

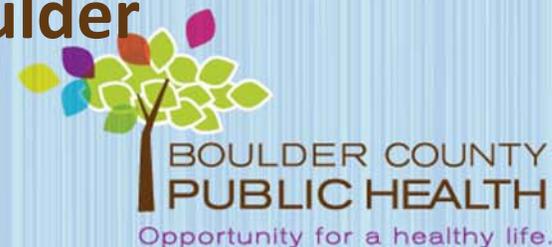
# Understanding Air Toxics and Carbonyl Pollutant Sources in Boulder County, Colorado

Presented by:

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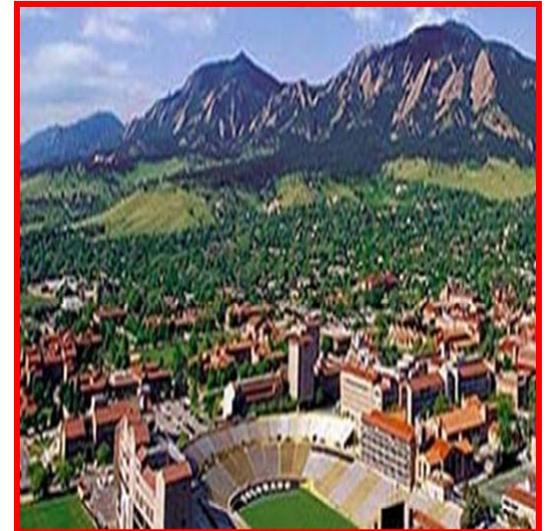
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Department of Mechanical Engineering and the  
Institute of Arctic & Alpine Research

**University of Colorado, Boulder**



# Motivation

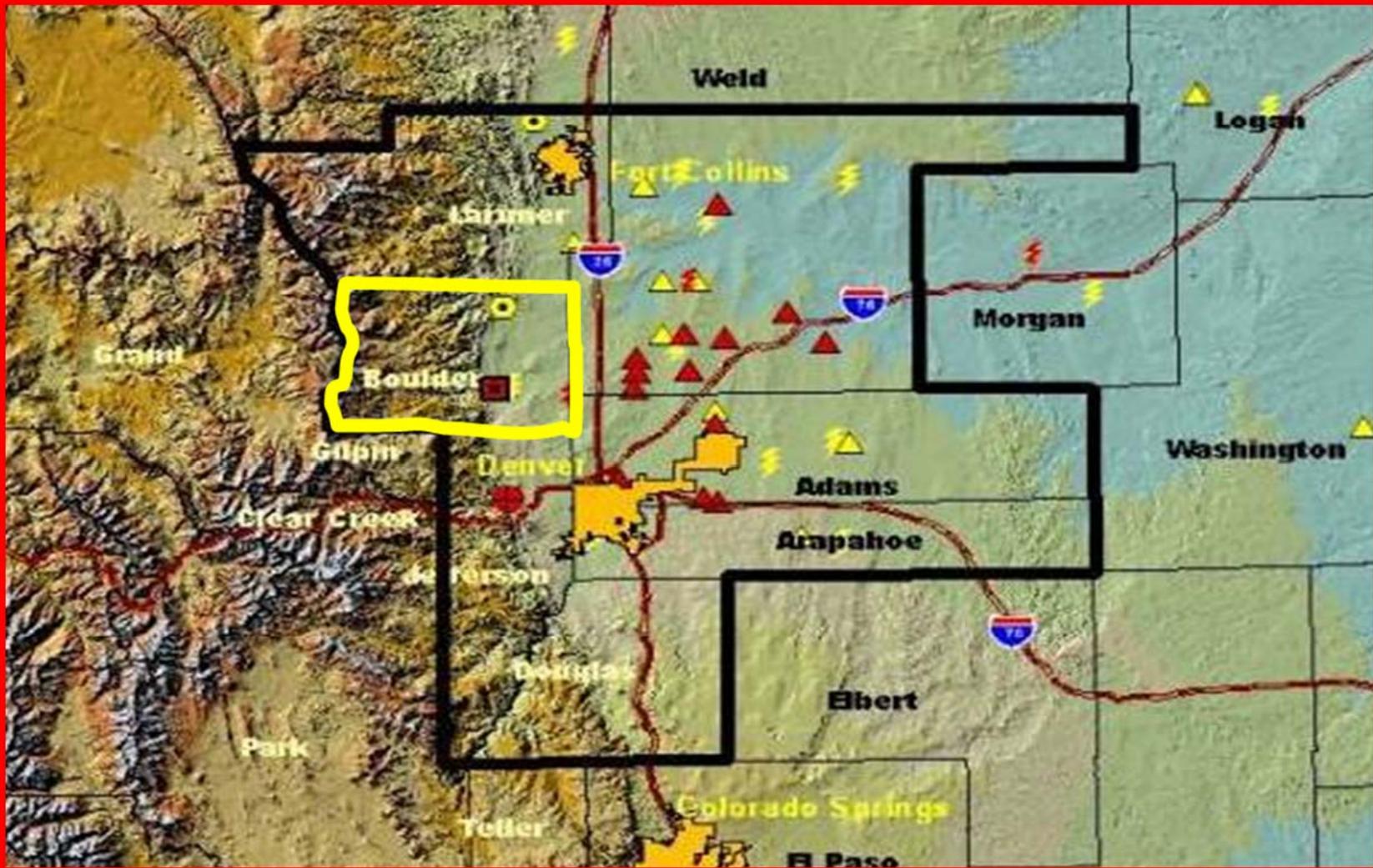
- Anderson Study in 1996 found higher aldehyde concentrations in Boulder than Denver
- Oil and natural gas production activities in neighboring counties increased and began to pose potential health risks
- Denver Metro North Front Range Area (DMA) is a non-attainment for failing to meet the 8-hr ozone NAAQS set by the EPA



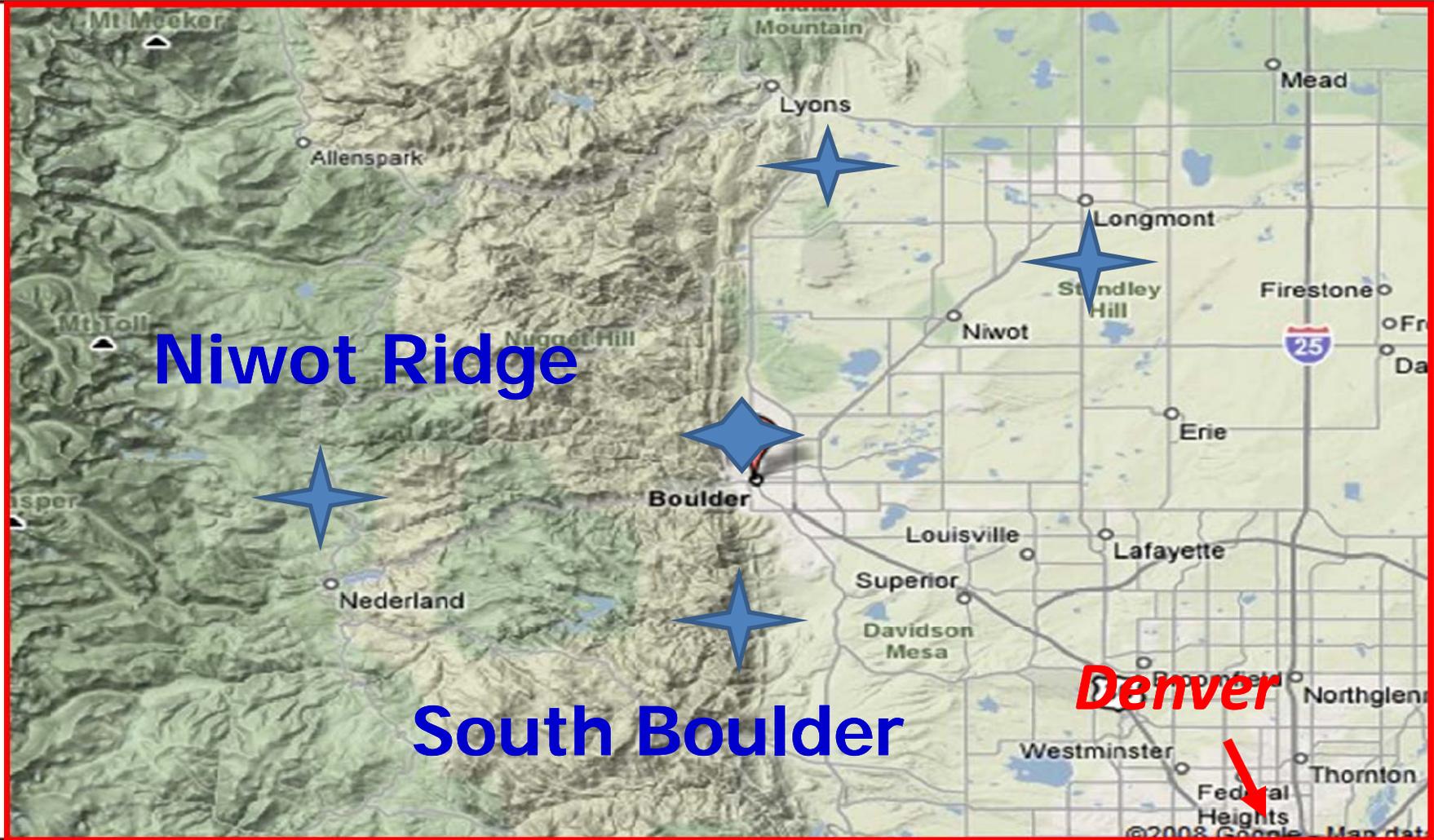
# Successful Partnerships

- BCPH, University of Colorado, and EPA Region 8 collaborated to form project team
- A number of students were trained and educated on measuring air quality; two of which now work at EPA
- Public Health staff gained valuable monitoring knowledge and experience and provided valuable information to residents

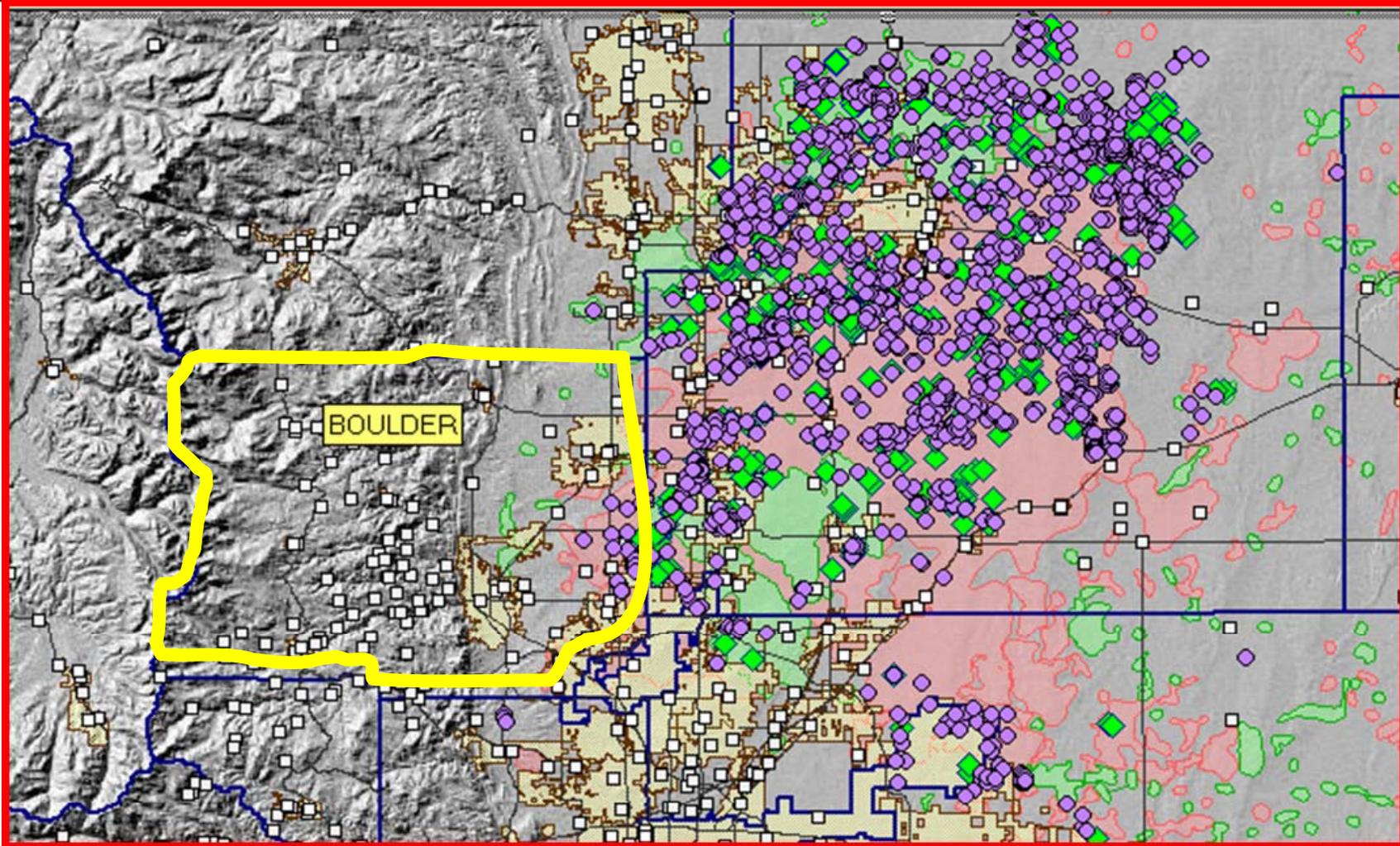
# DMA NFR 2008 Nonattainment Area



# 5 Sampling Locations



# 2008 Oil & Gas Activities



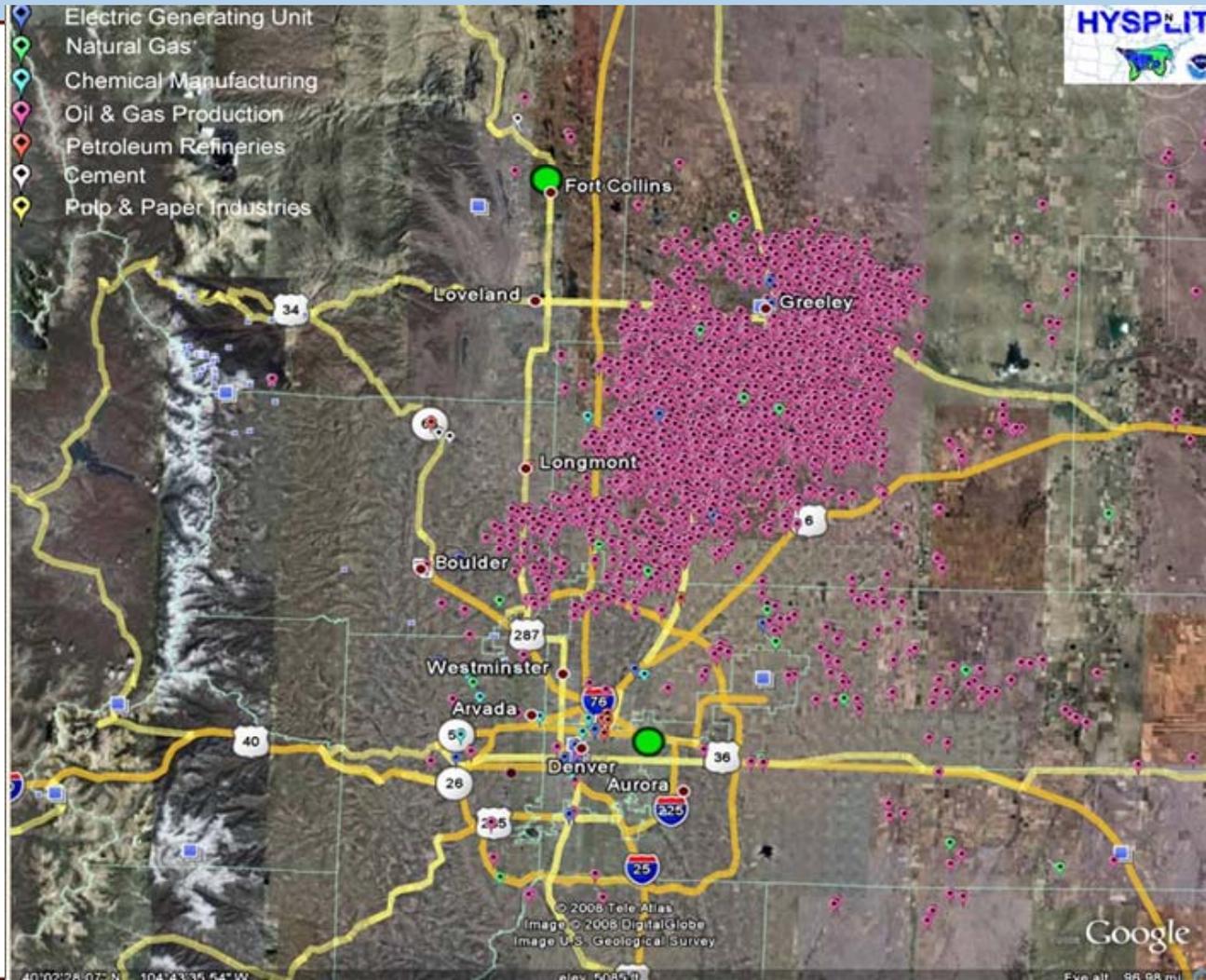
Existing Permits



Pending Permits

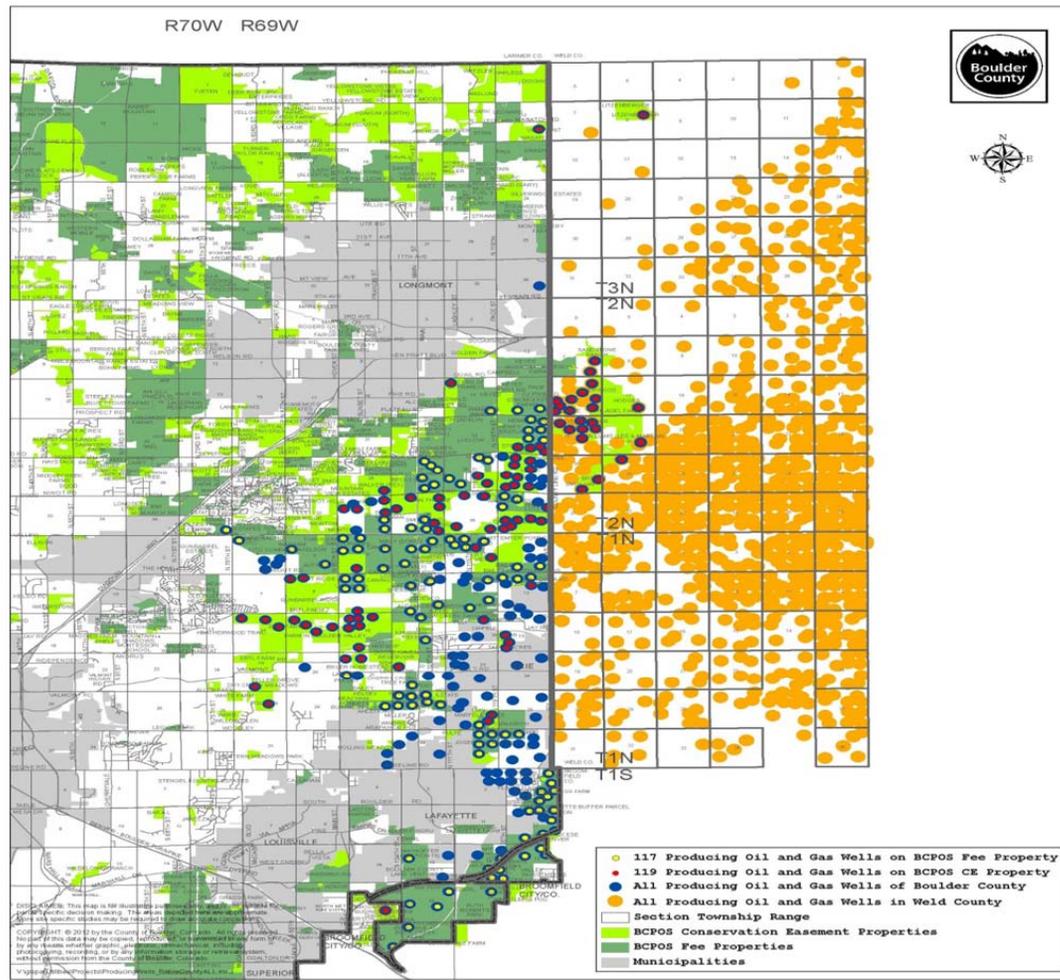
(COGCC, 2008)

# 2008 Adjacent Oil & Gas Activities



# 2012 Oil and Gas Activities

Producing Oil and Gas Wells on Boulder and Weld Counties



(COGCC, 2012)

# Project Objectives

- Delineate concentrations of local scale VOCs, carbonyls, and ozone
- Develop a baseline reference for longer-term measurements
- Evaluate and improve ambient air quality exposure and community-scale dispersion models
- Aid in air quality management strategies in Boulder County and Denver DMA including 2008 State Implementation Plan

# Measurements

March 1 2007 – February 24, 2008

- Sampling
  - VOCs (27)
  - Carbonyls (8)

24hr integrated sample every 6<sup>th</sup> day at each location (roughly 60 samples per site)

Eight consecutive 3hr samples every 6<sup>th</sup> day at one location
- Insitu
  - Ozone
  - Meteorological data

# Percent of Samples Detected

## Carbonyls

	3-hr	24-hr
formaldehyde	75	100
acetaldehyde	55	100
acrolein	2	77
acetone	68	100
propionaldehyde	28	94
crotonaldehyde	1	12
butyraldehyde	63	99
benzaldehyde	3	33

## VOCs

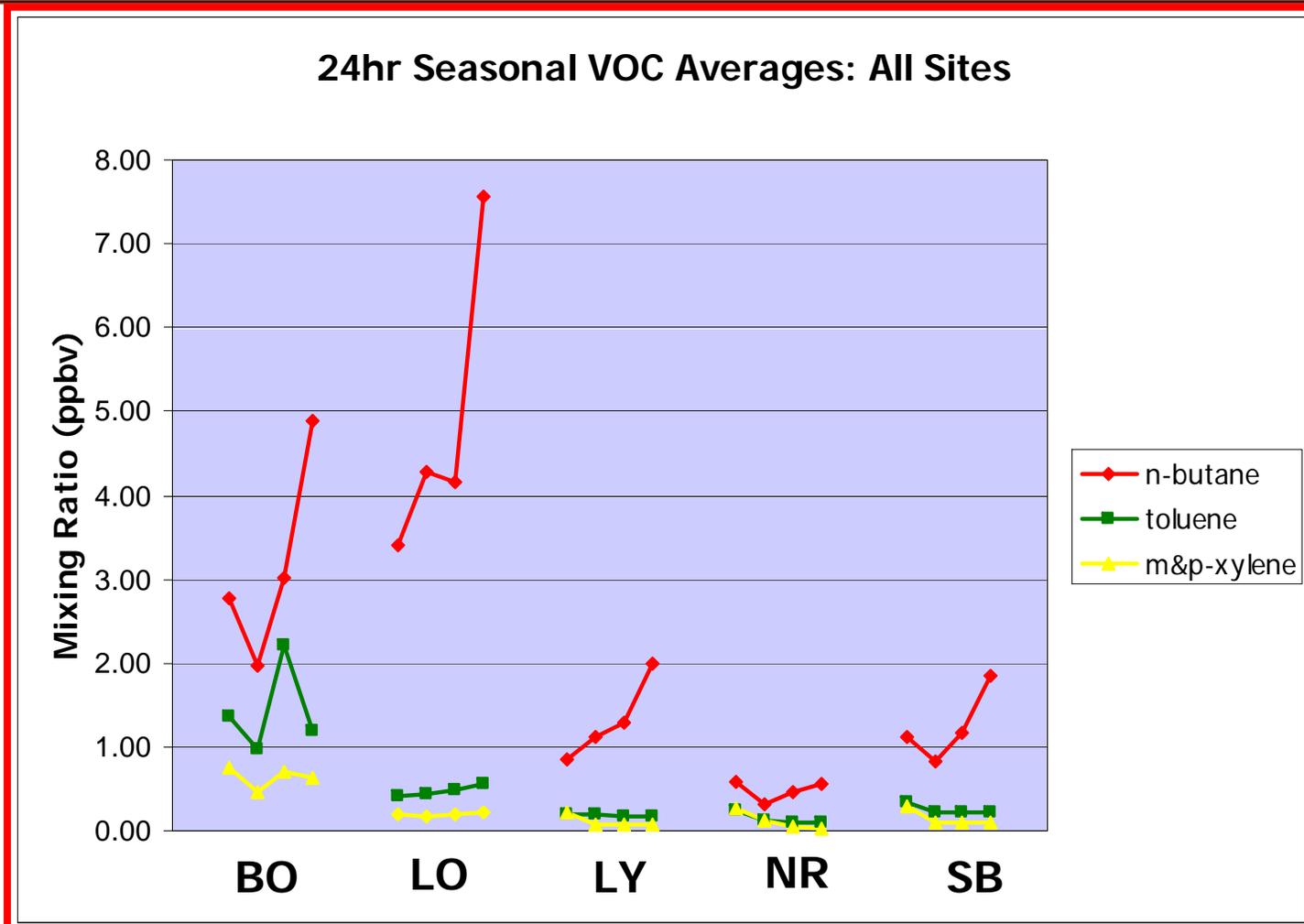
	3-hr	24-hr
n-butane	100	100
n-pentane	99	98
hexane	97	94
toluene	99	98
octane	69	68
ethylbenzene	90	88
m&p-xylene	95	97
o-xylene	72	72
nonane	65	66

Analytical issues with benzene, unable to detect propane, methane, ethane

# Sampling Instrumentation

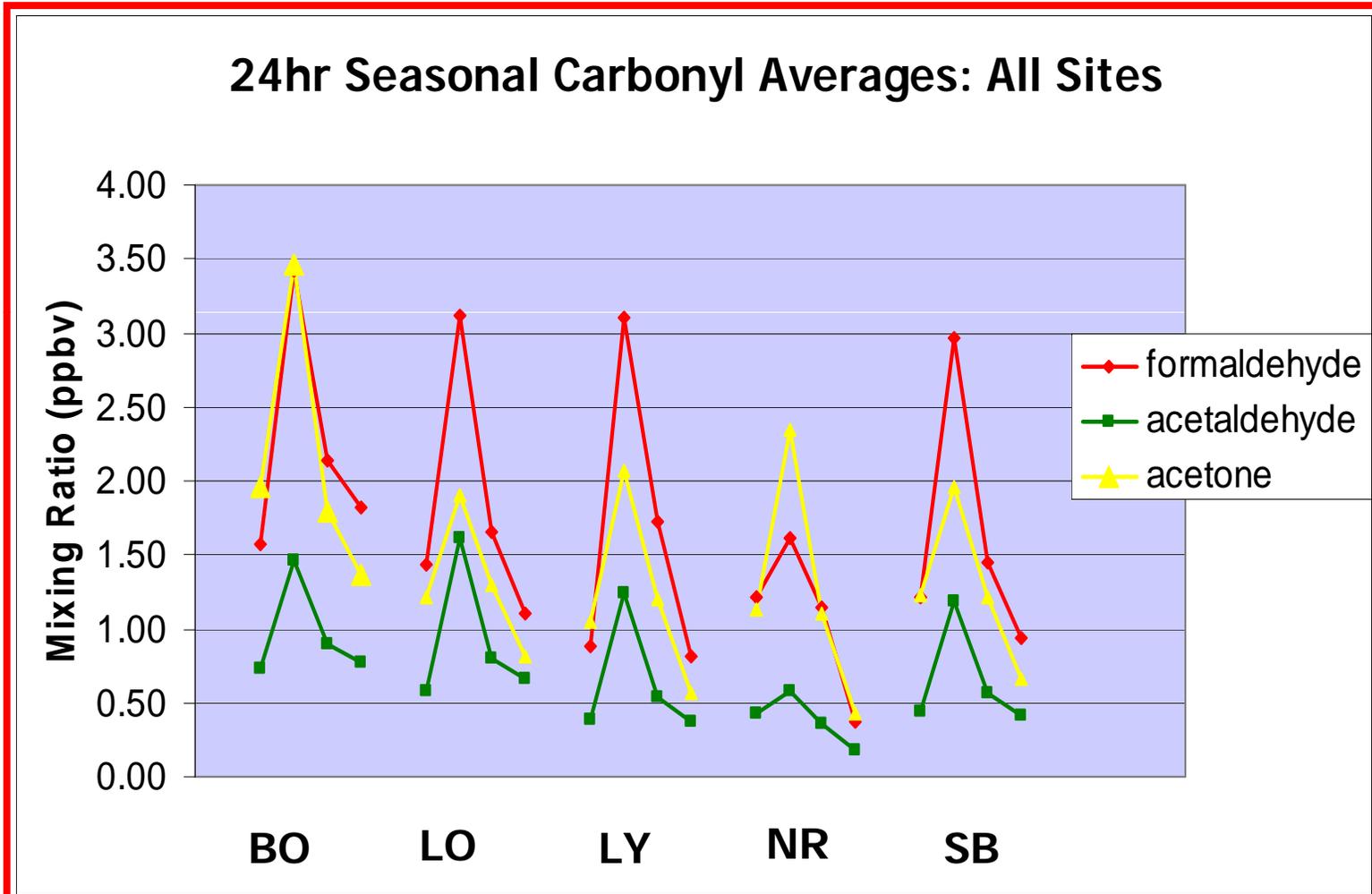


# Seasonal Averages: VOCs



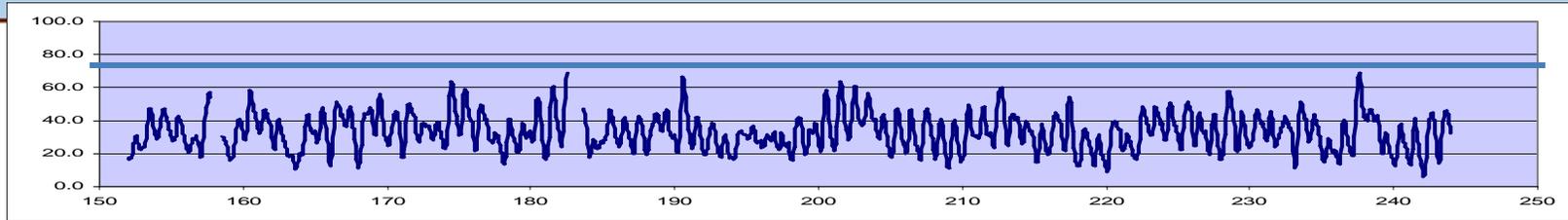
*Each dot represents a season, starting with spring*

# Seasonal Averages: Carbonyls

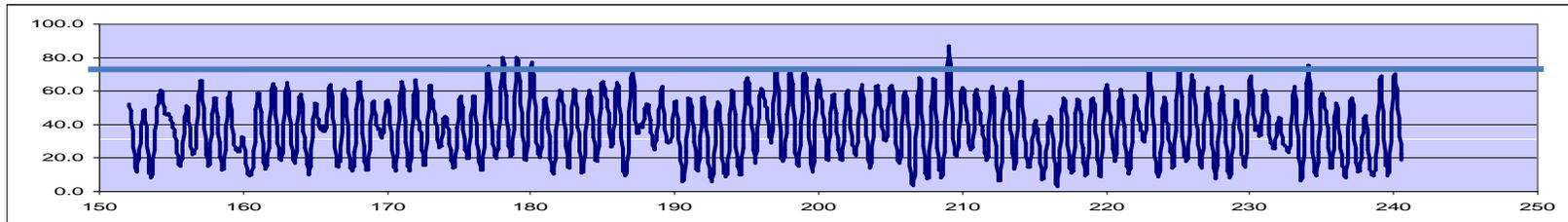


*Each dot represents a season, starting with spring*

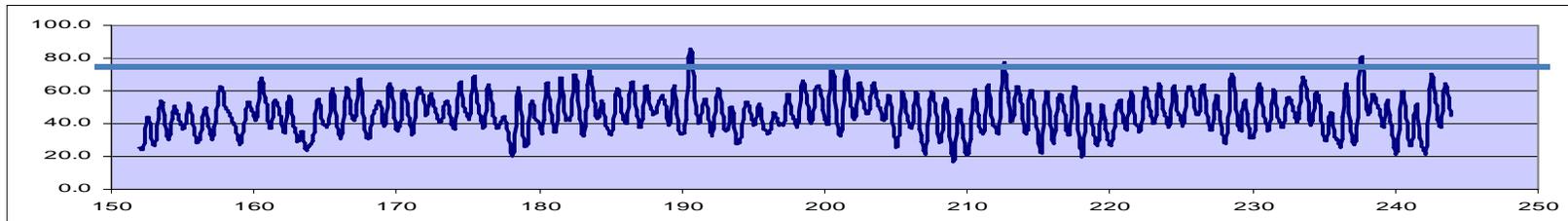
# 8hr Average Ozone: Summer 2007



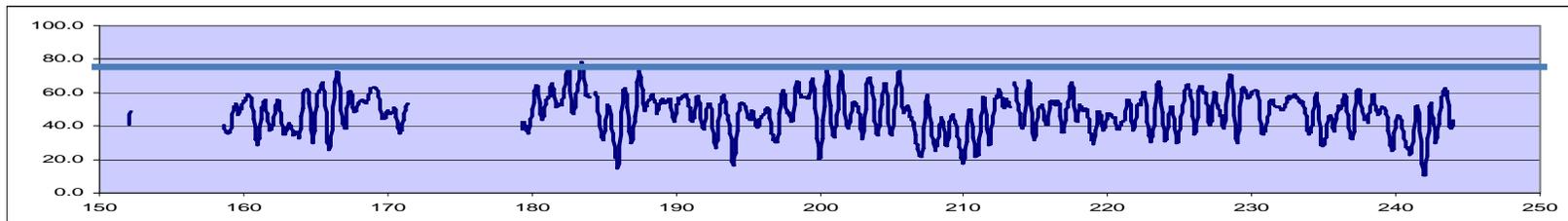
BO



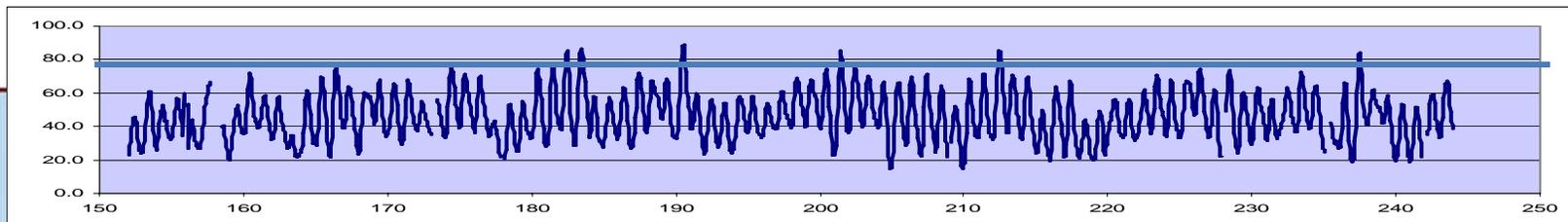
LO



LY

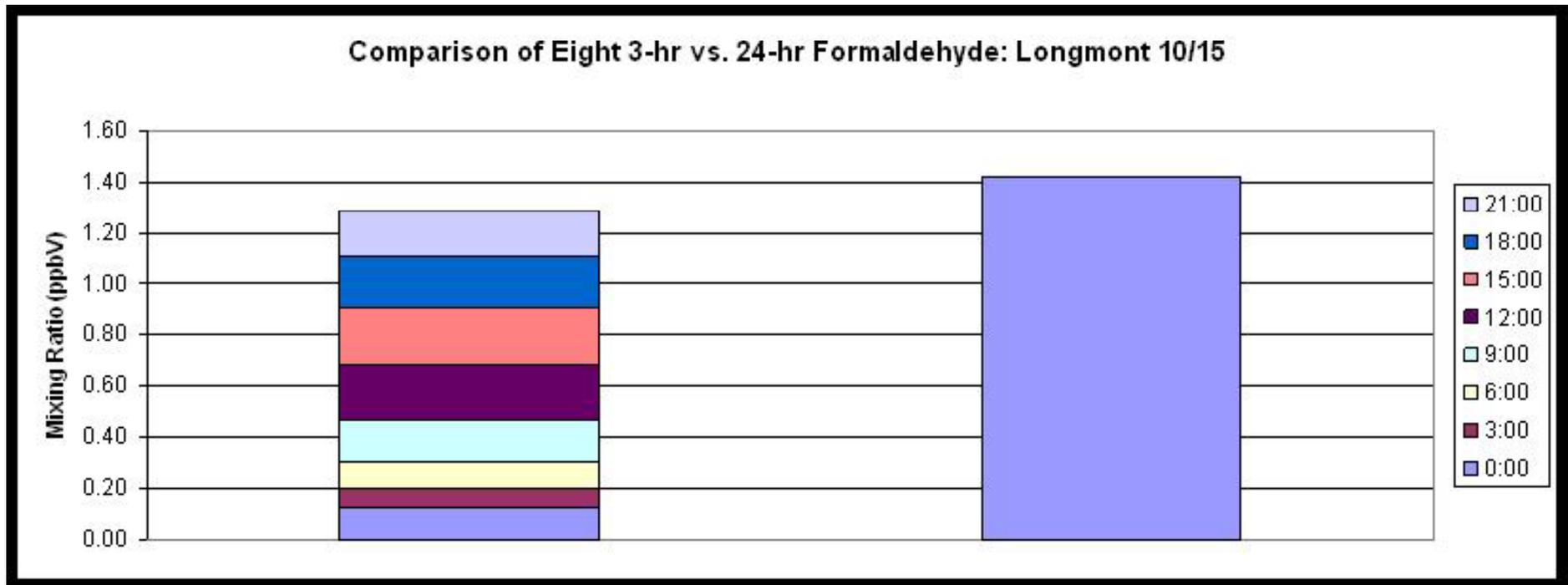


NR



SB

# Eight 3-hr vs. 24-hr Formaldehyde: Longmont



***The sum of the eight 3-hr samples compared well to the one 24-hr sample collected during the same period***

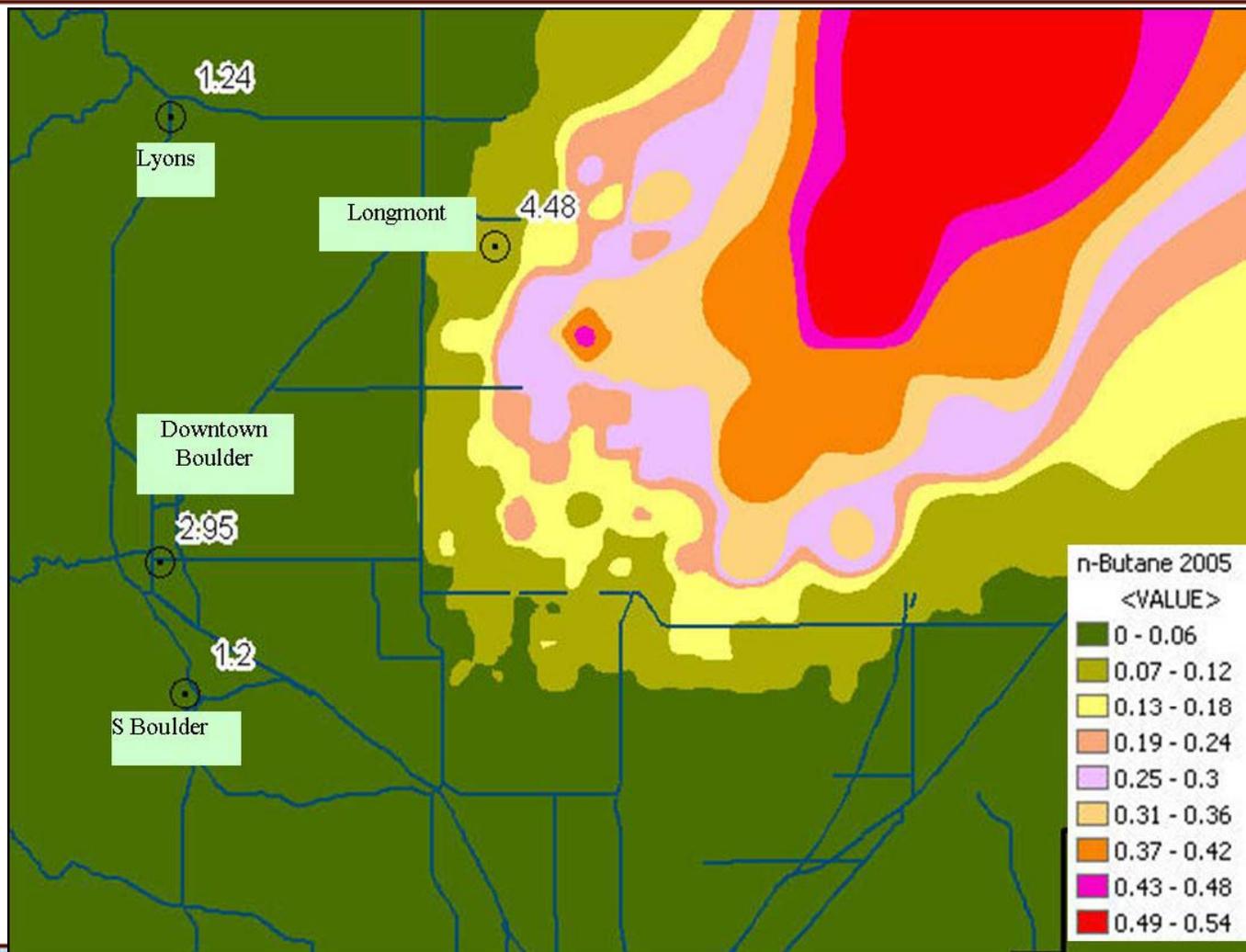
# Principal Components Analysis Source Attribution

Potential Pollution Source Rank by Site			
	1st	2nd	3rd
<b><u>Boulder</u></b>	Mobile Source	Secondary Formation	Evaporative
<b><u>Longmont</u></b>	Evaporative	Secondary Formation	Mobile Source
<b><u>Lyons</u></b>	Secondary Formation	Evaporative	Mobile Source
<b>Niwot Ridge</b>	Secondary Formation	Mobile Source	Evaporative
<b><u>South Boulder</u></b>	Mobile Source	Evaporative	Secondary Formation

# Dispersion Modeling

- AERMOD & MOBILE6.2 models used
- Pollutants included in model
  - Formaldehyde
  - Acetaldehyde
  - BTEX
  - Hexane
  - Diesel PM

# Predicted 2006 n-butane with 2007 Boulder Observed n-butane (ppbV)



***Inventories underpredict n-butane direct emissions***

# Conclusions

- Overall carbonyl & VOC concentrations in 07-08 were lower than those in the Anderson Study
- Carbonyl concentrations peaked in the summer months, suggesting increased photochemistry
- VOC concentrations were relatively stable and were not seasonably variable

# Conclusions

- From PCA results, mobile source exhaust, natural gas emissions, and meteorology are significant pollution source
- Ozone values varied from site to site, but increased significantly in summer
- Ozone values exceeded the former/current 8-hour NAAQS values in South Boulder Creek, Longmont, and Lyons

# Recommendations

- Use higher resolution sampling durations for source apportionment
- Use analytical equipment capable of quantifying all natural gas markers
- Get EPA assistance with AQS uploads for community scale grants - don't underestimate it

# Acknowledgements

- Boulder County Public Health, Colorado Dept. of Public Health and Environment, & EPA Region 8
- Boulder County Housing, Boulder Fire, and Foothills Baptist Church
- Specifically
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  - Ken Distler and Michael Copeland
  - Gordon Pierce
  - Gregg Thomas
  - Larry Anderson

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