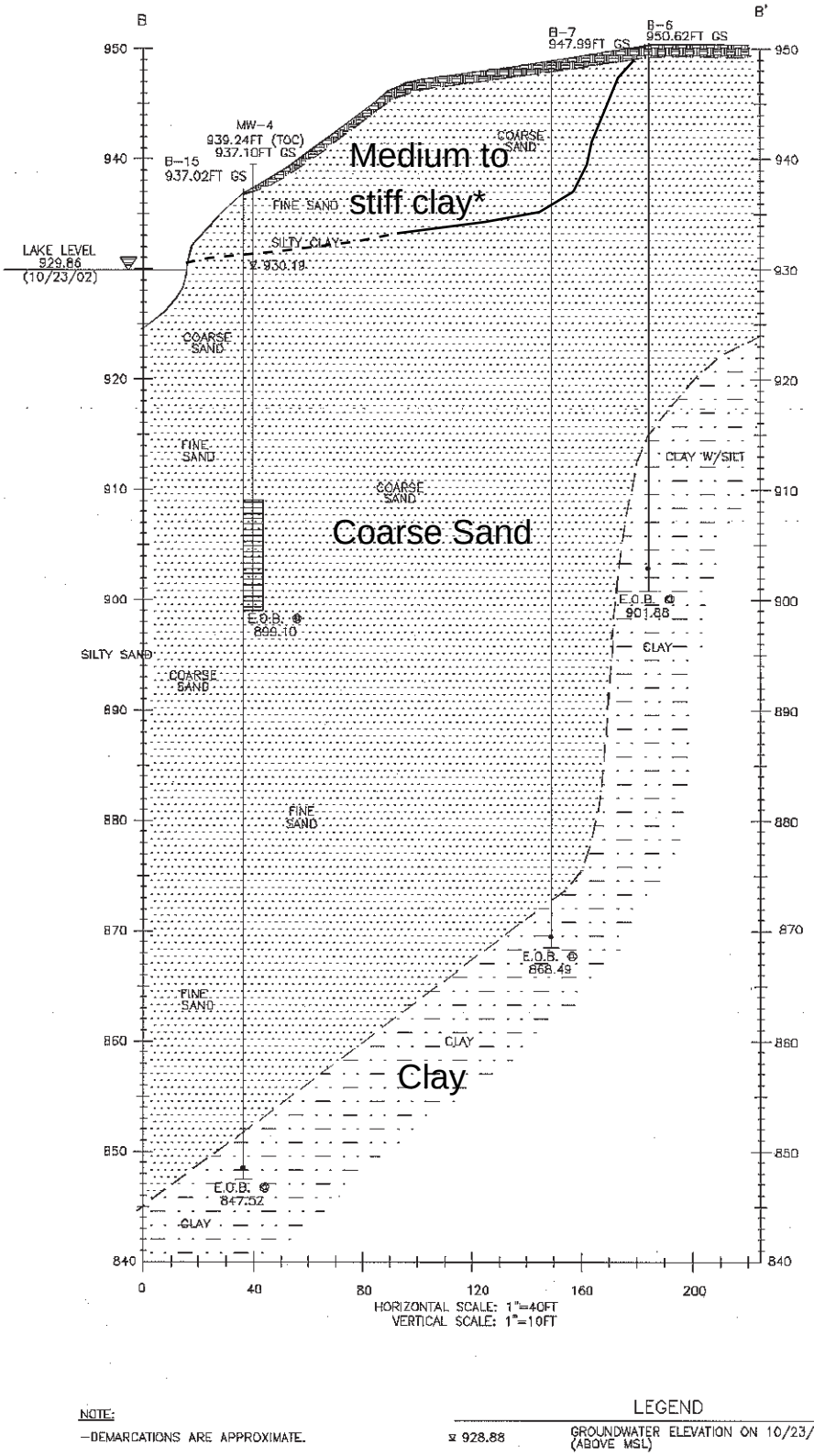
- Advance Machine site boundary
- TCE = 100 ppb
- TCE = 1000 ppb
- B — B' Location of cross-section shown in Figure 4

N
W E
S

NOTE: TCE concentrations in Depot Plume based on 1998-2002 investigation data, no current data available for this area

Prepared by MDH, 4/2/2013

Figure 4 - Cross-section Showing Main Geologic Units



*Upper clay layer added based on boring log for B-7 which recorded 13 ft. of clay (Wenck, 2002); location of this cross-section shown on Figure 3.

Wenck Associates, Inc. Environmental Engineers
1800 Pioneer Creek Center (763) 476-1250
Maple Plain, MN 55359 Fax (763) 476-4242

PROJECT: FORMER ADVANCE MACHINE COMPANY

SHEET TITLE: GEOLOGIC CROSS-SECTION B-B'

DATE: MAY, 2003

REVISIONS DATE

DWR DWR DSCN SW APP'D

Modified from Wenck, 2002

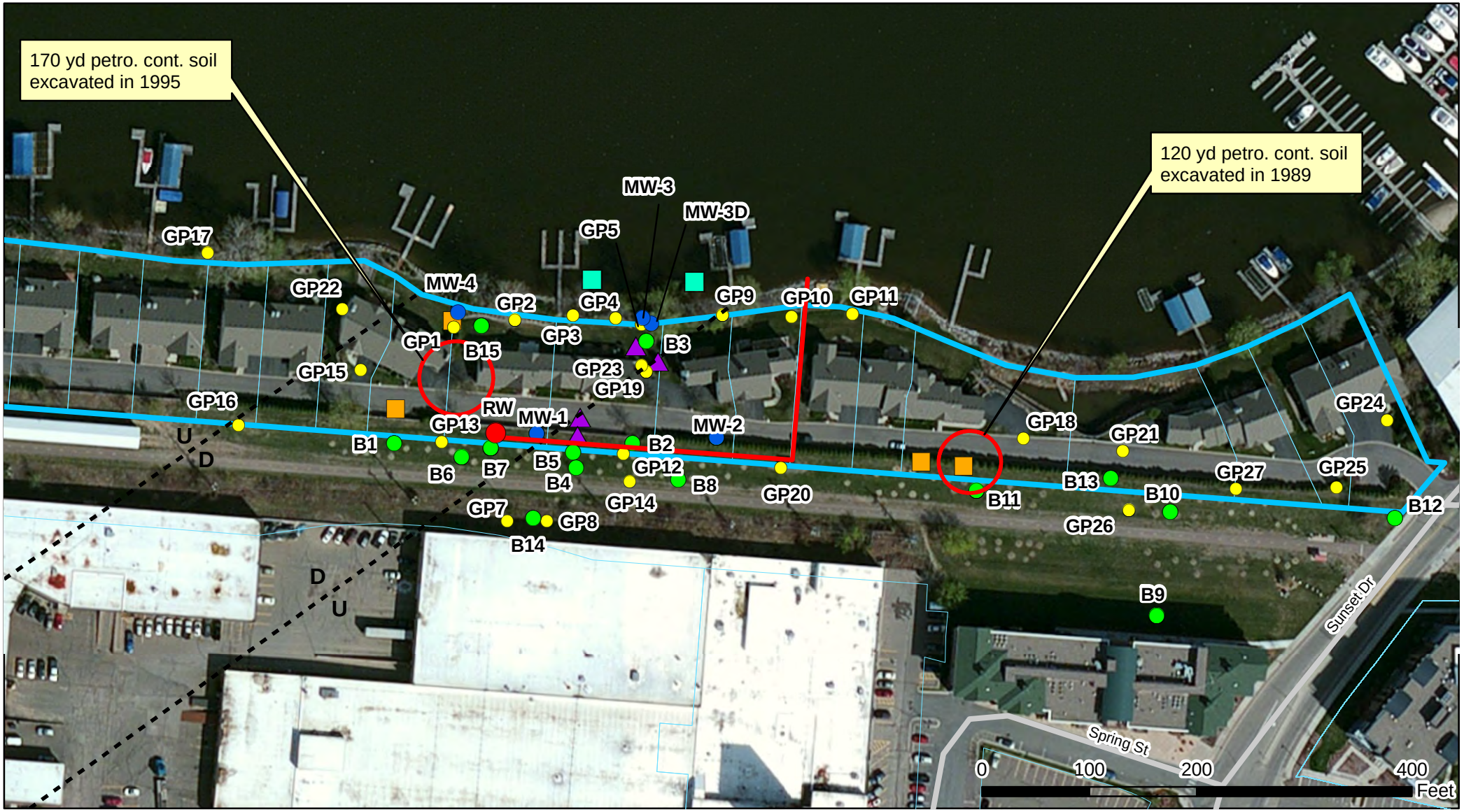


Figure 5: Location of Remedial Investigation Features

Legend

- Advance Machine site boundary
- Former TCE storage or use area
- Former underground storage tank
- Soil excavation area (approx.)
- Monitoring well
- Soil boring
- Push probe
- Surface water sample
- Recovery well
- Treated water discharge line
- Approx. location of reported graben (U/D indicates direction of displacement across "fault"; U = up; D = down)

N
W
E
S

Prepared by MDH, 4/4/2013

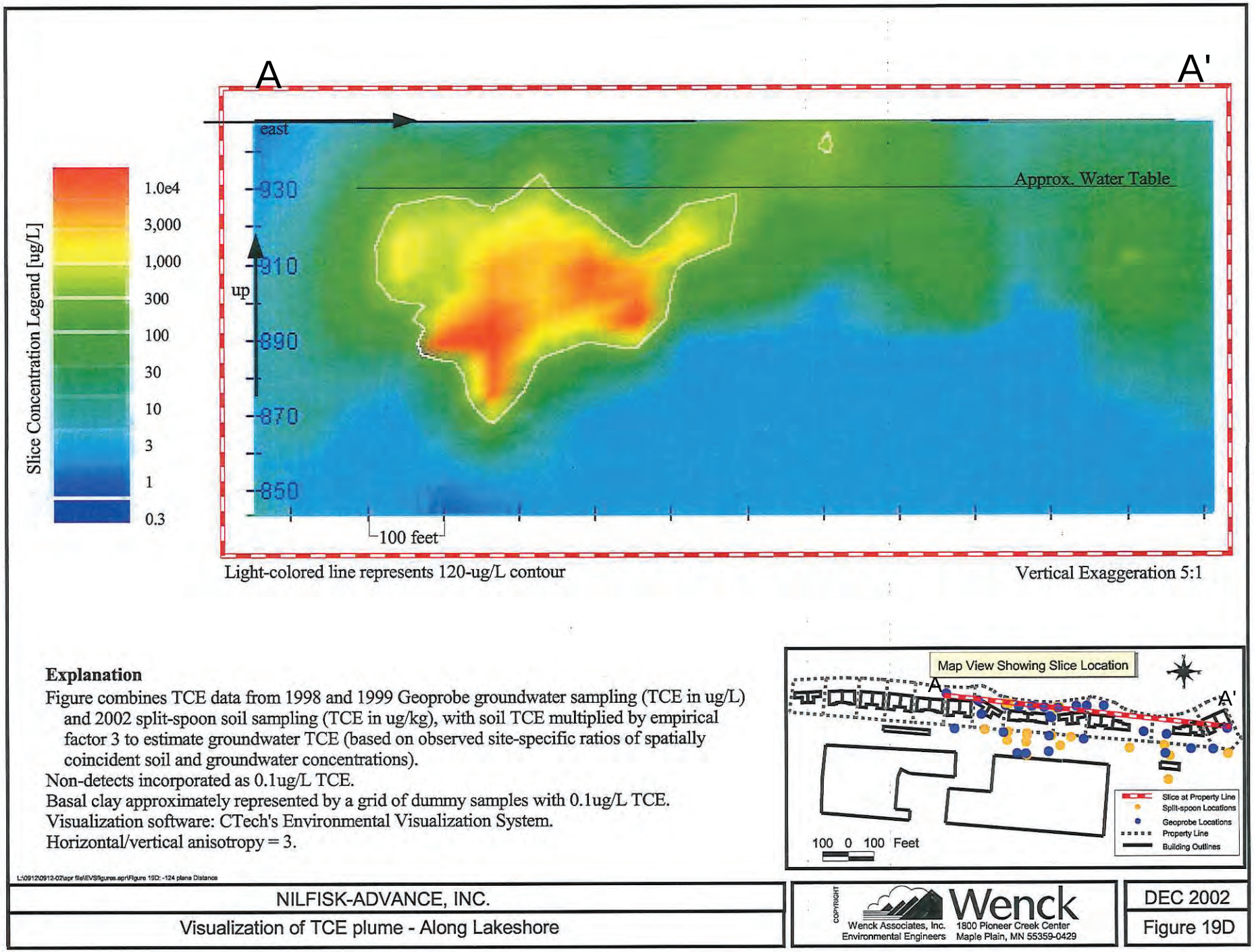


Figure 6: Cross-section of TCE Plume Illustrating Higher Concentrations at Depth

From: Wenck (2002)

Figure 7: Location of City Wells and Capture Zone Relative to Advance Machine Site

Legend

- City well
- Spring Park 10-Year Capture Zone
- Advance Machine site boundary
- TCE greater than 100 ppb

N
W E
S

Prepared by MDH, 4/5/2013

Figure 8: Trichloroethylene Soil Vapor and Indoor Air Concentrations (µg/m^3)

Note: Specific dates of the sampling and the addresses can be found in Table 7.

Tables

Table 1: 1998-1999 Push Probe Groundwater Sample Results (in ppb)

Approx. Sample Elevation	Chemical	GP-1	GP-2	GP-3	GP-4	GP-5	GP-9	GP-10	GP-11	GP-12	GP-13	GP-14	GP-15
925 to 929	TCE	380	330	340	37	480	NS	NS	NS	NS	NS	NS	NS
	PCE	<10	20	<10	17	<10	NS	NS	NS	NS	NS	NS	NS
	cis-1,2-DCE	<10	<10	<10	<10	<10	NS	NS	NS	NS	NS	NS	NS
	trans-1,2-DCE	<10	<10	<10	<10	<10	NS	NS	NS	NS	NS	NS	NS
	1,1-DCE	<10	<10	<10	<10	<10	NS	NS	NS	NS	NS	NS	NS
	1,1,1-TCA	<10	<10	<10	<10	<10	NS	NS	NS	NS	NS	NS	NS
	Vinyl chloride	NA	NA	NA	NA	NA	NS	NS	NS	NS	NS	NS	NS
915 to 925	TCE	690	1200	2400	2400	2800	1100	240	45	690	130	49	120
	PCE	<10	45	230	65	90	<10	<10	<10	110	17	<10	<10
	cis-1,2-DCE	<10	<10	146	93	<10	<10	48	<10	<10	<10	<10	16
	trans-1,2-DCE	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	1,1-DCE	<10	<10	<10	38	<10	<10	<10	<10	<10	<10	<10	<10
	1,1,1-TCA	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Vinyl chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
905 to 915	TCE	120	1200	1070	15,000 (22,000)	2300	2800	120	210	500	180	NS	490 (1700)
	PCE	<5	<10	<5	<50 (<200)	<10	<10	<10	<10	33	14	NS	30 (13)
	cis-1,2-DCE	<5	630	20	<50 (<200)	<10	<10	<10	15	<10	<10	NS	26 (38)
	trans-1,2-DCE	<5	<10	<5	<50 (<200)	<10	<10	<10	<10	<10	<10	NS	<10 (<10)
	1,1-DCE	<5	<10	<5	<50 (<200)	<10	<10	<10	<10	<10	<10	NS	<10 (<10)
	1,1,1-TCA	<5	<10	<5	<50 (<200)	<10	<10	<10	<10	<10	<10	NS	<10 (<10)
	Vinyl chloride	<5	NA	<5	<50 (<200)	NA	NA	NA	NA	NA	NA	NS	NA (<0.2)
	DCDFM	7.8	NA	<5	<50 (<200)	NA	NA	NA	NA	NA	NA	NS	NA (<10)
	Ethyl benzene	<5	NA	<5	<50 (<200)	NA	NA	NA	NA	NA	NA	NS	NA (<10)
	Toluene	<5	NA	<5	<50 (<200)	NA	NA	NA	NA	NA	NA	NS	NA (<10)
895 to 905	TCE	NS	NS	1800	NS	1300 (520)	650	490	160	NS	NS	NS	110
	PCE	NS	NS	<5	NS	<10 (<1.1)	<10	<10	<10	NS	NS	NS	<10
	cis-1,2-DCE	NS	NS	83	NS	450 (120)	120	84	26	NS	NS	NS	17
	trans-1,2-DCE	NS	NS	<5	NS	<10 (<2)	<10	<10	<10	NS	NS	NS	<10
	1,1-DCE	NS	NS	<5	NS	<10 (1.4)	<10	<10	<10	NS	NS	NS	<10
	1,1,1-TCA	NS	NS	<5	NS	<10 (<0.75)	<10	<10	15	NS	NS	NS	<10
	Vinyl chloride	NS	NS	<5	NS	NA (<0.5)	NA	NA	NA	NS	NS	NS	NA
	Benzene	NS	NS	<5	NS	NA (0.83)	NA	NA	NA	NS	NS	NS	NA
	Toluene	NS	NS	<5	NS	NA (1.6)	NA	NA	NA	NS	NS	NS	NA
885 to 895	TCE	NS	NS	NS	200	NS	NS	NS	NS	NS	NS	NS	NS
	PCE	NS	NS	NS	<10	NS	NS	NS	NS	NS	NS	NS	NS
	cis-1,2-DCE	NS	NS	NS	47	NS	NS	NS	NS	NS	NS	NS	NS
	trans-1,2-DCE	NS	NS	NS	<10	NS	NS	NS	NS	NS	NS	NS	NS
	1,1-DCE	NS	NS	NS	<10	NS	NS	NS	NS	NS	NS	NS	NS
	1,1,1-TCA	NS	NS	NS	<10	NS	NS	NS	NS	NS	NS	NS	NS
	Vinyl chloride	NS	NS	NS	NA	NS	NS	NS	NS	NS	NS	NS	NS

Table 1: 1998-1999 Push Probe Groundwater Sample Results (in ppb)

Approx. Sample Elevation	Chemical	GP-16	GP-17	GP-18	GP-19	GP-20	GP-21	GP-22	GP-24	GP-25	GP-26	GP-27
925 to 929	TCE	NS	<1	NS	7.6	NS	NS	NS	NS	NS	NS	NS
	PCE	NS	<1	NS	1.8	NS	NS	NS	NS	NS	NS	NS
	cis-1,2-DCE	NS	<1	NS	<1	NS	NS	NS	NS	NS	NS	NS
	trans-1,2-DCE	NS	<1	NS	<1	NS	NS	NS	NS	NS	NS	NS
	1,1-DCE	NS	<1	NS	<1	NS	NS	NS	NS	NS	NS	NS
	1,1,1-TCA	NS	<1	NS	<1	NS	NS	NS	NS	NS	NS	NS
	Vinyl chloride	NS	NA	NS	NA	NS	NS	NS	NS	NS	NS	NS
915 to 925	TCE	<1	NS	71	72	33	7.6	NS	13	<2	3.3	NS
	PCE	<1	NS	<1	<5	<1	<1	NS	<2	<2	<1	NS
	cis-1,2-DCE	<1	NS	<1	<5	<1	<1	NS	<2	<2	<1	NS
	trans-1,2-DCE	<1	NS	<1	<5	<1	<1	NS	<2	<2	<1	NS
	1,1-DCE	<1	NS	<1	<5	<1	<1	NS	<2	<2	<1	NS
	1,1,1-TCA	<1	NS	<1	<5	<1	<1	NS	<2	<2	<1	NS
	Vinyl chloride	NA	NS	NA	NA	NA	NA	NS	<2	<2	<1	NS
905 to 915	TCE	11 (13)	NS	3.9 (46)	3600	63	199	(670)	120 (100)	10 (5.5)	96 (130)	<1
	PCE	<1 (0.84)	NS	<1 (<0.4)	35	<1	1.8	(<2.1)	<2 (<1)	<2 (<1)	<1 (<1)	<1
	cis-1,2-DCE	<1 (<0.3)	NS	<1 (<0.3)	19	2.4	1.1	(40)	2.0 (2.3)	<2 (<1)	<1 (<1)	<1
	trans-1,2-DCE	<1 (<0.3)	NS	<1 (<0.8)	<5	<1	<1	(<4)	<2 (<1)	<2 (<1)	<1 (<1)	<1
	1,1-DCE	<1 (<0.3)	NS	<1 (<0.4)	<5	<1	<1	(<2.1)	<2 (<1)	<2 (<1)	<1 (<1)	<1
	1,1,1-TCA	<1 (<0.3)	NS	<1 (<0.3)	<5	<1	<1	(<1.5)	<2 (<1)	<2 (<1)	<1 (<1)	<1
	Vinyl chloride	NA (<0.2)	NS	NA (<0.2)	NA	NA	NA	(<1)	NA (<1)	NA (<1)	NA (<1)	<1
	DCDFM	NA (<0.47)	NS	NA (<0.47)	NA	NA	NA	(<2.3)	NA (<1)	NA (<1)	NA (<1)	<1
	Ethyl benzene	NA (0.38)	NS	NA (0.47)	NA	NA	NA	<1.6)	NA (<1)	NA (<1)	NA (<1)	<1
	Toluene	NA (0.53)	NS	NA (0.68)	NA	NA	NA	(<1.4)	NA (<1)	NA (<1)	NA (<1)	<1
895 to 905	TCE	NS	NS	NS	5200	NS	270	NS	40	<5	1100	NS
	PCE	NS	NS	NS	24	NS	1.3	NS	<10	<5	<1	NS
	cis-1,2-DCE	NS	NS	NS	42	NS	6.8	NS	<10	<5	5.5	NS
	trans-1,2-DCE	NS	NS	NS	<5	NS	<1	NS	<10	<5	<1	NS
	1,1-DCE	NS	NS	NS	<5	NS	1.1	NS	<10	<5	<1	NS
	1,1,1-TCA	NS	NS	NS	<5	NS	<1	NS	<10	<5	<1	NS
	Vinyl chloride	NS	NS	NS	NA	NS	NA	NS	NA	<5	<1	NS
	Benzene	NS	NS	NS	NA	NS	NA	NS	NA	<5	<1	NS
	Toluene	NS	NS	NS	NA	NS	NA	NS	NA	<5	<1	NS
885 to 895	TCE	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	PCE	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	cis-1,2-DCE	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	trans-1,2-DCE	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1,1-DCE	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1,1,1-TCA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Vinyl chloride	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 1: 1998-1999 Push Probe Groundwater Sample Results (in ppb)

NOTES:
TCE = trichloroethene
PCE = tetrachloroethene (or perchloroethene)
cis-1,2-DCE = cis-1,2-dichloroethene
trans-1,2-DCE = trans-1,2-dichloroethene
1,1-DCE = 1,1-dichloroethene
1,1,1-TCA = 1,1,1-trichloroethane
NS - no sample
NA - sample not analyzed for this compound
< indicates chemical was not detected at or above the method detection limit (which is the value shown; e.g. <10
All detected chemicals shown in **bold** type
Concentration exceeds Health Risk Limit (HRL)
Elevations are in feet above mean sea level
Values shown in parentheses are confirmation samples analyzed by En Chem, Inc.; all others are Northeast Technical Services mobile or fixed lab analyse
No water samples were collected from GP-6, GP-7, GP-8, or GP-23
This table shows only detected chemicals - samples analyzed in fixed lab (by En Chem or Northeast Technical Services) were analyzed for 68 volatile organic compounds (VOCs

Table 2: Soil Boring Samples (in ppb)

Boring	Elevation	Depth (ft)	Date	TCE	PCE	c-1,2-DCE	Naphthalene
MW-1	928.5	19-21	5/7/2002	<31	<31	<31	<31
	918.5	29-31	5/7/2002	**430**	<29	<29	<29
	908.5	39-41	5/7/2002	**2700**	**53**	<32	<32
	901.5	46-48	5/7/2002	**2300**	<32	<32	<32
MW-2	928.1	19-21	5/8/2002	<30	<30	<30	<30
	918.1	29-31	5/8/2002	**300**	<41	<41	<41
	908.1	39-41	5/8/2002	<31	<31	<31	<31
	903.1	44-46	5/8/2002	<30	<30	<30	<30
B-1	926.6	20-22	5/16/2002	<29	<29	<29	<29
	916.6	30-32	5/16/2002	**48**	<30	<30	<30
	906.6	40-42	5/16/2002	<33	<33	<33	<33
	899.1	47.5-49.5	5/16/2002	<32	<32	<32	<32
B-2	927.4	20-22	5/16/2002	<32	<32	<32	<32
	919.9	27.5-29.5	5/16/2002	**43**	<30	<30	<30
	907.4	40-42	5/16/2002	<33	<33	<33	<33
	899.9	47.5-49.5	5/16/2002	<31	<31	<31	<31
B-3	929.4	10-12	5/20/2002	<31	<31	<31	<31
	919.4	20-22	5/20/2002	<29	<29	<29	<29
	906.9	32.5-34.5	5/20/2002	**380**	<32	<32	<32
	899.4	40-42	5/20/2002	**5200**	<31	<31	<31
	889.4	50-52	5/20/2002	**9600**	<32	**220**	<32
	879.4	60-62	5/20/2002	<32	<32	<32	<32
	869.4	70-72	5/20/2002	<34	<34	<34	<34
	859.4	80-82	5/20/2002	<31	<31	<31	<31
B-4	900.4	47.5-49.5	7/22/2002	**860**	**36**	<32	<32
	890.4	57.5-59.5	7/22/2002	**440**	<30	**87**	<30
	885.4	62.5-64.5	7/22/2002	**250**	<30	<30	<30
B-5	929.6	18-20	7/22/2002	<28	<28	<28	<28
	917.6	30-32	7/22/2002	**6600**	**120**	<33	<33
	905.1	42.5-44.5	7/22/2002	<33	<33	<33	<33
B-6	929.9	18-20	7/23/2002	<30	<30	<30	<30
	917.9	30-32	7/23/2002	**250**	<29	<29	<29
	902.9	45-47	7/23/2002	<31	<31	<31	<31
B-7	929.5	17.5-19.5	7/23/2002	<32	<32	<32	<32
	919.5	27.5-29.5	7/23/2002	**85**	<30	<30	<30
	909.5	37.5-39.5	7/23/2002	**95**	<30	<30	<30
	899.5	47.5-49.5	7/23/2002	**170**	<32	<32	<32
	889.5	57.5-59.5	7/23/2002	**1300**	<30	**36**	<30
	879.5	67.5-69.5	7/23/2002	**10,000**	**86**	<30	<30
	869.5	77.5-79.5	7/23/2002	**39**	<31	<31	<31
B-8	927.4	20-22	7/24/2002	<30	<30	<30	<30
	917.4	30-32	7/24/2002	<32	<32	<32	<32
	914.9	32.5-34.5	7/24/2002	<31	<31	<31	<31
B-9	927.1	22.5-24.5	7/24/2002	<31	<31	<31	<31
	917.1	32.5-34.5	7/24/2002	<33	<33	<33	<33
	907.1	42.5-44.5	7/24/2002	<31	<31	<31	<31

Table 2: Soil Boring Samples (in ppb)

Boring	Elevation	Depth (ft)	Date	TCE	PCE	c-1,2-DCE	Naphthalene
B-9	897.1	52.5-54.5	7/24/2002	<31	<31	<31	<31
(cont.)	887.1	62.5-64.5	7/24/2002	<30	<30	<30	<30
	877.1	72.5-74.5	7/24/2002	<32	<32	<32	<32
B-10	928.3	20-22	7/25/2002	<32	<32	<32	<32
	918.3	30-32	7/25/2002	<32	<32	<32	<32
	908.3	40-42	7/25/2002	**440**	<32	<32	<32
	898.3	50-52	7/25/2002	**47**	<31	<31	<31
	888.3	60-62	7/25/2002	<32	<32	<32	<32
	880.3	67.5-69.5	7/25/2002	<31	<31	<31	<31
B-11	930.2	17.5-19.5	7/25/2002	**310**	<29	<29	<29
	920.2	27.5-29.5	7/25/2002	**32**	<29	<29	<29
	910.2	37.5-39.5	7/25/2002	**68**	<32	<32	<32
	900.2	47.5-49.5	7/25/2002	**58**	<32	<32	<32
	890.2	57.5-59.5	7/25/2002	<31	<31	<31	<31
B-12	929.6	17.5-19.5	7/25/2002	<29	<29	<29	<29
	917.1	30-32	7/25/2002	<31	<31	<31	**64**
	907.1	40-42	7/25/2002	<31	<31	<31	<31
	894.6	52.5-54.5	7/25/2002	<33	<33	<33	<33
B-13	931	17.5-19.5	7/30/2002	<31	<31	<31	<31
	921	27.5-29.5	7/30/2002	<31	<31	<31	<31
	911	37.5-39.5	7/30/2002	<32	<32	<32	<32
	901	47.5-49.5	7/30/2002	**270**	<32	<32	<32
	891	57.5-59.5	7/30/2002	**110**	<30	<30	<30
	881	67.5-69.5	7/30/2002	<31	<31	<31	<31
B-14	942.9	5-7	7/30/2002	<31	<31	<31	<31
	930.4	17.5-19.5	7/30/2002	<30	<30	<30	<30
	920.4	27.5-29.5	7/30/2002	<30	<30	<30	<30
	910.4	37.5-39.5	7/30/2002	<31	<31	<31	<31
	902.9	45-47	7/30/2002	<31	<31	<31	<31
B-15	928.5	7.5-9.5	10/9/2002	<30	<30	<30	<30
	918.5	17.5-19.5	10/9/2002	**58**	<29	<29	<29
	908.5	27.5-29.5	10/9/2002	**1600**	<31	<31	<31
	906	30-32	10/9/2002	**3700**	<31	<31	<31
	898.5	37.5-39.5	10/9/2002	**1200**	<31	<31	<31
	896	40-42	10/9/2002	**5700**	**47**	**63**	<31
	888.5	47.5-49.5	10/9/2002	**7000**	<32	**470**	<32
	878.5	57.5-59.5	10/9/2002	**1100**	<31	**150**	<31
	868.5	67.5-69.5	10/9/2002	**2800**	<32	**470**	<32
	858.5	77.5-79.5	10/9/2002	<30	<30	<30	<30
	848.5	87.5-89.5	10/9/2002	<31	<31	<31	<31

NOTES: TCE = trichloroethene

PCE = tetrachloroethene

cis-1,2-DCE = cis-1,2-dichloroethene

< indicates not detected at or above method detection limit, which is the value shown

Only detected chemicals shown; samples were analyzed for 68 volatile organic compounds

Elevation in feet above mean sea level

Table 3: Monitoring and Recovery Well Groundwater Sample Results (in ppb)

		PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	VC
	HRL	5	5	50	40	100	0.2
Well	Date						
MW-1	6/5/2002	<100	**11000**	<100	<100	<100	<100
	7/29/2002*	<100	**14000**	<100	<100	<100	<100
	10/23/2002*	<200	**22000**	<200	<200	<200	<200
	5/8/2003	<100	**11000**	<100	NR	NR	NR
	10/9/2003*	<50	**7900**	<50	<50	<50	<50
	6/3/2004	**730**	**39000**	<250	<250	<250	<250
	10/18/2004	**87**	**570**	**31**	<5	<5	<5
	6/8/2005	**26**	**640**	**79**	<10	<10	<10
	10/25/2005	**21**	**420**	**38**	<4	<4	<4
	6/29/2006	**9**	**300**	**51**	**5.7**	<2.5	<2.5
	10/18/2006	**13**	**350**	**20**	<5	<5	<5
	6/27/2007*	**7.9**	**305**	**22**	<5	<5	<5
	10/8/2007	**6.9**	**170**	**37**	**5.1**	**1.4**	<1
	6/24/2008	**5.5**	**286**	**26**	**2.3**	<2	<0.8
	10/16/2008*	**5.6**	**198**	**12**	<2	<2	<0.8
	8/10/2009	**7.6**	**423**	**80**	**8**	<1	<0.4
MW-2	6/5/2002	<1	**31**	<1	<1	<1	<1
	7/29/2002	<1	**110**	**1.5**	<1	<1	<1
	10/23/2002	<10	**860**	**11**	<1	<1	<1
	5/8/2003	**1.9**	**74**	**4.9**	NR	NR	NR
	10/9/2003	<5	**420**	**11**	<5	<5	<5
	6/3/2004	<1	**11**	**2.6**	<1	<1	<1
	10/18/2004	<1	**31**	**5.9**	<1	<1	<1
	6/8/2005*	**1.1**	**170**	**19**	**1.2**	<1	<1
	10/25/2005	<1	**9.9**	**2.7**	<1	<1	<1
	6/29/2006	<1	**21**	**2.5**	<1	<1	<1
	10/18/2006	<1	**7.4**	**1.3**	<1	<1	<1
	6/27/2007	<1	**45**	**3.7**	<1	<1	<1
	10/8/2007	<1	**13**	**1.4**	<1	<1	<1
	6/24/2008	<1	**74**	**9.7**	<1	<1	<0.4
	10/16/2008	**1.7**	**270**	**17**	**1.1**	<1	<0.4
	8/10/2009	<1	<1	<1	<1	<1	<0.4

Table 3: Monitoring and Recovery Well Groundwater Sample Results (in ppb)

		PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	VC
	HRL	5	5	50	40	100	0.2
Well	Date						
MW-3	6/5/2002*	67	8100	<50	<50	<50	<50
	7/29/2002	81	9400	<50	<50	<50	<50
	10/23/2002	110	9700	<100	<100	<100	<100
	5/8/2003*	85	4050	<50	NR	NR	NR
	10/9/2003	64	2400	<20	<20	<20	<20
	6/3/2004	32	1000	<10	<10	<10	<10
	10/18/2004	18	800	64	<10	<10	<10
	6/8/2005	8.1	610	19	<5	<5	<5
	10/25/2005	7.4	320	11	<4	<4	<4
	6/29/2006	4.3	210	<2.5	<2.5	<2.5	<2.5
	10/18/2006*	<10	1400	570	19	<10	<10
	6/27/2007	<5	210	<5	<5	<5	<5
	10/8/2007	3.2	150	2.5	<1	<1	<1
	6/24/2008	3	172	1.4	<1	<1	<0.4
	10/16/2008	3.7	280	4.4	<1	<1	<0.4
	8/10/2009	2.4	244	2.2	<1	<1	<0.4
MW-3D	6/5/2002	<25	2100	200	<25	<25	<25
	7/29/2002	<25	2700	270	<25	<25	<25
	10/23/2002	<20	3300	340	<20	<20	<20
	5/8/2003	<20	2000	310	NR	NR	NR
	10/9/2003	<20	2300	310	<20	<20	<20
	6/3/2004	<10	1800	280	<10	<10	<10
	10/18/2004	<20	1600	280	22	<20	<20
	6/8/2005	<10	1900	410	18	<10	<10
	10/25/2005*	<25	1400	570	27	<25	<25
	6/29/2006	<10	1500	650	43	<10	<10
	10/18/2006	<10	1400	570	19	<10	<10
	6/27/2007	<20	1800	470	<20	<20	<20
	10/8/2007*	<25	1650	570	27	<25	<25
	6/24/2008	<5	1580	520	22	<5	<2
	10/16/2008	<10	1700	542	22	<10	<4
	8/10/2009	<1	27.4	8.5	34	<1	675

Table 3: Monitoring and Recovery Well Groundwater Sample Results (in ppb)

		PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	VC
	HRL	5	5	50	40	100	0.2
Well	Date						
MW-4	10/23/2002	<100	10000	<100	<100	<100	<100
	5/8/2003	<100	10000	<100	NR	NR	NR
	10/9/2003	<50	6000	<50	<50	<50	<50
	6/3/2004	57	5200	<50	<50	<50	<50
	10/18/2004*	25	1250	<20	<20	<20	<20
	6/8/2005	19	680	<5	<5	<5	<5
	10/25/2005	11	170	10	<2.5	<2.5	<2.5
	6/29/2006*	13	315	25	<5	<5	<5
	10/18/2006	12	370	40	<4	<4	<4
	6/27/2007	12	350	<10	<10	<10	<10
	10/8/2007	9.7	200	7.9	<2.5	<2.5	<2.5
	6/24/2008*	8.8	185	3.1	<1	<1	<0.4
	10/16/2008	7.8	174	4.3	<1	<1	<0.4
	8/10/2009	4.1	94	6.8	<1	<1	<0.4
RW-1	8/12/2003	<50	7100	<50	<50	<50	<50
	8/13/2003	<50	6600	<50	<50	<50	<50
	8/14/2003	<50	6500	<50	<50	<50	<50
	4/3/2004	<100	9300	<100	<100	<100	<100
	6/3/2004*	<50	6200	230	<50	<50	<50
	7/1/2004	<50	6200	210	<50	<50	<50
	8/1/2004	49	4700	210	<25	<25	<25
	9/9/2004	<50	3500	140	<50	<50	<50
	10/18/2004	<50	3000	190	<50	<50	<50
	11/1/2004	28	3000	170	<20	<20	<20
	12/8/2004	<50	2800	160	<50	<50	<50
	4/15/2005	27	3500	210	<25	<25	<25
	5/3/2005	<40	3600	160	<40	<40	<40
	6/8/2005	<25	3600	170	<25	<25	<25
	7/28/2005	21	2900	210	<20	<20	<20
	8/19/2005	<20	2600	190	<20	<20	<20
	9/28/2005	61	2800	200	<50	<50	<50
	10/25/2005	<25	2700	210	<25	<25	<25
	11/15/2005	<25	2600	200	<25	<25	<25
	12/12/2005	<25	2700	200	<25	<25	<25
	4/27/2006	<20	2600	290	<20	<20	<20
	5/17/2006	<25	3000	270	<25	<25	<25
	6/29/2006	<20	2800	230	<20	<20	<20
	7/19/2006	<25	2700	240	<25	<25	<25

Table 3: Monitoring and Recovery Well Groundwater Sample Results (in ppb)

		PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	VC
	HRL	5	5	50	40	100	0.2
Well	Date						
RW-1 (cont.)	8/15/2006	<40	**2500**	**230**	<40	<40	<40
	9/26/2006	<25	**2700**	**230**	<25	<25	<25
	10/18/2006	<25	**2300**	**220**	<25	<25	<25
	11/9/2006	<50	**2300**	**210**	<50	<50	<50
	12/8/2006	<25	**2600**	**260**	<25	<25	<25
	3/29/2007	<25	**2200**	**280**	<25	<25	<25
	4/20/2007	**31**	**3500**	**300**	<25	<25	<25
	5/11/2007	<25	**2900**	**240**	<25	<25	<25
	6/27/2007	<50	**2500**	**250**	<50	<50	<50
	7/24/2007	<25	**2300**	**220**	<25	<25	<25
	8/22/2007	<20	**2000**	**250**	<20	<20	<20
	9/14/2007	<20	**2200**	**240**	<20	<20	<20
	10/8/2007	<25	**2400**	**280**	<25	<25	<25
	11/14/2007	<20	**2100**	**310**	<20	<20	<20
	11/17/2007	<25	**1900**	**250**	<25	<25	<25
	11/20/2007*	<25	**1950**	**260**	<25	<25	<25
	11/23/2007	<40	**2000**	**280**	<40	<40	<40
	11/26/07*	<25	**2000**	**255**	<25	<25	<25
	11/29/2007	**26**	**1900**	**250**	<25	<25	<25
	12/2/2007	**20**	**2000**	**250**	<20	<20	<20
	4/23/2008	**25.1**	**2130**	**337**	**5.8**	**2.1**	**1.1**
	4/26/2008	**31.5**	**2330**	**336**	**5**	**2.1**	**0.98**
	4/28/2008	**28.6**	**2660**	**295**	<20	<20	<8
	5/1/2008	**26.1**	**2670**	**314**	<20	<20	<8
	5/4/2008	**31.1**	**2840**	**320**	<20	<20	<8
	5/7/2008	<20	**2840**	**314**	<20	<20	<8
	5/10/2008	**23.9**	**2820**	**318**	<20	<20	<8
	5/13/2008	<20	**2670**	**342**	<20	<20	<8
	5/16/2008	<20	**2870**	**322**	<20	<20	<8
	5/30/2008	<20	**2400**	**311**	<20	<20	<8
	6/24/2008	<20	**2130**	**277**	<20	<20	<8
	7/24/2008	<20	**1960**	**289**	<20	<20	<8
	8/13/2008	<20	**1760**	**272**	<20	<20	<8
	9/4/2008	<10	**1720**	**264**	<10	<10	<4
	9/24/2008	<20	**2030**	**303**	<20	<20	<8
	9/25/2008	<20	**1680**	**298**	<20	<20	<8
	9/26/2008	<20	**1590**	**279**	<20	<20	<20
	9/29/2008	<20	**1830**	**285**	<20	<20	<8

Table 3: Monitoring and Recovery Well Groundwater Sample Results (in ppb)

		PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	VC
	HRL	5	5	50	40	100	0.2
Well	Date						
RW-1	10/16/2008	<20	**2170**	**258**	<20	<20	<8
(cont.)	10/27/2008	<20	**1720**	**220**	<20	<20	<20
	10/28/2008	<20	**1690**	**241**	<20	<20	<20
	11/4/2008	**12.9**	**1950**	**326**	<10	<10	<4
	5/15/2009	<10	**1590**	**385**	<10	<10	<10
	6/5/2009	**50.7**	**4980**	**611**	<20	<20	<20
	6/12/2009	**26**	**2510**	**351**	**4.2**	**1.7**	**1**
	7/15/2009	<25	**2370**	**350**	<25	<25	<10
	8/12/2009	<25	**2110**	**419**	<25	<25	<10
	11/10/2009	<25	**1940**	**371**	<25	<25	<10
	4/19/2010	**17.5**	**2040**	**417**	<10	<10	<10
	5/10/2010	**22.8**	**2100**	**418**	<10	<10	<4
	6/17/2010	<20	**2060**	**409**	<20	<20	<8
	7/12/2010	<20	**2140**	**359**	<20	<20	<8
	8/24/2010	<20	**1650**	**433**	<20	<20	<8
	9/24/2010	<10	**1290**	**371**	<10	<10	<4
	10/25/2010	<10	**1470**	**368**	<10	<10	<4
	11/13/2010	<10	**1290**	**354**	<10	<10	<4
	4/22/2011	<10	**1250**	**375**	<10	<10	<4
	5/12/2011	**17**	**2130**	**428**	<10	<10	<4
	6/6/2011	**10.1**	**1660**	**390**	<40	<10	<4
	7/22/2011	<10	**1640**	**378**	<40	<10	<4
	8/15/2011	<10	**1050**	**245**	<40	<10	<4
	9/5/2011	<10	**949**	**197**	<40	<10	<4
	10/24/2011	<5	**634**	**157**	<40	<10	<4
	11/15/2011	**5.2**	**1150**	**295**	<40	<10	<4

NOTES:

TCE = trichloroethene

PCE = tetrachloroethene (or perchloroethene)

cis-1,2-DCE = cis-1,2-dichloroethene

trans-1,2-DCE = trans-1,2-dichloroethene

1,1-DCE = 1,1-dichloroethene

1,1,1-TCA = 1,1,1-trichloroethane

VC = vinyl chloride

NR = results not reported

All detected chemicals shown in **bold** type

exceeds Health Risk Limit (HRL)

* duplicate samples collected on this date, results shown are the average of the two samples

< indicates chemical was not detected above method detection limit, which is the value shown

Only detected chemicals are shown - samples were analyzed for 68 volatile organic compounds (VOCs)

Table 4: Treated Water Discharge Sample Results (in ppb)

	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	VC
HRL	**5**	**5**	**50**	**40**	**100**	**0.2**
Date						
4/3/2004	<1	<1	<1	<1	<1	<1
5/14/2004	<1	<1	<1	<1	<1	<1
6/3/2004	<1	<1	<1	<1	<1	**1.6**
7/1/2004	<1	**20**	**1.3**	<1	<1	<1
8/1/2004	<1	**4.6**	<1	<1	<1	<1
9/9/2004	<1	<1	<1	<1	<1	<1
10/18/2004	<1	<1	**17**	<1	<1	1.8
11/1/2004	<1	**1.2**	**150**	<1	**1.5**	**2**
12/8/2004	<1	<1	<1	<1	<1	**1.5**
4/15/2005	<1	<1	**45**	<1	<1	**1.5**
5/3/2005	<5	**41**	**510**	<5	<5	<5
6/8/2005	<1	**4.4**	<1	<1	<1	<1
7/28/2005	<1	**20**	**1.8**	<1	<1	<1
8/19/2005	<1	**6.8**	**8.8**	<1	<1	<1
9/28/2005	<1	**2.7**	<1	<1	<1	<1
10/25/2005	<1	**1.2**	**18**	<1	<1	**1.2**
11/15/2005	<1	**1.3**	**160**	<1	**1.1**	**1.2**
12/12/2005	<1	**14**	**1.6**	<1	<1	<1
4/27/2006	<1	**5.7**	**2**	<1	<1	<1
5/17/2006	<2.5	**4.2**	**250**	<2.5	<2.5	<2.5
6/29/2006	<1	**12**	**2.1**	<1	<1	<1
7/19/2006	<1	**4.9**	**1.2**	<1	<1	<1
8/15/2006	<1	**3.4**	**41**	<1	<1	<1
9/26/2006	<1	**3.7**	**2.4**	<1	<1	<1
10/18/2006	<1	**3**	**1.6**	<1	<1	<1
11/9/2006	<1	**3.3**	**2.9**	<1	<1	**1**
12/8/2006	<1	<1	<1	<1	<1	<1
3/29/2007	<1	<1	<1	<1	<1	<1
4/20/2007	<2.5	<2.5	**290**	<2.5	<2.5	<2.5
5/11/2007	<5	<5	**650**	**5.9**	<5	<5
6/27/2007	<1	**7.5**	**4.6**	<1	<1	**1.2**
7/11/2007	<1	**6.1**	**120**	<1	<1	**1.2**
8/22/2007	<1	**3.2**	**1.1**	<1	<1	<1
9/14/2007	<1	**1.9**	**21**	<1	<1	**1.2**
10/8/2007	<4	<4	**450**	<4	<4	<4
11/20/2007	<1	**5.6**	**1**	<1	<1	<1
12/2/2007	<1	**3.9**	<1	<1	<1	<1
4/23/2008	<2	**3.4**	**365**	<2	**2.4**	**1.2**
5/30/2008	<1	<1	<1	<1	<1	<0.4
6/24/2008	<1	**1.5**	**54.5**	<1	<1	**1.2**
7/24/2008	<1	<1	<1	<1	<1	<0.4
8/13/2008	<1	<1	**2**	<1	<1	**1.4**
9/4/2008	<1	**6.3**	**281**	<1	<1	**1.7**
9/24/2008	<1	<1	<1	<1	<1	<0.4
9/25/2008	<1	<1	<1	<1	<1	<0.4

Table 4: Treated Water Discharge Sample Results (in ppb)

	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	VC
HRL	**5**	**5**	**50**	**40**	**100**	**0.2**
Date						
9/26/2008	<1	<1	<1	<1	<1	<1
9/29/2008	<1	<1	<1	<1	<1	<0.4
10/16/2008	<1	**2.6**	**163**	<1	<1	**1.2**
10/27/2008	<1	<1	**2.3**	<1	<1	<1
10/28/2008	<1	<1	**3.7**	<1	<1	<1
11/4/2008	<1	**1.1**	**52.8**	<1	<1	**1.1**
5/15/2009	<1	<1	<1	<1	<1	<1
6/5/2009	<1	<1	<1	<1	<1	<1
6/8/2009	<1	<1	<1	<1	<1	<1
6/10/2009	<1	<1	<1	<1	<1	<0.4
6/12/2009	<1	<1	<1	<1	<1	<0.04
6/17/2009	<1	<1	<1	<1	<1	**0.83**
6/19/2009	<1	<1	<1	<1	<1	**0.8**
6/24/2009	<1	<1	<1	<1	<1	**0.77**
6/29/2009	<1	<1	<1	<1	<1	**1.3**
7/2/2009	<1	<1	<1	<1	<1	**1.4**
7/15/2009	<1	<1	<1	<1	<1	<0.4
7/24/2009	<1	<1	<1	<1	<1	<0.4
8/12/2009	<1	<1	<1	<1	<1	<0.4
11/10/2009	<1	<1	<1	<1	<1	**1.2**
4/19/2010	<1	<1	<1	<1	<1	<0.4
5/10/2010	<1	<1	<1	<1	<1	<0.4
6/17/2010	<1	<1	<1	<1	<1	<0.4
7/12/2010	<1	<1	<1	<1	<1	<0.4
8/24/2010	<1	<1	<1	<1	<1	<0.4
9/24/2010	<1	<1	**6.4**	<1	<1	**1.3**
10/25/2010	<1	<1	**1**	<1	<1	<0.4
11/13/2010	<1	<1	<1	<1	<1	<0.4
4/22/2011	<1	<1	**1.1**	<1	<1	<0.4
5/12/2011	<1	<1	**40.6**	<1	<1	**1.3**
6/6/2011	<1	**5.2**	**1.6**	<4	<1	<0.4
6/8/2011	<1	**5**	**1.8**	<4	<1	<0.4
6/15/2011	<1	**4.5**	**1.3**	<4	<1	<0.4
7/22/2011	<1	<1	**1.4**	<4	<1	<0.4
8/15/2011	<1	<1	<1	<4	<1	<0.4
9/5/2011	<1	<1	**5**	<4	<1	<0.4
10/24/2011	<1	**2.6**	**2.6**	<4	<1	<0.4
11/15/2011	<1	**1.6**	**1.3**	<4	<1	<0.4

NOTES:

TCE = trichloroethene

PCE = tetrachloroethene (or perchloroethene)

cis-1,2-DCE = cis-1,2-dichloroethene

exceeds Health Risk Limit (HRL)

All detected chemicals shown in **bold** type

VC = vinyl chloride

1,1-DCE = 1,1-dichloroethene

1,1,1-TCA = 1,1,1-trichloroethane

trans-1,2-DCE = trans-1,2-dichloroethene

< indicates chemical was not detected above method detection limit, which is the value shown

Only detected chemicals are shown - samples were analyzed for 68 volatile organic compounds (VOCs)

Table 5: City of Spring Park Drinking Water Compliance Sampling Results (ppb)

	TCE	cis-1,2-DCE	PCE	Toluene	Xylenes
HRL	**5**	**50**	**5**	**200**	**300**
Date of sample					
3/1/1995	< 0.1	<0.2	<0.2	<0.2	<0.5
10/27/2000	< 0.1	<0.2	<0.2	<0.2	<0.2
9/21/2004	**0.9**	**1.4**	<0.2	**0.2**	NR
9/13/2005	**0.7**	**1.5**	<0.2	<0.5	NR
3/21/2007	< 0.1	<0.2	<0.2	<0.5	**0.9**
6/28/2007	< 0.1	<0.2	<0.2	<0.5	<0.5
11/18/2008	**1.1**	**1.9**	<0.2	<0.5	<0.5
6/10/2009	**1.6**	**2.3**	**0.2**	<0.5	<0.5
8/27/2009	**1.7**	**2.5**	<0.2	<0.5	<0.5
8/31/2009	**1.8**	**2.6**	<0.2	<0.5	<0.5
12/8/2009	**1.4**	**1.8**	<0.2	<0.5	<0.5
5/18/2010	**1.7**	**2.4**	<0.2	<0.5	<0.5
7/8/2010	< 0.1	<0.2	<0.2	<0.5	<0.5
11/10/2010	**1.8**	**2.4**	<0.2	<0.5	<0.5
8/30/2011	< 0.1	<0.2	<0.2	<0.2	<0.5
6/26/2012	**2.4**	**3**	<0.2	<0.2	**0.31**
8/2/2012	**2.3**	**3.1**	<0.2	<0.2	<0.5
11/21/2012	< 0.1	<0.2	<0.2	<0.2	<0.5
12/13/2012	**1.8**	**2.3**	<0.2	<0.2	<0.5

NOTES:
TCE = trichloroethene
cis-1,2-DCE = cis-1,2-dichloroethene
PCE = tetrachloroethene
NR = not reported

Table 6: Vapor Intrusion Screening Levels (µg/m^3)

	TCE	PCE	cis-1,2-DCE	trans-1,2-DCE
Indoor air	2*	20	60*	60
slab or sub-slab)	20	200	600	600

Source: MPCA February 2009 Intrusion Screening Levels

* Based on June 2013 MPCA determination

Table 7: Soil Vapor and Indoor Air Data (µg/m3)

Address	Sample Date	Sampling Type	TCE	PCE	cis-1,2-DCE	trans-1,2-DCE
4202		no data	--	--	--	--
4204		no data	--	--	--	--
4206	7/10/2008	near slab	300	5.3	25	2.6
	11/1/2010	sub-slab	7	--	--	--
4208	1/24/2007	indoor air	<1.1	<1.4	<0.8	<0.8
4210*	5/7/2008	near slab	3.4	<1.4	<0.8	<0.8
	5/7/2008	near slab	23	<1.4	3.3	<0.8
	11/13/2010	sub-slab	691	22.2	4.9	1.5
4212	1/23/2007	indoor air	17	<1.4	<0.8	<0.8
4214	1/23/2007	indoor air	2.8	<1.4	<0.8	<0.8
	1/23/2007	indoor air	2.5	<1.4	<0.8	<0.8
4216		no data	--	--	--	--
4218	9/24/2007	near slab	27	3.9	<0.8	<0.8
	3/7/2013	near slab	41	1.5	<1.3	<1.3
4220	11/17/2006	indoor air	<2.14	<2.7	<1.6	<1.6
	1/23/2007	indoor air	2.6	3.4	<0.8	<0.8
	1/24/2007	indoor air	2.1	3.2	<0.8	<0.8
	9/24/2007	near slab	13	16	<0.8	<0.8
4222	9/24/2007	near slab	18	2	<0.8	<0.8
4224*	1/22/2007	indoor air	1.4	<1.4	<0.8	<0.8
	10/3/2011	near slab	750	42.2	5.1	<1.2
4226	5/7/2008	near slab	17	1.6	<0.8	<0.8
4228	5/7/2008	near slab	1100	11	350	<1.6
4230	5/7/2008	near slab	260	<2.7	<1.6	<1.6
4232		no data	--	--	--	--
4234	7/10/2008	near slab	38	6.4	<0.8	<0.8
4236		no data	--	--	--	--
4238	7/10/2008	near slab	540	12	39	3
4240		no data	--	--	--	--
4242		no data	--	--	--	--
4244		no data	--	--	--	--
4246		no data	--	--	--	--
4248		no data	--	--	--	--
4250		no data	--	--	--	--

gray shaded cells exceed current screening levels

* indicates sub slab depressurization system has been installed

Appendices

Appendix A: Short-Term Inhalation Screening Values for TCE

Source	Inhalation Value ($\mu g/m^3$)	Type of Value	Basis
Massachusetts Department of Environmental Protection	2	Residential Imminent Hazard Level	Based on fetal developmental effects
New Jersey Department of Environmenal Protection	4	Residential Rapid Action Level	Rapid Action Levels are the lower value generated from using a factor of 100x for carcinogens and a factor of 2x for noncarcinogens using their health-based vapor intrusion guidance values. For TCE, this is equivalent to doubling EPA's RfC of 2.
USEPA Region 9	15	Occupational Removal Action Level	Applies to a single daily exposure; adjusts the EPA RfC of 2 to 5 to account for a 10-hour work day instead of 24 hour exposure, then multipled by 3 per an EPA policy on the use of a HQ of 3 for setting RALs.
California Environmental Protection Agency Department of Toxic Substances Control	15	Occupational Removal Action Level	California is enforcing the Region 9 Removal Action Level as an interim measure until EPA Headquarters completes its review.
USEPA Region 10	2	Short-term noncancer	Not to be exceeded, applies to an average 21-day exposure to women of reproductive age to prevent fetal cardiac malformations.
USEPA Region 3	27	Evacuation from building level	Site-specific value, basis unknown