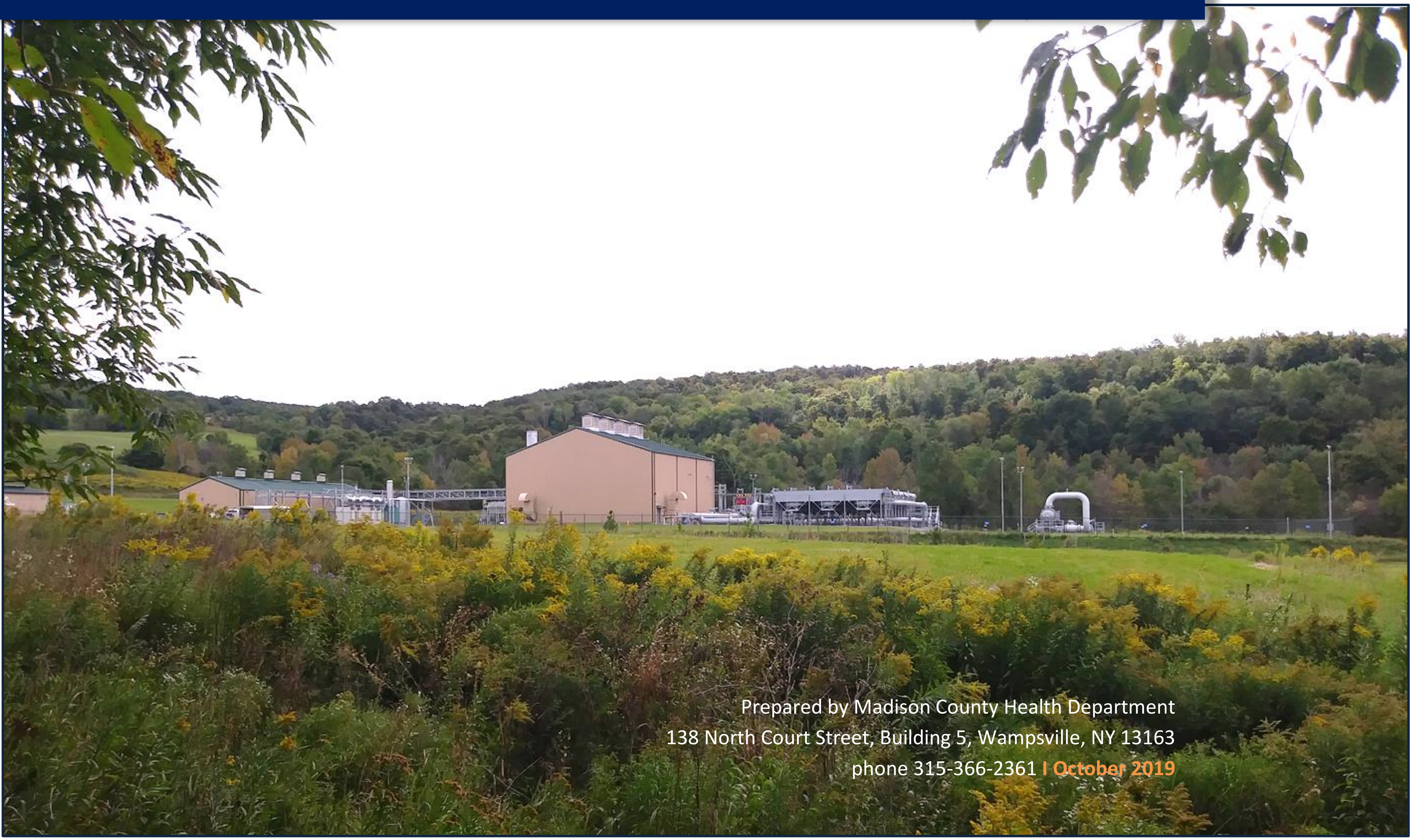
Environmental Health Report

Addressing Community Health Concerns
Shed's Gas Compressor Station, Georgetown, NY



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BACKGROUND

In April 2014, residents and local officials living in the Sheds area, in the Town of Georgetown, contacted the Madison County Department of Health (MCDOH) to express their concerns about the potential health impacts of a gas compressor station proposed for construction in their neighborhood. Madison County residents reported numerous concerns to the MCDOH and to the Federal Energy Regulatory Commission (FERC), who permits gas compressor operations. Primary concerns were for health and safety. Residents raised concerns about the safety record of compressors and pipelines, food/crop and livestock safety, impact on community character and home values, emergency response preparedness, air quality and other environmental impacts.

In June 2014, Dominion Transmission, Inc. (DTI), filed an application with the Federal Energy Regulatory Commission (FERC), pursuant to Section 7(c) of the Natural Gas Act, to "construct, install, own, operate and maintain certain compression facilities that comprise the New Market Project located in Chemung, Herkimer, Madison, Montgomery, Schenectady, and Tompkins Counties, New York." One of the new compressor stations, known as the Sheds compressor station, would be located in the Town of Georgetown in the southern portion of Madison County.

In June 2014, the Madison County Department of Health (MCDOH) responded to the resident' concerns by hiring an environmental consulting firm (Thimble Creek Research, LLC) to assist the county in several activities. Thimble Creek provided Madison County with a compilation of the current body of health and environmental evidence, potential health issues associated with gas compressor stations, comments for submission to the Federal Energy Regulatory Commission (FERC), and a framework for assessing our resident's health.

Information specific to gas compressors was limited. The set of research related to health effects associated with gas compressor operations relied primarily on self-reported data from public health surveys. The symptoms identified are associated with health impacts on respiratory, neurological and cardiovascular body systems. These health effects correlate with the impacts associated with many of the chemicals emitted from compressor stations. The types of chemicals identified with such operations include Volatile Organic Compounds (VOCs), carbonyls and aldehydes, Hazardous Air Pollutants (HAPs), and aromatics and particulate matter. More importantly, data gaps exist regarding the potential health effects associated with gas compressor operations.

Health risks from VOCs in the short term include eye and respiratory tract irritation, headaches, dizziness, visual disorders, fatigue, loss of coordination, allergic skin reaction, nausea, and memory impairment. Effects from long-term exposure include loss of coordination and damage to the liver, kidney, and central nervous system as well as elevated risk of cancer. Health effects from particulate matter (PM) affect both the respiratory and cardiovascular systems. Inhalation of PM2.5 can cause decreased lung function, aggravate asthma symptoms, nonfatal heart attacks and high blood pressure. Diesel emissions from truck traffic (primarily during construction of the compressor) can irritate the eyes, nose, throat and lungs, and can cause coughs, headaches, lightheadedness and nausea. Short-term exposure to diesel exhaust also causes inflammation in the lungs, which may aggravate chronic respiratory symptoms and increase the frequency or intensity of asthma attacks. Long-term exposure can cause increased risk of lung cancer. Chemical exposure to vulnerable populations is of particular concern. Furthermore, the mixtures of these various agents/chemicals, and how these mixtures might affect health, is not clearly understood.

Noise exposures are associated with compressor operations, especially during “blowdown” episodes, where gas is released either through the testing of equipment or during an emergency release. Excessive noise is associated with an array of psychological and physical effects. As with air exposures, the periods of extreme noise levels can cause different and sometimes more serious effects than low-level exposures.

The MCDOH formed a work group comprised of residents, town and county officials, and health department staff to guide the development of the FERC report, identify concerns, and use this information to design and implement the environmental health assessment. Additionally, MCDOH formed an expert advisory group to provide technical guidance on the project. (Appendix A)

In October 2014, the MCDOH submitted comments to the FERC outlining health concerns for the proposed Compressor Station. MCDOH’s concerns derived from the United States Environmental Protection Agency (USEPA) Inspector General report that documents a lack of emissions data from oil and gas facilities, which, in turn, casts doubt on the accuracy of projected air quality impacts. This brought into question the appropriateness of using the National Ambient Air Quality Standards to establish health safety risk near the Sheds compressor station. The NAAQS standards reflect what, over a region and over time, is deemed safe population-wide; however, the standards do not adequately assess risk to human health for residents living in close proximity to sources such as gas compressor stations. The literature suggests that emissions produced during the operation of the proposed Compressor station could have the potential to put nearby residents at risk for health effects, and that a more comprehensive public health assessment is needed.

MCDOH had a unique opportunity to assess the health and environmental impact on the community prior to and after the construction of the gas compressor station. MCDOH, in consultation with experts and community residents, designed an approach to work with the community to measure air, noise, and water exposures generated by compressor station and monitor the health of residents in close proximity to the compressor station over time. The project engaged and informed the community of their potential exposures to air, water, and noise pollution. The result of the project raised awareness, empowered residents with knowledge, facilitated advocacy, identified mitigation measures, affected local policies, and contributed to a growing body of scientific evidence. Furthermore, this project enhanced MCDOH’s capacity to provide similar services to all residents.

THE PROJECT

The primary purpose for the project was to address resident's concerns. The impact of gas industry operations on human health has been a prominent issue in the public eye, not only in Madison County, but in NYS and nationwide. Although the emphasis on the gas industry focused on hydraulic fracking, which led to the subsequent ban in NYS, other gas development projects, such as the expansion of existing gas distribution systems, continue. These projects increased concerns on their impact to health. Most of the limited health data associated with such operations (e.g., gas compressor stations) is anecdotal observations associated with existing gas compressor stations.

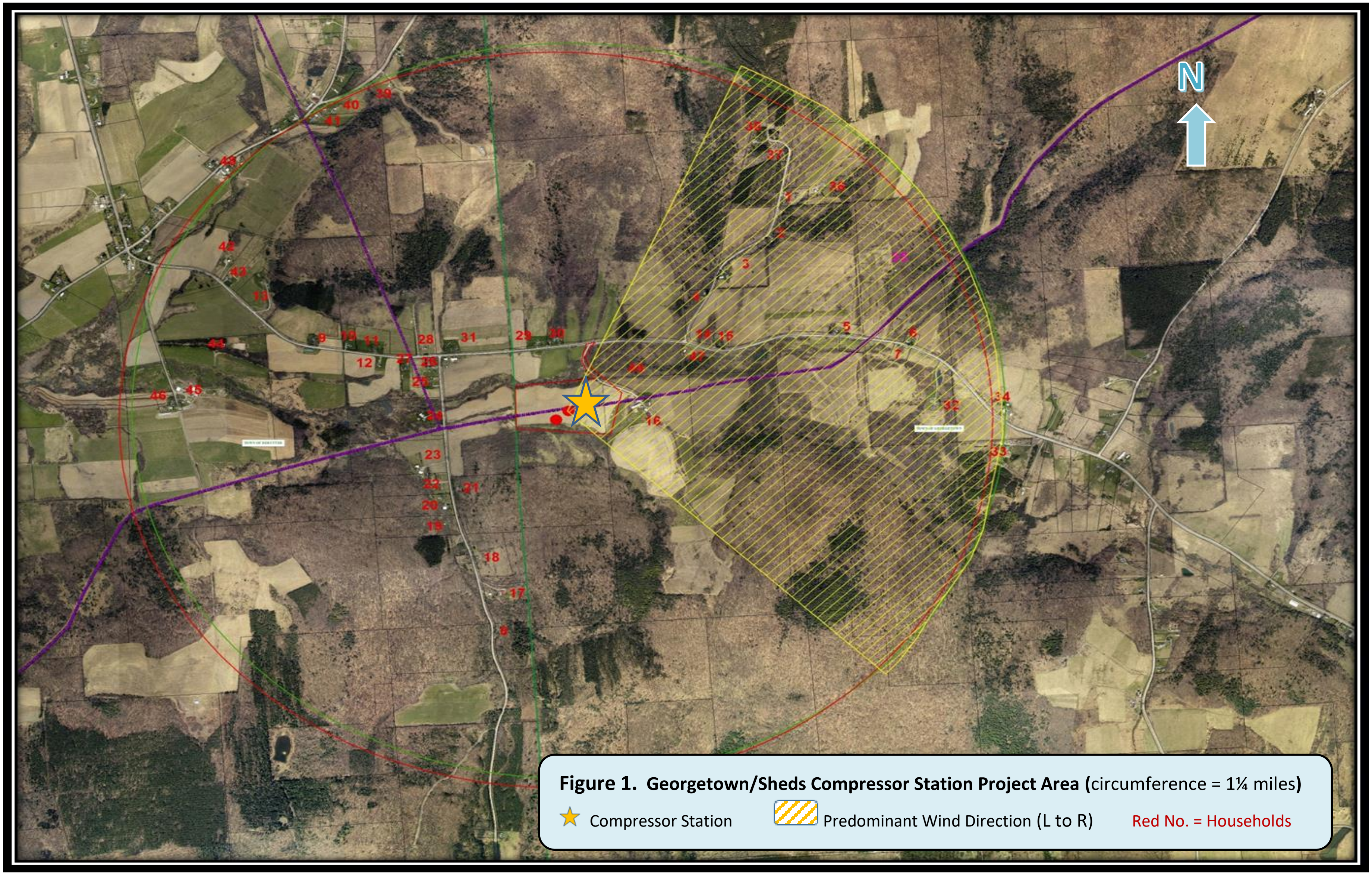


Figure 1. Georgetown/Sheds Compressor Station Project Area (circumference = 1¼ miles**)**

★ Compressor Station   Predominant Wind Direction (L to R)   Red No. = Households

MCDOH assessed the potential health impacts of the compressor station on residents living within one mile and a quarter mile of the station site (Figure 1). MCDOH assessed the health status of nearby residents and on certain environmental parameters associated with gas compressor operations.

MCDOH staff conducted the health assessment/environmental monitoring activities in three phases over the course of a multi-year period (Figure 2; Appendix A). MCDOH conducted Phase 1 of the project in October/November 2015 prior to construction of the gas compressor station to determine baseline health status and existing environmental contaminant levels.

During Phase 1, MCDOH staff assessed resident's health status through the administration of an individual health survey and individual lung function testing. Staff simultaneously collected environmental air samples from inside and outside the resident's homes. Air samples were analyzed for volatile organic compounds (VOCs), radon, particulate matter (PM), formaldehyde, and hydrogen sulfide. Outdoor methane gas samples were collected within the targeted project area. All participating households had onsite water systems. Water samples were collected from each household's water source (well or spring) and tested for sources of contamination and physical characteristics. Water sample were analyzed using the New York Standards for Individual Onsite Water Supply and Individual Onsite Wastewater Treatment Systems and for contaminants associated with gas compressor station operations (e.g. VOCs). Additionally, MCDOH staff monitored noise levels both inside and outside the resident's homes, and collected data on traffic activity (traffic counts). Staff conducted home environmental assessments and physical assessments of the wells at each household.

Phase 2 monitoring occurred during the construction phase of the gas compressor station. MCDOH staff conducted monitoring for noise and particulate matter levels inside/outside the homes. Phase 3 monitoring was slated to occur within 6 months after the station became operational and then annually for 2 years thereafter, with Phase 3 activities duplicating those conducted during Phase 1. Over the course of the project, several participating households declined to continue. The project went from seventeen participating households in Phase 1 to seven households in Phase 3. Several participants moved out of the area and new residents were not interested in participating. Unfortunately, only the Phase 3 6-month, post-operational monitoring event occurred. Shortly thereafter, the remaining participating residents relayed to the MCDOH that they were no longer going to continue with the project. The project officially ended in July 2019. MCDOH analyzed and compared the data collected from the three phases to determine what, if any, impact on resident's health. The following section presents the results of the monitoring activities.

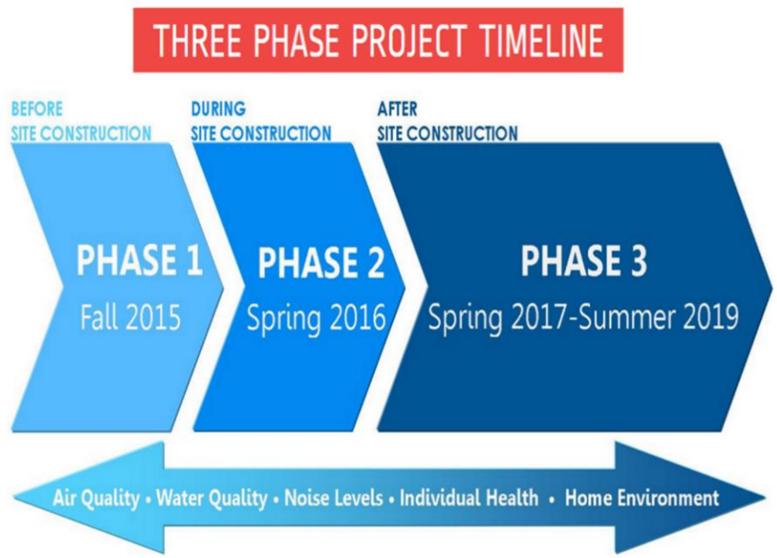


Figure 2

INTRODUCTION

To address community health concerns the Madison County Health Department initiated a three phase community environmental health monitoring project among households within one and a quarter miles of the gas compressor station. Monitoring activities to address health concerns were identified in the literature or by researchers as being associated with gas industry products, activities, and/or operations. The monitoring activities conducted by Phase are included in Table 1.

Table 1: Comprehensive List of Monitoring Activities by Project Phase

Monitoring Activities (Parameters)	Baseline: Phase 1 Fall 2015	Construction: Phase 2 Summer 2017	Operational: Phase 3 Summer 2018
Individual onsite water system testing	✓	Not scheduled	Not scheduled
Individual onsite water system visual assessment	✓	Not scheduled	Not scheduled
Surface water testing	✓	Not scheduled	Not scheduled
Air monitoring for volatile organize compounds, outdoors & indoors	✓	Not scheduled	✓
Air monitoring for formaldehyde and hydrogen sulfide, outdoors & indoors	✓	✓	✓
Air monitoring for fine particulate matter using Dylos meters (24 hours), outdoors & indoors	✓	✓	✓
Air monitoring for fine particulate matter using Speck meters (30 days), outdoors & indoors	✓	✓	✓
Air monitoring for radon gas, indoors	✓	Not scheduled	Not scheduled
Air monitoring for hydrogen sulfide (24 hours), outdoors & indoors	✓	✓	✓
Home noise monitoring (24 hours), outdoors & indoors	✓	Not scheduled	✓
Community noise monitoring (30 minutes at 0, 100, 200, and 300 feet from the site), outdoors	✓[1]	✓	✓
Community methane gas monitoring, outdoors	✓	Not scheduled	Not scheduled
Individual Health Assessment	✓	Not scheduled	✓
Lung function testing	✓	Not scheduled	✓
Household Environmental Home Assessment	✓	Not scheduled	✓
Traffic Counts	✓	✓	✓

[1] Noise methodology changed between events – data should not be compared

HEALTH ASSESESMENT

Health Surveys

All participants were asked to complete an individual health assessment at two different times. Once, prior to the gas compressor station's construction (Phase 1 – November 2015), and a second time about 6 months after it became operational (Phase 3 – May 2018). The assessment asks questions about mental, emotional, and physical health, health behaviors, and occupational history. A total of 25 individuals completed the assessment during the first phase, and of those, 13 completed it in the third phase. The survey results were analyzed two ways. First all phase 1 responses (n=25) were compared to phase 3 (n=13) responses. A second analysis was conducted to compare only the thirteen participants who responded during both phases.

No major differences in the demographics (sex, age, and health behavior) of the individuals completing the health assessment survey in phase 1 and 3 were observed. Pre- and post-assessment health assessment findings revealed:

- The proportion reporting medical conditions remained similar.
- Reported mental and emotional health improved.
- Overall, a lower proportion of individuals reported suffering from an extensive list of symptoms/complaints.
- Reported general health was similar or improved.
- There was not a change in reported limitations during physical, social, or mental activities.

Due to the small sample size, and to protect confidentiality of health information, the data tables and percentages are not included in this report.

Some limitations exist with the health assessment results. First, due to the small sample size true differences in answers between the pre- and post-assessments cannot be confirmed. Second, the participants who completed both assessments may be affected differently by the compressor station than those who only completed the first assessment.

Lung Function Testing

The Occupational Health Clinical Center (OHCC) at SUNY Upstate Medical University preformed two lung function testing (LFT) events. Once prior to the gas compressor's construction (November 2015), and a second time about 6 months after the station began operation (May 2018). LFT, using a spirometer, measures the amount of air the lungs can hold. The test measures how forcefully one can empty air from the

Spirometer
(Lung Function Test)

lungs. Lung function testing screens for diseases that affect lung volumes and/or affect the airways, such as chronic obstructive pulmonary disease (COPD) or asthma.

OHCC provided each participant his or her own individual results. Eleven (11) individuals participated in both the pre- and post-testing. Doctors from OHCC did not find any differences or trends regarding participants' lung function between the two events.

AIR QUALITY

Air quality data was collected outdoors and indoors for volatile organic compounds, fine particulate matter, and hydrogen sulfide (Tables 2 & 3). Air quality testing included parameters known to be commonly found in homes or have been associated with natural gas activities, and have the potential to affect health.

Monitoring for Volatile Organic Compounds (VOCs)

Volatile Organic Compounds (VOCs) are a large group of carbon-based chemicals that easily evaporate or “off-gas” at room temperature. While most people can smell high levels of some VOCs, other VOCs have no odor. The VOCs tested for indoors and outdoors have been associated with or have the potential to result from gas industry activities, operations, and/or products. Organic chemicals are widely used as ingredients in household products. Paints, varnishes and wax all contain organic solvents, as do many cleaning, disinfecting, cosmetic, degreasing, and hobby products. Fuels are made up of organic chemicals. All of these products can release organic compounds while you are using them, and, to some degree, when they are stored.

Regardless of whether the homes are located in rural or highly industrial areas, the EPA's Office of Research and Development's "Total Exposure Assessment Methodology (TEAM) Study" (Volumes I through IV, completed in 1985) found levels of about a dozen common organic pollutants to be 2 to 5 times higher *inside* homes than outside. Community VOC results in Georgetown also had higher indoor VOCs.

With the exception of Formaldehyde, VOCs were sampled using SUMMA Canisters. Formaldehyde and hydrogen sulfide were sampled using a 24-hour badge. The thresholds to consider action were selected based on the most conservative values that could be found, and in some cases no thresholds could be found.

Among participating homes overall, a greater number of VOCs were detected indoors (45), versus outdoors (23).

- Six VOCs detected indoors (benzene, formaldehyde, naphthalene, propylene, tetrachloroethylene, and vinyl acetate) also had at least one household with a level over the threshold to consider action (highlighted in orange). *See Appendix D for the public health statements on how exposure to these six VOCs may occur.*
- All outdoor VOCs detected were under recommended threshold levels across all households during all testing phases.

DEFINITIONS

Geometric mean: This is an average level measured in the community study.
Median: This is the middle level measured in the community study.
Range: This is the lowest to the highest levels of a VOC measured in the community study
Detection Frequency: This is the percent of homes in the community study with a measurable VOC level
Percent Above Threshold: This is the percent of homes in the community study that detected a VOC level equal to or higher than the level to consider action

VOC Gas Canister

Table 2: Indoor VOCs

Indoor VOCs	Threshold to consider action (ppm)	Standard name	More information	Phase	Community results across all households tested: Number of homes tested	Geometric mean (ppm)	Median (ppm)	Range (ppm)	Detection frequency (%)	Percent above threshold (%)
1,1,1-Trichloroethane	0.7	MRL	https://www.atsdr.cdc.gov/PHS/PHS.asp?id=430&tid=76	1	17	0.0009	0.0008	0.0005-0.0025	0%	0%
				3	7	0.0001	0.0001	0.0001-0.0005	29%	0%
1,2,4-Trimethylbenzene	25	NIOSH	https://www.cdc.gov/niosh/npg/npgd0638.html	1	17	0.0010	0.0010	0.0005-0.0025	6%	0%
				3	7	0.0004	0.0003	0.0001-0.0042	57%	0%
1,2-Dichlorobenzene	50	OSHA/NIOSH	https://www.cdc.gov/niosh/ipcsneng/neng1066.html	1	17	0.0009	0.0008	0.0005-0.0025	0%	0%
				3	7	0.0002	0.0001	0.0001-0.0022	29%	0%
1,2-Dichloroethane	0.6	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=590&tid=110	1	17	0.0009	0.0008	0.0005-0.0025	0%	0%
				3	7	0.0002	0.0001	0.0001-0.0007	43%	0%
1,3,5-Trimethylbenzene	25	NIOSH	https://www.cdc.gov/niosh/npg/npgd0639.html	1	17	0.0009	0.0008	0.0005-0.0025	0%	0%
				3	7	0.0002	0.0001	0.0001-0.0012	29%	0%
1,4-Dichlorobenzene	0.01	MRL	https://www.cdc.gov/niosh/ipcsneng/neng0037.html	1	17	0.0009	0.0008	0.0005-0.0025	0%	0%
				3	7	0.0001	0.0001	0.0001-0.0007	14%	0%
2,2,4-Trimethylpentane	300	ACGIH	https://www.cdc.gov/niosh/ipcsneng/neng0496.html	1	17	0.0010	0.0008	0.0005-0.0025	6%	0%
				3	7	0.0003	0.0001	0.0001-0.0045	43%	0%
4-Ethyltoluene	Unknown	-	Not available	1	17	0.0011	0.0010	0.0005-0.0025	6%	-
				3	7	0.0002	0.0001	0.0001-0.0014	29%	-
Acetone	13	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=3&tid=1	1	17	0.0274	0.0220	0.01-0.13	71%	0%
				3	7	0.0390	0.0300	0.011-0.49	100%	0%
Acetonitrile	20	NIOSH	https://www.cdc.gov/niosh/ipcsneng/neng0088.html	1	-	-	-	-	-	-
				3	7	0.0030	0.0020	0.00025-0.038	86%	0%
Acrolein	0.003	MRL	https://www.atsdr.cdc.gov/PHS/PHS.asp?id=554&tid=102	1	-	-	-	-	-	-
				3	7	0.0004	0.0005	0.0001-0.0014	86%	0%

Indoor VOCs	Threshold to consider action (ppm)	Standard name	More information	Phase	Community results across all households tested					
					Number of homes tested	Geometric mean (ppm)	Median (ppm)	Range (ppm)	Detection frequency (%)	Percent above threshold (%)
Benzene	0.003	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=37&tid=14	1	17	0.0016	0.0018	0.0005-0.011	18%	12%
				3	7	0.0004	0.0004	0.0001-0.0082	57%	14%
Butane	800	NIOSH	https://www.cdc.gov/niosh/ipcsneng/neng0232.html	1	-	-	-	-	-	-
				3	7	0.0153	0.0120	0.0021-0.28	100%	0%
Carbon Disulfide	0.3	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=472&tid=84	1	17	0.0020	0.0020	0.001-0.005	6%	0%
				3	7	0.0003	0.0003	0.00025-0.00025	0%	0%
Chlorobenzene	75	OSHA	https://www.atsdr.cdc.gov/phs/phs.asp?id=487&tid=87	1	17	0.0009	0.0008	0.0005-0.0025	0%	0%
				3	7	0.0001	0.0001	0.0001-0.0005	29%	0%
Chloroform	0.02	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=51&tid=16	1	17	0.0009	0.0008	0.0005-0.0025	0%	0%
				3	7	0.0001	0.0001	0.0001-0.0002	14%	0%
Chloromethane	0.05	MRL	https://www.atsdr.cdc.gov/PHS/PHS.asp?id=585&tid=109	1	17	0.0009	0.0008	0.0005-0.0025	6%	0%
				3	7	0.0003	0.0005	0.0001-0.0006	71%	0%
Cumene	50	OSHA/NIOSH	https://www.cdc.gov/niosh/ipcsneng/neng0170.html	1	-	-	-	-	-	-
				3	7	0.0002	0.0001	0.0001-0.0009	43%	0%
Cyclohexane	300	OSHA/NIOSH	https://www.cdc.gov/niosh/ipcsneng/neng0242.html	1	17	0.0015	0.0018	0.0005-0.011	12%	0%
				3	7	0.0004	0.0002	0.0001-0.0052	57%	0%
Ethyl Acetate	400	OSHA/NIOSH	https://www.cdc.gov/niosh/npg/npgd0260.html	1	17	0.0010	0.0008	0.0005-0.003	24%	0%
				3	7	0.0018	0.0019	0.0003-0.0059	100%	0%
Ethyl Alcohol	1000	OSHA/NIOSH	https://www.cdc.gov/niosh/npg/npgd0262.html	1	-	-	-	-	-	-
				3	7	0.2182	0.2000	0.092-0.61	100%	0%
Ethylbenzene	0.06	MRL	https://www.atsdr.cdc.gov/PHS/PHS.asp?id=381&tid=66	1	17	0.0014	0.0018	0.0005-0.007	12%	0%
				3	7	0.0004	0.0002	0.0001-0.0056	71%	0%

Indoor VOCs	Threshold to consider action (ppm)	Standard name	More information	Phase	Community results across all households tested					
					Number of homes tested	Geometric mean (ppm)	Median (ppm)	Range (ppm)	Detection frequency (%)	Percent above threshold (%)
Formaldehyde[1]	0.008	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=218&tid=39	1	17	0.013	0.020	0.002-0.042	94%	35%
				3	7	0.013	0.020	0.002-0.06	86%	71%
Freon 11	1000	OSHA/NIOSH	https://www.cdc.gov/niosh/npg/npgd0290.html	1	17	0.0009	0.0008	0.0005-0.0025	0%	0%
				3	7	0.0005	0.0004	0.0003-0.0012	100%	0%
Freon 12	1000	OSHA/NIOSH	https://www.cdc.gov/niosh/npg/npgd0192.html	1	17	0.0009	0.0008	0.0005-0.0025	0%	0%
				3	7	0.0005	0.0005	0.0004-0.001	100%	0%
Heptane	85	NIOSH	https://www.cdc.gov/niosh/npg/npgd0312.html	1	17	0.0016	0.0018	0.0005-0.01	18%	0%
				3	7	0.0006	0.0006	0.0001-0.005	71%	0%
Hexane	0.6	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=391&tid=68	1	17	0.0023	0.0025	0.0005-0.016	29%	0%
				3	7	0.0008	0.0007	0.0001-0.02	71%	0%
Isopropyl Alcohol	400	OSHA/NIOSH	https://www.cdc.gov/niosh/ipcsneng/neng0554.html	1	17	0.0416	0.0665	0.0055-0.19	94%	0%
				3	7	0.0058	0.0050	0.0008-0.037	100%	0%
m,p-Xylene	100	OSHA	https://www.atsdr.cdc.gov/phs/phs.asp?id=293&tid=53	1	17	0.0031	0.0035	0.001-0.023	18%	0%
				3	7	0.0014	0.0008	0.00025-0.02	86%	0%
Methyl Ethyl Ketone	200	OSHA/NIOSH	https://www.cdc.gov/niosh/npg/npgd0069.html	1	17	0.0010	0.0008	0.0005-0.0025	12%	0%
				3	7	0.0011	0.0012	0.0003-0.0027	100%	0%
Methyl Isobutyl Ketone	50	NIOSH	https://www.cdc.gov/niosh/ipcsneng/neng0511.html	1	17	0.0036	0.0030	0.002-0.01	0%	0%
				3	7	0.0002	0.0001	0.0001-0.0008	43%	0%
Methyl Methacrylate	100	OSHA/NIOSH	https://www.cdc.gov/niosh/npg/npgd0426.html	1	-	-	-	-	-	-
				3	7	0.0001	0.0001	0.0001-0.0003	14%	0%

[1] Formaldehyde was measured using a 24-hour formaldehyde badge

Indoor VOCs	Threshold to consider action (ppm)	Standard name	More information	Phase	Community results across all households tested: Number of homes tested	Geometric mean (ppm)	Median (ppm)	Range (ppm)	Detection frequency (%)	Percent above threshold (%)
Methyl n-Butyl Ketone	1	NIOSH	https://www.atsdr.cdc.gov/phs/phs.asp?id=736&tid=134	1	17	0.0036	0.0030	0.002-0.01	0%	0%
				3	7	0.0002	0.0001	0.0001-0.0011	29%	0%
Methylene Chloride	0.3	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=232&tid=42	1	17	0.0009	0.0008	0.0005-0.0025	6%	0%
				3	7	0.0001	0.0001	0.0001-0.0006	29%	0%
Naphthalene	0.0007	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=238&tid=43	1	-	-	-	-	-	-
				3	7	0.0003	0.0001	0.0001-0.0019	43%	29%
Nonane	200	NIOSH	https://www.cdc.gov/niosh/npg/npgd0466.html	1	17	0.0000	0.0000	0-0	0%	0%
				3	7	0.0003	0.0002	0.0001-0.004	57%	0%
n-Propylbenzene	Unknown	-	Not available	1	-	-	-	-	-	-
				3	7	0.0002	0.0001	0.0001-0.0008	29%	-
o-Xylene	100	OSHA	https://www.atsdr.cdc.gov/phs/phs.asp?id=293&tid=53	1	17	0.0014	0.0018	0.0005-0.007	12%	0%
				3	7	0.0005	0.0003	0.0001-0.0072	71%	0%
Pentane	120	NIOSH	https://www.cdc.gov/niosh/npg/npgd0486.html	1	-	-	-	-	-	-
				3	7	0.0014	0.0012	0.0001-0.094	86%	0%
Propylene	0.009	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=1120&tid=240	1	17	0.0564	0.0545	0.003-0.81	100%	76%
				3	7	0.0607	0.0500	0.0014-4.2	100%	86%
Styrene	0.2	MRL	https://www.atsdr.cdc.gov/PHS/PHS.asp?id=419&tid=74	1	17	0.0009	0.0008	0.0005-0.0025	0%	0%
				3	7	0.0002	0.0001	0.0001-0.0013	43%	0%
Tert-Butanol	100	OSHA/NIOSH	https://www.cdc.gov/niosh/ipcsneng/neng0114.html	1	-	-	-	-	-	-
				3	7	0.0003	0.0003	0.00025-0.0005	14%	0%
Tetrachloroethylene	0.006	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=263&tid=48	1	17	0.0012	0.0008	0.0005-0.014	12%	12%
				3	7	0.0001	0.0001	0.0001-0.0006	14%	0%
Tetrahydrofuran	200			1	17	0.0009	0.0008	0.0005-0.0025	0%	0%

Indoor VOCs	Threshold to consider action (ppm)	Standard name	More information	Phase	Community results across all households tested					
					Number of homes tested	Geometric mean (ppm)	Median (ppm)	Range (ppm)	Detection frequency (%)	Percent above threshold (%)
		OSHA/NIOSH	https://www.cdc.gov/niosh/ipcsneng/neng0578.html	3	7	0.0005	0.0010	0.0001-0.0017	71%	0%
Toluene	1	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=159&tid=29	1	17	0.0047	0.0033	0.002-0.064	71%	0%
				3	7	0.0026	0.0018	0.0004-0.035	100%	0%
Vinyl Acetate	0.01	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=669&tid=124	1	17	0.0009	0.0008	0.0005-0.0025	0%	0%
				3	7	0.0012	0.0009	0.0003-0.015	100%	14%

Table 3: Outdoor VOCs

Outdoor VOCs	Threshold to consider action (ppm)	Standard name	More information	Phase	Community results across all households tested					
					Number of homes tested	Geometric mean (ppm)	Median (ppm)	Range (ppm)	Detection frequency (%)	Percent above threshold (%)
1,2-Dichlorobenzene	50	OSHA/NIOSH	https://www.cdc.gov/niosh/ipcsneng/neng1066.html	1	17	0.0005	0.0005	0.0005-0.0005	0%	0%
				3	8	0.0002	0.0001	0.0001-0.0058	13%	0%
1,4-Dichlorobenzene	0.01	MRL	https://www.cdc.gov/niosh/ipcsneng/neng0037.html	1	17	0.0005	0.0005	0.0005-0.0005	0%	0%
				3	8	0.0001	0.0001	0.0001-0.0009	13%	0%
2,2,4-Trimethylpentane	300	ACGIH	https://www.cdc.gov/niosh/ipcsneng/neng0496.html	1	17	0.0005	0.0005	0.0005-0.0005	0%	0%
				3	8	0.0001	0.0001	0.0001-0.0002	13%	0%
Acetone	13	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=3&tid=1	1	17	0.0050	0.0050	0.005-0.005	0%	0%
				3	8	0.0032	0.0029	0.0023-0.0048	100%	0%
Acetonitrile	20	NIOSH	https://www.cdc.gov/niosh/ipcsneng/neng0088.html	1	-	-	-	-	-	-
				3	8	0.0021	0.0016	0.0013-0.014	100%	0%

Outdoor VOCs	Threshold to consider action (ppm)	Standard name	More information	Phase	Community results across all households tested					
					Number of homes tested	Geometric mean (ppm)	Median (ppm)	Range (ppm)	Detection frequency (%)	Percent above threshold (%)
Acrolein	0.003	MRL	https://www.atsdr.cdc.gov/PHS/PHS.asp?id=554&tid=102	1	-	-	-	-	-	-
				3	8	0.0001	0.0001	0.0001-0.0003	13%	0%
Benzene	0.003	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=37&tid=14	1	17	0.0005	0.0005	0.0005-0.0005	0%	0%
				3	8	0.0001	0.0001	0.0001-0.0002	13%	0%
Butane	800	NIOSH	https://www.cdc.gov/niosh/ipcsneng/neng0232.html	1	-	-	-	-	-	-
				3	8	0.0003	0.0003	0.0001-0.005	63%	0%
Chloromethane	0.05	MRL	https://www.atsdr.cdc.gov/PHS/PHS.asp?id=585&tid=109	1	17	0.0005	0.0005	0.0005-0.0005	0%	0%
				3	8	0.0005	0.0005	0.0005-0.0005	100%	0%
Ethyl Acetate	400	OSHA/NIOSH	https://www.cdc.gov/niosh/npg/npgd0260.html	1	17	0.0005	0.0005	0.0005-0.0005	0%	0%
				3	8	0.0002	0.0001	0.0001-0.0067	25%	0%
Ethyl Alcohol	1000	OSHA/NIOSH	https://www.cdc.gov/niosh/npg/npgd0262.html	1	-	-	-	-	-	-
				3	8	0.0026	0.0020	0.0015-0.007	100%	0%
Formaldehyde[2]	0.008	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=218&tid=39	1	17	0.003	0.004	0.002-0.007	35%	0%
				3	8	0.005	0.006	0.004-0.006	100%	0%
Freon 11	1000	OSHA/NIOSH	https://www.cdc.gov/niosh/npg/npgd0290.html	1	17	0.0005	0.0005	0.0005-0.0005	0%	0%
				3	8	0.0004	0.0003	0.0002-0.0017	100%	0%
Freon 12	1000	OSHA/NIOSH	https://www.cdc.gov/niosh/npg/npgd0192.html	1	17	0.0005	0.0005	0.0005-0.0005	0%	0%
				3	8	0.0005	0.0005	0.0005-0.0007	100%	0%
Hexane	0.6	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=391&tid=68	1	17	0.0005	0.0005	0.0005-0.0005	0%	0%
				3	8	0.0001	0.0001	0.0001-0.0004	13%	0%

[2] Formaldehyde was measured using a 24-hour formaldehyde badge

Outdoor VOCs	Threshold to consider action (ppm)	Standard name	More information	Phase	Community results across all households tested					
					Number of homes tested	Geometric mean (ppm)	Median (ppm)	Range (ppm)	Detection frequency (%)	Percent above threshold (%)
Isopropyl Alcohol	400	OSHA/NIOSH	https://www.cdc.gov/niosh/ipcsneng/neng0554.html	1	17	0.0056	0.0050	0.005-0.012	12%	0%
				3	8	0.0005	0.0005	0.00025-0.0021	50%	0%
m,p-Xylene	100	OSHA	https://www.atsdr.cdc.gov/phs/phs.asp?id=293&tid=53	1	17	0.0010	0.0010	0.001-0.001	0%	0%
				3	8	0.0003	0.0003	0.00025-0.0007	13%	0%
Methyl Ethyl Ketone	200	OSHA/NIOSH	https://www.cdc.gov/niosh/npg/npgd0069.html	1	17	0.0005	0.0005	0.0005-0.0005	0%	0%
				3	8	0.0001	0.0001	0.0001-0.0004	38%	0%
Naphthalene	0.0007	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=238&tid=43	1	-	-	-	-	-	-
				3	8	0.0001	0.0001	0.0001-0.0003	13%	0%
o-Xylene	100	OSHA	https://www.atsdr.cdc.gov/phs/phs.asp?id=293&tid=53	1	17	0.0005	0.0005	0.0005-0.0005	0%	0%
				3	8	0.0001	0.0001	0.0001-0.0003	13%	0%
Pentane	120	NIOSH	https://www.cdc.gov/niosh/npg/npgd0486.html	1	-	-	-	-	-	-
				3	8	0.0002	0.0001	0.0001-0.0019	38%	0%
Propylene	0.009	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=1120&tid=240	1	17	0.0005	0.0005	0.0005-0.001	12%	0%
				3	8	0.0003	0.0003	0.00025-0.0012	13%	0%
Toluene	1	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=159&tid=29	1	17	0.0009	0.0008	0.0005-0.004	29%	0%
				3	8	0.0003	0.0002	0.0001-0.0012	50%	0%
Vinyl Acetate	0.01	MRL	https://www.atsdr.cdc.gov/phs/phs.asp?id=669&tid=124	1	17	0.0005	0.0005	0.0005-0.0005	0%	0%
				3	8	0.0001	0.0001	0.0001-0.0004	25%	0%

Some limitations exist when looking at the results for VOCs. First, the households who participated in both phases may be different from those who only participated in the first one. For example, one household may be closer to an emissions source or have different behaviors that may result in more or less VOCs in and around the home. Lastly, VOCs can come from many different sources. We cannot determine the source of any VOC measured in this analysis.

Monitoring for Hydrogen Sulfide

Hydrogen sulfide is a chemical that occurs naturally in natural gas and is associated with gas and oil operations, including gas compressor stations. Hydrogen sulfide was measured using a badge monitor for a period of 24 hours, both indoors and outdoors (Table 4).

Hydrogen Sulfide and Formaldehyde Gas Sampling Badges

Table 4: Hydrogen Sulfide

DEFINITIONS

Geometric mean: This is an average level measured in the community study.
Median: This is the middle level measured in the community study.
Range: This is the lowest to the highest level measured in the community study
Detection Frequency: This is the percent of homes in the community study with a measurable level
Percent Above Threshold: This is the percent of homes in the community study that detected a level equal to or higher than the level to consider action

Hydrogen Sulfide	Threshold to consider action (ppm)	Standard name	More information	Phase	Community results across all households tested					
					Number of homes tested	Geometric mean (ppm)	Median (ppm)	Range (ppm)	Detection frequency (%)	Percent above threshold (%)
Indoors	0.02	MRL	https://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=389&tid=67	1	16	0.0003	0.0003	0.0003-0.0003	0%	0%
	0.02	MRL	https://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=389&tid=67	3	7	0.0040	0.0040	0.0040-0.0040	0%	0%
Outdoors	0.02	MRL	https://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=389&tid=67	1	16	0.0003	0.0003	0.0003-0.0003	0%	0%
	0.02	MRL	https://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=389&tid=67	3	8	0.0040	0.0040	0.0040-0.0040	0%	0%

Monitoring for Fine Particulate Matter (PM2.5)

Particle pollution, also called particulate matter or PM, is a mixture of solids and liquid droplets floating in the air. Staff tested homes for fine particulate matter (PM2.5); this refers to the tiny size of the solid and liquid particles floating in the air. There are outdoor and indoor sources of fine particles.

Outdoor sources of fine particulate matter may generate from vehicle exhaust, fires or smokestacks, construction sites, unpaved roads, fields, burning of fuels, power plants and industries. Indoor sources of fine particulate matter may generate from tobacco smoke, cooking, burning candles, and operating fireplaces or other fuel (wood, propane, and other) burning appliances, and some hobbies. Pet dander and dust can also contribute to particulate matter levels. According to the EPA, indoor PM levels are dependent on several factors including outdoor levels, infiltration, types of ventilation and filtration systems used, indoor sources, and personal activities of occupants. In homes without smoking or other strong particle sources, indoor PM should be the same as, or lower than, outdoor levels.

Staff placed Dylos air quality monitors inside and outside homes to measure PM 2.5 for six days. 5 and Figures 3, 4, and 5 display the results.

DEFINITIONS

Min: This is the lowest level measured in the community study.
Max: This is the highest level measured in the community study.
Geometric mean: This is an average level measured in the community study.
Median: This is the middle level measured in the community study.
Peak: This is a level when the PM county at a home is above the community level (indoor peak = 90.9 and outdoor peak = 203.1). It is calculated by multiplying the middle level (median) during the baseline measurement (Phase 1) by 3 (Brown, 2014).
Percent of minutes above peak: This is the proportion of the total minutes measured at a home when PM counts were higher than the peak level (defined above).
Average duration of peaks: This is the average number of consecutive minutes where levels were above the peak level (defined above).
Median duration of peaks: This is the middle number of consecutive minutes where levels were above the peak level (defined above).
Time of day of minutes about peaks: This is the distribution of when the minutes measured above the peak level (defined above) occurred during the day

**Units = PM count per 0.01 ft^3.*

Table 5: Household PM Monitoring Using Dylos Monitors

Fine Particulate Matter Monitoring	Indoors			Outdoors		
	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
Total homes	17	-	7	17	9	7
Min*	2.4	-	8.1	1.8	0.1	13.1
Max*	4310.2	-	5351.4	5451.1	3774.0	2122.1
Geometric mean*	40.9	-	69.8	70.8	51.4	120.6
Median*	30.3	-	61.2	67.7	49.0	99.1
Peak*	90.9	-	90.9	203.1	203.1	203.1
Total minutes measured	134617	-	34718	144597	640489	40016
Percent of minutes above peak	22%	-	32%	15%	12%	31%
Average duration of peaks (minutes)	70.3	-	68.7	17.5	22.2	51.2
Median duration of peaks (minutes)	3	-	2	2	2	3
Time of day of minutes above peaks						
0:00 - 5:59	13%	-	22%	39%	41%	54%
6:00 - 11:59	25%	-	28%	38%	24%	25%
12:00 - 17:59	31%	-	21%	11%	11%	0%
18:00 - 23:59	31%	-	29%	11%	25%	21%

Some limitations exist when looking at the results for fine particulate matter. First, due to the small sample size true differences between measurements at each phase cannot be confirmed. Second, the households who participated in both phases may be different from those who only participated in the first one. For example, one household may be closer to an emissions source or have different behaviors that may result in more or less particulate matter in and around the home. The Dylos meters can be inaccurate due to environmental factors, such as temperature and high humidity, or from low PM2.5 concentrations. Lastly, particulate matter can come from many different sources. We cannot determine the source of any particulate matter counts measured in this analysis.

Figure 3:

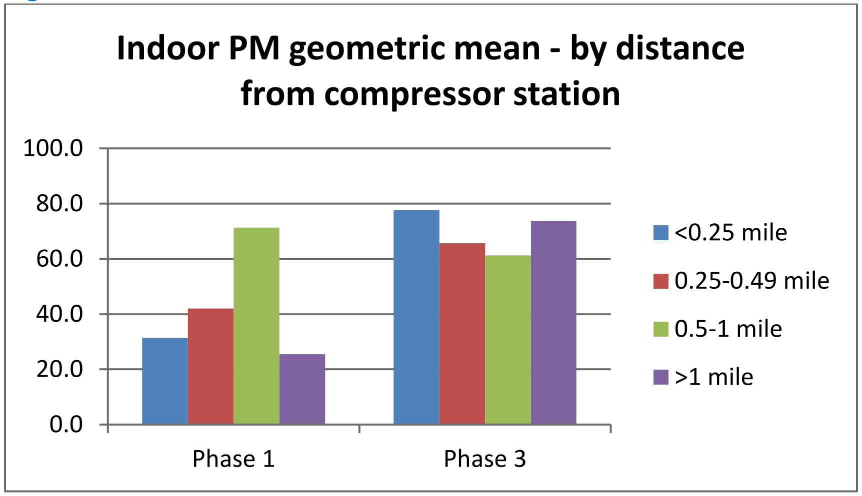


Figure 5:

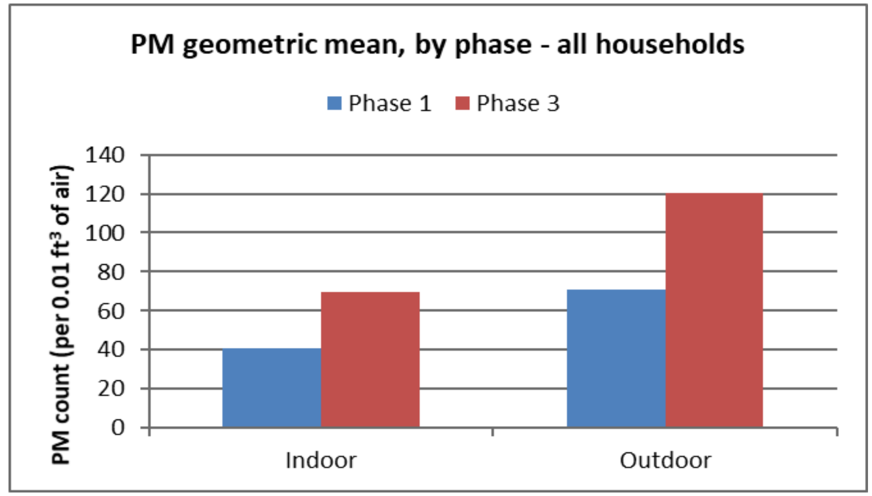
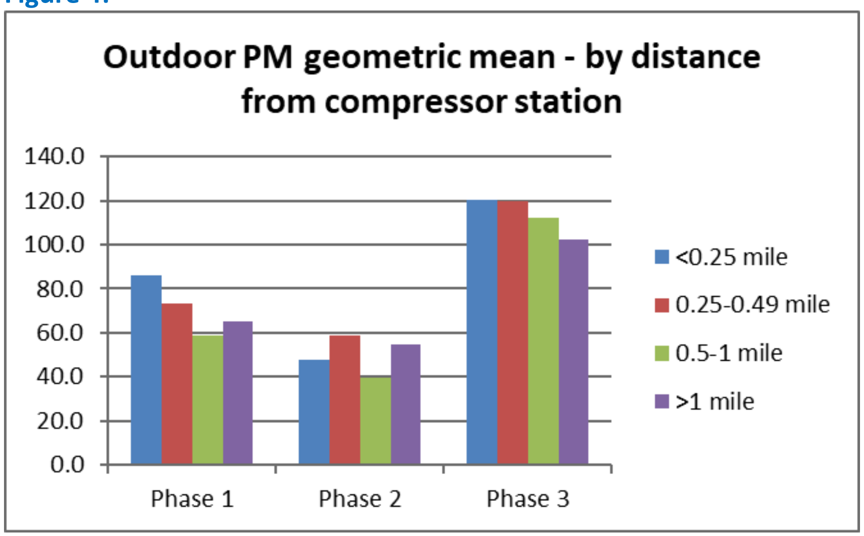


Figure 4:



Particulate Meter

Extended Monitoring for Outdoor Fine Particulate Matter (PM2.5)

Additional outdoor PM2.5 was collected using Speck monitors by Madison County Health Department in collaboration with the Southwest Pennsylvania Environmental Health Project (EHP). The Speck monitors allowed for the monitoring of particulate matter over an extended period of time, approximately 30-32 days. The EHP has conducted similar monitoring activities in other sites in New York, Pennsylvania, and Ohio. The speck monitors for this project were provided by EHP. Madison County Health Department staff placed the Speck monitors in four homes during all three project phases.

The EHP analyzed the data in comparison to similar monitoring activities the group has conducted at other sites. It is normal for peaks to occur occasionally, and there are many possible sources of peaks. The use of wood stoves, outdoor barbeque and heating with wood in winter can be significant sources of these peaks. The wind direction and wind speed from the compressor site or another nearby source could also affect these results. Figures 6 through 12 display the results.

Phase 1, October-November 2016:
The results for this location indicates overall good air quality. EHP bases this assessment on the relatively low baseline PM2.5 levels found and the low accumulated particle count.

Phase 2, May 2017:
The PM2.5 data for this location indicate that duration of peaks at all participating homes is lower than the average found at other sites. Other variables like peaks per day, time between peaks and baseline air quality are either below or above the average.

Phase 3, May-June 2018:
The PM2.5 data for this location indicate that baseline air quality is higher than the average found at other sites. Variables like peaks per day and duration of peaks are either below or above the average. Time between peaks is higher at two locations, which means there is less number of peaks occurring at these two locations. EHP conducted similar PM monitoring at other compressor station sites in Pennsylvania and New York, outside of this project. The red bar in Figures 6 – 10 represents the aggregate Speck monitor data at EHP across all study sites to date.

Speck Particulate Monitor

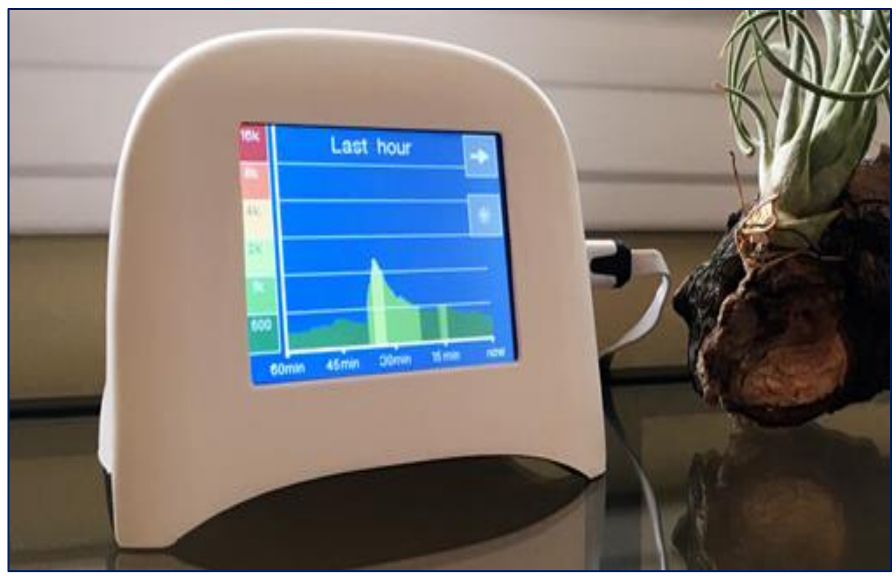


Figure 6: Peaks per Day by Phase

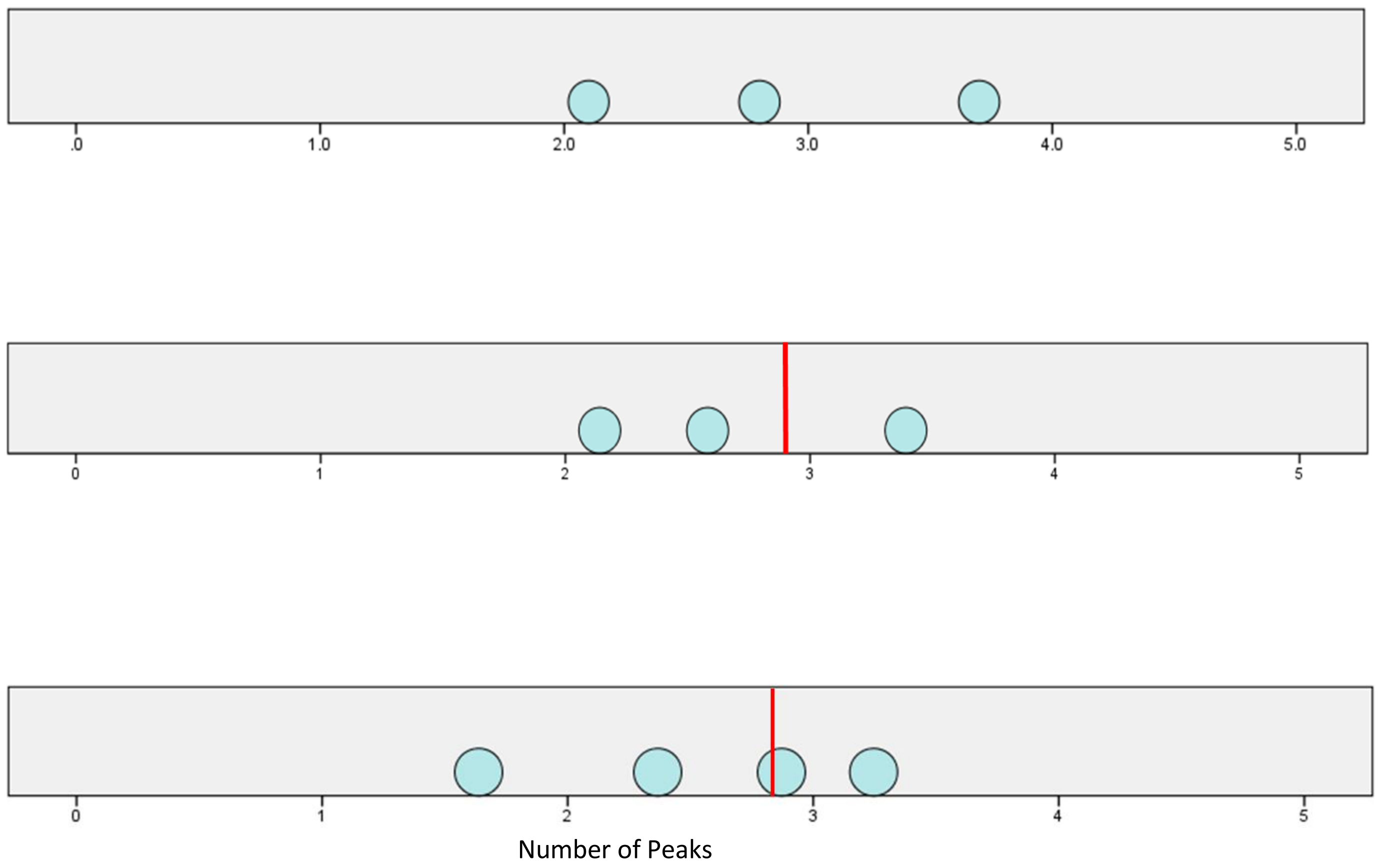
Represents the average results for outdoor air levels at one home

Marks the average (median) of all results compiled by the EHP of PA

Phase 1a (n=3[3])
This dot plot shows the average number of large scale changes (peaks) in air quality per day recorded by each Speck over a 32-day period. These results range from about 2 - 4 peaks/day.

Phase 2a (n=3[4])
This dot plot shows the average number of large-scale changes (peaks) in air quality per day recorded by each Speck over a 26-day period. These results range from about 2 to over 3.5 peaks per day.

Phase 3a (n=4)
This dot plot shows the average number of large-scale changes (peaks) in air quality per day recorded by each Speck over a 32-day period. These results range from about 1 to 4 peaks per day.



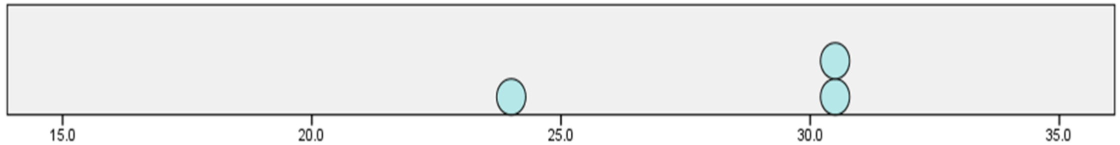
[3] One of four Speck monitors used gave unusual results, so data from that monitor was not included in the analysis.

Figure 7: Duration of Peaks by Time in Minutes by Phase

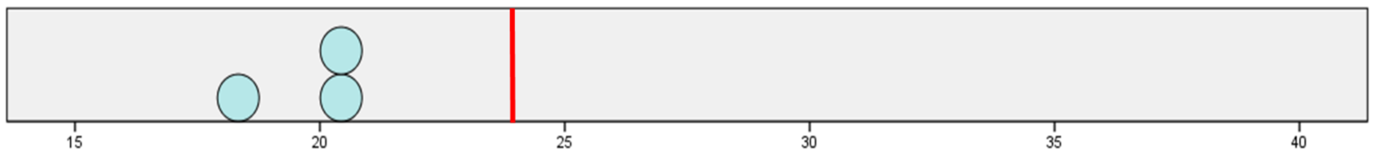
Represents the average results for outdoor air levels at one home

Marks the average (median) of all results compiled by the EHP of PA

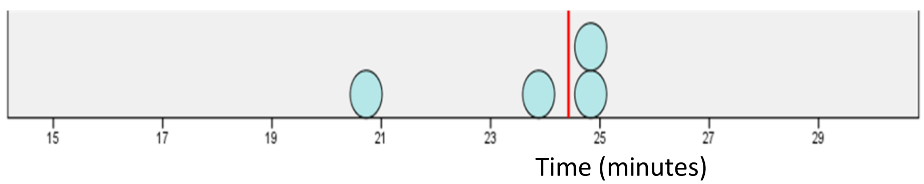
Phase 1b (n-=3[4])
This dot plot shows the average length of time peaks lasted. These results show a range of slightly below average to above average: from about 24 - 31 minutes/peak.



Phase 2b (n=3[5])
This dot plot shows the average length of time peaks lasted. These results show below average duration of peaks from about 18 - 20 minutes per peak.



Phase 3b (n=4)
This dot plot shows the average length of time peaks lasted. These results show a range from about 20 - 25 minutes per peak.



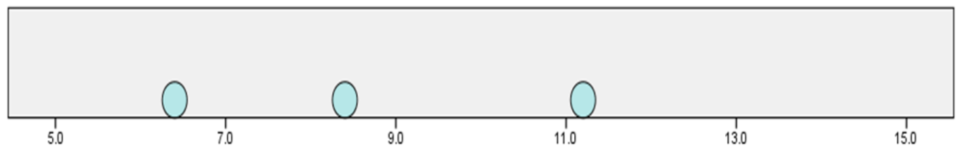
4 One of four Speck monitors used gave unusual results, so data from that monitor was not included in the analysis.

Figure 8: Time Between Peaks by Time in Hours by Phase

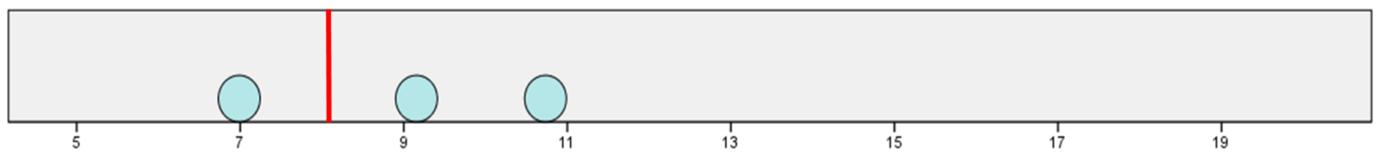
Represents the average results for outdoor air levels at one home

Marks the average (median) of all results compiled by the EHP of PA

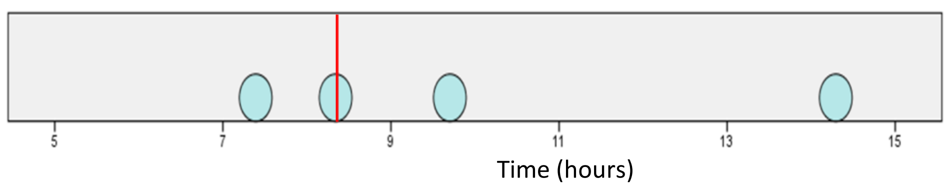
Phase 1c (n=3[5])
This dot plot shows the average length of time between peaks. The fewer the number of peaks, the greater the time period between peaks. These results range from about 6-11 hours, lower than average to slightly above.



Phase 2c (n=3[6])
This dot plot shows the average length of time between peaks. The fewer the number of peaks the greater the time period between peaks. These results range from about 7 - 11 hours, with 2 locations being above average.



Phase 3c (n=4)
This dot plot shows the average length of time between peaks. The fewer the number of peaks, the greater the time period between peaks. These results range from about 7-15 hours, with two locations above average.



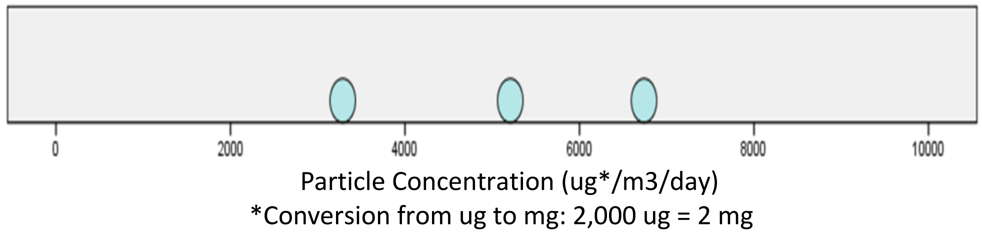
[5] One of four Speck monitors used gave unusual results, so data from that monitor was not included in the analysis.

Figure 9: Accumulated Particulate Matter by Particle Concentration (mg/m3/day) by Phase

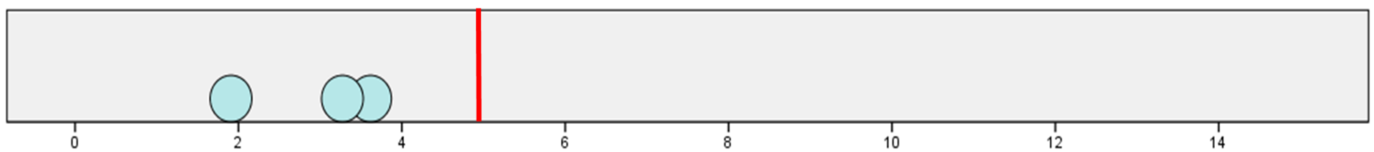
○ Represents the average results for outdoor air levels at one home

| Marks the average (median) of all results compiled by the EHP of PA

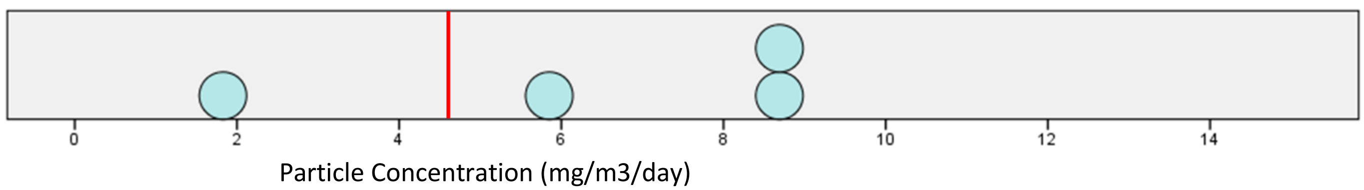
Phase 1d (n=3[6])
This dot plot shows the total sum of particle counts over the 32-day period for each outdoor Speck. These results show a range close to the average levels of accumulated PM2.5.



Phase 2d (n=3[7])
This dot plot shows the total sum of particle counts over a 26-day period for each outdoor Speck. These results show lower than the average levels of accumulated PM2.5.



Phase 3d (n=4)
This dot plot shows the total sum of particle counts over the 32-day period for each outdoor Speck. These results show a range above and below the average levels of accumulated PM2.5.



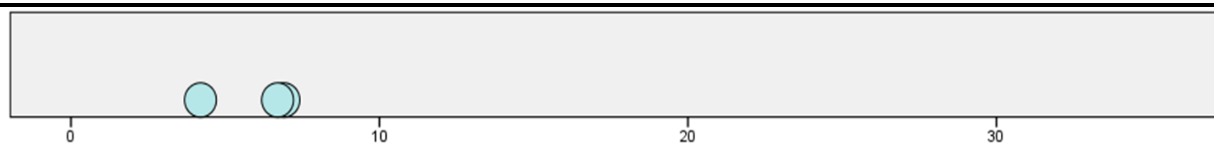
6 One of four Speck monitors used gave unusual results, so data from that monitor was not included in the analysis.

Figure 10: Baseline Air Quality by Particle Concentration (ug/m3) by Phase

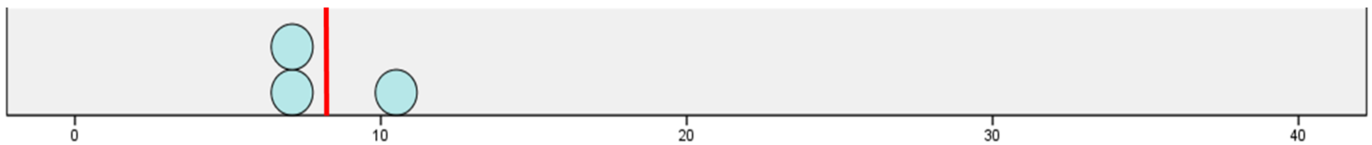
Represents the average results for outdoor air levels at one home

Marks the average (median) of all results compiled by the EHP of PA

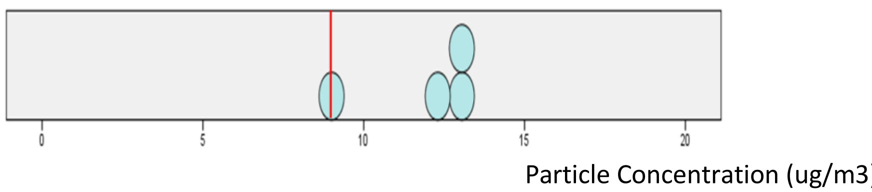
Phase 1e (n=3[7])
This dot plot shows the level of particles generally found outside when peaks are not occurring. These results show lower than average baseline outdoor air quality.



Phase 2e (n=3[8])
This dot plot shows the level of particles generally found outside when peaks are not occurring. These results show 2 locations being lower than average baseline outdoor air quality.

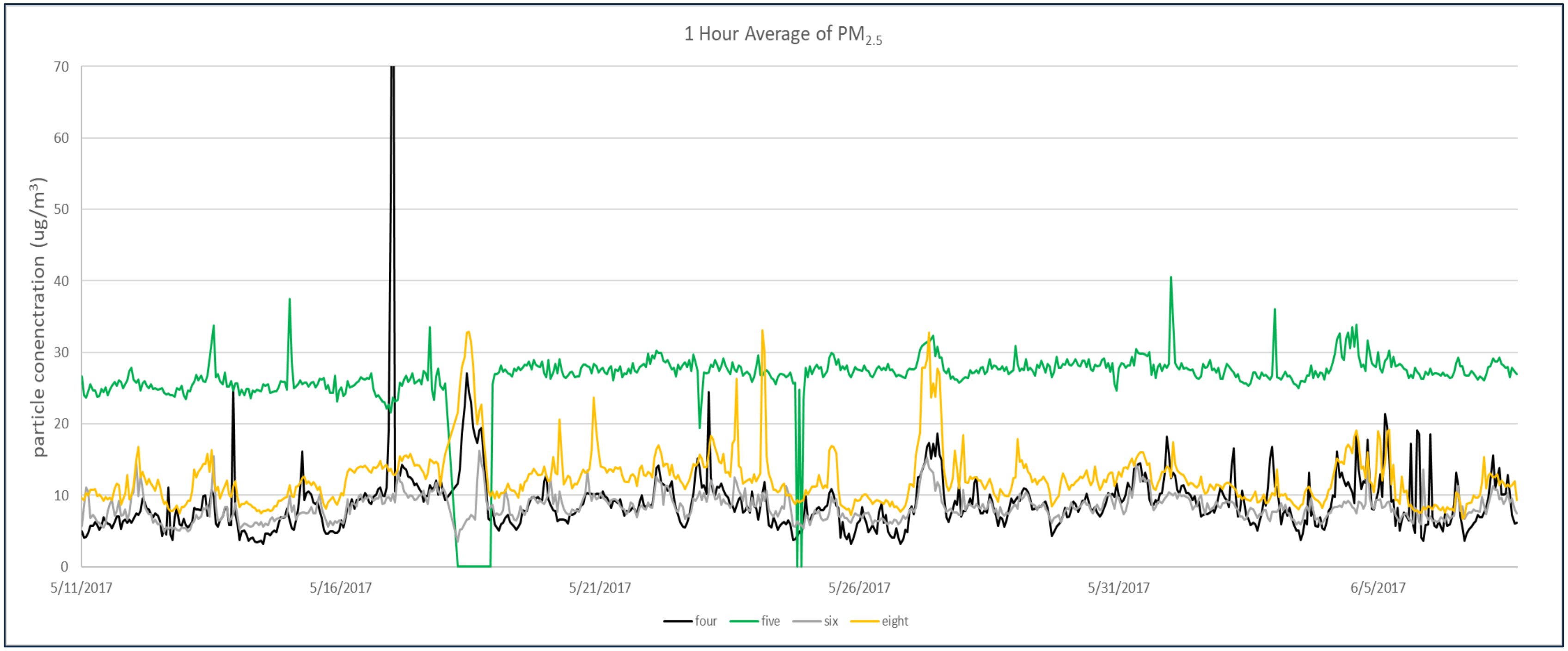


Phase 3e (n=4)
This dot plot shows the level of particles generally found outside when peaks are not occurring. These results show 3 locations being higher than average baseline outdoor air quality.



[7] One of four Speck monitors used gave unusual results, so data from that monitor was not included in the analysis.

Figure 11: Phase 2 Outdoor PM2.5 Results from 3 Locations, May 11-June 5, 2017[8]



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[8] The green line above in

Figure 11 represents data from the Speck that provided unusual results that may have been caused by an electronic malfunction. The lower three lines in show similar, more typical results.

Figure 12: Phase 3 Outdoor PM2.5 Results from 4 locations, May 21–June 20, 2018

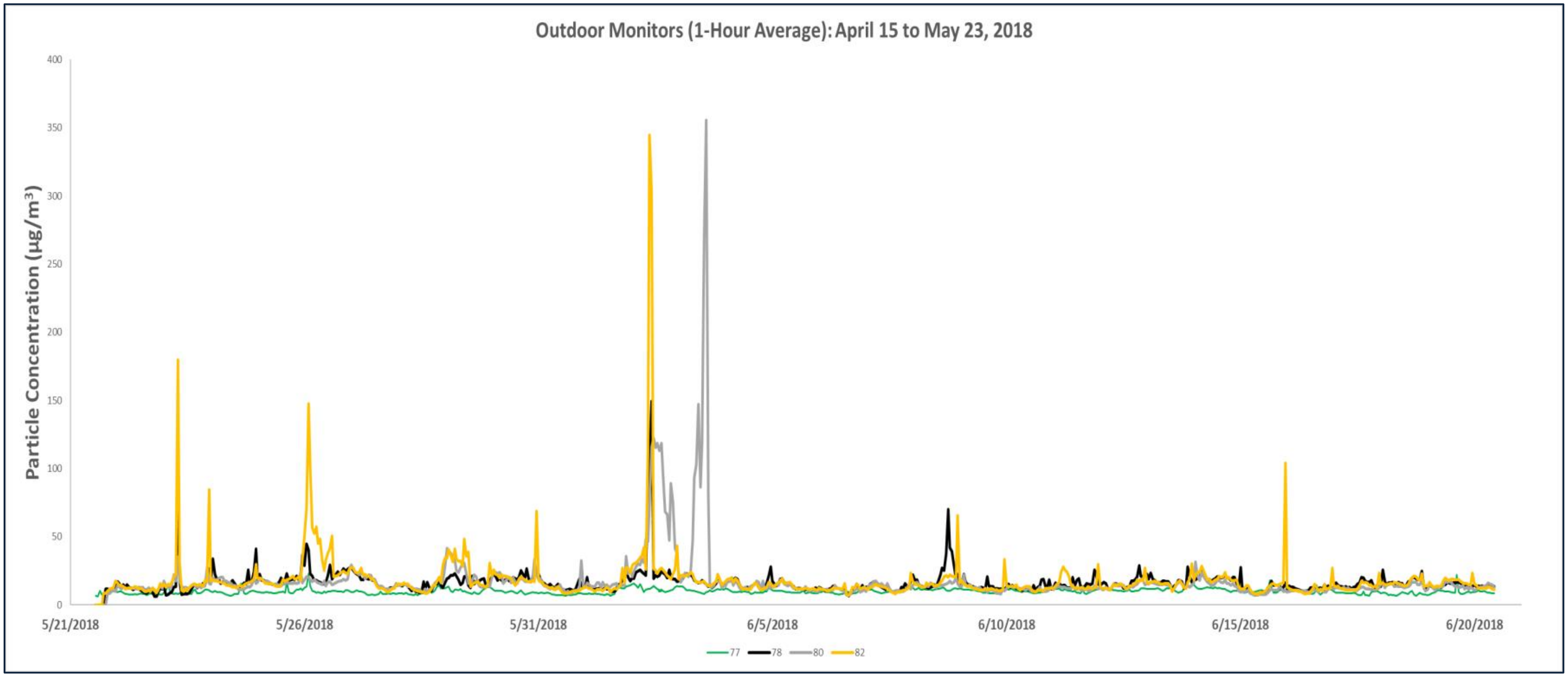

Figure 11 and Figure 12 show the results from the four outdoor Speck monitors placed in the community for about 30 days during two phases, construction and post-construction. There were many times when peaks in PM2.5 occurred simultaneously at all locations. This could indicate that there is a common source of increased particulate matter (PM) in the area. The source of PM responsible for these spikes cannot be determined.

Monitoring for Methane

Methane is a component of natural gas. Methane gas has the potential to leak from facilities where natural gas is stored, compressed, or transported. A baseline methane survey was conducted to document typical local ambient air methane levels prior to construction and operation of the proposed compressor station and likely sources of any atypical methane concentrations within the study area.

Methane samples were collected from equipment mounted on a vehicle along all roads within 1.25 miles of the proposed compressor station site location along with some additional surrounding areas (Figure 13). The methane survey was conducted on December 2, 2015, from noon to 6:30 pm.[9]

The methane data showed that over all 4 survey runs, the study area has an average methane concentration of 2.047 ppm (99% confidence interval 2.044 to 2.050 ppm). The survey runs, approximately 1 hour each, covered time intervals beginning at noon, 2:30, 3:40, and 5:50 PM.

The collected baseline methane data provided reasonable confirmation that methane levels in the study area display normal diurnal (daily) variations in methane concentration. The noon run had the highest average methane concentration at 2.096 ppm, which declined to 2.038 during the 2:30 run and 1.994 during the 3:40 PM run, rising again to 2.036 ppm during the 5:50 run. Methane concentrations in the study area and surrounding areas were consistent.

There were only 2 locations within the study area with notably elevated methane levels. The highest observed methane level was 3.29 ppm on Carpenter Road during the noon survey run (Figure 14). This elevated methane level appeared to be associated with a gas pipeline surface facility located just west (upwind) of Carpenter Road. However, the source of the methane causing this elevated methane level could not be confirmed as it occurred on only 1 of the 8 survey passes along Carpenter Road. It may have been due to a gas pressure vent or other brief operational release of gas from the pipeline facility.

The next highest methane level, 2.72 ppm, occurred during the 2:30 survey run on Williams Road in the vicinity of an animal farm (Figure 15). The elevated levels were present only during one pass of the 2:30 survey run, but the methane levels in the area were also slightly elevated more broadly over the Williams Road area during both the other 2 runs (noon and 5:50). The slight elevations and extended area were coincident with the observed locations of animals during the survey, clearly indicating the animal farm operation was the methane source.

The methane levels in the study area were consistent and similar to other areas in southern New York away from recognizable methane sources (natural gas infrastructure, industrial facilities, landfills, other waste management facilities, wetlands, etc.). The time pattern of methane concentrations over the four survey runs was consistent with typical diurnal variations in ambient air methane concentrations. As shown by data for

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[9] *Gas Safety Incorporated* conducted the Methane Survey with the results provided in the December 2015 Report to Madison County, entitled "Ambient Air Methane Survey in the Vicinity of Dominion Transmission, Inc. Natural Gas Pipeline Compressor Station Proposed to be Constructed in the Town of Georgetown, Madison County, New York"

the only 2 locations in the study area with exceptional methane levels, sources as limited as a small number of cattle, or small, brief releases from natural gas infrastructure were rare, but distinguishable within the survey data. Any similar or larger methane emissions sources will be readily detected in future, similarly run methane surveys.

Table 6: Methane Gas

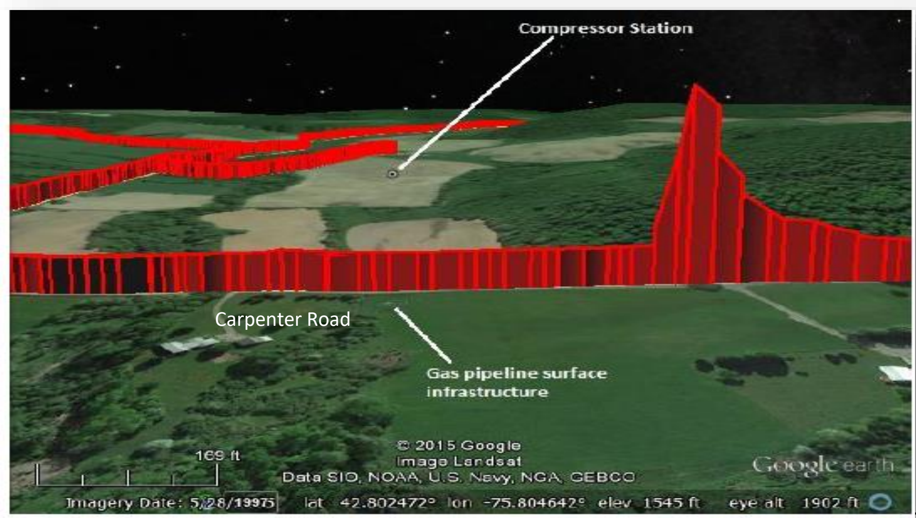
Methane Gas	Threshold Source	Threshold to Consider Action	Potential Health Effects of Parameter	Average Test Result	Result Range (Low-High)	Percent Over Threshold
Methane in ambient air	TBD	TBD	Flammable; excessive levels inhaled in excess of 500,000 ppm may cause death	2.047 ppm	1.8 -3.29 ppm	TBD

Figure 13: Map of Methane Survey Area

Baseline methane survey (2 December 2015) of natural gas compressor station health impacts study area. Overhead view showing (red lines) road course of methane survey vehicle.

Figure 14. Highest Detected Methane Level.

Baseline methane survey (2 December 2015) of natural gas compressor station health impacts study area – highest methane level encountered, 3.29 ppm, probably due to emission from gas pipeline infrastructure on Carpenter Road. Methane measurement locations indicated by vertical red lines. Methane concentrations indicated by height of vertical red lines. Methane concentrations at bottom of all vertical lines is 1.80 ppm, top of most vertical lines 2.10 ppm, top of highest vertical line 3.29 ppm.



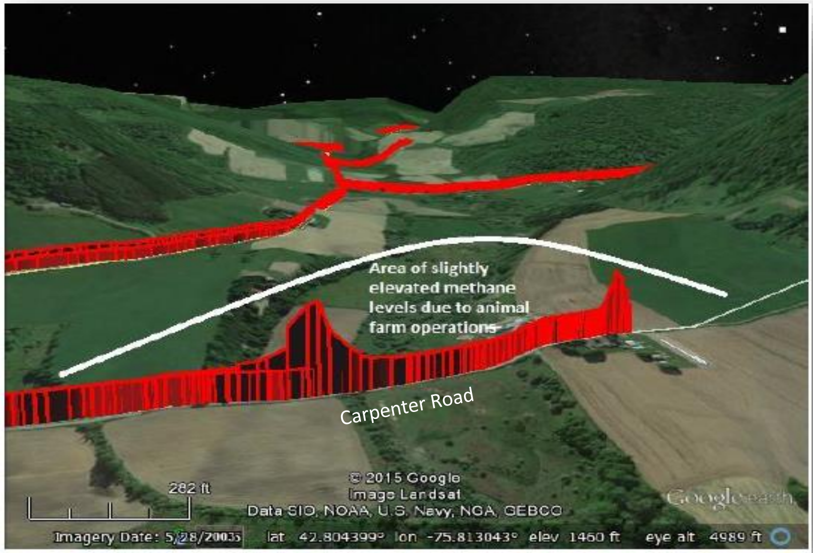


Figure 15. Second Highest Detected Methane Level.
Baseline methane survey (2 December 2015) of natural gas compressor station health impacts study area – 2nd highest methane level encountered, 2.72 ppm, associated with animal farm operation along Williams Road. Methane measurement locations indicated by vertical red lines. Methane concentrations indicated by height of vertical red lines. Methane concentrations at bottom of all vertical lines is 1.80 ppm, top of most vertical lines 2.04 ppm, top of highest vertical line 2.72 ppm.

Monitoring for Radon

Radon is a cancer-causing radioactive gas that may be a problem in homes. Although the U.S Environmental Protection Agency (U.S. EPA) believes that any exposure to radon carries some risk; no level is considered safe. The U.S. EPA recommends fixing a home to lower radon levels when test results are 4.0 picocuries per liter of air (pCi/L) or higher. Following the U.S. EPA guidance, a second follow-up test is recommended if a first result was 4.0 pCi/L or greater. When results were over 4.0 pCi/L, radon mitigation is recommended to lower the level of radon in a home.

A short-term charcoal radon detector from RTCA was placed in each participating home for two to seven days; *table 7 shows the results.*

Table 7: Radon Indoors

Radon Test Parameter	Threshold Source	Threshold to Consider Action	Potential Health Effects of Parameter	Average First Floor Radon Test Result	Result Range (Low-High) (n=17)	Percent Over Threshold
Radon Indoors	(US EPA, 2012)	4.0 pCi/L	Long-term exposure increases risk of lung cancer	3.01 pCi/L (first floor)	0.1 – 13.3 pCi/L	29.4%

NOISE MONITORING

A sound becomes unwanted when it either interferes with normal activities such as sleeping, or disrupts or diminishes one's quality of life. Health problems related to unwanted noise exposure can occur and may include effects such as hearing loss, annoyance, stress, sleeplessness, hypertension, and cardiovascular disease.

Table 8 depicts familiar sounds for comparison. For example, without proper hearing protection, running a chain saw for only two minutes can become dangerous to the human ear.

The Casella™ CEL-246 noise meter was used to record household and community noise levels every 10 seconds in decibels (dB). The noise meter used is a high quality instrument. The meter used does not record sound for playback and only detects levels between 29 and 100 decibels. MCDOH staff calibrated noise meters before placement for data collection.

To sample noise at households, noise meters were placed indoors and outdoors of seven households for a period of 24 hours during Phase 1 – May-July 2016, and a second time about 6 months after the gas compressor station became operational, Phase 3 – May 2018.

Table 8: Noise Levels of Familiar Sounds

Decibel Level (dB)	Average Noise Level by Activity (CDC, 2013)	Estimated Exposure Leading to Hearing Loss (CDC, 2013)	WHO Guidelines: Potential Critical Health Effects from Community Noise (WHO, 1999)
30 dB	Library or inside bedroom at night	Hearing loss unlikely	May begin to cause sleep disturbance at night-time
50 dB	Outdoor living area	Hearing loss unlikely	May cause sleep disturbance and moderate annoyance to outdoor living, day & evening
60 dB	Normal conversation or traffic	Hearing loss unlikely	May cause serious annoyance to outdoor living, day & evening
75 dB	Vacuum	Hearing loss unlikely	May cause serious annoyance to outdoor living, day & evening; May cause hearing impairment
85 dB	Garbage disposal	8 hrs	May cause hearing impairment
88 dB	Power lawn mower	4 hrs	May cause hearing impairment
91 dB	Food blender	2 hrs	May cause hearing impairment
94 dB	Motorcycle	1 hr	May cause hearing impairment
97 dB	Tractor	30 min.	May cause hearing impairment
100 dB	Hand drill	15 min.	May cause hearing impairment
103 dB	Impact wrench	7.5 min.	May cause hearing impairment
106 dB	Spray painter	<4 min.	May cause hearing impairment
109 dB	Chain saw	<2 min.	May cause hearing impairment
112 dB	Rock band	<1 min.	May cause hearing impairment
120 dB	Ambulance sirens	Immediate danger to hearing	May cause hearing impairment
150 dB	Firecracker or firearms	Immediate danger to hearing	May cause hearing impairment

Household Noise Levels

From the household noise level data collected, the average sound level (LAeq), and the "quiet background noise level" (L_{90}) during a given time period were calculated (Table 9). Staff measured noise levels in the homes over a four-day period. Weather varied during the sampling period, including times of high winds and rain.

Between the pre- and post-assessment:

- Across all households, about half (43%) had a greater than 10% increase in the "quiet background" noise level (L_{90}) indoors, while 71% had an increase in the "quiet background" level outdoors, see Table 9.
- One household had a greater than 10% increase in outdoor average noise level (LAeq). All other households' average noise levels, both indoors and outdoors either stayed the same or decreased between the 2 phases (construction versus post-construction).

Some limitations exist when looking at the summary of household noise results. First, there was not any information about what was happening acoustically during each household's monitoring period. Therefore, we cannot determine the source of any noise. A second limitation is the timing of the study. These randomly chosen days ideally represent a "normal" day in the area. However, it may be that the noise levels in the area were higher or lower than normal. Due to the limited by the number of noise meters available for project monitoring, household noise levels were measured on different days

Noise Meter

Table 9: Noise Level Percent Change Between Pre- and Post- Testing

Testing Across all households (n=7)	Lower by more than 10%	Within 10% - no change	Higher by more than 10%
LAeq			
Indoor	14%	86%	0%
Outdoor	43%	43%	14%
L_{90}			
Indoor	0%	57%	43%
Outdoor	0%	29%	71%

Community Noise Monitoring

Community noise sampling occurred at two different times; during construction and after the station became operational. Community noise levels were measured at four locations in each direction (East, South, West, and North) from the compressor station site, simultaneously for 30 continuous minutes. Noise levels were measured four times at various distances (0, 100, 200, and 300 meters) from the compressor station site. The weather during both sampling days was similar, with little to no wind and no precipitation.

Table 10 shows the L_{90} and LAeq levels between each phase by direction and distance from the compressor station. Figures 16 and 17 show these same statistics graphically. Generally, noise levels were similar to what we would expect in an outdoor living area (Table 8). During both sampling events, the loudest average noise was recorded at the North 200 meters location. This location is adjacent to US Route 80. The noise levels range between what we would expect from normal traffic (Table 8). Hearing loss would not be expected at any of these noise levels.

Table 10: Noise Levels by Phase and Distance

Measured Noise - LAeq [ave. level] and L_{90} [quiet background level] by Phase and by Distance from Shed's Compressor Station									
		0 meters		**100 meters**		**200 meters**		**300 meters**	
		P2	**P3**	**P2**	**P3**	**P2**	**P3**	**P2**	**P3**
L_{90}	**East**	41.6	36.7	34.8	41.7	35.3	34.2	34.1	34.0
	South	48.4	50.7	40.4	43.5	44.1	44.0	39.8	37.5
	West	46.6	46.5	43.2	43.1	44.8	44.5	49.2	41.3
	North	43.9	47.6	50.1	48.5	42.9	42.1	42.9	42.2
LA_{eq}	**East**	45.8	43.0	42.6	44.5	50.5	49.4	37.4	43.1
	South	52.4	51.7	47.7	45.8	50.3	46.0	41.7	42.8
	West	48.4	51.8	45.1	46.1	52.3	46.6	52.4	45.2
	North	50.7	49.6	52.6	52.1	62.5	73.1	48.0	47.9

A concern expressed by the local community living near the gas compressor station was the consistent low-level noise from the compressor station. Looking at the phase 3 results, there appears to be a decrease in L_{90} ("quiet background" noise level) when moving away from the gas compressor station. This indicates that there is a noise coming from the site (Figure 17). However, at the distances of the closest homes (≥200 meters) the L_{90} noise levels are similar to those recorded prior to the station becoming operational (Figure 16). This study cannot determine the direct source of any noise or how these noises may affect an individual physically or emotionally.

We acknowledge some additional limitations for all noise level monitoring. First, the noise meters cannot detect differences in certain sound frequencies. Thus, while there may be similar noise levels, what that noise sounds like to the human ear may be different. A second limitation is the timing of the study. These randomly chosen days ideally represent a "normal" day in the area. However, it may be that the noise levels in the area were higher or lower than normal.

Figure 16: Construction Phase 2, September 11, 2017

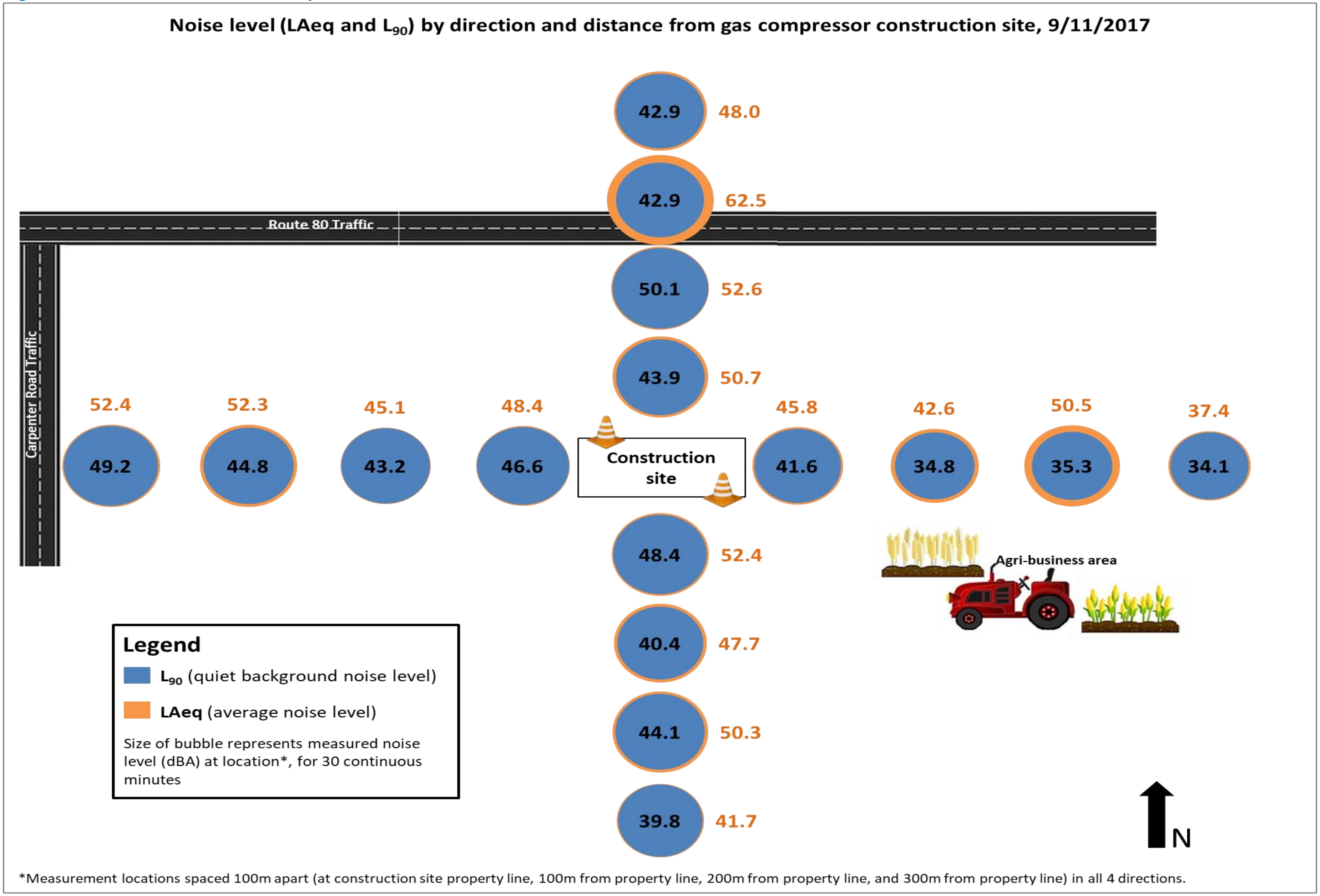
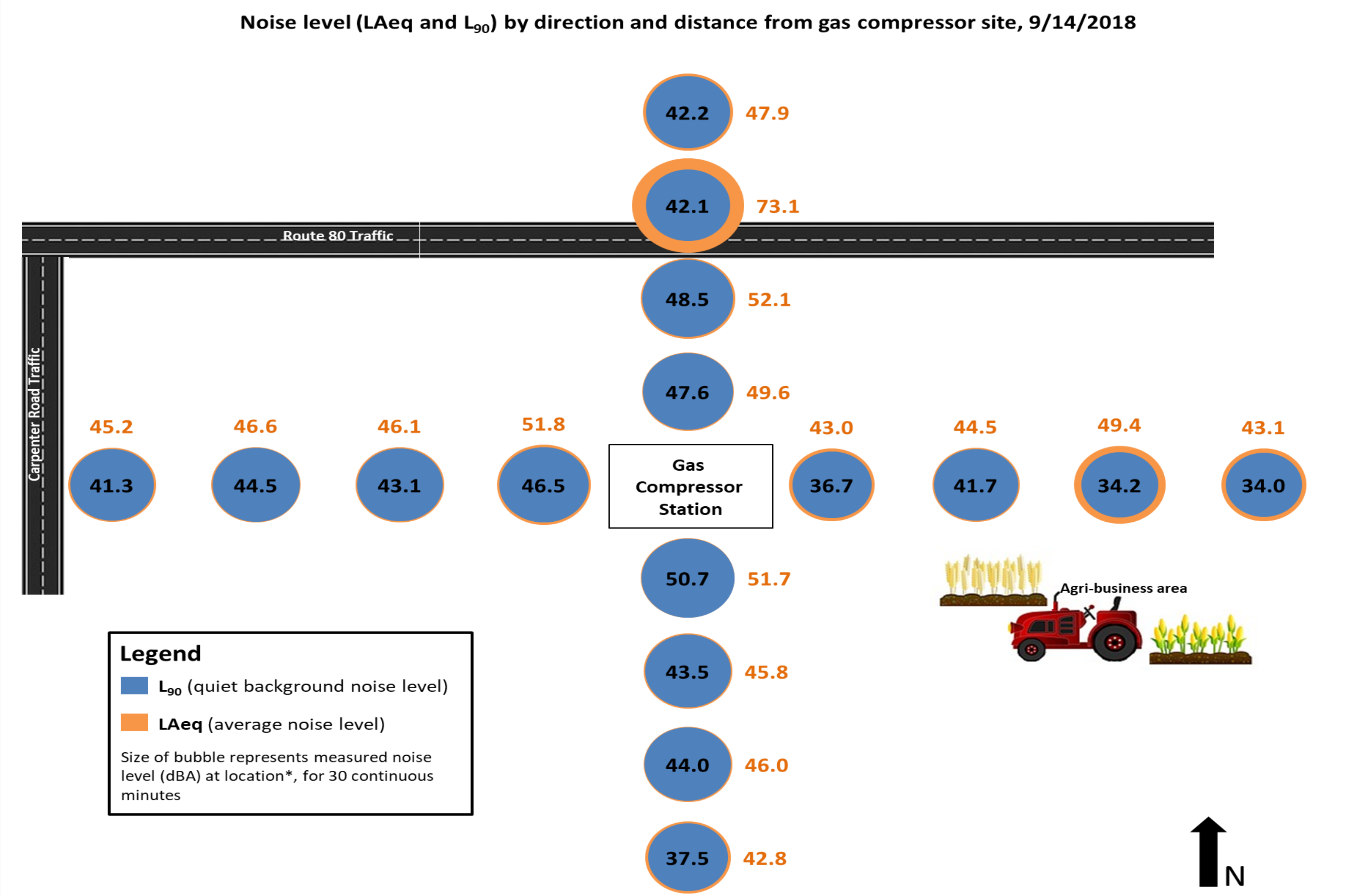


Figure 17: Post-Construction Phase 3, September 14, 2018



*Measurement locations spaced 100m apart (at construction site property line, 100m from property line, 200m from property line, and 300m from property line) in all 4 directions.

HOME ENVIRONMENTAL ASSESSMENT

All participating households completed two home environmental assessments. Once, prior to the gas compressor station's construction (Phase 1 – November 2015), and a second time about six months after it became operational (Phase 3 – May 2018). The assessment asks about characteristics of the home (e.g., heating source), recent changes made by the owner/tenant (e.g., new furniture), and observed environmental conditions (e.g., unusual odors) that are known to have the potential to impact air quality and health. All 17 households completed the assessment during the first phase, and of those, seven completed it in the third phase. No major differences were observed among the households who completed the survey in each phase. Between the pre- and post-assessment (Table 11):

- There were not any observed changes in water quality.
- A higher proportion of households reported that dust in the home increased over the past two months.
- Fewer households reported any unusual odors.
- There were not any reports of changes in households' gardens (e.g., taste, ability to grow).

Some limitations exist with the results. First, due to the small sample size true differences in answers between the pre- and post-assessments cannot be confirmed. Second, the households who completed both assessments may be affected differently by the compressor station than those who only completed only the first one.

Table 11: Home Environmental Assessment

Observations	Phase 1 n (%)	Phase 3 n (%)
Total houses	17 (-)	7 (-)
Any changes in water	0 (0%)	0 (0%)
Any changes in garden (e.g., taste or ability to grow) (if garden)	0 (0%)	0 (0%)
Any unusual odors in the air	2 (12%)	0 (0%)
Outside	0 (0%)	0 (0%)
Inside	2 (12%)	0 (0%)
In the past 2 months, the dust in the home…		
Increased	0 (0%)	2 (29%)
Stayed the same	17 (100%)	5 (71%)
Decreased	0 (0%)	0 (0%)
Carbon monoxide detector alarmed in past 3 months (if have CO detector)*	0 (0%)	0 (0%)
Any problems with mold in the home	2 (12%)	2 (29%)

*Carbon monoxide (CO) is an odorless gas that produced in homes with fuel burning appliances such as gas, oil or wood fuel-burning appliances and homes with a chimney.

Home Environment and Health

Below is a descriptive list of common conditions found in homes known to have the potential to impact air quality and health (US HUD and US EPA). The summary of the related responses provided from the self-administered home environmental assessment follow each list item below.

A. Pets and other animals can increase the amount of dust and dander in a home and trigger asthma and allergies.

- 76% (13/17) of households reported having at least one pet.
- 18% (3/17) of households also reported having at least one farm animal.

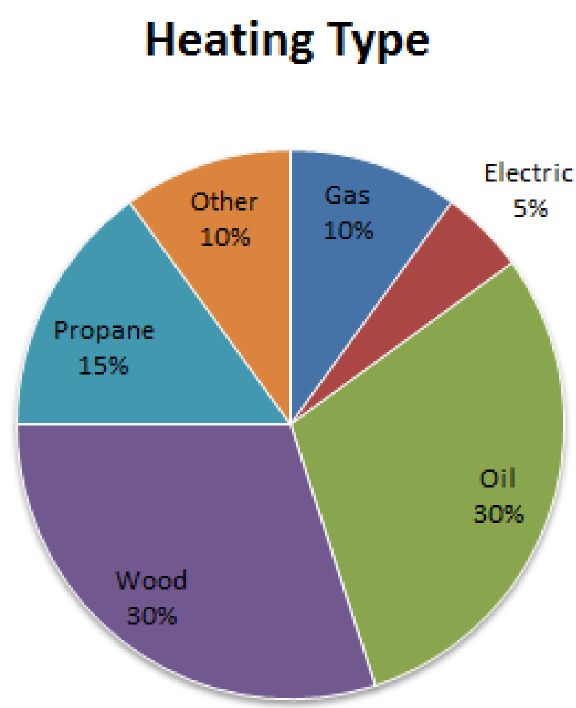
B. Non-Vented Kitchens and Bathrooms may have poor ventilation and air circulation, which can increase moisture in a home and result in condensation and high humidity, mold, increase in odors, and an overall decrease in air quality. Symptoms associated with an increase in indoor moisture may include upper respiratory symptoms, cough, wheezing, and asthma.

- 71% (12/17) of households reported having a ventilated bathroom.
- 65% (11/17) of households reported having a ventilated kitchen.
- 13% (2/16) of households reported having had a mold problem.

C. Homes heating sources such as oil, kerosene, wood, propane, or coal add to the level of fine particulate matter in a home and the air, decreasing air quality that may affect health and lead to or trigger respiratory problems.

- The top three homes heating sources households reported was wood (30%), oil (30%), or propane (15%), see figure 6.
- 47% (8/17) of households reported having either a working gas or wood burning fireplace.

D. Carbon monoxide (CO) is an odorless gas produced in homes with fuel burning appliances such as gas, oil or wood fuel-burning appliances and homes with a chimney. Exposure to CO gas may cause symptoms of headaches, dizziness, weakness, upset stomach, vomiting, chest pain, confusion, and death.



- 71% (12/17) of households reported having at least one gas appliance in their home.
- 65% (11/17) of households reported having a carbon monoxide detector in their home.

E. Radon is a cancer-causing, naturally occurring radioactive gas that may be present in homes, affected most by soil type and geology. Radon is the second leading cause of lung cancer in the U.S. today.

  - 6% (1/17) of households reported having tested their home previously for radon.
  - 100% (17/17) of households have now had their homes tests for radon as part of this project's baseline monitoring.

F. Homes built before 1950 are most likely to have lead in paint and water pipes or have lead in the solder that joins pipes together. Risk of exposure to lead and lead poisoning is higher in older homes. Lead in household paint was banned in 1978, however many older homes still have lead in them. Lead is highly toxic and exposure through ingestion or inhalation may cause damage to the brain and nervous system, hearing loss, and learning and behavior problems.

  - 19% (3/16) of households that responded reported that their home was built before 1970.

G. Houses built between 1930 and 1950 are most likely to have asbestos as insulation. Asbestos materials in a home may become damaged over time. Damaged asbestos may release asbestos fibers and become a health hazard. Asbestos may also be present in textured paint and in patching compounds used on wall and ceiling joints. Their use was banned in 1977. Some roofing and siding shingles are made of asbestos cement. Artificial ashes and embers sold for use in gas-fired fireplaces may contain asbestos. Older products such as stove-top pads may have some asbestos compounds. Walls and floors around wood burning stoves may be protected with asbestos paper, millboard, or cement sheets. Asbestos is found in some vinyl floor tiles and the backing on vinyl sheet flooring and adhesives. Hot water and steam pipes in older houses may be coated with an asbestos material or covered with an asbestos blanket or tape. Oil and coal furnaces and door gaskets may have asbestos insulation. Breathing in asbestos can affect respiratory health and may lead to lung disease through long-term exposure.

  - 100% (17/17) of households reported that no asbestos was known to be in their home.

H. The use of pesticides or herbicides (bug or weed killers, flea or tick sprays, collars, powders, or shampoos) in a home, lawn, garden, or on pets may pose a health concern. Contact with pesticides or herbicides may cause skin or respiratory problems, or may increase the chance of accidental poisoning from ingestion when products are not used or stored properly.

  - 50% (8/16) of households that responded reported having used pesticides or herbicides in their house or garden.

I. New furniture, carpet, vinyl flooring or refinished furniture may contain high levels of formaldehyde, which is a chemical that is a known carcinogen (cancer-causing agent). Exposure to formaldehyde can lead to symptoms such as a sore throat, cough, scratchy eyes, and/or nosebleeds.

- 12% (2/17) of households reported having recently acquired new furniture, carpet, vinyl flooring or refinished furniture.

J. Winterizing a home may increase efficiency of heating or cooling systems, but it also can prevent harmful gases from "leaking out" of the home. As such, winterized homes have the potential to increase both home radon levels and the levels of indoor air contaminants.

- 12% (2/17) of households reported recently winterizing their home.
- 12% (2/17) of households also reported remodeling their home in the last six months.

TRAFFIC COUNTS

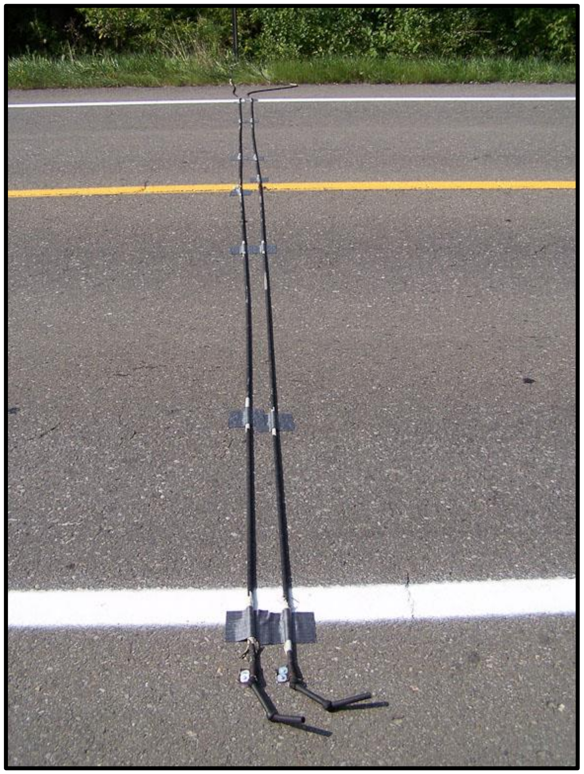
Community Traffic Monitoring

Traffic counts were measured by the Madison County Department of Transportation on NY Route 80, and on Carpenter Road. Counts were collected for 3-6 continuous days, at 3 different time periods: 1) prior to the gas compressor station's construction (Phase 1 – July 2015); 2) during the gas compressor station's construction (Phase 2 – May 2017); and 3) about 6 months after the gas compressor station became operational (Phase 3 – July/August 2018). The Average Daily Traffic (ADT) count during the time period was calculated (Figures 18 and 19). The counting instrument was able to differentiate between these different types of vehicles:

- Autos (standard cars) and motorcycles;
- Pick-up trucks, vans, and motorhomes; and
- Heavy trucks.

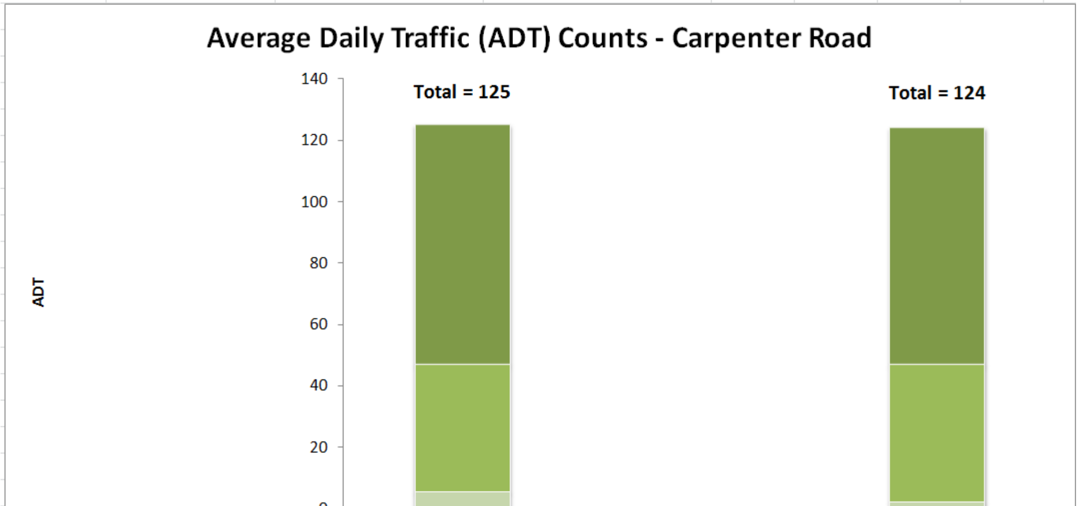
On Capenter Road, there does not appear to be a change in the ADT overall, or by type between pre- and post-construction (Figure 18).

On NY Route 80, there was a slight decrease in the overall ADT between Phase 1 and Phase 2 (construction) (Figure 19). However, the average number of autos and motorcycles decreased (decrease of 126), while there was an increase in the average number of heavy trucks (increase of 61) and pickups, vans, and motorhomes (increase of 53). It cannot be determined if these vehicles were related to construction activities from these data. An ADT of 149 more vehicles traveled on the road between Phase 1 and Phase 3. Heavy trucks (increase of 75) and pickups, vans, and motorhomes (increase of 75) were responsible for this increase. There is no way to determine if this increase is due to the gas compressor station being in the area from these data.



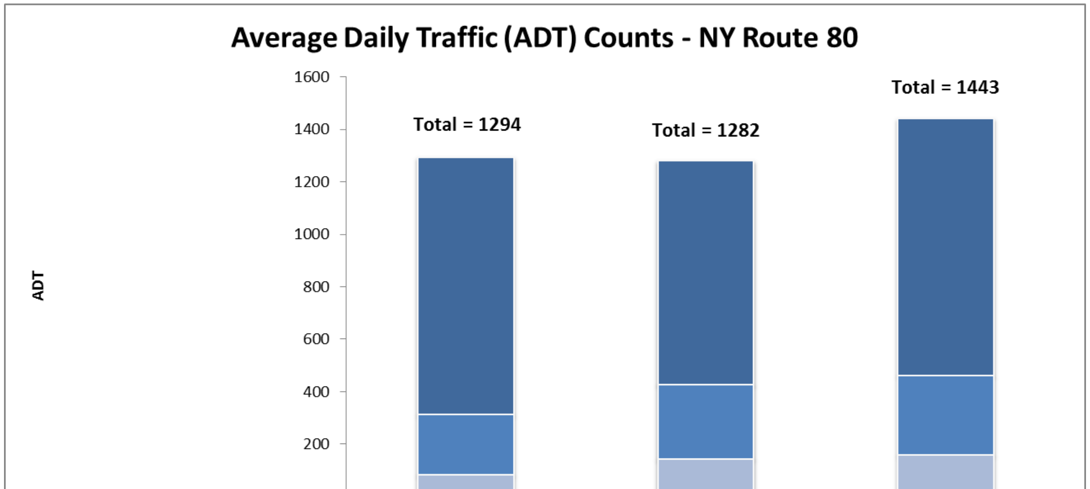
Traffic Counter

Figure 18



	Baseline: Phase 1 (July 2015)	Construction: Phase 2 (May 2017)	Operation: Phase 3 (July/Aug. 2018)
Autos and motorcycles	78	0	77
2 axle, 4-tire pickups, vans, motorhomes	41	0	45
Heavy trucks	6	0	2

Figure 19



	Baseline: Phase 1 (July 2015)	Construction: Phase 2 (May 2017)	Operation: Phase 3 (July/Aug. 2018)
Autos and motorcycles	981	855	980
2 axle, 4-tire pickups, vans, motorhomes	230	283	305
Heavy trucks	83	144	158

WATER QUALITY

Individual Onsite Water: Monitoring Water Contaminants

All participating households have individual onsite water systems. Water samples were collected from each household's individual onsite water source (well or spring) and tested for sources of contamination and physical characteristics. Contaminants found in water may cause illness or have the potential to impact health. The physical characteristics of the water samples were examined as they can impact the taste and/or look of the water, as well as, indicate other problems that could affect the performance of a water system, and subsequently impact water quality. In addition, visual observations of the physical water systems were made to identify factors that may impact water quality. Water sample analysis was based on the New York Standards for Individual Onsite Water Supply and Individual Onsite Wastewater Treatment Systems (NYSDOH, 2016) and for contaminants associated with gas compressor station operations (Tables 12 & 13). Where a standard did not exist for a contaminant or physical characteristic, other sources, such as proposed standards and/or health advisory levels were used to provide guidance for comparison. In some cases, the level for comparison is yet to be determined (TBD) pending further research.

Table 12: Water Contaminants

Water Contaminant Test Parameter	Threshold Source	Threshold to Consider Action	Potential Health Effects of Parameter	Average Water Test Result	Result Range (Low-High) (n=17)	Percent Above Threshold
Total Coliform	(NYSDOH, 2006a)	Any positive result is unsatisfactory	Provides a general indication of the sanitary condition of a water supply and indicates the potential presence of other harmful bacteria	---	10 negative 7 positive	41%
E. coli	(NYSDOH, 2011)	Any positive result is unsatisfactory	Indicator of possible disease causing organism, e.g. gastrointestinal illness	---	14 negative 3 positive	18%
Barium	(NYSDOH, 2011)	2 ppm	Increase in blood pressure	0.101 ppm	0.012 – 0.6 ppm	0%
Sodium	(NYSDOH, 2006a)	20 ppm* 270 ppm**	Effects blood pressure; *Greater than 20 ppm should not be consumed if on a severely restrictive sodium diet and **Greater than 270 ppm is not recommended for consumption if on a moderately restricted sodium diet	53.541 ppm	1.6 – 560 ppm	24%
Strontium	(ODOH)	4 ppm-lifetime health advisory	Naturally occurring Strontium may cause growth deformities; Radioactive	0.274 ppm	0.045 – 1.1 ppm	0%

Water Contaminant Test Parameter	Threshold Source	Threshold to Consider Action	Potential Health Effects of Parameter	Average Water Test Result	Result Range (Low-High) (n=17)	Percent Above Threshold
		25 ppm-one day health advisory	Strontium may attack bone marrow and soft tissues developing into anemia and leukemia			
Arsenic	(NYSDOH, 2006a)	0.01 ppm	Skin damage or problem with circulatory system	0.002 ppm	0.002 – 0.003 ppm	0%
Copper	(US EPA, n.d.)	1.3 ppm	Short-term gastrointestinal distress; Long-term liver or kidney damage; metallic taste; blue-green staining; Corrosion of household plumbing systems	0.026 ppm	0.001 – 0.25 ppm	0%
Lead	(NYSDOH, 2006a)	0.015 ppm	Brain, nerve and kidney damage (especially in infants and children)	0.001 ppm	0.001 ppm	0%
Mercury	(NYSDOH, 2011)	0.002 ppm	Kidney damage	Not detected	Not detected	0%
Toxaphene	(NYSDOH, 2011)	0.003 ppm	Kidney, liver, or thyroid problems; increased risk of cancer	Not detected	Not detected	0%
2,4 D	(NYSDOH, 2011)	0.05 ppm	Kidney, liver, or adrenal gland problems	Not detected	Not detected	0%
Dalapon	(US EPA, n.d.)	0.2 ppm	Minor kidney changes	Not detected	Not detected	0%
VOC's includes BTEX	(NYSDOH, 2011)	0.005 µg/l	Increased risk of cancer, anemia, blood problems depending on the specific VOC	Not detected	Not detected	0%
Nitrate	(NYSDOH, 2006a)	10 ppm	Infants: consuming could lead to *blue-baby syndrome* from lack of oxygen to the body's cells and tissues	2.169 ppm	0.038 – 9.6 ppm	0%
Nitrite	(NYSDOH, 2006a)	1 ppm	Infants: consuming could lead to *blue-baby syndrome* from lack of oxygen to the body's cells and tissues	Not detected	Not detected	0%
Gross Alpha	(NYSDOH, 2011)	15 pCi/l	Increased risk of cancer	0.86 ppm	-0.86 – 2.95 ppm	0%
Gross Beta	(NYSDOH, 2011)	50 pCi/l	Increased risk of cancer	0.92 ppm	-0.21 – 1.89 ppm	0%

Individual Onsite Water: Monitoring Water Characteristics

Table 13: Water Characteristics

Water Quality Parameter	Threshold Source	Threshold to Consider Action	Potential Health Effects of Parameter	Average Water Quality Test Result	Result Range (Low-High) (n=17)	Percent Above Threshold
Ethane	TBD	TBD	Causes flammable vapors; inhalation may cause mild intoxication, drowsiness, or loss of coordination	Not detected	Not detected	TBD
Methane	(USGS, 2016)	>10 ppm > 28 ppm*	Breathing in high gas levels could lead to suffocation, and/or gas released into the air if allowed to accumulate in a confined space could ignite or explode *indicates a potential explosive environment in an enclosed area with an ignition source	4.56 ppm	0.013 – 23 ppm	6%
Oil and Grease (TPH)	(MA DEP, 2004)	0.2 ppm	Acute exposure at high concentrations can affect the central nervous system and with such symptoms as lethargy, confusion, headache, dizziness and nausea	Not detected	Not detected	0%
Calcium	(WHO, 2009)	TBD	TBD	39.563 ppm	14 – 87 ppm	TBD
Manganese	(NYSDOH, 2006a)	0.3 ppm (Iron plus manganese 0.5 ppm)	Black to brown staining of fixtures or clothes, bitter metallic taste	0.098 ppm	0.011 – 0.24 ppm	0%
Surfactants	TBD	TBD	TBD	Not detected	Not detected	TBD
Chloride	(NYSDOH, 2011)	250 ppm	Salty taste; may increase rates of corrosion of metals in the distribution system, depending on the alkalinity of the water	57.53 ppm	1 – 380 ppm	6%
Fluoride	(NYSDOH, 2011)	2.2 ppm	Lack of fluoride may cause cavities; excessive fluoride may cause stained or pitted teeth	0.23 ppm	0.1 – 1 ppm	0%

Water Quality Parameter	Threshold Source	Threshold to Consider Action	Potential Health Effects of Parameter	Average Water Quality Test Result	Result Range (Low-High) (n=17)	Percent Above Threshold
Total Suspended Solids (TSS)	(State of Michigan)	>40 ppm* >150 ppm**	Increases water temperature and subsequently decreases levels of dissolved oxygen *Cloudy appearance **Dirty appearance	Not detected	Not detected	0%
Bromide	(WHO, 2010)	TBD	Large doses of bromide cause nausea and vomiting, abdominal pain, coma and paralysis	125.48 ppm	58.2 – 284 ppm	TBD
Total Dissolved Solids (TDS)	(US EPA, 2016)	500 ppm	Hardness; deposits; colored water; staining; salty taste	154.92 ppm	35.1 – 860 ppm	6%
pH	(NYSDOH, 2006a)	6.5-8.5	Water quality indicator; pipe corrosion; metallic-bitter taste; rain pH 5-6; Stream water pH 6-8	7.64	6.62 – 8.43 units	0%
Conductivity	TBD	TBD	Indicates the amount of solids, substances, minerals, and chemicals dissolved in water	240.4 uS/cm	54.7 – 1,326 uS/cm	TBD
Alkalinity	(NYSDOH, 2006a)	TBD	Dry skin; inhibits chlorine effectiveness; metallic bitter taste	385 mg/L	385 mg/L	TBD
Sulfate	(NYSDOH, 2011)	250 ppm	Salty taste	Not detected	Not detected	0%
Temperature	Varies based on contaminant	Varies based on contaminant	Impacts water chemistry such as solubility of contaminants in water and disinfection measures	13.67 celsius	11 – 18.1 celsius	0%
Hardness	(NYSDOH, 2006a)	150 ppm	Mineral and soap deposits; detergents less effective	186.94 ppm	0 – 359.10 ppm	82%
Chlorine Residual	(NYSDOH, 2011)	0.2-4.0 ppm	Presence indicates the absence of disease-causing organisms by identifying recent disinfection; Presence may	Not detected	Not detected	0%

Water Quality Parameter	Threshold Source	Threshold to Consider Action	Potential Health Effects of Parameter	Average Water Quality Test Result	Result Range (Low-High) (n=17)	Percent Above Threshold
			impact test results for bacterial contaminants; use of chlorine produces disinfection/disinfectant by-products that may present a small increase in cancer risk			
Iron	(NYSDOH, 2006a)	0.3 ppm	Rusty color and staining of fixtures or clothes	0.0925 ppm	0 – 1.0 ppm	12%

Water Sampling Kit

Individual Onsite Water: Visual Observations of Household Well or Spring Source Systems

82% **of homes had wells for a drinking water system.**

(14 out of 17)

86% **of wells were visually observed and assessed for potential risk of bacteriological contamination based well depth, construction, and casing.**

(12 out of 14)

92% **of wells observed did not have a well cap providing a proper sanitary seal.**
A sanitary seal prevents entry by insects, vermin, and contaminated from surface water runoff and above ground pollutants.

(11 out of 12)

67% **of well casings observed did not extend at least 18 inches above ground.**
A well casing that extends at least 18 inches above ground lowers the risk for bacteriological and/or chemical contamination from flooding and surface water run-off.

(8 out of 12)

75% **of wells were reported to have a depth of 50 feet or greater.**
A well depth of 50 feet of greater reduces the risk for potential bacteriological contamination from surface water impacts.

(9 out of 12)

Private Well

Surface Water Monitoring–Location 1: Pond

During Phase 1, nearby surface water samples were collected twice at three locations; once in the fall of 2015 (first collection) and again in the summer of 2016 *(second collection, as noted by an asterisks * in tables 3a-c)*. Currently different standards exist that pertain to bodies of water. The use of such bodies of water will determine which standard to apply to the results. MCDOH is in the process of reviewing and determining the most appropriate standard to apply to the bodies of water tested.

Water samples were collected from a surface water source (pond) located near the proposed site. The water quality results from each surface water source sampled are included in Table 14 through Table 16.

Table 14: Surface Water Monitoring at Location 1

Surface Water Quality Parameter	Threshold Source	Threshold to Consider Action	Potential Health Effects of Parameter	Location 1 Phase 1 (n=1)
Total Coliform	TBD	TBD	Provides a general indication of the sanitary condition of a water supply and indicates the potential presence of other harmful bacteria	Positive 30 colonies/100 mL
Fecal Coliform	TBD	TBD	Indicates the possible presence of organisms that can cause illness in people, and the potential for illness when fecal coliform is present may also depend on how the water is being used such as for swimming	30 colonies/100 mL*
Methane	TBD	TBD	Breathing in high gas concentrations can lead to suffocation; if methane gas released into the air from groundwater is allowed to accumulate in a confined space, when mixed with air could ignite or explode; *indicates gas levels in groundwater with the potential to cause an explosive environment in an enclosed area with an ignition source	Below detection levels
Arsenic	TBD	TBD	Skin damage or problem with circulatory system	Below detection levels
Barium	TBD	TBD	Increase in blood pressure	Below detection levels
Cadmium	TBD	TBD	High levels may severely irritates the stomach, leading to vomiting and diarrhea; lower levels over a long period of time may lead to kidneys damage and bones that may become fragile and break easily	Below detection levels

Surface Water Quality Parameter	Threshold Source	Threshold to Consider Action	Potential Health Effects of Parameter	Location 1 Phase 1 (n=1)
Strontium	TBD	TBD	Naturally occurring Strontium may cause growth deformities; Radioactive Strontium may attack bone marrow and soft tissues developing into anemia and leukemia	0.0580 ppm
Phenol	TBD	TBD	Vomiting and lethargy; ingestion of concentrated phenol may cause gastrointestinal damage	Below detection levels
Bromide	TBD	TBD	Large doses of bromide cause nausea and vomiting, abdominal pain, coma and paralysis	Below detection levels
Ethylene Glycol	TBD	TBD	High levels can damage the kidneys, nervous system, lungs, and heart	Below detection levels
Propylene Glycol	TBD	TBD	High levels increases the amount of acid in the body	Below detection levels
VOC's Includes BTEX	TBD	TBD	Increased risk of cancer, anemia, blood problems depending on the specific VOC	Below detection levels
Styrene	TBD	TBD	May affect the nervous system reasonably anticipated to be a human carcinogen	Below detection levels
Chloride	TBD	TBD	Salty taste; may increase rates of corrosion of metals in the distribution system, depending on the alkalinity of the water	<2 ppm*
Temperature	Varies based on contaminant	Varies based on contaminant	Impacts water chemistry such as solubility of contaminants in water and disinfection measures	23.7 celcius*
pH	TBD	TBD	Water quality indicator; rain pH 5-6; Stream water pH 6-8	6.86*
Conductivity	TBD	TBD	Indicates the amount of solids, substances, minerals, and chemicals dissolved in water	71.5 uS/cm*
Total Dissolved Solids (TDS)	TBD	TBD	Hardness; deposits; colored water; staining; salty taste	34.6 ppm*
Dissolved Oxygen (DO)	TBD	TBD	Lack of DO can cause aquatic life in a water body to die; DO concentrations fluctuate with water temperature seasonally and daily, with lower DO typically in the summer and fall	4 mg/L*

Surface Water Monitoring –Location 2: Upstream

Water samples were collected from a second surface water source (stream) located near the proposed site.

Table 15: Surface Water Monitoring at Location 2

Surface Water Quality Parameter	Threshold Source	Threshold to Consider Action	Potential Health Effects of Parameter	Location 2 Phase 1 (n=1)
Total Coliform	TBD	TBD	Provides a general indication of the sanitary condition of a water supply and indicates the potential presence of other harmful bacteria	Positive 120 colonies/100 mL
Fecal Coliform	TBD	TBD	Indicates the possible presence of organisms that can cause illness in people, and the potential for illness when fecal coliform is present may also depend on how the water is being used such as for swimming	130 colonies/100 mL*
Methane	TBD	TBD	Breathing in high gas concentrations can lead to suffocation; if methane gas released into the air from groundwater is allowed to accumulate in a confined space, when mixed with air could ignite or explode	Below detection levels
Arsenic	TBD	TBD	Skin damage or problem with circulatory system	Below detection levels
Barium	TBD	TBD	Increase in blood pressure	Below detection levels
Cadmium	TBD	TBD	High levels may severely irritates the stomach, leading to vomiting and diarrhea; lower levels over a long period of time may lead to kidneys damage and bones that may become fragile and break easily	Below detection levels
Strontium	TBD	TBD	Naturally occurring Strontium may cause growth deformities; Radioactive Strontium may attack bone marrow and soft tissues developing into anemia and leukemia	0.058 ppm
Phenol	TBD	TBD	Vomiting and lethargy; ingestion of concentrated phenol may cause gastrointestinal damage	Below detection levels
Bromide	TBD	TBD	Large doses of bromide cause nausea and vomiting, abdominal pain, coma and paralysis	Below detection levels
Ethylene Glycol	TBD	TBD	High levels can damage the kidneys, nervous system, lungs, and heart	Below detection levels

Surface Water Quality Parameter	Threshold Source	Threshold to Consider Action	Potential Health Effects of Parameter	Location 2 Phase 1 (n=1)
Propylene Glycol	TBD	TBD	High levels increases the amount of acid in the body	Below detection levels
VOC's Includes BTEX	TBD	TBD	Increased risk of cancer, anemia, blood problems depending on the specific VOC	Below detection levels
Styrene	TBD	TBD	May affect the nervous system reasonably anticipated to be a human carcinogen	Below detection levels
Chloride	TBD	TBD	Salty taste; may increase rates of corrosion of metals in the distribution system, depending on the alkalinity of the water	13 ppm*
Temperature	Varies based on contaminant	Varies based on contaminant	Impacts water chemistry such as solubility of contaminants in water and disinfection measures	18 celcius*
pH	TBD	TBD	Water quality indicator; pipe corrosion; metallic-bitter taste; rain pH 5-6; Stream water pH 6-8	8.4*
Conductivity	TBD	TBD	Indicates the amount of solids, substances, minerals, and chemicals dissolved in water	179.9 uS/cm*
Total Dissolved Solids (TDS)	TBD	TBD	Hardness; deposits; colored water; staining; salty taste	99.5 ppm*
Dissolved Oxygen (DO)	TBD	TBD	Lack of DO can cause aquatic life in a water body to die; DO concentrations fluctuate with water temperature seasonally and daily, with lower DO typically in the summer and fall	5.2 mg/L*

Surface Water Monitoring –Location 3: Downstream

Water samples were collected from a third surface water source (stream) located near the proposed site.

Table 16: Surface Water Monitoring at Location 3

Surface Water Quality Parameter	Threshold Source	Threshold to Consider Action	Potential Health Effects of Parameter	Location 3 Phase 1 (n=1)
Total Coliform	TBD	TBD	Provides a general indication of the sanitary condition of a water supply and indicates the potential presence of other harmful bacteria	Positive 50 colonies/100 mL
Fecal Coliform	TBD	TBD	Indicates the possible presence of organisms that can cause illness in people, and the potential for illness when fecal coliform is present may also depend on how the water is being used such as for swimming	80 colonies/100 mL*
Methane	TBD	TBD	Breathing in high gas concentrations can lead to suffocation; if methane gas released into the air from groundwater is allowed to accumulate in a confined space, when mixed with air could ignite or explode	0.005 ppm
Arsenic	TBD	TBD	Skin damage or problem with circulatory system	Below detection levels
Barium	TBD	TBD	Increase in blood pressure	Below detection levels
Cadmium	TBD	TBD	High levels may severely irritates the stomach, leading to vomiting and diarrhea; lower levels over a long period of time may lead to kidneys damage and bones that may become fragile and break easily	Below detection levels
Strontium	TBD	TBD	Naturally occurring Strontium may cause growth deformities; Radioactive Strontium may attack bone marrow and soft tissues developing into anemia and leukemia	0.06 ppm
Phenol	TBD	TBD	Vomiting and lethargy; ingestion of concentrated phenol may cause gastrointestinal damage	Below detection levels

Surface Water Quality Parameter	Threshold Source	Threshold to Consider Action	Potential Health Effects of Parameter	Location 3 Phase 1 (n=1)
Bromide	TBD	TBD	Large doses of bromide cause nausea and vomiting, abdominal pain, coma and paralysis	Below detection levels
Ethylene Glycol	TBD	TBD	High levels can damage the kidneys, nervous system, lungs, and heart	Below detection levels
Propylene Glycol	TBD	TBD	High levels increases the amount of acid in the body	Below detection levels
VOC's Includes BTEX	TBD	TBD	Increased risk of cancer, anemia, blood problems depending on the specific VOC	Below detection levels
Styrene	TBD	TBD	May affect the nervous system reasonably anticipated to be a human carcinogen	Below detection levels
Chloride	TBD	TBD	Salty taste; may increase rates of corrosion of metals in the distribution system, depending on the alkalinity of the water	12 ppm*
Temperature	Varies based on contaminant	Varies based on contaminant	Impacts water chemistry such as solubility of contaminants in water and disinfection measures	16 celcius*
pH	TBD	TBD	Water quality indicator; pipe corrosion; metallic-bitter taste; rain pH 5-6; Stream water pH 6-8	7.89*
Conductivity	TBD	TBD	Indicates the amount of solids, substances, minerals, and chemicals dissolved in water	165 uS/cm*
Total Dissolved Solids (TDS)	TBD	TBD	Hardness; deposits; colored water; staining; salty taste	95.8 ppm*
Dissolved Oxygen (DO)	TBD	TBD	Lack of DO can cause aquatic life in a water body to die; DO concentrations fluctuate with water temperature seasonally and daily, with lower DO typically in the summer and fall	6.6 mg/L*

ACRONYMS

ATSDR	Agency for Toxic Substances and Disease Registry
AQI	Air Quality Index (from the US EPA)
CDC	Centers for Disease Control and Prevention
cfu	colony forming units (also referred to as *colonies*)
dB	Decibel→noise quality measurement
EHP	Southwest Pennsylvania Environmental Health Project (EHP)
EPA	Environmental Protection Agency, of the United States
HUD	United States Department of Housing and Urban Development
MA DEP	Massachusetts Department of Environmental Protection
mg/L	Milligram per liter (equals ppm)
mL	milliliter
MRL	Minimum risk level: an estimate of the daily human exposure that is likely to be safe over a certain period of exposure
N	Total sample size (total number of participating households)
n	Subset of sample (number of households a data parameter is reported out for)
NIOSH	National Institute for Occupational Safety and Health
NYCRR	New York Compilation of the Rules and Regulations
NYS	New York State
NYSDOH	New York State Department of Health
OSHA	Occupational Safety and Health Administration
ODH	Ohio Department of Health
ppm	Parts per million→air quality measurement (equals mg/L)
pCi/L	Pico curies per liter→water AND air quality measurement
TBD	To be determined
µg/l	Micrograms per liter→water quality measurement
$\mu g/m^3$	Micrograms per cubic meter→ air quality measurement
USGS	United States Geological Survey (of the United States Department of Interior)
µS/cm	Conductivity→water quality measurement
VOC	Volatile organic compound
WHO	World Health Organization

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Appendix A: Madison County Expert Advisory Group

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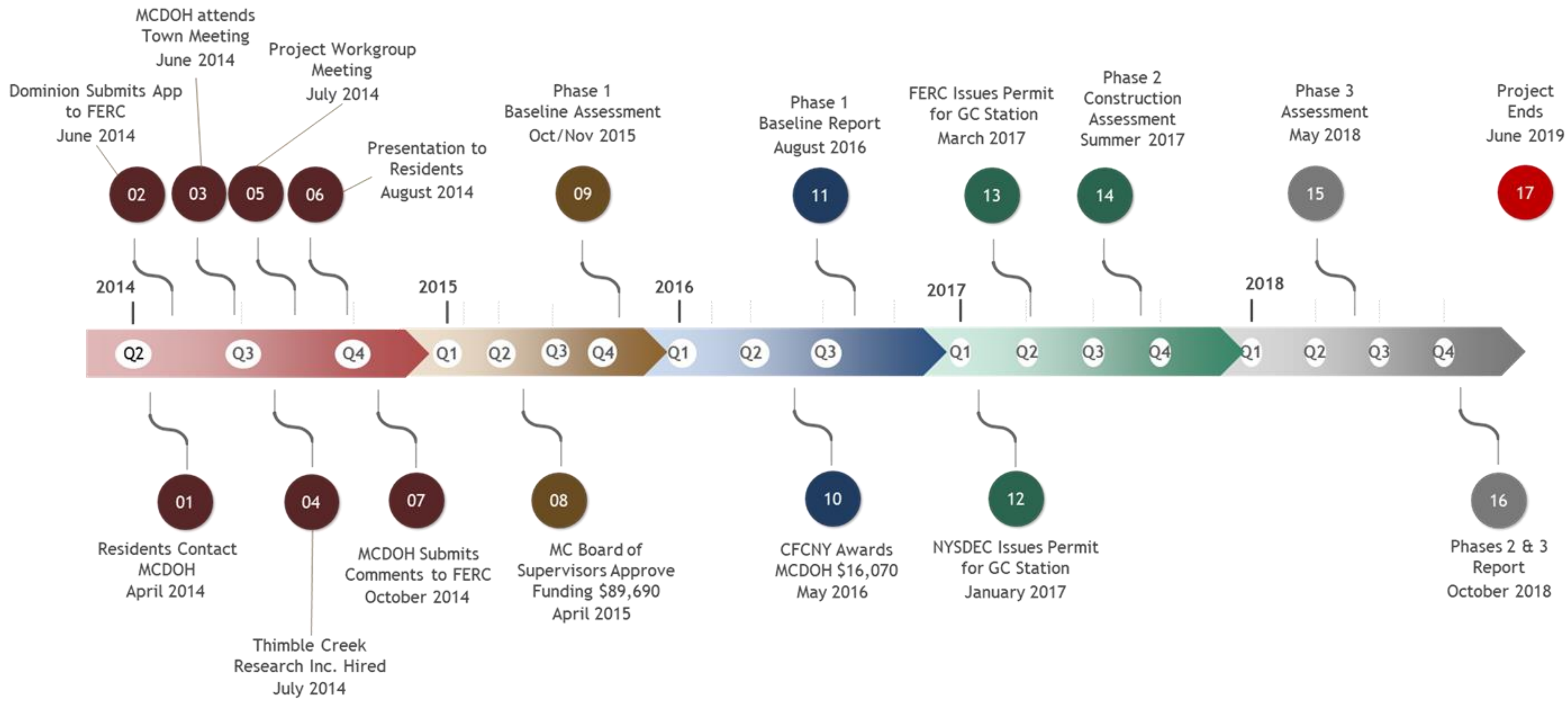
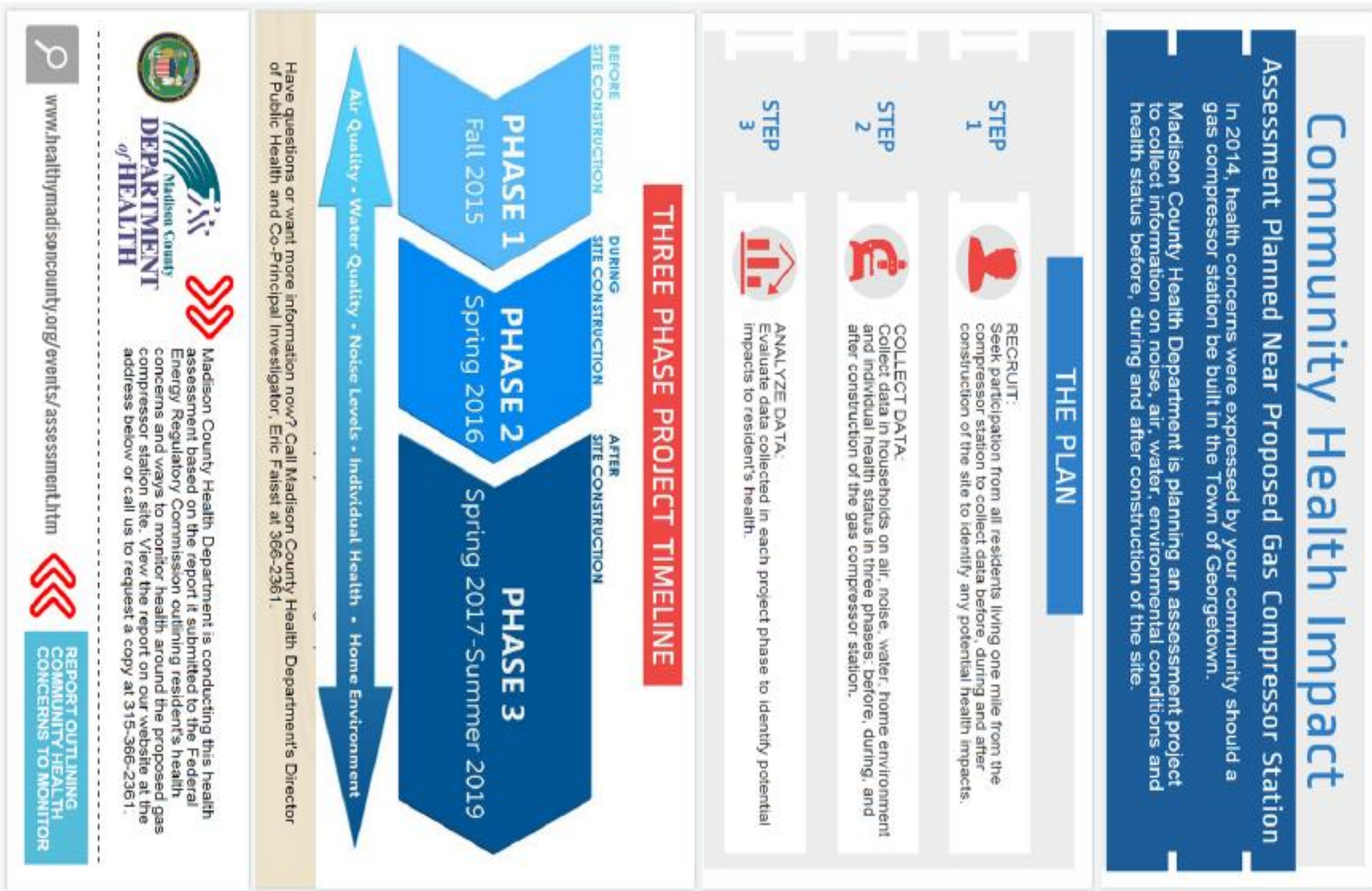
Appendix B: Shed's Gas Compressor Project Timeline

April 2015 – June 2019



Appendix C: Community Awareness Flyer



Appendix D: Public Health Statements on Select VOCs

If you are exposed to a hazardous substance, several factors will determine whether harmful health effects will occur and what the type and severity of those health effects will be. These factor include the dose (how much), the duration (how long), the route or pathway by which you are exposed (breathing, eating, drinking, or skin contact), the other chemicals to which you are exposed, and your individual characteristics such as age, sex, nutritional status, family traits, life style, and state of health.

Potential Exposure Pathways and Health Effects	
Benzene	Everyone is exposed to a small amount of benzene every day. You are exposed to benzene in the outdoor environment, in the workplace, and in the home. Exposure of the general population to benzene mainly occurs through breathing air that contains benzene. The major sources of benzene exposure are tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions. Vapors (or gases) from products that contain benzene, such as glues, paints, furniture wax, and detergents, can also be a source of exposure. Auto exhaust and industrial emissions account for about 20% of the total national exposure to benzene. About half of the exposure to benzene in the United States results from smoking tobacco or from exposure to tobacco smoke. The average smoker (32 cigarettes per day) takes in about 1.8 milligrams (mg) of benzene per day. This amount is about 10 times the average daily intake of benzene by nonsmokers. Measured levels of benzene in outdoor air have ranged from 0.02 to 34 parts of benzene per billion parts of air (ppb) (1 ppb is 1,000 times less than 1 ppm). People living in cities or industrial areas are generally exposed to higher levels of benzene in air than those living in rural areas. Benzene levels in the home are usually higher than outdoor levels. People may be exposed to higher levels of benzene in air by living near hazardous waste sites, petroleum refining operations, petrochemical manufacturing sites, or gas stations. For most people, the level of exposure to benzene through food, beverages, or drinking water is not as high as through air. Drinking water typically contains less than 0.1 ppb benzene. Benzene has been detected in some bottled water, liquor, and food. Leakage from underground gasoline storage tanks or from landfills and hazardous waste sites that contain benzene can result in benzene contamination of well water. People with benzene contaminated tap water can be exposed from drinking the water or eating foods prepared with the water. In addition, exposure can result from breathing in benzene while showering, bathing, or cooking with contaminated water. Individuals employed in industries that make or use benzene may be exposed to the highest levels of benzene. As many as 238,000 people may be occupationally exposed to benzene in the United States. These industries include benzene production (petrochemicals, petroleum refining, and coke and coal chemical manufacturing), rubber tire manufacturing, and storage or transport of benzene and petroleum products containing benzene. Other workers who may be exposed to benzene include coke oven workers in the steel industry, printers, rubber workers, shoe makers, laboratory technicians, firefighters, and gas station employees.

How may it affect my health?

Scientists use many tests to protect the public from harmful effects of toxic chemicals and to find ways for treating persons who have been harmed.

One way to learn whether a chemical will harm people is to determine how the body absorbs, uses, and releases the chemical. For some chemicals, animal testing may be necessary. Animal testing may also help identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method for getting information needed to make wise decisions that protect public health. Scientists have the responsibility to treat research animals with care and compassion. Scientists must comply with strict animal care guidelines because laws today protect the welfare of research animals.

After exposure to benzene, several factors determine whether harmful health effects will occur, as well as the type and severity of such health effects. These factors include the amount of benzene to which you are exposed and the length of time of the exposure. Most information on effects of long-term exposure to benzene are from studies of workers employed in industries that make or use benzene. These workers were exposed to levels of benzene in air far greater than the levels normally encountered by the general population. Current levels of benzene in workplace air are much lower than in the past. Because of this reduction and the availability of protective equipment such as respirators, fewer workers have symptoms of benzene poisoning.

Brief exposure (5–10 minutes) to very high levels of benzene in air (10,000–20,000 ppm) can result in death. Lower levels (700–3,000 ppm) can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. In most cases, people will stop feeling these effects when they are no longer exposed and begin to breathe fresh air.

Eating foods or drinking liquids containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, coma, and death. The health effects that may result from eating foods or drinking liquids containing lower levels of benzene are not known. If you spill benzene on your skin, it may cause redness and sores. Benzene in your eyes may cause general irritation and damage to your cornea.

Benzene causes problems in the blood. People who breathe benzene for long periods may experience harmful effects in the tissues that form blood cells, especially the bone marrow. These effects can disrupt normal blood production and cause a decrease in important blood components. A decrease in red blood cells can lead to anemia. Reduction in other components in the blood can cause excessive bleeding. Blood production may return to normal after exposure to benzene stops. Excessive exposure to benzene can be harmful to the immune system, increasing the chance for infection and perhaps lowering the body's defense against cancer.

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

	Department of Health and Human Services has determined that benzene is a known carcinogen (can cause cancer). Both the International Agency for Cancer Research and the EPA have determined that benzene is carcinogenic to humans. Exposure to benzene may be harmful to the reproductive organs. Some women workers who breathed high levels of benzene for many months had irregular menstrual periods. When examined, these women showed a decrease in the size of their ovaries. However, exact exposure levels were unknown, and the studies of these women did not prove that benzene caused these effects. It is not known what effects exposure to benzene might have on the developing fetus in pregnant women or on fertility in men. Studies with pregnant animals show that breathing benzene has harmful effects on the developing fetus. These effects include low birth weight, delayed bone formation, and bone marrow damage. We do not know what human health effects might occur after long-term exposure to food and water contaminated with benzene. In animals, exposure to food or water contaminated with benzene can damage the blood and the immune system and can cause cancer.
Formaldehyde	The primary way you can be exposed to formaldehyde is by breathing air source of containing it. Releases of formaldehyde into the air occur from: industries using or manufacturing formaldehyde, wood products (i.e. particle-board, plywood, furniture), automobile exhaust, cigarette smoke, paints and varnishes, and carpets and permanent press fabrics. Rural or suburban air generally contains lower concentrations of formaldehyde than urban air. Indoor air often contains higher levels of formaldehyde than outdoor air. Examples of concentrations of formaldehyde: • 0.0002–0.006 parts per million (ppm) in rural and suburban outdoor air • 0.0015–0.047 ppm in urban outdoor air • 0.020–4 ppm in indoor air **How may it affect my health?** Inhalation by Workers and residents: The most common health problems in people exposed to formaldehyde include irritation of the eyes, nose, and throat. Formaldehyde may cause occupational asthma, but this seems to be rare. Some studies of humans exposed repeatedly to formaldehyde in workplace air found more cases of nose and throat cancer than expected. Animal studies of laboratory rats exposed for life to formaldehyde in air found that some rats developed nose cancer. The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have characterized formaldehyde as a human carcinogen based on studies of inhalation exposure in humans and laboratory animals. Inhalation by Laboratory animals: Animal studies have shown that inhalation of formaldehyde can result in irritation and damage to the lining of the nose and throat. High concentrations can also affect the lung. Impaired learning and changes in behavior have

been observed in rats after high concentrations of formaldehyde. Oral: Stomach damage has been observed in rats exposed to high oral doses of formaldehyde.

Concentration in Air (ppm)	Effects in Humans	Effects in Animals
>50	no studies	bloody nasal discharge, pulmonary edema
11 to 50	no studies	nasal and eye irritation, nasal ulceration, change in pulmonary function[c], neurological effects[d], liver effects[e] decreased body weight, decreased fetal weight, nasal tumors, reduced survival
6.0 to 10.9	nasal, eye, throat and skin irritation, headache, nausea, discomfort in breathing, cough	nasal and eye irritation, nasal ulceration, change in pulmonary function[c], liver effects[e], testicular effects[f], nasal tumors, reduced survival
2.0 to 5.9	nasal, eye and throat irritation, eczema or skin irritation, change in pulmonary function[a]	nasal and eye irritation, throat irritation, change in pulmonary function[c], decreased body weight, enhanced allergic responses, neurological effects[g], liver effects[e], testicular effects[f]
0.6 to 1.9	nasal and eye irritation, eczema, change in pulmonary function[a]	change in pulmonary function[c], neurological effects[g]
0.1 to 0.5	nasal and eye irritation, neurological effects[b], increased risk of asthma and/or allergies	change in pulmonary function[c], enhanced allergic responses, neurological effects[g]

0.04 ppm Acute MRL
0.03 ppm Intermediate MRL
0.02 ppm Chronic MRL

[a]changes in pulmonary variables from spirometry testing (FEV, FVC)
[b]decreased performance on short-term memory tests
[c]decrease breathing rate and/or increased airway resistance
[d]listlessness, hunched appearance, uncoordinated movement, ataxia
[e]altered serum biochemistry and/or liver histopathology
[f]decreased testicular weight, testicular atrophy, altered sperm motility/morphology, decreased serum testosterone, decreased diameter of seminiferous tubules
[g]decreased motor activity, altered open field behavior, impaired learning and memory

Naphthalene

You are most likely to be exposed to naphthalene, 1-methylnaphthalene, or 2-methylnaphthalene from the air. Outdoor air contains low amounts of these chemicals. Burning of wood or fossil fuels and industrial discharges adds these chemicals to the environment. Automobile exhaust contributes naphthalene among other chemicals to air pollution in the cities. Typical air concentrations for naphthalene are low, 0.2 ppb or less. Studies of outdoor air reported concentrations of 0.09 ppb 1-methylnaphthalene and 0.011 ppb 2-methylnaphthalene. In homes or businesses where cigarettes are smoked, wood is burned, or moth repellents are used, the levels of naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene in the air are higher. Studies of indoor air typically report that average indoor air concentrations of these contaminants are less than 1 ppb.

You are not likely to be exposed to naphthalene, 1-methylnaphthalene, or 2-methylnaphthalene by eating foods or drinking beverages. These materials are unlikely to come in contact with naphthalene or methylnaphthalenes during production or processing. Naphthalene and the methylnaphthalenes are also unlikely to be present in tap water.

If you live near a hazardous waste site and have a well-used for drinking water, you might be exposed to naphthalene, 1-methylnaphthalene, or 2-methylnaphthalene. For this to happen, the chemicals must pass through the soil and dissolve in the underground water that supplies your well. Children might also contact these chemicals by playing in or eating the dirt near a waste site.

Work using or making moth repellents, coal tar products, dyes, or inks could expose you to naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene in the air. Working in the wood preserving, leather tanning, or asphalt industries could expose you to naphthalene.

Using moth repellents containing naphthalene in your home will expose you to naphthalene vapors. Your skin can come in contact with naphthalene via the use of naphthalene-treated clothing, blankets, or coverlets. You can breathe in the naphthalene vapors that are present in clothes and linen stored with moth-balls. Smoke from cigarettes can also expose you to naphthalene, 1-methylnaphthalene, or 2-methylnaphthalene. The highest airborne naphthalene concentrations in indoor air occur in the homes of cigarette smokers.

How may it affect my health?

Exposure to a large amount of naphthalene may damage or destroy some of your red blood cells. This could cause you to have too few red blood cells until your body replaces the destroyed cells. This problem is called hemolytic anemia. People, particularly children, have developed this problem after eating naphthalene-containing mothballs or deodorant blocks. Anemia has also occurred in infants wearing diapers that have been stored in mothballs. If your ancestors were from Africa or Mediterranean

	countries, naphthalene may be more dangerous to you than to people of other origins. These populations have a higher incidence of problems with an enzyme that usually protects red blood cells from damage created by oxygen in the air. Some of the symptoms that occur with hemolytic anemia are fatigue, lack of appetite, restlessness, and a pale appearance to your skin. Exposure to a large amount of naphthalene, such as by eating mothballs, may cause nausea, vomiting, diarrhea, blood in the urine, and a yellow color to the skin. If you have these symptoms, you should see a doctor quickly. Anemia is a common condition in pregnancy that can be due to causes other than naphthalene exposure. However, if you are a pregnant woman and are anemic due to naphthalene exposure, then it is possible that your unborn child may be anemic as well. Naphthalene can move from your blood to your baby's blood. Once your baby is born, naphthalene may also be carried from your body to your baby's body through your milk. It is not completely clear if naphthalene causes reproductive effects in animals; most evidence says that it does not. Laboratory rabbits, guinea pigs, mice, and rats sometimes develop cataracts (cloudiness) in their eyes after swallowing naphthalene at high dose levels. It is not certain whether cataracts also develop in humans exposed to naphthalene, but the possibility exists. When mice or rats breathed in naphthalene vapors daily throughout their lives (2 years), cells in the lining of their noses or lungs were damaged. Some exposed female mice also developed lung tumors. Some exposed male and female rats developed nose tumors. When mice or rats were fed naphthalene in their food for 13 weeks, no tumors or other tissue changes were found. The only effect found was decreased body weight in rats that were fed naphthalene. Based on these results from animal studies, the U.S. Department of Health and Human Services concluded that naphthalene is reasonably anticipated to be a human carcinogen. The International Agency for Research on Cancer (IARC) concluded that naphthalene is possibly carcinogenic to humans, because there is enough evidence that naphthalene causes cancer in animals, but not enough evidence about such an effect in humans. Under the EPA 1986 cancer guidelines, naphthalene was assigned to Group C – possible human carcinogen. When mice were fed food containing 1-methylnaphthalene or 2-methylnaphthalene for most of their lives (81 weeks), the gas-exchange part of the lungs of some mice became filled with an abnormal material. This type of lung injury is called pulmonary alveolar proteinosis. A few mice also had lung tumors, but the numbers of mice with lung tumors were not enough to conclude that 1-methylnaphthalene or 2-methylnaphthalene caused the tumors. Pulmonary alveolar proteinosis has been seen in some people, but the cause of this uncommon lung disease in humans is unknown.
Propylene	Propylene glycol has been approved for use at certain levels in food, cosmetics, and pharmaceutical products. If you eat food products, use cosmetics, or take medicines that contain it, you will be exposed to propylene glycol, but these amounts are not generally considered harmful. People who work in industries that use propylene glycol may be exposed by touching these products or inhaling mists from spraying them. These exposures tend to be at low levels, however. Propylene glycol is used to make artificial smoke and mists for fire safety training, theatrical performances, and rock concerts. These artificial smoke

	products may also be used by private citizens. These products are frequently used in enclosed spaces, where exposure may be more intense. **How may it affect my health?** Propylene glycol breaks down at the same rate as ethylene glycol, although it does not form harmful crystals when it breaks down. Frequent skin exposure to propylene glycol can sometimes irritate the skin.
Tetrachloroethylene	Much of the tetrachloroethylene released into the air comes from the dry cleaning industry. Some Tetrachloroethylene may be released from dry-cleaned or consumer products (metal degreasing solvent). **How may it affect my health?** Tetrachloroethylene exposure may harm the nervous system, liver, kidneys, and reproductive system, and may be harmful to unborn children. If you are exposed to tetrachloroethylene, you may also be at a higher risk of getting certain types of cancer. Short-term exposure effects: If you breathe in air containing a lot of tetrachloroethylene, you may become dizzy or sleepy, develop headaches, and become uncoordinated; exposure to very large amounts in the air can cause unconsciousness. Some people have died after being exposed in tanks or other small spaces, or after intentionally breathing in a large amount of tetrachloroethylene. Long-term exposure effects: People who are exposed for longer periods of time to lower levels of tetrachloroethylene in air may have changes in mood, memory, attention, reaction time, or vision. Studies in animals exposed to tetrachloroethylene have shown liver and kidney effects, and changes in brain chemistry, but we do not know what these findings mean for humans. Tetrachloroethylene may have effects on pregnancy and unborn children. Studies in people are not clear on this subject, but studies in animals show problems with pregnancy (such as miscarriage, birth defects, and slowed growth of the baby) after oral and inhalation exposure. Tetrachloroethylene and cancer: Exposure to tetrachloroethylene for a long time may lead to a higher risk of getting cancer, but the type of cancer that may occur is not well-understood. Studies in humans suggest that exposure to tetrachloroethylene might lead to a higher risk of getting bladder cancer, multiple myeloma, or non-Hodgkin's lymphoma, but the evidence is not very strong. In animals, tetrachloroethylene has been shown to cause cancers of the liver, kidney, and blood system. It is not clear whether these effects might also occur in humans, because humans and animals differ in how their bodies handle tetrachloroethylene. The EPA considers tetrachloroethylene to be "likely to be carcinogenic to humans by all routes of exposure" based on suggestive evidence in human studies and clear evidence of mononuclear cell leukemia in rats and liver tumors in mice exposed for 2 years by inhalation or stomach tube.

	The International Agency for Research on Cancer considers tetrachloroethylene "probably carcinogenic to humans" based on limited evidence in humans and sufficient evidence in animals. The National Toxicology Program considers tetrachloroethylene to be "reasonably anticipated to be a human carcinogen."
Vinyl acetate	Industrial facilities, accidental spills, contact with products that contain vinyl acetate, and hazardous waste disposal sites are possible sources of exposure to vinyl acetate. The most important way that you can be exposed to vinyl acetate if you live around factories that make, use, store, and dispose of vinyl acetate on site or if you live near waste sites in which vinyl acetate or products that contain vinyl acetate have been disposed, is by breathing air or drinking water that contain it. You can also be exposed to vinyl acetate by skin contact with products that were made with vinyl acetate, such as glues and paints. Exposure can also occur through ingestion of food items that were packaged in plastic films containing vinyl acetate or food items that contain vinyl acetate as a starch modifier. However, exposure to vinyl acetate occurs mostly in the workplace. Workers can breathe in the chemical when they are making it or using it to make other chemicals. Workers can also have skin contact with vinyl acetate solutions. It has been estimated that about 50,000 workers employed at about 5,000 plants are exposed to vinyl acetate in the United States. It has been measured in the air in industrial areas of Houston, Texas at a level of about 0.5 ppm. **How may it affect my health?** People who were exposed to vinyl acetate in air for short periods complained of irritation to their eyes, nose, and throat. One in nine volunteers who breathed air containing 4 ppm of vinyl acetate for 2 minutes had throat irritation. Several volunteers exposed to 72 ppm of vinyl acetate in air for 30 minutes reported coughing and hoarseness and eye irritation. No health effects were found in workers who were exposed to levels around 10 ppm of vinyl acetate in work room air for an average of 15 years of employment. However, we do not know if health effects would occur in people exposed to low levels for longer periods. Exposure to high levels (around 1,000 ppm) of vinyl acetate in air for a couple of weeks caused irritation of the eyes, nose, throat, and lungs of laboratory animals. Vinyl acetate at levels around 200 ppm caused irritation to the respiratory tract and nose when it was breathed by rats and mice for up to 2 years. In this same study, damage to the lungs (congestion and increased lung weight) was seen in rats at 200 and 600 ppm and in mice at 600 ppm vinyl acetate. Studies with animals also suggest that breathing vinyl acetate may affect the immune system and nervous system. The extent and way in which vinyl acetate affects these systems is not well understood. There is no evidence that vinyl acetate causes cancer in humans. Vinyl acetate caused tumors in the noses of rats that breathed 600 ppm for 2 years. The International Agency for Research on Cancer (IARC) has determined that vinyl acetate is possibly carcinogenic to humans (Group 2B). We have no information on health effects in humans exposed to vinyl acetate in contaminated food or water. Information from animals exposed to vinyl acetate in drinking water suggest that the immune system might be affected at very high levels. There is no information to show that birth defects or low birth weights occur in humans exposed to vinyl acetate. No birth defects were seen in the offspring of animals that were exposed to vinyl acetate during their pregnancy. Pregnant animals exposed to high levels of vinyl acetate in drinking water or air produced offspring which were smaller in size than normal.

These effects to the offspring were seen at the same level that caused reduced weight gain in pregnant animals. This suggests that the smaller size of the offspring may be due to the reduced weight gain in the pregnant animals and may not be a direct effect of vinyl acetate on the developing animal.

People who had a mild (2%) solution of vinyl acetate put on their skin for 48 - 72 hours did not show signs of skin irritation. However, vinyl acetate has caused skin irritation and blisters in workers who accidentally spilled it on their skin. More concentrated solutions of vinyl acetate have caused reddening, blisters, and corrosion to the skin of rabbits. The effects of continual or repeated skin contact with vinyl acetate or products that contain vinyl acetate over a long time are not known.

Exposure to vinyl acetate in air or direct contact with vinyl acetate solutions has caused irritation to the eyes. Several volunteers exposed to 72 ppm of vinyl acetate in air for 30 minutes reported eye irritation that lasted up to 60 minutes after exposure. Accidental contact of the eye with concentrated solutions of vinyl acetate has caused reddening and irritation to the eyes of workers. Symptoms were relieved after flushing the affected eye with water. We know of no cases in which permanent eye damage resulted after such contact. Rabbits that had very high concentrations of vinyl acetate put in their eyes for a short period also showed irritation and reddening to the eyes.

The above are excerpts from the public health statements provided by the Agency for Toxic Substances and Disease Registry.

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