Health Consultation

Residential Indoor Air Investigation

EGYPTIAN LACQUER MANUFACTURING COMPANY, INC.

FRANKLIN, WILLIAMSON COUNTY, TENNESSEE

Prepared by the
Tennessee Department of Health

NOVEMBER 22, 2010

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
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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Prepared By:

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Environmental Epidemiology Program
Under Cooperative Agreement with
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Foreword

This document summarizes an environmental public health investigation performed by the State of Tennessee Department of Health's Environmental Epidemiology Program. Our work is conducted under a Cooperative Agreement with the federal Agency for Toxic Substances and Disease Registry. In order for the Health Department to answer an environmental public health question, several actions are performed:

Evaluate Exposure: Tennessee health assessors begin by reviewing available information about environmental conditions at a site. We interpret environmental data, review site reports, and talk with environmental officials. Usually, we do not collect our own environmental sampling data. We rely on information provided by the Tennessee Department of Environment and Conservation, U.S. Environmental Protection Agency, and other government agencies, businesses, or the general public. We work to understand how much contamination may be present, where it is located on a site, and how people might be exposed to it. We look for evidence that people may have been exposed to, are being exposed to, or in the future could be exposed to harmful substances.

Evaluate Health Effects: If people could be exposed to contamination, then health assessors take steps to determine if it could be harmful to human health. We base our health conclusions on exposure pathways, risk assessment, toxicology, cleanup actions, and the scientific literature.

Make Recommendations: Based on our conclusions, we will recommend that any potential health hazard posed by a site be reduced or eliminated. These actions will prevent possible harmful health effects. The role of Environmental Epidemiology in dealing with hazardous waste sites is to be an advisor. Often, our recommendations will be actions items for other agencies. However, if there is an urgent public health hazard, the Tennessee Department of Health can issue a public health advisory warning people of the danger, and will work with other agencies to resolve the problem.

If you have questions or comments about this report, we encourage you to contact us.

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Or call us at: 615-741-7247 or toll-free 1-800-404-3006 during normal business hours
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SUMMARY

INTRODUCTION

Ensuring the wellbeing of those living in, working in, or visiting Tennessee is a priority of the Tennessee Department of Health's (TDH's) Environmental Epidemiology Program (EEP).

EEP wrote this health consultation at the request of the Tennessee Department of Environment and Conservation (TDEC) State Remediation Program (SRP). It documents our review of indoor and outdoor air sampling conducted near the Egyptian Lacquer Manufacturing Company (ELMCO) in January 2010. This site consists of a manufacturing facility and off-site areas including a residential neighborhood. Chemicals were released from damaged underground pipes to groundwater. These chemicals have since migrated under some homes and into Liberty Creek.

All data supplied for this health consultation were compared to the Agency for Toxic Substances and Disease Registry (ATSDR) and the U.S. Environmental Protection Agency (EPA) residential indoor comparison values. Comparison values are chemical concentrations or doses based on toxicology below which no adverse health effects are predicted to occur. When a comparison value is exceeded, it does not immediately indicate that people would be expected to develop adverse health effects. Instead, it means that the potential health risk requires further investigation.

CONCLUSIONS

EEP reached three important conclusions in this health consultation:

Conclusion 1

EEP concludes that the concentrations of the site-related chemicals, acetone, benzene, and toluene, measured in the indoor air of Home A on Daniels Drive, in January 2010 were greater than the outdoor background air sample collected in the backyard of Home B. Home A is located next to Home B. These levels detected are below levels that are considered harmful to adults or children living in the home.

Basis for Conclusion

Acetone, benzene, and toluene measurements in the indoor air of Home A were well below the levels considered by both ATSDR and EPA to be harmful to the health of adults and children. The amount of benzene measured in the indoor air was within the risk range of one excess cancer in 10,000 to 100,000 people used by EPA. There is some added risk associated with some exposure to these chemicals. However, the risk is considered low. The higher benzene concentration in the home could be due to storing gasoline and gasoline-powered lawn equipment in the basement / garage.

Next Steps

TDEC communicated all results to the homeowners and stated that the lawn equipment and gasoline containers should be removed from the basement / garage storage area. A benefit of this would be to decrease the amount of chemical vapors that could be present in the home from the equipment.

Conclusion 2

EEP concludes that the concentrations of the site-related chemicals, acetone, benzene, and toluene, measured in the indoor air of Home B on Daniels Drive in January 2010 were similar to concentrations measured in the outdoor background air sample collected in the backyard of Home B. These levels are below levels that are considered harmful to adults living in the home. No children are living in Home B.

Basis for Conclusion

All measurements of the acetone, benzene, and toluene in indoor air were similar to levels measured in the outside background air sample collected at this home. The amount of benzene measured in the indoor air was at the one excess cancer in 100,000 people risk level. There is some added risk associated with exposure to benzene at this amount. However, this added risk is considered to be low.

Next Steps

TDEC communicated all results to the homeowners. TDEC continues to work with ELMCO to clean up the site and prevent further migration of chemicals to Liberty Creek.

Conclusion 3

EEP concludes that the concentrations of site-related chemicals acetone, benzene, and toluene, measured in the indoor air of Home C on Daniels Drive in January 2010 were of similar concentration to the outdoor background air sample collected in the backyard of Home B. These levels are below the levels that are considered harmful to adults and children living in the home.

Basis for Conclusion

All measurements of the acetone, benzene, and toluene in indoor air were similar to concentrations measured in the outdoor background air sample collected in the backyard of Home B. The amount of benzene measured in the indoor air was at the one excess cancer in 100,000 people risk level. There is some added risk associated with some exposure to benzene at this amount. However, this added risk is considered to be low.

Next Steps

TDEC communicated all results to the homeowners. TDEC continues to work with ELMCO to clean up the site and prevent further migration of chemicals to Liberty Creek.

FOR MORE INFORMATION

If you have any questions or concerns about your health, you should contact your healthcare provider. For more information on this site call TDEC toll free at 888-891-8332. For information on your health you can call TDH EEP at 615-741-7247 or 1-800-404-3006. You can also email TDH EEP at eep.health@tn.gov.

Introduction

It has been over three years since chemicals were first discovered seeping into Liberty Creek from the Egyptian Lacquer Manufacturing Company (ELMCO) site. During this time, the Tennessee Department of Environment and Conservation (TDEC) has asked the Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP) to help interpret results of several environmental investigations conducted. EEP has also presented information about the toxicity of acetone and toluene at a public meeting and has also met with concerned parents and school administrators on several occasions to discuss children's health. EEP has prepared one previous health consultation and a technical assist which were based on environmental data collected near the ELMCO Site.

The first health consultation evaluated ambient (outdoor) air data collected from a residential area and a school downgradient from ELMCO. It was published on July 23, 2009 (ATSDR 2009). A technical assist was subsequently published in July 2010. It evaluated soil-gas data collected to identify if vapor migration from the groundwater plume was a cause for concern for residences downgradient from ELMCO. These documents described the site background and the previous investigations and remedial cleanup actions conducted by ELMCO with TDEC oversight.

This health consultation is a follow-up to the soil-gas investigation technical assist discussed above. In the soil-gas technical assist, EEP recommended that TDEC directly sample the indoor air of selected residents on the Daniels Drive cul-de-sac, a residential street located downgradient from the ELMCO site. In January 2010, the indoor air in three homes was sampled. The single family homes were of brick or wood frame construction and had either basements or crawlspaces. Two of the three homes were in the path of the underground chemical migration from ELMCO to Liberty Creek. One of the homes was located away from the underground chemical migration path. An ambient air sample was also collected outside in the backyard at one of the homes.

This health consultation evaluates the results of the indoor air sampling event conducted in January 2010.

Background

In January 2007, the City of Franklin, Williamson County, Tennessee, and TDEC conducted environmental sampling along Liberty Creek. This sampling was in response to complaints from citizens of strong chemical odors coming from the creek. Analytical results confirmed the presence of acetone and toluene in both water and air samples. TDEC initiated emergency response actions to contain the chemicals using its emergency response contractors. Further investigation by TDEC showed the solvents acetone and toluene to be entering Liberty Creek and ambient air through seeps along the banks of the creek. Liberty Creek's confluence with the Harpeth River is a short distance from where the active chemical seeps were found. The source of the chemicals entering the creek was a nearby paint and lacquer manufacturing facility. This facility was identified to be the ELMCO site, located at 113 Fort Granger Drive, Franklin, Tennessee. TDEC's file number for this waste site is SRS-01035.

ELMCO produces industrial coatings for a variety of products. The acetone and toluene solvents were used by ELMCO for manufacturing specialty paints and lacquers for the pencil industry. ELMCO stored the acetone and toluene in above-ground tanks on their property. As part of ELMCO's former chemical storage process, these solvents were then piped underground to the factory.

During the investigation for the source of acetone and toluene seeping into Liberty Creek, ELMCO discovered that elbow joints in their piping system had not been adequately sealed, allowing rust to form. Over the years, the rust caused the elbow joints to fail and leak solvents. Solvents traveled off the ELMCO site underground and reached Liberty Creek (Figure 1). No other pipes, ditches, or other drainage ways were discovered that could have delivered these chemicals to the creek.

ELMCO has conducted several environmental and human health–related investigations. In 2007, initial indoor air sampling in crawl spaces and basements was conducted in homes downgradient from ELMCO. In 2008, an ambient air sampling investigation was completed. In 2009, a soil-gas investigation along Daniels Drive was finished. The investigations were conducted by ELMCO's consultants with oversight by TDEC.

Discussion

Introduction to Chemical Exposure

To determine whether persons have been or are likely to be exposed to chemicals, TDH EEP evaluates mechanisms that could lead to human exposure. An exposure pathway contains five parts:

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

An exposure pathway is considered complete if there is evidence that all five of these elements have been, are, or will be present at the site. A pathway is considered potential if there is a lower probability of exposure. If there is no evidence that at least one of the five elements listed has been, is, or will be present at the site, then it is considered an incomplete exposure pathway. For this site, there is a potentially completed exposure pathway for the inhalation of indoor air contaminated with acetone, benzene, and toluene, which are volatile organic compounds (VOCs).

Physical contact alone with a potentially harmful chemical in the environment by itself does not necessarily mean that a person will develop adverse health effects. A chemical's ability to affect public health is controlled by a number of factors, including:

- the amount of the chemical that a person is exposed to (dose)
- the length of time that a person is exposed to the chemical (duration)
- the number of times a person is exposed to the chemical (frequency)

- the person’s age and health status, and
- the person’s diet and nutritional habits.

One purpose of this public health consultation is to evaluate the potential for vapor intrusion into homes on the Daniels Drive cul-de-sac from off-gassing of acetone, benzene, and toluene vapors migrating downgradient from ELMCO. Another purpose is to provide an update to previous vapor intrusion investigations performed in 2007 in homes on Daniels Drive.

To evaluate exposure to a hazardous substance, health assessors often use health comparison values. If the chemical concentrations are below the comparison value, then health assessors can be reasonably certain that no adverse health effects will occur in people who might be exposed. If concentrations are above the comparison values for a particular chemical (ATSDR 2010), then further evaluation of that chemical is in order.

The potentially exposed population includes the residents on Daniels Drive who live downgradient from ELMCO. The homes selected for sampling represented the population that live on the Daniels Drive cul-de-sac. Two of the homes were selected to be sampled because they appeared to be located in the direct path of the underground chemical plume. One was located away from the chemical plume. The three homes also represented a cross section of potentially exposed populations. Families with young children lived in two of the homes while an older resident and other adults lived the other home.

Health Comparison Values

ATSDR uses the no observed adverse effect level/uncertainty factor (NOAEL/UF) approach to derive Environmental Media Evaluation Guides (EMEGs) for non-carcinogenic effects of hazardous substances. EMEGs are set below levels that might cause adverse health effects to the most sensitive persons. EMEGs are derived for acute (1 to 14 days), intermediate (15 to 364 days), and chronic (365 days and longer) exposure durations, and for the oral and inhalation routes of exposure. ATSDR does not use serious health effects (such as damage to the liver or kidneys, or birth defects) as a basis for establishing EMEGs. Exposure to a level above the EMEG does not mean that adverse health effects will occur.

Cancer Risk Evaluation Guide (CREG) are screening values for chemicals that may cause cancer and are established for no more than one excess cancer in million people exposed during their lifetime (70 years). CREGs are calculated from EPA’s cancer slope factors for oral exposures or unit risk values for inhalation exposures. These values are based on EPA evaluations and assumptions about hypothetical cancer risks at low levels of chronic exposure.

Solvent Explanation

Acetone, benzene, and toluene have been found in previous environmental investigations conducted onsite at the ELMCO site. Offsite, the chemicals acetone and toluene were found to seep out of the bank of Liberty Creek down-gradient from ELMCO. Additionally, minor concentrations of benzene have been found in onsite groundwater monitoring wells and in Liberty Creek seeps.

ELMCO used acetone and toluene solvents because of their established fast drying properties. The benzene is reportedly a by-product of the toluene manufacturing process and may have been present in minor amounts within the toluene solvent ELMCO used (TDEC 2008). The physical characteristics and uses of acetone, benzene, and toluene have been discussed in the previous documents prepared for the site. Please refer to these documents for further information on these chemicals.

Introduction to Indoor Air Vapor Intrusion

Volatile and semi-volatile chemicals evaporate from impacted subsurface soil and/or groundwater beneath a building and move toward regions of lower chemical concentration such as the atmosphere, conduits, or basements. Soil-gas can flow into a building due to two main factors: environmental effects and building effects. Some examples of these factors are barometric pressure changes, wind load, temperature currents, or depressurization from building exhaust fans. Chemicals can migrate up and enter indoor air through foundation slabs, crawl spaces, or basements, depending on the construction of the home, if there are any unsealed joints or cracks in the foundation, or the heating and ventilation characteristics, among other factors. The rate of movement of the vapors into the building is difficult to measure and depends on soil type, chemical properties, building design and condition, and the pressure differences (ITRC 2007). Upon entry into a structure, soil-gas mixes with the existing air through the natural or mechanical ventilation of the building.

Commonly found concentrations of chemicals in indoor and outdoor air are referred to as "background levels." These levels are generally determined from the results of samples collected in homes, offices, and outdoor areas not known to be affected by “outside” sources of volatile chemicals (for example, a home not known to be near a chemical spill, a hazardous waste site, a dry-cleaner, or a factory). Background levels of volatile chemicals are considered when conducting an investigation of the vapor intrusion pathway (NYSDOH 2006).

Environmental Sampling

The 2010 indoor air testing was conducted in 3 homes along Daniels Drive by TDEC and TDH. The homes were selected (1) because of their location near the perceived underground groundwater contaminant plume, (2) residents granting access, and (3) the varying ages of potentially exposed populations in these homes.

These 3 homes were thought to be representative of the various construction types of homes on the Daniels Drive cul-de-sac. Two of the homes were considered by TDEC to be in the perceived underground chemical migration pathway from ELMCO to Liberty Creek, a worst-case scenario. A range of potentially exposed populations were also present in the homes and included children, adults, and an older adult. These populations are also thought to be representative of the people living on Daniels Drive.

TDEC secured access and discussed the sampling procedures with the homeowners. An information sheet was developed by TDH EEP and given to each homeowner during the initial discussion upon entering their home and before beginning the indoor air testing. This information sheet is presented in Appendix A.

Indoor air was sampled in the lowest level living areas of three homes on Daniels Drive, Homes A, B, and C (Figure 1). In addition, one ambient (outdoor) air sample was also collected to be used as a measure of outside air concentrations. The ambient air sample was placed in the backyard of Home B.

Home Characteristics

The three homes were of similar wood frame construction. Homes A and B were sheathed in brick while Home C was sheathed with vinyl siding. Homes A and B were also constructed about the same time, during the mid to late 1960s, according to the residents. Home C was newer and constructed in the 1980s or 1990s, according to the residents. Homes A and B had basements while Home C had a crawl space. Homes A and B were located above the apparent underground chemical pathway while Home C was not.

Home A

Home A was a brick, ranch-style home that had a full basement that was used for storage of household items and lawn equipment. The family lived on the main floor of the home. The basement was not finished and no one used this space as a living area. Lawn equipment items identified included several gasoline-powered lawnmowers, lawn trimmers, and a pressure washer. Containers of gasoline and cans of used paint were also noted. The basement was vented to the outside by louvered air flow screens on the sides and rear of the basement walls. There was also a taped-off drain pipe that extended approximately 2.5 feet above the basement floor. This pipe appeared to be a former drain for a kitchen sink. The unfinished basement had an overhead garage door and a normal walk-through access door. Personal vehicles were parked outside and not in the basement.

Home B

Home B was also a brick, ranch-style home. The homeowner and another adult lived on the main floor of the home. The home had a finished basement that was approximately two-thirds the length of the home. The remaining one-third was a large crawl space that was partly used for storage of household items. The finished basement was converted to a living area many years ago. The finished basement was also inhabited by an adult child of the homeowner. Personal vehicles were parked outside of the home.

Home C

Home C was a two-story home with the living area on the main or first floor. The home was sheathed with vinyl siding and wood trim. The home had a one-car attached garage. At the time of testing, the garage was used for storage of household items because the family was still moving into the home. Home C had a crawl space, the condition of which was unknown but it was described by the homeowner as not being very tall. TDEC and TDH did not inspect the crawl space. Personal vehicles were parked outside of the garage.

General Sampling Protocol

A general indoor air sampling protocol was developed for the Daniels Drive sampling event. This general indoor air sampling protocol is in Appendix B. The protocol outlines general steps that should be considered when conducting an indoor air sampling investigation and what regulatory or health values the results should be compared to, to understand them.

Building Inventory and Pre-Screening

Prior to implementing vapor sampling, an indoor air quality questionnaire and building inventory form was completed for each sampling location. The forms used were developed by the New York State Department of Health and are readily available online (NYSDOH 2006). The completed forms for each home are provided in Appendix C. Photographs in Appendix D show details of the various sampling locations. In general the building inventory sheets contained information on the following:

- historic and current storage and uses of volatile chemicals,
- sources of volatile chemicals present in the building,
- use of heating or air-conditioning systems during sampling,
- floor plan sketches,
- outdoor plot sketches,
- significant activities in the vicinity of the sampling locations,
- weather conditions and ventilation conditions,
- pertinent observations, such as spills, floor stains, odors, and readings from field instrumentation,
- overhead doors or man-door status,
- uses of VOCs during normal living in the home, and
- any pertinent observations, such as odors and readings from field instrumentation.

At each of the three homes, the occupants were advised not to smoke and to not burn candles in the home during the test. They were also advised to limit the number of times the front door to the outside was opened.

Home A

Home A contained various cleaning products stored beneath the kitchen sink (Appendix C). Photographs of the cleaning products are in Appendix D. A photoionization detector (PID) able to read in parts per billion (ppb) levels was used to determine if the products were emitting any volatile organic compounds (VOCs). No readings were obtained from the cleaning products stored beneath the kitchen sink in the home. Home A had a full unfinished basement / garage that was used for storage of household items, gasoline containers, and gasoline powered lawn equipment. Photographs of the items in the basement are presented in Appendix D. Numerous PID readings were measured from the items in the basement. The highest reading in the area of a push lawnmower, gasoline container, pressure washer, and lawn trimmer was 51 ppb of total VOCs. At the location of another lawnmower and gasoline container, the PID reading was 1,500 ppb of total VOCs (Appendix C).

Before beginning the indoor air sampling, background indoor air PID readings were measured to be 0 ppb total VOCs from the front living area on the main floor where the Summa canister was placed for the test.

Home B

The finished basement of Home B contained cans of spray paint, foam insulation, water sealant, and insecticide (wasp & hornet spray) (Appendices C and D). Personal care products such as mouthwash and wool clothing protectant (Woolite) were also noted. Again, the PID was used to detect any off-gassing of chemicals from the products noted in the basement. No readings from any of the individual products were noted using the PID. Total VOC readings in the general areas of the products ranged from 5 ppb in the crawlspace to 92 ppb near the bathroom area of the basement. VOC readings of 0 ppb were obtained from the common area in the basement where the Summa canister was placed.

Home C

Home C is rented by a family who was in the process of moving and becoming settled in the home when the test was conducted. Cleaning products were noted in the kitchen and first floor bathroom storage areas. VOC readings in these areas and in the front living area where the Summa canister was placed were 0 ppb. VOC readings were noted in the garage. Readings in the range of 200 to 203 ppb total VOCs were obtained and a distinct odor was noted (Appendices C and D). The occupants stated the owner of the home had painted a piece of furniture in the garage before moving out.

Indoor Air Sampling Methods

Sampling was conducted over an approximate 24-hour time period from January 19 to 20, 2010. Indoor and ambient air samples were collected using certified clean, 6-liter Summa canisters with 24-hour calibrated individual flow controllers. This certification process is how the subcontract laboratory, TestAmerica, Inc., in Knoxville, Tennessee, ensured the cleanliness of the media when dealing with low reporting limits. The air samples collected were analyzed for acetone, benzene, and toluene using the U.S. Environmental Protection Agency (EPA) Method TO-15 for VOCs.

The canisters were positioned in a heavy traffic area on the lowest floor used as the inhabited living area of the home, at a height of approximately 3 to 5 feet. The canisters were positioned at this height so that they would mimic the seated, breathing height of an individual in the home. For Home A, the Summa canister was positioned on a table in the front living room of the home. For Home B, the canister was positioned on a stool in the finished basement. In Home C, the Summa canister was positioned on a table in the front living room of the home. The outdoor air background sample was positioned approximately 3 feet above the ground surface in the backyard of Home B. The beginning sample time, sample identification, and initial pressure was recorded on each canister sample label.

A weather summary for testing period is in Appendix E. January 19, 2010, began as cool, warming into the low 60s during the day and settling into the low 50s at night. The day was partly cloudy or overcast (Wunderground 2010). For January 20, 2010, the temperature remained relatively steady, in the low 50s. The day was overcast with rain beginning before 7:00

am. The rain temporarily ended before 11:00 am and resumed later in the day (Wunderground 2010).

Limitations and Uncertainties

There are several characteristics of the homes, the chemical release, testing protocol, and the amount of cleaning or other products stored and/or used in the home that may influence indoor air testing. Limitations and uncertainties can sometimes influence the results of the investigation. Some examples include the detail of the design of each of the homes not being readily available. The number of cracks in floor slabs, concrete block walls, or utility perforations entering the home are also variables that can influence the test. Also, the amount of the contaminant plume lying beneath the home is unknown, and, hence, the amount of vapor off-gassing from the chemicals is not known. The presence of chemicals in the homes is also a limitation. The use of cleaning products that sometimes contain many chemicals can influence the results of the testing. This can be the case especially if cleaning products were recently used in the home. For one home, Home A, the presence of petroleum related chemicals likely influenced the sampling results. Having and following an accepted protocol for conducting these types of investigations is also important. A general protocol was developed for this investigation. The routines of the individuals living in the homes is another uncertainty. Sometimes people will smoke or burn candles during tests even though they have been advised not to do so.

Indoor and Outdoor Air Sampling Results

Results of the 3 indoor and 1 outdoor background air testing are shown in Table 1. Acetone, benzene, and toluene were measured in all air samples collected.

Commonly found concentrations of chemicals in indoor and outdoor air are referred to as "background levels." These levels are generally determined from the results of samples collected in homes, offices and outdoor areas not known to be affected by sources of volatile chemicals, for example, a home not known to be near a chemical spill, a hazardous waste site, a dry-cleaner, or a factory. Background levels of volatile chemicals are considered when conducting an investigation of the soil vapor intrusion pathway (NYSDOH 2006).

Chemicals are a part of our everyday life. They are found in the household products we use and in items we bring into our homes. As such, chemicals are found in indoor air of homes not affected by intrusion of contaminated soil vapor. Similarly, volatile chemicals can be in the outdoor air that enters a home or place of business. Certain distant commercial and industrial facilities, such as gasoline stations and dry cleaners, and vehicle exhaust, can increase general background levels of volatile chemicals in outdoor air (NYSDOH 2006).

Background or Outdoor Air Sample Results

The background air sample collected on Daniels Drive had measureable levels of site-related chemicals. The background acetone and toluene concentrations were 7.9 and 2.7 ppb respectively. Based on research conducted, the typical indoor air background concentrations identified by ATSDR for these two compounds are 8.0 ppb. (ATSDR 1994 and 2000).

TABLE 1. Indoor air sampling results for 3 homes on Daniels Drive in Franklin, Williamson County, Tennessee. Samples were collected on January 19-20, 2010, over an approximate 24-hour time period with Summa canisters. Values are reported in parts per billion (ppb). Results compared to health comparison values for chronic exposure duration of greater than 365 days. Comparisons were made using ATSDR's EMEGs for non-cancer effects and to ATSDR's CREGs and EPA's RSLs for cancer effects.

Chemical / Sampling Data and Location	Outdoor Air (outside of Home B)	Indoor Air Home A	Indoor Air Home B	Indoor Air Home C	ATSDR Chronic EMEG (non-cancer hazard)	ATSDR CREG		EPA RSL	
						(10^{-6} excess cancer risk)	(10^{-4} excess cancer risk)	(10^{-6} excess cancer risk)	(10^{-4} excess cancer risk)
acetone	7.9	230 E / 170 D	26	30	10,000	nc	nc	nc	nc
benzene	0.3	3.8	0.41	0.51	3	0.04	4	0.1	10
toluene	2.7 B	19 B	5.8 B	2.7 B	80	nc	nc	nc	nc

Notes Acetone and toluene are not classified as carcinogens. Benzene is classified as a known carcinogen. Cancer risk guidance for the toxicity of benzene is presented as a range. Inhalation Unit Risk values for benzene range from $7.8x10^{-6}$ $(ug/m^3)^{-1}$ to $2.2 x10^{-6}$ $(ug/m^3)^{-1}$. Both guidance values are valid estimates of risk. In the table, the excess cancer risk from benzene is shown for the both $1x10^{-6}$ and $1x10^{-4}$ risk values, the range of risk commonly evaluated by ATSDR and EPA (1991).

ATSDR EMEG = Agency for Toxic Substances and Disease Registry Minimum Risk Level / Environmental Media Evaluation Guide (ATSDR 2009). Chronic non-cancer exposure air comparison values (greater than 365 days) were used to determine if chemical concentrations needed further health-based screening.

ATSDR CREG = Agency for Toxic Substances and Disease Registry Cancer Risk Evaluation Guide (ATSDR 2009). Cancer risk air comparison values for cancer risk of 1 excess cancer in 1,000,000 people ($1x10^{-6}$) were used to determine if chemical concentrations warrant further health-based screening.

EPA RSL = Environmental Protection Agency Regional Screening Level (EPA 2009).

E = concentration exceeded the calibration level of the instrument. Sample was analyzed at a 25 time dilution (D) factor.

D = sample was analyzed at a 25 time dilution (D) factor to bring the concentration of the compound into the instrument calibration range.

B = the method blank for the analysis contains toluene at a reportable level (at an estimated concentration of 0.026 ppb).

nc = not classified as a carcinogen

2000). Thus, the measured background concentrations of acetone and toluene on Daniels Drive are consistent with typical indoor air background measurements.

The Daniels Drive background benzene concentration of 0.3 ppb was basically the same as EPA's measured background benzene concentration for the southeast (EPA Region 4) of 0.32 ppb (EPA 2008).

Home A Results

Home A, had different measured amounts of the three site-related chemicals of interest in its indoor air when compared to the measured amounts of chemicals in the other two homes. Home A had higher measured concentrations of acetone, benzene, toluene than the two other homes tested. Home A also had concentrations of chemicals that were higher than the outdoor ambient air sample collected at the time all three homes were tested. Acetone was detected at 170 parts per billion (ppb) in a sample that had to be diluted to get an accurate result. Benzene was detected at 3.8 ppb. Toluene was detected at 19 ppb.

Concentrations of acetone and toluene in Home A were within the acceptable range of health comparison values established by both ATSDR (ATSDR 2009) and EPA (EPA 2009).

The benzene measured in Home A was above the Cancer Risk Evaluation Guide (CREG) for a one in million risk of excess cancer used by ATSDR of 0.04 ppb. However, the measured benzene concentration is within the range of acceptable risk established by EPA of $1x10^{-6}$ to $1x10^{-4}$.

The cancer risk values established by ATSDR and EPA differ, with EPA using a range of concentrations for its determination of risk of excess cancer from benzene exposure. EPA's Inhalation Unit Risk values for benzene range from $7.8x10^{-6}$ $(\mu g/m^3)^{-1}$ to 2.2 $x10^{-6}$ $(\mu g/m^3)^{-1}$. This leads to health-based screening values ranging from 0.1 to 10 ppb, respectively. ATSDR's guidance value for a $1x10^{-6}$ excess cancer risk is 0.04 ppb. Both guidance values are valid estimates of risk.

A risk level of 1 in 1,000,000 excess cancers is typically chosen by risk assessors to evaluate excess cancer risk posed by chemical concentrations in private residences. The concentrations for this level of risk range from 0.04 ppb benzene (ATSDR) to 0.1 ppb benzene (EPA). The benzene concentration in Home A was higher than these established risk concentrations.

The benzene concentration of 3.8 ppb or 12.14 micrograms per cubic meter ($\mu g/m^3$) measured in the indoor air of Home A was multiplied by the two unit risk values established for benzene, $2.2x10^{-6}$ $(\mu g/m^3)^{-1}$ and $7.8x10^{-6}$ $(\mu g/m^3)^{-1}$ (ATSDR 2009). The range of risk, based on the measured concentration, was calculated to be $2.7x10^{-5}$ to $9.5x10^{-5}$. There is some additional risk associated with this exposure. However, the risk is considered to be low.

Home B Results

The measured concentrations of acetone, benzene, and toluene in Home B were slightly above the measured background at Daniels Drive. Acetone was measured at 26 ppb, benzene at 0.41 ppb, and toluene at 5.8 ppb. The values were compared to the ATSDR and EPA comparison values for indoor air. Concentrations of all three site-related chemicals in Home B were within the acceptable range of health comparison values established by both ATSDR (ATSDR 2010) and EPA (EPA 2009). There is no apparent health hazard from breathing indoor air in this home.

Home C Results

The measured concentrations of acetone, benzene, and toluene in Home C, like Home B, were slightly above the measured background at Daniels Drive. Acetone was measured at 30 ppb, benzene at 0.51 ppb, and toluene at 2.7 ppb. The values were compared to the ATSDR and EPA comparison values for indoor air. Concentrations of all three site-related chemicals in Home C were within the acceptable range of health comparison values established by both ATSDR (ATSDR 2010) and EPA (EPA 2009). There is no apparent health hazard from breathing indoor air in this home.

Other Considerations

As noted when conducting the product inventory while visiting Home A, various gasoline-powered lawn equipment and gasoline containers were stored in the unfinished basement / garage. The PID used in the home inventory measured VOC detections from 5 to 1,500 ppb in the vicinity of the equipment and gasoline containers. It was decided to proceed with the initial sampling to identify the potential for vapor intrusion into the living space of the home despite the presence of the equipment in the basement. Because of the differences in measured values of the chemicals in Home A compared to the other two homes, it is likely that this equipment had some bearing on the measured results. At this time, however, the extent is not known.

Based on the indoor air sampling results at Home A, EEP recommended to TDEC SRP that a follow-up indoor sampling be conducted. The follow-up sampling was recommended to determine the influence of the presence of the gasoline-powered lawn equipment and the gasoline containers had on the initial results. The follow-up sampling was to have been done after the lawn equipment and gasoline containers had been removed from the basement / garage. Samples of both the indoor air of the basement / garage and in the living space of the home were planned to be collected. The homeowners initially agreed to grant access for the additional sampling and to remove the lawn equipment and gasoline containers from the basement. Repeated attempts were made by TDEC to contact the homeowners to confirm a mutually agreeable date for the testing. The homeowners did not return the messages left by TDEC. The confirmation sampling did not occur. If future access is granted by the residents of Home A, TDEC stated they would consider resampling.

The 3 homes tested were thought to be representative of the construction types present on Daniels Drive. Two households were in the apparent underground chemical migration pathway, a worst-case scenario. The source has been eliminated as the deteriorated piping, impacted soil, and the above ground storage tank farm have been removed from the ELMCO facility. The impacted groundwater and acetone, benzene, and toluene migrating underground are being collected by a collection trench installed by ELMCO. The health risk from the site is less than in the past when it was first discovered or when the environmental sampling took place. This is because the source has been removed and the collection trench is working to collect site-related chemicals. In the future, the health risk should be similar to or likely less than it is now. This is because the chemicals will degrade in the soil and bedrock over time.

A mixture of the three main site chemicals were found in the indoor air of the 3 homes tested. Non-cancer health effects to those living in the homes should not increase based on the behavior of these three chemicals as a mixture. Acetone and toluene are not considered to cause cancer in humans. Therefore, breathing air inside homes that contains acetone, benzene, and toluene should not cause additive health effects to those breathing indoor air in the 3 homes.

Children's Health Considerations

Children could be at greater risk than adults from certain kinds of exposure to hazardous substances (ATSDR 1997, 1998). Children have lower body weights than adults. Although children's lungs are usually smaller than adults, children breathe a greater relative volume of air compared to adults. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus, adults need as much information as possible to make informed decisions regarding their children's health.

In preparation of this health document, the health of children was thoughtfully considered. Children breathe a higher volume of air than adults. The following discussion presents our consideration of how the chemicals measured in these homes might affect children.

Acetone was not measured in concentrations above health comparison values. The levels measured in the homes in this report were much too low to cause harmful effects. Therefore, acetone will not be discussed in this section.

Studies of children of mothers who abused toluene during pregnancy suggest that to exposure to very high levels of toluene may be toxic to the developing fetus. Children born to mothers who sniffed paint during their pregnancy in some cases had birth defects. This type of chemical abuse would be an exposure to much larger amounts of toluene than exposure from indoor air vapor intrusion.

Toluene and acetone can be metabolized by the same enzyme, Cyp2E1. The levels of this enzyme is increased by exposure to acetone, increasing the body's ability to eliminate any acetone or toluene. Cyp2E1 is present in children just a few hours after birth. Children have the same ability to metabolize toluene as do adults.

Long-term exposure to benzene can cause cancer of the blood-forming organs. This condition is called leukemia. Exposure to benzene has been associated with development of a particular type of leukemia called acute myeloid leukemia (AML). The U.S. Department of Health and Human Services has determined that benzene is a known human carcinogen (can cause cancer). Both the International Agency for Cancer Research and the EPA have determined that benzene is carcinogenic to humans. Children can be affected by benzene exposure in the same ways as adults. Benzene can pass from the mother's blood to a fetus. It is not known if children are more susceptible to benzene poisoning than adults.

Occupational epidemiologic studies suggest that, while inhalation exposures to 10,000 to 100,000 ppb of benzene are associated with leukemia, exposures to less than 1,000 ppb are not associated with leukemia or other significant changes in the blood.

The measured indoor air concentrations of acetone, benzene, and toluene in Homes B and C are basically the same as the outdoor ambient air sample and published background levels (ATSDR 1994 and 2000). The indoor air measurements of benzene in Home A are within EPA's acceptable risk range for cancer (EPA 1991). It is not known if the storage of gasoline powered lawn equipment and gasoline containers is affecting indoor air at the home. A sample was not collected from the home with the gasoline-powered lawn equipment removed from the basement.

Conclusions

EEP reached three important conclusions in this health consultation:

EEP concludes that the concentrations of the site-related chemicals, acetone, benzene, and toluene, measured in the indoor air of Home A on Daniels Drive, were greater than the outdoor background air sample collected in the back yard of Home B. Home A is located next to Home B. These levels detected are below levels that are considered harmful to adults or children living in the home.

Acetone, benzene, and toluene measurements in the indoor air of Home A are well below the levels established by both ATSDR and EPA that are not expected to harm the health of adults and children. The benzene concentration in Home A was slightly elevated. Toxicological studies of benzene indicate there is a range of risk for the chemical. The amount of benzene measured in the indoor air was within the risk range of one excess cancer in 10,000 to 100,000 people used by EPA. There is some added risk associated with some exposure to these chemicals. However, the risk is considered low. The higher benzene concentration in this home could be due to storing gasoline and gasoline-powered lawn equipment in the basement / garage.

EEP attempted to gather the best data possible. Based on the data collected there was a difference between the indoor air of Home A and the other two homes tested. TDH EEP and TDEC attempted to clarify the results with a second sampling of the home, this time with the gasoline containers and gasoline-powered lawn equipment removed from the basement / garage. However, access for a second sampling could not be negotiated by TDEC. TDEC communicated that the gasoline containers and gasoline powered lawn equipment should be removed from the basement. A benefit in doing this would be to decrease the amount of chemical vapors that could be present in the home from this equipment.

EEP concludes that the concentrations of the site-related chemicals, acetone, benzene, and toluene, measured in the indoor air of Home B on Daniels Drive were similar to concentrations measured in the outdoor background air sample collected in the backyard of Home B. These levels are below levels that are considered harmful to adults living in the home. There are no children living in this home.

All measurements of the acetone, benzene, and toluene in indoor air were similar to levels measured in the outside background air sample collected at this home. The amount of benzene measured in the indoor air was at the one excess cancer in 100,000 people risk level. There is some added risk associated with exposure to benzene at this amount. However, this added risk is considered to be low.

EEP concludes that the concentrations of the site-related chemicals, acetone, benzene, and toluene, measured in the indoor air of Home C on Daniels Drive were of similar concentration to the outdoor background air sample collected in the backyard of Home B. These levels are below the levels that are considered harmful to adults and children living in the home.

All measurements of the acetone, benzene, and toluene in indoor air were similar to concentrations measured in the outdoor background air sample collected in the backyard of Home B. The amount of benzene measured in the indoor air was at the one excess cancer in 100,000 people risk level. There is some added risk associated with some exposure to benzene at this amount. However, this added risk is considered to be low.

Recommendations

The focus of this health consultation was to evaluate the results of the indoor air sampling event conducted in January 2010 in homes downgradient from the ELMCO Site. The evaluation was done to identify if vapor intrusion from an underground chemical source was emitting VOCs into the indoor air breathed by children and adults who live in the homes tested. With that in mind, the following recommendations are believed to be appropriate based on EEP’s review of the indoor air sampling data.

- It is recommended that the residents of Home A remove gasoline containers and gasoline-powered lawn equipment from the unfinished basement / garage. A benefit in doing this would be to decrease the amount of chemical vapors that could be present in the home from this equipment.

- It is recommended that the TDEC, the TDH, and other appropriate parties continue to work together to see that public health continues to be protected during clean up of the ELMCO Site.

Public Health Action Plan

The public health action plan for the ELMCO Site contains a list of actions that have been or will be taken by EEP and other agencies. The purpose of the public health action plan is to ensure that this health consultation identifies public health hazards and offers a plan of action designed to mitigate and prevent harmful health effects that result from breathing, eating, drinking, or touching hazardous substances in the environment. Included is a commitment on the part of EEP to follow up on this plan to ensure that it is implemented.

Public health actions that have been taken by TDH's EEP include:

- Review of ambient air data collected by ELMCO with oversight from TDEC.
- Participation in a public meeting with stakeholders in Franklin, Tennessee held on March 22, 2007.
- Preparation of a technical fact sheet and information used to make health decisions for handout at the public meeting held on March 22, 2007.
- Publishing a health consultation that evaluated ambient air concentrations of acetone and toluene on July 23, 2009.
- Publishing a technical assist that evaluated soil-gas concentrations of acetone, benzene, and toluene on July 2010.
- Preparation of this health consultation.

Public health actions that will be taken include:

- TDH EEP and TDEC will provide copies of this health consultation to the residents of the 3 homes tested as part of this investigation.
- TDH EEP will provide copies of this health consultation to state, federal, and local government, environmental groups, community groups, other residents of the Daniels Drive cul-de-sac, and others interested in the ELMCO Site.
- TDH EEP will maintain dialogue with ATSDR, TDEC, EPA, and other interested stakeholders to safeguard public health.
- TDH EEP will be available to review newly collected or additional environmental data, and provide interpretation of the data, as requested by TDEC.

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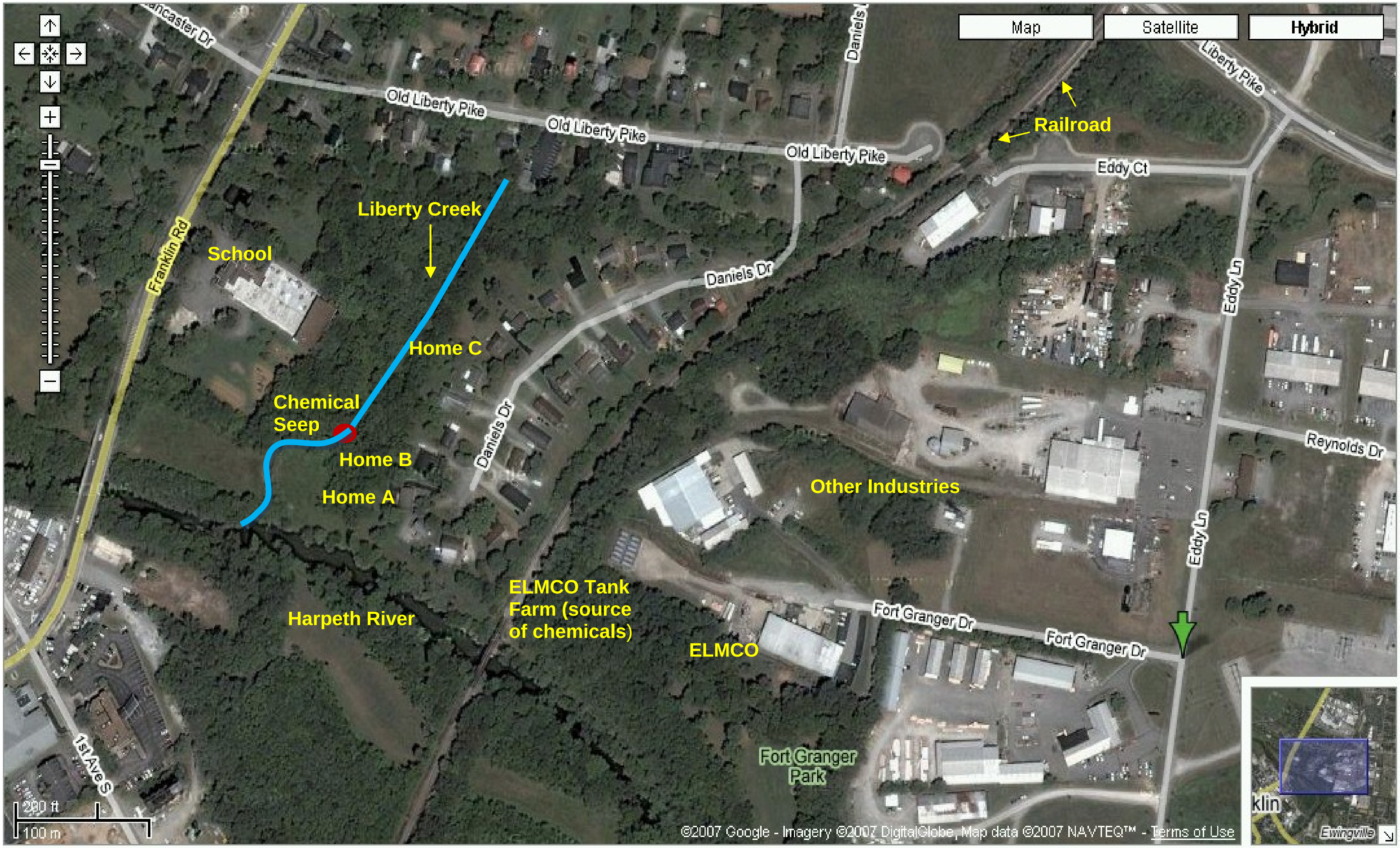
Figure 1: Locations of School, Homes Tested on Daniels Drive, Liberty Creek, and ELMCO, Franklin, Williamson County, Tennessee.



Certification

This Public Health Consultation: *Residential Indoor Air Investigation, Egyptian Lacquer Manufacturing Company, Inc., Franklin, Williamson County, Tennessee*, was prepared by the Tennessee Department of Health Environmental Epidemiology under a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It was prepared in accordance with the approved methodology and procedures that existed at the time the health consultation was begun.

Technical Project Officer, CAT, CAPEB, DHAC, ATSDR

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

for AY

Team Leader, CAT, CAPEB, DHAC, ATSDR

Appendix A

Homeowner Information Sheet

What is soil vapor intrusion?

The phrase "soil vapor intrusion" refers to the process by which volatile chemicals move from a subsurface source into the indoor air of overlying buildings.

Soil vapor, or soil gas, is the air found in the pore spaces between soil particles. Because of a difference in pressure, soil vapor enters buildings through cracks in slabs or basement floors and walls, and through openings around sump pumps or where pipes and electrical wires go through the foundation. Heating, ventilation or air-conditioning systems may create a negative pressure that can draw soil vapor into the building. This intrusion is similar to how radon gas seeps into buildings.

Why is the sampling being done?

Chemicals that readily evaporate are called "volatile chemicals." Volatile chemicals include volatile organic compounds (VOCs). Subsurface sources of volatile chemicals may include contaminated soil and groundwater, or buried wastes. If soil vapor is contaminated, and enters a building as described above, indoor air quality may be affected. Indoor air sampling being done in your home is to identify if this has happened.

What should I expect if indoor air samples are collected in my home?

Indoor air samples are generally collected from the lowest-level space in a building, typically a basement, during the heating season. Indoor air samples may also be collected from the first floor of living space. Indoor air is believed to represent the greatest exposure potential with respect to soil vapor intrusion. An indoor air quality questionnaire and building inventory will be completed. The questionnaire includes a summary of the building's construction characteristics; the building's heating, ventilation and air-conditioning system operations; and potential indoor and outdoor sources of volatile chemicals. The building inventory describes products present in the building that might contain volatile chemicals. In addition, we take monitoring readings from a real-time organic vapor meter (also known as a photoionization detector or PID). The PID is an instrument that detects many VOCs in the air. When indoor air samples are collected, the PID is used to help determine whether products containing VOCs might be contributing to levels that are detected in the indoor air.

We will be doing the sampling using clean Summa canisters. These are stainless steel sample collection cylinders that are under a vacuum. They take in air which is in your home over the designated sampling period. The sampling will be done over a 24-hour time period. A flow controller that is placed on top of the Summa canister controls the flow of air into the canister. It is important during the sampling that opening doors and windows be kept to a minimum. You should also not smoke inside, use craft supplies such as hobby paints or glues, use cleaning products, or vacuum your home. It is fine to keep the heat on in your home.

Once the 24-hour sampling period has ended, the Summa canister will be retrieved and shipped to an environmental laboratory where it is tested. The compounds we are looking for in this testing are acetone, benzene, and toluene. These are the chemicals that were identified to be present in the groundwater that migrates to Liberty Creek.

Appendix B

General Sampling Protocol

General Protocol for Monitoring of Air with Summa Canisters

Sampling Equipment

The most common sampling device used to collect indoor vapor samples is a 6-liter Summa canister. The Summa canister is under vacuum and needs an accompanying flow controller calibrated to the amount of time the test is to be performed (e.g. 8 hour or 12 hours or longer flow controller calibration). The Summa canisters and each individual flow controller should be certified to the reporting limits is suggested. This certification process is how the laboratory ensures cleanliness of the media when dealing with low reporting limits. It is recommended that the Summa canisters be of stainless steel construction.

Preferred Sampling Equipment Location

Two schools of thought are expressed here. One is that sampling equipment (Summa canisters) should be placed on the lowest occupied space of the dwelling of interest, at a height of approximately 3 feet above the floor to represent the breathing height at which occupants are normally seated. Another is that the height of the breathing zone of occupants should be sampled. This height can vary from approximately 3 feet to five feet, representing a normal standing breathing zone. However, the most common height at which samples are collected is approximately 3 feet above the floor surface.

Ideally, the sampling location should also be centrally located in a high-use area. For a conservative approach to the sampling, if the dwelling is slab on grade, collect the sample from the lowest occupied space at a height of 3 to 5 feet. If the dwelling has a basement, samples should be collected from the basement and lowest main floor, as a conservative approach, at a 3 to 5 foot height. For large surveys (multiple locations on the same property) and also for use as a background sample, an ambient air sample should also be collected outside, upwind, and in a relatively protected area from the location(s) of interest.

Summa Canister/Flow Controller General Sampling Procedures

The procedures below are recommended to be followed when conducting the sampling.

1. **The flow controller will be calibrated at the laboratory to the sampler's specifications prior to shipping. This calibration valve is sealed with a protective locked cap and** should not be altered in the field.

2. If sampling outside, keep in mind that precipitation may clog the flow controller filter and could cause a reduction or stoppage of flow. Sampling in this type of weather should be avoided, if possible, or some type of U-shaped sampling tube or temporary shelter provided. Usually, problems do not crop up during precipitation events.

3. First remove the brass cap on the Summa canister (typically 9/16-inch size) and the quarter-inch plug (if included) on the flow controller. Do not open the Summa canister.

4. Connect the flow controller to the canister.

5. Record starting date and time on the sampling label and chain of custody.

6. Open sampling valve by turning knob counter clockwise. Turn until knob moves easily, usually 1 and one-half turns. The vacuum gauge should read near 30" of mercury (Hg - vacuum) when opened. Record the initial pressure on the sampling

label and chain of custody. If the initial pressure reading is less than 25" of mercury, close and set aside the initial Summa canister and use another Summa canister for the sampling (indoor air and ambient air sample flow rates should be less than 0.2 liters per minute).

7. When sampling period has ended to designated specification, close the knob tightly. It is not necessary to "crank down" on the valve knob-this can cause permanent damage.

8. Remove the flow controller and replace the brass cap on sampling port.

9. Record sampling stop date, time, and final pressure on label and chain of custody. The final pressure should be near 5" Hg at the end of the sampling period. If it less the sample will be biased to earlier in the sampling time period. If the reading is close to 0" Hg at the end of the test period, there is not sufficient pressure to "drive" the flow controller. The sampler can't be sure the desired sampling interval was achieved before the canister arrived at ambient conditions. The actual sampling interval is uncertain but the canister still contains a sample from the site.

10. Place flow controller in the protective packing it was shipped in to provide maximum protection during shipment to lab.

General Notes:

- Summa canisters should be checked regularly during the sample collection period to make sure a substantial drop in pressure does not occur. If a pressure drop occurred, then there was a leak in the sampling system and another canister must be deployed at the location to obtain an accurate sample.

- Observations related to weather conditions, work activities by others, location of other chemicals or cleaning solutions, etc. in the vicinity of the monitoring, and other relevant items should be documented as they are helpful in the overall analysis of the data. A photoionization detector (PID) capable of reading in parts per billion (ppb) should be used to evaluate the chemicals or cleaning solutions. A chemical inventory should be conducted using visual observations and the PID prior to sampling.

- Photographs of sampling locations and any items, chemicals, or activities that could have influenced the sampling event should also be taken.

- Samples must be submitted with chain-of-custody documentation to a Tennessee-accredited analytical laboratory for analysis.

Sample Collection Duration

Depending on the proposed use of the former drycleaner, sample collection during can be either an 8-hour duration to simulate a normal workday exposure, or a 24-hour duration to simulate a residential exposure. Samples should be collected anytime during the standard workday period of approximately 7 a.m. to 6 p.m. for the 8-hour sampling period. The 24-hour sample collection duration is recommended for residences to obtain normal living exposure concentrations for the inhabitants. Other time spans can be accommodated for certain exposures such as in for retail or commercial setting (e.g. 12 hours). If you are uncertain of the sampling period duration, contact the analytical laboratory, as they may be able to assist you in determining which may be best for your specific site.

Sample Collection Characteristics

A pre-sampling inspection should be performed in all spaces in which a sample is scheduled to be collected. Try to identify and minimize conditions that may interfere with the proposed testing. The inspection should evaluate the type of structure, floor layout, air flows, and physical conditions of the building(s) being sampled. This information along with information on sources of potential indoor air contamination from other substances should be compiled. Items to be noted include the following:

- construction characteristics of the building including foundation cracks and utility penetrations,
- presence of attached garage or work area,
- recent renovations or maintenance to the building (e.g., fresh paint, new carpet, etc.),
- mechanical equipment that can effect pressure gradients (e.g., heating systems, exhaust fans, air conditioners, etc.),
- use or storage of petroleum products (fuel containers, gasoline-operated equipment),
- recent use of cleaners or products containing volatile chemicals, and
- drop off or pickup for drycleaned clothing.

Building construction characteristics of the spaces indoor air is to be sampled should be noted. In addition to cracks in the foundation or floor and utility penetrations, locations of drains or storm sewers (if beneath the floor) should also be noted.

Any buildings attached, or in very close proximity, to the location of the building in which indoor air sampling is scheduled should be noted. This includes enclosed attached storage areas or shed-like structures.

When collecting an indoor air sample within a residence, items used by residents include various hair care products, bathroom and other cleaning products, and vapors from stored items, new furniture items, or refinished furniture contain compounds whose vapors can be detected. Because of this, an inventory of items stored or used in the general location of the sample collection area should be taken. Ingredients of the products should also be recorded. The specific ingredients or compounds making up each product can be typically found on the product’s label. Photographs of items are extremely helpful. If compounds contained in the products in the area of sampling are indentified in the indoor air analysis, and you have performed a product inventory or taken a sufficient number of photographs, you likely have a starting point to investigate the occurrence of the compounds detected. To minimize or prevent detection of some vapors, the resident can be contacted in advance and asked not to use these products or remove them from the area near the sampling location.

The ventilation system for the spaces sampled should be in normal operating capacity and condition during the sampling period. It is the goal of the sampling to simulate normal representative conditions and not to induce any additional variations into the sampling environment. Any heating or air conditioning system operation should be noted. Sometimes there is no control of systems if the system is shared with another tenant.

Sample Holding Time

It is advisable to ship your summa canisters back to the laboratory shortly after sampling. There is no need to “preserve” the sample containers other than making sure the brass cap is sealing the inlet. They are shipped back to the laboratory in the boxes they arrived in, and the flow controllers are returned. Analytical laboratories typically report that a hold time to analysis is up to 30 days.

Detection Limits

Ideally, one should obtain the lowest possible detection limit for each compound when analyzed by the contract laboratory. The first sampling event will identify if the lowest detection limits can be achieved. Typically there can be interferences from degassing of infrastructure (plywood, carpets, newly painted walls, household cleaner storage, flooring) or storage of chemicals in or near the spaces tested. Currently, the State of Tennessee does not have established indoor air concentration regulations for any compound. The State typically defaults to comparison values established by the Federal Agency for Toxic Substances and Disease Registry (ATSDR). In addition, indoor air guideline values established by EPA are also reviewed. For some compounds, these established concentration values are low. A detection limit of a fraction of a part per billion (ppb) or less than 1 microgram per cubic meter ($\mu g/m^3$) is usually sufficient for nearly all compounds. Some analytical laboratories do not have this capability so the analytical laboratory should be consulted before contracting with them.

EPA OSWER Vapor Intrusion Guidance

EPA issued the draft RCRA Environmental Indicator Supplemental Guidance for Evaluating the Vapor Intrusion into Indoor Air Pathway. EPA issued this draft guidance to provide current technical and policy recommendations on determining if the vapor intrusion pathway poses an unacceptable risk to human health at cleanup sites. This guidance is not intended to provide recommendations for delineating extent of risk or eliminating risk.

The guidance is suggested for use at the Resource Conservation and Recovery Act (RCRA) Corrective Action sites, National Priorities List and Superfund Alternative sites and Brownfield sites, but is not recommended for use at Subtitle I Underground Storage Tank sites at this time.

EPA recommends that program implementers consider the use of the draft vapor intrusion guidance as a screening approach in implementing the RCRA and CERCLA programs. Implementers should remember, of course, that this document serves as guidance only and should not be construed in any fashion as mandatory.

As part of the draft EPA OSWER vapor intrusion guidance, chemicals that may be found at hazardous waste sites are listed and identified as whether, in EPA’s judgment, they are sufficiently toxic and volatile to result in a potentially unacceptable indoor inhalation risk. It also provides a column for checking off the chemicals found or reasonably suspected to be present in the subsurface at a site. Under this approach, a chemical is considered sufficiently toxic if the vapor concentration of the pure component poses an incremental lifetime cancer risk greater than 10^{-6} or results in a non-cancer hazard index greater than one. A chemical is considered sufficiently volatile if it’s Henry’s Law Constant is 1×10^{-5} atm-m^3/mol or greater (EPA 1991). In EPA’s judgment, if a chemical does not meet both of these criteria, it does not need to be further considered as part of the evaluation.

Also included in the draft vapor intrusion guidance is a table that provides generic soil gas and groundwater screening concentrations corresponding to risk-based concentrations for indoor air in residential settings calculated using the methodology. Blank columns are included to allow the user to enter measured or reasonably estimated concentrations specific to a site. The target soil gas and groundwater concentrations are calculated using generic vapor intrusion attenuation factors.

EPA's vapor intrusion guidance also provides soil gas and groundwater screening concentrations for a select set of attenuation factors. Guidance for selecting the appropriate attenuation factor to use is given. As with other tables with in the guidance, the target soil gas and groundwater concentrations are calculated and correspond to risk-based concentrations for indoor air in residential settings. **The target concentrations in the guidance are screening levels. They are not intended to be used as clean-up levels nor are they intended to supersede existing criteria of the lead regulatory authority.** The lead regulatory authority for a site may determine that criteria other than those provided herein are appropriate for the specific site or area. Thus, EPA recommends that the user's initial first step should involve consultation with their lead regulatory authority to identify the most appropriate criteria to use.

EPA Regional Screening Levels (RSLs)

The EPA RSLs are risk-based tools for evaluating and cleaning up contaminated sites. They are being used to streamline and standardize all stages of the risk decision-making process and were originally published in May 2008 by EPA in conjunction with the Oak Ridge National Laboratory (ORNL). More recent updates are posted on EPA's RSL website.

The RSL table combines current human health toxicity values with standard exposure factors to estimate contaminant concentrations in environmental media (soil, air, and water) that are considered by EPA to be health protective of human exposures (including sensitive groups), **over a lifetime**. Chemical **concentrations above these levels would not automatically designate a site as "dirty" or trigger a response action.** However, exceeding a SV suggests that further evaluation of the potential risks that may be posed by site contaminants is appropriate. Further evaluation may include additional sampling, consideration of ambient levels in the environment, or a reassessment of the assumptions contained in these screening-level estimates (e.g. appropriateness of route-to-route extrapolations, appropriateness of using chronic toxicity values to evaluate childhood exposures, appropriateness of generic exposure factors for a specific site etc.). The risk-based concentrations presented in the RSL table may be used as screening goals or initial cleanup goals if applicable. Generally a screening level is intended to provide health protection without knowledge of the specific exposure conditions at a site. RSLs may also be used as initial cleanup goals when the exposure assumptions based on site-specific data match up with the default exposure assumptions in the RSL table. When considering RSLs as cleanup goals, it is EPA's preference to assume maximum beneficial use of a property (that is, residential use) unless a non-residential number (for example, industrial soil RSL) can be justified.

Before applying RSLs at a particular site, the table user should consider whether the exposure pathways and exposure scenarios at the site are fully accounted for in the RSL calculations. The EPA RSL concentrations are based on direct contact pathways for which generally accepted methods, models, and assumptions have been developed (i.e. ingestion, dermal contact, and inhalation) for specific land-use conditions and do not consider impact to groundwater or ecological receptors.

With some exceptions, **RSLs are chemical concentrations that correspond to fixed levels of risk** (i.e. either a one-in-one million [10^{-6}] cancer risk or a non-carcinogenic hazard quotient of 1) in soil, air, or water. In most cases, where a substance causes cancer and non-cancer (systemic) effects, the 10^{-6} cancer risk will result in a more stringent criteria and consequently this value is presented in the printed copy of the table. RSL concentrations that equate to a 10^{-6} cancer risk are indicated by "ca". RSL concentrations that equate to a hazard quotient of 1 for non-carcinogenic concerns are indicated by "nc".

If the risk-based concentrations are to be used for site screening, it is recommended that both cancer and non-cancer-based RSLs be used.

ATSDR Comparison Values (CVs)

The Agency for Toxic Substances and Disease Registry (ATSDR) also has risk-based tools for assessing the impact of waste sites on human health. Indoor air results can be screened against the ATSDR Environmental Media Evaluation Guide (EMEG) and Cancer Risk Evaluation Guide (CREG) comparison values. These values are available at the ATSDR website: http://www.atsdr.cdc.gov/mrls/index.html.

EMEGs are derived from Minimal Risk Levels (MRLs) for hazardous substances using standard assumptions for breathing rates, body weights, and generalized exposure periods. These standard assumptions can be modified to account for the differences between adults and children.

Non-Cancer Screening Values

EMEGs are derived from ATSDR's MRLs and are derived for chronic exposure (365 days or longer), intermediate exposure (15 days to 364 days) and acute exposure (1 to 14 days). The TDH EEP is most concerned with concentrations as compared to the chronic exposure EMEGs. Indoor air EMEGs are reported in parts per billion (ppb) for vapors at standard temperatures and pressures and as micrograms per cubic meter ($\mu g/m^3$) for solids or dusts at standard temperatures and pressures. We can use results reported in either ppb or $\mu g/m^3$. We prefer results to be reported in ppb but we can work with either.

EMEGs are derived for a continuous 24-hours-a-day exposure to children and adults. MRLs are calculated for all segments of the population.

Cancer Screening Values

For screening purposes, ATSDR uses EPA cancer slope factors to derive CREGs based on a 1×10^{-6} excess risk of cancer. Because of the conservative assumptions built into the CREG calculations, the CREG value is generally the lowest of comparison values. CREGs are still a screening tool and do not predict adverse health effects.

Appendix C

Building Inventory Forms

OSR – 3

NEW YORK STATE DEPARTMENT OF HEALTH
INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY
CENTER FOR ENVIRONMENTAL HEALTH

This form must be completed for each residence involved in indoor air testing.

Preparer's Name J. George Date/Time Prepared 1-19-10 9:05

Preparer's Affiliation TDH CEDS EEP Phone No. 741-7247

Purpose of Investigation Identify if vapor intrusion is issue

1. OCCUPANT:

Interviewed: [✓ **Y**] / **N**

Last Name: ______ First Name: ______

Address: Home A Daniels Drive Franklin TN

County: Williamson

Home Phone: ______ Office Phone: ______

Number of Occupants/persons at this location 4 Age of Occupants 30, 30, 10, 3

2. OWNER OR LANDLORD: (Check if same as occupant X)

Interviewed: Y / N

Last Name: ______ First Name: ______

Address: ______

County: ______

Home Phone: ______ Office Phone: ______

3. BUILDING CHARACTERISTICS

Canister# 6654
cleaning lot# 8487
Flow Cont # K405
initial press - 30 psi

Type of Building: (Circle appropriate response)

[✓ Residential] School Commercial/Multi-use
Industrial Church Other: ______

no PID reading when picked up canister

If the property is residential, type? (Circle appropriate response)

[✓ Ranch]
[✓ Raised Ranch]
Cape Cod
Duplex
Modular
2-Family
Split Level
Contemporary
Apartment House
Log Home
3-Family
Colonial
Mobile Home
Townhouses/Condos
Other:______________

If multiple units, how many? ________

If the property is commercial, type?

Business Type(s) ____________________________________

Does it include residences (i.e., multi-use)? Y / N If yes, how many? ______

Other characteristics:

Number of floors 1+ unfinished basement Building age built 1964-1965 - 45 yrs

Is the building insulated? [✓ Y] / N How air tight? Tight / [✓ Average] / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow between floors

vents in floor

Airflow near source

Outdoor air infiltration

no drafts felt

Infiltration into air ducts

5. BASEMENT AND CONSTRUCTION CHARACTERISTICS (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	[✓ brick]
b. Basement type:	[✓ full]	crawlspace	slab	other ________
c. Basement floor:	[✓ concrete]	dirt	stone	other ________
d. Basement floor:	[✓ uncovered]	covered	covered with ________	
e. Concrete floor:	[✓ unsealed]	sealed	sealed with ________	
f. Foundation walls:	poured	[✓ block]	stone	other ________
g. Foundation walls:	unsealed	[✓ sealed] — not all way around	sealed with unknown	
h. The basement is:	wet	[✓ damp] — after rain	dry	moldy
i. The basement is:	finished	[✓ unfinished]	partially finished	
j. Sump present?	Y / [✓ N]			
k. Water in sump?	Y / N / [✓ not applicable]			

Basement/Lowest level depth below grade: ~8 (feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

former drain from kitchen sink

6. HEATING, VENTING and AIR CONDITIONING (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

Hot air circulation
Space Heaters
Electric baseboard
[✓ Heat pump]
Stream radiation
Wood stove
Hot water baseboard
Radiant floor
Outdoor wood boiler
Other ____________

The primary type of fuel used is:

Natural Gas
[✓ Electric]
Wood
Fuel Oil
Propane
Coal
Kerosene
Solar

Domestic hot water tank fueled by: electric

Boiler/furnace located in:	Basement	Outdoors	Main Floor	Other heater located outside
Air conditioning:	[✓ Central Air]	Window units	Open Windows	None

air conditioner in basement

Are there air distribution ducts present? [✓ Y] / N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

good condition

7. OCCUPANCY

Is basement/lowest level occupied? Full-time Occasionally Seldom [✓ Almost Never]

Level **General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)**

Basement storage

1st Floor all living kitchen familyroom bedrooms

2nd Floor

3rd Floor

4th Floor

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Y / [✓ N]

b. Does the garage have a separate heating unit? Y / [✓ N] / NA

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, atv, car) [✓ Y] / N / NA lawn mower weedeater
Please specify gas cans

d. Has the building ever had a fire? Y / [✓ N] When?

e. Is a kerosene or unvented gas space heater present? Y / [✓ N] Where?

f. Is there a workshop or hobby/craft area? Y [✓ N] Where & Type?

g. Is there smoking in the building? Y / [✓ N] How frequently?

h. Have cleaning products been used recently? [✓ Y] / N When & Type? clorox & lysol wipes

i. Have cosmetic products been used recently? [✓ Y] N When & Type?

j. Has painting/staining been done in the last 6 months? [✓ Y] / N Where & When? daughters room 2 wks ago

k. Is there new carpet, drapes or other textiles? Y / [✓ N] Where & When? ______________

l. Have air fresheners been used recently? [✓ Y] / N When & Type? candle

m. Is there a kitchen exhaust fan? [✓ Y] / N If yes, where vented? hood

n. Is there a bathroom exhaust fan? Y / [✓ N] If yes, where vented? ___________

o. Is there a clothes dryer? [✓ Y] / N If yes, is it vented outside? [✓ Y] / N

p. Has there been a pesticide application? [✓ Y] / N When & Type? 2 months ago - Terminex

Are there odors in the building? Y / [✓ N]
If yes, please describe: ____

Do any of the building occupants use solvents at work? Y / [✓ N]
(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? ______________________________________

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, use dry-cleaning regularly (weekly)
Yes, use dry-cleaning infrequently (monthly or less)
Yes, work at a dry-cleaning service
[✓ No]
Unknown

Is there a radon mitigation system for the building/structure? Y / [✓ N] Date of Installation: ___________
Is the system active or passive? Active/Passive

9. WATER AND SEWAGE

Water Supply: [✓ Public Water] Drilled Well Driven Well Dug Well Other: _______

Sewage Disposal: [✓ Public Sewer] Septic Tank Leach Field Dry Well Other: _______

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: N/A

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

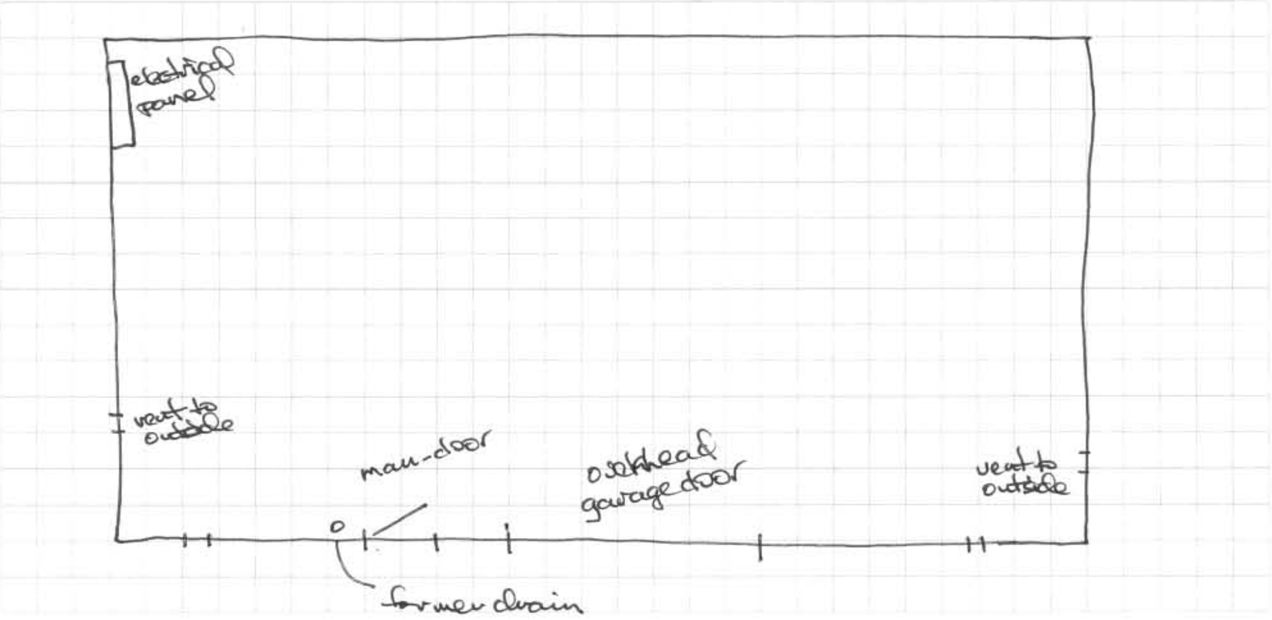
c. Responsibility for costs associated with reimbursement explained? Y / N

d. Relocation package provided and explained to residents? Y / N

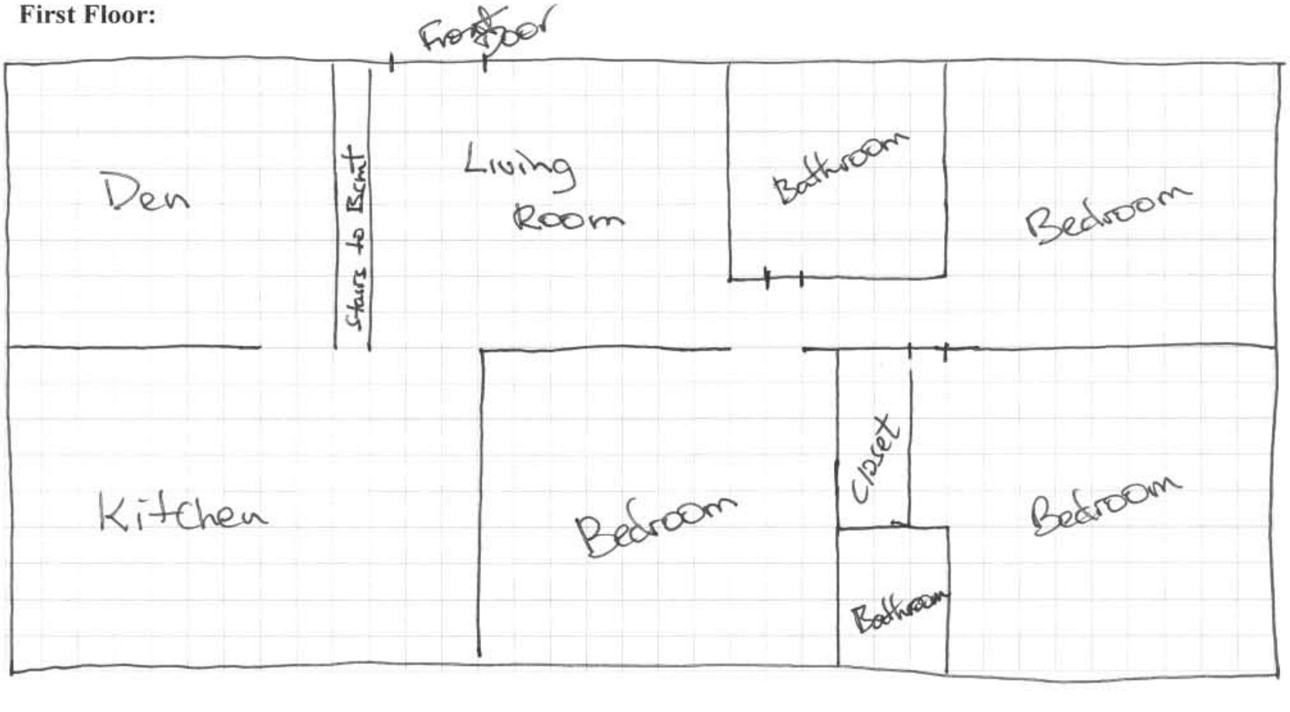
11. FLOOR PLANS

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement:



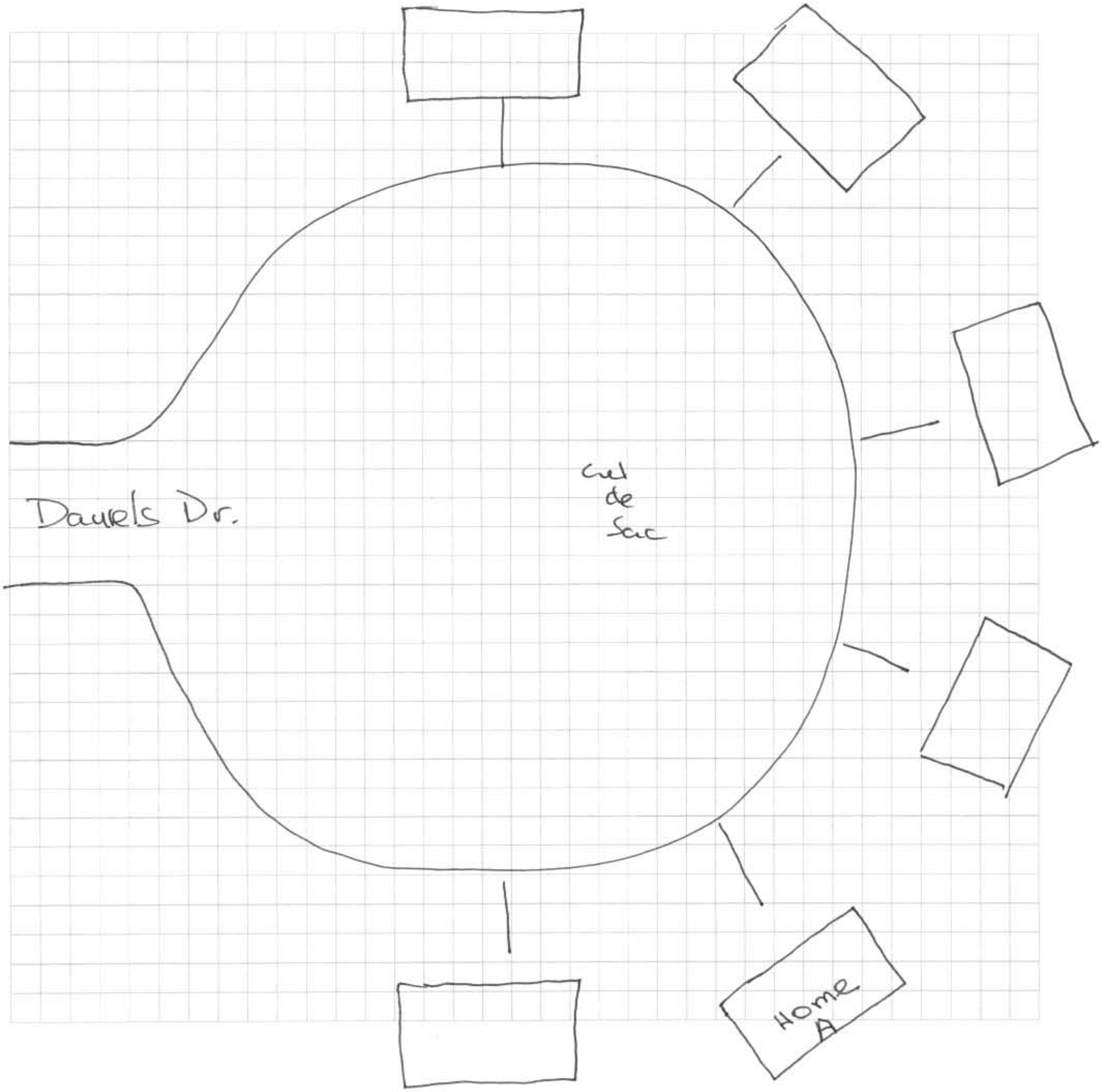
First Floor:



12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.



13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: Rae ppb Rae

List specific products found in the residence that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Photo** Y / N
Kitchen	WD-40	8oz	fair-D	petroleum distillate	0	Y
	Tile Grout Cleaner	4.3	good-U	Borax	0	Y
	carpet cleaner	16oz	good-U		0	Y
	garbage disp. cleaner	16oz	good-U		0	Y
	Easy Off Oven Cleaner	16oz	poor-D		0	Y
	Clorox toilet bowl cleaner	16oz	good-U		0	Y
	Windex	16oz	good-U		0	Y
	Mildew Remover	16oz	good-U		0	Y
	HiTraffic Carpet Cleaner	24oz	good-U		0	Y
Basement	weed eater	NW side			5	Y
	lawnmower #1	NW side			51	Y
	press. washer	NW side			5	Y
	2 gas cans	1 NW side 1 by Yard Man mower			50	Y
	paint cans	center			5	Y
	Yard Man Lawn Mower	Center - ~~NW side~~			1500	Y

* Describe the condition of the product containers as **Unopened (UO), Used (U),** or **Deteriorated (D)**
** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

OSR – 3

NEW YORK STATE DEPARTMENT OF HEALTH
INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY
CENTER FOR ENVIRONMENTAL HEALTH

This form must be completed for each residence involved in indoor air testing.

Preparer's Name J. George Date/Time Prepared 1-19-10 955

Preparer's Affiliation TDH CEDS EEP Phone No. 615-741-7247

Purpose of Investigation Identify if vapor intrusion is an issue

1. OCCUPANT:

Interviewed: [✓ Y] / N

Last Name: First Name:

Address: Home B Daniels Drive Franklin TN

County: Williamson

Home Phone: Office Phone:

Number of Occupants/persons at this location 4 + dog Age of Occupants 79, 52, 42, 32

2. OWNER OR LANDLORD: (Check if same as occupant X)

Interviewed: Y / N

Last Name: First Name:

Address:

County:

Home Phone: Office Phone:

3. BUILDING CHARACTERISTICS

Basement occupied
Canister # 6377
Flow Cont # K223
Cleaning lot # 8487
Initial press -29.5

Outside canister # 11339
Flow Cont # K331
Beginning press -29.6

Type of Building: (Circle appropriate response)

[✓ Residential] School Commercial/Multi-use
Industrial Church Other:

If the property is residential, type? (Circle appropriate response)

[✓ Ranch]
Raised Ranch
Cape Cod
Duplex
Modular
2-Family
Split Level
Contemporary
Apartment House
Log Home
3-Family
Colonial
Mobile Home
Townhouses/Condos
Other:______________

If multiple units, how many? ________

If the property is commercial, type?

Business Type(s) ___________________________________

Does it include residences (i.e., multi-use)? Y / N If yes, how many? ______

Other characteristics:

Number of floors 2

Building age 43 yrs old

Is the building insulated? [✓ Y] / N

How air tight? Tight / [✓ Average] / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow between floors

window air unit in basement
space heater in basement

Airflow near source

Outdoor air infiltration

possibly around doors

Infiltration into air ducts

5. BASEMENT AND CONSTRUCTION CHARACTERISTICS (Circle all that apply)

a. Above grade construction: wood frame concrete stone [✓ brick]

b. Basement type: full [✓ 3/4] crawlspace slab other ________

c. Basement floor: [✓ concrete] [✓ dirt] in remainder stone other Limestone bedrock outcrops also

d. Basement floor: uncovered [✓ covered] covered with paint/sealent

e. Concrete floor: unsealed [✓ sealed] sealed with ________________

f. Foundation walls: poured [✓ block] stone other ________

g. Foundation walls: unsealed [✓ sealed] sealed with ________________

h. The basement is: wet damp [✓ dry] moldy

i. The basement is: finished unfinished [✓ partially finished]

j. Sump present? Y / [✓ N]

k. Water in sump? Y / N / [✓ not applicable]

Basement/Lowest level depth below grade: 10 (feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

drain in finished section of basement

Crawl space in unfinished 1/4 of basement - S side of home

6. HEATING, VENTING and AIR CONDITIONING (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

[✓ Hot air circulation] Heat pump Hot water baseboard

[✓ Space Heaters] Stream radiation Radiant floor

Electric baseboard Wood stove Outdoor wood boiler Other ________

upstairs is elect heat
downstairs - elect space heaters

The primary type of fuel used is:

Natural Gas Fuel Oil Kerosene

[✓ Electric] Propane Solar

Wood Coal

Domestic hot water tank fueled by: electric

Boiler/furnace located in: [✓ Basement] Outdoors Main Floor Other__________

Air conditioning: [✓ Central Air] Window units Open Windows None

Are there air distribution ducts present? [✓ Y] / N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

good condition

7. OCCUPANCY

Is basement/lowest level occupied? Full-time Occasionally Seldom Almost Never

Level	**General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)**
Basement	living in finished section / storage in unfinished
1st Floor	living family room kitchen bedrooms laundry
2nd Floor	
3rd Floor	
4th Floor	

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Y / [✓ N]

b. Does the garage have a separate heating unit? Y / [✓ N] / NA

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, atv, car) Y / [✓ N] / NA
Please specify________________

d. Has the building ever had a fire? Y / [✓ N] When?________________

e. Is a kerosene or unvented gas space heater present? Y / [✓ N] Where?________________

f. Is there a workshop or hobby/craft area? [✓ Y] / N Where & Type?________________

g. Is there smoking in the building? [✓ Y] / N How frequently? each day - basement

h. Have cleaning products been used recently? [✓ Y] / N When & Type? furniture polish

i. Have cosmetic products been used recently? Y / [✓ N] When & Type?________________

j. Has painting/staining been done in the last 6 months? Y [✓ N] Where & When? ______________

k. Is there new carpet, drapes or other textiles? Y [✓ N] Where & When? ______________

l. Have air fresheners been used recently? [✓ Y] N When & Type? candles

m. Is there a kitchen exhaust fan? Y [✓ N] If yes, where vented? ___________

n. Is there a bathroom exhaust fan? Y [✓ N] If yes, where vented? ___________

o. Is there a clothes dryer? Y [✓ N] If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y [✓ N] When & Type? ________________

Are there odors in the building? [✓ Y] N
If yes, please describe: There were before ELMCO began remediation activities

Do any of the building occupants use solvents at work? Y [✓ N]
(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? ____

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

- Yes, use dry-cleaning regularly (weekly)
- Yes, use dry-cleaning infrequently (monthly or less)
- Yes, work at a dry-cleaning service
- No
- [✓ Unknown]

Is there a radon mitigation system for the building/structure? Y [✓ N] Date of Installation: ___________
Is the system active or passive? Active/Passive

9. WATER AND SEWAGE

Water Supply:	[✓ Public Water]	Drilled Well	Driven Well	Dug Well	Other: _______
Sewage Disposal:	[✓ Public Sewer]	Septic Tank	Leach Field	Dry Well	Other: _______

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: N/A

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

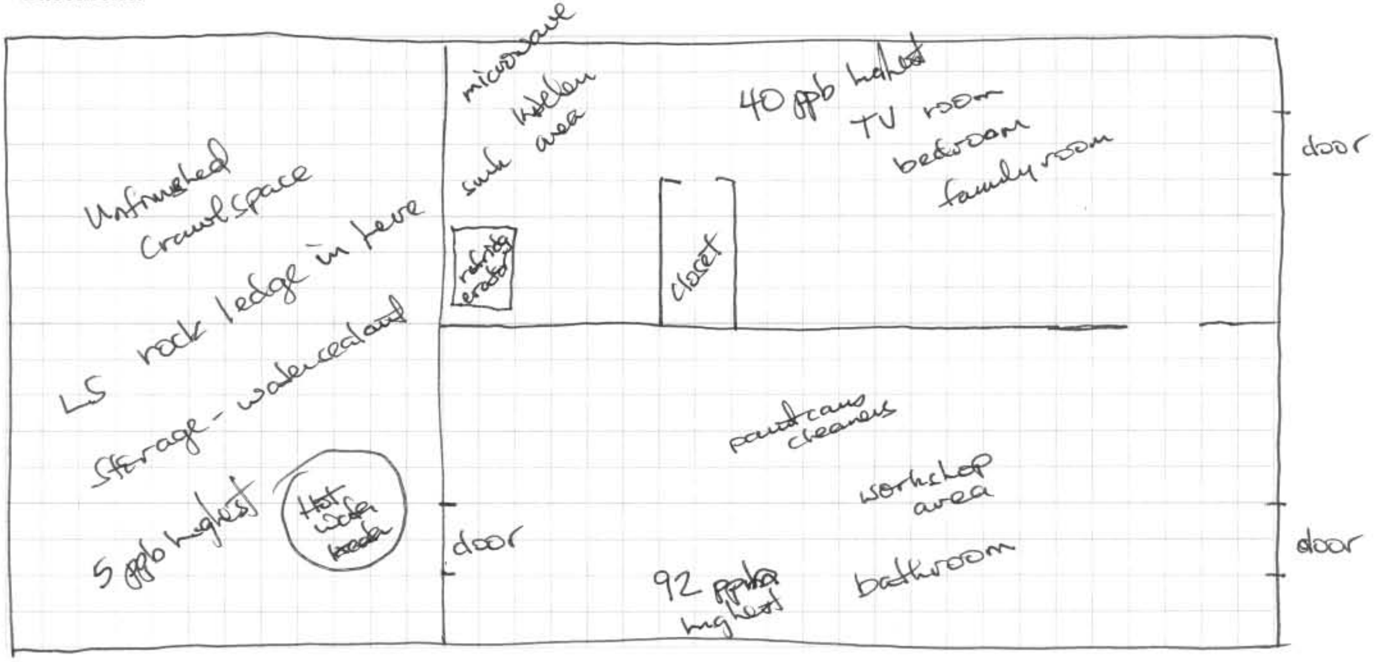
c. Responsibility for costs associated with reimbursement explained? Y / N

d. Relocation package provided and explained to residents? Y / N

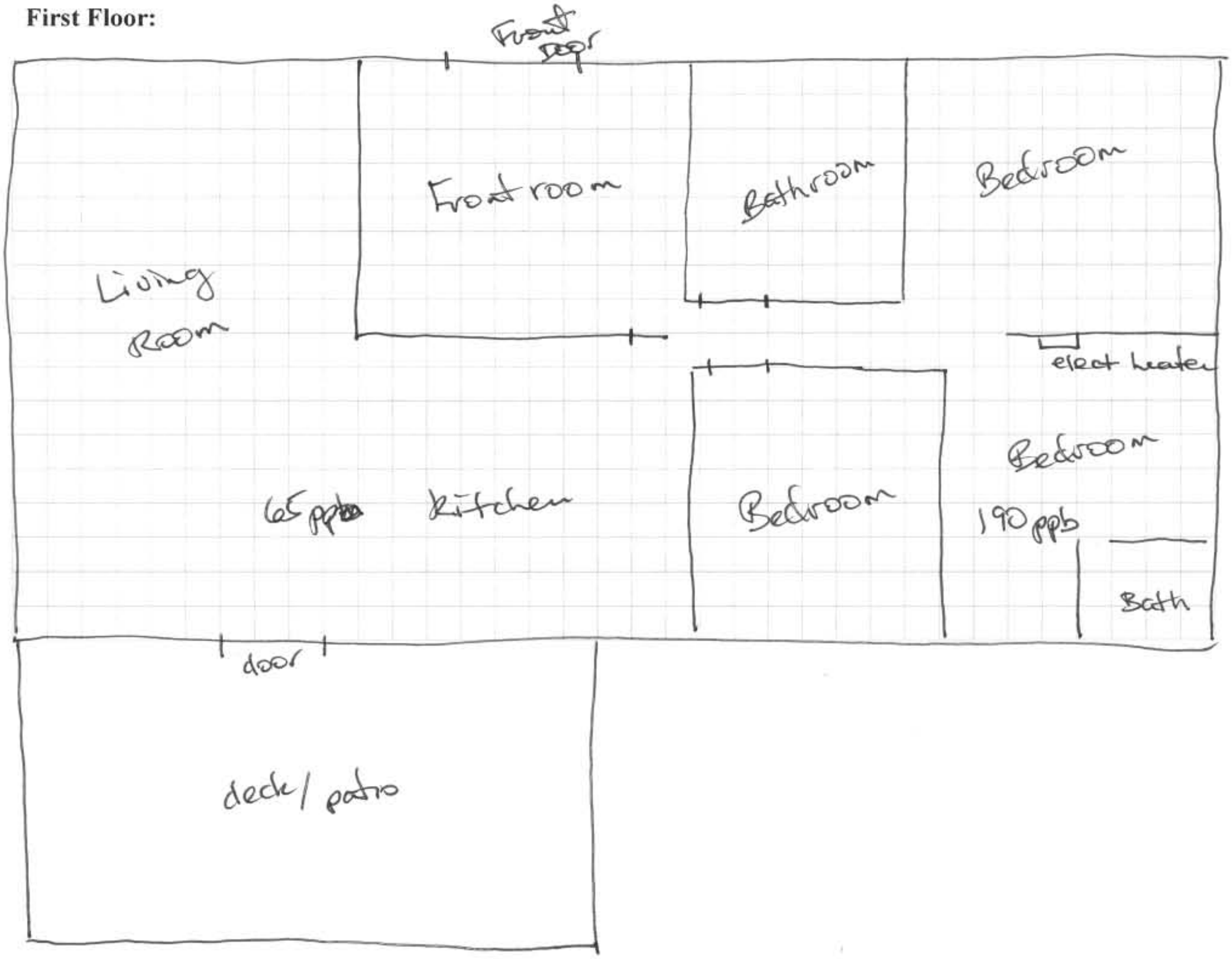
11. FLOOR PLANS

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement:



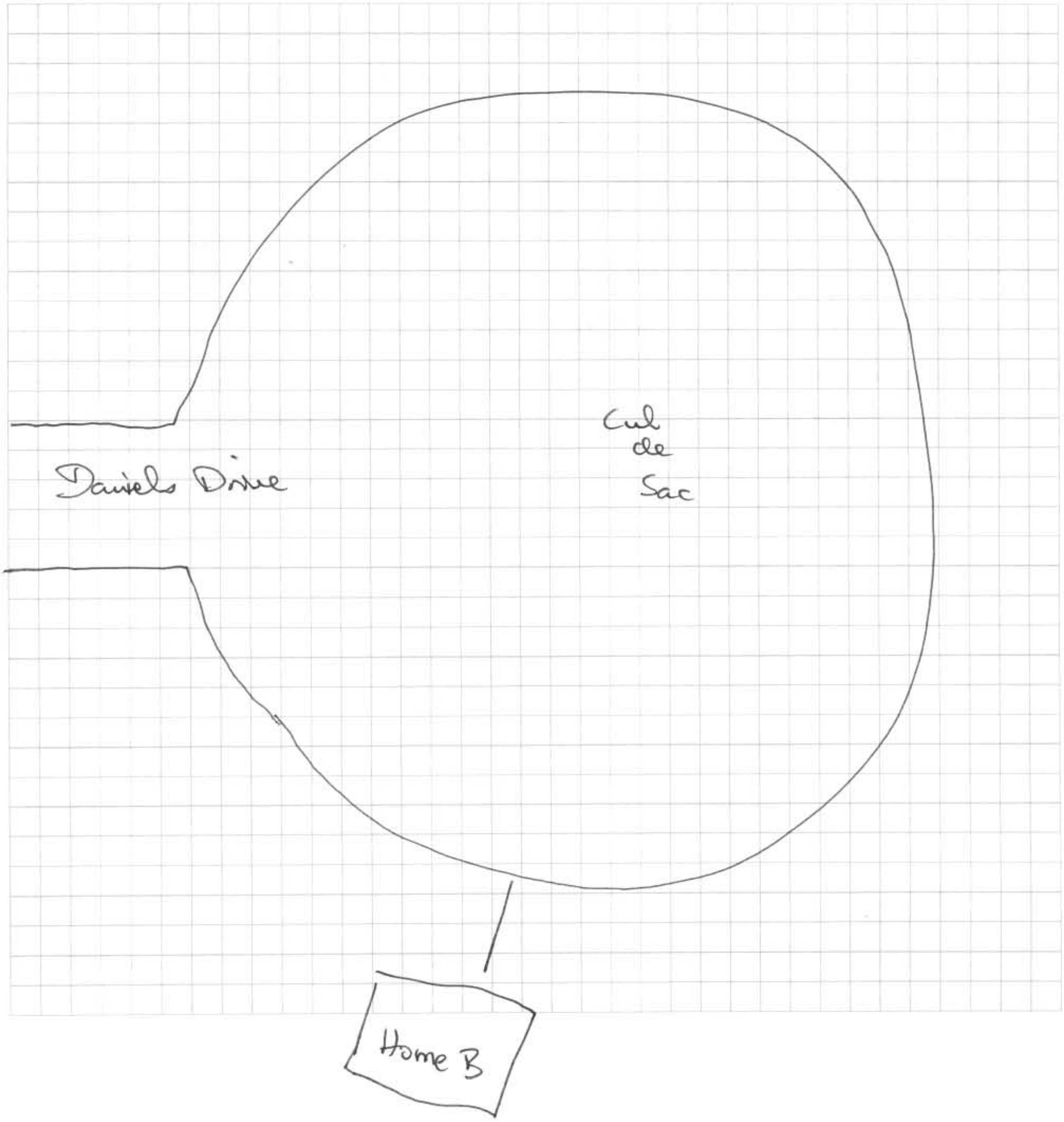
First Floor:



12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.



13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: Rae ppb Rae

List specific products found in the residence that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Photo** Y / N
Basement	Workshop ~~Storage~~ Area	12oz	4cans good	benzene flammable gas	0	Y
	Kylon spray paint	12oz	2 cans good	" "	0	Y
	Great Stuff	12oz	good	flam. gas	0	Y
	Listerine	12oz	good-U	alcohol	0	Y
	Woolite	8oz	good-U		0	Y
	wasp+hornet	20.5.	good-N	flam gas	0	Y
Basement	Storage Area					
	Thompson Waterseal	1gal	good-U	acetone petrol distillates	0	Y
	Krylon spray paint	12oz	cans good	benzene flam gas	0	Y

* Describe the condition of the product containers as **Unopened (UO), Used (U),** or **Deteriorated (D)**
** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

OSR – 3

NEW YORK STATE DEPARTMENT OF HEALTH
INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY
CENTER FOR ENVIRONMENTAL HEALTH

This form must be completed for each residence involved in indoor air testing.

Preparer's Name J. Georg Date/Time Prepared 1-19-10 - 10:40

Preparer's Affiliation TDH - CEDS - EEP Phone No. 615-7417247

Purpose of Investigation Identify if vapor intrusion is an issue

1. OCCUPANT:

Interviewed: Y / N

Last Name: ______ First Name: ______

Address: Home @ Daniels Drive Franklin TN

County: Williamson

Home Phone: ______ Office Phone: ______

Number of Occupants/persons at this location 6 Age of Occupants adults-2- 30's-40's children-4- 5 to 16

2. OWNER OR LANDLORD: (Check if same as occupant ___)

Interviewed: Y / [✓ N]

Last Name: ______ First Name: ______

Address: Texas

County: ______

Home Phone: ______ Office Phone: ______

Canister# 93210
Flow Cont# 1C377
Cleaning Lot# 8487
Initial Press 30 psi

3. BUILDING CHARACTERISTICS

Type of Building: (Circle appropriate response)

[✓ Residential] School Commercial/Multi-use
Industrial Church Other: ______

If the property is residential, type? (Circle appropriate response)

Ranch
~~Raised Ranch~~
[✓ Cape Cod]
Duplex
Modular

2-Family
Split Level
Contemporary
Apartment House
Log Home

3-Family
Colonial
Mobile Home
Townhouses/Condos
Other:______________

frame ·
vinyl siding

If multiple units, how many? ________

If the property is commercial, type?

Business Type(s) ____________________________________

Does it include residences (i.e., multi-use)? Y / N If yes, how many? ______

Other characteristics:

Number of floors 2

Building age 80's-90's constructed

Is the building insulated? [✓ Y] / N

How air tight? Tight / [✓ Average] / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow between floors

upstairs - seperate unit does not work
right now air flow is from downstairs unit

Airflow near source

Outdoor air infiltration

Infiltration into air ducts

no draft

floor vents

5. BASEMENT AND CONSTRUCTION CHARACTERISTICS (Circle all that apply)

a. Above grade construction:	[✓ wood frame]	concrete	stone	brick
b. Basement type:	full	[✓ crawlspace]	slab	other ________
c. ~~Basement~~ Crawl Space floor:	concrete	dirt	stone	other unknown
d. Basement floor:	uncovered	covered	covered with N/A	
e. Concrete floor:	unsealed	sealed	sealed with N/A	
f. Foundation walls:	poured	[✓ block]	stone	other ________
g. Foundation walls:	unsealed	sealed	sealed with unknown	
h. The basement is:	wet	damp	dry	moldy unknown
i. The basement is:	finished	unfinished	partially finished	unknown
j. Sump present?	Y / N	unknown		
k. Water in sump?	Y / N / not applicable			

Basement/Lowest level depth below grade: 3-4 (feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

____

____

6. HEATING, VENTING and AIR CONDITIONING (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

[✓ Hot air circulation]	Heat pump	Hot water baseboard	
Space Heaters	Stream radiation	Radiant floor	
Electric baseboard	Wood stove	Outdoor wood boiler	Other __________

The primary type of fuel used is:

Natural Gas	Fuel Oil	Kerosene
[✓ Electric]	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: electric

Boiler/furnace located in:	Basement	[✓ Outdoors]	Main Floor	Other__________
Air conditioning:	[✓ Central Air]	Window units	Open Windows	None

Are there air distribution ducts present? Y / N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

7. OCCUPANCY

Is basement/lowest level occupied? Full-time Occasionally Seldom Almost Never

Level	**General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)**
Basement	none crawl space
1st Floor	living familyroom laundry, kitchen, bathroom
2nd Floor	living bedrooms bathroom
3rd Floor	
4th Floor	

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? [✓ Y] / N 1 car

b. Does the garage have a separate heating unit? Y / [✓ N] / NA

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, atv, car) Y / [✓ N] / NA Please specify machines stored in detached shed

d. Has the building ever had a fire? Y / [✓ N] When? ______

e. Is a kerosene or unvented gas space heater present? Y / [✓ N] Where? ______

f. Is there a workshop or hobby/craft area? Y / [✓ N] Where & Type? ______

g. Is there smoking in the building? Y / [✓ N] How frequently? ______

h. Have cleaning products been used recently? [✓ Y] / N When & Type? household cleaners

i. Have cosmetic products been used recently? [✓ Y] / N When & Type? ______

j. Has painting/staining been done in the last 6 months? [✓ Y] / N Where & When? living room, kitchen 2 wk
water-based paint

k. Is there new carpet, drapes or other textiles? Y / [✓ N] Where & When? ______

l. Have air fresheners been used recently? Y / [✓ N] When & Type? ______

m. Is there a kitchen exhaust fan? [✓ Y] / N If yes, where vented? kitchen hood

n. Is there a bathroom exhaust fan? [✓ Y] / N If yes, where vented? only downstairs

o. Is there a clothes dryer? [✓ Y] / N If yes, is it vented outside? [✓ Y] / N

p. Has there been a pesticide application? [✓ Y] / N When & Type? unknown when but regular treatment

Are there odors in the building? [✓ Y] / N
If yes, please describe: in garage from staining or painting a piece of furniture

Do any of the building occupants use solvents at work? Y / [✓ N]
(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? ______

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, use dry-cleaning regularly (weekly)
[✓ Yes,] use dry-cleaning infrequently (monthly or less)
Yes, work at a dry-cleaning service
No
Unknown

Is there a radon mitigation system for the building/structure? Y / [✓ N] Date of Installation: ______
Is the system active or passive? Active/Passive

9. WATER AND SEWAGE

Water Supply: [✓ Public Water] Drilled Well Driven Well Dug Well Other: ______

Sewage Disposal: [✓ Public Sewer] Septic Tank Leach Field Dry Well Other: ______

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: N/A

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

c. Responsibility for costs associated with reimbursement explained? Y / N

d. Relocation package provided and explained to residents? Y / N

11. FLOOR PLANS

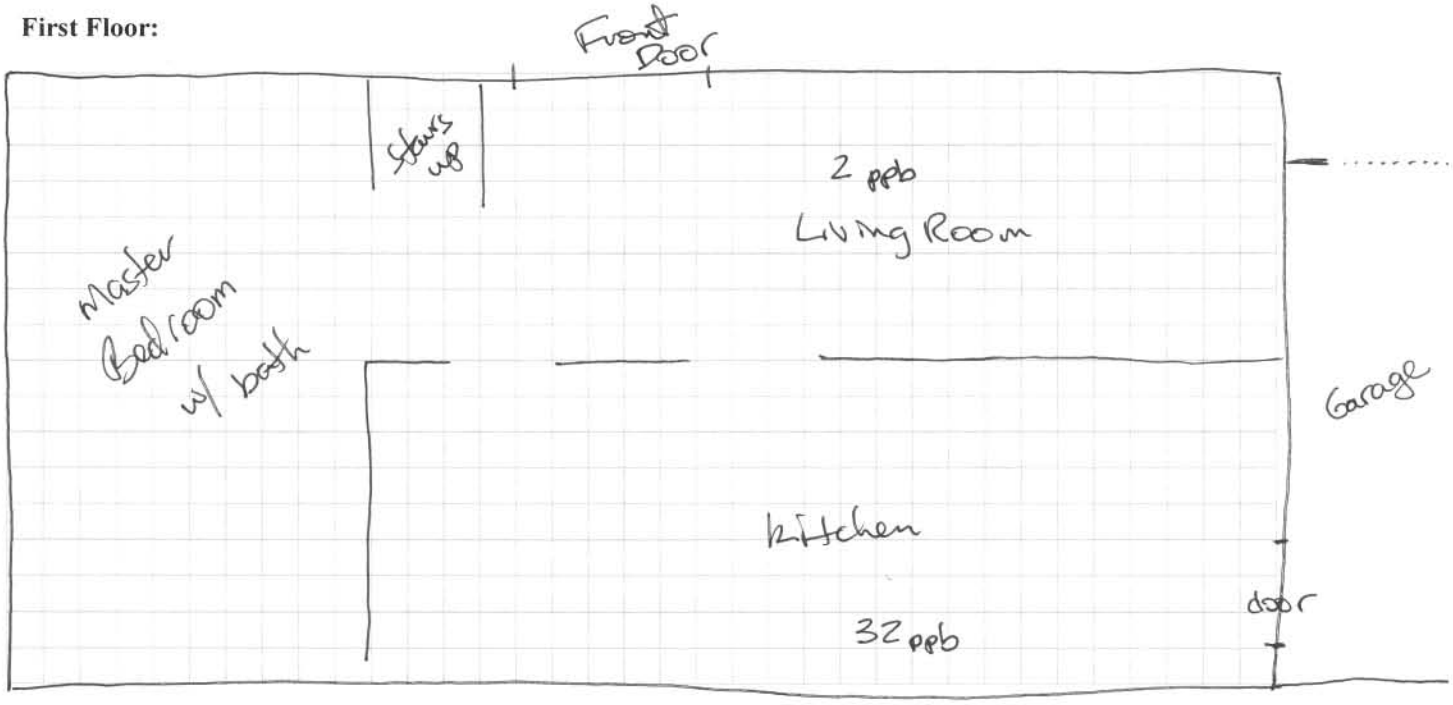
Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement:

upstairs:

Central Hall with bedrooms and bathroom off the hall.

First Floor:

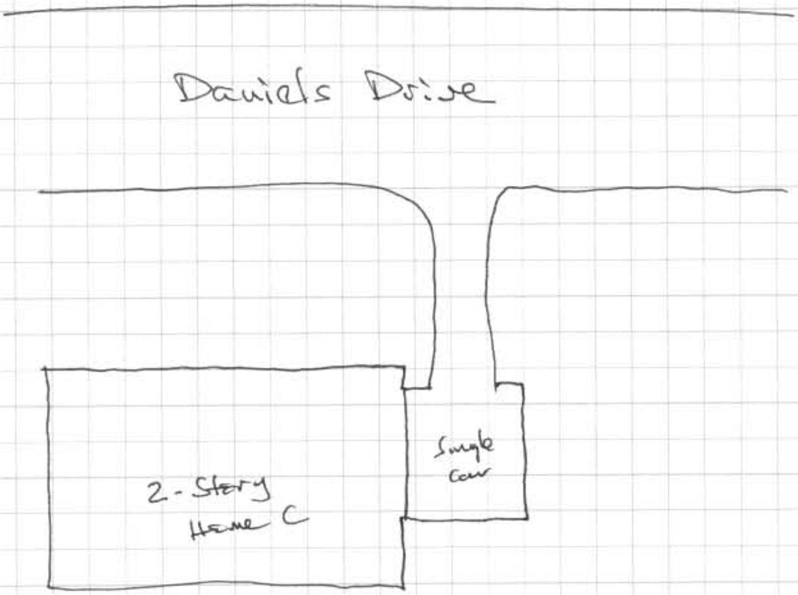


Not to scale

12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.



13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: Rae ppb Rae

List specific products found in the residence that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Photo** Y / N
Kitchen	Cleaning Products			no access		
1st Floor Bath	Cleaning Products			no access	no photos taken	
Garage						
	garage is unheated					
	used currently for temporary storage as family is just moving into home					
	owner stained or painted piece of furniture in garage				200-203	
					highest reading	

* Describe the condition of the product containers as **Unopened (UO), Used (U),** or **Deteriorated (D)**

** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

Appendix D

Photographs

Photo 1 - Photo of the household products stored beneath the kitchen sink in Home A. These products did not have detectable readings of organic vapors. (Photo credit: Joe George, TDH, 01/19/10).

Photo 2 - View of gasoline-powered yard equipment stored in basement of Home A. (Photo credit: Joe George, TDH, 01/19/10).

Photo 3 - Another photo of gasoline-powered lawn equipment stored in the basement of Home A. Photoionization detector readings were 1,500 parts per billion near this lawnmower. (Photo credit: Joe George, TDH, 01/19/10).

Photo 4 - View of storage of paints, sealants, and gasoline containers in basement of Home A. (Photo credit: Joe George, TDH, 01/19/10).

Photo 5 - View of Summa canister indoor air sampling device and location in the front living room of Home A. Entrance to kitchen is at right. (Photo credit: Joe George, TDH, 01/19/10).

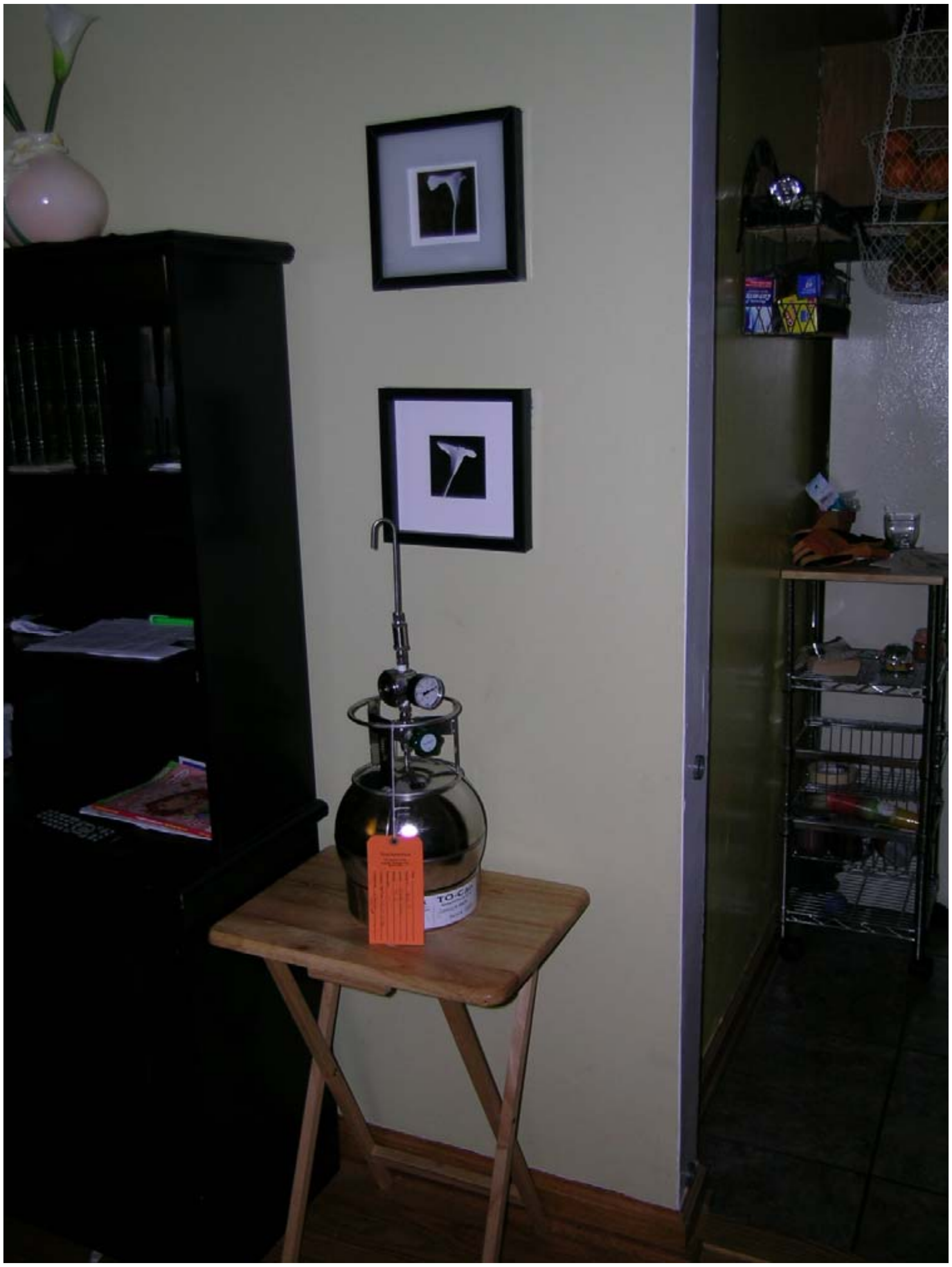


Photo 6 - Home B workbench / storage area in basement. No vapors were measured here from the cans of spray paint or foam sealant. (Photo credit: Joe George, TDH, 01/19/10).

Photo 7 - View of the unfinished section of basement, essentially a crawl space, of Home B. There is storage of sealants, and paints in this area. (Photo credit: Joe George, TDH, 01/19/10).

Photo 8 - Storage area within crawlspace shown previously. Paints, sealers, and glues are present. No vapors were detected from these products. (Photo credit: Joe George, TDH, 01/19/10).

Photo 9 - View of sample location in the basement of Home B. Note electric heater in wall that was not operating at time of sampling. (Photo credit: Joe George, TDH, 01/19/10).

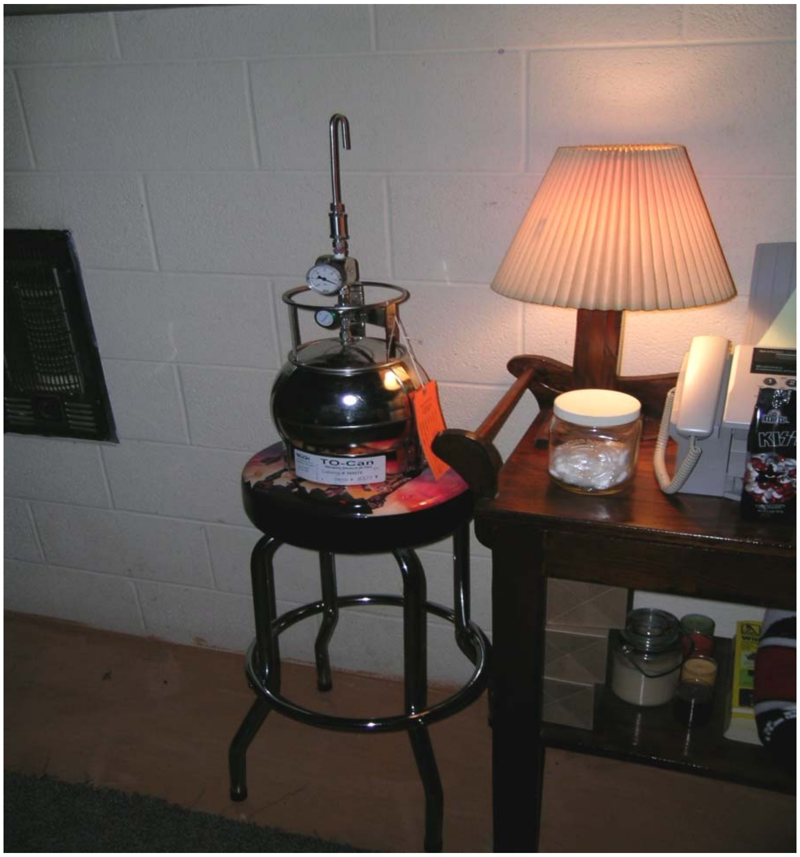


Photo 10 - Background or ambient air sampling location in back yard of Home B. (Photo credit: Joe George, TDH, 01/19/10).

Photo 11 - Background or ambient air sampling location in back yard of Home B. Liberty Creek is down an embankment beyond the brush at the back of the lawn. Photo credit: Joe George, TDH, 01/19/10).

Photo 12 - Sampling location in front living area of Home C. (Photo credit: Joe George, TDH, 01/19/10).

Appendix E

Weather Information for Sampling Dates

History for Nashville, TN

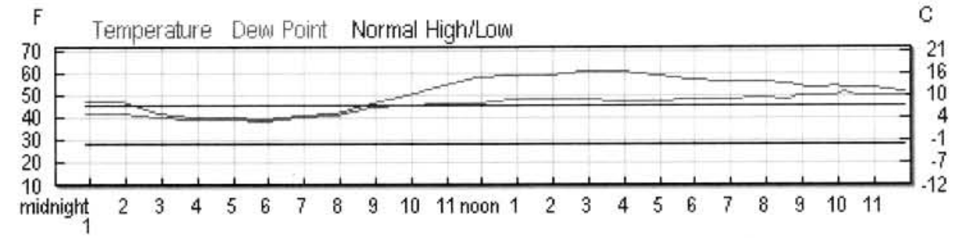
Tuesday, January 19, 2010

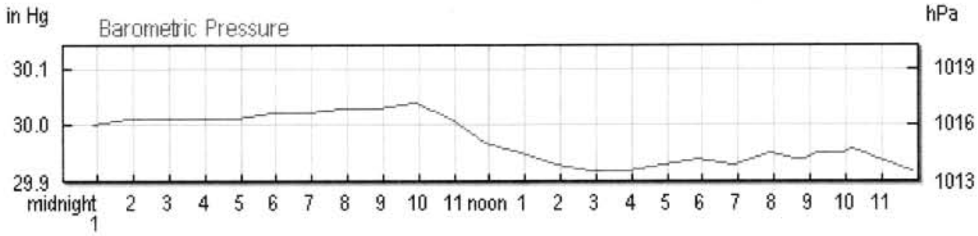
Daily Summary

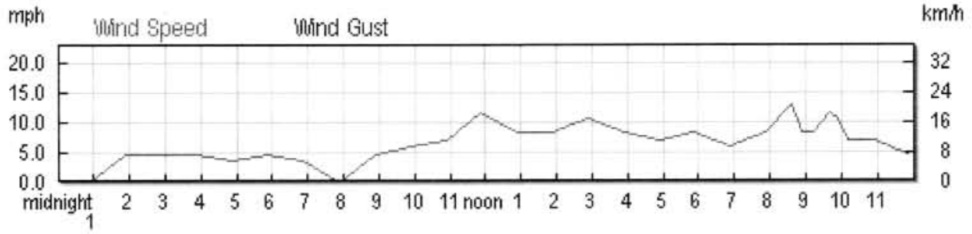
	Actual:	Average :	Record :
Temperature:			
Mean Temperature	**51** °F	**37** °F	
Max Temperature	**62** °F	**45** °F	**72** °F (1974)
Min Temperature	**39** °F	**28** °F	**-5** °F (1940)
Degree Days:			
Heating Degree Days	14	28	
Month to date heating degree days	681	528	
Since 1 July heating degree days	2142	1945	
Cooling Degree Days	0	0	
Month to date cooling degree days	0	0	
Year to date cooling degree days	0	0	
Moisture:			
Dew Point	**46** °F		
Average Humidity	80		
Maximum Humidity	100		
Minimum Humidity	60		
Precipitation:			
Precipitation	**0.00** in	**0.13** in	**2.36** in (1988)
Month to date precipitation	1.97	2.48	
Year to date precipitation	1.97	2.48	
Snow:			
Snow	**0.00** in	**0.10** in	**6.20** in (1936)
Month to date snowfall	0.7	1.9	
Since 1 July snowfall	0.7	2.5	
Snow Depth	**0.00** in		
Sea Level Pressure:			
Sea Level Pressure	**29.97** in		
Wind:			
Wind Speed	**6** mph (South)		
Max Wind Speed	**13** mph		
Max Gust Speed	**17** mph		
Visibility	**8** miles		
Events			

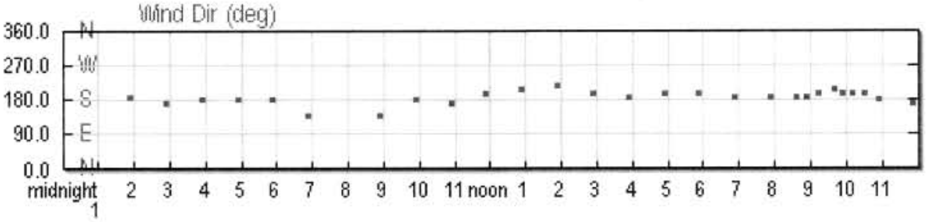
T = Trace of Precipitation, **MM** = Missing Value

Source: NWS Daily Summary









Hourly Observations

Time (CST):	Temp.:	Dew Point:	Humidity:	Sea Level Pressure:	Visibility:	Wind Dir:	Wind Speed:	Gust Speed:	Precip:	Events:	Conditions:
12:53 AM	**46.9** °F	**42.1** °F	83%	**30.00** in	**10.0** miles	Calm	Calm	-	N/A		Mostly Cloudy
1:53 AM	**46.9** °F	**42.1** °F	83%	**30.01** in	**10.0** miles	South	**4.6** mph	-	N/A		Partly Cloudy
2:53 AM	**42.1** °F	**39.9** °F	92%	**30.01** in	**6.0** miles	South	**4.6** mph	-	N/A		Partly Cloudy
3:53 AM	**39.9** °F	**39.0** °F	97%	**30.01** in	**5.0** miles	South	**4.6** mph	-	N/A		Mostly Cloudy
4:53 AM	**39.9** °F	**39.0** °F	97%	**30.01** in	**6.0** miles	South	**3.5** mph	-	N/A		Scattered Clouds
5:53 AM	**39.0** °F	**37.9** °F	96%	**30.02** in	**6.0** miles	South	**4.6** mph	-	N/A		Mostly Cloudy
6:53 AM	**41.0** °F	**39.9** °F	96%	**30.02** in	**4.0** miles	SE	**3.5** mph	-	N/A		Mostly Cloudy
7:53 AM	**42.1** °F	**41.0** °F	96%	**30.03** in	**4.0** miles	Calm	Calm	-	N/A		Overcast
8:53 AM	**46.0** °F	**44.1** °F	93%	**30.03** in	**6.0** miles	SE	**4.6** mph	-	N/A		Overcast
9:53 AM	**50.0** °F	**45.0** °F	83%	**30.04** in	**8.0** miles	South	**5.8** mph	-	N/A		Mostly Cloudy

10:53 AM	**54.0** °F	**46.0** °F	75%	**30.01** in	**10.0** miles	South	**6.9** mph	-	N/A	Mostly Cloudy
11:53 AM	**57.9** °F	**46.0** °F	65%	**29.97** in	**10.0** miles	SSW	**11.5** mph	-	N/A	Mostly Cloudy
12:53 PM	**59.0** °F	**48.0** °F	67%	**29.95** in	**10.0** miles	SSW	**8.1** mph	-	N/A	Mostly Cloudy
1:53 PM	**59.0** °F	**48.0** °F	67%	**29.93** in	**10.0** miles	SW	**8.1** mph	-	N/A	Mostly Cloudy
2:53 PM	**61.0** °F	**48.0** °F	62%	**29.92** in	**10.0** miles	SSW	**10.4** mph	-	N/A	Mostly Cloudy
3:53 PM	**61.0** °F	**46.9** °F	60%	**29.92** in	**10.0** miles	South	**8.1** mph	-	N/A	Scattered Clouds
4:53 PM	**59.0** °F	**46.9** °F	64%	**29.93** in	**10.0** miles	SSW	**6.9** mph	-	N/A	Mostly Cloudy
5:53 PM	**57.0** °F	**48.0** °F	72%	**29.94** in	**10.0** miles	SSW	**8.1** mph	-	N/A	Overcast
6:53 PM	**55.9** °F	**48.0** °F	75%	**29.93** in	**10.0** miles	South	**5.8** mph	-	N/A	Overcast
7:53 PM	**55.9** °F	**48.9** °F	77%	**29.95** in	**10.0** miles	South	**8.1** mph	-	N/A	Overcast
8:36 PM	**55.4** °F	**48.2** °F	77%	**29.94** in	**10.0** miles	South	**12.7** mph	-	N/A	Overcast
8:53 PM	**54.0** °F	**50.0** °F	86%	**29.94** in	**10.0** miles	South	**8.1** mph	-	N/A	Overcast
9:13 PM	**53.6** °F	**50.0** °F	88%	**29.95** in	**10.0** miles	SSW	**8.1** mph	-	N/A	Overcast
9:42 PM	**53.6** °F	**50.0** °F	88%	**29.95** in	**9.0** miles	SSW	**11.5** mph	-	N/A	Overcast
9:53 PM	**54.0** °F	**50.0** °F	86%	**29.95** in	**9.0** miles	SSW	**10.4** mph	-	N/A	Overcast
10:12 PM	**53.6** °F	**51.8** °F	94%	**29.96** in	**8.0** miles	SSW	**6.9** mph	-	N/A	Overcast
10:31 PM	**53.6** °F	**50.0** °F	88%	**29.95** in	**7.0** miles	SSW	**6.9** mph	-	N/A	Overcast
10:53 PM	**53.1** °F	**50.0** °F	89%	**29.94** in	**7.0** miles	South	**6.9** mph	-	N/A	Overcast
11:53 PM	**52.0** °F	**50.0** °F	93%	**29.92** in	**7.0** miles	South	**4.6** mph	-	N/A	Overcast

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History for Nashville, TN

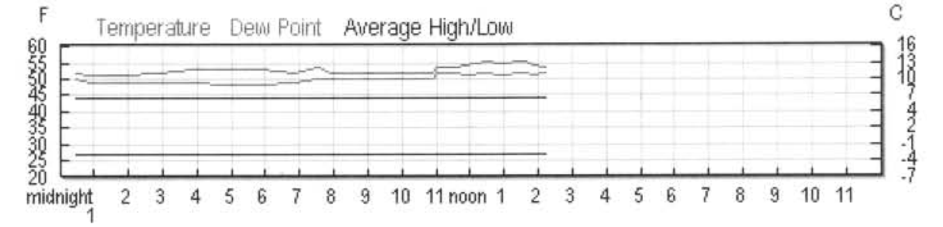
Wednesday, January 20, 2010

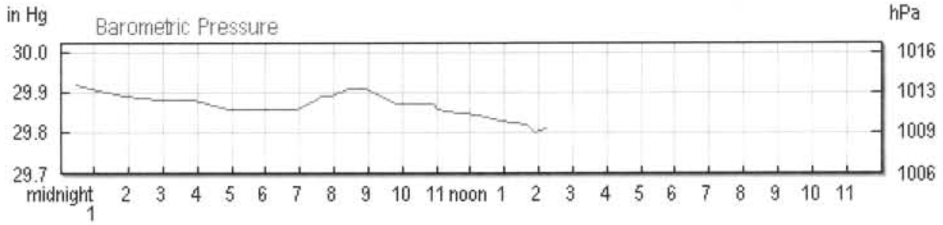
Daily Summary

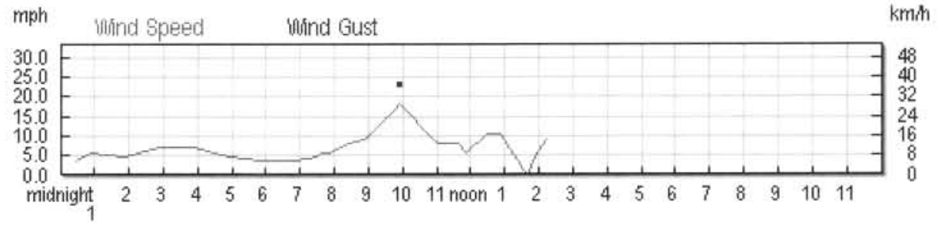
	Actual:	Average :	Record :
Temperature:			
Mean Temperature	**53** °F	**37** °F	
Max Temperature	**55** °F	**45** °F	**72** °F (1906)
Min Temperature	**51** °F	**28** °F	**-16** °F (1985)
Degree Days:			
Heating Degree Days	12	28	
Month to date heating degree days		556	
Since 1 July heating degree days		1973	
Cooling Degree Days	0	0	
Month to date cooling degree days		0	
Year to date cooling degree days		0	
Growing Degree Days	3 (Base 50)		
Moisture:			
Dew Point	**50** °F		
Average Humidity	90		
Maximum Humidity	94		
Minimum Humidity	83		
Precipitation:			
Precipitation	**0.29** in	**0.13** in	**2.43** in (1935)
Month to date precipitation		2.61	
Year to date precipitation		2.61	
Snow:			
Snow	-	**0.10** in	- ()
Month to date snowfall		2.0	
Since 1 July snowfall		2.6	
Snow Depth	-		
Sea Level Pressure:			
Sea Level Pressure	**29.87** in		
Wind:			
Wind Speed	**6** mph ()		
Max Wind Speed	**18** mph		
Max Gust Speed	**23** mph		
Visibility	**7.0** miles		
Events	Rain , Thunderstorm		

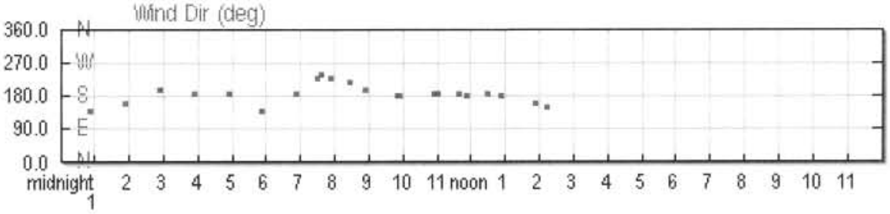
T = Trace of Precipitation, **MM** = Missing Value

Source: Averaged Metar Reports









Hourly Observations

Time (CST):	Temp.:	Dew Point:	Humidity:	Sea Level Pressure:	Visibility:	Wind Dir:	Wind Speed:	Gust Speed:	Precip:	Events:	Conditions:
12:29 AM	**51.8** °F	**50.0** °F	94%	**29.92** in	**7.0** miles	SSE	**3.5** mph	-	N/A		Overcast
12:53 AM	**51.1** °F	**48.9** °F	92%	**29.91** in	**7.0** miles	SE	**5.8** mph	-	N/A		Overcast
1:53 AM	**51.1** °F	**48.9** °F	92%	**29.89** in	**7.0** miles	SSE	**4.6** mph	-	**0.01** in		Overcast
2:53 AM	**52.0** °F	**48.9** °F	89%	**29.88** in	**10.0** miles	SSW	**6.9** mph	-	N/A		Overcast
3:53 AM	**53.1** °F	**48.9** °F	86%	**29.88** in	**10.0** miles	South	**6.9** mph	-	N/A		Overcast
4:53 AM	**53.1** °F	**48.0** °F	83%	**29.86** in	**10.0** miles	South	**4.6** mph	-	N/A		Overcast
5:53 AM	**53.1** °F	**48.0** °F	83%	**29.86** in	**10.0** miles	SE	**3.5** mph	-	N/A		Overcast
6:53 AM	**52.0** °F	**48.9** °F	89%	**29.86** in	**7.0** miles	South	**3.5** mph	-	**0.00** in	Rain	Light Rain
7:28 AM	**53.6** °F	**50.0** °F	88%	**29.88** in	**2.5** miles	SW	**4.6** mph	-	**0.04** in	Rain	Light Rain
7:35 AM	**53.6** °F	**50.0** °F	88%	**29.89** in	**2.5** miles	WSW	**5.8** mph	-	**0.05** in	Rain	Rain
7:53 AM	**52.0** °F	**50.0** °F	93%	**29.89** in	**2.0** miles	SW	**5.8** mph	-	**0.16** in	Rain	Rain
8:28											

AM	**51.8** °F	**50.0** °F	94%	**29.91** in	**3.0** miles	SW	**8.1** mph	-	**0.05** in	Rain	Light Rain
8:53 AM	**52.0** °F	**50.0** °F	93%	**29.91** in	**4.0** miles	SSW	**9.2** mph	-	**0.05** in	Rain	Light Rain
9:51 AM	**51.8** °F	**50.0** °F	94%	**29.87** in	**4.0** miles	South	**17.3** mph	**23.0** mph	**0.06** in	Rain	Light Rain
9:53 AM	**52.0** °F	**50.0** °F	93%	**29.87** in	**4.0** miles	South	**18.4** mph	**23.0** mph	**0.06** in	Rain	Light Rain
10:53 AM	**52.0** °F	**50.0** °F	93%	**29.87** in	**7.0** miles	South	**9.2** mph	-	**0.00** in		Overcast
11:00 AM	**53.6** °F	**51.8** °F	94%	**29.86** in	**10.0** miles	South	**8.1** mph	-	N/A		Overcast
11:38 AM	**53.6** °F	**51.8** °F	94%	**29.85** in	**8.0** miles	South	**8.1** mph	-	N/A		Overcast
11:53 AM	**54.0** °F	**51.1** °F	90%	**29.85** in	**8.0** miles	South	**5.8** mph	-	N/A		Mostly Cloudy
12:28 PM	**55.4** °F	**51.8** °F	88%	**29.84** in	**10.0** miles	South	**10.4** mph	-	N/A		Overcast
12:53 PM	**55.0** °F	**51.1** °F	86%	**29.83** in	**10.0** miles	South	**10.4** mph	-	N/A		Overcast
1:38 PM	**55.4** °F	**51.8** °F	88%	**29.82** in	**7.0** miles	Calm	Calm	-	**0.00** in	Rain , Thunderstorm	Light Thunderstorms and Rain
1:53 PM	**54.0** °F	**51.1** °F	90%	**29.80** in	**7.0** miles	SSE	**4.6** mph	-	**0.01** in	Rain , Thunderstorm	Light Thunderstorms and Rain
2:14 PM	**53.6** °F	**51.8** °F	94%	**29.81** in	**10.0** miles	SSE	**9.2** mph	-	**0.00** in		Overcast

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