Northeastern Pennsylvania Marcellus Shale Short-Term Ambient Air Sampling Report

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Commonwealth of Pennsylvania
Department of Environmental Protection

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Executive Summary

Since the beginning of 2008, natural gas exploration activities in the Marcellus Shale Formation have increased significantly in the Commonwealth of Pennsylvania—more than 2,349 wells have been drilled, primarily in the southwest, northeast and northcentral regions. In response to the increased number of well sites and concerns about the impact of the Marcellus Shale natural gas development activities on air quality, the Pennsylvania Department of Environmental Protection (PA DEP or Department) launched a short-term, screening- level air quality sampling initiative in the northeast region in August 2010 culminating in October 2010. This report includes the findings of the screening air sampling surveys conducted by PA DEP in Susquehanna County and background sampling conducted in Sullivan County.

The scope of this short-term sampling effort was limited to several natural gas facilities in Susquehanna County. Due to the limited scope and duration of the sampling and the limited number of sources and facilities sampled, the findings only represent conditions at the time of the sampling and do not represent a comprehensive study of emissions. While this short-term sampling effort does not address the cumulative impact of air emissions from natural gas operations in northeastern Pennsylvania, the sampling results do provide basic information on the type of pollutants emitted to the atmosphere during selected phases of gas extraction operations in the Marcellus Shale formation. This information will also be utilized to determine if the scope of the study should be expanded and will identify areas where additional sampling may be warranted.

Samples were collected during four "sampling weeks" using the Department's Bureau of Laboratories Mobile Analytical Unit (MAU) to measure the concentrations of a target list of pollutants associated with gas development operations. The Mobile Analytical Unit used Gas Chromatography/ Mass Spectrometry (GC/MS) and Open Path Fourier Transform Infrared (OP-FTIR or Open Path) samplers to screen for approximately 48 volatile organic compounds (VOCs) including methane and benzene. Additional air samples were collected in canisters over a 24-hour period and analyzed by the PA DEP Laboratory. The four sampling weeks focused on ambient air pollution levels near two different compressor stations, a completed and functioning well site, a well site during fracking operations and a background site.

The project goals include the short term screening of ambient air concentrations of target pollutants near certain of Marcellus Shale gas drilling operations, assessing preliminary air quality impacts and determining if there were any immediate health risks from ambient pollutant concentrations to nearby residents or communities.

The key findings of the short-term air sampling surveys are provided as follows:

- Concentrations of certain natural gas constituents including methane, ethane, propane and butane, and associated compounds, in the air near Marcellus Shale drilling operations were detected during the four sampling weeks.

- Elevated methane levels were detected in the ambient air during short-term sampling conducted at two compressor stations (the Lathrop and Teel compressor stations) and two well sites (Carter Road and Loomis well sites).

- Certain compounds, mainly methyl mercaptan, were detected at levels which generally produce odors.

- Results of the limited ambient air sampling initiative in the northeast region did not identify concentrations of any compound that would likely trigger air-related health issues associated with Marcellus Shale drilling activities.

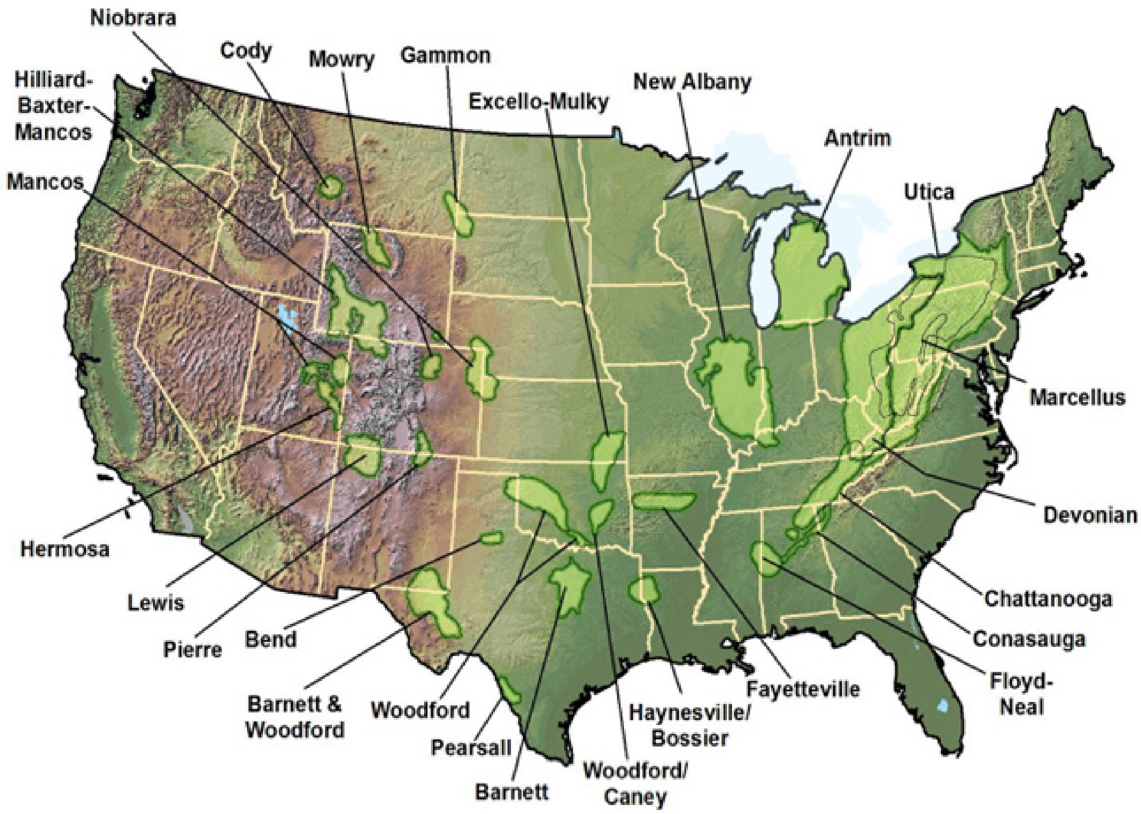
- Sampling for carbon monoxide, nitrogen dioxide, sulfur dioxide and ozone, did not detect concentrations above National Ambient Air Quality Standards at any of the sampling sites. However, the Department is unable to determine at this time whether the potential cumulative emissions of criteria pollutants from natural gas exploration activities will result in violations of the health and welfare-based federal standards.

- A specialized infrared camera that can detect emissions of certain pollutants from a source that otherwise may be invisible to the naked eye, did detect fugitive and direct emissions from the well equipment at the Carter Road well site. These emissions may contribute to the ambient concentrations detected at the site.

PA DEP has also completed air sampling near Marcellus natural gas operations in the northcentral region of the Commonwealth, specifically in Sullivan, Bradford, Tioga and Lycoming counties. When all data analysis is completed, PA DEP will compare results from the surveyed regions to determine any regional differences where wet gas is extracted in the southwest region versus dry gas in the northcentral and northeast regions of the Commonwealth. Following the completion of the comparative analysis, the Department will determine whether additional sampling is warranted. The PA DEP will also determine if the implementation of additional measures will be necessary for the protection of public health and the environment during natural gas development operations in the Commonwealth.

Introduction

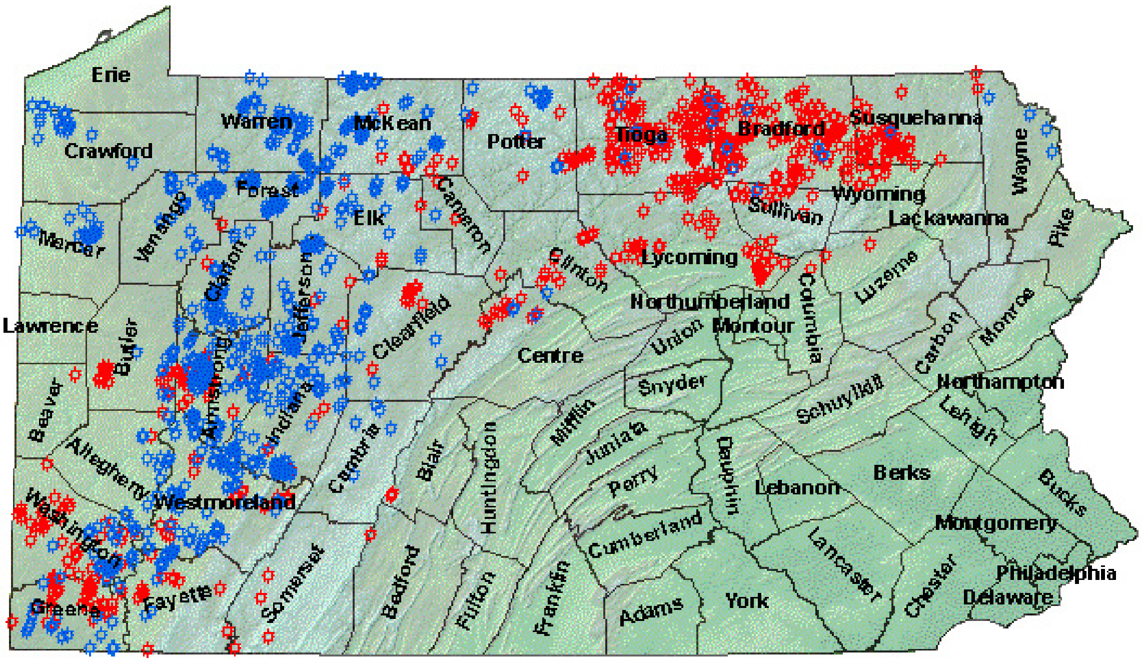
Shale gas is available in many basins across the United States (Figure 1). The Marcellus Shale Formation, which extends from New York into Pennsylvania, Maryland, Ohio, Virginia, and West Virginia, and covers approximately 95,000 square miles, is the most expansive shale gas "play" in the United States. The Marcellus play located within the borders of Pennsylvania is now one of the most active shale plays in terms of drilling, with operations primarily in the southwest, northcentral and northeast portions of the state. However, the Barnett Shale play in the Fort Worth Texas basin is the most active play in the country.



Source: U.S. DOE, 2009

Figure 1: Gas shale formations in the United States (U.S. DOE, 2009).

In recent years, the number of Marcellus Shale wells drilled in Pennsylvania has rapidly increased. In 2008, the number of wells drilled to tap Marcellus Shale gas was 195. In 2009 that number jumped to 768. Since January 2010, 1,386 wells have been drilled (Figure 2) (PA DEP, 2010a).



Source: Pa. DEP, 2010a

Figure 2: Map of Marcellus (red) and non-Marcellus (blue) wells drilled in Pennsylvania in 2010 (PA DEP, 2010a).

The extraction of natural gas from Marcellus Shale involves many stages and provides many opportunities for the release of air pollutants during the process. The major stages of natural gas extraction include:

- Pad, Impoundment and Road Construction – All drilling operations need a flat area of certain acreage to conduct the drilling activities. Impoundments for fresh water or wastewater may also be built. Pollutants are emitted from diesel engines and dust is produced from truck traffic and heavy equipment.
- Drilling – Drilling rigs require power from diesel engines. Again more emissions from these engines.
- Fracturing – During this stage, large amounts of water and fracturing fluid are pumped into the well to create fractures for the gas to escape from the shale. A portion of the fluid is returned into a wastewater impoundment where it is eventually trucked for treatment. Emissions can come from diesel engines, the evaporation of the wastewater and the release of fracturing fluid chemicals, heavy metals and volatile organic compounds.
- Flaring – Flaring is done to test the gas well before production. Emissions are created from the burning of gas and atmospheric venting of non-combusted gas.
- Condensate Tanks – Gas pumped from the well may contain brine and other volatile organic compounds that condense into collection tanks. Air space in the tanks is vented to the atmosphere during periods of filling. If the nature of

the gas is considered "wet" (vs. "dry"), the condensate may contain many other compounds such as benzene, toluene and xylenes.

- Compressor stations – Raw gas is piped from wells to compressor stations where the gas is pre-treated and compressed. Emissions from engines that power the compressors, fugitive emissions from compression equipment, pipes and tanks are possible.

Along with the increased drilling operations described above, there has been an increase in the number of complaints to the Department's regional offices. The majority of the complaints pertained to odors and nuisance dust from truck traffic.

Ambient Air Sampling

Prior to launching its Marcellus Shale short-term monitoring initiative, the PA DEP examined air sampling projects conducted by other states in separate shale basins (i.e. Barnett Shale in Forth Worth, Texas) during the development of the sampling protocol for this project. The sampling goals for this project were to obtain preliminary Pennsylvania-specific concentrations of certain pollutants emitted at, or near, natural gas Marcellus Shale exploration activities. As a result, the sampling goals are to:

- screen for ambient air concentrations of target pollutants near certain Marcellus Shale gas drilling operations;
- assess potential air quality impacts;
- assess potential health risks from exposure to ambient concentrations; and
- determine whether the scope of the short-term Marcellus sampling initiative should be expanded.

The PA DEP conducted short-term air sampling near natural gas operations in densely-drilled areas in the southwest, northcentral and northeast regions of the Commonwealth. This report focuses solely on Marcellus ambient air sampling completed in the northeast region (Sullivan and Susquehanna counties) in September and October of 2010. This report does not address water quality or other environmental issues dealing with natural gas extraction.

Air sampling in Washington and Greene counties in southwestern Pennsylvania was completed earlier in the year (April through July) and the report on that effort was published on November 1, 2010 (PA DEP, 2010c). Sampling in the northcentral region including Sullivan, Bradford, Tioga and Lycoming counties has recently been completed. The Department will prepare and issue a report for the northcentral region when analysis of the results is completed.

The general overview of the sampling plan is to conduct continuous downwind sampling near sources at natural gas facilities, and collect individual samples at population points at further distances from the source.

For the purpose of this report, a population point can either be an individual residence, community or town. The PA DEP sampling in the northeast region consisted of four, week-long, sampling events.

Table 1 provides a list of target compounds selected by PA DEP for this project. The list was compiled based on target information from other shale gas studies (Texas Commission on Environmental Quality [TCEQ], 2010; NYDEC, 2009; Town of Dish, 2009; Fed. Reg. 72:1; PA DEP, 2010b; Texas Environmental Research Consortium [TERC], 2009). The list also shows the PA DEP Bureau of Laboratories (BOL) capability to "detect" these target compounds by the various methods utilized during the project.

The main constituent of natural gas is methane. There are other compounds in natural gas found in lesser quantities (ethane, propane and butane), and still more in trace amounts.

- Methane, Ethane, Propane and Butane – Simple straight-chained molecules containing carbon and hydrogen, these compounds when isolated or combined are used mainly as fuels. Burning these compounds in the presence of excess oxygen produces carbon dioxide and water. Incomplete combustion can produce undesirable pollutants such as carbon monoxide and formaldehyde. Methane itself is a potent greenhouse gas. Standards have been established for acceptable concentrations of these compounds in workplace settings. However, there are no standards for acceptable levels in ambient air.
- "BTEX" – A group of compounds, namely Benzene, Toluene, Ethylbenzene and Xylene that are primarily found in petroleum derivatives are the main constituents of gasoline, however they are naturally occurring in some shale gas formations. They are also used as solvents and/or intermediates in the production of other chemicals. There are many health–related issues associated with chronic exposure to these compounds, mainly neurological effects. Benzene is also associated with hematological and carcinogenic effects.
- Methyl mercaptan – Methyl mercaptan is a naturally occurring compound present in some shale gas formations as well as in crude oil. Methyl mercaptan has a strong unpleasant smell that can be detected by the human nose at very low levels. Olfactory fatigue, or the inability to no longer smell methyl mercaptan, occurs after prolonged exposure.
- Carbon Monoxide, Nitrogen dioxide, Ozone – These pollutants are part of a group of six criteria air pollutants that are considered harmful to public health and the environment above certain levels. These pollutants come from or are caused by reactions of emissions from a wide variety of sources such as industry, energy production and mobile sources. The federal government has created ambient air standards for these pollutants that states strive to meet through monitoring, permitting and planning.

Equipment

Mobile Analytical Unit

The Department's BOL Mobile Analytical Unit (MAU) was deployed for each sampling week. The BOL utilized two MAU sampling vehicles, the MAU-1 and the MAU-4, when sampling:

> **MAU-1** – A RV-sized vehicle that houses an Agilent 6890/5975 MSD Gas Chromatograph/Mass Spectrometer (GC/MS) with a Dynatherm IACEM 980 Air Sampler. For each sample, a total of 0.5L of air was acquired at a constant rate over a 5-minute time period, either through direct sampling of the outside air or through remote air collection in Tedlar bags. Air samples were collected once per hour for the duration of the sampling session.
>
> **MAU-4** – A utility-sized truck that houses a RAM 2000 Open Path Fourier Transform Infrared Spectrometer (OP-FTIR or Open Path sampler). Pollutants in air between the MAU-4, containing the OP-FTIR, and a strategically-placed mirror are measured using an infrared beam that bounces off the mirror and back to a detector (referred to as the open path). The actual emplacement of the OPFTIR equipment depends on factors including topography, site layout, safety considerations and current meteorological conditions. A tradeoff exists between the length of the open path and detection limits; the longer the path, the higher the detection limits. The minimum length of the open path as well as other operational procedures, are based on the U. S. Environmental Protection Agency's (EPA) Compendium Method TO-16 (U.S. EPA, 1999a). A list of compounds that the OP-FTIR can detect can be found in the data files in Appendix A.

The MAU equipment was set up downwind of the target source and operated continuously during selected sampling windows. The sampling windows were designed to capture pollutant concentrations during the early morning hours and late evening hours, to reflect the predominate times when complaints related to Marcellus gas exploration activities received by the Department.

During the sampling week, the BOL personnel would drive the MAU from Harrisburg to the sampling site and conduct six sampling sessions before returning to Harrisburg. Three of the sessions would run from 5:00 am to 12:00 pm and three would run from 5:00 pm to 12:00 am. PA DEP regional personnel familiar with the area, the drilling activities and reported complaints provided support during the MAU sampling sessions.

Table 1: List of target compounds and PA DEP sampling capability.

CAS#	Target Compounds	DEP Sampling Capability		
		MAU	Canister	FLIR Camera[1]
71-55-6	1,1,1-Trichloroethane		x	
79-34-5	1,1,2,2-Tetrachloroethane		x	
79-00-5	1,1,2-Trichloroethane		x	
75-34-3	1,1-Dichloroethane		x	
75-35-4	1,1-Dichloroethene		x	
95-63-6	1,2,4-Trimethylbenzene	x	x	
106-93-4	1,2-Dibromoethane		x	
107-06-2	1,2-Dichloroethane		x	
78-87-5	1,2-Dichloropropane		x	
106-99-0	1,3-Butadiene		x	
542-75-6	1,3-Dichloropropene		x	
67-64-1	Acetone		x	
71-43-2	Benzene	x	x	x
74-83-9	Bromomethane		x	
75-15-0	Carbon Disulfide	x	x	
56-23-5	Carbon Tetrachloride		x	
108-90-7	Chlorobenzene		x	
75-01-4	Chloroethene		x	
67-66-3	Chloroform		x	
74-87-3	Chloromethane	x	x	
630-08-0	Carbon monoxide	x		
110-82-7	Cyclohexane		x	
74-84-0	Ethane	x		x
100-41-4	Ethylbenzene	x	x	x
107-21-1	Ethylene Glycol			
50-00-0	Formaldehyde	x		
7647-01-0	Hydrogen Chloride	x		
7783-06-4	Hydrogen Sulfide	x		
74-82-8	Methane	x		x
67-56-1	Methanol	x		x
75-09-2	Methylene Chloride		x	
108-38-3	m-Xylene	x		
91-20-3	Naphthalene	x		
106-97-8	n-Butane	x		x
110-54-3	n-Hexane	x	x	x
	Nitrogen oxides	x		
95-47-6	o-Xylene	x	x	x
74-98-6	Propane	x		x
115-07-1	Propene		x	
106-42-3	p-Xylene	x		x
100-42-5	Styrene	x	x	
127-18-4	Tetrachloroethene		x	
108-88-3	Toluene	x	x	x
79-01-6	Trichloroethylene		x	
1330-20-7	Xylenes, Mixture		x	x

[1] The FLIR can detect thousands of compounds. The compounds checked have associated minimum detected leak rates.

Canister Sampling

Air canister samples were collected using a method based on EPA Compendium Method TO-15 (U.S. EPA, 1999b). The method uses a specially-prepared canister and sampler that collects an air sample over a 24-hour period, which is then sent to the Department's BOL in Harrisburg for analysis using GC/MS. The equipment and methods used for this project are the same as is used in the statewide toxics monitoring network. Detection limits are low and in the sub part-per-billion volume (ppbv) level. A list of quantifiable compounds can be found in the data files in Appendix B.

The canisters are analyzed by the Department's BOL utilizing a 61-compound calibration mix. The calibration mix covers compounds-of-interest for various toxics work (Urban Air Toxics, Ozone, Fuel Spill, Superfund, etc.) and includes alkanes, alkenes, aromatics, CFC's, chlorobenzenes and oxygenated compounds.

The compounds of interest for this project that are not detected or quantified by this method include the simpler alkanes (methane, ethane, propane and butane) and criteria pollutants like carbon monoxide and nitrogen oxides. However, these compounds are able to be detected by the MAU's Open Path sampler.

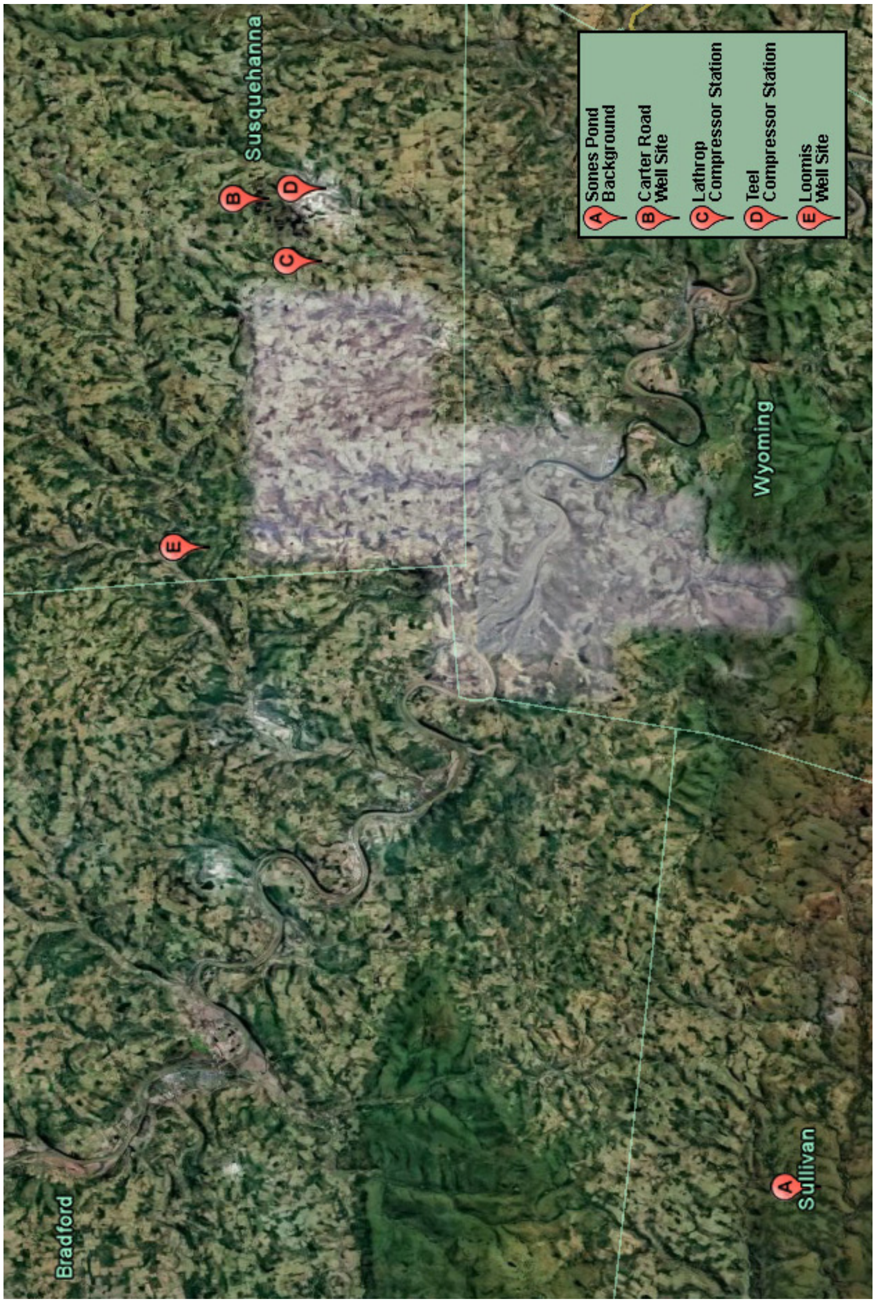
The PA DEP, Bureau of Air Quality, Toxics Monitoring Section provided the canisters and samplers to collect air samples and the training for regional field personnel to collect the air samples.

FLIR Infrared Camera

An infrared camera was employed to visually detect any gas plumes from the source of interest. The FLIR Model GF-320 infrared camera was used for this project. According to the FLIR Web site: "An infrared camera is a non-contact device that detects infrared energy (heat) and converts it into an electronic signal, which is then processed to produce a thermal image on a video monitor" (FLIR, 2010). When using the camera, gases that may be invisible to the naked eye look like smoke or thermal colors on the FLIR camera.

The camera was not used by PA DEP to quantify emissions but to show how emissions from the source of interest can possibly contribute to the sampling results. Advantages of the FLIR camera include the following:

- The camera is designed to detect leaks of the type of pollutants coming from drilling operations and detects emissions safely from a distance;
- The camera can survey a large area, then zoom in to a particular spot of interest, and;
- The camera can also record regular and infrared still images for comparison, as well as video.



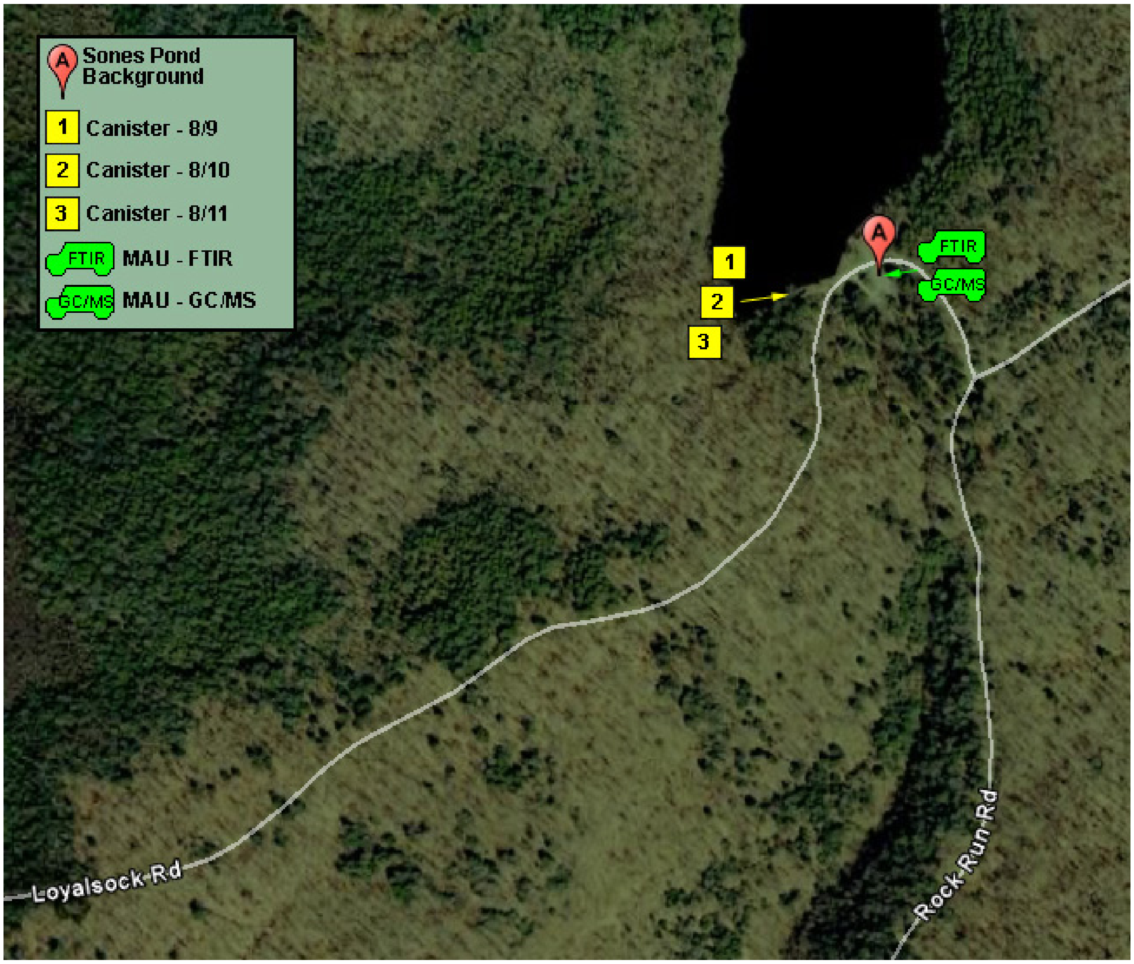
Source: Google, 2010

Figure 3: Map of sampling sites in the northeast region of Pennsylvania.

Sampling Sites

The map in Figure 3 shows the overall sampling area in northeast Pennsylvania. The four sampling weeks were conducted in Sullivan and Susquehanna counties. The satellite maps used in this report were generated from Google Earth (Google, 2010) and in most cases, are from a period before drilling operations began. These maps show the approximate sampling locations and the surrounding terrain and population impacts.

Sones Pond Background – Week of August 9

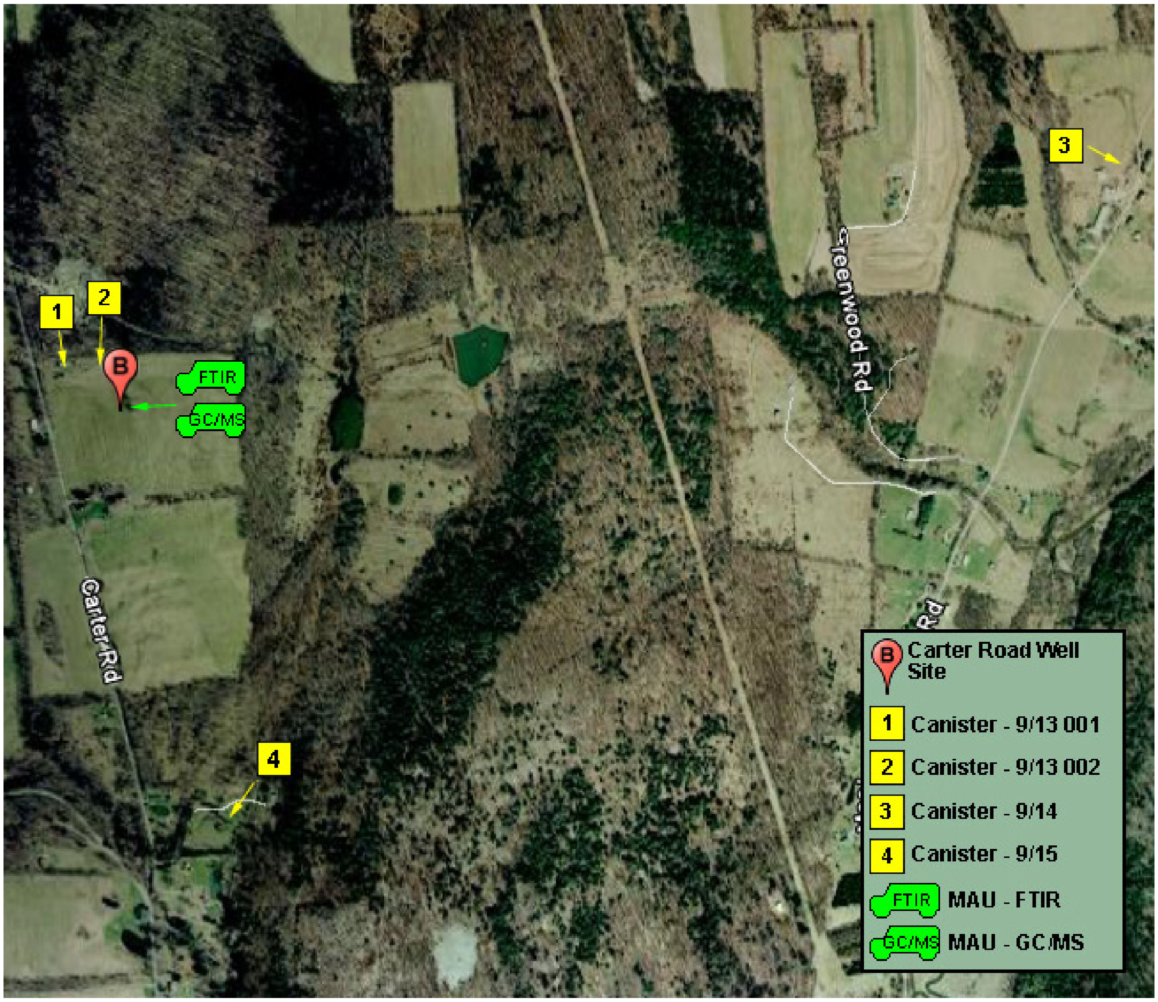


Source: Google, 2010

Figure 4: Map of the Sones Pond background site and sampling locations.

Both MAUs were located at the Sones Pond parking lot in the Loyalsock State Forest in Sullivan County for the duration of the sampling period. Three canister samples were collected at the site at an open site near the pavilion. The weather during the sampling week was mostly clear with calm winds and a bit of rain Tuesday and Thursday morning (Appendix F). Sampling was conducted at this site to collect background information on pollutant concentrations in the area to compare to the future sampling weeks near drilling operations.

Carter Road Well Site – Week of September 13

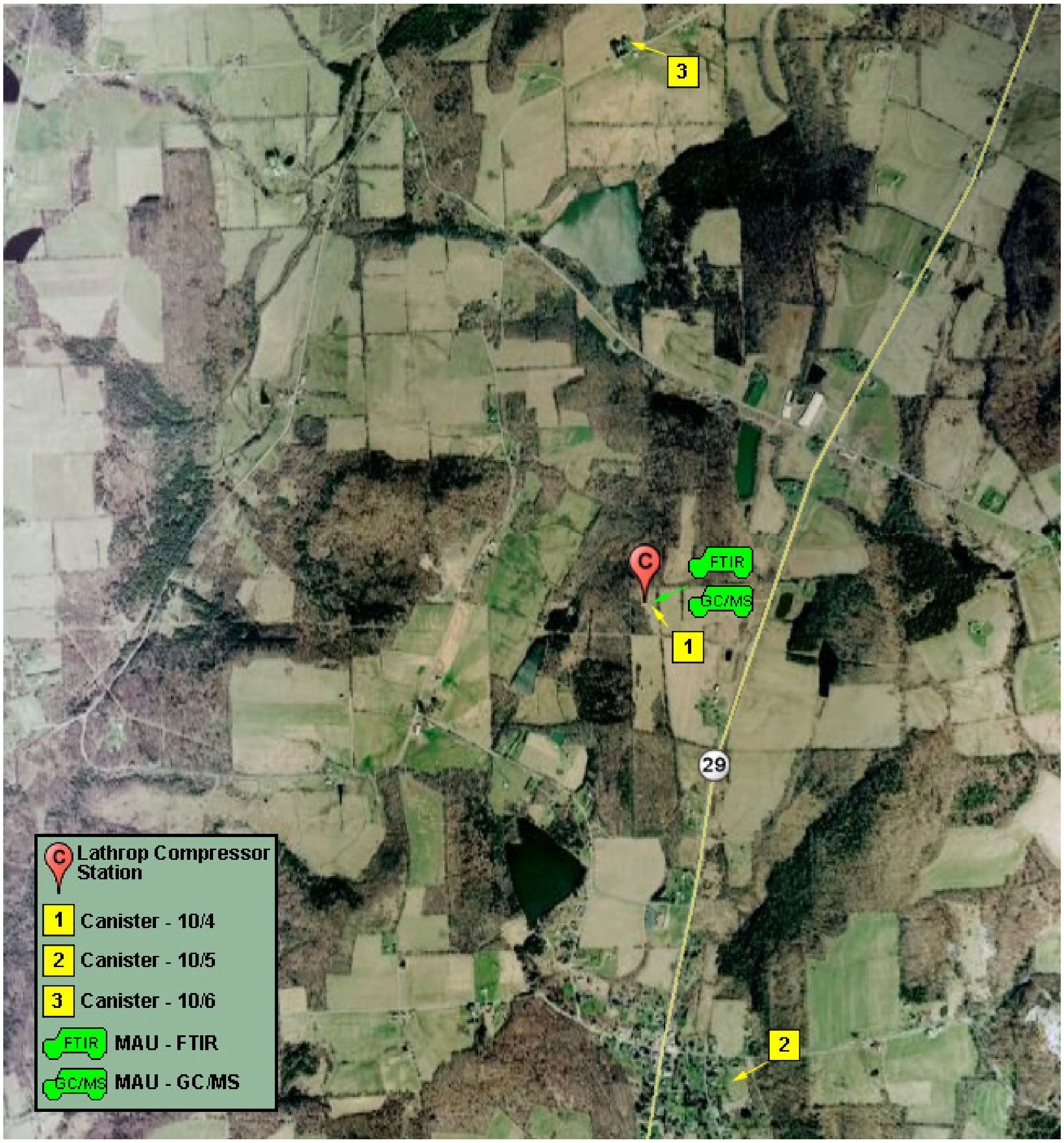


Source: Google, 2010

Figure 5: Map of the Carter Road site and sampling locations.

During the second sampling week PA DEP monitored ambient air pollutant concentrations close to Cabot's Gesford 2V and 7H well site off Carter Road near Dimock, Susquehanna County, PA. Both MAU samplers were situated next to the well. The weather during the week was clear with light winds mainly from the northwest. Canister samples were collected downwind from the well at various locations including the closest residence to the well and other residential locations where air quality complaints were received.

Lathrop Compressor Station – Week of October 4

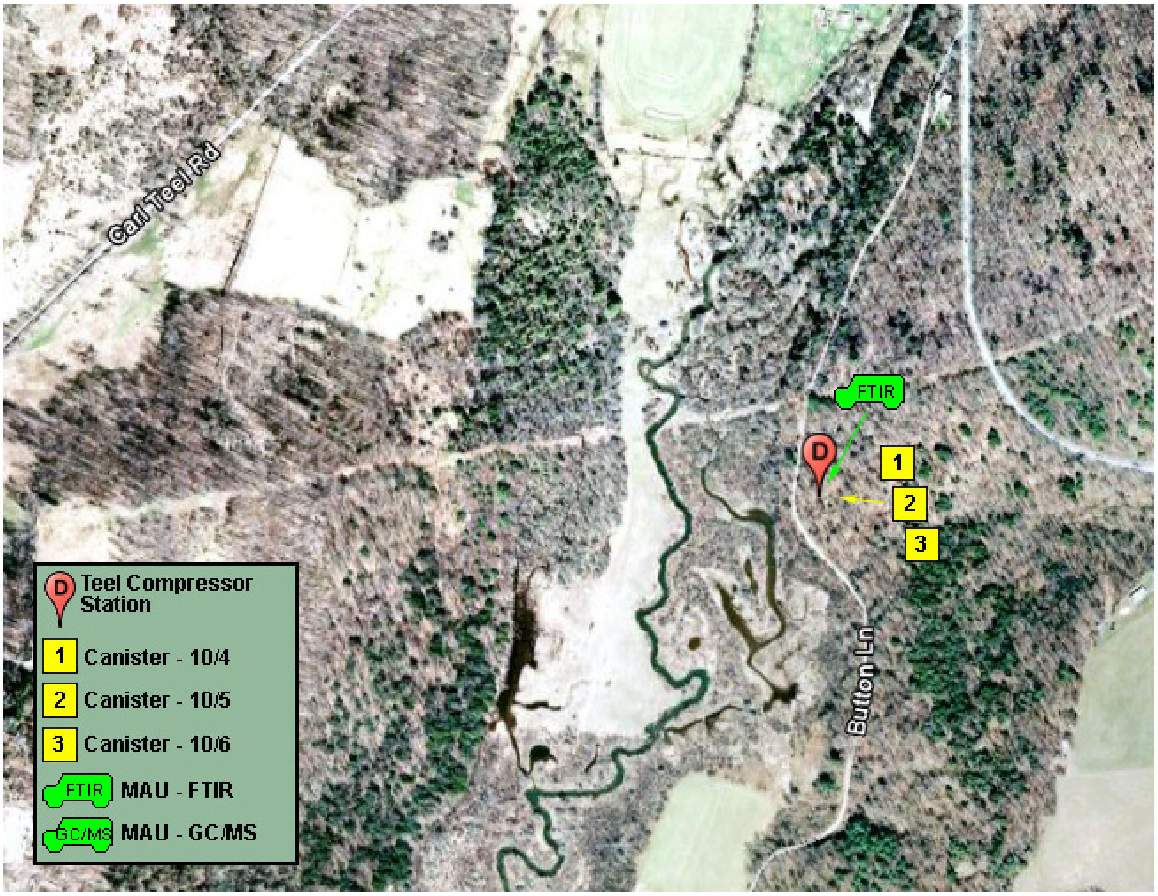


Source: Google, 2010

Figure 6: Map of the Lathrop Compressor Station site and sampling locations.

During the third sampling week, the Department monitored ambient air pollutant concentrations downwind of Cabot's Lathrop Compressor Station off of Route 29, just north of Springville, Susquehanna County, PA. For the first two days of sampling (October 4-5, 2010), both MAU samplers were situated next to and downwind of the compressor station. On October 6, 2010, the FTIR equipment was moved to the Teel Compressor Station to obtain ambient data. The weather during the week was mostly overcast with periods of rain and fog at the beginning and end of the sampling week. Canister samples were collected at the station as well as other nearby population areas.

Teel Compressor Station – Week of October 4



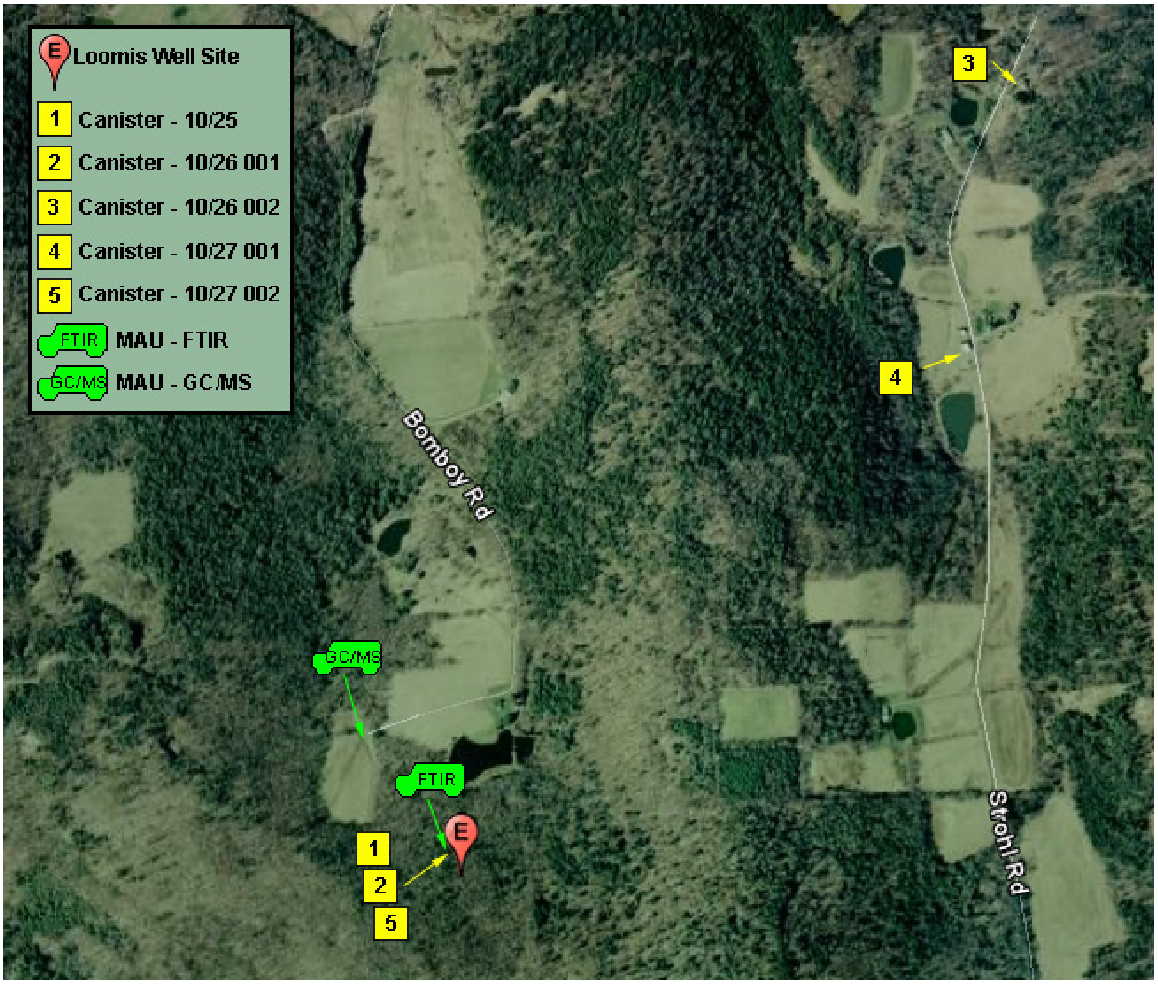
Source: Google, 2010

Figure 7: Map of the Teel Compressor Station site and sampling locations.

For the evening sampling session on Wednesday October 6, the FTIR equipment was diverted from the Lathrop Compressor Station to Cabot's Teel site off of Button Lane, also near Springville, Susquehanna County, PA. This second compressor station was chosen as a sampling site in response to an internet video that claimed to show substantial emissions from the site.

The FTIR sampler was situated next to the compressor station. The weather during the FTIR sampling was overcast with rain developing for the last sampling session. Three canister samples were taken at the compressor station fenceline downwind.

Loomis Well Site – Week of October 25



Source: Google, 2010

Figure 8: Map of the Loomis well site and sampling locations.

During the fourth sampling week, PA DEP monitored ambient air pollutant concentrations next to Stone Energy's Loomis well site near Lawton, Susquehanna County, PA. The sampling occurred while the well site was undergoing the fracking process. The FTIR was located next to the well. Because of a radio frequency transmitter in the GC/MS bus, that bus had to be located further from the site for safety reasons. The weather during the week was variable with periods of rain and clearing and winds from a southerly direction. In all, five canister samples were collected; three at the site and two at nearby residential locations.

Sampling Results

Mobile Analytical Units

Results of the MAU Open Path sampling are presented in Appendix A. These results are reported in separate tables for each site and in two types of units, parts per billion volume (ppbv) and micrograms per cubic meter (ug/m3). The ppbv unit is simply the number of parts of a chemical contained within a billion parts of air. The results are converted from ppbv to ug/m^3 by multiplying by the compounds molecular weight and dividing by the molar volume. The ug/m^3 units are useful when comparing the result to reference concentrations discussed in the Acute Risk Characterization section.

The OP-FTIR, an open path sampler, typically reports the highest 2-minute value if a compound was detected (unless otherwise noted). If the compound was detected at levels during the sampling session (approximately 8 hours) that could be used to calculate a time-weighted average greater than the method detection limit (MDL), that average was reported. The Open Path sampling results provided in Appendix A also include the detection limits for each compound during the sampling period. The OP-FTIR detection limits will vary depending on factors including the mode of deployment, humidity, and the distance traversed; water vapor will also interfere with the detection limits. Many of the compounds listed in Appendix A were not detected (neither an average nor maximum concentration was reported). For the compounds that were detected, most of the compounds had just the 2-minute maximum concentration reported rather than maximum and average concentrations.

When comparing the OP-FTIR data between sites, the Sones Pond background site had fewer detects of natural gas constituents than the other sites. For the sites other than the background, natural gas components such as methane, ethane, propane and butane were detected during every sampling session. Methane concentrations detected at the Carter Road well site were on par with the levels detected at the Lathrop and Teel Compressor Stations. Less methane was detected at the Loomis well site where there was a fracking operation in progress. Other compounds seen during the OP-FTIR sampling include carbon monoxide, MTBE and the odor-producing methyl mercaptan.

At the Sones Pond background site located in the interior of the Loyalsock State Forest, the OP-FTIR (Open path sampler) did not detect concentrations of any pollutant at high enough levels to produce a reportable average. However, there was one 2-minute maximum benzene reading of 400 ppb made during the evening session on August 10, 2010 that will be discussed later in this report. Because of where the OP-FTIR was situated (next to parking lot and road), this one benzene reading is most likely due to a mobile source. The three canister samples collected during the week, which were sited away from the parking lot, did not detect elevated levels of benzene.

The Carter Well site does appear to be a source of natural gas emissions with maximum methane concentrations detected in the 11.6 to 17.3 parts per million (ppm) range (1 ppm = 1,000 ppb). During the six 7-hour sampling sessions at the well site, average methane concentrations were calculated for all six sampling sessions. The highest average methane concentration was approximately 5.8 ppm. Other compounds detected include methyl mercaptan, carbon monoxide and low levels of methyl tertiary butyl ether (MTBE). In 1979, MTBE was used at low levels in gasoline to help reduce engine knocking following the phase-out of lead in gasoline. Following the enactment of the 1990 Clean Air Act Amendments, MTBE was blended at higher concentrations (minimum of 2 percent oxygen by weight) in reformulated gasoline to reduce ground-level ozone (smog) in certain ozone nonattainment areas including the five-county Philadelphia area (Bucks, Chester, Delaware, Montgomery and Philadelphia counties). MTBE was eventually banned for use in gasoline due to its contribution to groundwater pollution issues. The MTBE findings are not related to Marcellus shale gas activities because the compound is a man-made chemical—the compound is not used in the fracturing process nor was it detected in the 24-hour canister samples.

OP-FTIR sampling at the Lathrop and Teel compressor stations also detected the same type of pollutants with methane being the predominate pollutant. The maximum methane concentration detected at the Lathrop facility was 19.8 ppm with a high average of 7.8 ppm. Other constituents of shale gas were seen at this facility including ethane, propane and butane. In addition, dimethyl sulfide and methyl mercaptan, both odor-producing chemicals, were also detected. The maximum methane concentration detected at the Teel facility was 21.9 ppm with a maximum average of 7.0 ppm. Similar compounds were detected during sampling near the Loomis well site. However, less methane was detected at the Loomis well site most likely due to the ongoing fracking operation and because production had not yet begun.

The Department's GC/MS equipment did not detect quantifiable amounts of the targeted pollutants at the Sones Pond background site or Lathrop compressor station facility. At the other two samples sites, the Carter Road and the Loomis well sites, the GC/MS picked up a variety of volatile organic compounds including a group of compounds called BTEX (benzene, toluene, ethylbenzene and xylene), chlorinated and methyl benzenes, and other compounds, most in the low 1 to 6 ppb range. At the Loomis well site, the solvents trichloroethene and tetrachloroethene were detected in bag samples and estimated to be 49 ppb and 73 ppb, respectively. Other tentatively identified compounds were detected by the GC/MS but at levels below the quantitation limit of the instrument. The quantitation limit of 0.5 ppbv is the lowest amount of compound in a sample which can be quantitatively determined with suitable precision and accuracy. The types of compounds detected below the quantitation limit are widely variable but do include components of natural gas, benzenes and naphthalene. Because those compounds cannot be quantified, they are not included in this report.

Canister Sampling

Results of the canister sampling can be found in Appendix B. Most of the 57 compounds in the analysis were not detected. This is common and seen at most sampling sites in the Commonwealth, simply because of the variety of compounds analyzed. However, more compounds were detected at the two DEP monitoring network sites in Arendtsville

(Adams County) and Marcus Hook (Delaware County) in 2009 simply because the larger sample set provides a greater chance of detection over the year. The averages for the two network sites in Adams and Delaware counties are based on results from a possible 61 samples collected over an entire year.

For compounds not detected, one-half the method detection limit was used in the tables as well as in any risk calculations. Note that the method detection limits shown in Appendix B are for samples collected after August 23, 2010. For the samples collected at the Sones Pond, Arendtsville and Marcus Hook sites other method detection limits were used that are not provided in this report.

Of the compounds detected, some are found everywhere in the atmosphere and present in stable amounts. For example, the compounds 1,1,2-trichloro-1,2,2-trifluoroethane, dichlorodifluoromethane, trichlorofluoromethane and chloromethane were once used as refrigerants and propellants but have been phased out due to their impact on the ozone layer. Carbon tetrachloride was used to produce these refrigerants but its production declined as their use was banned. Again even though these compounds are no longer being used or had their use curtailed, they persist at certain levels in the atmosphere.

Other compounds detected in the canister sampling are also seen at the PA DEP network sites across the Commonwealth. Results for 2-butanone (MEK) and acrolein were found at similar levels at monitoring sites in other regions of the Commonwealth where there are no natural gas drilling operations.

The following compounds that were detected at low concentrations may be related to the Marcellus Shale natural gas activities: 2-hexanone, acetone, benzene, propene and toluene. Concentrations of these pollutants were at, or slightly higher than, levels detected in the DEP monitoring network sites. However, none were detected at levels of concern.

Recently, EPA determined that acrolein data from their School Air Toxics Monitoring Initiative was unreliable (U.S. EPA, 2010b). That initiative used the same canister collection method used in this project. PA DEP has adopted the same approach as EPA, which is to present the acrolein data in effort of transparency, but to note the data should not be used for any type of analysis because of the uncertainty.

Most of the canister samples had several tentatively identified compounds. Again, these are compounds determined by the Department to be present in a sample, but cannot be quantified. The canister samples from the Carter Road and Lathrop sampling sites contained tentatively identified compounds that were not substantially different from ambient air samples collected at the network sites. For the canister samples collected at the Teel and Loomis compressor stations, the tentatively identified compounds seen were a mix of straight-chained hydrocarbon compounds; typical constituents of natural gas.

FLIR Infrared Camera

The FLIR infrared camera was utilized during sampling at the Carter Road well site during the week of September 13, 2010. Two locations where filming took place and emissions were detected are presented here.

FLIR images of the well condensate tanks are shown in Figure 9. As seen in the regular image on the left, each tank is vented by multiple pipes at the top of the tank. None of the pipes contain control devices. When condensate is pumped into the tank, the displaced air above the liquid is vented to the atmosphere. This venting can clearly be seen in the image on the right, highlighted by white arrows.

FLIR images of the condensate separator are shown in Figure 10. As seen in the regular image on the left, no emissions are visible when viewed by the naked eye. When viewed using the infrared detection (image on the right), a plume is visibly emanating from the separator joints, highlighted by the green arrow. This plume most likely contains compounds from the gas stream.

Again, these images show emissions from the well site that most likely relate to the results of the OP-FTIR sampling.

Figure 9: FLIR images of the condensate tanks at the Carter Road well site. Gas emissions are referenced by the white arrows.

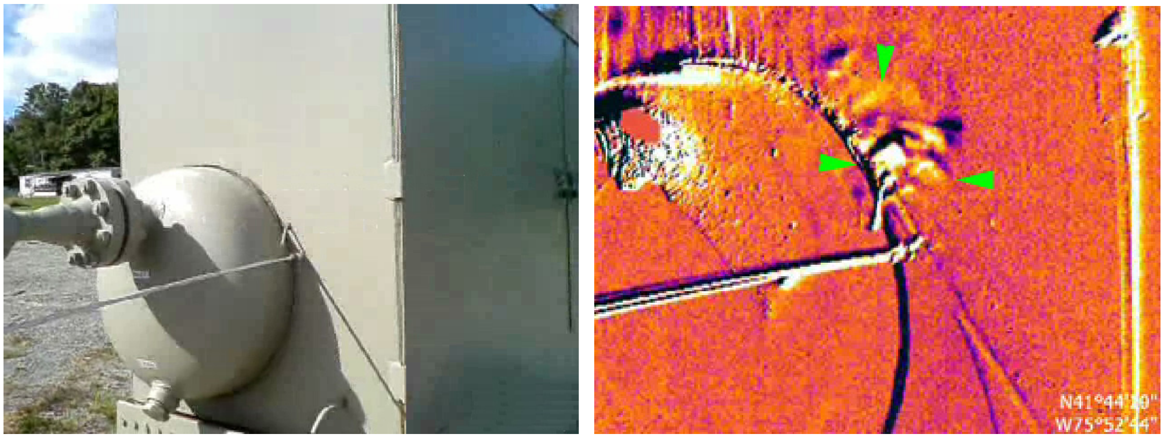


Figure 10: FLIR images of the condensate separator at the Carter Road well site. Fugitive gas emissions from piping are reference by the green arrow.

Acute Risk Characterization

The sampling results were used to characterize the acute non-cancer health risks of ambient pollutant concentrations found around Marcellus Shale drilling operations to nearby residences or communities. To this end, the PA DEP compared sampling results to available reference concentrations (RfCs) and standards.

RfC and standards are concentrations of a particular pollutant, below which (non-cancer) adverse health effects are not expected to occur over a period of continuous exposure. There are RfCs and standards available for different periods of time. For example, there are chronic RfCs to compare against data collected over at least a one-year period. For this study, acute reference concentrations representing time periods of one day or less were used for the characterization. Values found above a reference concentration do not necessarily mean that adverse health effects will occur, but that there is more of a potential.

Appendix C lists the RfCs available for comparison to the OP-FTIR and canister results. A total of 33 of the 45 target compounds have an associated RfC for comparison. Because the Open Path sampling and canister samples were collected over different time periods, different sets of RfCs were used. In order to make the comparison between the sample result and the RfC, a hazard quotient is calculated. A hazard quotient (HQ) is simply the sampling result (in ug/m^3) divided by the RfC. If the value is less than one, then non-cancer health effects are not expected. To be even more conservative in the risk assessment, and to account for effects from multiple pollutants that may be additive, the individual hazard quotients of a sample may be added to produce a hazard index (HI). Again, if the HI is less than one, then non-cancer health effects are not expected.

Any estimate of acute risk is based on a number of assumptions and some of the assumptions made for this study include the following:

- concentrations measured at the sampling sites are representative of exposures to the population in the area;
- effects from exposure to multiple chemicals are additive, and;
- only inhalation risk is considered in this report.

The lifetime cancer risk was not calculated for this short-term sampling study. Typically, a sampling period of at least one year is necessary for a lifetime cancer risk analysis.

Hazard Quotients for MAU Samples

The hazard quotient and index calculations for the OP-FTIR and GC/MS data are provided in Appendix D. In order to be more conservative with the risk estimates, hazard quotients were calculated using three different sets of RfCs used for screening risk assessments (U.S. EPA, 2010a). The three sets of RfCs include:

- Reference Exposure Levels (RELs) - California Environmental Protection Agency's (EPA) Reference Exposure Levels for no adverse effects. Most of the RELs used in this study are for 1-hour exposures.
- Acute Exposure Guideline Levels (AEGL) - EPA's Office of Prevention, Pesticides and Toxic Substances established the National Advisory Committee to develop Acute Exposure Guideline Levels (AEGL). The AEGL values are used by local, state and federal agencies for emergency planning, prevention and response to provide guidance in situations where the general public may be accidentally exposed to certain chemicals. PA DEP mainly used AEGL-1 values where the general population may experience mild transient and reversible effects. When these values were not available, AEGL-2 values were used where moderate effects may occur in the general population.
- Emergency Response Planning Guidelines (ERPGs) – American Industrial Hygiene Association, Emergency Response Planning Guidelines. Again, PA DEP mainly used ERPG-1 values that represent concentrations for exposure of the general population for up to 1 hour with effects to be mild.

The hazard quotient and indices in Appendix D were calculated using the OP-FTIR 2-minute maximum data. In doing this, an assumption is made that the 2-minute maximum represents a 1-hour average. Even with this assumption, most of the calculated hazard quotients and indices were well below the acceptable limit of 1.0 indicating non-cancer health effects are not expected when breathing pollutants in air at concentrations detected during the short-term sampling initiative. In fact, most hazard quotient calculations are so low they appear to be zero, but this is only due to rounding.

Only one hazard quotient close to 1.0 was calculated for a single 2-minute benzene concentration of 400 ppb, which was detected at the Sones Pond background site. The calculated HQ value of 0.98 for benzene during the Sones Pond background sampling is most likely not a concern due to the "2-minute equals 1-hour" assumption and the fact that the other two RfCs for benzene produce acceptable hazard quotient calculations well below 1.0. Furthermore, canister sampling results in the Sones Pond area, were within acceptable levels as well. The Department believes that the location of the OP-FTIR sampler next to a parking lot and road where the benzene concentration was detected could be associated with nearby mobile sources. The Department does not believe that there is a risk of adverse health effects from the MTBE concentrations detected in the area.

The report does not include the hazard quotient and indices for OP-FTIR 7-hour average data because few averages were generated. Because there are fewer 8-hour RfCs available for comparison, only a small number of quotients were calculated. All of these quotients were well under the acceptable limit range and therefore were not included in this report.

Hazard Quotients for Canister Samples

The hazard quotient and index calculations for the canister data are presented in Appendix E. Because canister samples are 24-hours in duration, the hazard quotients were calculated using a different set of reference concentrations that are for the most part more conservative (are smaller values) than the ones used for the MAU data. Acute RfC values were taken from the Department of Energy's Risk Assessment Information System (RAIS) database (U.S. DOE, 2010). The list of RfC values in the database were compiled from a variety of sources using a selection hierarchy accepted by the PA DEP.

None of the calculated hazard quotients or indices approached the value of 1.0, indicating non-cancer health effects are not expected when breathing pollutants in air at concentrations during sampling.

National Ambient Air Quality Standards

Section 109(a)(1)(A) of the Clean Air Act (CAA) mandates that the EPA Administrator publish regulations prescribing national primary and secondary national ambient air quality standards (NAAQS) for each air pollutant for that the agency has issued air quality criteria. The standards must be set for "criteria pollutants" at a level that provides protection from adverse effects on the public health and welfare. Section 109(b) of the CAA provides for "primary standards" for the protection of public health within an adequate margin of safety and "secondary standards" for the protection of public welfare from any known or anticipated adverse effects including decreased visibility, and damage to wildlife, crops, vegetation, and buildings. 42 U.S.C.A. § 7409. To date, EPA has promulgated NAAQS for the following criteria pollutants shown in Table 2: carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter and sulfur dioxide.

Table 2: The National Ambient Air Quality Standards.

Pollutant	Primary Standards		Secondary Standards	
	Level	Averaging Time	Level	Averaging Time
Carbon Monoxide	9 ppm	8-hour	None	
	35 ppm	1-hour		
Lead	0.15 µg/m3	Rolling 3-Month Avg	Same as Primary	
	1.5 µg/m3	Quarterly Average	Same as Primary	
Nitrogen Dioxide	53 ppb	Annual (Arithmetic Avg)	Same as Primary	
	100 ppb	1-hour	None	
Particulate Matter (PM10)	150 µg/m^3	24-hour	Same as Primary	
Particulate Matter (PM2.5)	15.0 µg/m^3	Annual (Arithmetic Avg)	Same as Primary	
	35 µg/m^3	24-hour	Same as Primary	
Ozone	0.075 ppm (2008 std)	8-hour	Same as Primary	
	0.08 ppm (1997 std)	8-hour	Same as Primary	
	0.12 ppm	1-hour	Same as Primary	
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Avg)	None	
	0.14 ppm	24-hour		
	75 ppb	1-hour	0.5 ppm	3-hour

The criteria pollutants monitored in this study by the MAU OP-FTIR include carbon monoxide, nitrogen dioxide, sulfur dioxide and ozone. The carbon monoxide standard for an 8-hour averaging time is 9,000 ppbv. EPA's recently adopted 1-hour nitrogen dioxide NAAQS is 100 ppb. The new 1-hour sulfur dioxide health-based standard is 75 ppb. In 2008, EPA issued a revised 8-hour ozone standard of 75 ppb; EPA intends to issue a more protective ozone standard by July 31, 2011.

The EPA specifies how data is to be collected for comparison to the NAAQS. Although the federal methods were not employed for this study, the OP-FTIR did not detect concentrations of nitrogen dioxide, sulfur dioxide nor ozone to produce a 7-hour average result. Furthermore, for the four 7-hour averages calculated for carbon monoxide (the maximum being 165 ppb), none were close to the standard.

Although it is unlikely that drilling operations at a single site will cause an exceedance or violation of the NAAQS, combined effects from many of these operations in an area, along with other sources, may contribute to exceedances or violations of the NAAQS or interfere with the maintenance of the health-based standards in attainment areas.

Odors

The Open Path sampler did detect certain compounds in concentrations above their odor thresholds. Methyl mercaptan, a sulfur-containing colorless gas with an unpleasant odor described as rotten cabbage, is detectable by the nose at 1 ppb. This compound was detected at all sampling sites (even the Sones Pond background site) for short periods. The highest two-minute reading for methyl mercaptan was 1,095 ppb during sampling at the Carter Road well site.

Discussion

Sampling by the PA DEP using OP-FTIR, GC/MS and canister methods, did detect concentrations of natural gas constituents including methane, ethane, propane and butane in the air near various Marcellus Shale drilling operations. Appreciable concentrations of methane were detected by the OP-FTIR at all sampling events other than the background event. Methane was measured at a maximum level of 21,874 ppb (or 21.9 ppm) during sampling at the Teel compressor station.

Some compounds detected at low levels by the OP-FTIR and GC/MS, other than the basic natural gas constituents, could be attributed to Marcellus shale gas operations including the measured BTEX compounds (benzene, toluene, ethylbenzene and xylene), methylbenzenes and naphthalene (Pa. DEP, 2010b). Other compounds mentioned in the report, including MTBE, trichloroethene and tetrachloroethene, are not used by the gas industry and are mostly likely from other sources.

Benzene was one of the major pollutants of concern in the Texas Commission on Environmental Quality monitoring projects of the Barnett Shale formation (TCEQ, 2010). Although all three sampling methods employed by the PA DEP for this study detected benzene, none were at the levels found in the Texas study. Only one benzene concentration (measured over a two-minute period) of 400 ppb produced a hazard quotient close to 1.0, when compared to the most conservative of the three health-based reference concentrations (i.e. California EPA Reference Exposure Level) used in this study. Considering the assumptions made during the acute risk characterization and that this single high benzene value was measured at the background site, the PA DEP has determined that benzene should not be considered a pollutant of concern near Pennsylvania Marcellus Shale operations.

Certain compounds were detected at levels to produce odors; mainly the methyl mercaptan concentrations measured at brief intervals during all sampling events. The levels detected could cause violations of PA DEP odor emission provisions in 25 *Pa. Code* Section 123.31 (relating to limitations) if they persisted off the property and the Department determined that the odors were "malodors" as defined in 25 *Pa. Code* Section 121 (relating to definitions).[1] Prolonged or repeated exposures to strong odors may produce odor-related health effects such as headaches and nausea.

The FLIR infrared camera has been an effective tool in showing emissions from drilling operations that may relate to the sampling results, especially at the Carter Road well site.

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[1] *Malodor*—An odor which causes annoyance or discomfort to the public and which the Department determines to be objectionable to the public.

Here the camera documented fugitive and direct emissions of what is most likely methane. Although the ambient methane concentrations detected in the air were not considered unacceptable in terms of adverse inhalation health effects, the methane emissions do represent a waste of resources and a fractional contribution to greenhouse gas levels. The camera will continue to be deployed during future investigative and/or sampling efforts.

Even though constituents of natural gas and other associated target compounds were detected, the screening results found to date do not indicate a potential for major air-related health issues associated with the Marcellus Shale drilling activities.

How do the sampling results reported above for the northeast portion of the state compare to those in southwestern Pa.? Sampling in both regions found natural gas constituents in the ambient air near gas drilling and processing operations. The same pollutants (e.g., methane, ethane, propane and butane) were measured at compressor stations in both regions and at comparable levels. For example, the maximum ambient methane concentrations near the Energy Corp. compressor station in Greene County were in the range of 2,124 ppb to 44,744 ppb, whereas the maximums near the Lathrop and Teel facilities were 2,722 ppb to 21,874 ppb.

Odor-producing methyl mercaptan levels were not as high at the Loomis well site compared to the Yeager Impoundment site in the southwest (Washington County). Both sites were undergoing the fracturing process during sampling. However, the sampling at the Loomis well site was during the initial stages of fracturing where fracturing fluids were being pumped underground in stages and no fluids were returning to the surface. The Yeager Impoundment sampling occurred after the fracturing fluid was produced or returned to the surface and was being held in an open retention pond.

The above ground natural gas infrastructure in both regions, from well sites to condensate tank farms to compressor stations, does appear to produce emissions of pollutants through fugitive and/or direct means. However, when looking at the individual operations, the emissions do not seem to create ambient air pollution conditions where acute adverse health impacts are expected.

Next Steps

PA DEP has also completed air sampling near Marcellus natural gas operations in the northcentral region of the Commonwealth, specifically in Sullivan, Bradford, Tioga and Lycoming counties. When all data analysis is completed, PA DEP will compare results from the surveyed regions to determine any regional differences where wet gas is extracted in the southwest region versus dry gas in the northcentral and northeast regions of the Commonwealth. Following the completion of the comparative analysis, the Department will determine whether additional sampling is warranted. The PA DEP will also determine if the implementation of additional measures will be necessary for the protection of public health and the environment during natural gas development operations in the Commonwealth.

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Appendices

Appendix A: Mobile Analytical Unit OP-FTIR Data
Appendix B: Canister Data
Appendix C: Reference Concentrations
Appendix D: Mobile Analytical Unit Hazard Calculations
Appendix E: Canister Hazard Calculations
Appendix F: Mobile Analytical Unit Meteorological Data

Appendix A: Mobile Analytical Unit OP-FTIR Data

Sones Pond Background Concentrations (expressed in ppb)

Compound	8/9/10			8/10/10						8/11/10						8/12/10		
	5:00 pm - 12:00 pm			5:00 am - 12:00 pm			5:00 pm - 12:00 am			5:00 am - 12:00 pm			5:00 pm - 12:00 am			5:00 am - 12:00 pm		
	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)
1,2,4-Trimethylbenzene	242	--	--	173	--	--	164	--	--	167	--	--	137	--	--	151	--	--
2-Methoxy-2-methylpropane (MTBE)	6	--	41	8	--	22	11	--	58	31	--	98	4	--	--	7	--	24
2-Methyl Butane	38	--	--	25	--	56	16	--	69	31	--	452	14	--	--	29	--	--
2-Methyl Pentane	46	--	--	36	--	--	24	--	--	60	--	853	19	--	--	34	--	--
3-Methyl Pentane	46	--	--	32	--	--	20	--	--	45	--	130	18	--	--	34	--	--
Benzene	72	--	--	71	--	150	77	--	400	92	--	269	57	--	--	69	--	--
Carbon Disulfide	40	--	--	38	--	--	49	--	--	110	--	--	32	--	--	48	--	--
Carbon Monoxide	24	--	70	18	--	103	10	--	27	21	--	--	9	--	121	18	--	1573
Carbonyl Sulfide	5	--	--	4	--	--	7	--	--	11	--	--	2	--	--	4	--	--
Chloromethane	97	--	--	110	--	--	140	--	353	443	--	--	79	--	--	103	--	--
Dimethyl sulfide	30	--	--	33	--	--	41	--	--	110	--	--	24	--	--	35	--	--
Ethane	114	--	--	84	--	--	54	--	--	129	--	--	47	--	--	85	--	--
Ethylbenzene	115	--	--	79	--	--	62	--	--	108	--	317	46	--	--	96	--	--
Formaldehyde	13	--	--	12	--	--	8	--	--	25	--	--	7	--	--	12	--	--
Hydrogen Chloride	18	--	--	15	--	--	11	--	--	35	--	--	9	--	--	17	--	--
Hydrogen Sulfide	3468	--	--	3590	--	--	4204	--	--	8319	--	--	2720	--	--	3816	--	--
iso-Butane	25	--	--	19	--	--	13	--	--	32	--	--	12	--	--	22	--	--
Methane	113	--	--	78	--	--	47	--	208	114	--	--	42	--	186	92	--	--
Methanol	7	--	--	7	--	--	8	--	--	8	--	--	5	--	--	6	--	--
Methyl mercaptan	73	--	340	86	--	350	145	--	--	263	--	--	51	--	--	81	--	--
m-Xylene	58	--	--	46	--	--	36	--	--	48	--	--	33	--	--	46	--	112
Naphthalene	24	--	--	18	--	--	15	--	--	19	--	--	13	--	--	18	--	--
n-Butane	34	--	--	27	--	--	20	--	--	56	--	--	17	--	--	29	--	--
n-Heptane	215	--	--	165	--	360	123	--	--	285	--	609	105	--	--	180	--	510
n-Hexane	74	--	--	53	--	--	37	--	--	81	--	455	34	--	--	60	--	--
Nitric Acid	6	--	--	7	--	--	11	--	32	21	--	--	5	--	13	6	--	--
Nitric Oxide	382	--	--	320	--	--	536	--	--	899	--	--	177	--	--	291	--	--
Nitrogen Dioxide	41	--	--	45	--	--	60	--	--	160	--	--	31	--	--	48	--	--
Nitrous Acid	2	--	--	2	--	--	3	--	--	3	--	10	2	--	3	2	--	--
n-Octane	163	--	--	130	--	--	100	--	--	227	--	1911	81	--	--	137	--	--
n-Pentane	68	--	--	45	--	--	27	--	--	58	--	--	25	--	--	52	--	--
o-Xylene	45	--	--	38	--	--	24	--	--	68	--	--	31	--	--	38	--	--
Ozone	13	--	--	12	--	--	17	--	--	15	--	75	10	--	--	12	--	--
Propane	53	--	--	36	--	--	21	--	--	48	--	530	20	--	--	41	--	--
p-Xylene	167	--	--	114	--	--	77	--	--	125	--	--	89	--	--	124	--	--
Styrene	18	--	--	14	--	--	14	--	--	25	--	--	12	--	--	14	--	--
Sulfur Dioxide	68	--	--	78	--	--	90	--	--	120	--	--	54	--	--	85	--	--
Toluene	92	--	--	68	--	172	47	--	154	102	--	--	61	--	--	85	--	--

8/11/10 - Nitric Acid - 7-10 (9:10 sustained through noon)
8/11/10 - Ozone - 75 (9:07 sustained through noon)
8/11/10 - Methane - 186 (occurred twice)
8/12/10 - MTBE - 24 (occurred twice)
8/12/10 - n-Heptane - 510 (occurred twice)

Carter Road Well Site Concentrations (expressed in ppb)

Compound	9/13/10			9/14/10						9/15/10						9/16/10		
	5:30 pm - 12:00 pm			5:00 am - 12:00 pm			5:00 pm - 12:00 am			5:00 am - 12:00 pm			4:45 pm - 12:00 am			5:00 am - 12:00 pm		
	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)
1,2,4-Trimethylbenzene	259	--	--	259	--	--	258	--	--	306	--	--	297	--	--	308	--	--
2-Methoxy-2-methylpropane (MTBE)	8	19	156	8	24	115	4	--	41	5	--	66	4	--	28	8	--	87
2-Methyl Butane	303	--	--	273	--	--	235	--	--	228	--	--	168	--	--	170	--	--
2-Methyl Pentane	332	--	--	307	--	--	239	--	--	231	--	--	161	--	--	157	--	--
3-Methyl Pentane	333	--	--	302	--	--	256	--	--	244	--	--	168	--	--	170	--	--
Benzene	73	--	--	75	--	--	71	--	--	73	--	--	72	--	--	77	--	--
Carbon Disulfide	56	--	--	59	--	--	37	--	--	37	--	--	69	--	--	84	--	--
Carbon Monoxide	32	--	115	29	--	179	30	--	133	26	--	90	30	--	458	34	--	343
Carbonyl Sulfide	4	--	--	5	--	--	2	--	--	2	--	--	2	--	--	4	--	--
Chloromethane	116	--	--	111	--	--	64	--	--	80	--	--	57	--	--	117	--	--
Dimethyl sulfide	64	--	--	65	--	--	52	--	--	54	--	--	41	--	--	56	--	--
Ethane	761	--	--	701	--	--	557	--	--	541	--	--	378	--	--	372	--	--
Ethylbenzene	238	--	--	223	--	--	202	--	--	201	--	--	207	--	--	236	--	--
Formaldehyde	38	--	--	36	--	--	29	--	--	28	--	--	22	--	--	24	--	--
Hydrogen Chloride	47	--	--	45	--	--	35	--	--	35	--	--	27	--	--	30	--	--
Hydrogen Sulfide	4944	--	--	4997	--	--	3689	--	--	3751	--	--	2947	--	--	4459	--	--
iso-Butane	259	--	--	235	--	--	184	--	--	177	--	--	120	--	--	120	--	--
Methane	381	4994	14024	329	5818	17232	369	3515	14159	230	3641	13279	161	2541	17250	188	2463	11600
Methanol	7	--	--	6	--	--	6	--	--	6	--	--	6	--	28	7	--	16
Methyl mercaptan	271	--	566	268	--	--	148	--	921	162	--	--	131	--	1095	235	--	--
m-Xylene	90	--	--	86	--	--	73	--	--	81	--	--	75	--	--	89	--	--
Naphthalene	36	--	--	31	--	--	28	--	--	27	--	--	29	--	--	32	--	--
n-Butane	139	--	--	119	--	--	102	--	460	96	--	321	83	--	250	101	--	--
n-Heptane	2815	--	--	2500	--	--	2201	--	--	2113	--	--	1477	--	--	1498	--	--
n-Hexane	734	--	--	660	--	--	569	--	--	551	--	--	407	--	--	409	--	--
Nitric Acid	7	--	--	8	--	--	5	--	--	6	--	14	4	--	--	8	--	18
Nitric Oxide	436	--	--	513	--	--	175	--	--	258	--	--	138	--	--	505	--	--
Nitrogen Dioxide	740	--	--	621	--	--	319	--	--	333	--	--	384	--	--	315	--	--
Nitrous Acid	2	--	--	2	--	--	1	--	--	2	--	--	1	--	--	2	--	--
n-Octane	2267	--	--	2038	--	--	1723	--	--	1651	--	--	1133	--	--	1134	--	--
n-Pentane	404	--	--	366	--	--	320	--	--	313	--	--	238	--	--	242	--	--
o-Xylene	144	--	--	134	--	--	121	--	--	120	--	--	123	--	--	132	--	--
Ozone	16	--	--	13	--	--	14	--	--	13	--	--	14	--	--	13	--	--
Propane	441	--	--	398	--	--	339	--	--	328	--	--	237	--	--	239	--	--
p-Xylene	280	--	--	263	--	--	245	--	--	268	--	--	248	--	--	270	--	--
Styrene	25	--	--	22	--	--	22	--	--	23	--	--	22	--	--	24	--	--
Sulfur Dioxide	60	--	--	57	--	--	45	--	--	49	--	--	40	--	--	67	--	--
Toluene	188	--	--	172	--	--	164	--	--	173	--	--	170	--	--	185	--	--

9/13/10 - MTBE - 156 (4-minute episode)
9/13/10 - Methane - 14024 (occurred twice)
9/14/10 - Methane - 17232 (occurred 3 times)
9/15/10 - Methane - 13279 (occurred twice)
9/15/10 - Nitric Acid - 14 (occurred twice)
9/15/10 - MTBE - 28 (10-minute episode)
9/15/10 - Methyl mercaptan - 1095 (occurred twice)
9/16/10 - MTBE - 87 (12-minute episode)

Pennsylvania Department of Environmental Protection
Northeastern PA Marcellus Shale Short-Term Ambient Air Sampling Report
January 12, 2011

Lathrop Compressor Station Concentrations (expressed in ppb)

Compound	10/4/10			10/5/10						10/6/10								
	6:00 pm - 12:00 pm			5:00 am - 12:00 pm			4:45 pm - 12:00 am			5:00 am - 12:00 pm								
	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)
1,2,4-Trimethylbenzene	104	--	--	366	--	--	306	--	--	325	--	--						
2-Methoxy-2-methylpropane (MTBE)	10	20	43	32	--	167	8	18	63	9	19	100						
2-Methyl Butane	41	--	--	104	--	554	175	--	--	388	--	--						
2-Methyl Pentane	47	--	--	200	--	1048	198	--	--	553	--	--						
3-Methyl Pentane	42	--	--	128	--	--	184	--	--	457	--	--						
Benzene	82	--	--	310	--	--	95	--	--	79	--	--						
Carbon Disulfide	99	--	--	404	--	--	87	--	--	98	--	--						
Carbon Monoxide	10	--	962	56	--	1039	35	--	243	44	--	138						
Carbonyl Sulfide	5	--	--	18	--	--	6	--	--	5	--	--						
Chloromethane	125	--	--	531	--	--	154	--	--	134	--	--						
Dimethyl sulfide	100	--	--	319	--	1359	87	--	--	77	--	209						
Ethane	104	--	751	396	--	--	445	--	--	1201	--	--						
Ethylbenzene	93	--	--	446	--	--	276	--	--	245	--	--						
Formaldehyde	13	--	--	83	--	--	34	--	--	64	--	--						
Hydrogen Chloride	18	--	--	119	--	--	43	--	--	78	--	--						
Hydrogen Sulfide	6198	--	--	25796	--	--	6568	--	--	6625	--	--						
iso-Butane	32	--	--	109	--	--	149	--	--	417	--	--						
Methane	55	437	13788	288	591	2722	208	2793	19846	442	7775	17676						
Methanol	7	--	--	26	--	66	8	--	--	7	--	--						
Methyl mercaptan	242	--	567	710	--	--	378	--	--	364	--	550						
m-Xylene	28	--	--	102	--	374	115	--	--	101	--	--						
Naphthalene	9	--	--	37	--	--	39	--	--	30	--	--						
n-Butane	31	--	144	170	--	683	119	--	--	159	--	325						
n-Heptane	355	--	--	1048	--	--	1548	--	--	3617	--	--						
n-Hexane	99	--	--	272	--	--	424	--	--	941	--	--						
Nitric Acid	13	--	--	43	--	--	12	--	--	11	--	--						
Nitric Oxide	381	--	--	1601	--	--	474	--	--	541	--	--						
Nitrogen Dioxide	198	--	--	448	--	--	434	--	--	1015	--	--						
Nitrous Acid	3	--	--	8	--	--	2	--	--	2	--	--						
n-Octane	278	--	--	866	--	3095	1201	--	--	3056	--	--						
n-Pentane	57	--	--	162	--	--	238	--	--	512	--	--						
o-Xylene	19	--	--	70	--	--	216	--	--	209	--	--						
Ozone	14	--	--	53	--	--	18	--	--	16	--	--						
Propane	55	--	--	159	--	692	252	--	--	583	--	--						
p-Xylene	48	--	--	173	--	504	311	--	--	281	--	--						
Styrene	15	--	--	63	--	--	35	--	--	30	--	--						
Sulfur Dioxide	118	--	--	381	--	--	93	--	--	72	--	--						
Toluene	48	--	--	166	--	--	207	--	--	198	--	--						

10/6/10 - Carbon monoxide - 138 (3-minute episode)
10/6/10 - n-Butane - 325 (3-minute episode)

Teel Compressor Station Concentrations (expressed in ppb)

Compound													10/6/10 4:30 pm - 12:00 am			10/7/10 5:00 am - 12:00 pm		
	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)
1,2,4-Trimethylbenzene													355	--	--	355	--	--
2-Methoxy-2-methylpropane (MTBE)													6	13	34	9	--	76
2-Methyl Butane													387	--	--	298	--	--
2-Methyl Pentane													490	--	--	369	--	--
3-Methyl Pentane													433	--	--	334	--	--
Benzene													94	--	--	81	--	--
Carbon Disulfide													255	--	--	361	--	--
Carbon Monoxide													35	165	2495	33	--	2465
Carbonyl Sulfide													4	--	--	5	--	--
Chloromethane													83	--	--	104	--	--
Dimethyl sulfide													62	--	--	66	--	--
Ethane													1091	--	--	841	--	--
Ethylbenzene													278	--	--	250	--	--
Formaldehyde													56	--	--	45	--	--
Hydrogen Chloride													69	--	--	55	--	--
Hydrogen Sulfide													5832	--	--	5960	--	--
iso-Butane													367	--	--	280	--	--
Methane													430	6967	20833	323	5167	21874
Methanol													7	--	--	7	--	--
Methyl mercaptan													287	--	640	290	--	--
m-Xylene													95	--	--	95	--	--
Naphthalene													33	--	--	32	--	--
n-Butane													116	--	319	105	--	284
n-Heptane													3613	--	--	2749	--	--
n-Hexane													938	--	--	720	--	--
Nitric Acid													6	--	--	7	--	--
Nitric Oxide													315	--	--	459	--	--
Nitrogen Dioxide													985	--	--	1041	--	--
Nitrous Acid													2	--	--	2	--	--
n-Octane													2970	--	--	2241	--	--
n-Pentane													516	--	--	401	--	--
o-Xylene													111	--	--	108	--	--
Ozone													16	--	--	15	--	--
Propane													565	--	--	434	--	--
p-Xylene													306	--	--	301	--	--
Styrene													28	--	--	27	--	--
Sulfur Dioxide													70	--	--	71	--	--
Toluene													204	--	--	195	--	--

10/6/10 - n-Butane - 319 (occurred twice)

Loomis Well Site Concentrations (expressed in ppb)

Compound	10/25/10			10/26/10						10/27/10						10/28/10		
	5:30 pm - 12:00 pm			5:00 am - 12:00 pm			5:00 pm - 12:00 am			5:00 am - 12:00 pm			4:50 pm - 12:00 am			5:00 am - 12:00 pm		
	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)	Detect. Limit (ppb)	Avg. Conc. (ppb)	Max. Conc. (ppb)
1,2,4-Trimethylbenzene	319	--	--	282	--	--	280	--	--	241	--	--	233	--	--	233	--	--
2-Methoxy-2-methylpropane (MTBE)	11	--	34	13	--	69	5	--	35	4	--	17	3	--	--	3	--	11
2-Methyl Butane	113	--	793	92	--	--	89	--	--	79	--	--	79	--	--	86	--	--
2-Methyl Pentane	125	--	1392	89	--	--	78	--	--	69	--	--	67	--	--	74	--	--
3-Methyl Pentane	119	--	--	97	--	--	88	--	--	78	--	--	75	--	--	85	--	--
Benzene	119	--	--	112	--	240	94	--	--	88	--	--	76	--	--	76	--	--
Carbon Disulfide	146	--	--	173	--	--	60	--	--	40	--	--	29	--	--	26	--	--
Carbon Monoxide	46	96	408	44	--	521	39	--	167	33	--	249	26	57	151	29	62	210
Carbonyl Sulfide	11	--	--	11	--	--	4	--	--	3	--	--	2	--	--	2	--	--
Chloromethane	180	--	--	215	--	--	78	--	--	65	--	--	58	--	--	59	--	--
Dimethyl sulfide	82	--	--	105	--	--	39	--	--	26	--	72	21	--	--	28	--	96
Ethane	281	--	--	209	--	--	179	--	--	159	--	388	161	--	--	179	--	--
Ethylbenzene	331	--	--	284	--	--	279	--	--	226	--	--	238	--	--	290	--	--
Formaldehyde	37	--	--	24	--	--	23	--	--	17	--	--	13	--	--	15	--	--
Hydrogen Chloride	47	--	--	31	--	--	26	--	--	19	--	--	15	--	--	17	--	--
Hydrogen Sulfide	6393	--	--	7477	--	--	3115	--	--	2312	--	--	1814	--	--	2150	--	--
iso-Butane	79	--	371	62	--	--	57	--	--	49	--	--	47	--	--	53	--	--
Methane	189	1166	2761	155	920	1520	134	938	1391	112	882	1301	89	942	1051	120	1014	1869
Methanol	11	--	--	10	--	--	9	--	--	7	--	--	6	--	--	6	--	--
Methyl mercaptan	236	--	--	328	--	--	95	--	269	63	--	210	49	--	166	59	--	151
m-Xylene	110	--	--	118	--	--	108	--	--	92	--	--	78	--	--	77	--	--
Naphthalene	36	--	--	40	--	--	35	--	--	27	--	--	21	--	--	23	--	--
n-Butane	110	--	--	75	--	--	66	--	--	59	--	194	58	--	--	65	--	--
n-Heptane	876	--	--	708	--	--	647	--	--	597	--	--	616	--	--	711	--	--
n-Hexane	283	--	845	221	--	--	213	--	--	191	--	--	191	--	--	210	--	--
Nitric Acid	14	--	--	17	--	--	6	--	--	5	--	--	5	--	18	5	--	14
Nitric Oxide	750	--	--	896	--	--	343	--	--	232	--	--	150	--	325	135	--	--
Nitrogen Dioxide	178	--	--	167	--	--	56	--	--	39	--	--	30	--	--	38	--	--
Nitrous Acid	3	--	--	4	--	--	2	--	--	1	--	--	1	--	--	1	--	--
n-Octane	673	--	2884	513	--	--	490	--	--	453	--	--	467	--	--	524	--	--
n-Pentane	180	--	--	149	--	--	141	--	--	123	--	--	121	--	--	131	--	--
o-Xylene	264	--	--	277	--	--	262	--	--	235	--	--	222	--	--	213	--	--
Ozone	23	--	--	21	--	--	19	--	--	16	--	--	15	--	--	17	--	--
Propane	164	--	1286	131	--	--	125	--	--	111	--	--	110	--	--	121	--	--
p-Xylene	245	--	--	266	--	--	229	--	--	225	--	--	190	--	--	198	--	--
Styrene	33	--	--	32	--	--	25	--	--	24	--	--	20	--	--	20	--	--
Sulfur Dioxide	98	--	--	98	--	--	55	--	--	44	--	--	34	--	--	36	--	--
Toluene	277	--	--	254	--	--				183	--	--	161	--	--	170	--	--

10/26/10 - Carbon monoxide - 167 (occurred twice)
10/26/10 - Methane - 1391 (occurred multiple times)
10/28/10 - Dimethyl sulfide - 96 (occurred twice)

Sones Pond Background Concentrations (expressed in ug/m^3)

Compound	MW	8/9/10			8/10/10						8/11/10						8/12/10		
		5:00 pm - 12:00 pm			5:00 am - 12:00 pm			5:00 pm - 12:00 am			5:00 am - 12:00 pm			5:00 pm - 12:00 am			5:00 am - 12:00 pm		
		Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3
1,2,4-Trimethylbenzene	120.2	1190	--	--	850	--	--	806	--	--	821	--	--	673	--	--	742	--	--
2-Methoxy-2-methylpropane (MTBE)	88.2	22	--	148	29	--	79	40	--	209	112	--	353	14	--	--	25	--	87
2-Methyl Butane	72.2	112	--	--	74	--	165	47	--	204	91	--	1334	41	--	--	86	--	--
2-Methyl Pentane	86.2	162	--	--	127	--	--	85	--	--	211	--	3006	67	--	--	120	--	--
3-Methyl Pentane	86.2	162	--	--	113	--	--	71	--	--	159	--	458	63	--	--	120	--	--
Benzene	78.1	230	--	--	227	--	479	246	--	1278	294	--	859	182	--	--	220	--	--
Carbon Disulfide	76.1	125	--	--	118	--	--	153	--	--	342	--	--	100	--	--	149	--	--
Carbon Monoxide	28.0	27	--	80	21	--	118	11	--	31	24	--	--	10	--	139	21	--	1802
Carbonyl Sulfide	60.1	12	--	--	10	--	--	17	--	--	27	--	--	5	--	--	10	--	--
Chloromethane	50.5	200	--	--	227	--	--	289	--	729	915	--	--	163	--	--	213	--	--
Dimethyl sulfide	62.1	76	--	--	84	--	--	104	--	--	279	--	--	61	--	--	89	--	--
Ethane	30.1	140	--	--	103	--	--	66	--	--	159	--	--	58	--	--	105	--	--
Ethylbenzene	106.2	499	--	--	343	--	--	269	--	--	469	--	1377	200	--	--	417	--	--
Formaldehyde	30.0	16	--	--	15	--	--	10	--	--	31	--	--	9	--	--	15	--	--
Hydrogen Chloride	36.5	27	--	--	22	--	--	16	--	--	52	--	--	13	--	--	25	--	--
Hydrogen Sulfide	34.1	4833	--	--	5003	--	--	5859	--	--	11594	--	--	3791	--	--	5318	--	--
iso-Butane	58.1	59	--	--	45	--	--	31	--	--	76	--	--	29	--	--	52	--	--
Methane	16.0	74	--	--	51	--	--	31	--	136	75	--	--	28	--	122	60	--	--
Methanol	32.0	9	--	--	9	--	--	10	--	--	10	--	--	7	--	--	8	--	--
Methyl mercaptan	48.1	144	--	669	169	--	689	285	--	--	517	--	--	100	--	--	159	--	--
m-Xylene	106.2	252	--	--	200	--	--	156	--	--	208	--	--	143	--	--	200	--	486
Naphthalene	128.2	126	--	--	94	--	--	79	--	--	100	--	--	68	--	--	94	--	--
n-Butane	58.1	81	--	--	64	--	--	48	--	--	133	--	--	40	--	--	69	--	--
n-Heptane	100.2	881	--	--	676	--	1475	504	--	--	1168	--	2495	430	--	--	738	--	2090
n-Hexane	86.2	261	--	--	187	--	--	130	--	--	286	--	1604	120	--	--	212	--	--
Nitric Acid	63.0	15	--	--	18	--	--	28	--	82	54	--	--	13	--	33	15	--	--
Nitric Oxide	30.0	469	--	--	393	--	--	658	--	--	1103	--	--	217	--	--	357	--	--
Nitrogen Dioxide	46.0	77	--	--	85	--	--	113	--	--	301	--	--	58	--	--	90	--	--
Nitrous Acid	47.0	4	--	--	4	--	--	6	--	--	6	--	19	4	--	6	4	--	--
n-Octane	114.2	761	--	--	607	--	--	467	--	--	1060	--	8927	378	--	--	640	--	--
n-Pentane	72.2	201	--	--	133	--	--	80	--	--	171	--	--	74	--	--	153	--	--
o-Xylene	106.2	195	--	--	165	--	--	104	--	--	295	--	--	135	--	--	165	--	--
Ozone	48.0	26	--	--	24	--	--	33	--	--	29	--	147	20	--	--	24	--	--
Propane	44.1	96	--	--	65	--	--	38	--	--	87	--	956	36	--	--	74	--	--
p-Xylene	106.2	725	--	--	495	--	--	334	--	--	543	--	--	386	--	--	538	--	--
Styrene	104.2	77	--	--	60	--	--	60	--	--	107	--	--	51	--	--	60	--	--
Sulfur Dioxide	64.1	178	--	--	204	--	--	236	--	--	314	--	--	141	--	--	223	--	--
Toluene	92.1	346	--	--	256	--	648	177	--	580	384	--	--	230	--	--	320	--	--

Carter Road Well Site Concentrations (expressed in ug/m^3)

Compound	MW	9/13/10			9/14/10						9/15/10						9/16/10		
		5:30 pm - 12:00 pm			5:00 am - 12:00 pm			5:00 pm - 12:00 am			5:00 am - 12:00 pm			4:45 pm - 12:00 am			5:00 am - 12:00 pm		
		Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3
1,2,4-Trimethylbenzene	120.2	1273	--	--	1273	--	--	1268	--	--	1504	--	--	1460	--	--	1514	--	--
2-Methoxy-2-methylpropane (MTBE)	88.2	29	69	563	29	87	415	14	--	148	18	--	238	14	--	101	29	--	314
2-Methyl Butane	72.2	894	--	--	805	--	--	693	--	--	673	--	--	496	--	--	502	--	--
2-Methyl Pentane	86.2	1170	--	--	1082	--	--	842	--	--	814	--	--	567	--	--	553	--	--
3-Methyl Pentane	86.2	1174	--	--	1065	--	--	902	--	--	860	--	--	592	--	--	599	--	--
Benzene	78.1	233	--	--	240	--	--	227	--	--	233	--	--	230	--	--	246	--	--
Carbon Disulfide	76.1	174	--	--	184	--	--	115	--	--	115	--	--	215	--	--	262	--	--
Carbon Monoxide	28.0	37	--	132	33	--	205	34	--	152	30	--	103	34	--	525	39	--	393
Carbonyl Sulfide	60.1	10	--	--	12	--	--	5	--	--	5	--	--	5	--	--	10	--	--
Chloromethane	50.5	240	--	--	229	--	--	132	--	--	165	--	--	118	--	--	242	--	--
Dimethyl sulfide	62.1	163	--	--	165	--	--	132	--	--	137	--	--	104	--	--	142	--	--
Ethane	30.1	936	--	--	862	--	--	685	--	--	665	--	--	465	--	--	457	--	--
Ethylbenzene	106.2	1034	--	--	968	--	--	877	--	--	873	--	--	899	--	--	1025	--	--
Formaldehyde	30.0	47	--	--	44	--	--	36	--	--	34	--	--	27	--	--	29	--	--
Hydrogen Chloride	36.5	70	--	--	67	--	--	52	--	--	52	--	--	40	--	--	45	--	--
Hydrogen Sulfide	34.1	6890	--	--	6964	--	--	5141	--	--	5228	--	--	4107	--	--	6214	--	--
iso-Butane	58.1	616	--	--	559	--	--	437	--	--	421	--	--	285	--	--	285	--	--
Methane	16.0	250	3276	9199	216	3816	11303	242	2306	9287	151	2388	8710	106	1667	11315	123	1616	7609
Methanol	32.0	9	--	--	8	--	--	8	--	--	8	--	--	8	--	37	9	--	21
Methyl mercaptan	48.1	533	--	1114	527	--	--	291	--	1812	319	--	--	258	--	2154	462	--	--
m-Xylene	106.2	391	--	--	373	--	--	317	--	--	352	--	--	326	--	--	386	--	--
Naphthalene	128.2	189	--	--	162	--	--	147	--	--	142	--	--	152	--	--	168	--	--
n-Butane	58.1	330	--	--	283	--	--	242	--	1093	228	--	763	197	--	594	240	--	--
n-Heptane	100.2	11534	--	--	10244	--	--	9019	--	--	8658	--	--	6052	--	--	6138	--	--
n-Hexane	86.2	2587	--	--	2327	--	--	2006	--	--	1942	--	--	1435	--	--	1442	--	--
Nitric Acid	63.0	18	--	--	21	--	--	13	--	--	15	--	36	10	--	--	21	--	46
Nitric Oxide	30.0	535	--	--	630	--	--	215	--	--	317	--	--	169	--	--	620	--	--
Nitrogen Dioxide	46.0	1392	--	--	1168	--	--	600	--	--	627	--	--	722	--	--	593	--	--
Nitrous Acid	47.0	4	--	--	4	--	--	2	--	--	4	--	--	2	--	--	4	--	--
n-Octane	114.2	10590	--	--	9520	--	--	8049	--	--	7712	--	--	5293	--	--	5297	--	--
n-Pentane	72.2	1192	--	--	1080	--	--	944	--	--	923	--	--	702	--	--	714	--	--
o-Xylene	106.2	625	--	--	582	--	--	525	--	--	521	--	--	534	--	--	573	--	--
Ozone	48.0	31	--	--	26	--	--	27	--	--	26	--	--	27	--	--	26	--	--
Propane	44.1	795	--	--	718	--	--	611	--	--	592	--	--	427	--	--	431	--	--
p-Xylene	106.2	1216	--	--	1142	--	--	1064	--	--	1163	--	--	1077	--	--	1172	--	--
Styrene	104.2	107	--	--	94	--	--	94	--	--	98	--	--	94	--	--	102	--	--
Sulfur Dioxide	64.1	157	--	--	149	--	--	118	--	--	128	--	--	105	--	--	176	--	--
Toluene	92.1	708	--	--	648	--	--	618	--	--	652	--	--	640	--	--	697	--	--

Lathrop Compressor Station Concentrations (expressed in ug/m^3)

Compound	MW	10/4/10			10/5/10						10/6/10								
		6:00 pm - 12:00 pm			5:00 am - 12:00 pm			4:45 pm - 12:00 am			5:00 am - 12:00 pm								
		Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3
1,2,4-Trimethylbenzene	120.2	511	--	--	1799	--	--	1504	--	--	1597	--	--						
2-Methoxy-2-methylpropane (MTBE)	88.2	36	72	155	115	--	602	29	65	227	32	69	361						
2-Methyl Butane	72.2	121	--	--	307	--	1635	516	--	--	1145	--	--						
2-Methyl Pentane	86.2	166	--	--	705	--	3693	698	--	--	1949	--	--						
3-Methyl Pentane	86.2	148	--	--	451	--	--	649	--	--	1611	--	--						
Benzene	78.1	262	--	--	990	--	--	303	--	--	252	--	--						
Carbon Disulfide	76.1	308	--	--	1258	--	--	271	--	--	305	--	--						
Carbon Monoxide	28.0	11	--	1102	64	--	1190	40	--	278	50	--	158						
Carbonyl Sulfide	60.1	12	--	--	44	--	--	15	--	--	12	--	--						
Chloromethane	50.5	258	--	--	1097	--	--	318	--	--	277	--	--						
Dimethyl sulfide	62.1	254	--	--	810	--	3453	221	--	--	196	--	531						
Ethane	30.1	128	--	923	487	--	--	547	--	--	1477	--	--						
Ethylbenzene	106.2	404	--	--	1937	--	--	1199	--	--	1064	--	--						
Formaldehyde	30.0	16	--	--	102	--	--	42	--	--	79	--	--						
Hydrogen Chloride	36.5	27	--	--	177	--	--	64	--	--	116	--	--						
Hydrogen Sulfide	34.1	8638	--	--	35950	--	--	9153	--	--	9233	--	--						
iso-Butane	58.1	76	--	--	259	--	--	354	--	--	991	--	--						
Methane	16.0	36	287	9044	189	388	1785	136	1832	13018	290	5100	11594						
Methanol	32.0	9	--	--	34	--	86	10	--	--	9	--	--						
Methyl mercaptan	48.1	476	--	1116	1397	--	--	744	--	--	716	--	1082						
m-Xylene	106.2	122	--	--	443	--	1624	499	--	--	438	--	--						
Naphthalene	128.2	47	--	--	194	--	--	204	--	--	157	--	--						
n-Butane	58.1	74	--	342	404	--	1623	283	--	--	378	--	772						
n-Heptane	100.2	1455	--	--	4294	--	--	6343	--	--	14821	--	--						
n-Hexane	86.2	349	--	--	959	--	--	1495	--	--	3317	--	--						
Nitric Acid	63.0	33	--	--	111	--	--	31	--	--	28	--	--						
Nitric Oxide	30.0	468	--	--	1965	--	--	582	--	--	664	--	--						
Nitrogen Dioxide	46.0	373	--	--	843	--	--	817	--	--	1910	--	--						
Nitrous Acid	47.0	6	--	--	15	--	--	4	--	--	4	--	--						
n-Octane	114.2	1299	--	--	4045	--	14457	5610	--	--	14275	--	--						
n-Pentane	72.2	168	--	--	478	--	--	702	--	--	1511	--	--						
o-Xylene	106.2	83	--	--	304	--	--	938	--	--	908	--	--						
Ozone	48.0	27	--	--	104	--	--	35	--	--	31	--	--						
Propane	44.1	99	--	--	287	--	1248	454	--	--	1051	--	--						
p-Xylene	106.2	208	--	--	751	--	2188	1350	--	--	1220	--	--						
Styrene	104.2	64	--	--	268	--	--	149	--	--	128	--	--						
Sulfur Dioxide	64.1	309	--	--	998	--	--	244	--	--	189	--	--						
Toluene	92.1	181	--	--	625	--	--	780	--	--	746	--	--						

Teel Compressor Station Concentrations (expressed in ug/m^3)

Compound	MW										10/6/10						10/7/10		
														4:30 pm - 12:00 am			5:00 am - 12:00 pm		
		Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3
1,2,4-Trimethylbenzene	120.2													1745	--	--	1745	--	--
2-Methoxy-2-methylpropane (MTBE)	88.2													22	47	123	32	--	274
2-Methyl Butane	72.2													1142	--	--	879	--	--
2-Methyl Pentane	86.2													1727	--	--	1300	--	--
3-Methyl Pentane	86.2													1526	--	--	1177	--	--
Benzene	78.1													300	--	--	259	--	--
Carbon Disulfide	76.1													794	--	--	1124	--	--
Carbon Monoxide	28.0													40	189	2858	38	--	2823
Carbonyl Sulfide	60.1													10	--	--	12	--	--
Chloromethane	50.5													171	--	--	215	--	--
Dimethyl sulfide	62.1													158	--	--	168	--	--
Ethane	30.1													1342	--	--	1034	--	--
Ethylbenzene	106.2													1207	--	--	1086	--	--
Formaldehyde	30.0													69	--	--	55	--	--
Hydrogen Chloride	36.5													103	--	--	82	--	--
Hydrogen Sulfide	34.1													8128	--	--	8306	--	--
iso-Butane	58.1													872	--	--	665	--	--
Methane	16.0													282	4570	13665	212	3389	14348
Methanol	32.0													9	--	--	9	--	--
Methyl mercaptan	48.1													565	--	1259	571	--	--
m-Xylene	106.2													412	--	--	412	--	--
Naphthalene	128.2													173	--	--	168	--	--
n-Butane	58.1													276	--	758	250	--	675
n-Heptane	100.2													14804	--	--	11264	--	--
n-Hexane	86.2													3306	--	--	2538	--	--
Nitric Acid	63.0													15	--	--	18	--	--
Nitric Oxide	30.0													387	--	--	563	--	--
Nitrogen Dioxide	46.0													1853	--	--	1959	--	--
Nitrous Acid	47.0													4	--	--	4	--	--
n-Octane	114.2													13874	--	--	10468	--	--
n-Pentane	72.2													1522	--	--	1183	--	--
o-Xylene	106.2													482	--	--	469	--	--
Ozone	48.0													31	--	--	29	--	--
Propane	44.1													1019	--	--	783	--	--
p-Xylene	106.2													1328	--	--	1307	--	--
Styrene	104.2													119	--	--	115	--	--
Sulfur Dioxide	64.1													183	--	--	186	--	--
Toluene	92.1													768	--	--	734	--	--

Loomis Well Site Concentrations (expressed in ug/m^3)

Compound	MW	10/25/10			10/26/10						10/27/10						10/28/10		
		5:30 pm - 12:00 pm			5:00 am - 12:00 pm			5:00 pm - 12:00 am			5:00 am - 12:00 pm			4:50 pm - 12:00 am			5:00 am - 12:00 pm		
		Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3	Detect. Limit ug/m3	Avg. Conc. ug/m3	Max. Conc. ug/m3
1,2,4-Trimethylbenzene	120.2	1568	--	--	1386	--	--	1376	--	--	1185	--	--	1145	--	--	1145	--	--
2-Methoxy-2-methylpropane (MTBE)	88.2	40	--	123	47	--	249	18	--	126	14	--	61	11	--	--	11	--	40
2-Methyl Butane	72.2	333	--	2340	271	--	--	263	--	--	233	--	--	233	--	--	254	--	--
2-Methyl Pentane	86.2	441	--	4906	314	--	--	275	--	--	243	--	--	236	--	--	261	--	--
3-Methyl Pentane	86.2	419	--	--	342	--	--	310	--	--	275	--	--	264	--	--	300	--	--
Benzene	78.1	380	--	--	358	--	767	300	--	--	281	--	--	243	--	--	243	--	--
Carbon Disulfide	76.1	455	--	--	539	--	--	187	--	--	125	--	--	90	--	--	81	--	--
Carbon Monoxide	28.0	53	110	467	50	--	597	45	--	191	38	--	285	30	65	173	33	71	241
Carbonyl Sulfide	60.1	27	--	--	27	--	--	10	--	--	7	--	--	5	--	--	5	--	--
Chloromethane	50.5	372	--	--	444	--	--	161	--	--	134	--	--	120	--	--	122	--	--
Dimethyl sulfide	62.1	208	--	--	267	--	--	99	--	--	66	--	183	53	--	--	71	--	244
Ethane	30.1	346	--	--	257	--	--	220	--	--	196	--	477	198	--	--	220	--	--
Ethylbenzene	106.2	1437	--	--	1233	--	--	1212	--	--	981	--	--	1034	--	--	1259	--	--
Formaldehyde	30.0	45	--	--	29	--	--	28	--	--	21	--	--	16	--	--	18	--	--
Hydrogen Chloride	36.5	70	--	--	46	--	--	39	--	--	28	--	--	22	--	--	25	--	--
Hydrogen Sulfide	34.1	8910	--	--	10420	--	--	4341	--	--	3222	--	--	2528	--	--	2996	--	--
iso-Butane	58.1	188	--	882	147	--	--	135	--	--	116	--	--	112	--	--	126	--	--
Methane	16.0	124	765	1811	102	603	997	88	615	912	73	579	853	58	618	689	79	665	1226
Methanol	32.0	14	--	--	13	--	--	12	--	--	9	--	--	8	--	--	8	--	--
Methyl mercaptan	48.1	464	--	--	645	--	--	187	--	529	124	--	413	96	--	327	116	--	297
m-Xylene	106.2	478	--	--	512	--	--	469	--	--	399	--	--	339	--	--	334	--	--
Naphthalene	128.2	189	--	--	210	--	--	183	--	--	142	--	--	110	--	--	121	--	--
n-Butane	58.1	261	--	--	178	--	--	157	--	--	140	--	461	138	--	--	154	--	--
n-Heptane	100.2	3589	--	--	2901	--	--	2651	--	--	2446	--	--	2524	--	--	2913	--	--
n-Hexane	86.2	998	--	2979	779	--	--	751	--	--	673	--	--	673	--	--	740	--	--
Nitric Acid	63.0	36	--	--	44	--	--	15	--	--	13	--	--	13	--	46	13	--	36
Nitric Oxide	30.0	920	--	--	1100	--	--	421	--	--	285	--	--	184	--	399	166	--	--
Nitrogen Dioxide	46.0	335	--	--	314	--	--	105	--	--	73	--	--	56	--	--	71	--	--
Nitrous Acid	47.0	6	--	--	8	--	--	4	--	--	2	--	--	2	--	--	2	--	--
n-Octane	114.2	3144	--	13472	2396	--	--	2289	--	--	2116	--	--	2181	--	--	2448	--	--
n-Pentane	72.2	531	--	--	440	--	--	416	--	--	363	--	--	357	--	--	387	--	--
o-Xylene	106.2	1147	--	--	1203	--	--	1138	--	--	1021	--	--	964	--	--	925	--	--
Ozone	48.0	45	--	--	41	--	--	37	--	--	31	--	--	29	--	--	33	--	--
Propane	44.1	296	--	2319	236	--	--	225	--	--	200	--	--	198	--	--	218	--	--
p-Xylene	106.2	1064	--	--	1155	--	--	994	--	--	977	--	--	825	--	--	860	--	--
Styrene	104.2	141	--	--	136	--	--	107	--	--	102	--	--	85	--	--	85	--	--
Sulfur Dioxide	64.1	257	--	--	257	--	--	144	--	--	115	--	--	89	--	--	94	--	--
Toluene	92.1	1043	--	--	957	--	--	0	0	0	689	--	--	606	--	--	640	--	--

Appendix B: Canister Data

Canister Data All Sites (expressed in ppbv)

	2010	Annual Average (ppbv)												
Compounds	**MDL**	**Sones Pond 8-9**	**Sones Pond 8-10**	**Sones Pond 8-11**	**Carter 9-13 001**	**Carter 9-13 002**	**Carter 9-14**	**Carter 9-15**	**Lathrop 10-4**	**Lathrop 10-5**	**Lathrop 10-6**	**Teel 10-4**	**Teel 10-5**	**Teel 10-6**
1,1,1-Trichloroethane	0.051	0.021	0.021	0.021	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
1,1,2,2-Tetrachloroethane	0.042	0.034	0.034	0.034	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
1,1,2-Trichloro-1,2,2-trifluoroethane	0.059	0.013	0.013	0.11	0.12	0.11	0.088	0.086	0.11	0.10	0.10	0.11	0.068	0.11
1,1,2-Trichloroethane	0.039	0.012	0.012	0.012	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
1,1-Dichloroethane	0.057	0.018	0.018	0.018	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
1,1-Dichloroethene	0.038	0.012	0.012	0.012	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
1,2,4-Trichlorobenzene	0.514	0.018	0.018	0.018	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
1,2,4-Trimethylbenzene	0.087	0.018	0.018	0.018	0.044	0.11	0.044	0.044	0.044	0.044	0.044	0.28	0.044	0.044
1,2-Dibromoethane	0.055	0.013	0.013	0.013	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
1,2-Dichloro-1,1,2,2-tetrafluoroethane	0.059	0.013	0.013	0.013	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
1,2-Dichlorobenzene	0.102	0.025	0.025	0.025	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051
1,2-Dichloroethane	0.032	0.012	0.012	0.012	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
1,2-Dichloropropane	0.057	0.012	0.012	0.012	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.058
1,3,5-Trimethylbenzene	0.076	0.032	0.032	0.032	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038
1,3-Butadiene	0.062	0.082	0.082	0.082	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
1,3-Dichlorobenzene	0.083	0.025	0.025	0.025	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
1,4-Dichlorobenzene	0.095	0.025	0.025	0.025	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
1-Bromopropane	0.069	0.011	0.011	0.011	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
1-Ethyl-4-methylbenzene	0.087	0.024	0.024	0.024	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.14	0.044	0.044
2-Butanone (MEK)	0.187	0.080	0.68	0.60	0.35	1.2	0.28	0.38	0.094	0.24	0.39	1.7	0.40	0.094
2-Hexanone	0.053	0.074	0.074	0.074	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.21	0.027	0.22
2-Methoxy-2-methylpropane (MTBE)	0.098	0.021	0.021	0.021	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049
4-Methyl-2-pentanone (MIBK)	0.121	0.074	0.074	0.074	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061
Acetone	0.078	11	7.4	7.0	7.6	12	5.6	5.4	5.2	6.5	6.2	26	9.4	3.1
Acrolein	0.047	0.69	0.59	0.44	0.024	0.64	0.024	0.64	0.69	0.63	0.52	0.95	0.83	0.22
Benzene	0.093	0.011	0.011	0.13	0.047	0.11	0.047	0.047	0.047	0.11	0.047	0.20	0.047	0.047
Bromodichloromethane	0.035	0.012	0.012	0.012	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018
Bromoform	0.036	0.012	0.012	0.012	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018
Bromomethane	0.042	0.013	0.013	0.013	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
Carbon disulfide	0.047	0.076	0.076	0.076	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
Carbon tetrachloride	0.068	0.012	0.012	0.12	0.12	0.12	0.074	0.034	0.12	0.11	0.12	0.12	0.074	0.12
Chlorobenzene	0.032	0.012	0.012	0.012	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
Chloroethane	0.060	0.014	0.014	0.014	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.18	0.030	0.030
Chloroethene	0.071	0.013	0.013	0.013	0.036	0.036	0.036	0.036	0.036	0.036	0.10	0.036	0.036	0.036
Chloroform	0.035	0.012	0.012	0.012	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018
Chloromethane	0.048	0.71	0.67	0.64	0.70	0.63	0.38	0.52	0.49	0.64	0.63	0.50	0.40	0.46
cis-1,2-Dichloroethene	0.091	0.011	0.011	0.011	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046
cis-1,3-Dichloro-1-propene	0.084	0.020	0.020	0.020	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
Cyclohexane	0.053	0.013	0.013	0.013	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027
Dibromochloromethane	0.028	0.012	0.012	0.012	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Dichlorodifluoromethane	0.053	0.79	0.69	0.68	0.76	0.69	0.46	0.55	0.42	0.40	0.70	0.40	0.35	0.41
Ethylbenzene	0.083	0.011	0.011	0.011	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042
Hexachloro-1,3-butadiene	0.031	0.027	0.027	0.027	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
m&p-Xylene	0.133	0.023	0.023	0.023	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.20	0.067	0.067
Methylene chloride	0.340	0.011	0.011	0.078	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
n-Heptane	0.068	0.012	0.012	0.012	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034
n-Hexane	0.096	0.010	0.010	0.010	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
o-Xylene	0.075	0.011	0.011	0.011	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038
Propene	0.031	1.1	0.38	0.38	1.6	1.4	0.22	0.56	1.7	0.20	0.60	0.41	0.59	0.83
Styrene	0.095	0.010	0.010	0.010	0.048	0.45	0.048	0.048	0.048	0.048	0.048	2.8	0.048	0.048
Tetrachloroethene (PERC)	0.064	0.010	0.010	0.010	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032
Tetrahydrofuran (THF)	0.173	0.025	0.025	0.025	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.087
Toluene	0.044	0.011	0.10	0.13	0.15	0.10	0.084	0.11	0.068	0.12	0.12	0.14	0.062	0.091
trans-1,2-Dichloroethene	0.077	0.013	0.013	0.013	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
trans-1,3-Dichloro-1-propene	0.039	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Trichloroethylene (TCE)	0.064	0.012	0.012	0.012	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032
Trichlorofluoromethane	0.053	0.013	0.36	0.33	0.34	0.34	0.25	0.26	0.31	0.29	0.31	0.29	0.19	0.31

- Detected compounds

Canister Data All Sites (expressed in ppbv)

	2010	Annual Average (ppbv)						
Compounds	**MDL**	**Loomis 10-25**	**Loomis 10-26 001**	**Loomis 10-26 002**	**Loomis 10-27 001**	**Loomis 10-27 002**	**Arendtsville 2009**	**Marcus Hook 2009**
1,1,1-Trichloroethane	0.051	0.026	0.026	0.026	0.026	0.026	0.021	0.021
1,1,2,2-Tetrachloroethane	0.042	0.021	0.021	0.021	0.021	0.021	0.034	0.034
1,1,2-Trichloro-1,2,2-trifluoroethane	0.059	0.030	0.074	0.19	0.19	0.11	0.084	0.081
1,1,2-Trichloroethane	0.039	0.020	0.020	0.020	0.020	0.020	0.012	0.012
1,1-Dichloroethane	0.057	0.029	0.029	0.029	0.029	0.029	0.018	0.018
1,1-Dichloroethene	0.038	0.019	0.019	0.019	0.019	0.019	0.012	0.012
1,2,4-Trichlorobenzene	0.514	0.26	0.26	0.26	0.26	0.26	0.042	0.062
1,2,4-Trimethylbenzene	0.087	0.044	0.044	0.044	0.044	0.044	0.028	0.089
1,2-Dibromoethane	0.055	0.028	0.028	0.028	0.028	0.028	0.013	0.013
1,2-Dichloro-1,1,2,2-tetrafluoroethane	0.059	0.030	0.030	0.030	0.030	0.030	0.013	0.013
1,2-Dichlorobenzene	0.102	0.051	0.051	0.051	0.051	0.051	0.025	0.025
1,2-Dichloroethane	0.032	0.016	0.016	0.016	0.016	0.016	0.013	0.012
1,2-Dichloropropane	0.057	0.029	0.029	0.029	0.029	0.029	0.017	0.015
1,3,5-Trimethylbenzene	0.076	0.038	0.038	0.038	0.038	0.038	0.032	0.033
1,3-Butadiene	0.062	0.031	0.031	0.031	0.031	0.031	0.082	0.082
1,3-Dichlorobenzene	0.083	0.042	0.042	0.042	0.042	0.042	0.025	0.025
1,4-Dichlorobenzene	0.095	0.048	0.048	0.048	0.048	0.048	0.025	0.026
1-Bromopropane	0.069	0.035	0.035	0.035	0.035	0.035	0.011	0.011
1-Ethyl-4-methylbenzene	0.087	0.044	0.044	0.044	0.044	0.044	0.037	0.036
2-Butanone (MEK)	0.187	0.48	0.87	0.094	1.0	0.094	0.89	0.79
2-Hexanone	0.053	0.027	0.086	0.16	0.51	0.027	0.13	0.081
2-Methoxy-2-methylpropane (MTBE)	0.098	0.049	0.049	0.049	0.049	0.049	0.021	0.021
4-Methyl-2-pentanone (MIBK)	0.121	0.061	0.061	0.061	0.46	0.061	0.074	0.074
Acetone	0.078	7.7	21	39	33	4.4	7.9	7.4
Acrolein	0.047	0.36	1.3	1.6	0.77	0.12	0.86	0.54
Benzene	0.093	0.12	0.047	0.19	0.32	0.047	0.16	0.54
Bromodichloromethane	0.035	0.018	0.018	0.018	0.018	0.018	0.012	0.012
Bromoform	0.036	0.018	0.018	0.018	0.018	0.018	0.012	0.012
Bromomethane	0.042	0.021	0.021	0.021	0.021	0.021	0.014	0.027
Carbon disulfide	0.047	0.024	0.024	0.024	0.024	0.024	0.076	0.079
Carbon tetrachloride	0.068	0.095	0.086	0.17	0.21	0.11	0.11	0.10
Chlorobenzene	0.032	0.016	0.016	0.016	0.016	0.016	0.017	0.031
Chloroethane	0.060	0.030	0.030	0.030	0.030	0.030	0.055	0.032
Chloroethene	0.071	0.036	0.036	0.036	0.036	0.036	0.013	0.016
Chloroform	0.035	0.018	0.018	0.018	0.018	0.018	0.013	0.016
Chloromethane	0.048	0.78	0.61	2.3	1.2	0.72	0.56	0.55
cis-1,2-Dichloroethene	0.091	0.046	0.046	0.046	0.046	0.046	0.012	0.011
cis-1,3-Dichloro-1-propene	0.084	0.042	0.042	0.042	0.042	0.042	0.020	0.020
Cyclohexane	0.053	0.027	0.027	0.027	0.027	0.027	0.026	0.17
Dibromochloromethane	0.028	0.014	0.014	0.014	0.014	0.014	0.012	0.012
Dichlorodifluoromethane	0.053	0.54	0.47	1.3	1.0	0.62	0.56	0.55
Ethylbenzene	0.083	0.042	0.042	0.042	0.042	0.042	0.019	0.083
Hexachloro-1,3-butadiene	0.031	0.016	0.016	0.016	0.055	0.016	0.029	0.032
m&p-Xylene	0.133	0.067	0.067	0.067	0.067	0.067	0.043	0.29
Methylene chloride	0.340	0.17	0.17	0.17	0.17	0.17	0.23	0.15
n-Heptane	0.068	0.034	0.034	0.034	0.034	0.034	0.044	0.18
n-Hexane	0.096	0.048	0.048	0.048	0.048	0.048	0.053	0.44
o-Xylene	0.075	0.038	0.038	0.038	0.038	0.038	0.018	0.096
Propene	0.031	0.44	0.33	1.7	1.1	0.42	0.60	14
Styrene	0.095	0.048	0.048	0.048	0.048	0.048	0.024	0.018
Tetrachloroethene (PERC)	0.064	0.032	0.066	0.032	0.032	0.28	0.016	0.037
Tetrahydrofuran (THF)	0.173	0.087	0.087	0.087	0.31	0.087	0.027	0.029
Toluene	0.044	0.16	0.083	0.16	0.11	0.065	0.17	1.7
trans-1,2-Dichloroethene	0.077	0.039	0.039	0.039	0.039	0.039	0.015	0.013
trans-1,3-Dichloro-1-propene	0.039	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Trichloroethylene (TCE)	0.064	0.032	0.032	0.032	0.032	0.032	0.013	0.012
Trichlorofluoromethane	0.053	0.29	0.22	0.59	0.58	0.30	0.26	0.25

- Detected compounds

Canister Data All Sites (expressed in ug/m^3)

	2010	Annual Average (ug/m3)												
Compounds	**MDL**	**Sones Pond 8-9**	**Sones Pond 8-10**	**Sones Pond 8-11**	**Carter 9-13 001**	**Carter 9-13 002**	**Carter 9-14**	**Carter 9-15**	**Lathrop 10-4**	**Lathrop 10-5**	**Lathrop 10-6**	**Teel 10-4**	**Teel 10-5**	**Teel 10-6**
1,1,1-Trichloroethane	0.278	0.12	0.12	0.12	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
1,1,2,2-Tetrachloroethane	0.288	0.23	0.23	0.23	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
1,1,2-Trichloro-1,2,2-trifluoroethane	0.452	0.097	0.097	0.84	0.92	0.84	0.67	0.66	0.84	0.77	0.77	0.84	0.52	0.84
1,1,2-Trichloroethane	0.213	0.066	0.066	0.066	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
1,1-Dichloroethane	0.231	0.071	0.071	0.071	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
1,1-Dichloroethene	0.151	0.046	0.046	0.046	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
1,2,4-Trichlorobenzene	3.813	0.14	0.14	0.14	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
1,2,4-Trimethylbenzene	0.428	0.087	0.087	0.087	0.21	0.54	0.21	0.21	0.21	0.21	0.21	1.4	0.21	0.21
1,2-Dibromoethane	0.423	0.099	0.099	0.099	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
1,2-Dichloro-1,1,2,2-tetrafluoroethane	0.412	0.092	0.092	0.092	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
1,2-Dichlorobenzene	0.613	0.15	0.15	0.15	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
1,2-Dichloroethane	0.130	0.051	0.051	0.051	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065
1,2-Dichloropropane	0.263	0.055	0.055	0.055	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.27
1,3,5-Trimethylbenzene	0.374	0.16	0.16	0.16	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
1,3-Butadiene	0.137	0.18	0.18	0.18	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.069
1,3-Dichlorobenzene	0.499	0.15	0.15	0.15	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
1,4-Dichlorobenzene	0.571	0.15	0.15	0.15	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
1-Bromopropane	0.347	0.054	0.054	0.054	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
1-Ethyl-4-methylbenzene	0.428	0.12	0.12	0.12	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.69	0.21	0.21
2-Butanone (MEK)	0.551	0.24	2.0	1.8	1.0	3.5	0.83	1.1	0.28	0.71	1.1	5.0	1.2	0.28
2-Hexanone	0.217	0.30	0.30	0.30	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.86	0.11	0.90
2-Methoxy-2-methylpropane (MTBE)	0.353	0.074	0.074	0.074	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
4-Methyl-2-pentanone (MIBK)	0.496	0.30	0.30	0.30	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Acetone	0.185	26	18	17	18	29	13	13	12	15	15	62	22	7.4
Acrolein	0.108	1.6	1.4	1.0	0.054	1.5	0.054	1.5	1.6	1.4	1.2	2.2	1.9	0.50
Benzene	0.297	0.035	0.035	0.42	0.15	0.35	0.15	0.15	0.15	0.35	0.15	0.64	0.15	0.15
Bromodichloromethane	0.234	0.080	0.080	0.080	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Bromoform	0.372	0.13	0.13	0.13	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Bromomethane	0.163	0.049	0.049	0.049	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082	0.082
Carbon disulfide	0.146	0.24	0.24	0.24	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073
Carbon tetrachloride	0.428	0.079	0.079	0.75	0.75	0.75	0.47	0.21	0.75	0.69	0.75	0.75	0.47	0.75
Chlorobenzene	0.147	0.056	0.056	0.056	0.074	0.074	0.074	0.074	0.074	0.074	0.074	0.074	0.074	0.074
Chloroethane	0.158	0.036	0.036	0.036	0.079	0.079	0.079	0.079	0.079	0.079	0.079	0.47	0.079	0.079
Chloroethene	0.181	0.032	0.032	0.032	0.091	0.091	0.091	0.091	0.091	0.091	0.26	0.091	0.091	0.091
Chloroform	0.171	0.056	0.056	0.056	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085
Chloromethane	0.099	1.5	1.4	1.3	1.4	1.3	0.78	1.1	1.0	1.3	1.3	1.0	0.83	0.95
cis-1,2-Dichloroethene	0.361	0.045	0.045	0.045	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
cis-1,3-Dichloro-1-propene	0.381	0.091	0.091	0.091	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Cyclohexane	0.182	0.044	0.044	0.044	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091
Dibromochloromethane	0.239	0.10	0.10	0.10	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Dichlorodifluoromethane	0.262	3.9	3.4	3.4	3.8	3.4	2.3	2.7	2.1	2.0	3.5	2.0	1.7	2.0
Ethylbenzene	0.360	0.046	0.046	0.046	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Hexachloro-1,3-butadiene	0.330	0.29	0.29	0.29	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
m&p-Xylene	0.578	0.098	0.098	0.098	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.87	0.29	0.29
Methylene chloride	1.180	0.037	0.037	0.27	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
n-Heptane	0.279	0.050	0.050	0.050	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
n-Hexane	0.338	0.036	0.036	0.036	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
o-Xylene	0.326	0.046	0.046	0.046	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Propene	0.053	1.9	0.65	0.65	2.8	2.4	0.38	0.96	2.9	0.34	1.0	0.71	1.0	1.4
Styrene	0.405	0.042	0.042	0.042	0.20	1.9	0.20	0.20	0.20	0.20	0.20	12	0.20	0.20
Tetrachloroethene (PERC)	0.434	0.070	0.070	0.070	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Tetrahydrofuran (THF)	0.510	0.075	0.075	0.075	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Toluene	0.166	0.043	0.38	0.49	0.56	0.38	0.32	0.41	0.26	0.45	0.45	0.53	0.23	0.34
trans-1,2-Dichloroethene	0.305	0.052	0.052	0.052	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
trans-1,3-Dichloro-1-propene	0.177	0.091	0.091	0.091	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089	0.089
Trichloroethylene (TCE)	0.344	0.067	0.067	0.067	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Trichlorofluoromethane	0.298	0.074	2.0	1.9	1.9	1.9	1.4	1.5	1.7	1.6	1.7	1.6	1.1	1.7

Canister Data All Sites (expressed in ug/m^3)

	2010	Annual Average (ug/m3)						
Compounds	**MDL**	**Loomis 10-25**	**Loomis 10-26 001**	**Loomis 10-26 002**	**Loomis 10-27 001**	**Loomis 10-27 002**	**Arendtsville 2009**	**Marcus Hook 2009**
1,1,1-Trichloroethane	0.278	0.14	0.14	0.14	0.14	0.14	0.12	0.12
1,1,2,2-Tetrachloroethane	0.288	0.14	0.14	0.14	0.14	0.14	0.23	0.23
1,1,2-Trichloro-1,2,2-trifluoroethane	0.452	0.23	0.57	1.5	1.5	0.84	0.64	0.62
1,1,2-Trichloroethane	0.213	0.11	0.11	0.11	0.11	0.11	0.066	0.066
1,1-Dichloroethane	0.231	0.12	0.12	0.12	0.12	0.12	0.071	0.071
1,1-Dichloroethene	0.151	0.075	0.075	0.075	0.075	0.075	0.046	0.046
1,2,4-Trichlorobenzene	3.813	1.9	1.9	1.9	1.9	1.9	0.31	0.46
1,2,4-Trimethylbenzene	0.428	0.21	0.21	0.21	0.21	0.21	0.14	0.44
1,2-Dibromoethane	0.423	0.21	0.21	0.21	0.21	0.21	0.099	0.099
1,2-Dichloro-1,1,2,2-tetrafluoroethane	0.412	0.21	0.21	0.21	0.21	0.21	0.092	0.092
1,2-Dichlorobenzene	0.613	0.31	0.31	0.31	0.31	0.31	0.15	0.15
1,2-Dichloroethane	0.130	0.065	0.065	0.065	0.065	0.065	0.054	0.051
1,2-Dichloropropane	0.263	0.13	0.13	0.13	0.13	0.13	0.076	0.067
1,3,5-Trimethylbenzene	0.374	0.19	0.19	0.19	0.19	0.19	0.16	0.16
1,3-Butadiene	0.137	0.069	0.069	0.069	0.069	0.069	0.18	0.18
1,3-Dichlorobenzene	0.499	0.25	0.25	0.25	0.25	0.25	0.15	0.15
1,4-Dichlorobenzene	0.571	0.29	0.29	0.29	0.29	0.29	0.15	0.15
1-Bromopropane	0.347	0.17	0.17	0.17	0.17	0.17	0.054	0.054
1-Ethyl-4-methylbenzene	0.428	0.21	0.21	0.21	0.21	0.21	0.18	0.17
2-Butanone (MEK)	0.551	1.4	2.6	0.28	2.9	0.28	2.6	2.3
2-Hexanone	0.217	0.11	0.35	0.66	2.1	0.11	0.51	0.33
2-Methoxy-2-methylpropane (MTBE)	0.353	0.18	0.18	0.18	0.18	0.18	0.074	0.074
4-Methyl-2-pentanone (MIBK)	0.496	0.25	0.25	0.25	1.9	0.25	0.30	0.30
Acetone	0.185	18	50	93	78	10	19	18
Acrolein	0.108	0.83	3.0	3.7	1.8	0.28	2.0	1.2
Benzene	0.297	0.38	0.15	0.61	1.0	0.15	0.52	1.7
Bromodichloromethane	0.234	0.12	0.12	0.12	0.12	0.12	0.080	0.080
Bromoform	0.372	0.19	0.19	0.19	0.19	0.19	0.13	0.13
Bromomethane	0.163	0.082	0.082	0.082	0.082	0.082	0.053	0.11
Carbon disulfide	0.146	0.073	0.073	0.073	0.073	0.073	0.24	0.25
Carbon tetrachloride	0.428	0.60	0.54	1.1	1.3	0.69	0.67	0.63
Chlorobenzene	0.147	0.074	0.074	0.074	0.074	0.074	0.077	0.14
Chloroethane	0.158	0.079	0.079	0.079	0.079	0.079	0.14	0.084
Chloroethene	0.181	0.091	0.091	0.091	0.091	0.091	0.032	0.041
Chloroform	0.171	0.085	0.085	0.085	0.085	0.085	0.062	0.077
Chloromethane	0.099	1.6	1.3	4.7	2.5	1.5	1.2	1.1
cis-1,2-Dichloroethene	0.361	0.18	0.18	0.18	0.18	0.18	0.049	0.045
cis-1,3-Dichloro-1-propene	0.381	0.19	0.19	0.19	0.19	0.19	0.091	0.091
Cyclohexane	0.182	0.091	0.091	0.091	0.091	0.091	0.090	0.57
Dibromochloromethane	0.239	0.12	0.12	0.12	0.12	0.12	0.10	0.10
Dichlorodifluoromethane	0.262	2.7	2.3	6.4	4.9	3.1	2.8	2.7
Ethylbenzene	0.360	0.18	0.18	0.18	0.18	0.18	0.084	0.36
Hexachloro-1,3-butadiene	0.330	0.17	0.17	0.17	0.59	0.17	0.31	0.34
m&p-Xylene	0.578	0.29	0.29	0.29	0.29	0.29	0.18	1.3
Methylene chloride	1.180	0.59	0.59	0.59	0.59	0.59	0.79	0.51
n-Heptane	0.279	0.14	0.14	0.14	0.14	0.14	0.18	0.75
n-Hexane	0.338	0.17	0.17	0.17	0.17	0.17	0.19	1.6
o-Xylene	0.326	0.16	0.16	0.16	0.16	0.16	0.078	0.41
Propene	0.053	0.76	0.57	2.9	1.9	0.72	1.0	24
Styrene	0.405	0.20	0.20	0.20	0.20	0.20	0.10	0.079
Tetrachloroethene (PERC)	0.434	0.22	0.45	0.22	0.22	1.9	0.11	0.25
Tetrahydrofuran (THF)	0.510	0.26	0.26	0.26	0.91	0.26	0.080	0.085
Toluene	0.166	0.60	0.31	0.60	0.41	0.24	0.64	6.4
trans-1,2-Dichloroethene	0.305	0.15	0.15	0.15	0.15	0.15	0.059	0.052
trans-1,3-Dichloro-1-propene	0.177	0.089	0.089	0.089	0.089	0.089	0.091	0.091
Trichloroethylene (TCE)	0.344	0.17	0.17	0.17	0.17	0.17	0.068	0.067
Trichlorofluoromethane	0.298	1.6	1.2	3.3	3.3	1.7	1.4	1.4

Appendix C: Reference Concentrations

MAU – Reference Concentrations (RfC)

		RfC		
CAS#	**Compound**	**REL (ug/m3)**	**AEGL (ug/m3)**	**ERPG-1 (ug/m3)**
622-96-8	1-Ethyl-4-methylbenzene			
95-63-6	1,2,4-Trimethylbenzene			
1634-04-4	2-Methoxy-2-methylpropane (MTBE)		180000	
78-78-4	2-Methyl Butane			
73513-42-5	2-Methyl Pentane			
96-14-0	3-Methyl Pentane			
71-43-2	Benzene	1300	170000	170000
75-15-0	Carbon Disulfide	6200	40000	40000
630-08-0	Carbon Monoxide			
463-58-1	Carbonyl Sulfide		**140000**	
74-87-3	Chloromethane		**1900000**	
75-18-3	Dimethyl sulfide			
74-84-0	Ethane			
100-41-4	Ethylbenzene		140000	
50-00-0	Formaldehyde	55	1100	1100
7647-01-0	Hydrogen Chloride	2100	2700	2700
7783-06-4	Hydrogen Sulfide	42	710	710
75-28-5	iso-Butane			
74-82-8	Methane			
67-56-1	Methanol	28000	690000	690000
74-93-1	Methyl mercaptan			
1330-20-7	m-Xylene	22000		
91-20-3	Naphthalene			
106-97-8	n-Butane			
142-82-5	n-Heptane			
110-54-3	n-Hexane		**12000000**	
7697-37-2	Nitric Acid			
	Nitric Oxide			
10102-44-0	Nitrogen Dioxide			
7782-77-6	Nitrous Acid			
111-65-9	n-Octane			
109-66-0	n-Pentane			
95-47-6	o-Xylene			
10028-15-6	Ozone			
74-98-6	Propane			
1330-20-7	p-Xylene	22000		
100-42-5	Styrene	21000	85000	85000
7446-09-5	Sulfur Dioxide			
127-18-4	Tetrachloroethene	20000	240000	240000
108-88-3	Toluene	37000	750000	750000
75-69-4	Trichloroethene		700000	700000

Sources
REL - CalEPA Recommended Exposure Limits (1-hr)
AEGL-1 - EPA Acute Exposure Guideline Levels for Mild Effects (1-hr)
AEGL-2 - EPA Acute Exposure Guideline Levels for Moderate Effects (1-hr)
ERPG-1 - DOE Emergency Removal Program Guidelines for Mild or Transient Effects (1-hr)

Canister – Acute Reference Concentrations (RfC)

CAS#	Preferred Compound Names	Acute RfC (ug/m3)	Source RfC
71-55-6	1,1,1-Trichloroethane	9000	IRIS
79-34-5	1,1,2,2-Tetrachloroethane		
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane		
79-00-5	1,1,2-Trichloroethane		
75-34-3	1,1-Dichloroethane		
75-35-4	1,1-Dichloroethene		
120-82-1	1,2,4-Trichlorobenzene		
95-63-6	1,2,4-Trimethylbenzene		
106-93-4	1,2-Dibromoethane		
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane		
95-50-1	1,2-Dichlorobenzene		
107-06-2	1,2-Dichloroethane		
78-87-5	1,2-Dichloropropane	231	ATSDR
108-67-8	1,3,5-Trimethylbenzene		
106-99-0	1,3-Butadiene	220	ATSDR
541-73-1	1,3-Dichlorobenzene		
106-46-7	1,4-Dichlorobenzene	12000	ATSDR
106-94-5	1-Bromopropane		
622-96-8	1-Ethyl-4-methylbenzene		
78-93-3	2-Butanone (MEK)	13000	CALEPA
591-78-6	2-Hexanone		
1634-04-4	2-Methoxy-2-methylpropane (MTBE)	7210	ATSDR
108-10-1	4-Methyl-2-pentanone (MIBK)		
67-64-1	Acetone	61800	ATSDR
107-02-8	Acrolein	6.88	ATSDR
71-43-2	Benzene	28.8	ATSDR
75-27-4	Bromodichloromethane		
75-25-2	Bromoform		
74-83-9	Bromomethane	194	ATSDR
75-15-0	Carbon disulfide	6200	CALEPA
56-23-5	Carbon tetrachloride	1900	CALEPA
108-90-7	Chlorobenzene		
75-00-3	Chloroethane	39600	ATSDR
75-01-4	Chloroethene	1280	ATSDR
67-66-3	Chloroform	488	ATSDR
74-87-3	Chloromethane	1030	ATSDR
156-59-2	cis-1,2-Dichloroethene		
10061-01-5	cis-1,3-Dichloro-1-propene		
110-82-7	Cyclohexane		
124-48-1	Dibromochloromethane		
75-71-8	Dichlorodifluoromethane		
100-41-4	Ethylbenzene	43400	ATSDR
87-68-3	Hexachloro-1,3-butadiene		
108-38-3	m&p-Xylene	8680	ATSDR
75-09-2	Methylene chloride	2080	ATSDR
142-82-5	n-Heptane		
110-54-3	n-Hexane		
95-47-6	o-Xylene	22000	CALEPA
115-07-1	Propene		
100-42-5	Styrene	8520	ATSDR
127-18-4	Tetrachloroethene (PERC)	1360	ATSDR
109-99-9	Tetrahydrofuran (THF)		
108-88-3	Toluene	3770	ATSDR
156-60-5	trans-1,2-Dichloroethene	793	ATSDR
10061-02-6	trans-1,3-Dichloro-1-propene		
79-01-6	Trichloroethylene (TCE)	10700	ATSDR
75-69-4	Trichlorofluoromethane		

Sources
ATSDR - Agency for Toxics Substances and Disease Registry
CalEPA - California EPA
IRIS - EPA's Integrated Risk Information System
HEAST - EPA's Health Effects Assessment Summary Tables
NCEA - EPA's National Center for Environmental Assessment
PROV - EPA's Provisional Peer Reviewed Toxicity Values

Appendix D: Mobile Analytical Unit Hazard Calculations

OP-FTIR – Sones Pond Background (based on maximum concentrations)

Compound	Hazard Quotient (Highest Conc/REL)						Hazard Quotient (Highest Conc/AEGL)						Hazard Quotient (Highest Conc/ERPG-1)					
	8/9/10	8/10/10		8/11/10		8/12/10	8/9/10	8/10/10		8/11/10		8/12/10	8/9/10	8/10/10		8/11/10		8/12/10
	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning
1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Methoxy-2-methylpropane (MTBE)	--	--	--	--	--	--	0.00	0.00	0.00	0.00	--	0.00	--	--	--	--	--	--
2-Methyl Butane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Methyl Pentane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3-Methyl Pentane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzene	--	0.37	0.98	0.66	--	--	--	0.00	0.01	0.01	--	--	--	0.00	0.01	0.01	--	--
Carbon Disulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon Monoxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbonyl Sulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloromethane	--	--	--	--	--	--	--	--	0.00	--	--	--	--	--	--	--	--	--
Dimethyl sulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	--	--	0.01	--	--	--	--	--	--	--	--
Formaldehyde	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hydrogen Chloride	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hydrogen Sulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
iso-Butane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methanol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl mercaptan	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
m-Xylene	--	--	--	--	--	0.02	--	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Butane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Heptane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Hexane	--	--	--	--	--	--	--	--	--	0.00	--	--	--	--	--	--	--	--
Nitric Acid	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitric Oxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen Dioxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrous Acid	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Octane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Pentane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
o-Xylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ozone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Propane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
p-Xylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Styrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfur Dioxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Toluene	--	0.02	0.02	--	--	--	--	0.00	0.00	--	--	--	--	0.00	0.00	--	--	--
Hazard Index	--	0.39	1.00	0.66	--	0.02	0.00	0.00	0.01	0.02	--	0.00	--	0.00	0.01	0.01	--	--

OP-FTIR – Carter Road Well Site (based on maximum concentrations)

Compound	Hazard Quotient (Highest Conc/REL)						Hazard Quotient (Highest Conc/AEGL)						Hazard Quotient (Highest Conc/ERPG-1)					
	9/13/10	9/14/10		9/15/10		9/16/10	9/13/10	9/14/10		9/15/10		9/16/10	9/13/10	9/14/10		9/15/10		9/16/10
	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning
1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Methoxy-2-methylpropane (MTBE)	--	--	--	--	--	--	0.00	0.00	0.00	0.00	0.00	0.00	--	--	--	--	--	--
2-Methyl Butane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Methyl Pentane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3-Methyl Pentane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon Disulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon Monoxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbonyl Sulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dimethyl sulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Formaldehyde	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hydrogen Chloride	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hydrogen Sulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
iso-Butane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methanol	--	--	--	--	0.00	0.00	--	--	--	--	0.00	0.00	--	--	--	--	0.00	0.00
Methyl mercaptan	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
m-Xylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Butane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Heptane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Hexane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitric Acid	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitric Oxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen Dioxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrous Acid	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Octane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Pentane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
o-Xylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ozone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Propane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
p-Xylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Styrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfur Dioxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Toluene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hazard Index	--	--	--	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	--	--	--	--	0.00	0.00

OP-FTIR – Lathrop Compressor Station (based on maximum concentrations)

Compound	Hazard Quotient (Highest Conc/REL)						Hazard Quotient (Highest Conc/AEGL)						Hazard Quotient (Highest Conc/ERPG-1)					
	10/4/10	10/5/10		10/6/10			10/4/10	10/5/10		10/6/10			10/4/10	10/5/10		10/6/10		
	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning
1,2,4-Trimethylbenzene	--	--	--	--			--	--	--	--			--	--	--	--		
2-Methoxy-2-methylpropane (MTBE)	--	--	--	--			0.00	0.00	0.00	0.00			--	--	--	--		
2-Methyl Butane	--	--	--	--			--	--	--	--			--	--	--	--		
2-Methyl Pentane	--	--	--	--			--	--	--	--			--	--	--	--		
3-Methyl Pentane	--	--	--	--			--	--	--	--			--	--	--	--		
Benzene	--	--	--	--			--	--	--	--			--	--	--	--		
Carbon Disulfide	--	--	--	--			--	--	--	--			--	--	--	--		
Carbon Monoxide	--	--	--	--			--	--	--	--			--	--	--	--		
Carbonyl Sulfide	--	--	--	--			--	--	--	--			--	--	--	--		
Chloromethane	--	--	--	--			--	--	--	--			--	--	--	--		
Dimethyl sulfide	--	--	--	--			--	--	--	--			--	--	--	--		
Ethane	--	--	--	--			--	--	--	--			--	--	--	--		
Ethylbenzene	--	--	--	--			--	--	--	--			--	--	--	--		
Formaldehyde	--	--	--	--			--	--	--	--			--	--	--	--		
Hydrogen Chloride	--	--	--	--			--	--	--	--			--	--	--	--		
Hydrogen Sulfide	--	--	--	--			--	--	--	--			--	--	--	--		
iso-Butane	--	--	--	--			--	--	--	--			--	--	--	--		
Methane	--	--	--	--			--	--	--	--			--	--	--	--		
Methanol	--	0.00	--	--			--	0.00	--	--			--	0.00	--	--		
Methyl mercaptan	--	--	--	--			--	--	--	--			--	--	--	--		
m-Xylene	--	0.07	--	--			--	--	--	--			--	--	--	--		
Naphthalene	--	--	--	--			--	--	--	--			--	--	--	--		
n-Butane	--	--	--	--			--	--	--	--			--	--	--	--		
n-Heptane	--	--	--	--			--	--	--	--			--	--	--	--		
n-Hexane	--	--	--	--			--	--	--	--			--	--	--	--		
Nitric Acid	--	--	--	--			--	--	--	--			--	--	--	--		
Nitric Oxide	--	--	--	--			--	--	--	--			--	--	--	--		
Nitrogen Dioxide	--	--	--	--			--	--	--	--			--	--	--	--		
Nitrous Acid	--	--	--	--			--	--	--	--			--	--	--	--		
n-Octane	--	--	--	--			--	--	--	--			--	--	--	--		
n-Pentane	--	--	--	--			--	--	--	--			--	--	--	--		
o-Xylene	--	--	--	--			--	--	--	--			--	--	--	--		
Ozone	--	--	--	--			--	--	--	--			--	--	--	--		
Propane	--	--	--	--			--	--	--	--			--	--	--	--		
p-Xylene	--	0.10	--	--			--	--	--	--			--	--	--	--		
Styrene	--	--	--	--			--	--	--	--			--	--	--	--		
Sulfur Dioxide	--	--	--	--			--	--	--	--			--	--	--	--		
Toluene	--	--	--	--			--	--	--	--			--	--	--	--		
Hazard Index	--	0.18	--	--			0.00	0.00	0.00	0.00			--	0.00	--	--		

OP-FTIR – Teel Compressor Station (based on maximum concentrations)

Compound	Hazard Quotient (Highest Conc/REL)						Hazard Quotient (Highest Conc/AEGL)						Hazard Quotient (Highest Conc/ERPG-1)					
				10/6/10		10/7/10				10/6/10		10/7/10				10/6/10		10/7/10
	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning
1,2,4-Trimethylbenzene					--	--					--	--					--	--
2-Methoxy-2-methylpropane (MTBE)					--	--					0.00	0.00					--	--
2-Methyl Butane					--	--					--	--					--	--
2-Methyl Pentane					--	--					--	--					--	--
3-Methyl Pentane					--	--					--	--					--	--
Benzene					--	--					--	--					--	--
Carbon Disulfide					--	--					--	--					--	--
Carbon Monoxide					--	--					--	--					--	--
Carbonyl Sulfide					--	--					--	--					--	--
Chloromethane					--	--					--	--					--	--
Dimethyl sulfide					--	--					--	--					--	--
Ethane					--	--					--	--					--	--
Ethylbenzene					--	--					--	--					--	--
Formaldehyde					--	--					--	--					--	--
Hydrogen Chloride					--	--					--	--					--	--
Hydrogen Sulfide					--	--					--	--					--	--
iso-Butane					--	--					--	--					--	--
Methane					--	--					--	--					--	--
Methanol					--	--					--	--					--	--
Methyl mercaptan					--	--					--	--					--	--
m-Xylene					--	--					--	--					--	--
Naphthalene					--	--					--	--					--	--
n-Butane					--	--					--	--					--	--
n-Heptane					--	--					--	--					--	--
n-Hexane					--	--					--	--					--	--
Nitric Acid					--	--					--	--					--	--
Nitric Oxide					--	--					--	--					--	--
Nitrogen Dioxide					--	--					--	--					--	--
Nitrous Acid					--	--					--	--					--	--
n-Octane					--	--					--	--					--	--
n-Pentane					--	--					--	--					--	--
o-Xylene					--	--					--	--					--	--
Ozone					--	--					--	--					--	--
Propane					--	--					--	--					--	--
p-Xylene					--	--					--	--					--	--
Styrene					--	--					--	--					--	--
Sulfur Dioxide					--	--					--	--					--	--
Toluene					--	--					--	--					--	--
Hazard Index					--	--					0.00	0.00					--	--

OP-FTIR – Loomis Well Site (based on maximum concentrations)

Compound	Hazard Quotient (Highest Conc/REL)						Hazard Quotient (Highest Conc/AEGL)						Hazard Quotient (Highest Conc/ERPG-1)					
	10/25/10	10/26/10		10/27/10		10/28/10	10/25/10	10/26/10		10/27/10		10/28/10	10/25/10	10/26/10		10/27/10		10/28/10
	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening	Morning
1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Methoxy-2-methylpropane (MTBE)	--	--	--	--	--	--	0.00	0.00	0.00	0.00	--	0.00	--	--	--	--	--	--
2-Methyl Butane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Methyl Pentane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3-Methyl Pentane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzene	--	0.59	--	--	--	--	--	0.00	--	--	--	--	--	0.00	--	--	--	--
Carbon Disulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon Monoxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbonyl Sulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dimethyl sulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Formaldehyde	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hydrogen Chloride	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hydrogen Sulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
iso-Butane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methanol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl mercaptan	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
m-Xylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Butane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Heptane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Hexane	--	--	--	--	--	--	0.00	--	--	--	--	--	--	--	--	--	--	--
Nitric Acid	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitric Oxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrogen Dioxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrous Acid	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Octane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Pentane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
o-Xylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ozone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Propane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
p-Xylene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Styrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfur Dioxide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Toluene	--	--	0.00	--	--	--	--	--	0.00	--	--	--	--	--	0.00	--	--	--
Hazard Index	--	0.59	0.00	--	--	--	0.00	0.01	0.00	0.00	--	0.00	--	0.00	0.00	--	--	--

GC/MS – All Sites

Site	Date	Bag/ Time[1]	Compound	Conc. (ppbv)	MW	Conc. (ug/m3)	Hazard Quotient (HQ)		
							Conc/ REL	Conc/ AEGL	Conc/ ERPG-1
Sones Pond			None						
Carter Road	9/15/10	10:50	Toluene	1.5	92.1	5.6	0.00	0.00	0.00
			Ethylbenzene	1.5	106.2	6.5		0.00	
			m/p-Xylene	5.5	106.2	24	0.00		
			Styrene	4.0	104.2	17	0.00	0.00	0.00
			o-Xylene	2.4	106.2	10			
			1-Ethyl-4-methylbenzene	1.3	120.2	6.4			
			1,3,5-Trimethylbenzene	2.4	120.2	12			
			1,2,4-Trimethylbenzene	5.7	120.2	28			
			Naphthalene	0.97	128.2	5.1			
Lathrop Compressor Station			None						
Loomis Well Site	10/26/10	1	Tetrachloroethene	1.1	165.8	7.5	0.00	0.00	0.00
		4	Trichloroethene	1.3	131.4	7.0		0.00	0.00
		5	Benzene	1.2	78.1	3.8	0.00	0.00	0.00
			Trichloroethene	2.5	131.4	13		0.00	0.00
			n-Heptane	3.8	100.2	16			
			Tetrachloroethene	73	165.8	495	0.02	0.00	0.00
		6	Tetrachloroethene	1.6	165.8	11	0.00	0.00	0.00
		7	Benzene	1.4	78.1	4.5	0.00	0.00	0.00
			Trichloroethene	49	131.4	263		0.00	0.00
		18:59	Tetrachloroethene	0.88	165.8	6.0	0.00	0.00	0.00
	10/27/10	1	1-Ethyl-4-methylbenzene	0.69	120.2	3.4			
			1,2,4-Trimethylbenzene	0.97	120.2	4.8			
		5:38	Trichloroethene	2.3	131.4	12		0.00	0.00

-- No RfC available

[1] Samples collected in bags or drawn directly from outside air.

(green shaded box) - An estimated value. Concentration above highest calibration level of 9.8 ppbv.

Appendix E: Canister Hazard Calculations

Canister - All Sites

	RAIS 12/13		Hazard Quotient (HQ) Acute												
Compounds	**RfC Acute (ug/m3)**	**Source RfC**	**Sones Pond 8-9**	**Sones Pond 8-10**	**Sones Pond 8-11**	**Carter 9-13 001**	**Carter 9-13 002**	**Carter 9-14**	**Carter 9-15**	**Lathrop 10-4**	**Lathrop 10-5**	**Lathrop 10-6**	**Teel 10-4**	**Teel 10-5**	**Teel 10-6**
1,1,1-Trichloroethane	9000	IRIS													
1,1,2,2-Tetrachloroethane															
1,1,2-Trichloro-1,2,2-trifluoroethane															
1,1,2-Trichloroethane															
1,1-Dichloroethane															
1,1-Dichloroethene															
1,2,4-Trichlorobenzene															
1,2,4-Trimethylbenzene															
1,2-Dibromoethane															
1,2-Dichloro-1,1,2,2-tetrafluoroethane															
1,2-Dichlorobenzene															
1,2-Dichloroethane															
1,2-Dichloropropane	231	ATSDR													0.00
1,3,5-Trimethylbenzene															
1,3-Butadiene	220	ATSDR													
1,3-Dichlorobenzene															
1,4-Dichlorobenzene	12000	ATSDR													
1-Bromopropane															
1-Ethyl-4-methylbenzene															
2-Butanone (MEK)	13000	CALEPA		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	
2-Hexanone															
2-Methoxy-2-methylpropane (MTBE)	7210	ATSDR													
4-Methyl-2-pentanone (MIBK)															
Acetone	61800	ATSDR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acrolein	6.88	ATSDR													
Benzene	28.8	ATSDR			0.01		0.01				0.01		0.02		
Bromodichloromethane															
Bromoform															
Bromomethane	194	ATSDR													
Carbon disulfide	6200	CALEPA													
Carbon tetrachloride	1900	CALEPA			0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Chlorobenzene															
Chloroethane	39600	ATSDR											0.00		
Chloroethene	1280	ATSDR										0.00			
Chloroform	488	ATSDR													
Chloromethane	1030	ATSDR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
cis-1,2-Dichloroethene															
cis-1,3-Dichloro-1-propene															
Cyclohexane															
Dibromochloromethane															
Dichlorodifluoromethane															
Ethylbenzene	43400	ATSDR													
Hexachloro-1,3-butadiene															
m&p-Xylene	8680	ATSDR											0.00		
Methylene chloride	2080	ATSDR			0.00										
n-Heptane															
n-Hexane															
o-Xylene	22000	CALEPA													
Propene															
Styrene	8520	ATSDR					0.00						0.00		
Tetrachloroethene (PERC)	1360	ATSDR													
Tetrahydrofuran (THF)															
Toluene	3770	ATSDR		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
trans-1,2-Dichloroethene	793	ATSDR													
trans-1,3-Dichloro-1-propene															
Trichloroethylene (TCE)	10700	ATSDR													
Trichlorofluoromethane															
	Acute Hazard Index		0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.03	0.00	0.00

Canister - All Sites (continued)

Compounds	RAIS 12/13 RfC Acute (ug/m3)	Source RfC	Hazard Quotient (HQ) Acute Loomis 10-25	Loomis 10-26 001	Loomis 10-26 002	Loomis 10-27 001	Loomis 10-27 002	Arendtsville 2009	Marcus Hook 2009
1,1,1-Trichloroethane	9000	IRIS							
1,1,2,2-Tetrachloroethane									
1,1,2-Trichloro-1,2,2-trifluoroethane									
1,1,2-Trichloroethane									
1,1-Dichloroethane									
1,1-Dichloroethene									
1,2,4-Trichlorobenzene									
1,2,4-Trimethylbenzene									
1,2-Dibromoethane									
1,2-Dichloro-1,1,2,2-tetrafluoroethane									
1,2-Dichlorobenzene									
1,2-Dichloroethane									
1,2-Dichloropropane	231	ATSDR							
1,3,5-Trimethylbenzene									
1,3-Butadiene	220	ATSDR							
1,3-Dichlorobenzene									
1,4-Dichlorobenzene	12000	ATSDR							
1-Bromopropane									
1-Ethyl-4-methylbenzene									
2-Butanone (MEK)	13000	CALEPA	0.00	0.00		0.00		0.00	0.00
2-Hexanone									
2-Methoxy-2-methylpropane (MTBE)	7210	ATSDR							
4-Methyl-2-pentanone (MIBK)									
Acetone	61800	ATSDR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acrolein	6.88	ATSDR							
Benzene	28.8	ATSDR	0.01		0.02	0.04		0.02	0.06
Bromodichloromethane									
Bromoform									
Bromomethane	194	ATSDR							
Carbon disulfide	6200	CALEPA							
Carbon tetrachloride	1900	CALEPA	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chlorobenzene									
Chloroethane	39600	ATSDR						0.00	0.00
Chloroethene	1280	ATSDR							
Chloroform	488	ATSDR							0.00
Chloromethane	1030	ATSDR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
cis-1,2-Dichloroethene									
cis-1,3-Dichloro-1-propene									
Cyclohexane									
Dibromochloromethane									
Dichlorodifluoromethane									
Ethylbenzene	43400	ATSDR						0.00	0.00
Hexachloro-1,3-butadiene									
m&p-Xylene	8680	ATSDR						0.00	0.00
Methylene chloride	2080	ATSDR						0.00	0.00
n-Heptane									
n-Hexane									
o-Xylene	22000	CALEPA						0.00	0.00
Propene									
Styrene	8520	ATSDR						0.00	0.00
Tetrachloroethene (PERC)	1360	ATSDR		0.00			0.00	0.00	0.00
Tetrahydrofuran (THF)									
Toluene	3770	ATSDR	0.00	0.00	0.00	0.00	0.00	0.00	0.00
trans-1,2-Dichloroethene	793	ATSDR							
trans-1,3-Dichloro-1-propene									
Trichloroethylene (TCE)	10700	ATSDR							
Trichlorofluoromethane									
		Acute Hazard Index	0.02	0.00	0.03	0.04	0.00	0.02	0.06

Appendix F: Mobile Analytical Unit Meteorological Data

Sones Pond Background

8/9/10				8/10/10								8/11/10								8/12/10			
Evening				Morning				Evening				Morning				Evening				Morning			
Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)
5:30 PM	84	2	180	4:45 AM	72	0	80	4:40 PM	78	4	317	4:45 AM	65	0	45	4:58 PM	85	1	323	4:45 AM	67	0	123
6:00 PM	83	0	270	5:00 AM	69	0	180	5:00 PM	81	1	292	5:00 AM	64	0	135	5:30 PM	84	7	269	5:00 AM	67	0	123
6:30 PM	82	0	265	5:30 AM	68	0	90	5:30 PM	83	2	208	5:30 AM	63	0	135	6:00 PM	83	2	308	5:30 AM	67	0	123
7:00 PM	81	0	199	6:00 AM	67	0	90	6:00 PM	83	3	270	6:00 AM	63	0	135	6:30 PM	83	0	317	6:00 AM	67	1	123
7:30 PM	78	0	164	6:30 AM	65	0	90	6:30 PM	83	0	317	6:30 AM	63	0	135	7:00 PM	81	0	315	6:30 AM	67	0	123
8:00 PM	77	0	164	7:00 AM	67	0	90	7:00 PM	84	0	227	7:00 AM	63	0	135	7:30 PM	80	1	333	7:00 AM	67	0	123
8:30 PM	76	0	164	7:30 AM	68	0	38	7:30 PM	82	0	232	7:30 AM	64	0	135	8:00 PM	78	0	333	7:30 AM	67	0	123
9:00 PM	74	0	209	8:00 AM	68	0	38	8:00 PM	78	0	321	8:00 AM	64	0	135	8:30 PM	76	0	333	8:00 AM	68	1	123
9:30 PM	74	0	221	8:30 AM	68	0	40	8:30 PM	77	0	331	8:30 AM	65	0	135	9:00 PM	75	1	333	8:30 AM	69	0	123
10:00 PM	73	0	225	9:00 AM	70	0	40	9:00 PM	75	0	331	9:00 AM	69	0	135	9:30 PM	75	0	290	9:00 AM	70	0	178
10:30 PM	72	0	225	9:30 AM	71	0	43	9:30 PM	73	0	331	9:30 AM	71	2	285	10:00 PM	74	0	343	9:30 AM	71	0	180
11:00 PM	71	0	225	10:00 AM	71	0	46	10:00 PM	72	0	331	10:00 AM	72	2	355	10:30 PM	73	0	317	10:00 AM	72	0	180
11:30 PM	71	0	350	10:30 AM	73	0	46	10:30 PM	70	0	331	10:30 AM	74	2	291	11:00 PM	72	0	317	10:30 AM	72	1	63
12:00 PM	70	0	347	11:00 AM	76	1	46	11:00 PM	69	0	331	11:00 AM	75	3	335	11:30 PM	71	0	321	11:00 AM	71	0	163
				11:30 AM	75	0	263	11:30 PM	69	0	331	11:30 AM	75	3	279	12:00 AM	69	0	321	11:30 AM	71	0	36
				12:00 PM	75	0	265	12:00 PM	69	0	331	12:00 PM	76	3	239					12:00 PM	70	0	36

Carter Road Well Site

9/13/10				9/14/10								9/15/10								9/16/10			
Evening				Morning				Evening				Morning				Evening				Morning			
Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)
5:30 PM	65	2	202	5:00 AM	54	1	77	5:00 PM	66	6	327	5:00 AM	49	1	311	4:45 PM	64	7	290	5:00 AM	51	1	90
6:00 PM	63	0	173	5:30 AM	50	1	77	5:30 PM	63	5	323	5:30 AM	47	0	311	5:00 PM	64	0	321	5:30 AM	48	0	90
6:30 PM	63	0	281	6:00 AM	51	1	76	6:00 PM	64	3	342	6:00 AM	46	0	311	5:30 PM	63	4	338	6:00 AM	46	1	58
7:00 PM	63	1	253	6:30 AM	49	1	76	6:30 PM	62	1	15	6:30 AM	46	0	243	6:00 PM	62	5	64	6:30 AM	45	2	57
7:30 PM	62	2	336	7:00 AM	49	0	76	7:00 PM	60	2	355	7:00 AM	46	1	78	6:30 PM	61	3	53	7:00 AM	45	1	87
8:00 PM	61	3	342	7:30 AM	51	0	272	7:30 PM	59	1	12	7:30 AM	48	1	287	7:00 PM	58	4	360	7:30 AM	46	1	60
8:30 PM	60	1	68	8:00 AM	52	2	220	8:00 PM	58	0	26	8:00 AM	49	2	319	7:30 PM	56	4	31	8:00 AM	48	2	62
9:00 PM	59	0	340	8:30 AM	53	0	291	8:30 PM	57	1	351	8:30 AM	51	3	246	8:00 PM	55	1	34	8:30 AM	50	6	102
9:30 PM	57	0	340	9:00 AM	55	2	298	9:00 PM	57	1	343	9:00 AM	52	6	294	8:30 PM	54	1	15	9:00 AM	54	5	130
10:00 PM	56	0	339	9:30 AM	56	3	279	9:30 PM	56	1	315	9:30 AM	53	4	273	9:00 PM	52	3	38	9:30 AM	56	5	138
10:30 PM	55	1	340	10:00 AM	57	1	300	10:00 PM	54	1	360	10:00 AM	54	6	300	9:30 PM	52	1	63	10:00 AM	57	10	144
11:00 PM	54	0	360	10:30 AM	59	4	336	10:30 PM	52	1	85	10:30 AM	55	2	309	10:00 PM	51	1	41	10:30 AM	60	13	153
11:30 PM	53	0	360	11:00 AM	60	7	5	11:00 PM	52	2	278	11:00 AM	57	8	306	10:30 PM	51	1	5	11:00 AM	63	12	147
12:00 AM	52	1	323	11:30 AM	62	9	355	11:30 PM	51	0	300	11:30 AM	57	9	304	11:00 PM	49	2	25	11:30 AM	63	12	146
				12:00 PM	62	7	305	12:00 AM	51	1	250	12:00 PM	57	8	305	11:30 PM	48	1	21	12:00 PM	63	11	136

Lathrop Compressor Station

10/4/10				10/5/10								10/6/10								10/7/10			
Evening				Morning				Evening				Morning				Evening				Morning			
Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)
6:00 PM	47	3	0	5:00 AM	46	1	342	4:45 PM	50	5	331	5:00 AM	50	4	113								
6:30 PM	46	1	38	5:30 AM	46	3	355	5:00 PM	50	3	319	5:30 AM	52	4	137								
7:00 PM	46	2	22	6:00 AM	46	4	29	5:30 PM	50	2	294	6:00 AM	52	5	117								
7:30 PM	46	1	42	6:30 AM	46	1	345	6:00 PM	50	2	308	6:30 AM	52	8	123								
8:00 PM	46	2	329	7:00 AM	46	2	315	6:30 PM	50	2	325	7:00 AM	52	10	144								
8:30 PM	46	4	46	7:30 AM	46	2	336	7:00 PM	49	2	51	7:30 AM	52	13	126								
9:00 PM	45	4	309	8:00 AM	47	5	350	7:30 PM	50	5	83	8:00 AM	52	7	172								
9:30 PM	45	0	344	8:30 AM	47	2	323	8:00 PM	50	1	10	8:30 AM	52	6	182								
10:00 PM	45	5	350	9:00 AM	47	1	298	8:30 PM	50	1	48	9:00 AM	50	5	185								
10:30 PM	45	6	355	9:30 AM	48	4	355	9:00 PM	50	0	55	9:30 AM	50	11	175								
11:00 PM	46	4	90	10:00 AM	48	2	317	9:30 PM	50	1	55	10:00 AM	51	11	178								
11:30 PM	46	5	86	10:30 AM	48	2	326	10:00 PM	50	0	318	10:30 AM	52	6	190								
12:00 AM	46	0	97	11:00 AM	48	2	351	10:30 PM	50	1	318	11:00 AM	52	5	206								
				11:30 AM	48	2	311	11:00 PM	49	2	317	11:30 AM	53	5	198								
				12:00 PM	48	2	--	11:30 PM	49	2	329												
								12:00 AM	50	3	326												

Teel Compressor Station

10/4/10				10/5/10								10/6/10								10/7/10			
Evening				Morning				Evening				Morning				Evening				Morning			
Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)
																4:30 PM	57	1	207	5:00 AM	52	1	247
																5:00 PM	57	1	190	5:30 AM	51	0	180
																5:30 PM	56	2	207	6:00 AM	52	2	154
																6:00 PM	56	2	211	6:30 AM	51	2	206
																6:30 PM	55	5	175	7:00 AM	51	1	235
																7:00 PM	54	1	214	7:30 AM	51	0	208
																7:30 PM	52	0	214	8:00 AM	51	0	208
																8:00 PM	52	0	200	8:30 AM	52	0	279
																8:30 PM	51	0	211	9:00 AM	53	0	339
																9:00 PM	51	1	191	9:30 AM	54	2	331
																9:30 PM	50	2	324	10:00 AM	55	2	286
																10:00 PM	50	0	324	10:30 AM	56	3	265
																10:30 PM	50	1	194	11:00 AM	58	4	278
																11:00 PM	50	0	185	11:30 AM	59	0	279
																11:30 PM	50	0	186	12:00 PM	59	3	305
																12:00 AM	50	0	210				

Loomis Well Site

10/25/10				10/26/10								10/27/10								10/28/10			
Evening				Morning				Evening				Morning				Evening				Morning			
Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)	Time	Temp (°F)	Wind Speed (mph)	Wind Dir. (Deg.)
5:30 PM	67	6	196	5:00 AM	59	5	186	5:00 PM	64	11	161	5:00 AM	62	2	209	4:30 PM	69	2	198	5:00 AM	56	7	236
6:00 PM	66	5	175	5:30 AM	59	4	197	5:30 PM	65	17	153	5:30 AM	62	4	226	5:00 PM	69	5	261	5:30 AM	56	6	223
6:30 PM	64	6	150	6:00 AM	59	4	213	6:00 PM	65	8	148	6:00 AM	61	3	213	5:30 PM	67	4	246	6:00 AM	57	4	221
7:00 PM	61	0	152	6:30 AM	59	1	176	6:30 PM	64	8	192	6:30 AM	61	2	346	6:00 PM	64	3	224	6:30 AM	54	3	212
7:30 AM	61	2	162	7:00 AM	58	2	198	7:00 PM	63	9	215	7:00 AM	60	1	290	6:30 PM	63	4	223	7:00 AM	55	1	207
8:00 AM	60	1	93	7:30 AM	58	0	186	7:30 PM	63	7	199	7:30 AM	59	2	254	7:00 PM	62	5	198	7:30 AM	54	4	228
8:30 AM	60	2	231	8:00 AM	58	5	130	8:00 PM	63	6	192	8:00 AM	58	2	286	7:30 PM	61	5	203	8:00 AM	54	4	221
9:00 AM	58	5	336	8:30 AM	59	2	198	8:30 PM	63	4	181	8:30 AM	58	0	271	8:00 PM	60	4	220	8:30 AM	56	4	232
9:30 AM	57	2	329	9:00 AM	60	9	168	9:00 PM	65	10	161	9:00 AM	58	3	275	8:30 PM	60	5	208	9:00 AM	57	6	236
10:00 AM	57	0	360	9:30 AM	61	5	149	9:30 PM	65	14	157	9:30 AM	58	1	263	9:00 PM	60	3	223	9:30 AM	59	4	244
10:30 AM	57	0	225	10:00 AM	62	5	136	10:00 PM	65	10	200	10:00 AM	58	0	254	9:30 PM	59	2	202	10:00 AM	60	9	273
11:00 AM	57	0	213	10:30 AM	62	8	181	10:30 PM	67	10	178	10:30 AM	58	1	350	10:00 PM	58	3	219	10:30 AM	61	15	249
11:30 AM	57	0	200	11:00 AM	65	6	180	11:00 PM	68	11	221	11:00 AM	58	2	265	10:30 PM	57	5	196	11:00 AM	62	8	308
12:00 PM	57	0	208	11:30 AM	67	4	120	11:30 PM	67	13	197	11:30 AM	59	3	248	11:00 PM	59	6	236	11:30 AM	62	6	233
				12:00 PM	68	9	186	12:00 AM	66	10	189	12:00 PM	60	2	293	11:30 PM	59	8	222	12:00 PM	63	16	355
																12:00 AM	58	1	233				