AIR EMISSIONS CASE STUDY RELATED TO OIL AND GAS DEVELOPMENT IN ERIE, COLORADO

COLORADO
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EXECUTIVE SUMMARY

From late July to late August 2012, the Colorado Department of Public Health and Environment, Air Pollution Control Division, conducted air sampling adjacent to natural gas well completion activities in Erie, Colorado. The purpose of the sampling was to measure air emissions that may be associated with the well completion activities.

The air sampling results are consistent with what would be expected. Concentrations of likely oil and gas related compounds such as ethane and propane were found to be slightly higher at the Erie sites than in downtown Denver, but much lower than in Platteville where greater oil and gas activity is taking place. Similarly, methane levels at the Erie sites were consistent with other locations, and were higher than in Denver, and lower than in Platteville. Toluene and benzene levels were higher at one Erie monitor than the other, likely due to emissions from truck traffic.

The monitored concentrations of benzene, one of the major risk driving chemicals, are well within acceptable limits to protect public health, as determined by the U.S. Environmental Protection Agency. The concentrations of various compounds are comparatively low and are not likely to raise significant health issues of concern. However, it should be noted the current state of the science is unable to estimate the potential risks due to exposure from multiple chemicals at the same time, which may be higher.

Natural gas is composed primarily of "alkanes" such as methane, ethane and propane, with methane comprising up to 90% of the gas. Alkanes are generally considered to have a low potential for adverse health effects. Methane is a greenhouse gas that can contribute to environmental impacts. Volatile organic compound emissions from oil and gas development, along with emissions from other industrial activities and vehicles, can contribute to ground level ozone formation.

This study provides a snapshot in time for this natural gas completion activity at this well pad only. The completion activities at this well pad were done using reduced emission or "green" completion techniques, which are a "best management" requirement designed to minimize air emissions from well completions. No significant concentrations were recorded that could be directly attributed to well completion operations at this well pad. This study includes a limited data set and may or may not be representative of conditions and potential emissions at other locations.

A detailed and technical discussion of the study and its findings, including the relevant data collected, follows this Executive Summary.

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1.0 INTRODUCTION

In Colorado's North Front Range, a significant contributor to air emissions is the oil/natural gas industry. There are a large number of wells (over 20,000) in the northern Front Range in the Wattenberg Field, which is part of the Denver-Julesburg Basin. Since 2010, Weld County has led the state in the number of drilling permits issued (Colorado Oil and Gas Conservation Comission, 2012). Erie, Colorado sits on the border of Boulder and Weld Counties in the Front Range. It is located along the western edge of the Wattenberg Field.

Emissions from the oil/natural gas industry can be from both development activities, such as drilling, or from production activities, such as condensate tanks. Organic emissions are a concern as they may contribute to the formation of ozone. This is is not unique to oil and gas development. Other sources of organic emissions include industrial activities and motor vehicles. The North Front Range area is currently listed as a non-attainment area for ozone. Emissions from the oil/natural gas industry, particularly methane, are also potential greenhouse gas contributors. Some organic emissions create odors.

Completion technologies have improved over the past decade. The Colorado Oil and Gas Conservation Commission (COGCC) regulations now call for "green" completions, which involve the use of closed systems and the routing of flowback gas into sales lines. This is in contrast to former methods that used open pits for flowback and flaring of gas. As a result of this "best management" practice, oil/gas development emissions from this activity are generally much lower than in the past.

1.1. Purpose of Study

In July of 2012, a natural gas production company began work on the drilling and completion of a number of wells on one well pad on the west side of Erie. This location is near a residential area and two elementary schools: Red Hawk Elementary to the south-southwest and Erie Elementary to the east. The current minimum distance a well must be set back from an occupied building is 150 feet (Colorado Oil and Gas Conservation Commission, 2006). The wells in question meet and exceed the 150 foot minimum distance requirement, as they are over 450 feet from the closest residence to the northeast, greater than 950 feet from the closest house in the residential area to the south, greater than 2,000 feet from Red Hawk Elementary to the south-southwest, and greater than 1,400 feet from Erie Elementary to the east (distances measured using Google Earth).

A previous monitoring study by the Colorado Department of Public Health and Environment (CDPHE) to investigate emissions from specific oil and gas development activities, done in Garfield County during the summer of 2008, showed that increased concentrations of volatile organic compounds (VOCs) were more likely to occur during well completion activities than during drilling activities. Although the location of the Erie wells meets all specified COGCC setback distances, there was a great deal of concern from the community regarding potential air emissions of organic compounds. In response to the community's concerns, the CDPHE's Air Pollution Control Division (APCD) conducted monitoring in two locations after work on the wells began, primarily during completion activities. It should be noted that "green" completions

technologies were employed by this natural gas production company, which are designed to minimize air emissions from well completion activities. This report discusses the results of that monitoring.

1.2. Monitoring Site Locations

Figure 1 is an overview map of the neighborhood in Erie where the wells are located. The elementary schools are marked with green building icons. The approximate location of the wells is marked with a red pushpin icon. Supporting equipment and tanks were located to the southwest of the wells. The APCD air sampling locations are marked with yellow pushpin icons.

Figure 1. Map of Erie sampling sites

The E1CO and E2CO sampling locations were chosen based on their general directions toward the elementary schools and residential housing, and the availability/location of land owned by the Town of Erie, which agreed to let the APCD perform sampling on town-owned land. The average wind direction was estimated to be from a northerly or westerly direction. As such, APCD placed samplers in areas that were likely to be downwind from the wells and supporting equipment to try to capture any fugitive emissions.

The E1CO monitor was placed south-southwest of the entrance to the well site, in between the two roads used to enter and exit the site, approximately 1650' from the wellheads, with the supporting equipment and tanks being closer to the monitor. These two roads are the only

entrance and exit points for the well site. They can be seen in Figure 2. The exit road is on the left, and the entrance road on the right. In the upper portion of the picture, near the center, a drilling rig can be seen. This is the location of the well sites.

Figure 2. View north from E1CO sampler

The E2CO monitor was placed to the southeast of the well sites, across a depressed field meant to hold water in the case of a 100 year flood, approximately 850' from the wellheads. It was on the edge of an embankment. There was no water in this depression. There was, however, water in a smaller retaining pond that was southeast of the sampler, which can be seen in Figure 1. Figure 3 shows the view from the E2CO sampler, looking west to northwest at the well pad. The pad is surrounded on all sides by several rows of hay bales stacked on top of each other, in addition to stacks of shipping containers, for sound and light mitigation.

Figure 3. View to the E-NE from E2CO

1.3. Sampling Equipment

The APCD used passive samplers with timers attached to 6-liter "Summa" canisters to capture whole air samples. Stainless steel 1/8" lines were used for the sample inlets, which had particle filters. The passive samplers do not require constant power to operate. Instead, a battery-operated, programmable timer is used to control the valve in the passive sampling device. This timer is coded via an infrared programmer that can be used to control numerous other timers for simultaneous sampling. This ensured that both the timers used in the project were programmed to open at exactly the same time.

Figure 4 shows pictures of the sampling set ups at the E1CO and E2CO sites. At E1CO, the passive sampler and canister were contained in an insulated box that sat on the ground. The sample line was routed through the top of the box, and attached to the street sign frame to allow the inlet to be placed above the sign. At E2CO, the passive sampler and canister were contained in a small, hard plastic box. This box was then mounted to a pole approximately six feet off the ground, with the inlet at approximately the same height as the one at E1CO.

The passive samplers used were made by Entech Instruments. They were fitted with a sapphire orifice to accurately control the flow of air into the canister. Both passive samplers were flow calibrated for altitude with the use of a Bios Definer 220 flow meter before field sampling began. Both samplers were also field tested at a different site before use in this study to ensure they would operate properly.

Figure 4. Sampling equipment used (E1CO, left, and E2CO, right)

1.4. Sampling and Analysis Procedures

Samples were taken on an every third day basis, starting on July 20, 2012. After approximately two weeks, however, daily sampling was performed. This began August 6, 2012 and ran through August 13, 2012 to attempt to capture more days related to completion activities. At that point, when completion activities had ended, sampling on every third day began again until the last sample was taken on August 25, 2012. The samples were taken for a three hour time period from 06:00 a.m. to 09:00 a.m. Mountain Standard Time (MST), with the exception of two samples, which were taken from 08:00 a.m. to 11:00 a.m. MST.

Three-hour morning sampling was selected to match sampling that is ongoing by APCD to monitor for ozone precursors in the North Front Range area. The early morning period is desired to obtain concentrations of pollutants in the ambient air before reactions take place in sunlight.

On 8/4/2012 and 8/6/2012, sample times were switched from the previously mentioned time frame to 08:00 to 11:00 MST to determine if sampling was occurring at an appropriate time to capture any possible fugitive emissions. After the 8/6/2012 sample, the sample time was switched back to the original period. On those two days, the concentrations of ethane, propane and the butanes were lower than those on previous sample days. This is likely due to the fact that sampling was taking place during a more photochemically active time of day than the other samples were. Sampling was done for a total of 19 of 37 days. Each site missed one sample due to equipment issues, leaving a total of 18 samples from each of the Erie sites.

Samples were set up either the day before scheduled sampling, or the morning of the scheduled sampling. This involved going to each site, recording the run data (if necessary), closing and removing the old canister (if necessary), installing the new canister, leak checking the system, and finally, programming the timer for the run. Generally, the samples were picked up the same day their run was completed, or the following day. The completed samples were then shipped to an independent laboratory for analysis. The lab selected was Eastern Research Group (ERG), a national contract lab for EPA for air toxics analyses. ERG also provides canisters and analyses for the other North Front Range ozone precursor sampling being conducted by the APCD.

For the purposes of this study, two subsets of organic compounds were measured: non-methane organic compounds (NMOCs), and methane. The NMOCs are further split into three groups of compounds, speciated non-methane organic compounds (SNMOCs), unknown organic compounds (UKs), and total non-methane organic compounds (TNMOCs). SNMOCs have been implicated as ozone precursors. The TNMOC concentrations are the sum of the UK and SNMOC concentrations. TNMOC concentrations are based on the total carbon content of the samples. The total of the SNMOC concentrations is subtracted from the TNMOC concentration total to get the concentrations of the unknown compounds.

Once received in the lab, the samples were processed and analyzed according to a modified EPA method TO-12, which uses a gas chromatograph to analyze the samples. In brief, a known sample volume was drawn from the canister into a cold trap, then released directly to the gas chromatographic column, where the individual sample constituents were separated out and passed on to the detector. The data were analyzed, and validated by ERG laboratory staff before being transmitted to APCD.

2.0 DATA

The following sub-sections detail the results of the analyses performed on data collected from the Erie sites. Also included are data from the APCDs ongoing North Front Range Ozone Precursor Study. This long-term study began collecting data in December 2011 from two different sites in the Front Range: the CAMP site in downtown Denver (DECO) and the PVCO site in Platteville. Samples were taken from these two sites on an every 3rd day basis during the same time period the Erie study was taking place. Sampling at those two sites is conducted via the same EPA approved methods that were used to collect the Erie samples.

Figure 5 is a map of the Greater Wattenberg Area field. It shows the number of wells per quarter section, via color coding, with areas of red and orange indicating six to ten well pads per quarter section. The Town of Erie is located in the 1N, 69W section of the map (in the lower left corner area). It is along the southwestern edge of the field, in an area where well pad density is one to two well pads per quarter section, on average. Platteville is to the northeast of Erie, and located in an area with a much higher well pad density than Erie, as it is located in the middle of the gas field. Not shown in that map is the area where the DECO site is. The map shows the northernmost portions of the greater Denver-metro area, but the DECO site is located in downtown Denver, outside of the Wattenberg field area.

The natural gas product in the Wattenberg Field is composed primarily of methane, ethane, propane, butane and isobutane, with methane comprising 65% to 90% of the gas product (LT Environmental, Inc., 2007). Generally, sampling done in the Platteville area in the past has indicated those compounds to have the greatest concentrations detected.

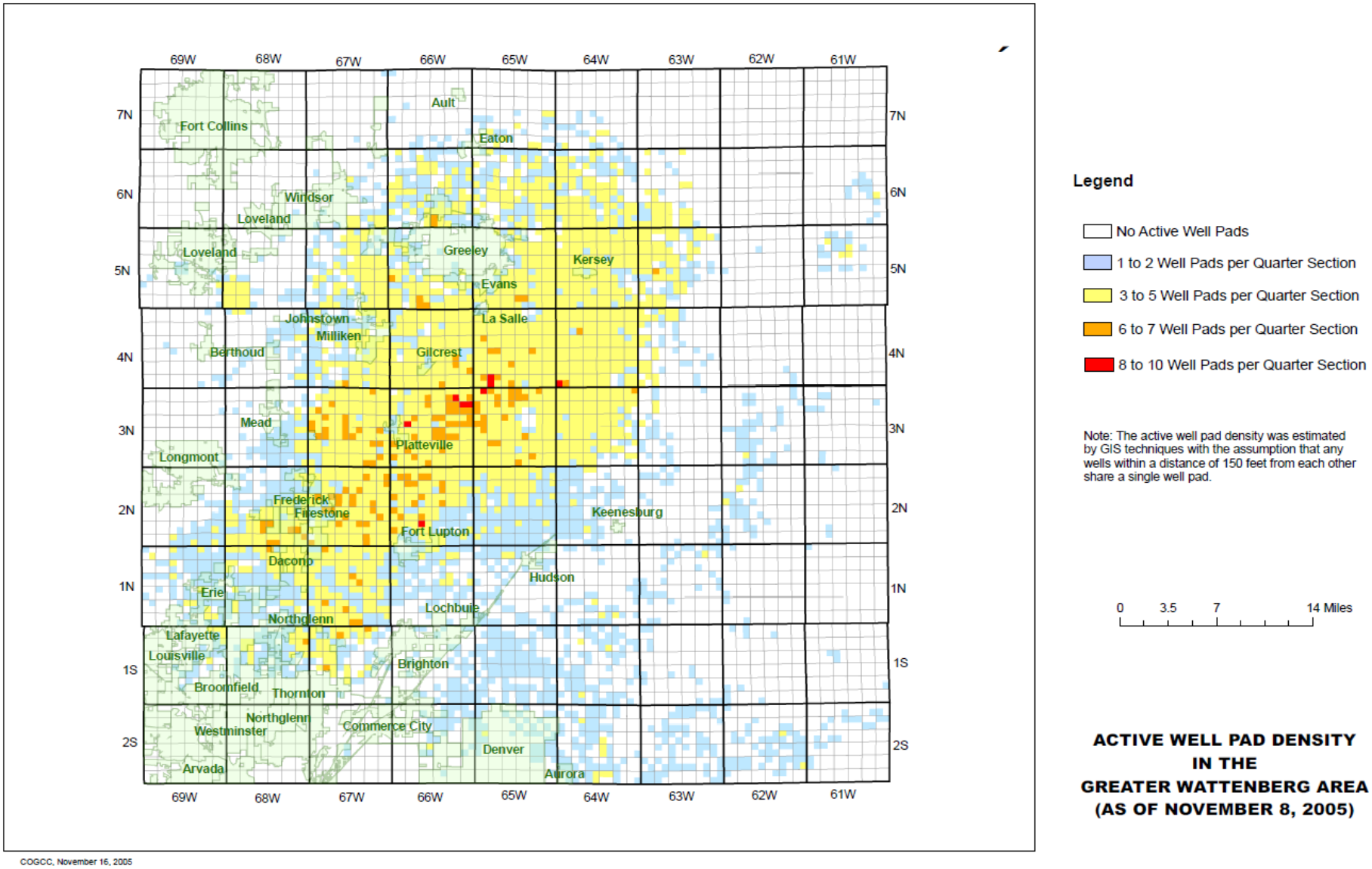


Figure 5. Map of the Greater Wattenberg Area

2.1. Excluded Sample

On Friday, July 20, 2012, the first day of sampling at the Erie sites, the E2CO site recorded significantly large concentrations of NMOCs. The E1CO site did not see the same elevated concentrations. The TNMOC concentrations for E1CO and E2CO were 440 and 5,440 parts per billion carbon (ppbC), respectively. The SNMOC concentrations for E1CO and E2CO were 283 and 1,740 ppbC, respectively; and the unknown concentrations were 157 and 3,700 ppbC, respectively. A look at the both the Erie samples, as well as the DECO and PVCO samples, shows that generally the concentration of unknowns comprises roughly one-third of the TNMOC concentrations. In the 7/20/2012 E2CO sample, however, it accounts for nearly 70% of the TNMOC concentration.

The 7/20/2012 sample had several SNMOC compounds with concentrations that were significantly higher than the three-hour average concentration for the respective compound at all four sites for the study period. Table 1 lists several compounds with 7/20/2012 concentrations in parts per billion by volume (ppbv) that were much larger than the average concentration for those same compounds.

Table 1. Excluded Sample and Average Concentrations for Selected Compounds

Compound	E2CO 7/20/2012 ppbv	E2CO Avg. ppbv	E1CO Avg. ppbv	DECO Avg. ppbv	PVCO Avg. ppbv
1,2,4-Trimethylbenzene	2.900	0.061	0.069	0.127	0.077
1,3,5-Trimethylbenzene	1.311	0.019	0.014	0.040	0.029
1-Dodecene	4.858	0.021	0.036	0.018	0.023
1-Nonene	2.567	0.015	0.011	0.016	0.015
Ethylbenzene	20.875	0.057	0.047	0.116	0.067
Isobutene/1-Butene	7.550	0.431	0.104	0.308	0.398
Isopentane	13.720	2.693	2.604	1.909	17.458
m-Xylene/p-Xylene	49.875	0.214	0.161	0.331	0.446
n-Decane	25.800	0.063	0.035	0.062	0.051
n-Dodecane	19.750	0.084	0.029	0.023	0.021
o-Xylene	16.500	0.077	0.059	0.141	0.094
Toluene	14.071	0.727	5.489	0.806	0.884

The compounds listed above are not indicative of fugitive emissions from the well pad. If that were the case, there would be extraordinarily large concentrations of the smaller alkane compounds like methane, ethane, propane and butane. This is not the case with this sample. The methane concentrations recorded at the E2CO site on that day were similar to those recorded at the E1CO site, with values of 1.21 and 1.65 ppmv, respectively. This was the lowest methane concentration recorded during sampling at both Erie sites. In addition, this was the case for ethane, propane and the butane compounds. Their concentrations on 7/20/2012 were all much lower than their respective averages, and were the lowest values recorded during the 06:00 a.m. to 09:00 a.m. MST sampling times.

It is unclear what was the source of the elevated concentrations on 7/20/2012. The chemicals in Table 1 are more indicative of emissions from vehicular exhaust or some type of paint type solvent, rather than fugitive gas emissions. A review of meteorological data from the nearest weather station, the National Oceanic and Atmospheric Administration (NOAA) Boulder Atmospheric Observatory (BAO) tower (located three miles due east of the Erie sampling sites), shows that for the 06:00 a.m. to 09:00 a.m. time frame on 7/20/2012 winds were blowing generally from a northeasterly direction, which is generally not blowing from the well pad and tanks for the E2CO site. Wind speeds were light, ranging from zero to five miles per hour, with an average speed of 2.6 miles per hour. Figure 6 and Figure 7 show the wind directions and speeds for the 06:00 a.m. to 09:00 a.m. MST time period on 7/20/2012.

There are several possible sources for emissions generally upwind from the E2CO site that are all less than one-third of a mile away. These include a cabinet making business, two automotive repair businesses, a large self-storage business with many RVs and boats stored out back, and a lumber yard. Any of these places could have been performing activities that would have caused the high concentrations. As such, this sample was discarded from the NMOC averages, but still mentioned in the report as a comparative tool. The methane concentration was not removed from that average, however, as it does not appear that it was significantly affected by the unknown fugitive emissions source.

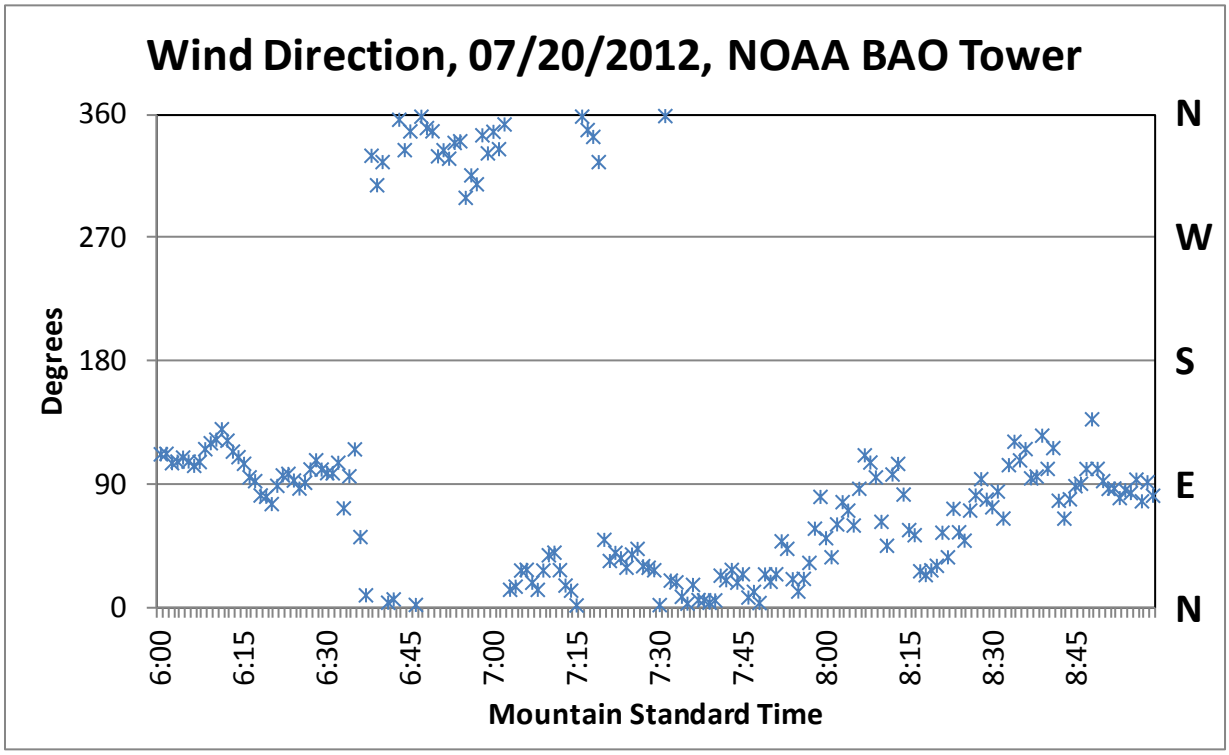


Figure 6. Observed 10-m Wind Direction at BAO on 7/20/2012

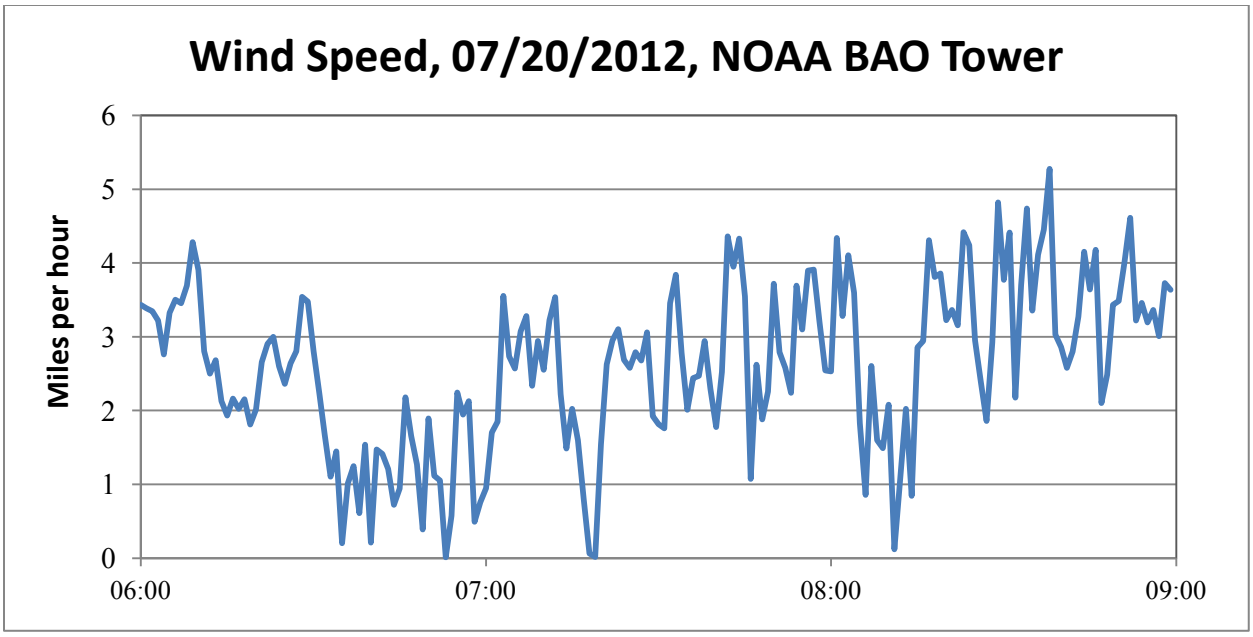


Figure 7. Observed 10-m Wind Speeds at BAO on 7/20/2012

2.2. Methane

The information in Section 2.2 regarding methane concentrations has been removed due to errors in calculating the data at the analysis laboratory. Corrected data and graphs can be seen in the addendum at the end of this document.

~~Table 2 lists the average methane concentrations in parts per million by volume (ppmv) detected at the Erie sites from July 20 through August 25, 2012. Also listed are the average concentrations for the DECO and PVCO sites. As previously stated, the PVCO and DECO sites have been in operation since December 2011. However, methane analyses did not begin until February 2012. The methane averages shown here for the PVCO and DECO sites are for the period from July 20, 2012 through August 28, 2012.~~

~~**Table 2. Average Methane Concentrations**~~

~~*Maximum, Minimum and Average Methane Concentrations*~~					
~~**Site**~~	~~**Maximum ppmv**~~	~~**Minimum ppmv**~~	~~**Average ppmv**~~	~~**Std. Deviation ppmv**~~	~~**Number of Samples**~~
~~E1CO~~	~~2.13~~	~~1.48~~	~~1.73~~	~~0.19~~	~~18~~
~~E2CO~~	~~2.22~~	~~1.21~~	~~1.80~~	~~0.23~~	~~18~~
~~DECO~~	~~1.51~~	~~1.11~~	~~1.26~~	~~0.10~~	~~14~~
~~PVCO~~	~~2.81~~	~~1.15~~	~~2.07~~	~~0.39~~	~~14~~

~~The average concentrations recorded at the Erie sites are in line with the concentrations seen at the DECO and PVCO sites. As was expected, the methane concentrations at the PVCO site are slightly higher than those detected at the DECO and Erie sites due to its location in the middle of the Wattenberg field, and lower at the DECO site as it is not located in the Wattenberg field area. The averages obtained in Erie fall in line with measurements obtained in a study performed by~~

NOAA in 2008 in the Denver-Julesburg Basin. That study detected methane concentrations to be in the range of 1.800 ppm to 1.840 ppm (Petron, et al., 2012).

The NOAA study gathered methane data while driving a zero emissions vehicle on a predetermined route through the Boulder, Lafayette, Erie and Longmont areas. Several of the flask based methane samples taken during that study were at a location approximately one-half mile north of the E1CO and E2CO sites. Those samples (PFP9-11) indicated methane concentrations of just over 1.820 ppm at that location, which corresponds with the methane data from their continuous analyzer at the same point (Petron, et al., 2012). In other locations along that route, methane concentrations approached values of 3.00 ppm when near methane emissions sources (Petron, et al., 2012).

Figure 8 is a chart of the methane concentrations obtained from both Erie sites on each sample day. The samples correlate well, with a maximum standard deviation of 0.31 ppmv between samples taken on the same day, and a minimum of 0.01 ppmv. It would appear that the methane concentrations recorded during the Erie sampling are typical concentrations, and were not significantly affected by the operations taking place on the well pad.

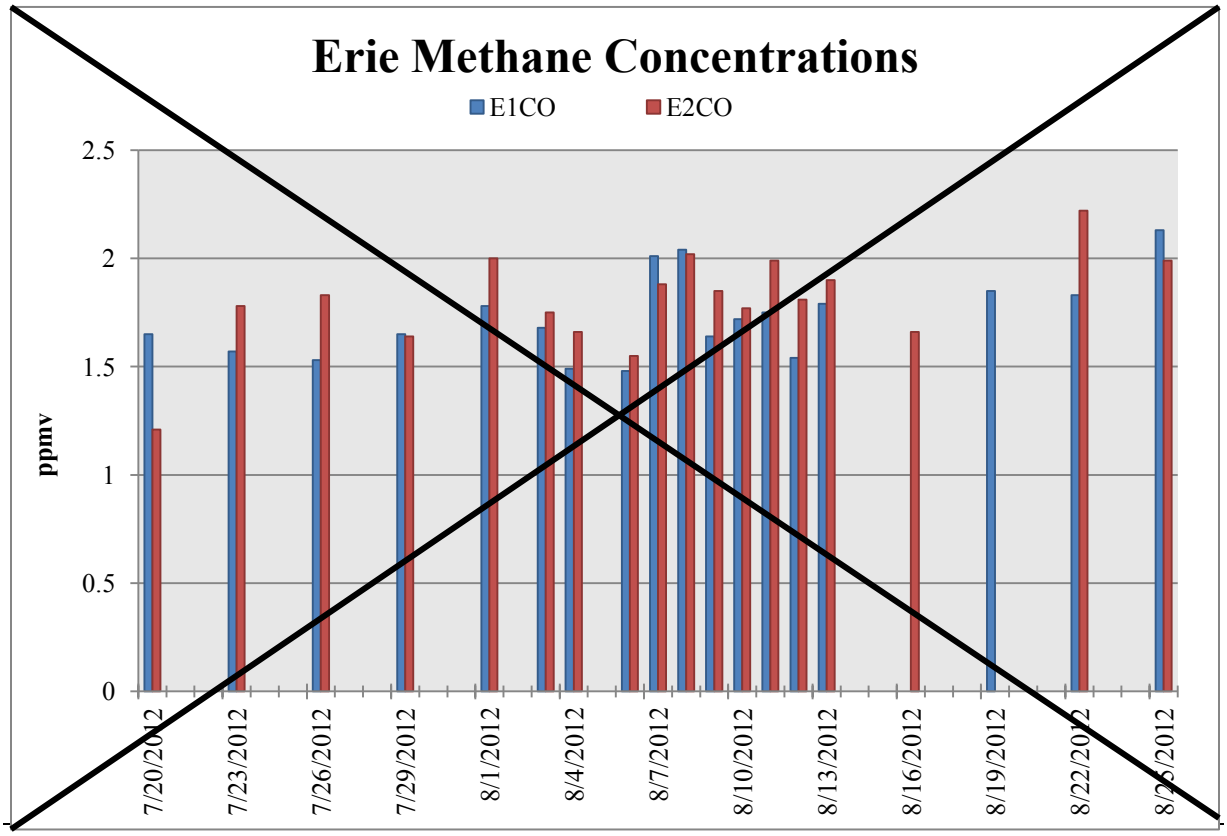


Figure 8. Erie Methane Concentrations by Sample Date

2.3. NMOCs

EPA modified method TO-12 calls for the analysis of 78 different speciated non-methane organic compounds. In addition to those 78 compounds, the total concentration of NMOCs is

obtained. The concentration of each SNMOC compound is then summed, and subtracted from the TNMOC concentration to provide a concentration value for "unknown" compounds. These "unknowns" are compounds that are generally difficult to analyze for, are not considered important as ozone precursors, or are not expected to be found in significant amounts. SNMOCs are reported by ERG as ppbC and are then converted to ppbv. Table 3 is a listing of the speciated NMOCs analyzed for in this study, and their respective Chemical Abstract System (CAS) numbers.

The following sections include SNMOC data from Erie sites as well as the DECO and PVCO sites for July 20, 2012 through August 28, 2012.

Table 3. SNMOC Target Compounds

Compound	CAS	Compound	CAS	Compound	CAS
1,2,3-Trimethylbenzene	526-73-8	2-Methylpentane	107-83-5	Methylcyclopentane	96-37-7
1,2,4-Trimethylbenzene	95-63-6	3-Methyl-1-butene	563-45-1	m-Ethyltoluene	620-14-4
1,3,5-Trimethylbenzene	108-67-8	3-Methylheptane	589-81-1	m-Xylene/p-Xylene	108-38-3/106-42-3
1,3-Butadiene	106-99-0	3-Methylhexane	589-34-4	n-Butane	106-97-8
1-Decene	872-05-9	3-Methylpentane	96-14-0	n-Decane	124-18-5
1-Dodecene	112-41-4	4-Methyl-1-pentene	691-37-2	n-Dodecane	112-40-3
1-Heptene	592-76-7	Acetylene	74-86-2	n-Heptane	142-82-5
1-Hexene	592-41-6	a-Pinene	80-56-8	n-Hexane	110-54-3
1-Nonene	124-11-8	Benzene	71-43-2	n-Nonane	111-84-2
1-Octene	111-66-0	b-Pinene	127-91-3	n-Octane	111-65-9
1-Pentene	109-67-1	cis-2-Butene	590-18-1	n-Pentane	109-66-0
1-Tridecene	2437-56-1	cis-2-Hexene	7688-21-3	n-Propylbenzene	103-65-1
1-Undecene	821-95-4	cis-2-Pentene	627-20-3	n-Tridecane	629-50-5
2,2,3-Trimethylpentane	564-02-3	Cyclohexane	110-82-7	n-Undecane	1120-21-4
2,2,4-Trimethylpentane	540-84-1	Cyclopentane	287-92-3	o-Ethyltoluene	611-14-3
2,2-Dimethylbutane	75-83-2	Cyclopentene	142-29-0	o-Xylene	95-47-6
2,3,4-Trimethylpentane	565-75-3	Ethane	74-84-0	p-Diethylbenzene	105-05-5
2,3-Dimethylbutane	79-29-8	Ethylbenzene	100-41-4	p-Ethyltoluene	622-96-8
2,3-Dimethylpentane	565-59-3	Ethylene	74-85-1	Propane	74-98-6
2,4-Dimethylpentane	108-08-7	Isobutane	75-28-5	Propylene	115-07-1
2-Ethyl-1-butene	760-21-4	Isobutene/1-Butene	115-11-7/106-98-9	Propyne	74-99-7
2-Methyl-1-butene	563-46-2	Isopentane	78-78-4	Styrene	100-42-5
2-Methyl-1-pentene	763-29-1	Isoprene	78-79-5	Toluene	108-88-3
2-Methyl-2-butene	513-35-9	Isopropylbenzene	98-82-8	trans-2-Butene	624-64-6
2-Methylheptane	592-27-8	m-Diethylbenzene	141-93-5	trans-2-Hexene	4050-45-7
2-Methylhexane	591-76-4	Methylcyclohexane	108-87-2	trans-2-Pentene	646-04-8

2.3.1. SNMOCs

Of the 78 speciated compounds analyzed for in this study, a total of 15 were either not detected at all, or only detected one time at either Erie site. These compounds are listed in Table 4, but were disregarded in the rest of the data analysis, as their concentration (obtained by replacing the "non-detect" label with a value that is equal to ½ the MDL for the compound) values provided little information for the purposes of this report.

Table 4. Undetected Compounds

Not Detected	
E1CO	**E2CO**
1-decene	1-decene
1-tridecene	1-tridecene
2-ethyl-1-butene	1-undecene
2-methyl-1-pentene	2-ethyl-1-butene
3-methyl-1-butene	2-methyl-1-pentene
4-methyl-1-pentene	3-methyl-1-butene
β-pinene	4-methyl-1-pentene
cyclopentene	β-pinene
propyne	cis-2-hexene
trans-2-hexene	cyclopentene
-	propyne
-	styrene
-	trans-2-hexene
Detected 1 time	
E1CO	**E2CO**
1-undecene	isopropylbenzene
cis-2-hexene	p-diethylbenzene
isopropylbenzene	-
p-diethylbenzene	-
styrene	-

Conversely, there were 42 of the 78 compounds that were detected in greater than 75% of the samples at both Erie sites. For the purposes of this analysis, those 42 compounds were then compared to a similar list for each of the PVCO and DECO sites. Each of those sites had 38 and 49 compounds detected in greater than 75% of their samples, respectively. Upon inspection, a total of 36 compounds were detected at all three sites in 75% or more of the data set. Figure 9 through Figure 12 show the averages for those 36 compounds graphically, and their actual values are listed in Table 5. Both the graphs and the table are grouped in order from highest average concentration to lowest average concentration, based on the PVCO site.

Table 5. Average SNMOC Concentrations

COMPOUND	E1CO ppbv	E2CO ppbv	DECO ppbv	PVCO ppbv
Ethane	24.656	21.908	10.078	104.439
Propane	14.853	13.848	6.154	90.690
n-Butane	6.844	6.437	2.805	45.057
Isobutane	2.900	2.665	1.077	18.521
n-Pentane	2.924	2.774	2.112	16.453
n-Hexane	1.084	1.005	0.893	4.617
2-Methylpentane	0.916	0.905	0.694	3.952
Ethylene	1.490	1.448	3.021	2.168
3-Methylpentane	0.494	0.477	0.466	2.098
Methylcyclopentane	0.476	0.454	0.439	1.774
Cyclohexane	0.377	0.364	0.232	1.505
Methylcyclohexane	0.376	0.394	0.160	1.263
n-Heptane	0.287	0.298	0.186	1.101
Cyclopentane	0.208	0.199	0.183	0.957
Toluene	5.489	0.727	0.806	0.884
2-Methylhexane	0.258	0.287	0.270	0.807
Acetylene	0.484	0.504	1.042	0.591
Propylene	0.371	0.311	0.733	0.535
m-Xylene/p-Xylene	0.161	0.214	0.331	0.446
n-Octane	0.115	0.134	0.084	0.341
1-Heptene	0.088	0.083	0.025	0.262
2,3-Dimethylpentane	0.085	0.089	0.135	0.244
2,2-Dimethylbutane	0.072	0.067	0.093	0.239
2,4-Dimethylpentane	0.063	0.061	0.079	0.207
2-Methylheptane	0.052	0.062	0.056	0.196
3-Methylheptane	0.044	0.050	0.053	0.134
1,3-Butadiene	0.070	0.078	0.156	0.101
n-Nonane	0.038	0.046	0.049	0.094
o-Xylene	0.059	0.077	0.141	0.094
1-Pentene	0.059	0.065	0.124	0.079
1,2,4-Trimethylbenzene	0.069	0.061	0.127	0.077
Ethylbenzene	0.047	0.057	0.116	0.067
n-Decane	0.035	0.063	0.062	0.051
trans-2-Pentene	0.035	0.036	0.077	0.051
n-Undecane	0.023	0.026	0.031	0.027
n-Dodecane	0.029	0.084	0.023	0.021

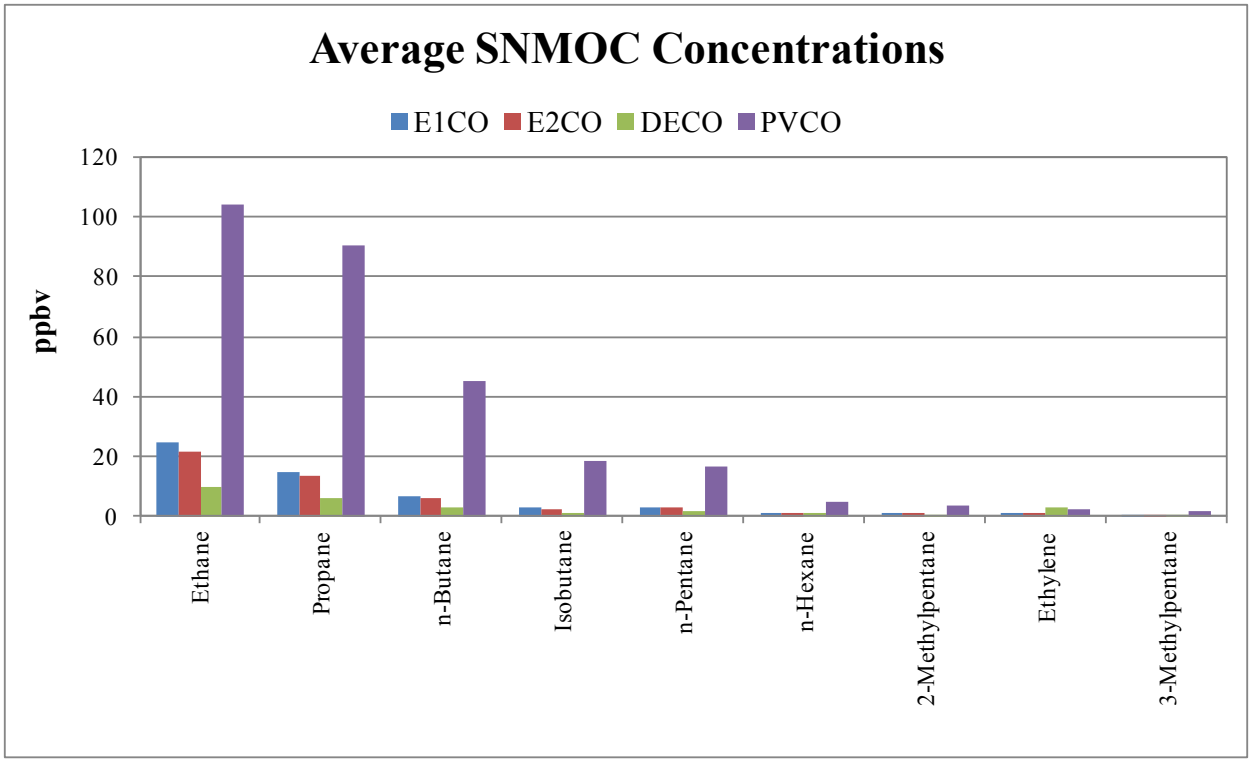


Figure 9. Average SNMOC Concentrations

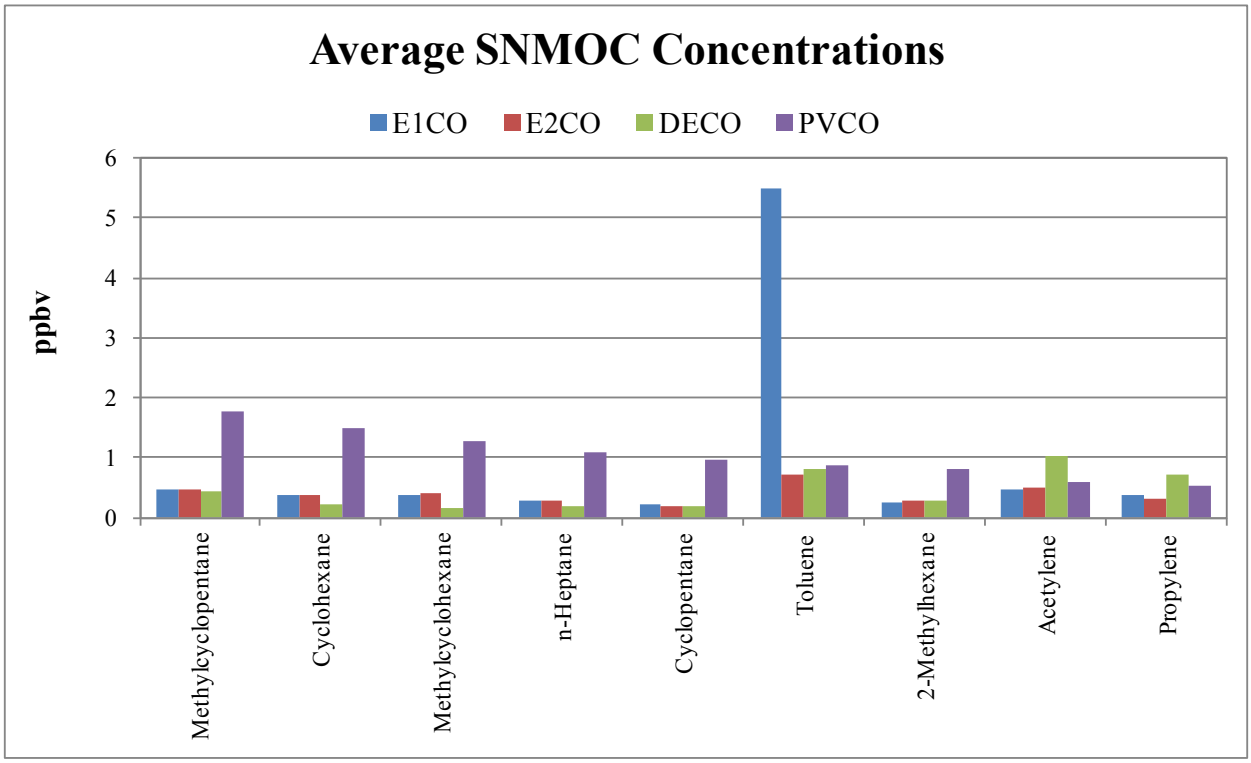


Figure 10. Average SNMOC Concentrations

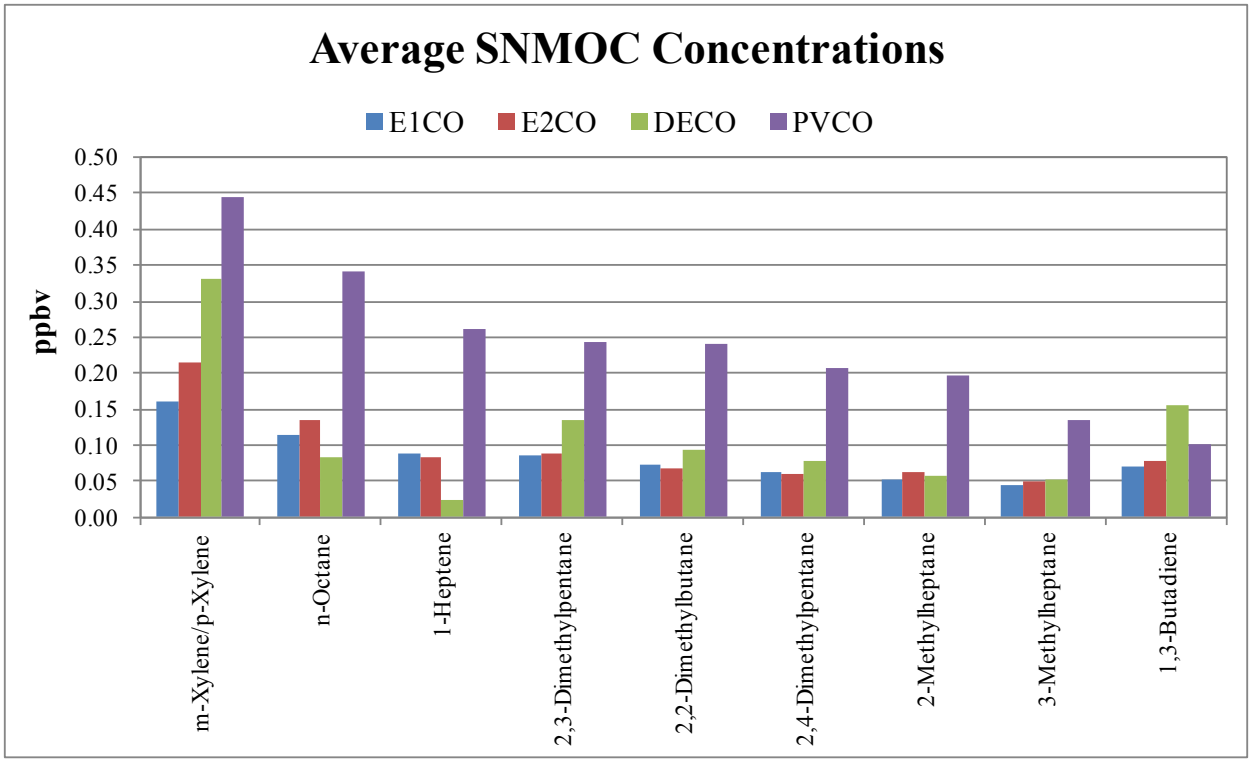


Figure 11. Average SNMOC Concentrations

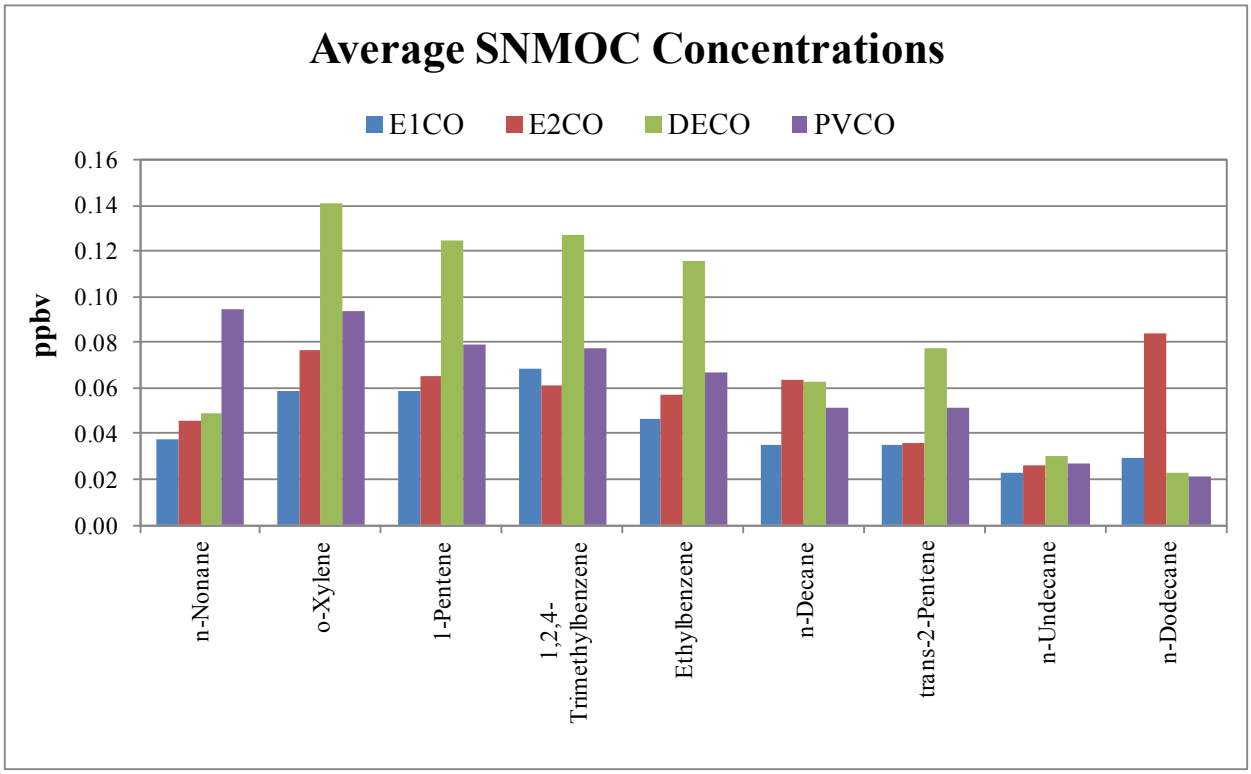


Figure 12. Average SNMOC Concentrations

As was expected, ethane, propane, isobutane, and n-butane all had the highest concentrations among the compounds analyzed, with the Platteville PVCO site recording much higher values for those four compounds than any other site. At the Erie sites, the average concentrations of 17 of the compounds fell between those of the DECO and PVCO sites, with DECO being lower and PVCO higher. This equates to 47% of the compounds. Of the 19 remaining compounds, the DECO site had the highest averages for 11 of them, PVCO for five, E2CO for two, and E1CO for one.

At E2CO the highest average concentrations were seen for n-decane, and n-dodecane. These compounds are typically found together as kerosene. Figure 13 and Figure 14 show the n-decane and n-dodecane concentrations for both sites throughout the sampling period. Concentrations for both compounds appear to have followed the same trend, with the exception of the 7/23/2012 sample.

Figure 15 focuses on n-decane and n-dodecane from the E2CO site only. Increased concentrations of n-decane can be seen on 8/8/2012 and 8/11/2012, but not for n-dodecane. An inspection of the available meteorological data from the BAO tower for 8/8/2012 and 8/11/2012 does not indicate many apparent correlations between the data and wind direction, speed, or humidity values that might account for this difference.

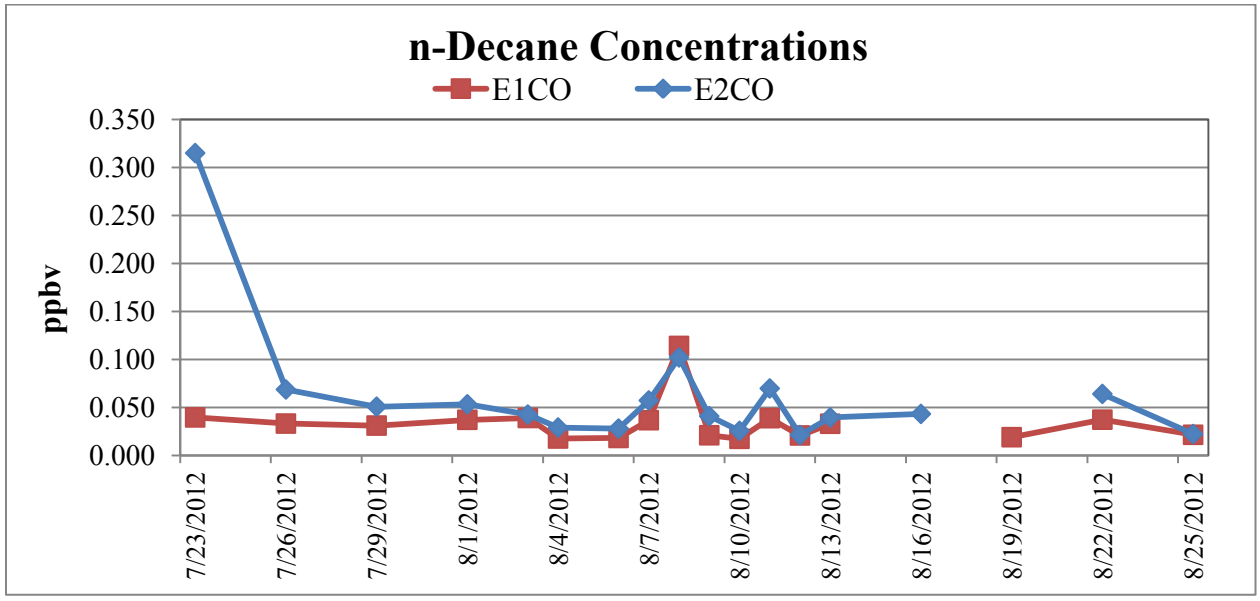


Figure 13. n-Decane Concentrations in Erie

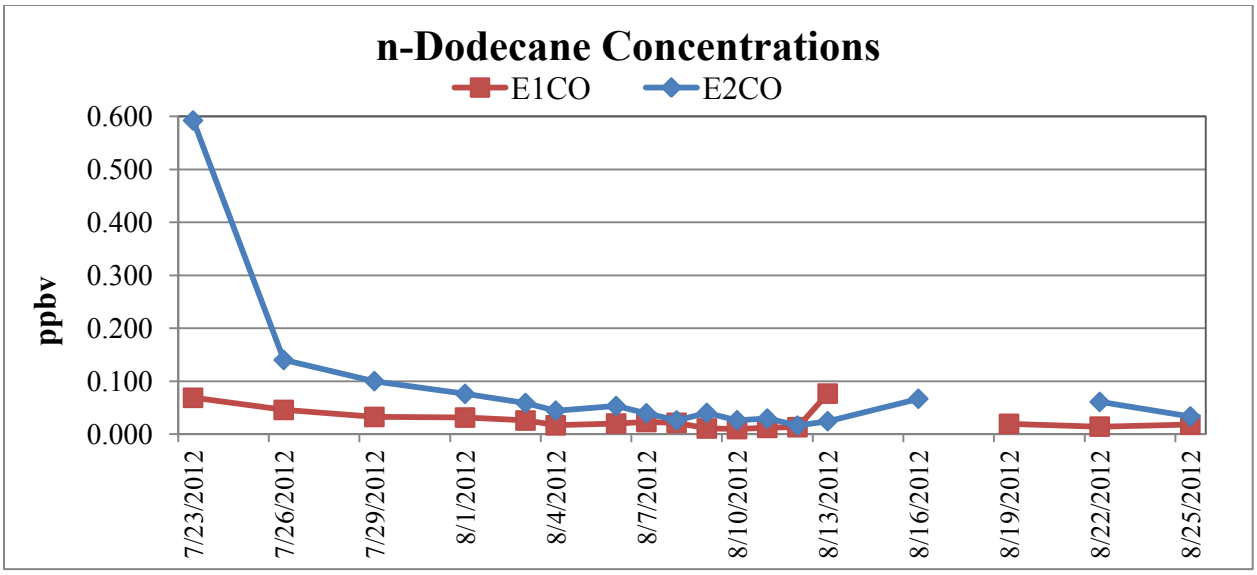


Figure 14. n-Dodecane Concentrations in Erie

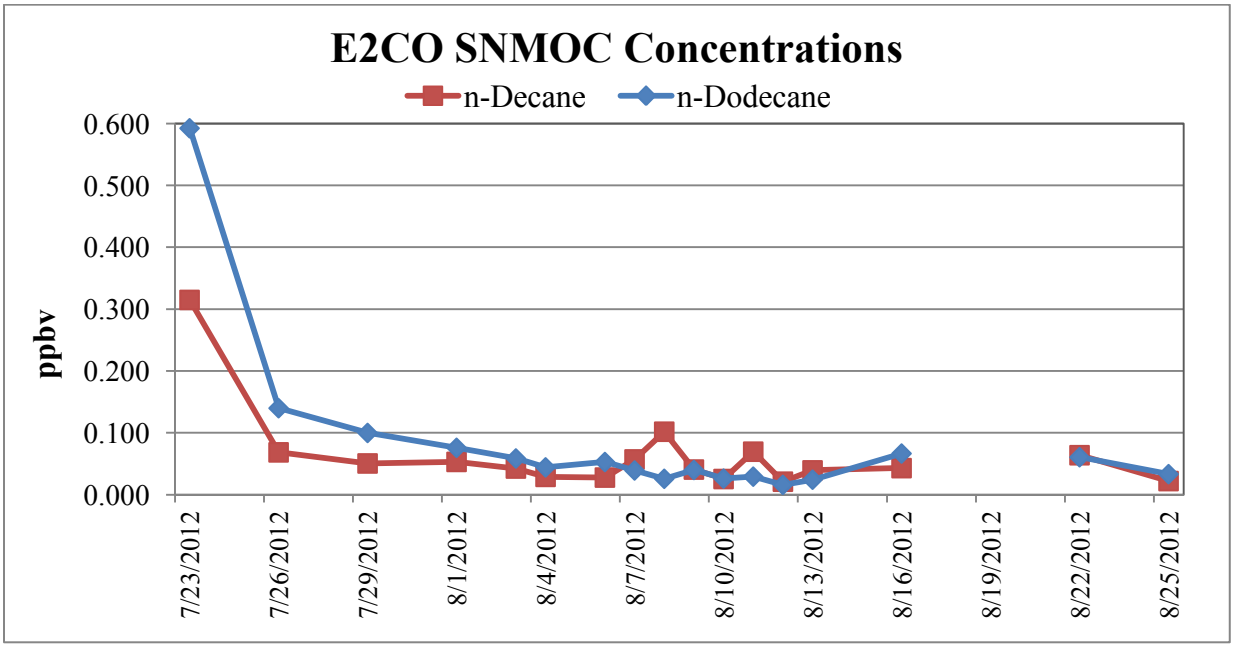


Figure 15. E2CO n-Decane and n-Dodecane Concentration Comparison

As reflected in Figure 16, for the first two hours of the sampling period the wind was generally out of a northwesterly direction. For the last hour, however, the wind shifted more to a northeasterly direction. The 7/20/2012 sample that was excluded for high concentrations was taken while the wind was blowing from the northeasterly direction during the most of the course of that sample, and as such, the concentrations observed were much larger. Throughout the course of the Erie sampling, the wind generally blew from a northwesterly direction, based on data from the BAO tower (see Figure 19). The concentration spike seen in the 7/23/2012 sample

was not as large as that seen in the 7/20/2012 sample, but it stands to reason that the source of the compounds is likely in a more easterly direction from the E2CO site. It is also possible that the higher concentrations seen on 7/23/2012 in the E2CO sample are from a residual contamination in the inlet from the 7/20/2012 excluded sample as no flushing of sample lines took place between samples. That being said, there are just not enough data in this set to draw a definitive conclusion, and the meteorology data are not from the same location.

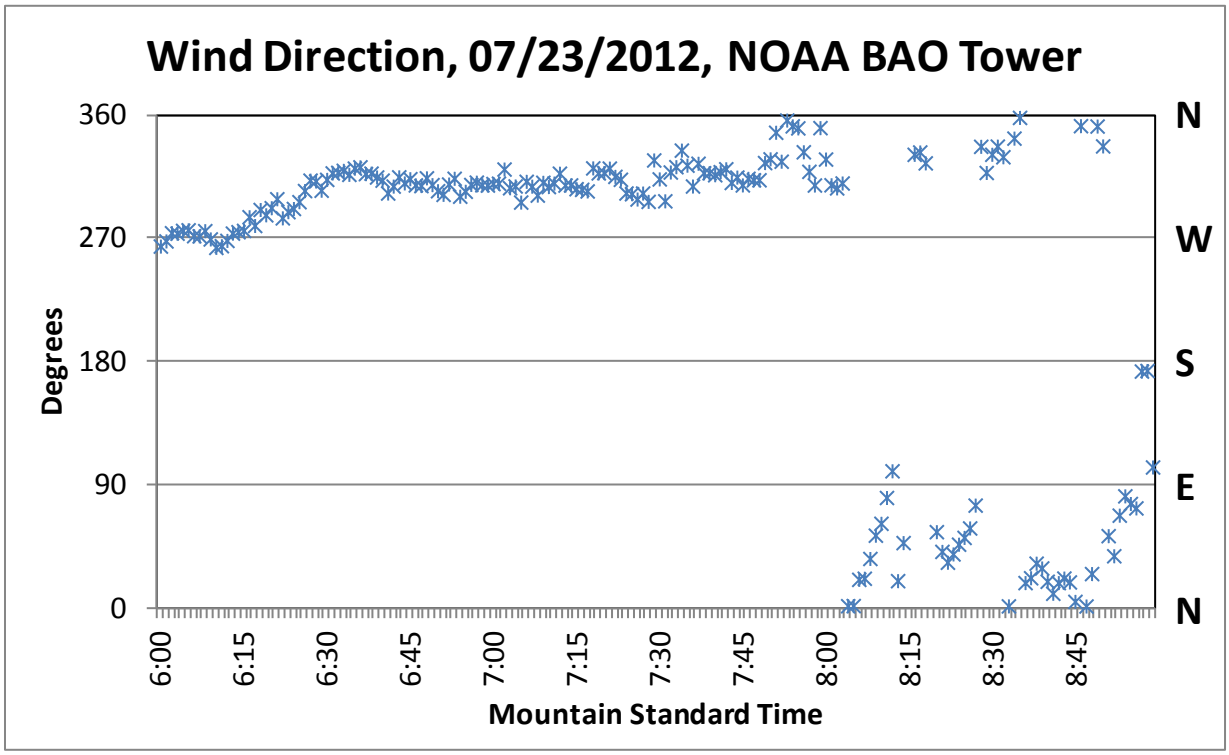


Figure 16. Wind Direction from 06:00 to 09:00 MST on 7/23/2012

E1CO had the highest average concentration for toluene. This is quite likely due to the fact that this sampler was placed in between the entrance and exit roads to the well pad. It has been well established that toluene is a by-product of diesel engine exhaust. There were a large number of trucks entering and leaving the well site in the early part of the sampling. During this time, a large volume of truck traffic was bringing in the various pieces of equipment needed for the drilling and completing activities: water tanks, large crane and drilling rig pieces, heavy equipment, etc.

As the sampling progressed, the truck traffic dropped off significantly. This is reflected in Figure 17. At E1CO, the toluene concentrations dropped off from near 12 ppbv at the beginning of sampling, to about half of that value, or less, by the end of the sampling. This corresponds with the decreasing amount of truck traffic seen at the well site, as visually observed during visits to each sampling site. The toluene concentrations at the E2CO site were much less variable, and more indicative of typical concentrations for the area. This site was located in an area that did not receive any vehicular traffic on any type of regular basis, and as such was not exposed to any of the tailpipe emissions that the E1CO site was.

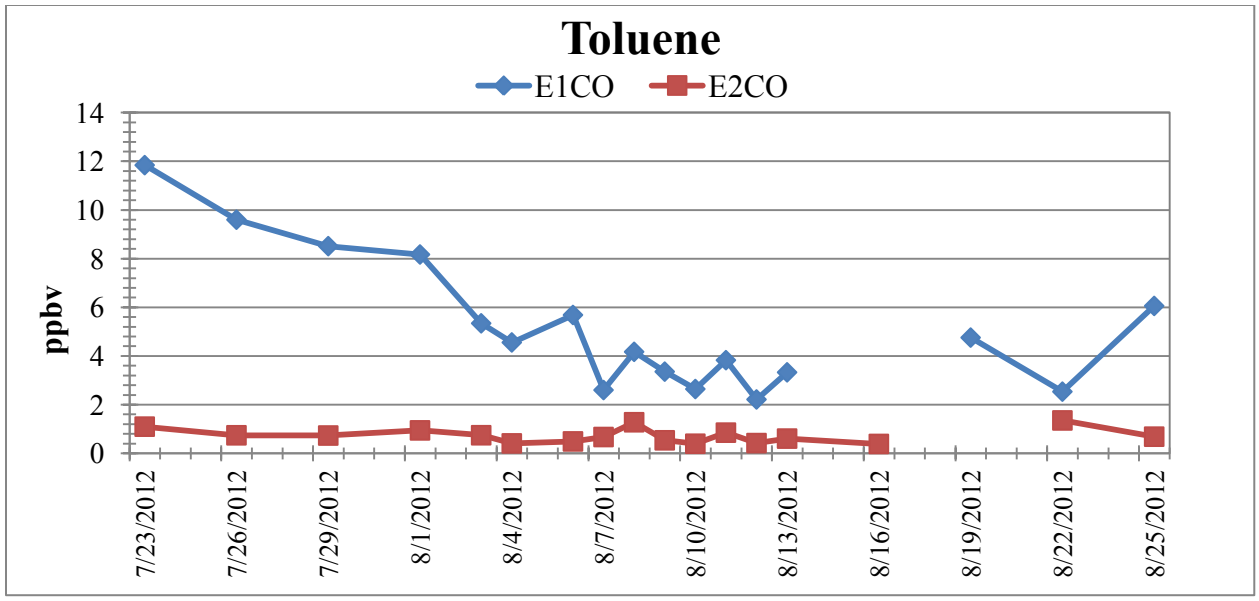


Figure 17. Toluene Concentrations in Erie

In a NOAA study done in 2008 around the Erie area, propane concentrations in the 0 to 80 ppb range (with an average of approximately 10 ppb) and n-butane concentrations in the 0 to 40 ppb range (approximate average of 5ppb) were observed (Petron, et al., 2012). The values recorded during this APCD study ranged between 2 ppb and 33 ppb at the E1CO site for propane, with an average of 15 ppb, and 2 ppb and 32 ppb at E2CO, with an average of 14 ppb. At E1CO, the values for n-butane ranged from 1 ppb to 16 ppb, with an average of 7 ppb. At E2CO the values for n-butane ranged from 1 ppb to 16 ppb, with an average concentration of 6 ppb for the study. The concentrations obtained in Erie are very similar to those recorded in NOAA's 2008 study.

Figure 18 shows the sum of the SNMOC concentrations on each sample date for each of the Erie sites. For eleven of the sixteen sample days with data from both Erie sites, E1CO had higher speciated total concentrations than the E2CO site, likely due to the truck traffic by E1CO. The overall average totals for each site are 250 ppbC for E1CO and 207 ppbC for E2CO. Those same averages for the DECO and PVCO sites during the same time period are 138 ppbC and 1,067 ppbC, respectively. It appears that the SNMOC concentrations observed at the Erie sites are typical concentrations for the area as they fall in between those observed at the DECO and PVCO sites. Again, it is expected that PVCO will generally have the highest NMOC concentrations as it sits in the middle of the Wattenberg field, while Erie sits on the southwestern edge.

Figure 19 shows a wind rose for the sample periods from 7/20/2012 to 8/25/2012, based on data from the NOAA BAO tower located three miles to the east of the well site. It can be seen that the average wind direction during the specified sample times and days was from the north to northwest. The strongest winds were from the north to north-northeast, and the lightest winds were from the northwest to north-northwest. While these meteorological data are not from the actual well pad location, they do provide an idea of wind patterns for the area.

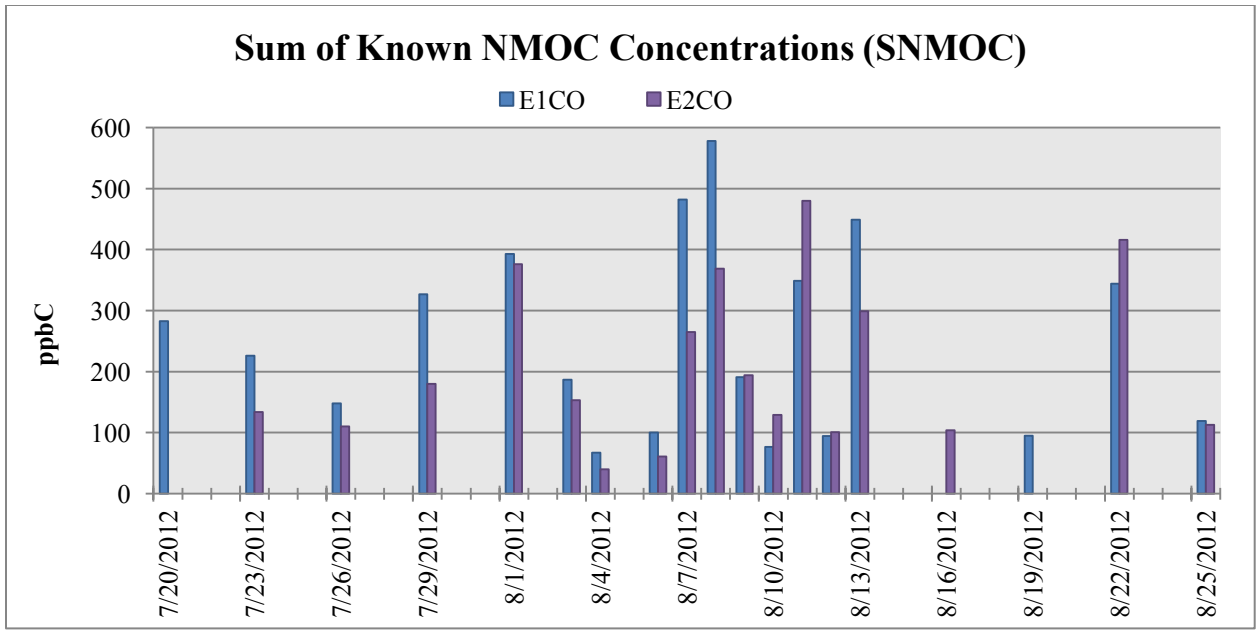


Figure 18. SNMOC Totals at E1CO and E2CO

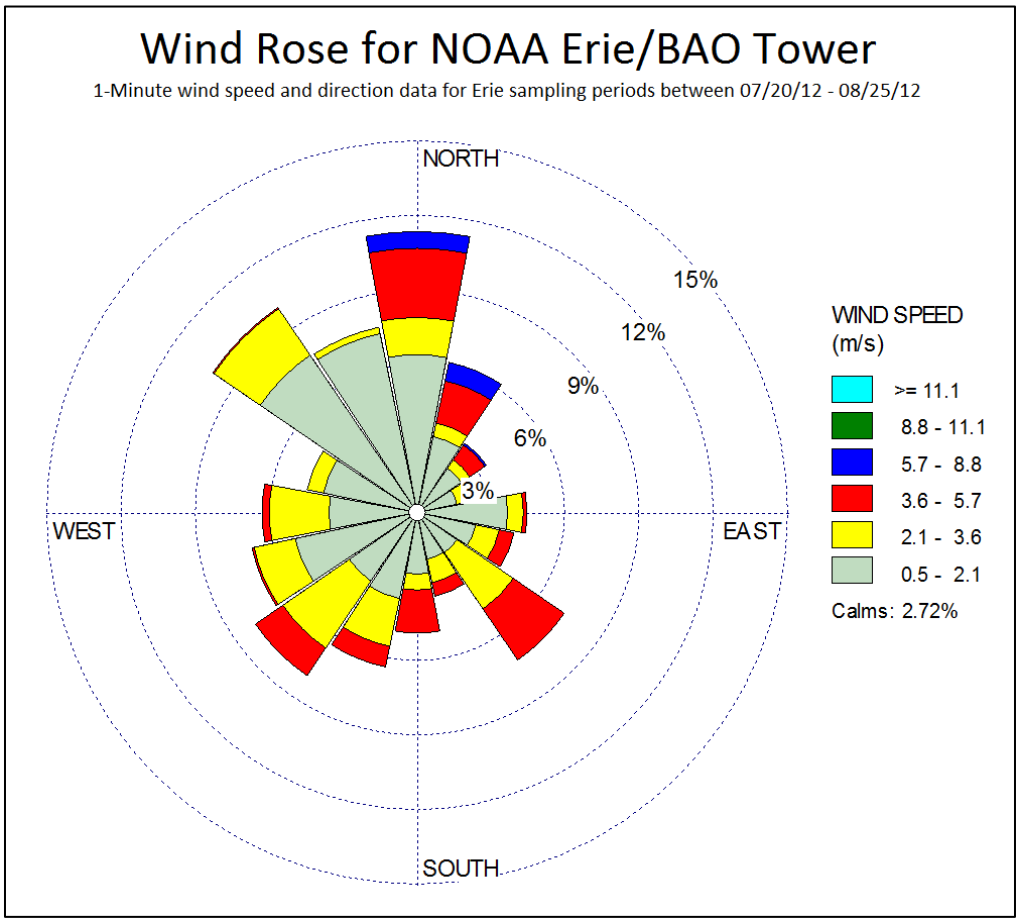


Figure 19. Wind Rose for Erie

2.3.2. Unknowns

Figure 20 shows the total concentrations of the unknown NMOC compounds. For eleven of the sixteen sample dates with data from both sites, the E2CO site had higher unknown concentrations. It appears that both sites had similar concentrations on most days. The overall average unknown concentrations at E1CO and E2CO were 97 ppbC and 117 ppbC, respectively. At the DECO and PVCO sites, those same averages are 82 and 123 ppbC, respectively. Thus, it appears that the unknown concentrations recorded in Erie are similar to those observed at the DECO and PVCO sites, indicating that they are likely typical concentrations for the area.

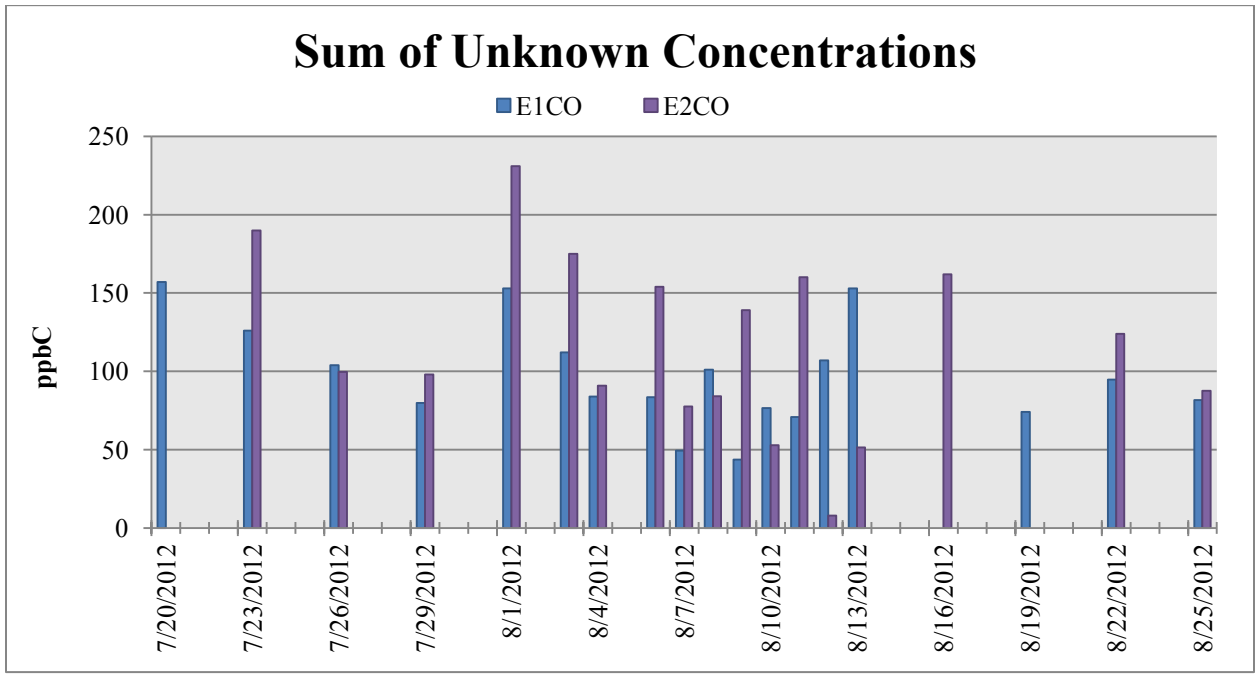


Figure 20. Sum of Unknown NMOC Concentrations in Erie

2.3.3. TNMOCs

Figure 21 is a chart of the TNMOC concentrations for each sample date at the Erie sites. The sites generally recorded concentrations that were similar, and trended together rather well. On nine of the sixteen sample dates having data from both sites, the E1CO site had higher TNMOC concentrations, while the E2CO site was higher on seven days. There does not appear to be any connection between the concentrations observed and the day of the week, though this data set is too small to accurately assume that.

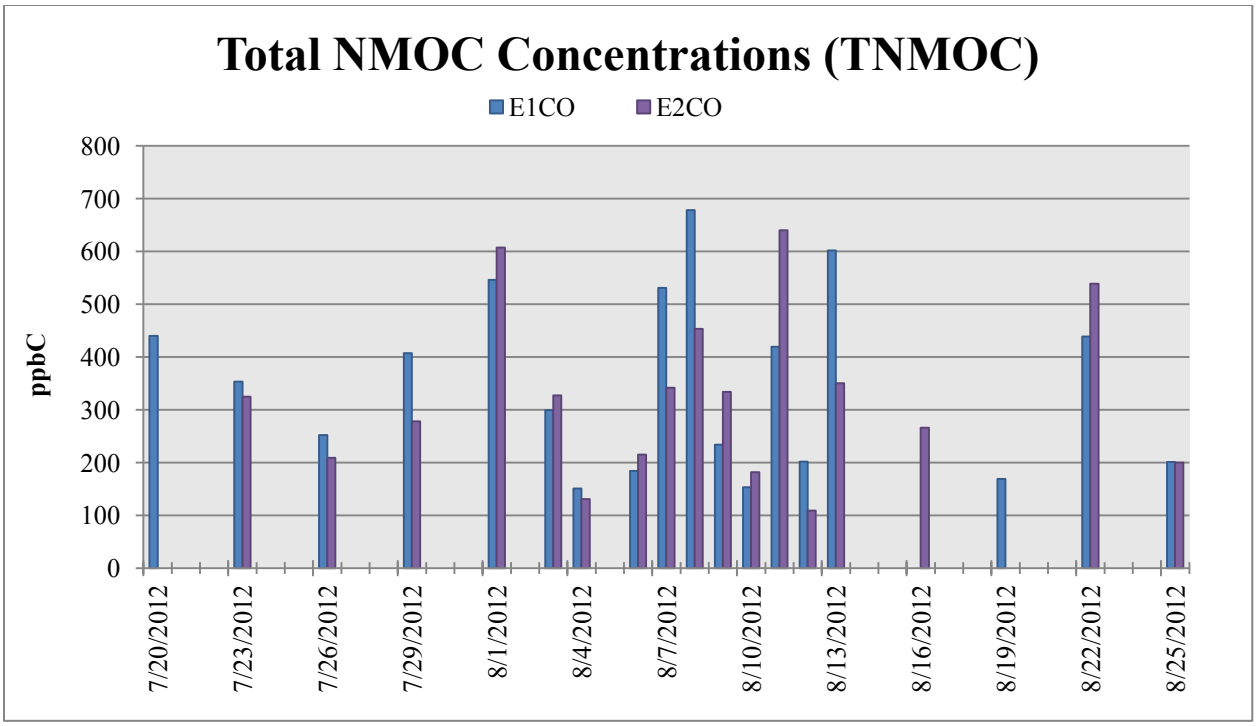


Figure 21. TNMOC Concentrations in Erie

The average TNMOC concentrations at E1CO and E2CO were 348 ppbC and 324 ppbC, respectively. These values indicate rather good agreement between the overall concentrations recorded at the Erie sites. The fact that neither site consistently recorded the highest concentration values appears to indicate that the values recorded were typical concentrations for the Erie area. This statement is also supported by a comparison with the same averages for the DECO and PVCO sites. Those values were 221 ppbC and 1,190 ppbC, respectively.

3.0 SCREENING RISK ESTIMATES

Screening risk assessments provide predictions of hypothetical health risks that are intended as screening tools for risk management. These risk estimates are not predictions of specific health outcomes in specific populations. EPA has developed chronic or acute risk factors for a number of the 78 SNMOCs that were analyzed.

Alkanes, such as methane, ethane and propane, were the highest concentration compounds analyzed in the Erie samples, as well as at the PVCO site. At low concentrations, the toxicity of individual lighter alkanes (methane, ethane, propane) is generally considered to be minimal and is not likely to result in significant health effects. Methane is a greenhouse gas, and thus may have other environmental implications.

It should be noted that the current state of the science is unable to assess the potential toxicity of exposures to complex mixtures of air toxics. It is possible that complex mixtures of chemicals could act synergystically to cause health effects. Also, several chemicals occurred in samples for

which there are no toxicity values. No attempt is being made in this report to address potential risks from all individual chemicals or cumulative risk from multiple chemicals, either from this well development or from other sources.

3.1. Screening Risk Estimates for Benzene

Of the SNMOCs that were analyzed, benzene has some of the greatest concerns for health risk. Benzene is an emission from both oil and gas sources as well as motor vehicles and other urban sources.

Chronic risk is assumed to be from exposures lasting 30 to 70 years. Estimates of cancer risk are expressed as a probability, for example, an additional lifetime risk of contracting cancer of 1 chance in 1,000,000 (or one additional person in 1,000,000). In contrast to cancer risks, noncancer hazards are not expressed as a probability of an individual suffering an adverse effect. The noncancer hazard to individuals is expressed in terms of the hazard quotient (HQ). For a given air toxic, exposures below the reference concentration (HQ<1) are not likely to be associated with an appreciable risk of adverse health effects. With exposures increasingly greater than the reference concentration, the potential for adverse effects increases.

EPA considers a chronic non-cancer hazard quotient of 1 or less to be acceptable and a cancer risk range of 1 in a million to less than 100 in a million to be acceptable. For estimating chronic risk, the use of the average data over the the time period of a study is the most applicable metric, therefore the average concentration of benzene between 7/20/2012 and 8/25/2012 is used in the table below.

Acute risk is for short-term exposures, typically of a few hours to 14 days. EPA considers an acute hazard quotient of 1 or less to be acceptable. In the absence of short-term air monitoring data for estimating acute risk, the use of the maximum data value in the study period is the most applicable metric and is used in the table below.

Table 6 provides a summary of screening risk values for benzene, based on data from the Erie sites as well as the DECO and PVCO sites for the 7/20/2012 to 8/25/2012 time period. Average concentrations include non-detect samples that have been adjusted by using one-half of the minimum detection level, which is a common technique.

Table 6. Screening Risk Summary for Benzene

Site	Average concentration µg/m^3	Maximum concentration µg/m^3	Chronic non-cancer hazard quotient	Chronic cancer risk value	Acute hazard quotient
E1CO	1.117	2.055	0.04	8.7 per million	0.07
E2CO	0.728	1.528	0.02	5.7 per million	0.05
DECO	0.247	1.225	0.01	1.9 per million	0.04
PLCO	0.886	10.809	0.03	6.4 per million	0.37

As can be seen for benzene, the chronic non-cancer and acute hazard quotients are much less than 1, and the estimated lifetime cancer risk value is much less than 100 in a million at all the

sites. As discussed earlier with toluene, it is likely that the slightly higher average concentration for benzene at the E1CO site is due to the truck traffic that was in close proximity to the site.

This screening risk assessment has focused on benzene because it is one of the major risk driving chemicals. As previously noted, the current state of the science cannot assess the potential risk of combinations of different chemicals, and thus the risk screening estimates for benzene alone may undersestimate cumulative risk. Nonetheless, the concentrations of various chemicals in this limited data set are comparatively low and are not likely to raise significant health issues of concern.

4.0 SUMMARY

With the exception of the E2CO sample taken on the first day of sampling, it appears that the samples taken during the course of the Erie study are indicative of typical NMOC ~~and methane~~ concentrations for that area. Many of the concentrations recorded at the Erie sites had values that fell in between those of the DECO and PVCO sites, as was expected. Throughout the course of the sampling, when the wind blew it was from a general northwesterly to northerly direction – in the general direction of the E2CO sampler from the well pad. During the one anomalous sample taken on 7/20/2012 at E2CO, however, the winds were from an easterly direction, and that was the only time significantly large concentrations were recorded.

Generally the E2CO site had unknown concentration values that were larger than the E1CO site. This did not show up in the TNMOC or SNMOC data set from that site though, and the larger unknown concentrations were "washed out" when the SNMOC and unknown concentrations were summed to give the TNMOC concentrations. Roughly half the time the E1CO site had higher TNMOC concentrations, and the other half the E2CO site did, which would support a conclusion that these concentrations are typical for the area.

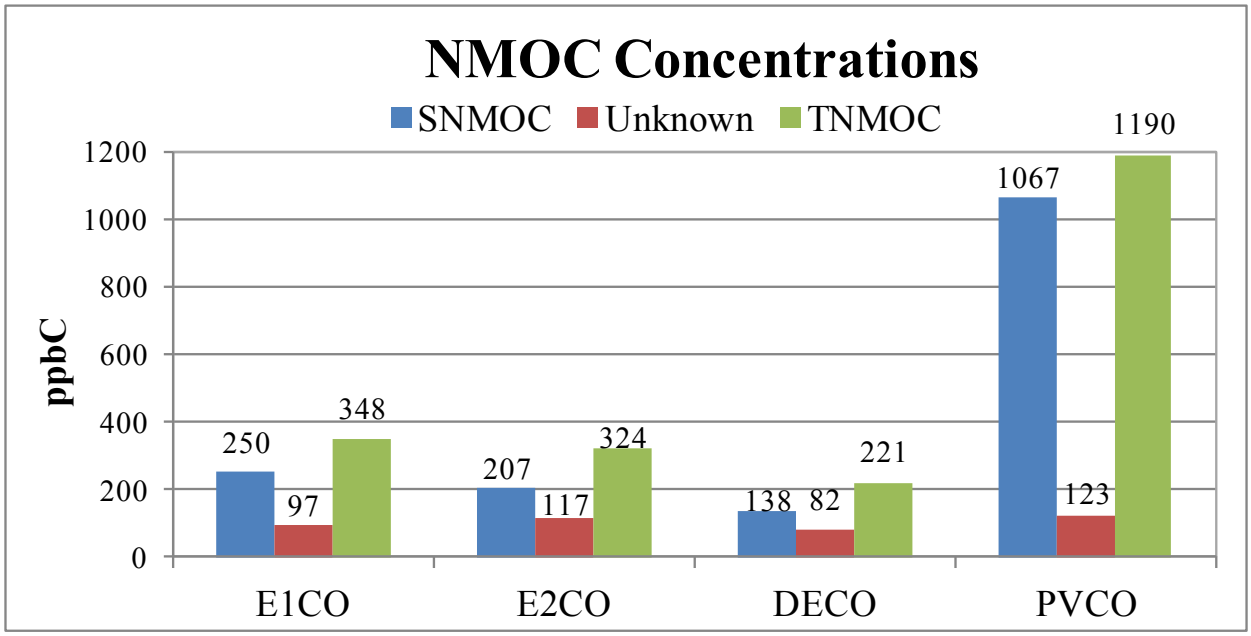


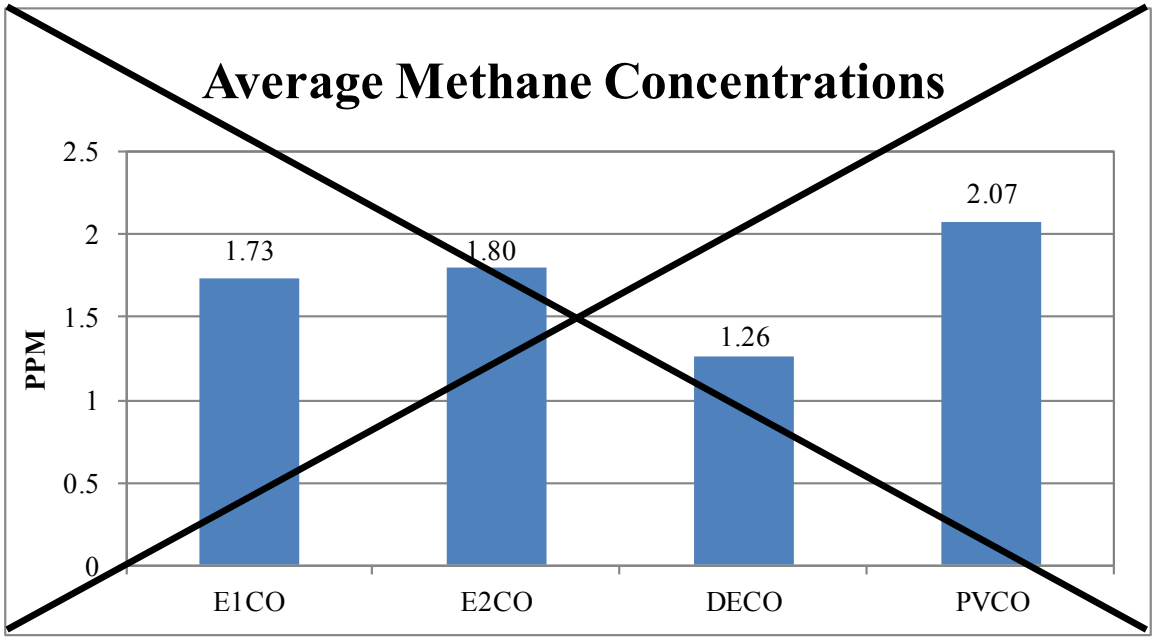
Figure 22. Average NMOC Concentrations in Colorado's Front Range

Figure 22 is a chart that shows the average concentrations for each of the NMOC species at both the Erie sites, as well as the sites in Denver, and Platteville. The Erie sites appear to correlate well, given the small size of the data set. They have unknown concentration values that are very similar to those seen at the DECO and PVCO sites, and have values for SNMOC and TNMOC concentrations that fall in between those of the DECO and PVCO sites.

There appears to be a gradient in NMOC concentrations going from the PVCO site south to the DECO site, which would make sense given the locations of these sites. The PVCO site should have the highest concentrations of all the sites in this report, as it sits in the middle of the Wattenberg field. The DECO site should see the lowest NMOC concentrations, as it sits outside of the Wattenberg field. It stands to reason that the Erie sites should have recorded averages that were somewhat higher than the DECO site, and much lower than the PVCO site due Erie's location on the western edge of the Wattenberg field.

The following information in Section 4.0 regarding methane concentrations has been removed due to errors in calculating the data at the analysis laboratory. Corrected data and graphs can be seen in the addendum at the end of this document.

~~This gradient is also seen in the methane concentrations in Figure 23, though it is more subtle. The concentrations were much closer together, and are indicative of the same typical methane concentrations recorded during other studies in the area.~~



~~Figure 23. Average Methane Concentrations in Colorado's Front Range~~

In all, no significant SNMOC concentrations were recorded that could be directly attributed to well completion operations at this location. The estimated screening lifetime cancer risk values for benzene from both Erie sites as well as the Denver and Platteville sites are well within EPA's acceptable cancer risk range of 1 in a million to 100 in a million. In addition, the estimated acute

and chronic noncancer hazard quotients are well below the benchmark level of one. No attempt is being made in this report to address potential health risks from all individual chemicals as well as cumulative health risk from multiple chemicals from this well development or from other sources. Therefore, the risk screening estimate for benzene alone is likely to underestimate cumulative risks from all chemicals and cannot be used to draw definitive conclusions about the health impacts from all chemicals.

It should be noted that the data included in this report are not intended to provide an accurate inventory of organic compounds in the Erie area. Rather, it is a snapshot in time that gives an indication of what the values may be seen during completion activities. The data set is not nearly large or thorough enough to draw accurate, hard-line conclusions on any of the species monitored, yet does provide an indication of what was going on during the 7/20/2012 to 8/25/2012 time period around the well site. These data may or may not be indicative of conditions at other well sites.

NOTE: All data from this study are available electronically on request.

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APPENDIX A – DATA TABLES

The information in the following data tables regarding methane concentrations has been removed due to errors in calculating the data at the analysis laboratory. Corrected data and graphs can be seen in the addendum at the end of this document.

Raw Methane ppbC Values – E1CO and E2CO (06:00-09:00 MST)

Site	Analyte	Date	Result	MDL	Units
E1CO	Methane	7/20/2012	1.65	0.169	ppmC
E1CO	Methane	7/23/2012	1.57	0.169	ppmC
E1CO	Methane	7/26/2012	1.53	0.169	ppmC
E1CO	Methane	7/29/2012	1.65	0.169	ppmC
E1CO	Methane	8/1/2012	1.78	0.169	ppmC
E1CO	Methane	8/3/2012	1.68	0.169	ppmC
E1CO	Methane	8/4/2012*	1.49	0.169	ppmC
E1CO	Methane	8/6/2012*	1.48	0.169	ppmC
E1CO	Methane	8/7/2012	2.01	0.169	ppmC
E1CO	Methane	8/8/2012	2.04	0.169	ppmC
E1CO	Methane	8/9/2012	1.64	0.169	ppmC
E1CO	Methane	8/10/2012	1.72	0.169	ppmC
E1CO	Methane	8/11/2012	1.75	0.169	ppmC
E1CO	Methane	8/12/2012	1.54	0.169	ppmC
E1CO	Methane	8/13/2012	1.79	0.169	ppmC
E1CO	Methane	8/19/2012	1.85	0.169	ppmC
E1CO	Methane	8/22/2012	1.88	0.169	ppmC
E1CO	Methane	8/25/2012	2.13	0.169	ppmC

* Samples collected from 08:00 – 11:00 MST

Site	Analyte	Date	Result	MDL	Units
E2CO	Methane	7/20/2012	1.21	0.169	ppmC
E2CO	Methane	7/23/2012	1.78	0.169	ppmC
E2CO	Methane	7/26/2012	1.83	0.169	ppmC
E2CO	Methane	7/29/2012	1.64	0.169	ppmC
E2CO	Methane	8/1/2012	2.00	0.169	ppmC
E2CO	Methane	8/3/2012	1.75	0.169	ppmC
E2CO	Methane	8/4/2012*	1.66	0.169	ppmC
E2CO	Methane	8/6/2012*	1.55	0.169	ppmC
E2CO	Methane	8/7/2012	1.88	0.169	ppmC
E2CO	Methane	8/8/2012	2.02	0.169	ppmC
E2CO	Methane	8/9/2012	1.85	0.169	ppmC
E2CO	Methane	8/10/2012	1.77	0.169	ppmC
E2CO	Methane	8/11/2012	1.99	0.169	ppmC
E2CO	Methane	8/12/2012	1.81	0.169	ppmC
E2CO	Methane	8/13/2012	1.90	0.169	ppmC
E2CO	Methane	8/16/2012	1.53	0.169	ppmC
E2CO	Methane	8/22/2012	2.22	0.169	ppmC
E2CO	Methane	8/25/2012	1.99	0.169	ppmC

* Samples collected from 08:00 – 11:00 MST

Raw Methane ppbC Values – DECO and PVCO (06:00-09:00 MST)

Site	Analyte	Date	Result	MDL	Units
DECO	Methane	7/20/2012	1.35	0.169	ppmC
DECO	Methane	7/23/2012	1.19	0.169	ppmC
DECO	Methane	7/26/2012	1.20	0.169	ppmC
DECO	Methane	7/29/2012	1.25	0.169	ppmC
DECO	Methane	8/1/2012	1.25	0.169	ppmC
DECO	Methane	8/4/2012	1.31	0.169	ppmC
DECO	Methane	8/7/2012	1.21	0.169	ppmC
DECO	Methane	8/10/2012	1.21	0.169	ppmC
DECO	Methane	8/13/2012	1.35	0.169	ppmC
DECO	Methane	8/17/2012	1.11	0.169	ppmC
DECO	Methane	8/19/2012	1.15	0.169	ppmC
DECO	Methane	8/22/2012	1.51	0.169	ppmC
DECO	Methane	8/25/2012	1.29	0.169	ppmC
DECO	Methane	8/28/2012	1.32	0.169	ppmC

Site	Analyte	Date	Result	MDL	Units
PVCO	Methane	7/20/2012	2.11	0.169	ppmC
PVCO	Methane	7/23/2012	2.24	0.338	ppmC
PVCO	Methane	7/26/2012	2.19	0.169	ppmC
PVCO	Methane	7/29/2012	2.35	0.169	ppmC
PVCO	Methane	8/1/2012	2.18	0.169	ppmC
PVCO	Methane	8/4/2012	1.92	0.169	ppmC
PVCO	Methane	8/7/2012	2.23	0.169	ppmC
PVCO	Methane	8/10/2012	1.82	0.169	ppmC
PVCO	Methane	8/13/2012	2.44	0.169	ppmC
PVCO	Methane	8/16/2012	1.15	0.169	ppmC
PVCO	Methane	8/19/2012	1.94	0.169	ppmC
PVCO	Methane	8/22/2012	2.81	0.169	ppmC
PVCO	Methane	8/25/2012	1.67	0.169	ppmC
PVCO	Methane	8/28/2012	1.92	0.169	ppmC

Raw SNMOC Minimum Detection (MDL) Values in ppbC

Analyte	MDL	7/23/2012	MDL
1,2,3-Trimethylbenzene	0.104	Ethane	0.102
1,2,4-Trimethylbenzene	0.183	Ethylbenzene	0.115
1,3,5-Trimethylbenzene	0.119	Ethylene	0.063
1,3-Butadiene	0.199	Isobutane	0.125
1-Decene	0.215	Isobutene/1-Butene	0.165
1-Dodecene	0.383	Isopentane	0.260
1-Heptene	0.225	Isoprene	0.247
1-Hexene	0.342	Isopropylbenzene	0.159
1-Nonene	0.187	m-Diethylbenzene	0.215
1-Octene	0.212	Methylcyclohexane	0.142
1-Pentene	0.183	Methylcyclopentane	0.114
1-Tridecene	0.383	m-Ethyltoluene	0.122
1-Undecene	0.237	m-Xylene/p-Xylene	0.188
2,2,3-Trimethylpentane	0.212	n-Butane	0.198
2,2,4-Trimethylpentane	0.125	n-Decane	0.155
2,2-Dimethylbutane	0.197	n-Dodecane	0.383
2,3,4-Trimethylpentane	0.141	n-Heptane	0.151
2,3-Dimethylbutane	0.241	n-Hexane	0.141
2,3-Dimethylpentane	0.225	n-Nonane	0.123
2,4-Dimethylpentane	0.174	n-Octane	0.155
2-Ethyl-1-butene	0.342	n-Pentane	0.161
2-Methyl-1-butene	0.260	n-Propylbenzene	0.137
2-Methyl-1-pentene	0.342	n-Tridecane	0.383
2-Methyl-2-butene	0.260	n-Undecane	0.237
2-Methylheptane	0.126	o-Ethyltoluene	0.135
2-Methylhexane	0.131	o-Xylene	0.094
2-Methylpentane	0.093	p-Diethylbenzene	0.172
3-Methyl-1-butene	0.260	p-Ethyltoluene	0.187
3-Methylheptane	0.120	Propane	0.183
3-Methylhexane	0.111	Propylene	0.099
3-Methylpentane	0.155	Propyne	0.183
4-Methyl-1-pentene	0.342	Styrene	0.187
Acetylene	0.151	Toluene	0.212
a-Pinene	0.215	trans-2-Butene	0.145
Benzene	0.192	trans-2-Hexene	0.342
b-Pinene	0.215	trans-2-Pentene	0.152
cis-2-Butene	0.199	SNMOC	n/a
cis-2-Hexene	0.342	Sum of Unknowns	n/a
cis-2-Pentene	0.215	TNMOC	n/a
Cyclohexane	0.180		
Cyclopentane	0.149		
Cyclopentene	0.260		

Raw SMNOC ppbC Values – E1CO (06:00-09:00 MST)

Site	Analyte	7/20/ 2012	7/23/ 2012	7/26/ 2012	7/29/ 2012	8/01/ 2012	8/03/ 2012	8/04/ 2012*	8/06/ 2012*	8/07/ 2012	8/08/ 2012	8/09/ 2012	8/10/ 2012	8/11/ 2012	8/12/ 2012	8/13/ 2012	8/19/ 2012	8/22/ 2012	8/25/ 2012
E1CO	1,2,3-Trimethylbenzene	0.27	ND	ND	ND	0.17	0.12	ND	ND	0.20	0.20	ND	ND	ND	ND	ND	ND	ND	ND
E1CO	1,2,4-Trimethylbenzene	0.65	0.47	0.41	0.37	0.57	0.63	0.264	0.272	0.57	1.15	0.29	0.25	0.43	0.44	3.27	0.19	0.58	0.23
E1CO	1,3,5-Trimethylbenzene	0.18	ND	ND	ND	0.11	0.18	ND	ND	0.35	0.30	0.16	0.08	ND	ND	0.10	ND	0.17	ND
E1CO	1,3-Butadiene	ND	ND	0.15	0.15	0.25	0.37	0.216	0.2	0.12	0.35	0.31	0.27	0.21	0.24	0.47	0.45	0.57	0.45
E1CO	1-Decene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E1CO	1-Dodecene	ND	ND	ND	ND	ND	ND	ND	ND	0.32	ND	ND	ND	ND	0.82	3.58	0.36	ND	ND
E1CO	1-Heptene	0.69	0.29	0.20	0.80	0.71	0.52	ND	0.133	1.01	2.27	0.44	0.28	0.88	0.22	1.36	ND	0.77	0.28
E1CO	1-Hexene	ND	ND	ND	ND	ND	ND	ND	ND	0.37	ND	ND	ND	ND	0.12	0.35	ND	ND	ND
E1CO	1-Nonene	ND	ND	0.10	ND	ND	0.10	ND	ND	0.07	ND	ND	ND	ND	ND	0.21	ND	ND	ND
E1CO	1-Octene	0.28	0.14	0.12	0.17	0.16	0.11	0.098	0.107	0.15	0.39	0.11	0.15	0.23	0.18	0.39	ND	ND	0.12
E1CO	1-Pentene	0.45	0.21	0.2	0.18	0.26	0.22	0.14	0.131	0.29	0.37	0.17	0.16	0.17	0.29	0.71	0.39	0.49	0.43
E1CO	1-Tridecene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E1CO	1-Undecene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.18	ND	ND	ND
E1CO	2,2,3-Trimethylpentane	ND	ND	ND	ND	ND	ND	ND	ND	0.26	ND	ND	ND	ND	0.14	0.3	ND	0.29	ND
E1CO	2,2,4-Trimethylpentane	0.35	0.43	0.29	ND	0.71	0.61	0.217	0.183	0.45	0.64	0.14	0.10	ND	0.43	ND	ND	0.55	ND
E1CO	2,2-Dimethylbutane	0.53	0.32	0.23	0.53	0.56	0.49	0.13	0.155	0.90	1.2	0.28	0.13	0.56	0.19	0.56	0.11	0.68	0.15
E1CO	2,3,4-Trimethylpentane	0.42	0.44	0.33	0.22	0.41	0.30	0.168	0.212	0.28	0.54	0.15	0.14	0.21	0.47	0.51	0.13	0.36	0.21
E1CO	2,3-Dimethylbutane	1.14	0.61	0.38	1.32	1.36	1.06	0.192	0.246	1.87	2.98	0.62	0.27	1.42	0.29	1.39	0.22	1.46	0.32
E1CO	2,3-Dimethylpentane	0.72	0.41	0.32	0.72	0.82	0.68	0.173	0.193	1.13	1.83	0.38	0.22	0.70	0.26	0.75	0.2	0.88	0.22
E1CO	2,4-Dimethylpentane	0.52	0.28	0.20	0.57	0.63	0.48	0.096	0.115	0.87	1.44	0.29	0.16	0.57	0.17	0.59	0.09	0.64	0.14
E1CO	2-Ethyl-1-butene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E1CO	2-Methyl-1-butene	0.27	ND	ND	ND	ND	0.21	ND	ND	ND	0.36	ND	ND	ND	ND	0.18	ND	0.26	ND
E1CO	2-Methyl-1-pentene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E1CO	2-Methyl-2-butene	0.27	ND	ND	ND	0.24	ND	ND	ND	0.10	0.31	ND	ND	0.19	0.18	0.15	ND	ND	0.18
E1CO	2-Methylheptane	0.62	0.24	0.12	0.42	0.58	0.51	ND	ND	0.88	1.3	0.23	0.25	0.78	ND	0.40	0.08	0.53	0.21
E1CO	2-Methylhexane	1.94	1.36	0.86	2.12	1.85	1.58	0.529	0.51	2.47	5.82	1.35	0.81	2.28	1.74	3.72	0.51	2.28	0.72
E1CO	2-Methylpentane	6.31	3.68	2.19	7.71	7.47	5.2	0.943	1.33	8.24	17.3	4.42	1.82	9.04	2.2	9.91	1.23	8	1.92
E1CO	3-Methyl-1-butene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E1CO	3-Methylheptane	0.40	0.21	0.14	0.42	0.41	0.41	ND	ND	0.68	1.29	0.21	0.17	0.48	0.09	0.52	0.10	0.52	0.14
E1CO	3-Methylhexane	1.52	ND	ND	1.81	1.7	1.45	ND	ND	2.3	5.16	0.87	0.54	1.97	ND	1.86	ND	2.26	ND
E1CO	3-Methylpentane	3.45	1.92	1.12	4.29	4.13	2.98	0.515	0.658	4.83	9.62	2.24	0.95	4.75	0.86	4.9	0.66	4.48	1.01
E1CO	4-Methyl-1-pentene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E1CO	Acetylene	0.72	0.38	0.58	0.41	1.18	1	0.81	0.794	1.13	1.88	1.17	0.98	1.13	1.38	0.90	0.61	1.53	0.81
E1CO	a-Pinene	ND	ND	ND	ND	ND	0.55	ND	ND	0.27	ND	ND	ND	ND	ND	ND	ND	ND	ND
E1CO	Benzene	3.01	2.66	2.08	2.69	2.91	2.21	1.48	1.32	2.52	3.86	1.41	0.95	2.15	1.06	2.26	1.2	2.19	1.79
E1CO	b-Pinene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E1CO	cis-2-Butene	0.28	ND	0.11	0.14	0.13	0.16	ND	0.103	0.31	0.24	0.09	0.09	0.11	0.12	0.20	0.17	0.21	0.12
E1CO	cis-2-Hexene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.25	ND	ND	ND
E1CO	cis-2-Pentene	0.12	ND	ND	ND	ND	ND	ND	ND	0.21	ND	ND	ND	ND	ND	ND	ND	0.09	ND
E1CO	Cyclohexane	2.48	1.33	0.77	3.41	3.05	2.02	0.321	0.533	3.93	8.23	1.54	0.81	3.52	0.57	3.97	0.48	2.88	0.84
E1CO	Cyclopentane	1.16	0.76	0.48	1.32	1.53	0.88	0.255	0.312	1.78	2.76	0.90	0.40	1.63	0.36	1.95	0.36	1.42	0.42

Site	Analyte	7/20/ 2012	7/23/ 2012	7/26/ 2012	7/29/ 2012	8/01/ 2012	8/03/ 2012	8/04/ 2012*	8/06/ 2012*	8/07/ 2012	8/08/ 2012	8/09/ 2012	8/10/ 2012	8/11/ 2012	8/12/ 2012	8/13/ 2012	8/19/ 2012	8/22/ 2012	8/25/ 2012
E1CO	Cyclopentene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E1CO	Ethane	47.6	24	14.4	58.5	89	35.1	6.61	10.4	149	134	30.6	11.1	58.9	13.5	79.9	14	92.8	18.2
E1CO	Ethylbenzene	0.64	0.30	0.40	0.30	0.55	0.53	0.217	0.246	0.49	0.74	0.28	0.25	0.34	0.24	0.28	0.16	0.50	0.19
E1CO	Ethylene	4.16	3.45	3.5	3.32	4.57	4.07	2.78	2.3	2.62	4.04	2.34	1.89	2.35	3.04	3.29	1.19	2.98	1.76
E1CO	Isobutane	11.8	7.3	4.03	15	21.8	7.24	1.56	2.55	24.8	27	9.38	2.62	20	2.76	25.3	2.91	18.6	4.12
E1CO	Isobutene/1-Butene	ND	ND	ND	ND	ND	ND	ND	1.84	ND	ND	ND	ND	ND	ND	ND	ND	4.34	ND
E1CO	Isopentane	ND	19.1	ND	24.4	ND	ND	ND	2.45	32.6	47.2	16.3	ND	31.2	14.9	42.3	2.85	ND	ND
E1CO	Isoprene	3.41	3.67	1.64	2.65	2.96	4.8	0.738	7.19	2.39	3.22	1.64	1.41	2.76	1.4	0.85	0.49	1.56	0.24
E1CO	Isopropylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	0.25	ND	ND	ND	ND	ND	ND	ND	ND	ND
E1CO	m-Diethylbenzene	0.28	ND	ND	ND	0.54	0.39	ND	ND	0.33	0.56	ND	0.33	0.18	0.45	0.89	0.23	ND	0.33
E1CO	Methylcyclohexane	2.87	1.5	0.83	3.75	3.26	2.42	0.402	0.624	4.34	10.5	1.81	1.08	4.22	0.55	4.3	0.55	3.3	1.11
E1CO	Methylcyclopentane	3.21	1.7	1.15	4.13	3.94	2.66	0.476	0.701	4.47	9.6	2.4	1.03	4.61	0.83	4.8	0.74	3.88	1.08
E1CO	m-Ethyltoluene	0.90	0.45	0.38	0.38	0.36	0.40	ND	0.176	0.41	0.66	0.37	0.19	0.29	0.27	ND	ND	0.37	0.16
E1CO	m-Xylene/p-Xylene	2.04	1.31	1.12	1.24	1.71	1.76	0.56	0.657	1.52	3.19	0.85	0.71	1.56	0.8	1.22	0.47	1.8	0.59
E1CO	n-Butane	28.5	17.6	9.62	33.5	50.5	15.4	3.83	6.04	54.8	61.6	24.4	6.83	48	6.54	63.9	8.18	43.2	10.3
E1CO	n-Decane	0.57	0.39	0.33	0.31	0.37	0.38	0.175	0.181	0.36	1.14	0.20	0.17	0.38	0.20	0.32	0.18	0.37	0.21
E1CO	n-Dodecane	0.81	0.82	0.54	0.38	0.37	0.30	0.199	0.239	0.27	0.25	0.12	0.11	0.14	0.15	0.91	0.23	0.17	0.21
E1CO	n-Heptane	2.39	1.12	0.67	2.92	2.37	1.91	0.287	0.414	3.38	7.53	1.38	0.88	3.15	0.53	3.12	0.46	2.81	0.76
E1CO	n-Hexane	7.73	3.96	2.35	9.79	8.45	5.78	0.793	1.54	11	21.8	5.13	2.17	11	1.75	11.3	1.26	9.07	2.21
E1CO	n-Nonane	0.41	0.22	0.19	0.29	0.37	0.33	0.091	0.111	0.47	1.18	0.24	0.18	0.52	0.13	0.47	0.16	0.46	0.20
E1CO	n-Octane	1.02	0.54	0.42	1.02	1	0.91	0.274	0.335	1.41	3.06	0.66	0.52	1.39	0.52	1.47	0.26	1.19	0.49
E1CO	n-Pentane	16.7	9.57	5.56	19.7	23	10.7	2.3	3.4	25.7	38.1	12.2	4.48	26	3.85	30	3.85	22.4	5.61
E1CO	n-Propylbenzene	0.21	0.16	0.17	0.11	0.15	0.15	ND	ND	0.23	0.28	ND	ND	0.10	ND	0.29	ND	0.13	0.09
E1CO	n-Tridecane	0.63	0.75	0.36	0.23	0.23	0.16	0.138	0.17	ND	0.14	ND	ND	ND	0.11	0.12	0.10	0.12	0.13
E1CO	n-Undecane	0.40	0.33	0.23	0.24	0.28	0.25	0.192	ND	0.32	0.47	0.13	0.11	0.15	0.15	0.42	0.16	0.20	0.25
E1CO	o-Ethyltoluene	0.20	ND	ND	ND	0.21	ND	ND	ND	0.32	0.38	ND	ND	0.12	ND	ND	ND	0.23	ND
E1CO	o-Xylene	0.75	0.47	0.43	0.41	0.61	0.67	0.228	0.263	0.56	1.04	0.33	0.27	0.49	0.36	0.52	0.16	0.66	0.19
E1CO	p-Diethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	0.17	ND	ND	ND	ND	ND	ND	ND	ND	0.20
E1CO	p-Ethyltoluene	0.28	0.18	0.18	0.17	0.31	0.23	ND	0.118	0.33	0.32	ND	0.10	0.17	ND	ND	0.19	0.25	0.13
E1CO	Propane	43.9	27.3	16.3	53.6	85.8	26.6	6.36	10.1	100	96.4	37.6	10.6	69.1	11.9	99.7	14.3	76.2	16.3
E1CO	Propylene	2.46	0.74	0.55	0.52	0.98	0.97	0.509	0.496	1.21	1.58	0.79	0.74	0.79	1.4	3.63	0.62	1.29	0.74
E1CO	Propyne	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E1CO	Styrene	ND	ND	3.48	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E1CO	Toluene	68.4	82.9	67.2	59.6	57.2	37.4	31.9	39.8	18.2	29.2	23.5	18.5	26.8	15.5	23.3	33.3	16.5	42.4
E1CO	trans-2-Butene	1.12	ND	0.12	0.14	0.14	0.15	ND	0.096	0.26	0.28	0.19	0.14	0.16	ND	0.23	0.12	0.2	ND
E1CO	trans-2-Hexene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E1CO	trans-2-Pentene	0.37	0.17	0.15	0.18	0.18	0.15	ND	0.091	0.25	0.25	0.13	ND	0.21	0.11	0.16	0.14	0.20	0.15
E1CO	SNMOC	283	226	148	327	393	187	67.1	100	482	578	191	76.6	349	94.7	449	94.9	340	119
E1CO	Sum of Unknowns	157	126	104	79.9	153	112	84	83.6	49.3	101	43.7	76.6	70.8	107	153	74.1	98.2	81.6
E1CO	TNMOC	440	353	252	407	546	299	151	184	531	678	234	153	419	202	602	169	438	201

* Samples collected from 08:00 – 11:00 MST

Raw SNMOC ppbC Values – E2CO (06:00-09:00 MST)

Site	Analyte	7/20/2012	7/23/2012	7/26/2012	7/29/2012	8/01/2012	8/03/2012	8/04/2012*	8/06/2012*	8/07/2012	8/08/2012	8/09/2012	8/10/2012	8/11/2012	8/12/2012	8/13/2012	8/16/2012	8/22/2012	8/25/2012
E2CO	1,2,3-Trimethylbenzene	3.1	0.17	ND	ND	0.11	0.11	ND	ND	0.20	0.16	0.47	ND	0.22	ND	ND	ND	0.12	ND
E2CO	1,2,4-Trimethylbenzene	26.1	0.71	0.50	0.37	0.54	0.56	0.358	0.285	0.65	0.94	0.90	0.47	1.07	0.25	0.42	0.18	0.87	0.27
E2CO	1,3,5-Trimethylbenzene	11.8	0.31	0.27	ND	ND	0.20	ND	ND	0.26	0.34	0.12	0.09	0.22	0.11	0.18	ND	0.42	ND
E2CO	1,3-Butadiene	1.39	ND	ND	ND	0.22	0.29	0.177	0.191	0.1	0.39	0.45	0.46	0.44	0.42	0.43	0.37	0.61	0.43
E2CO	1-Decene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	1-Dodecene	58.3	ND	ND	ND	ND	ND	ND	ND	0.53	ND	ND	0.47	ND	ND	ND	ND	ND	0.69
E2CO	1-Heptene	0.52	0.24	0.19	0.38	0.80	0.50	0.08	0.121	0.67	1.39	0.64	0.48	1.4	0.15	0.90	0.23	1.35	0.29
E2CO	1-Hexene	0.42	ND	ND	ND	ND	ND	ND	ND	0.34	ND	0.13	ND	ND	ND	ND	ND	ND	ND
E2CO	1-Nonene	23.1	0.44	ND	ND	ND	ND	ND	ND	0.06	ND	0.12	ND	0.22	ND	0.14	0.12	0.20	0.12
E2CO	1-Octene	1.62	0.10	ND	ND	0.12	ND	0.09	ND	0.16	0.29	0.28	0.22	0.51	0.17	0.34	0.23	0.40	0.33
E2CO	1-Pentene	1.88	0.20	0.21	0.18	0.27	0.24	0.127	0.148	0.31	0.33	0.46	0.35	0.52	0.36	0.36	0.41	0.58	0.44
E2CO	1-Tridecene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	1-Undecene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	2,2,3-Trimethylpentane	0.93	ND	ND	ND	ND	ND	ND	ND	0.30	ND	0.27	ND	ND	ND	ND	ND	0.49	ND
E2CO	2,2,4-Trimethylpentane	1.21	0.44	0.37	0.30	0.62	0.60	0.212	0.192	0.56	0.66	0.29	ND	ND	0.54	ND	0.10	0.78	0.28
E2CO	2,2-Dimethylbutane	0.24	0.27	0.21	0.34	0.61	0.46	0.11	0.156	0.67	0.80	0.30	0.18	0.66	0.19	0.34	0.15	1.03	0.25
E2CO	2,3,4-Trimethylpentane	5.44	0.41	ND	0.28	0.39	0.35	0.147	0.232	0.33	0.47	0.59	0.22	ND	0.28	0.18	0.21	0.42	0.28
E2CO	2,3-Dimethylbutane	0.60	0.50	0.42	0.77	1.52	1	0.186	0.28	1.26	1.94	0.69	0.43	1.85	0.46	1	0.35	2.32	0.48
E2CO	2,3-Dimethylpentane	1.59	0.42	0.34	0.45	0.86	0.68	0.185	0.216	0.99	1.31	0.56	0.36	1.03	0.36	0.65	0.26	1.58	0.31
E2CO	2,4-Dimethylpentane	0.31	0.22	0.18	0.30	0.66	0.48	ND	0.135	0.68	0.99	0.38	0.26	0.80	0.24	0.46	0.13	0.96	0.20
E2CO	2-Ethyl-1-butene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	2-Methyl-1-butene	ND	ND	ND	ND	ND	0.27	ND	ND	0.15	0.33	ND	ND	0.20	ND	ND	ND	0.31	ND
E2CO	2-Methyl-1-pentene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	2-Methyl-2-butene	0.54	ND	0.26	0.17	ND	0.2	ND	0.149	0.22	0.40	0.22	ND	0.21	ND	ND	ND	0.43	0.28
E2CO	2-Methylheptane	ND	0.15	0.18	0.17	0.66	0.49	ND	ND	0.95	0.94	0.61	0.35	1.25	0.11	0.90	ND	1.16	0.24
E2CO	2-Methylhexane	1.81	1.15	1.42	1.46	1.98	1.63	0.575	0.618	2.02	3.86	3.31	1.55	4.96	0.80	2.15	0.99	4.73	0.94
E2CO	2-Methylpentane	4.11	2.85	2.91	4.52	8.29	5.1	1.02	1.49	5.16	12	5.19	4.24	12.1	2.5	7.24	2.08	12.8	2.85
E2CO	3-Methyl-1-butene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	3-Methylheptane	1.98	0.21	0.15	0.23	0.46	0.37	0.109	ND	0.71	0.97	0.44	0.32	0.90	0.1	0.56	0.15	0.88	0.14
E2CO	3-Methylhexane	ND	ND	ND	0.80	2.05	1.54	ND	ND	1.92	3.53	1.3	0.92	2.98	0.53	1.95	0.51	4.92	0.52
E2CO	3-Methylpentane	1.15	1.42	1.34	2.37	4.56	2.88	0.497	0.797	3.1	6.09	2.58	1.68	6.45	1.28	4.17	1.11	6.84	1.48
E2CO	4-Methyl-1-pentene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	Acetylene	0.30	0.38	0.55	0.44	1.19	1.47	0.744	0.925	1.19	1.93	1.08	0.81	1.06	1.29	0.82	0.78	1.58	0.86
E2CO	a-Pinene	1.91	ND	ND	ND	ND	ND	ND	ND	0.28	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	Benzene	ND	1.24	0.93	1.09	1.96	1.52	0.676	0.644	1.85	2.87	1.06	0.86	2.2	1.08	1.74	0.77	2.87	1.16
E2CO	b-Pinene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	cis-2-Butene	0.14	ND	0.11	0.13	0.13	0.15	ND	0.102	0.33	0.26	0.14	0.12	0.16	0.13	0.12	0.14	0.29	0.16
E2CO	cis-2-Hexene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	cis-2-Pentene	ND	ND	ND	ND	ND	ND	ND	ND	0.22	0.12	ND	ND	ND	ND	ND	ND	0.13	0.07
E2CO	Cyclohexane	2.23	1.11	0.90	1.58	3.41	2.03	0.329	0.65	2.64	4.87	2.29	1.56	5.5	0.82	3.13	0.80	4.48	0.98
E2CO	Cyclopentane	0.46	0.66	0.56	0.81	1.78	0.87	0.252	0.353	1.17	1.7	0.95	0.59	2.12	0.49	1.58	0.5	1.96	0.53

Site	Analyte	7/20/2012	7/23/2012	7/26/2012	7/29/2012	8/01/2012	8/03/2012	8/04/2012*	8/06/2012*	8/07/2012	8/08/2012	8/09/2012	8/10/2012	8/11/2012	8/12/2012	8/13/2012	8/16/2012	8/22/2012	8/25/2012
E2CO	Cyclopentene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	Ethane	13.9	18.1	16.8	35.3	97.7	34.4	6.68	10.9	71.7	79.6	28.2	24.1	101	20.4	53.2	20	94.6	32.2
E2CO	Ethylbenzene	167	1.36	0.33	0.32	0.52	0.54	0.193	0.267	0.52	0.76	0.26	0.18	0.32	0.27	0.30	0.43	0.78	0.29
E2CO	Ethylene	5.53	3.5	3.53	3.4	4.4	3.65	2.7	2.12	2.47	4.33	2.79	1.97	3.06	2.34	2.05	1.45	3.74	1.73
E2CO	Isobutane	3.26	4.93	4.84	10	24	7.4	1.57	2.75	12.1	16.7	8.76	5.44	26.4	4.79	16.5	5.53	24.1	5.38
E2CO	Isobutene/1-Butene	30.2	ND	ND	ND	ND	ND	ND	1.89	ND	ND	4.28	3.95	6.2	3.63	3.98	ND	4.55	ND
E2CO	Isopentane	68.6	16.1	15.4	18.4	ND	ND	1.62	ND	22.4	37.8	25.2	15	46.5	5.87	23.8	ND	ND	ND
E2CO	Isoprene	2.03	1.66	0.94	1.42	2.34	4.08	0.431	3.66	1.39	2.42	0.65	0.88	2.21	1.06	0.55	0.21	1.81	0.39
E2CO	Isopropylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	0.22	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	m-Diethylbenzene	ND	0.95	ND	ND	0.50	0.54	0.452	ND	0.31	ND	1.08	0.28	0.78	0.15	0.15	ND	0.18	0.36
E2CO	Methylcyclohexane	1.16	1.2	1.11	1.56	3.66	2.42	0.389	0.525	3.39	6.66	3.32	2.37	7.03	0.97	4.23	0.93	5.99	1.08
E2CO	Methylcyclopentane	1.24	1.44	1.24	2.08	4.38	2.62	0.465	0.749	2.81	5.96	2.61	1.84	6.18	1.22	4.39	1.15	5.79	1.37
E2CO	m-Ethyltoluene	5.22	0.96	0.41	0.41	0.34	0.38	ND	0.168	0.42	0.62	ND	ND	0.30	0.17	0.23	ND	0.51	0.19
E2CO	m-Xylene/p-Xylene	399	3.63	1.34	1.22	1.98	1.81	0.596	0.737	1.86	3.1	1.6	0.91	2.47	0.82	1.58	1.43	3.16	0.89
E2CO	n-Butane	7.34	12.2	11.6	23.4	55.4	15.8	3.86	6.53	27.9	37.7	23.7	13.7	64.2	11.6	45.6	14.5	57.7	12.3
E2CO	n-Decane	258	3.15	0.68	0.50	0.53	0.42	0.29	0.279	0.57	1.02	0.40	0.25	0.69	0.21	0.39	0.45	0.64	0.22
E2CO	n-Dodecane	237	7.11	1.68	1.2	0.91	0.70	0.532	0.636	0.47	0.31	0.48	0.31	0.35	0.19	0.29	0.87	0.72	0.40
E2CO	n-Heptane	2.05	0.89	0.76	1.18	2.66	1.76	0.267	0.43	2.84	4.87	2.05	1.73	5.02	0.72	3.24	0.81	5.38	0.80
E2CO	n-Hexane	3.23	3	2.64	4.89	9.55	5.6	0.815	1.67	5.99	13.5	5.63	3.99	14.4	2.56	9.88	2.37	13.2	2.82
E2CO	n-Nonane	15.6	0.35	0.19	0.18	0.40	0.28	0.1	0.111	0.66	1.03	0.55	0.32	1.06	0.11	0.57	0.17	0.75	0.14
E2CO	n-Octane	7	0.56	0.52	0.47	1.35	0.93	0.273	0.332	1.59	2.3	1.39	1.03	2.59	0.41	1.63	0.40	1.95	0.44
E2CO	n-Pentane	7.21	7.36	6.62	12.8	25.6	10.5	2.3	3.71	14.3	23.8	12.6	8.05	34.3	6.44	21.9	6.72	31.8	7.01
E2CO	n-Propylbenzene	1.76	0.20	0.16	0.13	0.17	0.15	ND	ND	0.23	0.21	0.37	ND	0.40	ND	0.11	0.09	0.18	0.09
E2CO	n-Tridecane	3.36	0.96	0.39	0.33	0.34	0.26	0.16	0.295	0.07	ND	0.20	ND	0.14	ND	ND	0.10	0.10	0.11
E2CO	n-Undecane	51.3	1.08	0.36	0.32	0.28	0.21	0.112	0.13	0.31	0.37	0.27	0.09	0.26	0.11	0.17	0.4	0.29	0.12
E2CO	o-Ethyltoluene	8.21	ND	ND	ND	0.16	ND	ND	ND	0.31	0.30	ND	ND	ND	ND	0.14	ND	0.26	ND
E2CO	o-Xylene	132	1.32	0.56	0.48	0.69	0.68	0.269	0.304	0.71	1.03	0.61	0.32	0.77	0.33	0.47	0.48	1.06	0.33
E2CO	p-Diethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	0.20	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	p-Ethyltoluene	ND	0.28	0.16	0.18	0.26	0.21	ND	0.212	0.40	0.35	ND	ND	ND	ND	0.18	0.20	0.31	0.21
E2CO	Propane	11.8	19.6	19.3	36.7	96.3	26.6	6.84	10.8	51.9	62.9	35.9	21.7	96.1	19.5	68.4	21.6	88.8	23.3
E2CO	Propylene	1.58	0.79	0.60	0.55	0.97	0.91	0.439	0.439	1.17	1.53	1.64	0.76	1.57	0.68	0.75	0.60	1.66	0.74
E2CO	Propyne	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	Styrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	Toluene	98.5	7.68	5.19	5.12	6.6	5.21	2.86	3.43	4.69	8.94	3.75	2.76	5.95	2.94	4.24	2.9	9.46	4.79
E2CO	trans-2-Butene	0.60	ND	ND	0.18	0.15	0.14	ND	0.104	0.28	0.38	ND	0.22	0.24	ND	ND	0.10	0.27	0.16
E2CO	trans-2-Hexene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E2CO	trans-2-Pentene	0.96	0.14	0.15	0.12	0.14	0.15	ND	0.086	0.25	0.29	0.15	0.13	0.22	0.29	0.13	0.10	0.34	0.19
E2CO	SNMOC	1740	134	110	180	376	153	40.1	61	265	369	194	129	480	101	299	94.7	416	113
E2CO	Sum of Unknowns	3700	190	99.6	98	231	175	90.9	154	77.6	84.1	139	52.9	160	7.98	51.4	171	124	87.6
E2CO	TNMOC	5440	325	209	278	607	327	131	215	342	453	334	182	640	109	350	266	539	200

* Samples collected from 08:00 – 11:00 MST

Raw ppbC Values – DECO (06:00-09:00 MST)

Site	Analyte	7/20/ 2012	7/23/ 2012	7/26/ 2012	7/29/ 2012	8/01/ 2012	8/04/ 2012	8/07/ 2012	8/10/ 2012	8/13/ 2012	8/17/ 2012	8/19/ 2012	8/22/ 2012	8/25/ 2012	8/28/ 2012
DECO	1,2,3-Trimethylbenzene	0.222	0.246	0.295	0.101	0.237	0.164	0.239	0.51	0.198	0.223	ND	0.559	ND	0.25
DECO	1,2,4-Trimethylbenzene	1.05	1.13	1.53	0.545	1.18	0.392	0.976	1.74	1.12	1.24	0.34	3.12	0.338	1.35
DECO	1,3,5-Trimethylbenzene	0.526	0.415	0.651	0.214	0.531	0.221	0.441	0.33	0.501	0.499	0.142	ND	ND	0.44
DECO	1,3-Butadiene	0.395	0.565	0.709	0.276	0.491	0.086	0.268	0.712	0.911	1.06	0.514	1.43	0.515	0.777
DECO	1-Decene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECO	1-Dodecene	0.275	ND	ND	ND	ND	0.191	0.121	ND	0.343	ND	ND	0.302	ND	ND
DECO	1-Heptene	0.243	ND	ND	ND	ND	ND	ND	ND	0.628	ND	0.216	ND	0.217	ND
DECO	1-Hexene	ND	ND	ND	ND	0.151	0.337	0.403	0.297	0.307	0.12	ND	0.392	0.105	0.14
DECO	1-Nonene	ND	ND	ND	ND	ND	ND	0.108	0.144	0.315	ND	ND	0.461	0.118	ND
DECO	1-Octene	ND	ND	ND	ND	ND	ND	0.068	0.206	0.298	ND	ND	ND	0.134	ND
DECO	1-Pentene	0.678	0.451	0.487	0.214	0.806	0.265	0.374	0.691	0.717	0.611	0.403	1.48	0.487	1.05
DECO	1-Tridecene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECO	1-Undecene	ND	ND	ND	ND	ND	ND	ND	ND	0.108	ND	ND	ND	ND	ND
DECO	2,2,3-Trimethylpentane	ND	ND	ND	ND	ND	0.074	0.256	0.298	0.386	0.328	ND	0.781	ND	0.318
DECO	2,2,4-Trimethylpentane	1.07	1.6	2.05	0.775	1.69	0.445	1.14	1.35	1.5	1.32	0.432	3.18	0.441	1.3
DECO	2,2-Dimethylbutane	0.441	0.79	0.638	0.272	0.495	0.352	0.541	0.399	0.692	0.532	0.265	1.58	0.173	0.626
DECO	2,3,4-Trimethylpentane	0.362	0.543	0.71	0.255	0.508	0.207	0.472	0.611	0.567	0.474	0.149	1.12	0.247	0.442
DECO	2,3-Dimethylbutane	0.735	1.08	1.14	0.49	0.961	0.51	0.936	0.674	1.47	0.947	0.43	2.7	0.33	0.994
DECO	2,3-Dimethylpentane	0.927	1.13	1.23	0.5	1.28	0.504	0.912	0.752	1.13	0.9	0.353	2.33	0.304	1.02
DECO	2,4-Dimethylpentane	0.436	0.616	0.717	0.32	0.645	0.34	0.607	0.447	0.729	0.52	0.228	1.34	0.185	0.569
DECO	2-Ethyl-1-butene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECO	2-Methyl-1-butene	0.436	0.524	0.524	0.318	0.572	ND	0.355	0.368	0.521	0.541	0.214	1.14	ND	0.617
DECO	2-Methyl-1-pentene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECO	2-Methyl-2-butene	0.503	0.767	0.573	0.262	0.54	0.184	0.455	0.464	0.624	0.583	0.277	1.38	ND	0.665
DECO	2-Methylheptane	0.404	0.528	0.7	0.209	0.475	0.239	0.393	0.371	0.656	0.544	0.159	0.94	0.19	0.518
DECO	2-Methylhexane	2.02	2.2	2.23	0.874	2.41	0.835	1.45	2.4	2.26	1.65	0.733	4.38	0.836	2.14
DECO	2-Methylpentane	3.22	5.04	5.04	1.98	3.94	1.16	2.84	3.32	7.74	4.32	2.27	11.4	1.68	4.34
DECO	3-Methyl-1-butene	ND	ND	ND	ND	ND	ND	ND	ND	0.382	0.38	ND	0.932	ND	ND
DECO	3-Methylheptane	0.359	0.436	0.604	0.183	0.456	0.229	0.408	0.311	0.543	0.49	0.171	1.09	0.148	0.478
DECO	3-Methylhexane	2.08	2.2	2.03	0.725	2.45	0.552	1.39	1.12	2.24	1.93	0.821	4.61	0.59	2.27
DECO	3-Methylpentane	1.83	8.26	2.97	1.13	2.33	0.792	1.84	1.83	4.21	2.56	1.2	6.68	0.899	2.61
DECO	4-Methyl-1-pentene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECO	Acetylene	2.09	2.69	0.204	ND	2.38	0.9	2.29	1.9	3.6	3.19	1.04	8.26	ND	0.425
DECO	a-Pinene	0.381	0.441	5.15	1.32	0.32	ND	0.135	ND	ND	ND	ND	0.636	1.18	3.39
DECO	Benzene	ND	ND	ND	ND	1.72	ND	ND	ND	ND	2.3	0.775	ND	ND	0.708
DECO	b-Pinene	0.976	ND	ND	ND	0.495	ND	0.335	2.54	ND	ND	ND	0.691	0.874	ND
DECO	cis-2-Butene	0.254	0.37	0.37	0.179	0.371	0.27	0.415	0.319	0.364	0.443	0.231	0.88	0.192	0.428
DECO	cis-2-Hexene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECO	cis-2-Pentene	0.159	0.261	0.205	0.096	0.217	0.208	0.306	0.161	0.22	0.223	0.103	0.54	0.077	0.26
DECO	Cyclohexane	1.2	1.6	1.56	0.61	1.58	0.632	1.14	1.09	2.55	1.36	0.75	3.35	0.586	1.48
DECO	Cyclopentane	0.605	1.04	0.798	0.398	0.681	0.346	0.604	0.504	1.51	1.29	0.571	3.26	0.406	0.812

Site	Analyte	7/20/ 2012	7/23/ 2012	7/26/ 2012	7/29/ 2012	8/01/ 2012	8/04/ 2012	8/07/ 2012	8/10/ 2012	8/13/ 2012	8/17/ 2012	8/19/ 2012	8/22/ 2012	8/25/ 2012	8/28/ 2012
DECO	Cyclopentene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECO	Ethane	14.2	17.4	18.9	17.4	13.1	9.39	14.8	11.7	50.9	21.1	16.6	43.4	12.4	20.9
DECO	Ethylbenzene	1.24	1.12	1.16	0.46	1.01	0.255	0.751	0.757	0.929	1.01	0.294	2.61	0.298	1.1
DECO	Ethylene	6.21	7.7	9.04	4.76	7.63	2.19	4.71	4.97	6.2	6.96	2.16	13.6	2.76	5.71
DECO	Isobutane	2.19	5.31	4.19	2.09	2.61	2.16	3.1	1.97	15.1	4.29	4.05	7.53	2.39	3.32
DECO	Isobutene/1-Butene	ND	ND	ND	ND	ND	ND	ND	5.79	5.19	5.36	ND	ND	ND	ND
DECO	Isopentane	ND	ND	ND	4.99	ND	7.47	14.9	16.5	29.3	ND	6.68	49.9	3.12	ND
DECO	Isoprene	1.38	1.39	0.705	0.473	1.62	0.402	0.806	0.565	0.871	0.404	0.304	1.09	0.296	0.804
DECO	Isopropylbenzene	ND	ND	ND	ND	ND	0.235	0.223	ND	ND	ND	ND	0.142	ND	ND
DECO	m-Diethylbenzene	0.193	0.288	0.208	ND	ND	0.267	0.259	0.835	0.124	ND	ND	0.333	ND	ND
DECO	Methylcyclohexane	0.74	2.44	0.981	0.401	0.946	0.546	0.771	0.65	2.51	1.44	0.738	2.28	0.251	0.983
DECO	Methylcyclopentane	1.54	8.21	3.64	1.44	1.84	0.63	1.44	1.46	3.68	2.17	1.21	5.14	0.872	3.61
DECO	m-Ethyltoluene	0.78	0.781	1.52	0.567	0.88	0.28	0.586	ND	0.667	0.756	0.205	1.94	0.636	1.48
DECO	m-Xylene/p-Xylene	4.61	3.04	2.38	0.915	3.17	0.668	2.06	2.22	2.85	3.25	0.892	7.99	0.878	2.13
DECO	n-Butane	7.46	8.43	9.68	4.44	9.29	5.22	8.76	5.2	40.3	12.8	12.4	17.8	6.49	8.81
DECO	n-Decane	0.633	0.877	0.729	0.369	0.589	0.25	0.546	0.376	0.54	0.492	0.203	1.94	0.184	1
DECO	n-Dodecane	0.314	0.309	0.241	ND	0.224	0.193	0.252	0.342	0.195	0.281	ND	0.732	0.095	0.241
DECO	n-Heptane	1.07	1.64	1.53	0.541	1.35	0.509	0.974	0.844	2.28	1.48	0.642	3.34	0.565	1.46
DECO	n-Hexane	3.21	28.3	4.19	1.69	3.55	1.1	2.4	2.43	7.61	3.89	2.18	8.74	1.79	3.97
DECO	n-Nonane	0.502	0.418	0.536	0.193	0.506	0.248	0.371	0.345	0.501	0.452	0.16	1.2	0.176	0.579
DECO	n-Octane	0.586	0.684	0.834	0.322	0.684	0.351	0.524	0.592	0.977	0.795	0.446	1.6	0.322	0.688
DECO	n-Pentane	5.1	27	8.83	3.72	6.65	2.67	5.68	4.82	21.2	12.2	6.33	31.7	4.11	7.8
DECO	n-Propylbenzene	0.28	0.291	0.346	0.123	0.268	0.199	0.271	0.408	0.196	0.249	ND	0.616	0.085	0.28
DECO	n-Tridecane	0.15	0.125	0.143	ND	ND	0.066	0.058	ND	ND	0.178	ND	0.588	ND	ND
DECO	n-Undecane	0.293	0.371	0.335	0.132	0.287	0.219	0.334	0.455	0.281	0.32	0.093	1.04	0.159	0.392
DECO	o-Ethyltoluene	0.494	ND	0.623	0.198	0.597	0.234	0.394	ND	0.347	0.368	ND	1.08	0.102	0.603
DECO	o-Xylene	1.7	1.22	1.44	0.57	1.23	0.334	0.849	0.915	1.09	1.23	0.365	3.04	0.347	1.42
DECO	p-Diethylbenzene	ND	ND	ND	ND	ND	0.123	0.182	0.551	ND	ND	ND	ND	ND	ND
DECO	p-Ethyltoluene	0.403	0.504	0.524	0.191	0.454	0.317	0.419	ND	0.36	0.397	0.119	0.982	0.121	0.454
DECO	Propane	12.4	12.6	14.5	9.82	12.7	8.76	12.9	7.49	59.9	20.3	19.7	38.7	10.5	18.2
DECO	Propylene	1.75	2.31	2.7	1.01	1.97	1.19	2.06	2.64	2.57	2.68	1.01	5.47	1.17	2.24
DECO	Propyne	ND	0.136	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECO	Styrene	ND	ND	ND	ND	0.191	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECO	Toluene	5.48	7.15	7.03	3.03	7.27	1.23	4.25	4.32	6.31	6.8	1.67	14.9	1.98	7.54
DECO	trans-2-Butene	0.346	0.574	0.502	0.242	0.412	0.279	0.423	0.431	0.487	0.444	0.188	0.959	0.271	0.465
DECO	trans-2-Hexene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.219	ND	0.104
DECO	trans-2-Pentene	0.301	0.503	0.373	0.173	0.406	0.184	0.374	0.295	0.544	0.418	0.166	1.04	0.156	0.473
DECO	SNMOC (Sum of	99.5	176	131	72.5	111	58.6	109	106	303	143	91.6	343	63.8	127
DECO	Sum of Unknowns	81.4	142	105	44.5	64.8	28.6	41.8	180	69.1	62.6	29.4	167	43.2	93.9
DECO	TNMOC	181	319	236	117	176	87.2	150	286	373	206	121	510	107	221

Raw ppbC Values – PVCO (06:00-09:00 MST)

Site	Analyte	7/20/ 2012	7/23/ 2012	7/26/ 2012	7/29/ 2012	8/01/ 2012	8/04/ 2012	8/07/ 2012	8/10/ 2012	8/13/ 2012	8/16/ 2012	8/19/ 2012	8/22/ 2012	8/25/ 2012	8/28/ 2012
PVCO	1,2,3-Trimethylbenzene	0.176	0.494	0.142	0.214	0.145	ND	0.211	ND	ND	ND	ND	0.128	ND	0.187
PVCO	1,2,4-Trimethylbenzene	0.825	1.96	0.918	0.636	0.809	0.611	0.605	0.252	0.406	0.267	0.435	0.822	0.228	0.951
PVCO	1,3,5-Trimethylbenzene	0.311	0.264	0.415	0.221	0.308	0.391	0.401	0.119	0.26	0.152	ND	0.39	ND	0.356
PVCO	1,3-Butadiene	0.256	0.395	0.369	0.2	0.338	0.203	0.094	0.452	0.5	0.466	0.467	0.804	0.483	0.615
PVCO	1-Decene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PVCO	1-Dodecene	ND	ND	ND	0.392	ND	ND	0.154	0.38	0.402	0.167	0.488	0.371	ND	ND
PVCO	1-Heptene	3.55	2.78	3.06	3.13	2.2	0.821	ND	ND	ND	0.304	0.913	4.25	0.222	4.1
PVCO	1-Hexene	ND	ND	0.131	0.17	ND	ND	0.39	ND	ND	ND	0.207	ND	0.086	0.081
PVCO	1-Nonene	ND	0.312	0.246	0.23	ND	ND	ND	ND	ND	ND	0.096	ND	ND	0.208
PVCO	1-Octene	0.388	0.526	ND	0.534	ND	ND	0.245	ND	ND	ND	0.227	ND	ND	0.426
PVCO	1-Pentene	0.335	0.524	0.263	0.338	0.46	0.114	0.311	0.325	0.394	0.377	0.534	0.484	0.478	0.588
PVCO	1-Tridecene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PVCO	1-Undecene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PVCO	2,2,3-Trimethylpentane	ND	ND	ND	ND	ND	ND	0.532	ND	ND	ND	0.255	0.998	ND	0.81
PVCO	2,2,4-Trimethylpentane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PVCO	2,2-Dimethylbutane	1.92	1.89	2.22	1.9	1.43	0.482	1.34	0.799	2.25	0.298	0.527	2.85	0.201	2
PVCO	2,3,4-Trimethylpentane	0.417	0.464	0.261	0.337	0.34	ND	0.253	0.109	0.207	ND	0.342	0.427	0.116	0.326
PVCO	2,3-Dimethylbutane	5.29	5.05	6.02	5.49	3.73	1.24	3.6	2.13	6.18	0.537	1.19	8.5	0.399	5.82
PVCO	2,3-Dimethylpentane	2.7	2.21	2.44	2.3	1.83	0.673	1.68	0.834	2.19	0.318	0.579	3.32	0.226	2.65
PVCO	2,4-Dimethylpentane	2.08	1.91	2.17	2.04	1.41	0.51	1.42	0.757	2.08	0.203	0.473	2.87	0.184	2.18
PVCO	2-Ethyl-1-butene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.29	ND	ND	ND
PVCO	2-Methyl-1-butene	0.219	ND	0.156	0.133	0.489	ND	ND	ND	ND	0.269	0.243	0.179	ND	0.138
PVCO	2-Methyl-1-pentene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PVCO	2-Methyl-2-butene	0.237	ND	0.247	0.29	0.677	0.168	0.188	ND	ND	0.378	0.273	0.331	0.237	0.336
PVCO	2-Methylheptane	2.44	2	2.83	2.07	1.72	1.2	1.54	0.612	2.02	0.374	0.479	2.85	ND	1.74
PVCO	2-Methylhexane	7.11	9.3	7.95	9.04	5.11	2.29	4.3	2.88	7.28	0.926	3.9	9.91	1.71	7.41
PVCO	2-Methylpentane	32.7	31.7	35.4	33	21.3	6.41	19.5	12.3	36.8	3.52	9.01	50.1	3.55	36.7
PVCO	3-Methyl-1-butene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PVCO	3-Methylheptane	1.52	1.35	1.85	1.4	1.21	0.862	0.994	0.504	1.34	0.232	0.307	1.89	0.115	1.47
PVCO	3-Methylhexane	7.91	6.34	7.33	7.1	4.79	2.36	4.1	3.02	7.22	0.964	1.93	9.81	0.716	7.91
PVCO	3-Methylpentane	17.3	16.5	19	17.5	11.6	3.54	10.7	6.5	19.6	1.93	4.43	26.9	1.23	19.5
PVCO	4-Methyl-1-pentene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PVCO	Acetylene	1.89	0.669	1.15	1.04	2.14	0.481	1.29	0.949	1.53	1.79	0.66	2.6	ND	0.249
PVCO	a-Pinene	0.276	ND	0.233	ND	0.341	ND	0.162	ND	ND	ND	ND	0.246	0.689	1.8
PVCO	Benzene	20.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.167	ND
PVCO	b-Pinene	ND	ND	ND	ND	ND	ND	0.364	ND	ND	ND	ND	ND	ND	ND
PVCO	cis-2-Butene	0.151	0.161	0.176	0.116	0.524	ND	0.306	0.128	0.142	0.263	0.176	0.233	0.152	0.161
PVCO	cis-2-Hexene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PVCO	cis-2-Pentene	ND	ND	ND	ND	0.234	ND	0.225	ND	ND	0.102	ND	0.081	ND	0.077
PVCO	Cyclohexane	13.1	11.6	13.2	12.6	8.12	2.97	8.29	4.48	12.7	1.27	3.17	19.4	0.956	14.6
PVCO	Cyclopentane	7.1	6.24	6.66	6.44	3.88	1.06	4.36	2.31	6.87	0.822	1.68	11.3	0.452	7.84

Site	Analyte	7/20/ 2012	7/23/ 2012	7/26/ 2012	7/29/ 2012	8/01/ 2012	8/04/ 2012	8/07/ 2012	8/10/ 2012	8/13/ 2012	8/16/ 2012	8/19/ 2012	8/22/ 2012	8/25/ 2012	8/28/ 2012
PVCO	Cyclopentene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PVCO	Ethane	277	278	216	262	196	83.1	216	95.3	333	35.9	72.1	500	19.9	340
PVCO	Ethylbenzene	0.871	0.48	0.905	0.676	1.03	0.322	0.48	0.208	0.428	0.212	0.136	0.878	0.098	0.805
PVCO	Ethylene	5.59	8.17	5.36	5.65	6.33	2.69	2.99	2.18	3.4	3.38	2.93	5.8	2	4.23
PVCO	Isobutane	105	90.1	111	95.9	53.7	16.8	71.2	35.2	112	9.75	22.8	183	5.74	125
PVCO	Isobutene/1-Butene	ND	ND	ND	ND	ND	ND	ND	3.62	3.85	ND	5.68	4.33	ND	3.99
PVCO	Isopentane	120	117	137	122	73.2	ND	80.1	44.3	130	12.4	43.5	190	15.4	137
PVCO	Isoprene	2.63	3.56	1.95	2.85	2.02	0.29	2.35	1.15	0.495	0.123	0.205	0.966	0.146	2.08
PVCO	Isopropylbenzene	ND	0.157	ND	0.095	ND	ND	0.247	ND	ND	ND	ND	ND	ND	ND
PVCO	m-Diethylbenzene	0.258	0.898	ND	ND	0.239	0.288	0.262	ND	ND	ND	0.318	ND	ND	ND
PVCO	Methylcyclohexane	15	12.5	15.5	13.6	9.74	5.28	8.61	5.16	13.3	1.5	3.33	19.6	ND	0.606
PVCO	Methylcyclopentane	17.3	15.3	16.9	16.5	10.6	3.46	10.3	6.14	16.7	1.82	3.91	26.1	0.358	3.64
PVCO	m-Ethyltoluene	0.516	ND	0.521	0.368	0.512	0.261	0.369	ND	0.242	0.126	ND	0.491	1.06	15.9
PVCO	m-Xylene/p-Xylene	3.42	2.17	4.18	2.79	4.26	2.3	1.76	0.945	2.24	0.743	0.775	3.84	1.12	19.4
PVCO	n-Butane	259	228	270	238	126	35.9	172	84.3	280	26.5	60.2	420	14.3	309
PVCO	n-Decane	0.723	0.65	0.784	0.564	0.7	0.815	0.551	0.197	0.398	0.221	0.224	0.651	ND	0.596
PVCO	n-Dodecane	0.277	0.467	0.273	0.178	0.296	0.61	0.24	ND	0.11	0.123	0.129	0.237	ND	0.203
PVCO	n-Heptane	10.8	10	12.7	10.8	7.25	3.89	6.55	4.14	10.6	1.2	2.52	15.5	0.765	11.2
PVCO	n-Hexane	38.3	37.9	42	39.3	24.6	7.97	22.4	14.4	42.3	4.15	9.29	58.7	2.79	43.7
PVCO	n-Nonane	1.2	1.1	1.4	0.939	1.06	1.26	0.777	0.353	0.838	0.294	0.304	1.19	0.106	1.08
PVCO	n-Octane	3.95	3.46	4.57	3.41	2.86	2.48	2.27	1.39	3.12	0.748	0.995	4.77	0.391	3.81
PVCO	n-Pentane	114	108	124	112	63.5	16.8	73.1	38	129	12.4	26.7	194	7.22	133
PVCO	n-Propylbenzene	0.244	0.527	0.258	0.31	0.228	ND	0.22	ND	ND	ND	0.085	0.188	ND	0.204
PVCO	n-Tridecane	0.132	ND	0.114	ND	0.139	0.171	ND	ND	ND	ND	ND	0.139	ND	0.121
PVCO	n-Undecane	0.395	0.376	0.546	0.262	0.403	0.526	0.352	0.088	0.215	0.121	0.146	0.323	ND	0.298
PVCO	o-Ethyltoluene	0.34	ND	0.331	ND	0.405	0.219	0.387	ND	ND	ND	ND	0.288	ND	0.329
PVCO	o-Xylene	1.15	0.934	1.14	0.868	1.38	0.589	0.635	0.308	0.604	0.285	0.273	1.15	0.13	1.06
PVCO	p-Diethylbenzene	ND	0.595	ND	ND	ND	ND	0.143	ND	ND	ND	ND	ND	ND	ND
PVCO	p-Ethyltoluene	0.376	ND	0.571	0.271	0.356	0.23	0.39	ND	0.173	ND	ND	0.332	ND	0.417
PVCO	Propane	393	331	382	341	204	68.5	271	128	406	38.5	92.8	658	21.2	474
PVCO	Propylene	1.71	2.98	1.61	2.12	1.59	0.549	1.4	0.975	1.44	0.839	2	2.38	1.06	1.8
PVCO	Propyne	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PVCO	Styrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PVCO	Toluene	8.89	7.87	10.1	8.52	7.49	3.81	4.74	2.79	7.07	1.51	2.4	11.7	1.01	8.78
PVCO	trans-2-Butene	0.243	0.203	0.211	0.286	0.574	ND	0.299	ND	ND	0.23	0.36	0.236	0.302	0.203
PVCO	trans-2-Hexene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PVCO	trans-2-Pentene	0.353	0.283	0.23	0.278	0.57	ND	0.309	ND	0.272	0.227	0.168	0.333	0.108	0.32
PVCO	SNMOC (Sum of	1510	1370	1480	1390	876	285	1020	508	1610	169	397	2470	108	1750
PVCO	Sum of Unknowns	113	264	213	178	112	90.5	57	63.6	73.5	57.5	163	121	76.2	138
PVCO	TNMOC	1630	1630	1690	1570	989	376	1080	572	1680	227	560	2590	184	1880

Site Notes

			E1CO			E2CO			
Sample Time	**Weekday**	**Sample Date**	**SNMOC (ppbC)**	**Sum of Unknowns (ppbC)**	**TNMOC (ppbC)**	**SNMOC (ppbC)**	**Sum of Unknowns (ppbC)**	**TNMOC (ppbC)**	**Notes**
06:00-09:00*	Friday	7/20/2012	283	157	440	1,740	3,700	5,440	* = review of BAO met data indicates elevation concentrations at E2CO site are from Easterly direction, not from rig.
06:00-09:00	Monday	7/23/2012	226	126	353	134	190	325	
06:00-09:00*	Thursday	7/26/2012	148	104	252	110	100	209	* = drilling rig out. Completion equipment being set up.
06:00-09:00	Sunday	7/29/2012	327	80	407	180	98	278	
06:00-09:00*	Wednesday	8/1/2012	393	153	546	376	231	607	* = appears completions have begun. Diesel engines are running and cranes are gone.
06:00-09:00	Friday	8/3/2012	187	112	299	153	175	327	
08:00-11:00	Saturday	8/4/2012	67	84	151	40	91	131	
08:00-11:00	Monday	8/6/2012	100	84	184	61	154	215	
06:00-09:00*	Tuesday	8/7/2012	482	49	531	265	78	342	* = Heavy equipment on site moving lots of dirt. 5-6 trucks in/out in ~40 minutes.
06:00-09:00*	Wednesday	8/8/2012	578	101	678	369	84	453	* = completions "rig" up. Heavy equipment moving dirt.
06:00-09:00*	Thursday	8/9/2012	191	44	234	194	139	334	* = engines running at 04:15.
06:00-09:00*	Friday	8/10/2012	77	77	153	129	53	182	* = heavy equipment in operation near E1CO sampler. Wind from WNW-W.
06:00-09:00*	Saturday	8/11/2012	349	71	419	480	160	640	* = heavy equipment in operation near E1CO sampler.
06:00-09:00*	Sunday	8/12/2012	95	107	202	101	8	109	* = heavy equipment in operation near E1CO sampler. Big hole 50' away with new valve installed. "tie in"
06:00-09:00*	Monday	8/13/2012	449	153	602	299	51	350	* = heavy equipment in operation near E1CO sampler.
06:00-09:00*	Thursday	8/16/2012				95	171	266	* = E1CO duplicate samples rejected by lab b/c vacuum was too high. Flow not set high enough on passive sampler.
06:00-09:00*	Sunday	8/19/2012	95	74	169				* = E2CO sample did not run. Clear lubricant type substance found smeared around inlet to sampler.
06:00-09:00*	Wednesday	8/22/2012	340	98	438	416	124	539	* = very smoky and hazy from fires in pacific NW.
06:00-09:00	Saturday	8/25/2012	119	82	201	113	88	200	

BAO Wind Data Used

Time (MST)	7/20/ 2012	7/23/ 2012	7/26/ 2012	7/29/ 2012	8/01/ 2012	8/03/ 2012	8/4/2012 (08:00-10:59)	8/6/2012 (08:00-10:59)	8/07/ 2012	8/08/ 2012	8/09/ 2012	8/10/ 2012	8/11/ 2012	8/12/ 2012	8/13/ 2012	8/16/ 2012	8/19/ 2012	8/22/ 2012	8/25/ 2012
06:00	112.2	264.3	267.5	243.6	32.8	179.1	173.7	240.6	222.4	216.3	305.6	279.5	285.5	235.8	277.1	132.9	298.5	240.6	19.5
06:01	112.6	268.1	257.1	243.6	32.5	179.3	171.1	244.8	222.2	215.9	305.8	280.3		239.3	281.9	127.8	301.3	241.9	12.3
06:02	105.7	274.1	230.4	245.1	54.1	177.1	197.0	242.4	221.9	215.2	304.1	283.8	350.1	239.2	288.9	126.8	306.5	241.7	14.6
06:03	106.9	273.7	210.6	242.8	69.9	175.3	191.8	249.4	220.3	213.4	301.8	275.3	345.7	243.1	293.0	126.5	311.0	239.7	14.4
06:04	109.8	275.8	209.1	237.7	74.7	177.5	185.5	221.6	220.8	213.9	300.6	273.8	327.2	247.2	289.7	134.0	311.5	239.5	20.6
06:05	106.9	276.2	217.7	234.9	76.7	176.4	215.3	246.7	219.2	212.1	298.7	267.2	297.5	245.9	287.3	127.2	308.7	238.6	13.1
06:06	103.7	271.9	227.7	235.1	87.8	177.9	221.8	254.0	216.7	212.8	298.2	262.0	255.4	241.8	286.4	134.0	308.5	231.6	19.4
06:07	106.6	271.8	241.2	240.1	92.1	179.9	235.2	222.3	217.2	213.8	297.4	264.1	250.2	240.9	285.7	131.3	309.1	234.4	15.4
06:08	115.9	275.6	248.2	249.7	85.9	179.8	247.3	233.2	218.3	211.8	299.3	265.6	250.0	242.6	281.9	123.6	314.4	237.3	17.1
06:09	120.3	269.5	260.4	250.8	78.0	183.7	219.6	215.2	216.7	210.5	298.4	262.1	252.6	243.1	278.9	137.4	316.5	241.1	13.7
06:10	122.9	263.3	253.3	253.5	74.1	184.2	209.2	250.7	217.8	209.2	294.9	260.6		242.3	279.5	139.0	318.3	245.1	18.1
06:11	130.5	264.6	248.0	256.8	76.7	182.2	184.7	268.6	216.6	207.9	292.3	264.5		239.9	276.7	139.5	322.6	252.2	16.1
06:12	122.1	268.4	251.9	261.4	81.1	184.1	198.7	267.3	214.7	210.4	291.9	261.5		240.4	278.8	143.9	324.7	255.4	13.1
06:13	114.2	273.8	246.5	265.3	82.8	183.6	184.6	263.0	214.4	215.7	296.4	261.8	253.3	239.8	278.6	138.9	328.0	256.2	20.6
06:14	110.1	274.8	250.7	266.0	87.0	180.8	115.4	256.3	216.9	222.3	303.9	257.3	243.4	238.1	282.4	131.4	327.1	255.1	14.4
06:15	105.2	275.7	247.1	269.3	91.6	185.0	194.8	242.6	216.6	224.3	304.3	253.3	229.9	237.9	279.2	137.7	328.2	254.7	19.8
06:16	95.4	285.8	253.0	274.2	85.4	182.7	203.6	243.1	216.3	227.7	303.7	247.2	214.7	238.3	274.8	132.6	327.1	260.1	17.8
06:17	92.6	279.3	249.8	277.0	83.4	183.1	195.7	231.7	214.9	224.1	301.3	248.3	209.1	239.0	278.5	132.0	326.4	261.2	16.4
06:18	82.1	291.0	254.2	274.0	80.1	181.1	186.6	242.9	212.3	223.4	307.9	244.1	214.0	238.6	274.6	128.9	328.0	258.2	20.8
06:19	81.1	287.2	256.2	272.0	79.5	180.8	214.0	254.4	207.8	221.1	311.9	251.1	204.7	240.6	275.5	127.1	328.2	247.6	14.1
06:20	75.8	292.3	256.4	269.8	82.7	182.8	247.9	260.8	204.2	220.7	316.2	246.1	203.5	241.5	275.4	115.2	324.5	241.3	8.2
06:21	89.1	298.9	255.1	271.6	80.1	183.9	255.7	274.4	204.8	221.2	314.1	242.0		240.8	279.8	128.6	330.5	245.8	11.9
06:22	96.7	284.9	262.1	267.7	83.1	186.0	245.6	259.0	207.6	218.8	312.0	242.8		241.0	281.2	127.1	334.6	249.1	14.3
06:23	97.9	289.5	266.5	270.3	82.9	180.9	165.4	261.5	205.3	219.7	309.8	241.7		238.3	289.5	125.9	326.6	248.9	11.9
06:24	93.0	291.8	267.7	270.8	82.8	182.1	157.2	266.0	203.0	228.4	305.3	239.4	183.8	235.2	295.8	137.3	326.4	244.7	14.9
06:25	87.2	296.8	264.0	269.3	83.1	183.4	144.5	270.9	204.4	225.2	312.1	239.9	196.6	230.8	293.6	131.9	331.4	239.2	14.1
06:26	91.4	304.9	257.0	277.5	83.6	184.0	146.7	271.8	205.8	232.8	312.1	236.5	181.9	230.2	297.7	131.3	332.8	239.5	8.5
06:27	101.1	312.5	258.0	277.2	84.8	182.1	171.6	281.9	206.4	237.1	310.0	237.3	175.4	226.4	308.4	130.8	332.0	240.4	8.2
06:28	107.8	311.9	253.1	271.9	86.0	177.8	209.9	285.8	206.9	239.3	316.9	241.9	163.3	227.2	316.3	132.2	329.9	232.7	16.8
06:29	101.0	305.1	255.5	272.1	87.2	177.2	165.1	180.6	203.4	237.8	317.7	261.5	168.4	227.1	313.5	126.2	336.3	222.9	14.3
06:30	98.4	313.0	258.5	271.9	86.3	176.3	133.9	169.7	203.6	231.8	319.2	265.6	168.2	228.0	309.7	132.8	335.4	220.5	14.4
06:31	98.3	317.8	261.2	273.5	88.8	179.2	163.8	228.4	206.3	234.5	324.7	256.4	178.0	227.1	309.8	121.9	339.3	219.3	12.9

Time (MST)	7/20/ 2012	7/23/ 2012	7/26/ 2012	7/29/ 2012	8/01/ 2012	8/03/ 2012	8/4/2012 (08:00-10:59)	8/6/2012 (08:00-10:59)	8/07/ 2012	8/08/ 2012	8/09/ 2012	8/10/ 2012	8/11/ 2012	8/12/ 2012	8/13/ 2012	8/16/ 2012	8/19/ 2012	8/22/ 2012	8/25/ 2012
06:32	106.0	318.1	259.1	276.1	85.1	189.1	179.1	226.3	208.6	235.4	320.4	259.0	168.4	228.1	307.4	128.5	330.1	223.1	11.2
06:33	72.7	319.6	261.1	266.8	85.8	188.1	185.3	251.7	207.8	237.8	312.3	227.8	178.4	228.8	309.6	125.6	324.4	238.6	23.0
06:34	96.1	316.7	263.5	269.6	86.2	186.9	183.5	227.6	207.8	238.3	308.7	299.0	187.8	226.2	318.7	137.2	325.4	232.2	22.8
06:35	115.8	321.2	263.6	271.1	90.7	187.8	187.1	232.9	209.4	237.2	317.3	291.5	193.3	224.5	320.6	138.7	337.8	232.6	16.8
06:36	51.7	322.2	275.6	269.6	100.1	183.4	170.8	242.4	209.4	234.2	320.0	273.6	202.8	227.7	318.7	140.1	339.8	239.7	13.9
06:37	9.2	317.3	272.8	270.8	103.1	184.8	212.8	247.4	210.8	231.6	324.7	274.9	207.7	226.5	326.8	141.3	330.3	---	14.3
06:38	330.3	317.6	269.8	276.5	109.0	190.9	226.3	342.5	204.5	231.9	316.9	267.8	208.8	226.1	331.8	138.0	337.6	---	11.9
06:39	308.8	314.8	269.5	281.2	120.2	191.4	221.6	258.4	206.2	225.3	312.6	292.6	210.3	227.6	335.6	142.5	336.9	---	7.0
06:40	325.8	312.5	275.2	284.8	132.7	185.3	206.7	248.4	208.1	228.6	314.1	286.5	216.3	228.6	332.2	133.8	330.9	299.1	4.5
06:41	3.7	303.1	272.5	278.9	144.2	181.8	211.4	256.9	209.2	233.4	324.1	301.9	211.3	232.4	331.9	134.0	335.0	316.4	13.4
06:42	6.2	308.1	265.5	275.4	150.0	187.7	225.8	249.5	211.0	239.6	322.4	244.8	202.3	233.4	336.0	131.6	328.7	320.5	21.8
06:43	356.6	314.9	266.6	274.3	146.4	185.2	219.4	256.3	211.4	237.6	325.8	236.0	198.2	232.3	348.1	125.4	332.7	321.6	11.0
06:44	334.5	310.5	266.4	276.5	158.6	188.0	197.4	251.0	215.5	250.4	331.8	249.2	184.9	230.2	343.2	132.9	346.1	325.8	8.9
06:45	348.1	313.5	265.7	276.0	163.8	189.1	220.5	233.6	219.9	257.8	331.1	287.8	186.5	232.4	329.2	132.1	343.8	308.0	11.7
06:46	2.1	309.0	258.6	278.7	164.3	182.7	226.5	187.4	217.0	239.9	327.7	303.5	208.5	229.2	333.2	126.8	348.9	314.5	8.6
06:47	358.9	308.6	254.9	283.3	177.7	182.9	236.3	220.3	219.4	209.4	329.9	304.7	239.6	220.0	329.3	131.5	354.1	294.3	8.1
06:48	350.6	314.2	259.6	275.2	186.2	185.2	202.0	268.1	221.5	222.6	327.3	305.7	287.4	219.7	337.0	129.9	344.9	301.6	13.9
06:49	348.2	309.2	265.1	283.3	186.3	181.6	208.0	258.0	228.3	231.9	331.9	295.8	325.1	212.7	327.7	129.8	336.1	291.9	10.1
06:50	329.9	304.8	264.0	282.9	183.5	181.7	221.6	248.7	229.4	241.2	322.5	347.5	334.0	220.5	326.2	124.8	350.1	307.3	13.2
06:51	334.4	302.1	263.2	276.6	186.1	183.8	246.0	235.4	230.6	254.3	326.3	358.3	343.8	211.6	337.6	133.6	347.6	311.1	10.3
06:52	328.2	309.6	257.8	277.5	195.5	187.6	213.7	249.4	231.7	238.8	329.5	9.3	335.6	208.9	348.7	137.3	354.7	284.6	12.5
06:53	339.7	313.8	271.3	281.6	186.2	190.0	227.6	277.2	229.8	222.5	334.0	0.2	336.5	210.4	333.6	144.3	358.1	308.5	13.1
06:54	340.9	300.7	272.8	281.2	194.6	188.8	239.8	298.2	229.9	213.5	339.6	352.0	345.2	208.5	347.4	137.5	341.9	339.1	12.1
06:55	299.6	304.3	268.3	270.6	186.0	191.1	208.7	256.0	227.8	213.9	344.9	330.3	347.6	210.8	329.5	140.0	347.3	299.2	13.2
06:56	316.0	309.3	271.0	277.6	179.8	188.3	177.8	233.7	225.2	202.2	350.8	343.9	343.0	211.4	332.0	137.3	356.5	308.5	9.4
06:57	309.5	311.0	256.1	285.6	187.0	188.1	160.3	249.9	226.0	168.2	354.3	314.2	357.3	206.4	320.8	138.5	353.4	302.8	6.2
06:58	345.3	309.1	262.0	281.8	183.4	193.2	214.8	242.5	213.4	163.9	356.6	320.2	0.7	208.4	326.0	134.1	337.0	321.1	4.7
06:59	332.1	308.9	258.1	278.5	180.6	189.3	176.8	230.7	210.3	172.5	357.1	326.4	358.0	214.6	324.1	129.5	332.8	316.2	11.1
07:00	347.8	310.0	264.1	274.1	177.3	186.0	154.4	199.8	209.2	145.1	348.4	353.6	358.7	215.8	324.0	126.8	355.4	310.2	8.0
07:01	335.2	310.2	265.2	275.3	177.8	185.4	148.4	247.3	212.5	152.3	328.6	344.1	1.2	211.1	330.4	130.6	358.4	308.3	10.3
07:02	353.2	320.6	267.7	270.3	177.7	188.2	160.7	246.0	222.6	145.5	338.9	327.9	11.7	214.6	332.0	130.0	323.5	314.1	9.9
07:03	13.2	306.9	263.6	287.1	171.7	192.9	167.6	262.3	216.4	149.6	348.3	348.7	9.3	218.6	335.1	133.6	326.3	308.2	10.5
07:04	15.5	308.2	262.3	295.9	178.8	189.8	171.3	277.4	224.5	173.8	343.5	345.3	12.6	209.9	349.9	128.5	349.7	313.2	10.3
07:05	27.3	296.4	268.0	283.3	182.9	190.4	207.3	266.1	222.4	188.4	354.1	350.2	16.9	207.5	347.6	132.3	351.6	315.0	2.2

Time (MST)	7/20/ 2012	7/23/ 2012	7/26/ 2012	7/29/ 2012	8/01/ 2012	8/03/ 2012	8/4/2012 (08:00-10:59)	8/6/2012 (08:00-10:59)	8/07/ 2012	8/08/ 2012	8/09/ 2012	8/10/ 2012	8/11/ 2012	8/12/ 2012	8/13/ 2012	8/16/ 2012	8/19/ 2012	8/22/ 2012	8/25/ 2012
07:06	27.8	311.6	280.3	271.5	179.9	187.9	178.4	235.9	217.7	214.7	326.1	352.4	22.1	216.1	357.9	133.6	349.6	306.4	10.3
07:07	18.3	308.1	278.0	283.7	179.2	191.4	176.0	250.5	219.7	241.1	331.4	355.0		215.7	332.6	125.4	328.3	334.4	6.6
07:08	13.1	301.6	297.2	273.1	175.6	198.9	173.0	259.9	217.0	250.6	354.1	342.0	279.4	216.0	336.9	124.4	336.3	324.8	6.5
07:09	27.2	310.9	294.4	272.3	170.0	205.7	148.2	260.7	201.4	255.6	335.5	354.2	282.9	211.8	342.1	117.7	340.1	329.1	11.9
07:10	38.4	307.8	318.3	280.5	161.5	206.9	135.5	247.6	197.1	243.1	337.4	314.9	278.3	202.9	331.5	134.6	355.6	324.9	11.6
07:11	40.3	310.3	309.3	304.9	165.7	205.2	143.8	242.0	199.0	231.2	339.5	326.2	277.1	205.8	322.4	139.3	353.5	325.9	10.9
07:12	27.5	317.6	318.4	303.5	157.5	198.6	131.8	290.2	198.1	219.8	342.8	327.9	249.0	205.9	324.6	137.7	351.5	311.7	358.4
07:13	16.3	308.9	337.3	317.6	153.5	194.7	169.0	318.9	200.6	213.1	340.6	332.7	229.2	207.2	324.8	129.4	353.5	321.6	360.0
07:14	12.5	309.0	311.4	287.6	164.6	195.4	172.6	298.3	199.2	189.7	351.8	326.9	222.2	214.6	319.0	135.1	353.9	333.7	2.6
07:15	1.7	306.2	307.0	306.4	150.6	201.1	159.2	10.9	201.5	61.4	356.1	326.2	258.6	209.1	322.3	131.9	355.6	320.1	10.6
07:16	359.0	305.7	302.3	305.4	148.5	205.2	194.4	337.9	200.7	56.8	344.7	322.2	292.4	208.9	322.3	132.1	337.6	324.6	6.5
07:17	349.1	304.6	271.4		147.8	204.2	192.9	29.3	206.4	63.1	354.4	314.8	287.6	208.7	325.2	129.8	0.4	328.1	2.4
07:18	344.1	321.4	255.1	2.4	151.1	199.9	206.0	32.5	206.9	78.8	358.3	321.1	294.6	211.7	328.0	135.1	359.2	312.2	4.4
07:19	325.7	317.8	228.3	7.3	165.2	201.1	193.6	43.8	196.8	89.0	349.1	312.5		211.0	330.4	136.6	357.1	294.6	358.3
07:20	49.6	318.0	258.6	18.3	168.5	198.9	218.7	72.2	195.8	117.0	351.8	315.7	224.0	210.5	329.9	132.8	353.7	300.8	6.4
07:21	34.2	321.3	278.8	29.2	160.9	201.2	291.5	26.4	185.9	137.8	345.5	302.3	221.9	213.3	323.2	127.8	10.4	336.6	0.3
07:22	40.2	315.2	257.3	41.5	161.1	198.5	345.3	6.0	187.7	163.5	344.5	303.8		215.5	326.1	135.9	355.0	287.5	2.6
07:23	36.3	313.1	274.9	32.7	153.4	194.7	333.1	1.3	175.1	155.7	348.2	305.7	224.0	214.5	314.7	130.5	358.8	309.5	4.8
07:24	29.3	303.1	255.3	15.4	162.9	201.0	210.5	5.0	176.0	134.3	345.5	310.2	234.0	218.3	320.2	138.1	358.9	320.8	4.1
07:25	39.0	302.5	257.7	326.0	167.1	202.9	174.3	349.3	184.1	116.9	332.6	311.1	236.6	211.5	317.6	139.3	355.6	311.9	7.3
07:26	43.1	298.7	252.8	311.6	168.2	205.7	151.0	323.6	179.7	122.1	339.3	320.7	238.5	214.2	313.8	129.2	357.3	317.4	3.5
07:27	30.4	303.1	256.5	288.0	171.1	210.3	183.3	348.1	160.1	129.0	358.7	335.4	260.8	210.1	323.9	126.6	3.8	328.5	6.0
07:28	29.3	296.9	252.0	295.2	162.8	211.2	169.7	4.6	165.5	120.1	4.3	357.2	268.5	204.6	326.3	126.6	3.3	348.6	359.8
07:29	27.5	327.2	241.8	309.3	174.8	206.5	128.4	22.8	157.8	114.3	11.5	343.1	278.6	215.7	331.1	134.2	357.8	320.6	5.5
07:30	2.0	313.4	237.9	311.6	170.1	214.6	140.0	347.5	151.5	122.8	352.4	332.1	289.3	213.2	336.8	143.7	351.7	326.5	1.3
07:31	359.4	297.4	247.7	308.7	175.2	218.3	176.2	324.6	177.1	113.2	349.9	332.1	286.1	219.2	317.2	150.3	359.2	312.6	359.6
07:32	19.9	318.4	241.2	342.5	187.9	221.4	163.0	334.0	161.6	123.8	336.0	333.2	281.3	215.0	314.6	147.5	359.0	317.3	354.0
07:33	18.6	322.3	229.3	11.0	173.2	219.0	164.0	323.1	146.0	133.0	345.4	342.4	281.5	215.1	312.2	151.9	0.3	314.8	8.2
07:34	8.1	334.4	283.9	30.2	165.4	222.7	174.7	1.6	149.6	153.7	325.7	326.2	295.6	210.6	316.9	150.1	348.5	356.1	7.1
07:35	3.0	323.4	281.7	46.1	154.9	230.6	187.3	10.7	141.7	154.8	314.5	342.5	313.0	205.7	324.8	149.8	355.9	343.1	10.3
07:36	16.7	308.2	292.5	48.8	158.7	224.2	191.6	338.9	152.6	195.9	329.3	319.8	323.1	204.6	340.7	142.3	357.3	350.1	6.4
07:37	5.7	324.8	288.7	44.8	139.1	223.5	126.7	326.0	171.4	245.3	346.3	326.1	347.0	207.6	336.8	140.5	352.1	317.6	8.7
07:38	5.5	317.8	312.9	55.1	139.6	233.6	111.9	299.1	143.9	223.8	324.6	350.4	346.6	218.1	331.0	124.9	353.8	314.8	1.0
07:39	3.7	318.0	310.3	64.5	141.5	215.0	96.2	258.2	125.5	202.4	319.8	5.3	328.9	223.5	344.0	130.9	353.4	333.0	2.7

Time (MST)	7/20/ 2012	7/23/ 2012	7/26/ 2012	7/29/ 2012	8/01/ 2012	8/03/ 2012	8/4/2012 (08:00-10:59)	8/6/2012 (08:00-10:59)	8/07/ 2012	8/08/ 2012	8/09/ 2012	8/10/ 2012	8/11/ 2012	8/12/ 2012	8/13/ 2012	8/16/ 2012	8/19/ 2012	8/22/ 2012	8/25/ 2012
07:40	5.4	316.4	316.2	56.6	143.0	219.7	100.3	88.2	118.5	217.8	353.2	339.7	331.7	221.1	356.9	115.7	352.0	333.4	6.7
07:41	23.5	318.7	1.3	49.2	148.8	226.6	88.1	78.5	117.4	212.4	6.4	320.5	330.0	216.9	347.7	125.1	1.7	324.7	4.4
07:42	20.2	320.8	325.6	78.6	150.3	219.3	111.1	62.0	134.5	229.0	356.8	325.5	327.3	216.8	352.9	138.5	350.0	28.4	0.4
07:43	27.7	310.8	0.8	15.5	149.9	203.5	161.9	98.9	94.8	208.6	334.0	336.6	343.6	219.1	350.2	155.5	349.1	303.1	3.1
07:44	18.4	314.7	19.8	5.9	146.4	207.3	163.5	109.2	83.3	211.4	314.6	347.1	314.0	222.4	324.4	148.2	352.8	310.7	359.8
07:45	24.5	309.0	15.2	6.4	151.8	211.4	138.1	121.8	68.2	205.9	323.2	354.5	301.9	225.4	328.5	157.7	356.9	321.0	358.4
07:46	7.5	313.8	315.9	349.8	159.8	207.6	136.7	112.1	69.6	210.7	337.3	5.4	311.5	225.9	341.7	145.0	0.3	287.0	3.9
07:47	11.7	312.7	305.9	5.0	145.9	213.5	149.1	113.0	54.9	231.0	330.5	357.4	305.1	226.4	346.6	127.6	355.0	304.2	5.6
07:48	3.5	312.7	292.9	43.3	134.9	233.0	181.4	114.7	113.6	247.8	313.2	356.2	305.6	223.9	359.2	116.4	359.4	311.9	8.4
07:49	24.4	325.3	12.2	357.4	134.8	227.3	164.7	114.2	93.1	209.2	321.0	330.1	297.7	217.9	350.2	115.3	358.1	327.6	359.6
07:50	19.0	328.1	4.4	347.7	136.9	220.8	169.5	101.6	100.8	188.2	320.2	340.5	281.4	218.2	347.3	118.1	0.9	---	1.1
07:51	24.5	347.5	1.0	271.3	129.7	229.3	146.7	113.0	106.2	142.4	334.3	329.3	275.1	218.6	324.5	122.6	351.1	300.4	0.4
07:52	48.6	326.3	2.8	269.0	145.3	233.7	161.9	116.0	80.6	181.2	342.5	358.8	293.8	217.5	322.8	118.1	350.8	322.4	1.0
07:53	43.1	356.4	7.1	304.5	146.0	241.6	140.6	105.3	76.4	206.7	328.3	23.8	322.0	217.3	350.3	127.0	348.8	320.0	6.9
07:54	21.0	352.2	14.0	297.1	148.1	233.9	124.1	91.4	109.5	150.6	322.2	18.5	298.4	223.0	349.8	133.3	350.2	319.0	10.1
07:55	11.9	350.7	338.4	49.4	132.7	233.2	144.6	86.3	110.0	169.1	338.5	320.8	301.5	221.4	355.9	127.8	346.8	300.6	7.7
07:56	21.2	333.2	31.4		149.8	235.8	151.0	59.9	102.9	212.2	330.6	319.4	300.3	222.7	351.1	132.6	346.1	253.3	12.0
07:57	32.8	318.9	35.4	74.1	156.0	241.4	119.0	77.3	99.3	251.6	356.8	336.0	299.8	223.8	342.1	130.9	353.3	242.8	358.1
07:58	57.8	308.9	45.1	94.3	143.9	250.2	145.6	48.0	114.4	202.2	343.5	319.4	311.5	226.7	346.1	114.1	358.7	231.2	3.4
07:59	81.0	350.9	72.3	81.5	147.3	244.6	222.2	25.3	111.5	181.2	336.3	335.4	319.7	220.2	338.0	116.3	350.3	207.1	0.5
08:00	50.9	327.9	84.7	90.8	151.4	245.9	196.2	22.2	126.2	210.6	330.1	332.7	314.8	216.9	337.8	120.4	355.9	284.3	8.9
08:01	37.0	309.1	32.2	98.4	153.9	237.4	163.3	38.0	112.8	195.9	306.4	347.5	288.0	230.3	349.1	121.4	342.7	311.7	11.6
08:02	61.0	306.8	20.0	90.2	153.4	238.7	150.9	49.6	106.8	204.5	313.7	327.3	294.2	226.3	352.1	130.6	348.8	309.2	15.3
08:03	77.2	310.4	25.2	97.0	141.6	242.6	146.3	48.9	105.7	184.9	312.4	8.0	297.6	211.7	344.6	141.1	342.5	189.6	6.4
08:04	71.0	1.5	42.8	81.6	135.3	252.4	153.3	46.8	101.4	190.1	315.6	6.5	283.7	202.0	352.4	129.0	352.4	170.4	1.3
08:05	60.1	1.6	47.3	55.6	144.8	253.3	129.7	54.4	97.9	197.8	321.1	14.4	295.5	206.6	357.0	130.7	2.9	201.1	357.2
08:06	87.0	20.7	27.6	54.1	133.6	256.0	128.7	41.1	95.9	229.7	319.3	2.2	297.0	198.4	333.5	124.4	350.0	211.7	359.2
08:07	111.4	21.6	24.2	23.4	132.3	236.5	118.6	30.4	99.0	223.4	316.9	10.4	299.6	201.5	334.4	146.8	352.0	196.9	5.1
08:08	106.2	36.0	38.8	16.2	129.3	224.8	107.5	28.3	99.4	233.5	327.0	21.1	278.0	200.2	347.1	136.6	348.5	188.0	0.5
08:09	95.3	53.0	23.2	12.6	144.8	241.0	108.1	34.5	101.0	224.8	346.1	15.3	278.7	219.8	0.8	117.5	4.0	158.4	8.2
08:10	62.8	61.7	28.0	33.2	132.3	224.6	88.7	57.4	85.6	209.4	325.7	322.3	288.6	218.1	339.0	118.6	8.1	---	13.2
08:11	45.3	80.6	48.5	37.5	127.4	224.0	100.6	84.4	83.6	194.8	350.7	320.9	286.7	213.6	325.0	123.7	5.7	110.2	1.3
08:12	97.4	100.1	32.4	28.4	148.4	212.8	109.8	76.6	88.5	205.1	4.5	309.3	283.5	222.7	331.1	121.0	2.5	89.3	10.5
08:13	105.2	19.8	32.3	36.9	130.7	224.3	110.6	48.7	83.1	247.1	341.6	311.4	287.2	201.4	334.9	125.0	360.0	108.3	9.4

Time (MST)	7/20/ 2012	7/23/ 2012	7/26/ 2012	7/29/ 2012	8/01/ 2012	8/03/ 2012	8/4/2012 (08:00-10:59)	8/6/2012 (08:00-10:59)	8/07/ 2012	8/08/ 2012	8/09/ 2012	8/10/ 2012	8/11/ 2012	8/12/ 2012	8/13/ 2012	8/16/ 2012	8/19/ 2012	8/22/ 2012	8/25/ 2012
08:14	82.8	47.6	39.4	358.0	152.3	224.9	97.1	44.7	80.9	246.8	325.4	341.6	258.5	218.3	334.9	143.8	2.4	117.5	7.2
08:15	56.8		39.9	17.1	157.2	237.6	124.6	44.6	81.0	244.4	343.7	6.1	267.0	217.6	326.0	140.3	359.4	218.5	9.5
08:16	53.1	331.3	50.1	0.9	157.3	237.5	164.8	11.6	74.0	256.8	350.9	12.4	266.9	205.9	349.4	122.9	4.1	240.4	6.5
08:17	26.7	333.1	64.3	324.8	151.9	274.7	148.1	6.4	84.4	254.9	1.5	19.0	256.9	200.0	357.3	113.7	359.5	217.4	3.5
08:18	23.9	325.1	48.7	325.7	145.3	249.9	158.6	359.0	97.2	221.2	355.2	20.3	237.5	222.1	354.0	125.1	1.4	81.2	1.3
08:19	27.4		44.4	295.8	134.5	259.4	184.9	36.2	89.5	211.1	340.6	346.3	219.5	214.9	3.9	138.3	355.4	33.6	1.7
08:20	30.7	55.6	21.0	280.9	139.1	233.1	165.4	40.8	105.8	242.8	310.8	309.9	214.8	196.4	3.8	146.4	355.2	7.0	1.4
08:21	54.9	41.2	12.5	262.9	143.9	242.6	157.1	54.1	104.3	243.4	343.7	269.6	254.8	218.4	6.2	141.0	5.2	8.3	8.9
08:22	36.9	33.3	4.7	326.3	121.3	249.5	139.7	53.0	88.3	240.1	328.7	253.7	319.9	232.2	359.2	138.0	7.2	17.4	3.5
08:23	72.3	39.3	357.9	10.9	106.7	237.7	149.2	67.7	102.9	199.4	307.6	309.4		210.5	355.9	135.4	348.3	18.2	5.9
08:24	55.2	46.4	24.5	39.5	117.4	228.2	156.9	52.0	85.7	190.0	308.8	306.3		228.5	358.1	124.6	352.3	13.0	4.3
08:25	49.1	51.4	41.1	322.2	113.1	216.3	202.6	47.5	88.5	188.9	307.6	310.9	359.6	230.0	2.5	118.8	2.2	348.5	11.3
08:26	71.1	58.3	46.7	325.4	105.2	202.2	219.9	56.0	131.0	194.5	309.0	263.5	15.3	184.6	3.7	108.3	343.7	331.7	3.6
08:27	82.1	75.0	46.1	301.2	126.6	218.6	244.9	72.7	87.0	209.5	318.8	279.2	42.6	182.4	9.1	114.0	358.3	320.4	13.4
08:28	94.0	337.2	22.8	284.1	137.0	225.2	249.1	60.8	84.8	178.9	325.2	273.8	45.1	207.9	2.8	114.9	339.8	16.3	10.1
08:29	79.1	318.1	3.3	282.7	147.4	240.9	217.0	50.9	75.0	188.0	313.7	269.5	44.1	211.4	2.3	152.7	334.3	2.9	3.3
08:30	73.4	331.4	36.2	294.3	137.2	213.5	135.9	42.8	93.8	259.6	313.1	304.1		209.7	5.8	153.0	333.4	5.5	7.1
08:31	85.0	337.3	49.2	300.7	133.7	203.1	125.1	45.8	65.9	273.6	300.5	327.0		203.6	2.1	151.6	342.8	359.8	2.1
08:32	65.2	329.6	28.5	312.7	141.0	202.3	128.6	45.6	100.3	266.6	340.5	297.3	157.4	124.2	349.5	163.0	347.2	4.6	1.7
08:33	104.3	1.4	43.4	333.2	146.4	208.6	143.8	44.5	91.2	279.5	329.4	308.3	206.1	180.7	359.3	154.6	346.3	50.6	15.1
08:34	121.4	343.2	47.7	323.7	128.3	183.1	148.1	23.4	58.8	269.9	317.5	295.8	216.5	175.5	356.7	127.7	341.1	34.8	14.9
08:35	107.7	358.3	44.6	308.7	111.7	182.0	128.8	49.3	59.3	283.4	321.8	279.9	218.6	169.9	0.4	123.5	330.8	32.0	7.1
08:36	116.0	18.4	37.8	314.1	103.8	197.4	124.0	26.4	54.5	293.3	313.1	284.9	271.9	145.2	357.5	123.4	326.8	56.7	15.3
08:37	94.6	21.9	44.3	319.0	88.2	195.7	120.5	56.2	65.1	307.9	7.8	39.2	255.0	118.4	355.2	126.6	328.7	97.7	20.4
08:38	95.9	32.6	45.9	339.9	113.6	228.1	131.9	55.0	86.0	297.8	353.8	205.2	263.3	100.5	6.6	114.4	329.4	84.9	15.0
08:39	125.8	29.1	54.6	0.6	97.4	227.4	152.7	49.9	98.1	257.6	11.8	192.4	285.1	66.3	3.9	119.3	328.7	138.3	357.9
08:40	101.5	19.3	74.2	20.0	93.3	207.8	139.4	59.4	104.2	238.9	6.8	219.2	277.5	60.0	3.4	117.2	327.4	132.6	12.0
08:41	116.8	10.6	54.5	321.3	135.5	213.4	121.5	54.6	83.6	253.8	3.2	255.6	251.4	57.5	358.5	126.9	325.9	125.1	6.5
08:42	78.2	18.4	59.0	348.3	112.0	252.7	116.0	59.3	80.7	261.0	15.7	208.8	255.2	77.5	11.5	130.5	336.1	147.0	5.6
08:43	65.2	21.7	87.7	340.6	136.3	233.6	90.5	84.5	68.6	288.5	10.8	132.5	282.4	98.9	19.8	135.1	326.7	131.4	16.0
08:44	79.3	18.9	127.4	347.4	119.8	208.2	84.2	59.7	64.5	274.1	356.3	95.9	277.3	154.8	26.1	121.4	350.0	134.1	34.1
08:45	88.9	4.6	126.0	338.2	129.6	203.5	66.5	64.1	56.3	287.6	353.3	107.5	260.6	197.9	14.0	108.6	7.0	123.8	38.0
08:46	90.7	352.3	81.7	306.8	135.9	190.6	57.6	71.2	71.3	256.1	325.7	140.1	274.1	226.6	1.7	114.9	7.6	140.1	34.7
08:47	101.4	1.3	71.3	297.0	128.8	227.7	54.3	70.5	69.2	258.4	4.7	132.3	302.3	257.1	2.2	114.7	15.3	139.2	25.5

Time (MST)	7/20/ 2012	7/23/ 2012	7/26/ 2012	7/29/ 2012	8/01/ 2012	8/03/ 2012	8/4/2012 (08:00-10:59)	8/6/2012 (08:00-10:59)	8/07/ 2012	8/08/ 2012	8/09/ 2012	8/10/ 2012	8/11/ 2012	8/12/ 2012	8/13/ 2012	8/16/ 2012	8/19/ 2012	8/22/ 2012	8/25/ 2012
08:48	137.8	25.0	63.3	0.3	144.8	233.2	197.2	76.7	74.2	270.0	26.4	131.2	281.9	270.6	16.1	106.7	19.9	141.1	20.0
08:49	101.6	352.0	44.3	345.1	143.8	209.5	199.3	79.3	66.8	256.2	14.5	189.2	293.8	295.3	21.8	106.3	28.2	142.1	27.1
08:50	92.6	337.5	57.6	342.3	131.7	209.8	190.5	76.5	69.4	321.6	23.8	206.0	289.6	55.9	22.9	126.7	14.7	140.5	26.3
08:51	86.9	52.7	107.4	350.0	115.1	214.0	152.4	71.9	63.1	318.7	21.4	164.1	268.6	26.3	6.9	115.4	30.4	152.5	26.1
08:52	87.2	38.0	81.3	332.7	139.2	250.0	135.4	85.7	66.5	300.0	20.7	119.8	262.4	40.1	20.2	128.3	30.4	125.9	33.5
08:53	80.2	67.7	71.5	324.5	129.9	242.6	117.0	121.4	71.5	283.6	18.6	93.4	259.9	34.7	11.2	120.6	28.4	117.1	30.5
08:54	86.0	81.8	84.9	324.8	121.0	258.2	117.4	70.7	73.8	293.2	1.8	69.9	260.5	47.2	7.8	111.1	14.3	151.7	17.4
08:55	83.9	76.2	48.2	290.0	117.5	213.1	126.9	56.0	60.5	283.5	26.2	233.8	272.3	46.0	3.5	124.8	19.3	149.8	1.9
08:56	93.7	73.0	115.4	280.7	136.0	216.9	117.0	52.3	53.5	269.7	9.8	231.2	268.3	36.6	21.9	115.3	9.8	85.1	15.3
08:57	77.9	173.0	122.2	280.8	145.5	214.7	136.7	53.2	86.3	270.9	358.5	195.2	266.1	24.1	24.0	130.0	9.0	96.2	17.1
08:58	91.8	173.4	111.0	272.0	108.7	249.7	135.1	39.3	98.1	274.0	351.6	194.9	258.4	24.9	9.1	133.2	14.8	101.4	10.2
08:59	81.9	102.9	96.3	259.2	94.1	263.6	147.3	25.2	104.7	283.6	347.3	202.6	257.8	15.6	8.1	127.4	12.0	76.3	5.5

Addendum to Air Emissions Case Study Related to Oil and Gas Development in Erie, Colorado For Correction of Incorrect Methane Data

COLORADO

Department of Public Health & Environment

Air Pollution Control Division

Technical Services Program

October 16, 2014

2.2 Methane

In 2012, the Colorado Department of Public Health and Environment (CDPHE) performed an air emissions case study related to oil and gas development in the Erie, Colorado area. The results of that study were subsequently published in a report by the CDPHE titled "Air Emissions Case Study Related to Oil and Gas Development in Erie, Colorado." It can be found at the following link: http://www.colorado.gov/airquality/tech_doc_repository.aspx?action=open&file=Erie_Air_Emissions_Case_Study_2012.pdf. Approximately eighteen months after the publication of that report, an error regarding the calculation of the methane concentrations presented was discovered.

A close review of the methane data, by both internal and external sources, indicated that the initial concentrations listed were likely erroneous, in that they were lower than the global background methane concentrations. A subsequent review of all methane data, and analytical equipment, by CDPHE's contracted lab discovered that the methane concentrations were not being corrected with a pressure factor before being released from the lab. The samples in the Front Range are taken at a higher altitude than that of the lab, and thus a lower pressure. In addition, the canisters are shipped back to the lab for analysis at a sub-ambient pressure. The difference in the pressure at which the analytical equipment is calibrated, and the pressure at which the sample is analyzed caused the results to be off by a factor of the ratio of the pressures.

Once the error was discovered and the data corrected, the methane concentrations increased. This put the average concentrations more in line with the global background methane concentrations, and those obtained by other researchers who have performed studies in the same area. Section 2.2 in the Erie case study report covers the methane concentrations obtained. Table 7 below shows the corrected maximum, minimum, and average methane concentrations, as well as the standard deviation of the data sets, and a sample breakdown for each of the Erie sites, as well as the two other sites in operation at the time of the study, Denver – CAMP (DECO) and Platteville (PVCO). The data for both DECO and PVCO is over the same sampling period as that from Erie.

Table 7. Corrected Methane Concentration Data

Corrected Methane Concentrations (ppmv)						
Site	**Max**	**Min**	**Average**	**Std. Deviation**	**# Samples**	**# Duplicates**
DECO	2.57	1.87	2.19	0.18	13	1
E1CO	2.61	1.67	2.19	0.27	18	1
E2CO	2.50	1.25	2.15	0.26	18	1
PVCO	3.56	1.95	2.62	0.49	13	1

Figure 24 is a chart of the methane concentrations obtained from both Erie sites on each sample day. The samples correlate well, with a maximum standard deviation of 0.63 ppm between samples taken on the same day at the Erie sites, and a minimum standard deviation of 0.01 ppm. It would appear that the methane concentrations recorded during the Erie sampling are typical concentrations, and were not significantly affected by the operations taking place on the well pad.

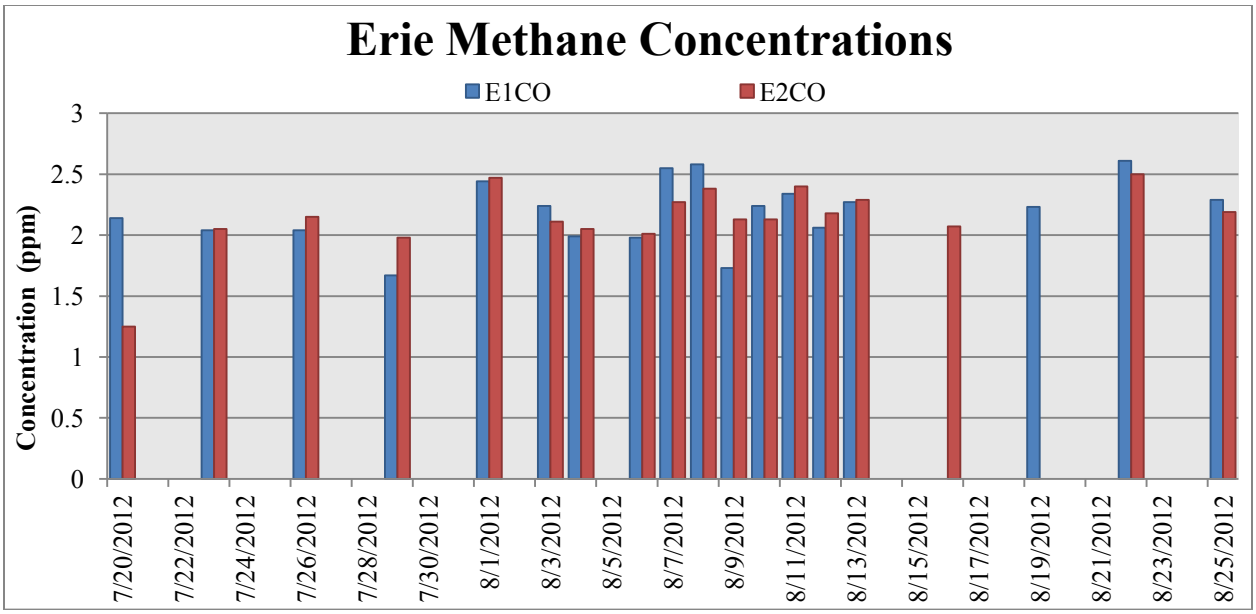

Figure 24. Erie Methane Concentrations by Date

4.0 Summary

Figure 25 is a graph of the average concentrations from the Erie sites, as well as those from the DECO and PVCO sites, along with error bars representing the standard deviation of each average. The methane concentrations in Erie are more in line with those seen at the DECO site. As is expected, the concentrations at the PVCO site were slightly higher than those detected at the other two sites. This is due to the location of the PVCO site being in the middle of the Wattenberg gas field. The Erie sites are on the very southwestern edge of the field, and the DECO site is in downtown Denver, well away from the gas field.

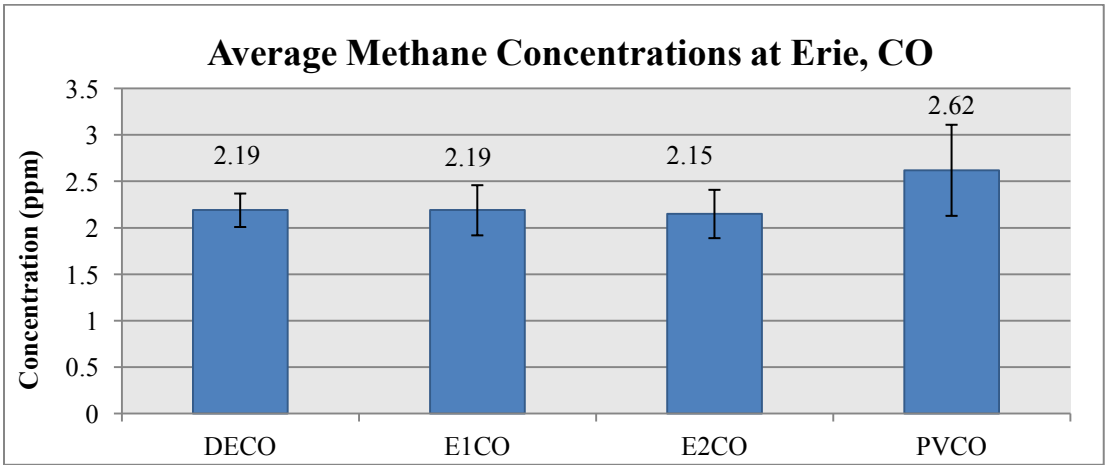

Figure 25. Average Methane Concentrations at Erie, CO

A study performed by NOAA in 2008 in the Denver-Julesburg Basin detected methane concentrations in the range of 1.800 to 1.840 ppm in the same geographical area as the Erie sites (Petron, et al., 2012). These numbers are slightly lower than the concentrations found in CDPHE's study. It should be noted here that the methods being used to collect samples are different. The Erie site used evacuated SUMMA canisters that passively sampled at the appropriate times via the use of an electronic timer and solenoid valve device. The DECO and PVCO canister samples are taken using a different type of computer controlled timer/solenoid valve system to passively sample the air. The NOAA study gathered methane data while driving a zero emissions vehicle on a predetermined route through the Boulder, Lafayette, Erie, and Longmont areas. Both continuous gas chromatograph, and flask based methane samples were taken. Several of the flask based methane samples taken during that study were at a location approximately one-half mile north of the E1CO and E2CO sites. Those samples (PFP9-11) indicated methane concentrations of just over 1.820 ppm at that location, which corresponds with the methane data from their continuous analyzer at the same point (Petron, et al, 2012). In other locations along that route, methane concentrations approached values of 3.00 ppm when near methane emissions sources (Petron, et al., 2012).

In conclusion, although it was discovered that the methane concentrations were incorrect after having been reported, the corrected concentrations did not drastically change the outcome(s) of the original study. The methane concentrations obtained during the Erie study appear to still be indicative of typical methane concentrations for the area. The methane concentrations seen in Erie still fall between those of the DECO and PVCO sites, and are more in line with the DECO site. Again, this is likely due to the Erie sites being located on the very edge of the gas field, while the DECO site is nowhere near it, and the PVCO site is right in the middle of the gas field.

NOTE: All data from this study are available electronically on request.

Appendix A - CORRECTED METHANE DATA TABLES

Raw Methane ppbC Values – E1CO and E2CO (06:00-09:00 MST)

Site	Analyte	Date	Result	MDL	Units
E1CO	Methane	7/20/2012	2.14	0.169	ppmC
E1CO	Methane	7/23/2012	2.04	0.169	ppmC
E1CO	Methane	7/26/2012	2.04	0.169	ppmC
E1CO	Methane	7/29/2012	1.67	0.169	ppmC
E1CO	Methane	8/1/2012	2.44	0.169	ppmC
E1CO	Methane	8/3/2012	2.24	0.169	ppmC
E1CO	Methane	8/4/2012*	1.99	0.169	ppmC
E1CO	Methane	8/6/2012*	1.98	0.169	ppmC
E1CO	Methane	8/7/2012	2.55	0.169	ppmC
E1CO	Methane	8/8/2012	2.58	0.169	ppmC
E1CO	Methane	8/9/2012	1.73	0.169	ppmC
E1CO	Methane	8/10/2012	2.24	0.169	ppmC
E1CO	Methane	8/11/2012	2.34	0.169	ppmC
E1CO	Methane	8/12/2012	2.06	0.169	ppmC
E1CO	Methane	8/13/2012	2.27	0.169	ppmC
E1CO	Methane	8/19/2012	2.23	0.169	ppmC
E1CO	Methane	8/22/2012	2.61	0.169	ppmC
E1CO	Methane	8/25/2012	2.29	0.169	ppmC

* Samples collected from 08:00 – 11:00 MST

Site	Analyte	Date	Result	MDL	Units
E2CO	Methane	7/20/2012	1.25	0.169	ppmC
E2CO	Methane	7/23/2012	2.05	0.169	ppmC
E2CO	Methane	7/26/2012	2.15	0.169	ppmC
E2CO	Methane	7/29/2012	1.98	0.169	ppmC
E2CO	Methane	8/1/2012	2.47	0.169	ppmC
E2CO	Methane	8/3/2012	2.11	0.169	ppmC
E2CO	Methane	8/4/2012*	2.05	0.169	ppmC
E2CO	Methane	8/6/2012*	2.01	0.169	ppmC
E2CO	Methane	8/7/2012	2.27	0.169	ppmC
E2CO	Methane	8/8/2012	2.38	0.169	ppmC
E2CO	Methane	8/9/2012	2.13	0.169	ppmC
E2CO	Methane	8/10/2012	2.13	0.169	ppmC
E2CO	Methane	8/11/2012	2.40	0.169	ppmC
E2CO	Methane	8/12/2012	2.18	0.169	ppmC
E2CO	Methane	8/13/2012	2.29	0.169	ppmC
E2CO	Methane	8/16/2012	2.07	0.169	ppmC
E2CO	Methane	8/22/2012	2.50	0.169	ppmC
E2CO	Methane	8/25/2012	2.19	0.169	ppmC

* Samples collected from 08:00 – 11:00 MST

Raw Methane ppbC Values – DECO and PVCO (06:00-09:00 MST)

Site	Analyte	Date	Result	MDL	Units
DECO	Methane	7/20/2012	2.15	0.169	ppmC
DECO	Methane	7/23/2012	2.34	0.169	ppmC
DECO	Methane	7/26/2012	2.04	0.169	ppmC
DECO	Methane	7/29/2012	2.20	0.169	ppmC
DECO	Methane	8/1/2012	1.87	0.169	ppmC
DECO	Methane	8/4/2012	2.15	0.169	ppmC
DECO	Methane	8/7/2012	2.13	0.169	ppmC
DECO	Methane	8/10/2012	2.13	0.169	ppmC
DECO	Methane	8/13/2012	2.46	0.169	ppmC
DECO	Methane	8/17/2012	2.23	0.169	ppmC
DECO	Methane	8/19/2012	2.02	0.169	ppmC
DECO	Methane	8/22/2012	2.57	0.169	ppmC
DECO	Methane	8/25/2012	2.19	0.169	ppmC
DECO	Methane	8/28/2012	2.17	0.169	ppmC

Site	Analyte	Date	Result	MDL	Units
PVCO	Methane	7/20/2012	2.98	0.169	ppmC
PVCO	Methane	7/23/2012	1.95	0.338	ppmC
PVCO	Methane	7/26/2012	2.92	0.169	ppmC
PVCO	Methane	7/29/2012	2.77	0.169	ppmC
PVCO	Methane	8/1/2012	2.99	0.169	ppmC
PVCO	Methane	8/4/2012	2.46	0.169	ppmC
PVCO	Methane	8/7/2012	2.76	0.169	ppmC
PVCO	Methane	8/10/2012	2.19	0.169	ppmC
PVCO	Methane	8/13/2012	3.05	0.169	ppmC
PVCO	Methane	8/16/2012	2.14	0.169	ppmC
PVCO	Methane	8/19/2012	2.28	0.169	ppmC
PVCO	Methane	8/22/2012	3.56	0.169	ppmC
PVCO	Methane	8/25/2012	2.01	0.169	ppmC
PVCO	Methane	8/28/2012	2.79	0.169	ppmC