DRAFT

EPA Region 8

Monitoring Network Assessment

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Prepared by

Air Technical Assistance Unit

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Table of Contents

1.0 Introduction

This assessment of ambient air quality monitors in EPA Region 8 was undertaken in response to a national assessment conducted by the EPA Office of Air Quality Planning and Standards (OAQPS) in 2001. OAQPS requested that EPA regions and State and local monitoring agencies conduct assessments of their respective monitoring networks. OAQPS believes it is an appropriate time to identify changes in monitoring networks needed to facilitate a transition in priorities from the era of the 1970s and 1980s, when most or all criteria pollutants were being regularly exceeded in many American cities, to the current condition, where much of the country is only observing exceedances for ozone and $PM_{2.5}$. The Region 8 assessment includes a statistical evaluation of correlations between monitors and concentrations currently being observed, as well as discussions of the unique geographic, topographic, meteorologic, and demographic influences on the Region 8 network design.

This draft assessment report is intended to present data that can be used to identify potential network modifications for further evaluation by Region 8, State, local and Tribal air monitoring agencies.

1.1 Region 8 Network Assessment Intended Use

This report represents the scheduled draft Network Assessment report requested by OAQPS for fall 2002. The report is being delivered to OAQPS, and Region 8 States and Tribes. Other EPA regional monitoring groups will also be receiving copies from OAQPS. Region 8 intends to follow this report with discussions with the States and Tribes, regarding changes to State and Tribal networks in light of the Assessment results. Results of this collaboration will then be included in a final Network Assessment Report, scheduled for March, 2003. That report is intended to include any proposed network changes suggested by the Assessment results.

1.2 Region 8 Network Assessment Approach

The Region 8 Network Assessment was conducted by EPA staff in the Region 8 Air and Radiation Program. Preliminary findings and progress was shared with the States and Tribes in Region 8.

The Regional Network Assessment focused on regional monitors from several points of view. First, the unique meteorological and geographic considerations of the region (described in Section 4) were considered to establish the context for monitoring in the region. Next, the regulatory monitoring requirements and federal funding mechanisms were considered (discussed on Section 5), since these are important factors for consideration during implementation of the National Monitoring Strategy. Finally, the Statistical Analysis System (SAS) software package was used to conduct pairwise correlation analysis of all grant-funded monitors in Region 8.

1.3 Statistical Methodology

SAS System for Windows version 8 was used to calculate pairwise correlations for each monitor pair in EPA Region 8. SAS routines developed by staff members at EPA Region 5 and OAQPS were tailored to calculate the desired results and generate output in the desired formats. These routines were then used to test the pairwise correlation approach using $PM_{2.5}$ and ozone data for the region using data extracted from the legacy mainframe AIRS database. When the approach was validated, the routines were adapted to utilize output from the new Oracle AIRS-AQS database. Region 8 chose to use three years of data from 1999 to 2001 so that the network analyzed would be as current as possible. Year 2001 data are only available from Oracle AIRS-AQS. For $PM_{2.5}$ monitors operating in early 1999, 2001 was the third of the required three years of data, and Region 8 staff felt this year was important, particularly with regard to the $PM_{2.5}$ and ozone networks. Since it was conducted in early to mid 2001, the national assessment evaluated the 1995 to 1997 and the 1998 to 2000 data sets.

Correlations were calculated using measured concentrations directly. Often, data transformations (such as the logarithmic transformation) are used to transform non-normally distributed air quality data to something more like the normal distribution. For the purposes of this assessment, however, this was not felt to be needed. Correlations were used to rank monitor pairs, but no statistical testing based on the calculated correlation coefficient was done. Rankings should be the same or similar on the untransformed data as that which would be obtained by correlating transformed data. In this report, for each criteria pollutant, we report monitor pairs with correlation coefficients above arbitrarily selected thresholds. For most pollutants, we report correlations greater than $r = 0.8$. For $PM_{2.5}$, however, a very large number of monitor pairs have correlations this high, and only those with correlations greater than 0.85 are reported. For SO_2, on the other hand, the highest correlation seen in the region for a monitor pair is 0.75, and only this pair is discussed in the report. The threshold correlation values used for each parameter were chosen simply to identify a set of monitor pairs as candidates for further evaluation.

Datasets extracted from AIRS-AQS were limited to data collected by State and Tribal agencies, and the National Park Service (ozone only). The Park Service data, while not funded by grants administered by the Region 8 office, were included because of their importance in Region 8 states with no other ozone monitors operating.

Initially, all flagged data were included in the analyzed datasets. While exceedances flagged in AIRS as being due to exceptional or natural events may be given special consideration when making attainment decisions, these data are critical for inclusion for other objectives of the national monitoring network. For instance, for AQI reporting, the flagged data are equally important to unflagged data when issuing health advisories to the public. Some areas in Region 8 are subject to recurring natural events, such as wildfires and high winds exceedances, so unhealthy conditions due to natural events are expected to recur in these areas, and may not be controlled through the SIP process.

Including flagged data, in some cases, leads to unusually high correlations. For example, when PM_{10} monitor pairs were correlated across the regions, monitor pairs in western Colorado dominated the higher correlations, even though some pairs are widely separated and in different airsheds. Examination of scatter diagrams of data collected at specific monitor pairs revealed that the high correlations were largely due to simultaneous very high PM_{10} concentrations on a single day. On March 31, 1999, a multi-state dust storm moved from the four corners region across western Colorado. For many PM_{10} monitors in this area, the highest PM_{10} concentrations ever measured at the sites were recorded on that day, and some monitors recorded their only exceedance of the PM_{10} 24-hour NAAQS. For this case, exceedance data recorded on March 31, 1999 were removed from the dataset, and the correlation analysis was rerun

For other flagged data leading to high correlations (but less widespread than the March 31, 1999 event) the anomalous correlations are identified in the discussions of Section 6.

Similar to flagged exceedance events, simultaneous unflagged values spread over large areas can lead to unusually large correlations between monitor pairs. The Wasatch front of Utah is unique in the region, in that it is a very large trapped airshed, and includes both a very large salt water lake and a large urban area (Salt Lake City, and the adjacent communities in Utah, Davis, Weber and Box Elder Counties). Winter inversion events can occur that tend to trap emissions and secondary pollutants in the Salt Lake Basin for several days. At least three events such as this occurred in the 3 years evaluated in the network assessment, and lead to high inter-correlations of all the $PM_{2.5}$ monitors operating in Utah in these years. In this case, the high correlations are noted in the discussion in Section 6, so that other states with lower correlated pairs will know that direct comparison of correlation ranks in different areas in the region may not give meaningful results. $PM_{2.5}$ pairs in other states, correlated less well than those in Utah, may in fact be more redundant than the Utah pairs in terms of consistently measuring similar values in all meteorological conditions.

2.0 Region 8 Overview

EPA Region 8, consisting of the States of Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming, comprises a large, mostly rural section of the interior of the United States. The continental divide bisects the region from north to south, and the topography ranges from the Great Basin valleys of western Utah, through the Rocky Mountains, rising as high as 14,000 feet, to the Great Plains of Colorado, Montana, the Dakotas and Wyoming. Region 8 is second only to Region 10 (with Alaska) in land area and lowest population density. Corner to corner, the region is more than 1,100 miles in length (St. George, Utah to Grand Forks, North Dakota), equivalent to the distance from Durham, NC to Dallas, TX, or from Washington, D.C. to Sioux Falls, South Dakota.

Indicative of large, rural areas, three of the States in Region 8 are termed "half-percent" States. The populations of these States (North Dakota, South Dakota and Wyoming) are each less than 0.3% of the national total. These States each receive 0.5% of the national ambient air management grant funds in accordance with section 105 of the clean air act. Their combined total population in the 2000 census was 1,891,000. They lack large population centers (the Fargo, North Dakota - Moorehead, Minnesota MSA, at 174,367 and Sioux Falls, South Dakota MSA, at 172,412 are the largest cities in these three States). The three States combined have one non-attainment area: Sheridan, Wyoming is non-attainment for PM_{10} (last exceedance in 1997).

The region does contain two large metropolitan areas: the Denver – Boulder – Greeley CMSA, 19th largest in the country in 2000, with 2.58 million people, and the Salt Lake City – Ogden MSA, number 36 in the country, at 1.33 million people. For parameters other than PM_{10} and SO_2, between 30 and 60 % of the region's monitoring assets are concentrated in these two urban areas.

For the parameters PM_{10} and SO_2, large numbers of industrial monitors exist in the region. These monitors are not funded with EPA grant monies, and long term continuity cannot be assured through EPA oversight. Taking into account the nature and potential transience of these industrial monitors constitutes one of the most significant differences between the Region 8 network assessment, and the National Assessment.

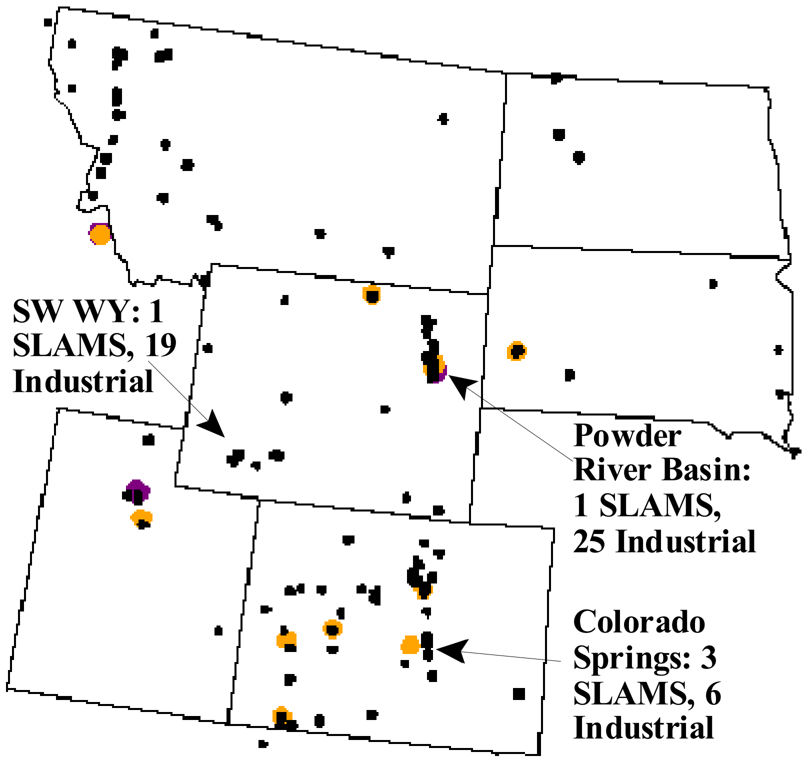
3.0 Region 8 in the National Monitoring Assessment

A national monitoring assessment was conducted in 2001 to attempt to compare the relative value of ambient air quality monitors across the country. The most significant difference between the national assessment data set and the Region 8 data set is in the years of data evaluated. The national assessment considered data collected in two 3-year time periods: 1995-1997, and 1998-2000. Region 8 used the 1999-2001 time period.

The monitors evaluated in the national assessment were those reporting data to AIRS. The AIRS database contains several categories of monitors which are not typically used in regulatory decisions, including monitors operated by the National Park Service and other Federal Agencies, monitors operated by industry, and special purpose monitors operated by State, local and Tribal air quality agencies. These monitoring types may operate with little or no EPA oversight, and the ongoing status of the monitors may not be subject to EPA review and approval. For this reason, EPA Region 8 believes the inclusion of these monitors in an analysis of relative worth within a monitoring network is inappropriate. These monitors can be altered or discontinued at any time, and their inclusion in network optimization strategies could lead to unforeseen losses of monitored data continuity necessary for regulatory decisions. Exclusion of industrial monitors from the Region 8 analysis, and cautious use of Park Service and special purpose monitors constitute a significant difference between the national assessment and the Region 8 assessment. Special purpose monitors in particular require case-by-case evaluation for inclusion in the network Assessment. Some SPMs should not be compared to the NAAQS for regulatory purposes, because of methods used, limited quality assurance programs, or siting. Other SPMs meet the SLAMS methods, siting and QA requirements, have significant EPA oversight, and may be used for regulatory purposes.

3.1 PM_{10}

Figure 3-1 shows the map of PM_{10} measured concentrations ranked by percent of the National Ambient Air Quality Standard (NAAQS) for Region 8 for 1998 - 2000 from the National Assessment. Two dense monitor networks are shown in Wyoming that are in fact dominated by industrial monitors. In each network, only 1 SLAMS is sited to monitor population exposure. The remaining monitors (a total of 44 PM_{10} sites) are industrial monitors located on surface coal mine properties. These monitors are subject to moves as mining needs dictate, and are inactivated during periods when mine operations cease for prolonged periods. They are not funded by government resources. Inclusion of these monitors in a network assessment can lead to erroneous conclusions regarding redundancy, area coverage and populations represented for the two isolated SLAMS monitors in the same areas. Colorado Springs is an urban area in Region 8 where more PM_{10} monitors are operated by the local electrical utility than are operated by the State of Colorado for regulatory purposes.



Purple = 80 to 100% of NAAQS
Orange = 60 to 80% of NAAQS
Black = <60% of NAAQS

Figure 3-1 PM_{10} Percentage of NAAQS, 1998-2000 from the National Assessment

3.2 Ozone

Figure 3-2 a and b show maps from the National Assessment. The maps show aggregate data value of ozone monitors in EPA Region 8 using different weighting schemes of parameters that characterize the individual monitors. The maps show the inclusion of Park Service monitors in the National Assessment. These monitors were also considered in the Region 8 assessment, but in a manner in which conclusions can either include or discount comparisons with the Park Service monitors. The pooling of all AIRS monitors in the National Assessment did not allow this selective use, so the presence of the Park Service monitors in the National Assessment skews the results when considering population, area, and uniqueness of monitored values. The Park Service data is not generally included in NAAQS determinations and SIP provisions in Region 8 States, and does not influence State and local network design.

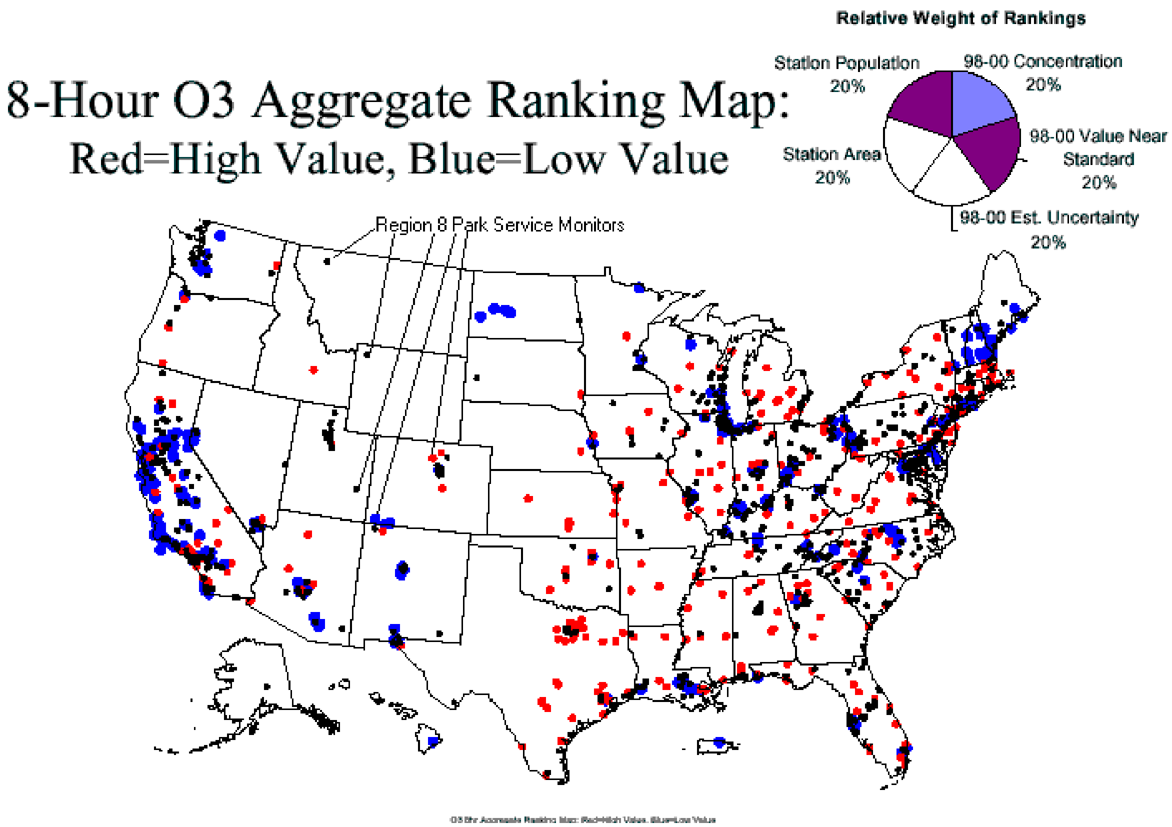
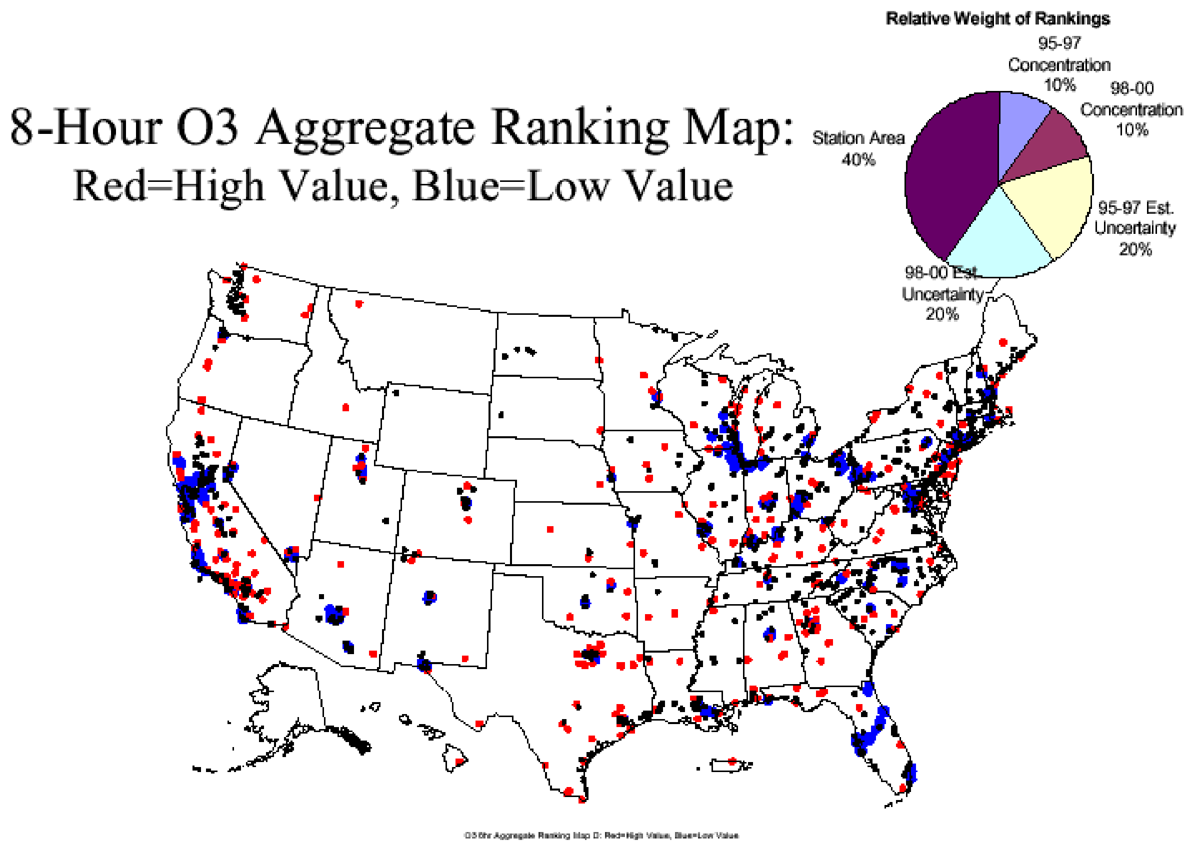


Figure 3-2a National Assessment Aggregate Data Value of Region 8 and Neighboring Ozone Monitors



Red = Highest Value
Black = Medium Value
Blue = Lowest Value

Weighting Scheme: Area Represented 40%, 1995-1997 Uncertainty 20%, 1998-2000 Uncertainty 20%, 1995-1997 Concentration 10%, 1998-2000 Concentration 10%

Figure 3-2b National Assessment Aggregate Data Value of Region 8 and Neighboring Ozone Monitors

3.3 Carbon Monoxide

Figure 3-3 shows an aggregate monitor ranking map for CO monitors across the US. Two complications in Region 8 are illustrated: inclusion of a National Park Service monitor at the entrance to Yellowstone National Park, and inclusion of 4 industrial monitors in El Paso County (Colorado Springs), Colorado. In Colorado Springs, industrial monitors operated by the local utility agency outnumber the SLAMS operated by the Colorado Department of Public Health and the Environment. The utility monitors are not funded by EPA grants, and are not required under the Carbon Monoxide SIP. It is not appropriate to include these monitors in a comparison or ranking of the Colorado Springs SLAMS, as the utility monitors are operated at the discretion of the utility, and may be terminated at any time.

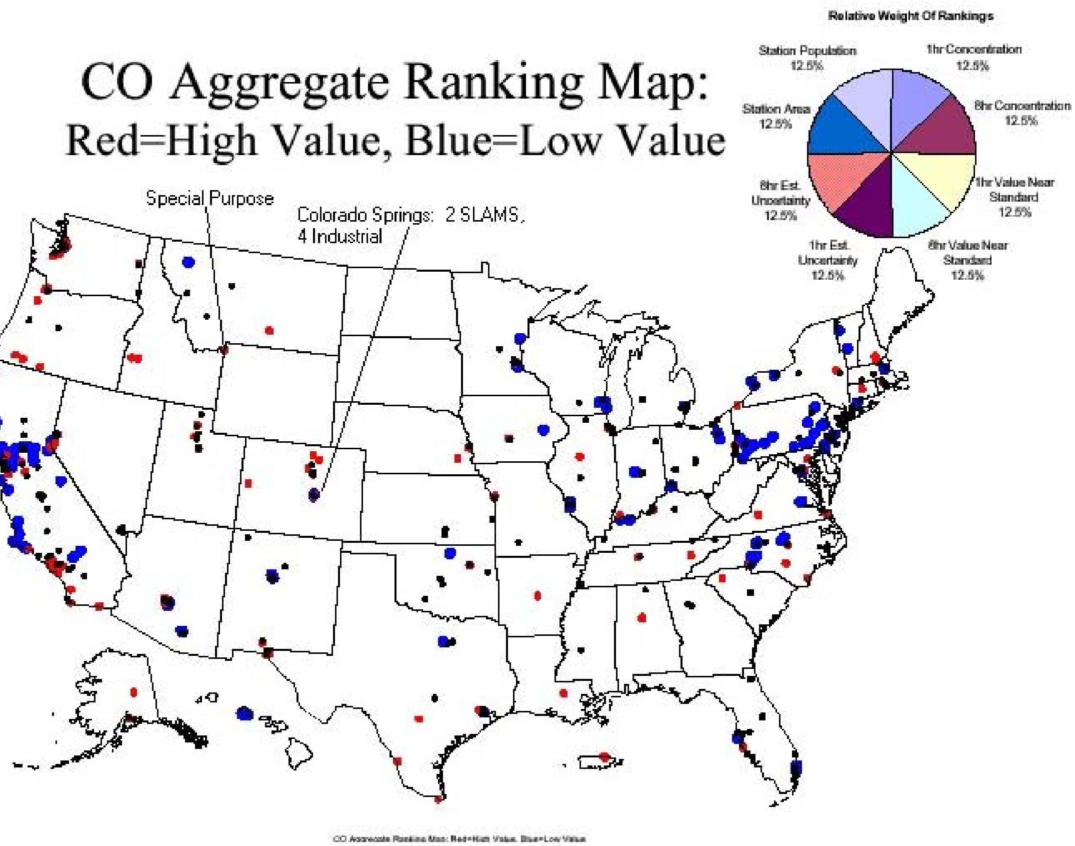


Figure 3-3 Carbon Monoxide Relative Rankings from the National Assessment

3.4 Nitrogen Dioxide

Figure 3-4 shows a comparative ranking of NO_2 monitors from the National Assessment. Monitors in Region 8 have been traditionally concentrated in the two largest metropolitan areas in the region. States in Region 8 have been assessing their networks through the annual Network Review process, and only 2 SLAMS are currently operated in Denver, while 5 SLAMS are operated along the 4 county Wasatch Front (Provo, Salt Lake City (2), Bountiful and Ogden).

Several of the NO_2 monitors shown in the National Assessment are rural sites targeted at industrial impacts on Class I and Class II PSD areas, including 3 industrial funded Tribal NO_2 monitors operated on the Class I Northern Cheyenne Reservation, as well as grant-funded monitors on the Southern Ute Indian Reservation, in Teddy Roosevelt National Park, and in the Boundary Dam area (cooperative US/Canada monitoring program). These monitors point out an important factor not considered in the National Assessment. Some monitors in rural, traditionally clean air portions on the country may be used for comparisons with concentrations well below the NAAQS. For example, the PSD Class I increment for NO_2 is only 2.5 μg/m^3, compared to an annual NAAQS of 100 μg/m^3. If a monitor's primary objective is for assessing PSD increment consumption, a monitor may have a critical value on the order of 10 μg/m^3, rather than the NAAQS.

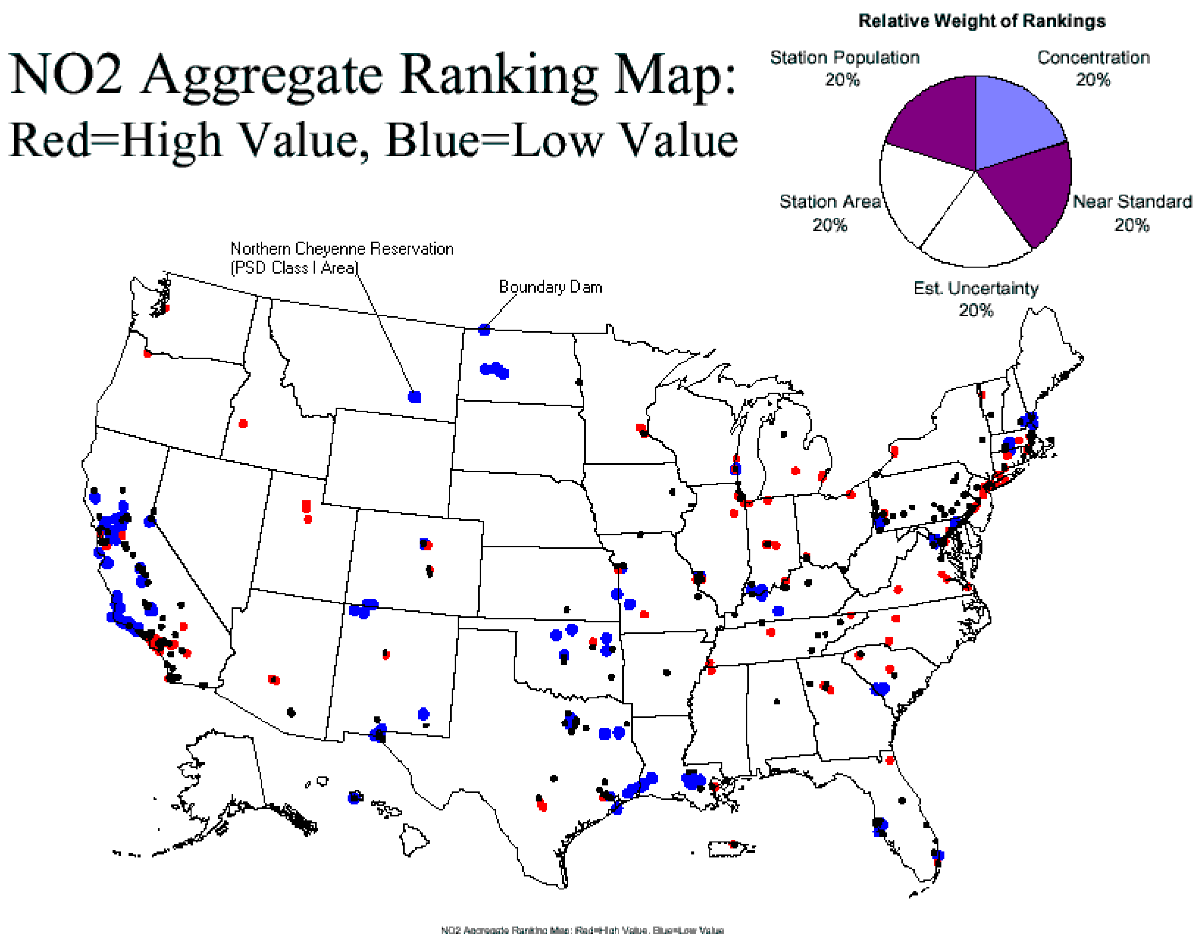


Figure 3-4 Comparative Rankings of NO_2 Monitors from the National Assessment

3.5 $PM_{2.5}$

Figure 3-5 shows comparative rankings of $PM_{2.5}$ monitors from the National Assessment. Unlike some other parts of the country, most monitors in Region 8 do not appear to be likely to violate the $PM_{2.5}$ annual standard. Some monitors in Region 8 may have trouble meeting the 24-

hour standard (again, unlike much of the rest of the nation).

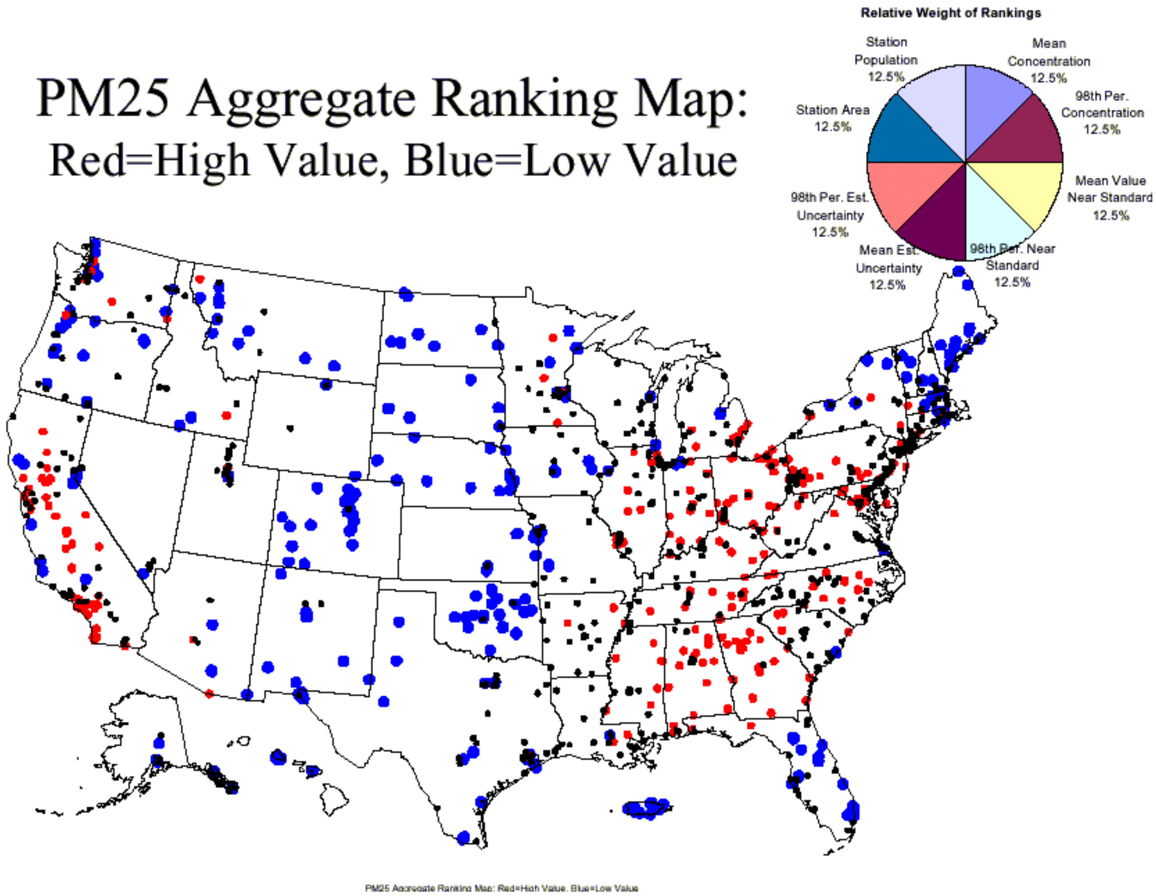


Figure 3-5 Comparative Ranking of $PM_{2.5}$ Monitors from the National Assessment

3.6 SO_2

Figure 3-6 shows a comparative ranking of SO_2 monitors from the National Assessment. In addition to population oriented NAMS and SLAMs in the population centers, the map shows large numbers of source oriented industrial and SLAMS monitors, as well as industrial, special purpose, and PSD tracking monitors.

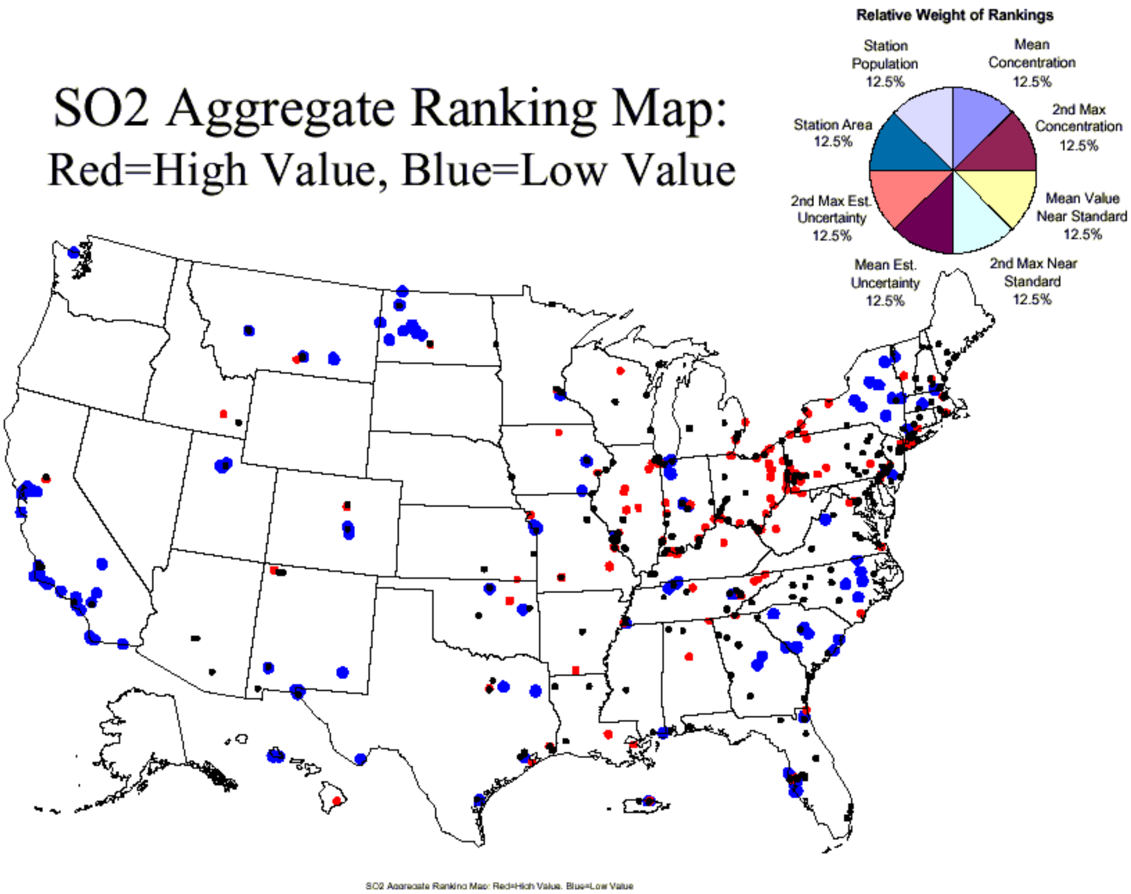


Figure 3-6 Comparative Ranking of SO_2 Monitors from the National Assessment

3.7 Pb

Figure 3-7 shows a comparative ranking of Lead (Pb) monitors from the National Assessment. While there are only a few monitors shown in Region 8, state and local monitoring agencies continue to evaluate their monitoring needs and update their networks. For example, the single red dot in Montana actually represents several monitors in East Helena, Montana. The smelter in East Helena has recently closed, and Pb monitoring is no longer conducted there.

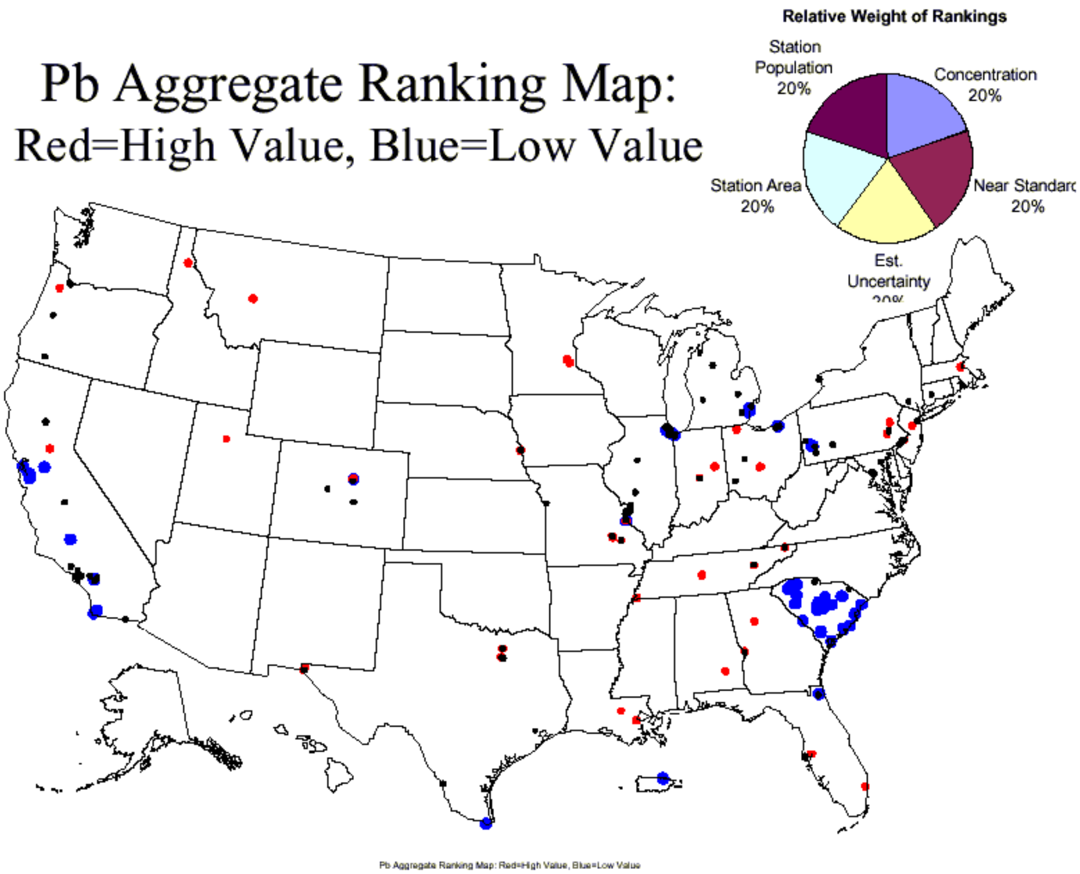


Figure 3-7 Comparative Ranking of Lead Monitors from the National Assessment

4.0 Region 8 Topography and Meteorology

Region 8 covers a large area including steppelands, mountain forests, alpine tundra, and desert areas. The region has several climatic and topographic divisions. Low overall population, long distances between population centers, the presence of mountain ranges, and climatic differences define the character of air quality issues in Region 8. Separate airsheds may have similar air quality but vastly different conditions may exist between them, and isolated pockets can have special problems due to local conditions. Each of the six States in the region has unique features, which are summarized below.

4.1 Colorado

Colorado is the southernmost of the three States in Region 8 that span the continental divide. The lowest point in the State is 1,010 m above sea level, and the highest point is over 4400 m. Communities exist as high as 3000 m, but the population centers along the eastern slope of the Rocky Mountain Front Range are closer to 1,600 m in elevation. Struggles to achieve proper engine stoichiometry at this altitude and the incidence of winter inversions caused these communities, notably the Denver metropolitan area, to violate the CO standard in the past. Snowstorms alternating with dry periods contribute to entrainment of coarse particulate matter which mixes with particulates from other sources. Problems with PM_{10} have occurred in Denver, as well as in inter-mountain communities at elevations of 2,000 to 2,500 m and higher during winter inversions. In dry agricultural areas such as the southeastern plains with 30 cm annual precipitation or the San Luis Valley with as little as 18 cm annual precipitation, winds can readily pick up coarse particulate matter. Summer conditions are usually favorable to ventilation. Occasional hot, clear days with light upslope (easterly) surface winds can cause ozone concentrations near or over the eight hour standard of 80 ppb along the foothills west of Denver and even in Rocky Mountain National Park, 50 miles northwest of the Denver metropolitan area.

4.2 Montana

Montana has an area larger than that of EPA Region 3 and the distance between its northwestern and southeastern corners is about the same as that from Raleigh, North Carolina to Chicago, Illinois. The eastern plains near the Saskatchewan border are just over 600 m elevation while the mountains near Yellowstone National Park reach 3,900 m. The eastern plains of Montana are among the driest portions of Region 8 east of the continental divide and receive only about 30 cm of precipitation per year, but Pacific storms can deposit 4 to 5 m of snow per year in the western mountain ranges. Winter inversions in communities in mountain valleys (and sporadically along the eastern foot of the Rockies) caused some areas to violate the CO standard. Communities located in the forests of western Montana have experienced particulate matter from residential and commercial sources of woodsmoke. Controlled burns and wildland fires have also contributed to particulate pollution. The drying of street sanding materials in springtime or during dry winter periods with subsequent entrainment is a source of coarse particulate matter.

4.3 North Dakota

North Dakota is the smallest State in Region 8 but it has an area larger than that of Region 1. The topography varies from the lowland plains at approximately 300 m in the east to rolling, dissected plateau country in the west with elevations up to 1,000 m. Precipitation ranges from about 50 cm per year in the east to 35 cm per year in the west. The State has a continental climate, and the open terrain permits frequent passage of weather systems. Temperature inversions and accompanying air stagnation do not normally cause significant air pollution problems. Because energy development has been concentrated in the west, most of the monitoring in the State is in the higher plains west of the Coteau du Missouri (a narrow plateau on the east bank of the Missouri River). Nevertheless, there has been monitoring in Grand Forks and Fargo near the eastern border. Historically, North Dakota has had no non-attainment areas.

4.4 South Dakota

The Missouri River bisects the plains of South Dakota. Elevations range from about 300 m along the Missouri and James Rivers and near the Minnesota border to over 2,000 m in the Black Hills at the western side of the State. As in North Dakota, precipitation decreases from about 50 to 35 cm per year from east to west, but the Black Hills receive more moisture than the surrounding plains. In general, the State's climate is not conducive to air stagnation. Rapid City, however, has experienced problems with fugitive dust emissions that fail to disperse during periodic inversions. The incidence of dry, windy periods, particularly in the spring, continues to pose problems with coarse particulate matter in Rapid City.

4.5 Utah

Utah is the only State in Region 8 that is entirely west of the continental divide. The State has complex topography. Elevations range from 600 m in the southwest corner of the State to over 4,000 m in the Uintah Mountains in the northeast. The Great Salt Lake is at 1,280 m and the salt flats and basins in the western part of the State are only slightly higher. The Wasatch Range east of the Salt Lake City-Provo area acts as a barrier that can shut off horizontal movement of stable air masses. Most of the monitoring in Utah is concentrated in this area, which is the most heavily populated part of the State. The Wasatch Front has experienced wintertime episodes of air pollution in the form of CO and particulate matter, similar to the experience of many other communities at the base of mountain ranges in Region 8. The high mountains receive average annual snowfall of 10 m or more. The lower elevations tend to be arid, typically receiving 20 to 30 cm per year of precipitation. Wintertime relative humidity tends to be higher in the Wasatch Front than on the eastern slope of the Rockies, which leads to more frequent haze and fog and may influence measurements of particulate mass. Summertime temperatures in the Salt Lake basin can be very high, and when desert sunlight is combined with natural and urban emissions, high ozone concentrations are sometimes recorded.

4.6 Wyoming

The terrain of Wyoming varies from mountain ranges of up to 4,200 m, a basin on the continental divide at 2,000 m, and high plains in the northeast at about 1,000 m. The eastern plains are semi-arid grassland usually receiving less than 35 cm of precipitation per year. The complex terrain of the west results in a mixed precipitation pattern, with mountain ranges that can receive optimum snow pack of 5 m and deserts that get only 20 cm of moisture per year. Air basins in the State show similar variety. Sheridan, at the foot of the Bighorn Mountains, experiences winter temperature extremes and periodic air stagnation, and violated the PM_{10} standard in the past. Were it not for controls, emissions of SO_2 and H_2S from oil and gas production and processing in western valleys could cause pollution episodes during winter inversions. Weather systems tracking over the eastern plains tend to ventilate pollution but also entrain coarse particulate matter, especially during dry periods.

5.0 Regulatory and Funding Setting

As explained in the section titled "Scope" of the National Ambient Air Monitoring Strategy, EPA is concerned with several categories of ambient air monitoring in the United States. The developers of the strategy recognized that EPA and its partners could effect changes in the portion of the national air monitoring network that EPA funds, in part, through grants to State, local, and tribal governments. Region 8's network assessment concerned itself with this grant-funded portion of the network, while distinguishing other important subsets that overlap with the grant-funded portion. The grant-funded portion of the network generally includes designated SLAMS and NAMS monitors, as well as special purpose monitors. Additional networks exist in AIRS-AQS which are not grant-funded, any of which are industrial networks funded privately, but another large monitoring category is the non-EPA federal monitoring network. Included as non-EPA federal are National Park Service monitors.

A brief treatment of the EPA grant-funded monitoring activities follows.

5.1 Regulatory Monitoring

The grant-funded network overlaps partly with a network that exists for regulatory purposes. Regulatory monitoring is that specifically required by 40 CFR, Part 58. Table 5-1 summarizes the minimum number of stations required to monitor various pollutants. Many of these minimum numbers are derived from population. According to the 2000 census, the two largest population centers in Region 8 are the Denver–Boulder–Greeley consolidated metropolitan statistical area with 2.58 million people, and the Salt Lake City–Ogden metropolitan statistical area with 1.33 million people. Table 5-2 shows the number of monitors that the regulations require the States in Region 8 to operate for each criteria pollutant and the number of monitors actually operating in 2001. Note that population changes from the 2000 census resulting in changes in required numbers of monitors are not reflected in the table. Tribal monitors are included here in the total number of grant-funded monitors operated within the borders of the States. Figures 5-1 and 5-2 illustrate the distribution of the required and reporting monitors by State and by pollutant. More than one monitor may operate at an air monitoring station, consequently the numbers shown do not reflect the total number of air monitoring stations.

Table 5-1. Numerical Requirements for SLAMS and NAMS

Pollutant	Min. Number SLAMS	Basis	Citation	Min. Number NAMS	Basis	Citation
Sulfur dioxide				0 - 10	MSA 100,000 to > 1 million; concentrations 60% of NAAQS to > NAAQS	Appendix D, 3.2; Table 3
Carbon monoxide				2	Urbanized area > 500,000	Appendix D, 3.3
Ozone				2	Urbanized area > 200,000	Appendix D, 3.4
Nitrogen dioxide				2	Urbanized area > 1 million	Appendix D, 3.5
Lead	2	Any major urbanized area where Pb concentrations have exceeded NAAQS in last 8 quarters	Appendix D, 2.7	1 1	Per EPA Region Area with violation , past 8 quarters	Appendix D, 3.6
PM_{10}	undefined	TSP surrogates can satisfy "minimum number"	Appendix D, 2.8.2.1, Appendix C, 2.2	0 - 10	MSA 100,000 to > 1 million; concentrations 80% of NAAQS to > 120% NAAQS	Appendix D, 3.7.1, Table 4
$PM_{2.5}$	1 (1:3) 2 (1:1) As above + 1-7 (1:3) + 1 Continuous	MSA > 200,000 MSA > 500,000 MSA's > 1 to > 8 million	Appendix D, 2.8.1.3.1 Appendix D, 2.8.1.3.1 Table 1	1 10 - 50	Metropolitan area > 1 million Per EPA Region	Appendix D, 3.7.3 Appendix D, 3.7.5, Table 5

	Table 5-2. Numbers of SLAMS/NAMS Monitors Required (Pre-2000 Census)|SLAMS/NAMS/Tribal/SPM Reporting in 2001					
	Colorado	Montana	North Dakota	South Dakota	Utah	Wyoming
SO_2	2|3	2|4	0|10	0|0	2|4	0|0
CO	2|13	0|8	0|0	0|0	2|11	0|0
O_3	2|15	0|0	0|6	0|1	2|14	0|0
NO_2	2|4	0|0	0|6	0|0	2|4	0|0
Pb	1|6	0|2	0|0	0|0	0|1	0|0
PM_{10}*	2|56	0|28	0|4	0|13	2|8	0|9
$PM_{2.5}$	13|20	6|16	5|9	5|11	8|16	4|5
Total	24|117	8|58	5|35	5|25	18|58	4|14
Difference (Reporting minus Required)	97	50	30	20	40	10

Note: Table includes SLAMS, NAMS, SPM and Tribal reporting in 2001 only. SLAMS/NAMS required may not reflect all new requirements resulting from the 2000 census, as census data is still being evaluated for "urbanized area" sizes, and NAMS are in transition because of proposed regulatory changes.
* Substantial numbers of PM10 monitors are required within SIP Maintenance Plans, beyond those required by 40 CFR Part58. Those monitor requirements are not included in this Table.

Figure 5-1. Number of Grant-Funded Monitors (NAMS/SLAMS, SPM & Tribal) in EPA Region 8 in 2001, Required (SLAMS & NAMS) and Reporting, by State

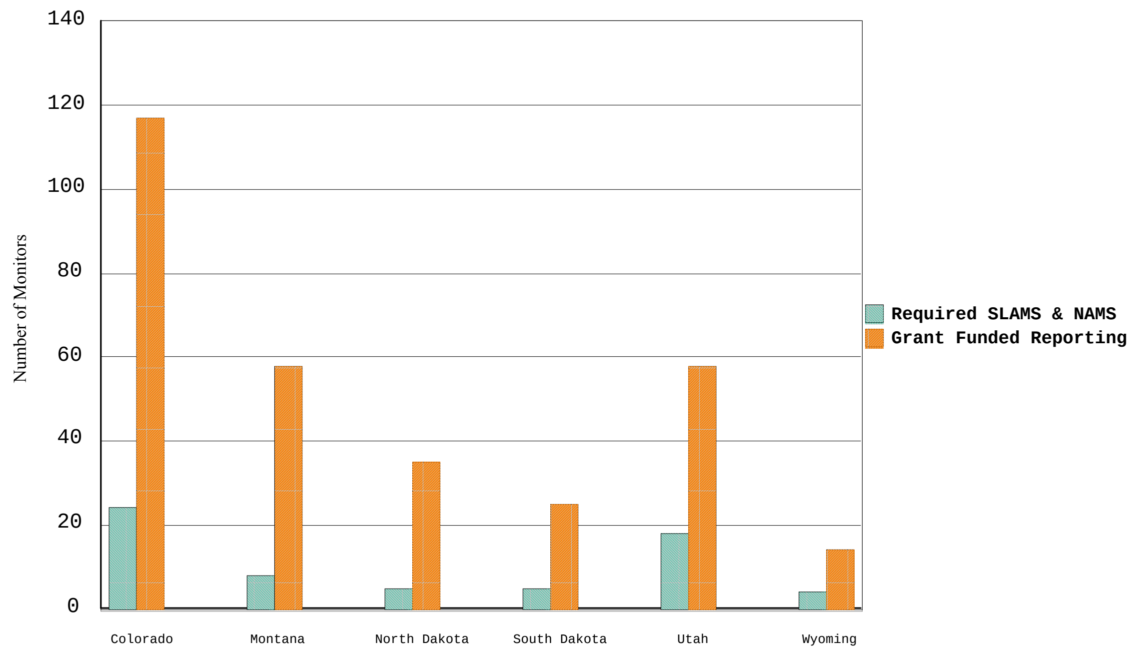
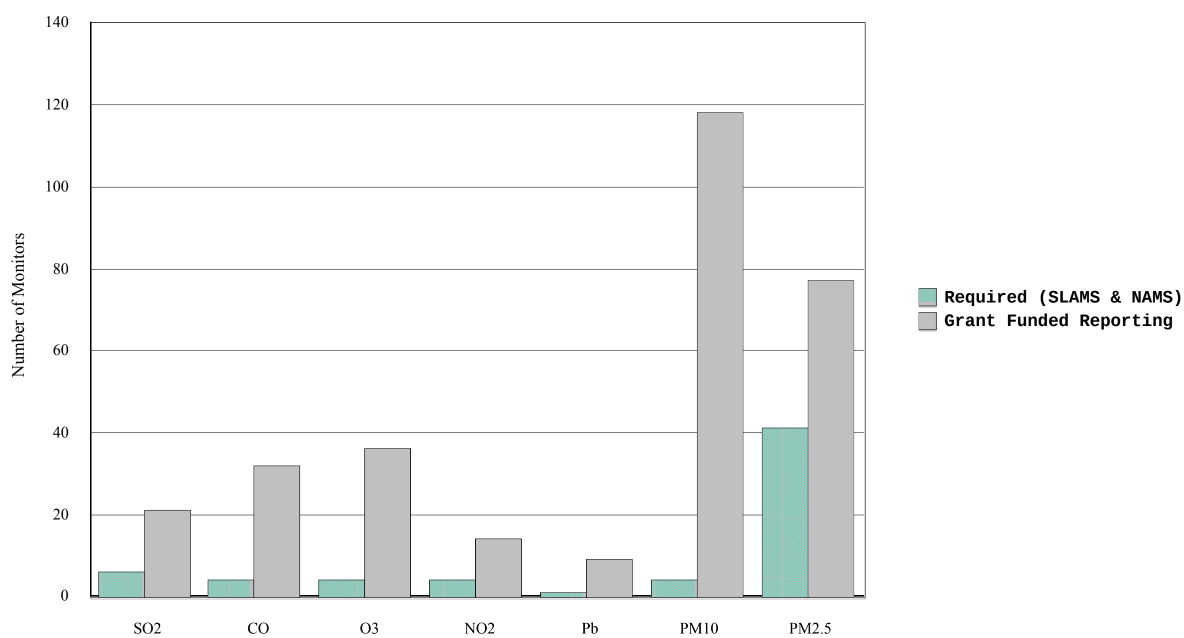


Figure 5-2. Numbers of Grant-Funded Monitors (NAMS/SLAMS, SPM & Tribal) in EPA Region 8 in 2001, Required (SLAMS and NAMS) and Reporting, by Pollutant



Monitoring organizations in Region 8 operate more air monitoring stations than are required under the regulations. Part 58 specifies only minimum numbers of monitors. In no case does the regulation specify a maximum number. In addition to the minimum numbers defined in Part 58, States operate additional monitors required by SIPs, maintenance plans (where contingency planning is tied to measured air quality), "good science" practices, and local citizen concerns. Air pollution control authorities find themselves looking to other factors besides regulations when making decisions about deploying air monitoring stations. They also make these decisions on the basis of grant funds and local revenues available and the six data collection needs recognized by the national strategy document:

- compliance
- population exposure and public awareness
- accountability for progress in emissions control programs
- emission control program development
- environmental welfare assessments
- research

Policies can also convey the urgency of establishing large numbers of air monitoring stations. A memorandum of October 2, 1997 sent by John Sietz to EPA managers and citing, in turn, the President's memorandum of July 16, 1997, referred to a commitment to deploy "approximately 1,500 $PM_{2.5}$ monitoring sites over the next 2 years." OAQPS subsequently reduced the target to 1,100 stations, and 1,104 were running at the end of 2001. Agencies also received advice to increase the size of networks before the $PM_{2.5}$ standard existed. In 1989, the General Accounting Office concluded that, "While EPA has established a national air monitoring network, shortages of monitors continue to exist approximately 7 years after the network was to be complete." Air pollution control authorities are encouraged to expand networks by policies and reviews that focus on the need for new monitoring and rarely receive offsetting advice to reduce networks.

Generally, only data from regulatory air monitoring stations are used to determine attainment or nonattainment of NAAQS. Nonattainment acts as a force stabilizing the size of networks. In the case of PM_{10}, for example, 40 CFR, Part 50 and associated guidance require three years of complete, current data showing no violations at a single sampler at a single air monitoring station in order to redesignate an area from nonattainment to attainment. Staff members of regional offices of EPA, OAQPS, and OGC periodically confer regarding the attainment status in areas not meeting one or more of the conditions, including incompleteness of data and changes in monitoring sites. Region 8 has 17 PM_{10} nonattainment areas that have not been redesignated back to attainment, as of Fall 2002. Until these areas are redesignated or policy changes, Region 8 monitoring staff will recommend against voluntarily closing PM_{10} stations that are tracking trends with the object of redesignation.

Air monitoring networks in Region 8 have been dynamic in spite of forces acting to increase and stabilize their size. Air pollution control authorities work within budgets that change little from year to year. They must find resources for any new initiatives, including monitoring programs. New information may show that some air monitoring stations can be closed, or indicate that other sites may better meet monitoring objectives. Practical considerations, such as demolition, construction, and change of monitoring site ownership may cause the loss of monitoring sites. Region 8 works cooperatively with States and tribes to manage such changes through annual network reviews and a network modification process. Guidance on conducting network reviews categorically states that agencies should ensure that monitoring stations are not redundant, as well as sufficient in number. From a network of slightly over 300 grant-funded monitors, Region 8 typically handles between 20 and as 80 network modification request forms annually.

5.2 Regulatory Monitoring and Scope of Network Assessment

The monitoring regulations of 40 CFR 58 set requirements for acquiring air quality data suitable for two primary uses:

- Comparison to NAAQS
- Measurement of Major Source Impacts

In reality, monitors intended for either of these primary uses typically has value for the other use, as well. All monitored data is compared with the NAAQS, and any significant trends identified for a given monitor could be indicating Major Source impacts.

For the first use (comparison to the NAAQS) State and local agencies operate many of the air monitoring stations that compose the regulatory network, and these stations are funded by a combination of federal grants and matching State funds. The same agencies operate some special purpose monitors, which may resemble regulatory air monitoring stations but not meet all of the technical requirements. For example, a special purpose monitoring station might use a non-regulatory monitoring method. The organization operating the station could use the resulting data for screening purposes or to aid in planning network design, but generally not to determine attainment of a NAAQS. Region 8 supports this class of special purpose monitors through grants and has some influence over their deployment. We included them, along with all air monitoring supported through grants issued by Region 8, in this assessment.

Tribal governments also participate in the regulatory network through grants. Although 40 CFR 58 does not specify minimum numbers of air monitoring stations that Tribes must operate, Tribal monitoring can serve regulatory purposes. Air monitoring stations on reservations must comply with regulatory criteria for installation and operation if these purposes are to be met. Where EPA and Tribal governments cooperate to bridge this gap in the regulations, the data collected at Tribal stations can be defended and used in the event that a NAAQS is violated. Region 8 requires that grant-supported Tribal monitoring comply with 40 CFR 58. We have included Tribal air monitoring stations in this assessment.

The second use of data from regulatory monitoring stations is to measure air quality changes that might be related to industrial development. Portions of 40 CFR Part 58 specify requirements for air monitoring that industry carries out under the section of the Clean Air Act dedicated to the Prevention of Significant Deterioration (PSD) program. Industry operates PSD stations without grant funds, usually under permits issued by States. States also commonly require other industrial sources that do not meet the PSD emission thresholds to monitor the ambient air. In these cases, States often require the sources to follow the PSD monitoring regulations. States treat some industrial stations as special purpose monitors and sometimes use industrial data to show attainment or non-attainment of air quality standards. The operation of the networks and the continuity of operation, however, are determined by industrial, rather than regulatory needs, and the monitor networks can be changed or terminated based on the status of the source. EPA Region 8 did not include industrial monitors in its assessment of the regional network, because the operation of industrial monitors cannot be directly controlled through grants or network reviews. Permits are the controlling documents for industrial monitors. Furthermore, some industrial monitors may not meet regulatory requirements.

Air monitoring stations can also be grouped by their requirements for reporting data to the national air quality data base, AIRS-AQS. Region 8 requires grantees to report air quality data, except for data from some special purpose monitors, to AQS. The National Park Service and other government organizations report some data to AQS from networks over which EPA, at least at the regional level, has little influence. Some industrial networks also report data to AQS through State agencies. We can analyze data from most of the grant-funded portion of the network (excluding some special purpose monitors not reporting to AIRS-AQS) by making selective retrievals from AQS, whereas indiscriminate retrievals would include data from other sources (special purpose, industrial, non-EPA federal, and non-equivalent measurement methods, among others) and give misleading results.

The Region 8 network assessment was based upon retrievals from AQS, excluding data from industrial monitors. In general, we also excluded data from stations operated by other federal agencies; however, we made an exception in the case of ozone. Region 8 has large areas without ozone monitoring. For example, the only ozone stations reporting data to AQS in Wyoming and Montana are operated in parks by the National Park Service. In order to assess coverage, we included data from a few stations operated by the National Park Service.

5.3 Monitor Funding

For the reasons cited above, the network assessment conducted by Region 8 focuses on the grant-funded air monitoring networks operated by State, local, and tribal agencies. Congress allocates the funds that make the grants possible under sections 103 and 105 of the Clean Air Act. Grant awards under section 103 are closely tied to program objectives and individuals who work with grants at the regional offices of EPA commonly refer to these as *programmatic grants*. Grant awards under section 105, which constitute the majority of the grant funds awarded under the air program, are incorporated in broader *performance partnership grants*.

Cost sharing under section 103 is variable, however EPA fully funds the current section 103 grants for monitoring $PM_{2.5}$ and toxic air pollutants. States in Region 8 share 40 percent of the cost of section 105 grants. Because grantees generally must contribute more to activities funded under section 105, management and negotiators presume that the grantees have a greater stake and more control in setting priorities. Furthermore, the concept of performance partnership grants worked out among EPA and States in the mid-1990's expressly gives grantees flexibility in deciding which environmental programs receive the most emphasis. Because performance partnership grants allow grantees this flexibility, there is no assurance that section 105 funds allocated for air monitoring will actually be spent in air monitoring or even in the air program.

Grantees expect to have some control over the number and location of air monitoring stations funded through programmatic (section 103) grants and they have substantial control over stations funded through performance partnership (section 105) grants. Because the influence that EPA has over air monitoring stations funded through section 105 is indirect, Region 8 does not plan to create lists of air monitoring stations to be established or to be closed. Instead, we anticipate that proposed changes in the networks would be negotiated through existing administrative processes including commenting on network reviews and negotiating performance partnership agreements.

Region 8 States and Tribes receive a small portion of the national budget for ambient air monitoring and operate a small portion of the national network. Monitoring costs are comparable to, if not somewhat lower than, the national average. In fiscal year 2000, State, local and Tribal governments nationwide were allocated $138 million for section 105 grants and $30 million for monitoring $PM_{2.5}$ under section 103 grants. Region 8 was allocated $7.2 million for section 105 grants and $1.7 million for monitoring $PM_{2.5}$ under section 103 grants. Consequently Region 8's share was approximately 5.3 percent of the total. In 2000 to 2001, there were 4,174 SLAMS/NAMS monitors, including $PM_{2.5}$ monitors. States in Region 8 operated 239 SLAMS/NAMS monitors, or approximately 5.7 percent of the total. In the same time period, Tribes in Region 8 operated between 30 and 40% of the 50 to 60 Tribal monitors in the U. S.

It was not possible to extract the monitoring portions of the section 105 grants because they were incorporated in performance partnership grants. An OAQPS estimate of the portion of State and Tribal Assistance Grant funds used for monitoring in the fiscal 2002 budget was 47.8 percent. Applying this ratio to the grant allocations in 2000 shows an estimated cost of $21,600 (in gross grant monies allocated for monitoring) per monitor in Region 8, compared to a national value of $23,000 per monitor. Table 5-3 shows the estimated cost per monitor by State in Region 8. Colorado had the lowest cost per monitor at an estimated $17,700 and Montana had the highest at an estimated $26,200. The three half-percent States and Utah are clustered nearer the mean. Probable influences on these results include economy of scale (Colorado operated far more monitors than other States, as shown in Table 5-2), variations in salaries and travel costs, the means of hiring and paying local operators, the geographic area covered, the costs of special studies, other overhead, and different intensities of labor between continuous monitoring and manual monitoring with the attendant laboratory costs. The degree to which States actually allocate monies to monitoring under performance partnership grants is unknown and may significantly influence the results.

Table 5-3. Estimated Annual Cost per Monitor, by State		
State	Makeup of Network	Cost per Monitor (thousands)
Colorado	CO, Pb, NO_2, PM_{10}, $PM_{2.5}$, O_3, SO_2	$17.7
Montana	CO, Pb, PM_{10}, $PM_{2.5}$, SO_2	$26.2
North Dakota	NO_2, PM_{10}, $PM_{2.5}$, O_3, SO_2	$20.3
South Dakota	PM_{10}, $PM_{2.5}$, O_3	$23.9
Utah	CO, Pb, NO_2, PM_{10}, $PM_{2.5}$, O_3, SO_2	$24.0
Wyoming	PM_{10}, $PM_{2.5}$	$22.3

A primary objective of the National Ambient Air Monitoring Strategy is the optimization of resources in order to support more monitoring in emerging areas. The strategy states that resources freed are not to be transferred among grantees, but instead be diverted to new uses within the agencies making network changes. In fact, the national strategy aims for "shifts to different pollution measurements and technologies, and not resource shifts across geographical regimes." Even optimizing resources locally presents a challenge when viewed in the context of performance partnership grants, which still account for a majority of air monitoring monies. Although EPA may identify portions of section 105 grant allocations as being intended for air monitoring, grantees may not distinguish the allotment in the same way.

Region 8 will work toward the goal of optimizing resources within grants rather than optimizing by moving resources from one grant to another. It remains to be seen how readily we will be able to optimize within the grants of the six States in Region 8. With their higher budgets, Colorado and Utah have larger staffs than the three half-percent States and Montana and generally would have greater capacity to adopt new monitoring technologies. Colorado and Utah represent about half of the grant funds for monitoring in Region 8; the four smaller States and eight tribal monitoring programs consume the other half. This disparity between distribution of capacity resources may limit the absolute number of new monitoring technologies adopted in Region 8, even given maximal acceptance by the individual agencies. Of the grant-funded monitors which are shown in Table 5-2, half were in half-percent States or were ozone or $PM_{2.5}$ monitors. While neither ozone monitoring nor $PM_{2.5}$ monitoring will be exempt from reductions, the national strategy places priority on monitoring these two pollutants. Optimizing resources will require careful negotiation under the grant process.

6.0 Region 8 Statistical Assessment

The primary statistical evaluation method used in the Region 8 network assessment was pairwise correlation. This was used to attempt to identify monitor pairs which appear to record similar data. Highly correlated pairs could then be evaluated with respect to maximum value comparison with the NAAQS, monitoring objectives and other factors to see if one member of a highly correlated pair would be a candidate for closure in order to free resources for new monitoring needs.

Determination of what constitutes high correlation is fairly arbitrary. Correlations were found to vary greatly with parameter, even for site pairs each having several of the same parameters. $PM_{2.5}$ monitor pairs were found to have the highest correlations.

6.1 Ozone

As a secondary pollutant with solar radiation dependence, ozone would be expected to correlate better over long distances than other pollutants. Cities with similar climates might experience high ozone concentrations on the same day with no physical basis in terms of shared air basins and common sources. Because of this, a higher standard to indicate significant correlation may be needed for ozone than for other pollutants.

With this said, all the pairs of ozone monitors in EPA Region 8 (along with a few monitors outside the region that correlate with monitors within the region) having correlation coefficients greater than 0.80 are shown in Table 6-1. All correlation pairs are geographically related to some extent. The monitor pair most widely separated with a correlation of 0.8 is the North Provo monitor in Utah County, Utah when correlated with the Logan monitor in Cache County, Utah. The distance between the North Provo and Logan sites is approximately 100 miles. Logan is in the Cache Valley, northeast of the Salt Lake Basin, from which it is separated by a ridge approximately 1500 feet above the basin floor. North Provo is in the Utah Lake Basin southeast of the Salt Lake Basin. The Utah Lake Basin can exchange air parcels with the Salt Lake Basin via a narrow mountain gap at Point of the Mountain, at the south end of Salt Lake County.

Of the monitor pairs with correlations greater than 0.85, the separation distance is generally 40 miles or less.

Table 6-2 shows the 1999-2001 3-year first maximum, and the 3 year mean of 4^{th} maxima percentage of the O_3 NAAQS for all the Region 8 ozone monitors considered.

Table 6-1 Correlation Between Region 8 Ozone Monitor Pairs

Site1AIRS ID	Site 1 Name	Site2AIRS ID	Site 2 Name	Correlation Coefficient
080310014	**Carriage**	**080590002**	**Arvada**	**0.92**
490571002	**N. Ogden (Closed)**	**490571003**	**Harrisville**	**0.92**
490350003	**Cottonwood**	**490353007**	**W. Valley**	**0.92**
080013001	**Welby**	**080590002**	**Arvada**	**0.89**
080013001	**Welby**	**080310014**	**Carriage**	**0.89**
080590006	**Rocky Flats**	**080590011**	**NREL**	**0.88**
380570004	**Beulah**	**380650002**	**Hannover**	**0.88**
380250003	**Dunn Center**	**380530002**	**TRNP North**	**0.87**
080677001	**Ute 7001**	**080677003**	**Ute 7003**	**0.86**
490350003	**Cottonwood**	**490490002**	**N. Provo**	**0.86**
490050004	**Logan**	**490570007**	**Washington Terrace**	**0.86**
080050002	**Highland Res.**	**080350002**	**Chatfield**	**0.85**
080590005	**Welch**	**080590011**	**NREL**	**0.85**
490350003	Cottonwood	490353006	Hawthorne	0.84
080691004	Fort Collins	081230007	Greeley	0.84
490350003	Cottonwood	490352004	Beach	0.84
490570007	Washington Terrace	490571003	Harrisville	0.84
380250003	Dunn Center	380570004	Beulah	0.84
080130011	S. Boulder	080590011	NREL	0.83
490350003	Cottonwood	490570007	Washington Terrace	0.83
490353007	W. Valley	490570007	Washington Terrace	0.83
490490002	N. Provo	490495010	Spanish Fork	0.83
080050002	Highland Res.	080590005	Welch	0.83
080130011	S. Boulder	080590006	Rocky Flats	0.83
490353007	W. Valley	490490002	N. Provo	0.83
080677003	Ute 7003	350450009	Bloomfield, NM (Region VI)	0.83
490352004	Beach	490353007	W. Valley	0.83
490030003	Brigham City	490571003	Harrisville	0.82
490495008	Highland	490495010	Spanish Fork	0.82
490353006	Hawthorne	490353007	W. Valley	0.81
080013001	Welby	081230007	Greeley	0.81
490050004	Logan	490571003	Harrisville	0.81
490353006	Hawthorne	490490002	N. Provo	0.81
490490002	N. Provo	490570007	Washington Terrace	0.81
490353006	Hawthorne	490570007	Washington Terrace	0.80
490353006	Hawthorne	490571003	Harrisville	0.80
490050002	Logan (Closed)	490570007	Washington Terrace	0.80
490050004	Logan	490350003	Cottonwood	0.80
080677001	Ute 7001	350450009	Bloomfield, NM (Region VI)	0.80
490353003	Herriman	490495008	Highland	0.80
490050004	Logan	490490002	N. Provo	0.80

Table 6-2 Region 8 Ozone Monitor 8-hour Values, Ranked Within States

AIRS Site ID	Site Name	3-year Maximum 8-hour Ozone Percent of NAAQS	3-year 8-hour Ozone 4th Maximum Mean Percent of NAAQS[1]
080590006	Rocky Flats	115%	102%
080590011	NREL	113%	102%
080350002	Chatfield	111%	98%
080690007	RMNP	111%	93%
080050002	Highland Res.	108%	95%
080130011	S. Boulder	108%	91%
080677001	Ute 7001	105%	79%
081230007	Greely	105%	88%
080830101	Mesa Verde	103%	86%
080013001	Welby	101%	82%
080410013	Air Force Academy	101%	85%
080590005	Welch	100%	83%
080310014	Carriage	98%	88%
080691004	Fort Collins	96%	83%
080677003	Ute 7003	91%	75%
300298001	Glacier NP	81%	68%
380070002	TRNP-South Unit	89%	79%
380650002	Hannover	86%	71%
380910001	Sharon (Closed)	85%	82%[3]
380570004	Beulah	85%	71%
380530002	TRNP-North Unit	81%	70%[3]
380250003	Dunn Center	78%	70%
460990007	Sioux Falls	96%	81%
461030018	Rapid City	81%	76%[3]
490110001	Bountiful	148%[2]	106%[2]
490350003	Cottonwood	139%[2]	102%[2]
490353007	W. Valley	139%[2]	107%[2]
490352004	Beach	136%[2]	104%[2]
490353006	Hawthorne	134%[2]	100%[2]
490353003	Herriman	131%	103%[2]
490495008	Highland	131%[2]	102%[2]
490571002	North Ogden (Closed)	126%[2]	97%[2]
490050004	Logan	124%	89%[2]
490570007	Washington Terrace	121%[2]	100%[2]
490495010	Spanish Fork	116%[2]	100%[2]
490571003	Harrisville	113%	98%[3]
490030003	Brigham City	111%	98%[3]
490490002	N. Provo	109%[2]	93%[2]
490370101	Canyonlands NP	100%	90%
490050002	Logan (Closed)	88%	83%
560391011	Yellowstone NP	98%	84%

[1] Three year averages of annual 4th maximum 8-hour values of 0.081 to 0.084 ppm (101-105% of the NAAQS) round down to the 8-hour NAAQS of 0.080 ppm

[2] Includes data impacted by wildfires in 2000, which will be excluded from future attainment determinations

[3] Preliminary calculation based on less than 3 years of data

To further evaluate the most highly correlated ozone monitor pairs in Region 8, scatter diagrams were constructed for the top 7 pairs (correlation coefficients greater than 0.88).

Denver Carriage Site Correlation with Arvada NAMS Site

The scatter diagram of data pairs from the central Denver Carriage site and the Arvada NAMS site 5 miles northwest of Carriage in a suburb northwest of Denver is shown in Figure 6-1. The scatter diagram shows poor correlation when at least one of the monitors is reporting low ozone concentrations, but with better correlations as concentrations increase. The Arvada monitor, further from the urban center and nearer the foothills west of Denver, shows higher peak concentrations relative to Carriage.

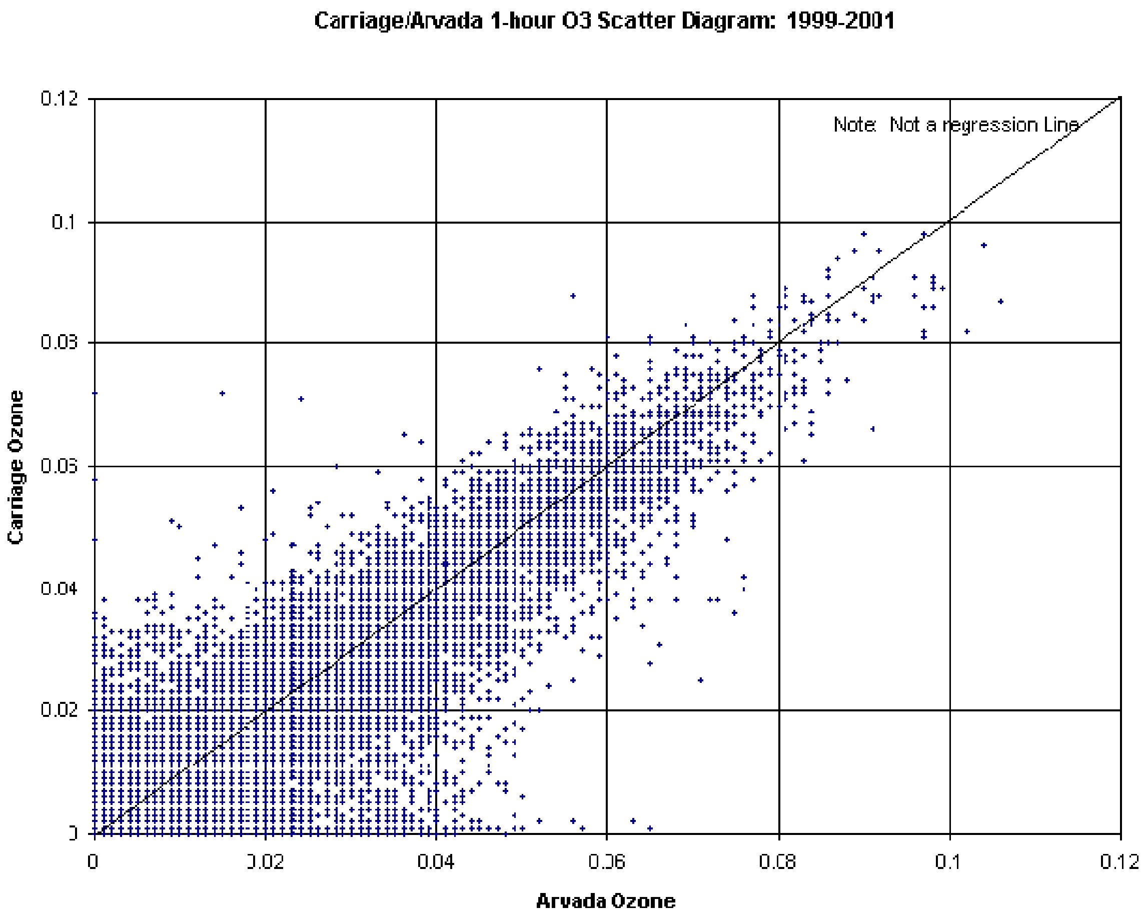


Figure 6-1 Scatter Diagram for Carriage (Denver) and Arvada NAMS 1-hour Ozone, 1999-2001

North Ogden (Closed) Site Correlation with Harrisville, Utah Site

Figure 6-2 shows the ozone scatter diagram for North Ogden and Harrisville, two monitors approximately 2 miles apart in north Weber County, in the suburbs north of Ogden, Utah. The Harrisville monitor is a new site which the State of Utah proposed as a replacement for the North Ogden monitor. The State operated both monitors during the 2001 ozone season. While the North Ogden monitor generally had higher concentrations when both monitors were well below the NAAQS, the Harrisville monitor generally read higher values when the ozone concentration was elevated. This demonstrated that the Harrisville location was a better maximum concentration site during the 2001 season, and ozone monitoring at North Ogden was discontinued at the end of the 2001 season once this was confirmed.

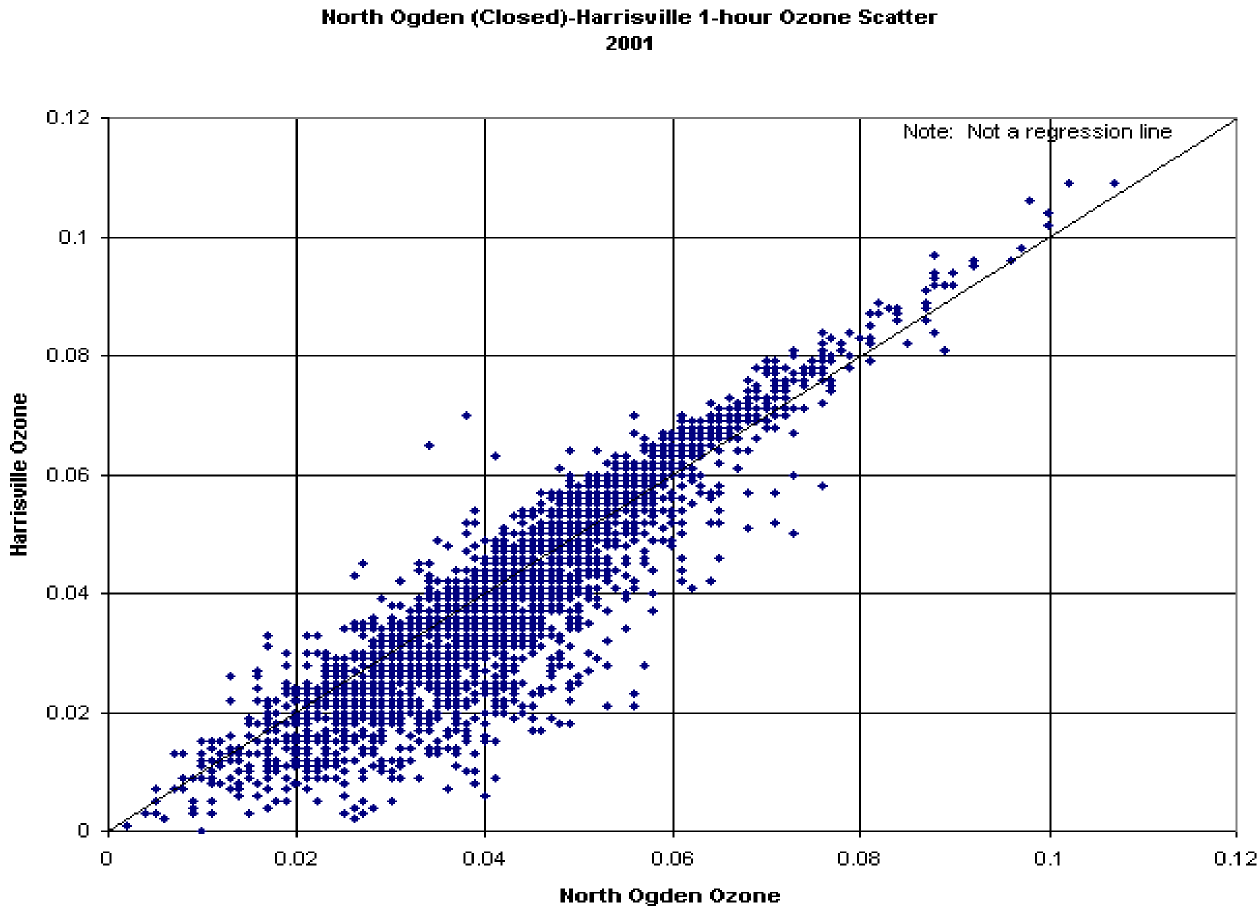


Figure 6-2 North Ogden-Harrisville, Utah 1-hour Ozone Scatter Diagram, 2001

Cottonwood Site Correlation with West Valley, City Site (Both Salt Lake County, Utah)

Figure 6-3 shows the 1-hour ozone scatter diagram for the Salt Lake County Cottonwood NAMS and West Valley monitors. These monitors are located southeast and southwest, respectively of the Salt Lake City urban core, approximately 7 miles apart. The scatter diagram shows data pairs with maximum concentrations at each monitor. Thus, on any given ozone event day, the peak concentration recorded by one of these monitors could be as much as 10% higher than that recorded at the other monitor. The two monitors appear to be equally as likely to record the higher concentration.

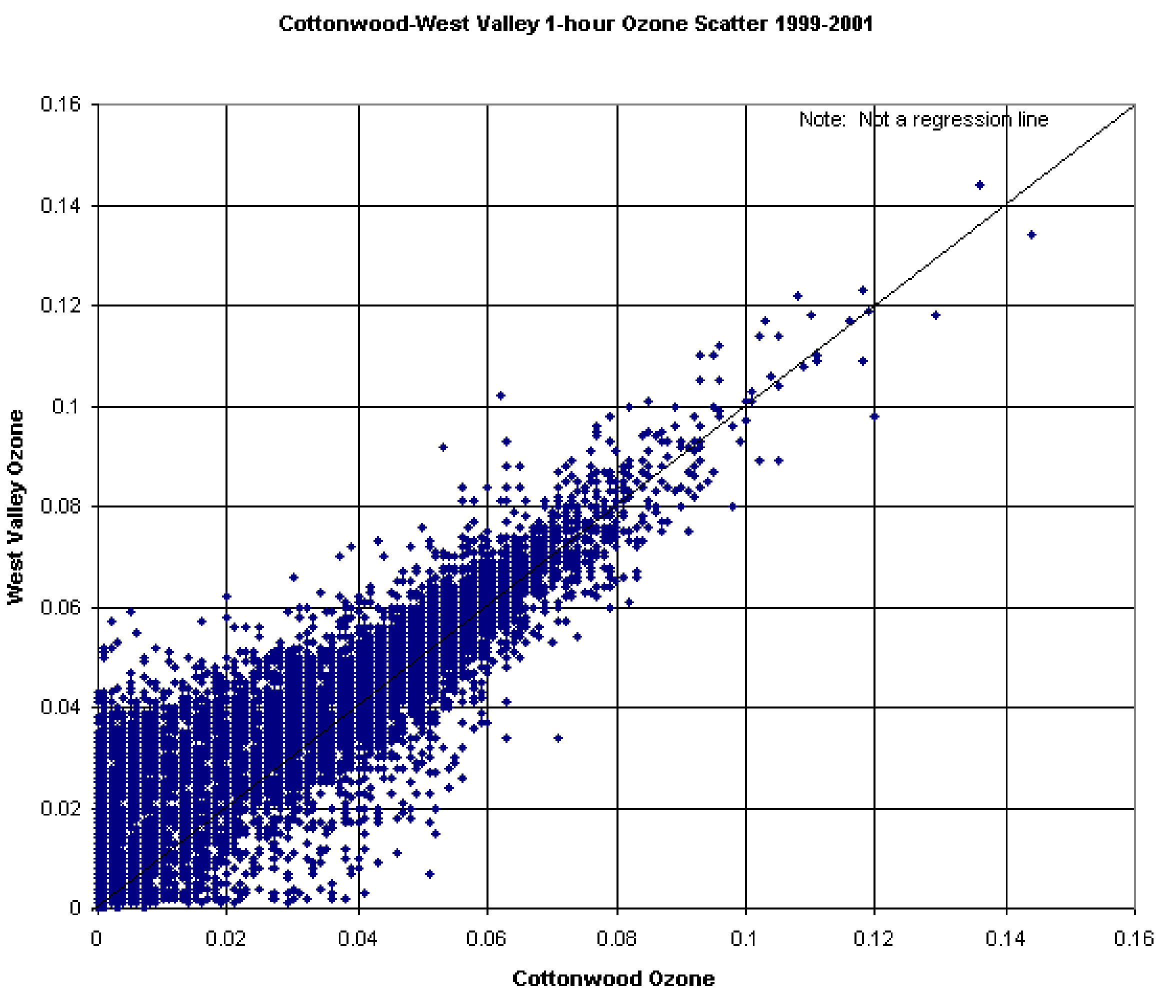


Figure 6-3 Cottonwood NAMS-West Valley City, Utah 1-hour O_3 Scatter Diagram, 1999-2001

Arvada Site Ozone Correlation with Welby Site(Denver, Colorado)

Figure 6-4 shows the scatter diagram for Arvada, 7 miles northwest of downtown Denver, and Welby, 7 miles north-northeast of downtown. The monitors are approximately 8 miles apart. The scatter diagram shows a pronounced tendency for the Arvada monitor to record values higher than those at Welby. This may be due to the tendency for afternoon up valley flow of the urban plume toward the west, and NOx depletion at the Welby site.

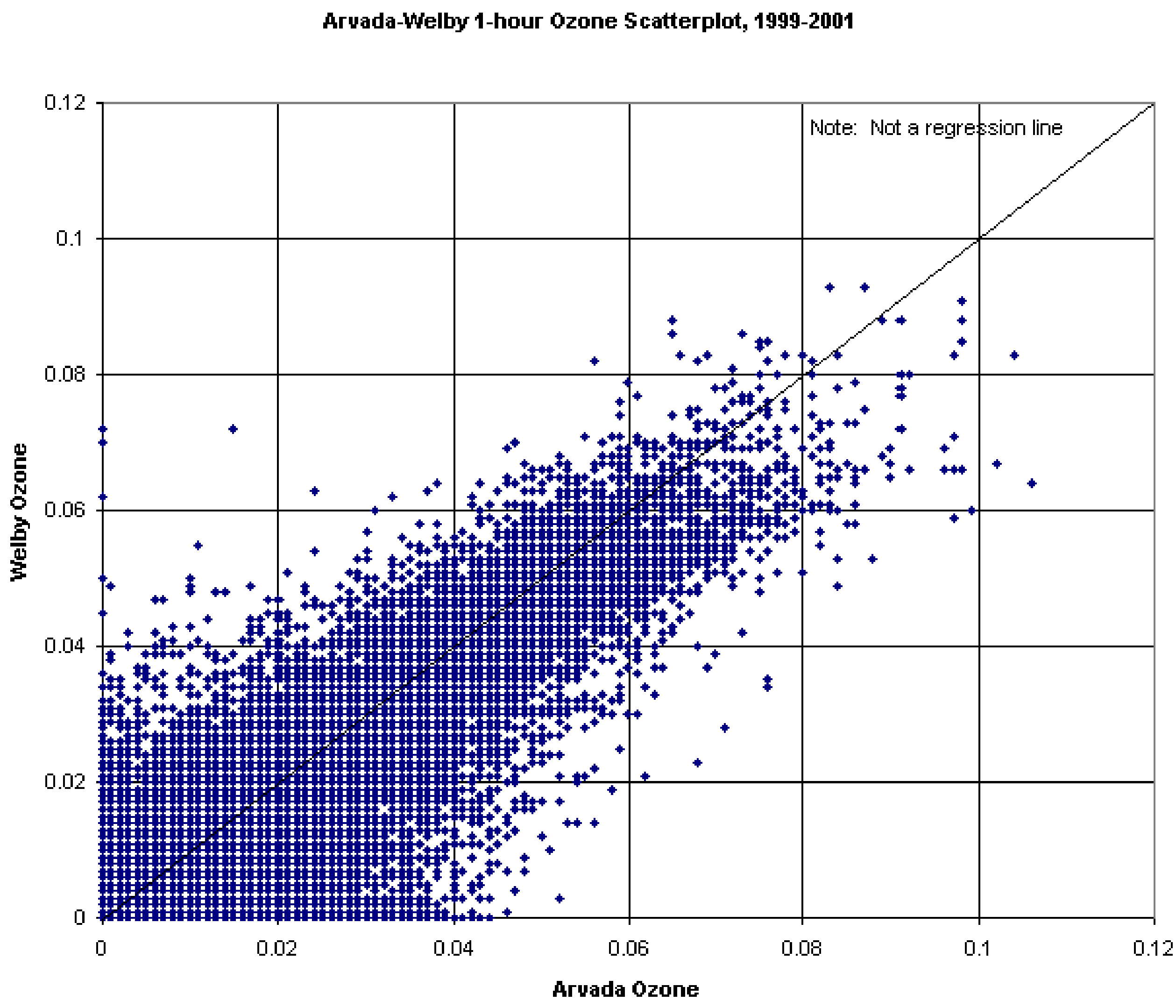


Figure 6-4 Arvada NAMS-Welby, Colorado 1-hour Ozone Scatter Diagram, 1999-2001

Figure 6-5 shows the scatter diagram for the Welby and Carriage sites, north-northeast and just west of downtown Denver, respectively. The monitors are population exposure sites approximately 7 miles apart. The scatter diagram indicates that of these two monitors, Carriage records the higher value more often than Welby.

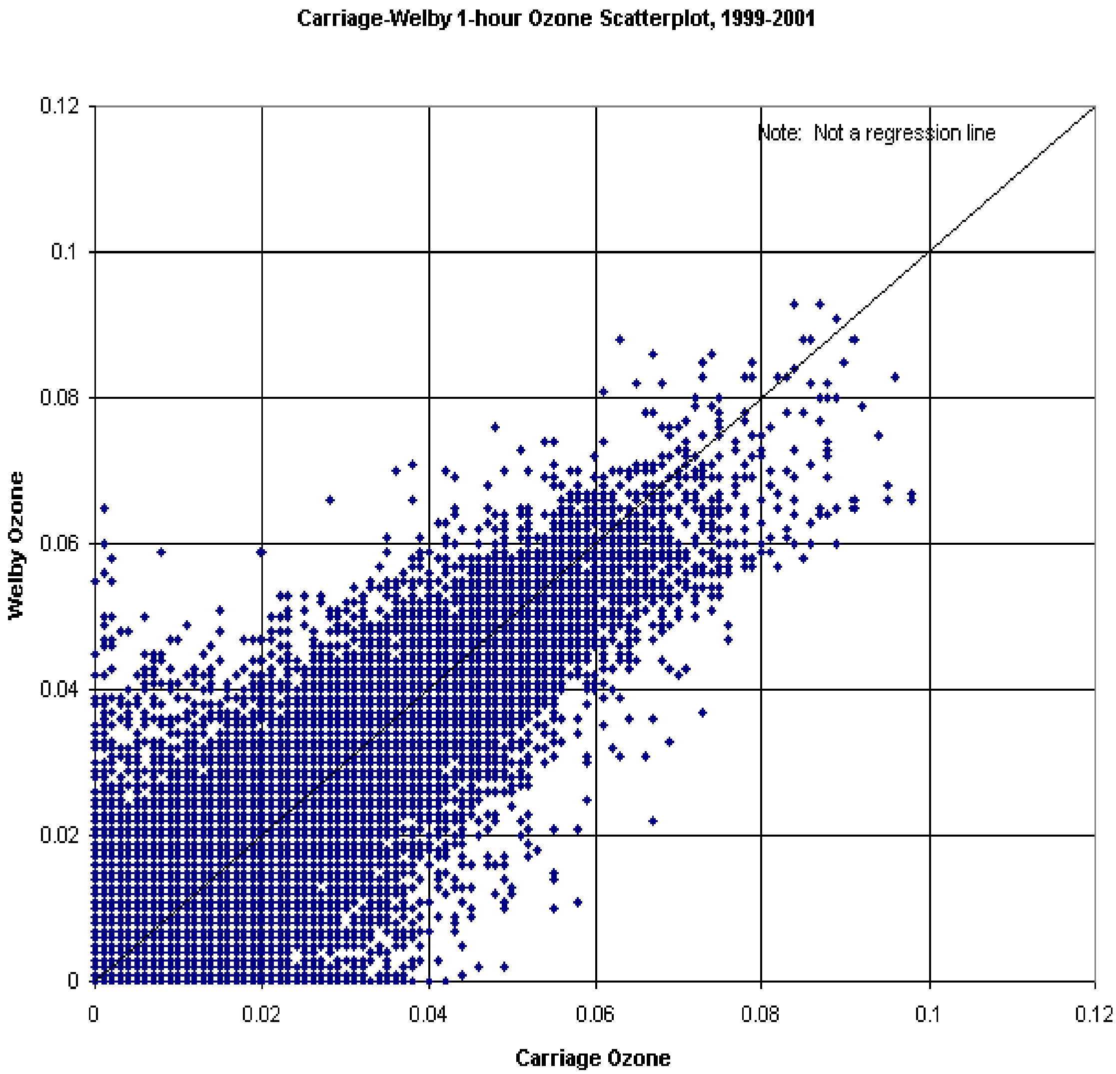


Figure 6-5 Carriage (Denver)-Welby 1-hour Ozone Scatter Diagram, 1999-2001

Figure 6-6 shows the scatter diagram for the National Renewable Energy Laboratory (NREL) maximum concentration site and the Rocky Flats special purpose monitor (SPM). Both are located on the northwest edge of the Denver urbanized area, at the base of the front range foothills. The NREL monitor is approximately 11 miles west of the Denver urban core, and the Rocky Flats monitor is approximately 10 miles north of NREL. Both monitors have recorded high regional concentrations during ozone events. The two highest Denver area 1-hour ozone concentrations in the 1999-2001 period were at NREL (0.118 and 0.115 ppm) while the third highest was at Rocky Flats (0.112 ppm), excluding the 0.117 ppm value recorded at Greeley in 2001, approximately 50 miles from downtown Denver. These maximum values were not recorded simultaneously, so during a given ozone event, the maximum concentration could occur at either of these monitors, or at other maximum concentration sites at the south edge of the Denver urbanized area. Because of the high concentrations seen at the Rocky Flats site, the State of Colorado is considering converting this SPM to SLAMS status.

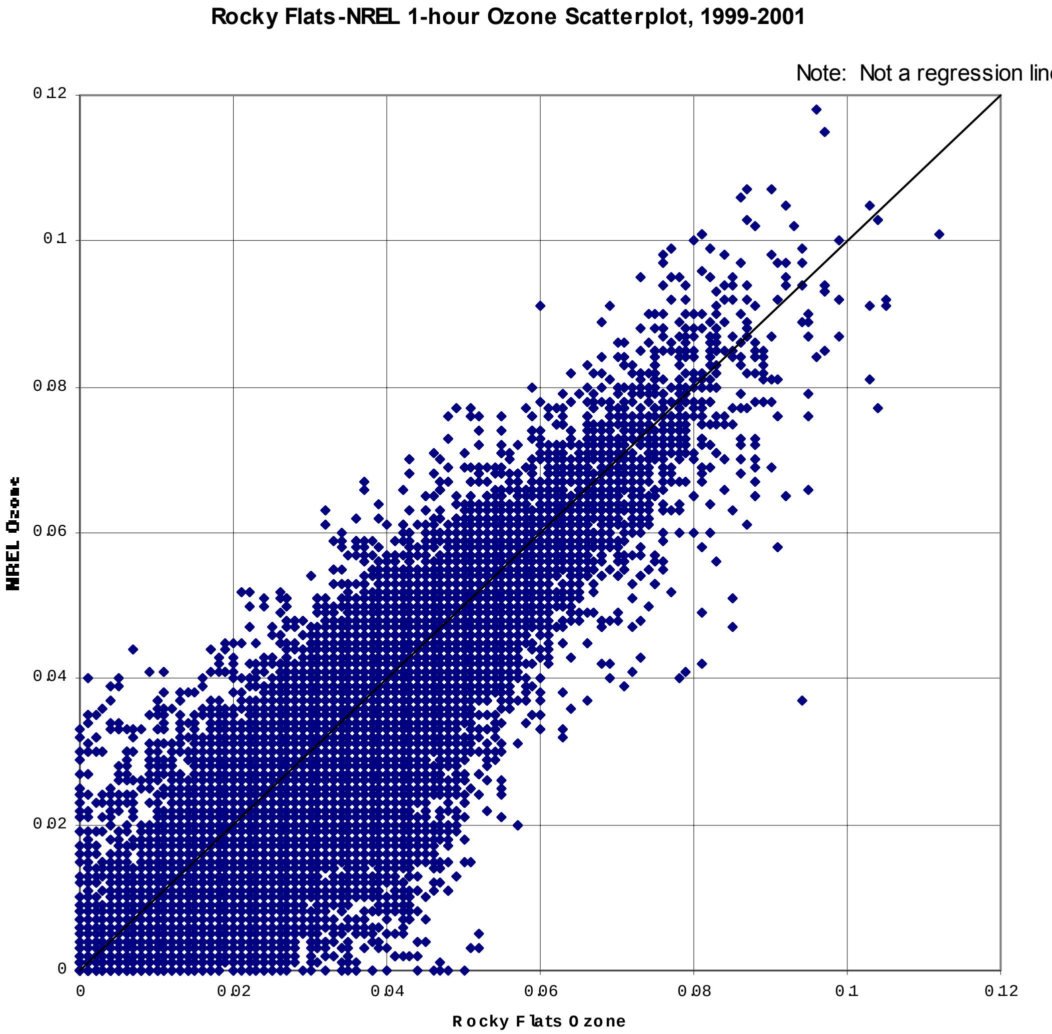


Figure 6-6 NREL (Colorado)-Rocky Flats 1-hour Ozone Scatter Diagram, 1999-2001

Figure 6-7 shows the scatter diagram between the Beulah population exposure site and the Hannover background site in North Dakota. These monitors are approximately 21 miles apart in central North Dakota. The Hannover monitor tends to record higher concentrations than Beulah, although neither site tends to see 1-hour readings above 0.080 ppm.

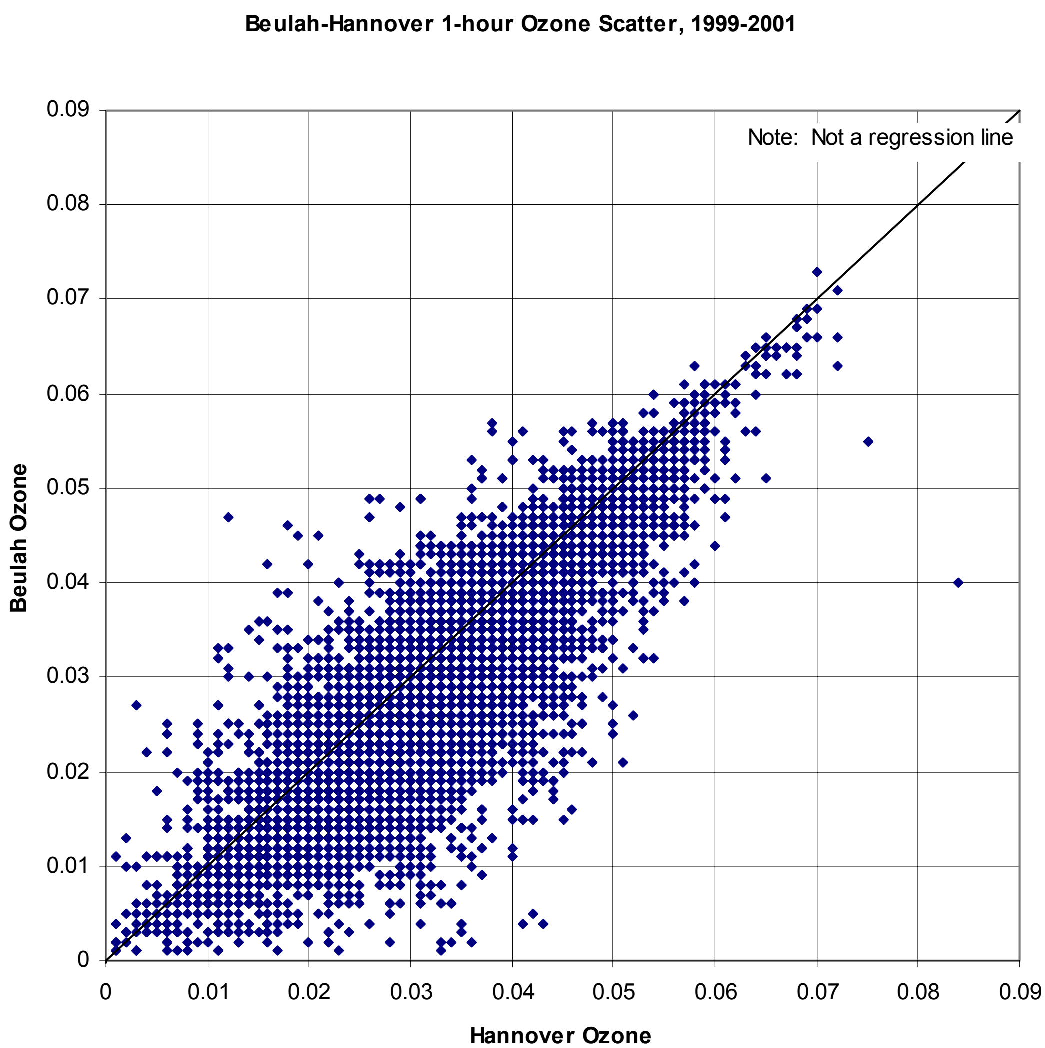


Figure 6-7 Beulah-Hannover, North Dakota 1-hour Ozone Scatter Diagram, 1999-2001

For comparison with the well correlated sites shown above, Figure 6-8 shows a scatter diagram for two sites that would not be expected to correlate well. The West Valley City ozone monitor, in Salt Lake City, Utah, and the NREL ozone monitor in the western suburbs of Denver are shown. The correlation coefficient for 1999-2001 data from these monitors is 0.57. Because of the diurnal nature of ozone formation, some correlation for ozone is expected for widely separated monitors.

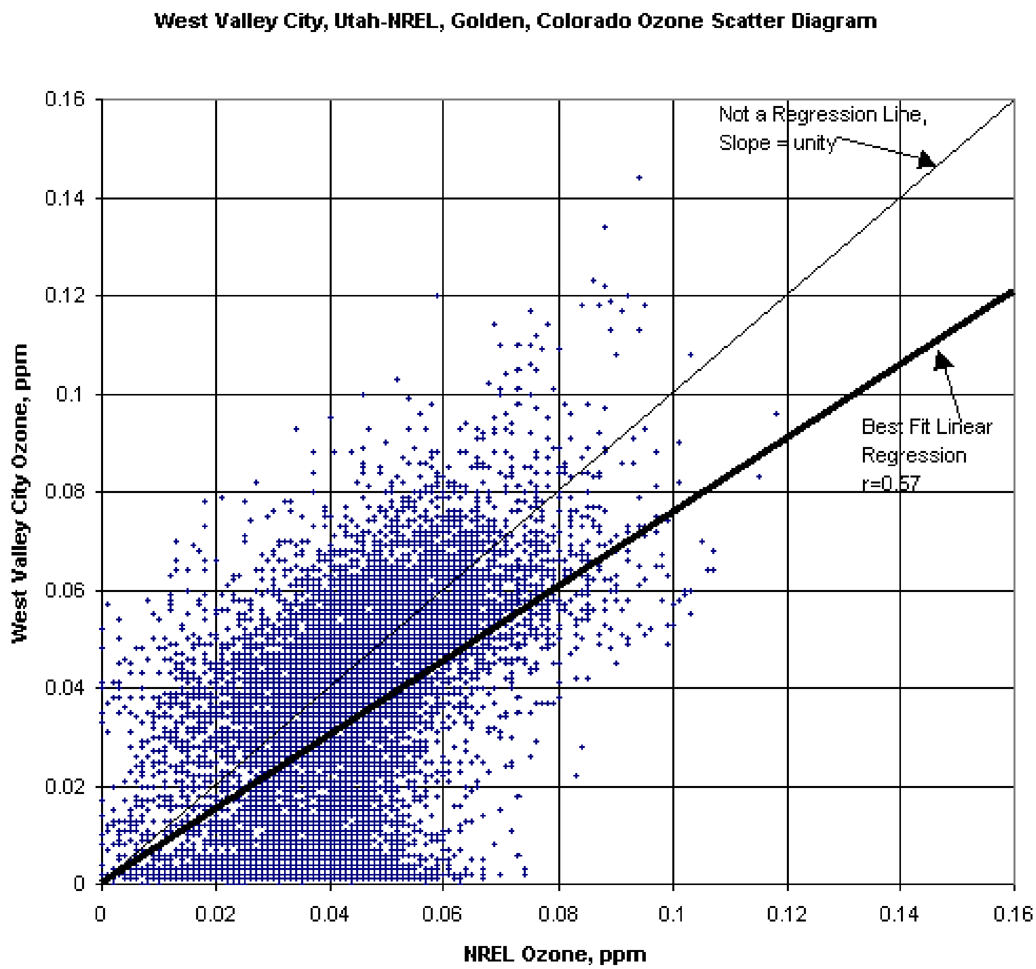


Figure 6-8 Scatter Diagram for West Valley City, Utah and NREL (Golden, Colorado) Ozone

6.2 $PM_{2.5}$

Monitor pairs are ranked in Table 6-3 by pairwise correlation of $PM_{2.5}$ data points. The table is dominated by Utah monitor pairs (69 out of 84 pairs). The entire Utah $PM_{2.5}$ monitoring network is located in the urban areas along the Wasatch front. This area has experienced wintertime inversion conditions which affect the entire monitoring network. This results in significantly elevated $PM_{2.5}$ concentrations simultaneously over the entire network. On occasion, concentrations exceed the 24-hour $PM_{2.5}$ NAAQS. With these infrequent readings so far above the median, the entire Utah $PM_{2.5}$ monitoring network is highly self-correlated. This can be illustrated with the scatter diagrams which follow.

Table 6-3 Region 8 $PM_{2.5}$ Monitor Pairs with Correlation Coefficients Greater Than 0.85

Site 1 AIRS ID	Site 1 Name	Site 2 AIRS ID	Site 2 Name	Correlation Coefficient
080310002-1	Denver CAMP Poc 1	080310017-1	Denver Visitors' Center (Closed)	0.98
490490002-1	North Provo	490494001-1	Lindon	0.97
490490002-1	North Provo	490495010-1	Spanish Fork	0.97
490350012-1	North Salt Lake City	490353007-1	West Valley	0.96
490030003-1	Brigham City	490571003-1	Harrisville	0.95
300630024-1	Boyd Park Poc 1 (Closed)	300630031-1	Missoula Health Dept.	0.95
080310013-1	Denver NJH (Closed)	080310017-1	Denver Visitors' Center (Closed)	0.95
490570007-1	Washington Terrace	490571003-1	Harrisville	0.95
490030003-1	Brigham City	490110001-1	Bountiful	0.94
490030003-1	Brigham City	490570007-1	Washington Terrace	0.94
490353006-1	Hawthorne Poc 1	490353007-1	West Valley	0.94
490110001-1	Bountiful	490353006-1	Hawthorne Poc 1	0.94
490110001-1	Bountiful	490570007-1	Washington Terrace	0.94
490494001-1	Lindon	490495010-1	Spanish Fork	0.94
490350012-1	North Salt Lake City	490353006-1	Hawthorne Poc 1	0.93
490030003-1	Brigham City	490350003-1	Cottonwood	0.93
380130002-1	Short Creek	380130003-2	Lignite Poc 1	0.93
080310002-1	Denver CAMP Poc 1	080310013-1	Denver NJH (Closed)	0.92
490110001-1	Bountiful	490353003-1	Herriman	0.92
490350003-1	Cottonwood	490353006-1	Hawthorne Poc 1	0.92
490030003-1	Brigham City	490353006-1	Hawthorne Poc 1	0.92
490353006-1	Hawthorne Poc 1	490570007-1	Washington Terrace	0.92
461030013-1	Guard Camp	461030019-1	Fire Station #3	0.92

Site 1 AIRS ID	Site 1 Name	Site 2 AIRS ID	Site 2 Name	Correlation Coefficient
490110001-1	Bountiful	490571003-1	Harrisville	0.92
490353003-1	Herriman	490490002-1	North Provo	0.91
490490002-1	North Provo	490570007-1	Washington Terrace	0.91
490350003-1	Cottonwood	490571003-1	Harrisville	0.91
490110001-1	Bountiful	490450002-1	Grantsville	0.91
490030003-1	Brigham City	490350012-1	North Salt Lake City	0.91
490353003-1	Herriman	490494001-1	Lindon	0.91
490110001-1	Bountiful	490350012-1	North Salt Lake City	0.90
490495008-1	Highland	490570007-1	Washington Terrace	0.90
490350003-1	Cottonwood	490353003-1	Herriman	0.90
490110001-1	Bountiful	490353007-1	West Valley	0.90
490495008-1	Highland	490495010-1	Spanish Fork	0.90
490353006-1	Hawthorne Poc 1	490571003-1	Harrisville	0.90
490030003-1	Brigham City	490353007-1	West Valley	0.90
490494001-1	Lindon	490570007-1	Washington Terrace	0.89
490353007-1	West Valley	490570007-1	Washington Terrace	0.89
490353003-1	Herriman	490495010-1	Spanish Fork	0.89
490495010-1	Spanish Fork	490570007-1	Washington Terrace	0.89
490350003-1	Cottonwood	490353007-1	West Valley	0.89
490350003-1	Brigham City	490350012-1	North Salt Lake City	0.89
490353006-1	Hawthorne Poc 1	490494001-1	Lindon	0.89
560330001-1	Sheridan Junior High	560330002-1	Sheridan Police	0.89
490490002-1	North Provo	490495008-1	Highland	0.89
490353006-1	Hawthorne Poc 1	490450002-1	Grantsville	0.89
490110001-1	Bountiful	490350003-1	Cottonwood	0.89
460990006-1	Sioux Falls KELO	460990007-1	Sioux Falls Hilltop	0.89
490353003-1	Herriman	490353006-1	Hawthorne Poc 1	0.89
490110001-1	Bountiful	490490002-1	North Provo	0.88
490030003-1	Brigham City	490450002-1	Grantsville	0.88
461030013-1	Guard Camp	461031001-1	Rapid City Library	0.88
490350003-1	Cottonwood	490570007-1	Washington Terrace	0.88
490353007-1	West Valley	490450002-1	Grantsville	0.88
490353007-1	West Valley	490571003-1	Harrisville	0.88
490353006-1	Hawthorne Poc 1	490490002-1	North Provo	0.88
490030003-1	Brigham City	490050004-1	Logan	0.88
490110001-1	Bountiful	490494001-1	Lindon	0.88
080010001-1	Adams City Poc 1	080310013-1	Denver NJH (Closed)	0.87

Site 1 AIRS ID	Site 1 Name	Site 2 AIRS ID	Site 2 Name	Correlation Coefficient
490350012-1	North Salt Lake City	490571003-1	Harrisville	0.87
080050005-1	Arapahoe Community College	080310013-1	Denver NJH (Closed)	0.87
490110001-1	Bountiful	490495010-1	Spanish Fork	0.87
490110001-1	Bountiful	490495008-1	Highland	0.87
380171004-1	Fargo NW Poc 1	380350004-1	Grand Forks	0.87
490490002-1	North Provo	490571003-1	Harrisville	0.87
490450002-1	Grantsville	490570007-1	Washington Terrace	0.87
080010001-1	Adams City Poc 1	081230008-1	Platteville	0.86
490350012-1	North Salt Lake City	490450002-1	Grantsville	0.86
490353006-1	Hawthorne Poc 1	490495008-1	Highland	0.86
490350012-1	North Salt Lake City	490570007-1	Washington Terrace	0.86
490353003-1	Herriman	490570007-1	Washington Terrace	0.86
490353007-1	West Valley	490494001-1	Lindon	0.86
490494001-1	Lindon	490495008-1	Highland	0.86
080130003-1	Longmont	080690009-1	Fort Collins	0.86
490050004-1	Logan	490571003-1	Harrisville	0.86
490030003-1	Brigham City	490353003-1	Herriman	0.86
490350003-1	Cottonwood	490495008-1	Highland	0.85
490350003-1	Cottonwood	490494001-1	Lindon	0.85
080010006-1	Commerce City	081230006-1	Greeley	0.85
490450002-1	Grantsville	490571003-1	Harrisville	0.85
490350012-1	North Salt Lake City	490353003-1	Herriman	0.85
490030003-1	Brigham City	490490002-1	North Provo	0.85
490030003-1	Brigham City	490495008-1	Highland	0.85

The highest correlation for a $PM_{2.5}$ monitor pair in Region 8 is the 0.98 correlation for the central Denver CAMP and Visitor Center monitor sites. The Denver CAMP site is a long term monitor in the central Denver urban core. The Denver Visitor Center site, six blocks south of CAMP, was used as a special purpose $PM_{2.5}$ site during the winter of 1999-2000. The scatter diagram for this single season of data is shown in Figure 6-9. In general, the Denver CAMP monitor records higher 24-hour $PM_{2.5}$ concentrations, and serves as a better maximum concentration site for the central business district.

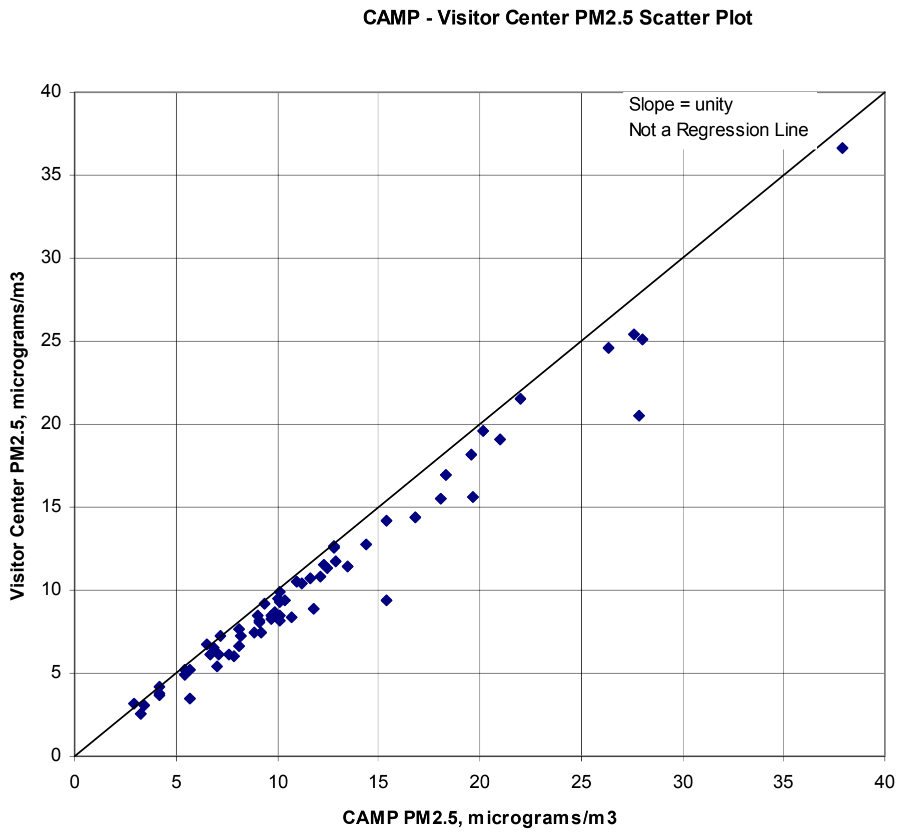


Figure 6-9 Scatter Diagram for Denver CAMP and Denver Visitor Center $PM_{2.5}$, 1999-2000

Figure 6-10 shows the scatter diagram for the second highest correlation pair, Lindon and North Provo, both in Utah County, Utah.

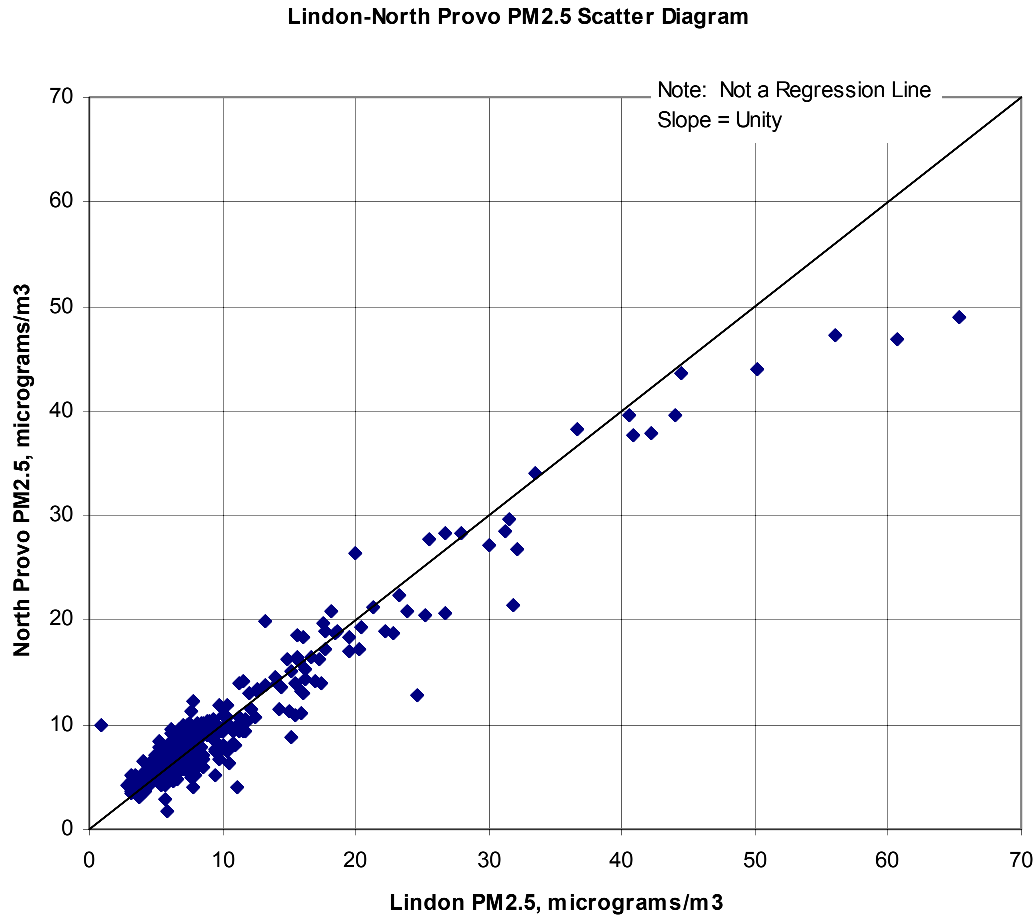


Figure 6-10 Scatter Diagram for Lindon and North Provo $PM_{2.5}$ Monitors in Utah Co., Utah

Table 6-4 shows the $PM_{2.5}$ monitors in EPA Region 8, ranked in terms of three year average 98th percentile 24-hour $PM_{2.5}$. The table also includes maximum 24-hour concentration, and the mean of annual means.

Table 6-4 EPA Region 8 $PM_{2.5}$ Monitors, Ranked in Terms of 3-year Average of 98th Percentile 24-hour $PM_{2.5}$

AIRS ID No.	Site Name	3 Year Mean of 98th Percentile 24-hour $PM_{2.5}$ Percent of NAAQS	3-year Maximum 24-hour $PM_{2.5}$ Percent of NAAQS	3 year Average of Annual Mean Pecent of NAAQS
300810001-1	Hamilton	110%	307%	83%
490570002-1	Ogden #2	102%	102%	77%
490353006-1	Hawthorne Poc 1	84%	124%	74%
490350003-1	Cottonwood	84%	119%	80%
490350012-1	North Salt Lake City	82%	106%	90%
490050004-1	Logan	82%	135%	81%
300930005-1	Butte	77%	206%	62%
560210001-1	Laramie	77%	29%	36%
490353007-1	West Valley	75%	102%	79%
300530018	Libby	72%	102%	109%
560131004-1	Lander Lincoln	71%	85%	65%
490494001-1	Lindon	67%	121%	68%
490495008-1	Highland	66%	112%	59%
300310008-1	Belgrade Conagra	65%	134%	67%
300630031-1	Missoula Health Dept.	65%	255%	79%
490110001-1	Bountiful	64%	101%	60%
490490002-1	North Provo	61%	128%	70%
490571003-1	Harrisville	60%	79%	74%
490353003-1	Herriman	60%	94%	58%
490030003-1	Brigham City	60%	73%	59%
300630024-1	Boyd Park Poc 1 (Closed)	59%	276%	73%
300290009-1	Whitefish	56%	56%	76%
080010001-1	Adams City Poc 1	54%	88%	70%
490495010-1	Spanish Fork	52%	124%	55%
300480018-1	Helena	51%	69%	56%
560330001-1	Sheridan Junior High	51%	74%	68%
490570007-1	Washington Terrace	49%	101%	59%
300470013-1	Ronan Park	48%	108%	69%
080310002-1	Denver CAMP Poc 1	47%	105%	69%
461030019-1	Fire Station	47%	56%	61%
560131003-1	Lander Washington	47%	47%	114%

AIRS ID No.	Site Name	3 Year Mean of 98th Percentile 24-hour $PM_{2.5}$ Percent of NAAQS	3-year Maximum 24-hour $PM_{2.5}$ Percent of NAAQS	3 year Average of Annual Mean Pecent of NAAQS
490450002-1	Grantsville	46%	80%	54%
560330002-1	Sheridan Police	46%	74%	73%
300470028-1	Polson	45%	97%	71%
300480025-1	Helena 1st Bank	44%	44%	59%
081230008-1	Platteville	44%	78%	62%
080310017-1	Denver Visitors' Center (Closed)	43%	56%	65%
300290039-1	Whitefish Markus Foods	43%	82%	83%
460990006-1	Sioux Falls Bahnson	43%	53%	70%
461030014-1	Family Thrift	42%	55%	65%
560390006-1	Jackson	41%	45%	57%
081230006-1	Greeley	40%	63%	58%
080310013-1	Denver NJH (Closed)	40%	79%	68%
460110002-1	Brookings	40%	68%	61%
490570001-1	Ogden Health (Closed)	39%	76%	92%
460990006-1	Sioux Falls KELO	39%	54%	66%
380350004-1	Grand Forks	38%	54%	59%
300290047-1	Kalispell	37%	49%	53%
380171004-1	Fargo NW Poc 1	37%	55%	57%
300290043-1	Evergreen Fire Station	36%	36%	62%
461030016-1	Robinsdale	35%	45%	55%
080690009-1	Fort Collins	35%	49%	54%
080130003-1	Longmont	35%	80%	61%
461030013-1	Guard Camp	35%	45%	54%
301111065-1	Billings	35%	58%	54%
300131025-1	Great Falls	35%	62%	42%
080010006-1	Commerce City	34%	84%	70%
080050005-1	Arapahoe Community College	34%	216%	58%
460130003-1	Aberdeen	33%	39%	58%
080130012-1	Boulder Chamber Center	31%	51%	52%
461031001-1	Rapid City Library	30%	26%	55%
461030015-1	Northdale	30%	44%	52%
080770003-1	Grand Junction Poc 1	29%	46%	49%
380910001-1	Sharon	29%	58%	44%
380150003-1	Bismarck Residential	28%	38%	46%

AIRS ID No.	Site Name	3 Year Mean of 98th Percentile 24-hour $PM_{2.5}$ Percent of NAAQS	3-year Maximum 24-hour $PM_{2.5}$ Percent of NAAQS	3 year Average of Annual Mean Pecent of NAAQS
080410008-1	Colorado Spgs. Meadowlands	27%	33%	47%
080290004-1	Delta	27%	30%	49%
081010012-1	Pueblo	27%	44%	51%
080070002-1	Pagosa Springs	27%	32%	45%
461030017-1	Flormann	26%	36%	48%
300870307-1	Lame Deer	26%	49%	51%
300890007-1	Thompson Falls	26%	66%	44%
081070003-1	Steamboat Springs	25%	28%	42%
380570004-1	Beulah North Poc 1	25%	33%	42%
380130002-1	Short Creek	24%	34%	39%
080510005-1	Crested Butte	24%	26%	42%
080410011-1	Colorado Spgs. RBD Poc 1	22%	29%	48%
380890002-1	Dickinson	21%	26%	38%
080070001-1	Pagosa Springs High School	20%	20%	32%
460710003-1	Badlands	20%	21%	37%
080870008-1	Durango	20%	22%	33%
460930001-1	Pierre	19%	36%	41%
080350003-1	Parker	19%	24%	38%
380130003-1	Lignite Poc 1	18%	22%	36%
380070002-1	TRNP-South Unit	18%	20%	34%
080390001-1	Elbert County	15%	19%	27%
081130004-1	Telluride	14%	72%	40%

6.3 PM_{10}

Table 6-5 shows the top PM_{10} monitor pairs in terms of pairwise correlation coefficient.

Table 6-5 EPA Region 8 PM_{10} Monitor Pairs with Correlations Greater Than 0.80

Site 2 AIRS ID No.	Site 1 Name	Site 2 AIRS ID No.	Site 2 Name	Correlation Coefficient
300630031-2	Missoula HD 2	300810003-1	Stevensville Ranger St.	0.94
300630031-2	Missoula HD 2	300810001-2	Ravalli Court House	0.92
490350003-1	Cottonwood	490353006-1	Hawthorne	0.91
490490002-2	North Provo	490494001-2	Lindon	0.91
490350010-1	Air Monitoring Center (Closed)	490353006-1	Hawthorne	0.89
080010001-2	Adams City	080010006-1	7101 Birch Street	0.89
080310013-1	National Jewish (Closed)	080310017-1	Visitors Center	0.88
300490018-1	Lincoln School, Helena	300490024-1	Helena-Rossiter	0.85
300290043-1	Evergreen Firestation (Closed)	300470028-5	Polson Saddle Shop	0.85
490353006-1	Hawthorne	490490002-2	North Provo	0.85
490494001-2	Lindon	490570002-1	New Ogden	0.84
460990006-1	S. Phillips, Sioux Falls	460990007-1	Bahnson Ave. Sioux Falls	0.84
490350003-1	Cottonwood	490490002-2	North Provo	0.84
080770003-1	Mesa Co. Health Dept.	080770014-2	Stocker Stadium	0.84
490350003-1	Cottonwood	490494001-2	Lindon	0.83
490350010-1	Air Monitoring Center (Closed)	490350012-2	North Salt Lake City	0.83
490353006-1	Hawthorne	490570002-1	New Ogden	0.83
490050002-1	Logan	490570001-2	Ogden Health Dept. (Closed)	0.83
080010006-1	7101 Birch Street	080310013-1	National Jewish (Closed)	0.82
461030013-1	Rapid City Armory	461030014-1	Rapid City Thrift	0.82
490350010-1	Air Monitoring Center (Closed)	490494001-2	Lindon	0.82
300290003-2	Columbia Falls	300291015-2	Universal Athletic	0.81
461030013-1	Rapid City Armory	461030019-1	Rapid City Fire Sta. #3	0.81
490353006-1	Hawthorne	490570001-2	Ogden Health Dept. (Closed)	0.81
490350010-1	Air Monitoring Center (Closed)	490570001-2	Ogden Health Dept. (Closed)	0.80

The two highest correlations are for the Missoula Health Department monitor with the Stevensville Ranger Station and Ravalli County Court House monitors in the neighboring county. Preliminary correlation analysis had also found very high PM_{10} correlations across western Colorado, often between widely separated pairs of monitors. Investigation of this surprising result showed that the correlation calculations were dominated by data collected on March 31, 1999, when very large PM_{10} values were recorded across the four corners region (and beyond) during a regional dust storm. The correlations in Table 6-5 resulted when high PM_{10}

values recorded on March 31, 1999 were removed from the analysis.

Plots of the two highest PM_{10} correlation pairs are shown in Figures 6-11 and 6-12. Both figures show that the high correlations result primarily from elevated PM_{10} levels which were measured while large wild fires were generating dense smoke over southwest Montana. If the four days with elevated concentrations were removed from the regional analysis set, these Montana monitor pairs would no longer be near the top of the regional correlation table.

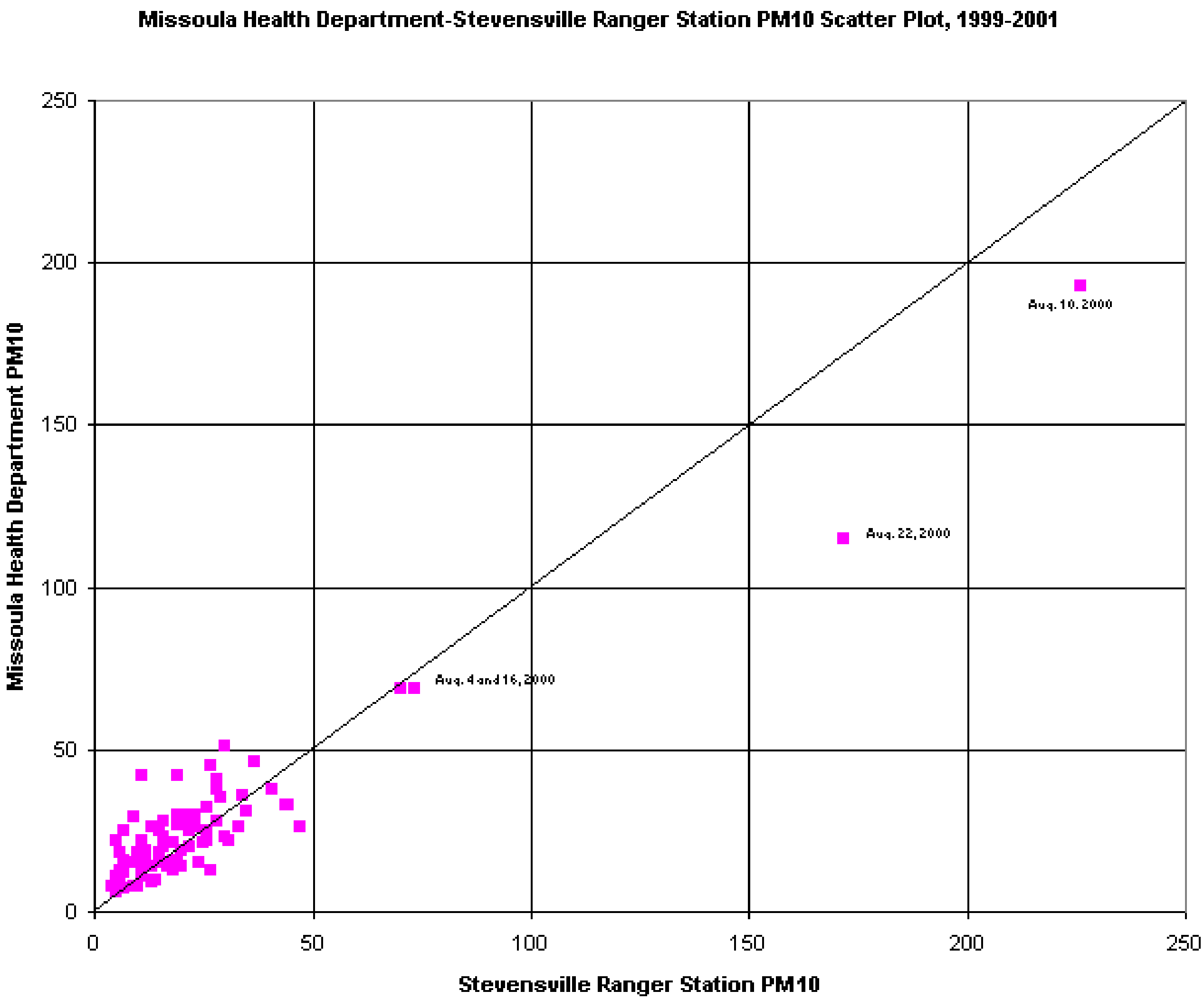


Figure 6-11 Missoula-Stevensville PM_{10} Scatter Diagram, 1999-2001

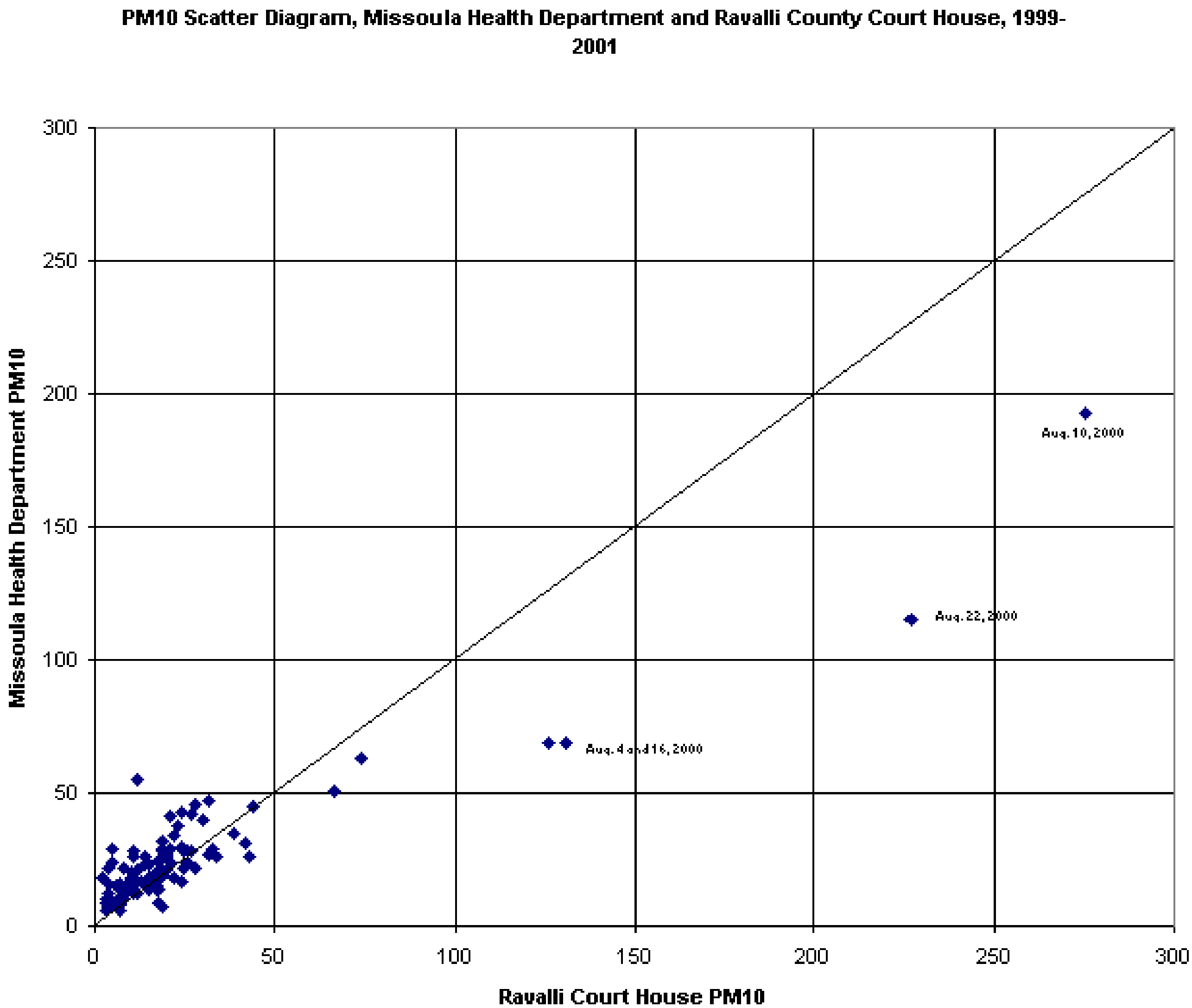


Figure 6-12 Missoula-Ravalli Court House PM_{10} Scatter Diagram, 1999-2001

6.4 NO_2

Table 6-6 shows the only EPA Region 8 NO_2 monitor pair with correlation greater than 0.8. Only one monitor pair meets this criterion, reflecting the relatively low density of NO_2 monitors. The Hawthorne NO_2 monitor is located near downtown Salt Lake City, while the Cottonwood monitor is approximately 6 miles southeast of Hawthorne.

Table 6-6 EPA Region 8 NO_2 Monitor Pairs with Correlations Greater than 0.80

Site1 AIRS ID No.	Site 1 Name	Site 2 AIRS ID No.	Site 2 Name	Correlation Coefficient
490350003	Cottonwood	490353006	Hawthorne	0.82

Figure 6-13 shows the scatter diagram for the monitor pair of Table 6-6. The Hawthorne monitor nearer the urban core tends to record higher peak values.

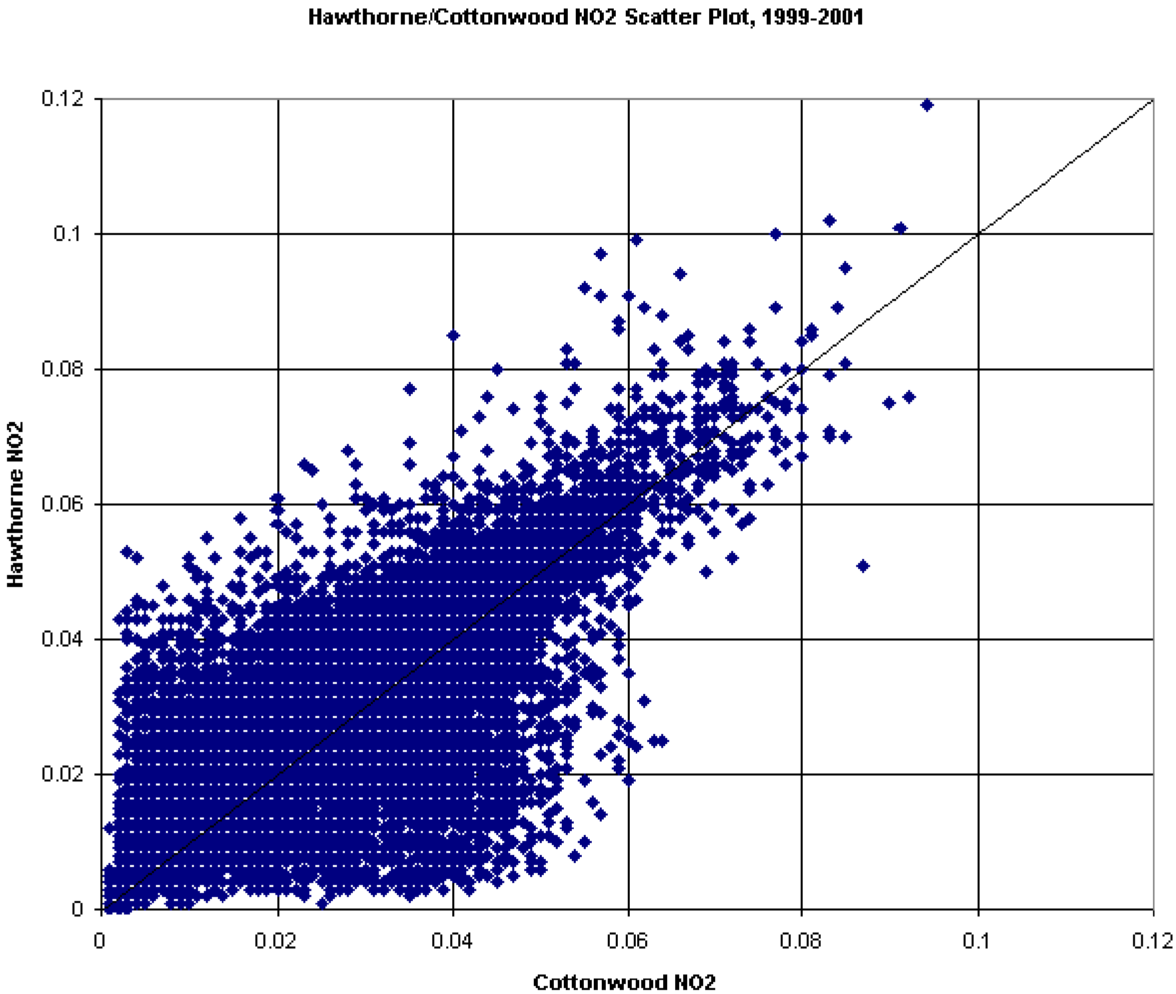


Figure 6-13 Scatter Diagram for Hawthorne and Cottonwood, Utah NO_2 Monitors, 1999-2001

6.5 SO_2

The highest SO_2 monitor pair correlations over the period 1999-2001 occur in Billings, Montana. No correlation is greater than 0.75, indicating a good degree of independence in the data collected by the Region 8 monitors. The State of Montana has been actively managing the SO_2 monitoring network in Billings, including discontinuing monitoring at low value sites. The State has been a participant in the Intervention Levels 5-minute SO_2 data collection program, reporting 5-minute SO_2 data to AQS. The State has considered the 5-minute data needs in its evaluation of the Billings network. No location in Region 8 outside Billings shows monitor pair correlations above 0.70.

6.6 Lead

Table 6-7 shows the Pb monitor pairs in EPA Region 8 with data correlations greater than 0.85. Three of the four pairs involve monitors in Helena, Montana which are now closed, since the industries responsible for high lead emissions in Helena have closed.

The Adams City monitor is located 7 miles northeast of downtown Denver, while the Gates monitor is 2.5 miles south of downtown. The highest quarterly mean for either monitor in the analysis period is 0.03 micrograms/m^3.

Table 6-7 EPA Region 8 Lead Monitor Pairs with Correlations Greater Than 0.85

Site1 AIRS ID No.	Site 1 Name	Site 2 AIRS ID No.	Site 2 Name	Correlation Coefficient
300490703-1	Kennedy Park (Closed)	300490714-1	Firehall (Closed)	0.92
300490714-1	Firehall (Closed)	300490727-1	Prickly Pear (Closed)	0.86
080010001-1	Adams City	080310015-1	Gates POC 1	0.86
300490703-1	Kennedy Park (Closed)	300490727-1	Prickly Pear Closed)	0.85

6.7 Carbon Monoxide

Table 6-8 shows the carbon monoxide monitor pairs in Region 8 with correlations greater than 0.8. All such pairs are in either the Denver, Salt Lake City or Provo metropolitan areas.

Table 6-8 Carbon Monoxide Monitor Pairs With Correlations Greater Than 0.8

Site1 AIRS ID No.	Site 1 Name	Site 2 AIRS ID No.	Site 2 Name	Correlation Coefficient
490350014	State Street	490353006	Hawthorne	0.91
490490002	North Provo	490490005	University Ave. #3	0.86
490350003	Cottonwood	490353006	Hawthorne	0.84
490490002	North Provo	490495005	South Orem	0.83
490350003	Cottonwood	490350014	State Street	0.80
80310013	National Jewish	80310019	Auraria Pkwy	0.80

Figure 6-14 shows the scatter diagram for carbon monoxide concentrations at the State Street and Hawthorne monitoring sites in Salt Lake City. State Street is a micro-scale population exposure site along a major downtown street, while Hawthorne is a neighborhood scale site at a High School near downtown. The two sites are approximately 3/4 mile apart. Surprisingly, Hawthorne records the higher carbon monoxide level more often than does State Street.

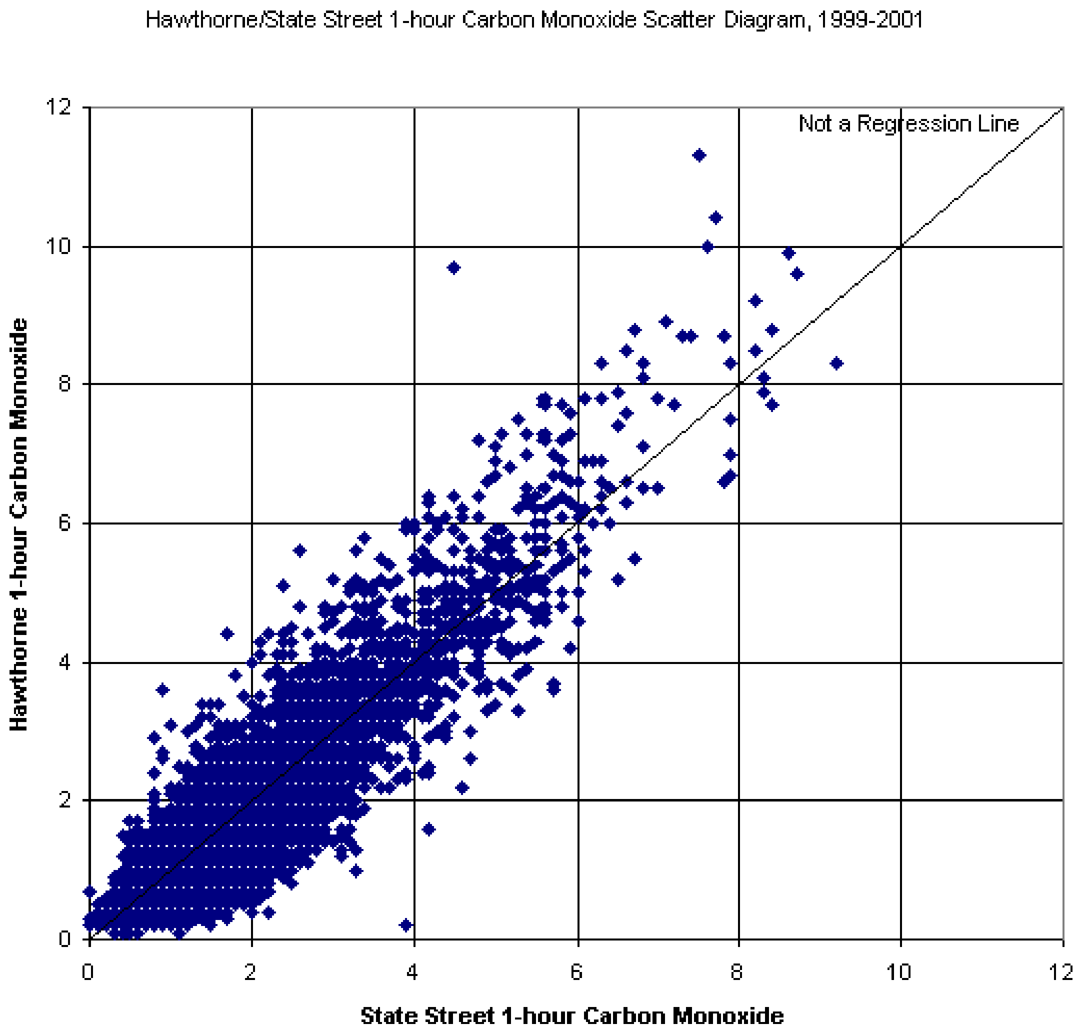


Figure 6-14 State Street-Hawthorne (Salt Lake City) CO Scatter Diagram, 1999-2001

Figure 6-15 shows the scatter diagram for the second highest correlated carbon monoxide monitor pair in Region 8 (the North Provo and University Avenue monitors in Provo, Utah). The North Provo population exposure monitor is approximately 2 miles north of the micro-scale University Avenue monitor. While this pair is well correlated, University Avenue consistently records higher carbon monoxide concentrations than does the North Provo monitor.

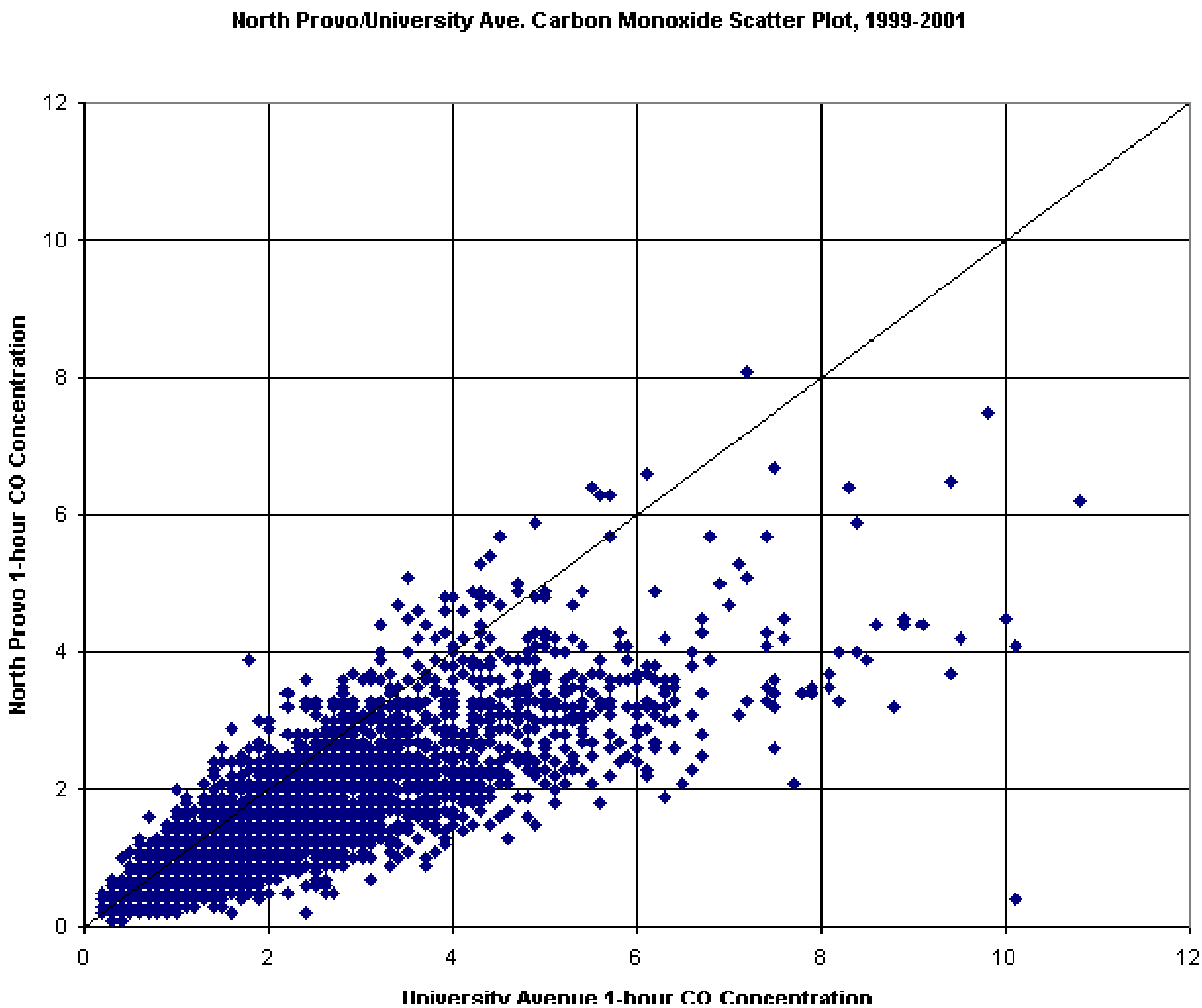


Figure 6-15 University Avenue-N. Provo, Utah CO Scatter Diagram, 1999-2001

7.0 Results

Results, including further interpretation of the Region 8 Network Assessment results will be provided in the Final Region 8 Network Assessment Report, scheduled for March, 2003. The reactions and recommendations of the States in Region 8 to the assessment will form a large part of those results.

7.1 Identification of Potential Network Changes

States and Tribes within Region 8 conduct annual reviews of their networks in accordance with CFR requirements. Within the context of these reviews, annual network modifications are identified and implemented, ensuring networks remain consistent with current monitoring needs. This region wide Network Assessment brings a fresh perspective to evaluations of networks within the region. The Network Assessment results are intended to provide additional tools to State and Tribal monitoring personnel for use in evaluating their networks. According to the national schedule for regional assessments, a final assessment report is due at the end of March, 2003. Region 8 asks the State and Tribal monitoring agencies with the region to consider the results of this assessment, along with the National Monitoring Strategy, and identify any resulting recommended changes. Any desired changes the State and Tribal monitoring organizations may identify will be identified in this Section of the March, 2003 Final Report.

7.2 Potential Future Assessment Methods

In the performance of this regional Network Assessment, several potential approaches to data analysis were considered.

As has been discussed, ambient air pollutant concentrations were not transformed (via logarithmic or other transform) to attempt to develop a normally distributed population. Doing so would decrease the effect on correlation that a single or small number of very high simultaneous data points can have. This transformation could be done in future assessments.

For attainment and AQI reporting purposes, often only a small number of high readings from monitors in EPA Region 8 are of real importance. One approach considered for the Region 8 Network Assessment was to concentrate on only high values (the top 5% of readings, for example). Networks could then be evaluated on the basis of whether two sites are duplicates with regard to maximum concentrations. One question to be answered would be whether, of a given pair, one site always has the higher maximum concentration, or both monitors in a pair might be the maximum concentration site for a give pollution event.

Network Assessments may become recurring exercises. If another regional Network Assessment is conducted in the future, monitoring objectives may be different at that time. One objective with increased emphasis in the National Monitoring Strategy is real time data reporting and mapping. As mapping becomes a more importing network objective, spatial data analysis will assume a more important role.

8.0 Summary

This Draft Region 8 Network Assessment Report has been prepared to attempt to fulfill two major objectives:

Present the EPA Region 8 geographic, meteorological, funding and regulatory context in which progress toward the objectives of the National Monitoring Strategy must proceed

Present results of a statistical evaluation of correlation between Region 8 monitors which can be used as a tool to evaluate relative worth of various monitors.

Subsequent reports will address recommended actions relative to the National Monitoring Strategy in light of the material in this report. State and Tribal monitoring organizations within Region 8 are requested to evaluate the Network Assessment results, as described in Section 7.1.