Health Consultation

Public Health Implications of Soil Gas and Air Sampling Data

GRAND TRAVERSE OVERALL SUPPLY NPL SITE
GREILICKVILLE, LEELANAU COUNTY, MICHIGAN

EPA FACILITY ID: MID017418559

Prepared by
Michigan Department of Community Health

DECEMBER 3, 2012

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

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

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

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HEALTH CONSULTATION

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Acronyms and Abbreviations

$\mu g/m^3$	micrograms per cubic meter
AEGL	Acute Exposure Guideline Level
AIAC	Acceptable Indoor Air Concentration
ASGSC	Acceptable Soil Gas Screening Concentration
ATSDR	Agency for Toxic Substances and Disease Registry
CalEPA	California Environmental Protection Agency
cMRL	chronic Minimal Risk Level
EPA	U.S. Environmental Protection Agency
GTOS	Grand Traverse Overall Supply
HQ	Hazard Quotient
MCL	Maximum Contaminant Level
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
NA	not available
NPL	National Priorities List
PCB	polychlorinated biphenyl
PCE	perchloroethylene (tetrachloroethylene, tetrachloroethene)
ppb	part per billion
ppm	part per million
RfC	Reference Concentration
ROD	Record of Decision
TCE	trichloroethylene (trichloroethene)
UST	underground storage tank
VOC	volatile organic compounds

Summary

The Grand Traverse Overall Supply (GTOS) National Priorities List (NPL, or "Superfund") site is a former commercial laundry in Greilickville (Leelanau County), Michigan. Perchloroethylene (PCE) and trichloroethylene (TCE), among other chemicals (including benzene), are present in the soil and/or groundwater. Local officials requested that the Michigan Department of Community Health (MDCH) review current environmental data and determine if past public health conclusions regarding vapor intrusion exposure risks are still valid.

While short-term harm is *not* expected, MDCH cannot determine the degree of any long-term public health hazard posed by benzene, PCE, and TCE detected near the GTOS site because there are insufficient indoor air data to determine exposure levels. Soil gas data for benzene at Norris Elementary School and for PCE and TCE at Harbor West Condominiums suggest that indoor air could be impacted by subsurface contamination. It is possible that the soil removal completed in 2011and the groundwater extraction system that EPA is planning to implement in 2013 will reduce soil gas concentrations to the point where indoor air impacts are not expected.

Next Steps:

1. MDCH requested that EPA and MDEQ determine the source of benzene at the school and take steps to control it. However, benzene is not related to the GTOS contamination and therefore will not be addressed by the EPA remedial action. It is possible that the benzene is residual contamination following underground storage tank (UST) removals at the school in 1990. Future site owners would have the responsibility for this issue.
2. MDCH will continue to review environmental sampling reports up to at least four quarters after implementation of the groundwater extraction system, and will update public health conclusions at that time, unless conditions warrant public health actions sooner.

Purpose and Health Issues

The Grand Traverse County (Michigan) Health Department medical director and the Elmwood Township supervisor contacted MDCH with questions about current public health implications at the GTOS site following a U.S. Environmental Protection Agency (EPA) public meeting. The officials questioned whether current environmental conditions changed any conclusions that MDCH reached during previous evaluations, particularly regarding vapor intrusion risks. MDCH responded directly to the officials in letter form (Appendices A and B), but is documenting that response and follow-up activities in this public health consultation.

MDCH conducted this evaluation under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR conducts public health activities (assessments/consultations, advisories, education) at sites of environmental contamination and concern. ATSDR is primarily an advisory agency. Therefore, its reports usually identify what actions are appropriate to be undertaken by the regulatory agency overseeing the site, other responsible parties, other health agencies, and communities to reduce exposures to environmental contamination. As such, ATSDR recommendations may not encompass all types of federal and state requirements from a regulatory perspective. The purpose of a public health

assessment or consultation is not to evaluate or confirm regulatory compliance but to determine if any potentially harmful exposures are occurring or may occur in the future.

Background

Grand Traverse Overall Supply (GTOS) was a commercial laundry in Greilickville (Leelanau County), Michigan, operating from 1953 through 1987. The site is about 1.5 miles north of Traverse City (Grand Traverse County), Michigan (Figure 1). The GTOS building was demolished in 2007 and the site is now a vacant lot. Norris Elementary School is immediately east of the GTOS property. Since 2008, Norris Elementary is no longer being used as a school, but various groups use the building (SulTRAC 2011b; C. Grant, Benzie-Leelanau District Health Department, personal communication, 2011). Also to the east are Harbor West Condominiums and the west arm of the Grand Traverse Bay, which is part of Lake Michigan. Southeast of the site is West Bay Covenant Church. (Current environmental investigations occur at the school, the condominiums, and the church.) West of the site is Cedar Lake, which is drained by Cedar Creek, north of the site. The creek flows into the west arm of Grand Traverse Bay (SulTRAC 2011b).

Wastewater from the laundry and dry-cleaning operations at GTOS was originally disposed of in a dry well and lagoons, before being diverted to the sanitary sewer in 1977 (MDCH 2005, SulTRAC 2011b). The site was placed on the EPA's Superfund list in 1983 because of groundwater contamination. Past and current on- and off-site environmental investigations have indicated the presence of PCE, TCE, and their breakdown products in the soil, the soil vapor, the groundwater, and surface water (ATSDR 1994; MDCH 2005; SulTRAC 2009b, 2010a-e, 2011a-e, 2012a-b).

MDCH (then the Michigan Department of Public Health) conducted a public health assessment at GTOS and released a report in 1994 (ATSDR 1994). The report concluded that, based on a 1991 EPA Remedial Investigation Report that showed no significant contamination, the site posed no apparent public health hazard at the time (i.e., exposure was not expected to cause harm). Specifically, contaminated drinking water wells had been abandoned and replaced by deeper wells drilled into an uncontaminated aquifer. MDCH recommended that additional sampling be done to confirm that significant contamination was no longer present in the shallow aquifer.

A Baseline Environmental Assessment conducted in 1995 reported high concentrations of site-related contaminants in the soil and groundwater under the GTOS building. Results from subsequent investigations indicated that site-related chemicals were present in the soil gas both on- and off-site. In 2005, MDCH evaluated soil gas and indoor air samples taken at Norris Elementary School and reported the findings in a health consultation report. Levels of PCE and TCE detected in the indoor air at the school posed no apparent health hazard. MDCH recommended that monitoring continue until the contamination could be prevented from reaching the school (MDCH 2005).

EPA's Removal Program conducted subslab (the soil space immediately beneath a building's cement foundation) and indoor air sampling at the school in 2006, following installation of a soil

Figure 1. Grand Traverse Overall Supply site and vicinity, Leelanau County, Michigan. (Source: SulTRAC 2011e)

vapor extraction system, which significantly decreased soil gas concentrations. EPA's Remedial Program (Superfund) has since become responsible for oversight of clean-up at GTOS and has continued monitoring contaminant levels (EPA 2006, SulTRAC 2009a). The agency conducted a time-critical removal of contaminated soils at the GTOS site in 2008. During that action, an area containing hydrocarbons and low levels of polychlorinated biphenyls (PCBs) was discovered. In an amendment to the Record of Decision (ROD, the remedial plan for a Superfund site), EPA proposed to excavate more soil than was originally planned, to include remediation of the hydrocarbon and PCB contamination (EPA 2010). (The excavation occurred during the fall of 2011 [L. Martin, EPA, personal communication, 2011]).

EPA held a public meeting in Traverse City, Michigan on November 9, 2010 to present the proposed changes to the ROD and seek public comments. Following the meeting, the Grand Traverse County Health Department asked MDCH for assistance in interpreting the more recent data. The Elmwood Township supervisor also contacted MDCH with a similar request. MDCH reviewed historic and current data and responded to the local officials in letter format in January 2011 (Appendices A and B). Since then, MDCH has verified EPA's and the Michigan Department of Environmental Quality's (MDEQ) responses to issues raised in the letter to the local health department and has reviewed additional quarterly Soil Vapor and Ambient Air Data Summary reports.

On September 27, 2011, MDCH attended an EPA public availability session regarding the site at the Elmwood Township Hall. Several community members had concerns about the upcoming soil removal that EPA would be conducting (see "Community Health Concerns" section of this document). The soil removal was completed during the fall of 2011.

On October 17, 2012, EPA held an open house at the Elmwood Township Hall regarding plans for the groundwater cleanup portion of the remedy. Construction of the pump-and-treat system was scheduled to begin at the end of October 2012, with activation anticipated for mid-April 2013. MDCH attended the open house and received a couple of questions, which are discussed in the "Community Health Concerns" section of this document.

Discussion

Regulatory Agencies' Responses to Issues Raised by MDCH

In its January 2011 letter to the local health department, MDCH raised seven issues with EPA and MDEQ regarding the on-going monitoring around the GTOS site and the reports prepared by EPA's consultant. These issues are listed in italic print below (more detailed discussion is in Appendix A), with the resultant actions listed in plain print:

1. *The data for ambient air samples should be listed separately from the soil vapor data, to avoid confusion when evaluating the two different media.* This suggestion has been implemented (SulTRAC 2011 a-c,e; 2012a-b).
2. *For the sake of transparency, the acrolein results should be reported in the tables, but a footnote should be added to the table, and discussion to the text, regarding the unreliability of the data.* This suggestion was implemented (SulTRAC 2011a-c). In the June 2011 Soil Vapor and Ambient Air Data Summary Report, the consultant requested

to the EPA that acrolein be removed from the analyte list, since it is not a site-related contaminant (SulTRAC 2011c). MDCH felt this step would help eliminate confusion.

3. *EPA should correct the column headings for "EPA/MDCH Sub-Slab Screening Levels" to "ATSDR/MDCH Sub-Slab Screening Levels."* This suggestion has been implemented (SulTRAC 2011a-c,e; 2012a-b).
4. *EPA should correct the comparison values for 1,1,2-trichloroethane and benzene, and ensure that all comparison values in the tables are correct*. This suggestion has been implemented (SulTRAC 2011a-c,e; 2012a-b). EPA has recently updated the toxicity values for TCE (EPA 2011c) and PCE (EPA 2012c), which affected the MDEQ screening levels (A. Salisbury, MDEQ Remediation Division, personal communication, 2011 and 2012). MDCH notified the EPA Remedial Project Manager of these changes.
5. *Benzene detections in sub-slab samples taken at Norris Elementary School need further investigation.* Following the October 2012 EPA open house, MDCH learned that two USTs containing gasoline and diesel fuel were removed at the school in 1990 (S. Kitler, MDEQ, personal communication, 2012). It is possible there is residual contamination that is causing the benzene detections. Benzene is not associated with former activities at GTOS and therefore does not fall within EPA's investigative framework for the site (L. Martin, EPA, personal communication, 2011). MDEQ currently does not plan to conduct any additional investigation regarding benzene (C. Fairbanks, MDEQ, personal communication, 2011). Detections in sub-slab samples at the school have been below MDEQ screening levels since December 2010 (SulTRAC 2011a-c,e; 2012a-b). The benzene data trend is discussed further in the "Environmental Contamination" section of this public health assessment report.
6. *Elevated PCE and TCE in the soil vapor samples taken next to the Harbor West Condominiums should be investigated further.* The PCE and TCE data trend at the condominiums is discussed further in the "Environmental Contamination" section of this public health assessment report. Both EPA and MDEQ anticipate that, when the groundwater extraction system is implemented (expected in mid-spring of 2013), there will be a decrease in contaminant levels (L. Martin, EPA, personal communication, 2011; C. Fairbanks, MDEQ, personal communication, 2011).
7. *Sampling equipment should remain consistent (regarding sub-slab vapor and ambient air sampling).* This suggestion has been implemented (SulTRAC 2011a-c,e; 2012a-b).

Environmental Contamination

MDCH reviewed the Soil Vapor and Ambient Air Data Summary reports for each quarter, starting with the sampling done June 2009 through March 2012. EPA's contractor, SulTRAC, conducted soil gas and indoor or outdoor air sampling[1] at Norris Elementary School, West Bay Covenant Church, and Harbor West Condominiums (Figures 2 – 4). The samples were analyzed for volatile organic compounds (VOCs) using EPA Compendium Method TO-15 (EPA 1999). SulTRAC compared the results to media-specific screening levels:

[1] SulTRAC conducted the air sampling for Quality Control purposes, to ensure that chemicals present in indoor or outdoor air were not interfering with soil gas readings, and *not* for air monitoring purposes (SulTRAC, personal communication, 2011).

Figure 2. Sampling locations at Norris Elementary School, near the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. Note that the "ambient air sampling location" is an indoor air sample. (Source: SulTRAC 2011b)

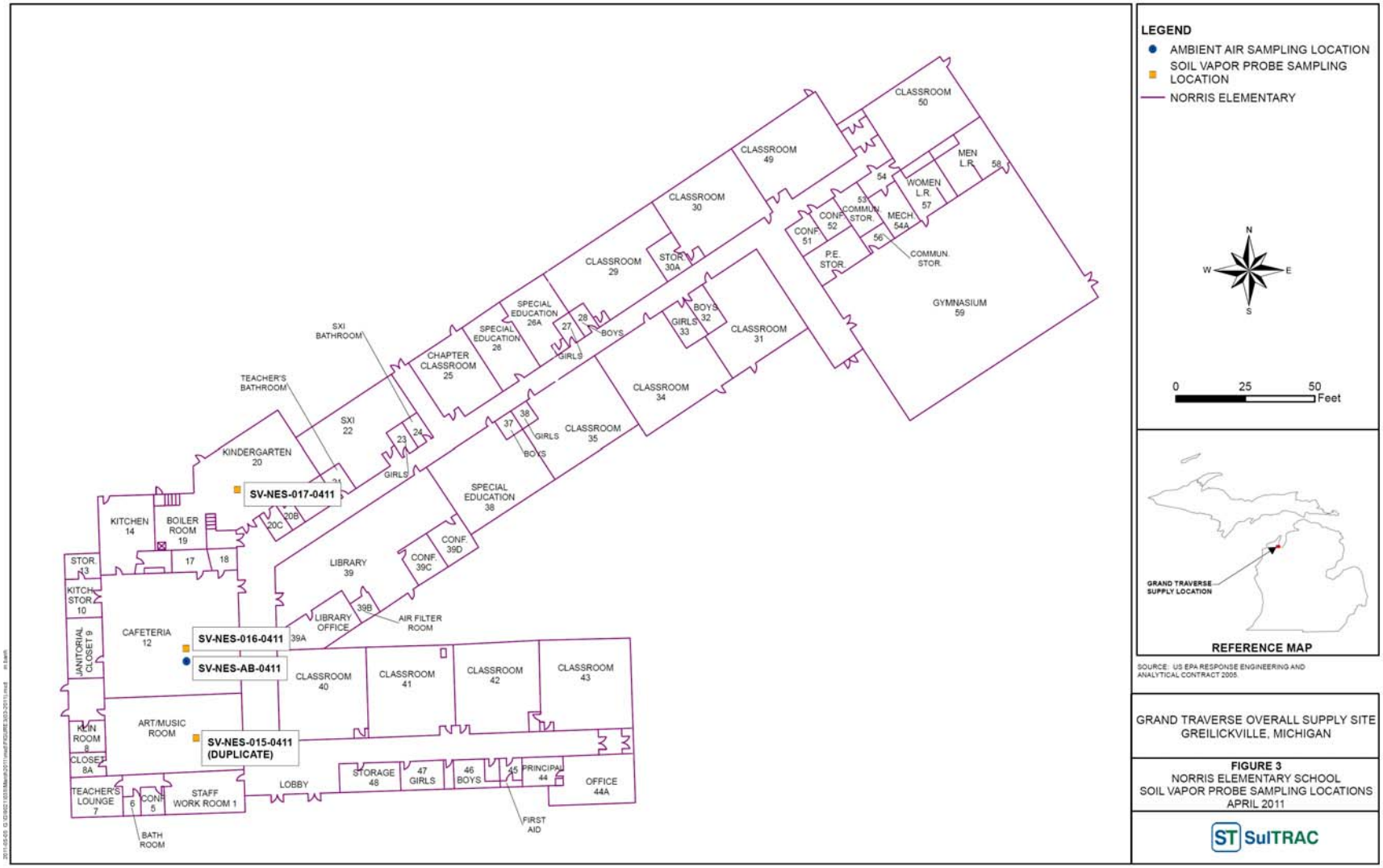


Figure 3. Sampling locations at West Bay Covenant Church, near the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. (Source: SulTRAC 2011b)

Figure 4. Sampling locations at Harbor West Condominiums, near the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. (Source: SulTRAC 2011b)

Soil Gas

- ATSDR/MDCH screening levels (MDCH 2005)
- MDEQ Part 201 Acceptable Soil Gas Screening Concentrations (ASGSCs)[2]

Indoor/OutdoorAir

- the MDEQ Part 201 Acceptable Indoor Air Concentrations (AIACs; for indoor air samples only)[3]
- EPA Reference Concentrations (RfCs)
- ATSDR chronic Minimal Risk Levels (cMRLs)

Note that none of the comparison values are criteria or regulatory standards but, instead, are screening tools. If an analytical result exceeds its respective comparison value, that indicates a need for further investigation (e.g., data validation review, more sampling, or an exposure assessment).

The ATSDR/MDCH screening levels were developed to evaluate soil gas concentrations measured during an indoor air assessment at Norris Elementary School (MDCH 2005). At that time, there were no MDEQ criteria or screening levels for soil gas. ATSDR/MDCH derived the screening levels by multiplying the AIAC by 10 to reflect attenuation from sub-slab to indoor air. (A building's foundation provides some degree of a barrier between the underlying soil gas and the indoor space. Unless site-specific information is available to derive an attenuation factor, a default value is applied.) The EPA used the values derived in the 2005 assessment as "site-specific" screening levels for the data discussed in this document (see "Soil Gas" section). There have been recent (2012 and 2011, respectively) toxicity updates to PCE and TCE. MDEQ is updating its AIACs but the values are not yet finalized. Appendix D discusses the comparison of the soil gas data to what the ATSDR/MDCH screening levels would be using the draft AIAC updates.

The ASGSCs currently are draft screening levels, however MDEQ is allowing their use for site-specific evaluation purposes. They are derived similarly to the ATSDR/MDCH screening levels above, however MDEQ multiplies the AIAC by 50, for sub-slab or depths down to five feet below the ground surface, and by 500 for depths greater than five feet (MDEQ 2009b). The understanding of the vapor intrusion pathway has improved, since ATSDR/MDCH developed their screening levels, such that MDEQ has determined that, in general, an assumption of greater attenuation between soil gas and indoor air is defensible (A. Salisbury, MDEQ, personal communication, 2011). The EPA has been using the ASGSCs that were in place in 2009 as "site-specific" screening levels for the data discussed in this document (see "Soil Gas" section). Due to toxicity updates to PCE and TCE and increased understanding of vapor intrusion, MDEQ is updating its ASGSCs but the values are not yet finalized. Appendix D discusses the comparison of the soil gas data to the draft ASGSC updates.

[2] Under Michigan Governor Snyder's administration, MDEQ is reinventing its remediation and brownfield redevelopment programs. When the process is complete, it is possible that the "Acceptable Soil Gas Screening Concentrations" will have a different name.

[3] Under Michigan Governor Snyder's administration, MDEQ is reinventing its remediation and brownfield redevelopment programs. When the process is complete, it is possible that the "Acceptable Indoor Air Concentrations" will have a different name.

The AIACs also are draft screening levels, however MDEQ is allowing their use for site-specific evaluation purposes. They are derived by adjusting the MDEQ Air Quality Division's outdoor-air screening level (which is adopted from the RfC, occupational exposure limits, or other data sources) from a continuous lifetime exposure to that of a residential or non-residential scenario (MDEQ 2009b). The EPA has been using the AIACs that were in place in 2009 as "site-specific" screening levels for the data discussed in this document (see "Indoor or Outdoor Air" section). Due to toxicity updates to PCE and TCE, MDEQ has been updating its AIACs but the values are not yet finalized. Although EPA began using the updated AIAC for TCE starting with its December 2011 sampling, the agency is waiting until MDEQ finalizes its AIAC for PCE before using the updated value for that chemical. Appendix D discusses the comparison of the indoor air data to the draft update.

The RfC and cMRL represent continuous long-term exposure concentrations below which adverse (non-cancer) human health effects would not be expected (ATSDR 2005, EPA 2010). Due to agency-specific interpretations and risk assessment practices at EPA and ATSDR, these values can differ, even if the same critical study is used to identify potential health effects. When EPA began the quarterly monitoring at the GTOS site in June 2009, neither PCE nor TCE had an RfC and only PCE had a cMRL. Both chemicals have since received updated toxicity values (the PCE cMRL remained the same), as shown in Table 2 (see "Indoor or Outdoor Air" section).

Soil Gas

The soil gas comparison values for benzene, PCE, and TCE are shown in Table 1.

Table 1. Site-specific comparison values for soil gas samples taken at the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. Concentrations are parts per billion (ppb).

Chemical	MDCH/ATSDR Screening Level	MDEQ Part 201 ASGSC
Benzene	9.2	46
PCE	62	310
TCE	26	18.62

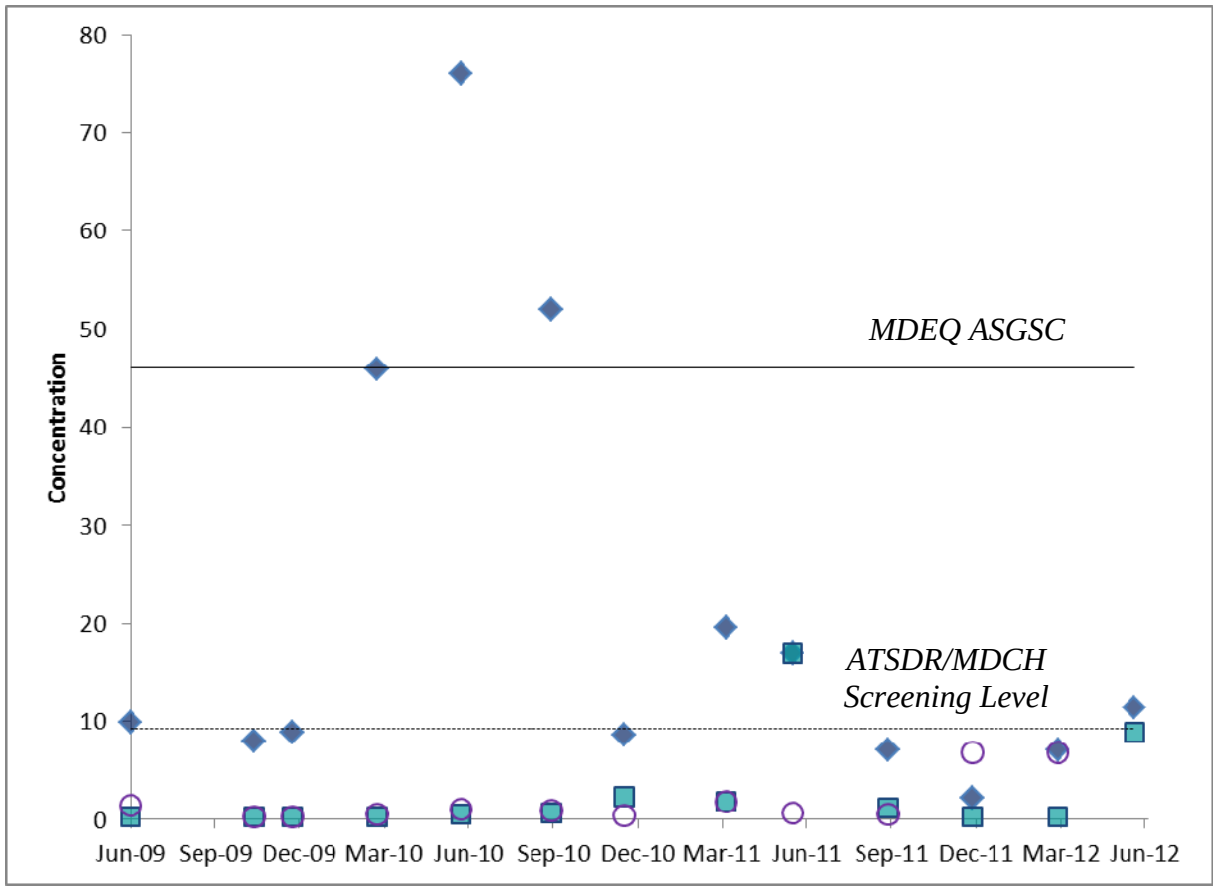
References: MDCH 2005, MDEQ 2009a

Abbreviations and Acronyms

ASGSC	Acceptable Soil Gas Screening Concentration
ATSDR	Agency for Toxic Substances and Disease Registry
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
PCE	perchloroethylene (tetrachloroethylene, tetrachloroethene)
TCE	trichloroethylene (trichloroethene)

Figures 5, 6, and 7 show the maximum soil gas concentration of benzene, PCE, and TCE, respectively, at each site, comparing the data to the MDCH/ATSDR Screening Level (dotted line) and the ASGSC (solid line) for each chemical. (Values for the sample results are shown in Appendix C.) Benzene exceeded at least one of its comparison values several times at the school and once at the church. PCE exceeded its comparison values several times at the school and condominiums. The December 2010 PCE data from one of the soil gas samples taken at the church was well above its comparison values, at 467 ppb, but this detection was likely an error

Figure 5. Maximum soil gas concentrations of benzene in the vicinity of the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. All concentrations are in parts per billion (ppb).



Norris Elementary School

West Bay Covenant Church

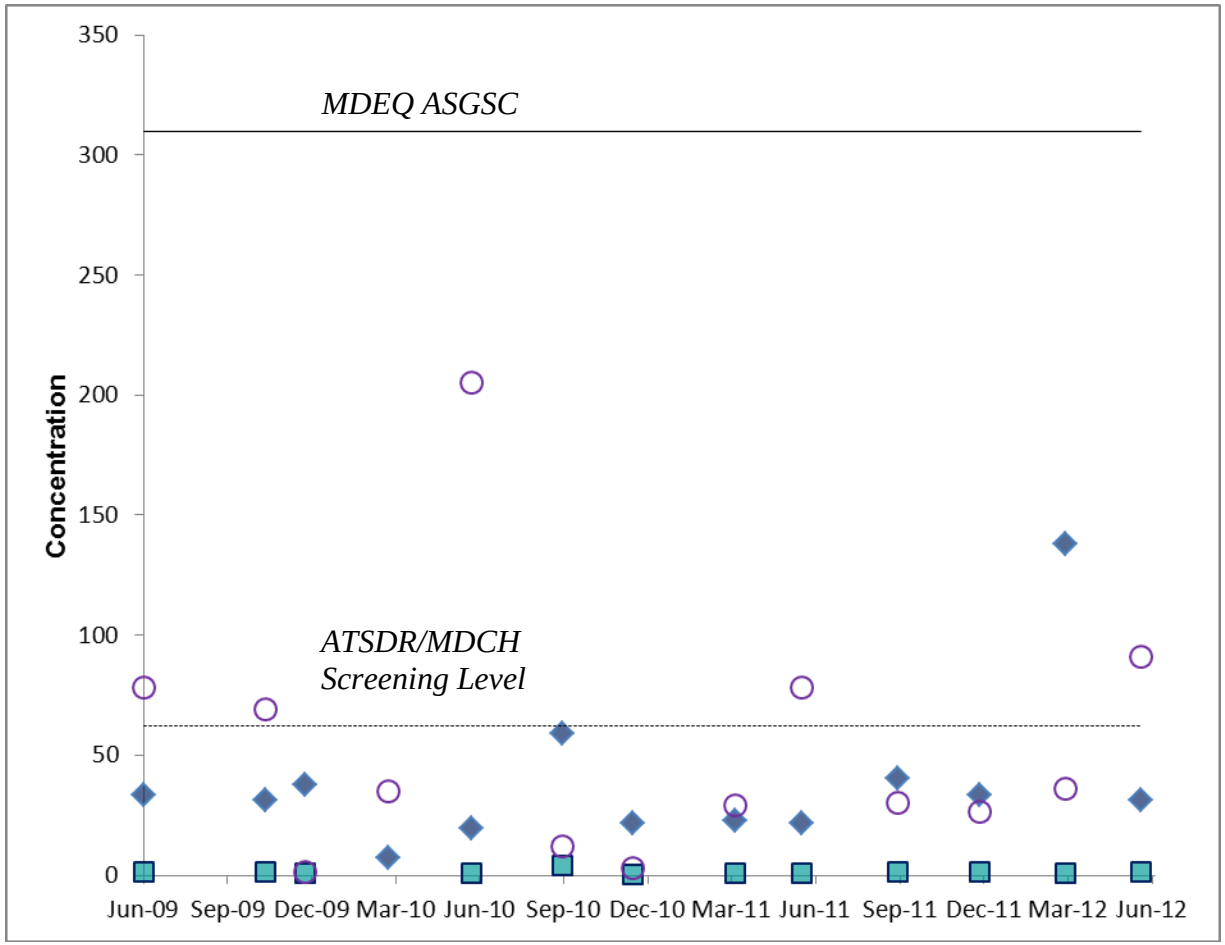
Harbor West Condominiums

If benzene was not detected, there is no marker for the sampling event.

See Appendix C for numerical values reported.

Acronyms:
ASGSC = Acceptable Soil Gas Screening Concentration
ATSDR = Agency for Toxic Substances and Disease Registry
MDCH = Michigan Department of Community Health
MDEQ = Michigan Department of Environmental Quality

Figure 6. Maximum soil gas concentrations of perchloroethylene in the vicinity of the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. All concentrations are in parts per billion (ppb).



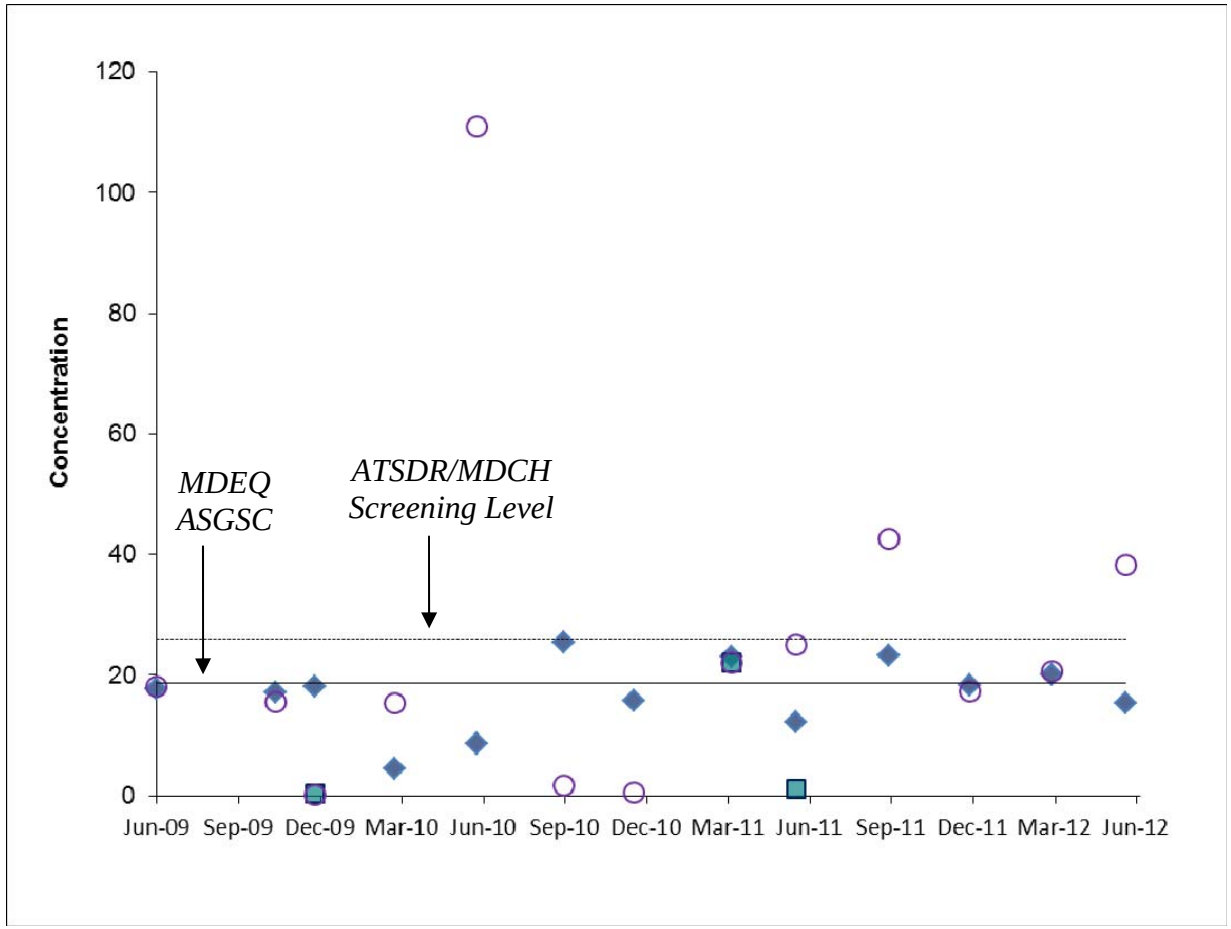
Norris Elementary School
West Bay Covenant Church
Harbor West Condominiums

If perchloroethylene was not detected, there is no marker for the sampling event.

See Appendix C for numerical values reported.

Acronyms:
ASGSC = Acceptable Soil Gas Screening Concentration
ATSDR = Agency for Toxic Substances and Disease Registry
MDCH = Michigan Department of Community Health
MDEQ = Michigan Department of Environmental Quality

Figure 7. Maximum soil gas concentrations of trichloroethyelene in the vicinity of the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. All concentrations are in parts per billion (ppb).



Norris Elementary School

West Bay Covenant Church

Harbor West Condominiums

If trichloroethylene was not detected, there is no marker for the sampling event.

See Appendix C for numerical values reported.

Acronyms:
ASGSC = Acceptable Soil Gas Screening Concentration
ATSDR = Agency for Toxic Substances and Disease Registry
MDCH = Michigan Department of Community Health
MDEQ = Michigan Department of Environmental Quality

[SulTRAC 2011a] and is not shown in Figure 6. TCE exceeded both of its screening values at least once at each location. The soil gas detections of these three chemicals will be discussed further in the "Exposure Pathways Analysis" section of this document.

Indoor or Outdoor Air[4]

The comparison values for benzene, PCE, and TCE air samples are shown in Table 2.

Table 2. Site-specific comparison values for indoor or outdoor air samples taken at the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. Concentrations are parts per billion (ppb).

Chemical	MDEQ Part 201 AIAC	EPA RfC	ATSDR cMRL
Benzene	0.92	9.3	3
PCE	6.2	5.9	40[A]
TCE	0.4	0.37	0.37

References: ATSDR , 2007, 2012; EPA 2002, 2011c, 2012b; MDEQ 2009a

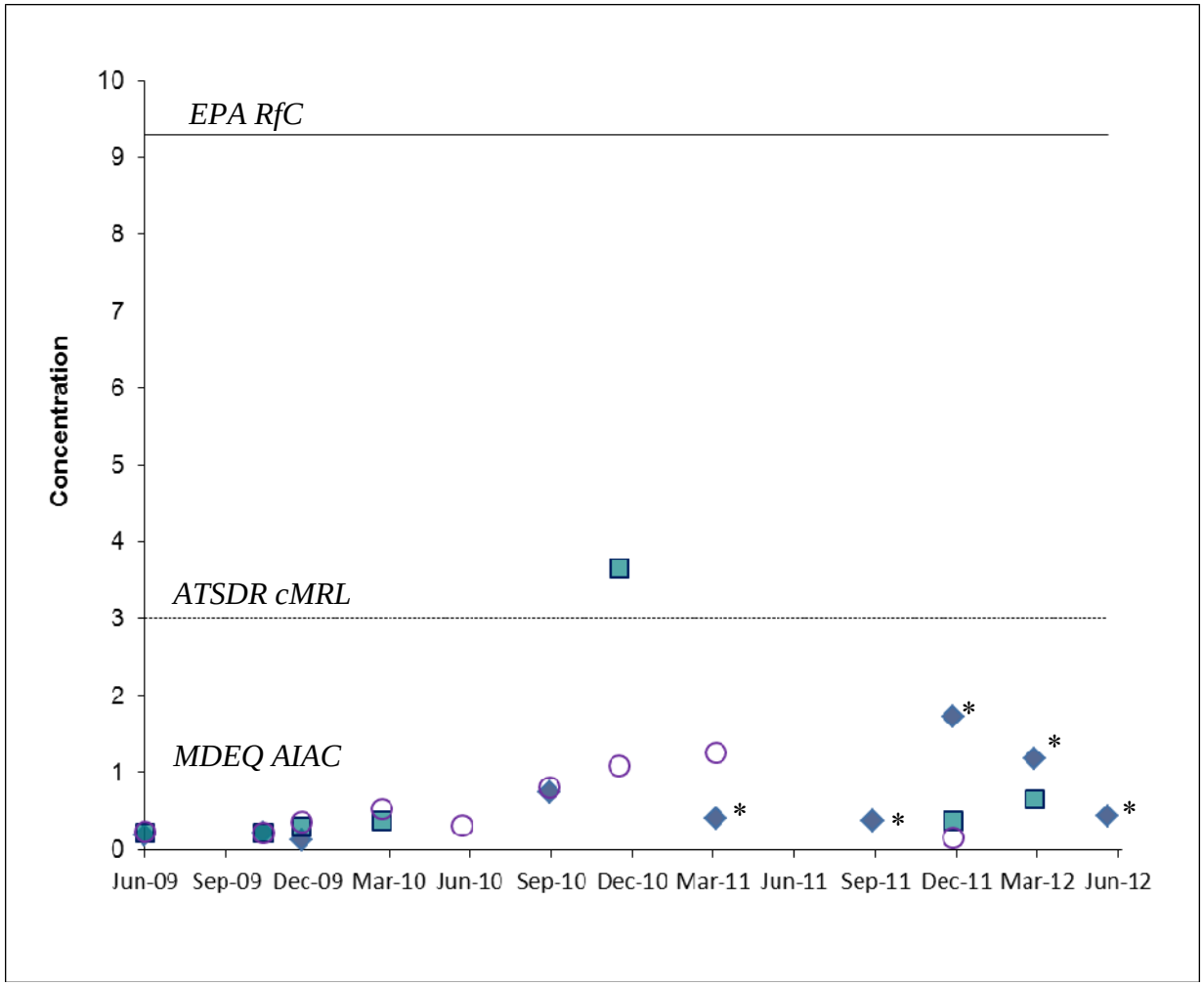
Abbreviations and Acronyms

AIAC	Acceptable Indoor Air Concentration
ATSDR	Agency for Toxic Substances and Disease Registry
cMRL	chronic Minimal Risk Level
EPA	U.S. Environmental Protection Agency
MDEQ	Michigan Department of Environmental Quality
PCE	perchloroethylene (tetrachloroethylene, tetrachloroethene)
RfC	Reference Concentration
TCE	trichloroethylene (trichloroethene)

Figures 8, 9 and 10 show the maximum air concentration of benzene, PCE, and TCE, respectively, at each site. All samples were of outdoor air except for the samples taken at Norris starting December 2010, which were indoor air samples. All sample results were compared to the EPA RfC (solid line) and the ATSDR cMRL (dotted line) for each chemical. The indoor air samples at Norris were also compared to the AIAC (dashed line) for each chemical. (Values for the sample results are shown in Appendix C.) Benzene detections in indoor air at the school exceeded the AIAC twice. These detections will be discussed further in the "Exposure Pathways Analysis" section of this document. Benzene detected in outdoor air at the church in December 2010 exceeded the cMRL but not the RfC. This detection was only slightly above the cMRL and is not considered significant. Therefore, it will not be discussed further. PCE was detected only on one sampling date, at the church and condominiums, but the detections were less than the comparison value. There were no detections of TCE in indoor or outdoor air at Norris. TCE detections in outdoor air samples at the church and the condominiums will be discussed further in the "Exposure Pathways Analysis" section of this document.

[4] As indicated earlier, SulTRAC collected air samples for Quality Control purposes. However, MDCH is evaluating the results to determine implications of exposure.

Figure 8. Maximum indoor and outdoor air concentrations of benzene in the vicinity of the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. All concentrations are in parts per billion (ppb).



Norris Elementary School

West Bay Covenant Church

Harbor West Condominiums

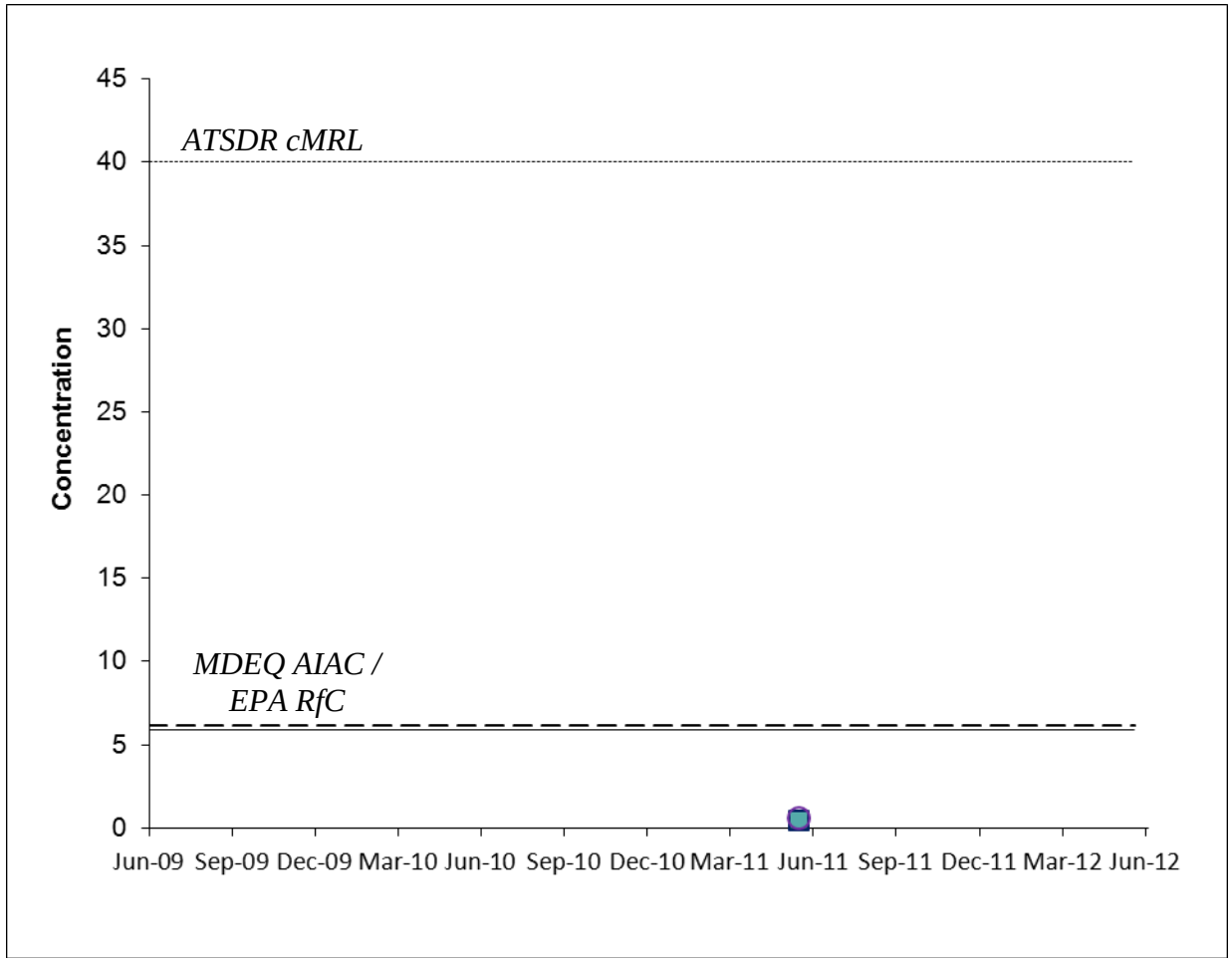
If benzene was not detected, there is no marker for the sampling event.

The *s for Norris Elementary School's detections (starting March 2011) indicate that these were indoor air samples. All other samples for which there were detections were outdoor air samples.

See Appendix C for numerical values reported.

Acronyms:
AIAC = Acceptable Indoor Air Concentration
ATSDR = Agency for Toxic Substances and Disease Registry
cMRL = chronic Minimal Risk Level
EPA = U.S. Environmental Protection Agency
MDEQ = Michigan Department of Environmental Quality
RfC = Reference Concentration

Figure 9. Maximum indoor and outdoor air concentrations of perchloroethylene in the vicinity of the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. All concentrations are in parts per billion (ppb).



West Bay Covenant Church

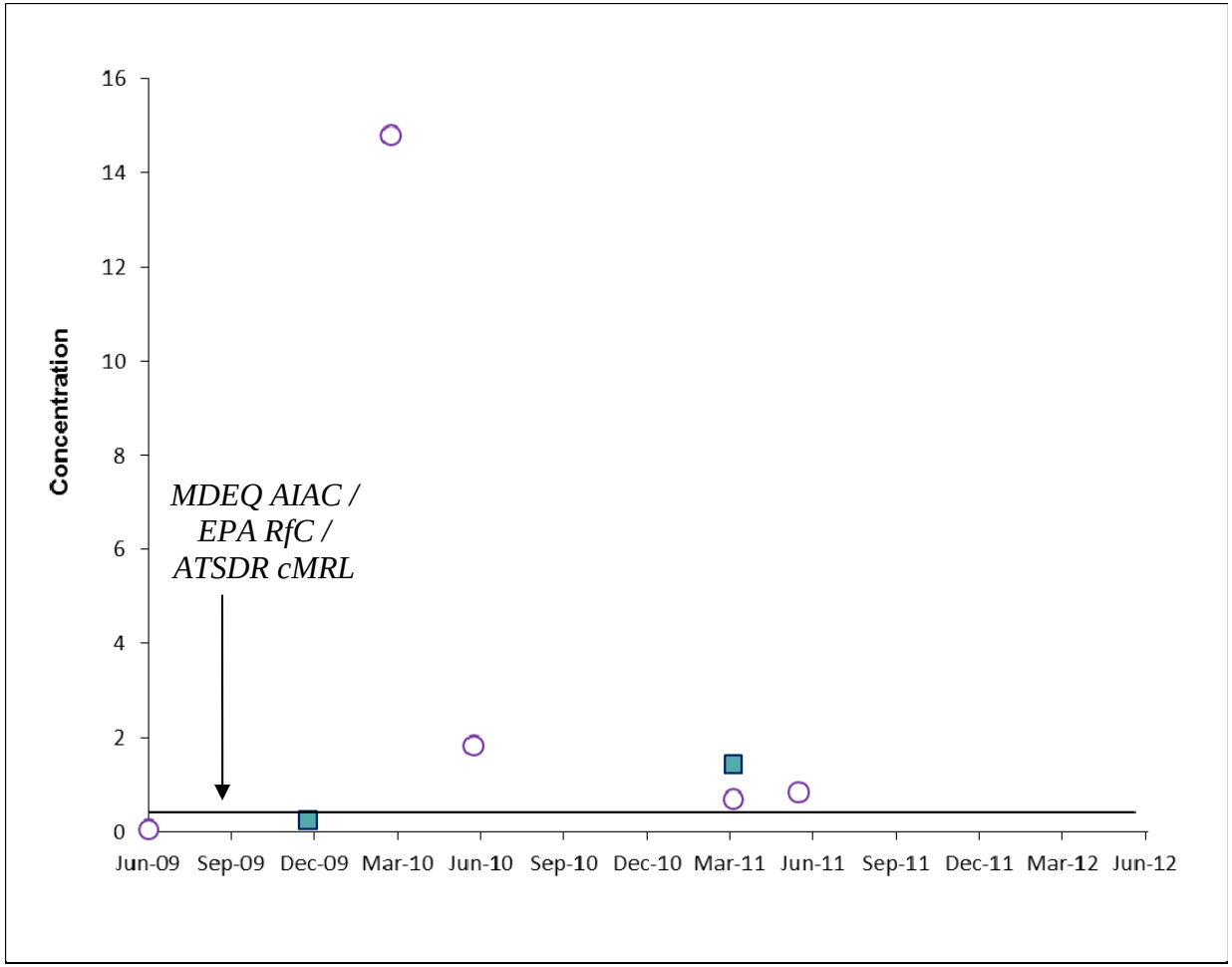
Harbor West Condominiums

If perchloroethylene was not detected, there is no marker for the sampling event. There were no detections at Norris Elementary School.

See Appendix C for numerical values reported.

Acronyms:
AIAC = Acceptable Indoor Air Concentration
ATSDR = Agency for Toxic Substances and Disease Registry
cMRL = chronic Minimal Risk Level
EPA = U.S. Environmental Protection Agency
MDEQ = Michigan Department of Environmental Quality
RfC = Reference Concentration

Figure 10. Maximum indoor and outdoor air concentrations of trichloroethylene in the vicinity of the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. All concentrations are in parts per billion (ppb).



If trichloroethylene was not detected, there is no marker for the sampling event. There were no detections at Norris Elementary School.

See Appendix C for numerical values reported.

Acronyms:
AIAC = Acceptable Indoor Air Concentration
ATSDR = Agency for Toxic Substances and Disease Registry
cMRL = chronic Minimal Risk Level
EPA = U.S. Environmental Protection Agency
MDEQ = Michigan Department of Environmental Quality
RfC = Reference Concentration

Exposure Pathways Analysis

To determine whether persons are, have been, or are likely to be exposed to contaminants, MDCH evaluates the environmental and human components that could lead to human exposure. An exposure pathway contains five elements:

- a source of contamination
- contaminant transport through an environmental medium
- a point of exposure
- a route of human exposure
- a receptor population

An exposure pathway is considered complete if there is evidence, or a high probability, that all five of these elements are, have been, or will be present at a site. It is considered either a potential or an incomplete pathway if there is a lower probability of exposure or there is no evidence that at least one of the elements above are, have been, or will be present. Table 3 shows the exposure pathways analysis for the chemicals of interest near the GTOS site.[5]

Table 3: Exposure pathways analysis for benzene, perchloroethylene (PCE), and trichloroethylene (TCE) in soil gas and air near the Grand Traverse Overall Supply site in Greilickville (Leelanau County), Michigan.

Contamination Source	Environmental Medium	Chemicals of Interest	Exposure Point	Exposure Route	Exposed Population	Time Frame	Exposure Likelihood
Possible residual contamination from removed underground storage tank	Soil gas	Benzene	Indoor air	Inhalation	Persons using Norris Elementary School	Past	Potential
						Present	Potential
						Future	Potential
Former drycleaning operations at GTOS	Soil gas	PCE, TCE	Indoor air	Inhalation	Former Norris school staff and students, condominium residents	Past	Potential
						Present	Potential
						Future	Potential

As discussed earlier, soil gas sample results exceeded the comparison values for each chemical at least once. Soil gas data provide only *theoretical* inhalation exposure information, since the sample is taken from the soil. Indoor air data would provide a clearer understanding of the levels to which people may be exposed.

[5] This document focuses on vapor intrusion and exposure via inhalation, however past exposure included the drinking water pathway. At that time, affected wells were replaced with wells drilled into a deeper, uncontaminated aquifer (ATSDR 1994). Currently, the buildings over the groundwater plume emanating from GTOS are served by the Traverse City Water Treatment Plant (Wilcox 2008). Therefore, exposure via the drinking water pathway is no longer occurring and is not considered in Table 3.

There were seven indoor air samples taken, those being at Norris Elementary School starting December 2010. Two of those samples did not detect any benzene, PCE, or TCE; the other five samples detected only benzene. (Two samples exceeded the AIAC.) The soil gas results at Norris Elementary School for the sampling dates matching the indoor air detections do not clearly support vapor intrusion (they do not follow a similar pattern). However, the results for the soil gas samplings in March, June, and September 0f 2010 were at or above the ASGSC. It is possible that indoor air results for those dates, if sampling had occurred, could have been greater than the comparison values. Therefore, although not related to contamination at the GTOS site, there is potential for exposure to benzene via indoor air at Norris Elementary School. Note that the benzene is not related to contamination at the GTOS site but might be due to residual contamination from USTs that were removed from the school's property.

Since the PCE and TCE contamination was first discovered at GTOS in 1978, it is possible that there was sufficient soil gas that could have affected indoor air at Norris Elementary School in the past. However, the first sub-slab and indoor air sampling did not occur until 2005 (MDCH 2005). The school building is no longer being used as a regular school. However, some of the rooms are used by various groups (SulTRAC 2011b; C. Grant, Benzie-Leelanau District Health Department, personal communication, 2011). Until remedial actions are taken, it is likely that the contaminants from the GTOS site will continue to threaten down-gradient properties with potential vapor intrusion.

Because the potential for exposure to indoor air concentrations of benzene, PCE, and TCE exists, these chemicals of interest are discussed further under the "Toxicological Evaluation" section of this document.

Toxicological Evaluation

Benzene

Benzene is commonly found in the environment, both from industrial and natural sources. It is present in crude oil, gasoline, and smoke (e.g., from forest fires, tobacco, and engine exhaust). Benzene evaporates very quickly into air, where it can react with other chemicals and break down within a few days. It is slightly soluble in water, and degrades more slowly there and in soil. It is highly flammable (ATSDR 2007).

People are exposed to small amounts of benzene every day, primarily in air. Concentrations in outdoor air can range from 0.02 to 34 parts per billion (ppb). Urban and industrial areas generally have higher levels of benzene in the air than rural areas. Benzene levels in the home are usually higher than outdoor levels (ATSDR 2007). If benzene enters groundwater and is used as drinking water, people may be exposed. However, public drinking water supplies are regulated under the National Primary Drinking Water Regulations and must be tested regularly to ensure compliance with EPA's Maximum Contaminant Levels (MCLs; EPA 2011a).

Short-term exposure to high levels of benzene can result in dizziness, rapid heart rate, tremors, headaches, and unconsciousness (ATSDR 2007). The EPA has developed Acute Exposure Guideline Levels (AEGLs) for hazardous substances to assist with community emergency planning and response. AEGL exposure limits, which are tiered by exposure time (from 10 minutes to eight hours) and severity of effect (non-disabling, disabling, or lethal), are intended to

protect the majority of people, including sensitive populations such as children. The AEGL program recognizes that some individuals may have sensitivities that may cause them to experience health effects at concentrations less than the associated AEGL (EPA 2012a). The most protective AEGL for non-disabling effects from benzene exposure is 9 parts per million (ppm), for an eight-hour exposure. At this level, a person may experience mild central nervous system effects, such as dizziness, which would stop once the exposure stops (EPA 2009a). Based on the data for the GTOS site, it is *not* likely that acute levels are occurring here.

Long-term exposure to benzene in the air (0.1 ppm in occupational studies) can result in damage to the hematopoietic (blood production) system. This damage can lead to anemia, excessive bleeding, or a depressed immune system. Research studies suggest that exposure may be harmful to the reproductive organs (ATSDR 2007).

Benzene is a known human carcinogen: exposure has been associated with the development of acute myeloid leukemia, a particular type of leukemia (ATSDR 2007).

ATSDR has developed Cancer Risk Evaluation Guides (CREGs) for carcinogenic chemicals. CREGs are media-specific comparison values that are not expected to result in excess cancer in an exposed population (this assumes that an *unexposed* population already has some risk of developing cancer). CREGs are only available for adult exposures; there are no CREGs specific to children's exposures. CREGs assume that exposure is occurring for a lifetime. CREGs are not predictive of an exposed *individual's* likelihood of developing cancer. CREGs are derived using cancer slope factors and inhalation unit risks developed by EPA (ATSDR 2004c).

The CREG for benzene in air is 0.04 ppb (ATSDR 2012), meaning that at this exposure level, there would be a possible risk of one excess cancer out of one million people exposed. There were seven indoor air samples, all taken at the school. The arithmetic average of those results (see Table C-4), using one-half the reporting limit for the non-detects (0.27 ppb in December 2010 and 0.16 ppb in June 2011 [SulTRAC 2011a,c]), is 0.6 ppb, a possible risk of 1.5 excess cancers out of 100,000 people exposed to that concentration. Note, however, that more frequent sampling would be necessary to better characterize long-term air quality.

The outdoor-air benzene detections near the GTOS site may be due to vehicle traffic on nearby M-22 (Figure 1) and, as shown by the data (Appendix C), fluctuate throughout the year. Any risk posed by these detections can be considered "background" risk.

There are only seven indoor air samples in the dataset so far (two samples had no benzene detections; Appendix C). The indoor air detections of benzene at the school might be attributable to the USTs that were removed in 1990. Continued indoor air testing at the school would help determine the level of risk that indoor concentrations of benzene may pose to occupants of the building. Note that the CREG is based on continuous exposure, which would not be the case for persons using the school.

PCE

Perchloroethylene (PCE, also known as "perc," tetrachloroethylene, and tetrachloroethene) is mostly known for its use in dry-cleaning but also has been used as a metal degreaser and a

general anesthetic agent. It has a sharp, sweet odor (noticeable at air concentrations above 1 ppm) and is a nonflammable liquid at room temperature. It evaporates easily and can remain in the air for several months before it degrades or returns via rain. Typical background levels in air are usually less than 1 ppb; however, the air near dry-cleaning operations will have higher concentrations. Released liquid PCE can travel through soil and contaminate groundwater (ATSDR 1997a).

People are exposed to PCE most frequently in air, such as when bringing dry-cleaned materials home. PCE is present in some consumer products, such as spray water repellants, spot removers, and adhesives. It can also be found, though less frequently, in contaminated drinking water and some foods, especially food prepared near a dry-cleaning shop (ATSDR 1997a). Public drinking water supplies are regulated under the National Primary Drinking Water Regulations and must be tested regularly to ensure compliance with EPA's MCLs (EPA 2011a). Babies may be exposed through breast milk if the mothers were exposed (ATSDR 1997a).

Repeated or extended skin contact with liquid PCE may result in skin irritation. High concentrations of PCE in air, especially in poorly ventilated areas, can cause central nervous system effects, such as dizziness, headaches, confusion, nausea, unconsciousness, and death. These exposures typically are seen in work or hobby environments or when substances containing PCE have been abused to get a "high" (ATSDR 1997a). The eight-hour AEGL for non-disabling effects from PCE exposure is 35 ppm (EPA 2012b). High concentrations are *not* expected at or near the GTOS site. The effects of lower levels of exposure, such as might occur near dry-cleaning operations or hazardous waste sites, are not definitely known (ATSDR 1997a).

Studies in laboratory animals have shown that PCE can cause damage, including cancer, to the liver and kidneys (ATSDR 1997a). EPA has determined that PCE is likely to be carcinogenic to humans, noting associations between exposure and bladder cancer, non-Hodgkins lymphoma, and multiple myeloma. The dataset for cancers of the esophagus, kidney, lung, liver, cervix, and breast is more limited and only suggestive of an association. Studies in rats and mice indicate that PCE causes cancer in laboratory animals (EPA 2012c). The ATSDR CREG for PCE is 0.57 ppb (ATSDR 2012).

There were two detections of PCE in the outdoor air samples taken near the GTOS site, both on the same sampling date. It is not likely that such sporadic detections would cause any increased risk of cancer.

There are seven indoor air samples, taken at the school, in the dataset for PCE so far, none of which had detections of the chemical. The soil gas data from the condominiums, sampled outside of the buildings' footprint, suggest that indoor air could be impacted (Appendix C). Actual subslab sampling at the condominiums may clarify whether subsurface contamination is likely to affect indoor air concentrations of PCE. It would be necessary to conduct indoor and outdoor air sampling concurrently, to help differentiate between interior and exterior sources.

TCE

Trichloroethylene (TCE, also known as trichloroethene) is used mainly as a degreaser for metal parts, but also is found in typewriter correction fluid, paint removers, adhesives, and spot

removers. Like PCE, it also was used as a general anesthetic agent. It was used as a drycleaning agent before being replaced with PCE. It has a somewhat sweet odor (noticeable at around 100 ppm), is liquid at room temperature, and is nonflammable. TCE evaporates easily and about half of the vapors break down within a week. Typical outdoor air levels are between 0.1 and 0.5 ppb. (Note that, as previously mentioned, the RfC for TCE is 0.37 ppb, indicating background concentrations may sometimes exceed the RfC.) If released to soil, TCE generally does not degrade there but travels to groundwater, where it does break down but at a slower rate than in air (ATSDR 1997b).

People are usually exposed to TCE via the air or drinking water (ATSDR 1997b). As indicated above, the chemical is present in various consumer products, the vapors of which can be inhaled during a product's use or as it is drying or curing. If TCE enters groundwater used as drinking water, people may be exposed. However, public drinking water supplies are regulated under the National Primary Drinking Water Regulations and must be tested regularly to ensure compliance with EPA's MCLs (EPA 2011a).

Liver and kidney damage, changes in heart beat, and damage to facial nerves have been reported in people breathing high concentrations of TCE. Exposure to moderate-to-very-high air levels of TCE can result in central nervous system effects, such as dizziness, sleepiness, and loss of consciousness (ATSDR 1997b). The eight-hour AEGL for non-disabling (mild central nervous system depression) effects from TCE exposure is 77 ppm (EPA 2009b). The air concentrations seen near the GTOS site are far below the AEGL, by at least 10,000 times (Appendix C), and would *not* be expected to cause the effects discussed here.

EPA has determined that TCE is carcinogenic to humans, with the strongest evidence being for kidney cancer, followed by non-Hodgkin's lymphoma, and liver and biliary tract cancers. TCE exposure is associated with other cancers (bladder, esophageal, prostate, cervical, breast, and childhood leukemia), but the evidence is limited and not as strong. EPA estimates that a concentration of 0.04 ppb TCE in air is associated with a one-in-one-million increased risk of cancer (EPA 2011c). The ATSDR CREG for TCE is 0.045 ppb (ATSDR 2012).

There were no detections of TCE in indoor or outdoor air at the school, very few detections in outdoor air at the church, and sporadic detections of the chemical in outdoor air by the condominiums. The highest concentration of TCE in outdoor air near the condominiums (14.8 ppb) occurred during the March 2010 sampling. The highest soil gas reading occurred during the June 2010 sampling. The outdoor air concentration may not be related to the subsurface contamination. Actual subslab sampling at the condominiums may clarify whether subsurface contamination is likely to affect indoor air concentrations of TCE. It would be necessary to conduct indoor air and outdoor sampling concurrently, to help differentiate between interior and exterior sources. Currently, there are no indoor air data at the condominiums.

Evaluation of Potential for Chemical Interaction

Because people are exposed to a mixture of chemicals at hazardous waste sites, rather than to one chemical at a time, there is the potential for chemicals to interact and cause a different health effect than would be expected from single-chemical exposure. This interaction can result in an "additive" effect, in which the actions of each chemical are summed; a "synergistic" effect, in

which the effect is greater-than-additive; or an "antagonistic" effect, in which the effect is less-than-additive (ATSDR 2004a).

It is more likely that compounds that cause the same health effect, such as neurotoxicity (e.g., PCE and TCE), will interact, versus compounds that have different effects (e.g., benzene [blood production effects] and PCE/TCE). ATSDR has completed several interaction profiles for toxic substances, including one for 1,1,1-trichloroethane, 1,1-dichloroethane, PCE, and TCE (2004b). PCE and TCE have similar metabolic pathways, suggesting that they may interfere with each other's metabolism in the body. Occupational studies indicated that workers exposed to both PCE and TCE had lower levels of trichloro-metabolites in the urine than workers exposed only to TCE at about the same concentration that occurred in the mixture. These data suggest that coexposure to PCE at fairly low exposure levels inhibits the metabolism of TCE in humans. The metabolites of PCE and TCE are considered to be responsible for the chemicals' toxicity to the liver and kidney, however it is unclear whether the parent compounds or their metabolites (particularly TCE's metabolites) have the greater impact on neurotoxic effects. ATSDR scientists concluded that PCE had a less-than-additive effect on TCE whereas TCE had an additive effect on PCE and that health assessors should calculate a Hazard Index to provide an indicator of the hazard of coexposure to these two chemicals (ATSDR 2004b).

The Hazard Index for a chemical mixture is the sum of the Hazard Quotients (HQs) of its components. Risk assessors calculate HQs by dividing the expected dose of a chemical by its health-based screening level. If a component has an HQ of less than 0.1, then it is not likely to be of concern for joint toxic action. If only one component's HQ exceeds 0.1 and approaches unity (1), the situation is not a mixtures problem, but that chemical should be evaluated further on its own (ATSDR 2004a).

As shown in Appendix C in Tables C-5 and C-6, neither PCE nor TCE were detected in indoor air at Norris Elementary School. The only sampling date when both chemicals were detected in outdoor air was in June 2011, at Harbor West Condominiums. The HQ for PCE for that result is 0.01 (0.566 / 40 [the ATSDR chronic MRL from Table 2]), which likely eliminates that chemical as a concern for joint toxic action. Therefore, based on the data and the guidance provided by ATSDR, no interaction between the toxicities of PCE and TCE is expected[6]. This is emphasized by the fact that many of the sample results showed no detections of the chemicals.

Children's Health Considerations

In general, children may be at greater risk than adults from exposure to hazardous substances at sites of environmental contamination. Children engage in activities such as playing outdoors and hand-to-mouth behaviors that could increase their intake of hazardous substances. They are shorter than most adults, and therefore breathe dust, soil, and vapors found closer to the ground. Their lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. The developing body systems of children can sustain permanent damage if toxic exposures are high enough during critical growth stages. Fetal development involves the

[6] The evaluation for chemical interaction was not conducted on past exposure to contaminated drinking water at the school because exposure doses cannot be calculated with certainty. See Appendix A for discussion of the uncertainties/unknowns.

formation of the body's organs. Injury during key periods of prenatal growth and development could lead to malformation of organs (teratogenesis), disruption of function, and premature death. Exposure of the mother could lead to exposure of the fetus, via the placenta, or affect the fetus because of injury or illness sustained by the mother (ATSDR 1998). The implication for environmental health is that children can experience substantially greater exposures to toxicants in soil, water, or air than adults can.

Children exposed to known or potential carcinogens, such as benzene, PCE, or TCE, have a longer remaining lifespan during which any resulting development of cancer can occur. Currently, Norris Elementary School is not in use as a formal learning facility, so children are not being exposed to indoor air contaminants that may be present there. When GTOS was an operating laundry, it is likely that children attending the school, which is immediately east of the GTOS property, were exposed to dry-cleaning chemicals in the air, both outside and indoors (from ambient air entering the building [ATSDR 1994]).[7] These children may have been at risk for experiencing negative health effects, during that time or in the future, but the risk cannot be determined with certainty, as explained in Appendix A.

There are no indoor air data available for West Bay Covenant Church or Harbor West Condominiums. Children would not spend a lot of time at the church, except in the daycare center reported to be in the building. The soil gas data for the church strongly suggest that vapor intrusion is *not* a threat there. There may be residents with children at the condominiums. The soil gas data for the condominiums suggest that there may be a vapor intrusion threat there; however more data would be necessary to determine the likelihood of that threat.

Community Health Concerns

The Grand Traverse County Health Department and Charter Township of Elmwood requested that MDCH update its evaluation of public health implications at the GTOS site, specifically regarding vapor intrusion, to determine if a possible public health concern exists. The initial responses from MDCH are in Appendices A and B. This health consultation report more completely shows the agency's conclusions and follow-up activities.

At least one citizen has made repeated requests for health agencies to conduct a health study of students who may have been exposed to PCE and other contaminants in the air and drinking water at Norris Elementary School. ATSDR and MDCH cannot conduct such a study, for reasons discussed in Appendix A.

EPA referred to MDCH a citizen whose pregnant daughter had moved in the summer of 2011 into a house near the GTOS site. Both the citizen and his daughter were concerned about her exposure to potentially affected drinking water, which is obtained from a private well. According to groundwater data (SulTRAC 2011d), the well is outside of and upgradient from the groundwater plume emanating from the GTOS property and should *not* be impacted. MDCH asked the Benzie-Leelanau District Health Department to check on any well sampling records in their files (for chemicals or other contaminants) and to relay the information to the caller.

[7] Children at Norris Elementary School likely were exposed to GTOS-related contaminants via the drinking water as well, until the affected well was abandoned.

According to the local health department, nearby wells had been tested for bacteria and nitrates but none had been detected. The local agency communicated this information to the caller (W. Crawford, Benzie-Leelanau District Health Department, personal communication, 2011).

At the September 27, 2011 public availability session at Elmwood Township Hall, a resident who lives southwest of the GTOS site expressed concerns about the effects on air quality a planned soil excavation at the site (to fulfill the amended ROD) might have. EPA monitored noise and air quality parameters, including VOCs, at the site during the work and posted analytical results from daily air sampling events onto their website (https://explore.data.gov/Environment/Grand-Traverse-Overall-Supply-Air-Monitoring/v7h3-9e9g). (No corrective action regarding air quality was necessary during excavation.) MDCH discussed how the prevailing winds in the area were from the southwest, placing the resident upwind from the site and less likely to experience air quality problems related to the excavation.

Another person at the public availability session asked about the health effects of exposure to the site contaminants. MDCH gave the information provided in the "Toxicological Evaluation" section of this document, and also discussed how dose, timing, and exposure route are considered when evaluating exposure.

At the October 17, 2012 EPA open house at Elmwood Township Hall, a citizen mentioned his concerns that his wife, formerly an employee at Norris Elementary School, may have been exposed to PCE and other contaminants. They had moved to the area in the mid-1980s. The drinking water contamination was discovered in 1978 (MDCH files) and steps immediately were taken to stop exposures. Therefore, the man's wife likely was not exposed to contaminated water at the school. It cannot be determined if she may have been exposed to PCE in indoor or outdoor air.

Another person at the open house felt that EPA should be testing his private drinking water well during their quarterly monitoring of the site. The person lives north of Cedar Creek, which is north of the site. EPA had tested his well previously and had not found contamination. Monitoring well data have indicated that, where the groundwater plume occurs north of the creek (which happens rarely and only to a very small geographical extent), the concentrations have been below drinking water standards (SulTRAC 2011d). MDCH would not expect drinking water wells north of Cedar Creek to be adversely affected by the contamination that is currently at the GTOS site.

Conclusions

While short-term harm is *not* expected, MDCH cannot determine the degree of any long-term public health hazard currently posed by benzene, PCE, and TCE detected near the GTOS site because there are insufficient indoor air data to determine exposure levels. Soil gas data for benzene at Norris Elementary School and for PCE and TCE at Harbor West Condominiums suggest that indoor air could be impacted by subsurface contamination. It is possible that the soil removal completed in 2011 and the groundwater extraction system that EPA is planning to implement in 2013 will reduce soil gas concentrations to the point where indoor air impacts are not expected.

Recommendations

1. Determine the source of the benzene in the soil gas and indoor air at Norris Elementary School, so that it can be addressed appropriately.
2. Continue soil gas and air sampling as remedial actions are taken, to determine efficacy of such actions.

Public Health Action Plan

1. MDCH requested that EPA and MDEQ determine the source of benzene at the school and take steps to control it. Benzene is not related to the GTOS contamination and therefore will not be addressed by the EPA remedial action. It is possible that the benzene is residual contamination following underground storage tank (UST) removals at the school in 1990. Future site owners would have the responsibility for this issue.
2. EPA will continue environmental monitoring at the site and nearby vicinity.
3. MDCH will continue to review sampling reports up to at least four quarters after implementation of the groundwater extraction system, and will update public health conclusions at that time, unless conditions warrant public health actions sooner.

MDCH will remain available as needed for future consultation at this site.

If any citizen has additional information or health concerns regarding this public health consultation, please contact MDCH's Division of Environmental Health at 1-800-648-6942.

Report Preparation

This Health Consultation was prepared by the Michigan Department of Community Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, procedures existing at the date of publication. Editorial review was completed by the cooperative agreement partner. ATSDR has reviewed this document and concurs with its findings based on the information presented.

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Appendix A: January 21, 2011 Letter to Grand Traverse County Health Department (Traverse City, Michigan) regarding Grand Traverse Overall Supply site[8]

[8] When MDCH originally sent this letter to the Grand Traverse County Health Department, citations that now refer to "SulTRAC" were then attributed to "McCarty JL." MDCH has changed the citations per EPA's request.

Rick Snyder
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF COMMUNITY HEALTH
LANSING

Olga Dazzo
DIRECTOR

January 21, 2011

Fred Keeslar, Medical Officer/Director
Grand Traverse County Health Department
2325 Garfield Road North
Traverse City, MI 49686

Dear Mr. Keeslar:

Per your request, I have reviewed the environmental data for the Grand Traverse Overall Supply (GTOS) Superfund site in Greilickville, Leelanau County, Michigan (Figure 1) to determine if public health conclusions reached by the Michigan Department of Community Health (MDCH) in 2005 have changed. The U.S. Environmental Protection Agency (EPA) is proposing to amend the Record of Decision (ROD) for the site and excavate additional contaminated soil that was discovered during a time-critical removal action. *MDCH finds that this is a health-protective action and supports the ROD amendment.*

However, during review of the data, I found several issues that need clarification or further investigation before public-health implications can be clearly determined. Those issues are listed briefly here and discussed in detail below:

1. The data for ambient air samples taken during EPA's on-going monitoring should be listed separately from the soil-vapor data, to avoid confusion when evaluating the two different media.
2. Ambient air results for acrolein should be considered invalid, due to quality-control issues with equipment preparation, the calibration standard, and the analytical method.
3. The methodology for establishing the MDCH sub-slab screening levels is acceptable. However, MDCH established this methodology with the federal Agency for Toxic Substances and Disease Registry (ATSDR), not the EPA.
4. MDCH noted two errors in the values listed for the Michigan Department of Environmental Quality (MDEQ) comparison values and has notified EPA and the Michigan Department of Natural Resources and Environment (MDNRE, formerly the MDEQ) of these errors.
5. Benzene detections in sub-slab samples taken at the former Norris Elementary School need further investigation.
6. Elevated tetrachloroethene (PCE) and trichloroethene (TCE) in the soil-vapor samples taken next to the Harbor West Condominiums should be investigated further.
7. Sampling equipment should remain consistent.

In the matter of parents' concerns of previous exposure to students at Norris Elementary School, immediately to the east of the GTOS site, exposure to dry-cleaning related chemicals may have

occurred, but the duration and amount cannot be known with certainty. That information would be necessary to determine potential health outcomes.

Background and Statement of Issues

GTOS was a commercial laundry, beginning operations in 1953. Environmental investigations at the site began in 1978, following complaints of odors and unusual tastes in the water supply at Norris Elementary School. These investigations found PCE, TCE, and their breakdown products migrating from the site. In 1983, the GTOS site was placed on the National Priorities List (NPL, or "Superfund"), and a Remedial Investigation (RI) and Feasibility Study (FS) took place. The ROD, signed in early 2008, called for a "limited" excavation of contaminated soils, since it was assumed that an EPA time-critical removal, to be done that summer, would remove the majority of the contamination. However, during the time-critical removal, an area containing hydrocarbons and low levels of polychlorinated biphenyls (PCBs) was discovered. Due to budgetary and time constraints, and Michigan laws regarding hazardous waste, the additional contamination could not be fully addressed at that time. Therefore, the remaining contamination is to be addressed by the remedial branch of EPA Superfund, as outlined in the proposed ROD amendment (EPA 2010a).

EPA held a public meeting at the Elmwood Township Center Office in Traverse City, Michigan on November 9, 2010 to present the proposed changes to the ROD and take public comment. Following the meeting, local health departments were contacted by the media for more information. The Grand Traverse County Health Department asked MDCH for toxicological assistance in interpreting the more recent data. (Although the GTOS site is in Leelanau County, and therefore under the jurisdiction of the Benzie-Leelanau District Health Department, Norris Elementary School was part of the Traverse City school system, making it easy for one to assume it is within Grand Traverse County.) MDCH contacted EPA Remedial Project Manager Linda Martin and requested recent environmental data, particularly soil-gas and indoor-air results. MDCH and MDNRE conducted a conference call with EPA and their contractor on December 7, 2010 regarding the issues discussed below.

Discussion: Issues and Recommendations

Health Implications of ROD Amendment

Issue: The proposed amendment to the ROD for the GTOS site maintains the same Remedial Action Objectives as the original ROD: to be protective of direct skin contact with the soil and prevent leaching to groundwater that is used for drinking water or vents to surface water (EPA 2010a). The GTOS site is now fenced; local planners are considering alternatives for reuse of the site, following EPA's remedial work (L. Martin, EPA, personal communication, 2010) . The laundry has closed and the building has been removed, so there are no air emissions. Use of the Norris Elementary building as a school stopped after 2008; it is still used on occasion for

meetings or community functions (L. Martin, EPA, personal communication, 2010). Homes and businesses that previously had been affected by contaminants in the groundwater plume now have deeper, unaffected wells or are served by municipal water (MDPH 1994, ATSDR 2005a). Therefore, there is infrequent, if any, exposure to the contaminants. The proposed amendment to the ROD will allow for reuse of the site that is protective of public health.

Recommendation: EPA should adopt the amendment to the ROD.

Presentation of Ambient Air Sampling Results

Issue: In the Summary Reports for the quarterly monitoring at the former Norris Elementary School, West Bay Covenant Church (south of the school), and Harbor West Condominiums (east of the school), ambient air results are listed in the same tables that show sub-slab soil vapor results. The tables do show the screening levels for soil gas but no screening levels for ambient air (SulTRAC 2009, 2010a-e). This may unintentionally cause the reader to compare ambient air data to soil gas screening levels, leading to incorrect conclusions.

Recommendation: The data for ambient air samples taken during EPA's on-going site monitoring should be listed separately from the soil vapor data. (This step was implemented in the December 2010 Summary Report [SulTRAC 2010e].) Although air data are not meant for air monitoring purposes but for quality control of the soil vapor monitoring, the ambient air results should be compared to the respective EPA Reference Concentrations (RfCs). (This will be implemented in future reports [L. Martin, EPA, personal communication, 2011].) Discussion of the findings should be added to the text of the reports, as necessary.

Acrolein Data

Issue: Occasionally, ambient air samples at the three sampling locations (school, church, and condos) indicated acrolein was present above the RfC of 0.009 ppb (SulTRAC 2009, 2010a-e). (Acrolein is *not* associated with past activities at the GTOS site.) MDCH discussed these findings with the MDNRE Air Quality Division (AQD), to determine how best to conduct follow-up investigation. Based on findings in the EPA's School Air Toxics Initiative (a national air-sampling program investigating ambient air quality near schools), *AQD has determined that acrolein cannot be measured in an accurate and valid way and recommends that all acrolein data from Michigan be voided* (M. Heindorf, MDNRE AQD, personal communication, 2010).

Acrolein is highly reactive and can react with other chemicals to form other compounds that complicate laboratory analysis. Also, other chemical compounds can react to form acrolein, potentially even within the canisters used for collecting air quality samples. Studies are being conducted to examine whether the type of canister used or the way it is prepared for sample collection is a factor in this anomaly (EPA 2010b). There may also be an issue with the calibration standard (M. Heindorf, MDNRE AQD, personal communication, 2010).

Recommendation: For the sake of transparency, the acrolein results should be reported in the tables, along with the EPA RfC, but a footnote should be added to the table, and discussion to the text, regarding the unreliability of the data. (This was implemented in the December 2010 Summary Report [SulTRAC 2010e].) Readers can be referred to the EPA website listed in the references for this letter.

MDCH Screening Levels

Issue: In the soil vapor tables, EPA uses sub-slab screening levels they attribute to EPA and MDCH (SulTRAC 2009b, 2010a-d). The methodology for devising these screening levels was actually developed by ATSDR and MDCH when evaluating soil-gas and indoor air samples taken at Norris Elementary School in 2005. The methodology indicated multiplying indoor air screening values by 10 to reflect attenuation between indoor air and sub-slab, based on EPA vapor intrusion guidance at the time (ATSDR 2005a).

To ensure that EPA was using current guidance on attenuation factors, MDCH contacted Amy Salisbury, lead toxicologist at MDNRE for vapor intrusion issues. EPA has suggested that the attenuation coefficient for chlorinated solvents, such as PCE and TCE, sampled at any depth in the soil, remain at that ten-fold value (A. Salisbury, MDNRE, personal communication, 2010).

Recommendation: EPA should change the column heading for "EPA/MDCH Sub-Slab Screening Levels" to "ATSDR/MDCH Sub-Slab Screening Levels" and continue to use the methodology developed by ATSDR and MDCH to calculate the values. (This was implemented in the December 2010 Summary Report [SulTRAC 2010e].)

MDEQ Comparison Values for 1,1,2-Trichloroethane and Benzene

Issue: There are two typographical errors in the soil vapor tables for the "MDEQ Parts 201 and 213 AIAC and ASGSC" (Acceptable Indoor Air Concentration and Acceptable Soil Gas Screening Concentration) for 1,1,2-trichloroethane and benzene. The concentrations are listed as 140 and 450 ppbv, respectively (SulTRAC 2009b, 2010a-d). They should 14 and 45 ppbv, respectively, based on the MDNRE June 2008 Peer Review Draft table for these values. While the correction for 1,1,2-trichloroethane does not result in exceedances of the MDNRE comparison values, the correction for benzene does result in exceedances.

Recommendation: EPA should ensure that all comparison values in the tables are correct. (This was implemented in the December 2010 Summary Report [SulTRAC 2010e].) As necessary, incorrect conclusions from past reports should be resolved in a memo to MDNRE.

Sub-Slab Benzene Detections at the Former Norris Elementary School

Issue: Benzene was detected in sub-slab vapor samples taken at the former Norris Elementary School, sometimes at levels above comparison values (SulTRAC 2009, 2010c-e). (Benzene is

not associated with past activities at the GTOS site.) The report suggested that these detections were attributable to the storage of lawn mowers near the sampling locations in the school. If this assumption is true, it is possible that the integrity of one or more seals in the sampling system is questionable and indoor air may be contaminating and diluting the sub-slab vapor samples. Another possibility is that the sampling line that attaches to the port for the sub-slab space needs to be purged before the vacuum is applied and a sample is drawn, as indicated in the Sampling and Analysis Plan.

Recommendation: The benzene detections should be investigated further to determine a source.

Elevated Soil-Vapor PCE and TCE at Condominiums

Issue: On several sampling occasions, elevated PCE and TCE soil vapor readings were detected at the north end of Harbor West Condominiums, at times above the comparison values. These samples were located outside of the condominiums and were not sub-slab, although near the edge of the building (SulTRAC 2009b, 2010a-e). Therefore, the risk of vapor intrusion is unclear. The condo association has not allowed EPA to sample inside of the buildings (L. Martin, EPA, personal communication, 2010).

Recommendation: Part of the cleanup plan in the ROD included a soil-vapor extraction system, already in place at Norris Elementary School, and a groundwater extraction and treatment program, yet to be implemented. It is possible that, when groundwater extraction begins, soil gas concentrations will diminish. In the meantime, EPA should continue monitoring soil gas and strive to gain access to the condominiums to conduct sub-slab sampling.

Sampling Equipment

Issue: The sub-slab vapor and ambient air samples taken in 2009 were collected in amber bottles whereas the samples taken in 2010 were collected in SUMMA canisters. Also, a different laboratory took over analytical duties in 2010. Results from the amber bottles showed more chemical detections (SulTRAC 2009, 2010a-b). It is unclear whether the discrepancies were due to these chemicals actually being present in the vapor or air sampled, the integrity of the seal on the bottle being questionable and allowing contamination by surrounding air, or different handling procedures at the different labs.

Recommendation: Sampling equipment and procedures should remain consistent. However, MDCH understands that equipment logistics at the laboratory used in 2009 caused the need for using amber bottles. EPA has indicated that all future sub-slab vapor and ambient air samples will be taken with SUMMAs (L. Martin, EPA, personal communication, 2010). According to MDNRE, amber bottles are appropriate collection devices for vapor intrusion investigations in Michigan (M. Williams, MDNRE, personal communication, 2010).

Community Health Concerns

Issue: MDCH has learned that some community members have asked whether there will be health surveillance of children who attended Norris Elementary School in the 1970s, when the contamination was first discovered. To track health outcome data for sites of environmental contamination, it is necessary to know the extent (dose and duration) of exposure. However, exposure information is not known with certainty. More discussion on this issue is in the attached appendix.

Recommendation: Although students and staff may have been exposed to PCE and TCE at the school, the information needed to conduct a health study is not available and cannot be known with certainty at this time (i.e., after more than 30 years). People who were students at Norris Elementary between 1968 and 1978 may want to make sure their healthcare provider is aware of their exposure concerns.

Conclusions

1. MDCH finds the proposed amendment to the ROD to be health-protective and supports it.
2. There are several areas in the on-going EPA monitoring/sampling that need further investigation: sub-slab benzene detections at Norris Elementary, and soil-gas PCE and TCE detections at Harbor West Condominiums.
3. A health study of students who attended Norris Elementary before the contamination was discovered would not have sufficient scientific strength to be justified.

If I may be of further assistance in this matter, please do not hesitate to contact me. Thank you.

Sincerely,

Christina Rose Bush

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Attachments

CC: William Crawford, Environmental Health Director, Benzie-Leelanau DHD
Cindy Fairbanks, Project Manager, MDNRE-RD
Linda Martin, Remedial Project Manager, EPA
Jack Kelly, Elmwood Township Supervisor

Figure 1. Grand Traverse Overall Supply site and vicinity, Leelanau County, Michigan. (Source: SulTRAC 2011b)

Appendix: Exposure Dose Calculations for PCE and TCE at GTOS

Calculated doses, assuming exposure was to maximum concentrations found:
GTOS discharged its wastes to dry wells and lagoons from 1968 to 1977. When the groundwater contamination was first discovered in 1978, PCE and TCE concentrations in the drinking water at Norris Elementary were as high as 860 and 900 parts per billion (ppb) or micrograms per liter (µg/L), respectively. The school immediately stopped using its well for drinking water (MDPH 1994).

For this exposure-dose calculation exercise, MDCH used the EPA Child-Specific Exposure Factors Handbook (EPA 2008) to obtain the average body weight (BW) for a child, age 6 to less than 11 years, and the average amount of water consumed per day (IR, for intake rate) by a child in that same age range.

BW	=	31.8 kilograms (kg)
IR	=	480 milliliters per day (ml/day), or 0.48 L/day

The maximum amount of PCE a child may have been drinking per 24-hour day, based on the 1978 concentration data from Norris Elementary, would have been

$$860\mu g / L \times 0.48 L / day = 413\mu g / dayPCE$$

The previous calculation assumes that the child is obtaining *all* his drinking water at the school. Although a child would spend only one-third of a school day at school, MDCH assumes, for this exercise, that the child obtains *one-half* his drinking water there. This allows for extra consumption during gym class, at recess, and at on-site functions outside of the school day and is very protective. Therefore, the maximum amount of PCE a child may have been drinking while at school would be 206 µg/day. Since the child would only spend about three-quarters of the year in school, *the time-weighted dose (206 X 0.75) would be 154 µg/day PCE.*

A similar calculation exercise for TCE results in a *time-weighted dose of 162 µg/day TCE*.

The Reference Dose (RfD) for PCE is 10 µg/kg BW/day (EPA 1988). An RfD is "an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime" (EPA 2010). The RfD for PCE for a child weighing 31.8 kg would be 318 µg/day. *The estimated exposure dose for PCE for a student at Norris Elementary is less than the RfD.*

The developmental RfD for TCE derived by MDNRE is 1.7 µg/kg BW/day (A. Salibury, MDNRE, personal communication, 2010). Developmental toxicity is defined as adverse effects resulting from exposure that occurred pre-conception, *in utero*, or postnatally up until sexual maturation (EPA 2011b). The RfD for TCE for a child weighing 31.8 kg would be 54 µg/day. *The estimated exposure dose for TCE for a student at Norris Elementary is three times greater than the developmental RfD.*

Uncertainties/unknowns:
Although the exercise above suggests that drinking water containing up to 860 PCE does *not* exceed levels of concern, and drinking water with up to 900 ppb TCE *does* exceed levels of concern, there are several unknown variables that would affect public health conclusions:

- It is unknown what the actual highest concentrations of PCE and TCE were in the drinking water at Norris Elementary. The maximum concentrations could have been greater than 860 and 900 ppb, respectively.
- It is unknown how long exposure occurred. It is not known when the contaminants first appeared in the drinking water. Children may not have attended the school for all of their elementary education. Staff may have moved elsewhere during the time the contamination was present.
- It is unknown if children may have lived within the groundwater contamination plume and whether their homes had private wells.
- Inhalation of PCE and TCE in the air is another potential exposure pathway. It is unknown what air concentrations of PCE and TCE were being emitted by laundry processes at GTOS. People in the vicinity, especially downwind, of GTOS when it was in operation would have been exposed by inhalation. The first air monitoring done for the site was in 1988 and no chemicals were detected (MDPH 1994).

Health outcome data review consideration
Several citizens have asked if former students and staff at Norris Elementary have been or will be tracked, as far as whether they suffered ill effects from any exposure they may have had to chemicals attributable to GTOS. The federal Agency for Toxic Substances and Disease Registry (ATSDR), for whom MDCH conducts public health assessments under a cooperative agreement, provides the following criteria when determining if a health-outcome data review is warranted (answers specific to the GTOS site follow each question):

1. **Are there one or more current or past potential or completed exposure pathways at the site?** Yes, for past exposures. People were potentially exposed to air emissions from GTOS when it was operating as a laundry. People were potentially exposed to drinking water contamination before the contamination was discovered.
2. **Can one determine the time period of exposure?** No. It is not known when the contamination of the drinking water occurred. After the contamination was discovered in 1978, the school stopped using the affected well. As stated previously, GTOS started discharging its waste to dry wells and lagoons in 1968. Therefore, the maximum duration of exposure could have been 10 years but was likely less, due to the time needed for the contamination to leach into the aquifer and travel through the groundwater to the well.
3. **Can one quantify the population that was, or is being, exposed?** One can reasonably assume that staff and students at Norris Elementary drank the water at the school, but as discussed in Point 2, it is not evident when the contamination first entered the drinking water.
4. **Are the estimated exposure doses(s) and the duration of exposure sufficient for a plausible, reasonable expectation of health effects?** This cannot be determined for air exposures because air emissions from GTOS were not measured until 1988 (and no chemicals were detected). For drinking water exposures, a time-weighted dose was calculated above, however that calculation, as discussed above, has much uncertainty.

5. **Are health outcome data available at a geographic level or with enough specificity (e.g., census tract or census block) to allow it to be correlated to the exposed population?** No. The Michigan Cancer Registry and other health-outcome databases typically provide statistics by county. Using county rates of disease when only a small percentage of the population may have been exposed to an environmental contaminant would not provide useful information. Health-outcome databases rarely have statistics for smaller geographic/demographic units. Also, it is probable that some students and staff no longer live in Grand Traverse or Leelanau counties. Cancer statistics are coded by the county in which one is living at the time of diagnosis, which may be different than the county in which one may have been exposed to a suspected carcinogen.
6. **Do the validated data sources or databases have information on the specific health outcomes or disease(s) of interest likely to occur from exposure to the site contaminants and are those data accessible?** Both PCE and TCE are "reasonably anticipated" to cause cancer in humans, according to the National Toxicology Program's 11th Report on Carcinogens (2005). Studies of humans exposed occupationally to PCE show a positive association between exposure and the incidence of esophageal and cervical cancer and non-Hodgkin's lymphoma (NHL). Studies of humans exposed occupationally to TCE show a positive association between exposure and the incidence of liver, kidney, and prostate cancers, NHL, and multiple myeloma. ATSDR has tracked nearly 5,000 registrants in the TCE National Exposure Registry since 1989. These registrants were exposed non-occupationally via drinking water. Health effects reported that were above the national average were anemia, cancer, skin rashes, urinary tract disorders, stroke, diabetes, liver disease, kidney disease, hearing impairment, and speech impairment (Schultz et al. 2010). MDCH is not aware of a national registry for persons exposed to PCE. Due to the uncertainty in exposure dose and duration, the likelihood of disease occurrence in students and staff exposed to PCE and TCE at Norris Elementary cannot be determined. People who were students or staff at Norris Elementary between 1968 and 1978 may want to discuss exposure concerns with their healthcare provider.

The ATSDR Public Health Assessment Guidance Manual (2005, see Chapter 8.6) goes into further detail when considering the above criteria. If any of the answers to the questions is "no," a health outcome review is *not* conducted because there would not be enough scientific strength to the analysis. Therefore, MDCH cannot justify conducting a health outcome data review regarding students and staff at Norris Elementary.

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Appendix B: January 27, 2011 Letter to Elmwood Township (Traverse City, Michigan) regarding Grand Traverse Overall Supply site

Rick Snyder
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF COMMUNITY HEALTH
LANSING

Olga Dazzo
DIRECTOR

January 27, 2011

Jack Kelly, Supervisor
Charter Township of Elmwood
10090 E. Lincoln Road
Traverse City, MI 49684

Dear Mr. Kelly:

This letter is in response to public comment you submitted to the U.S. Environmental Protection Agency (EPA) regarding the Grand Traverse Overall Supply (GTOS) site (per your letter to Linda Martin dated December 16, 2010). Some of your comments pertained to public health matters.

The federal Agency for Toxic Substances and Disease Registry (ATSDR) carries out public health activities at Superfund sites. Under a cooperative agreement, the Michigan Department of Community Health (MDCH) conducts those activities on ATSDR's behalf in Michigan. Note that state health department staff who worked on the GTOS site when the contamination was first discovered no longer work at MDCH. However, I retrieved archived records, and also reviewed our current files, in order to answer your questions. Listed below are your requests pertaining to public health, paraphrased and in italics, and our responses.

Identify past well testing locations and the timeframes when these well samples were taken.

Due to privacy laws, I cannot divulge the addresses or owners of private residential wells that were tested. All I can reveal is that the wells were located on West Bay Shore Road, Cherry Bend Road, Cedar Lane, Spruce, and Pico Drive. Other wells that were tested were located at: Grand Traverse Overall Supply, Norris Elementary, West Bay Covenant Church, Harbor West Condominiums, Harbor West Marina, Elmwood Township Hall (at 10740 Cherry Bend Road), the township fire station (on Cherry Bend Road), the city coal dock (no address given), the township artesian well (no address given), and NBT Bank (on West Bay Shore Drive). This list may not be complete, but it reflects when the drinking water sampling first occurred, which was in May and June 1978 (MDCH files). You may want to inquire with the local health department regarding more extensive well-testing records.

Have there been any epidemiological studies conducted on the school children who attended, or teachers who taught at Norris Elementary School during both the period of time that contamination was occurring but undetected, and also after the time when either the State of Michigan or the EPA became aware of the GTOS contamination? Were any such studies ever undertaken by the ATSDR or MDCH's Bureau of Epidemiology? If yes, when were such studies undertaken and by which agency? If not, was there an epidemiological threshold evaluation that

resulted in an official determination that such epidemiological studies were unnecessary? If so, who made that determination and when?

To our knowledge, no epidemiological studies have been conducted here. Please see the January 21, 2011 letter (MDCH 2011) to Fred Keeslar, Medical Officer/Director of the Grand Traverse County Health Department, regarding the rationale for ATSDR and MDCH not conducting such studies (you were copied electronically on that letter).

In a file memo dated July 23, 1992, an MDCH staff member had checked with the local (Grand Traverse County) health department about any community health concerns: "Once exposure was cut off, by well replacement, expressed concerns stopped." Also, the county had "no records of increased illness in the site area" (MDCH files).

Does EPA, ATSDR, or MDCH have any information regarding the names and current whereabouts of the children who attended Norris Elementary School, and the teachers who taught there, during the period of time that the GTOS site was found to be contaminated? Was this information ever requested from the Traverse City Area Public School system? If not, why not?

Because follow-up medical surveillance was not conducted, MDCH did not request information on former students and staff at Norris Elementary.

MDCH takes the issue of informing people about potential exposure to environmental contaminants very seriously. The Michigan Department of Public Health (the name of the state health agency at the time) Water Supply Division "issued a health advisory to the Traverse City School District on May 16, 1978, by telephone and confirmed with a letter dated May 18, 1978. The recommendation was to cease use of the water for drinking and cooking." The owners of all the wells sampled were issued letters with the results of the sampling, interpretation of the results, and recommendations regarding well use or abandonment. State agency staff had an open meeting with the Elmwood Township Board on August 10, 1978 to provide information on the contamination issue (MDCH files).

Was there a certain period during which potential exposure to the contaminated soils and vapors was determined to be of more immediate concern, after which time the potential harmful effects to the general public were determined to be negligible? If so, when did that occur and was that determination ever made public?

Drinking water was considered the critical exposure pathway when the contamination was discovered in 1978. The school immediately stopped using its well for drinking water.

Residents with affected wells were informed of the contamination and advised against continued use of the wells (MDCH files).

As environmental investigations continued and the vapor-intrusion pathway (gases in soil entering building space) was evaluated, MDCH reviewed the soil-vapor and indoor-air sampling data from Norris Elementary School. In a health consultation report dated November 8, 2005, MDCH concluded that very low levels of PCE (perchloroethene or perchloroethylene) and TCE (trichloroethene or trichloroethylene) detected in the indoor air at the school were not expected to cause harm to public health (ATSDR 2008). The school reportedly closed in 2008 (L. Martin, EPA, personal communication, 2010).

MDCH has looked at more recent soil-vapor sampling data and has requested that EPA continue to obtain data so that public health implications can be determined. Specifically, benzene detections in sub-slab samples at Norris Elementary need further investigation and sub-slab sampling at (inside) Harbor West Condominiums should occur (MDCH 2011).

If you have any further questions, please do not hesitate to contact me.

Sincerely,

Christina Rose Bush

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References:

Agency for Toxic Substances and Disease Registry (ATSDR). Health consultation concerning Norris Elementary School Indoor Air Assessment, Grand Traverse Overall Supply Company,

Greilickville, Leelanau County, Michigan. Atlanta: US Department of Health and Human Services; 2005a November 8. http://www.michigan.gov/documents/Norris_Elementary_School_Health_Consultation_142189_7.pdf

Michigan Department of Community Health (MDCH). Letter to Fred Keeslar, Grand Traverse County Health Department, from Christina Bush concerning Grand Traverse Overall Supply Superfund site in Greilickville, Michigan. Lansing, Michigan. January 21, 2011.

Appendix C: Maximum benzene, perchloroethylene (PCE), and trichloroethylene (TCE) soil gas and air sampling results from the Grand Traverse Overall Supply site vicinity, Greilickville (Leelanau County), Michigan

Locations: NES = Norris Elementary School
WBCC= West Bay Covenant Church
HWC = Harbor West Condominiums

All concentrations are in units of parts per billion (ppb). "ND" means "not detected."

Sample Dates	NES	WBCC	HWC
Jun-09	9.84	0.298	1.49
Oct-09	8.06	0.255	0.27
Dec-09	8.9	0.285	0.354
Mar-10	45.9	0.37	0.523
Jun-10	76.1	0.523	1.05
Sep-10	52	0.677	0.924
Dec-10	8.62	2.28	0.431
Mar-11	19.6	1.85	1.85
Jun-11	16.9	17	0.647
Sep-11	7.14	1.17	0.585
Dec-11	2.19	0.37	6.87
Mar-12	7.11	0.37	6.9
Jun-12	11.4	8.93	ND

Table C- 1. Maximum benzene soil gas concentrations.

Sample Dates	NES	WBCC	HWC
Jun-09	33.3	1.22	78
Oct-09	31.3	1.23	68.9
Dec-09	37.4	0.889	1.18
Mar-10	7.05	ND	35.1
Jun-10	19.6	0.798	205
Sep-10	59.2	3.83	12.3
Dec-10	21.9	0.464	2.71
Mar-11	22.6	0.624	28.9
Jun-11	21.8	1.06	78.2
Sep-11	40.5	1.22	30.2
Dec-11	33.4	1.38	26.3
Mar-12	138	0.711	36
Jun-12	31.5	1.55	91.2

Table C- 2. Maximum perchloroethylene soil gas concentrations.

Sample Dates	NES	WBCC	HWC
Jun-09	17.8	ND	18.1
Oct-09	17.2	ND	15.5
Dec-09	18.1	0.239	0.153
Mar-10	4.38	ND	15.3
Jun-10	8.59	ND	111
Sep-10	25.4	ND	1.78
Dec-10	15.7	ND	0.494
Mar-11	23.1	22	22
Jun-11	12.2	1.15	25.1
Sep-11	23.2	ND	42.5
Dec-11	18.3	ND	17.4
Mar-12	20.1	ND	20.7
Jun-12	15.3	ND	38.3

Table C- 3. Maximum trichloroethylene soil gas concentrations.

Sample Dates	NES	WBCC	HWC
Jun-09	0.174	0.209	0.221
Oct-09	0.218	0.206	0.21
Dec-09	0.118	0.285	0.354
Mar-10	ND	0.37	0.523
Jun-10	ND	ND	0.299
Sep-10	0.739	ND	0.801
Dec-10	ND	3.66	1.08
Mar-11	0.4	ND	1.26
Jun-11	ND	ND	ND
Sep-11	0.37	ND	ND
Dec-11	1.72	0.37	0.145
Mar-12	1.17	0.647	ND
Jun-12	0.431	ND	ND

Table C- 4. Maximum benzene air concentrations. (All samples are outside air except for NES starting Dec-10, which are indoor air.)

Sample Dates	NES	WBCC	HWC
Jun-09	ND	ND	ND
Oct-09	ND	ND	ND
Dec-09	ND	ND	ND
Mar-10	ND	ND	ND
Jun-10	ND	ND	ND
Sep-10	ND	ND	ND
Dec-10	ND	ND	ND
Mar-11	ND	ND	ND
Jun-11	ND	0.435	0.566
Sep-11	ND	ND	ND
Dec-11	ND	ND	ND
Mar-12	ND	ND	ND
Jun-12	ND	ND	ND

Table C- 5. Maximum perchloroethylene air concentrations. (All samples are outside air except for NES starting Dec-10, which are indoor air.)

Sample Dates	NES	WBCC	HWC
Jun-09	ND	ND	0.0522
Oct-09	ND	ND	ND
Dec-09	ND	0.236	ND
Mar-10	ND	ND	14.8
Jun-10	ND	ND	1.83
Sep-10	ND	ND	ND
Dec-10	ND	ND	ND
Mar-11	ND	1.43	0.696
Jun-11	ND	ND	0.842
Sep-11	ND	ND	ND
Dec-11	ND	ND	ND
Mar-12	ND	ND	ND
Jun-12	ND	ND	ND

Table C- 6. Maximum trichloroethylene air concentrations. (All samples are outside air except for NES starting Dec-10, which are indoor air.)

Appendix D. Comparison of soil gas and air sampling data from the Grand Traverse Overall Supply site vicinity, Greilickville (Leelanau County), Michigan to draft updated comparison values

Explanation:
When the U.S. Environmental Protection Agency (EPA) began quarterly monitoring of the Grand Traverse Overall Supply (GTOS) site, the agency established several site-specific screening levels to which the soil gas and air data would be compared:

- the Agency for Toxic Substances and Disease Registry (ATSDR)/Michigan Department of Community Health (MDCH) screening levels (MDCH 2005), for soil gas
- the Michigan Department of Environmental Quality (MDEQ) Part 201 Acceptable Soil Gas Screening Concentrations (ASGSCs), for soil gas
- the MDEQ Part 201 Acceptable Indoor Air concentrations (AIACs), for indoor air

These site-specific screening levels, along with the EPA Reference Concentrations and ATSDR chronic Minimal Risk Levels, were shown in Tables 1 and 2 in this document and depicted in the accompanying figures.

EPA updated toxicity values for perchloroethylene (PCE) and trichloroethylene (TCE) during the period that monitoring has been conducted at the GTOS site. These updates would affect the ATSDR/MDCH screening levels, the ASGSCs, and the AIACs. Due to the regulatory structure of MDEQ, the state's screening levels have not been formally updated. For transparency, the draft updated values are shown here in tables and compared to the GTOS soil gas and air monitoring data in figures. Note that the public health conclusions discussed in the main document remain the same.

Table D- 1. *Draft* comparison values for soil gas samples taken at the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. Concentrations are parts per billion (ppb).

Chemical	MDCH/ATSDR Screening Level	MDEQ Part 201 ASGSC
Benzene	9.2	46
PCE	38	125
TCE	4	18

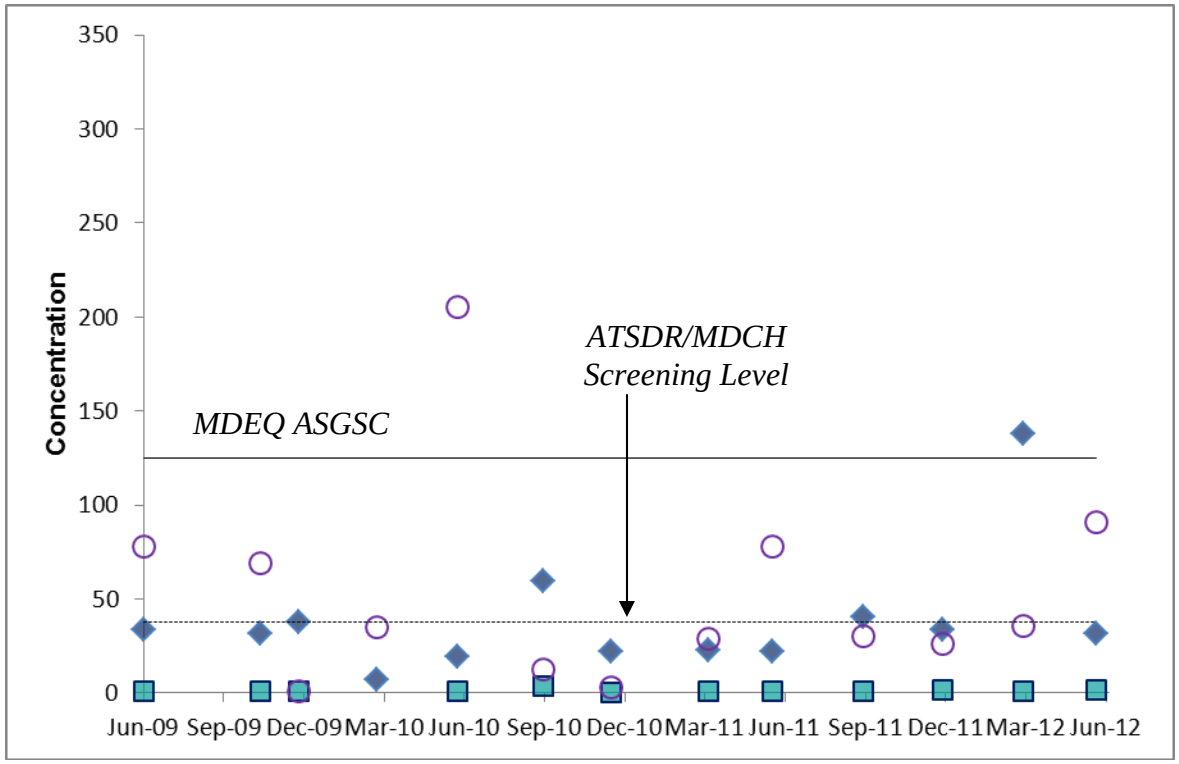
References: MDEQ 2009a; A. Salisbury, MDEQ, personal communication, 2012

Abbreviations and Acronyms:

ASGSC	Acceptable Soil Gas Screening Concentration
ATSDR	Agency for Toxic Substances and Disease Registry
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
PCE	perchloroethylene
TCE	trichloroethylene

Note that the comparison values for benzene are unchanged from "site-specific" to "draft." Therefore, there is no figure comparing the benzene soil gas detections to the draft values in this appendix (see Figure 5 in main document).

Figure D- 1. Maximum soil gas concentrations of perchloroethylene in the vicinity of the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. All concentrations are in parts per billion (ppb). Comparison values are *draft*.



Norris Elementary School

West Bay Covenant Church

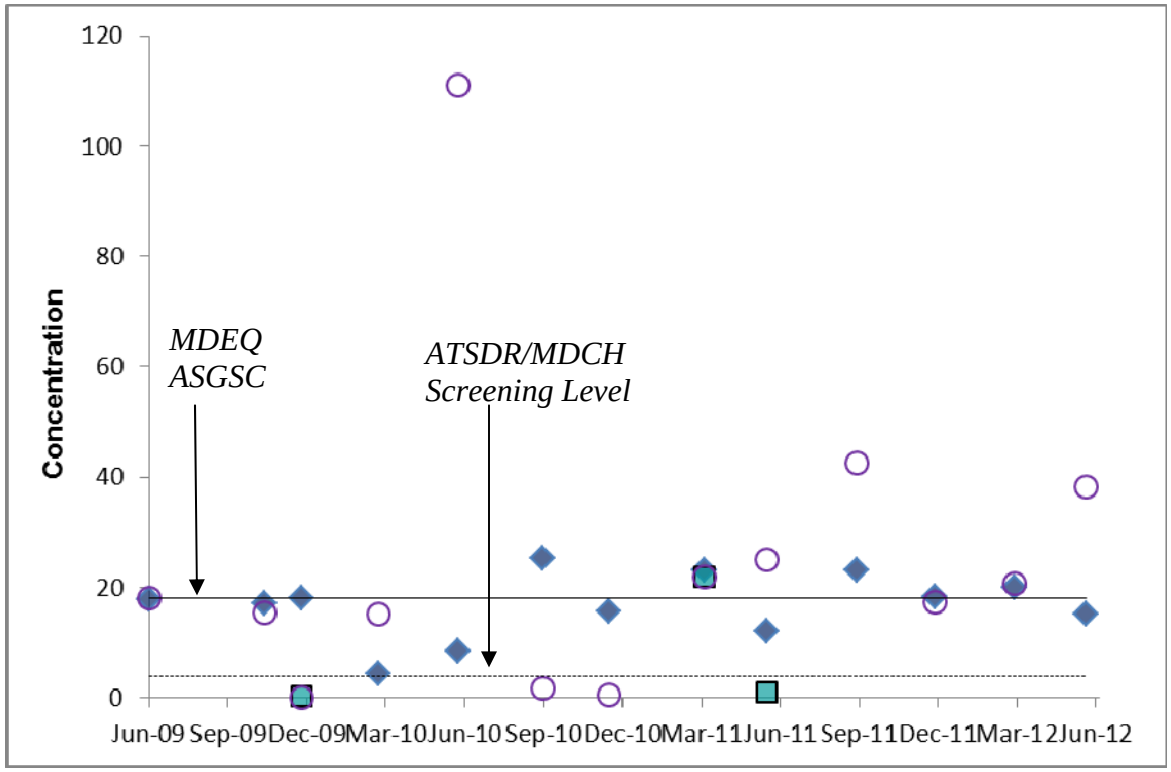
Harbor West Condominiums

If perchloroethylene was not detected, there is no marker for the sampling event.

See Appendix C for numerical values reported.

Acronyms:
ASGSC = Acceptable Soil Gas Screening Concentration
ATSDR = Agency for Toxic Substances and Disease Registry
MDCH = Michigan Department of Community Health
MDEQ = Michigan Department of Environmental Quality

Figure D- 2. Maximum soil gas concentrations of trichloroethylene in the vicinity of the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. All concentrations are in parts per billion (ppb). Comparison values are *draft*.



Norris Elementary School

West Bay Covenant Church

Harbor West Condominiums

If trichloroethylene was not detected, there is no marker for the sampling event.

See Appendix C for numerical values reported.

Acronyms:
ASGSC = Acceptable Soil Gas Screening Concentration
ATSDR = Agency for Toxic Substances and Disease Registry
MDCH = Michigan Department of Community Health
MDEQ = Michigan Department of Environmental Quality

Table D- 2. *Draft* comparison values for indoor or outdoor air samples taken at the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. Concentrations are parts per billion (ppb).

Chemical	MDEQ Part 201 AIAC	EPA RfC	ATSDR cMRL
Benzene	0.92	9.3	3
PCE	3.8	5.9	40
TCE	0.4	0.37	0.37

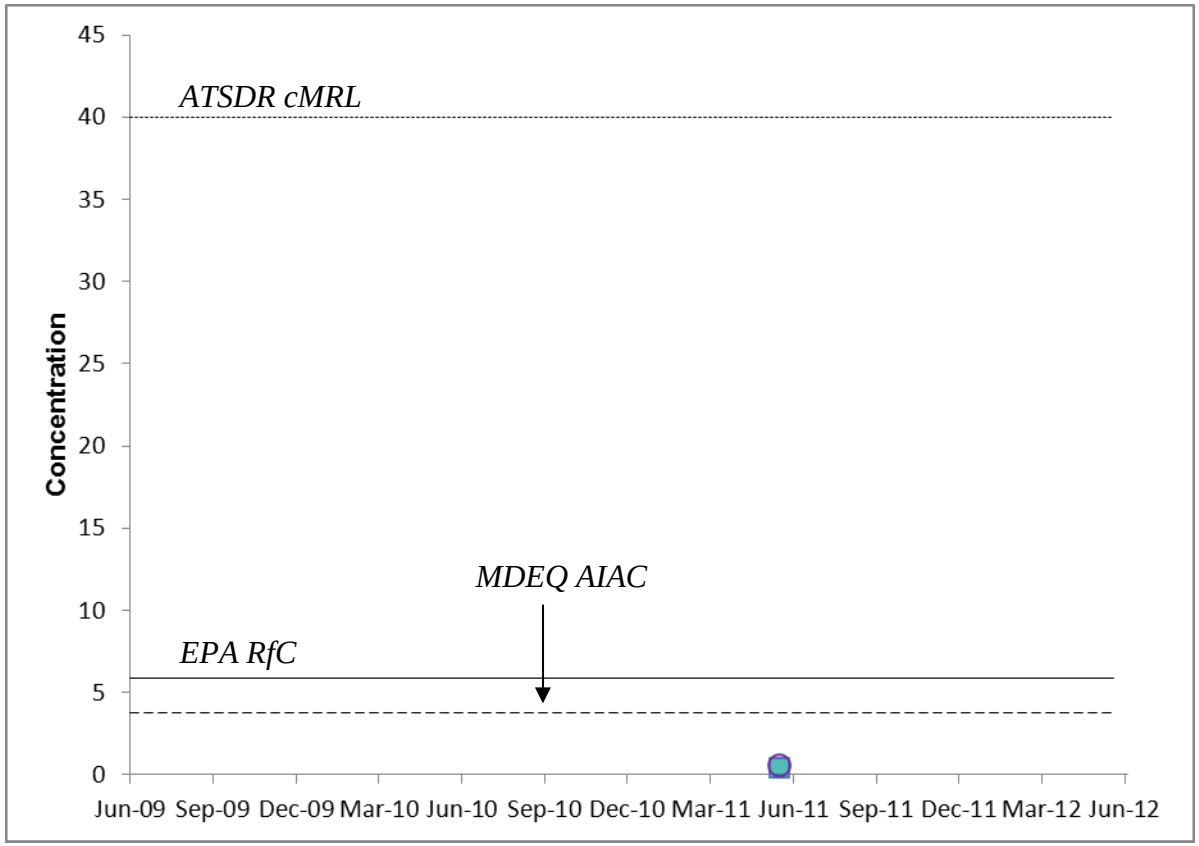
References: MDEQ 2009a; A. Salisbury, MDEQ, personal communication, 2012

Abbreviations and Acronyms:

AIAC	Acceptable Indoor Air Concentration
ATSDR	Agency for Toxic Substances and Disease Registry
cMRL	chronic Minimal Risk Level
EPA	U.S. Environmental Protection Agency
MDEQ	Michigan Department of Environmental Quality
PCE	perchloroethylene
RfC	Reference Concentration
TCE	trichloroethylene

Note that the comparison values for benzene and TCE are unchanged from "site-specific" to "draft." Therefore, there are no figures comparing the air detections of those chemicals to the draft values in this appendix (see Figures 8 and 10 in main document).

Figure D- 3. Maximum indoor and outdoor air concentrations of perchloroethylene in the vicinity of the Grand Traverse Overall Supply site, Greilickville (Leelanau County), Michigan. All concentrations are in parts per billion (ppb). Comparison values are *draft*.



West Bay Covenant Church

Harbor West Condominiums

If perchloroethylene was not detected, there is no marker for the sampling event. There were no detections at Norris Elementary School.

See Appendix C for numerical values reported.

Acronyms:
AIA = Acceptable Indoor Air Concentration
ATSDR = Agency for Toxic Substances and Disease Registry
cMRL = chronic Minimal Risk Level
EPA = U.S. Environmental Protection Agency
MDEQ = Michigan Department of Environmental Quality
RfC = Reference Concentration