# Garfield County Ambient Air Quality Study

June 2005 – May 2007

Energy Advisory Board Meeting

February 7, 2008

# *The Garfield County Ambient Air Quality Study attempts to:*

**Address public concern regarding potentially degraded air quality from industrial activity**

Characterize air quality in terms of $PM_{10}$ and VOC from Glenwood Springs to Parachute

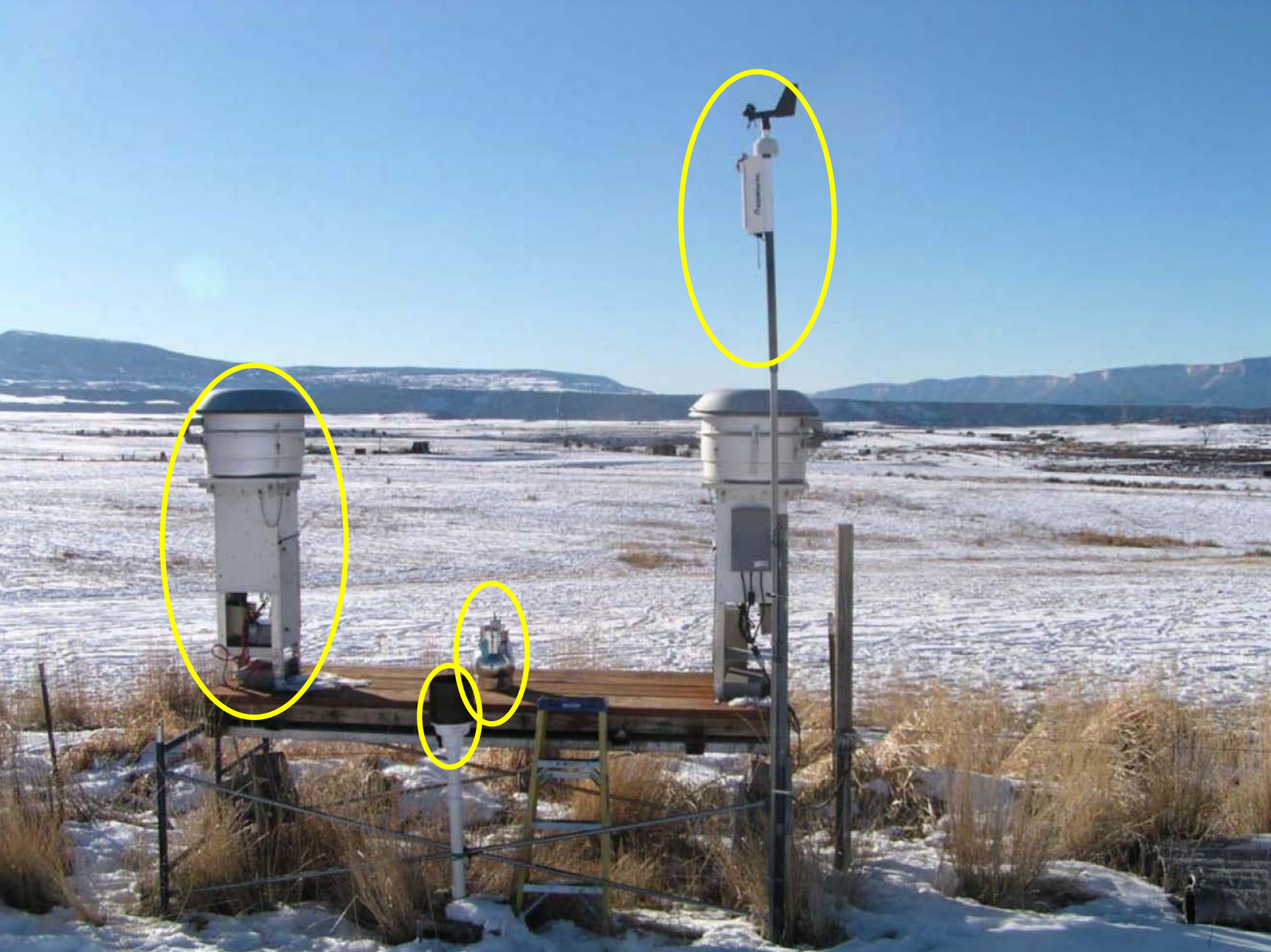
– create baseline for future monitoring efforts

# Sampling Locations

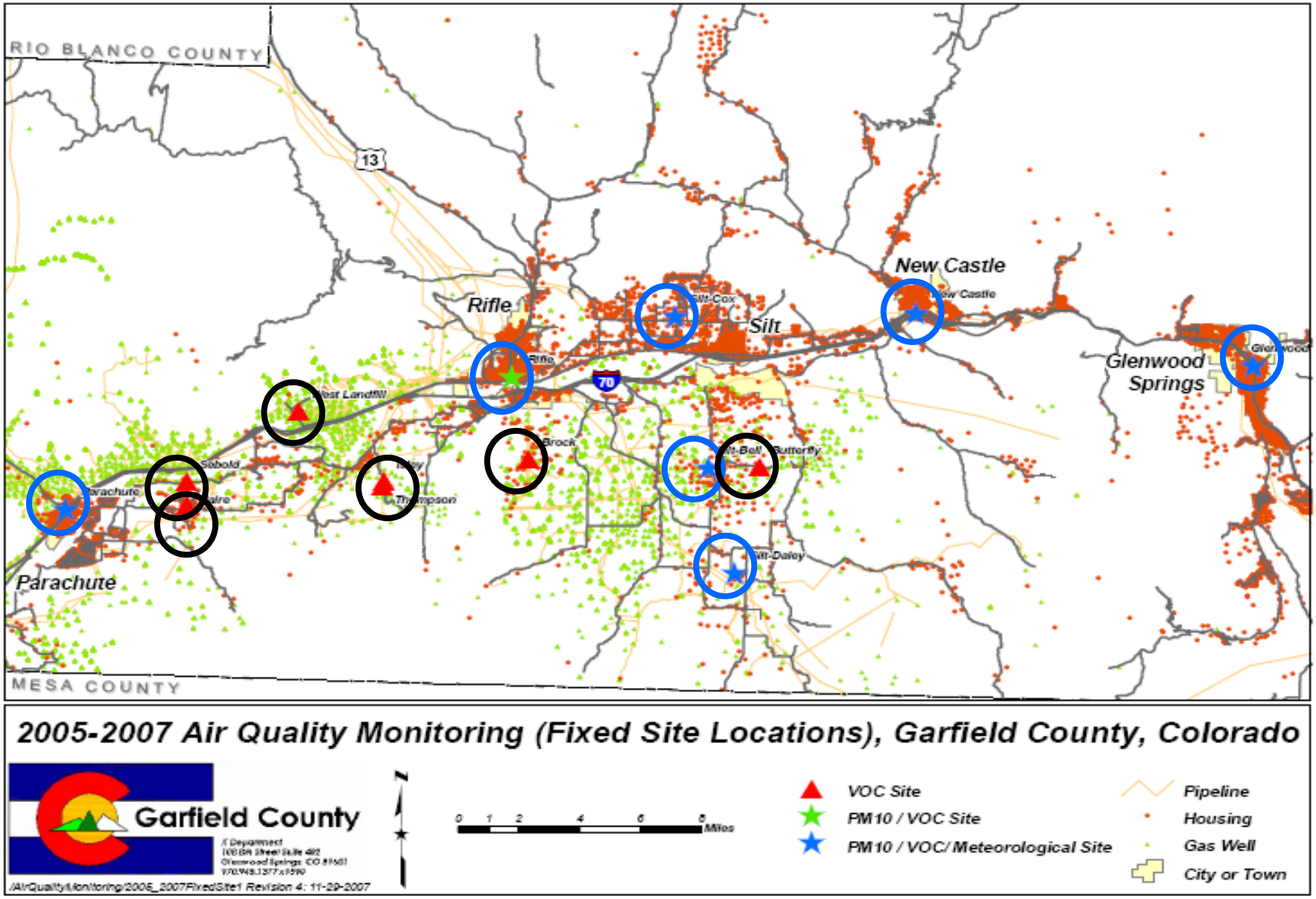
- $PM_{10}$ at 7 sites (every 3rd day)
- Volatile Organic Compounds (VOC) monitoring at 13 locations
  - Seven fixed monitoring sites monthly or quarterly (3 monthly, 4 quarterly)
  - Six additional locations also sampled monthly for VOC only
  - Grab samples (27 total)
    - GC Staff, CMC Staff and local residents in response to complaints

# Additional Monitoring

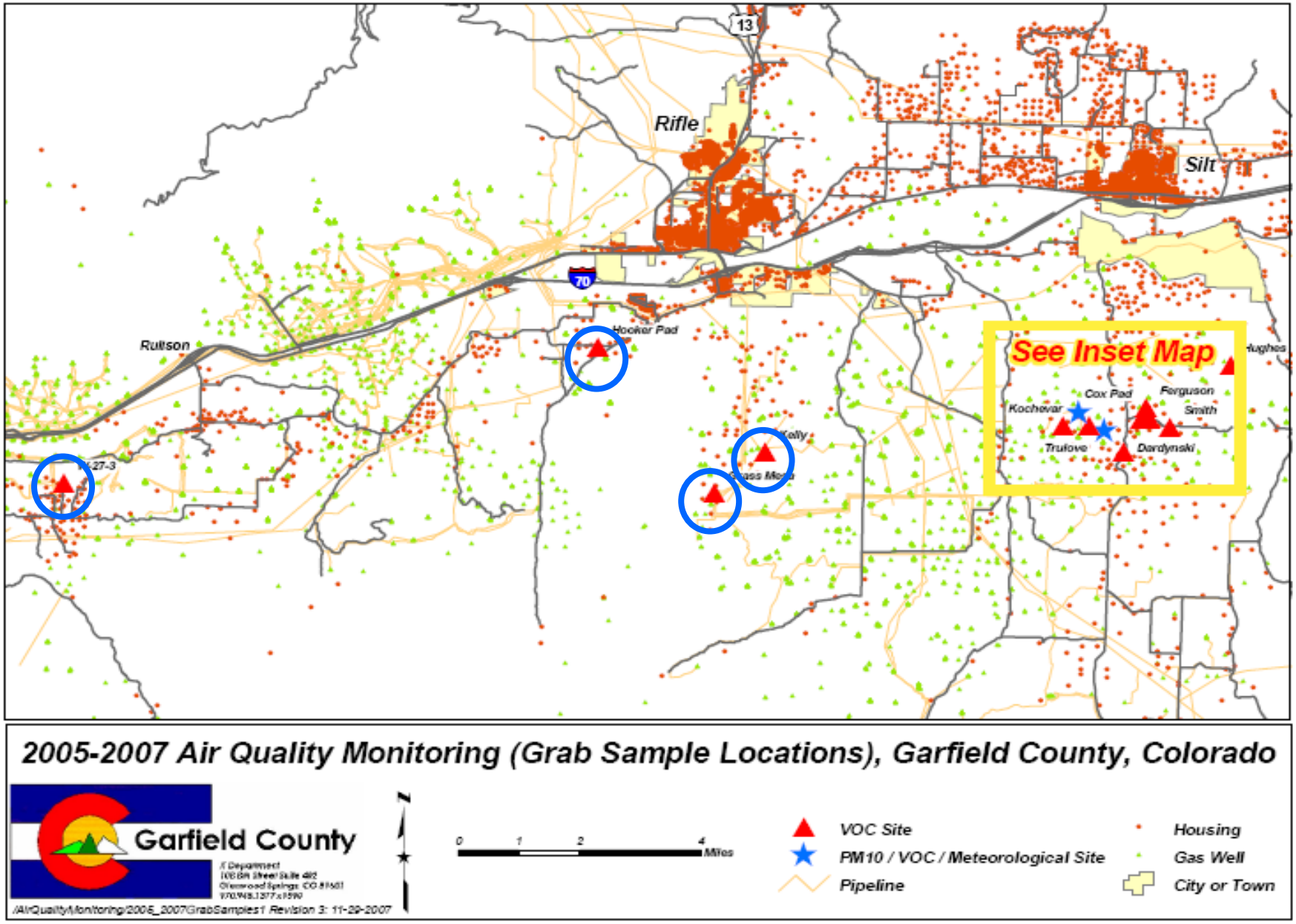
- Meteorological equipment installed at 6 of the fixed monitoring stations
  - Stations continuously record
    - Windspeed & direction
    - Temperature
    - Relative humidity
    - Barometric pressure
    - Precipitation



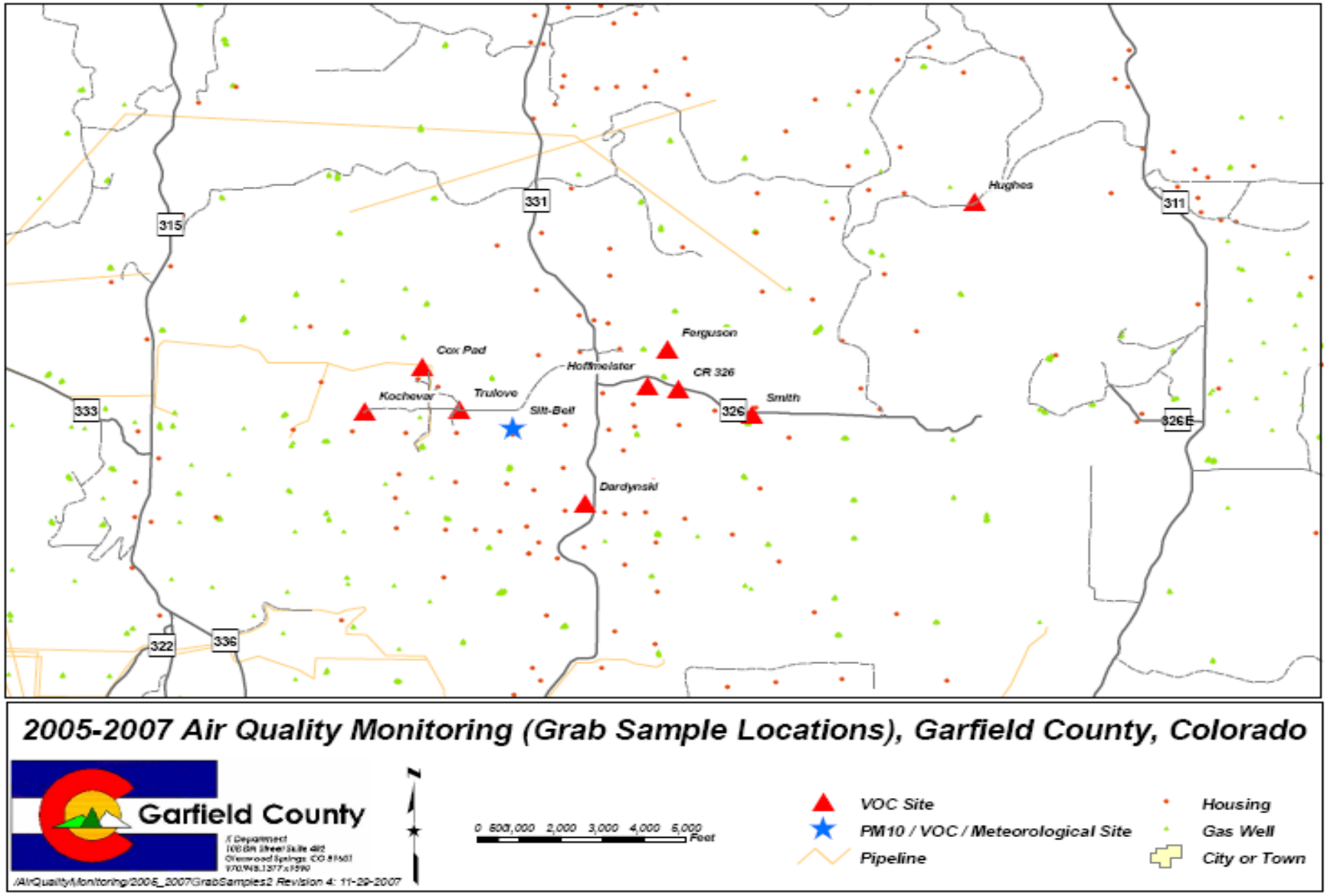
# Land Use Map of Fixed Site Locations



# Land Use Map of VOC Grab Sample Locations



# Land Use Map of VOC Grab Sample Locations (Inset Map)



# Meteorological Monitoring Overview

- Meteorology plays an important part in determining potential exposure to pollutants
- Exposure can occur when:
  - winds blow from the direction in which a source is located
  - stagnant and inversion conditions don’t allow pollution to disperse
- Meteorological monitoring was performed at six locations on a continuous basis with half-hour averages being generated.

# Meteorological Monitoring Findings

- The area is generally quite dry
- Winds are generally light (during study period)
- Topography plays an important role in wind flow patterns and wind speeds
- Definite diurnal wind patterns are evident
- Examples of possible meteorological connection to pollutant concentration are evident
  - December 28, 2006

# Summary Statistics for PM10

| 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% |

# PM10 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 |

# $PM_{10}$ Data Findings

- **No exceedances of the 24-hour NAAQS of 150 $\mu g/m^3$ (1 per year on average over 3 years) were observed**
- **Former annual average NAAQS of 50 $\mu g/m^3$ would not have been exceeded**
- **Parachute, Rifle and New Castle sites have higher concentrations of particulates than the other sites**
  - urban areas surrounded by arid undeveloped land, dirt roads
  - Glenwood Springs low levels likely due to lack of undeveloped land
- **Rural settings recorded the lowest concentrations of particulates**
- **Motor vehicles and other man-made activities are likely the largest contributors to PM10 in the area**
  - Localized spikes – earth moving, train track bedding, mudslides

# $PM_{10}$ Speciation Study

- A very limited, qualitative study of select $PM_{10}$ samples that can provide rudimentary understanding of the chemical makeup.
- 14 $PM_{10}$ samples, 7 sites, 2 dates were analyzed for chemical species.
- Different seasonal regimes:
  - Rifle 7/18/2005 clear skies, low winds, high temperatures in the 90s.
  - Rifle 1/11/2006 clear skies becoming overcast, calm winds and high temperatures in the 30s.

# $PM_{10}$ Speciation Study Limitations

- Qualitative study
  - caution must be invoked in drawing any quantitative conclusions
- Quantitative estimate is needed to provide a more rigorous/defensible analysis
- Quantitative source apportionment requires the use of receptor models.

# $PM_{10}$ Speciation Study Findings

- Predominant although slightly lower geologic component than what might be expected.
- Slightly elevated nitrate values in the winter samples (1/11/2006) – likely secondary nitrate formation.
- Slightly higher organic component than what might be expected in the arid West.
- Organic potassium ratios ($K^+/K$)
  - indicate a greater likelihood of contribution of organic carbon from combustion of fossil fuels rather than wood burning or fire.
- Low contribution of elemental carbon relative to organic carbon
  - suggests that the excess of organic carbon observed could be attributed to the combustion of lighter weight fossil fuels (i.e. natural gas, propane)

# Volatile Organic Compounds Regulation

- No National Ambient Air Quality Standards or any other ambient air standards for VOC's
- EPA, ATSDR and others have developed sets of risk factors for both acute and chronic exposures
- Emission limits on industrial sources have been set to control VOC levels in ambient air

# Volatile Organic Compounds Monitoring Overview

- Overall, 232, 24-hour VOC samples were collected on either a monthly or quarterly basis
- Additionally, 27 grab samples were collected during a various odor events
- 2 grab samples were also collected from a specific condensate truck loading event

# VOC Summary Data

- 15 of 43 analyzed compounds detected throughout sampling period (24-hour samples)
- 12 of 43 compounds detected in grab samples
- 5 of 43 compounds in the condensate load-out grab (special purpose) samples.
- 6 of the detected compounds detected >20% of the time at most sites
  - BTEX Compounds (Benzene, Toluene, Ethylbenzene and Xylene), Acetone, Vinyl Acetate and 2-Butanone (MEK)

# 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 | % Detect | Avg µg/m³ | Max µg/m³ | Min µg/m³ | % Detect |
| 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 | Trichloroethylene | 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 | Tetrachloroethylene | 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 |

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

# 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%** | **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%** | **10.0** | **13.0** | **2.1** | **100%** |
| **136777-61-2** | ***m,p*-Xylenes** | **5.9** | **12.0** | **1.7** | **100%** | **6.6** | **11.0** | **0.8** | **87.5%** |

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

# 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.

# 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.** | **0.9** | **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 %** |

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

# Rural Oil and Gas Area
# Site Summary Statistics for 24-Hour VOC's

| ***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. %** | **3.3** | **3.8** | **2.3** | **100. %** | **14.1** | **26.0** | **2.4** | **100. %** |
| **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 %** |

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

# Rural Oil and Gas Area
# Site Summary Statistics for 24-Hour VOC's

| ***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.

# Special Purpose Samples

| ***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%** |

# What does the data tell us?

- 24-hour VOC levels were generally very low
- No compound was detected 100 percent of the time.
  - Some compounds (toluene, xylene) were detected 100 percent of the time at some sites.
- Concentrations quite varied for different compounds at some sites; relatively stable at others
  - Somewhat indicative of being either in an urban area, an oil and gas development area, or a rural background area
- Certain days had higher concentrations in general than other days
  - December 28, 2006

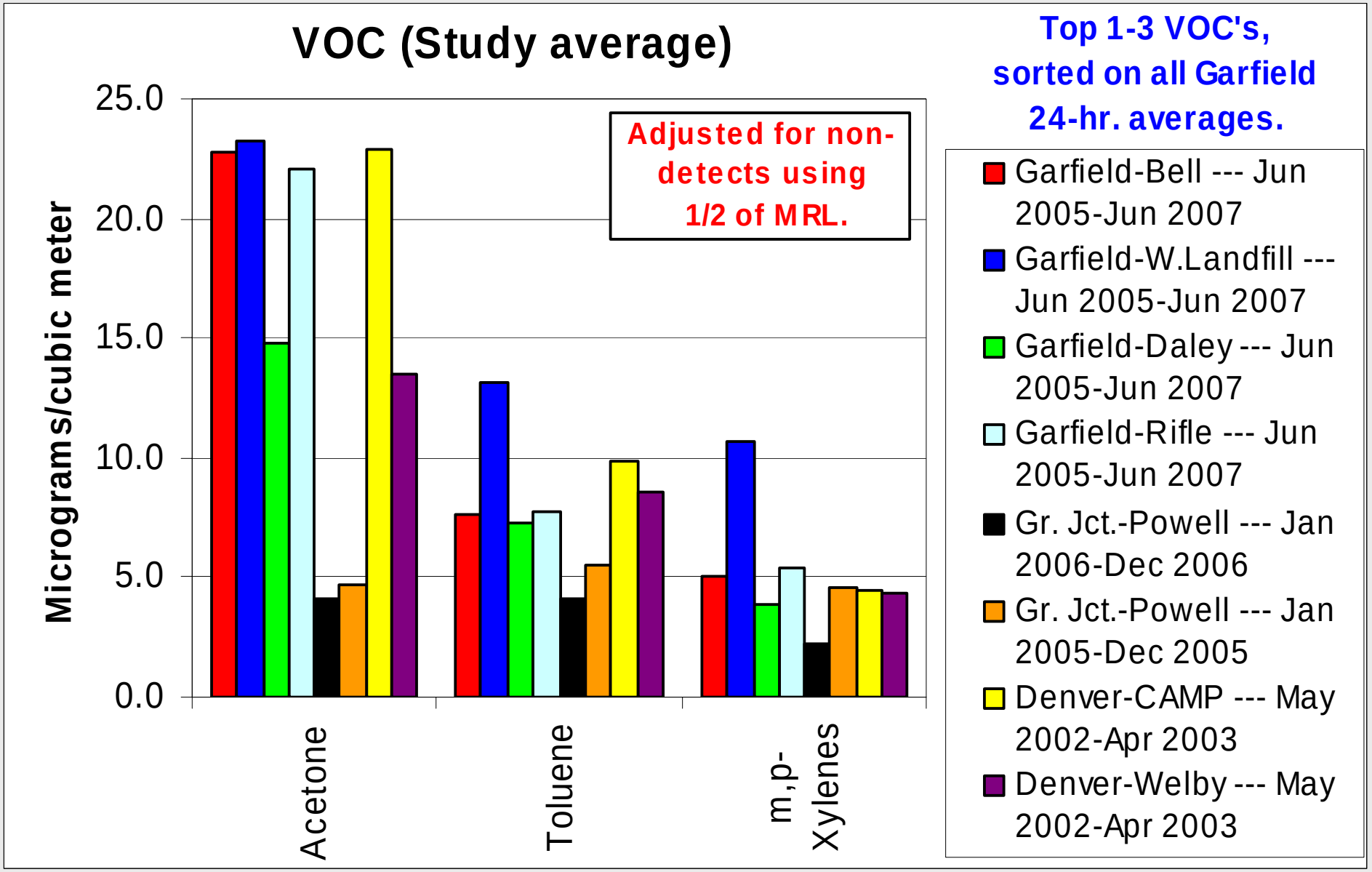
# What does the data tell us?

- The grab samples verify that the BTEX compounds are associated with the oil and gas development activities
  - significantly higher concentrations than in the 24-hour samples
  - indicates a probable local source of those compounds
- No surprise to find BTEX in the urban areas of Glenwood Springs, New Castle, Rifle and Parachute
  - many mobile and stationary sources (commercial facilities)
- Acetone, MEK and vinyl acetate are probably not directly emitted from oil and gas production sources.

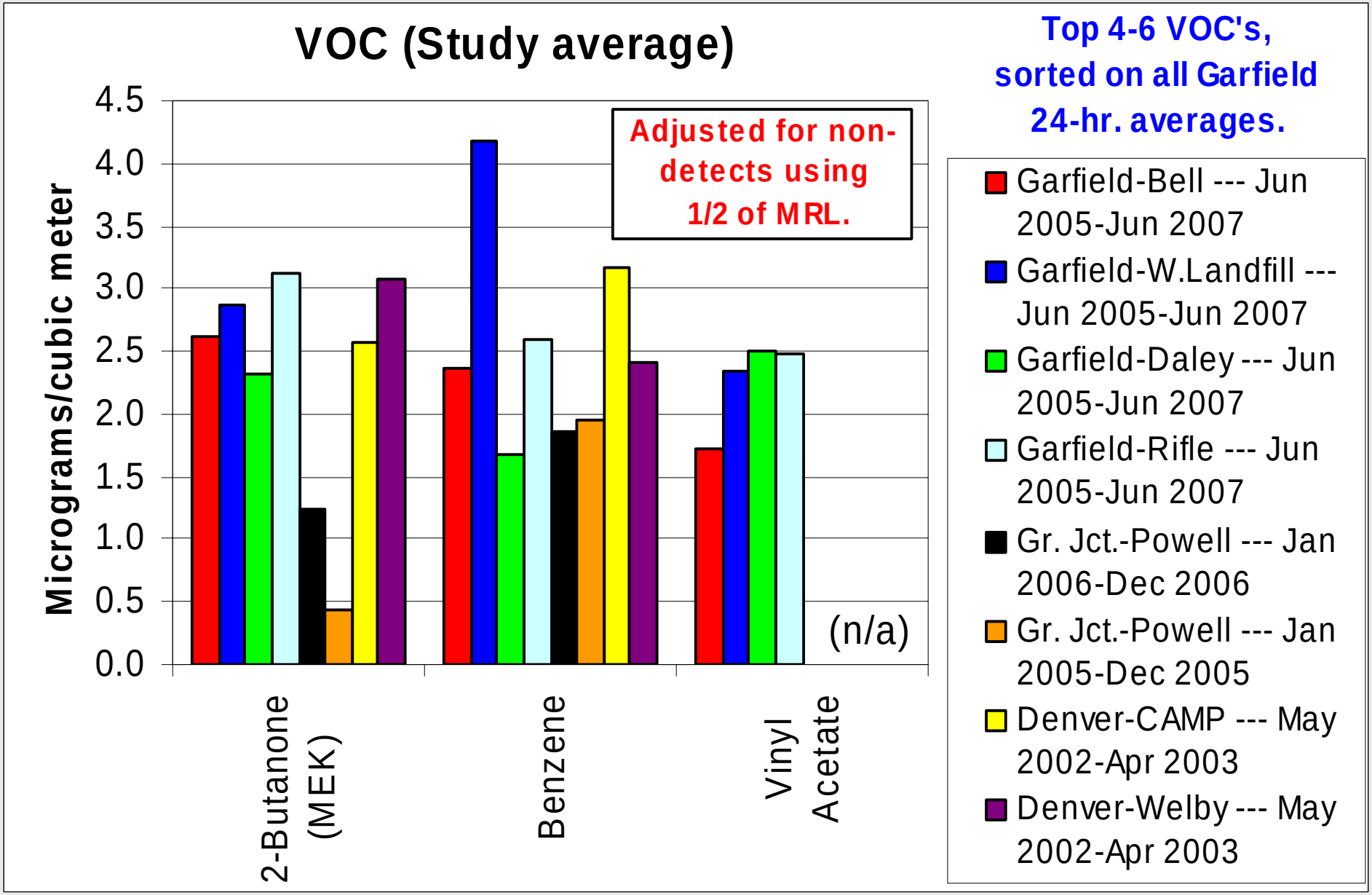
# How does our air compare?

- Comparison made with Denver and Grand Junction – Less samples in our study
- Some VOC concentrations in Garfield County are similar to those measured in larger urban areas, and in some cases, higher
- In general, acetone and the BTEX compounds are prevalent in all compared locations
- Local sources are likely playing a role in the different areas
  - 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
  - some of the highest measured compounds in Grand Junction and Denver were not detected in any of the Garfield County samples

# VOC Comparison – Top 1st-3rd Average Compounds



# VOC Comparison – Top 4th-6th Average Compounds



# Health Risk Assessment

- At the request of Garfield County Public Health, Dr. Raj Goyal, CDPHE Toxicologist conducted a screening-level risk assessment
  - Utilizing Tier-1 of EPA's Air Toxics Risk Assessment Library (EPA 2004)
    - relatively simple, screening-level analysis
    - uses very conservative exposure assumptions (e.g., receptors in the area with the highest estimated concentrations)
  - Utilizing the VOC data from this study
  - Specific to health risks of VOC inhalation
  - Best viewed as a "snapshot" of air quality

# Health Risk Assessment

- Evaluated cancer and non-cancer health effects.
- Characterized non-cancer hazards exposure durations
  - long-term (chronic; 7 years to lifetime)
  - short-term (intermediate; 15-364 days, and acute; 1-14 days)
- Evaluated a plausible range of exposures short-term, non-cancer hazards due to limited quantity of data
  - 24-hour average
  - 24-hour maximum
  - 15-second maximum

# Uncertainties of the Screening-Level Risk Assessment

- Uncertainties of Monitoring
- Uncertainty of chemicals of potential concern
- Uncertainty of concentration estimates
- Uncertainties of exposure
- Multi-contaminant exposure risks
- Uncertainty of toxicity values

# Cancer Risk Findings

- Cancer risks are not similar across monitoring sites.
  - risks across the oil and gas development and urban areas are somewhat higher than the rural background area.
  - largest individual contributors to the total cancer risks are different across oil and gas (benzene), urban (trichloroethene and 1,4-dichlorobenzene), and rural background (1,4-dichlorobenzene) sites.

# Non-Cancer Risk Findings

- Continuous chronic exposures of 7 years to lifetime are not likely to result in significant non-cancer adverse health effects across all monitoring sites
- No significant non-cancer adverse health effects when evaluating exposure to the average concentrations across all monitoring sites for short-term exposures (1- 364 days).
- Non-cancer health risks increase when 24-hour maximums and 15-second maximum exposures are evaluated.
- This screening-level analysis stresses the continued need for continued air monitoring and source apportionment.

# Additional Health Risk Assessment

- Screening-level risk assessment is a “first blush” simple look at this study data and calculates the relative risks associated with inhalation of VOC
- CDPHE will be conducting a more in depth ATSDR Health Risk Consultation early 2008
- Saccomanno Research Institute Community Health Risk Assessment will be completed in early 2008
  - creating a baseline assessment of the health status of residents of all parts of Garfield County; looks at both the qualitative (resident perceptions and concerns) and quantitative (health statistics) aspects of health
  - modeling that uses available environmental monitoring data and current activities that could impact health; developing an estimation of health-related risk to residents.

# 2008 Air Quality Monitoring Plan

*Next Steps for Studying Air Quality in Garfield County*

- Reduced monitoring locations
- Continuation of $PM_{10}$ at Rifle and Parachute
- Work with CDPHE to develop $PM_{2.5}$ site
- VOC monitoring Parachute, Rifle, Bell and roving site (currently Brock)
- Change VOC analytical method, SNMOC (every 6 days) & Carbonyls (every 13 days)
- Continue meteorological measurement
- Continue collaboration on ozone monitoring
- Develop mobile monitoring set-up for odor complaints and for screening sites for in-depth monitoring

# Additional Study

**Regional Geographic Initiative Grant**

- Source specific monitoring
- Enhanced emission inventory
- Assessment and analysis of GC air quality
  - Report to community leaders
- Outreach and education
  - Citizens Guide to Air Quality in Garfield County

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# Study Reports

- www.garfield-county.com (Latest News)
- http://www.garfield-county.com/index.aspx?page=1098
- Jim Rada

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