

Health Consultation

ALTHA SCHOOL AIR MONITORING
ALTHA, CALHOUN COUNTY, FLORIDA

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

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

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

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HEALTH CONSULTATION

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ALTHA, CALHOUN COUNTY, FLORIDA

Prepared by:

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

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Summary

Florida Department of Environmental Protection (DEP) asked the Florida Department of Health (DOH) about the public health implications of teachers' and students' exposures to leaking underground petroleum storage tank vapors in classroom air at Altha School.

Our evaluation of the levels of chemicals measured in air does not indicate a risk for non-cancer illness. Daily, long-term exposure to the highest levels of chemicals measured in air could increase a person's statistical risks for leukemia and lymphoma over their lifetime by 2 additional cases in 1 million people. ATSDR qualitatively classifies this level as between no apparent and no significant increased risk.

Because our evaluation did not find the chemicals measured in air to pose a public health hazard, and because DEP's contractor has nearly cleaned up the soil on the school property, the Florida DOH is not recommending additional air sampling. Nevertheless, relatively few air samples were analyzed and based on DEP's cleanup reports, the subsoil contained more gasoline and fuel oil components in the past. Therefore, Florida DOH recommends that people who feel ill, especially those with persistent symptoms, should see their doctors. They should tell their doctors about any concerns they might have about environmental exposures.

Purpose

The Florida DOH evaluates the public health significance of environmental contamination through a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR) in Atlanta, Georgia. Underground storage tanks, one for gasoline and two for fuel oil, were removed from the Altha school grounds in 1989 and 1990, respectively. These tanks were the likely sources for soil and groundwater contamination that DEP is currently remediating on the school property. Petroleum products in the soil and groundwater are the likely sources of intermittent odors detected in the elementary school addition classrooms. In January 2006, the Florida DEP asked the Florida DOH to evaluate the public health threat from chemicals measured in classroom air in August and December 2005.

Background



• Photo of Altha School from the school's website

Altha School serves kindergarteners through twelfth graders in rural Calhoun County Florida. The county population is about 13,000 or roughly 23 persons per square mile (Figure 1). About 650 children attend the school, which was established in 1906.

In 1987, the Calhoun County School Board applied to DEP's Early Detection Incentive (EDI) program for Altha School. DEP approved

Altha School's program eligibility in 1988. The EDI Program funds cleanups of eligible leaking underground petroleum storage tank sites. Once accepted into the program, site owners could choose to oversee and fund site remediation (and be reimbursed later by the state) or could let DEP oversee and carry out the remediation. Initially the school chose the first option, but did not follow through on having a contractor assess site-related contamination. Consequently, the state assumed responsibility for cleaning up the site and DEP's contractor began site assessment work in 1999.

After DEP's contractor assessed the extent of contamination, they designed and set up a remediation system to clean up petroleum contamination in soil and groundwater. Past cleanup work involved a multi-phase extraction system that recovered "free product" (fuel that floats on the water table). Ongoing cleanup work includes soil vapor extraction and sparging.

Soil vapor extraction (SVE) reduces petroleum constituent chemicals in the soil above the water table. SVE uses a vacuum applied to the soil matrix to create a negative pressure gradient that causes movement of vapors toward extraction wells. Sparging (introducing air into a liquid) reduces petroleum constituent chemicals in the soil below the water table; these vapors are also collected by the extraction wells. When using both processes, the extraction wells can collect vapors from above and below the water table. The SVE system operates continuously, except when the water table rises and the vapor extraction wells become submerged.

The integrated cleanup system has been operating about 2 ½ years, and has successfully cleaned up a large area of petroleum contaminated soil. Most of the remaining contaminated soil is beneath the elementary and preschool classrooms, which are separate from the main school. In the past, the contractors only used the sparging system when the children were not present. Cleanup contractors added additional vapor extraction wells this summer ('06) and plan to run both the vapor extraction and sparging parts of the system if they can determine the additional soil vapor extraction wells are capturing all of the vapors.

Contaminated groundwater extends offsite, to the southwest (Figure 2). The cleanup contractors installed oxygen injection wells in the down-gradient portion of this plume to break down the chemical components of the leaked gasoline and keep the plume from migrating further. This is important because the Altha public supply wells are down gradient of the plume. DEP's contractors have defined the gasoline plume.

The operators for the town of Altha water supply are aware of this groundwater contamination and have sampled drinking water supplies more frequently than required by Florida law. Samples of the Alpha public water supply, taken in mid-January 2006, did not show the presence of any volatile organic compounds such as those associated with gasoline or fuel oil groundwater contamination.

Community Health Concerns

During the January 31, 2006 Legislative Delegation Meeting held by Senator Lawson and Representative Cooley in the Altha School lunchroom, an Altha teacher handed out a statement. The Altha teacher asked about the past, present and future inhalation risks for the children and adults at Altha School. According to this statement, teachers in the elementary school wing had noticed unusual, intermittent odors in their classrooms beginning shortly after the wing was occupied in the mid-1980s. In the 1990-1991 school year, students, teachers and administrative personnel moved out of their classrooms and offices due to persistent odors. In the 2005-2006 school year, students, teachers and administrative personnel were moved out of their classrooms and offices due to safety precautions based on indoor air measurements of fuel components. Occupants of these rooms were moved to portable buildings, located away from the contaminated soil.

Laboratory-analyzed air samples are only available for August 5 and 13, 2005, and December 30, 2005; therefore Florida DOH is only able to evaluate concentrations of fuel components that were present in the air when the sparging equipment was operating. Sparged-air chemical levels may have been higher than what are normally present. Florida DOH evaluates the measured levels of fuel chemicals in the Public Health Implications section of the following Discussion section. In the summer of 2006, cleanup contractors installed additional wells to capture vapors that might enter classroom air.

Others at the January 31, 2006 Legislative Delegation Meeting mentioned that a former student developed fibromyalgia and a teacher had cancer, but did not mention what type of cancer.

Other Community Concerns

Some of the concerns expressed at the January 31, 2006 Legislative Delegation Meeting were indirectly related to health. An Altha teacher asked if Occupational Safety and Health Administration (OSHA) regulations were violated. Florida DOH researched the OSHA regulations for the chemicals measured in air and found all of the measured values were many times less than their respective OSHA Time-Weighted Averages (TWA) for workers working an 8 to 10 hour day.

Chemical	OSHA TWA	Measured Level	Multiple <u>less than</u> the TWA
Benzene	3.10 µg/m ³	0.006 µg/m ³	500
Ethylbenzene	435,000 µg/m ³	29 µg/m ³	15,000
Naphthalene	50,000 µg/m ³ ,	13 µg/m ³	3,846
Toluene	375,000 µg/m ³	3,100 µg/m ³	121
Xylenes (total)	435,000 µg/m ³	140 µg/m	3,107

A meeting attendee asked if children, faculty and staff had been notified, as required by Florida Statute 376.30702, about the petroleum contamination on Altha School grounds. Florida DOH will develop a fact sheet based on this report that Altha School can give to students to take home to their parents.

A meeting attendee asked if owners of off-site impacted properties had been notified. DEP notified off-site owners via letters sent out on January 20, 2006.

A meeting attendee asked if DEP would clean up the soil and groundwater to residential standards. At this time, cleanup of soil and groundwater to residential standards (DEP 2005) are DEP's goals.

A meeting attendee asked if there be continuous air monitoring in all the affected classrooms. DEP has discussed this with the school, but the monitors register alarms even if markers are opened in the classrooms. DEP and school staff determined that Organic Vapor Analyzer (OVA) monitoring would suffice because the teachers do not want disruption in the classrooms due to use of ordinary classroom supplies. DEP's contractors ran the sparging system continuously this summer ('06) and installed added additional vapor extraction wells. DEP's WRS site manager is working with the State Cleanup Contractor (Mactec) to determine if the additional soil vapor extraction wells will capture all of the vapors so that the air sparging system can be run continuously throughout the year without affecting the classrooms. The area between buildings 16 and 17 has been paved (entirely, from wall to wall), to eliminate this area as a potential pathway for vapor migration.

Discussion

Contamination of the soil and groundwater at Altha School occurs only in the subsurface where people are unlikely to contact it unless they dig or drill. DEP's contractors have characterized the extent of the groundwater plume. The Calhoun County Health Department staff did not locate any private drinking water in or near the contaminated groundwater. They found some people in downtown Altha still have irrigation wells. They did not think there are many of these in the area of the contaminated groundwater, although there may be a few in the surrounding area. Groundwater contamination has not affected the public water supply wells, and Altha businesses and residences use city water. Therefore, soil and groundwater are unlikely to be exposure pathways for people on or off the site.

Because gasoline components can become vapors, Florida DOH evaluated vapor intrusion into school classrooms as a possible exposure pathway. To do this we used data that DEP's contractor collected when the sparging equipment was in use. Chemical levels could have been higher than normal when the sparging equipment was being used, because this

equipment's function is to remove soil contaminants that can be vaporized. Cleanup contractors have installed additional wells and paved the soil next to the school to limit the potential for vapor intrusion into the school.

Quality Assurance and Quality Control

Florida DOH used the available air data in this health consultation. We assume these data are valid. The completeness and reliability of the referenced environmental data determine the validity of the analyses and resultingly the conclusions Florida DOH drew for this health consultation. The laboratory method detection level for benzene, $1.6 \mu\text{g}/\text{m}^3$, is higher than the ATSDR Cancer Risk Evaluation Guideline (CREG), $0.3 \mu\text{g}/\text{m}^3$ (0.1 ppb). A CREG is the exposure value for which there is a theoretical risk of 1 excess cancer case in 1 million people (ATSDR 1992a). The laboratory method detection level for most of the naphthalene analyses, $14 \mu\text{g}/\text{m}^3$, is higher than the ATSDR minimum risk level $4 \mu\text{g}/\text{m}^3$ and the Environmental Protection Agency (EPA) reference concentration $3 \mu\text{g}/\text{m}^3$; the highest measured level, $13 \mu\text{g}/\text{m}^3$, was below the detection level listed for the other results. Neither of these laboratory limitations affect the exposure concentration nor increased cancer risk Florida DOH calculated, just the reported frequency of occurrence "above the health-based screening level" in Table 2. The detection levels for toluene and xylenes were below their screening levels.

Air Pathways Analyses

During the June, July and August 2005 air-sparging activities, (students were on summer break), Advanced Environmental Technologies (AET), DEP's contractor, monitored the classroom air with a hand-held organic vapor analysis (OVA) meter. Based on the OVA readings[†], DEP staff suggested collecting classroom air samples.

To measure indoor vapors, due to possible intrusion from subsurface sources of petroleum volatile organic compounds (VOCs), AET collected the following samples in classrooms above the area of soil contamination:

- On **August 5, 2005**, AET collected three, one-hour summa canister air samples from rooms in buildings 16 and 17. Analytical results showed the sample collected from classroom 4 in Building #16 (Figure 3) contained toluene above the ATSDR screening values. Analytical results showed the sample collected from classroom 5 in Building 16 had benzene above the ATSDR CREG. AET recommended more extensive air quality testing.
- On **August 13, 2005**, AET collected seven summa canister air samples, from rooms in buildings 16 and 17. Analytical results showed classroom 5 contained naphthalene and toluene above their ATSDR screening values. Both classrooms 4 and 5 contained total xylenes above the EPA reference concentrations, but below the ATSDR screening value. These canisters are sent to a laboratory for analysis. It takes several weeks to process the samples, do quality assurance on the data, and return the results. Therefore, AET received these summa canister results after school had started back. AET recommended the Calhoun County School Board relocate the persons in rooms 4 and 5 when they received the results; the school board did so immediately.

[†] OVA readings do not indicate which specific organic compound(s) the instrument is detecting and measuring.

- As a follow-up, on **December 30, 2005**, during the school Christmas break, AET collected three silonite-canisters and one summa-canister air samples. Analytical results did not measure any chemicals above their screening levels.

Table 2 lists the highest levels of benzene, ethylbenzene, naphthalene, toluene, and total xylenes measured in in-door air.

Public Health Implications

In this section, we evaluate air data collected at Altha School in 2005, during air-sparging periods. The levels of petroleum components measured in the indoor air samples we evaluated included the fraction that naturally escapes from the soil and the fraction forced out by the introduction of ozone through the cleanup system sparging wells. DEP's contractor only uses the sparging system when children are not present, during the spring, summer and winter breaks. Although indoor air concentrations of gasoline and fuel oil components are likely to peak during sparging, increased rainfall during the summer and winter months could also increase indoor air concentrations. To decrease the chances of indoor vapor intrusion, the cleanup contractors have installed additional vapor extraction wells.

We list the highest measured fuel components concentrations measured above their screening values in Table 3. We list those concentrations again with lifetime-adjusted concentrations in Table 4. The lifetime-adjusted concentrations assume elementary school children might breathe school air for 7 hours a day, and middle and high school students and teachers might breathe school air for 9 hours a day.

In Table 5, we specify, by chemical, how the calculated exposure concentrations for each individual chemical relate to the lowest studied exposure concentration having health effects. We discuss the possible health effects of these exposures by chemical in the following section. We also evaluate exposure to a mixture of these chemicals. As detailed in the next section, the majority of the combined fractions came from toluene. We approximated exposure to a mixture of these chemicals by equating it with an equivalent level of toluene, which is greater than the measured level of toluene.

Mixtures Evaluation

Florida DOH assumed exposures to benzene, toluene, ethylbenzene and total xylenes (BTEX) could be additive because exposure to each can render nerve coatings less protective (ATSDR 2004). We determined a fraction of the total exposure for each chemical by dividing the calculated exposure by a minimum risk level (MRL) or guidance value for neurotoxic health effects for the appropriate exposure period. We added the fractions (also called Hazard Indexes) from each chemical to estimate total (mixture) toxicity for acute, intermediate, and chronic exposures (Table 4). *Acute* health effects may result from exposures to higher chemical levels, lasting 1 to 14 days. *Intermediate* health effects may result from exposures to lower levels of chemicals than those causing acute effects, but for a longer exposure period, 15-364 days. *Chronic* health effects may result from exposure to low levels of chemicals for an exposure period lasting longer than a year.

Because none of the combined *acute* Hazard Index totals was greater than 1.0 for the classroom air samples, measured chemical levels are unlikely to cause acute toxicity (Table 4).

Building 16, room 5 (8/13/05) had a combined *intermediate* exposure Hazard Index total of 2.4 (Table 4). Because most (about 85%) of the Hazard Index came from toluene, we chose to evaluate the mixture as if it were 100% toluene. The toluene level equivalent we calculated of

3.77 $\mu\text{g}/\text{m}^3$ (1 ppm) equals a No Observable Effect Level (NOAEL) in an intermediate study of exposed mice that showed increased susceptibility to infections at 9.4 $\mu\text{g}/\text{m}^3$ (2.5 ppm) (Aranyi et al. 1985). While this animal study indicates that the measured levels might cause increased susceptibility to infections, especially for sensitive members of the population, this effect and the other effects described for relatively low levels of exposure concentrations might not be readily apparent. In this study, decreased white blood cells and thrombocytes seen at 37.7 $\mu\text{g}/\text{m}^3$ (10 ppm) in mice. Even effects seen at higher exposure concentrations, 113 $\mu\text{g}/\text{m}^3$ (30 ppm) in rats, swelling of the throat lining and mild reduction in thyroid follicle size, might be difficult to discern in people.

Building 16, rooms 4 and 5 had a combined **chronic** Hazard Index of 1.8 (8/5/05), and 11.5 (8/13/05), respectively (Table 4). Although the totals exceed one for chronic exposures, students and teachers were not in the classrooms daily, and odors are reported as having been intermittent and likely related to excessive or prolonged rainfall. The toluene level equivalent to the mixture 3.77 $\mu\text{g}/\text{m}^3$ (1 ppm) is 35 times less than the Lowest Observable Adverse Effect Level (LOAEL) in a chronic study that showed increased color confusion index[†] in workers inhaling 132 $\mu\text{g}/\text{m}^3$ (35 ppm) toluene, 8 hours a day, for an average of 17 years (Zavalic et al. 1998a,c). Other chronic studies showed headaches and dizziness in workers inhaling 155 $\mu\text{g}/\text{m}^3$ (41 ppm) toluene, 8 hours a day, for 6 to 8 years (Yin et al. 1987). Based on the evaluated data, these chronic effects might be unlikely even in sensitive members of the population because daily exposures to these or higher levels are not consistent with exposures described at the school.

Benzene

Benzene is a sweet smelling component of gasoline and fuel oils. People can detect benzene's odor between roughly 2 and 5 parts per billion (ppb); these are very low concentrations. Some people may have been able to smell the benzene (2 ppb) measured in classrooms on August 5 and 13, 2005. The highest measured benzene level was below the ATSDR minimum risk level (MRL), meaning that even daily long-term exposures to this level would be unlikely to cause adverse non-cancer health effects (ATSDR 2006). Benzene vapors contribute less than 10 % to the combined total Hazard Indices.

Benzene was the only chemical measured above its screening value that is regulated as a carcinogen. Florida DOH multiplied an adjusted concentration (the air concentration multiplied by the exposure period divided by an average lifetime) by the cancer slope factor for benzene to calculate the increased cancer risk from possible daily exposures for adults exposed for part of the year for 20 years and children exposed for part of the year for 6 years.

The lifetime-adjusted concentrations calculated for elementary school students, middle and high school students, and teachers would slightly increase an exposed person's risk of cancer, to roughly 2 in 1 million. At much higher levels of exposure than were measured at the school, occupational studies have linked benzene inhalation with leukemia and lymphoma in workers. Workers that breathed benzene at a concentration 150 times greater than the highest level measured at the school for 18 months had in increased likelihood of developing leukemia. Workers that breathed benzene at a concentration 500 times greater than the highest level measured at the school for 1-10 years had in increased likelihood of developing lymphoma.

Naphthalene

The highest measured naphthalene level, 3 ppb, while greater than the chronic MRL (0.3 ppb)

[†] An increased color confusion index indicates an increased inability to distinguish colors.

is below the level at which people might smell it (84 ppb). When ATSDR authors calculate chronic MRLs, they adjust (or lower) the exposure concentrations showing effects in studies to reflect continuous exposure, 24 hours a day, seven days a week. Such chronic exposure assumptions are (and were) not met at Altha School. The toxicological profile authors did not find intermediate studies appropriate for deriving an intermediate exposure MRL. Because the highest measured level (3 ppb) is 3,000 times less than the lowest exposure concentration causing adverse health effects in animals in a chronic exposure study, it is unlikely that teachers and children would experience adverse health effects from intermittent exposures to the highest measured level of naphthalene.

All the reported inhalation health effects in the naphthalene toxicological profile (ATSDR 2005) were for acute or chronic animal studies. The acute and chronic adverse health effects occurring at the lowest exposure concentrations were due to irritation. Acute exposures irritated lung (Clara) cells, and chronic exposures irritated nasal cells leading to abnormal cell growth and tumors.

The EPA has judged naphthalene to be a possible human carcinogen, based on animal studies. Such studies have shown associations between naphthalene inhalation and tumors of the tissues in the nose and lungs in rats and mice. Animal studies have shown the development of cancer that arises in immature olfactory nerve cells in exposed rats' nasal tissues (olfactory epithelial neuroblastoma). We are unable to calculate an increased risk of cancer for the highest measured naphthalene level because toxicologists have not determined a cancer slope for naphthalene.

Toluene

While people can smell toluene in air at 8 parts per million, the highest level measured at Altha School was 10 times less than that, so people would have been unlikely to smell the measured level.

Because measured toluene (0.823 ppm) made up about 85% of the combined Hazard Index totals, Florida DOH calculated a toluene level that would be equivalent to 100% of the Hazard Index determined, 1 ppm. The measured level is 42.5 times less and the equivalent level is 35 times less than the Lowest Observed Adverse Effect Level (LOAEL), 35 ppm, at which workers exposed to toluene for an average of 17 years showed color vision loss (Zavalic et al. 1998a, c). Because these workers were exposed daily, and were exposed to much higher levels, it is much less likely that teachers and children exposed intermittently would experience similar neurological effects.

While the measured and total Hazard Index equivalent levels of toluene exceed the chronic MRL (0.08 ppm), when ATSDR authors calculate chronic MRLs, they adjust (lower) the lowest LOAEL to reflect continuous exposure, meaning exposure for 24 hours a day, seven days a week. Then they divide this continuous exposure level by an uncertainty factor of 100. The assumptions of long-term, daily, 24-hour exposure used to calculate this chronic MRL probably were not met at Altha School.

The National Toxicology Program (2001) has not listed toluene as a known or anticipated human carcinogen. The EPA determined that toluene is not classifiable as to carcinogenicity because human data are lacking and the animal data are inadequate.

Total Xylenes

There are three xylene isomers. An isomer is a chemical with the same atoms, but in the case of xylene, the two methyl groups (a carbon atom and two hydrogen atoms) vary in position relative to their attachment around a ring of six carbons. Although xylenes have a sweet odor, people would have been unlikely to smell the highest level measured in the school because the odor threshold is 0.08-3.7 ppm.

The highest measured level of total xylenes, $140 \mu\text{g}/\text{m}^3$, is 3.1 times less than the chronic MRL ($434 \mu\text{g}/\text{m}^3$ equals 0.1 ppm); therefore, it is unlikely that teachers and children might experience adverse health effects for shorter-term (intermediate) intermittent exposures. ATSDR authors derived the chronic MRL from a 14-ppm LOAEL in a study of workers exposed to xylenes 8 hours a day, for an average of 7 years who showed increased prevalence of anxiety, forgetfulness, inability to concentrate, and other symptoms (ATSDR 1995).

While two occupational studies suggested a possible relationship between coal-based xylene exposure and leukemia (Arp et al. 1983 and Wilcosky et al. 1984) the small number of subjects (9 to 85 males), lack of exposure concentrations, and unknown xylene composition prohibit a definitive conclusion regarding inhalation of xylene and cancer. ATSDR did not locate any cancer studies for animals inhaling xylenes.

Child Health Considerations

ATSDR and Florida DOH recognize that the unique vulnerabilities of infants and children demand special attention (ATSDR 2005a). Children are at a greater risk than are adults are for some hazardous substance exposures. Because children are smaller than adults are, their exposures can result in higher exposure concentrations of chemical per body weight. If toxic exposures occur during critical growth stages, the developing body systems of children can sustain permanent damage. Probably most important, however, is that children depend on adults for risk identification and risk management, hygiene awareness, and access to medical care. Thus, adults should be aware of public health risks in their community, so they can guide their children accordingly. In recognition of these concerns, ATSDR developed the chemical screening values for children's exposures that Florida DOH used in preparing this report.

Other susceptible populations may have different or enhanced responses to toxic chemicals than will most persons exposed to the same levels of that chemical in the environment. Reasons may include genetic makeup, age, health, nutritional status, and exposure to other toxic substances (like cigarette smoke or alcohol). These factors may limit a susceptible persons' ability to detoxify or excrete harmful chemicals or may increase the effects of damage to their organs or systems.

Conclusions

Florida DOH evaluated mixtures of the gasoline and fuel oil components measured in indoor air in the elementary wing of the Altha School. We found these mixtures would be unlikely to cause adverse health effects with intermittent exposures; therefore, the site is classified as "no apparent public health hazard". While our evaluation of the mixtures of chemicals measured in air do not indicate a risk for non-cancer illness, daily, long-term exposure to the highest levels of chemicals measured could increase a person's statistical risks for certain cancers (leukemia and lymphoma) over their lifetime by 2 additional cases in 1 million people. ATSDR qualifies this level as occurring between no apparent and no significant increased risk.

The chemical values measured in indoor air that Florida DOH evaluated were collected when DEP's contractor was performing soil and groundwater remediation work. The remediation equipment DEP's contractor uses on the school property is designed to remove petroleum contaminants from the soil and groundwater by extracting vapors from the soil via wells. Cleanup contractors added additional vapor extraction wells in the summer of 2006 and plan to run both the soil vapor extraction and air-sparging parts of the system continuously if they can show that the extraction wells are capable of capturing all of the vapors.

Recommendations

Because our evaluation did not find the chemicals measured in air to pose an apparent public health hazard, and because DEP's contractor has nearly cleaned up the soil on the school property, the Florida DOH is not recommending additional air sampling. Nevertheless, relatively few air samples were analyzed and based on DEP's cleanup reports the subsoil contained more gasoline and fuel oil components in the past. Therefore, Florida DOH recommends that people who feel ill, especially those with persistent symptoms, should see their doctors. They should tell their doctors about any concerns they might have about environmental exposures.

Public Health Action Plan

This section describes what ATSDR and Florida DOH plan to do at this site. An important part of risk communication is explaining what is known and what may not be known. ATSDR and Florida DOH will do the following:

1. Florida DOH, Bureau of Community Environmental Health staff will work with Altha School officials to prepare a fact sheet on our evaluation that they can give to students and parents.
2. Florida DOH, Bureau of Community Environmental Health staff will continue to work with the Florida DEP and Calhoun County Health Department staff to evaluate and protect public health.
3. Florida DOH, Bureau of Community Environmental Health staff will evaluate any additional air test results for public health implications.

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Appendix A—Figures

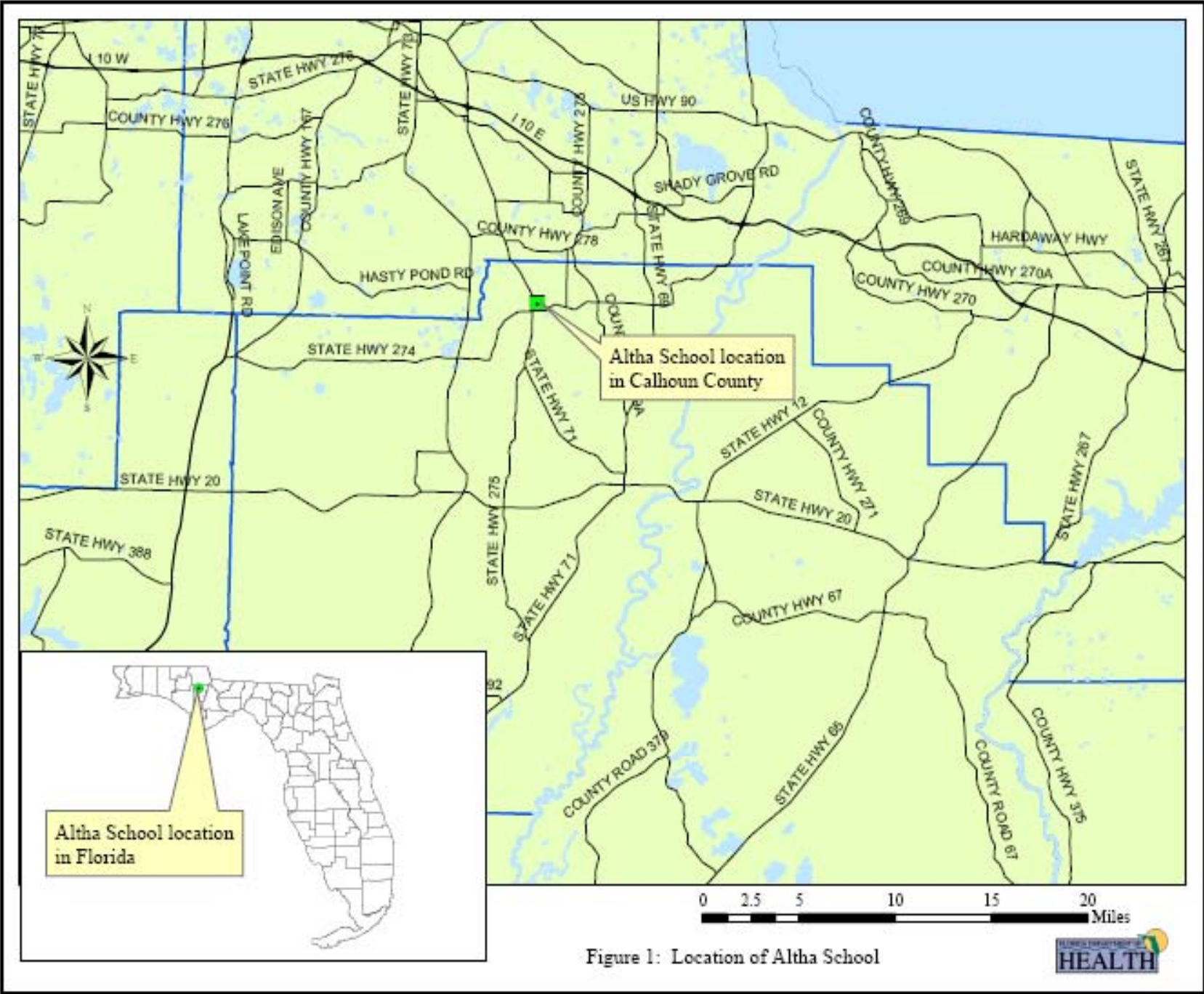


Figure 1: Location of Altha School



Legend

- Petroleum Facilities
- Well Location/Health Risk**
- Petroleum Indicator Results***
- >1/2 MCL/HAL
- >1/4 MCL/HAL
- <1/4 MCL/HAL
- Not Detects
- Not Sampled Within Previous Year
- >100,000 gpd
- <100,000 gpd



**Florida Department of Health
 Bureau of Water Programs
 Potable Well Survey**

Disclaimer
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* The following chemicals were used for the Petroleum Indicator analysis: Benzene, Ethylbenzene, Toluene, Xylene (Total), Naphthalene, and Methyl-Tert-Butyl-Ether (MTBE)

Figure 2: Approximate location of groundwater plume. AAA-labeled sites are city wells.

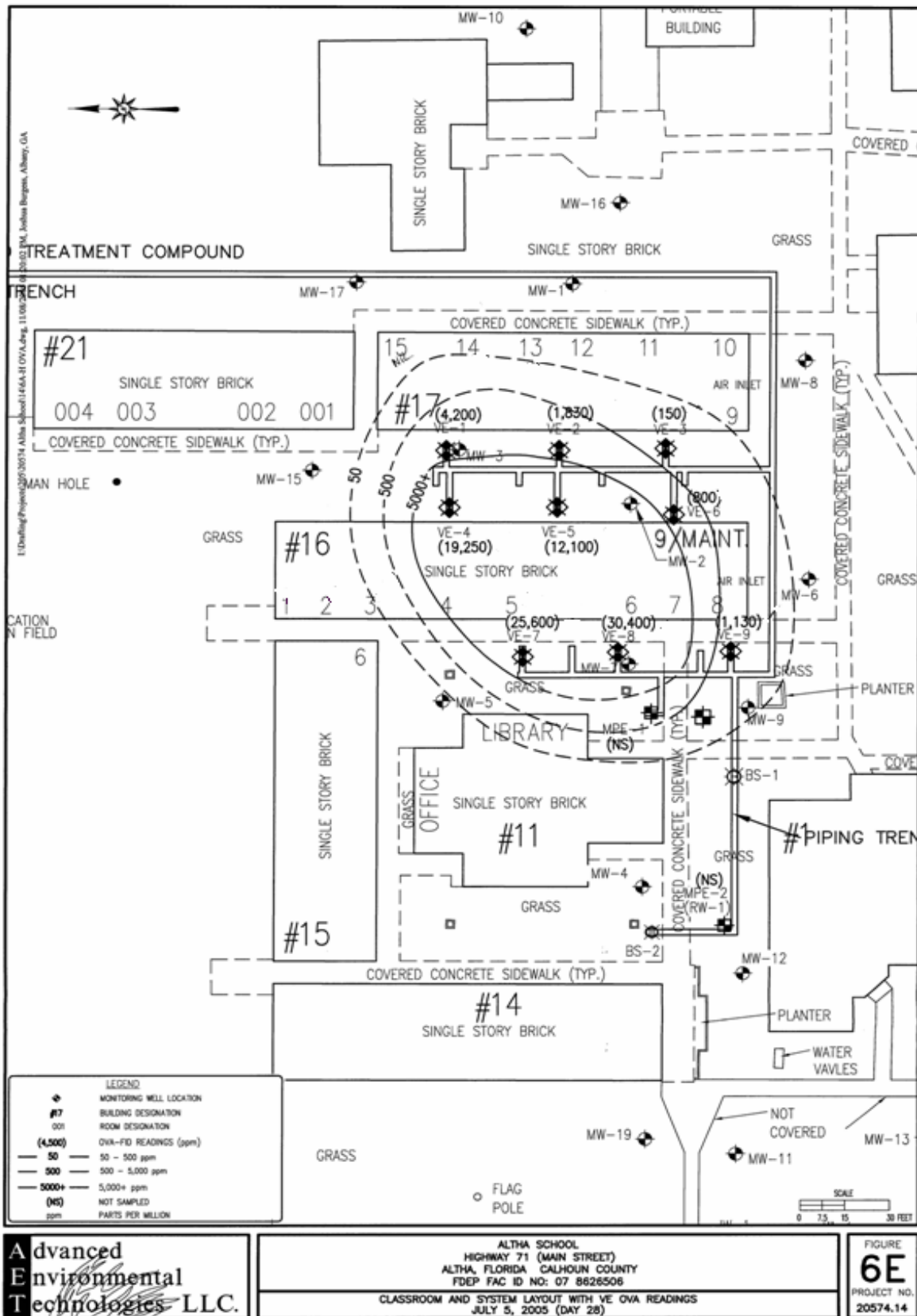


Figure 3, Contoured OVA readings near elementary wing (AET 6E)

Appendix B—Tables

Table 1. Completed Exposure Pathways

PATHWAY NAME	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	ENVIRONMENTAL MEDIA	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSED POPULATION	
Indoor Air	Contaminated soil under the building	Air	Classrooms	Inhalation	Teachers and student	Past

Table 2. Maximum Air Concentrations for Contaminants of Concern

Contaminants of Concern	Screening Value ($\mu\text{g}/\text{m}^3$)		Max. Air Concentration ($\mu\text{g}/\text{m}^3$)	Location and Date of Sample	Number of Samples Above Screening Value
	ATSDR:	EPA			
benzene	0.1 (CREG) 10 (Chronic EMEG/MRL) 20 (Int. EMEG /MRL) 30 (Acute EMEG/MRL)	30 (Rfc)	6	Bldg. 16 Room 5, 8/13/05	1/13
ethylbenzene	4,000 (Int. EMEG/MRL)	1,000 (Rfc)	29	Bldg. 16 Room 5, 8/13/05	0/13
naphthalene	4 (Chronic EMEG/MRL)	3 (Rfc)	13	Bldg. 16 Room 5, 8/13/05	1/13
toluene	300 (Chronic EMEG/MRL) 4,000 (Acute EMEG/MRL)	400 (Rfc)	3,100	Bldg. 16 Room 5, 8/13/05	2/13
xylenes (total)	434 (Chronic EMEG/MRL) 3,038 (Int. EMEG/MRL) 4,340 (Acute EMEG/MRL)	100 (Rfc)	140	Bldg. 16 Room 5, 8/13/05	2/13

CREG—ATSDR’s Cancer Risk Evaluation Guide for 1 excess cancer case in 1 million people (ATSDR 1992a).

Chronic EMEG/MRL—Environmental Media Evaluation Guide for chronic exposures (daily exposures lasting longer than one year)

MRL is the Minimum Risk Level.

Rfc—EPA’s reference concentration for air, in micrograms per cubic meter, $\mu\text{g}/\text{m}^3$.

Table 3. School Exposure Concentrations.

Contaminant of Concern	Maximum Air Concentration ($\mu\text{g}/\text{m}^3$)	Air MRL Guideline ($\mu\text{g}/\text{m}^3$)	Teacher, 20 years of exposure	Middle and high school students, 6 years of exposure	Elementary school students, 6 years of exposure
			Estimated Air Inhalation Conc. ($\mu\text{g}/\text{m}^3$)/adj. conc.†	Estimated Air Inhalation Conc. ($\mu\text{g}/\text{m}^3$)	Estimated Air Inhalation Conc. ($\mu\text{g}/\text{m}^3$)
benzene	6	Int. 20	6/0.3	6/0.2	6/0.27
naphthalene	13	Int. 3	13/0.6	13/0.4	13/0.58
toluene	3,038	Acute 4,000	3,100/137	3,100/104	3,100/138
xylenes (total)	140	Int. 2,600	140/6.2	140/4.7	140/6.2

Scenario Time frame: Past
Exposures Point—In-door air

MRL - Minimum Risk Level for non-cancer illnesses

Land Use Conditions: School

Receptor Population—Teachers and Students

$\mu\text{g}/\text{kg}$ = milligrams per kilogram

Exposure Medium- Air

$\mu\text{g}/\text{m}^3$ = micrograms per cubic meter

†When evaluating carcinogenic risk from exposures that last less than a lifetime, the exposure concentration is adjusted to a concentration that would yield an equivalent exposure if exposure continued for the entire lifetime. For inhalation exposures, this yields the adjusted concentration:
Adjusted concentration = concentration multiplied by (exposure period/lifetime)

Table 4. Hazard Indices determined for mixtures evaluation†

Room 5, 8/13/05 ug/m3 ug/m3 ug/m3 ug/m3 ug/m3 ug/m3

Chemical	Chronic			Intermediate			Acute		
Benzene	6	10	0.6	6	20	0.3	6	30	0.2
Ethylbenzene	29	1000	0.03	29	4000	0.007	29	4000	0.007
Toluene	3100	300	10.3	3100	1508	2.06	3100	4000	0.8
Xylenes	140	200	0.7	140	3000	0.05	140	9000	0.02
Hazard Index (HI)			11.7			2.4			1.0

Room 4, 8/5/05 ug/m3 ug/m3 ug/m3 ug/m3 ug/m3 ug/m3

Chemical	Chronic			Intermediate			Acute		
Benzene									
Ethylbenzene	8	1000	0.008	8	4000	0.002	8	4000	0.002
Toluene	440	300	1.5	440	1508	0.3	440	4000	0.1
Xylenes	74	200	0.4	74	3000	0.02	74	9000	0.008
Hazard Index (HI)			1.9			0.3			0.1

Room 4, 8/13/05 ug/m3 ug/m3 ug/m3 ug/m3 ug/m3 ug/m3

Chemical	Chronic			Intermediate			Acute		
Benzene									
Ethylbenzene									
Toluene	5.9	300	0.02	5.9	1508	0.004	5.9	4000	0.001
Xylenes	124	200	0.6	124	3000	0.04	124	9000	0.01
Hazard Index (HI)			0.6			0.04			0.01

40ppm/100 lowest int. NOAEL from animal study, converted to ug/m3
 EPA Rfc
same as int. MRL

†Hazard Indices are calculated by dividing the exposure concentration by the appropriate ARSDR MRL. We included the ethylbenzene levels to provide accurate totals; ethylbenzene was not measured above its health-base screening level.

Table 5: Comparison of exposure concentrations to LOAELs (Lowest Observable Adverse Effect Levels) occurring in human medical or animal studies. Toxic effects are not limited to those discussed, as chemicals regulated at low levels are often toxic to many organs and systems, the effects described here are just those noted at the lowest exp. conc.

Chemical	exposure concentrations are in mg/kg/day and are calculated using the highest measured level					
	Elementary student's exposure concentration	Middle and high student's exposure concentration	Teacher's exposure concentration	Elementary student's theoretical increased cancer risk	Middle and high student's theoretical increased cancer risk	Teacher's theoretical increased cancer risk
benzene	Inh 6 µg/m ³ 0.002 ppm	Inh 6 µg/m ³ 0.002 ppm	Inh 6 µg/m ³ 0.002 ppm	Inh—2 :1,000,000	Inh—2 :1,000,000	Inh—2 :1,000,000
Draft for Public Comment (ATSDR 2005a)	<p><u>Inhalation exposure concentration:</u> The inhalation exposure concentration is 285 times less than the exposure concentration associated with reduced white blood cell and platelet counts (0.57 ppm) for workers exposed to benzene for 6.1 years on average (Lan et al 2004a). This exposure concentration is also less than the minimum risk level (0.003 ppm) ATSDR derived from Lan's study. The measured level is therefore unlikely to cause non-cancer health effects. ATSDR derived this MRL by performing benchmark exposure concentration analysis on B-lymphocyte counts to select a point of departure, which they adjusted for intermittent exposure and divided by an uncertainty factor of 10 for human variability to determine this minimum risk level. At higher benzene exposure levels workers experienced the following:</p> <ul style="list-style-type: none"> • 0.69 ppm; leucopenia (too few leukocytes, a white blood cell); Xia et al., 1995, • 33 ppm; eye irritation, Yin et al., 1987, • 40 ppm; decreased lymphocytes, Cody et al., 1993, and • 60 ppm; skin irritation, mucous membrane irritation, breathlessness, nausea, dizziness, headache, exp. peculiar odor and chemical taste, fatigue, Midzenski et al. 1992. <p><u>Associated cancers:</u> Occupational studies have linked workers' extended inhalation exposures to leukemia (0.3 ppm, Ott et al. 1978, 18-month occupational exposure), and lymphoma (1 ppm; Aksoy et al. 1987, 1-10 year occupational exposure).</p>					

Chemical	exposure concentrations are in mg/kg/day and are calculated using the highest measured level					
	Elementary student's exposure concentration	Middle and high student's exposure concentration	Teacher's exposure concentration	Elementary student's theoretical increased cancer risk	Middle and high student's theoretical increased cancer risk	Teacher's theoretical increased cancer risk
naphthalene	Inh 13 $\mu\text{g}/\text{m}^3$ 0.003 ppm	Inh 13 $\mu\text{g}/\text{m}^3$ 0.003 ppm	Inh 13 $\mu\text{g}/\text{m}^3$ 0.003 ppm	No slope factor.	No slope factor.	No slope factor.
(ATSDR 2005b, Update)	<p><u>Inhalation exposure concentration:</u> The highest measured naphthalene level, 3 ppb, is 4 times higher than the minimum risk level. ATSDR derived the 0.7 ppb minimum risk level from long-term studies of mice and rats that showed inflammation of the nose and lung accompanied by abnormal cell growth and an overall increase in cell numbers or tissue components (tumors) at 10 ppm (NTP 2000, Adbo et al. 2001). ATSDR authors calculated a human equivalent concentration of 200 ppb and divided it by a factor of 300 (10 for the use of a lowest observable adverse effect level, 3 for extrapolating from rodents to humans with interspecies dosimetric adjustment, and 10 for human variability). This human equivalent concentration is adjusted for continuous exposure, 24 hours a day, seven days a week. The measured level (0.003 ppm) is 3,333 times less than the lowest exposure concentration causing adverse health effects in animals in a chronic exposure (long-term, daily) study, therefore it is unlikely that teachers and children would experience adverse health effects from intermittent exposures to the highest measured level, 0.003 ppm levels.</p> <p><u>Associated cancers:</u> The EPA has judged naphthalene to be a possible human carcinogen, based on animal studies. Such studies have shown associations between naphthalene inhalation and tumors of the tissues in the nose and lungs in rats and mice (NTP 2000: Adbo et al. 2001 and NTP 1992). Animal studies have shown the development of cancer that arises in immature olfactory nerve cells in exposed rats' nasal tissues (olfactory epithelial neuroblastoma, NTP 200: Adbo et al. 2001). However, at this time, EPA has not proposed a cancer slope factor for naphthalene.</p>					

Chemical	exposure concentrations are in mg/kg/day and are calculated using the highest measured level					
	Elementary student's exposure concentration	Middle and high student's exposure concentration	Teacher's exposure concentration	Elementary student's theoretical increased cancer risk	Middle and high student's theoretical increased cancer risk	Teacher's theoretical increased cancer risk
toluene	Inh 3,100 $\mu\text{g}/\text{m}^3$ 0.823 ppm	Inh 3,100 $\mu\text{g}/\text{m}^3$ 0.823 ppm	Inh 3,100 $\mu\text{g}/\text{m}^3$ 0.823 ppm	No slope factor.	No slope factor.	No slope factor.
(ATSDR 2000)	<p><u>Inhalation exposure concentration:</u> The highest measured level of toluene, 0.823 ppm, is 42.5 times less than the Lowest Observed Adverse Effect Level (LOAEL), 35 ppm, for workers exposed to toluene for an average of 17 years; workers showed increased color confusion index (Zavalic et al. 1998a, c). While this level is higher than the chronic MRL (0.08 ppm), chronic MRLs adjust (lower) the lowest LOAEL to estimate continuous exposure levels, 24 hours a day, seven days a week. This continuous exposure level is then divided by an uncertainty factor of 100, to account for its derivation from a LOAEL (10), and to account for human variations (10). Chronic exposure assumptions are (and were) not met at Altha School. The toxicological profile does not have intermediate studies appropriate for deriving an intermediate exposure MRL. However, it is unlikely that teachers and children would experience adverse health effects for intermittent exposures to 0.823 ppm, the highest measured level.</p> <p><u>Associated cancers:</u> Neither epidemiological studies of people exposed to toluene in the workplace nor animal studies have suggested links between cancer and toluene inhalation exposure.</p>					
total xylenes	Inh 140 $\mu\text{g}/\text{m}^3$ 0.03 ppm	Inh 140 $\mu\text{g}/\text{m}^3$ 0.03 ppm	Inh 140 $\mu\text{g}/\text{m}^3$ 0.03 ppm	No slope factor.	No slope factor.	No slope factor.
(ATSDR 1995)	<p><u>Inhalation exposure concentration:</u> The highest measured level of total xylenes, 140 $\mu\text{g}/\text{m}^3$, is 3.1 times less than chronic MRL of 434 $\mu\text{g}/\text{m}^3$ (which equals 0.1 ppm); therefore, it is unlikely that teachers and children might experience adverse health effects for shorter-term (intermediate) intermittent exposures. ATSDR authors derived the chronic MRL from a 14-ppm LOAEL in a study of workers exposed to xylene 8 hours a day, for an average of 7 years who showed increased prevalence of anxiety, forgetfulness, inability to concentrate, and other subjective symptoms.</p> <p><u>Associated cancers:</u> While limited occupational studies suggest a possible relationship between coal-based xylene exposure and leukemia (Arp et al. 1983 and Wilcosky et al. 1984) the small number of subjects (9 to 85 males), lack of exposure concentrations, and unknown xylene composition preclude a definitive conclusion regarding inhalation of xylene and cancer. ATSDR did not locate any cancer studies for animals inhaling xylenes.</p>					

Appendix C—Glossary of Environmental Health Terms

Absorption

The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute

Occurring over a short time [compare with [chronic](#)].

Acute exposure

Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with [intermediate duration exposure](#) and [chronic exposure](#)].

Additive effect

A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with [antagonistic effect](#) and [synergistic effect](#)].

Adverse health effect

A change in body function or cell structure that might lead to disease or health problems

Aerobic

Requiring oxygen [compare with [anaerobic](#)].

The Agency for Toxic Substances and Disease Registry (ATSDR)

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances.

Ambient

Surrounding (for example, *ambient air*).

Anaerobic

Requiring the absence of oxygen [compare with [aerobic](#)].

Analyte

A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study

A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect

A biologic response to exposure to multiple substances that is **less** than would be expected if the known effects of the individual substances were added together [compare with [additive effect](#) and [synergistic effect](#)].

Background level

An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation

Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study

A study that uses (a) [biomedical testing](#) or (b) the measurement of a substance [an [analyte](#)], its [metabolite](#), or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see [exposure investigation](#)].

Biologic monitoring

Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake

The transfer of substances from the environment to plants, animals, and humans.

Biota

Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

CAP [see [Community Assistance Panel](#).]

Cancer

Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk

A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen

A substance that causes cancer.

Case study

A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study

A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

Central nervous system

The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see [Comprehensive Environmental Response, Compensation, and Liability Act of 1980](#)]

Chronic

Occurring over a long time [compare with [acute](#)].

Chronic exposure

Contact with a substance that occurs over a long time (more than 1 year) [compare with [acute exposure](#) and [intermediate duration exposure](#)]

Cluster investigation

A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP)

A group of people from a community and from health and environmental agencies who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV)

Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see [exposure pathway](#)].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 CERCLA)

CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to

hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the [Superfund Amendments and Reauthorization Act \(SARA\)](#).

Concentration

The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant

A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Delayed health effect

A disease or an injury that happens as a result of exposures that might have occurred in the past.

Dermal

Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact

Contact with (touching) the skin [see [route of exposure](#)].

Descriptive epidemiology

The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit

The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Dose (for chemicals that are not radioactive)

The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An “exposure dose” is how much of a substance is encountered in the environment. An “absorbed dose” is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)

The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship

The relationship between the amount of exposure [[dose](#)] to a substance and the resulting changes in body function or health (response).

Environmental media

Soil, water, air, [biota](#) (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism

Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an [exposure pathway](#).

EPA

United States Environmental Protection Agency.

Epidemiologic surveillance [see [Public health surveillance](#)].

Epidemiology

The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure

Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [[acute exposure](#)], of intermediate duration, or long-term [[chronic exposure](#)].

Exposure assessment

The process of finding out how people come into contact with a hazardous substance, how often and

for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction

A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation

The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway

The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an [environmental media and transport mechanism](#) (such as movement through groundwater); a [point of exposure](#) (such as a private well); a [route of exposure](#) (eating, drinking, breathing, or touching), and a [receptor population](#) (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Exposure registry

A system of ongoing follow up of people who have had documented environmental exposures.

Feasibility study

A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Groundwater

Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with [surface water](#)].

Hazard

A source of potential harm from past, current, or future exposures.

Hazardous Substance Release and Health Effects Database (HazDat)

The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste

Potentially harmful substances that have been released or discarded into the environment.

Health investigation

The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

Indeterminate public health hazard

The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence

The number of new cases of disease in a defined population over a specific time period [contrast with [prevalence](#)].

Ingestion

The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see [route of exposure](#)].

Inhalation

The act of breathing. A hazardous substance can enter the body this way [see [route of exposure](#)].

Intermediate duration exposure

Contact with a substance that occurs for more than 14 days and less than a year [compare with [acute exposure](#) and [chronic exposure](#)].

In vitro

In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with [in vivo](#)].

In vivo

Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with [in vitro](#)].

Lowest-observed-adverse-effect level (LOAEL)

The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring

A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism

The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite

Any product of [metabolism](#).

mg/kg

Milligram per kilogram.

mg/cm²

Milligram per square centimeter (of a surface).

mg/m³

Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration

Moving from one location to another.

Minimal risk level (MRL)

An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see [reference dose](#)].

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)

EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

National Toxicology Program (NTP)

Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

No apparent public health hazard

A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)

The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard

A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see [National Priorities List for Uncontrolled Hazardous Waste Sites](#)]

Plume

A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure

The place where someone can come into contact with a substance present in the environment [see [exposure pathway](#)].

Population

A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP)

A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb

Parts per billion.

ppm

Parts per million.

Public availability session

An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public comment period

An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action

A list of steps to protect public health.

Public health advisory

A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)

An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health.

Public health hazard

A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or [radionuclides](#) that could result in harmful health effects.

Public health hazard categories

Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are [no public health hazard](#), [no apparent public health hazard](#), [indeterminate public health hazard](#), [public health hazard](#), and [urgent public health hazard](#).

Public health statement

The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public health surveillance

The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Receptor population

People who could come into contact with hazardous substances [see [exposure pathway](#)].

Reference dose (RfD)

An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Remedial investigation

The CERCLA process of determining the type and extent of hazardous material contamination at a site.

RfD [see [reference dose](#)]

Risk

The probability that something will cause injury or harm.

Risk reduction

Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication

The exchange of information to increase understanding of health risks.

Route of exposure

The way people come into contact with a hazardous substance. Three routes of exposure are breathing [[inhalation](#)], eating or drinking [[ingestion](#)], or contact with the skin [[dermal contact](#)].

Safety factor [see [uncertainty factor](#)]

SARA [see [Superfund Amendments and Reauthorization Act](#)]

Sample

A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see [population](#)]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size

The number of units chosen from a population or an environment.

Source of contamination

The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an [exposure pathway](#).

Special populations

People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Statistics

A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance

A chemical.

Surface water

Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with [groundwater](#)].

Surveillance [see [public health surveillance](#)]

Survey

A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see [prevalence survey](#)].

Synergistic effect

A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see [additive effect](#) and [antagonistic effect](#)].

Teratogen

A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent

Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile

An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology

The study of the harmful effects of substances on humans or animals.

Tumor

An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor

Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the [lowest-observed-adverse-effect-level \(LOAEL\)](#) or the [no-observed-adverse-effect-level \(NOAEL\)](#) to derive a [minimal risk level \(MRL\)](#). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

Urgent public health hazard

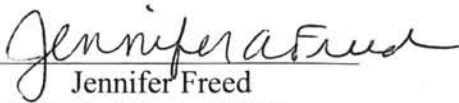
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)

Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, and methylene chloride.

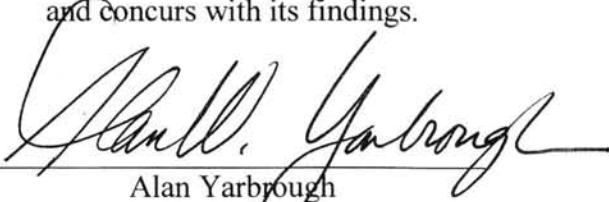
Certification

The Florida Department of Health, Bureau of Community Environmental Health prepared this Health Consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. Florida DOH followed approved methodologies and procedures existing at the time the health consultation was begun. The Cooperative Agreement Partner completed editorial review.



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



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