Garfield County Ambient Air Quality Monitoring Study

June 2005 – May 2007

Garfield County, Colorado

Colorado Department of Public Health and Environment

Prepared by:

Garfield County
Public Health Department

and

Colorado Department of Public Health & Environment
Air Pollution Control Division
Technical Services Program

December 2007

Executive Summary

This report summarizes the results of an ambient air monitoring study in Garfield County, Colorado, for the two-year period of June 2005 through May 2007. The overlying purpose of the study was to evaluate air quality characteristics within Garfield County with particular attention to particulate matter of ten microns or less (PM_{10}) and volatile organic compounds (VOC's). The study also attempted to address concerns from local citizens about air pollution in the area and potential health effects, primarily due to the dramatic increase in oil and gas development activities.

PM_{10} monitoring was performed at seven locations for 24-hours on an every third day basis. No exceedances of Federal National Ambient Air Quality Standards were recorded. In general, measured PM_{10} concentrations in urban areas were higher than in rural areas. In addition, PM_{10} concentrations were generally highest in the western Garfield County urban centers of Rifle and Parachute. PM_{10} chemical speciation indicates that the particulate mass is primarily from geologic material and that the particulate carbon is likely due to lighter weight fossil fuel combustion.

Routine monitoring for VOC's was conducted at fourteen fixed sites for 24-hours on a once per month or once per quarter basis using Summa-polished stainless steel canisters. In addition, grab samples were also collected for volatile organic compounds at a number of locations based on odor complaints. Two source-specific grab samples were also collected. In general, the VOC levels detected were extremely low for all routine samples. Additionally for the 24-hour samples, although concentrations of detected compounds were occasionally higher in rural oil and gas development areas than in the urban areas, the percentage of detection in samples from urban areas was greater. These data, along with that of the grab samples, appears to indicate that local VOC sources do have impacts on air pollution levels. Compounds that were detected in the highest concentrations were acetone and the BTEX group (benzene, toluene, ethylbenzene and xylenes.

Comparisons of PM_{10} and VOC data to other areas in Colorado show that PM_{10} concentrations in Garfield County are similar to or lower than other areas. The highest measured VOC concentrations in Garfield County are similar to other urban areas or are not detected. This shows the influence of local sources.

Meteorological monitoring was performed at six locations on a continuous basis with half-hour averages being generated. Meteorological parameters consisted of wind speed , wind direction, temperature, relative humidity, barometric pressure and rainfall. Monitoring showed that the area is generally quite dry and that topography and time of day plays an important part in wind flow patterns.

Overall for the study, pollutant levels were found to be generally very low. In some locations, it is likely that more elevated pollutant levels are the result of local or individual sources. Risk assessment work will be performed on the results of this study and will be presented in a separate paper.

Table of Contents

1.0 Introduction **1**
1.1 Overview 1
1.2 Site Information 1
2.0 PM_{10} Results **6**
2.1 PM_{10} Monitoring Overview 6
2.2 PM_{10} Summary Statistics 6
2.3 PM_{10} Graphs 6
2.4 PM_{10} Comparisons to Other Areas 8
2.5 PM_{10} Chemical Speciation 9
3.0 Volatile Organic Compounds **12**
3.1 Volatile Organic Compounds Monitoring Overview 12
3.2 Volatile Organic Compounds Summary Statistics 12
3.3 Volatile Organic Compounds Graphs 18
3.4 VOC Comparisons to Other Areas 29
4.0 Meteorological Results **32**
4.1 Meteorological Monitoring Overview 32
4.2 Meteorological Summary Statistics 32
4.3 Meteorology Wind Roses 33
5.0 Summary and Conclusions **39**
5.1 Summary and Conclusions 39
6.0 References **40**
Appendix A: Site Photographs **A-1**
Appendix B: VOC Full Results Summaries **B-1**

Tables

Table 1.1. Fixed Site Locations 2
Table 1.2. VOC Grab Sample Locations 2
Table 2.1. Summary Statistics for PM_{10} 6
Table 2.2. PM_{10} Comparisons to Other Areas 8
Table 2.3. Soil Mass Reconstruction Data 9
Table 2.4. Sulfate and Nitrate Contribution to Reconstructed Mass 10
Table 2.5. Biomass Burning Reconstruction Ratios 10
Table 2.6. Carbon Reconstruction Ratios 11
Table 3.1. Overall Summary Statistics for Detected VOC's 14
Table 3.2. Urban Site Summary Statistics for 24-Hour VOC's 15
Table 3.3. Rural Site Summary Statistics for 24-Hour VOC's 16
Table 3.4. Rural Oil and Gas Area Site Summary Statistics for 24-Hour VOC's 17
Table 3.5. Comparison of Ten Highest Concentration VOC's for Selected Sites in Colorado 30
Table 4.1. Summary Statistics for Meteorology 32

Figures

Figure 1.1. Topographic Map of Fixed Site Locations 3
Figure 1.2. Land Use Map of Fixed Site Locations 4
Figure 1.3. Land Use Map of VOC Grab Sample Locations 5
Figure 1.4. Land Use Map of VOC Grab Sample Locations (Inset Map) 5
Figure 2.1. PM_{10} Monthly 24-Hour Maximums 7
Figure 2.2. PM_{10} Monthly Averages 8
Figure 3.1. VOC 24-Hour Sample Summary 19
Figure 3.2 VOC Grab Sample Summary 19

Figure 3.3 VOC Source-Specific Grab Sample Summary 20
Figure 3.4. 24-Hour VOC's from Glenwood Springs-Courthouse Site (Urban) 21
Figure 3.5. 24-Hour VOC's from New Castle-Library Site (Urban) 21
Figure 3.6. 24-Hour VOC's from Rifle-Henry Building Site (Urban) 22
Figure 3.7. 24-Hour VOC's from Parachute Site (Urban & Oil/Gas) 22
Figure 3.8. 24-Hour VOC's from Silt-Cox Site (Rural) 23
Figure 3.9. 24-Hour VOC's from Silt-Daley Site (Rural) 23
Figure 3.10. 24-Hour VOC's from Butterfly Site (Oil & Gas area) 24
Figure 3.11. 24-Hour VOC's from Silt-Bell Site (Oil & Gas area) 24
Figure 3.12. 24-Hour VOC's from Brock Site (Oil & Gas area) 25
Figure 3.13. 24-Hour VOC's from Isley Site (Oil & Gas area) 25
Figure 3.14. 24-Hour VOC's from Thompson Site (Oil & Gas area) 26
Figure 3.15. 24-Hour VOC's from West Landfill Site (Oil & Gas area) 26
Figure 3.16. 24-Hour VOC's from Sebold Site (Oil & Gas area) 27
Figure 3.17. 24-Hour VOC's from Haire Site (Oil & Gas area) 27
Figure 3.18. 2005 Grab Sample VOC's 28
Figure 3.19. 2006 Grab Sample VOC's 28
Figure 3.20. 2007 Grab Sample VOC's 29
Figure 3.21. VOC Comparison – Top 1st-3rd Average Compounds 31
Figure 3.22. VOC Comparison – Top 4th-6th Average Compounds 31
Figure 4.1. Glenwood Springs-Courthouse Wind Rose – All Hours 34
Figure 4.2. New Castle-Library Wind Rose – All Hours 34
Figure 4.3. Silt-Bell Wind Rose – All Hours 35
Figure 4.4. Silt-Daley Wind Rose – All Hours 35
Figure 4.5. Silt-Cox Wind Rose – All Hours 36
Figure 4.6. Parachute Wind Rose – All Hours 36
Figure 4.7. Daytime Wind Roses 37
Figure 4.8. Nighttime Wind Roses 38

1.0 Introduction

1.1 Overview

This report discusses results for an ambient air quality monitoring study conducted in Garfield County from June 2005 through May 2007. The overlying purpose of the study was to evaluate air quality characteristics within Garfield County with particular attention to particulate matter of ten microns or less (PM_{10}) and volatile organic compounds (VOC's). In addition this study was performed to attempt to address concerns from local citizens about air pollution in the area and potential health effects, primarily due to the dramatic increase in oil and gas development activities. Monitoring initially commenced with funding that was primarily from a Department of Local Affairs grant. Continued funding has been provided by Garfield County in order to obtain a minimum of two years of data. It is expected that Garfield County will continue to provide monies for future ambient air monitoring, though the scope of monitoring is likely to change.

For the study, Garfield County Environmental Health Department has been the lead agency. Colorado Mountain College (CMC), as a contractor to Garfield County, has performed all field sampling work as well as some equipment installations. The Air Pollution Control Division (APCD) of the Colorado Department of Public Health and Environment (CDPHE) has provided some equipment and installations, calibrations/maintenance, as well as data processing and analysis support.

VOC samples were collected by CMC using equipment provided by Columbia Analytical, a consulting firm contracted by Garfield County to provide support and laboratory analyses. VOC collection and analysis was performed following U.S. Environmental Protection Agency (EPA) Method TO-15 and TO-14a guidelines, using Summa-polished stainless steel canisters and gas chromatograph/mass spectrometer analysis. The canister samples were analyzed for 43 VOC's.

In addition, PM_{10} samples were collected by CMC using high-volume particulate samplers. The PM_{10} sampling equipment, maintenance and calibrations support were provided by the APCD. PM_{10} filter weighings were performed by Inter-Mountain Laboratories (IML) as a contract laboratory. Selected filters from summer and winter were also sent to Chester LabNet for chemical speciation.

Concentrations of PM_{10} were compared to National Ambient Air Quality Standards (NAAQS) to determine if public health is potentially being compromised. For VOC's, no NAAQS exist. Thus, concentrations will be compared to risk levels that have been determined by EPA and others. The risk assessment will be completed as a separate report.[1]

Meteorological measurements were also taken for wind speed, wind direction, temperature, relative humidity and precipitation. Continuous monitors were employed with sensors being located on or near 3-meter tall towers. The meteorological monitoring equipment was purchased by Garfield County and installed by CMC. Data downloads were performed on a routine basis by CMC.

With this project, the Garfield County Air Quality Technical Work Group was established. This group consists of county, state, federal, health institute, industry, academic and contractor personnel. The charge of this group has been to review the data being collected and to provide guidance for future monitoring and health assessments.

1.2 Site Information

Ambient air monitoring in Garfield County was conducted at a number of locations. Seven PM_{10} sites, fourteen fixed VOC sites and five meteorological sites were established. In addition, VOC grab samples were collected at various locations based on citizen odor complaints. Fixed VOC sites were selected based on population exposure, local citizen complaints, or willingness of land owners. Thus, some sites are located in urban areas for population protection, oil and gas development areas for citizen complaints, and other rural areas for background concentrations. Maps of the fixed site locations are presented in Figures 1.1 and 1.2, with parameter, land use and

location information presented in Table 1.1. VOC grab sample locations are presented in Figures 1.3 and 1.4. Detailed site locations and photographs may be found in Appendix A.

Table 1.1. Fixed Site Locations

Name	Parameters	Setting	Latitude	Longitude	Elev. (ft.)
Glenwood Springs-Court.	PM10, VOC-qtr, Met.	Urban	39°32.843'	107°19.578'	5823
New Castle-Library	PM10, VOC-mo, Met.	Urban	39°34.301'	107°32.080'	5574
Silt-Cox	PM10, VOC-qtr	Rural	39°33.976'	107°40.993'	5643
Butterfly	VOC-mo	Rural, Oil/Gas	39°29.246'	107°37.693'	5981
Silt-Bell	PM10, VOC-mo, Met.	Rural, Oil/Gas	39°29.148'	107°39.584'	5869
Silt-Daley	PM10, VOC-qtr, Met.	Rural	39°25.765'	107°38.464'	6378
Rifle	PM10, VOC-mo, Met.	Urban	39°31.911'	107°46.932'	5351
Brock	VOC-mo	Rural, Oil/Gas	39°29.306'	107°46.194'	6135
Isley	VOC-mo	Rural, Oil/Gas	39°28.435'	107°51.528'	5833
Thompson	VOC-mo	Rural, Oil/Gas	39°28.297'	107°51.561'	5951
West Landfill	VOC-mo	Rural, Oil/Gas	39°30.895'	107°54.596'	5499
Sebold	VOC-mo	Rural, Oil/Gas	39°27.886'	107°58.725'	5850
Haire	VOC-mo	Rural, Oil/Gas	39°27.499'	107°58.742'	6017
Parachute	PM10, VOC-qtr, Met.	Urban, Oil/Gas	39°27.219'	108°03.196'	5125

PM10 = Particulates 10 microns in diameter and smaller on a once every third day sample period.
VOC-mo, VOC-qtr = Volatile organic compounds on a once per month or once per quarter sample period.
Met. = Meteorology on a continuous sampling basis.

Table 1.2. VOC Grab Sample Locations

Name	Latitude	Longitude	Elev. (ft.)
Silt-Bell	39°29.148'	107°39.584'	5869
CR 326	39°29.348'	107°38.743'	5827
Dardynski	39º28.822'	107º39.200'	5900
Ferguson	39°29.506'	107°38.883'	5779
Grass Mesa	39°28.031'	107°46.740'	7045
Hoffmeister	39°29.356'	107°38.904'	5780
Hooker Pad	39°30.219'	107°48.979'	5846
Hughes	39°30.226'	107°37.268'	5840
Kelly	39º28.692'	107º45.829'	6700
Kochevar	39°29.206'	107°40.338'	5827
Smith	39º29.242'	107º38.367'	5880
Trulove	39°29.230'	107°39.858'	5810
W-27-3	39°27.849'	107°58.740'	5837
West Landfill	39°30.895'	107°54.596'	5499
Cox Pad	39°29.417'	107°40.052'	5750

Figure 1.1. Topographic Map of Fixed Site Locations

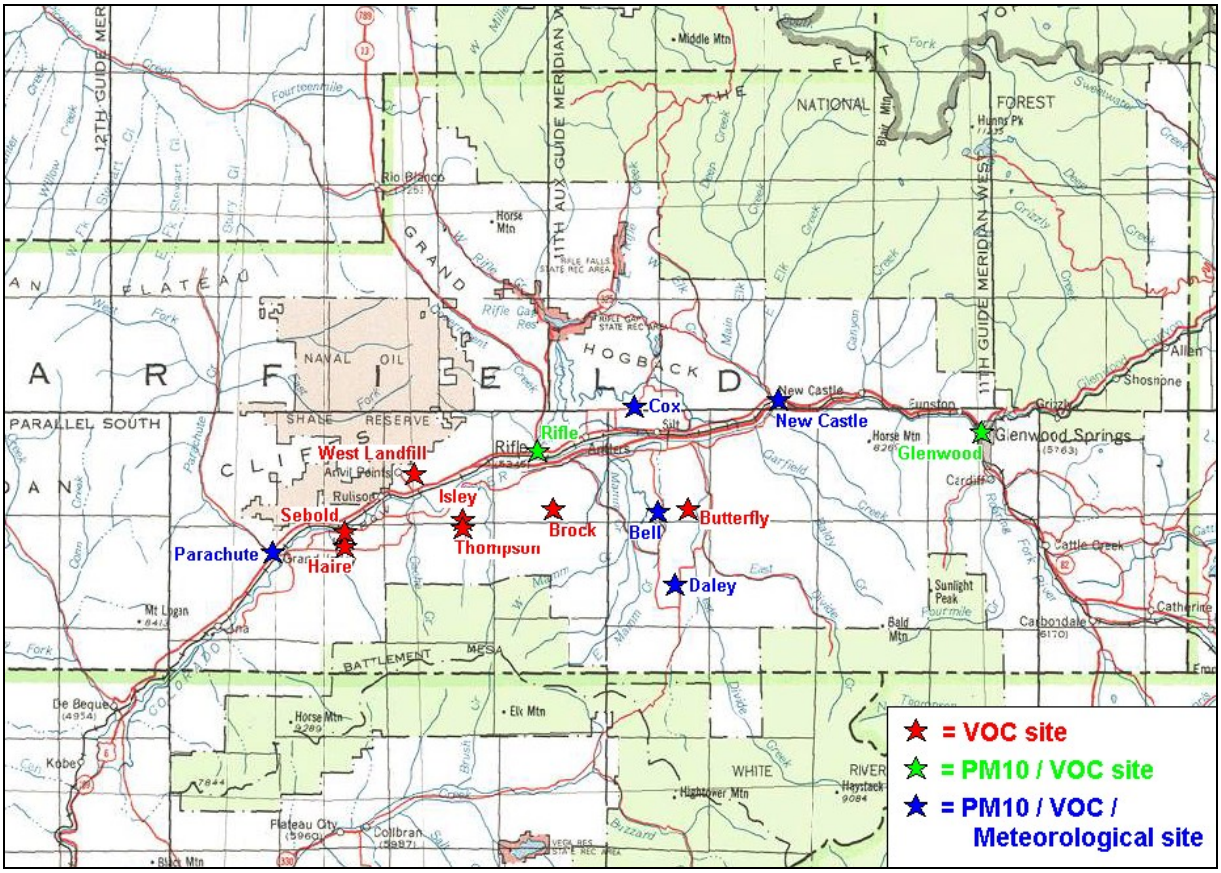


Figure 1.2. Land Use Map of Fixed Site Locations

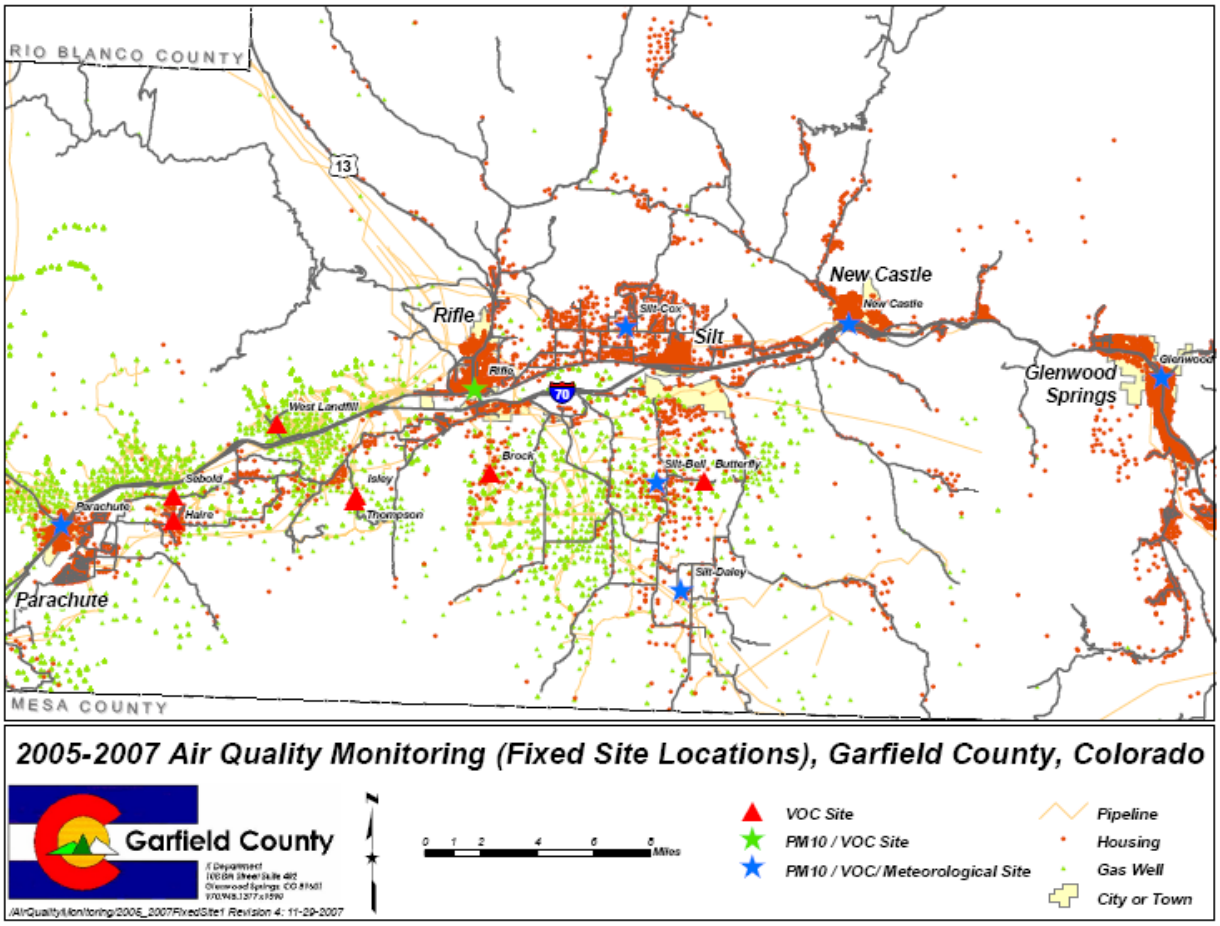


Figure 1.3. Land Use Map of VOC Grab Sample Locations

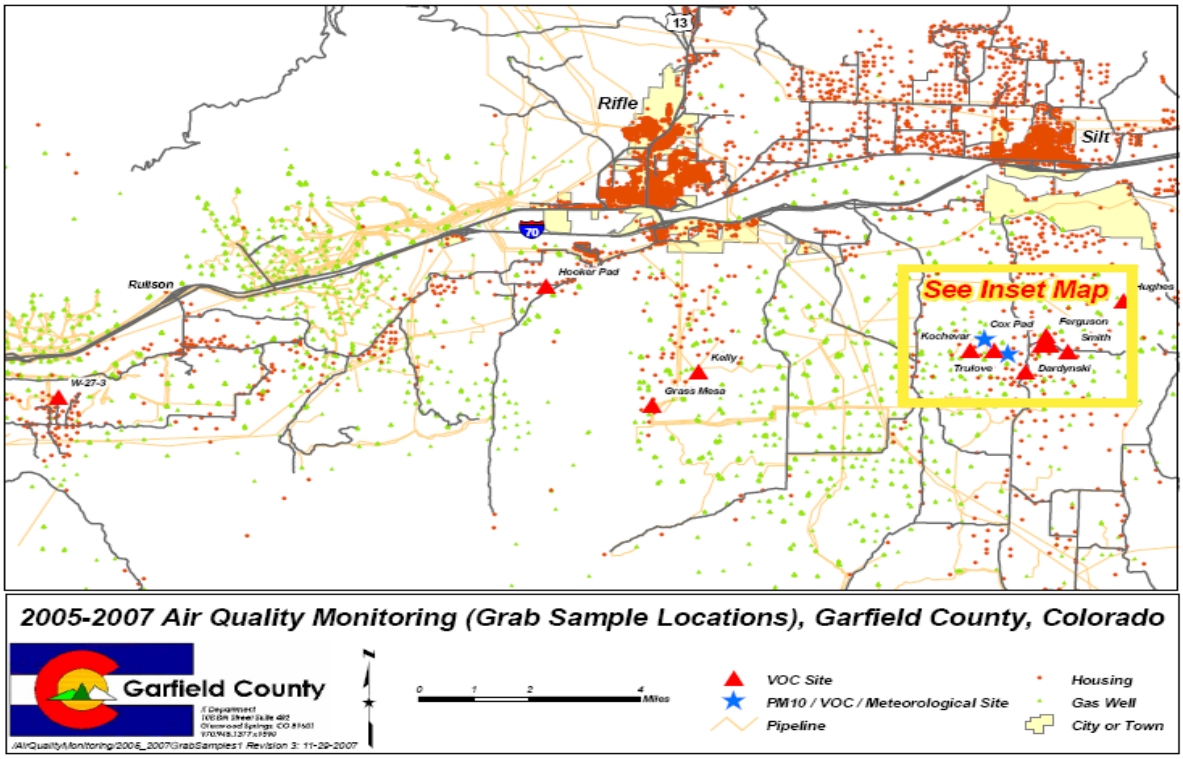
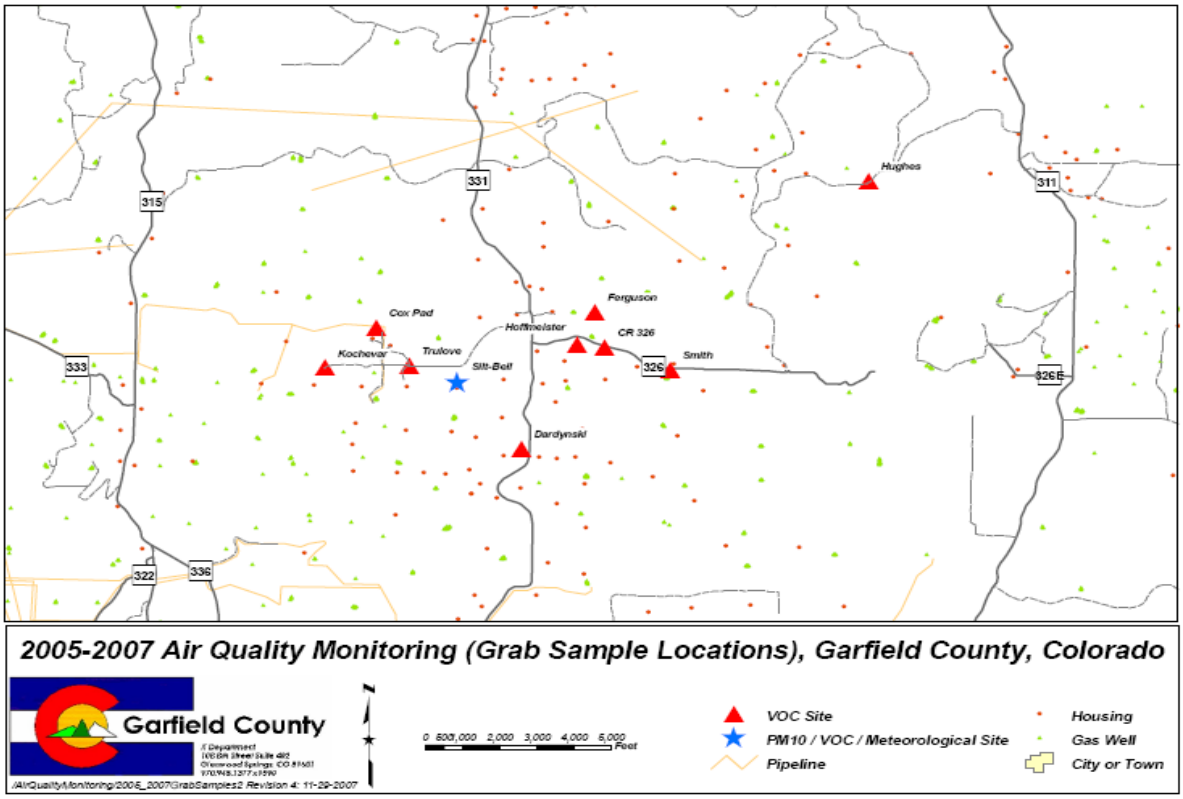


Figure 1.4. Land Use Map of VOC Grab Sample Locations (Inset Map)



2.0 PM_{10} Results

2.1 PM_{10} Monitoring Overview

Particulates 10 microns in diameter and smaller (PM_{10}) were designated by EPA as a "criteria" pollutant in 1987. That is, they have a NAAQS based on health effects. Heath effects from exposure to PM_{10} may include respiratory distress, aggravated asthma and chronic bronchitis. Unlike larger particles, PM_{10}-sized particles can get deep into the lungs. While not monitored in this study, $PM_{2.5}$, or particulates 2.5 microns in diameter or smaller, is another particle size range for which there is a NAAQS.

For this study, PM_{10} was monitored on an every third day basis for 24-hours (midnight-to-midnight). This is in accordance with the requirements set forth in the U.S. Code of Federal Regulations (CFR) Section 40, Part 50.[2] Monitoring was performed using Andersen model 1200 high-volume samplers that are designated by the EPA as reference samplers for PM_{10}. Maintenance and quality assurance followed CDPHE standard operating procedures and CFR Section 40, Part 58 requirements.[3,2] These samplers collected particulates on quartz-fiber filters that were pre- and post-weighed by IML.

The NAAQS for PM_{10} is currently set at 150 micrograms per cubic meter ($\mu g/m^3$) for a 24-hour sample (based on an expected number of exceedances over three consecutive years, not to be greater than one).[4] In addition, there was a former standard of 50 $\mu g/m^3$ as an annual average. This annual average standard was eliminated by EPA in December 2006.

2.2 PM_{10} Summary Statistics

Table 2.1 provides a summary of PM_{10} data from the seven sites for the two-year period. No exceedances of the 24-hour NAAQS of 150 $\mu g/m^3$ were observed. In general, 24-hour concentrations were 50 percent or less of the NAAQS. While direct comparisons to the former annual average NAAQS of 50 $\mu g/m^3$ are difficult due to only partial years being sampled, it is evident based on the overall two-year study average that it would not have been exceeded either. Overall for the study period, sample/data recovery was excellent with all sites over 90 percent.

Table 2.1. Summary Statistics for PM_{10}

Site	Overall Arithmetic Average ($\mu g/m^3$)	Overall 24-Hour Maximum ($\mu g/m^3$)	Possible Number of Sample Days	Number of Samples Recovered	Percent Data Recovery (%)
Glenwood-Courthouse	14.4	36	243	235	97%
New Castle-Library	22.8	92	243	238	98%
Silt-Bell	10.7	34	243	237	98%
Silt-Daley	9.2	28	243	231	95%
Silt-Cox	13.6	62	243	223	92%
Rifle-Henry Bldg.	27.9	72	243	240	99%
Parachute	27.9	76	243	234	96%

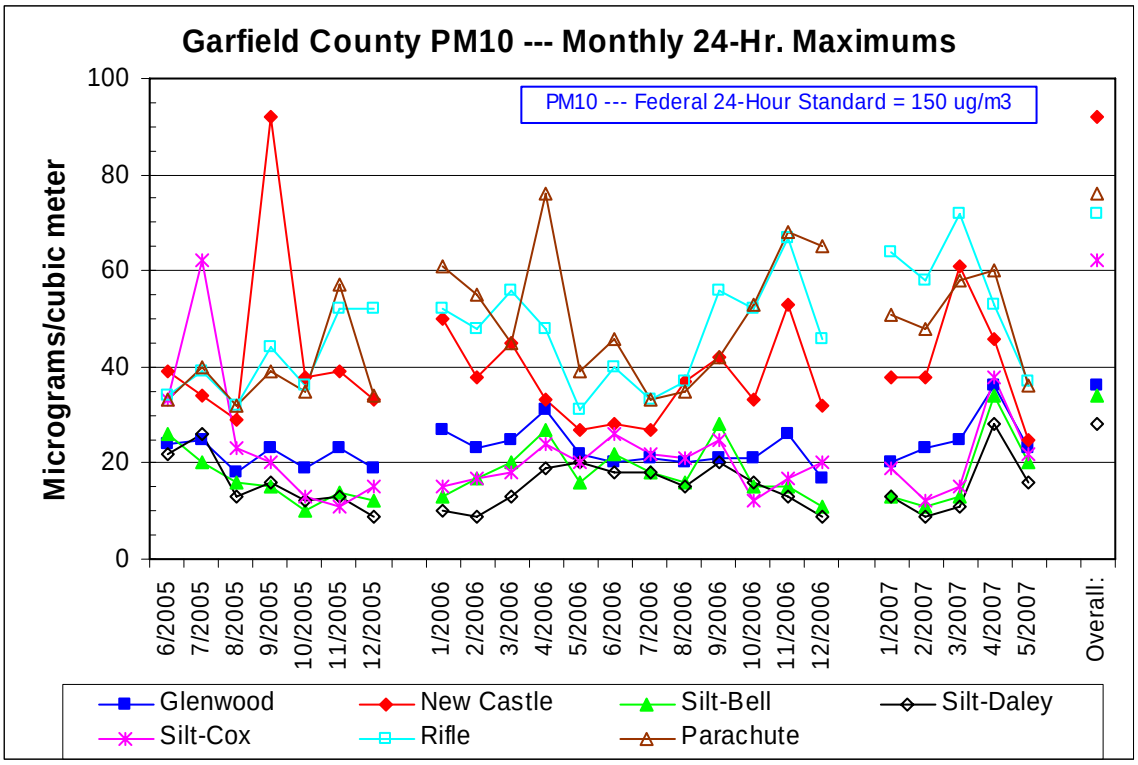
2.3 PM_{10} Graphs

Figures 2.1 and 2.2 present summary graphs of the PM_{10} data collected at the seven sites. It is evident that the Parachute, Rifle and New Castle sites have higher concentrations of particulates than the other sites. These sites are in urban areas that are surrounded by arid undeveloped land. The Glenwood site, while also in an urban area, recorded lower concentrations. This is likely due to the lack of undeveloped land around the town. The Silt-Bell,

Silt-Daley and Silt-Cox sites are all located in rural settings and recorded the lowest concentrations of particulates. Thus, based on the urban sites having higher concentrations, it is likely that motor vehicles as well as other man-made activities are the largest contributor to PM_{10} in the area.

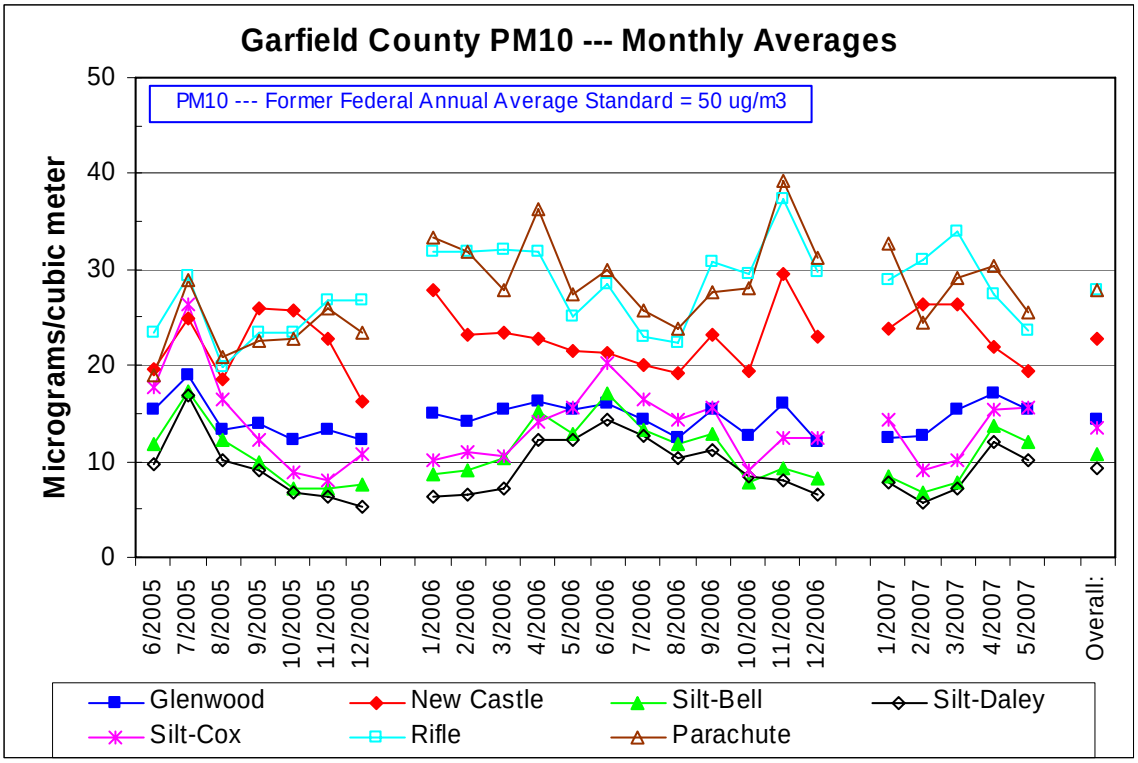
It should be noted that there were some higher concentration episodes during the two-year period. In particular, one higher value of 62 $\mu g/m^3$ at the Silt-Cox site on 21 July 2005 was determined to be due to dirt moving activities in the vicinity of the sampler. A high value of 92 $\mu g/m^3$ was recorded on 01 September 2005 at the New Castle site that was due to railroad re-bedding activities immediately across the street.

Figure 2.1. PM_{10} Monthly 24-Hour Maximums



NOTE: Silt-Cox high value in 7/2005 due to dirt moving activities nearby.
New Castle high value in 9/2005 due to railroad re-bedding across street from site.

Figure 2.2. PM_{10} Monthly Averages



2.4 PM_{10} Comparisons to Other Areas

Comparisons were made to other areas for PM_{10}, including Grand Junction, Delta, Aspen and Denver. This provides a comparative look at both western Colorado areas and a large urban area. Data are presented in Table 2.2 and show that PM_{10} levels in Garfield County are in general similar to or lower than concentrations in other areas of Colorado.

Table 2.2. PM_{10} Comparisons to Other Areas

Site	Overall Arithmetic Average ($\mu g/m^3$)	Overall 24-Hour Maximum ($\mu g/m^3$)
Glenwood-Courthouse	14.4	36
New Castle-Library	22.8	92
Silt-Bell	10.7	34
Silt-Daley	9.2	28
Silt-Cox	13.6	62
Rifle-Henry Bldg.	27.9	72
Parachute	27.9	76
Grand Junction-Powell	27.9	98
Delta	24.5	85
Aspen-Library	17.7	79
Denver-CAMP	27.0	63

2.5 PM_{10} Chemical Speciation

To help determine potential sources of PM_{10} material, filters from two sampling days were analyzed by Chester LabNet for a number of elements and species. Analyses included x-ray fluorescence for 35 elements and metals, ion chromatography for four anions, inductively coupled plasma for four cations and thermal optical reflectance for organic and elemental carbon. These are nationally accepted methods for this chemical profiling work. Based on the chemical profiles from the filter analyses, "chemical mass balance" calculations, or mass reconstructions, were performed. The two days chosen were a representative summer day and a representative winter day where all seven particulate monitoring sites had valid samples. Both of these days had relatively higher concentrations of PM_{10}. The two day selected were:

7/18/2005 = Summer = clear skies, low winds, temperatures in the 90's.
1/11/2006 = Winter = overcast, calm winds/stagnant, temperatures in the 30's.

A full report was developed by the CDPHE and is available on request.[5]

The data from both the winter and summer samples were quite similar in that the majority of the PM_{10} mass appears to be composed of geologic material . Geologic material is typically derived from re-suspended dust from roads, dirt lots and rural environments. This similarity can be seen in Table 2.3 where the overall averages for the geologic particular matter component are within two percent. However, it can also be seen that there are differences at specific sites between summer and winter, such as at the Silt-Bell Ranch site. Organic matter is derived from the decomposition of biomass, and when mixed with geologic material it binds to form soil. Ratios around 8:1 are typical for high wind events with blowing dust. For these samples, the ratio was quite low, which matches the known meteorological data for the sample days. This additional organic carbon is likely from either biomass burning or fossil fuel combustion.

Table 2.3. Soil Mass Reconstruction Data

	Geologic Particulate Matter Component (Soil)		**Reconstructed Mass Concentration / Organic Carbon Ratio (Soil)**	
Site	**7/18/2005 (Geologic as a % of RMC)**	**1/11/2006 (Geologic as a % of RMC)**	**7/18/2005 (RMC/OM Ratio)**	**1/11/2006 (RMC/OM Ratio)**
Glenwood Springs	62%	67%	2.1 : 1	2.8 : 1
New Castle	71%	67%	3.2 : 1	2.6 : 1
Silt – Bell Ranch	66%	52%	2.4 : 1	1.3 : 1
Silt – Cox Ranch	59%	59%	1.8 : 1	2.0 : 1
Silt – Daley Ranch	60%	58%	1.9 : 1	1.9 : 1
Rifle	69%	65%	2.9 : 1	2.3 : 1
Parachute	67%	73%	2.4 : 1	3.6 : 1
Average	**65%**	**63%**	**2.4 :1**	**2.4 : 1**

OM = Estimation of Organic Matter (proportional to organic carbon)
RMC = Reconstructed Mass Concentration

Table 2.4 presents the sulfate and nitrate contributions to the PM_{10} mass. Without major primary sources in the area, sulfate and nitrate in the Garfield County area are likely to be primarily due to secondary formation in the atmosphere. Two to six percent of the mass is typically seen for sulfate and one to three percent for nitrate. As the percentages calculated fall within these ranges, it is believed that there was not a significant secondary formation event during these two samples. Nitrate in the winter was slightly higher, however, which is probably indicative of the stagnant inversion-type of meteorology for that day that would lead to more secondary formation.

Table 2.4. Sulfate and Nitrate Contribution to Reconstructed Mass

Site	Percent Sulfate Contribution to Total Reconstructed Mass (Secondary Particulates)		Percent Nitrate Contribution to Total Reconstructed Mass (Secondary Particulates)	
	7/18/2005 (% Sulfate to RMC)	**1/11/2006 (% Sulfate to RMC)**	**7/18/2005 (% Nitrate to RMC)**	**1/11/2006 (% Nitrate to RMC)**
Glenwood Springs	5%	2%	1%	4%
New Castle	3%	2%	1%	2%
Silt – Bell Ranch	4%	3%	2%	4%
Silt – Cox Ranch	5%	3%	2%	5%
Silt – Daley Ranch	6%	4%	1%	5%
Rifle	4%	2%	1%	2%
Parachute	3%	2%	1%	2%
Average	**4%**	**3%**	**1%**	**3%**

RMC = Reconstructed Mass Concentration

Carbon in particulate matter is composed of two different species: organic and elemental. Organic carbon is typically associated with geologic material in soil or from the combustion of biomass and fossil fuels while elemental carbon is primarily derived from the combustion of biomass and fossil fuels. Low ratios around 0.05 indicate high winds and blowing dust, whereas higher ratios, such as seen in Table 2.5, indicate that more combustion-related sources are the likely reason. Potassium is common in both biomass fuels, fossil fuels and in soil, but only ionic potassium is predominately found in living plants and animals. Thus, a ratio of greater than 0.15 indicates that biomass burning has an influence. As can be seen in Table 2.5, the low ratios indicate that it is likely that the carbon material is from fossil fuel combustion rather than from biomass burning.

Table 2.5. Biomass Burning Reconstruction Ratios

Site	Organic Carbon to Gravimetric Mass Concentration Ratio (Biomass Burning)		Ionic to Total Potassium Ratio (Biomass Burning)	
	7/18/2005 (OC/GMC Ratio)	**1/11/2006 (OC/GMC Ratio)**	**7/18/2005 (K^+/K Ratio)**	**1/11/2006 (K^+/K Ratio)**
Glenwood Springs	0.35	0.27	0.11	0.05
New Castle	0.32	0.30	0.10	0.06
Silt – Bell Ranch	0.37	0.35	0.09	0.05
Silt – Cox Ranch	0.28	0.46	0.12	0.08
Silt – Daley Ranch	0.32	0.40	0.10	0.04
Rifle	0.25	0.28	0.10	0.07
Parachute	0.26	0.21	0.08	0.07
Average	**0.31**	**0.32**	**0.10**	**0.06**

OC = Organic Carbon (analytically measured)
GMC = Gravimetric Mass Concentration (analytically measured)
K = Potassium
K^+ = Ionic Potassium

Table 2.6 provides organic to total carbon ratios, which is an indicator of which type of fossil fuel is being combusted. A ratio around 0.50 to 0.60 is expected for coal combustion while a ratio around 0.90 is expected for lighter weight fossil fuel (i.e. natural gas or propane) combustion. From the calculated ratios, it appears that most of the carbon contribution is likely to be from lighter weight fossil fuel combustion.

Table 2.6. Carbon Reconstruction Ratios

Site	Organic Carbon to Total Carbon Ratio (Biomass Burning & Fossil Fuel Combustion)	
	7/18/2005 (OC/TC Ratio)	**1/11/2006 (OC/TC Ratio)**
Glenwood Springs	0.90	0.87
New Castle	0.86	0.88
Silt – Bell Ranch	0.97	0.88
Silt – Cox Ranch	0.96	0.93
Silt – Daley Ranch	0.96	0.90
Rifle	0.89	0.86
Parachute	0.94	0.82
Average	**0.93**	**0.88**

OC = Organic Carbon (analytically measured)
TC = Estimation of Total Carbon (Organic Carbon + Elemental Carbon)

To summarize the PM_{10} chemical speciation samples, it is evident that geologic material is the primary constituent of PM_{10} particulate matter in the ambient air. It also appears that lighter weight fossil fuel combustion is the main source of carbon in the samples. This is likely from a combination of oil and gas production and building heating. It should be kept in mind that these results are a snapshot of two days of sampling. However, as all the results are fairly similar, it is likely that it provides a good view of the primary components in the PM_{10} particulate matter. It should also be noted that these data are qualitative due to the assumptions and methods utilized in the creation of mass/material balance profiles and that caution must be invoked in drawing any quantitative conclusions.

3.0 Volatile Organic Compounds

3.1 Volatile Organic Compounds Monitoring Overview

Volatile organic compounds (VOC's) are a class of carbon-based compounds that readily evaporate at room temperatures. Exposure to some VOC's have shown toxicological effects including cancer, respiratory or neurological, depending on the exposure dose.

During the 24-month sampling period, 232 24-hour VOC samples were collected on either a monthly or quarterly basis. This infrequency was due to the high analytical costs for VOC's. Due to sampling equipment limitations, VOC samples were set out late-morning or early-afternoon on the sample day and were recovered at approximately the same time the following day. In addition, 27 grab samples were collected during a number of odor events. Two grab samples were also collected from a specific condensate truck loading event, one at the truck vent and one approximately 50 feet from the truck vent. Grab samples collect air over a period of approximately 10 to 15 seconds. Monitoring was performed using Summa-polished stainless steel canisters with a stainless steel flow control orifice. The canisters are evacuated in the lab prior to sampling, so no power was required for operation. The sampled canisters were analyzed and cleaned by Columbia Analytical for 43 different VOC's following EPA Methods TO-15 and TO-14a.[6]

There are no NAAQS or any other ambient air standards for VOC's. Instead, emissions limits on industrial sources have been set. EPA has developed a set of risk factors for both acute and chronic exposures. In addition, risk factors from the Agency for Toxic Substances and Disease Registry (ATSDR), the California Air Resources Board (CARB), the National Institute for Occupational Safety and Health (NIOSH) and others may also be used to determine potential risks from exposure to VOC's.[7]

3.2 Volatile Organic Compounds Summary Statistics

Table 3.1 provides a summary of detected VOC data from the fourteen fixed sites for the two-year period as well as for the grab samples. Only 15 of the 43 analyzed compounds were detected in some or all of the 24-hour samples, 12 in the grab samples and five in the condensate load-out grab samples. Tables 3.2 through 3.4 provide summary information from each of the fixed sites for VOC's that were detected as an overall average at least 20 percent of the time. These tables are presented as urban sites, rural sites and rural sites in oil and gas development areas, respectively. A full listing of VOC's and site summaries is available in Appendix B. As a conservative approach that is widely used, one-half of the minimum reporting level was substituted as a value when a particular VOC was not detected in a sample.

In general, 24-hour VOC levels were very low, and for all the samples, no compound was detected 100 percent of the time. Some compounds, however, were detected 100 percent of the time at some sites. Toluene, in particular, was detected 100 percent of the time at six locations; three urban sites and three rural sites in oil and gas development areas. The "BTEX" group of compounds (benzene, toluene, ethylbenzene and xylenes) were the most commonly detected VOC's. Acetone, methyl ethyl ketone (MEK) and vinyl acetate were also commonly detected.

The BTEX group of VOC's are commonly associated with motor vehicle fuel and exhaust, paints, solvents and cleaning agents. Thus it is no surprise to find these in the urban areas of Glenwood Springs, New Castle, Rifle and Parachute. The grab samples, and in particular the condensate truck loading grab samples, show that the BTEX compounds are also very much associated with the oil and gas development activities in this area and were found at significantly higher concentrations than in the 24-hour samples.

Acetone sources may be both natural and man-made. Acetone is widely used as a solvent and in the manufacture of other chemicals. It is emitted from vegetation and is present in human breath. It is also formed as a decomposition product from other chemicals in the atmosphere. Laboratory blanks conducted by Columbia Analytical showed no contamination of acetone. In addition, acetone was not detected in the condensate truck loading samples, indicating that it is probably not directly emitted from oil and gas production sources.

Methyl ethyl ketone (aka 2-Butanone or MEK) is a manufactured chemical but is also present in the environment from natural sources. MEK is manufactured in large quantities and used widely in paints, other coatings, glues and cleaning agents. Naturally, MEK is produced by some trees and is found in some fruits and vegetables. It is also in the exhaust of cars and trucks. Secondarily, MEK can also be produced in outdoor air by photooxidation of certain pollutants such as butane and other hydrocarbons, some of which are produced by the oil and gas industry. Laboratory blanks conducted by Columbia Analytical showed no contamination of MEK. In addition, MEK was not detected in the condensate truck loading samples, indicating that it is probably not directly emitted from oil and gas production sources.

Vinyl acetate is a very common chemical produced in large amounts and is widely used to produce other chemicals which, in turn, are used in the production of glues, paints, textiles and paper. It is also used in plastic food packaging and in food production. Laboratory blanks conducted by Columbia Analytical showed no contamination of vinyl acetate. In addition, vinyl acetate was not detected in the condensate truck loading samples, indicating that it is probably not directly emitted from oil and gas production sources.

Due to the low detection rates of other VOC during the study period, no further discussion of individual compounds is presented in this report. Additional information on specific VOC's and sources may be obtained from a variety of websites, including EPA's Air Toxics website[8], EPA's Integrated Risk Information System (IRIS) website[9] and the ATSDR ToxFAQs website[10].

Table 3.1. Overall Summary Statistics for Detected VOC's

Detected compounds		**Overall 24-Hr Samples (232 samples, 14 sites)**				**Overall Grab Samples (27 samples)**			
CAS #	**Compound**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**
74-87-3	Chloromethane	ND	ND	ND	ND	1.5	15.0	0.7	3.7%
67-64-1	Acetone	18.5	80.0	3.6	81.9%	26.0	81.0	3.7	77.8%
75-69-4	Trichlorofluoromethane	1.0	26.0	0.7	0.4%	1.5	15.0	0.7	7.4%
75-09-2	Methylene chloride	1.0	8.4	0.7	1.7%	ND	ND	ND	ND
108-05-4	Vinyl Acetate	2.1	15.0	0.7	23.3%	2.5	15.0	0.7	14.8%
78-93-3	2-Butanone (MEK)	2.2	12.0	0.7	55.2%	3.0	15.0	0.8	70.4%
67-66-3	Chloroform	ND	ND	ND	0.0%	1.5	15.0	0.7	3.7%
71-43-2	Benzene	2.2	49.0	0.8	39.2%	28.2	180.0	0.8	92.6%
79-01-6	Trichloroethene	0.9	2.7	0.7	0.4%	ND	ND	ND	ND
108-88-3	Toluene	7.4	130.0	0.8	89.7%	91.4	540.0	0.8	92.6%
591-78-6	2-Hexanone	1.0	4.4	0.7	3.0%	1.7	15.0	0.7	14.8%
127-18-4	Tetrachloroethene	0.9	2.3	0.7	0.9%	ND	ND	ND	ND
100-41-4	Ethylbenzene	1.0	3.4	0.7	3.4%	8.3	96.0	0.8	63.0%
136777-61-2	*m,p*-Xylenes	3.9	24.0	0.8	64.2%	106.6	1500.0	0.8	92.6%
100-42-5	Styrene	0.9	6.0	0.7	0.9%	ND	ND	ND	ND
95-47-6	o-Xylene	1.1	4.3	0.7	10.3%	18.1	260.0	0.8	81.5%
106-46-7	1,4-Dichlorobenzene	1.1	12.0	0.7	3.4%	ND	ND	ND	ND

Detected compounds		**Condensate Load-out Grabs (2 samples)**		
CAS #	**Compound**	**Vent Outlet µg/m³**	**50' distance µg/m³**	**% Detects**
71-43-2	Benzene	590000	360	100.0%
108-88-3	Toluene	770000	480	100.0%
100-41-4	Ethylbenzene	37000	29	100.0%
136777-61-2	*m,p*-Xylenes	250000	200	100.0%
95-47-6	o-Xylene	49000	43	100.0%

NOTES: 1/2 of Minimum Reporting Level used for all non-detect values.
ND = Not detected.

Table 3.2. Urban Site Summary Statistics for 24-Hour VOC's

Compounds detected > 20%		**Glenwood Springs-Courthouse (8 samples)**				**New Castle-Library (21 samples)**			
CAS #	**Compound**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**
67-64-1	Acetone	18.3	37.0	4.3	75.0%	15.8	73.0	3.6	71.4%
108-05-4	Vinyl Acetate	2.0	6.2	0.8	25.0%	1.7	14.0	0.7	14.3%
78-93-3	2-Butanone (MEK)	2.0	3.9	0.8	62.5%	1.7	4.5	0.7	42.9%
71-43-2	Benzene	1.2	3.5	0.8	12.5%	2.0	15.0	0.8	33.3%
108-88-3	Toluene	10.4	57.0	2.4	100.0%	8.6	100.0	0.8	90.5%
136777-61-2	*m,p*-Xylenes	2.5	5.4	0.8	50.0%	2.3	6.6	0.8	66.7%

Compounds detected > 20%		**Rifle-Henry Bldg. (23 samples)**				**Parachute (8 samples)**			
CAS #	**Compound**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**
67-64-1	Acetone	23.1	55.0	4.1	95.7%	20.9	46.0	6.5	87.5%
108-05-4	Vinyl Acetate	3.3	15.0	0.8	26.1%	2.4	12.0	0.8	25.0%
78-93-3	2-Butanone (MEK)	3.0	12.0	0.8	65.2%	2.6	7.2	0.8	62.5%
71-43-2	Benzene	2.9	6.9	0.8	78.3%	3.0	5.1	0.8	62.5%
108-88-3	Toluene	8.6	19.0	2.6	100.0%	10.0	13.0	2.1	100.0%
136777-61-2	*m,p*-Xylenes	5.9	12.0	1.7	100.0%	6.6	11.0	0.8	87.5%

NOTE: 1/2 of Minimum Reporting Level used for non-detect values.

Table 3.3. Rural Site Summary Statistics for 24-Hour VOC's

Compounds detected > 20%		**Silt-Cox (8 samples)**				**Silt-Daley (8 samples)**			
CAS #	**Compound**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**
67-64-1	Acetone	18.1	32.0	4.1	87.5%	12.1	21.0	4.4	87.5%
108-05-4	Vinyl Acetate	2.1	7.9	0.8	25.0%	1.2	3.2	0.8	12.5%
78-93-3	2-Butanone (MEK)	1.9	2.9	0.8	62.5%	1.6	3.7	0.8	37.5%
71-43-2	Benzene	1.0	1.9	0.8	12.5%	1.0	1.2	0.8	0.0%
108-88-3	Toluene	2.6	10.0	0.8	50.0%	5.1	27.0	0.8	37.5%
136777-61-2	*m,p*-Xylenes	1.5	4.2	0.8	25.0%	1.4	4.9	0.8	12.5%

NOTE: 1/2 of Minimum Reporting Level used for non-detect values.

Table 3.4. Rural Oil and Gas Area Site Summary Statistics for 24-Hour VOC's

Compounds detected > 20%		**Butterfly (21 samples)**				**Silt-Bell (24 samples)**				**Brock (22 samples)**			
CAS #	**Compound**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**
67-64-1	Acetone	17.1	61.0	4.0	85.7%	19.2	57.0	4.1	87.5%	19.5	56.0	4.4	86.4%
108-05-4	Vinyl Acetate	2.0	9.7	0.8	23.8%	2.1	13.0	0.8	16.7%	2.1	13.0	0.8	22.7%
78-93-3	2-Butanone (MEK)	1.6	4.1	0.8	42.9%	2.5	9.8	0.8	58.3%	2.4	6.7	0.9	63.6%
71-43-2	Benzene	2.0	7.7	0.8	38.1%	2.0	7.4	0.8	41.7%	3.9	49.0	0.9	45.5%
108-88-3	Toluene	6.8	43.0	0.9	85.7%	6.2	27.0	0.9	95.8%	11.6	130.0	0.9	90.9%
136777-61-2	*m,p*-Xylenes	4.1	19.0	0.8	47.6%	3.2	14.0	0.8	66.7%	3.2	12.0	0.9	63.6%

Compounds detected > 20%		**Isley (20 samples)**				**Thompson (3 samples)**				**West Landfill (23 samples)**			
CAS #	**Compound**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**
67-64-1	Acetone	15.2	51.0	4.0	65.0%	11.2	15.0	4.5	66.7%	24.5	80.0	3.9	87.0%
108-05-4	Vinyl Acetate	2.4	8.5	0.8	35.0%	0.9	1.0	0.9	0.0%	2.1	11.0	0.8	30.4%
78-93-3	2-Butanone (MEK)	1.9	6.0	0.8	55.0%	1.3	2.1	0.9	33.3%	2.3	6.6	0.8	52.2%
71-43-2	Benzene	1.2	3.0	0.8	20.0%	0.9	1.0	0.9	0.0%	4.4	7.5	0.8	95.7%
108-88-3	Toluene	4.1	10.0	2.2	100.0%	3.3	3.8	2.3	100.0%	14.1	26.0	2.4	100.0%
136777-61-2	*m,p*-Xylenes	2.0	4.8	0.8	55.0%	0.9	1.0	0.9	0.0%	11.5	24.0	1.8	100.0%

Compounds detected > 20%		**Sebold (21 samples)**				**Haire (22 samples)**			
CAS #	**Compound**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**
67-64-1	Acetone	18.1	58.0	3.6	76.2%	15.8	56.0	4.3	77.3%
108-05-4	Vinyl Acetate	2.1	8.8	0.7	33.3%	1.6	8.6	0.8	13.6%
78-93-3	2-Butanone (MEK)	2.8	8.1	0.7	66.7%	1.7	4.1	0.8	50.0%
71-43-2	Benzene	1.1	2.7	0.8	14.3%	1.0	2.3	0.8	9.1%
108-88-3	Toluene	3.9	10.0	0.8	90.5%	3.3	27.0	0.9	77.3%
95-47-6	o-Xylene	2.6	5.1	0.8	81.0%	1.5	5.0	0.8	31.8%

NOTE: 1/2 of Minimum Reporting Level used for non-detect values.

3.3 Volatile Organic Compounds Graphs

Figures 3.1 through 3.2 present summary graphs of VOC data collected at the fourteen fixed sites and the grab samples. Figure 3.3 presents the data from the two condensate truck loading grab samples. From the summary graphs, it can be seen that acetone was the highest concentration compound detected, on average, in the 24-hour samples followed by toluene and benzene. Toluene, however, had the single highest 24-hour concentration sample. For the grab samples, m,p-xylenes had the highest average and maximum concentrations followed by toluene and benzene. For the condensate truck loading grab samples, toluene had the highest concentration followed by benzene and m,p-xylenes.

In general, the grab samples also had higher concentrations than the 24-hour samples. This was expected as the grab samples were primarily taken during odor-related events. In addition, the grab samples generally revealed higher concentrations of several different compounds than the 24-hour samples,, indicating a possible local source of those compounds.

The source-specific grab samples, as expected, had very high VOC concentrations as they were taken at the vent of a condensate truck loading operation and at a 50-foot distance from the same source. These samples depict some of the likely compounds that are related to oil and gas development activities. These samples, as a corollary, also indicate that compounds such as acetone and MEK are not likely related to this oil and gas production VOC source by their lack of presence. It is evident that the concentrations from the sample taken 50 feet away from the vent is significantly lower in concentration than the sample taken at the vent. This shows the amount of natural dispersion that can take place.

Figures 3.4 through 3.17 show the individual 24-hour sample results for each of the 14 fixed sites for VOC's that were detected as an overall average at least 20 percent of the time. All of the 24-hour sample graphs are presented on the same concentration scale for comparability across the sites. It can be seen that the results are quite varied in concentration for different compounds at some sites while relatively stable at others. An example is toluene where it is relatively stable at the Rifle site and very variable at the Butterfly site. It can also be seen that in general the concentrations of different compounds are much higher at some sites than at others, such as m,p-xylenes being much higher at the West Landfill site than at the Haire site. As discussed previously, this is somewhat indicative of the site location being either in an urban area, an oil and gas development area, or a rural background area.

In looking across the 24-hour sample graphs, it can also be seen that certain days had higher concentrations in general than other days. A specific example was 28 December 2006 where toluene was significantly elevated at some sites compared to other days. The sites with elevated toluene concentrations include Glenwood Springs, New Castle, Butterfly, Silt-Bell, Silt-Daley, Silt-Cox, Brock, Sebold and Haire. Other examples include elevated benzene and toluene at the New Castle and Brock sites on 21 July 2005 and elevated concentrations of toluene and m,p-xylenes at the Butterfly and Silt-Bell sites on 27 December 2005. Though not shown in the graphs due to the generally low percent of time detected, elevated concentrations of 1,4-dichlorobenzene were observed at the Glenwood Springs, New Castle, Butterfly, Isley and Sebold sites on 29 March 2007. These elevated concentrations can be seen in the full VOC summary results in Appendix B. Detailed analyses can be performed on these elevated concentration days using meteorological data to possibly determine if there was a specific source or abnormal conditions that may have caused the results.

Figures 3.18 through 3.20 show the results for the individual grab samples. All of the grab sample graphs are presented on the same concentration scale for comparability. As is expected, there is a wide variation of concentrations across the samples as it is strictly a 15-second snapshot of what was happening at that time.

Figure 3.1. VOC 24-Hour Sample Summary

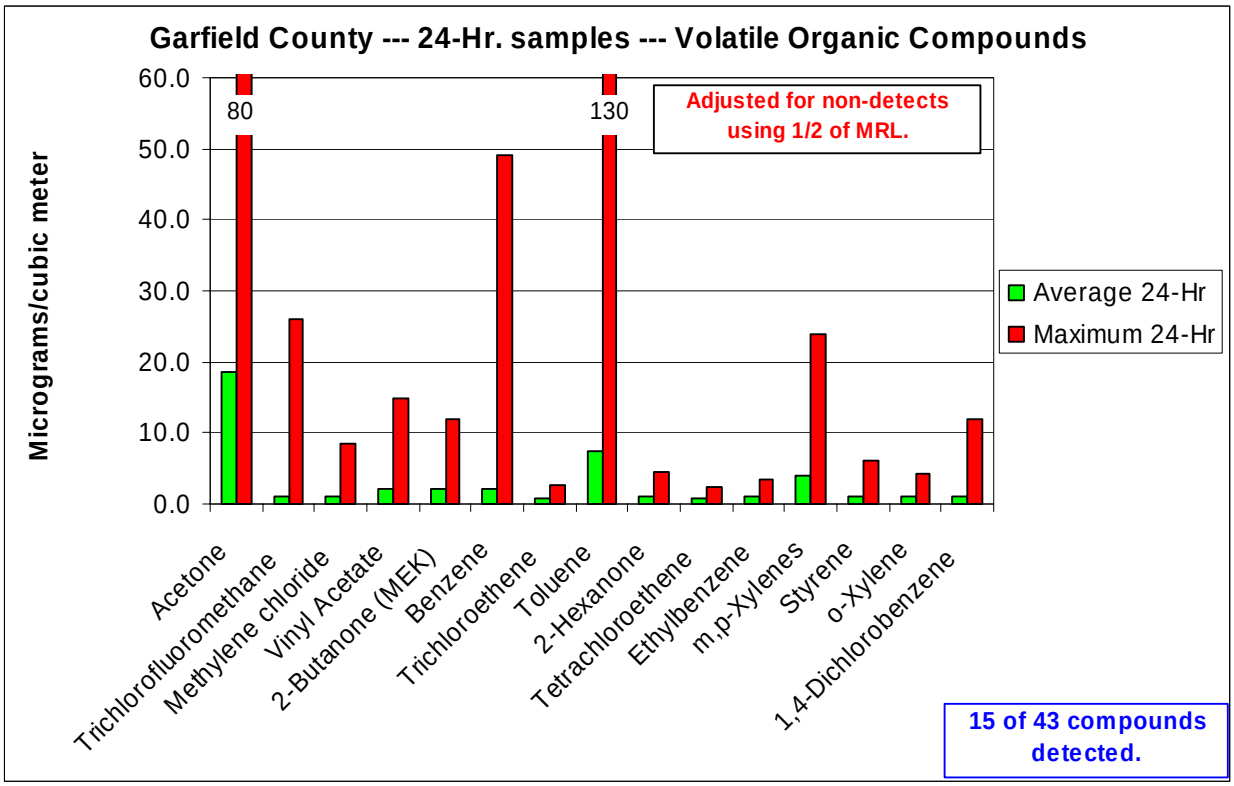


Figure 3.2 VOC Grab Sample Summary

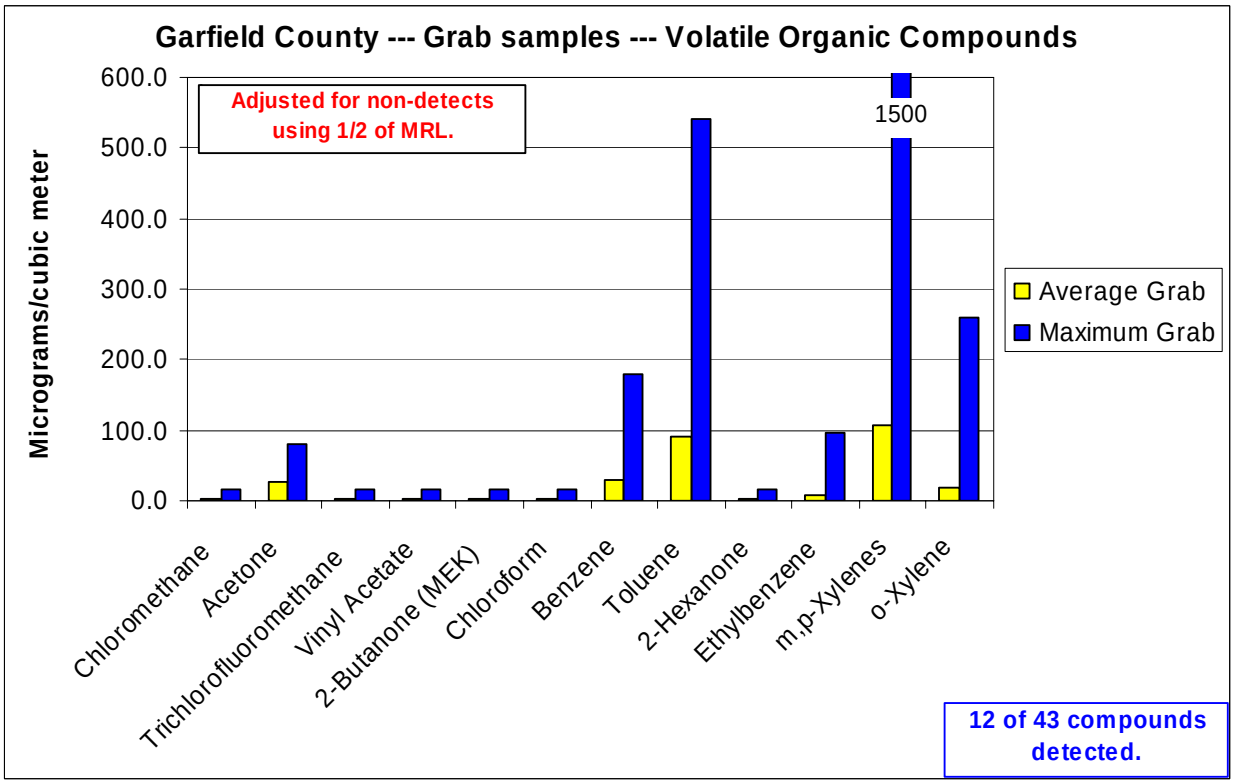


Figure 3.3 VOC Source-Specific Grab Sample Summary

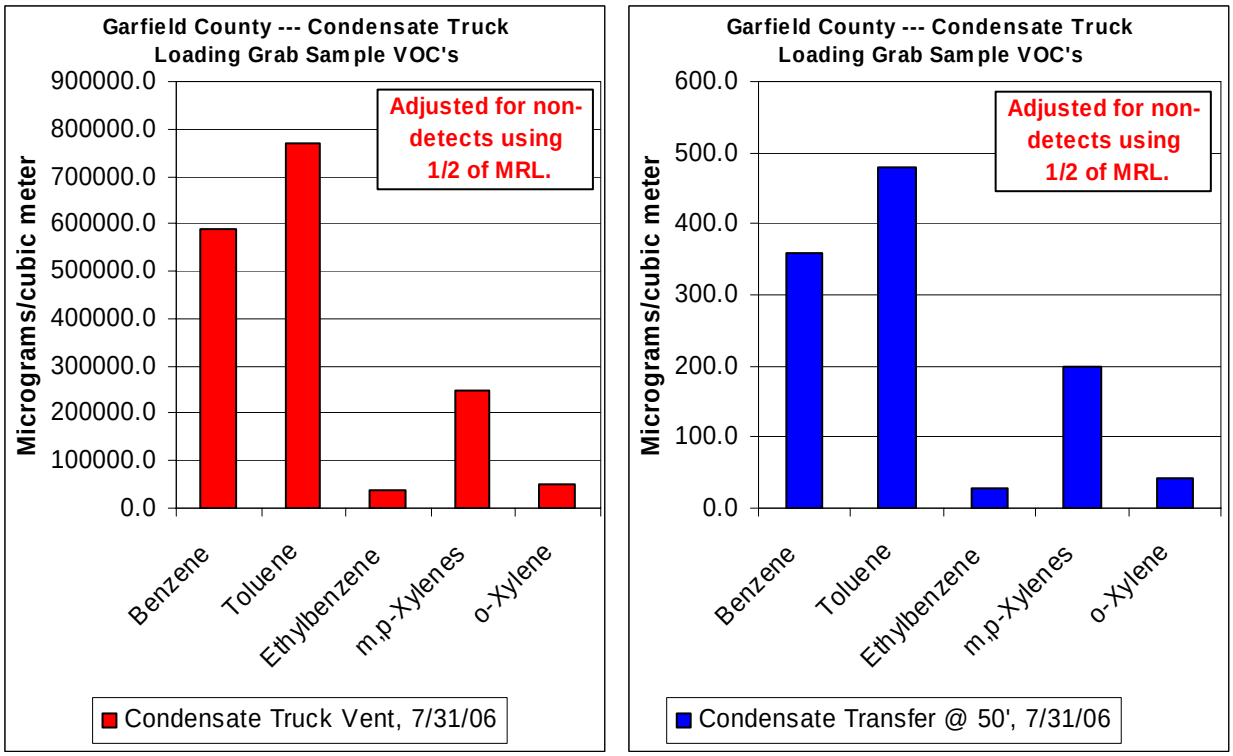


Figure 3.4. 24-Hour VOC's from Glenwood Springs-Courthouse Site (Urban)

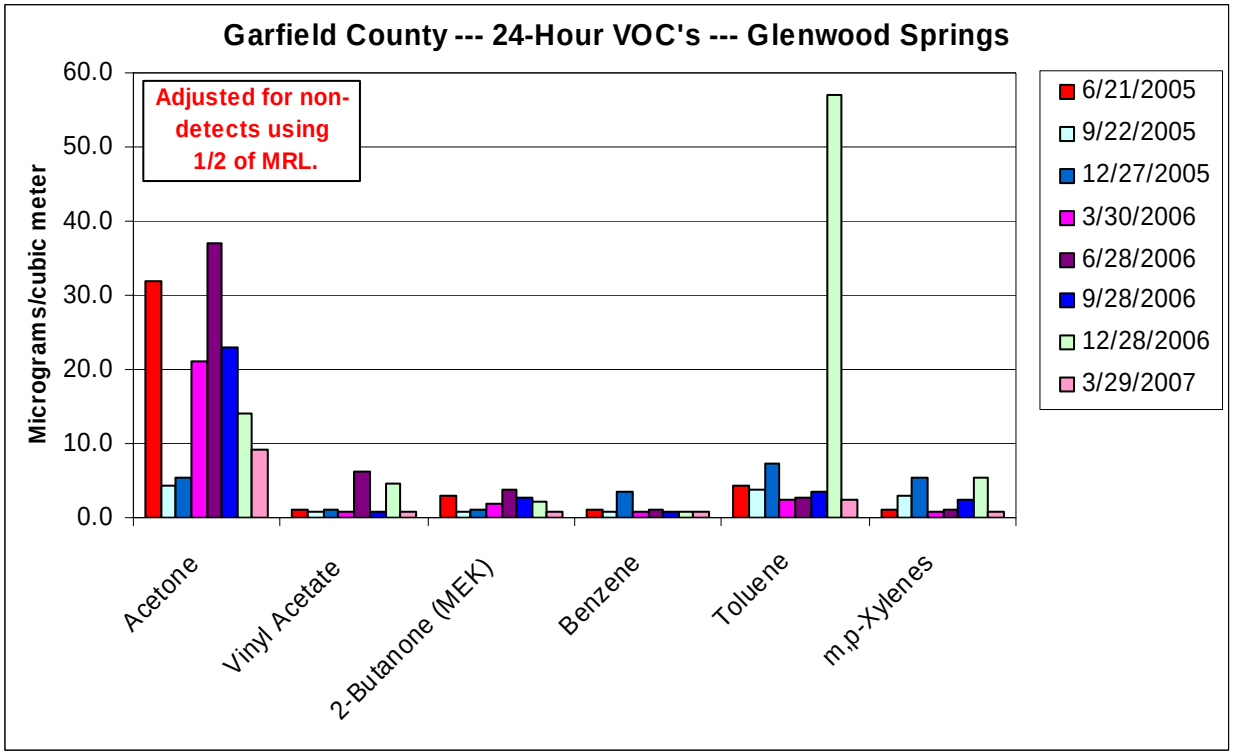


Figure 3.5. 24-Hour VOC's from New Castle-Library Site (Urban)

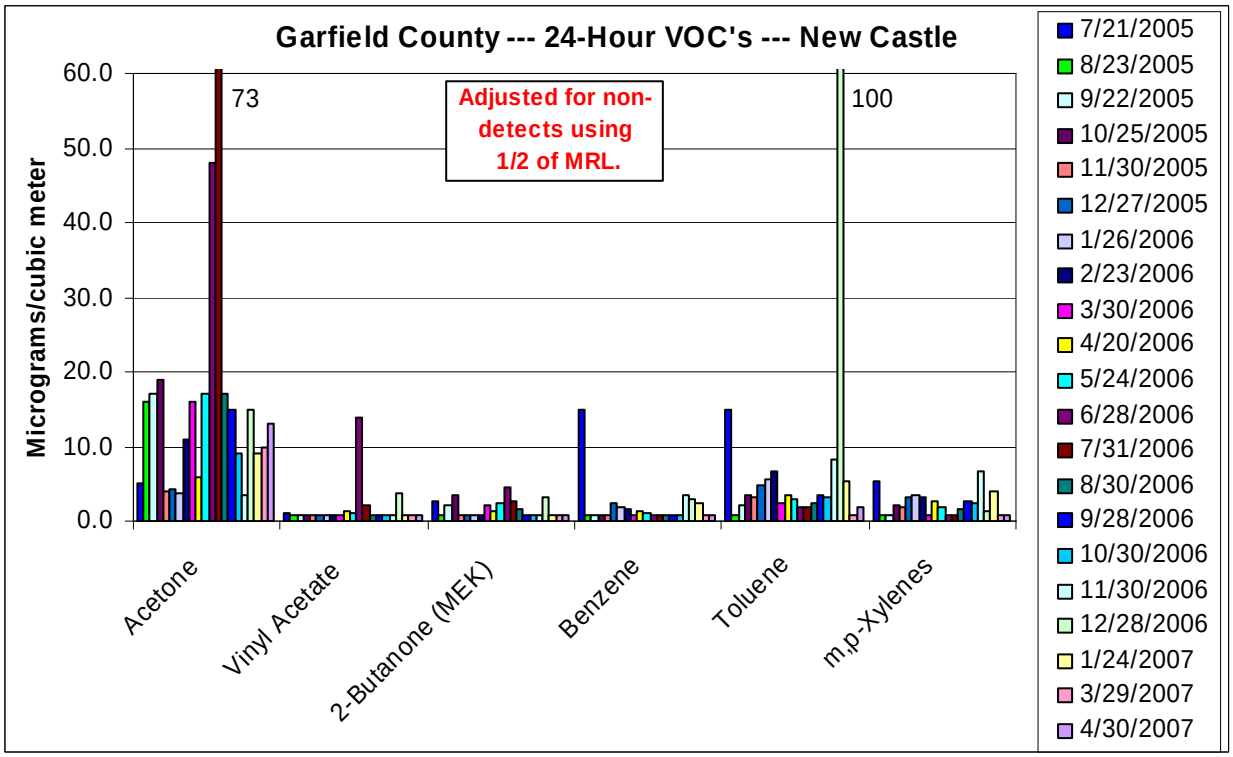


Figure 3.6. 24-Hour VOC's from Rifle-Henry Building Site (Urban)

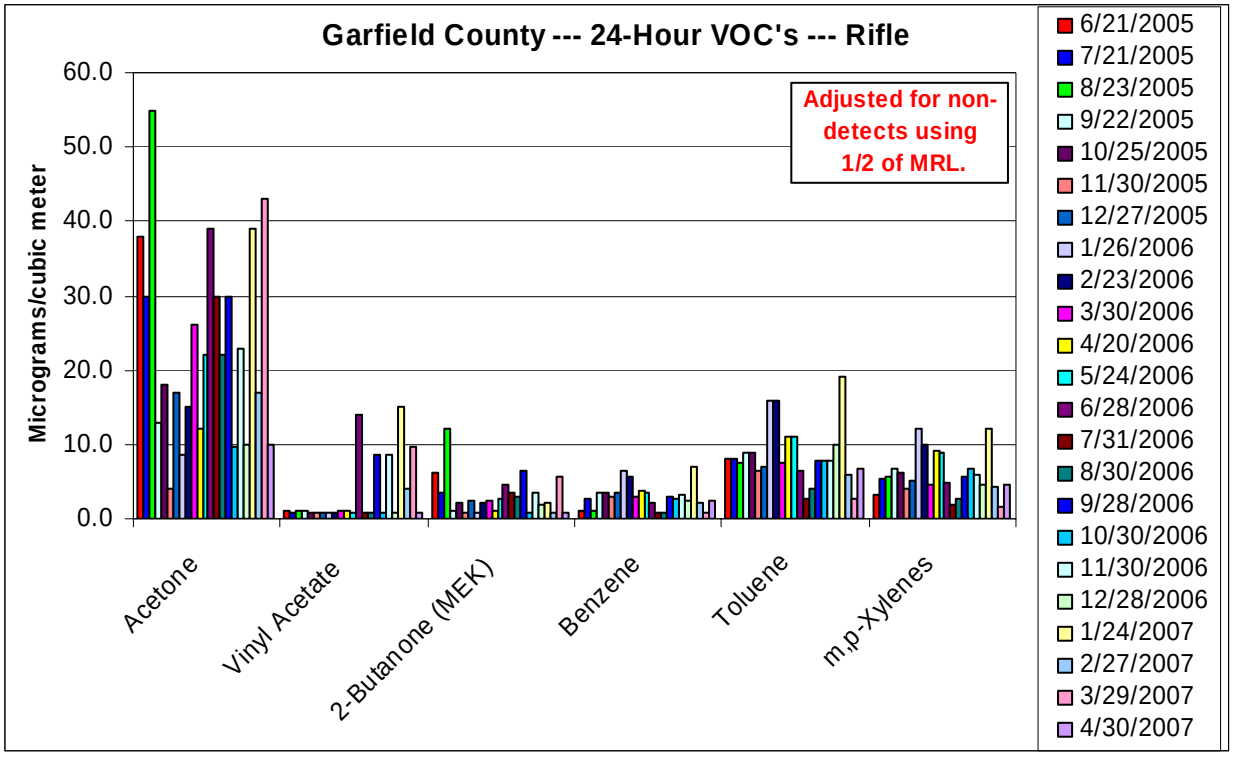


Figure 3.7. 24-Hour VOC's from Parachute Site (Urban & Oil/Gas)

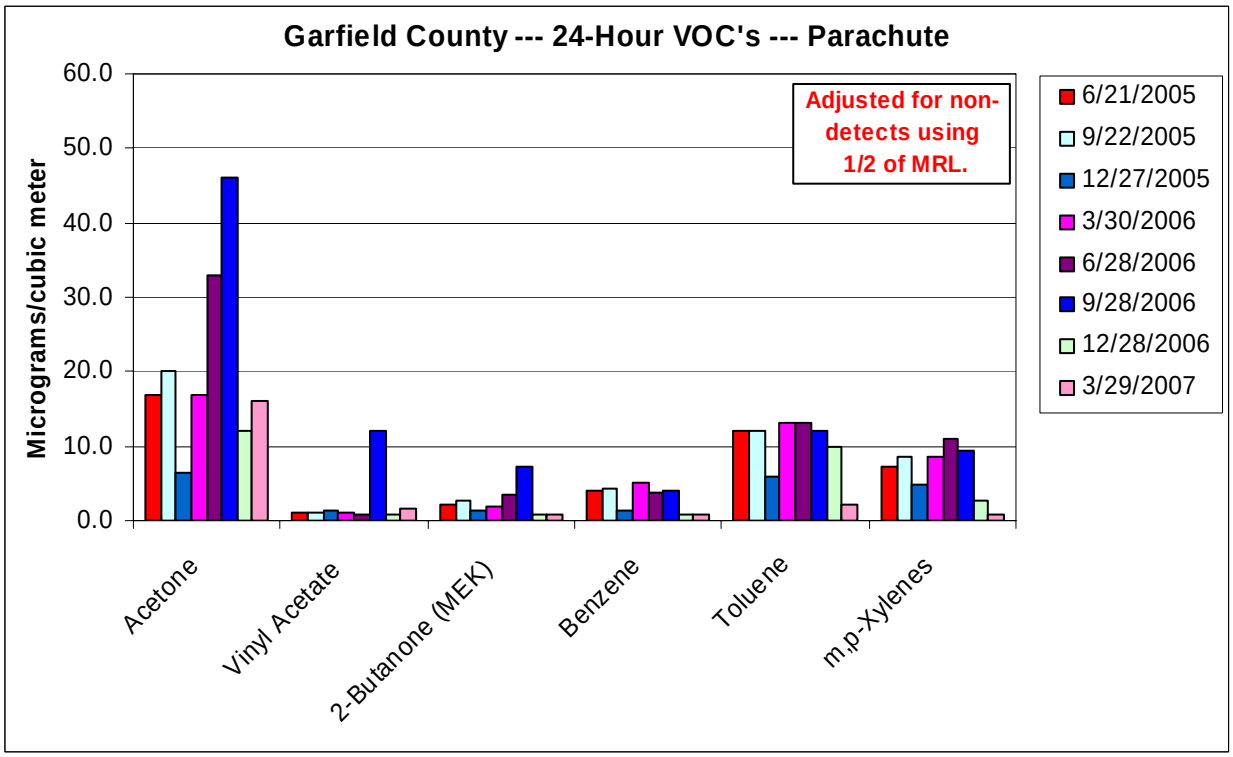


Figure 3.8. 24-Hour VOC's from Silt-Cox Site (Rural)

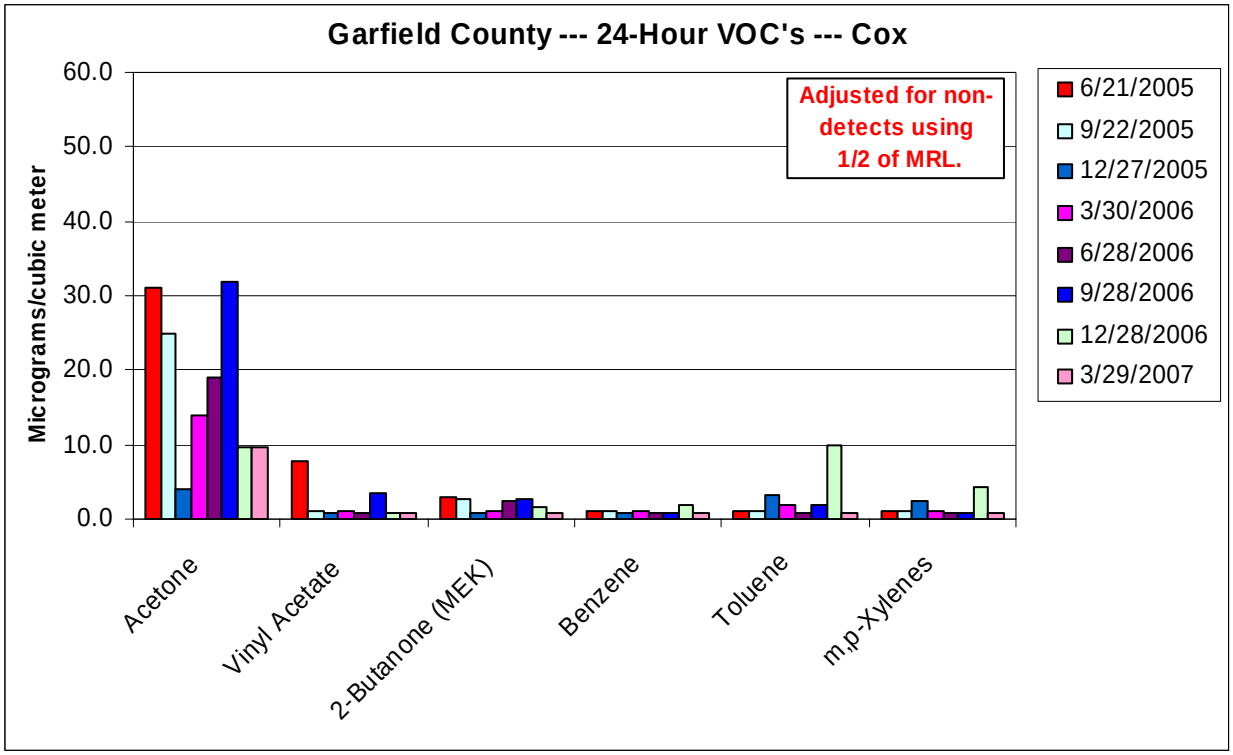


Figure 3.9. 24-Hour VOC's from Silt-Daley Site (Rural)

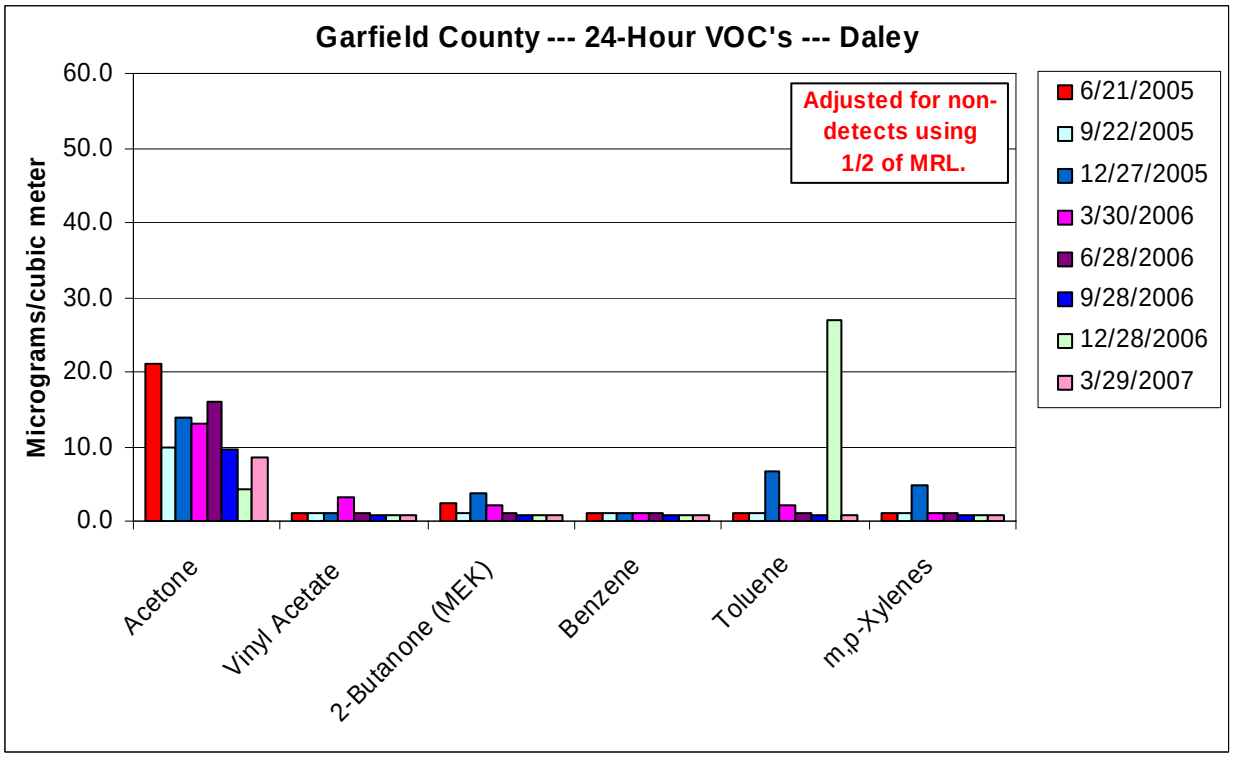


Figure 3.10. 24-Hour VOC's from Butterfly Site (Oil & Gas area)

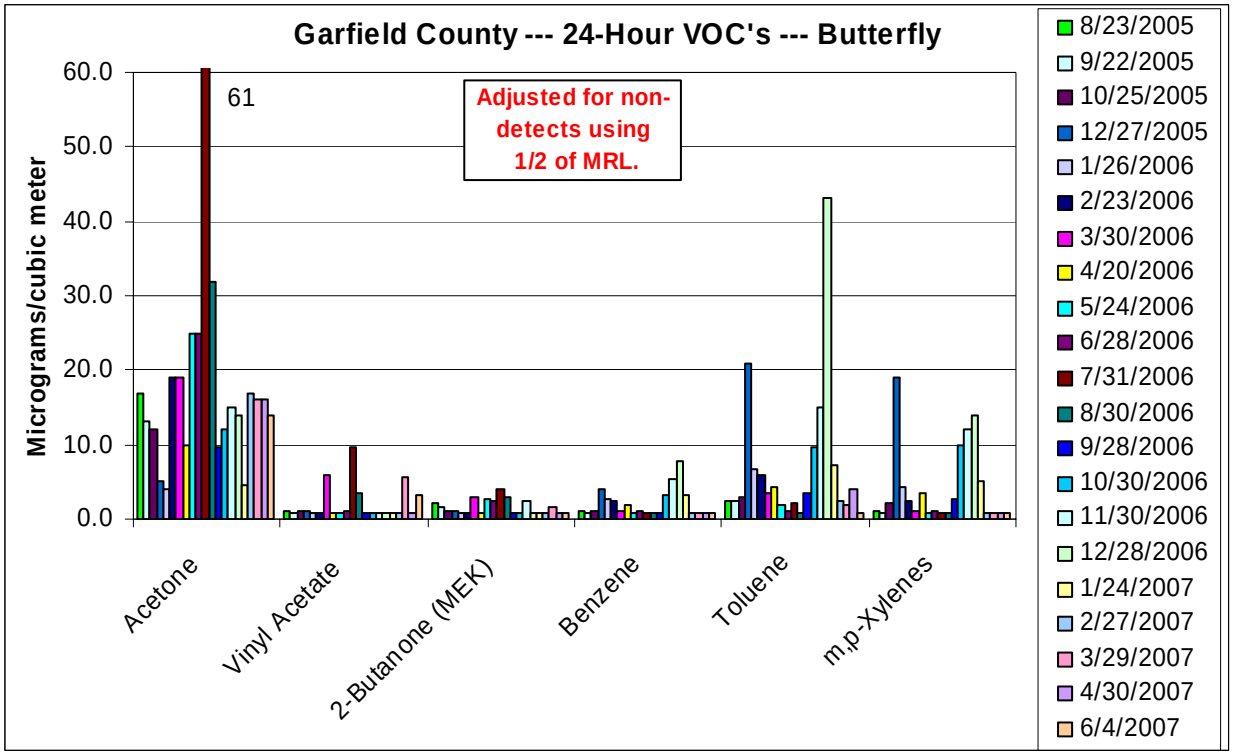


Figure 3.11. 24-Hour VOC's from Silt-Bell Site (Oil & Gas area)

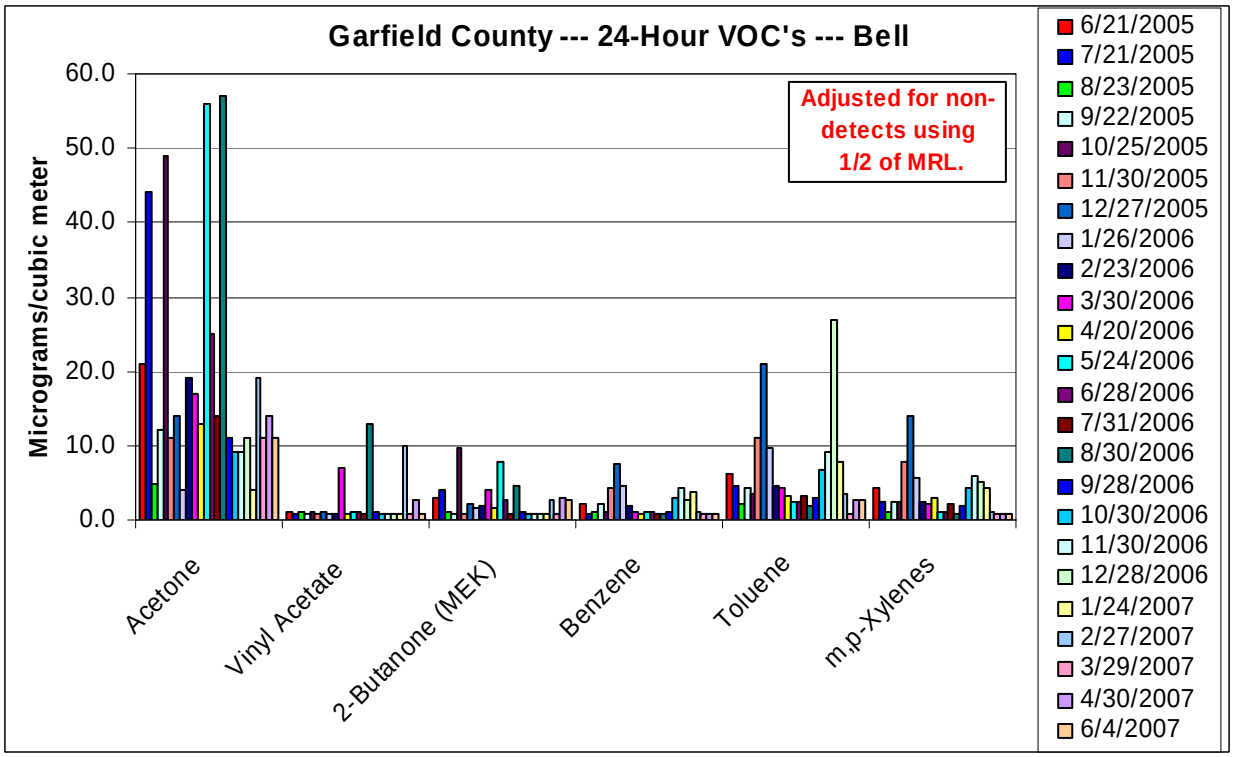


Figure 3.12. 24-Hour VOC's from Brock Site (Oil & Gas area)

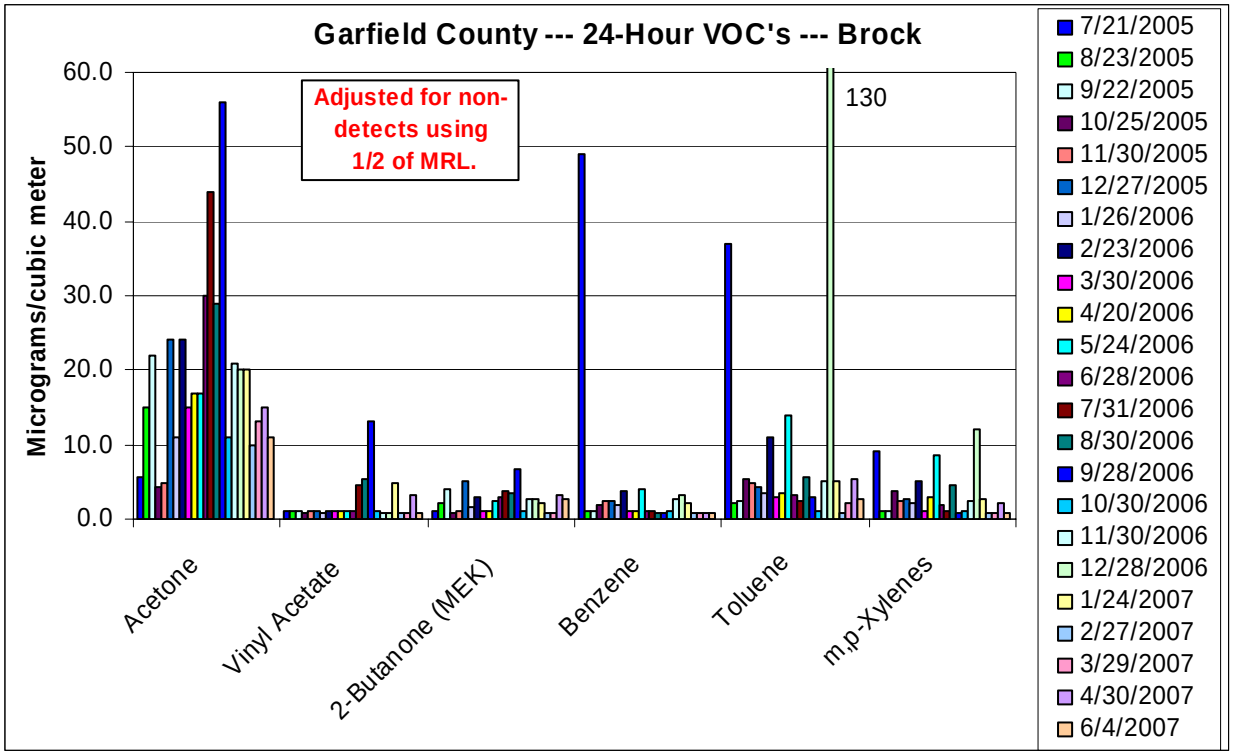


Figure 3.13. 24-Hour VOC's from Isley Site (Oil & Gas area)

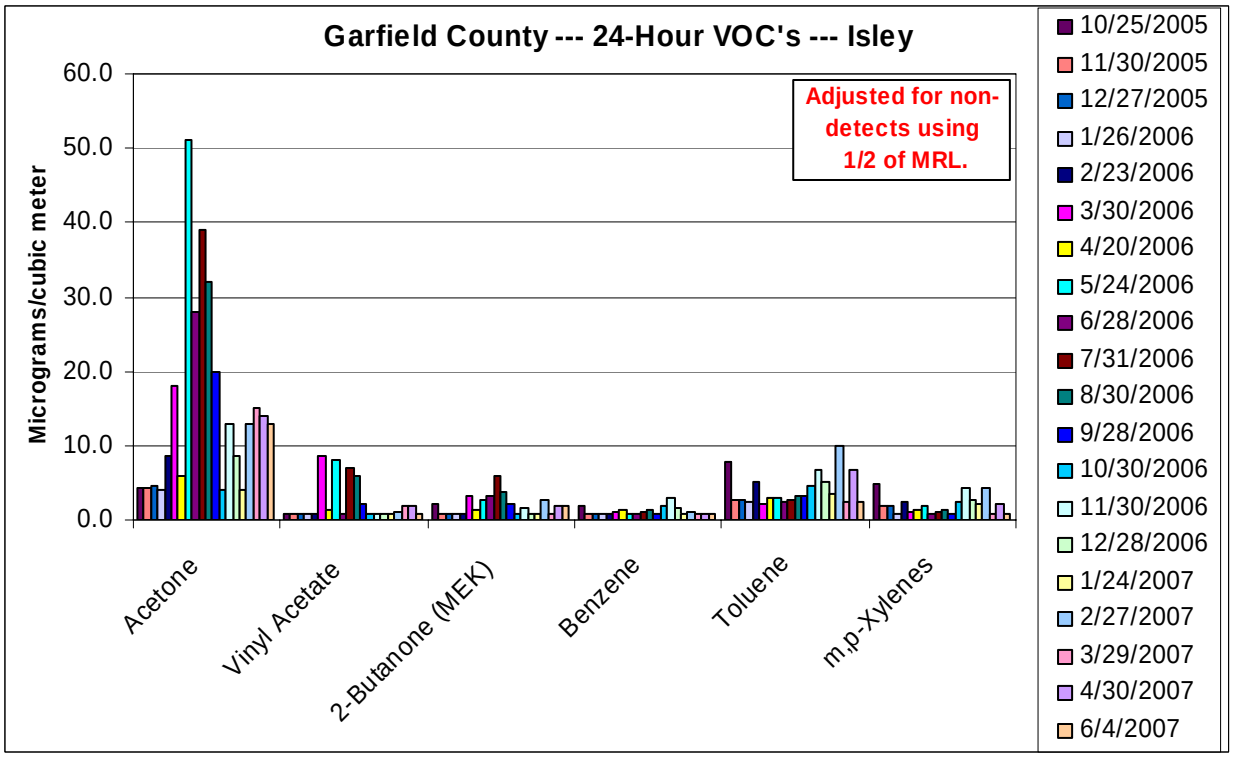


Figure 3.14. 24-Hour VOC's from Thompson Site (Oil & Gas area)

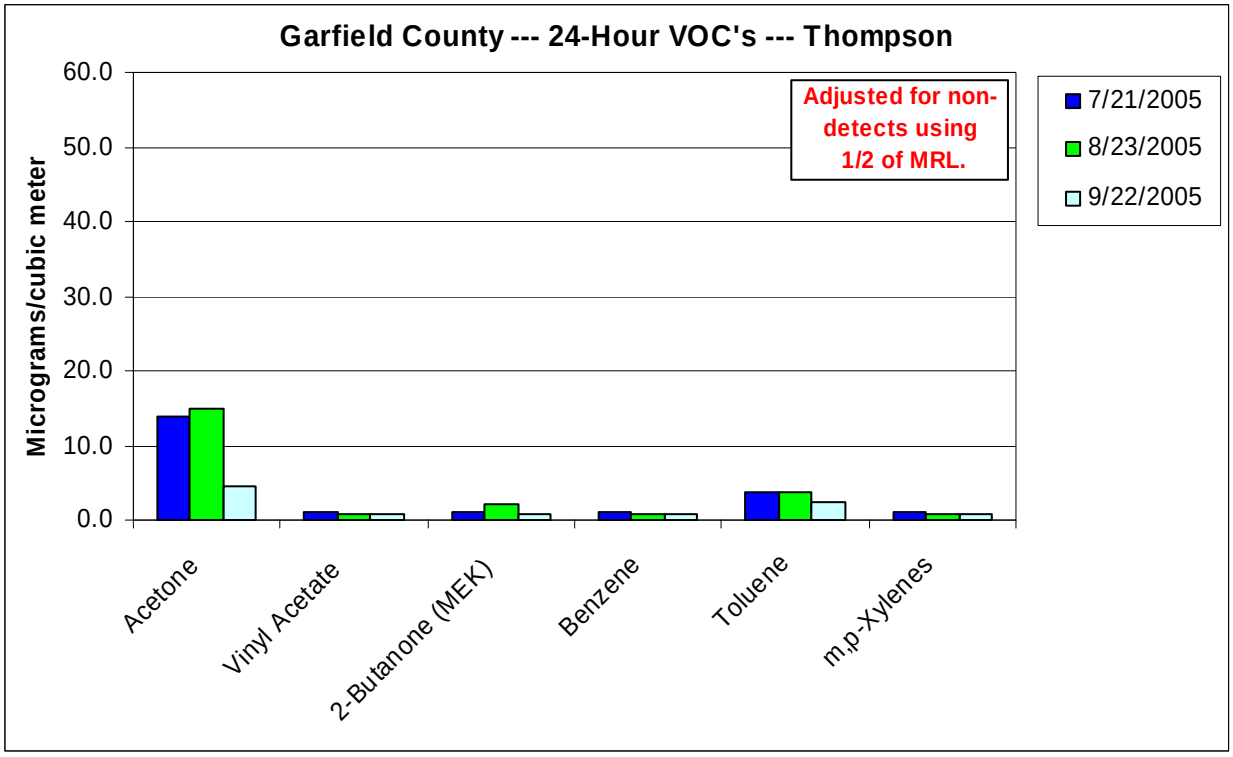


Figure 3.15. 24-Hour VOC's from West Landfill Site (Oil & Gas area)

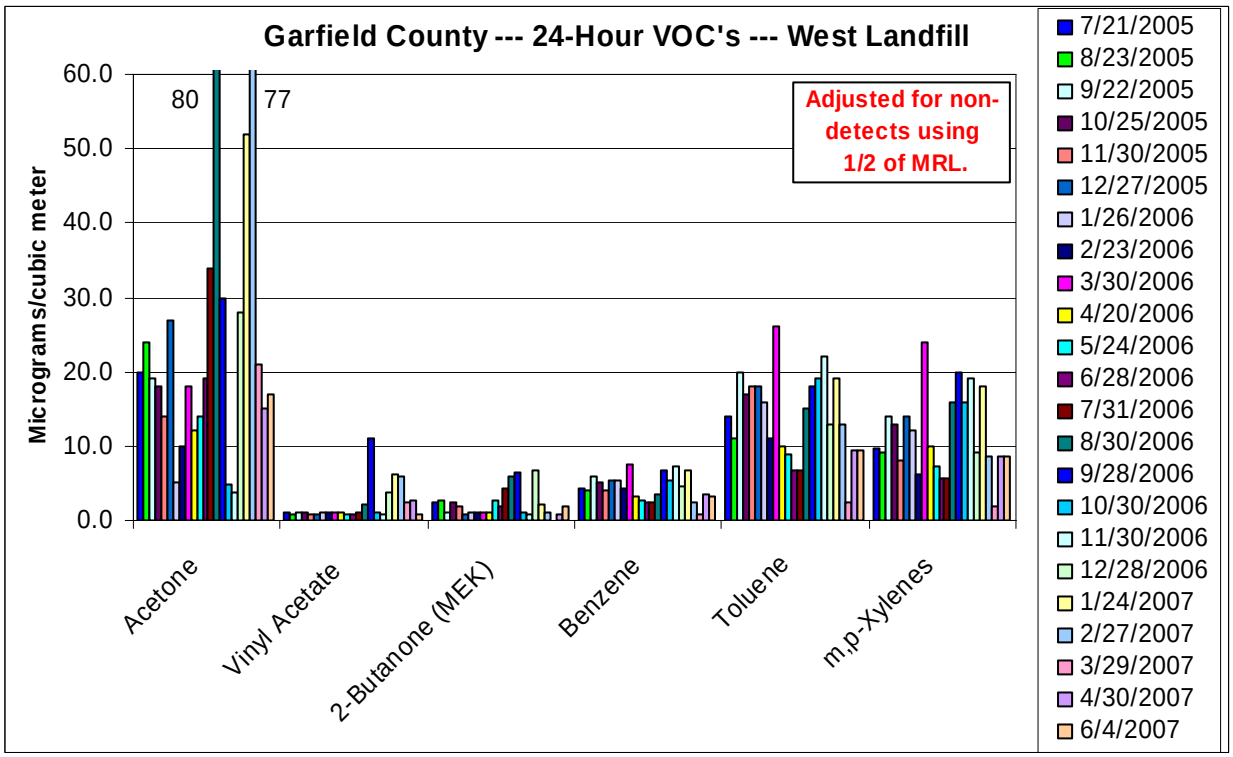


Figure 3.16. 24-Hour VOC's from Sebold Site (Oil & Gas area)

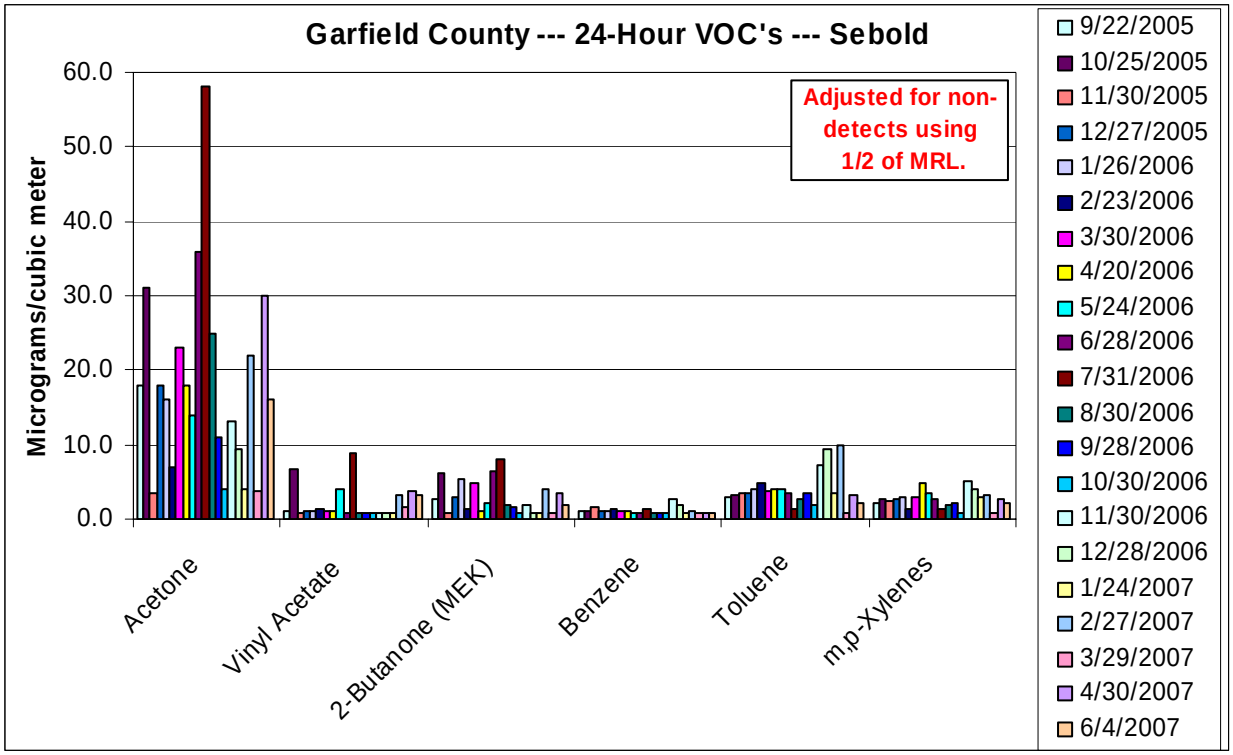


Figure 3.17. 24-Hour VOC's from Haire Site (Oil & Gas area)

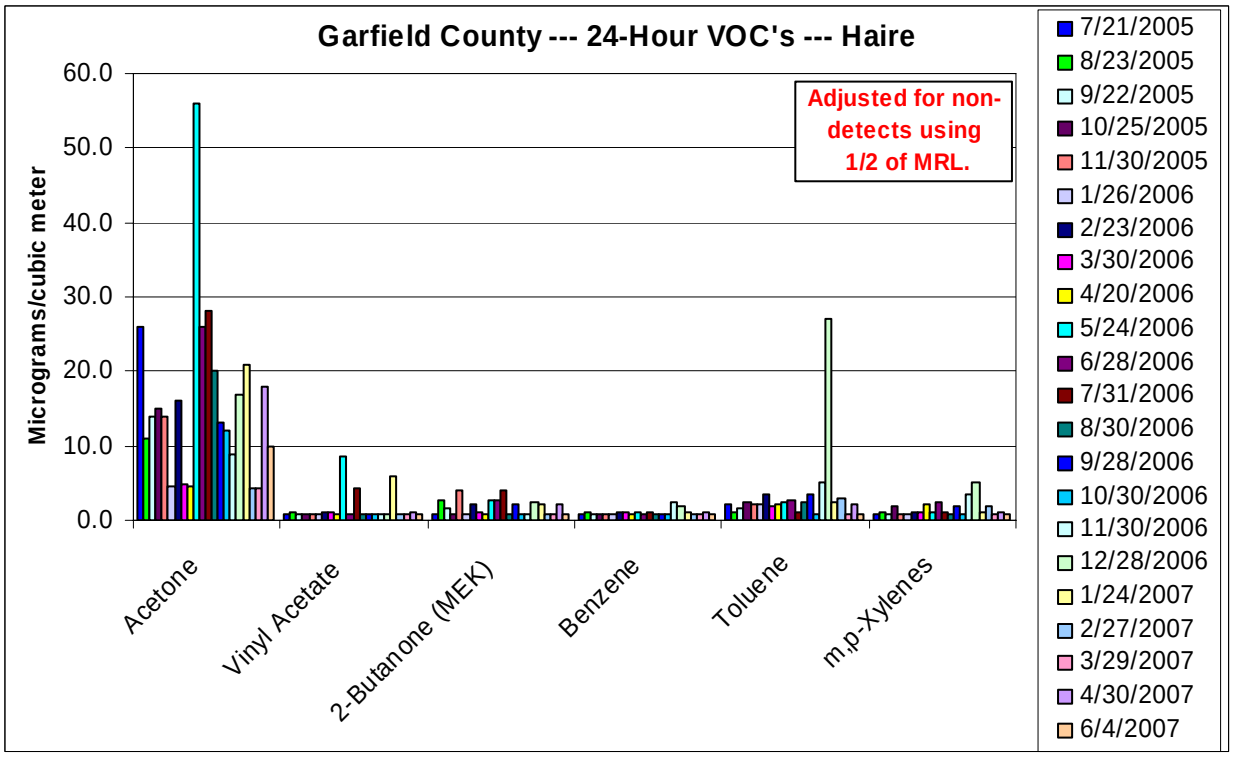


Figure 3.18. 2005 Grab Sample VOC's

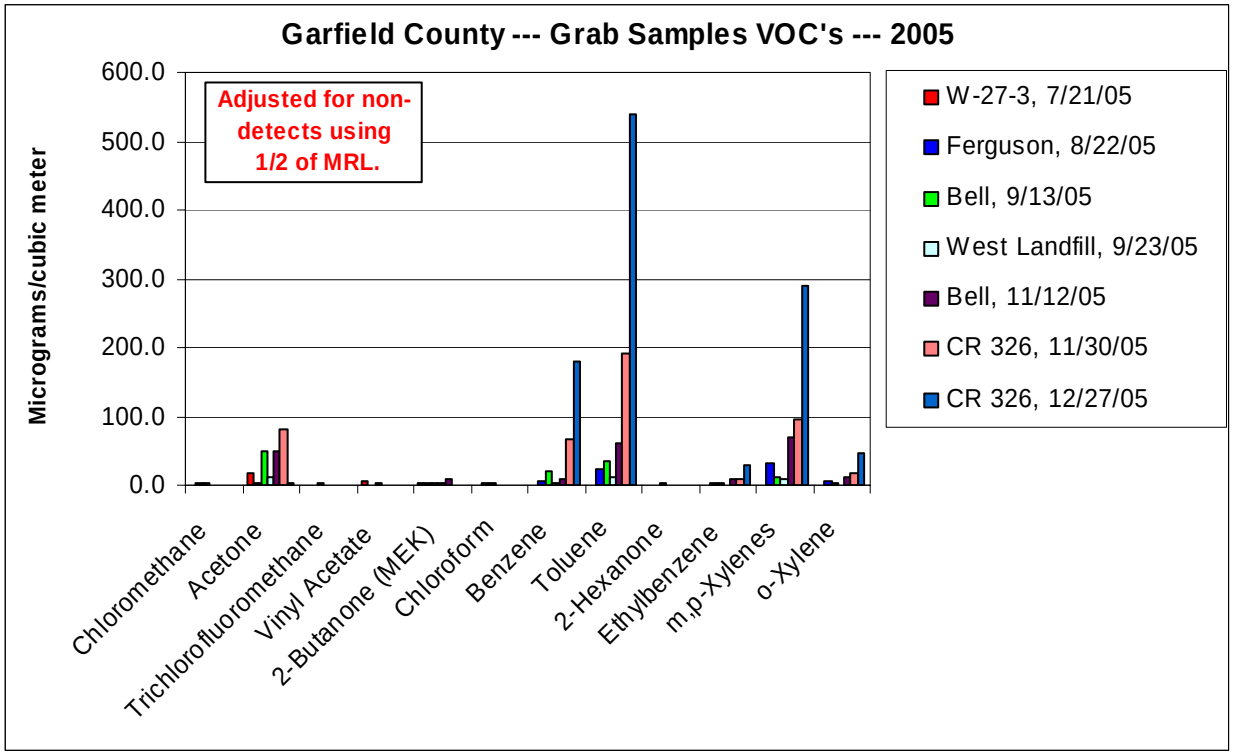


Figure 3.19. 2006 Grab Sample VOC's

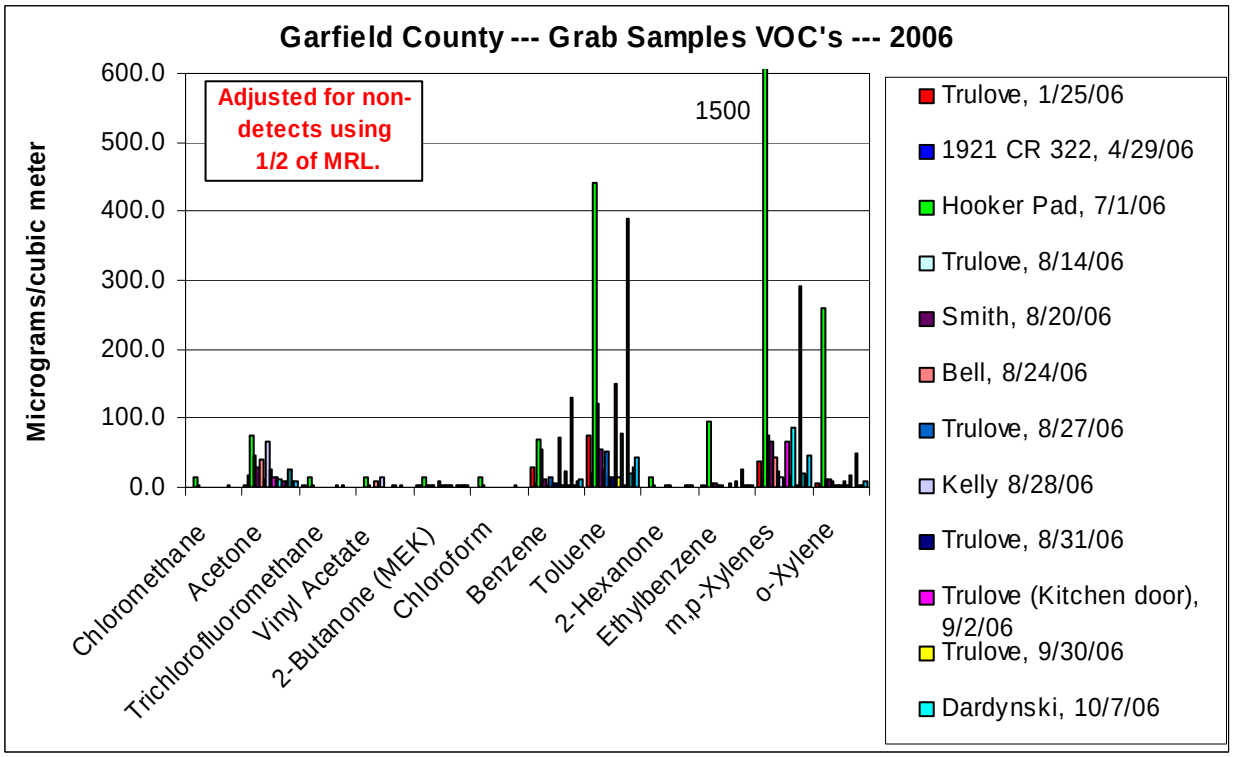
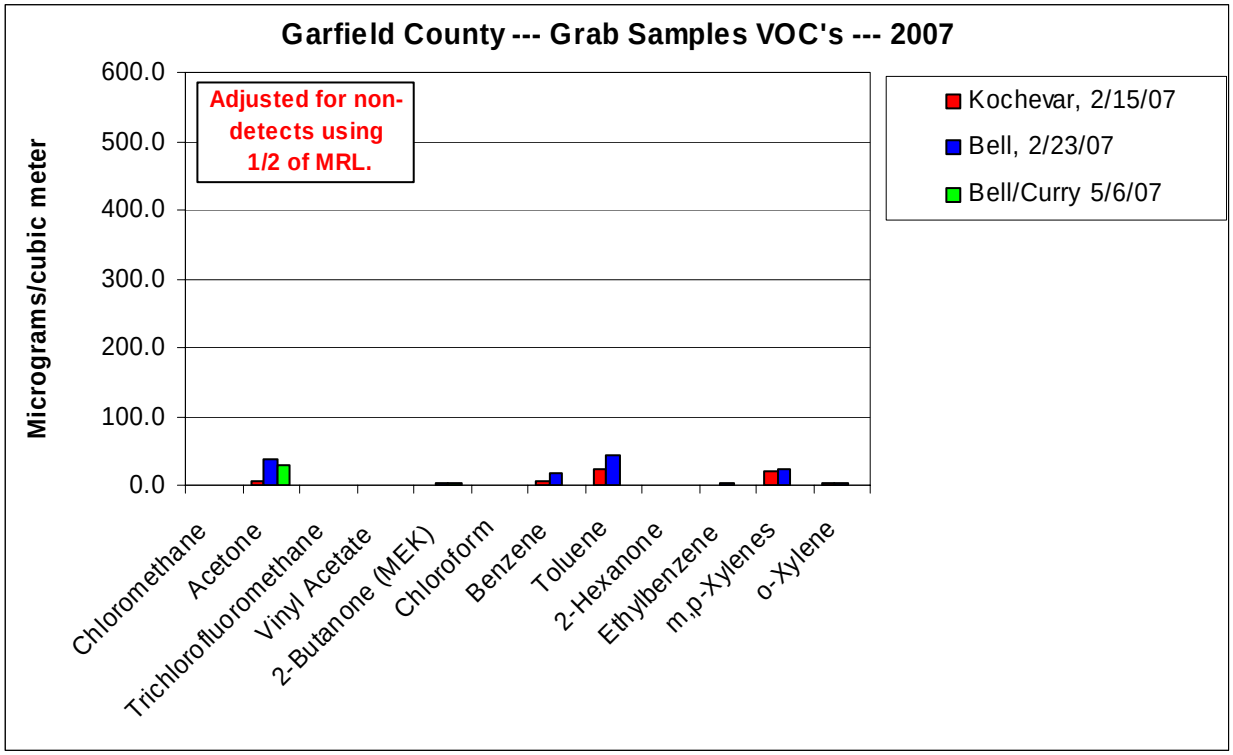


Figure 3.20. 2007 Grab Sample VOC's



3.4 VOC Comparisons to Other Areas

VOC concentrations were also compared to those recorded in other areas of Colorado. Due largely in part to the cost, VOC monitoring is quite limited, and has in general only been performed in urban areas for Colorado. Thus, data from Garfield County will be compared to studies conducted in Denver and Grand Junction. Reports on these other studies may be obtained from the Colorado Department of Public Health and Environment.[11]

Table 3.5 provides a summary of the top 10 compounds, by average, for selected sites in Garfield County that cover the range of land uses, as well as two years at one location in Grand Junction and two locations in Denver. It is evident that in general, acetone and the BTEX compounds are prevalent. It can also be seen that some of the highest concentration compounds at the Garfield County sites were not the highest concentration compounds for the Grand Junction and Denver urban areas. Also, some of the highest measured compounds in Grand Junction and Denver were not detected in any of the Garfield County samples. This indicates that local sources are likely playing a role in the different areas.

Figures 3.21 through 3.23 present the six compounds that were detected in at least 20 percent (overall) of the 24-hour Garfield County VOC samples, sorted by decreasing overall average. The graphs show the average concentrations for the selected Garfield County sites compared to the Grand Junction and Denver urban areas. It can be seen that for these six compounds, the VOC concentrations in Garfield County are relatively similar to those measured in larger urban areas, and in some cases, higher. As noted above, it should be kept in mind that each area is different and that local sources will play a role in what compounds have the highest concentrations.

Table 3.5. Comparison of Ten Highest Concentration VOC's for Selected Sites in Colorado

Silt-Bell June 2005 – May 2007 (24 samples) Rural, Oil& Gas Area		West Landfill June 2005 – May 2007 (23 samples) Rural, Oil& Gas Area		Silt-Daley June 2005 – May 2007 (8 samples) Rural Area		Rifle-Henry Building June 2005 – May 2007 (23 samples) Urban Area	
Compound	**Avg µg/m³**	**Compound**	**Avg µg/m³**	**Compound**	**Avg µg/m³**	**Compound**	**Avg µg/m³**
Acetone	22.79	Acetone	23.21	Acetone	14.74	Acetone	22.01
Toluene	7.68	Toluene	13.20	Toluene	7.24	Toluene	7.74
m,p-Xylenes	4.99	m,p-Xylenes	10.65	m,p-Xylenes	3.84	m,p-Xylenes	5.38
2-Butanone (MEK)	2.61	Benzene	4.17	Vinyl Acetate	2.50	2-Butanone (MEK)	3.12
Benzene	2.37	2-Butanone (MEK)	2.87	2-Butanone (MEK)	2.33	Benzene	2.60
Vinyl Acetate	1.72	Vinyl Acetate	2.35	Benzene	1.69	Vinyl Acetate	2.47
o-Xylene	1.21	o-Xylene	1.44	1,4-Dichlorobenzene	1.40	o-Xylene	1.38
2-Hexanone	1.05	2-Hexanone	1.18	o-Xylene	1.18	Ethylbenzene	0.98
Ethylbenzene	0.99	Methylene chloride	1.02	2-Hexanone	1.16	2-Hexanone	0.96
Trichlorofluoromethane	0.91	Ethylbenzene	0.99	Methylene chloride	0.96	Tetrachloroethene	0.94

Grand Junction-Powell January – December 2006 (61 samples) Urban Area		Grand Junction-Powell January – December 2005 (58 samples) Urban Area		Denver-CAMP May 2002 – April 2003 (57 samples) Urban Area		Denver-Welby May 2002 – April 2003 (52 samples) Urban Area	
Compound	**Avg µg/m³**	**Compound**	**Avg µg/m³**	**Compound**	**Avg µg/m³**	**Compound**	**Avg µg/m³**
Carbon Disulfide	8.51	Toluene	5.53	Acetone	22.84	Acetone	13.53
Acetone	4.08	Acetone	4.66	Toluene	9.81	Toluene	8.54
Toluene	4.06	m,p-Xylenes	4.62	m,p-Xylenes	4.48	m,p-Xylenes	4.36
m,p-Xylenes	2.29	o-Xylene	1.97	Benzene	3.17	2-Butanone (MEK)	3.07
Benzene	1.85	Benzene	1.95	2-Butanone (MEK)	2.57	Benzene	2.41
Trichlorofluoromethane	1.52	Trichlorofluoromethane	1.63	Trichlorofluoromethane	2.15	Trichlorofluoromethane	1.78
2-Butanone (MEK)	1.23	Ethylbenzene	1.36	o-Xylene	2.08	o-Xylene	1.77
Chloromethane	1.21	Chloromethane	1.32	Ethylbenzene	1.54	Methyl tert-Butyl Ether	1.75
o-Xylene	0.83	Styrene	1.05	Methylene chloride	1.40	4-Methyl-2-pentanone	1.46
Trichlorotrifluoroethane	0.76	Trichlorotrifluoroethane	0.81	Chloromethane	1.31	Ethylbenzene	1.41

Figure 3.21. VOC Comparison – Top 1st-3rd Average Compounds

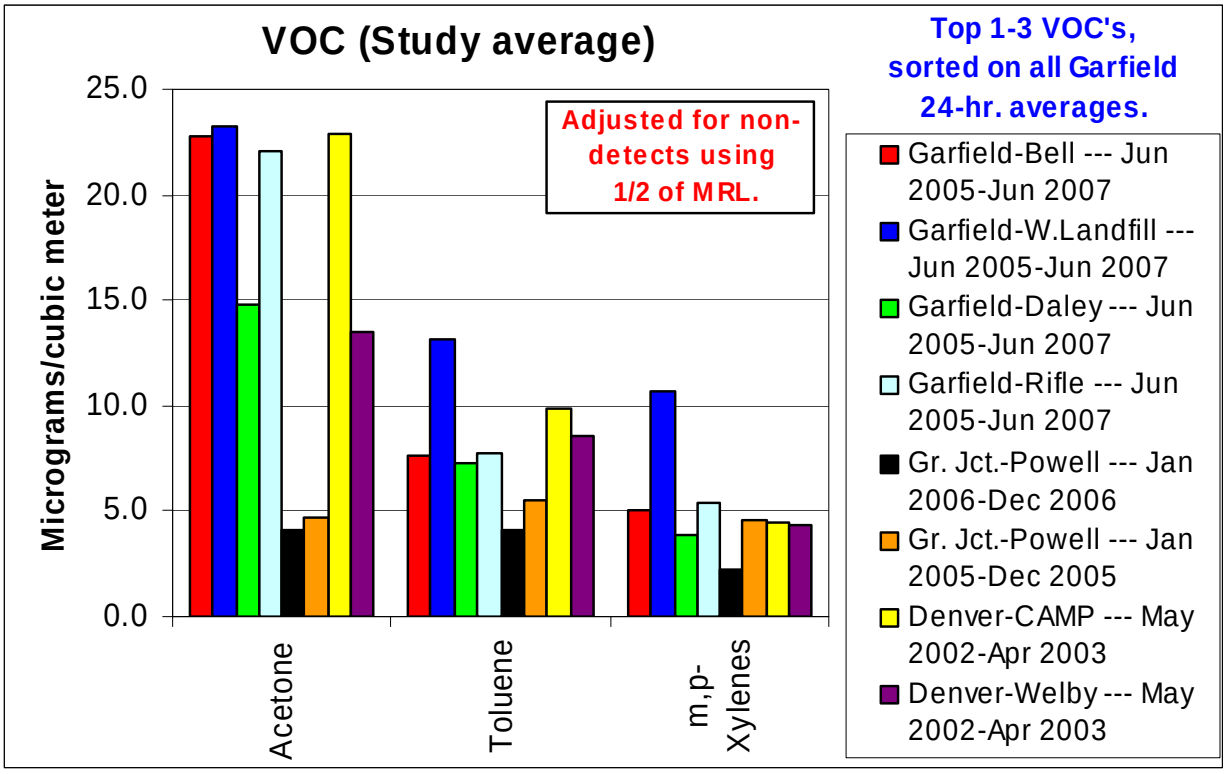
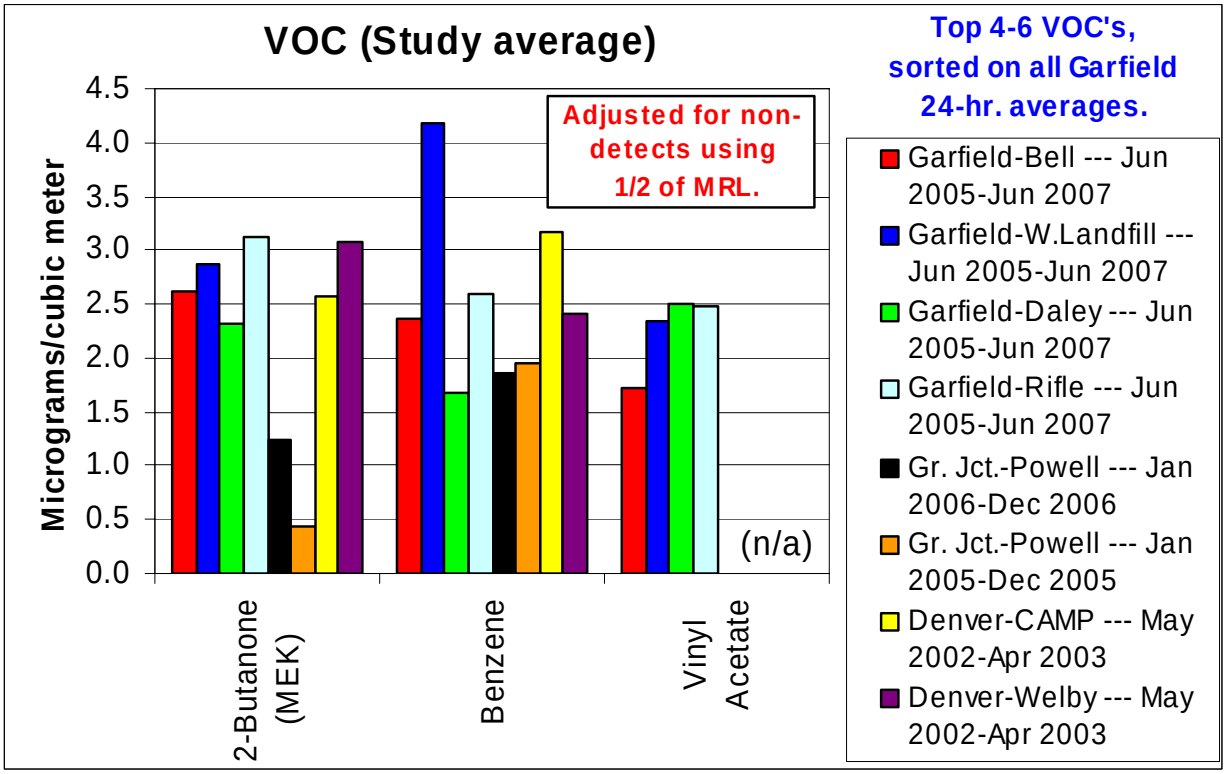


Figure 3.22. VOC Comparison – Top 4th-6th Average Compounds



4.0 Meteorological Results

4.1 Meteorological Monitoring Overview

Meteorological parameters were monitored on a continuous basis at six locations commencing in either January, February or March 2006. Monitoring was performed using RainWise® model MK-III RTR units for wind speed , wind direction, temperature, relative humidity, barometric pressure and precipitation. The sensors were located on top of a tripod tower, approximately 3-meters above the ground, with the exception of the precipitation sensor which was located at ground level. Data were stored on a half-hour basis on a RainWise® CC-2000 computer interface and periodically downloaded.

Meteorology play an important part in determining potential exposure to pollutants. Exposure can occur when winds blow from the direction in which a source is located or during stagnant and inversion conditions which don't allow pollution to disperse. The EPA has published guidelines for establishing meteorological monitoring sites.[12] Due to funding and location constraints, the meteorological monitoring for this project do not meet EPA recommendations for regulatory requirements. However, they do provide useful information for the monitoring locations and the Garfield County area in general.

4.2 Meteorological Summary Statistics

Table 4.1 provides a summary of meteorological data from the six sites for the period of commencing operation through May 2007. In the data, it can be seen that there are periods of high winds, up to 37 miles per hour for a one-half hour average. It is also evident that this area is quite arid, with only 10 to 15 inches of moisture in the total of approximately 15 months.

Table 4.1. Summary Statistics for Meteorology

Site	Parameter	Average	Maximum	Minimum	Total	# of Samples
Glenwood Springs-Courthouse	Wind Speed (miles/hour)	2	21	0	---	20719
	Wind Direction (degrees)	---	---	---	---	20719
	Temperature (Fahrenheit)	49	100	-4	---	20550
	Relative humidity (%)	38	100	0	---	20719
3/23/2006 – 5/31/2007	Barometric pressure (" Hg)	30	31	22	---	20719
	Rainfall (inches)	---	---	---	11.57	---
New Castle-Library	Wind Speed (miles/hour)	2	16	0	---	21946
	Wind Direction (degrees)	---	---	---	---	21946
	Temperature (Fahrenheit)	52	103	-4	---	21946
	Relative humidity (%)	48	98	4	---	21946
1/25/2006 – 5/31/2007	Barometric pressure (" Hg)	31	32	29	---	21946
	Rainfall (inches)	---	---	---	14.30	---
Silt-Bell	Wind Speed (miles/hour)	5	37	0	---	23243
	Wind Direction (degrees)	---	---	---	---	23243
	Temperature (Fahrenheit)	47	97	-12	---	23243
	Relative humidity (%)	59	100	7	---	23243
1/26/2006 – 5/31/2007	Barometric pressure (" Hg)	31	32	30	---	23243
	Rainfall (inches)	---	---	---	9.63	---

Table 4.1. Summary Statistics for Meteorology (continued)

Site	Parameter	Average	Maximum	Minimum	Total	# of Samples
Silt-Daley **2/9/2006 – 5/31/2007**	Wind Speed (miles/hour)	4	28	0	---	22511
	Wind Direction (degrees)	---	---	---	---	22511
	Temperature (Fahrenheit)	45	94	-17	---	22499
	Relative humidity (%)	58	100	7	---	22511
	Barometric pressure (“ Hg)	31	32	31	---	22511
	Rainfall (inches)	---	---	---	15.64	---
Silt-Cox **1/27/2006 – 5/17/2007**	Wind Speed (miles/hour)	3	24	0	---	22653
	Wind Direction (degrees)	---	---	---	---	22653
	Temperature (Fahrenheit)	47	99	-14	---	22618
	Relative humidity (%)	55	100	4	---	22653
	Barometric pressure (“ Hg)	31	32	30	---	22653
	Rainfall (inches)	---	---	---	11.05	---
Parachute **2/6/2006 – 5/31/2007**	Wind Speed (miles/hour)	3	18	0	---	21215
	Wind Direction (degrees)	---	---	---	---	21215
	Temperature (Fahrenheit)	52	104	-9	---	21215
	Relative humidity (%)	48	100	3	---	21215
	Barometric pressure (“ Hg)	31	32	30	---	21215
	Rainfall (inches)	---	---	---	13.46	---

4.3 Meteorology Wind Roses

Figures 4.1 through 4.6 present wind roses for the entire period of operation for each of the sites. A wind rose is a graphical depiction of wind direction and strength. The segments of the wind roses depict the direction from which the wind is blowing. The sections within each section depict the percentage of time that the wind was blowing at a certain speed range. By themselves, it is evident that the wind blows more frequently from certain directions than others. For example, with the Glenwood Springs-Courthouse site in Figure 4.1, the winds blow more frequently from a southerly direction, but the strongest winds are more from a less prevalent westerly direction. Topographically, these two directions fit with the Roaring Fork River drainage coming in from the south and the Colorado River valley being east to west. It is also apparent that winds across Garfield County during the measured time period were generally very light as is depicted by the predominance of black and yellow bands in the wind roses.

Wind roses were also generated for daylight hours, which were assumed to be 6:00 a.m. through 6:00 p.m. and nighttime hours, which were assumed to be 6:00 p.m. through 6:00 a.m. The daylight wind roses are presented in Figure 4.7 and the nighttime wind roses in Figure 4.8. From these, definite patterns are evident. For example, with the Silt-Bell site, daytime flows are predominantly from a westerly direction. These are flows up the Colorado River valley and are likely a combination of prevailing winds and convection heating. This direction also provides the strongest winds. There is also a down-valley component from the south-southeast. In the nighttime, the winds are almost exclusively the down-valley south-southeast component. Much of this at night would likely be due to convection cooling.

Thus, it is evident in all the wind roses that topography plays a significant component in wind direction patterns in the area, and, to a point, in the strength of the wind speeds. This becomes important for modeling and for potential air pollution impacts to different populations.

Figure 4.1. Glenwood Springs-Courthouse Wind Rose – All Hours

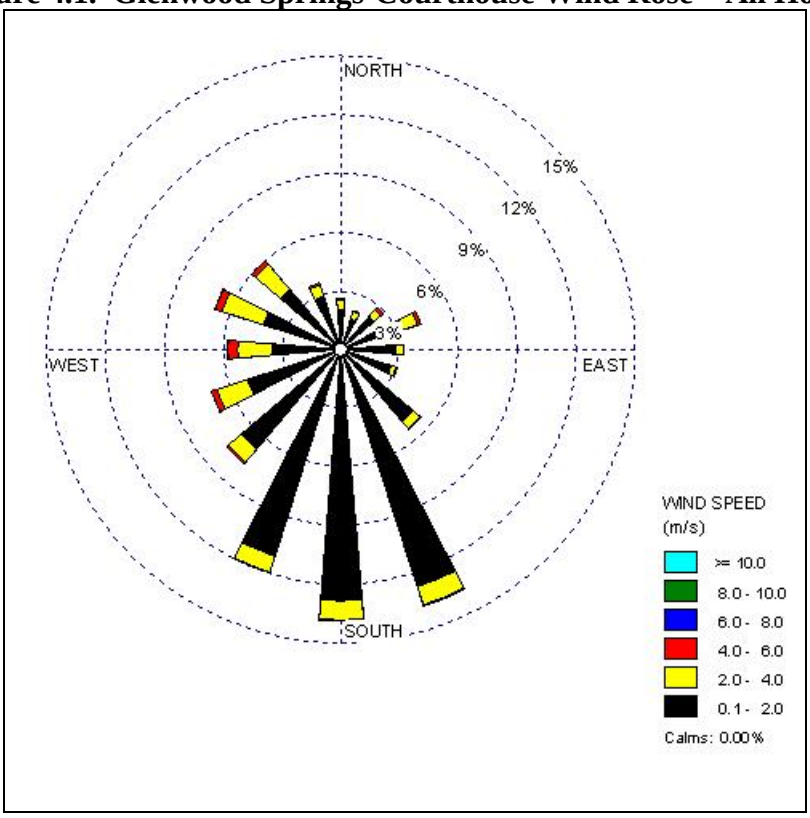


Figure 4.2. New Castle-Library Wind Rose – All Hours

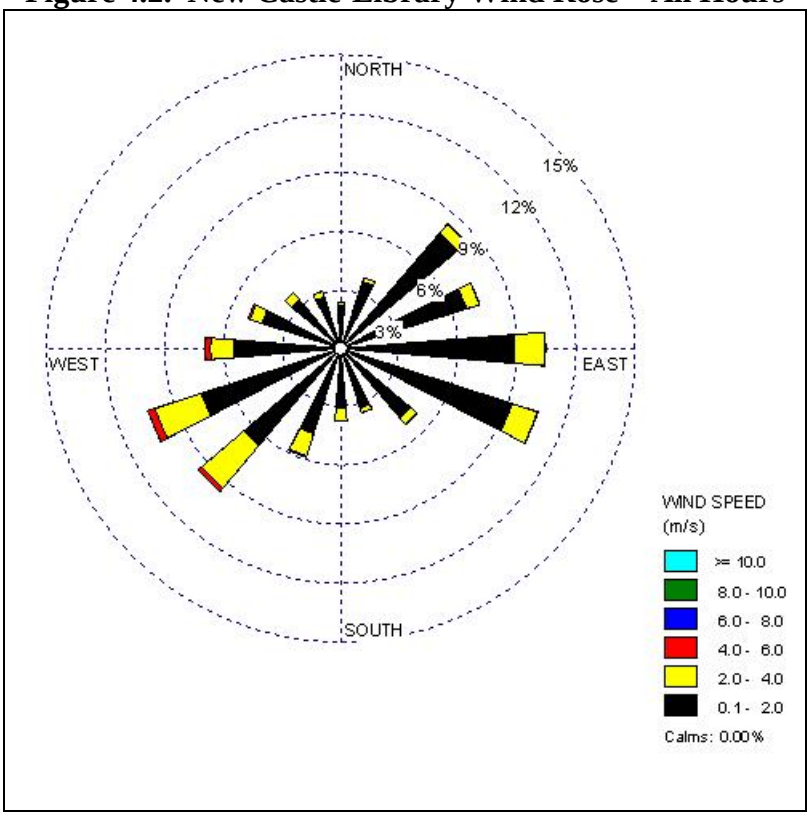


Figure 4.3. Silt-Bell Wind Rose – All Hours

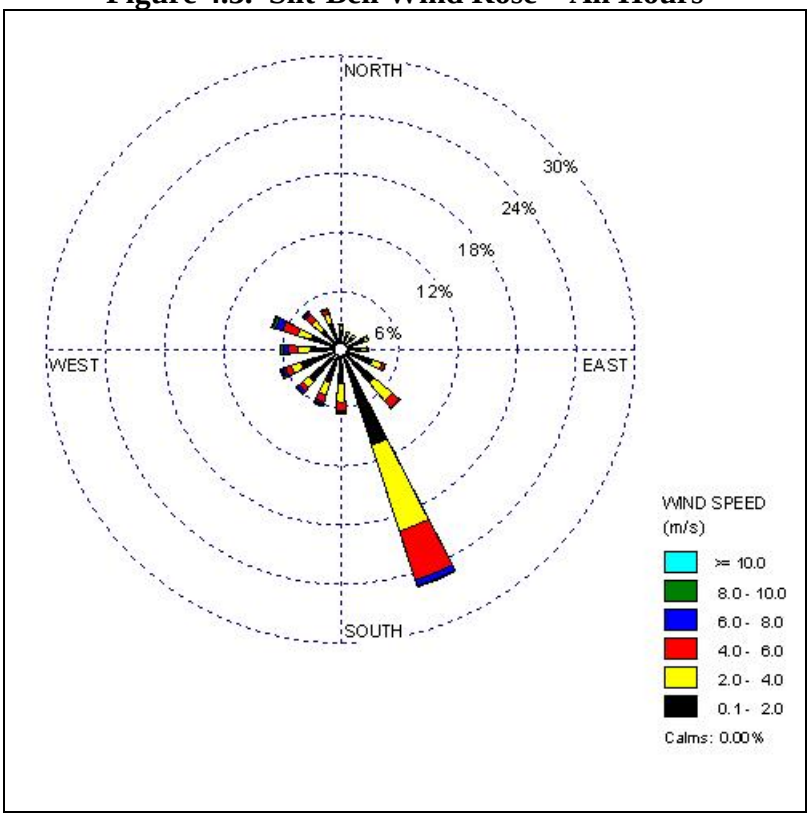


Figure 4.4. Silt-Daley Wind Rose – All Hours

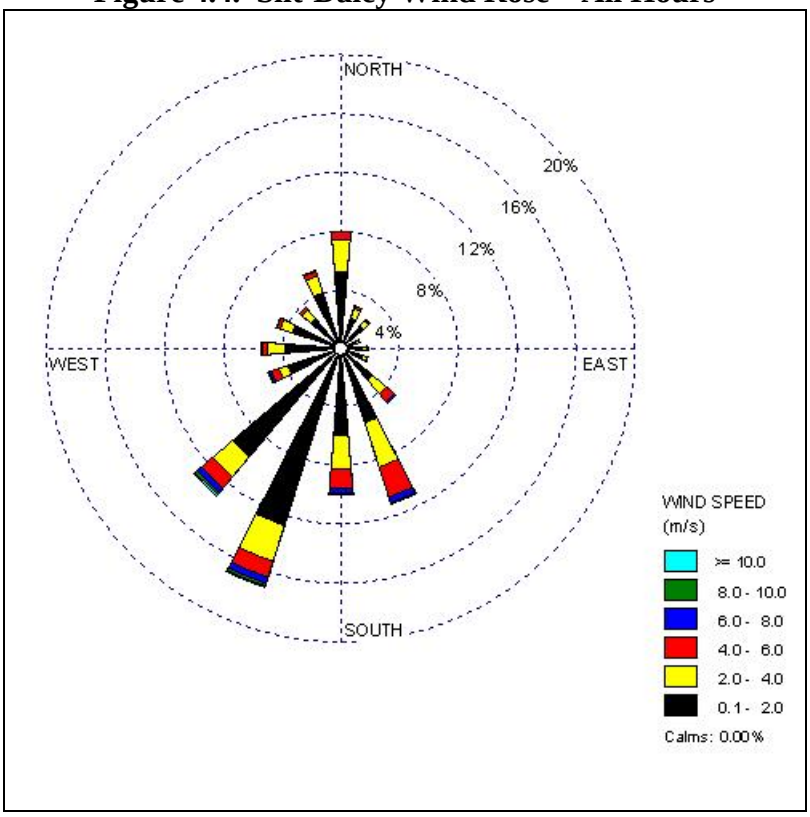


Figure 4.5. Silt-Cox Wind Rose – All Hours

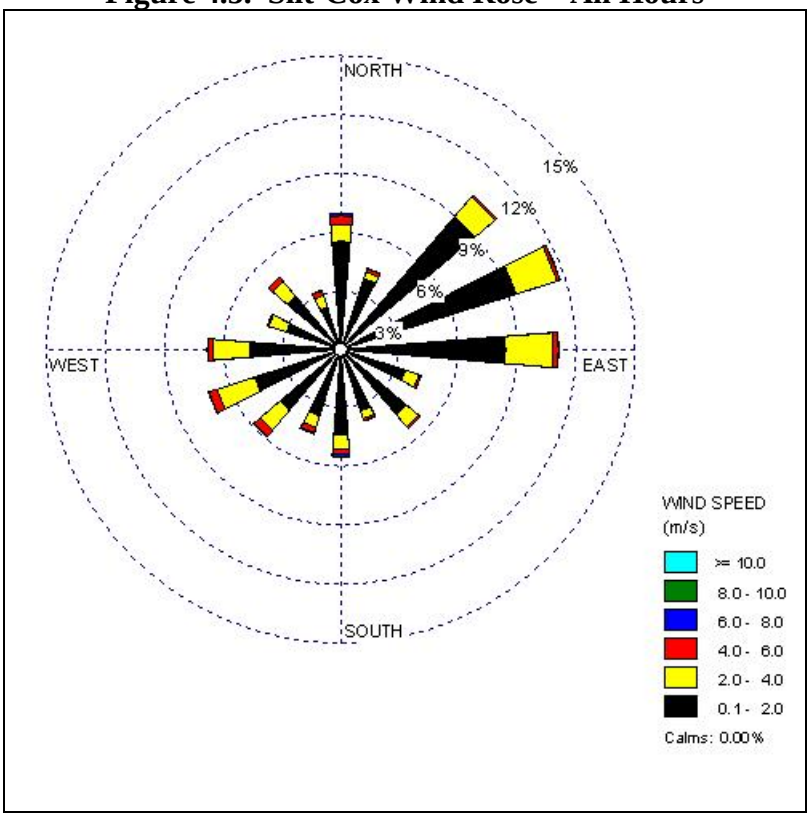


Figure 4.6. Parachute Wind Rose – All Hours

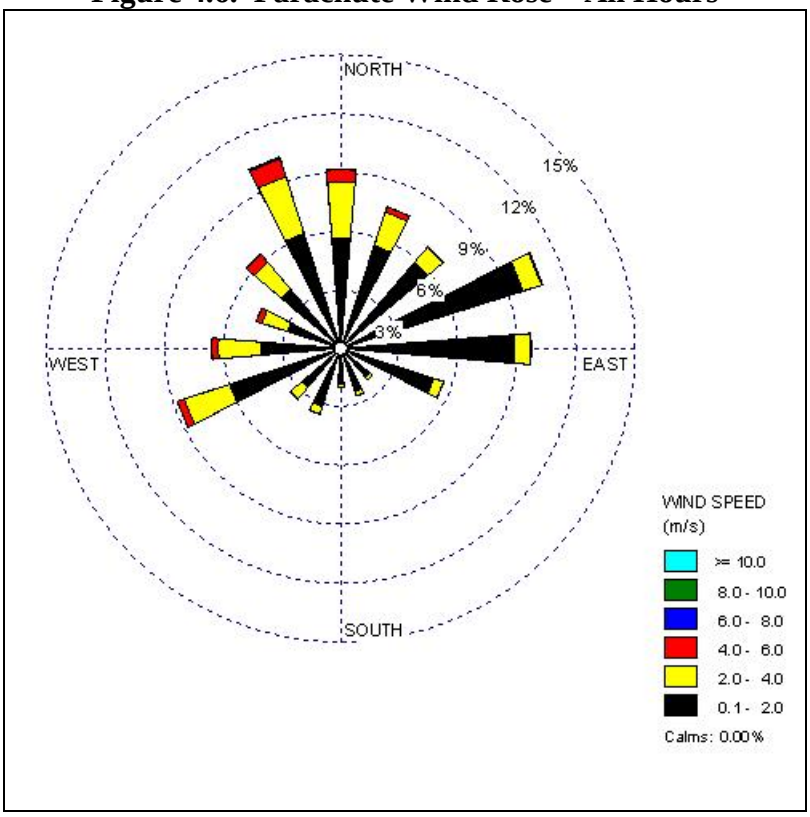
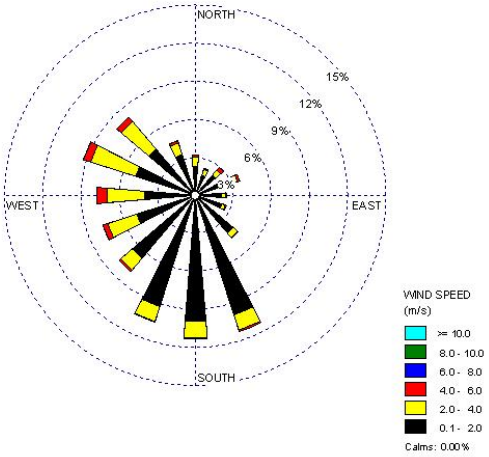
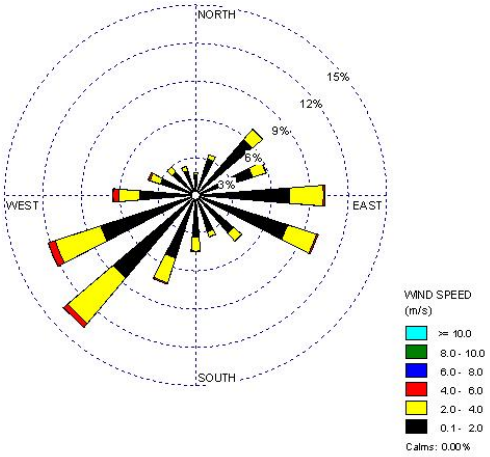


Figure 4.7. Daytime Wind Roses

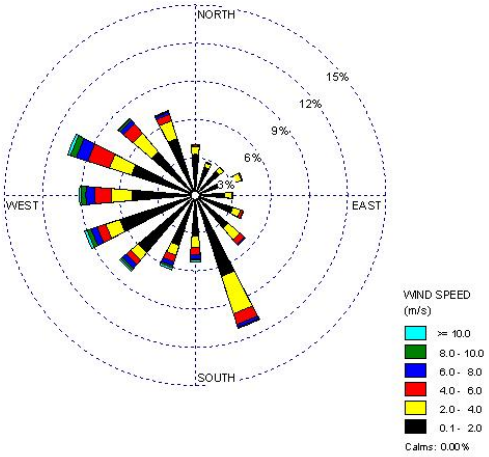
Glenwood Springs-Courthouse



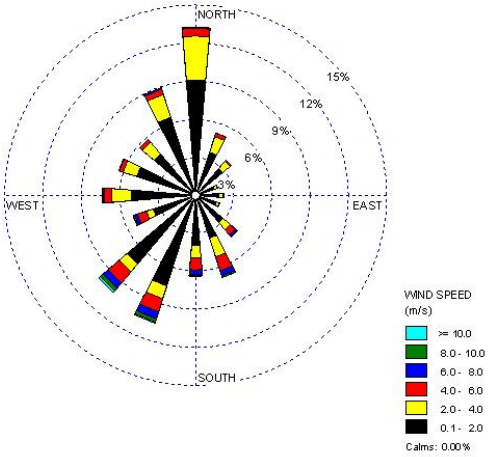
New Castle-Library



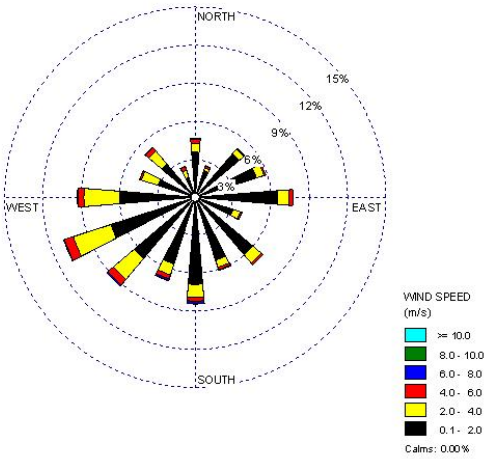
Silt-Bell



Silt-Daley



Silt-Cox



Parachute

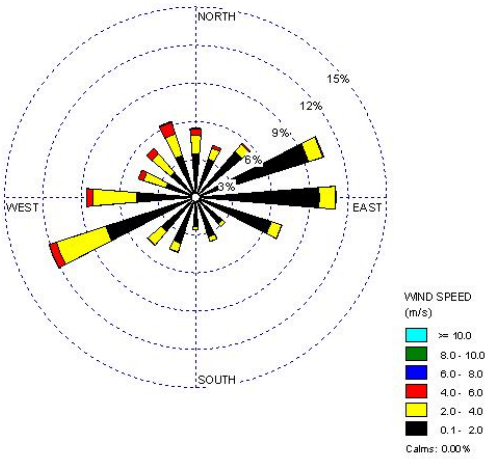
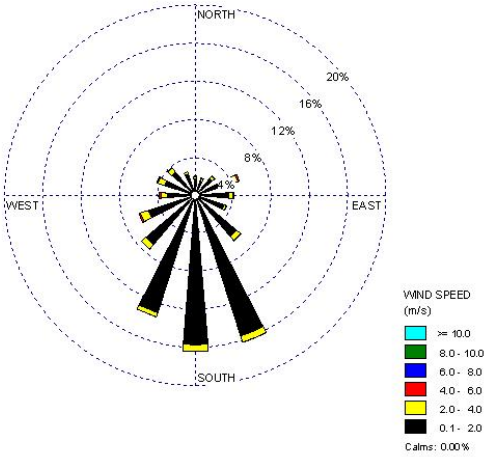
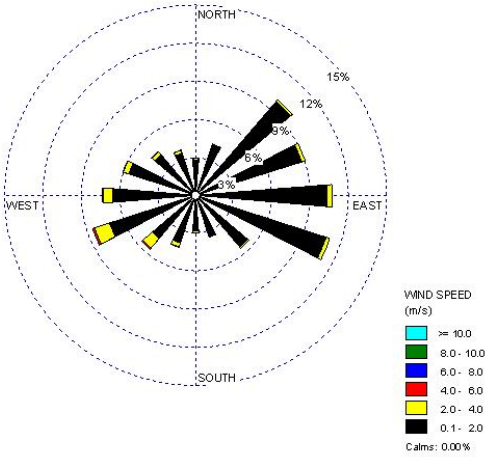


Figure 4.8. Nighttime Wind Roses

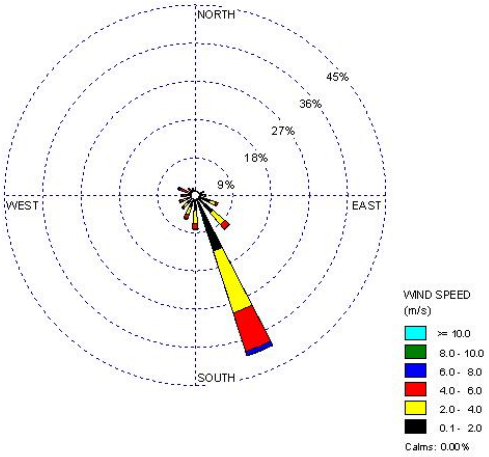
Glenwood Springs-Courthouse



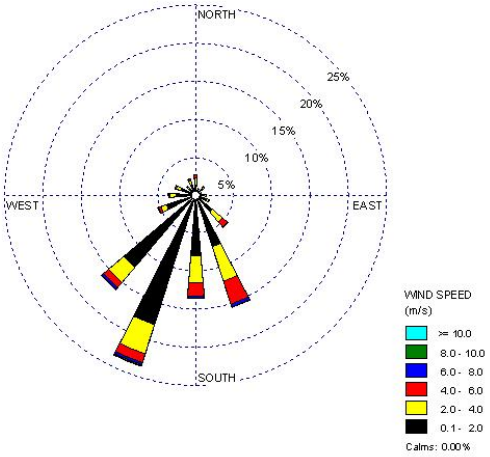
New Castle-Library



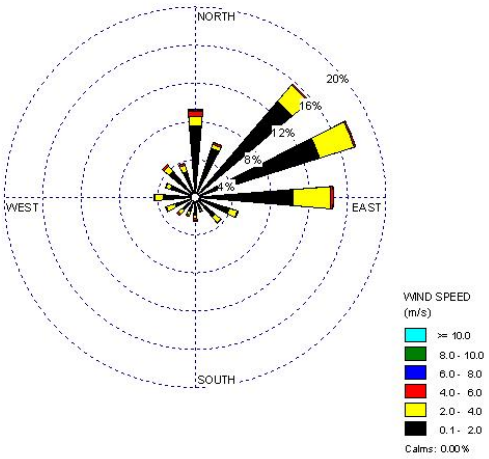
Silt-Bell



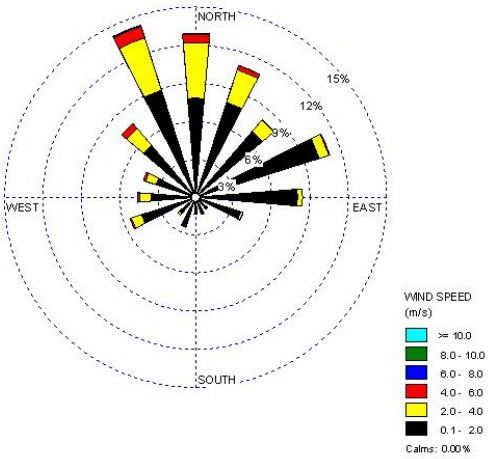
Silt-Daley



Silt-Cox



Parachute



5.0 Summary and Conclusions

5.1 Summary and Conclusions

This report summarizes the results of an ambient air quality monitoring study in Garfield County, Colorado, for the two-year period of June 2005 through May 2007. Monitoring was conducted for PM_{10} particulates, volatile organic compounds and meteorological parameters.

PM_{10} monitoring was performed at seven locations for 24-hours on an every third day basis using high-volume filter samplers. No exceedances of federal National Ambient Air Quality Standards were recorded. Two higher concentration values were noted that were due to nearby activities releasing dust in the air. These values were still below federal standards. Overall, PM_{10} concentrations in urban areas were generally higher than in rural areas. PM_{10} chemical speciation was conducted on two samples days, one summer day and one winter day. The results indicate that the particulate mass is primarily from geologic material, about 65 percent. They also indicate that there was little or no influence from biomass burning on those specific days and that the particulate carbon in the samples is likely due to lighter weight fossil fuel combustion.

Monitoring for volatile organic compounds was conducted at fourteen fixed sites for 24-hours on a once per month or once per quarter basis using Summa-polished stainless steel canisters. In addition, grab samples were also collected for volatile organic compounds at a number of locations based on odor complaints. Two source-specific grab samples were also collected. Of the 43 compounds that were analyzed, only 15 were detected in the 24-hour samples, 12 in the grab samples and only five in the source-specific grab samples. In general, for the 24-hour samples, concentrations of detected compounds were higher in rural oil and gas development areas than in the urban areas. This, along with grab samples, shows that local sources do have impacts on air pollution levels. Compounds that were detected in the highest concentrations were acetone and the BTEX group (benzene, toluene, ethylbenzene and xylenes). There are no federal standards for VOC's in the ambient air.

In comparisons to sites in other areas of Colorado, it appears that for PM_{10}, concentrations in Garfield County are similar to or lower than other areas. For VOC's, concentrations of the top six compounds in Garfield County are similar to or sometimes higher than those measured in Grand Junction and Denver. However, these larger urban areas also see measurable concentrations of compounds that were not detected in any of the Garfield County samples.

Meteorological monitoring was performed at six locations on a continuous basis with half-hour averages being generated. Meteorological parameters consisted of wind speed , wind direction, temperature, relative humidity, barometric pressure and rainfall. Due to meteorology being an item that was added later, monitoring did not commence until the first quarter of 2006. Monitoring showed that the area is generally quite dry, that winds are generally light, and that topography plays an important part in wind flow patterns.

This monitoring program has provided information on public exposure to a number of potential pollutants in the ambient air in Garfield County. Overall, pollutant levels were found to be generally very low, though individual sources may have impacts. Risk assessment work will be performed on the results and will be presented in a separate paper.[1]

6.0 References

[1] *Garfield County Air Toxics Inhalation: Screening Level Human Health Risk Assessment (working draft)*. Colorado Department of Public Health and Environment, Disease Control and Environmental Epidemiology Division. December 2007.

[2] *U.S. Code of Federal Regulations, 2007 Edition*. U.S. Government Printing Office. http://www.gpoaccess.gov/cfr/index.html.

[3] *Colorado Quality Assurance Project Plan*. Colorado Department of Public Health and Environment. Air Pollution Control Division. December 2006.

[4] National Ambient Air Quality Standards. U.S. Environmental Protection Agency. http://www.epa.gov/ttn/naaqs/.

[5] *Summary of Chemical Speciation Results from Select Garfield County PM_{10} Particulate Samples, July 2005 and January 2006*. Colorado Department of Public Health and Environment, Air Pollution Control Division, Technical Services Program. Technical Note. August 2006.

[6] *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition*. EPA/625/R-96/010b. U.S. Environmental Protection Agency. Office of Research and Development. January 1999. http://www.epa.gov/ttn/amtic/airtox.html.

[6] Dose Response Assessment Tables. U.S. Environmental Protection Agency. http://www.epa.gov/ttn/atw/toxsource/summary.html.

[8] Health Effects Notebook for Hazardous Air Pollutants. U.S. Environmental Protection Agency. http://www.epa.gov/ttn/atw/hlthef/hapindex.html.

[9] Integrated Risk Information System: A-Z List of Substances. U.S. Environmental Protection Agency. http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showSubstanceList.

[10] ToxFAQs. Agency for Toxic Substances and Disease Registry. http://www.atsdr.cdc.gov/toxfaq.html.

[11] (Various air toxics reports for Denver and Grand Junction). http://apcd.state.co.us/documents/techdocs.html. Colorado Department of Public Health and Environment, Air Pollution Control Division, Technical Services Program.

[12] *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements Version 1.0 (Draft)*. U.S. Environmental Protection Agency. October 2006. http://www.epa.gov/ttn/amtic/files/ambient/met/draft-volume-4.pdf.

Appendix A: Site Photographs

Glenwood Springs - Courthouse **Site Photo:** PM_{10}, Looking Northwest

Glenwood Springs - Courthouse **Site Photo:** VOC, Looking Northeast

New Castle – Library **Site Photo:** PM_{10}, Looking Southeast

New Castle – Library **Site Photo:** VOC, Looking West-southwest

Rifle – Henry Building **Site Photo:** PM_{10}, Looking East

Rifle – Henry Building **Site Photo:** VOC, Looking South-southwest

Parachute **Site Photo:** PM_{10}, Looking Northeast

Parachute **Site Photo:** VOC, Looking South-southwest

Silt – Bell Ranch **Site Photo:** PM_{10}, Looking Northwest

Silt – Bell Ranch **Site Photo:** VOC, PM_{10} and Meteorology, Looking West

Silt – Daley Ranch **Site Photo:** PM_{10}, Looking Southeast

Silt – Daley Ranch **Site Photo:** VOC, Looking West-southwest

Silt – Cox Ranch **Site Photo:** PM_{10}, Looking East

Silt – Cox Ranch **Site Photo:** VOC, PM_{10} and Meteorology, Looking West

Butterfly **Site Photo:** VOC

Brock **Site Photo:** VOC

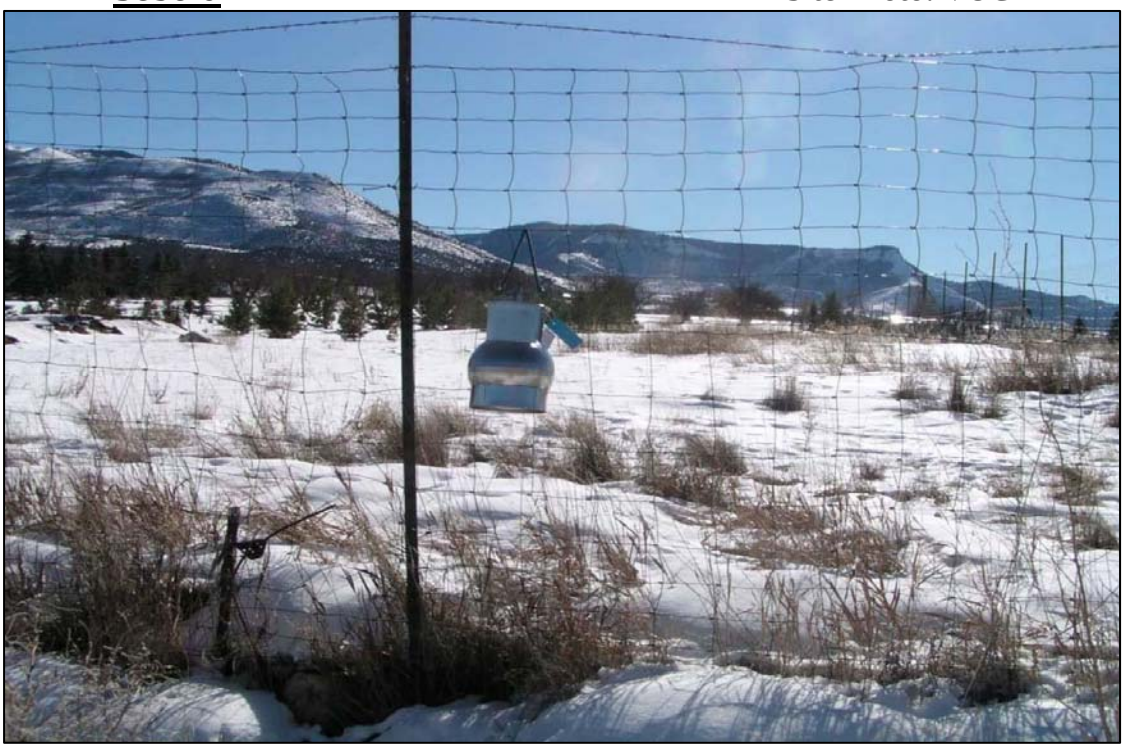
Isley **Site Photo:** VOC

Thompson **Site Photo:** VOC

(No photograph available due to short sampling period.)

West Landfill **Site Photo:** VOC

Sebold **Site Photo:** VOC



Haire **Site Photo:** VOC

Appendix B: VOC Full Results Summaries

		Glenwood Springs-Courthouse (8 samples)				New Castle-Library (21 samples)			
CAS #	**Compound**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**
74-87-3	Chloromethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
75-01-4	Vinyl Chloride	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
74-83-9	Bromomethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
75-00-3	Chloroethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
67-64-1	Acetone	18.3	37.0	4.3	75.0%	15.8	73.0	3.6	71.4%
75-69-4	Trichlorofluoromethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
75-35-4	1,1-Dichloroethene	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
75-09-2	Methylene chloride	1.1	2.3	0.8	12.5%	1.2	8.4	0.7	4.8%
76-13-1	Trichlorotrifluoroethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
75-15-0	Carbon Disulfide	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
156-60-5	trans-1,2-Dichloroethene	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
75-34-3	1,1-Dichloroethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
1634-04-4	Methyl tert-Butyl Ether	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
108-05-4	Vinyl Acetate	2.0	6.2	0.8	25.0%	1.7	14.0	0.7	14.3%
78-93-3	2-Butanone (MEK)	2.0	3.9	0.8	62.5%	1.7	4.5	0.7	42.9%
156-59-2	cis-1,2-Dichloroethene	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
67-66-3	Chloroform	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
107-06-2	1,2-Dichloroethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
71-55-6	1,1,1-Trichloroethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
71-43-2	Benzene	1.2	3.5	0.8	12.5%	2.0	15.0	0.8	33.3%
56-23-5	Carbon Tetrachloride	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
78-87-5	1,2-Dichloropropane	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
75-27-4	Bromodichloromethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
79-01-6	Trichloroethene	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
10061-01-5	cis-1,3-Dichloropropene	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
108-10-1	4-Methyl-2-pentanone	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
10061-02-6	trans-1,3-Dichloropropene	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
79-00-5	1,1,2-Trichloroethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
108-88-3	Toluene	10.4	57.0	2.4	100.0%	8.6	100.0	0.8	90.5%
591-78-6	2-Hexanone	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
124-48-1	Dibromochloromethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
106-93-4	1,2-Dibromoethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
127-18-4	Tetrachloroethene	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
108-90-7	Chlorobenzene	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
100-41-4	Ethylbenzene	0.9	1.1	0.8	0.0%	1.0	3.1	0.7	4.8%
136777-61-2	*m,p*-Xylenes	2.5	5.4	0.8	50.0%	2.3	6.6	0.8	66.7%
75-25-2	Bromoform	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
100-42-5	Styrene	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
95-47-6	o-Xylene	0.9	1.1	0.8	0.0%	1.0	3.0	0.7	4.8%
79-34-5	1,1,2,2-Tetrachloroethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
541-73-1	1,3-Dichlorobenzene	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%
106-46-7	1,4-Dichlorobenzene	2.3	12.0	0.8	12.5%	1.2	8.8	0.7	4.8%
95-50-1	1,2-Dichlorobenzene	0.9	1.1	0.8	0.0%	0.9	1.3	0.7	0.0%

NOTE: 1/2 of Minimum Reporting Level used for non-detect values.

		Silt-Cox (8 samples)				Butterfly (21 samples)			
CAS #	**Compound**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**
74-87-3	Chloromethane	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
75-01-4	Vinyl Chloride	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
74-83-9	Bromomethane	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
75-00-3	Chloroethane	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
67-64-1	Acetone	18.1	32.0	4.1	87.5%	17.1	61.0	4.0	85.7%
75-69-4	Trichlorofluoromethane	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
75-35-4	1,1-Dichloroethene	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
75-09-2	Methylene chloride	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
76-13-1	Trichlorotrifluoroethane	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
75-15-0	Carbon Disulfide	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
156-60-5	trans-1,2-Dichloroethene	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
75-34-3	1,1-Dichloroethane	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
1634-04-4	Methyl tert-Butyl Ether	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
108-05-4	Vinyl Acetate	2.1	7.9	0.8	25.0%	2.0	9.7	0.8	23.8%
78-93-3	2-Butanone (MEK)	1.9	2.9	0.8	62.5%	1.6	4.1	0.8	42.9%
156-59-2	cis-1,2-Dichloroethene	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
67-66-3	Chloroform	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
107-06-2	1,2-Dichloroethane	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
71-55-6	1,1,1-Trichloroethane	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
71-43-2	Benzene	1.0	1.9	0.8	12.5%	2.0	7.7	0.8	38.1%
56-23-5	Carbon Tetrachloride	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
78-87-5	1,2-Dichloropropane	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
75-27-4	Bromodichloromethane	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
79-01-6	Trichloroethene	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
10061-01-5	cis-1,3-Dichloropropene	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
108-10-1	4-Methyl-2-pentanone	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
10061-02-6	trans-1,3-Dichloropropene	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
79-00-5	1,1,2-Trichloroethane	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
108-88-3	Toluene	2.6	10.0	0.8	50.0%	6.8	43.0	0.9	85.7%
591-78-6	2-Hexanone	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
124-48-1	Dibromochloromethane	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
106-93-4	1,2-Dibromoethane	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
127-18-4	Tetrachloroethene	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
108-90-7	Chlorobenzene	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
100-41-4	Ethylbenzene	0.9	1.1	0.8	0.0%	0.9	1.7	0.8	4.8%
136777-61-2	*m,p*-Xylenes	1.5	4.2	0.8	25.0%	4.1	19.0	0.8	47.6%
75-25-2	Bromoform	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
100-42-5	Styrene	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
95-47-6	o-Xylene	0.9	1.1	0.8	0.0%	1.2	3.1	0.8	19.0%
79-34-5	1,1,2,2-Tetrachloroethane	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
541-73-1	1,3-Dichlorobenzene	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%
106-46-7	1,4-Dichlorobenzene	0.9	1.1	0.8	0.0%	1.3	9.9	0.8	4.8%
95-50-1	1,2-Dichlorobenzene	0.9	1.1	0.8	0.0%	0.9	1.1	0.8	0.0%

NOTE: 1/2 of Minimum Reporting Level used for non-detect values.

		Silt-Bell (24 samples)				Silt-Daley (8 samples)			
CAS #	**Compound**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**
74-87-3	Chloromethane	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
75-01-4	Vinyl Chloride	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
74-83-9	Bromomethane	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
75-00-3	Chloroethane	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
67-64-1	Acetone	19.2	57.0	4.1	87.5%	12.1	21.0	4.4	87.5%
75-69-4	Trichlorofluoromethane	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
75-35-4	1,1-Dichloroethene	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
75-09-2	Methylene chloride	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
76-13-1	Trichlorotrifluoroethane	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
75-15-0	Carbon Disulfide	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
156-60-5	trans-1,2-Dichloroethene	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
75-34-3	1,1-Dichloroethane	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
1634-04-4	Methyl tert-Butyl Ether	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
108-05-4	Vinyl Acetate	2.1	13.0	0.8	16.7%	1.2	3.2	0.8	12.5%
78-93-3	2-Butanone (MEK)	2.5	9.8	0.8	58.3%	1.6	3.7	0.8	37.5%
156-59-2	cis-1,2-Dichloroethene	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
67-66-3	Chloroform	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
107-06-2	1,2-Dichloroethane	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
71-55-6	1,1,1-Trichloroethane	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
71-43-2	Benzene	2.0	7.4	0.8	41.7%	1.0	1.2	0.8	0.0%
56-23-5	Carbon Tetrachloride	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
78-87-5	1,2-Dichloropropane	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
75-27-4	Bromodichloromethane	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
79-01-6	Trichloroethene	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
10061-01-5	cis-1,3-Dichloropropene	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
108-10-1	4-Methyl-2-pentanone	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
10061-02-6	trans-1,3-Dichloropropene	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
79-00-5	1,1,2-Trichloroethane	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
108-88-3	Toluene	6.2	27.0	0.9	95.8%	5.1	27.0	0.8	37.5%
591-78-6	2-Hexanone	1.0	4.4	0.8	4.2%	1.0	1.2	0.8	0.0%
124-48-1	Dibromochloromethane	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
106-93-4	1,2-Dibromoethane	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
127-18-4	Tetrachloroethene	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
108-90-7	Chlorobenzene	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
100-41-4	Ethylbenzene	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
136777-61-2	*m,p*-Xylenes	3.2	14.0	0.8	66.7%	1.4	4.9	0.8	12.5%
75-25-2	Bromoform	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
100-42-5	Styrene	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
95-47-6	o-Xylene	1.0	2.3	0.8	4.2%	1.0	1.2	0.8	0.0%
79-34-5	1,1,2,2-Tetrachloroethane	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
541-73-1	1,3-Dichlorobenzene	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%
106-46-7	1,4-Dichlorobenzene	1.0	2.3	0.8	4.2%	1.4	4.6	0.8	12.5%
95-50-1	1,2-Dichlorobenzene	0.9	1.1	0.8	0.0%	1.0	1.2	0.8	0.0%

NOTE: 1/2 of Minimum Reporting Level used for non-detect values.

		Rifle-Henry Bldg. (23 samples)				Brock (22 samples)			
CAS #	**Compound**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**
74-87-3	Chloromethane	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
75-01-4	Vinyl Chloride	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
74-83-9	Bromomethane	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
75-00-3	Chloroethane	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
67-64-1	Acetone	23.1	55.0	4.1	95.7%	19.5	56.0	4.4	86.4%
75-69-4	Trichlorofluoromethane	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
75-35-4	1,1-Dichloroethene	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
75-09-2	Methylene chloride	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
76-13-1	Trichlorotrifluoroethane	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
75-15-0	Carbon Disulfide	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
156-60-5	trans-1,2-Dichloroethene	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
75-34-3	1,1-Dichloroethane	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
1634-04-4	Methyl tert-Butyl Ether	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
108-05-4	Vinyl Acetate	3.3	15.0	0.8	26.1%	2.1	13.0	0.8	22.7%
78-93-3	2-Butanone (MEK)	3.0	12.0	0.8	65.2%	2.4	6.7	0.9	63.6%
156-59-2	cis-1,2-Dichloroethene	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
67-66-3	Chloroform	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
107-06-2	1,2-Dichloroethane	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
71-55-6	1,1,1-Trichloroethane	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
71-43-2	Benzene	2.9	6.9	0.8	78.3%	3.9	49.0	0.9	45.5%
56-23-5	Carbon Tetrachloride	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
78-87-5	1,2-Dichloropropane	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
75-27-4	Bromodichloromethane	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
79-01-6	Trichloroethene	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
10061-01-5	cis-1,3-Dichloropropene	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
108-10-1	4-Methyl-2-pentanone	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
10061-02-6	trans-1,3-Dichloropropene	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
79-00-5	1,1,2-Trichloroethane	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
108-88-3	Toluene	8.6	19.0	2.6	100.0%	11.6	130.0	0.9	90.9%
591-78-6	2-Hexanone	1.0	3.0	0.8	4.3%	0.9	1.2	0.8	0.0%
124-48-1	Dibromochloromethane	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
106-93-4	1,2-Dibromoethane	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
127-18-4	Tetrachloroethene	1.0	2.3	0.8	4.3%	0.9	1.2	0.8	0.0%
108-90-7	Chlorobenzene	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
100-41-4	Ethylbenzene	1.0	2.2	0.8	8.7%	1.2	3.4	0.8	9.1%
136777-61-2	*m,p*-Xylenes	5.9	12.0	1.7	100.0%	3.2	12.0	0.9	63.6%
75-25-2	Bromoform	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
100-42-5	Styrene	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
95-47-6	o-Xylene	1.4	3.0	0.8	34.8%	1.1	2.7	0.8	9.1%
79-34-5	1,1,2,2-Tetrachloroethane	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
541-73-1	1,3-Dichlorobenzene	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
106-46-7	1,4-Dichlorobenzene	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%
95-50-1	1,2-Dichlorobenzene	0.9	2.2	0.8	0.0%	0.9	1.2	0.8	0.0%

NOTE: 1/2 of Minimum Reporting Level used for non-detect values.

		Isley (20 samples)				Thompson (3 samples)			
CAS #	**Compound**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**
74-87-3	Chloromethane	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
75-01-4	Vinyl Chloride	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
74-83-9	Bromomethane	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
75-00-3	Chloroethane	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
67-64-1	Acetone	15.2	51.0	4.0	65.0%	11.2	15.0	4.5	66.7%
75-69-4	Trichlorofluoromethane	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
75-35-4	1,1-Dichloroethene	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
75-09-2	Methylene chloride	0.9	1.8	0.8	5.0%	0.9	1.0	0.9	0.0%
76-13-1	Trichlorotrifluoroethane	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
75-15-0	Carbon Disulfide	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
156-60-5	trans-1,2-Dichloroethene	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
75-34-3	1,1-Dichloroethane	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
1634-04-4	Methyl tert-Butyl Ether	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
108-05-4	Vinyl Acetate	2.4	8.5	0.8	35.0%	0.9	1.0	0.9	0.0%
78-93-3	2-Butanone (MEK)	1.9	6.0	0.8	55.0%	1.3	2.1	0.9	33.3%
156-59-2	cis-1,2-Dichloroethene	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
67-66-3	Chloroform	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
107-06-2	1,2-Dichloroethane	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
71-55-6	1,1,1-Trichloroethane	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
71-43-2	Benzene	1.2	3.0	0.8	20.0%	0.9	1.0	0.9	0.0%
56-23-5	Carbon Tetrachloride	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
78-87-5	1,2-Dichloropropane	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
75-27-4	Bromodichloromethane	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
79-01-6	Trichloroethene	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
10061-01-5	cis-1,3-Dichloropropene	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
108-10-1	4-Methyl-2-pentanone	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
10061-02-6	trans-1,3-Dichloropropene	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
79-00-5	1,1,2-Trichloroethane	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
108-88-3	Toluene	4.1	10.0	2.2	100.0%	3.3	3.8	2.3	100.0%
591-78-6	2-Hexanone	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
124-48-1	Dibromochloromethane	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
106-93-4	1,2-Dibromoethane	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
127-18-4	Tetrachloroethene	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
108-90-7	Chlorobenzene	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
100-41-4	Ethylbenzene	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
136777-61-2	*m,p*-Xylenes	2.0	4.8	0.8	55.0%	0.9	1.0	0.9	0.0%
75-25-2	Bromoform	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
100-42-5	Styrene	1.2	6.0	0.8	5.0%	0.9	1.0	0.9	0.0%
95-47-6	o-Xylene	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
79-34-5	1,1,2,2-Tetrachloroethane	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
541-73-1	1,3-Dichlorobenzene	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%
106-46-7	1,4-Dichlorobenzene	1.2	6.0	0.8	5.0%	0.9	1.0	0.9	0.0%
95-50-1	1,2-Dichlorobenzene	0.9	1.4	0.8	0.0%	0.9	1.0	0.9	0.0%

NOTE: 1/2 of Minimum Reporting Level used for non-detect values.

		West Landfill (23 samples)				Sebold (21 samples)			
CAS #	**Compound**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**
74-87-3	Chloromethane	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
75-01-4	Vinyl Chloride	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
74-83-9	Bromomethane	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
75-00-3	Chloroethane	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
67-64-1	Acetone	24.5	80.0	3.9	87.0%	18.1	58.0	3.6	76.2%
75-69-4	Trichlorofluoromethane	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
75-35-4	1,1-Dichloroethene	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
75-09-2	Methylene chloride	1.0	3.5	0.8	4.3%	0.9	1.4	0.7	0.0%
76-13-1	Trichlorotrifluoroethane	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
75-15-0	Carbon Disulfide	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
156-60-5	trans-1,2-Dichloroethene	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
75-34-3	1,1-Dichloroethane	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
1634-04-4	Methyl tert-Butyl Ether	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
108-05-4	Vinyl Acetate	2.1	11.0	0.8	30.4%	2.1	8.8	0.7	33.3%
78-93-3	2-Butanone (MEK)	2.3	6.6	0.8	52.2%	2.8	8.1	0.7	66.7%
156-59-2	cis-1,2-Dichloroethene	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
67-66-3	Chloroform	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
107-06-2	1,2-Dichloroethane	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
71-55-6	1,1,1-Trichloroethane	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
71-43-2	Benzene	4.4	7.5	0.8	95.7%	1.1	2.7	0.8	14.3%
56-23-5	Carbon Tetrachloride	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
78-87-5	1,2-Dichloropropane	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
75-27-4	Bromodichloromethane	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
79-01-6	Trichloroethene	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
10061-01-5	cis-1,3-Dichloropropene	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
108-10-1	4-Methyl-2-pentanone	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
10061-02-6	trans-1,3-Dichloropropene	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
79-00-5	1,1,2-Trichloroethane	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
108-88-3	Toluene	14.1	26.0	2.4	100.0%	3.9	10.0	0.8	90.5%
591-78-6	2-Hexanone	1.1	2.7	0.8	13.0%	1.0	2.1	0.7	4.8%
124-48-1	Dibromochloromethane	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
106-93-4	1,2-Dibromoethane	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
127-18-4	Tetrachloroethene	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
108-90-7	Chlorobenzene	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
100-41-4	Ethylbenzene	1.0	2.9	0.8	4.3%	0.9	1.4	0.7	0.0%
136777-61-2	*m,p*-Xylenes	11.5	24.0	1.8	100.0%	2.6	5.1	0.8	81.0%
75-25-2	Bromoform	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
100-42-5	Styrene	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
95-47-6	o-Xylene	1.5	4.3	0.8	30.4%	0.9	1.4	0.7	0.0%
79-34-5	1,1,2,2-Tetrachloroethane	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
541-73-1	1,3-Dichlorobenzene	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%
106-46-7	1,4-Dichlorobenzene	0.9	1.0	0.8	0.0%	1.0	3.0	0.7	4.8%
95-50-1	1,2-Dichlorobenzene	0.9	1.0	0.8	0.0%	0.9	1.4	0.7	0.0%

NOTE: 1/2 of Minimum Reporting Level used for non-detect values.

		Haire (22 samples)				Parachute (8 samples)			
CAS #	**Compound**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**
74-87-3	Chloromethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
75-01-4	Vinyl Chloride	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
74-83-9	Bromomethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
75-00-3	Chloroethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
67-64-1	Acetone	15.8	56.0	4.3	77.3%	20.9	46.0	6.5	87.5%
75-69-4	Trichlorofluoromethane	0.9	1.1	0.8	0.0%	4.0	26.0	0.8	12.5%
75-35-4	1,1-Dichloroethene	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
75-09-2	Methylene chloride	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
76-13-1	Trichlorotrifluoroethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
75-15-0	Carbon Disulfide	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
156-60-5	trans-1,2-Dichloroethene	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
75-34-3	1,1-Dichloroethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
1634-04-4	Methyl tert-Butyl Ether	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
108-05-4	Vinyl Acetate	1.6	8.6	0.8	13.6%	2.4	12.0	0.8	25.0%
78-93-3	2-Butanone (MEK)	1.7	4.1	0.8	50.0%	2.6	7.2	0.8	62.5%
156-59-2	cis-1,2-Dichloroethene	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
67-66-3	Chloroform	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
107-06-2	1,2-Dichloroethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
71-55-6	1,1,1-Trichloroethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
71-43-2	Benzene	1.0	2.3	0.8	9.1%	3.0	5.1	0.8	62.5%
56-23-5	Carbon Tetrachloride	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
78-87-5	1,2-Dichloropropane	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
75-27-4	Bromodichloromethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
79-01-6	Trichloroethene	0.9	1.1	0.8	0.0%	1.2	2.7	0.8	12.5%
10061-01-5	cis-1,3-Dichloropropene	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
108-10-1	4-Methyl-2-pentanone	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
10061-02-6	trans-1,3-Dichloropropene	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
79-00-5	1,1,2-Trichloroethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
108-88-3	Toluene	3.3	27.0	0.9	77.3%	10.0	13.0	2.1	100.0%
591-78-6	2-Hexanone	0.9	1.1	0.8	0.0%	1.1	2.1	0.8	12.5%
124-48-1	Dibromochloromethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
106-93-4	1,2-Dibromoethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
127-18-4	Tetrachloroethene	0.9	1.7	0.8	4.5%	0.9	1.3	0.8	0.0%
108-90-7	Chlorobenzene	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
100-41-4	Ethylbenzene	0.9	1.7	0.8	4.5%	0.9	1.3	0.8	0.0%
136777-61-2	*m,p*-Xylenes	1.5	5.0	0.8	31.8%	6.6	11.0	0.8	87.5%
75-25-2	Bromoform	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
100-42-5	Styrene	0.9	1.8	0.8	4.5%	0.9	1.3	0.8	0.0%
95-47-6	o-Xylene	0.9	1.1	0.8	0.0%	1.1	1.9	0.8	12.5%
79-34-5	1,1,2,2-Tetrachloroethane	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
541-73-1	1,3-Dichlorobenzene	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%
106-46-7	1,4-Dichlorobenzene	0.9	1.1	0.8	0.0%	1.1	2.2	0.8	12.5%
95-50-1	1,2-Dichlorobenzene	0.9	1.1	0.8	0.0%	0.9	1.3	0.8	0.0%

NOTE: 1/2 of Minimum Reporting Level used for non-detect values.

		Grab Samples (27 samples)				Condensate Load-out Grabs (2 samples)		
CAS #	**Compound**	**Avg µg/m³**	**Max µg/m³**	**Min µg/m³**	**% Detects**	**Vent µg/m³**	**50' dist. µg/m³**	**% Detects**
74-87-3	Chloromethane	1.5	15.0	0.7	3.7%	7500	8	0.0%
75-01-4	Vinyl Chloride	1.4	15.0	0.7	0.0%	7500	8	0.0%
74-83-9	Bromomethane	1.4	15.0	0.7	0.0%	7500	8	0.0%
75-00-3	Chloroethane	1.4	15.0	0.7	0.0%	7500	8	0.0%
67-64-1	Acetone	26.0	81.0	3.7	77.8%	38000	39	0.0%
75-69-4	Trichlorofluoromethane	1.5	15.0	0.7	7.4%	7500	8	0.0%
75-35-4	1,1-Dichloroethene	1.4	15.0	0.7	0.0%	7500	8	0.0%
75-09-2	Methylene chloride	1.4	15.0	0.7	0.0%	7500	8	0.0%
76-13-1	Trichlorotrifluoroethane	1.4	15.0	0.7	0.0%	7500	8	0.0%
75-15-0	Carbon Disulfide	1.4	15.0	0.7	0.0%	7500	8	0.0%
156-60-5	trans-1,2-Dichloroethene	1.4	15.0	0.7	0.0%	7500	8	0.0%
75-34-3	1,1-Dichloroethane	1.4	15.0	0.7	0.0%	7500	8	0.0%
1634-04-4	Methyl tert-Butyl Ether	1.4	15.0	0.7	0.0%	7500	8	0.0%
108-05-4	Vinyl Acetate	2.5	15.0	0.7	14.8%	7500	8	0.0%
78-93-3	2-Butanone (MEK)	3.0	15.0	0.8	70.4%	7500	8	0.0%
156-59-2	cis-1,2-Dichloroethene	1.4	15.0	0.7	0.0%	7500	8	0.0%
67-66-3	Chloroform	1.5	15.0	0.7	3.7%	7500	8	0.0%
107-06-2	1,2-Dichloroethane	1.4	15.0	0.7	0.0%	7500	8	0.0%
71-55-6	1,1,1-Trichloroethane	1.4	15.0	0.7	0.0%	7500	8	0.0%
71-43-2	Benzene	28.2	180.0	0.8	92.6%	590000	360	100.0%
56-23-5	Carbon Tetrachloride	1.4	15.0	0.7	0.0%	7500	8	0.0%
78-87-5	1,2-Dichloropropane	1.4	15.0	0.7	0.0%	7500	8	0.0%
75-27-4	Bromodichloromethane	1.4	15.0	0.7	0.0%	7500	8	0.0%
79-01-6	Trichloroethene	1.4	15.0	0.7	0.0%	7500	8	0.0%
10061-01-5	cis-1,3-Dichloropropene	1.4	15.0	0.7	0.0%	7500	8	0.0%
108-10-1	4-Methyl-2-pentanone	1.4	15.0	0.7	0.0%	7500	8	0.0%
10061-02-6	trans-1,3-Dichloropropene	1.4	15.0	0.7	0.0%	7500	8	0.0%
79-00-5	1,1,2-Trichloroethane	1.4	15.0	0.7	0.0%	7500	8	0.0%
108-88-3	Toluene	91.4	540.0	0.8	92.6%	770000	480	100.0%
591-78-6	2-Hexanone	1.7	15.0	0.7	14.8%	7500	8	0.0%
124-48-1	Dibromochloromethane	1.4	15.0	0.7	0.0%	7500	8	0.0%
106-93-4	1,2-Dibromoethane	1.4	15.0	0.7	0.0%	7500	8	0.0%
127-18-4	Tetrachloroethene	1.4	15.0	0.7	0.0%	7500	8	0.0%
108-90-7	Chlorobenzene	1.4	15.0	0.7	0.0%	7500	8	0.0%
100-41-4	Ethylbenzene	8.3	96.0	0.8	63.0%	37000	29	100.0%
136777-61-2	*m,p*-Xylenes	106.6	1500.0	0.8	92.6%	250000	200	100.0%
75-25-2	Bromoform	1.4	15.0	0.7	0.0%	7500	8	0.0%
100-42-5	Styrene	1.4	15.0	0.7	0.0%	7500	8	0.0%
95-47-6	o-Xylene	18.1	260.0	0.8	81.5%	49000	43	100.0%
79-34-5	1,1,2,2-Tetrachloroethane	1.4	15.0	0.7	0.0%	7500	8	0.0%
541-73-1	1,3-Dichlorobenzene	1.4	15.0	0.7	0.0%	7500	8	0.0%
106-46-7	1,4-Dichlorobenzene	1.4	15.0	0.7	0.0%	7500	8	0.0%
95-50-1	1,2-Dichlorobenzene	1.4	15.0	0.7	0.0%	7500	8	0.0%

NOTE: 1/2 of Minimum Reporting Level used for non-detect values.