



COLORADO

Air Pollution Control Division

Department of Public Health & Environment

Technical Services Program

2025 Ambient Air Monitoring Network Assessment



COLORADO AMBIENT AIR MONITORING NETWORK ASSESSMENT 2025

Air Pollution Control Division
APCD-TS-B1
4300 Cherry Creek Drive South
Denver, Colorado
80246-1530
(303) 692-1530

2025-06-28

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GLOSSARY

AADT	Annual Average Daily Traffic
APCD	Air Pollution Control Division
AQS	Air Quality System (EPA database)
AQS ID	9-digit site identification number used in the AQS database
ARS	Air Resources Specialists
BLM	Bureau of Land Management
CAA	Clean Air Act
CAMP	Continuous Air Monitoring Program
CAQCC	Air Quality Control Commission
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
CO	Carbon monoxide
CSA	Combined Statistical Area
DIC	Disproportionately Impacted Community
FEM	Federal Equivalent Method
FRAPPÉ	Front Range Air Pollution and Photochemistry Experiment
FRM	Federal Reference Method
GIS	Geographic Information System
HEEJ	Health Equity and Environmental Justice collaborative
LUR	Land-Use Regression
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standards
NCore	National Core multi-pollutant monitoring stations
NO	Nitric oxide
NO ₂	Nitrogen dioxide
NO _x	Reactive nitrogen oxides
NO _y	Total reactive nitrogen
NOAA	National Oceanic and Atmospheric Administration
O ₃	Ozone
NPS	National Park Service
PM _{2.5}	Particulate matter with an equivalent diameter less than or equal to 2.5 µm
PM ₁₀	Particulate matter with an equivalent diameter less than or equal to 10 µm
PMSA	Principal Metropolitan Statistical Area
PWEI	Population Weighted Emissions Index
QA/QC	Quality Assurance/Quality Control
RAQC	Regional Air Quality Council
SDoH	Social Determinants of Health index
SIP	State Implementation Plan
SLAMS	State or Local Air Monitoring Stations
SO ₂	Sulfur dioxide
SPM	Special Purpose Monitor
SUIT	Southern Ute Indian Tribe
TSP	Total Suspended Particulates
µg	Microgram (10 ⁻⁶ grams)
US EPA	United States Environmental Protection Agency
USFS	United States Forest Service
VOC	Volatile Organic Compound
WLC	Weighted Linear Combination

EXECUTIVE SUMMARY

On October 17, 2006, the U.S. Environmental Protection Agency (EPA) amended its ambient air monitoring regulations to include a requirement that all state and local air quality monitoring agencies prepare a technical assessment of their monitoring networks once every five years. This document describes the Colorado Department of Public Health and Environment (CDPHE) Air Pollution Control Division's (APCD) 2025 Ambient Air Monitoring Network Assessment.

Purpose of the Assessment

The mission of the APCD is to provide our customers with excellent air quality management services that contribute to the protection of public health, the protection of ecosystems, and continual improvement of air quality related aesthetic values (e.g., visibility). The technical assessment presented here will provide decision-makers with the information needed to maximize the efficiency and effectiveness of Colorado's ambient air monitoring network. The assessment also ensures that APCD and its partners have the information needed to protect human health and the environment for current and future generations in Colorado.

As of May 1, 2025, APCD operated a network of 45 air pollution monitoring stations throughout Colorado. The data obtained from these monitors serves a variety of needs. The APCD has chosen the following eleven objectives as being those that most accurately define the overall purposes of the network:

1. To determine background concentrations,
2. To establish regulatory compliance,
3. To track pollutant concentration trends,
4. To assess population exposure,
5. To evaluate emissions reductions,
6. To evaluate the accuracy of model predictions,
7. To assist with forecasting,
8. To locate maximum pollutant concentrations,
9. To assure proper spatial coverage of regions,
10. To assist in source apportionment, and
11. To address environmental justice concerns.

Assessment

To relate the value of its monitoring activities to its objectives and priorities, the APCD has evaluated the state network on a pollutant-by-pollutant basis to assess the relative value of each pollutant monitor and to identify areas where the inclusion of new monitoring sites would be most beneficial. This assessment was conducted in broad accordance with EPA guidance; however, the analyses and tools used here were assigned relative weights to reflect the unique objectives and priorities of the APCD within the context of the state of Colorado.

Findings

Overall, the APCD monitoring network meets all federal requirements and adequately supports APCD monitoring objectives. However, while wholesale changes are not necessary at this time, several targeted modifications are recommended to improve the network's efficiency and effectiveness. These include de-emphasizing monitoring for pollutants with consistently low concentrations, reallocating resources to address emerging priorities (e.g., ozone and PM_{2.5}), and expanding monitoring coverage in underserved

areas. Resources saved from site closures or network reductions should be reinvested to fill monitoring gaps and support higher-priority needs such as ozone precursor tracking and wildfire smoke impacts.

Recommendations

Sites recommended for closure:

- 1) Discontinue carbon monoxide monitoring (pending SIP expiration) at the Greeley, Fort Collins, and Colorado College (Colorado Springs) sites due to low concentration values and low relative values within the network.
- 2) Discontinue ozone monitoring in Cortez due to the low relative value of this site.

Recommended new sites/monitors:

- 1) Add NO₂ monitors at Mehaffey Park (Loveland), Fort Collins West, and Chatfield.
- 2) Consider the addition of a new NO₂ monitoring site east of I-25 (location to be determined).
- 3) Consider the addition of a new NO₂ monitoring site in Colorado Springs (location to be determined).
- 4) Consider the addition of a new O₃ monitors in Durango and San Luis.
- 5) Consider the addition of new particulate monitors in Edwards, Delta, Durango, and San Luis.

1 INTRODUCTION

The Air Pollution Control Division (APCD) of the Colorado Department of Public Health and Environment (CDPHE) has prepared the 2025 Ambient Air Monitoring Network Assessment as an examination and evaluation of the APCD's network of air pollution monitoring stations. The Network Assessment is an extension of the Network Plan, which is required to be submitted annually. The Network Assessment is required to be performed and submitted to the U.S. Environmental Protection Agency (EPA) every 5 years, with this fourth assessment due on July 1, 2025. The assessment must include specific analyses of the monitoring network, including: (1) a re-evaluation of the objectives and priorities for air monitoring, (2) an evaluation of the network's effectiveness and efficiency relative to its monitoring objectives, and (3) recommendations for network reconfigurations and improvements.

1.1 Background and Key Issues

The priorities and objectives of ambient air monitoring programs can change and evolve over time. Monitoring networks must therefore be re-evaluated and reconfigured on a periodic basis to ensure that objectives are obtained. Monitoring objectives may change for a number of different reasons, such as in response to changes in air quality. Air quality in the United States has improved dramatically since the adoption of the Clean Air Act and National Ambient Air Quality Standards (NAAQS).¹ For example, lead (Pb) concentrations in ambient air declined rapidly during the 1980s due to the phase-out of leaded gasoline (Eisenreich et al., 1986), and Pb monitoring activities were therefore deemphasized by the APCD and many other monitoring agencies. Changes in population and consumption patterns are another factor often motivating the re-evaluation of air monitoring programs. For instance, the U.S. population has become increasingly concentrated in suburban and exurban regions over the past 60 years, and rates of vehicle ownership and average distance driven have increased dramatically as the population has spread away from high-density urban centers (Kahn, 2000). This trend has resulted in the need for increased monitoring downwind of pollution sources due to enhanced production of photochemical smog in exurban and even rural environments (Sillman, 1999). Monitoring objectives may also change in response to the establishment of new air quality rules and regulations. Ambient air quality standards are periodically re-evaluated and reviewed by the EPA to ensure that they provide adequate health and environmental protection. This review process has often resulted in the establishment of new standards, including those that pertain to air toxics, fine particulate matter (PM_{2.5}), and regional haze. For example, the EPA revised the NAAQS for PM_{2.5} on February 7, 2024, lowering the primary (health-based) annual PM_{2.5} standard from 12.0 to 9.0 micrograms per cubic meter ($\mu\text{g m}^{-3}$) to enhance public health protection. Objectives can also change due to improvements in our understanding of air quality processes or enhanced monitoring capabilities. The basic understanding of air quality issues and air quality monitoring capabilities have both improved dramatically over the last five decades.

As a result of such changes, the APCD's air monitoring network may have unnecessary or redundant monitors. Alternatively, the network may be found to have inefficient network configurations for some pollutants, while other regions or pollutants may benefit from enhanced monitoring. This assessment will help the APCD to optimize its current network to help better protect today's population and environment, while maintaining the ability to understand long-term historical air quality trends.

¹ <http://www.epa.gov/airtrends/>

1.2 Study Objectives

The objectives of this network assessment are three-fold: (1) to determine whether the existing network is meeting its intended monitoring objectives, (2) to evaluate the network's adequacy for characterizing current air quality and impacts from future industrial and population growth, and (3) to identify potential areas where new monitors can be sited or existing monitors removed to support network optimization and/or to meet new monitoring goals. To meet these objectives, a suite of analyses were performed to address the following questions:

- How well does the existing monitoring network support current objectives? Which objectives are being met; which objectives are not being met? Are unmet objectives appropriate concerns for APCD? If so, what monitoring is necessary to meet those unaddressed objectives? What are potential future objectives for the monitoring network?
- Are the existing sites collectively capable of characterizing all criteria pollutants? Are the existing sites capable of characterizing criteria pollutant trends (spatially and temporally)? If not, what areas lack appropriate monitoring? If needed, where should new monitors be placed? Does the existing network support future emissions assessment, reconciliation, and modeling studies? Are there parameters at existing sites that need to be added to support these objectives?
- Is the current monitoring network sufficient to adequately assess regional air quality conditions with respect to all criteria pollutants? If not, where should monitors be relocated or added to improve the overall effectiveness of the monitoring network? How can the effectiveness of the monitoring network be maximized?

1.3 Guide to this Report

Section 1 resumes with an overview of the Colorado air monitoring network, including some general background on the geography of Colorado and the current state of air quality in the region, and ends with a general description of the assessment methodologies used in this report. Section 2 consists of a quantitative site-to-site comparison of the existing monitoring sites in the APCD network. In this section, a series of assessments are used to assign a relative score to each site to determine its comparative value within the network. Each assessment is assigned a weight and each site within the APCD monitoring network is then ranked by the weighted average of the analyses. Section 3 uses a Geographic Information System (GIS) driven suitability model to locate areas where the existing monitoring network does not adequately represent potential air pollution problems, and where additional sites are potentially needed. This evaluation has been conducted using a series of data maps representing a variety of indicators related to monitoring objectives. The maps are reclassified into a congruous ranking system and organized into three areas: source-oriented, population-oriented, and spatially-oriented. Each area and indicator is then assigned a weight and the spatial average of each weighted indicator is computed. This spatial average is then used to determine the optimal locations at which new monitors should be deployed. Section 4 provides recommendations based upon the evaluations described in the preceding sections. Recommendations concerning the addition of new sites or the relocation/discontinuation of existing sites reflect a variety of factors considered in the preceding evaluations, such as population density, pollution sources, monitoring history, compliance with air quality standards, and environmental justice concerns.

1.4 Overview of the Colorado Air Monitoring Network

The APCD currently operates monitors at 45 locations statewide. Ozone (O₃) and particulate matter (PM) monitors, including those for particulate matter < 10 µm in diameter (PM₁₀), and particulate matter < 2.5 µm in diameter (PM_{2.5}), are the most abundant and widespread. Currently, there are PM₁₀ monitors at 15 separate locations, PM_{2.5} monitors at 25 locations, O₃ monitors at 24 locations, carbon monoxide (CO) monitors at five locations, nitrogen dioxide (NO₂) monitors at nine locations, and sulfur dioxide (SO₂) monitors at three locations. The APCD also operates 17 meteorological sites statewide.

Within the particulate sampling network, the APCD operates both continuous and filter-based sampling methods for PM_{2.5} and PM₁₀. Continuous monitors sample without the need for subsequent filter retrieval and laboratory analysis, which is required for filter-based equipment. Thus, these monitors can continuously record concentrations and send the results back to APCD headquarters on a nearly instantaneous basis. Currently, twelve sites are equipped to measure continuous PM₁₀ and, of those twelve sites, one is located at a site that is also equipped with a filter-based PM₁₀ monitor. Of the 25 PM_{2.5} monitoring sites, all 25 measure PM_{2.5} on a continuous basis, with four of these sites also having filter-based samplers.

Thirty-two of the 45 current monitoring sites have been in operation for ten or more years, while 23 of these have been in operation for 20 or more years. Four monitoring sites have been in operation for more than 40 years. These sites are: Denver CAMP (59 years), Welby (51 years), Highland Reservoir (46 years), and Fort Collins - Mason (44 years).

Two of the ozone monitoring sites that are located on the Western Slope and have data included in this report are operated and maintained by a third-party contractor, Air Resource Specialists (ARS). These are the Rifle and Cortez ozone monitoring sites. ARS keeps these sites in proper working order and performs regular QC checks and data retrieval, while the APCD conducts the independent auditing of the sites for Quality Assurance (QA) purposes.

1.4.1 APCD Monitoring History

The State of Colorado has been monitoring air quality statewide since the mid-1960s when high volume and tape particulate samplers, dustfall buckets, and sulfation candles were the state of the art for defining the magnitude and extent of the very visible air pollution problem (Riehl and Crow, 1962). Monitoring for gaseous pollutants (CO, SO₂, NO₂, and O₃) began in 1965 when the federal government established the Continuous Air Monitoring Program (CAMP) station in downtown Denver at the intersection of 21st Street and Broadway, which was the area that was thought at the time to represent the best probability for detecting maximum levels of most of the pollutants of concern. Instruments were primitive by comparison with those of today and were frequently out of service.

Under provisions of the original Federal Clean Air Act of 1970, the Administrator of the U.S. EPA established National Ambient Air Quality Standards (NAAQS) designed to protect the public's health and welfare. Standards were set for TSP, CO, SO₂, NO₂, and O₃. In 1972, the first State Implementation Plan (SIP) was submitted to the EPA. It included an air quality surveillance system in accordance with EPA regulations of August 1971. That plan proposed a monitoring network of 100 monitors (particulate and gaseous) statewide. The system established as a result of that plan and subsequent modifications consisted of 106 monitors.

The 1977 Clean Air Act Amendments required States to submit revised SIPs to the EPA by January 1, 1979. The portion of the Colorado SIP pertaining to air monitoring was submitted separately on December 14, 1979, after a comprehensive review, and upon approval by the Colorado Air Quality Control Commission. The 1979 EPA requirements, as set forth in 40 CFR 58.20, have resulted in considerable modification to the network. These and subsequent modifications were made to ensure consistency and compliance with Federal monitoring requirements. Station location, probe siting, sampling methodology, quality assurance and quality control practices, and data handling procedures are all maintained throughout any changes made to the network.

1.4.2 Network Modification Procedures

The APCD develops changes to its monitoring network in several ways. New monitoring locations have been added as a result of community concerns about air quality, such as the PM₁₀ monitors in Cripple Creek and Hygiene established in 1998. Other monitors have been established in support of special studies, such as the O₃ monitoring sites in Aurora and Black Hawk.

Changes in property ownership represent the most common factor motivating network reconfigurations. The APCD owns neither the land nor the buildings where most of the monitors are located, and it is becoming increasingly difficult to get property owner's permission for use due to risk management issues. Other common reasons for relocating or removing monitors from the network are that either the land or building is modified in such a way that the site no longer meets current EPA siting criteria, or the area surrounding the monitor is being modified in a way that necessitates a change in the monitoring location. The most current examples of this are the removal of the Auraria meteorological monitoring station and the relocation of the NCore Denver Municipal Animal Shelter (DMAS) site. The Auraria station was removed due to the construction of a tall building in the immediate vicinity of the monitor that obstructed airflow around the monitoring site. The DMAS site was relocated due to a change in property ownership and land use. Monitors are also removed from the network after review of the data shows that pollutant levels have dropped to the point where it is no longer necessary to continue monitoring at a specific location.

Finally, all monitors are reviewed on a regular basis to determine if they are continuing to meet their monitoring objectives. If the population, land use, or vegetation around the monitor change undesirably over time, a more suitable location for the monitor is sought. An example of this is the O₃ monitor previously located at the Aspen Park monitoring site. It was shut down in 2019 and relocated to Black Hawk.

Detailed site descriptions of each monitoring location can be found in Table A.1 (Appendix A), which summarizes the locations and monitoring parameters of each site currently in operation, by county, alphabetically. The shaded lines in the table list the site AQS identification numbers, address, site start-up date, elevation, and longitude and latitude coordinates. Beneath each site description, the table lists each monitoring parameter in operation at that site, the orientation and spatial scale, which national monitoring network it belongs to, the type of monitor in use, and the sampling frequency. The parameter date is the date when valid data were first collected.

1.4.3 Description of Monitoring Regions in Colorado

The state has been divided into eight multi-county areas that are generally based on topography and have similar airshed characteristics (see Section 1.4.4). These areas are the Central Mountains, Denver

Metro/North Front Range, Eastern High Plains, Pikes Peak, San Luis Valley, South Central, Southwestern, and Western Slope regions. Figure 1 shows the approximate boundaries of these regions.

1.4.3.1 Central Mountains

The Central Mountains region consists of 12 counties in the central area of the state. The Continental Divide passes through much of this region. Mountains and mountain valleys are the dominant landscape features. Leadville, Steamboat Springs, Cañon City, Salida, Buena Vista, and Aspen represent the larger communities. The population of this region is 241,133, according to the 2019-2024 American Community Survey. Skiing, tourism, ranching, mining, and correctional facilities are the primary industries. Black Canyon of the Gunnison National Park is located in this region. All of the area complies with federal air quality standards.

The primary monitoring concern in this region is centered on particulate pollution from wood burning and road dust. Currently, there are three particulate monitoring sites operated by the APCD in the Central Mountains region. These sites are located in Steamboat, Aspen, and Canyon City. APCD does not currently operate any gaseous monitors in this region.

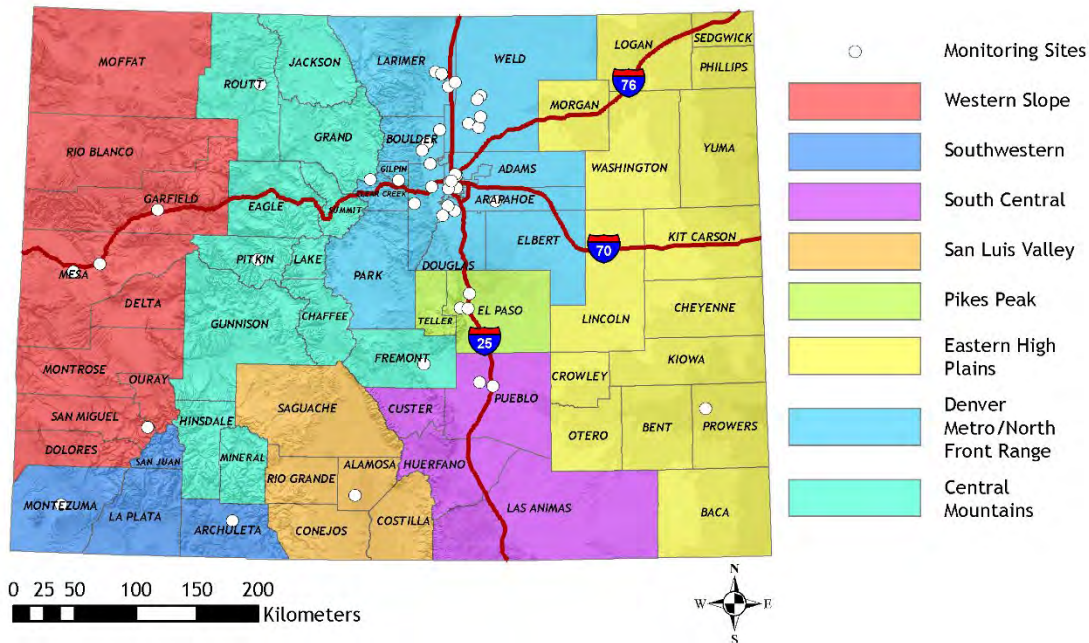


Figure 1. Counties and multi-county monitoring regions discussed in this report. Air quality monitoring sites measuring O₃, CO, NO₂, SO₂, PM₁₀, and PM_{2.5} are symbolized with white circles.

1.4.3.2 Denver Metro/North Front Range

The Denver-Metro/North Front Range region is comprised of 13 counties. It includes the largest population area of the state, with 3.0 million people living in the ten-county Denver-Aurora-Lakewood Metropolitan Statistical Area (MSA) and another 1.0 million living in the northern Front Range areas of Boulder, Larimer, and Weld counties. This area includes Rocky Mountain National Park and several other wilderness areas.

Since 2002, the region complies with all NAAQS, except for ozone. The area has been exceeding the EPA's current ozone standards since the early 2000s, and in 2007 was formally designated as a "nonattainment" area. This designation was re-affirmed in 2012 when the EPA designated the region as a "marginal" nonattainment area after a more stringent ozone standard was adopted in 2008. An even more stringent ozone standard was adopted in 2015.

In the past, the Denver-metropolitan area has violated health-based air quality standards for carbon monoxide and fine particles. In response, the Regional Air Quality Council (RAQC), the Colorado Air Quality Control Commission (CAQCC), and the APCD developed, adopted, and implemented air quality improvement plans to reduce each of these pollutants.

For the rest of the Northern Front Range, Fort Collins, Longmont, and Greeley were nonattainment areas for carbon monoxide in the 1980s and early 1990s but have met the federal standards since 1995. Air quality improvement plans have been implemented for each of these communities.

There are currently 69 air quality and meteorological monitors at 28 individual sites in the Denver-Metro/Northern Front Range Region. There are four CO monitors, 18 O₃ monitors, nine NO₂ monitors, three SO₂ monitors, as well as five PM₁₀ monitors, 15 PM_{2.5} monitors, and 14 meteorological towers. There are also two air toxics monitoring sites, one located each in Commerce City and in Platteville. In addition, there is one site that measures visual range by use of a nephelometer and a transmissometer.

1.4.3.3 Eastern High Plains

The Eastern High Plains region encompasses the counties on the plains of eastern Colorado. The area is semiarid and often windy. The area's population is approximately 132,623 according to the 2019-2023 American Community Survey. Its major population centers have developed around farming, ranching, and trade centers such as Sterling, Fort Morgan, Limon, La Junta, and Lamar. The agricultural base includes both irrigated and dry land farming. All of the area complies with federal air quality standards.

Historically, there have been a number of communities that were monitored for particulates and meteorology but not for any of the gaseous pollutants. In the northeast along the I-76 corridor, the communities of Sterling, Brush, and Fort Morgan have been monitored. Along the I-70 corridor, only the community of Limon has been monitored for particulates. Along the US-50/Arkansas River corridor, the Division has monitored for particulates in the communities of La Junta and Rocky Ford. These monitoring sites were all discontinued in the late 1970s and early 1990s after a review showed that the concentrations were well below the standard and trending downward.

For the Eastern High Plains region, there is currently one PM₁₀ and one PM_{2.5} monitor located in Lamar. There are no gaseous pollutant or meteorological monitoring sites in this region.

1.4.3.4 Pikes Peak

The Pikes Peak region includes El Paso and Teller counties. The area has a population of approximately 760,782 according to the 2019-2023 American Community Survey. Eastern El Paso County is rural prairie, while the western part of the region is mountainous. The U.S. Government is the largest employer in the area, and major industries include Fort Carson and the U.S. Air Force Academy in Colorado Springs, both military installations. Aerospace and technology are also large employers in the area. All of the area is currently in compliance with federal air quality standards.

Currently, there are three gaseous pollutants monitors at three sites and one particulate monitoring site in the Pikes Peak Region. There is one CO monitor and two O₃ monitors, as well as one PM₁₀ and one PM_{2.5} monitor in the region.

1.4.3.5 San Luis Valley

Colorado's San Luis Valley region is in the south central portion of Colorado and is comprised of a broad alpine valley situated between the Sangre de Cristo Mountains on the northeast and the San Juan Mountains of the Continental Divide to the west. The valley is some 114 km wide and 196 km long, extending south into New Mexico. The average elevation is 2290 km. Principal towns include Alamosa, Monte Vista, and Del Norte. The population of this region is 45,527 according to the 2019-2024 American Community Survey. Agriculture and tourism are the primary industries. The valley is semiarid and croplands of potatoes, head lettuce, and barley are typically irrigated. The valley is home to Great Sand Dunes National Park. All of the area complies with federal air quality standards.

Currently, there is one PM₁₀ and one PM_{2.5} monitor in Alamosa.

1.4.3.6 South Central

The South Central region is comprised of Pueblo, Huerfano, Las Animas, and Custer counties. Its population is approximately 195,137 according to the 2019-2023 American Community Survey. Population centers include Pueblo, Trinidad, and Walsenburg. The region has rolling semiarid plains to the east and is mountainous to the west. All of the area complies with federal air quality standards.

In the past the APCD has conducted particulate monitoring in both Walsenburg and Trinidad, but that monitoring was discontinued in 1979 and 1985, respectively, due to low concentrations.

Currently, there is one gaseous and one particulate monitoring station in the South Central Region. There is one O₃ monitor, one PM₁₀ and one PM_{2.5} monitor located in Pueblo. There is also a meteorological monitor located in Pueblo.

1.4.3.7 Southwest

The Southwestern region includes the Four Corners area counties of Montezuma, La Plata, Archuleta, and San Juan. The population of this region is about 96,712, according to the 2019-2023 American Community Survey. The landscape includes mountains, plateaus, high valleys, and canyons. Durango and Cortez are the largest towns, while lands of the Southern Ute and Ute Mountain Ute tribes make up large parts of this region. The region is home to Mesa Verde National Park. Tourism and agriculture are the dominant industries, although the oil and gas industry is becoming increasingly important. All of the area complies with federal air quality standards.

Currently there is one gaseous and one particulate monitoring station in the region. There is one O₃ monitor located in Cortez and one PM₁₀/PM_{2.5} monitor located in Pagosa Springs.

1.4.3.8 Western Slope

The Western Slope region includes nine counties on the far western border of Colorado. A mix of mountains on the east, and mesas, plateaus, valleys, and canyons to the west form the landscape of this region. Grand Junction is the largest urban area, and other cities include Telluride, Montrose, Delta, Rifle,

Glenwood Springs, Meeker, Rangely, and Craig. The population of this region is about 329,186, according to the 2019-2024 American Community Survey. Primary industries include ranching, agriculture, mining, energy development, and tourism. Dinosaur and Colorado National Monuments are located in this region.

The Western Slope, along with the central mountains, are projected to be the fastest growing areas of Colorado through 2025 with greater than two percent annual population increases, according to the Colorado Department of Local Affairs. All of the area complies with federal air quality standards.

Currently, there are two gaseous pollutant monitoring sites, one meteorological monitoring site, and two particulate monitoring sites in the Western Slope region. There are O₃ monitors located in Rifle and Palisade, a meteorological monitor in Grand Junction, and PM₁₀ monitors located in Telluride and Grand Junction.

1.4.4 Topography and Air Quality in Colorado

The “airshed” concept has been a useful tool in air quality management. Borrowed from the field of hydrology, the concept is based upon the assumption that topography separates regions of similar air quality and similar sources of air pollution. To the extent that air quality is affected by sources within an airshed, the airshed concept provides an easy way to identify the region of greatest impact associated with a source or group of sources

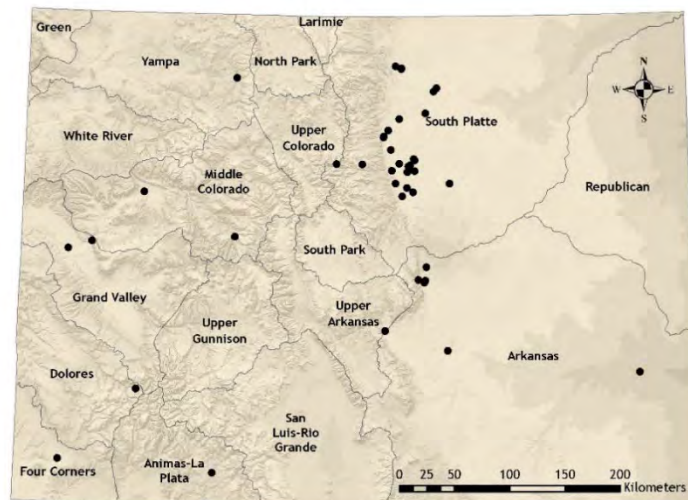


Figure 2. Shaded relief map showing the major airsheds of Colorado. CDPHE monitoring sites are symbolized by black circles.

The airshed concept is particularly relevant in mountainous areas and other regions of complex terrain (Greenland and Carleton, 1982). Daytime heating of elevated terrain creates localized low pressure that draws air up valleys and slopes toward ridge tops. This happens on both sides of an airshed boundary (ridge). In the absence of significant synoptic or regional-scale winds, flows diverge over ridge tops and return in an elevated “current” toward the center of the basin. This tends to isolate the daytime air in each basin. At night, radiational cooling creates slope flows that start at ridge tops (in the absence of synoptic-scale winds) and merge to form drainage flows in the valleys. These fill valleys with cooler air and form inversions that will tend to fill the entire depth of a mountain valley, regardless of the actual depth of the valley in question. Thus, to summarize, as long as larger-scale weather systems do not interfere, a

mountain valley system tends to breathe, with thermally-driven upslope flows during the day and down-valley slope and drainage flows at night (Doran, 1996).

The APCD has delineated the major airsheds of Colorado through a detailed examination of wind profiler data and temperature measurements across the state. The Colorado airshed scheme is based on the basin-defining topography of the state and estimated scales of basin flows and dispersion when synoptic-scale winds are minimal. This scheme is shown in Figure 2.

The Colorado airshed scheme will be used in this report in support of certain analytical techniques where it is necessary to account for the presence of distinct meteo-geographical boundaries within the state. These analytical techniques are described in detail in subsequent sections.

1.4.5 State-Wide Population Statistics

Colorado population data is obtained from the 2020 U.S. Census and the 2019-2023 American Community Survey (ACS) and is summarized in Table 1. The 2020 column refers to the U.S. Census and the 2023 column refers to the ACS. The counties have been grouped by both MSA and state monitoring region, as defined above. A map of the ACS census tract-level population data is presented in Figure 3.

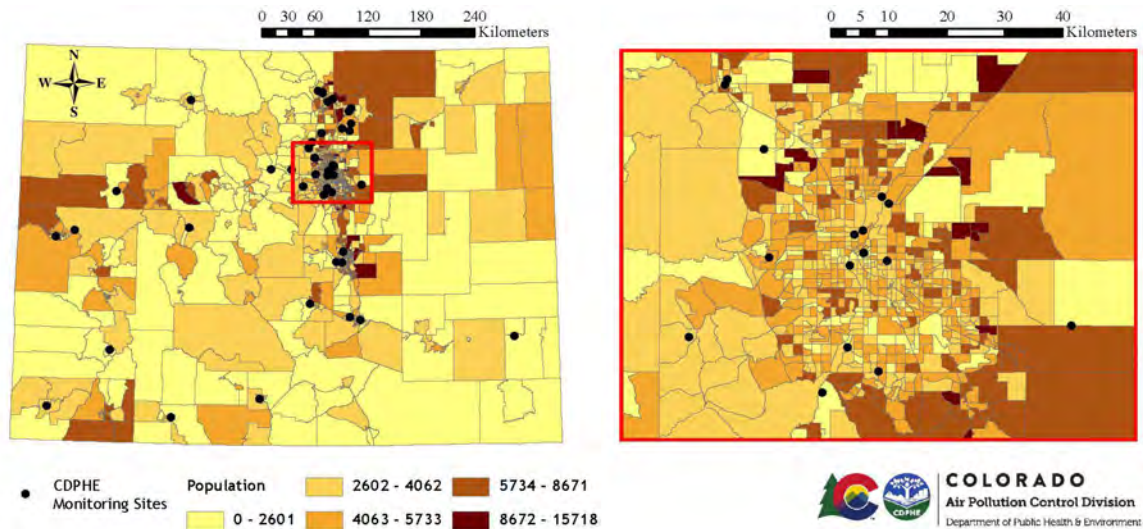


Figure 3. Population by census tract. CDPHE air quality monitoring sites are symbolized by black circles.

Table 1. Population data grouped by county, monitoring region, and Metropolitan Statistical Area (MSA).

Region	MSA/County	Population 2020 (U.S. Census)	Population 2023 (ACS)	% Change 2020-2023
Central Mountains		240,376	241,133	0.3%
	Chaffee	19,482	19,876	2.0%
	Eagle	55,671	55,374	-0.5%
	Fremont	48,883	49,394	1.0%
	Grand	15,749	15,794	0.3%
	Gunnison	16,947	17,158	1.2%
	Hinsdale	792	939	18.6%
	Jackson	1,377	1,422	3.3%
	Lake	7,412	7,411	0.0%
	Mineral	871	799	-8.3%
	Pitkin	17,356	17,119	-1.4%
	Routt	24,836	24,990	0.6%
	Summit	31,000	30,857	-0.5%
Denver Metro / North Front Range		3,992,426	4,009,674	0.4%
	<i>BOULDER MSA (Boulder County)</i>	330,944	328,317	-0.8%
	<i>DENVER-AURORA-LAKEWOOD MSA</i>	2,970,092	2,977,085	0.2%
	Adams	520,465	524,408	0.8%
	Arapahoe	655,260	655,709	0.1%
	Broomfield	74,499	75,110	0.8%
	Clear Creek	9,397	9,358	-0.4%
	Denver	717,597	713,734	-0.5%
	Douglas	360,300	368,283	2.2%
	Elbert	26,222	27,152	3.5%
	Gilpin	5,823	5,877	0.9%
	Jefferson	583,111	579,715	-0.6%
	Park	17,418	17,739	1.8%
	<i>FORT COLLINS MSA (Larimer County)</i>	359,943	363,561	1.0%
	<i>GREELEY MSA (Weld County)</i>	331,447	340,711	2.8%
Eastern High Plains		133,238	132,623	-0.5%
	Baca	3,478	3,460	-0.5%
	Bent	5,475	5,524	0.9%
	Cheyenne	1,745	1,732	-0.7%
	Crowley	5,690	5,734	0.8%
	Kiowa	1,454	1,356	-6.7%
	Kit Carson	7,068	7,015	-0.7%
	Lincoln	5,662	5,561	-1.8%
	Logan	21,199	21,067	-0.6%
	Morgan	29,080	29,186	0.4%
	Otero	18,669	18,460	-1.1%

Table 1. Population data grouped by county, monitoring region, and Metropolitan Statistical Area (MSA).

Region	MSA/County	Population 2020 (U.S. Census)	Population 2023 (ACS)	% Change 2020-2023
	Phillips	4,523	4,491	-0.7%
	Prowers	12,013	11,931	-0.7%
	Sedgwick	2,391	2,346	-1.9%
	Washington	4,813	4,839	0.5%
	Yuma	9,978	9,921	-0.6%
Pikes Peak		757,151	760,782	0.5%
	<i>COLORADO SPRINGS MSA</i>	<i>757,151</i>	<i>760,782</i>	<i>0.5%</i>
	El Paso	732,405	736,008	0.5%
	Teller	24,746	24,774	0.1%
San Luis Valley		45,256	45,527	0.6%
	Alamosa	16,372	16,515	0.9%
	Conejos	7,455	7,536	1.1%
	Costilla	3,503	3,571	1.9%
	Rio Grande	11,536	11,394	-1.2%
	Saguache	6,390	6,511	1.9%
South Central		194,360	195,137	0.4%
	Custer	4,721	5,073	7.5%
	Huerfano	6,832	6,946	1.7%
	Las Animas	14,485	14,392	-0.6%
	<i>PUEBLO MSA (Pueblo County)</i>	<i>168,322</i>	<i>168,726</i>	<i>0.2%</i>
Southwest		95,698	96,712	1.1%
	Archuleta	13,428	13,730	2.2%
	La Plata	55,670	56,088	0.8%
	Montezuma	25,889	26,204	1.2%
	San Juan	711	690	-3.0%
Western Slope		326,465	329,186	0.8%
	Delta	31,054	31,353	1.0%
	Dolores	2,078	2,385	14.8%
	Garfield	61,794	62,034	0.4%
	<i>GRAND JUNCTION MSA (Mesa County)</i>	<i>156,004</i>	<i>157,316</i>	<i>0.8%</i>
	Moffat	13,266	13,258	-0.1%
	Montrose	42,814	43,272	1.1%
	Ouray	4,877	5,024	3.0%
	Rio Blanco	6,522	6,518	-0.1%
	San Miguel	8,056	8,026	-0.4%

1.5 Assessment Methodology

1.5.1 Parameters Assessed

This Network Assessment will address the criteria pollutants monitored by APCD during the period 2020-2024: carbon monoxide (CO), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), ozone (O₃), and two size fractions of particulate matter, PM₁₀ (particles < 10 µm in diameter), PM_{2.5} (particles < 2.5 µm in diameter), and lead (Pb).

1.5.1.1 Carbon Monoxide (CO)

CO is a colorless and odorless gas formed when carbon compounds in fuel undergo incomplete combustion. The majority of CO emissions to ambient air originate from mobile sources (i.e., transportation), particularly in urban areas, where as much as 85% of all CO emissions may come from automobile exhaust. CO can cause harmful health effects by reducing oxygen delivery to the body's organs and tissues. High concentrations of CO generally occur in areas with heavy traffic congestion. In Colorado, peak CO concentrations typically occur during the colder months of the year when CO automotive emissions are highest and nighttime temperature inversions are more frequent (Reddy et al., 1995).

The EPA first set air quality standards for CO in 1971. For protection of both public health and welfare, EPA set an 8-hour primary standard at 9 parts per million (ppm) and a 1-hour primary standard at 35 ppm. In a review of the standards completed in 1985, the EPA revoked the secondary standards (for public welfare) due to a lack of evidence of adverse effects on public welfare at or near ambient concentrations. The last review of the CO NAAQS was completed in 2011 and the EPA chose not to revise the standards at that time.

The five CO monitors currently operated by the APCD are associated both with State Maintenance Plan requirements and CFR requirements. However, the EPA has revised the minimum requirements for CO monitoring by requiring CO monitors to be sited near roads in certain urban areas. EPA has also specified that monitors required in CBSAs of 2.5 million or more persons are to be operational by January 1, 2015, and that monitors required in CBSAs of one million or more persons are required to be operational by January 1, 2017. A monitor has been collocated with the near roadway NO₂ site (I-25 Denver) to satisfy these requirements.

1.5.1.2 Nitrogen Dioxide (NO₂)

NO₂ is one of a group of highly reactive gases known as "oxides of nitrogen," or nitrogen oxides (NO_x). Other NO_x species include nitric oxide (NO), nitrous acid (HNO₂), and nitric acid (HNO₃). The EPA's National Ambient Air Quality Standard uses NO₂ as the indicator for the larger group of nitrogen oxides. NO₂ forms quickly from emissions from cars, trucks and buses, power plants, and off-road equipment. In addition to contributing to the formation of ground-level ozone, and fine particle pollution, NO₂ is linked with a number of adverse effects on the respiratory system (Kampa and Castanas, 2008).

The EPA first set standards for NO₂ in 1971, setting both a primary standard (to protect health) and a secondary standard (to protect the public welfare) at 0.053 parts per million (53 ppb), averaged annually. The Agency has reviewed the standards twice since that time but chose not to revise the annual standards at the conclusion of each review. In January 2010, the EPA established an additional primary standard at

100 ppb, averaged over one hour. Together the primary standards protect public health, including the health of sensitive populations; i.e., people with asthma, children, and the elderly (Weinmayr et al., 2010).

The APCD has monitored NO₂ at ten locations in Colorado in the past. In 2025, the APCD will operate nine NO₂ monitors. The Denver CAMP monitor exceeded the NO₂ standard in 1977, though the Welby monitor has never exceeded the standard of 53 ppb as an annual average. NO₂ concentrations have exhibited a gradual decline over the past 20 years.

The EPA has established requirements for an NO₂ monitoring network that will include monitors at locations where maximum NO₂ concentrations are expected to occur, including within 50 meters of major roadways, as well as monitors sited to measure area-wide NO₂ concentrations that occur more broadly across communities. Per these requirements, at least one monitor must be located near a major road in any urban area with a population greater than or equal to 500,000 people. A second monitor is required near another major road in areas with either (1) population greater than or equal to 2.5 million people, or (2) one or more road segments with an annual average daily traffic (AADT) count greater than or equal to 250,000 vehicles. In addition to the near-roadway monitoring, there must be one monitoring station in each CBSA with a population of 1 million or more persons to monitor a location of expected highest NO₂ concentrations representing the neighborhood or larger spatial scales. The CAMP and Welby sites satisfy this requirement.

1.5.1.3 Sulfur Dioxide (SO₂)

Sulfur dioxide (SO₂) is one of a group of highly reactive gasses known as “oxides of sulfur,” or sulfur oxides (SO_x). The largest sources of SO₂ emissions are from fossil fuel combustion at power plants (73%) and other industrial facilities (20%). Smaller sources of SO₂ emissions include industrial processes such as extracting metal from ore, and the burning of high sulfur containing fuels by locomotives, large ships, and non-road equipment. SO₂ is linked with a number of adverse effects on the respiratory system (Kampa and Castanas, 2008; Ware et al., 1986). Furthermore, SO₂ dissolves in water and is oxidized to form sulfuric acid, which is a major contributor to acid rain, as well as fine sulfate particles in the PM_{2.5} fraction, which degrade visibility and represent a human health hazard.

The EPA first promulgated standards for SO₂ in 1971, setting a 24-hour primary standard at 140 ppb and an annual average standard at 30 ppb (to protect health). A 3-hour average secondary standard at 500 ppb was also adopted to protect the public welfare. In 1996, the EPA reviewed the SO₂ NAAQS and chose not to revise the standards. However, in 2010, the EPA revised the primary SO₂ NAAQS by establishing a new 1-hour standard at a level of 75 parts per billion (ppb). The two existing primary standards were revoked because they were deemed inadequate to provide additional public health protection given a 1-hour standard at 75 ppb.

The APCD has monitored SO₂ at eight locations in Colorado in the past. Currently, there are three monitoring sites in operation. No area of the country has been found to be out of compliance with the current SO₂ standards.

1.5.1.4 Ozone (O₃)

O₃ is an atmospheric oxidant composed of three oxygen atoms. It is not usually emitted directly into the air, but at ground-level is formed via photochemical reactions among NO_x and volatile organic compounds (VOCs) in the presence of sunlight (Monks, 2005). Emissions from industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapors, and chemical solvents are some of the major

sources of NO_x and VOCs. Breathing ozone can trigger a variety of health problems, particularly for children, the elderly, and people of all ages who have lung diseases such as asthma (Kampa and Castanas, 2008; Lippmann, 1989). Urban areas generally experience the highest ozone concentrations, but even rural areas may be subject to increased ozone levels because air masses can carry ozone and its precursors hundreds of kilometers away from their original source regions (Holland et al., 1999; National Research Council, 1992).

Sunlight and warm weather facilitate the ozone formation process and lead to high concentrations. Ozone is therefore considered to be primarily a summertime pollutant. However, ozone can also be a wintertime pollutant in some areas. Emerging science has indicated that snow-covered oil and gas-producing basins in the western U.S. are subject to wintertime ozone concentrations well in excess of current air quality standards. High ozone concentrations in winter are thought to occur when stable atmospheric conditions allow for a build-up of precursor chemicals, and the reflectivity of the snow cover increases the rate of UV-driven reactions during the day. Ozone and its precursors are then effectively trapped under the inversion. The Upper Green River Basin in Wyoming has been studied to model such effects (Carter and Seinfeld, 2012). Exceptionally high ozone concentrations have also been measured in the Uintah basin in Utah under such conditions (Edwards et al., 2014). To ensure compliance with the 2008 and 2015 O₃ standards, the EPA has extended the O₃ monitoring requirements for Colorado by 5 months, essentially redefining Colorado's O₃ season as January through December.

In 1971, the EPA promulgated the first NAAQS for photochemical oxidants, setting a 1-hour primary standard at 80 ppb (O₃ is one of a number of chemicals that are common atmospheric oxidants). The level of the primary standard was then revised in 1979 from 80 ppb to 120 ppb and the chemical designation of the standard was changed from "photochemical oxidants" to "ozone." In 1993, the EPA reviewed the O₃ NAAQS and chose not to revise the standards. However, in 1997, the EPA promulgated a new level of the NAAQS for O₃ of 80 ppb as an annual fourth-highest daily maximum eight-hour concentration, averaged over three years. The O₃ NAAQS was then revised in 2008 when the EPA set an 8-hour standard of 75 ppb. This change had a significant impact on the number of O₃ monitors in Colorado that were in violation of the standard, with the APCD then operating 5 sites out of 19 that had three-year design values (2012 - 2014) in excess of the current eight-hour O₃ NAAQS standard of 75 ppb (only three of these sites had design values in excess of 80 ppb). On October 26, 2015, the EPA again revised the O₃ NAAQS standard from its current value of 75 ppb to a level of 70 ppb. During 2024, there were 19 sites that exceeded the NAAQS standard of 70 ppb.

The EPA's monitoring requirements for O₃ include placing certain numbers of monitors in areas with high populations. For example, in Metropolitan Statistical Areas (MSAs) with a population greater than ten million people, the EPA recommends the placement of at least four monitors in areas with design value concentrations that are greater than or equal to 85% of the O₃ standard. The largest MSA in Colorado is the Denver-Aurora-Lakewood MSA. This MSA includes the counties of Adams, Arapahoe, Broomfield, Denver, Douglas, Elbert, Gilpin, Jefferson, and Park, and has a population of approximately 3.0 million. Table 2 lists EPA's O₃ monitoring requirements.

Table 2. EPA's minimum ozone monitoring requirements.

MSA population	Most recent 3-year design value concentrations \geq 85% of any O_3 NAAQS	Most recent 3-year design value concentrations $<$ 85% of any O_3 NAAQS
> 10 million	4	2
4 - 10 million	3	1
350,000 - 4 million	2	1
50,000 - 350,000	1	0

1.5.1.5 Particulate Matter (PM)

Atmospheric particulate matter (PM) is microscopic solid or liquid mass suspended in the air. PM can be made up of a number of different components, including acidic aerosols (i.e., nitrates and sulfates), organic carbon, metals, soil or dust particles, and allergens (such as fragments of pollen or mold spores). Some of these particles are carcinogenic and others have health effects due to their size, morphology, or composition.

Particle size is the factor most directly linked to the health impacts of atmospheric PM. Particles of less than 10 micrometers (μm) in diameter (PM_{10}) are inhalable and thus pose a health threat. Particles less than 2.5 μm in diameter ($\text{PM}_{2.5}$) can penetrate deeply into the alveoli, while the smallest particles, such as those less than 0.1 μm in diameter (ultrafine particles), can penetrate all the way into the bloodstream. Exposure to such particles can affect the lungs, the heart, and the cardiovascular system (Pope III and Dockery, 2006). Particles with diameters between 2.5 μm and 10 μm ($\text{PM}_{10-2.5}$) represent less of a health concern, although they can irritate the eyes, nose, and throat, and cause serious harm due to inflammation in the airways of people with respiratory diseases such as asthma, chronic obstructive pulmonary disease, and pneumonia (Weinmayr et al., 2010). Note that PM_{10} encompasses all particles smaller than 10 microns, including the $\text{PM}_{2.5}$ and ultrafine fractions.

EPA first established standards for PM in 1971. The reference method specified for determining attainment of the original standards was the high-volume sampler, which collects PM up to a nominal size of 25 to 45 μm (referred to as total suspended particulates or TSP). The primary standards, as measured by the indicator TSP, were 260 $\mu\text{g m}^{-3}$ (as a 24-hour average) not to be exceeded more than once per year, and 75 $\mu\text{g m}^{-3}$ (as an annual geometric mean). In October 1979, the EPA announced the first periodic review of the air quality criteria and NAAQS for PM, and significant revisions to the original standards were promulgated in 1987. In that decision, the EPA changed the indicator for particles from TSP to PM_{10} . EPA also revised the level and form of the primary standards. The EPA promulgated significant revisions to the NAAQS again in 1997. In that decision, the EPA revised the PM NAAQS in several respects. While it was determined that the PM NAAQS should continue to focus on particles less than or equal to 10 μm in diameter (i.e., PM_{10}), the EPA also decided that the fine and coarse fractions of PM_{10} should be considered separately. The Agency's decision to modify the standards was based on evidence that serious health effects were associated with short- and long-term exposure to fine particles in areas that met the existing PM_{10} standards (Heal et al., 2012). The EPA added new standards, using $\text{PM}_{2.5}$ as the indicator for fine particles and using PM_{10} as the indicator for the $\text{PM}_{10-2.5}$ fraction. The EPA established two new $\text{PM}_{2.5}$ standards: an annual standard of 15 $\mu\text{g m}^{-3}$, based on the 3-year average of annual arithmetic mean $\text{PM}_{2.5}$ concentrations from single or multiple community-oriented monitors, and a 24-hour standard of 65 $\mu\text{g m}^{-3}$, based on the 3-year average of the 98th percentile of 24-hour $\text{PM}_{2.5}$ concentrations at each population-oriented monitor within an area. These standards were modified again

in 2006, 2012, and 2024. The current NAAQS for PM_{10} is a primary 24-hour standard of $150 \mu\text{g m}^{-3}$ not to be exceeded more than once per year on average over 3 years. There are currently three NAAQS for $PM_{2.5}$: (1) a primary annual standard of $9 \mu\text{g m}^{-3}$, based on the 3-year average of annual arithmetic mean $PM_{2.5}$ concentrations, (2) a secondary annual standard of $15 \mu\text{g m}^{-3}$, based on the 3-year average of annual arithmetic mean $PM_{2.5}$ concentrations, and (3) a 24-hour standard of $35 \mu\text{g m}^{-3}$, based on the 3-year average of the 98th percentile of 24-hour $PM_{2.5}$ concentrations.

PM_{10}

In 2025, the APCD will operate PM_{10} monitors at 15 different locations. Three of these sites use manual filter-based PM_{10} samplers and 12 are equipped with continuous (i.e., “hourly”) monitors. There is one site with collocated filter-based samplers (La Casa).

$PM_{2.5}$

In 2025, the APCD will operate $PM_{2.5}$ monitors at 25 different locations. All of these sites are equipped with continuous (i.e., “hourly”) monitors and four of these sites are collocated with filter-based samplers. Four of these sites began monitoring in January 2025 and, as such, do not yet have data available for comparison to other sites. Therefore, they are not explicitly evaluated in this report.

1.5.1.6 Lead (Pb)

Lead is a metal found naturally in the environment and in manufactured products. The major sources of lead in ambient air have historically been motor vehicles (such as cars and trucks) and industrial sources (such as lead smelters). Due to the phase out of leaded gasoline for automobiles, piston engine aircraft and metals processing are now the major sources of lead emissions in the air today. The highest levels of airborne lead are generally found near lead smelters and general aviation airports. Other stationary sources include waste incinerators, utilities, and lead-acid battery manufacturers. Exposure to lead occurs mainly through inhalation of air and ingestion of lead in food, water, soil, or dust. Exposure to lead is linked to neurological impairments such as seizures, intellectual disability, and behavioral disorders.

On October 15, 2008, EPA strengthened the National Ambient Air Quality Standards for lead. The level for the previous lead standard was $1.5 \mu\text{g m}^{-3}$, not to be exceeded as an average for a calendar quarter, based on an indicator of lead in total suspended particulates (TSP). The new standard, measured in either TSP or low-volume PM_{10} samples, has a level of $0.15 \mu\text{g m}^{-3}$, not to be exceeded as an average for any rolling three-month period within three years. Monitoring for lead is required at non-airport sources which emit 0.50 or more tons per year and from each airport which emits 1.0 or more tons per year based on either the most recent National Emission Inventory or other scientifically justifiable methods and data.

The last lead-specific sampling in Colorado, at the La Casa NCore site, was discontinued on December 31, 2015 due to low concentrations and not being required. Lead monitoring was also performed at Centennial Airport in the past, but was discontinued due to low concentrations and due to lead emissions being below 1 ton per year. Lead does continue to be monitored as part of National Air Toxics Trends Stations project on PM_{10} samplers in Grand Junction and via three $PM_{2.5}$ Speciation Trends Network sites.

1.5.2 Current State of Air Quality in Colorado

Table 3 summarizes the 2024 criteria pollutant design value data for all sites operated by the APCD. For the purposes of determining compliance with regulatory standards, three-year average design values are

compared to the NAAQS value for many of the criteria pollutants evaluated here (see Table 19). Three-year average design values are presented in Section 2 of this report and are used in various analyses. The 2024 values are presented in Table 3 to provide a summary of the most recent data. Detailed site information is provided in subsequent sections of this Introduction and in Table A-1 of Appendix A.

Currently, all State and Local Air Monitoring Station (SLAMS) and Special Purpose Monitor (SPM) sites are in attainment for CO, NO₂, SO₂, PM₁₀, and PM_{2.5}. During 2024, there were 20 O₃ monitoring sites in the APCD network that had three-year average fourth-highest daily maximum eight-hour concentrations in excess of the O₃ NAAQS.

Table 3. Summary of 2024 CO, NO₂, SO₂, O₃, PM₁₀, and PM_{2.5} design values.

AQS ID	Pollutant								
	CO (ppm)		NO ₂ (ppb)		SO ₂ (ppb)	O ₃ (ppb)	PM ₁₀ (µg m ⁻³)	PM _{2.5} (µg m ⁻³)	
	8-Hr	1-Hr	Annual	1-Hr	1-Hr	4 th Max 8-Hr	24-Hr	Annual	24-Hr
080010010							142	7.1	21.5
080013001			14.4	51.4	4.1	83	139	7.0	21.6
080030001							150	5.1	12.8
080050002						73			
080050005								5.4	17.5
080050006						81			
080070001							76		
080130003							92	7.0	24.4
080130014						84			
080131001							72	4.8	17.2
080190006						77			
080310002			13.6	57.0	4.9	79		5.9	17.8
080310013								6.0	18.5
080310026	1.8	2.0	14.6	50.0	5.2	84	65	5.6	18.3
080310027	2.7	2.9	20.3	56.3				7.8	21.2
080310028			23.3	59.6				7.6	19.2
080350004						88		4.5	16.8
080410013						78			
080410016						82			
080410017	0.7	1.1					42	5.7	16.5
080430003							72		
080450012						63			
080470003						79			
080590006			2.5	17.6		88			
080590011						86			
080590014						85			
080690009								6.4	20.5
080690011						83			
080690015			5.4	32.3		84			
080690016			6.6	31.7		78		4.9	13.4
080691004	1.2	1.8				82			
080770017							50	4.9	14.1
080770018									
080770020						67			
080830006						65			
080970008							81	4.3	13
080990002							100	5.5	18.6
081010015							78	4.7	12.5
081010016						76			
081070003							59		
081130004							72		
081230006								6.8	20.6
081230008								8.5	24.8
081230009	1.1	1.2				81			
081230015			6.3	36.0		79			

1.5.3 Technical Approach

A number of different quantitative indicators are used in this report to compare sites within the existing network and to identify areas where the inclusion of new monitoring sites would be most beneficial. The indicators were chosen to represent a number of variables relevant to air pollution: population density, traffic volume, stationary source density, modeled and measured concentrations, etc. However, each indicator is not necessarily of equal importance to the overall analysis, and the relative importance of each indicator should be expected to vary among pollutants. For example, while traffic volume and point source density (i.e., “source-oriented” indicators) may be good predictors of CO, SO₂, and NO₂ concentration, these indicators are less relevant for O₃, a secondary pollutant whose concentration is often reduced via NO_x titration in areas immediately surrounding pollution sources. To reflect this variability among the factors addressed in the assessment, APCD has determined weights of relative importance to use when combining the individual indicators for each parameter assessed.

Decisions regarding the types of indicators used and their weights of relative importance were ultimately based on the purposes, objectives, and priorities of the APCD monitoring network as decided by technical experts and program managers at the APCD. Before beginning the network assessment, the objectives of the network were reviewed and prioritized. The APCD has chosen the following eleven objectives as being those that most accurately define the overall purposes of the network:

1. To determine background concentrations,
2. To establish regulatory compliance,
3. To track pollutant concentration trends,
4. To assess population exposure,
5. To evaluate emissions reductions,
6. To evaluate the accuracy of model predictions,
7. To assist with forecasting,
8. To locate maximum pollutant concentrations,
9. To assure proper spatial coverage of regions,
10. To assist in source apportionment, and
11. To address environmental justice concerns.

Each analytical technique used in the technical assessment was selected to support a specific objective of the overall network. This technical assessment consists of two phases: site-to-site comparisons and suitability modeling. These two assessment phases are briefly described below.

1.5.3.1 Phase I: Site-to-Site Comparisons

Site-by-site comparison analyses, described in detail in Section 2, assign a score to individual monitors according to a specific monitoring purpose. These analyses are good for assessing which monitors might be candidates for modification or removal.

Several steps are involved in a site-by-site analysis:

1. Determine which monitoring purposes are most important,
2. Assess the history of the monitor (including original purposes),
3. Select a list of site-by-site analysis indicators based on purposes and available resources,
4. Weight indicators based on the importance of their related purpose,
5. Score monitors for each indicator,
6. Sum scores and rank monitors, and
7. Examine lowest ranking monitors for possible resource reallocation.

The low-ranking monitors should be examined carefully on a case-by-case basis. There may be regulatory or historical reasons to retain a specific monitor. Also, the site could be made potentially more useful by monitoring a different pollutant or using a different technology.

Table 4 describes the site-to-site comparison analyses used in Section 2 of the assessment.

Table 4. Site-to-site comparison analyses used in this report.

Analysis	Description	Objectives Assessed
Number of Parameters Monitored	Multiple pollution parameters monitored at a site make that site more cost-effective. This analysis is the primary indicator of economic value of a site.	Evaluate model predictions Source apportionment
Trends Impact	This analysis ranks sites by the length of their continuous monitoring records. Monitors that have longer historical records are more valuable for tracking long-term trends.	Track concentration trends Evaluate emissions trends
Measured Concentration	This analysis ranks sites by their design value. Sites measuring higher concentrations are more important from a regulatory perspective.	Locate max concentrations Establish regulatory compliance
Deviation from the NAAQS	This analysis ranks sites by the difference between their design value and the NAAQS. Sites near the NAAQS are considered more important. Sites well above or below the NAAQS do not provide as much information in terms of regulatory compliance.	Establish regulatory compliance Assist with forecasting
Monitor-to-Monitor Correlation	Measured concentrations at one monitor are compared to those measured at other monitors to determine if concentrations correlate temporally. Monitors with lower correlations have more unique value and are ranked higher.	Assure proper spatial coverage
Removal Bias	Measured values for each individual pollutant are interpolated across the entire study area. Sites are systematically removed and the interpolation is repeated. The difference between the measured concentration and the predicted concentration is the site's removal bias. The greater a site's bias, the higher its ranking.	Assure proper spatial coverage Evaluate model predictions
Area Served	Sites are ranked based on their spatial coverage. Sites serving larger areas are ranked higher.	Assure proper spatial coverage Determine background
Population Served	Using the Area Served polygons, the number of people living within each polygon is calculated. Sites serving higher populations are ranked higher.	Assess population exposure
DIC Population Served	The raw Population Served is multiplied by the Disproportionately Impacted Community (DIC) percentile score. Sites serving higher DIC populations are ranked higher.	Assess population exposure Environmental justice
Emissions Inventory	Total annual emissions are aggregated by site using the Area Served polygons. Sites with higher emissions are ranked higher.	Evaluate emissions reductions Locate maximum concentrations
Traffic Counts	Uses current Annual Average Daily Traffic (AADT) data from both highways and major roads within the study area. Area Served polygons are used to assign a traffic volume to each monitoring site. A second indicator of road density is also calculated for each polygon, and a weighted average is created. Sites with higher traffic counts are ranked higher.	Evaluate emissions reductions Locate maximum concentrations

1.5.3.2 Phase II: Suitability Modeling

Suitability modeling, which is described in detail in Section 3, has been conducted to determine areas where the existing monitoring network does not adequately represent potential air pollution problems, and where additional sites are potentially needed. This is considered a “bottom-up” technique, as it examines directly the phenomena that are thought to cause high pollutant concentrations and/or population exposure, such as emissions (traffic and stationary) and population density. For example, emissions inventory data can be used to determine the areas of maximum expected concentrations of pollutants directly emitted (i.e., primary emissions). Emission inventory data are less useful to understand secondary pollutants formed in the atmosphere (i.e., O₃, PM_{2.5}). Suitability models are developed using a series of data maps representing a variety of indicators. The maps are reclassified into a congruous ranking system and organized into three purpose areas: source-oriented, population-oriented, and spatially-oriented. Each area and indicator is then assigned a weight, and the spatial average of each weighted indicator is computed. This spatial average is then used to determine the optimal locations at which new monitors should be deployed. In general, the results of these analyses indicate where monitors are best located based on specific objectives and expected pollutant behavior. However, the development of a useful suitability model relies on a thorough understanding of the phenomena that cause air quality problems, including the often complex source/sink relationships that determine pollutant concentrations in ambient air.

Table 5 describes the indicators used in the suitability model, the results of which are described in Section 3 of the assessment.

Table 5. Suitability model indicators used in this report.

	Analysis	Description	Objectives Assessed
Source - Oriented	Emissions Inventory	Uses the point-source emissions inventory data from Section 2 to identify areas of the highest point source pollution that are least represented by existing monitors.	Evaluate emissions reductions Locate maximum concentrations
	Traffic Counts	Uses traffic density and road density maps from Section 2 to identify areas of the highest traffic pollution that are least represented by existing monitors.	
Population-Oriented	Population Density	Uses population density maps from Section 2 to identify areas of high population density that are least represented by existing monitors.	Assess population exposure Environmental justice
Spatially-Oriented	Distance from an Existing Monitor	Uses the ground distance between existing monitoring sites to identify areas of the state least represented by existing monitors.	Assure proper spatial coverage Determine background
	Interpolation Map	Uses interpolation maps generated with monitoring data to identify areas of high pollutant concentration that are least represented by existing monitors.	Locate max concentrations Establish regulatory compliance Evaluate model predictions

1.5.4 Data Sources

Raw air pollution data for all of the analyses were obtained from the EPA’s Air Quality System (AQS) database. Data were extracted for the five-year period 2020-2024. Yearly and five-year averages were derived from the raw data. Other summary statistics were calculated as needed, such as maximum values

or the fourth-highest 8-hour O₃ concentration at a particular monitoring site. For the monitor-to-monitor correlation study, concentration data was averaged over 24-hour periods for all criteria pollutants. One advantage of averaging data at a single time resolution is that this technique normalizes data that has been collected at differing intervals; e.g., PM₁₀ concentrations that had been collected at 24-hour intervals vs. gaseous pollutant concentrations that are typically reported on an hourly basis.

Population data were obtained from the 2020 U.S. Census and the 2019-2023 American Community Survey (ACS).

Point source emissions data was obtained from the 2024 APCD facilities inventory, which lists reported emissions for over 29,000 permitted facilities within Colorado.

Road data and average annual daily traffic (AADT) counts were obtained from the Colorado Department of Transportation (CDOT). The most current available traffic count data from 2023 were used exclusively in this assessment.

1.5.5 Sites Considered in this Network Assessment

This network assessment takes into account all monitoring sites included in the AQS database and located within Colorado, including those sites operated by the U.S. Forest Service (USFS), the National Park Service (NPS), the Bureau of Land Management (BLM), the Southern Ute Indian Tribe (SUIT), the EPA, and the city of Aspen. Since most analytical assessments take into account the spatial location of existing monitoring sites, it is logical to include sites operated by other agencies, especially since data from these sites are available in the AQS database. Inclusion of these other sites also greatly increases the power of spatial interpolations, which play an important role in this assessment. However, only APCD sites are explicitly evaluated here. Three APCD-operated sites with data in the AQS database are not assessed in this report. These include the Grand Junction – Pitkin and DESC I sites, which do not monitor any criteria pollutants, and the Mines Peak site, which is not designated as a regulatory monitor.

Table 6 lists all of the APCD sites used in this assessment.

Table 6. APCD monitoring sites evaluated in this assessment. Asterisks denote PM_{2.5} monitoring that was initiated in early 2025.

AQS Site Number	Site Name	County	Parameters Monitored						
			O ₃	CO	NO ₂	SO ₂	PM ₁₀	PM _{2.5}	Met
08-001-0010	Birch Street	Adams					X	X	
08-001-3001	Welby	Adams	X		X	X	X	X	X
08-003-0001	Alamosa - ASC	Alamosa					X	X	
08-005-0002	Highland Reservoir	Arapahoe	X						X
08-005-0005	Arapaho Community College	Arapahoe						X	
08-005-0006	Aurora – East	Arapahoe	X						X
08-007-0001	Pagosa Springs School	Archuleta					X	X*	
08-013-0003	Longmont - Municipal Bldg.	Boulder					X	X	
08-013-0014	Boulder Reservoir	Boulder	X						X
08-013-1001	Boulder – CU	Boulder					X	X	
08-019-0006	Mines Peak	Clear Creek	X						
08-031-0002	CAMP	Denver	X		X	X		X	
08-031-0013	National Jewish Health (NJH)	Denver						X	
08-031-0026	La Casa	Denver	X	X	X	X	X	X	X
08-031-0027	I-25 Denver	Denver		X	X			X	X
08-031-0028	I-25 Globeville	Denver			X			X	X
08-035-0004	Chatfield State Park	Douglas	X					X	X
08-041-0013	U.S. Air Force Academy (USAFA)	El Paso	X						
08-041-0016	Manitou Springs	El Paso	X						
08-041-0017	Colorado College	El Paso		X			X	X	
08-043-0003	Cañon City	Fremont					X	X*	
08-045-0012	Rifle – Health Dept.	Garfield	X						
08-047-0003	Black Hawk	Gilpin	X						
08-059-0006	Rocky Flats – N.	Jefferson	X		X				X
08-059-0011	NREL	Jefferson	X						
08-059-0014	Evergreen	Jefferson	X						X
08-069-0009	Fort Collins – CSU	Larimer						X	
08-069-0011	Fort Collins – West	Larimer	X						X
08-069-0015	Fossil Creek	Larimer	X		X				X
08-069-0016	Bethke	Larimer	X		X			X	
08-069-1004	Fort Collins – Mason	Larimer	X	X					X
08-077-0017	Grand Junction (GJ) – Powell Bldg.	Mesa					X	X	
08-077-0018	Grand Junction (GJ) – Pitkin	Mesa							X
08-077-0020	Palisade - Water Treatment	Mesa	X						X
08-083-0006	Cortez – Health Dept.	Montezuma	X						
08-097-0008	Aspen	Pitkin					X	X	
08-099-0002	Lamar - Municipal Bldg.	Prowers					X	X	
08-101-0015	Pueblo – Fountain School	Pueblo					X	X	
08-101-0016	Pueblo West	Pueblo	X						X
08-107-0003	Steamboat Springs	Routt					X	X*	
08-113-0004	Telluride	San Miguel					X	X*	
08-123-0006	Greeley – Hospital	Weld						X	
08-123-0008	Platteville – Middle School	Weld						X	
08-123-0009	Greeley – County Tower	Weld	X	X					X
08-123-0015	La Salle	Weld	X		X				

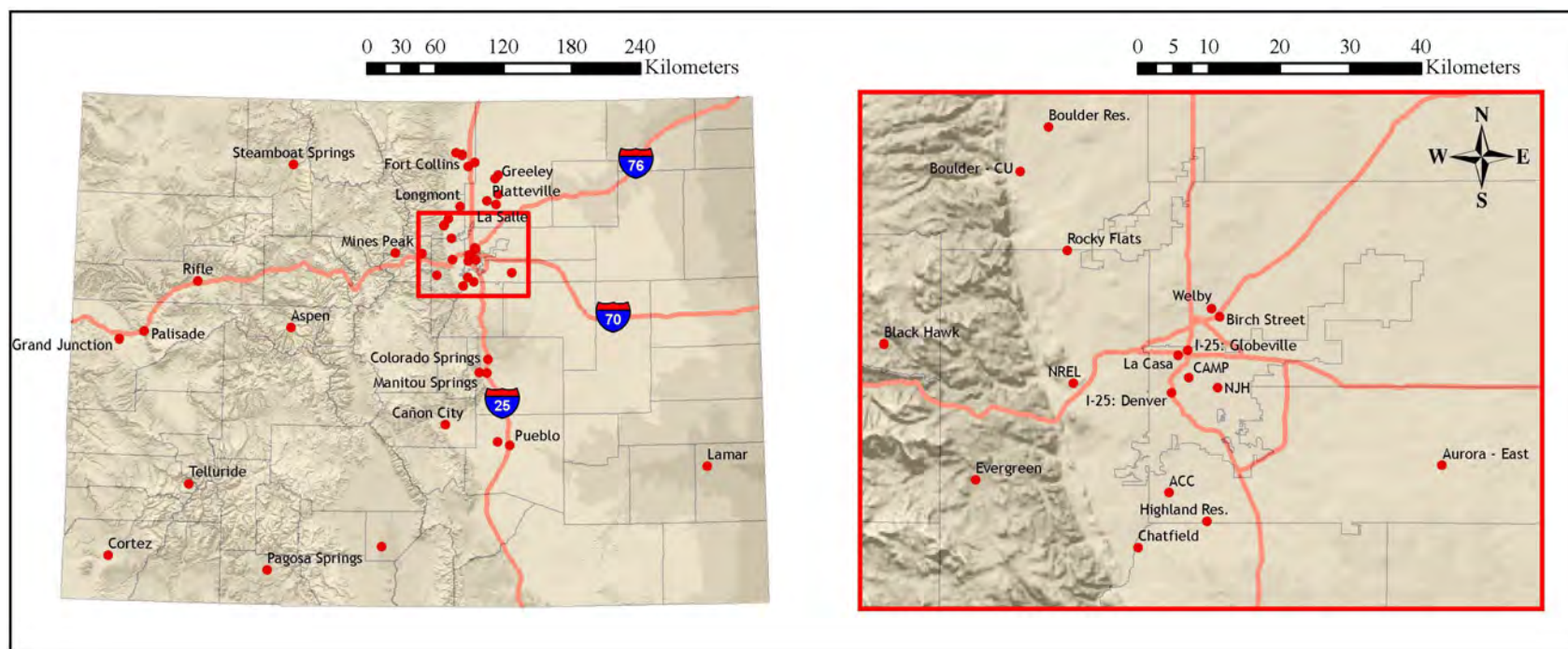


Figure 4. Map of Colorado with an inset map of the Denver metropolitan area showing the location of all monitoring sites operated by the APCD and listed in Table 6. Note that the Mines Peak site is shown on the map, although it has not been assessed in this report on account of its unique monitoring objectives. For the purpose of improving the readability of the map, labels for monitoring sites in Fort Collins, Grand Junction, and Colorado Springs have been combined under a single label. Detailed site information, including AQS identification numbers, site descriptions and histories, addresses and coordinates, monitoring start dates, site elevations, site orientation/scale designations, etc., can be found in Appendix A of this document.

2 SITE-TO-SITE COMPARISONS

In this section, the existing APCD monitoring network is assessed in a series of quantitative site-to-site comparison analyses. Each analysis assigns a score to individual monitors within each network based on a particular indicator (see Table 4). Each indicator is assigned a weight that reflects its overall importance relative to APCD's monitoring objectives and each monitor within each APCD monitoring network is then ranked by the weighted average of the analyses. These rankings are then used for subsequent analyses, including assessing which sites may no longer be needed and can be terminated. Indicators have been chosen to represent a number of different variables; e.g., economic cost-effectiveness, proximity to population and pollution sources, measured and modeled pollutant concentrations, etc. The objective of using many different, often competing, indicators is to provide a comprehensive evaluation technique that attempts to address all of the APCD's monitoring objectives, which are themselves often conflicting; e.g., the assessment of population exposure in areas of maximum pollutant concentrations and the determination of background concentrations are fundamentally different objectives requiring separate monitoring strategies. Weighting factors are used to emphasize indicators of particular relevance within each of the APCD's pollutant monitoring networks.

2.1 Number of Parameters Monitored

This analysis was performed by simply counting the number of parameters (including meteorology) measured at each monitoring site. Sites having the most parameters measured were ranked highest and sites with the same number of parameters measured were ranked equally. The scores were determined using a linear conversion in which the site with the fewest measured parameters was assigned a score of one and the site with the most measured parameters was assigned a maximum score equal to the number of sites in the network (e.g., five for the CO monitoring network).

While criteria pollutants are the primary focus of this analysis, wind speed/direction and temperature difference parameters were also considered, as these data are valuable for forecasting and modeling purposes and thus are entered into the AQS database. Note that many APCD sites also record measurements of other non-criteria pollutants and meteorological parameters such as temperature, barometric pressure, and relative humidity, which have not been considered in this analysis.

By emphasizing the intensity and complementarity of monitoring activities at a given location over the spatial distribution of all monitoring activities, this analysis addresses two of the APCD's monitoring network purposes: model evaluation and source apportionment. Furthermore, sites with collocated measurements of several pollutants are more cost-effective to maintain compared to sites measuring only one or two parameters, making this a good method for assessing a site's relative economic value. The main advantages of this method include its simplicity to perform and its applicability to all pollutant parameters. A disadvantage of the method is that it does not differentiate between different pollutant types and the relative importance of each. For example, it gives the same weight to an O₃ monitor as to a CO monitor, even though O₃ is of much more regulatory concern within the state of Colorado.

2.1.1 Results for All Parameters

Tables 7-12 list each APCD monitoring site in the CO, NO₂, SO₂, O₃, PM₁₀, and PM_{2.5} ambient networks, respectively, along with the total number of parameters monitored at each site and the score associated with each site.

Table 7. All APCD CO monitoring sites ranked by total number of parameters monitored.

Site Name	AQS Number	Total Number of Parameters Monitored	Rank	Score
La Casa	08-031-0026	7	1	5.0
I-25: Denver	08-031-0027	4	2	2.0
Fort Collins - Mason	08-069-1004	3	3	1.0
Colorado College	08-041-0017	3	3	1.0
Greeley - County Tower	08-123-0009	3	3	1.0

Table 8. All APCD NO₂ monitoring sites ranked by total number of parameters monitored.

Site Name	AQS Number	Total Number of Parameters Monitored	Rank	Score
La Casa	08-031-0026	7	1	9.0
Welby	08-001-3001	6	2	7.4
CAMP	08-031-0002	5	3	5.8
I-25: Denver	08-031-0027	4	4	4.2
I-25: Globeville	08-031-0028	3	5	2.6
Rocky Flats - N.	08-059-0006	3	5	2.6
Fossil Creek	08-069-0015	3	5	2.6
Bethke	08-069-0016	3	5	2.6
La Salle	08-123-0015	2	6	1.0

Table 9. All APCD SO₂ monitoring sites ranked by total number of parameters monitored.

Site Name	AQS Number	Total Number of Parameters Monitored	Rank	Score
La Casa	08-031-0026	7	1	3.0
Welby	08-001-3001	6	2	2.0
CAMP	08-031-0002	5	3	1.0

Table 10. All APCD O₃ monitoring sites ranked by total number of parameters monitored.

Site Name	AQS Number	Total Number of Parameters Monitored	Rank	Score
La Casa	08-031-0026	7	1	23.0
Welby	08-001-3001	6	2	19.3
CAMP	08-031-0002	5	3	15.7
Chatfield State Park	08-035-0004	3	4	8.3
Rocky Flats - N.	08-059-0006	3	4	8.3
Fossil Creek	08-069-0015	3	4	8.3
Bethke	08-069-0016	3	4	8.3
Fort Collins - Mason	08-069-1004	3	4	8.3
Greeley - County Tower	08-123-0009	3	4	8.3
Highland Reservoir	08-005-0002	2	5	4.7
Aurora - East	08-005-0006	2	5	4.7
Boulder Reservoir	08-013-0014	2	5	4.7
Evergreen	08-059-0014	2	5	4.7
Fort Collins - West	08-069-0011	2	5	4.7
Palisade Water Treatment	08-077-0020	2	5	4.7
Pueblo West	08-101-0016	2	5	4.7
La Salle	08-123-0015	2	5	4.7
USAFA	08-041-0013	1	6	1.0
Manitou Springs	08-041-0016	1	6	1.0
Rifle - Health Dept.	08-045-0012	1	6	1.0
Black Hawk	08-047-0003	1	6	1.0
NREL	08-059-0011	1	6	1.0
Cortez - Health Dept.	08-083-0006	1	6	1.0

Table 11. All APCD PM₁₀ monitoring sites ranked by total number of parameters monitored.

Site Name	AQS Number	Total Number of Parameters Monitored	Rank	Score
La Casa	08-031-0026	7	1	16.0
Welby	08-001-3001	6	2	13.5
CAMP	08-031-0002	5	3	11.0
Colorado College	08-041-0017	3	4	6.0
Birch Street	08-001-0010	2	5	3.5
Alamosa - ASC	08-003-0001	2	5	3.5
Longmont - Municipal Bldg.	08-013-0003	2	5	3.5
Boulder - CU	08-013-1001	2	5	3.5
Grand Junction - Powell Bldg.	08-077-0017	2	5	3.5
Lamar - Municipal Bldg.	08-099-0002	2	5	3.5
Pueblo - Fountain School	08-101-0015	2	5	3.5
Pagosa Springs School	08-007-0001	1	6	1.0
Cañon City - City Hall	08-043-0003	1	6	1.0
Steamboat Springs	08-107-0003	1	6	1.0
Telluride	08-113-0004	1	6	1.0

Table 12. All APCD PM_{2.5} monitoring sites ranked by total number of parameters monitored.

Site Name	AQS Number	Total Number of Parameters Monitored	Rank	Score
La Casa	08-031-0026	7	1	21.0
Welby	08-001-3001	6	2	17.67
CAMP	08-031-0002	5	3	14.33
I-25: Denver	08-031-0027	4	4	11.00
I-25: Globeville	08-031-0028	3	5	7.67
Chatfield State Park	08-035-0004	3	5	7.67
Colorado College	08-041-0017	3	5	7.67
Bethke	08-069-0016	3	5	7.67
Birch Street	08-001-0010	2	6	4.33
Alamosa - ASC	08-003-0001	2	6	4.33
Longmont - Municipal Bldg.	08-013-0003	2	6	4.33
Boulder - CU	08-013-1001	2	6	4.33
Grand Junction - Powell Bldg.	08-077-0017	2	6	4.33
Aspen	08-097-0008	2	6	4.33
Lamar - Municipal Bldg.	08-099-0002	2	6	4.33
Pueblo - Fountain School	08-101-0015	2	6	4.33
Arapaho Community College	08-005-0005	1	7	1.0
National Jewish Health (NJH)	08-031-0013	1	7	1.0
Fort Collins - CSU	08-069-0009	1	7	1.0
Greeley - Hospital	08-123-0006	1	7	1.0
Platteville - Middle School	08-123-0008	1	7	1.0

2.2 Trends Impact

In this analysis, monitoring sites in each network were ranked based on the length of their continuous measurement record for the pollutant of interest. Sites possessing an extended historical record are valuable for tracking long-term pollutant trends, and the continuation of these long uninterrupted records is deemed desirable. Therefore, those monitors with the longest uninterrupted historical records were scored the highest, while monitors with records of equal length were scored equally.

This analysis simply considers the number of years that a monitor has been operating continuously. Note that if a monitor had alternating periods of operation, then only the most recent operating period is considered.

This analysis is valuable in that it addresses two of the APCD's monitoring network purposes: trend tracking and emission reduction evaluation. The main advantages of this method are its simplistic analytical approach and its usefulness for identifying sites that provide a basis for assessing long-term trends. The main disadvantages of the method are: (1) the magnitude and direction of past trends are not necessarily good predictors of future trends due to potential changes in population or emissions, and (2) the length of a continuous record does not ensure that data are of good quality throughout the entire time period.

2.2.1 Results for all Parameters

Tables 13-18 list each APCD monitoring site in the CO, NO₂, SO₂, O₃, PM₁₀, and PM_{2.5} ambient networks, respectively, along with the total number of years (rounded to the nearest integer) that the site has been monitoring the pollutant of interest and the score associated with each site

Table 13. All APCD CO monitoring sites ranked by length of monitoring record.

Site Name	Length of Continuous Monitoring Record (years)	Rank	Score
Fort Collins - Mason	44	1	5.0
La Casa	11	2	2.0
I-25: Denver	11	3	2.0
Greeley - Weld County Tower	9	4	1.8
Colorado College	0	5	1.0

Table 14. All APCD NO₂ monitoring sites ranked by length of monitoring record.

Site Name	Length of Continuous Monitoring Record (years)	Rank	Score
CAMP	59	1	9.0
Welby	48	2	7.5
Rocky Flats - N.	29	3	4.9
I-25: Denver	11	4	2.5
La Casa	10	5	2.4
I-25: Globeville	9	6	2.2
Fossil Creek	0	7	1.0
Bethke	0	8	1.0
La Salle	0	9	1.0

Table 15. All APCD SO₂ monitoring sites ranked by length of monitoring record.

Site Name	Length of Continuous Monitoring Record (years)	Rank	Score
CAMP	59	1	3.0
Welby	51	2	2.7
La Casa	11	3	1.0

Table 16. All APCD O₃ monitoring sites ranked by length of monitoring record.

Site Name	Length of Continuous Monitoring Record (years)	Rank	Score
CAMP	52	1	23.0
Welby	51	2	22.6
Highland Reservoir	46	3	20.5
Fort Collins - Mason	44	4	19.6
Rocky Flats - N.	32	5	14.5
NREL	30	6	13.7
USAFA	28	7	12.8
Greeley - Weld County Tower	22	8	10.3
Chatfield State Park	20	9	9.5
Manitou Springs	20	10	9.5
Fort Collins - West	18	10	8.6
Rifle - Health Dept.	16	11	7.8
Palisade Water Treatment	16	12	7.8
Cortez - Health Dept.	16	12	7.8
Aurora - East	15	12	7.3
La Casa	11	13	5.7
Boulder Reservoir	8	14	4.4
Black Hawk	5	15	3.1
Evergreen	4	16	2.7
Pueblo West	1	17	1.4
Fossil Creek	0	18	1.0
Bethke	0	19	1.0
La Salle	0	20	1.0

Table 17. All APCD PM₁₀ monitoring sites ranked by length of monitoring record.

Site Name	Length of Continuous Monitoring Record (years)	Rank	Score
Pagosa Springs School	39	1	16.0
Longmont - Municipal Bldg.	39	1	16.0
Welby	38	2	15.6
CAMP	38	2	15.6
Lamar - Municipal Bldg.	38	2	15.6
Steamboat Springs	38	2	15.6
Alamosa - ASC	35	3	14.4
Telluride	34	4	14.0
Grand Junction - Powell Bldg.	22	5	9.3
Cañon City - City Hall	20	6	8.5
Colorado College	16	7	6.9
Pueblo - Fountain School	15	8	6.5
La Casa	12	9	5.3
Aspen	9	10	4.2
Birch Street	3	11	1.8
Boulder - CU	1	12	1.0

Table 18. All APCD PM_{2.5} monitoring sites ranked by length of monitoring record.

Site Name	Length of Continuous Monitoring Record (years)	Rank	Score
Arapaho Community College (ACC)	25	1	21.0
Longmont - Municipal Bldg.	25	1	21.0
CAMP	25	1	21.0
National Jewish Health (NJH)	25	1	21.0
Fort Collins - CSU	25	1	21.0
Greeley - Hospital	25	1	21.0
Platteville - Middle School	25	1	21.0
Grand Junction - Powell Bldg.	22	2	18.6
Chatfield State Park	19	3	16.2
Colorado College	16	4	13.8
Pueblo - Fountain School	15	5	13.0
La Casa	12	6	10.6
I-25: Denver	10	7	9.0
I-25: Globeville	9	8	8.2
Birch Street	3	9	3.4
Alamosa - ASC	1	10	1.8
Boulder - CU	1	10	1.8
Lamar - Municipal Bldg.	1	10	1.8
Welby	0	11	1.0
Bethke	0	11	1.0
Aspen	0	11	1.0

2.3 Measured Concentrations

This analysis ranks monitors by the magnitude of pollutant concentrations that they measure. The indicator is based on each monitoring site's design value, which is generally the highest concentration measured over a particular averaging interval in a given year (Table 19). Monitors with higher design values are ranked higher than those with lower design values. The assumption of this analysis is that sites measuring high concentrations are more important for determining NAAQS compliance and assessing population exposure. A drawback of this analysis is that it does not consider monitor siting issues, as a monitor located in a high concentration area may not measure maximum potential concentrations if it has not been sited optimally. Furthermore, because this analysis focuses only on those monitors measuring high concentrations, which are often urban monitors located in high-population areas, it does not take into account low-concentration monitors that are important for other reasons, such as rural monitors that measure background pollutant concentrations and assure appropriate spatial coverage.

Table 19. National Ambient Air Quality Standards (NAAQS) for the criteria pollutants assessed in this report. Primary standards provide public health protection, while secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Units of measure are parts per million (ppm) by volume, parts per billion (ppb) by volume, and micrograms per cubic meter ($\mu\text{g m}^{-3}$)

Pollutant	Primary / Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)	Primary	8-hr	9 ppm	Not to be exceeded more than once per year
		1-hr	35 ppm	
Lead (Pb)	Primary and Secondary	Rolling 3-month average	$0.15 \mu\text{g m}^{-3}$	Not to be exceeded
Nitrogen Dioxide (NO_2)	Primary	1-hr	100 ppb	98 th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Primary and Secondary	Annual	53 ppb	Annual mean
Sulfur Dioxide (SO_2)	Primary	1-hr	75 ppb	99 th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3-hr	0.5 ppm	Not to be exceeded more than once per year
Ozone (O_3)	Primary and Secondary	8-hr	0.070 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
PM_{10}	Primary and Secondary	24-hr	$150 \mu\text{g m}^{-3}$	Not to be exceeded more than once per year on average over 3 years
$\text{PM}_{2.5}$	Primary	Annual	$9 \mu\text{g m}^{-3}$	Annual mean, averaged over 3 years
	Secondary	Annual	$15 \mu\text{g m}^{-3}$	Annual mean, averaged over 3 years
	Primary and Secondary	24-hr	$35 \mu\text{g m}^{-3}$	98 th percentile, averaged over 3 years

2.3.1 Results for All Parameters

Tables 20-25 list each APCD monitoring site in the CO, NO_2 , SO_2 , O_3 , PM_{10} , and $\text{PM}_{2.5}$ ambient networks, respectively, along with the annual design values measured during the period 2022 - 2024, the average design value for that period, and the score associated with each site.

Table 20. All APCD CO monitoring sites ranked by design value.

Site Name	Max 1-Hour Concentration (ppm)				Rank	Score
	2022	2023	2024	Three-Year Average		
I-25: Denver	2.47	2.45	3.65	2.86	1	5.00
Fort Collins - Mason	2.33	1.83	2.02	2.06	2	3.11
La Casa	1.45	2.08	2.13	1.89	3	2.71
Greeley - County Tower	1.27	1.15	1.52	1.31	4	1.36
Colorado College	-	-	1.16	1.16	5	1.00

Table 21. All APCD NO₂ monitoring sites ranked by design value.

Site Name	98 th Percentile of 1-Hour Daily Max Concentrations (ppb)				Rank	Score
	2022	2023	2024	Three-Year Average		
I-25: Globeville	63.4	64.5	59.6	62.5	1	9.00
CAMP	58.1	65.7	57.0	60.3	2	8.52
I-25: Denver	60.4	61.5	56.3	59.4	3	8.34
Welby	57.3	56.2	51.4	55.0	4	7.40
La Casa	54.1	55.2	50.0	53.1	5	7.00
La Salle	-	-	36.0	36.0	6	3.36
Fossil Creek	-	-	32.3	32.3	7	2.57
Bethke	-	-	31.7	31.7	8	2.44
Rocky Flats - N.	25.7	31.5	17.6	24.9	9	1.00

Table 22. All APCD SO₂ monitoring sites ranked by design value.

Site Name	99 th Percentile of 1-Hour Daily Max Concentrations (ppb)				Rank	Score
	2022	2023	2024	Three-Year Average		
Welby	5.7	5.6	4.10	5.1	1	3.0
La Casa	4.8	4.7	5.20	4.9	2	1.9
CAMP	4.3	4.9	4.90	4.7	3	1.0

Table 23. All APCD O₃ monitoring sites ranked by design value.

Site Name	4 th Highest 8-hr Daily Max Concentration (ppm)				Rank	Score
	2022	2023	2024	Three-Year Average		
Fossil Creek	-	-	0.084	0.084	1	23.00
Rocky Flats - N.	0.078	0.077	0.088	0.081	2	20.36
Chatfield State Park	0.078	0.076	0.088	0.080	3	20.07
NREL	0.077	0.074	0.086	0.079	4	18.60
La Salle	-	-	0.079	0.079	4	18.60
Bethke	-	-	0.078	0.078	8	17.72
Evergreen	0.074	0.074	0.085	0.077	6	17.43
Welby	0.075	0.070	0.083	0.076	7	15.96
Boulder Reservoir	0.072	0.071	0.084	0.075	8	15.67
Fort Collins - West	0.073	0.071	0.083	0.075	8	15.67
La Casa	0.072	0.070	0.084	0.075	9	15.37
Aurora - East	0.070	0.073	0.081	0.074	10	14.79
Black Hawk	0.071	0.073	0.079	0.074	11	14.49
Highland Reservoir	0.073	0.075	0.073	0.073	12	13.91
CAMP	0.071	0.070	0.079	0.073	13	13.61
Manitou Springs	0.068	0.069	0.082	0.073	14	13.32
Fort Collins - Mason	0.070	0.067	0.082	0.073	14	13.32
Greeley - Weld County Tower	0.070	0.068	0.081	0.073	14	13.32
Pueblo West	-	0.067	0.076	0.071	15	12.00
U.S. Air Force Academy (USAFA)	0.069	0.064	0.078	0.070	16	10.97
Palisade Water Treatment	0.062	0.061	0.067	0.063	17	4.81
Cortez - Health Dept.	0.062	0.059	0.065	0.062	18	3.64
Rifle - Health Dept.	0.059	0.055	0.063	0.059	19	1.00

Table 24. All APCD PM₁₀ monitoring sites ranked by design value.

Site Name	Max 24-Hour Concentration ($\mu\text{g m}^{-3}$)				Rank	Score
	2022	2023	2024	Three-Year Average		
Lamar - Municipal Bldg.	451	160	101	237	1	16.0
Pagosa Springs School	373	193	77	214	2	14.2
Birch Street	114	98	142	118	3	6.7
Pueblo - Fountain School	195	64	84	114	4	6.4
Welby	100	95	140	112	5	6.2
Alamosa - ASC	-	70	150	110	6	6.1
Cañon City - City Hall	108	95	73	92	7	4.7
Telluride	89	62	72	74	8	3.3
Aspen	70	56	82	69	9	2.9
CAMP	64	73	68	68	10	2.8
Longmont - Municipal Bldg.	55	41	92	63	11	2.4
Grand Junction - Powell Bldg.	73	63	50	62	12	2.3
Steamboat Springs	46	69	60	58	13	2.0
La Casa	51	49	65	55	14	1.8
Boulder - CU	-	35	73	54	15	1.7
Colorado College	60	33	42	45	16	1.0

Table 25. All APCD PM_{2.5} monitoring sites ranked by design value.

Site Name	98 th Percentile of 24-Hour Concentrations ($\mu\text{g m}^{-3}$)				Rank	Score
	2022	2023	2024	Three-Year Average		
Platteville - Middle School	20.4	21.9	24.8	22.4	1	21.0
Greeley - Hospital	22.1	23.3	20.6	22.0	2	20.2
Welby	-	-	21.6	21.6	3	19.4
Birch Street	16.4	23.7	21.5	20.5	4	17.1
I-25: Globeville	17.2	23.0	19.2	19.8	5	15.5
Longmont - Municipal Bldg.	16.2	17.8	23.5	19.2	6	14.2
Fort Collins - CSU	17.4	18.2	20.5	18.7	7	13.2
CAMP	15.7	21.9	17.3	18.3	8	12.3
I-25: Denver	12.6	19.2	21.2	17.7	9	11.0
La Casa	14.8	16.6	18.3	16.6	10	8.6
National Jewish Health (NJH)	13.9	16.3	18.5	16.2	11	7.9
Alamosa - ASC	-	17.8	12.8	15.3	12	5.9
Arapaho Community College (ACC)	11.0	16.0	17.5	14.8	13	4.9
Boulder - CU	-	12.3	17.2	14.8	14	4.7
Lamar - Municipal Bldg.	-	9.6	18.6	14.1	15	3.3
Colorado College	12.0	13.3	16.5	13.9	16	3.0
Chatfield State Park	11.4	13.1	16.8	13.8	17	2.6
Bethke	-	-	13.4	13.4	18	1.9
Grand Junction - Powell Bldg.	14.8	10.2	14.1	13.03	19	2.05
Pueblo - Fountain School	16.2	10.4	12.5	13.03	19	2.05
Aspen	-	-	13.0	13.00	20	1.00

2.4 Deviation from the NAAQS

In this analysis, sites that measure design values close to the NAAQS exceedance threshold (Table 19) are ranked higher than those sites with design values well above or below it. Sites that are closest to the threshold are considered most valuable for the purpose of determining compliance with the NAAQS, whereas sites measuring values well above or below the NAAQS do not provide as much information in this regard. The purpose of this technique is to give weight to those sites that are closest to the standard; therefore, the absolute value of the difference between the measured design value and the standard is used to score each monitor. Monitors with the smallest absolute difference will rank as most important. This analysis has a disadvantage in that monitors with design values higher than the standard (i.e., those in violation of the standard) may be considered more valuable from the standpoint of compliance and public health than those with design values lower than the standard, but with a similar absolute difference. The objectives assessed by this analysis are regulatory compliance and forecasting assistance.

Design values for APCD monitoring sites are typically well below the NAAQS for most criteria pollutants, making this indicator redundant with the Measured Concentrations indicator for those networks. For this reason, the Deviation from the NAAQS indicator was applied only to the O₃ monitoring network, as this is the only network having sites with design values both above and below the NAAQS.

2.4.1 Results for all Parameters

Table 26 lists each APCD monitoring site in the O₃ ambient network, showing the average design value for the period 2022-2024, the difference between the average design values and the level of the NAAQS, and the score associated with each site.

Table 26. All APCD O₃ monitoring sites ranked by deviation from the primary O₃ NAAQS.

Site Name	3-Year Average Design Value (ppm)	NAAQS (ppb)	Deviation	Rank	Score
U.S. Air Force Academy (USAFA)	0.070	70	0.000	1	23.00
Pueblo West	0.072	70	0.002	2	21.12
Manitou Springs	0.073	70	0.003	3	18.71
Fort Collins - Mason	0.073	70	0.003	3	18.71
Greeley - Weld County Tower	0.073	70	0.003	3	18.71
CAMP	0.073	70	0.003	4	18.17
Highland Reservoir	0.074	70	0.004	5	17.63
Black Hawk	0.074	70	0.004	6	16.56
Aurora - East	0.075	70	0.005	7	16.02
La Casa	0.075	70	0.005	8	14.95
Boulder Reservoir	0.076	70	0.006	9	14.41
Fort Collins - West	0.076	70	0.006	9	14.41
Welby	0.076	70	0.006	10	13.88
Palisade Water Treatment	0.063	70	0.007	11	12.80
Evergreen	0.078	70	0.008	12	11.20
Bethke	0.078	70	0.008	13	10.66
Cortez - Health Dept.	0.062	70	0.008	13	10.66
NREL	0.079	70	0.009	14	9.05
La Salle	0.079	70	0.009	14	9.05
Chatfield State Park	0.081	70	0.011	15	6.37
Rifle - Health Dept.	0.059	70	0.011	16	5.83
Rocky Flats - N.	0.081	70	0.011	16	5.83
Fossil Creek	0.084	70	0.014	17	1.00

2.5 Monitor-to-Monitor Correlation

In this analysis, sites are ranked based on the correlation of their measured concentrations with those of the other monitors in the network. Monitors measuring concentrations that correlate well with those measured at other sites are considered redundant and are consequently assigned a lower ranking. Monitors with concentrations that do not correlate with other monitors are considered unique, and as such have more value for spatial monitoring objectives and are therefore assigned a higher ranking. The advantages of this method are: (1) it gives a measure of the site's uniqueness and representativeness, and (2) it is useful for identifying redundant sites. The disadvantages are that it requires large amounts of data with a high data completeness rate, and that the correlations are likely pollutant specific. The objectives assessed by this analysis are model evaluation, spatial coverage, and interpolation.

To conduct this analysis, 24-hour average concentration values were compiled for each criteria parameter monitored within Colorado for the period 2020-2024. Data obtained from sites in Colorado operated by other federal, local, and tribal agencies were considered in this analysis to ensure a spatially robust sample; however, the correlations observed between these sites and those in the APCD network are not considered when ranking the APCD monitors. The concentrations measured at each monitoring site were compared to those measured at every other monitoring site in the state using a matrix format, in which each monitoring pair was subjected to linear regression from which a Pearson correlation coefficient (r^2) was generated. The maximum correlation was then recorded for each site, as well as the number of sites well-correlated with that site. It is assumed here that sites having an r^2 value of 0.6 or greater are well-correlated. Sites were ranked based on both their maximum correlation and the number of sites well-correlated with them. A distance matrix was also developed, and a correlogram plot of distance vs. correlation was created for each parameter.

2.5.1 Carbon Monoxide (CO)

Table 27. CO monitor-to-monitor correlation analysis scores.

Site Name	Max. Correlation		$r^2 \geq 0.6$		Average Rank	Score
	Value	Score	No. of Sites	Score		
Colorado College	0.607	5.0	1	5	1	5.00
Greeley - Weld County Tower	0.745	2.4	1	5	2	3.71
La Casa	0.821	1.0	1	5	3	3.00
I-25: Denver	0.821	1.0	1	5	3	3.00
Fort Collins - Mason	0.745	2.4	2	1	4	1.71

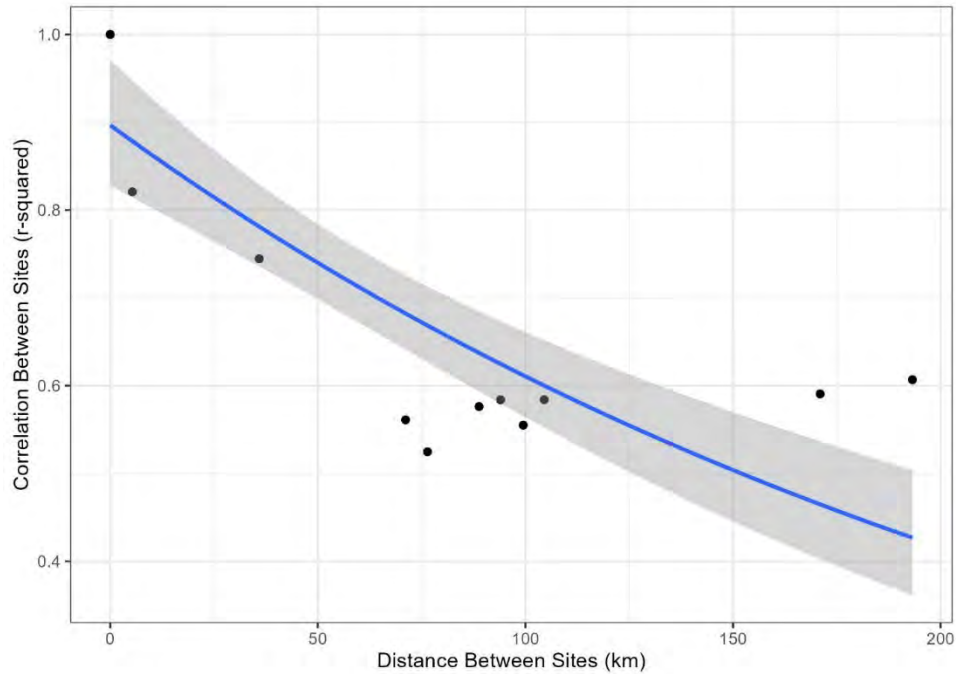


Figure 5. Correlogram for all CO monitoring sites in Colorado.

2.5.2 Nitrogen Dioxide (NO₂)

Table 28. NO₂ monitor-to-monitor correlation analysis scores.

Site Name	Max. Correlation		$r^2 \geq 0.6$		Average Rank	Score
	Value	Score	No. of Sites	Score		
Rocky Flats - N.	0.37	9.00	0	9.00	1	9.00
La Salle	0.80	2.32	3	5.57	2	3.95
CAMP	0.85	1.58	4	4.43	3	3.00
I-25: Globeville	0.86	1.36	5	3.29	4	2.32
Fossil Creek	0.89	1.00	5	3.29	5	2.14
La Casa	0.85	1.58	6	2.14	6	1.86
I-25: Denver	0.86	1.36	6	2.14	7	1.75
Bethke	0.89	1.00	6	2.14	8	1.57
Welby	0.82	2.00	7	1.00	9	1.50

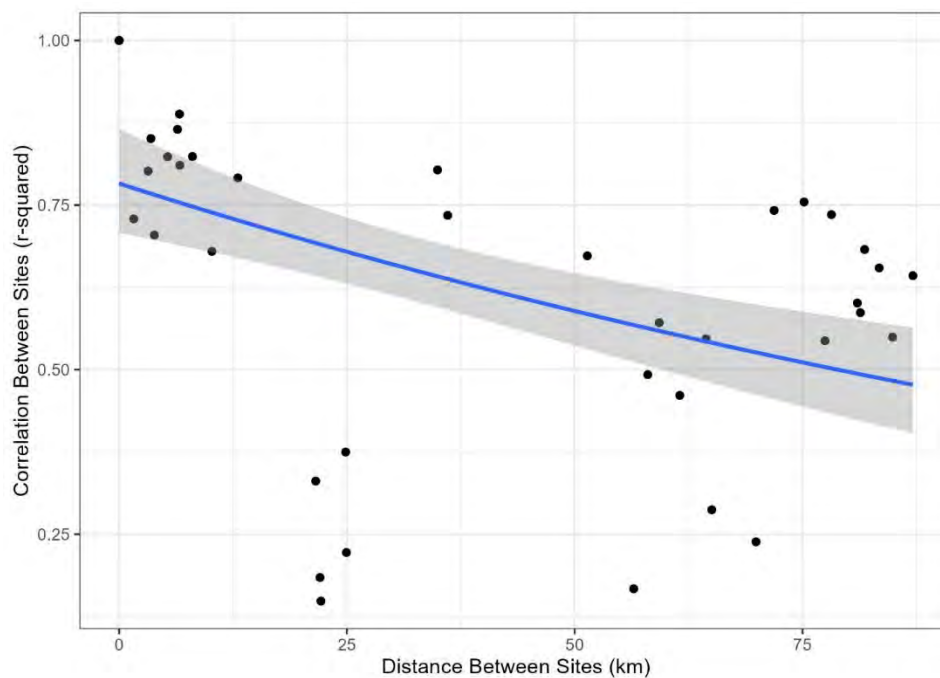
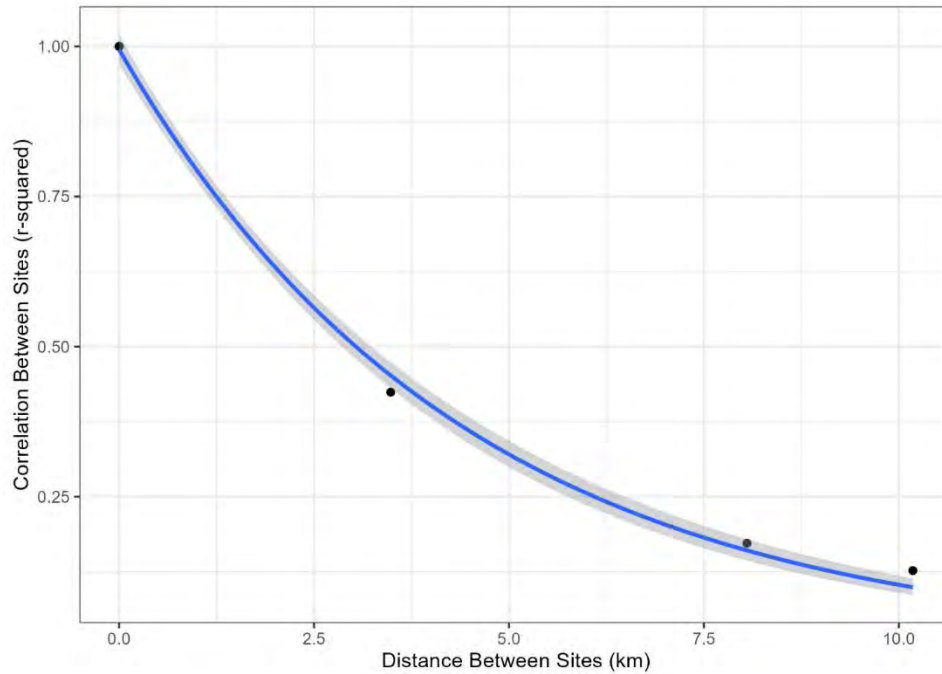


Figure 6. Correlogram for all NO₂ monitoring sites in Colorado.

2.5.3 Sulfur Dioxide (SO₂)

Table 29. SO₂ monitor-to-monitor correlation analysis scores.

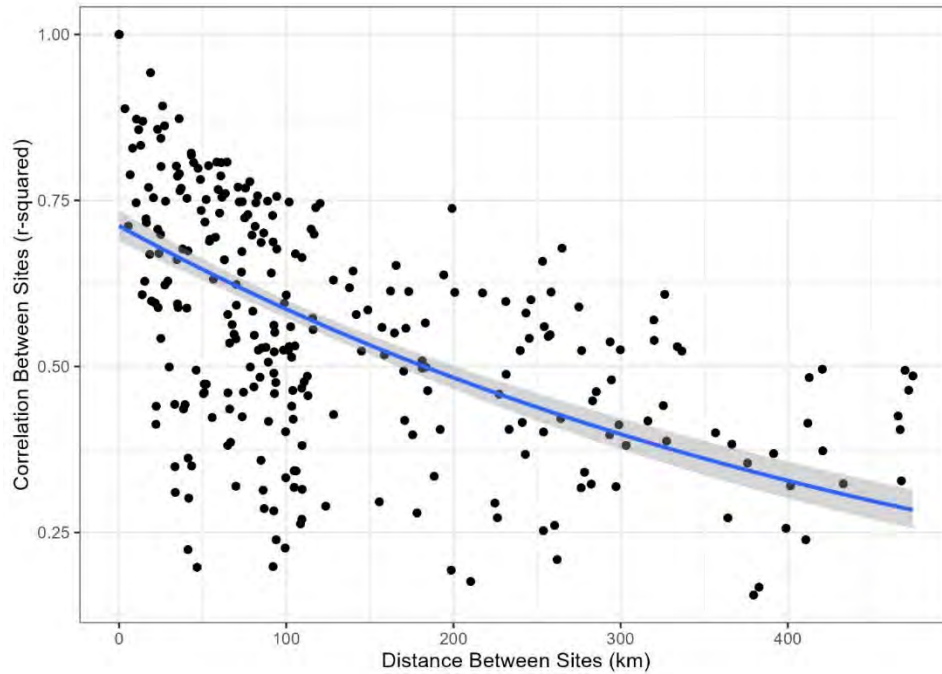
Site Name	Max. Correlation		$r^2 \geq 0.6$		Average Rank	Score
	Value	Score	No. of Sites	Score		
Welby	0.172	3.0	0	-	1	3.0
CAMP	0.424	1.0	0	-	2	1.0
La Casa	0.424	1.0	0	-	2	1.0

Figure 7. Correlogram for all SO₂ monitoring sites in Colorado.

2.5.4 Ozone (O₃)

Table 30. O₃ monitor-to-monitor correlation analysis scores.

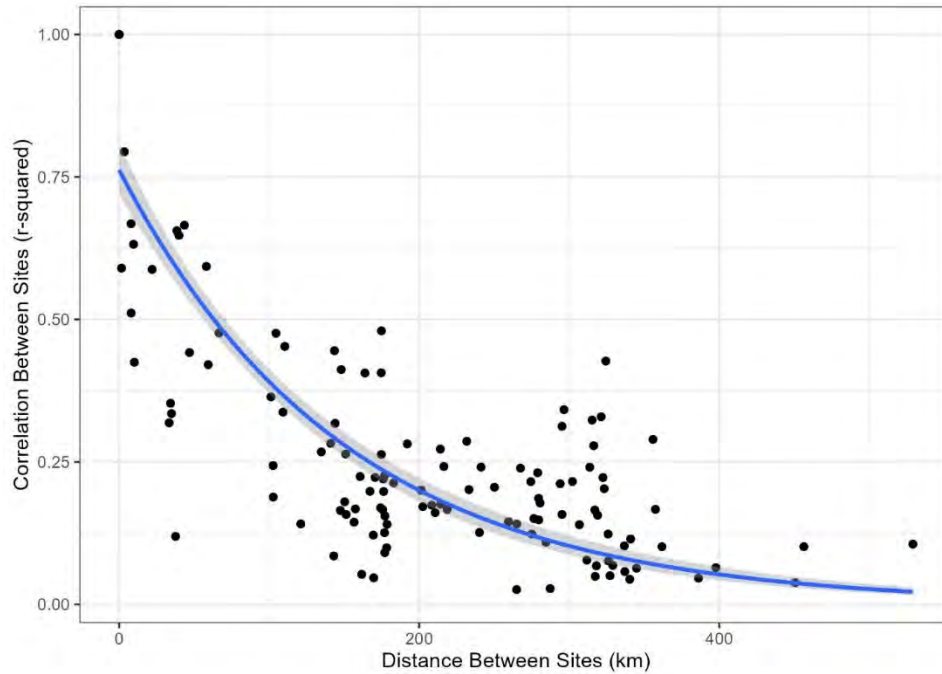
Site Name	Max. Correlation		$r^2 \geq 0.6$		Average Rank	Score
	Value	Score	No. of Sites	Score		
U.S. Air Force Academy (USAFA)	0.64	23.0	4	18.9	1	20.9
Evergreen	0.71	18.3	1	23.0	2	20.6
Black Hawk	0.71	18.3	3	20.3	3	19.3
Cortez - Health Dept.	0.74	16.0	2	21.6	4	18.8
Pueblo West	0.66	21.6	8	13.4	5	17.5
Palisade Water Treatment	0.81	10.9	3	20.3	6	15.6
Rifle - Health Dept.	0.81	10.9	4	18.9	7	14.9
Manitou Springs	0.75	15.3	10	10.6	8	12.9
Aurora - East	0.81	10.9	9	12.0	9	11.5
Welby	0.83	9.3	8	13.4	10	11.4
Highland Reservoir	0.87	6.1	9	12.0	11	9.1
Fort Collins - Mason	0.87	6.1	9	12.0	12	9.0
Greeley - Weld County Tower	0.89	4.7	9	12.0	13	8.3
Fort Collins - West	0.81	10.9	14	5.1	14	8.0
Fossil Creek	0.89	4.7	11	9.3	15	7.0
La Salle	0.87	6.4	13	6.5	16	6.4
Chatfield State Park	0.87	6.1	13	6.5	17	6.3
Bethke	0.86	7.2	14	5.1	18	6.2
Boulder Reservoir	0.81	10.9	17	1.0	19	5.9
Rocky Flats - N.	0.94	1.0	10	10.6	20	5.8
NREL	0.94	1.0	10	10.6	20	5.8
La Casa	0.89	5.0	13	6.5	21	5.7
CAMP	0.89	5.0	16	2.4	21	3.7

Figure 8. Correlogram for all O₃ monitoring sites in Colorado.

2.5.5 PM₁₀

Table 31. PM₁₀ monitor-to-monitor correlation analysis scores.

Site Name	Max. Correlation		$r^2 \geq 0.6$		Average Rank	Score
	Value	Score	No. of Sites	Score		
Pagosa Springs School	0.24	16.0	0	16.0	1	16.0
Alamosa - ASC	0.32	14.0	0	16.0	2	15.0
Telluride	0.41	11.6	0	16.0	3	13.8
Lamar - Municipal Bldg.	0.41	11.6	0	16.0	3	13.8
Grand Junction - Powell Bldg.	0.43	11.0	0	16.0	4	13.5
Aspen	0.45	10.5	0	16.0	5	13.3
Steamboat Springs	0.45	10.5	0	16.0	5	13.3
Pueblo - Fountain School	0.48	9.7	0	16.0	6	12.8
Boulder - CU	0.59	6.6	0	16.0	7	11.3
Colorado College	0.59	6.5	0	16.0	8	11.2
Cañon City - City Hall	0.59	6.5	0	16.0	8	11.2
Welby	0.66	4.8	1	11.0	9	7.9
CAMP	0.79	1.0	2	6.0	10	3.5
Longmont - Municipal Bldg.	0.67	4.5	3	1.0	11	2.8
Birch Street	0.67	4.4	3	1.0	12	2.7
La Casa	0.79	1.0	3	1.0	13	1.0

Figure 9. Correlogram for all PM₁₀ monitoring sites in Colorado.

2.5.6 PM_{2.5}

Table 32. PM_{2.5} monitor-to-monitor correlation analysis scores.

Site Name	Max. Correlation		$r^2 \geq 0.6$		Average Rank	Score
	Value	Score	No. of Sites	Score		
Grand Junction - Powell Bldg.	0.38	21.0	0	21.0	1	21.0
Alamosa - ASC	0.38	20.8	0	21.0	2	20.9
Aspen	0.41	20.0	0	21.0	3	20.5
Pueblo - Fountain School	0.54	15.7	0	21.0	4	18.4
Lamar - Municipal Bldg.	0.60	13.7	0	21.0	5	17.4
Colorado College	0.65	12.0	1	19.6	6	15.8
Bethke	0.71	9.8	3	16.7	7	13.3
Greeley - Hospital	0.73	9.3	5	13.9	8	11.6
Fort Collins - CSU	0.80	7.0	5	13.9	9	10.4
I-25: Denver	0.77	8.0	7	11.0	10	9.5
Platteville - Middle School	0.84	5.5	6	12.4	11	9.0
Chatfield State Park	0.86	4.8	6	12.4	12	8.6
Boulder - CU	0.83	5.8	8	9.6	13	7.7
Arapaho Community College (ACC)	0.86	4.8	8	9.6	14	7.2
Longmont - Municipal Bldg.	0.80	6.9	10	6.7	15	6.8
I-25: Globeville	0.89	3.9	8	9.6	16	6.7
CAMP	0.89	3.9	10	6.7	17	5.3
National Jewish Health (NJH)	0.93	2.5	10	6.7	18	4.6
La Casa	0.93	2.5	11	5.3	19	3.9
Birch Street	0.98	1.0	10	6.7	20	3.9
Welby	0.98	1.0	14	1.0	21	1.0

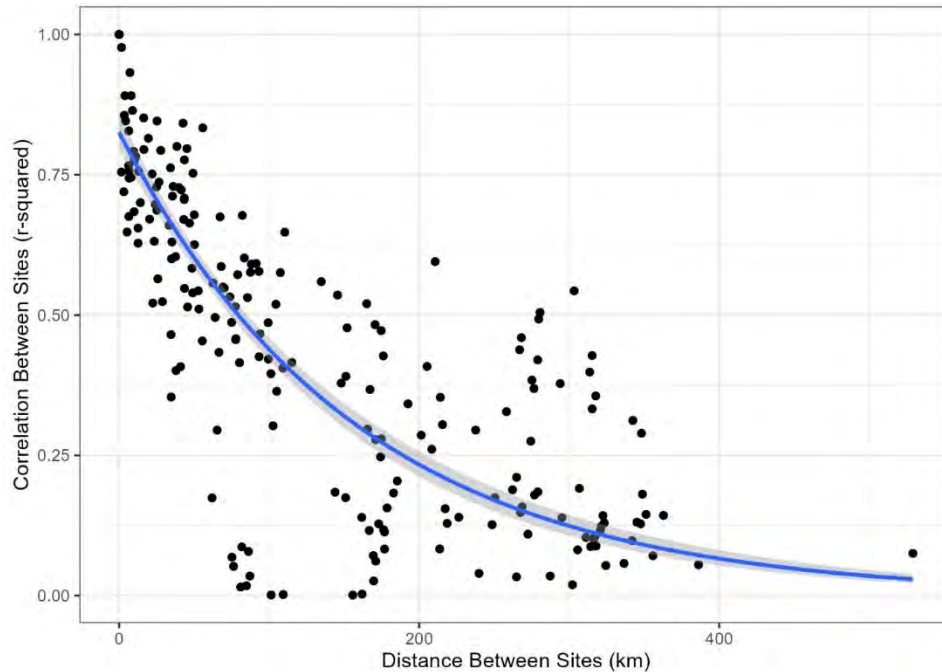


Figure 10. Correlogram for all PM_{2.5} monitoring sites in Colorado.

2.6 Removal Bias

This analysis evaluates the contribution of each monitoring site to the creation of an interpolation map. For each pollutant parameter, an interpolation map is created using all CDPHE monitoring data. Each APCD monitoring site is then systematically removed from the dataset and the interpolation map is regenerated. The difference between the actual value measured at the monitoring site and the predicted value from the interpolation once the site was removed is recorded; this is the removal bias. Sites are then ranked using the absolute value of the difference, with higher values being given higher rankings.

Five-year (2020-2024) average concentration values have been used in this analysis for each pollutant parameter, thus this analysis focuses on the long-term contributions that each site makes in determining the monitored pollution surface. The removal bias technique would likely result in a different interpretation if a different temporal scale were used; however, this network assessment has other analysis techniques that focus on shorter averaging periods (e.g., Measured Concentration).

Removal bias is a useful technique for noting redundancies in the monitoring network. Sites with a high removal bias are important for creating an accurate interpolation map, thus their values add a unique perspective to the overall pollution surface. On the other hand, sites with a low removal bias difference could possibly be redundant with other sites, at least in the long-term temporal scale.

In the following sections, an interpolation map of the predicted pollution surface generated using all CDPHE monitoring data is shown for O₃, PM₁₀, and PM_{2.5}, which were the only pollutant networks subjected to this analysis. The accompanying tables show the results of the removal bias analysis and the associated scores and rankings for each site. Note that there are not enough sites in the CO, NO₂, and SO₂ monitoring networks to apply this analysis.

2.6.1 Ozone (O₃)

Table 33. O₃ monitoring sites ordered and ranked by removal bias (units are in ppm).

Site Name	Avg. Concentration (2020-2024)	Interpolated Concentration	Removal Bias	Rank	Score
Rifle - Health Dept.	0.0286	0.0381	0.0095	1	23.00
Rocky Flats - N.	0.0450	0.0373	-0.0076	2	18.69
Fort Collins - West	0.0402	0.0330	-0.0073	3	17.86
Fort Collins - Mason	0.0321	0.0388	0.0068	4	16.70
Black Hawk	0.0459	0.0392	-0.0067	5	16.46
Manitou Springs	0.0432	0.0366	-0.0066	6	16.40
NREL	0.0432	0.0371	-0.0061	7	15.22
U.S. Air Force Academy (USAFA)	0.0360	0.0420	0.0059	8	14.82
Aurora - East	0.0426	0.0369	-0.0057	9	14.14
Palisade Water Treatment	0.0379	0.0334	-0.0045	10	11.34
Fossil Creek	0.0381	0.0340	-0.0041	11	10.50
Bethke	0.0331	0.0370	0.0039	12	10.05
Greeley - Weld County Tower	0.0329	0.0365	0.0037	13	9.49
Welby	0.0315	0.0346	0.0031	14	8.19
Cortez - Health Dept.	0.0344	0.0374	0.0030	15	7.85
La Casa	0.0314	0.0335	0.0021	16	5.87
La Salle	0.0369	0.0349	-0.0020	17	5.58
Boulder Reservoir	0.0377	0.0395	0.0018	18	5.16
Chatfield State Park	0.0398	0.0385	-0.0013	19	3.93
Highland Reservoir	0.0391	0.0382	-0.0009	20	3.00
Evergreen	0.0407	0.0400	-0.0007	21	2.72
Pueblo West	0.0390	0.0390	0.0000	22	1.07
CAMP	0.0327	0.0327	0.0000	23	1.00

Average O₃ concentrations in Colorado are highest at high elevation sites, particularly in the mountainous areas of the Central Mountains and Denver Metro/North Front Range regions, where annual average O₃ concentrations reach values as high as 50 ppb (Figure 11). The observation of enhanced O₃ concentrations with elevation in Colorado has been attributed to the low availability of nitric oxide (NO), which typically acts to reduce O₃ concentrations. High average concentrations are also observed in the suburban and rural regions immediately surrounding the Denver Metro area. Removal bias tends to be highest for these sites due to the steep gradient in average O₃ concentration that exists from the city center to the outlying suburban and rural regions. This gradient is a well-known feature of the spatial distribution of O₃ concentrations in and around large cities, where concentrations are depressed via NO_x titration in the urban center and reach maximum values along the suburban fringe (Sillman, 1999). In Figure 12, measured values are plotted against modeled (i.e., interpolated) values.

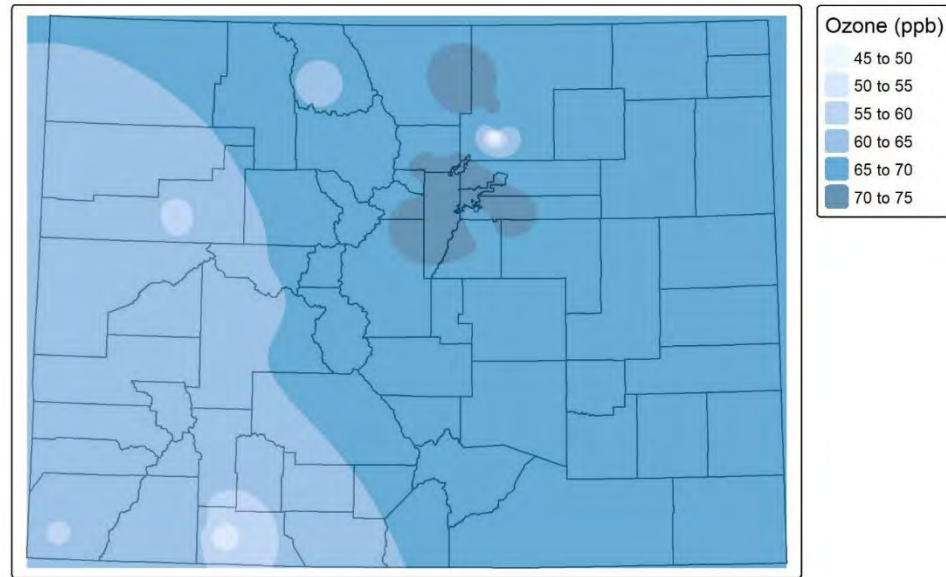


Figure 11. Interpolation map for O₃.

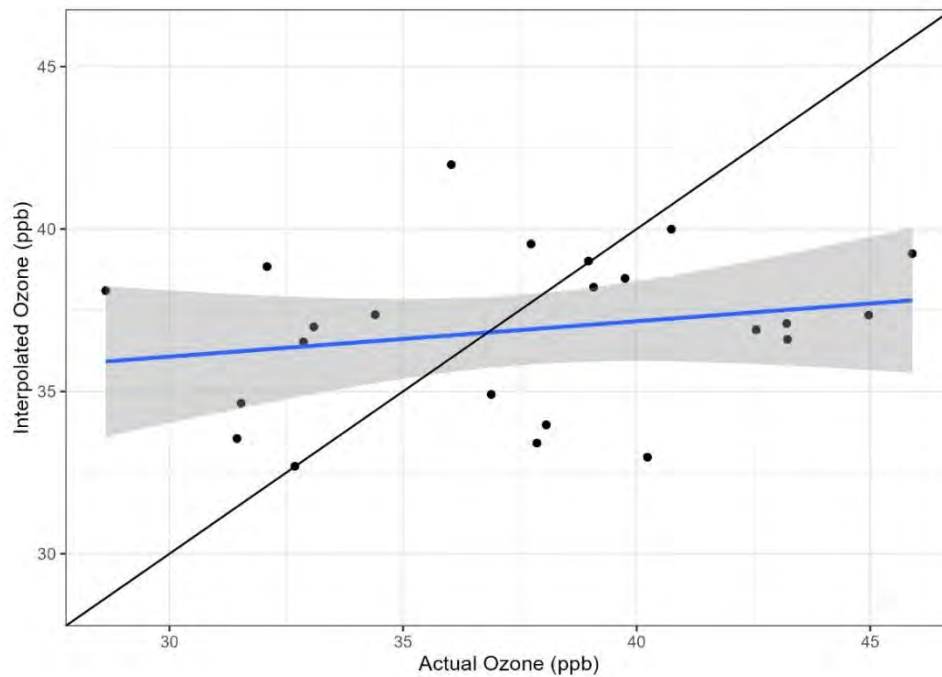


Figure 12. Removal bias for O₃ with actual concentration values plotted against modeled (i.e., interpolated) values.

2.6.2 PM₁₀

Table 34. PM₁₀ monitoring sites ordered and ranked by removal bias (units are in $\mu\text{g m}^{-3}$).

Site Name	Avg. Concentration (2020-2024)	Interpolated Concentration	Removal Bias	Rank	Score
Boulder - CU	15.49	27.63	12.14	1	16.0
La Casa	22.01	29.44	7.43	2	9.8

Site Name	Avg. Concentration (2020-2024)	Interpolated Concentration	Removal Bias	Rank	Score
Steamboat Springs	15.87	22.41	6.53	3	8.6
Aspen	15.13	21.42	6.29	4	8.3
Cañon City - City Hall	15.84	20.89	5.06	5	6.7
Colorado College	17.46	21.88	4.41	6	5.8
Birch Street	36.00	32.41	-3.59	7	4.7
Telluride	16.74	20.28	3.53	8	4.7
CAMP	27.89	24.47	-3.42	9	4.5
Lamar - Municipal Bldg.	24.81	21.85	-2.96	10	3.9
Grand Junction - Powell Bldg.	16.73	19.62	2.90	11	3.8
Longmont - Municipal Bldg.	25.44	23.02	-2.42	12	3.2
Welby	32.97	35.20	2.23	13	2.9
Alamosa - ASC	22.28	20.17	-2.11	14	2.8
Pagosa Springs School	21.29	19.89	-1.40	15	1.9
Pueblo - Fountain School	20.32	19.56	-0.75	16	1.0

Average annual PM₁₀ concentrations in Colorado are typically highest in the Denver Metro/North Front Range region, particularly at monitoring sites located near the city center, where emission density is typically highest (Figure 13).

Although dust storms occur infrequently, these events have a significant effect on the statistics calculated from the data. Sites impacted by dust storms have median values that are 3-7 $\mu\text{g m}^{-3}$ lower than their mean values, and coefficients of variation (CV; the ratio of the standard deviation to the mean) that are greater than or equal to one. In other words, although average PM₁₀ concentrations on the Eastern High Plains regions appear high, this is mostly a result of windblown dust events that skew the statistics. In terms of median values, the highest concentrations are observed at the Birch Street and Welby sites in central Denver. There is no apparent spatial trend in the removal bias results, although sites impacted by dust storms do tend to rank high in this analysis.

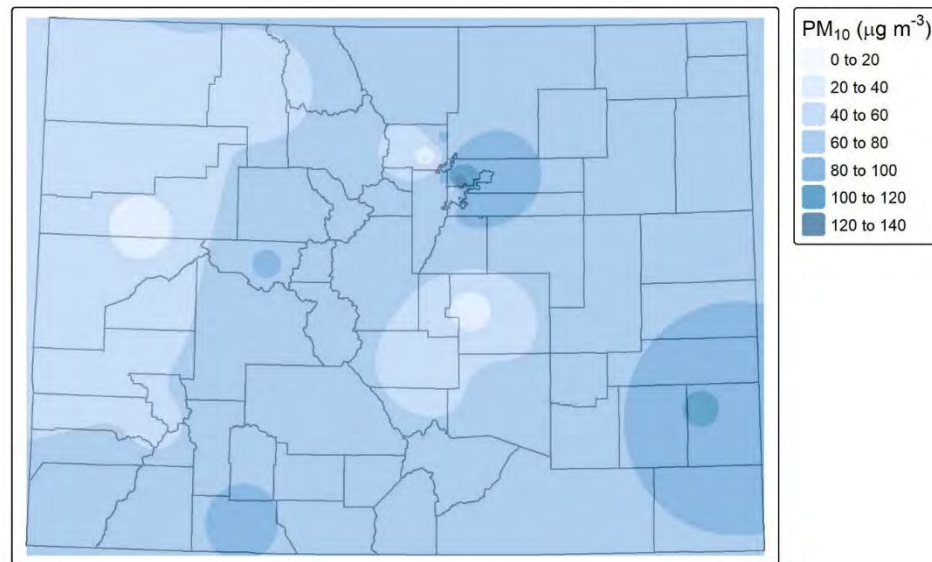


Figure 13. Interpolation map for PM₁₀.

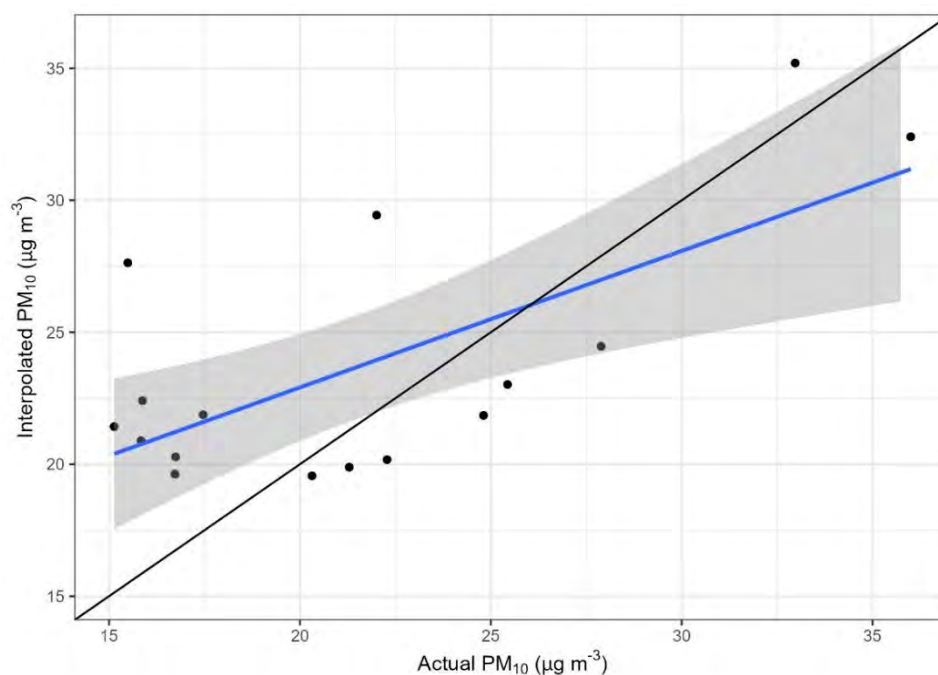


Figure 14. Removal bias for PM₁₀ with actual concentration values plotted against modeled (i.e., interpolated) values.

2.6.3 PM_{2.5}

Table 35. PM_{2.5} monitoring sites ordered and ranked by removal bias (units are in $\mu\text{g m}^{-3}$).

Site Name	Avg. Concentration (2020-2024)	Interpolated Concentration	Removal Bias	Rank	Score
Aspen	3.24	6.46	3.22	1	21.0
Boulder - CU	4.39	7.24	2.85	2	18.6
Bethke	5.11	7.07	1.95	3	12.9
I-25: Globeville	8.37	6.94	-1.43	4	9.6
La Casa	6.78	8.06	1.28	5	8.6
Pueblo - Fountain School	4.87	6.14	1.26	6	8.5
Arapaho Community College (ACC)	5.54	6.74	1.20	7	8.1
Colorado College	5.25	6.37	1.12	8	7.6
Greeley - Hospital	7.73	6.66	-1.07	9	7.3
Platteville - Middle School	7.98	6.96	-1.02	10	7.0
Fort Collins - CSU	6.83	5.81	-1.02	11	7.0
Longmont - Municipal Bldg.	7.59	6.60	-0.99	12	6.8
Lamar - Municipal Bldg.	5.38	6.30	0.93	13	6.4
Welby	6.84	7.74	0.90	14	6.2
Birch Street	7.79	6.93	-0.85	15	5.9
Grand Junction - Powell Bldg.	5.13	5.88	0.75	16	5.2
Chatfield State Park	5.69	6.32	0.63	17	4.5
Alamosa - ASC	5.67	6.00	0.33	18	2.6
National Jewish Health (NJH)	7.17	7.45	0.28	19	2.3
CAMP	7.56	7.38	-0.18	20	1.6
I-25: Denver	7.46	7.38	-0.09	21	1.0

Average annual $\text{PM}_{2.5}$ concentrations in Colorado are typically highest at sites located in the Denver Metro/North Front Range region (Figure 15). Due to steep gradients in $\text{PM}_{2.5}$ concentrations in and around this area, removal bias also tends to be higher for these sites.

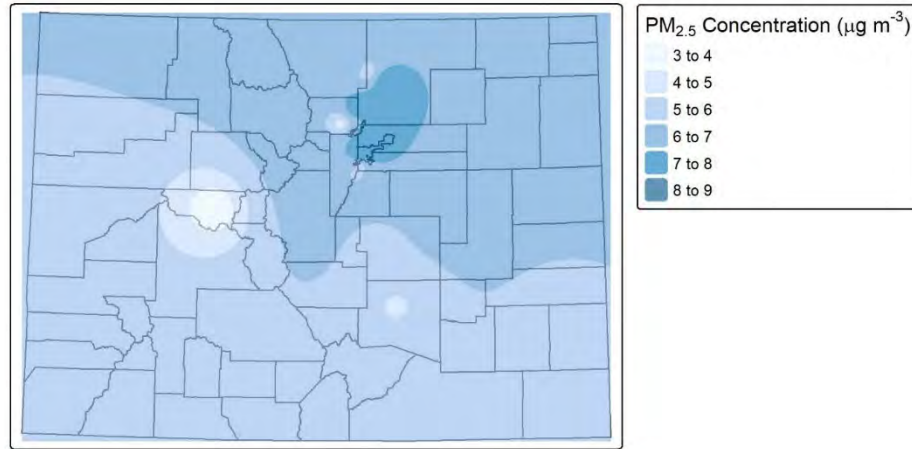


Figure 15. Interpolation map for $\text{PM}_{2.5}$.

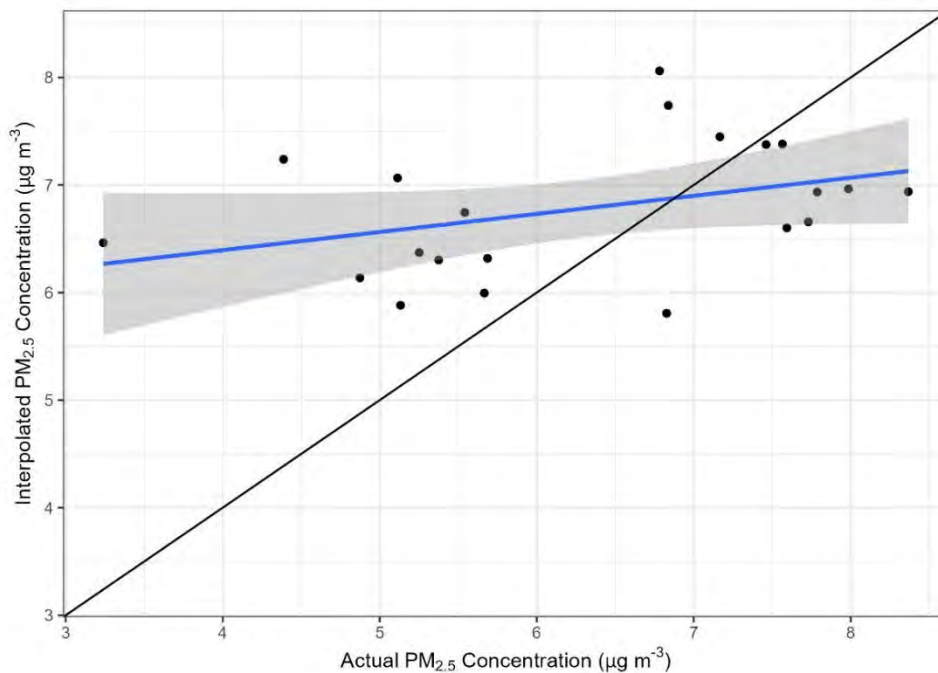


Figure 16. Removal bias results for $\text{PM}_{2.5}$.

2.7 Area Served

This analysis ranks monitoring sites in each network based on the extent of their spatial coverage, i.e., the size of their Area Served polygons. Conceptually, this zone represents the area around the monitoring site that is close enough to be represented by the concentrations measured at the monitor. The appropriate size and shape of this area is difficult to define precisely. The most common technique used to determine the spatial coverage of an air pollution monitor involves applying Thiessen polygons (also known as Voronoi diagrams) to represent each monitor's area of representation (Pope and Wu, 2014). Thiessen polygons are

commonly used in geography to assign a zone of influence around a point or in place of interpolation techniques to generalize a set of sample measurements to the areas closest to them. They are created by delineating an area around a monitoring site in which each point is closer to that monitoring site than any other monitoring site.

The Thiessen polygon technique is a purely spatial construct and does not take into account meteorology, landscape topography, or other factors that may influence the extent of a monitor's spatial coverage. Therefore, while the technique may be appropriate for states with dense monitoring networks (e.g., California) or simple topography (e.g., Florida), its utility is limited in Colorado due to the sparseness of monitoring sites and the complexity of the terrain. For example, the presence of distinct meteorological-geographical boundaries within Colorado (e.g., the Continental Divide, Palmer Divide, Cheyenne Ridge, etc.) limits atmospheric transport between airsheds, effectively separating regions of similar air quality and similar sources of air pollution (see Section 1.4.4). This can lead to some unreasonable results in the application of the Thiessen polygon technique, such as polygons that intersect the Continental Divide. Therefore, the Thiessen polygon approach has been modified in the present case: for airsheds possessing only one monitor, Thiessen polygons have not been constructed; rather, the entire area of the airshed has been assigned to that monitor. For airsheds possessing multiple monitors, Thiessen polygons have been drawn to assign coverage areas to each monitor within the airshed; however, the polygons were clipped such that they would not intersect airshed boundaries.

Restricting the Area Served polygons to airshed boundaries produces a more reasonable approximation of the extent of each monitoring site's spatial coverage; however, some polygons are so large that the monitoring point could not be said to adequately represent the entire area. For example, several of the polygons for PM_{2.5} have dimensions of over 100 km, while the monitor-to-monitor correlation study described in Section 2.5.6 suggests that PM_{2.5} concentrations are only weakly correlated over this distance of separation (Figure 10). Therefore, we have imposed a further restriction on the ultimate size of each monitor's area of representation: for each pollutant network, we have used the parameter correlograms presented in Section 2.5 to define a maximum radius of spatial extent as the distance where the correlation coefficient between monitors drops below an r^2 value of 0.6 (i.e., the maximum distance at which sites are still well-correlated according to the monitor-to-monitor correlation study). This maximum radius of spatial extent was then used as an upper-limit on the size of each Area Served polygon. The maximum spatial extent values for the CO, NO₂, O₃, PM₁₀, and PM_{2.5} networks are 16.5, 17.1, 91.3, 11.4, and 17.1 km, respectively. The correlogram for SO₂ was not robust enough to derive a maximum radius value due to the limited availability of data from within the state; therefore, we have assumed a value of 11.4 km for the SO₂ network (i.e., the value obtained from the CO correlogram).

In the following section, maps are presented showing the Area Served polygons derived for each APCD monitoring network. The accompanying tables show the results of the Area Served analysis and the associated scores and rankings for each site. Note that the presence of monitoring sites operated by other agencies in Colorado has not been considered in the delineation of the Area Served polygons for the APCD sites being assessed in this report.

2.7.1 Carbon Monoxide (CO)

Table 36. All APCD CO monitoring sites ranked by area served.

Site Name	Area Served (km ²)	Rank	Score
Greeley - Weld County Tower	855	1	5.0
Fort Collins - Mason	855	1	5.0
Colorado College	848	2	4.9
I-25: Denver	515	3	1.0
La Casa	515	3	1.0

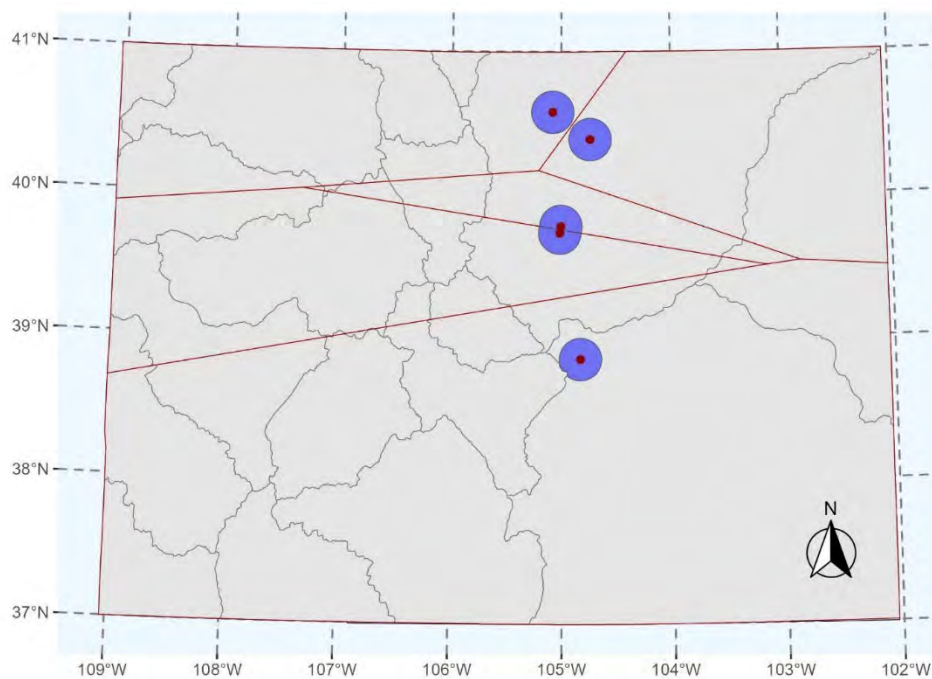


Figure 17. Map of Colorado showing the Area served polygons derived for the CO monitoring network.

2.7.2 Nitrogen Dioxide (NO₂)

Table 37. All APCD NO₂ monitoring sites ranked by area served.

Site Name	Area Served (km ²)	Rank	Score
La Salle	918	1	9.00
Rocky Flats - N.	772	2	7.67
Fossil Creek	572	3	5.84
Bethke	572	3	5.84
Welby	501	4	5.21
I-25: Denver	430	5	4.56
CAMP	181	6	2.29
La Casa	104	7	1.59
I-25: Globeville	39	8	1.00

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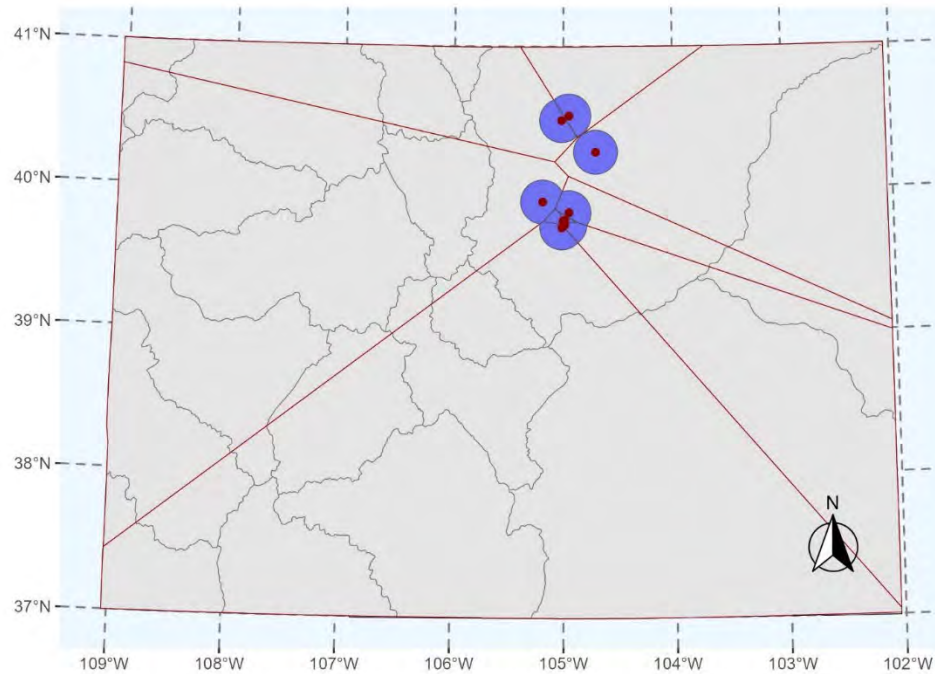


Figure 18. Map of Colorado showing the Area served polygons derived for the NO₂ monitoring network.

2.7.3 Sulfur Dioxide (SO₂)

Table 38. All APCD SO₂ monitoring sites ranked by area served.

Site Name	Area Served (km ²)	Rank	Score
Welby	286	1	3.0
CAMP	228	2	2.2
La Casa	148	3	1.0

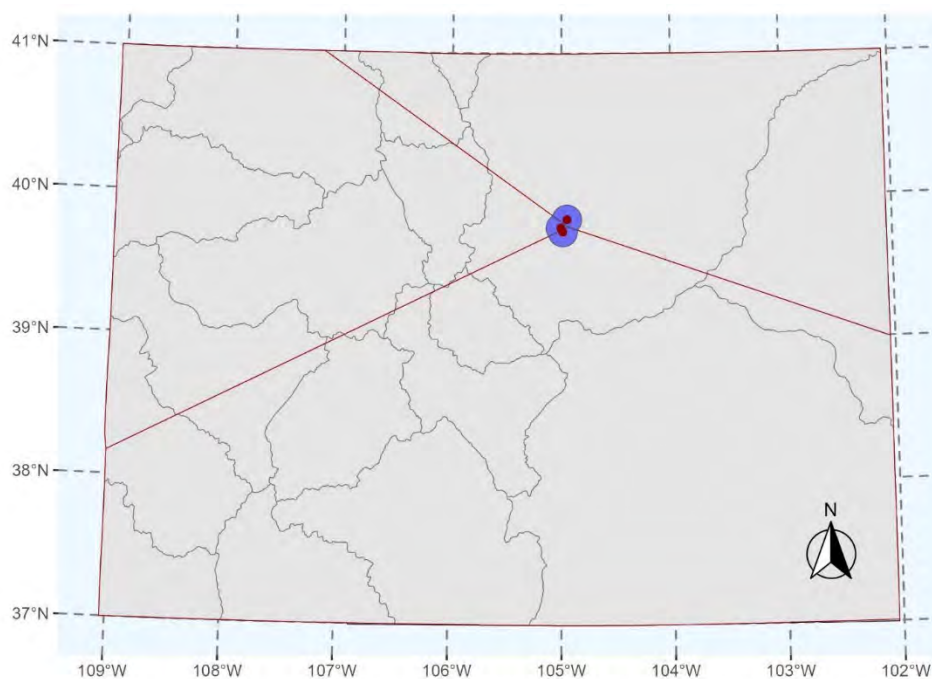


Figure 19. Map of Colorado showing the Area served polygons derived for the SO₂ monitoring network.

2.7.4 Ozone (O₃)

Table 39. All APCD O₃ monitoring sites ranked by area served

Site Name	Area Served (km ²)	Rank	Score
Pueblo West	15,974	1	23.0
Palisade Water Treatment	10,145	2	14.9
Rifle - Health Dept.	9,505	3	14.0
Aurora - East	7,971	4	11.9
Cortez - Health Dept.	6,083	5	9.3
Greeley - Weld County Tower	4,755	6	7.4
La Salle	4,528	7	7.1
Fort Collins - West	4,337	8	6.9
U.S. Air Force Academy (USAFA)	4,197	9	6.7
Boulder Reservoir	2,125	10	3.8
Evergreen	1,706	11	3.2
Black Hawk	1,664	12	3.2
Bethke	1,553	13	3.0
Manitou Springs	1,495	14	2.9
Chatfield State Park	1,451	15	2.9
Welby	960	16	2.2
Highland Reservoir	924	17	2.1
Fort Collins - Mason	906	18	2.1
Fossil Creek	696	19	1.8
Rocky Flats - N.	501	20	1.5
NREL	376	21	1.4
CAMP	289	22	1.2
La Casa	111	23	1.0

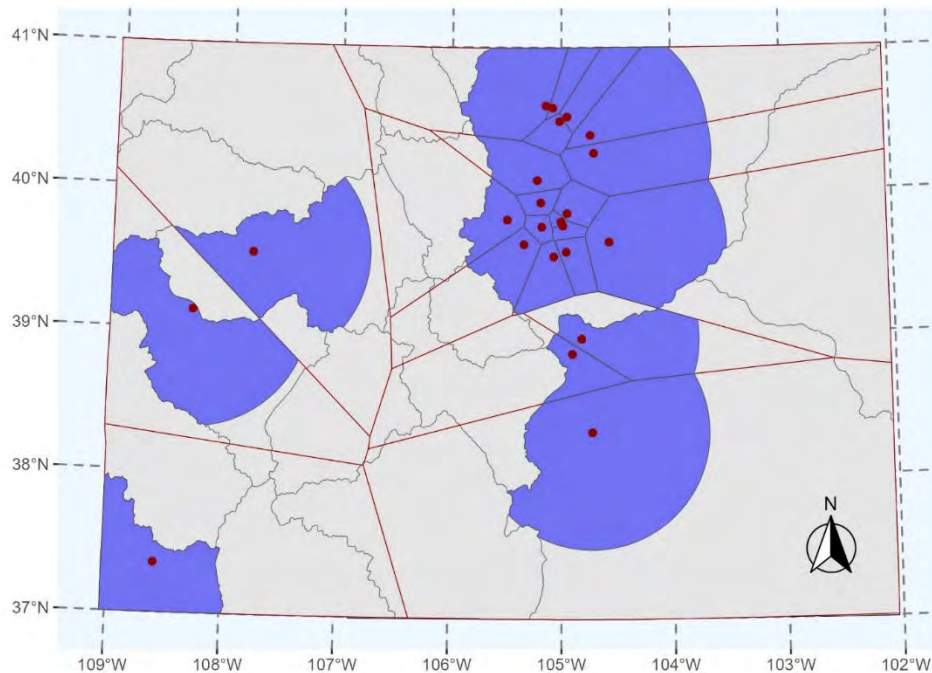


Figure 20. Map of Colorado showing the Area served polygons derived for the O₃ monitoring network.

2.7.5 PM₁₀

Table 40. All APCD PM₁₀ monitoring sites ranked by area served.

Site Name	Area Served (km ²)	Rank	Score
Colorado College	408	1	16.0
Alamosa - ASC	408	1	16.0
Lamar - Municipal Bldg.	408	1	16.0
Steamboat Springs	408	1	16.0
Pagosa Springs School	408	1	16.0
Grand Junction - Powell Bldg.	408	1	16.0
Aspen	408	1	16.0
Pueblo - Fountain School	408	1	16.0
Longmont - Municipal Bldg.	407	2	15.9
Boulder - CU	407	2	15.9
Telluride	254	3	7.2
CAMP	218	4	5.1
Cañon City - City Hall	213	5	4.8
Welby	167	6	2.2
Birch Street	150	7	1.2
La Casa	146	8	1.0

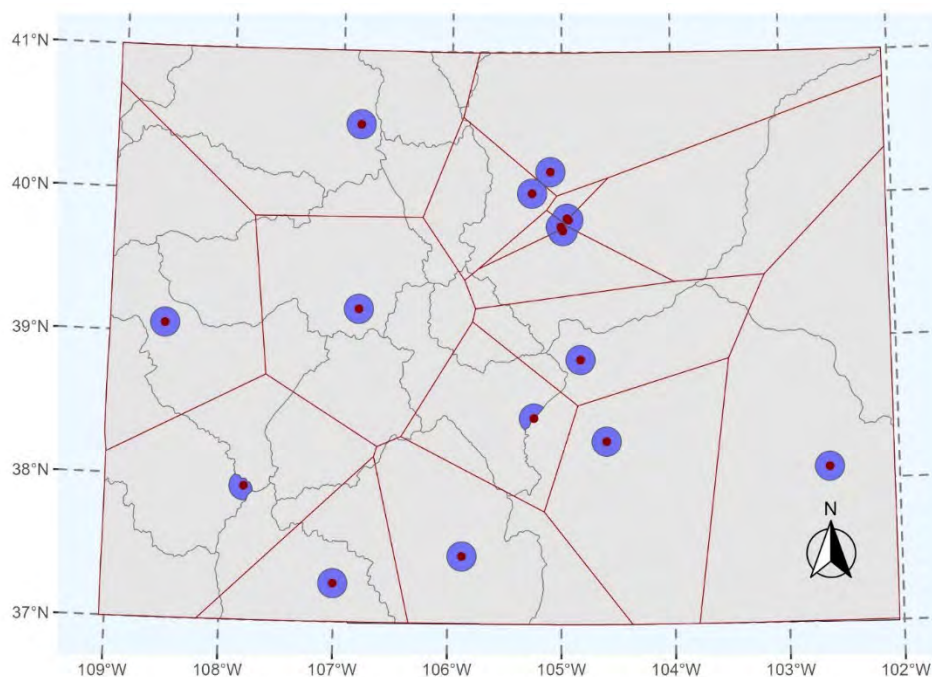


Figure 21. Map of Colorado showing the Area served polygons derived for the PM₁₀ monitoring network.

2.7.6 PM_{2.5}

Table 41. All APCD PM_{2.5} monitoring sites ranked by area served.

Site Name	Area Served (km ²)	Rank	Score
Lamar - Municipal Bldg.	918	1	21.0
Alamosa - ASC	918	1	21.0
Pueblo - Fountain School	918	1	21.0
Aspen	918	1	21.0
Grand Junction - Powell Bldg.	914	2	20.9
Colorado College	906	3	20.7
Boulder - CU	805	4	18.5
Platteville - Middle School	759	5	17.5
Greeley - Hospital	750	6	17.3
Longmont - Municipal Bldg.	723	7	16.7
Fort Collins - CSU	670	8	15.5
Chatfield State Park	610	9	14.2
Bethke	577	10	13.4
Arapaho Community College (ACC)	354	11	8.5
Welby	330	12	7.9
National Jewish Health (NJH)	290	13	7.1
Birch Street	226	14	5.6
I-25: Denver	211	15	5.3
La Casa	174	16	4.5
I-25: Globeville	29	17	1.3
CAMP	16	18	1.0

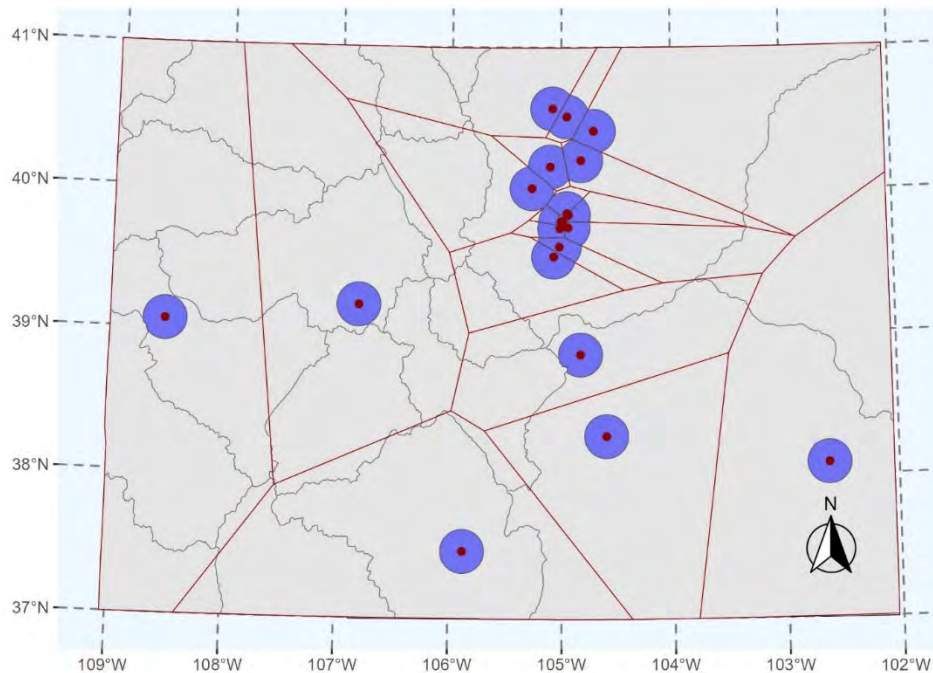


Figure 22. Map of Colorado showing the Area served polygons derived for the PM_{2.5} monitoring network.

2.8 Population Served

This analysis attempts to quantify the population represented by each monitoring site. It has been well-established that high population densities are associated with high emissions and high ambient pollutant concentrations; therefore, monitors representing more population will typically be of greater importance in determining regulatory compliance. Furthermore, the collection of data that is representative of the greatest possible number of people is an important monitoring objective; therefore, monitors with the highest population counts are given the highest rank in this analysis.

Calculating the population served by a particular monitor requires two steps: (1) a determination of the area of representation for each monitor, and (2) a determination of the population within each monitor's area of representation. Areas of representation for each monitor were determined using a modified Thiessen polygon approach as described in Section 2.7. Tract-level data from the 2019-2023 ACS was then used within ArcGIS to create a polygon coverage map of census tracts within Colorado, which is presented in Figure 3. The population within each monitor's Area Served polygon was then determined by summing the population count totals for those census tract polygons that intersect each Area Served polygon.

The advantage of this analysis is that it provides a simple technique to quantify the population represented by a particular monitor. This technique will provide more weight to sites located in areas of high population density and sites with large areas of representation.

2.8.1 Results for All Parameters

Tables 42-47 list the Population Served and associated score for each APCD monitoring site in the CO, NO₂, SO₂, O₃, PM₁₀, and PM_{2.5} ambient networks, respectively.

Table 42. All APCD CO monitoring sites ranked by population served.

Site Name	Population Served	Rank	Score
I-25: Denver	1,088,550	1	5.0
La Casa	845,672	2	3.9
Colorado College	628,817	3	2.9
Fort Collins - Mason	316,893	4	1.5
Greeley - Weld County Tower	212,972	5	1.0

Table 43. All APCD NO₂ monitoring sites ranked by population served.

Site Name	Population Served	Rank	Score
I-25: Denver	755664	1	9.0
CAMP	580571	2	6.9
Welby	573781	3	6.8
Rocky Flats - N.	436649	4	5.1
Fossil Creek	342969	5	4.0
La Casa	246725	6	2.8
Bethke	160682	7	1.7
La Salle	148706	8	1.6
I-25: Globeville	99346	9	1.0

Table 44. All APCD SO₂ monitoring sites ranked by population served.

Site Name	Population Served	Rank	Score
CAMP	711,562	1	3.0
Welby	447,339	2	1.6
La Casa	325,576	3	1.0

Table 45. All APCD O₃ monitoring sites ranked by population served.

Site Name	Population Served	Rank	Score
CAMP	864,191	1	23.0
Highland Reservoir	791,196	2	21.0
Welby	691,453	3	18.4
U.S. Air Force Academy (USAFA)	470,843	4	12.5
Manitou Springs	396,734	5	10.5
Boulder Reservoir	373,429	6	9.9
Aurora - East	327,811	7	8.7
NREL	314,675	8	8.3
Rocky Flats - N.	286,966	9	7.6
La Casa	273,749	10	7.2
Pueblo West	269,298	11	7.1
Chatfield State Park	245,066	12	6.5
Palisade Water Treatment	241,973	13	6.4
Fossil Creek	226,348	14	6.0
Greeley - Weld County Tower	214,248	15	5.6
Fort Collins - Mason	198,945	16	5.2
La Salle	159,356	17	4.2
Rifle - Health Dept.	126,142	18	3.3
Bethke	110,768	19	2.9
Fort Collins - West	96,937	20	2.5
Evergreen	82,341	21	2.1
Black Hawk	54,819	22	1.4
Cortez - Health Dept.	41,008	23	1.0

Table 46. All APCD PM₁₀ monitoring sites ranked by population served.

Site Name	Population Served	Rank	Score
CAMP	697,063	1	16.0
Colorado College	453,531	2	10.7
Welby	347,325	3	8.4
La Casa	321,139	4	7.8
Boulder - CU	176,370	5	4.6
Birch Street	173,290	6	4.5
Longmont - Municipal Bldg.	169,783	7	4.5
Pueblo - Fountain School	148,267	8	4.0
Grand Junction - Powell Bldg.	140,137	9	3.8
Cañon City - City Hall	25,004	10	1.3
Steamboat Springs	22,872	11	1.3
Alamosa - ASC	16,515	12	1.1
Lamar - Municipal Bldg.	14,470	13	1.1
Pagosa Springs School	13,730	14	1.1
Aspen	13,100	15	1.0
Telluride	10,955	16	1.0

Table 47. All APCD PM_{2.5} monitoring sites ranked by population served.

Site Name	Population Served	Rank	
National Jewish Health (NJH)	720,679	1	21.0
Colorado College	632,169	2	18.5
Arapaho Community College (ACC)	548,096	3	16.1
Welby	456,245	4	13.5
I-25: Denver	418,831	5	12.5
La Casa	318,219	6	9.6
Boulder - CU	262,420	7	8.0
Fort Collins - CSU	255,963	8	7.8
Longmont - Municipal Bldg.	221,737	9	6.9
Bethke	204,144	10	6.4
Birch Street	199,357	11	6.2
Greeley - Hospital	196,688	12	6.2
Chatfield State Park	193,106	13	6.1
Pueblo - Fountain School	168,726	14	5.4
Grand Junction - Powell Bldg.	157,316	15	5.0
CAMP	120,020	16	4.0
Platteville - Middle School	100,429	17	3.4
I-25: Globeville	73,745	18	2.7
Alamosa - ASC	23,217	19	1.2
Aspen	17,119	20	1.1
Lamar - Municipal Bldg.	14,470	21	1.0

2.9 DIC Population Served

Some communities in Colorado face higher levels of environmental and health risks due to factors like pollution and climate change. In 2021, the state legislature established a definition for disproportionately impacted communities (DICs) to identify these areas. The definition was revised in 2023 based on recommendations from the Environmental Justice Action Task Force, as outlined in Section 24-4-109 of the Colorado Revised Statutes. It is updated annually, with the most recent update in November 2024.

The Colorado EnviroScreen tool, released in June 2022 by the Colorado Department of Public Health and Environment (CDPHE), was developed to support the implementation of C.R.S. 24-4-109. The tool is designed to assist state and local agencies in identifying communities that are disproportionately impacted by environmental and public health stressors. It provides a standardized, data-driven approach to inform resource allocation, policy development, and program implementation in alignment with the state's environmental justice goals.

EnviroScreen² operates through an interactive, web-based mapping platform that integrates demographic, health, environmental, and socioeconomic indicators. Each census block group in the state receives a cumulative impact score ranging from 0 to 100. Census block groups scoring at or above the 80th percentile are presumptively identified as disproportionately impacted communities (DICs) under state policy.

The DIC Population Served analysis attempts to quantify the population represented by each monitoring site that resides in a DIC. Calculating the DIC Population Served by a particular monitor requires two steps: (1) a determination of the area of representation for each monitor, (2) a determination of the

² <https://cdphe.colorado.gov/enviroscreen>

population within each monitor's area of representation, and (3) a determination of the average DIC score as calculated by EnviroScreen. Areas of representation for each monitor were determined using a modified Thiessen polygon approach as described in Section 2.7. Tract-level data from the 2019-2023 ACS was then used within ArcGIS to create a polygon coverage map of census tracts within Colorado, which is presented in Figure 3. The population within each monitor's Area Served polygon was then determined by summing the population count totals for those census tract polygons that intersect each Area Served polygon. The total population was then multiplied by the average DIC percentile score for the Area Served polygon, calculated using block-level data from Colorado EnviroScreen.

The advantage of this analysis is that it provides a simple technique to quantify the DIC population represented by a particular monitor. This technique will provide more weight to sites located in DIC communities of high population density and sites with large areas of representation.

2.9.1 Results for All Parameters

Tables 48-53 list the DIC Population Served and associated score for each APCD monitoring site in the CO, NO₂, SO₂, O₃, PM₁₀, and PM_{2.5} ambient networks, respectively.

Table 48. All APCD CO monitoring sites ranked by DIC population served.

Site Name	DIC Population Served	Rank	Score
La Casa	524,308	1	5.0
I-25: Denver	494,526	2	4.7
Colorado College	279,217	3	2.6
Greeley - Weld County Tower	150,549	4	1.4
Fort Collins - Mason	108,395	5	1.0

Table 49. All APCD NO₂ monitoring sites ranked by DIC population served.

Site Name	DIC Population Served	Rank	Score
Welby	394,792	1	9.0
I-25: Denver	324,172	2	7.3
CAMP	298,666	3	6.6
La Casa	143,229	4	2.8
La Salle	116,624	5	2.2
Rocky Flats - N.	114,985	6	2.1
Fossil Creek	114,352	7	2.1
I-25: Globeville	81,489	8	1.3
Bethke	69,785	9	1.0

Table 50. All APCD SO₂ monitoring sites ranked by DIC population served.

Site Name	DIC Population Served	Rank	Score
CAMP	365,953	1	3.0
Welby	326,800	2	2.6
La Casa	191,004	3	1.0

Table 51. All APCD O₃ monitoring sites ranked by DIC population served.

Site Name	DIC Population Served	Rank	Score
CAMP	490,448	1	23.0
Welby	486,625	2	22.8
Highland Reservoir	256,632	3	12.2
Manitou Springs	193,697	4	9.3

Site Name	DIC Population Served	Rank	Score
La Casa	175,633	5	8.4
U.S. Air Force Academy (USAFA)	170,245	6	8.2
Pueblo West	167,136	7	8.0
Aurora - East	163,820	8	7.9
Greeley - Weld County Tower	153,063	9	7.4
Palisade Water Treatment	150,974	10	7.3
Boulder Reservoir	139,869	11	6.8
NREL	126,641	12	6.2
La Salle	110,660	13	5.4
Rocky Flats - N.	75,150	14	3.8
Fort Collins - Mason	74,136	15	3.7
Fossil Creek	73,321	16	3.7
Rifle - Health Dept.	67,943	17	3.4
Chatfield State Park	65,818	18	3.3
Bethke	43,010	19	2.3
Fort Collins - West	36,395	20	2.0
Cortez - Health Dept.	23,724	21	1.4
Evergreen	15,332	22	1.0
Black Hawk	15,146	23	1.0

Table 52. All APCD PM₁₀ monitoring sites ranked by DIC population served.

Site Name	DIC Population Served	Rank	Score
CAMP	355,087	1	16.0
Welby	255,307	2	11.8
Colorado College	213,347	3	10.0
La Casa	187,891	4	8.9
Birch Street	128,680	5	6.4
Pueblo - Fountain School	97,326	6	5.0
Grand Junction - Powell Bldg.	86,649	7	4.6
Longmont - Municipal Bldg.	81,611	8	4.4
Boulder - CU	36,855	9	2.5
Cañon City - City Hall	15,185	10	1.5
Alamosa - ASC	10,588	11	1.4
Lamar - Municipal Bldg.	10,584	12	1.4
Steamboat Springs	6,846	13	1.2
Pagosa Springs School	5,260	14	1.1
Aspen	2,868	15	1.0
Telluride	2,306	16	1.0

Table 53. All APCD PM_{2.5} monitoring sites ranked by DIC population served.

Site Name	DIC Population Served	Rank	
National Jewish Health (NJH)	383,043	1	21.0
Colorado College	280,022	2	15.6
Welby	276,920	3	15.4
I-25: Denver	211,655	4	12.0
Arapaho Community College (ACC)	177,985	5	10.2
La Casa	159,413	6	9.2
Greeley - Hospital	148,439	7	8.6
Birch Street	143,650	8	8.4
Longmont - Municipal Bldg.	113,143	9	6.8
Pueblo - Fountain School	107,733	10	6.5
Grand Junction - Powell Bldg.	96,381	11	5.9
Fort Collins - CSU	89,835	12	5.6
Bethke	72,571	13	4.7
I-25: Globeville	64,318	14	4.2
Platteville - Middle School	63,954	15	4.2
Boulder - CU	56,982	16	3.8
CAMP	48,612	17	3.4
Chatfield State Park	33,069	18	2.6
Alamosa - ASC	14,978	19	1.6
Lamar - Municipal Bldg.	10,584	20	1.4
Aspen	3,167	21	1.0

2.9 Emissions Inventory

This analysis ranks sites based on their proximity to point sources of pollution by giving weight to each monitor according to the sum of emissions within its area of representation. Areas of representation for each monitor were determined using a modified Thiessen polygon approach as described in Section 2.7. Point source emissions data was obtained from the 2025 APCD facilities inventory, which lists reported emissions for over 29,000 permitted sources within Colorado. Emissions data for CO, NO_x, SO₂, volatile organic compounds (VOCs), PM₁₀, and PM_{2.5} were spatially located within ArcGIS and then summed within each monitor's Area Served polygon. Polygons with larger total emissions were ranked higher.

2.9.1 Carbon Monoxide (CO)

CO point source emissions density is shown for illustration purposes in Figure 23.

Table 54. CO monitoring sites ranked by total emissions.

Site Name	Sum of CO Emissions (tons)	Maximum	Rank	Score
Greeley - Weld County Tower	4346	282	1	5.0
La Casa	1321	449	2	2.0
I-25: Denver	379	90	3	1.1
Fort Collins - Mason	331	34	4	1.0
Colorado College	299	71	5	1.0

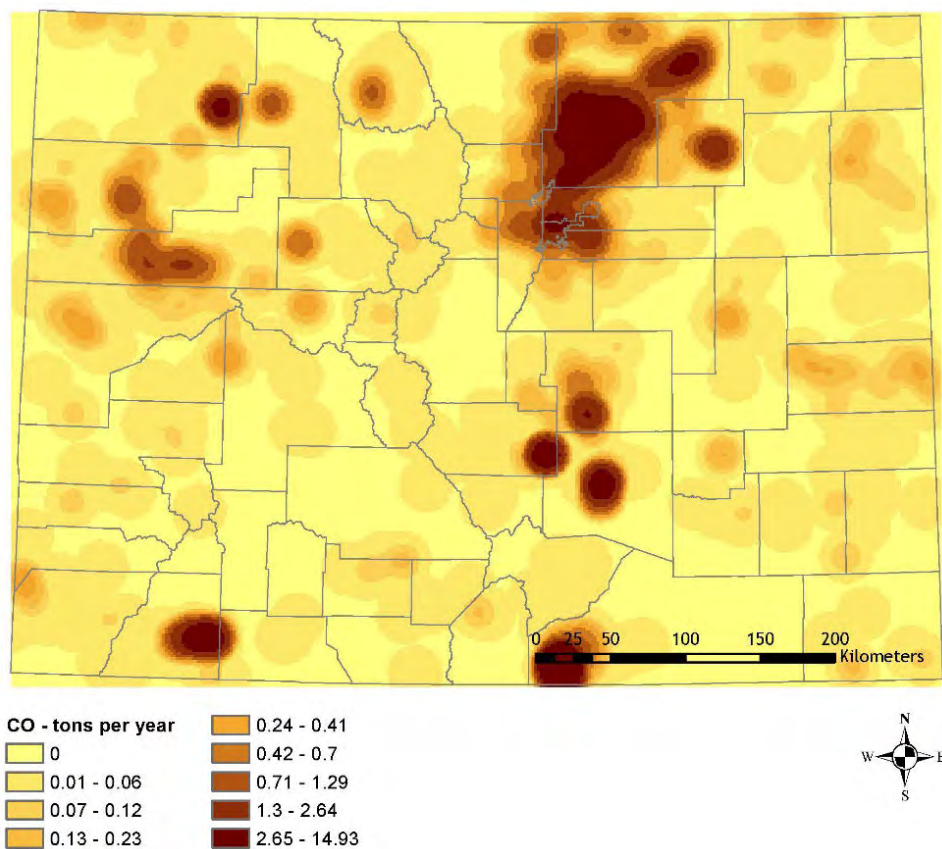


Figure 23. CO emissions density as calculated from point source data using the Kernel Density tool in ArcGIS. Class breaks have been determined using the quantile method.

2.9.2 Nitrogen Dioxide (NO₂)

NO_x point source emissions density is shown for illustration purposes in Figure 24.

Table 55. NO₂ monitoring sites ranked by total NO_x emissions.

Site Name	Sum of NO _x Emissions (tons)	Max.	Rank	Score
La Salle	2797	394	1	9.00
Bethke	1143	223	2	4.19
Welby	894	628	3	3.46
Rocky Flats - N.	726	255	4	2.97
I-25: Globeville	516	326	5	2.36
Fossil Creek	313	86	6	1.77
CAMP	302	76	7	1.74
I-25: Denver	290	58	8	1.70
La Casa	48	16	9	1.00

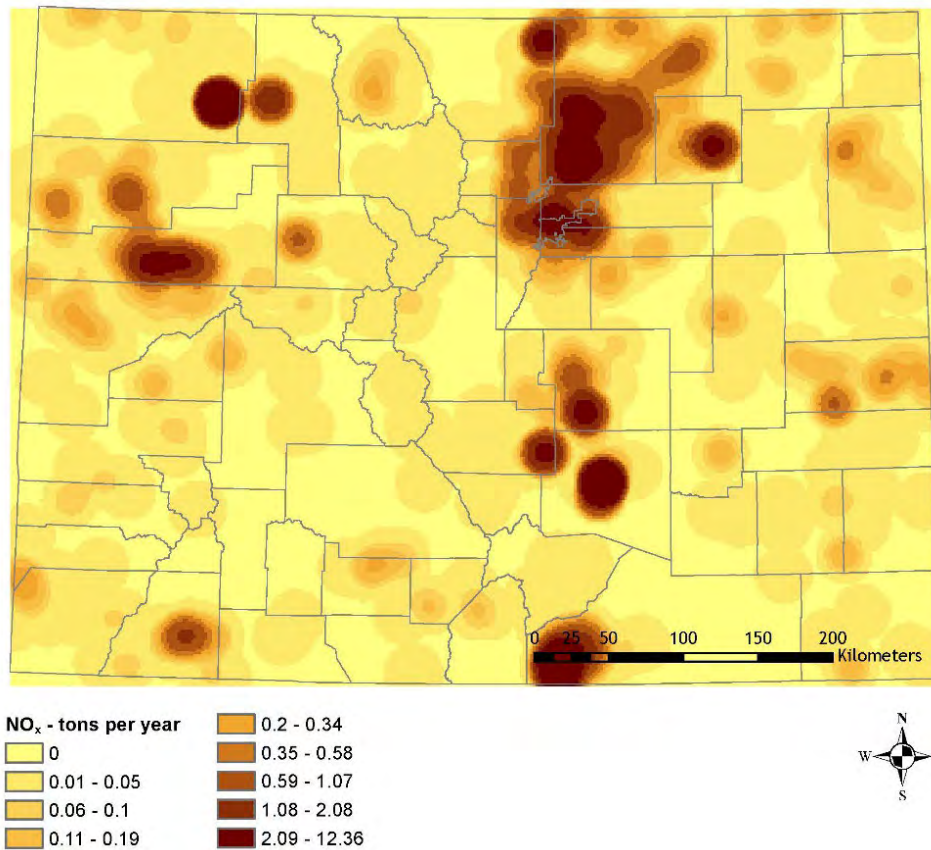


Figure 24. NO_x emissions density as calculated from point source data using the Kernel Density tool in ArcGIS. Class breaks have been determined using the quantile method.

2.9.3 Sulfur Dioxide (SO₂)

SO₂ point source emissions density is shown in Figure 25.

Table 56. SO₂ monitoring sites ranked by total emissions.

Site Name	Sum of SO ₂ Emissions (tons)	Max.	Rank	Score
Welby	332	214	1	3.00
La Casa	60	27	2	1.03
CAMP	57	40	3	1.00

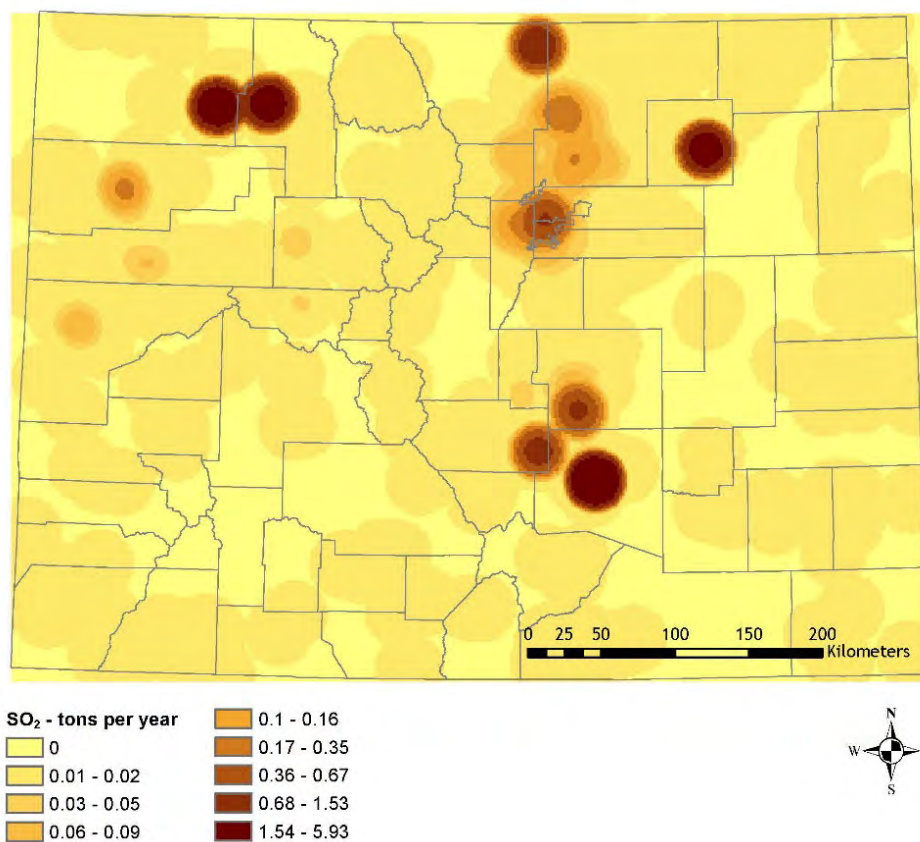


Figure 25. SO₂ emissions density as calculated from point source data using the Kernel Density tool in ArcGIS. Class breaks have been determined using the quantile method.

2.9.4 Ozone (O_3)

Tropospheric O_3 is a secondary pollutant, meaning that it is not directly emitted, but formed *in-situ* through photochemical reactions involving VOCs and NO_x . Furthermore, although O_3 requires the presence of NO_x in its formation reaction, it is also scavenged, or destroyed, by NO_x in the atmosphere (Sillman, 1999). Because of its complex source/sink dynamics, O_3 concentrations follow much different patterns than other primary pollutants. In the short-term (i.e., several hours or less), O_3 will form near its precursor sources and increase in concentration as the plume moves downwind and has more time to react during daylight hours. At night, when photochemical cycling has ceased, O_3 concentrations within the urban area will decrease as NO_x compounds in the area scavenge them. However, outside of the urban areas, where NO_x concentrations are typically low, O_3 will persist in the environment and can last for weeks before dissipating. This causes O_3 concentrations to be much higher in the rural areas downwind of an urban area, especially when viewing concentrations averaged over long temporal periods.

Because of these dynamics, the methodology of ranking O_3 monitors in order of the total VOC and NO_x point sources is not entirely valid. It is still practical to use the method established with the other primary pollutants, as the short-term O_3 levels can still be high in the area surrounding precursor point sources. However, another method of ranking that considers O_3 averages also needs to be adopted. This will be discussed in the following section.

VOC point source emissions density is shown for illustration purposes in Figure 26, while NO_x emissions have been previously discussed and are shown in Figure 24. The highest VOC emission densities in the state occur in the Denver Metro area and in regions of intensive oil and gas extraction in Weld and Garfield counties.

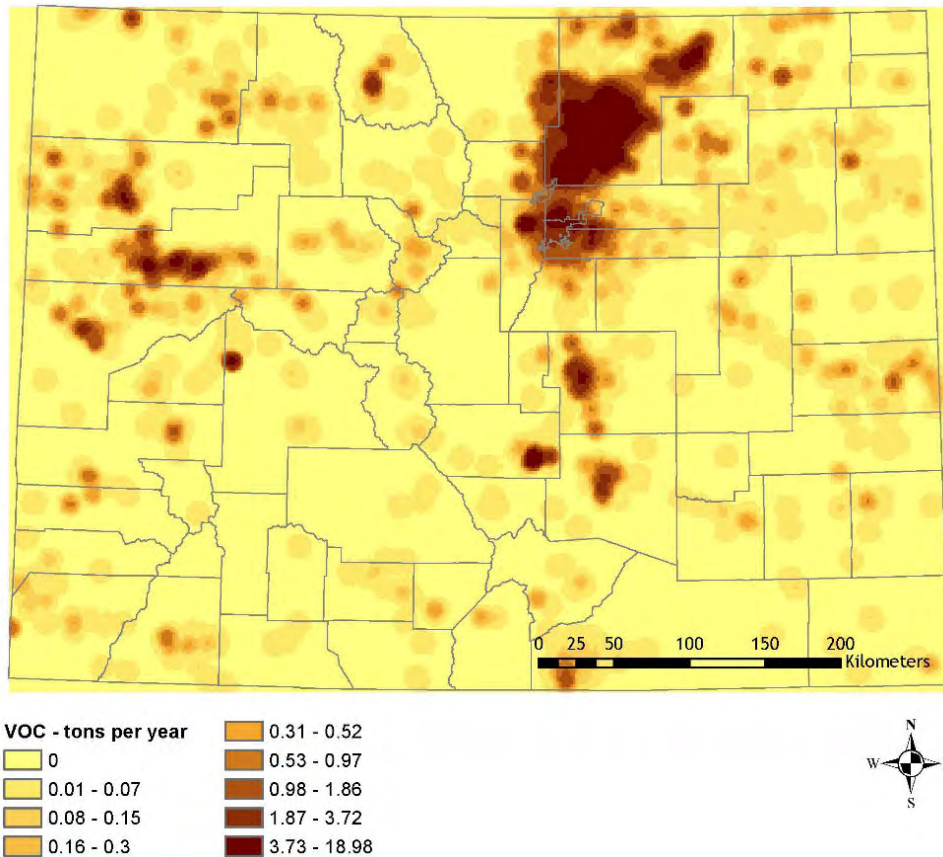


Figure 26. VOC emissions density as calculated from point source data using the Kernel Density tool in ArcGIS. Class breaks have been determined using the quantile method.

The emissions sums and maximum emission sections associated within each O_3 monitor are shown for NO_x and VOCs in Table 57 and Table 58 respectively. In Table 59, the NO_x - and VOC-based rankings have been averaged to determine an overall ranking for each site

Table 57. O₃ monitoring sites ranked by total VOC emissions.

Site Name	Sum of VOC Emissions (tons)	Max.	Rank
La Salle	12258	256	1
Greeley - Weld County Tower	10287	165	2
Rifle - Health Dept.	2984	166	3
Welby	2936	397	4
Pueblo West	1956	197	5
Bethke	1831	208	6
Aurora - East	1395	192	7
Boulder Reservoir	1268	74	8
NREL	971	338	9
Fossil Creek	852	117	10
CAMP	768	34	11
Palisade Water Treatment	761	121	12
U.S. Air Force Academy (USAFA)	759	167	13
Fort Collins - Mason	708	253	14
Highland Reservoir	634	22	15
Manitou Springs	610	46	16
La Casa	546	84	17
Rocky Flats - N.	219	24	18
Cortez - Health Dept.	182	76	19
Chatfield State Park	162	17	20
Fort Collins - West	100	35	21
Evergreen	64	13	22
Black Hawk	22	8	23

Table 58. O₃ monitoring sites ranked by total NO_x emissions.

Site Name	Sum of NO _x Emissions (tons)	Max.	Rank
Pueblo West	5,904	3,312	1
La Salle	5,840	878	2
Greeley - Weld County Tower	3,723	368	3
Rifle - Health Dept.	3,251	176	4
Welby	1,926	628	5
Manitou Springs	1,598	1,142	6
Fort Collins - West	1,175	1,149	7
Aurora - East	1,115	291	8
Bethke	926	194	9
Boulder Reservoir	632	230	10
Fort Collins - Mason	544	144	11
CAMP	510	76	12
NREL	490	255	13
Palisade Water Treatment	425	42	14
Fossil Creek	274	28	15
Cortez - Health Dept.	264	53	16
Rocky Flats - N.	202	107	17
Highland Reservoir	181	25	18
U.S. Air Force Academy (USAFA)	176	33	19
La Casa	152	16	20
Chatfield State Park	87	30	21
Black Hawk	31	21	22
Evergreen	0	0	23

Table 59. Overall emissions inventory rankings for the O₃ monitoring network.

Site Name	Scores		Average	Rank
	VOC	NO _x		
La Salle	23.0	22.8	22.9	1
Greeley - Weld County Tower	19.5	14.9	17.2	2
Pueblo West	4.5	23.0	13.7	3
Rifle - Health Dept.	6.3	13.1	9.7	4
Welby	6.2	8.2	7.2	5
Manitou Springs	2.1	7.0	4.5	6
Bethke	4.3	4.4	4.4	7
Aurora - East	3.5	5.2	4.3	8
Boulder Reservoir	3.2	3.4	3.3	9
Fort Collins - West	1.1	5.4	3.3	10
NREL	2.7	2.8	2.8	11
Fort Collins - Mason	2.2	3.0	2.6	12
CAMP	2.3	2.9	2.6	13
Palisade Water Treatment	2.3	2.6	2.5	14
Fossil Creek	2.5	2.0	2.3	15
U.S. Air Force Academy (USAFA)	2.3	1.7	2.0	16
Highland Reservoir	2.1	1.7	1.9	17
La Casa	1.9	1.6	1.8	18
Cortez - Health Dept.	1.3	2.0	1.6	19
Rocky Flats - N.	1.4	1.8	1.6	20
Chatfield State Park	1.3	1.3	1.3	21
Black Hawk	1.0	1.1	1.1	22
Evergreen	1.1	1.0	1.0	23

2.9.5 PM₁₀

PM₁₀ point source emissions density is shown in Figure 27.

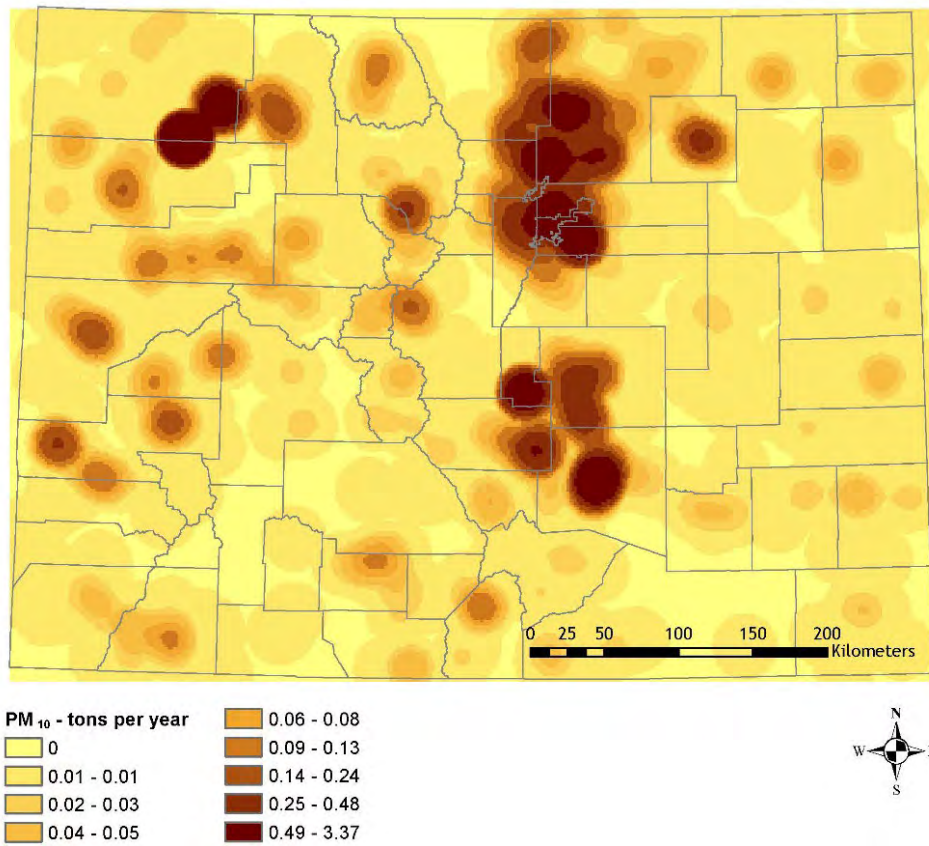


Figure 27. PM₁₀ emissions density as calculated from point source data using the Kernel Density tool in ArcGIS. Class breaks have been determined using the quantile method.

Table 60. PM₁₀ monitoring sites ranked by total emissions.

Site Name	Sum of PM ₁₀ Emissions (tons)	Max.	Rank	Score
Pueblo - Fountain School	648	406	1	16.0
Birch Street	371	122	2	9.6
Longmont - Municipal Bldg.	359	294	3	9.3
Colorado College	167	19	4	4.9
La Casa	146	23	5	4.4
Grand Junction - Powell Bldg.	115	30	6	3.7
CAMP	98	24	7	3.3
Boulder - CU	48	32	8	2.1
Welby	34	20	9	1.8
Lamar - Municipal Bldg.	26	7	10	1.6
Aspen	14	12	11	1.3
Cañon City - City Hall	13	10	12	1.3
Alamosa - ASC	6	3	13	1.1
Steamboat Springs	5	3	14	1.1
Telluride	2	1	15	1.0
Pagosa Springs School	0	0	16	1.0

2.9.6 PM_{2.5}

PM_{2.5}, like O₃, can be considered a secondary pollutant, although it can also be directly emitted to the atmosphere. Nitrate (NO₃⁻) and sulfate (SO₄²⁻) are particularly important components of secondary PM_{2.5}. Because these chemical species originate from the oxidation of NO_x and SO₂, respectively, NO_x and SO₂ point source emissions are also considered in the ranking of the PM_{2.5} sites.

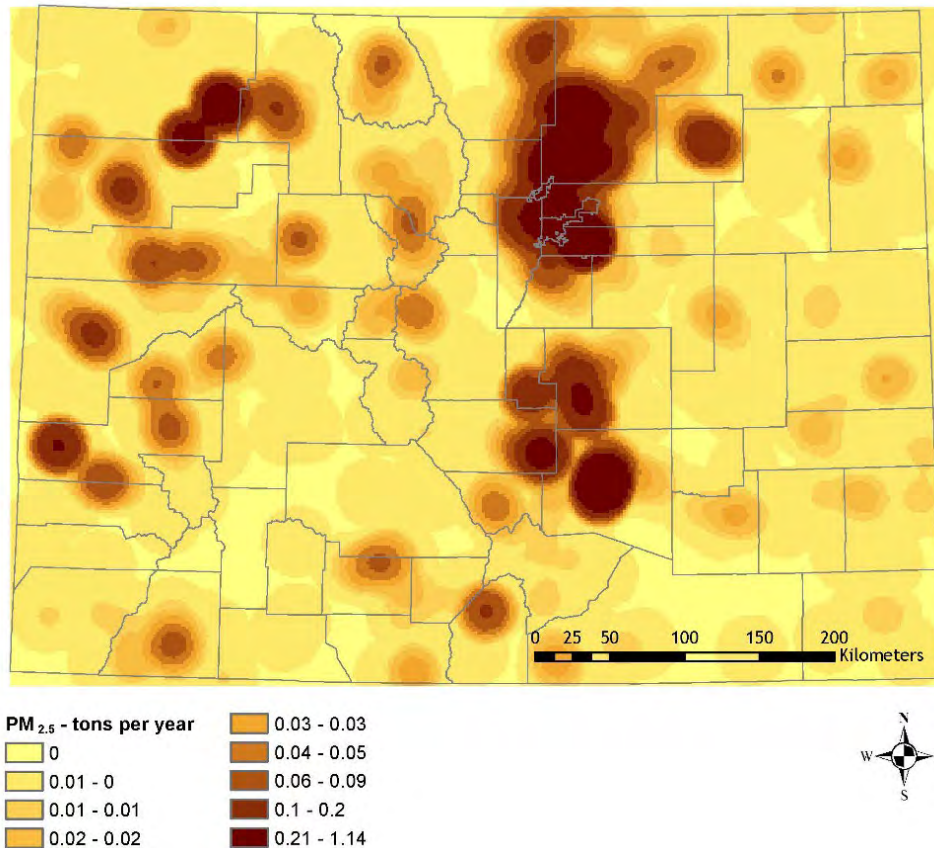


Figure 28. PM_{2.5} emissions density as calculated from point source data using the Kernel Density tool in ArcGIS. Class breaks have been determined using the quantile method.

PM_{2.5} point source emissions density is shown for illustration purposes in Figure 28, while NO_x and SO₂ emissions have been previously discussed and are shown in Figure 24 and Figure 25, respectively. The highest PM_{2.5} emission densities in the state occur in the Denver Metro area and in Weld County.

Table 61. PM_{2.5} monitoring sites ranked by total PM_{2.5} emissions.

Site Name	Sum of PM _{2.5} Emissions (tons)	Max.	Rank
Pueblo - Fountain School	773	392	1
Platteville - Middle School	276	60	2
Greeley - Hospital	258	57	3
Longmont - Municipal Bldg.	245	93	4
Bethke	207	90	5
Birch Street	185	111	6
I-25: Globeville	137	59	7
Colorado College	135	19	8
Grand Junction - Powell Bldg.	79	30	9
I-25: Denver	67	26	10
National Jewish Health (NJH)	60	22	11
Boulder - CU	56	18	12
Chatfield State Park	56	13	13
Arapaho Community College (ACC)	34	8	14
Fort Collins - CSU	33	6	15
Welby	30	6	16
La Casa	25	4	17
Aspen	15	12	18
Lamar - Municipal Bldg.	9	4	19
CAMP	6	1	20
Alamosa - ASC	4	3	21

Table 62. PM_{2.5} monitoring sites ranked by total NO_x emissions.

Site Name	Sum of NO _x Emissions (tons)	Max.	Rank
Pueblo - Fountain School	4,655	3,312	1
Platteville - Middle School	2,625	411	2
Greeley - Hospital	1,866	368	3
Birch Street	872	628	4
Bethke	728	194	5
Longmont - Municipal Bldg.	488	230	6
Colorado College	482	66	7
I-25: Globeville	476	326	8
Boulder - CU	390	107	9
National Jewish Health (NJH)	292	70	10
Fort Collins - CSU	244	86	11
I-25: Denver	243	58	12
Arapaho Community College (ACC)	195	25	13
CAMP	150	76	14
Grand Junction - Powell Bldg.	120	33	15
La Casa	90	27	16
Chatfield State Park	74	30	17
Welby	64	10	18
Alamosa - ASC	44	44	19
Aspen	24	13	20
Lamar - Municipal Bldg.	19	11	21

Table 63. PM_{2.5} monitoring sites ranked by total SO₂ emissions.

Site Name	Sum of SO ₂ Emissions (tons)	Max.	Rank
Pueblo - Fountain School	3,393	3,204	1
Birch Street	335	214	2
Bethke	147	117	3
Platteville - Middle School	96	38	4
Longmont - Municipal Bldg.	77	44	5
Greeley - Hospital	59	26	6
I-25: Globeville	59	27	7
Arapaho Community College (ACC)	59	40	8
Grand Junction - Powell Bldg.	46	21	9
I-25: Denver	45	27	10
Colorado College	40	15	11
Boulder - CU	32	23	12
Aspen	15	14	13
La Casa	11	7	14
National Jewish Health (NJH)	9	4	15
Fort Collins - CSU	8	4	16
Chatfield State Park	7	6	17
Welby	5	2	18
CAMP	1	0	19
Lamar - Municipal Bldg.	0	0	20
Alamosa - ASC	0	0	21

Table 64. Overall emissions inventory rankings for the PM_{2.5} monitoring network.

Site Name	Scores			Average	Rank
	PM _{2.5}	NO _x	SO ₂		
Pueblo - Fountain School	21.0	21.0	21.0	21.0	1
Platteville - Middle School	8.1	12.2	1.6	7.3	2
Greeley - Hospital	7.6	9.0	1.3	6.0	3
Birch Street	5.7	4.7	3.0	4.5	4
Bethke	6.3	4.1	1.9	4.1	5
Longmont - Municipal Bldg.	7.3	3.0	1.5	3.9	6
I-25: Globeville	4.5	3.0	1.3	2.9	7
Colorado College	4.4	3.0	1.2	2.9	8
Boulder - CU	2.4	2.6	1.2	2.0	9
I-25: Denver	2.6	2.0	1.3	2.0	10
National Jewish Health (NJH)	2.5	2.2	1.0	1.9	11
Grand Junction - Powell Bldg.	3.0	1.4	1.3	1.9	12
Arapaho Community College (ACC)	1.8	1.8	1.3	1.6	13
Fort Collins - CSU	1.8	2.0	1.0	1.6	14
Chatfield State Park	2.4	1.2	1.0	1.5	15
La Casa	1.6	1.3	1.1	1.3	16
Welby	1.7	1.2	1.0	1.3	17
CAMP	1.1	1.6	1.0	1.2	18
Aspen	1.3	1.0	1.1	1.1	19
Lamar - Municipal Bldg.	1.1	1.0	1.0	1.0	20
Alamosa - ASC	1.0	1.1	1.0	1.0	21

2.9.7 Lead (Pb)

Lead point sources required for monitoring are based on emissions are listed in the 2020 National Emissions Inventory, which is the most current version. The sources from the inventory with emissions greater than 0.1 tons per year (200 pounds per year) are shown in Table 65. There are no sources in the inventory with emissions greater than 0.5 tons per year

Table 65. Major lead sources in Colorado

Name	Location	Emissions (tons/year)
Simon Contractors (Rushmore)	Holyoke	0.135

2.10 Traffic Counts

Point sources typically account for only a portion of the pollution emissions within an area. The Traffic Count analysis considers transportation and mobile source emissions. This analysis evaluates the mobile source emissions within the influence of a monitoring site; these data, along with point source data from the Emissions Inventory analysis described in Section 2.9, are used to assess the total effect of emissions within each site's area of representation (i.e., Area Served polygon).

Emissions from mobile sources can vary greatly; factors which can affect the amount of pollution released include road type (e.g., fast-moving vehicles on a freeway generally emit less pollution per unit distance than vehicles on arterial roads and collectors), vehicle type (e.g., diesel vs. gasoline powered vehicles), traffic congestion, age and size of vehicles, etc. Ideally, a method which attempts to account for traffic emissions would account for all of these variables in a spatially resolved model. Unfortunately, such traffic modeling is outside of the scope of this network assessment. Instead, traffic counts and road density are used in this analysis as proxies for mobile source pollution.

Annual average daily traffic (AADT) counts were obtained from the Colorado Department of Transportation for 2023, the most recent year with available data. The dataset includes counts for highways and major roads with comprehensive sample location coverage; however, it is difficult to ascertain if AADT sample locations include all arterial roads with the same density (see Figure 29) and it is likely that additional new roads were not sampled. To account for variations in sampling density in different parts of the state, the total AADT counts within each site's Area Served polygon were normalized by the average distance between sampling locations. The rankings based on normalized AADT counts were then averaged together with rankings based on road density and each site was ranked based on this overall score. To further normalize the AADT counts, this analysis also considers the road density within each site's Area Served polygon when calculating the final rankings.

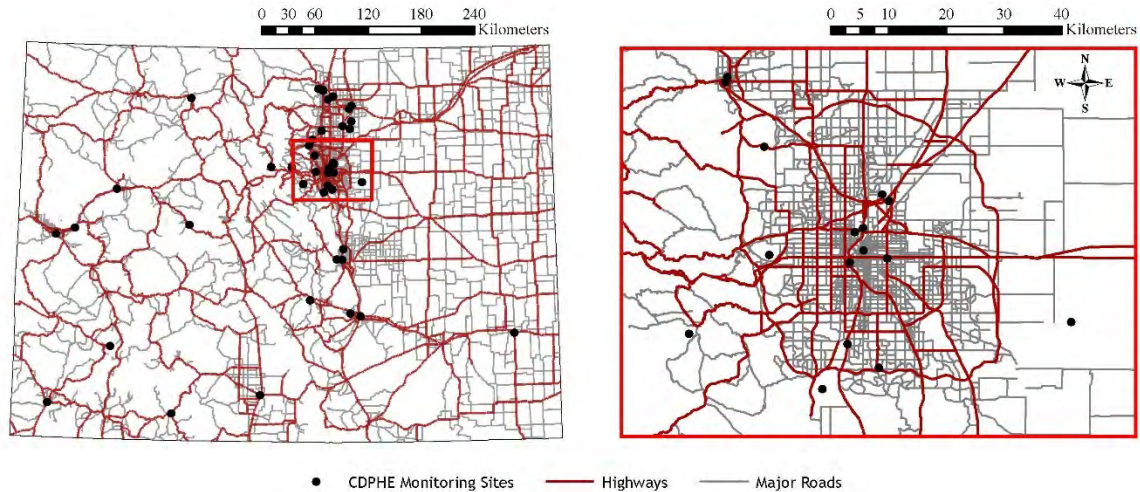


Figure 29. Highways and major roads in Colorado.

2.10.1 Carbon Monoxide (CO)

Table 66. CO monitoring sites ranked by traffic counts.

Site Name	Sum of AADT Counts		Total Normalized AADT Counts	Score
	Major Roads	Highways		
La Casa	50,963,460	216,063,400	91,526	5.0
I-25: Denver	74,616,000	191,553,300	74,629	4.0
Colorado College	51,565,860	74,107,100	65,906	3.5
Fort Collins - Mason	13,291,830	25,074,800	33,372	1.7
Greeley - Weld County Tower	6,911,610	20,209,420	21,422	1.0

Table 67. CO monitoring sites ranked by road density.

Site Name	Size of Area Served Polygon (km ²)	Total Road Length (km)	Road Density (m/km ²)	Score
I-25: Denver	515	733	1,424	5.0
La Casa	515	610	1,184	4.0
Colorado College	848	543	641	1.8
Fort Collins - Mason	855	374	437	1.0
Greeley - Weld County Tower	855	370	433	1.0

Table 68. Overall traffic counts rankings for the CO monitoring network.

Site Name	Scores			Rank
	Traffic Counts	Road Density	Average	
I-25: Denver	4.0	5.0	4.5	1
La Casa	5.0	4.0	4.5	2
Colorado College	3.5	1.8	2.7	3
Fort Collins - Mason	1.7	1.0	1.3	4
Greeley - Weld County Tower	1.0	1.0	1.0	5

2.10.2 Nitrogen Dioxide (NO₂)

Table 69. NO₂ monitoring sites ranked by traffic counts.

Site Name	Sum of AADT Counts		Total Normalized AADT Counts	Score
	Major Roads	Highways		
I-25: Globeville	4,464,670	52,635,300	120,780	9.00
Welby	42,492,000	121,931,700	83,792	6.02
CAMP	46,053,440	53,679,000	79,962	5.71
La Casa	10,169,200	49,331,000	76,879	5.46
I-25: Denver	44,604,870	173,195,600	75,537	5.35
Fossil Creek	14,249,710	33,337,800	44,538	2.85
Rocky Flats - N.	15,863,560	50,576,300	34,540	2.05
Bethke	3,488,180	17,350,320	26,704	1.42
La Salle	3,897,790	11,385,000	21,525	1.00

Table 70. NO₂ monitoring sites ranked by road density.

Site Name	Size of Area Served Polygon (km ²)	Total Road Length (km)	Road Density (m/km ²)	Score
CAMP	181	323	1782	9.0
I-25: Globeville	39	67	1703	8.6
La Casa	104	166	1597	8.0
I-25: Denver	430	549	1275	6.3
Welby	501	411	819	3.9
Fossil Creek	572	333	582	2.6
Rocky Flats - N.	772	417	540	2.4
Bethke	572	213	372	1.5
La Salle	918	263	286	1.0

Table 71. Overall traffic counts rankings for the NO₂ monitoring network.

Site Name	Scores			Rank
	Traffic Counts	Road Density	Average	
I-25: Globeville	9.0	8.6	8.8	1
CAMP	5.7	9.0	7.4	2
La Casa	5.5	8.0	6.7	3
I-25: Denver	5.4	6.3	5.8	4
Welby	6.0	3.9	4.9	5
Fossil Creek	2.9	2.6	2.7	6
Rocky Flats - N.	2.0	2.4	2.2	7
Bethke	1.4	1.5	1.4	8
La Salle	1.0	1.0	1.0	9

2.10.3 Sulfur Dioxide (SO₂)

Table 72. SO₂ monitoring sites ranked by traffic counts.

Site Name	Sum of AADT Counts		Total Normalized AADT Counts	Score
	Major Roads	Highways		
Welby	25,271,400	99,252,100	93,831	3.0
CAMP	62,003,720	109,111,000	87,299	1.9
La Casa	13,570,330	84,674,700	81,804	1.0

Table 73. SO₂ monitoring sites ranked by road density.

Site Name	Size of Area Served Polygon (km ²)	Total Road Length (km)	Road Density (m/km ²)	Score
CAMP	228	458	2013	3.0
La Casa	148	231	1565	2.2
Welby	286	265	924	1.0

Table 74. Overall traffic counts rankings for the SO₂ monitoring network.

Site Name	Scores			Rank
	Traffic Counts	Road Density	Average	
CAMP	1.9	3.0	2.5	1
Welby	3.0	1.0	2.0	3
La Casa	1.0	2.2	1.6	2

2.10.4 Ozone (O₃)

Table 75. O₃ monitoring sites ranked by traffic counts.

Site Name	Sum of AADT Counts		Total Normalized AADT Counts	Score
	Major Roads	Highways		
CAMP	72,722,170	121,963,200	88,090	23.0
La Casa	11,678,030	75,773,700	86,036	22.5
Highland Reservoir	37,355,080	143,635,200	83,713	21.8
Welby	53,885,620	150,146,000	76,386	19.9
NREL	8,410,270	67,299,300	48,942	12.6
Manitou Springs	27,137,670	55,793,700	45,883	11.8
Fossil Creek	7,743,260	34,742,200	39,800	10.2
Rocky Flats - N.	8,381,130	34,830,900	35,672	9.1
Chatfield State Park	6,238,620	27,632,940	34,788	8.9
USAFA	32,421,770	47,963,520	30,426	7.7
Fort Collins - Mason	7,562,680	15,261,400	29,144	7.4
Boulder Reservoir	15,765,680	49,783,480	25,824	6.5
Evergreen	826,200	18,424,340	18,075	4.4
Bethke	1,573,480	9,151,500	16,836	4.1
Rifle - Health Dept.	2,794,150	40,249,930	16,001	3.9
Black Hawk	36,400	26,605,430	12,758	3.0
Aurora - East	7,167,710	21,342,150	12,160	2.9
La Salle	1,537,770	24,877,720	12,079	2.9
Greeley - Weld County Tower	6,761,730	18,183,920	11,809	2.8
Palisade Water Treatment	12,198,000	36,234,590	9,890	2.3
Pueblo West	6,813,480	55,609,900	8,721	2.0
Fort Collins - West	1,298,940	6,580,270	5,741	1.2
Cortez - Health Dept.	468,100	8,353,030	5,070	1.0

Table 76. O₃ monitoring sites ranked by road density.

Site Name	Size of Area Served Polygon (km ²)	Total Road Length (km)	Road Density (m/km ²)	Score
CAMP	289	527	1823	23.0
La Casa	111	185	1670	21.1
NREL	376	271	722	9.1
Welby	960	578	602	7.6
Highland Reservoir	924	502	543	6.9
Rocky Flats - N.	501	240	480	6.1
Fossil Creek	696	283	406	5.2
Manitou Springs	1,495	474	317	4.1
Boulder Reservoir	2,125	601	283	3.6
Fort Collins - Mason	906	238	263	3.4
USAFA	4,197	926	221	2.8
Chatfield State Park	1,451	237	163	2.1
La Salle	4,528	726	160	2.1
Black Hawk	1,664	257	154	2.0
Bethke	1,553	226	145	1.9
Evergreen	1,706	240	141	1.8
Greeley - Weld County Tower	4,755	658	138	1.8
Aurora - East	7,971	805	101	1.3
Palisade Water Treatment	10,145	1022	101	1.3
Pueblo West	15,974	1593	100	1.3
Fort Collins - West	4,337	395	91	1.2
Cortez - Health Dept.	6,083	519	85	1.1
Rifle - Health Dept.	9,505	709	75	1.0

Table 77. Overall traffic counts rankings for the O₃ monitoring network.

Site Name	Scores			Rank
	Traffic Counts	Road Density	Average	
CAMP	23.0	23.0	23.0	1
La Casa	22.5	21.1	21.8	2
Highland Reservoir	21.8	6.9	14.4	3
Welby	19.9	7.6	13.8	4
NREL	12.6	9.1	10.9	5
Manitou Springs	11.8	4.1	7.9	6
Fossil Creek	10.2	5.2	7.7	7
Rocky Flats - N.	9.1	6.1	7.6	8
Chatfield State Park	8.9	2.1	5.5	9
Fort Collins - Mason	7.4	3.4	5.4	10
U.S. Air Force Academy (USAFA)	7.7	2.8	5.3	11
Boulder Reservoir	6.5	3.6	5.1	12
Evergreen	4.4	1.8	3.1	13
Bethke	4.1	1.9	3.0	14
Black Hawk	3.0	2.0	2.5	15
La Salle	2.9	2.1	2.5	16
Rifle - Health Dept.	3.9	1.0	2.4	17
Greeley - Weld County Tower	2.8	1.8	2.3	18
Aurora - East	2.9	1.3	2.1	19
Palisade Water Treatment	2.3	1.3	1.8	20
Pueblo West	2.0	1.3	1.6	21
Fort Collins - West	1.2	1.2	1.2	22
Cortez - Health Dept.	1.0	1.1	1.1	23

2.10.5 PM₁₀

Table 78. PM₁₀ monitoring sites ranked by traffic counts.

Site Name	Sum of AADT Counts		Total Normalized AADT Counts	Score
	Major Roads	Highways		
Welby	17,673,300	66,373,000	98,093	16.0
Birch Street	10,424,100	41,758,000	92,884	15.1
CAMP	60,934,720	105,179,000	85,671	14.0
La Casa	13,534,430	84,449,000	83,059	13.5
Colorado College	40,169,490	53,779,100	76,201	12.4
Longmont - Municipal Bldg.	7,586,740	20,435,800	37,111	6.0
Boulder - CU	8,005,130	22,688,600	33,853	5.5
Pueblo - Fountain School	5,119,850	25,177,400	27,806	4.5
Grand Junction - Powell Bldg.	9,210,410	15,506,400	23,081	3.7
Aspen	163,740	2,735,600	15,418	2.5
Steamboat Springs	376,280	3,386,000	13,856	2.2
Cañon City - City Hall	349,450	901,000	9,880	1.6
Pagosa Springs School	43,600	2,410,000	9,842	1.6
Alamosa - ASC	297,140	3,196,800	8,449	1.3
Telluride	50,500	764,900	6,474	1.0
Lamar - Municipal Bldg.	251,530	1,755,540	6,335	1.0

Table 79. PM₁₀ monitoring sites ranked by road density.

Site Name	Size of Area Served Polygon (km ²)	Total Road Length (km)	Road Density (m/km ²)	Score
CAMP	218	446	2051	16.0
La Casa	146	229	1568	12.3
Welby	167	188	1121	8.8
Colorado College	408	396	971	7.6
Birch Street	150	108	717	5.7
Pueblo - Fountain School	408	265	649	5.1
Longmont - Municipal Bldg.	407	229	564	4.5
Grand Junction - Powell Bldg.	408	213	521	4.2
Boulder - CU	407	201	495	3.9
Alamosa - ASC	408	101	248	2.0
Lamar - Municipal Bldg.	408	90	220	1.8
Steamboat Springs	408	78	191	1.6
Cañon City - City Hall	213	33	155	1.3
Telluride	254	37	147	1.3
Aspen	408	47	115	1.0
Pagosa Springs School	408	46	114	1.0

Table 80. Overall traffic counts rankings for the PM₁₀ monitoring network.

Site Name	Scores			Rank
	Traffic Counts	Road Density	Average	
CAMP	14.0	16.0	15.0	1
La Casa	13.5	12.3	12.9	2
Welby	16.0	8.8	12.4	3
Birch Street	15.1	5.7	10.4	4
Colorado College	12.4	7.6	10.0	5
Longmont - Municipal Bldg.	6.0	4.5	5.3	6
Pueblo - Fountain School	4.5	5.1	4.8	7
Boulder - CU	5.5	3.9	4.7	8
Grand Junction - Powell Bldg.	3.7	4.2	3.9	9
Steamboat Springs	2.2	1.6	1.9	10
Aspen	2.5	1.0	1.7	11
Alamosa - ASC	1.3	2.0	1.7	12
Cañon City - City Hall	1.6	1.3	1.5	13
Lamar - Municipal Bldg.	1.0	1.8	1.4	14
Pagosa Springs School	1.6	1.0	1.3	15
Telluride	1.0	1.3	1.1	16

2.10.6 PM_{2.5}

Table 81. PM_{2.5} monitoring sites ranked by traffic counts.

Site Name	Sum of AADT Counts		Total Normalized AADT Counts	Score
	Major Roads	Highways		
I-25: Globeville	3,373,270	44,073,700	126,044	21.0
CAMP	12,432,330	7,790,000	116,087	19.4
National Jewish Health (NJH)	53,008,860	101,860,600	97,342	16.3
Arapaho Community College	28,416,120	109,512,700	83,607	14.0
Welby	22,516,120	86,942,800	74,746	12.5
I-25: Denver	23,545,790	93,888,400	73,480	12.3
La Casa	12,672,590	51,368,900	70,154	11.8
Colorado College	52,211,460	76,155,100	64,553	10.9
Birch Street	19,621,140	24,641,300	63,221	10.6
Longmont - Municipal Bldg.	9,201,170	34,899,000	38,126	6.5
Bethke	5,686,970	30,231,840	37,696	6.4
Chatfield State Park	3,087,700	21,572,100	33,867	5.8
Fort Collins - CSU	10,373,040	14,239,800	28,727	4.9
Boulder - CU	10,764,440	35,717,000	28,290	4.9
Pueblo - Fountain School	5,898,500	28,908,300	24,597	4.3
Platteville - Middle School	1,248,810	12,183,600	21,524	3.8
Greeley - Hospital	6,370,350	14,616,400	20,539	3.6
Grand Junction - Powell Bldg.	9,385,320	18,185,030	19,620	3.4
Aspen	163,740	3,876,000	14,403	2.6
Alamosa - ASC	307,220	3,618,690	6,720	1.3
Lamar - Municipal Bldg.	276,070	1,971,900	4,830	1.0

Table 82. PM_{2.5} monitoring sites ranked by road density.

Site Name	Size of Area Served Polygon (km ²)	Total Road Length (km)	Road Density (m/km ²)	Score
CAMP	16	80	4904	21.0
I-25: Globeville	29	49	1690	7.7
I-25: Denver	211	291	1377	6.4
National Jewish Health (NJH)	290	378	1302	6.1
La Casa	174	222	1276	6.0
Arapaho Community College	354	368	1039	5.0
Welby	330	323	979	4.8
Colorado College	906	555	613	3.2
Birch Street	226	137	609	3.2
Longmont - Municipal Bldg.	723	330	456	2.6
Greeley - Hospital	750	331	442	2.5
Fort Collins - CSU	670	288	429	2.5
Boulder - CU	805	338	419	2.4
Bethke	577	237	410	2.4
Pueblo - Fountain School	918	341	372	2.2
Grand Junction - Powell Bldg.	914	290	317	2.0
Platteville - Middle School	759	216	285	1.9
Chatfield State Park	610	174	285	1.9
Alamosa - ASC	918	161	176	1.4
Lamar - Municipal Bldg.	918	150	163	1.4
Aspen	918	64	70	1.0

Table 83. Overall traffic counts rankings for the PM_{2.5} monitoring network.

Site Name	Scores			Rank
	Traffic Counts	Road Density	Average	
CAMP	19.4	21.0	20.2	1
I-25: Globeville	21.0	7.7	14.4	2
National Jewish Health (NJH)	16.3	6.1	11.2	3
Arapaho Community College (ACC)	14.0	5.0	9.5	4
I-25: Denver	12.3	6.4	9.4	5
La Casa	11.8	6.0	8.9	6
Welby	12.5	4.8	8.6	7
Colorado College	10.9	3.2	7.0	8
Birch Street	10.6	3.2	6.9	9
Longmont - Municipal Bldg.	6.5	2.6	4.5	10
Bethke	6.4	2.4	4.4	11
Chatfield State Park	5.8	1.9	3.8	12
Fort Collins - CSU	4.9	2.5	3.7	13
Boulder - CU	4.9	2.4	3.7	14
Pueblo - Fountain School	4.3	2.2	3.3	15
Greeley - Hospital	3.6	2.5	3.1	16
Platteville - Middle School	3.8	1.9	2.8	17
Grand Junction - Powell Bldg.	3.4	2.0	2.7	18
Aspen	2.6	1.0	1.8	19
Alamosa - ASC	1.3	1.4	1.4	20
Lamar - Municipal Bldg.	1.0	1.4	1.2	21

2.11 Results

The purpose of using many different, often competing, indicators is to provide a comprehensive evaluation technique that attempts to address all of the APCD's monitoring objectives, which are themselves often conflicting; e.g., the assessment of population exposure in areas of maximum pollutant concentrations and the determination of background concentrations are fundamentally different objectives requiring separate monitoring strategies. However, the various indicators used are not necessarily of equal importance to the overall analysis and the relative importance of each indicator should be expected to vary between pollutants. For example, the Measured Concentration indicator is widely believed to be the most relevant to the Network Assessment (Pope and Wu, 2014). However, in the case of the APCD PM₁₀ network, an overreliance on the Measured Concentration indicator would result in an analysis that is highly biased toward sites that are impacted by regional dust storms. Because these are exceptional events beyond the division's control, the APCD feels that the Deviation from the NAAQS indicator is a more appropriate metric by which to assess the PM₁₀ network. Furthermore, while traffic volume and point source density (i.e., "source-oriented" indicators) may be highly correlated with SO₂ and NO₂ concentrations in ambient air (Gulliver et al., 2011; Beelen et al., 2013), these sources are less relevant in determining the concentration of O₃, a secondary pollutant whose concentration is often reduced via NO_x titration in areas immediately surrounding pollution sources (Sillman, 1999). Therefore, the APCD feels that these indicators should be deemphasized in the case of O₃.

Another point that must be considered is that many of the indicators used in the site-to-site comparison analysis are spatially collocated and therefore correlated. For example, population density, traffic volume, and point source emissions all tend to be highest in areas of maximum economic activity (e.g., the central business district). To simply combine these indicators without weighting factors would result in an analysis that is biased heavily toward urban areas. This would be particularly problematic in the case of O₃, the pollutant of most concern within Colorado, which typically reaches its highest concentrations at suburban, rural, and high elevation sites. To reflect the variability among the factors addressed in the assessment, APCD has determined weights of relative importance to use when combining the individual indicators for each parameter assessed. These weighting factors were then used to produce a weighted score from the raw rankings derived from each analysis.

The weighting factors chosen for the CO, NO₂, SO₂, O₃, PM₁₀, and PM_{2.5} networks are shown in the following tables.

Table 84. Weighting factors applied to the site-to-site comparison results for each network.

Analysis	CO Weight	NO ₂ Weight	SO ₂ Weight	O ₃ Weight	PM ₁₀ Weight	PM _{2.5} Weight
Number of Parameters Monitored	12.6%	12.7%	7.0%	5.0%	3.8%	6.6%
Trends Impact	9.2%	8.9%	7.4%	7.0%	8.7%	8.9%
Measured Concentration	24.2%	23.3%	25.6%	21.0%	25.3%	21.8%
Deviation from the NAAQS	-	-	-	13.0%	-	-
Monitor-to-Monitor Correlation	7.4%	2.0%	2.8%	16.0%	8.3%	6.3%
Removal Bias	-	-	-	12.0%	8.6%	7.4%
Area Served	4.4%	6.0%	5.7%	16.0%	11.0%	9.7%
Population Served	8.6%	8.3%	9.5%	2.5%	8.7%	7.5%
DIC Population Served	8.6%	8.3%	9.5%	2.5%	8.7%	7.5%
Point Source Emissions	7.4%	17.4%	28.4%	3.0%	11.7%	16.0%
Traffic Counts	17.7%	13.0%	4.2%	2.0%	5.2%	8.3%

2.11.1 Parameter Details

In this section, the raw rankings derived from each analysis are converted to scores. For each monitoring network, the number of possible points is equivalent to the number of sites in the network (e.g., for the CO network, the maximum possible score is seven). Sites ranking first in a given analysis are assigned the maximum number of points (e.g., seven for the CO network), while the other sites are given scores that scale linearly between one and the maximum.

The following figures and tables show the results of the overall analysis for each pollutant network. The final rankings are based on the weighted average score, with the highest scoring monitor being given a one, the second highest scoring monitor being given a two, etc.

2.11.1.1 Carbon Monoxide (CO)

Table 85. Raw scores and weighted averages for the CO site-to-site comparison analyses.

Site Name	Parameters Monitored	Trends Impact	Measured Concentration	Monitor-to-Monitor Correlation	Area Served	Population Served	DIC Population Served	Point Source Emissions	Traffic Counts	Weighted Total Score	Rank
I-25: Denver	2.0	2.0	5.0	3.0	1.0	5.0	4.7	1.1	4.5	3.6	1
La Casa	5.0	2.0	2.7	3.0	1.0	3.9	5.0	2.0	4.5	3.4	2
Fort Collins - Mason	1.0	5.0	2.8	1.7	5.0	1.5	1.0	1.0	1.3	2.1	3
Colorado College	1.0	1.0	1.0	5.0	4.9	2.9	2.6	1.0	2.7	2.0	4
Greeley - County Tower	1.0	1.8	1.1	3.7	5.0	1.0	1.4	5.0	1.0	1.8	5
Weight	13%	9%	24%	7%	4%	9%	9%	7%	18%		

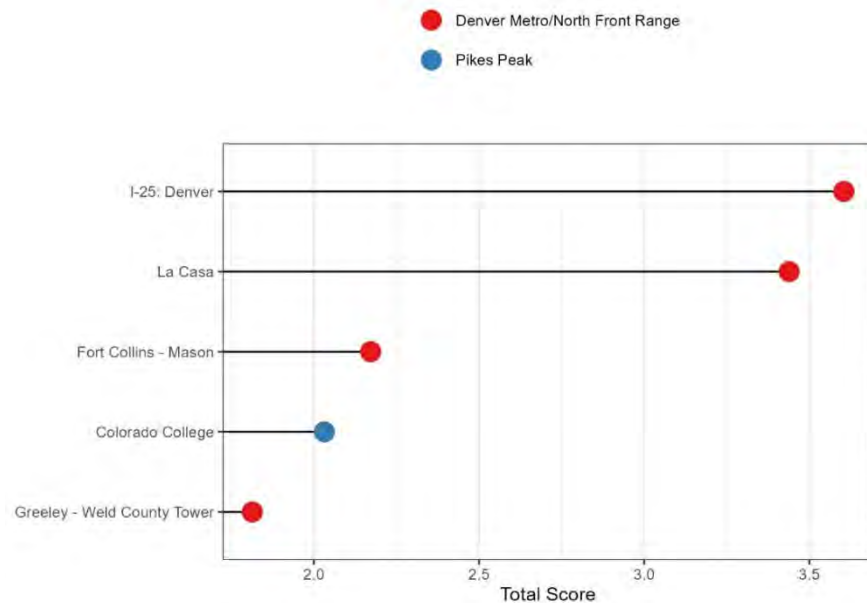


Figure 30. Cleveland dot plot showing the weighted total score for each site in the CO monitoring network.

2.11.1.2 Sulfur Dioxide (SO₂)

Table 86. Raw scores and weighted averages for the SO₂ site-to-site comparison analyses.

Site Name	Parameters Monitored	Trends Impact	Measured Concentration	Monitor-to-Monitor Correlation	Area Served	Population Served	DIC Population Served	Point Source Emissions	Traffic Counts	Weighted Total Score	Rank
Welby	2.0	2.7	3.0	3.0	3.0	1.6	2.6	3.0	2.0	2.6	1
CAMP	1.0	3.0	1.0	1.0	2.2	3.0	3.0	1.0	2.5	1.8	2
La Casa	3.0	1.0	1.9	1.0	1.0	1.0	1.0	1.0	1.6	1.6	3
Weight	7%	7%	26%	3%	6%	10%	10%	28%	4%		

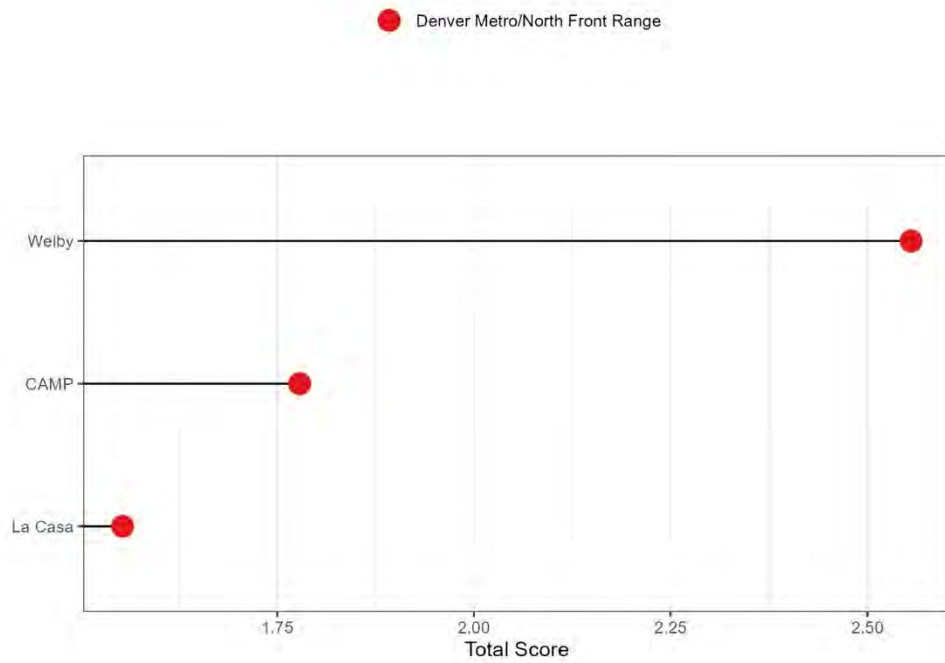


Figure 31. Cleveland dot plot showing the weighted total score for each site in the SO₂ monitoring network.

2.11.1.3 Nitrogen Dioxide (NO₂)

Table 87. Raw scores and weighted averages for the NO₂ site-to-site comparison analyses.

Site Name	Parameters Monitored	Trends Impact	Measured Concentration	Monitor-to-Monitor Correlation	Area Served	Population Served	DIC Population Served	Point Source Emissions	Traffic Counts	Weighted Total Score	Rank
Welby	7.4	7.5	7.4	1.5	5.2	6.8	9.0	3.5	4.9	6.0	1
CAMP	5.8	9.0	8.5	3.0	2.3	6.9	6.6	1.7	7.4	5.5	2
I-25: Denver	4.2	2.5	8.3	1.8	4.6	9.0	7.3	1.7	5.8	5.2	3
La Salle	1.0	1.0	3.4	3.9	9.0	1.6	2.2	9.0	1.0	4.6	4
I-25: Globeville	2.6	2.2	9.0	2.3	1.0	1.0	1.3	2.4	8.8	4.0	5
La Casa	9.0	2.4	7.0	1.9	1.6	2.8	2.8	1.0	6.7	3.8	6
Rocky Flats - N.	2.6	4.9	1.0	9.0	7.7	5.1	2.1	3.0	2.2	3.1	7
Bethke	2.6	1.0	2.4	1.6	5.8	1.7	1.0	4.2	1.4	2.8	8
Fossil Creek	2.6	1.0	2.6	2.1	5.8	4.0	2.1	1.8	2.7	2.5	9
Weight	13%	9%	23%	2%	6%	8%	8%	17%	13%		

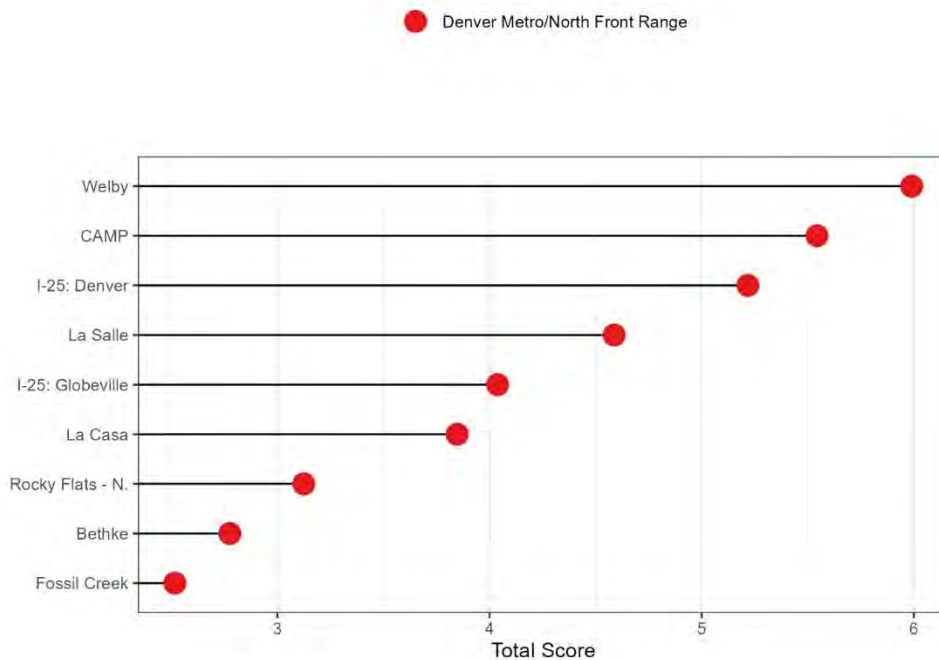


Figure 32. Cleveland dot plot showing the weighted total score for each site in the NO₂ monitoring network.

2.11.1.4 Ozone (O_3)

Table 88. Raw scores and weighted averages for the O_3 site-to-site comparison analyses.

Site Name	Parameters Monitored	Trends Impact	Measured Concentration	Deviation from the NAAQS	Monitor-to-Monitor Correlation	Removal Bias	Area Served	Population Served	DIC Population Served	Point Source Emissions	Traffic Counts	Weighted Total Score	Rank
U.S. Air Force Academy	1.0	12.8	11.0	23.0	20.9	14.8	6.7	12.5	8.2	2.0	5.3	13.1	1
Pueblo West	4.7	1.4	12.0	21.1	17.5	1.1	23.0	7.1	8.0	13.7	1.6	13.0	2
Welby	19.3	22.6	16.0	13.9	11.4	8.2	2.2	18.4	22.8	7.2	13.8	12.4	3
Aurora - East	4.7	7.3	14.8	16.0	11.5	14.1	11.9	8.7	7.9	4.3	2.1	12.0	4
Manitou Springs	1.0	9.5	13.3	18.7	12.9	16.4	2.9	10.5	9.3	4.5	7.9	11.2	5
Fort Collins - Mason	8.3	19.6	13.3	18.7	9.0	16.7	2.1	5.2	3.7	2.6	5.4	11.2	6
Black Hawk	1.0	3.1	14.5	16.6	19.3	16.5	3.2	1.4	1.0	1.1	2.5	11.2	7
Greeley - County Tower	8.3	10.3	13.3	18.7	8.3	9.5	7.4	5.6	7.4	17.2	2.3	10.9	8
Fort Collins - West	4.7	8.6	15.7	14.4	8.0	17.9	6.9	2.5	2.0	3.3	1.2	10.8	9
Rocky Flats - N.	8.3	14.5	20.4	5.8	5.8	18.7	1.5	7.6	3.8	1.6	7.6	10.4	10
CAMP	15.7	23.0	13.6	18.2	3.7	1.0	1.2	23.0	23.0	2.6	23.0	10.2	11
Highland Reservoir	4.7	20.5	13.9	17.6	9.1	3.0	2.1	21.0	12.2	1.9	14.4	10.2	12
Palisade Water Treatment	4.7	7.8	4.8	12.8	15.6	11.3	14.9	6.4	7.3	2.5	1.8	10.1	13
Evergreen	4.7	2.7	17.4	11.2	20.6	2.7	3.2	2.1	1.0	1.0	3.1	9.9	14
NREL	1.0	13.7	18.6	9.0	5.8	15.2	1.4	8.3	6.2	2.8	10.9	9.7	15
Rifle - Health Dept.	1.0	7.8	1.0	5.8	14.9	23.0	14.0	3.3	3.4	9.7	2.4	9.5	16
La Casa	23.0	5.7	15.4	15.0	5.7	5.9	1.0	7.2	8.4	1.8	21.8	9.4	17
La Salle	4.7	1.0	18.6	9.0	6.4	5.6	7.1	4.2	5.4	22.9	2.5	9.2	18
Bethke	8.3	1.0	17.7	10.7	6.2	10.1	3.0	2.9	2.3	4.4	3.0	8.6	19
Fossil Creek	8.3	1.0	23.0	1.0	7.0	10.5	1.8	6.0	3.7	2.3	7.7	8.6	20
Boulder Reservoir	4.7	4.4	15.7	14.4	5.9	5.2	3.8	9.9	6.8	3.3	5.1	8.5	21
Chatfield State Park	8.3	9.5	20.1	6.4	6.3	3.9	2.9	6.5	3.3	1.3	5.5	8.5	22
Cortez - Health Dept.	1.0	7.8	3.6	10.7	18.8	7.9	9.3	1.0	1.4	1.6	1.1	8.3	23
Weight	5%	7%	21%	13%	16%	12%	16%	3%	3%	3%	2%		

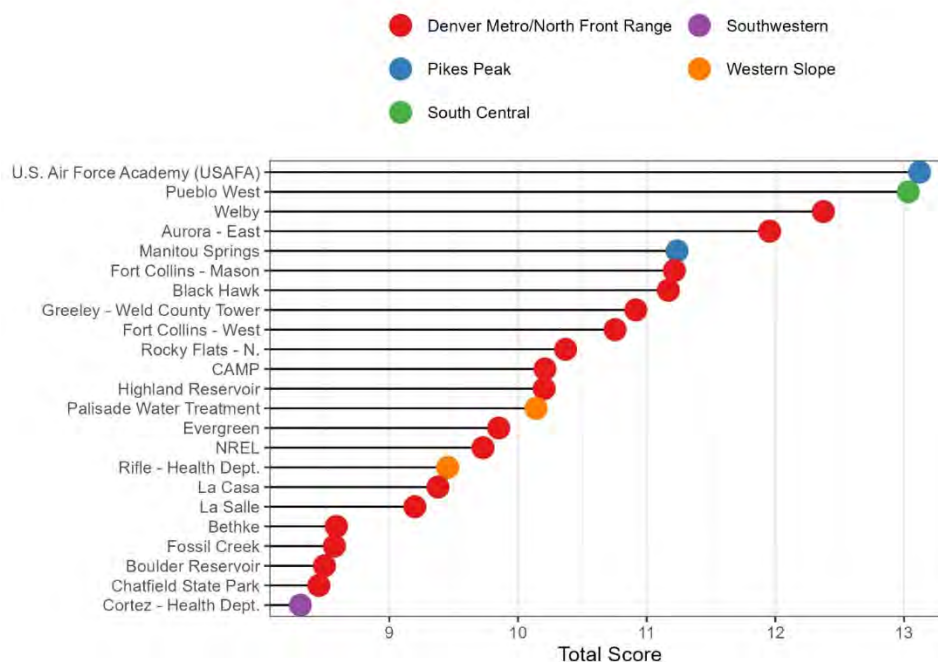


Figure 33. Cleveland dot plot showing the weighted total score for each site in the O₃ monitoring network.

2.11.1.5 PM_{10} Table 89. Raw scores and weighted averages for the PM_{10} site-to-site comparison analyses.

Site Name	Parameters Monitored	Trends Impact	Measured Concentration	Monitor-to-Monitor Correlation	Removal Bias	Area Served	Population Served	DIC Population Served	Point Source Emissions	Traffic Counts	Weighted Total Score	Rank
Lamar - Municipal Bldg.	3.5	15.6	16.0	13.8	3.9	16.0	1.1	1.4	1.6	1.4	9.2	1
Pagosa Springs School	1.0	16.0	14.2	16.0	1.9	16.0	1.1	1.1	1.0	1.3	8.6	2
Pueblo - Fountain School	3.5	6.5	6.4	12.8	1.0	16.0	4.0	5.0	16.0	4.8	8.1	3
CAMP	11.0	15.6	2.8	3.5	4.5	5.1	16.0	16.0	3.3	15.0	7.7	4
Welby	13.5	15.6	6.2	7.9	2.9	2.2	8.4	11.8	1.8	12.4	7.2	5
Colorado College	6.0	6.9	1.0	11.2	5.8	16.0	10.7	10.0	4.9	10.0	7.1	6
Alamosa - ASC	3.5	14.4	6.1	15.0	2.8	16.0	1.1	1.4	1.1	1.7	6.6	7
Longmont - Municipal	3.5	16.0	2.4	2.8	3.2	15.9	4.5	4.4	9.3	5.3	6.6	8
Grand Junction - Powell	3.5	9.3	2.3	13.5	3.8	16.0	3.8	4.6	3.7	3.9	6.1	9
Steamboat Springs	1.0	15.6	2.0	13.3	8.6	16.0	1.3	1.2	1.1	1.9	6.0	10
Boulder - CU	3.5	1.0	1.7	11.3	16.0	15.9	4.6	2.5	2.1	4.7	5.8	11
Birch Street	3.5	1.8	6.7	2.7	4.7	1.2	4.5	6.4	9.6	10.4	5.4	12
Aspen	3.5	4.2	2.9	13.3	8.3	16.0	1.0	1.0	1.3	1.7	5.2	13
La Casa	16.0	5.3	1.8	1.0	9.8	1.0	7.8	8.9	4.4	12.9	5.2	14
Telluride	1.0	14.0	3.3	13.8	4.7	7.2	1.0	1.0	1.0	1.1	4.8	15
Cañon City - City Hall	1.0	8.5	4.7	11.2	6.7	4.8	1.3	1.5	1.3	1.5	4.5	16
Weight	4%	9%	25%	8%	9%	11%	9%	9%	12%	5%		

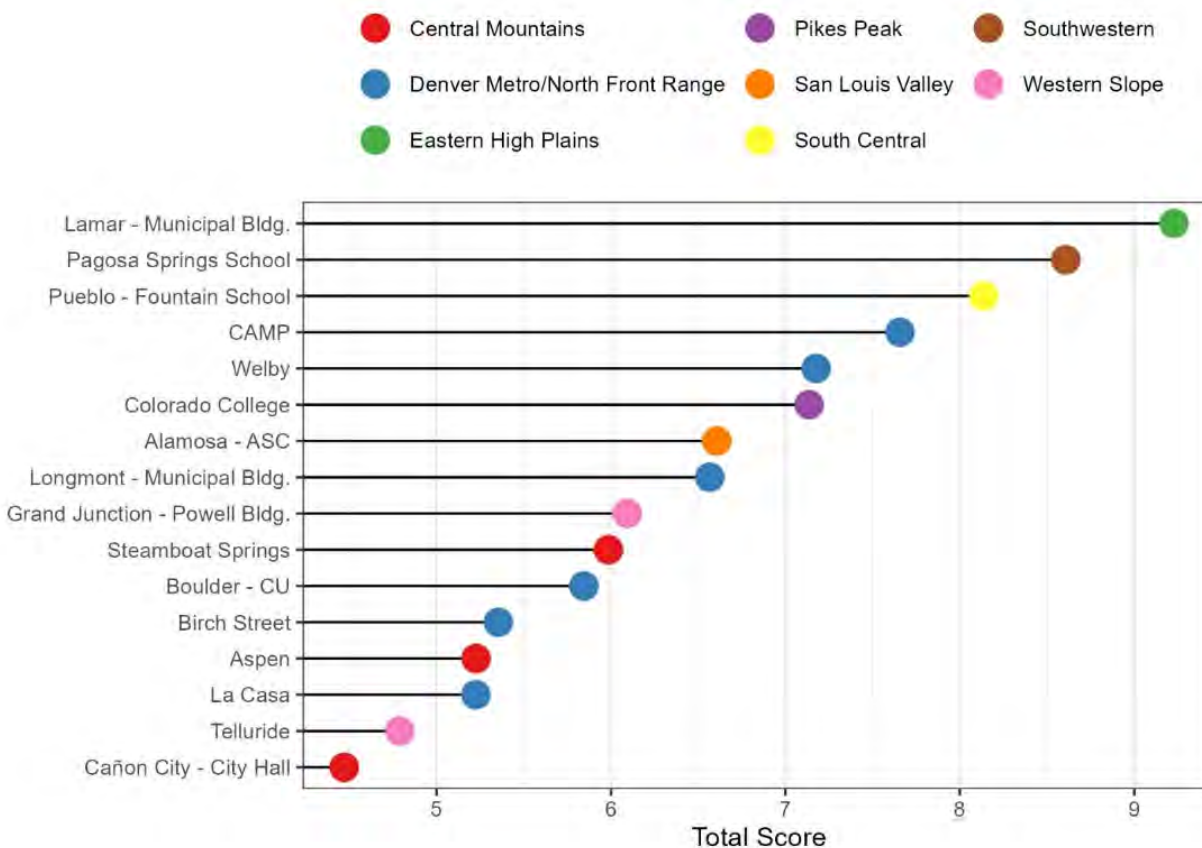


Figure 34. Cleveland dot plot showing the weighted total score for each site in the PM₁₀ monitoring network.

2.11.1.6 PM_{2.5}Table 90. Raw scores and weighted averages for the PM_{2.5} site-to-site comparison analyses.

Site Name	Parameters Monitored	Trends Impact	Measured Concentration	Monitor-to-Monitor Correlation	Removal Bias	Area Served	Population Served	DIC Population Served	Point Source Emissions	Traffic Counts	Weighted Total Score	Rank
Greeley - Hospital	1.0	21.0	20.2	11.6	7.3	17.3	6.2	8.6	6.0	3.1	11.7	1
Platteville - Middle School	1.0	21.0	21.0	9.0	7.0	17.5	3.4	4.2	7.3	2.8	11.3	2
Pueblo - Fountain School	4.3	13.0	1.1	18.4	8.5	21.0	5.4	6.5	21.0	3.3	10.0	3
Welby	17.7	1.0	19.4	1.0	6.2	7.9	13.5	15.4	1.3	8.6	9.9	4
Longmont - Municipal	4.3	21.0	14.2	6.8	6.8	16.7	6.9	6.8	3.9	4.5	9.9	5
Colorado College	7.7	13.8	3.0	15.8	7.6	20.7	18.5	15.6	2.9	7.0	9.6	6
NJH	1.0	21.0	7.9	4.6	2.3	7.1	21.0	21.0	1.9	11.2	9.2	7
Fort Collins - CSU	1.0	21.0	13.2	10.4	7.0	15.5	7.8	5.6	1.6	3.7	9.1	8
CAMP	14.3	21.0	12.3	5.3	1.6	1.0	4.0	3.4	1.2	20.2	8.5	9
I-25: Denver	11.0	9.0	11.0	9.5	1.0	5.3	12.5	12.0	2.0	9.4	8.1	10
I-25: Globeville	7.7	8.2	15.5	6.7	9.6	1.3	2.7	4.2	2.9	14.4	8.0	11
Birch Street	4.3	3.4	17.1	3.9	5.9	5.6	6.2	8.4	4.5	6.9	7.9	12
La Casa	21.0	10.6	8.6	3.9	8.6	4.5	9.6	9.2	1.3	8.9	7.9	13
ACC	1.0	21.0	4.9	7.2	8.1	8.5	16.1	10.2	1.6	9.5	7.9	14
Grand Junction - Powell	4.3	18.6	1.1	21.0	5.2	20.9	5.0	5.9	1.9	2.7	7.3	15
Boulder - CU	4.3	1.8	4.7	7.7	18.6	18.5	8.0	3.8	2.0	3.7	6.6	16
Chatfield State Park	7.7	16.2	2.6	8.6	4.5	14.2	6.1	2.6	1.5	3.8	6.0	17
Bethke	7.7	1.0	1.9	13.3	12.9	13.4	6.4	4.7	4.1	4.4	5.9	18
Aspen	4.3	1.0	1.0	20.5	21.0	21.0	1.1	1.0	1.1	1.8	5.9	19
Alamosa - ASC	4.3	1.8	5.9	20.9	2.6	21.0	1.2	1.6	1.0	1.4	5.8	20
Lamar - Municipal Bldg.	4.3	1.8	3.3	17.4	6.4	21.0	1.0	1.4	1.0	1.2	5.2	21
Weight	7%	9%	22%	6%	7%	10%	15%	15%	16%	8%		

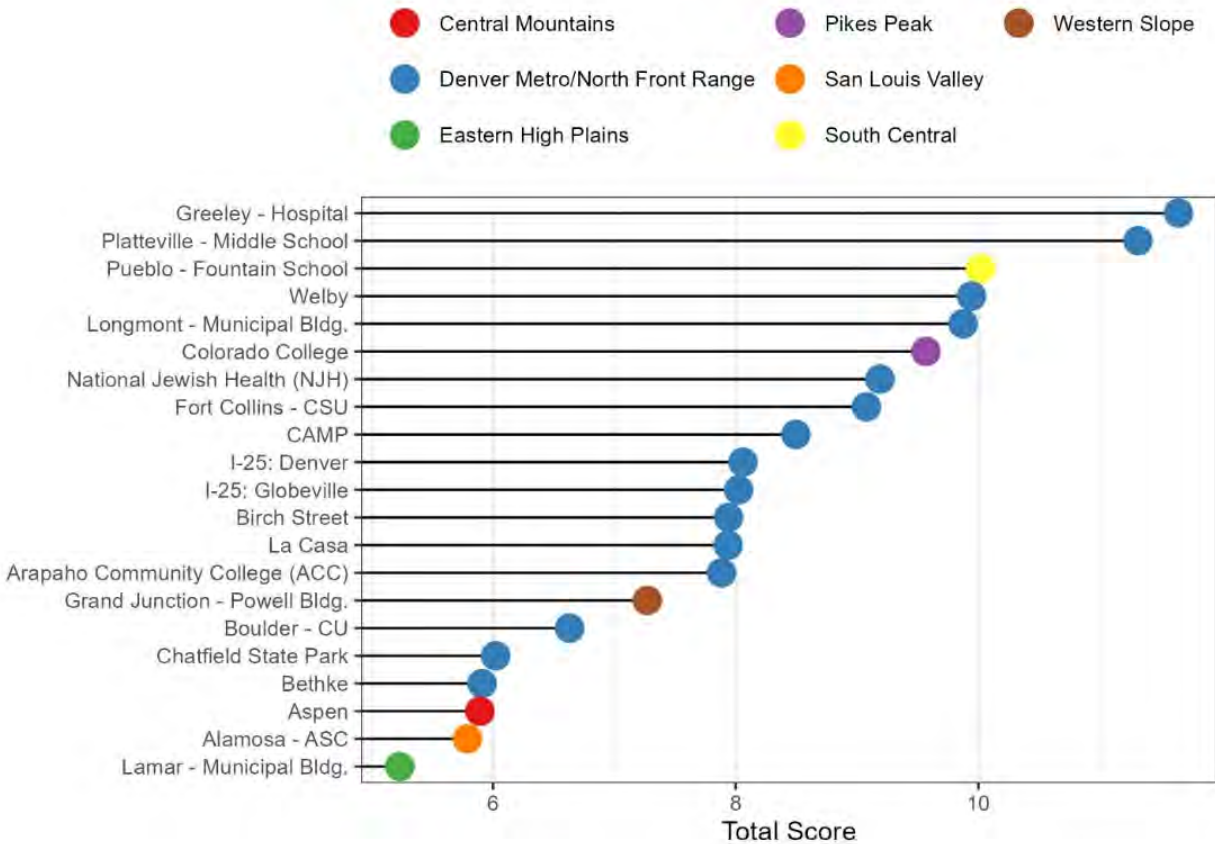


Figure 35. Cleveland dot plot showing the weighted total score for each site in the PM_{2.5} monitoring network.

2.11.1.7 Lead (Pb)

There is no current lead-specific monitoring in Colorado. Based on the 2020 National Emissions Inventory, monitoring is not required, as there are no sources in Colorado that are over 0.5 tons per year of permitted air emissions.

3 SUITABILITY MODELING

Suitability modeling and analysis is a common and valuable application of Geographic Information Systems (GIS) in the field of environmental planning and management. Broadly defined, suitability analysis aims to identify the most appropriate spatial pattern for a particular land use or activity according to specific requirements, preferences, or predictors. Suitability analysis is applied in a wide variety of fields including ecology, agriculture, and commerce, but its use is most widespread in environmental management and urban and regional planning (Malczewski, 2004). The most commonly used approaches are based on the concept of overlay analysis, in which multiple evaluation criteria map layers (“input maps”) are combined to obtain a composite suitability map (“output map”). For example, an agricultural suitability model may combine data pertaining to elevation, slope, aspect, precipitation, and soil chemistry to identify the most appropriate areas for planting a particular crop. Suitability models in the field of air pollution monitoring typically consider data related to population exposure and the source/sink relationships determining the concentration of pollutants in ambient air (Pope and Wu, 2014).

In this section, suitability analysis is used to identify areas where the existing APCD monitoring network does not adequately represent potential air pollution problems, and where additional sites are potentially needed. This has been accomplished using a weighted linear combination (WLC) technique, which is based on the concept of a weighted average. In this approach, technical experts and program managers at the APCD directly assigned weights of relative importance to a series of attribute map layers (“indicator maps”). The maps were then reclassified into a congruous ranking system (1-10 scale) and organized into three purpose areas: source-oriented, population-oriented, and spatially-oriented. The spatially averaged suitability map was then obtained by the multiplying the importance weight assigned to each attribute by that attribute’s value. This spatial average was then used to determine the optimal locations at which new monitors should be deployed.

In general, the results of these analyses indicate where monitors are best located based on specific objectives and expected pollutant behavior. However, the development of a useful suitability model relies on a thorough understanding of the phenomena that cause reduced air quality. The various indicator maps used in this section were introduced in Section 1.5 (see Table 5) and are described below.

3.1 Description of Indicators

Indicator maps have been grouped into three categories: source-oriented, population-oriented, and spatially oriented. This categorization has been used to simplify the assignment of weights and to make the weighting process transparent. Different weighting schemes have been used in the evaluation of each network due to the unique characteristics of each pollutant. For example, emissions inventory data can be used to determine the areas of maximum expected concentrations of pollutants directly emitted (i.e., primary emissions). However, emission inventory data are less useful to understand secondary pollutants formed in the atmosphere (i.e., O₃ and PM_{2.5}). Therefore, the emissions inventory indicator map was assigned a lower weight in the case of secondary pollutants (see Section 3.2).

3.1.1 Source-Oriented

3.1.1.1 Emissions Inventory

In this analysis, raster maps of point emission sources were created for each pollutant network using APCD emissions inventory data (see Section 2.9). Emission sources for each pollutant were spatially aggregated in ArcGIS using a 4 km² fishnet grid and the sum of emissions in each sector (“emission section”) was used as the raster value in the resulting indicator map. For CO, SO₂, and PM₁₀, only

primary emission sources of these species were considered. For NO₂, emissions of both NO and NO₂ (i.e., NO_x) were considered. For O₃, both NO_x and VOC emissions were considered. For PM_{2.5}, NO_x, SO₂, and primary PM_{2.5} emissions were considered. When reclassifying the raster maps, the entire distribution of emission sections was divided into 10 classes using the Jenks classification method and assigned a score of 1-10 with 10 being the highest score. This same approach was taken in the reclassification of all the indicator maps described below.

3.1.1.2 Traffic Counts

The association of road traffic and air pollution, particularly CO and NO₂, is a well-known phenomenon (Briggs et al., 2000). In this analysis, the normalized AADT counts derived in Section 2.10 were spatially aggregated using a 4 km² fishnet grid and the sum of normalized AADT in each sector was then used to create a raster map. The same AADT indicator map was used in the suitability model for each pollutant network.

3.1.1.3 Road Density

Similar to the approach discussed in Section 2.10, this analysis uses CDOT spatial data for highways and major roads within Colorado to create a raster map of road density using a 4 km² fishnet grid. The same road density indicator map was used in the suitability model for each pollutant network.

3.1.2 Population-Oriented

3.1.2.1 Population Density

In this analysis, a population density map was created using 2019-2023 ACS data (see Section 1.4.5). The population density of each census tract was calculated as the total population divided by the area of the census tract and this value was used in the resulting raster map. The same population density indicator map was then used in the suitability model for each pollutant network.

3.1.2.1 DIC Population Density

For this analysis, a DIC population density map was developed using 2019–2023 ACS data (see Section 1.4.5) and socioeconomic data from Colorado EnviroScreen. The DIC population density for each census tract was calculated by multiplying the total population by the average EnviroScreen DIC percentile score, then dividing by the tract's area. This value was used to generate the resulting raster map for input into the suitability model.

3.1.3 Spatially-Oriented

3.1.3.1 Distance from an Existing Monitor

This indicator calculates and spatially assigns scores based on the ground distance between existing monitoring sites. The assumption underlying this analysis is that it is more desirable to have a new monitoring site located farther away from an existing site. The score increases the farther away in space that the location is from existing monitoring sites.

3.1.3.2 Interpolation Map

This analysis uses pollutant interpolation maps generated with monitoring data to account for actual (i.e., measured) pollutant concentration surfaces.

3.1.3.4 Elevation

As discussed in Section 2.6.1 Ozone (O_3), O_3 in Colorado exhibits a strong positive correlation with elevation. The observation of enhanced O_3 concentrations with elevation in Colorado has been attributed to the low availability of nitric oxide (NO), which reacts with O_3 , and the increased importance of stratospheric O_3 transport at high elevation (Jaffe, 2010; Musselman and Korfmacher, 2014). Because of this relationship, we have used a digital elevation model (DEM) as a weighted indicator map in the O_3 suitability model.

3.2 Results for All Parameters

In the following sections, the weights of relative importance assigned to the indicator maps in each pollutant suitability model are presented and a brief justification of the chosen weighting scheme is provided. The final weighted suitability model for each network is then presented in the form of a raster map with a spatial resolution of 4 km. Values of the raster maps are suitability scores, which represent the suitability of the location for the addition of a new monitoring site.

3.2.1 Carbon Monoxide (CO)

Table 91. Weights applied in the CO suitability model.

Analysis	Weight Percentage
<i>Source-Oriented</i>	<i>42.5%</i>
Point Source Emissions	11.7%
Traffic Counts	18.3%
Road Density	12.5%
<i>Population-Oriented</i>	<i>28.2%</i>
Population Density	14.1%
DIC Population Density	14.1%
<i>Spatially-Oriented</i>	<i>29.3%</i>
Distance from an Existing Monitor	11.8%
Interpolated Concentration	17.5%

CO is generally non-reactive, thus concentrations are directly correlated to emission sources. The source-oriented indicators have therefore been given a large relative weighting in the CO suitability model. The majority of CO emissions to ambient air originate from mobile sources (i.e., transportation), particularly in urban areas, where as much as 85% of all CO emissions may come from automobile exhaust. Therefore, the mobile source indicators (i.e., Traffic Counts and Road Density) have been assigned almost three times the total weight given to the point source indicator.

Correlations between CO monitoring sites decrease rapidly with distance between sites (Figure 5). This suggests that CO sites can be located relatively close together without producing redundant data. Therefore, the Distance from an Existing Monitor indicator was given a relatively low weight. The Interpolated Concentration indicator was given a relatively large weight, as this represents the best available estimate of the spatial variability in CO at unmonitored locations.

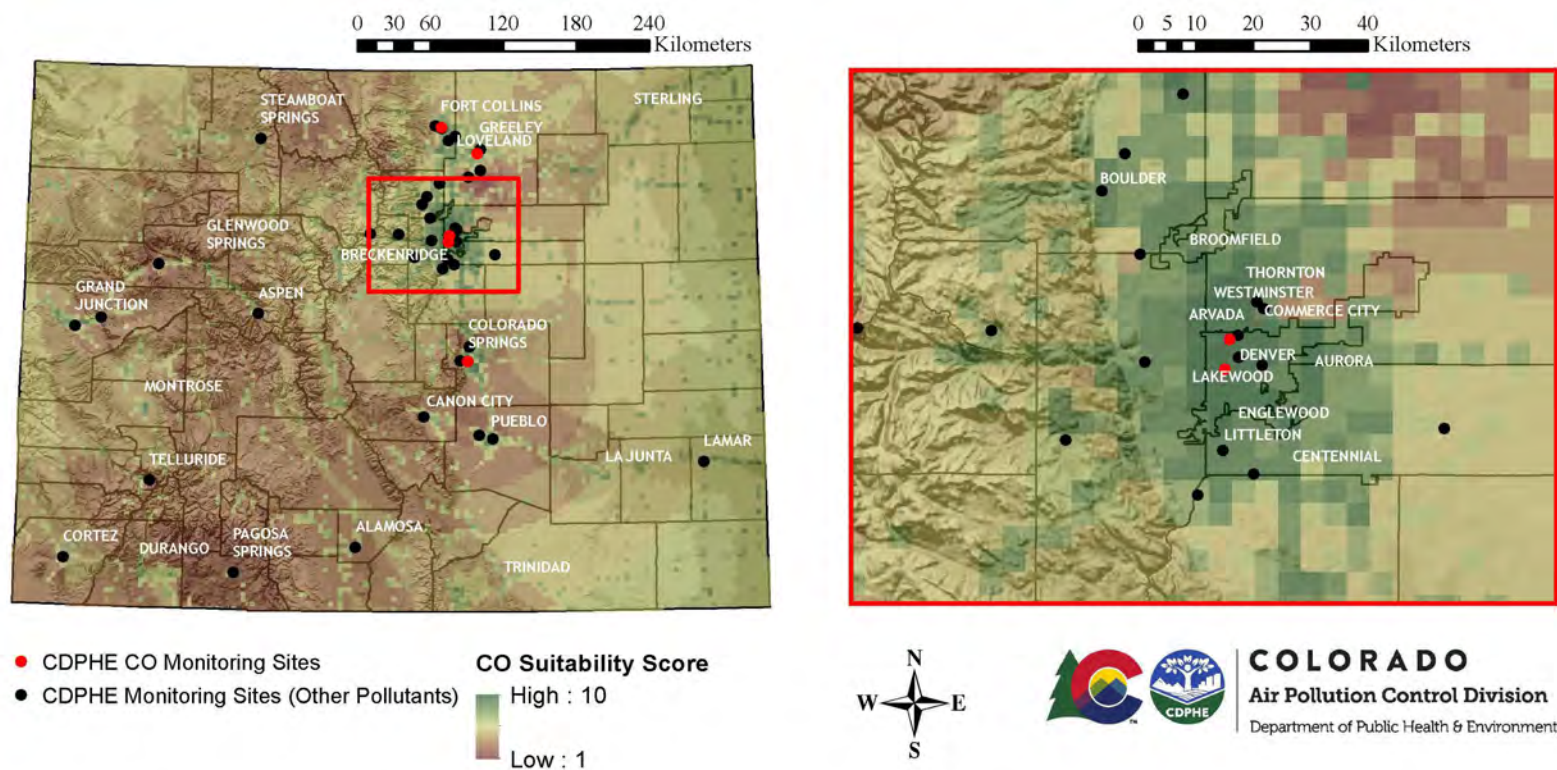


Figure 36. Results of the CO suitability model showing the entire state of Colorado as well as the Denver metropolitan area. Criteria pollutant monitoring sites operated by the APCD and listed in Table 6 are symbolized with black circles. Detailed site information, including AQS identification numbers, site descriptions and histories, addresses and coordinates, monitoring start dates, site elevations, site orientation/scale designations, etc., can be found in Appendix A.

3.2.2 Nitrogen Dioxide (NO₂)

Table 92. Weights applied in the NO₂ suitability model.

Analysis	Weight Percentage
<i>Source-Oriented</i>	<i>48.3%</i>
Point Source Emissions	20.8%
Traffic Counts	16.7%
Road Density	10.8%
<i>Population-Oriented</i>	<i>19.7%</i>
Population Density	9.9%
DIC Population Density	9.9%
<i>Spatially-Oriented</i>	<i>32.0%</i>
Distance from an Existing Monitor	14.5%
Interpolated Concentration	17.5%

NO₂ emissions are associated with both point sources (mostly fuel combustion) and mobile sources (i.e., transportation), and NO₂ concentrations in ambient air are directly correlated with emission sources (Briggs et al., 2000). For this reason, the source-oriented indicators were given almost half of the total weight in the NO₂ suitability model, with the mobile source indicators being given a higher total weight (27.5%) than the point source indicator (20.8%).

NO₂ is a public health concern and it is an objective of the APCD to maximize the number of citizens represented by each NO₂ monitor. However, NO₂ is also an important precursor to O₃, which tends to have a greater impact on regions of lower population density (see Section 3.1.3.2). The collocation of NO₂ and O₃ monitors at high O₃ sites could provide useful information regarding the balance between ozone production and destruction, which can be used to assess and validate model predictions and further optimize the network's configuration. Therefore, the Population Density indicator was assigned a lower weight in the NO₂ suitability model (19.7%) as compared to the CO suitability model (28.2%).

As with CO, the monitor-to-monitor correlation study described in Section 2.5.2 suggests that NO₂ sites can be located relatively close together without producing redundant data. Therefore, the Distance from an Existing Monitor indicator was given a relatively low weight. The Interpolated Concentration indicator was given a relatively large weight.

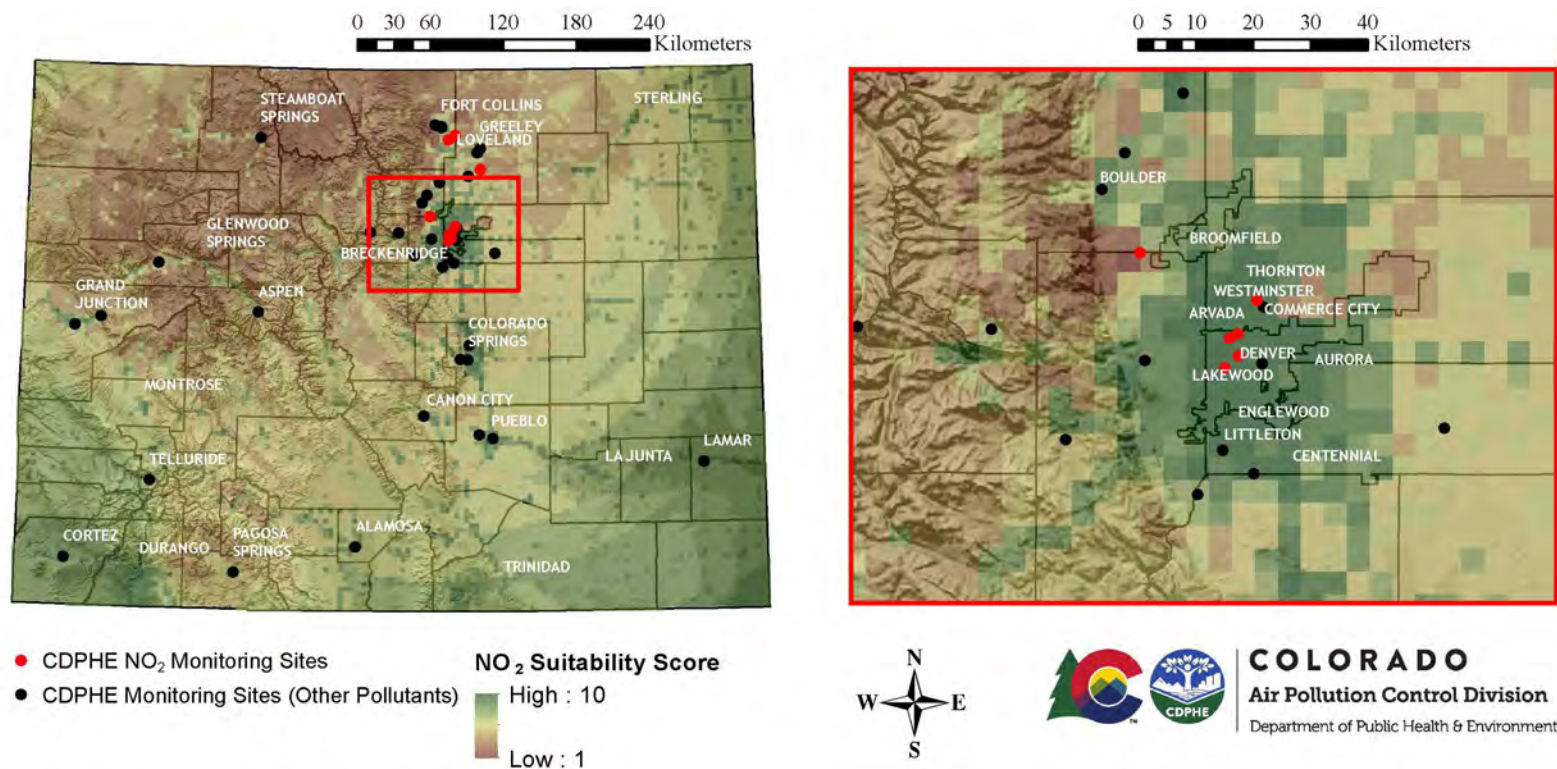


Figure 37. Results of the NO₂ suitability model showing the entire state of Colorado as well as the Denver metropolitan area. Criteria pollutant monitoring sites operated by the APCD and listed in Table 6 are symbolized with black circles. Detailed site information, including AQS identification numbers, site descriptions and histories, addresses and coordinates, monitoring start dates, site elevations, site orientation/scale designations, etc., can be found in Appendix A.

3.2.3 Sulfur Dioxide (SO₂)

Table 93. Weights applied in the SO₂ suitability model.

Analysis	Weight Percentage
<i>Source-Oriented</i>	<i>45.8%</i>
Point Source Emissions	30.8%
Traffic Counts	8.3%
Road Density	6.7%
<i>Population-Oriented</i>	<i>20.8%</i>
Population Density	10.4%
DIC Population Density	10.4%
<i>Spatially-Oriented</i>	<i>33.3%</i>
Distance from an Existing Monitor	10.8%
Interpolated Concentration	22.5%

The largest sources of SO₂ emissions in Colorado are from fossil fuel combustion at power plants, while mobile sources contribute less than 1 percent.³ For this reason, the point source indicator was assigned a relatively high weight in the SO₂ suitability model (30.8%), while the mobile source indicators were assigned a relatively low total weight (15.0%).

The monitor-to-monitor correlation study described in Section 2.5.3 showed very low correlations among the three SO₂ sites located in central Denver ($r^2 = 0.09-0.20$), suggesting that SO₂ sites can be located relatively close together without producing redundant data. Therefore, the Distance from an Existing Monitor indicator was given a relatively low weight in the SO₂ suitability model. The Interpolated Concentration indicator was given a relatively large weight.

³ <http://www.epa.gov/air/emissions/>

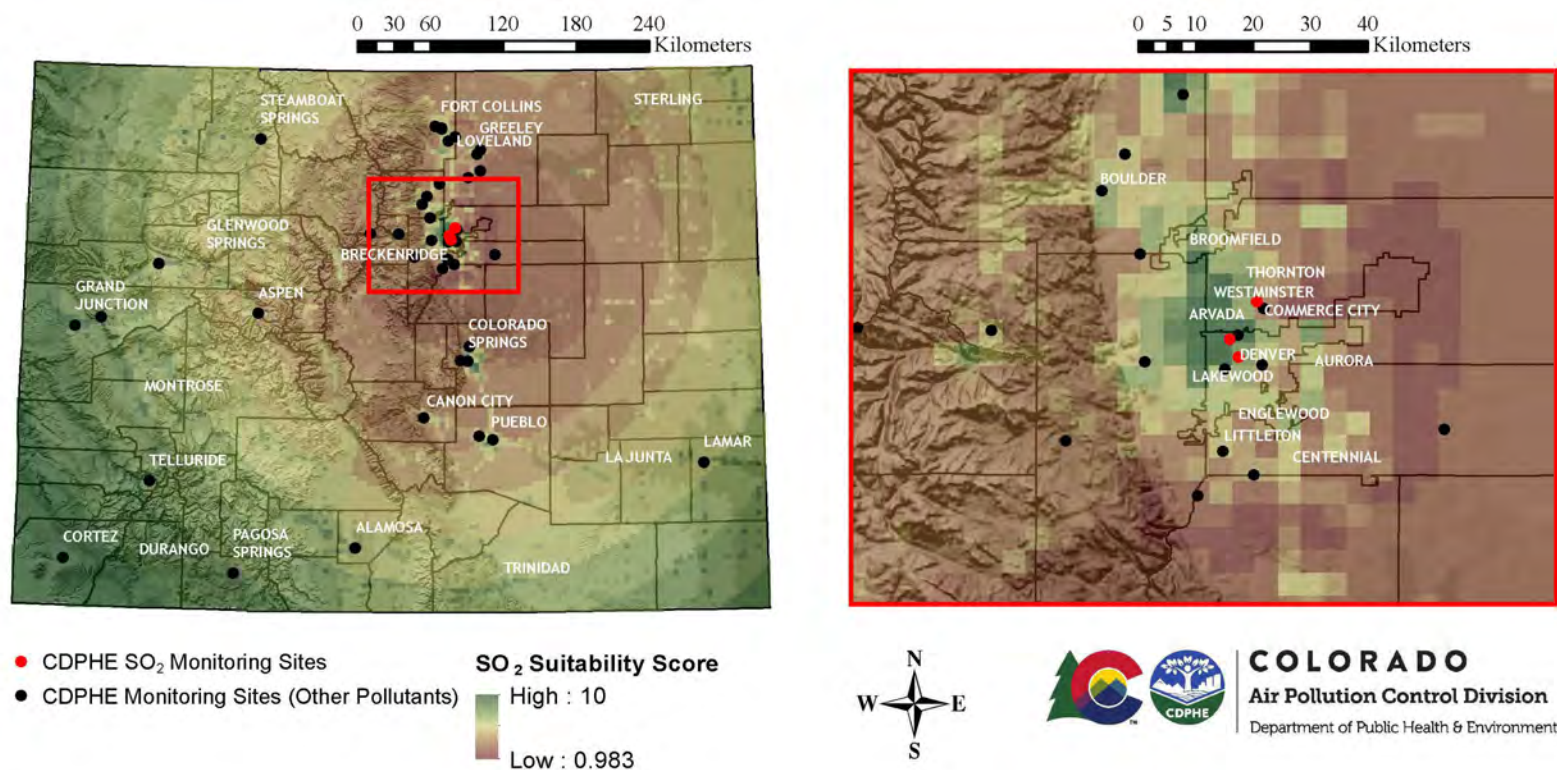


Figure 38. Results of the SO₂ suitability model showing the entire state of Colorado as well as the Denver metropolitan area. Criteria pollutant monitoring sites operated by the APCD and listed in Table 6 are symbolized with black circles. Detailed site information, including AQS identification numbers, site descriptions and histories, addresses and coordinates, monitoring start dates, site elevations, site orientation/scale designations, etc., can be found in Appendix A.

3.2.4 Ozone (O₃)

Table 94. Weights applied in the O₃ suitability model.

Analysis	Weight Percentage
<i>Source-Oriented</i>	<i>22.6%</i>
Point Source Emissions	10.8%
Traffic Counts	6.5%
Road Density	5.3%
<i>Population-Oriented</i>	<i>15.7%</i>
Population Density	7.9%
DIC Population Density	7.9%
<i>Spatially-Oriented</i>	<i>61.7%</i>
Distance from an Existing Monitor	18.4%
Interpolated Concentration	38.0%
Elevation	5.3%

As discussed in Section 2.9.4 Ozone (O₃), O₃ is a secondary pollutant and its spatial variability is only indirectly related to precursor emissions sources. Therefore, the source-oriented indicators were assigned a relatively small weight in the O₃ suitability model. Similarly, because O₃ concentrations tend to be reduced via NO_x titration in heavily populated areas, the population indicator was also assigned a lower weight compared to the other pollutant models.

O₃ monitoring sites tend to be well correlated over distances of approximately 90 km (see Section 2.5.4, Figure 8). This suggests that a dense network of O₃ monitoring sites is an inefficient use of resources as it will produce redundant data. Therefore, the Distance from an Existing Monitor indicator was given a relatively high weight in the O₃ suitability model. Because the Interpolated Concentration indicator in this case is based on maximum 8-hr values (see Section 3.1.3.2), which are more relevant from a regulatory perspective, this input was assigned a higher weight compared to the modeled concentration indicator.

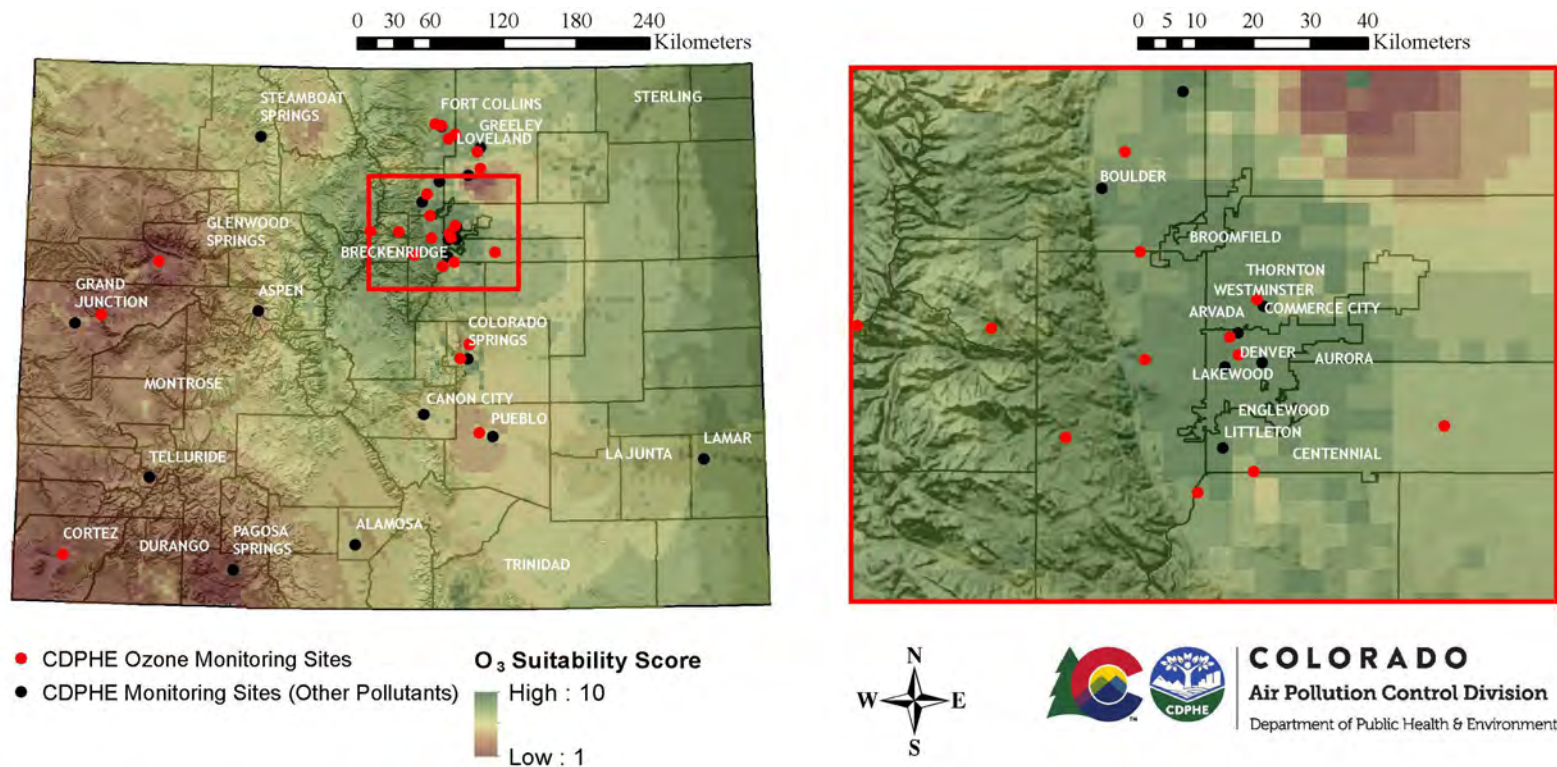


Figure 39. Results of the O₃ suitability model showing the entire state of Colorado as well as the Denver metropolitan area. Criteria pollutant monitoring sites operated by the APCD and listed in Table 6 are symbolized with black circles. Detailed site information, including AQS identification numbers, site descriptions and histories, addresses and coordinates, monitoring start dates, site elevations, site orientation/scale designations, etc., can be found in Appendix A.

3.2.5 PM₁₀

Table 95. Weights applied in the PM₁₀ suitability model.

Analysis	Weight Percentage
<i>Source-Oriented</i>	<i>36.2%</i>
Point Source Emissions	20.0%
Traffic Counts	8.8%
Road Density	7.4%
<i>Population-Oriented</i>	<i>22.8%</i>
Population Density	11.4%
DIC Population Density	11.4%
<i>Spatially-Oriented</i>	<i>41.0%</i>
Distance from an Existing Monitor	14.0%
Interpolated Concentration	27.0%

PM₁₀ concentrations typically have a strong relationship with point sources. Furthermore, dust from paved and unpaved roads is a particular problem in Colorado and the western U.S. in general. For this reason, the point and mobile source indicators were assigned relatively high weights, with the point source indicator being given a slightly larger weight than the mobile source indicators.

As with CO and NO₂, the monitor-to-monitor correlation study described in Section 2.5.5 suggests that PM₁₀ sites can be located relatively close together without producing redundant data. Therefore, the Distance from an Existing Monitor indicator was given a relatively low weight.

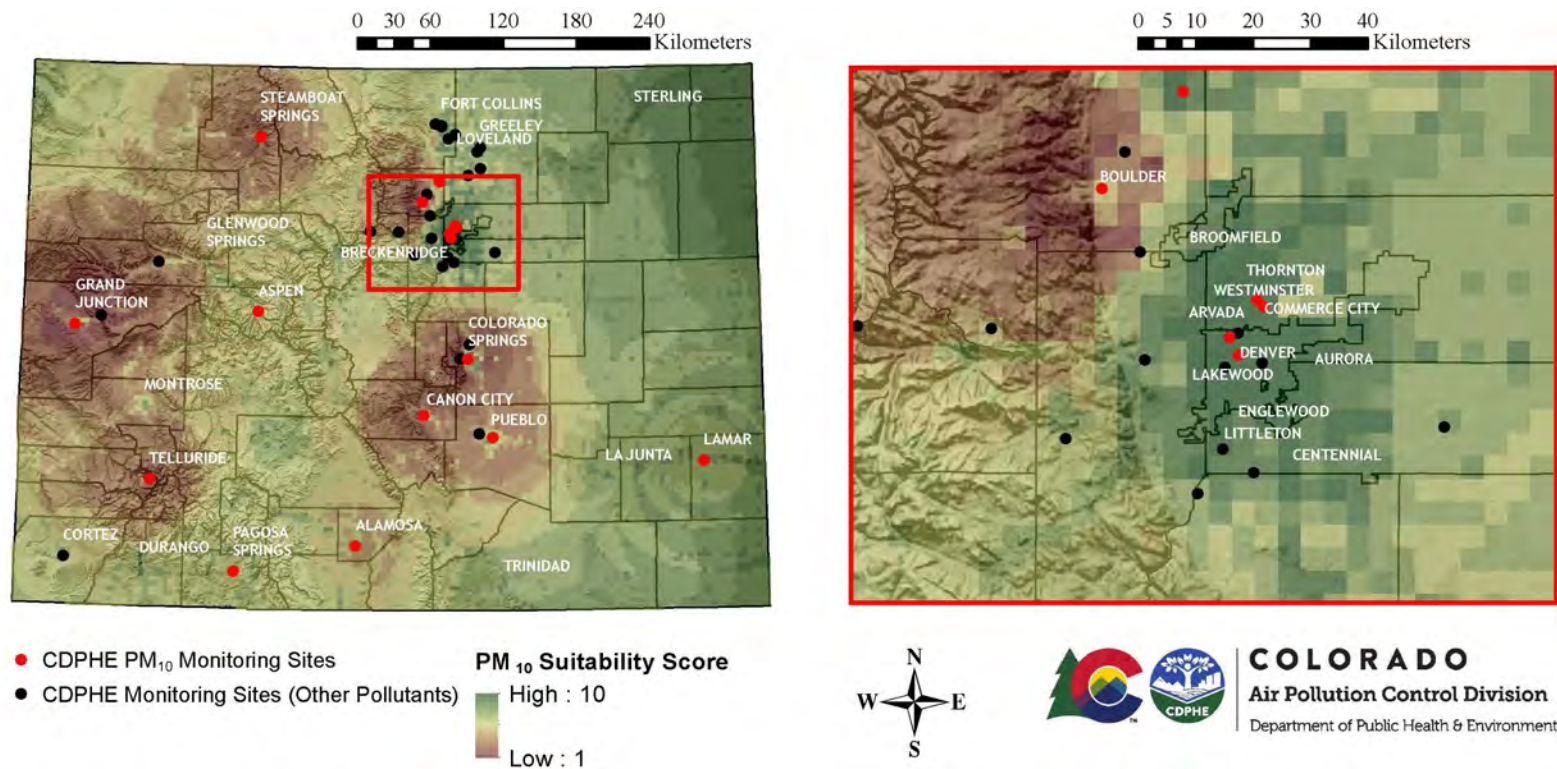


Figure 40. Results of the PM₁₀ suitability model showing the entire state of Colorado as well as the Denver metropolitan area. Criteria pollutant monitoring sites operated by the APCD and listed in Table 6 are symbolized with black circles. Detailed site information, including AQS identification numbers, site descriptions and histories, addresses and coordinates, monitoring start dates, site elevations, site orientation/scale designations, etc., can be found in Appendix A.

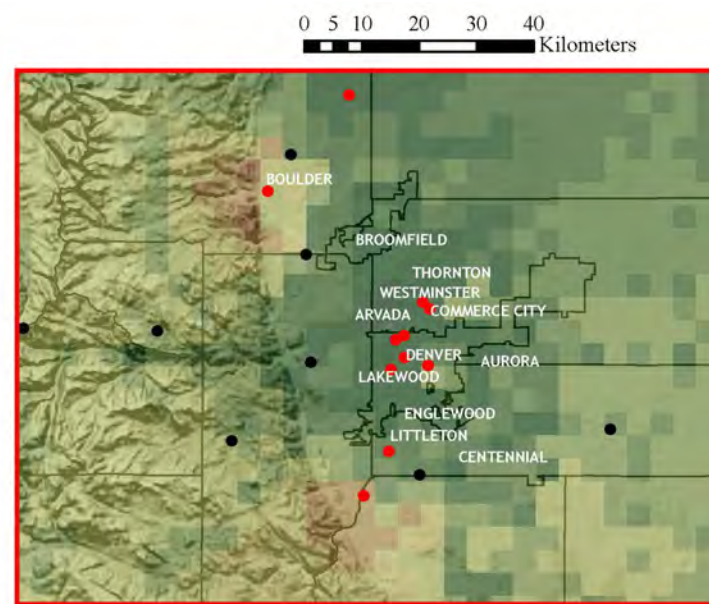
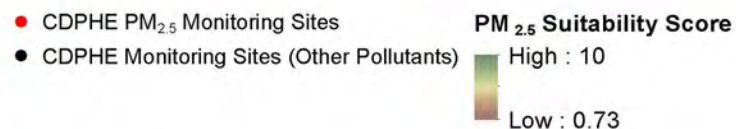
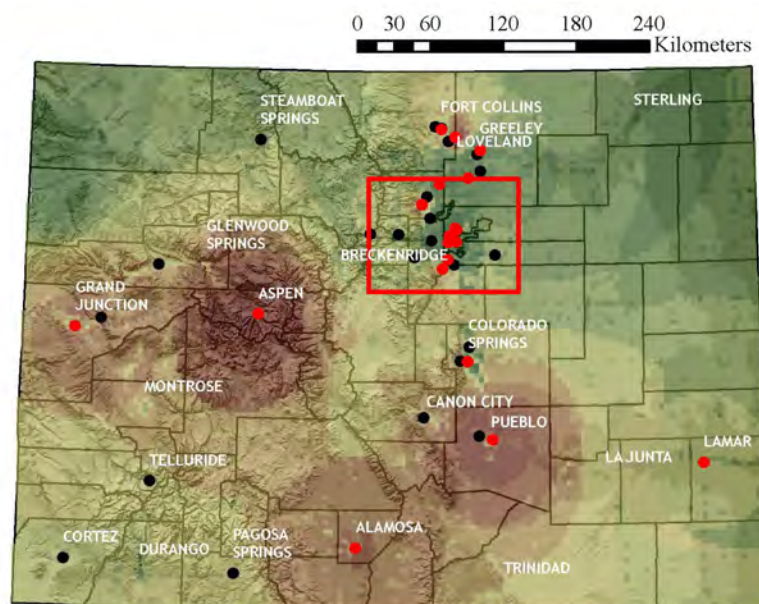
3.2.6 PM_{2.5}

Table 96. Weights applied in the PM_{2.5} suitability model.

Analysis	Weight Percentage
<i>Source-Oriented</i>	<i>25.0%</i>
Point Source Emissions	10.0%
Traffic Counts	9.0%
Road Density	6.0%
<i>Population-Oriented</i>	<i>21.2%</i>
Population Density	10.6%
DIC Population Density	10.6%
<i>Spatially-Oriented</i>	<i>53.8%</i>
Distance from an Existing Monitor	12.0%
Interpolated Concentration	41.8%

Like O₃, PM_{2.5} is a secondary pollutant and its spatial variability is only indirectly related to precursor emissions sources. Therefore, the source-oriented indicators were assigned a relatively small weight in the PM_{2.5} suitability model, with the mobile source indicators being given a slightly larger weight than the point source indicators.

As with PM₁₀, the monitor-to-monitor correlation study described in Section 2.5.6 suggests that PM_{2.5} sites can be located relatively close together without producing redundant data. Therefore, the Distance from an Existing Monitor indicator was given a relatively low weight in the PM_{2.5} suitability model. The Interpolated Concentration indicator was given a relatively large weight.



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Figure 41. Results of the PM_{2.5} suitability model showing the entire state of Colorado as well as the Denver metropolitan area. Criteria pollutant monitoring sites operated by the APCD and listed in Table 6 are symbolized with black circles. Detailed site information, including AQS identification numbers, site descriptions and histories, addresses and coordinates, monitoring start dates, site elevations, site orientation/scale designations, etc., can be found in Appendix A.

4. CONCLUSIONS AND RECOMMENDATIONS

Colorado's ambient air monitoring network has been and will continue to be in a constant state of flux. Change within the network is most notably driven by changes to the NAAQS, changes in population demographics, and changes in land use. For example, the EPA lowered the PM_{2.5} NAAQS standard from 12 $\mu\text{g m}^{-3}$ to 9 $\mu\text{g m}^{-3}$ in 2024, which may require the APCD to enhance its PM_{2.5} monitoring, identify potential precursor sources, and to refine its scientific understanding of Colorado's PM_{2.5} problems

The following section contains suggestions for modifications to the APCD monitoring network to be considered over the next five years. Results of the analyses presented in previous sections are used to suggest the addition, removal, or relocation of individual monitors or monitoring sites. These suggestions are ultimately based upon the EPA requirements for monitoring sites (e.g., site objective and number of required sites) and the objectives and priorities of the APCD as stated in Section 1.5.3.

4.1 Parameter-Specific Recommendations

4.1.1 Carbon Monoxide (CO)

The current CO monitoring network configuration adequately supports APCD monitoring objectives and meets all federal requirements. CO concentrations are typically well below the NAAQS and no state-operated monitor has recorded a violation of the 8-hour standard since 1996. For this reason, it is the opinion of APCD program managers and technical experts that CO monitoring should be deemphasized and funds shifted to monitoring objectives of higher priority. Most Colorado CO monitoring sites are currently in place in support of SIP maintenance plans, which necessitate that monitoring activities continue until these plans expire. However, we recommend the removal of the lowest value sites (e.g., Greeley, Fort Collins, and Colorado College) once they have achieved their monitoring objectives. A SIP amendment arguing that the maintenance plan for CO has been fulfilled and CO monitoring should be discontinued has been approved by the Colorado Air Quality Control Commission and is awaiting EPA approval.

4.1.2 Nitrogen Dioxide (NO₂)

The current NO₂ monitoring network meets all federal requirements and adequately supports most APCD monitoring objectives. NO₂ concentrations are typically well below the NAAQS. No state-operated monitor has recorded a violation of the annual standard since 1977 and the one-hour standard has not been violated since it was promulgated in 2010. However, despite the decreased relevance of NO₂ as an ambient air pollutant, the APCD feels that the monitoring network should be expanded due to the importance of NO₂ as an O₃ precursor. Furthermore, the collocation of O₃ and NO₂ monitors can be very helpful in understanding ozone dynamics at a particular site. Total oxidant, or "odd oxygen," estimates can be derived by simply adding NO₂ and O₃ concentrations. These estimates provide an important indicator of the O₃ production potential at a location, and help to differentiate low O₃ production potential from NO_x scavenging.

Therefore, we recommend adding supplemental NO₂ monitoring at high-concentration ozone monitoring sites in the Front Range. NO₂ monitoring has been added at Bethke Elementary School and will be added to Mehaffey Park in Loveland, Fort Collins West, and Chatfield. Determination of a suitable additional NO_x location to the east of Interstate 25 and within the ozone non-attainment area should be considered. Increases in population in Colorado Springs, and changes in land use, suggest the addition of NO₂ monitoring in the area. Either of these recommendations would require reallocation of limited resources.

4.1.3 Sulfur Dioxide (SO₂)

The current SO₂ monitoring network meets all federal requirements and adequately supports APCD monitoring objectives. All sites have 2024 one-hour design values less than 20% of the NAAQS standard.

4.1.4 Ozone (O₃)

The current O₃ monitoring network supports the APCD's monitoring objectives reasonably well. Areas of high concentrations, as well as background concentration areas have been monitored all along the Front Range, the Continental Divide, and in several areas on the Western Slope.

The North Front Range nonattainment area continues to exceed the NAAQS. Additional O₃ monitors have been installed at several sites in the North Front Range to add resolution to the monitoring program. Some of these monitors include NO₂ analyzers as discussed in Section 4.1.2. We recommend, in addition to the collocated NO₂ analyzers, that the O₃ network on the North Front Range not be reduced.

Cortez was ranked lowest in the O₃ site-to-site comparison analysis. We recommend that this site be closed.

The APCD recommends the installation of additional O₃ monitors in Durango in the Southwestern region, and in San Luis in the San Luis Valley region. These areas have limited previous air quality monitoring and emissions and modeling data suggest potential for elevated concentrations.

4.1.5 PM₁₀

The current PM₁₀ monitoring network meets all federal requirements and adequately supports APCD monitoring objectives. The APCD has decreased the size of its PM₁₀ monitoring network over the past 10-15 years and removed the monitors deemed to be of lowest value. This was done to make funding available for other monitoring networks of higher priority within the state of Colorado (e.g., O₃ and PM_{2.5}). Many of the lowest ranked sites in the site-to-site comparison analysis presented here are associated with SIP maintenance plans and cannot be removed or relocated. The APCD is working toward a SIP amendment that would determine the end of the SIP maintenance window for PM₁₀. Most of the PM₁₀ analyzers have been converted from filter-based to continuous analyzers. This conversion has made PM₁₀ (and PM_{2.5}) data available to the public in real-time.

The APCD is working toward installation of PM₁₀ and PM_{2.5} analyzers in Edwards along the Eagle River valley, in Delta on the Western Slope, in Durango in the Southwestern region, and in San Luis in the San Luis Valley region. These areas have limited previous air quality monitoring and an increased potential for impact from blowing dust events.

4.1.6 PM_{2.5}

The current PM_{2.5} monitoring network meets all federal requirements and adequately supports APCD monitoring objectives. The APCD is working toward installation of PM₁₀ and PM_{2.5} analyzers in Edwards, Colorado, along the Eagle River valley, in Delta on the Western Slope, in Durango in the Southwestern region, and in San Luis in the San Luis Valley region. These areas have limited previous air quality monitoring and an increased potential for impact from wildland fire events.

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APPENDIX A

Monitoring Site Descriptions

AQS #	Site Name	Address	Site Start	Elevation (m)	Latitude	Longitude
	Parameter	POC	Start	Orient/Scale	Monitor	Type
Adams						
080010010	Birch Street	7275 Birch St	Jul 2023	1569	39.8281	-104.93647
	PM ₁₀	3	Jul 2023	P.O. Neigh	Met One - E-Seq	SLAMS
	PM _{2.5}	3	Jul 2023	P.O. Neigh	URG - 3000-N	SLAMS
	PM _{2.5}	2	Dec 2023	P.O. Neigh	Met One - E-Seq	SLAMS
080013001	Welby	3174 E. 78TH AVE.	Jan 1975	1554	39.838119	-104.94984
	Temperature	1	Jan 1975		Met One - 062MP	OTHER
	Wind Speed	1	Jan 1992		RM Young - 05305V	OTHER
	Wind Direction	1	Jan 1992			OTHER
	SO ₂	2	Jan 2006	P.O. Neigh	TAPI - T100	SLAMS
	O ₃	2	Sep 2007	P.O. Neigh	TAPI - T400	SLAMS
	NO ₂	1	Nov 2019	P.O. Urban	TAPI - T200	SLAMS
	PM ₁₀	3	Jan 2023	P.O. Neigh	TAPI - 640X	SLAMS
	PM _{2.5}	3	Jan 2024	P.O. Neigh	TAPI - 640X	SLAMS
	PM ₁₀	4	May 2024	P.O. Neigh	TAPI - 640X	SLAMS
	PM _{2.5}	4	May 2024	P.O. Neigh	TAPI - 640X	SLAMS
Alamosa						
080030001	Alamosa - Adams State	208 EDMONT BLVD.	Oct 2023	2302	37.469391	-105.878691
	PM ₁₀	3	Oct 2023	P.O. Neigh	TAPI - 640X	SLAMS
	PM _{2.5}	3	Oct 2023	P.O. Neigh	TAPI - 640X	SLAMS
Arapahoe						
080050002	HIGHLAND RESERVOIR	8100 S. UNIVERSITY BLVD	Jun 1978	1747	39.567887	-104.957193
	O ₃	1	Sep 2015	H.C. Neigh	TAPI - T400	SLAMS
	Wind Speed	1	Sep 2015		Met One - 010C	OTHER
	Wind Direction	1	Sep 2015		Met One - 020C	OTHER
	Temperature	1	Sep 2015		Met One - 062	OTHER
080050005	Arapahoe Community College	6190 S. SANTA FE DR.	Apr 2024	1636	39.604399	-105.019526
	PM _{2.5}	3	Apr 2024	P.O. Neigh	Grimm - EDM 180	SLAMS
080050006	Aurora East	36001 E. Quincy Ave.	Jun 2009	1799	39.638522	-104.569335
	O ₃	1	Jun 2009	P.O. Urban	TAPI - T400	SLAMS
	Wind Speed	1	Jun 2009	P.O. Urban	Met One - 010C	OTHER
	Wind Direction	1	Jun 2009	P.O. Urban	Met One - 020C	OTHER
	Temperature	1	Jun 2009	P.O. Urban	Met One - 060	OTHER
Archuleta						
080070001	PAGOSA SPRINGS SCHOOL	309 LEWIS ST.	Nov 2023	2165	37.26842	-107.009659
	PM ₁₀	4	Nov 2023	P.O. Neigh	TAPI - 640X	SLAMS
	PM _{2.5}	4	Jan 2025	P.O. Neigh	TAPI - 640X	SLAMS
Boulder						
080130003	LONGMONT - MUNICIPAL BLDG	350 KIMBARK ST.	Jan 2024	1520	40.164576	-105.100856
	PM ₁₀	4	Jan 2024	P.O. Neigh	TAPI - 640X	SLAMS
	PM _{2.5}	4	Jan 2024	P.O. Neigh	TAPI - 640X	SLAMS
080130014	Boulder Reservoir	5545 Reservoir Road.	Sep 2016	1586	40.070016	-105.220238
	O ₃	1	Sep 2016	P.O. Urban	TAPI - 400E	SLAMS
	Wind Speed	1	Sep 2016	P.O.	RM Young - 05305V	OTHER
	Wind Direction	1	Sep 2016	P.O.		OTHER
	Temperature	1	Sep 2016	P.O.	RM Young - 41372V	OTHER
	Relative Humidity	1	Sep 2016	P.O.		OTHER
080131001	BOULDER - CU-ATHENS	2102 ATHENS ST.	Aug 2023	1622	40.012969	-105.267212
	PM _{2.5}	3	Aug 2023	P.O. Neigh	TAPI - 640X	SLAMS
	PM ₁₀	3	Aug 2023	P.O. Neigh	TAPI - 640X	SLAMS
Clear Creek						
080190006	Mines Peak	Near summit of Berthoud Pass off US Highway 40	Jul 2014	3806	39.794391	-105.76398
	O ₃	1	Jul 2014	Back Region	TAPI - T400	SPM
Delta						
080290004	DELTA HEALTH DEPT	255 WEST 6th ST.	Jun 2025	1511	38.739213	-108.07307
	PM ₁₀	3	Jun 2025	P.O. Neigh	TAPI - 640X	SLAMS
	PM _{2.5}	3	Jun 2025	P.O. Neigh		SLAMS
Denver						
	DENVER - CAMP	2105 BROADWAY	Jan 1985	1593	39.751184	-104.987625
	Temperature	1	Jan 1985			OTHER
	SO ₂	1	Nov 2005	H.C. Neigh	TAPI - T100	SLAMS

AQS #	Site Name	Address	Site Start	Elevation (m)	Latitude	Longitude
	Parameter	POC	Start	Orient/Scale	Monitor	Type
080310002	O ₃	6	Jan 2012	P.O. Neigh	TAPI - T400	SLAMS
	PM _{2.5}	3	Apr 2013	H.C. Micro	Grimm - EDM 180	SPM
	NO ₂	1	Jan 2014	H.C. Neigh	TAPI - T200U	SLAMS
	PM _{2.5}	1	Feb 2024	P.O. Micro	Met One - E-Seq	SLAMS
	PM _{2.5}	2	Feb 2024	P.O. Micro	Met One - E-Seq	SLAMS
080310013	DENVER - NJH-E	14TH AVE. & ALBION ST.	Mar 2018	1620	39.738578	-104.939925
	PM _{2.5}	3	Jul 2023	P.O. Neigh	TAPI - 640	SLAMS
080310026	La Casa	4545 Navajo St.	Jan 2013	1602	39.77949	-105.00518
	CO	1	Jan 2013	P.O. Neigh	Thermo - 48i-TL	SLAMS
	NOy - NO	1	Jan 2013	P.O. Neigh	TAPI - T200U-NOY	SLAMS
	O ₃	1	Jan 2013	P.O. Neigh	TAPI - T400	SLAMS
	Wind Speed	1	Jan 2013	P.O. Neigh	Met One - 010C	SLAMS
	Wind Direction	1	Jan 2013	P.O. Neigh	Met One - 020C	SLAMS
	Temperature	1	Jan 2013	P.O. Neigh	Met One - 010C	SLAMS
	Temperature	2	Jan 2013	P.O. Neigh	Met One - 010C	SLAMS
	SO ₂	1	Apr 2013	P.O. Neigh	TAPI - T100U	SLAMS
	NO ₂	1	Jul 2014	P.O. Neigh	TAPI - T500U	SLAMS
	Relative Humidity	1	Nov 2014	P.O. Neigh	Met One - 083E-1-35	SLAMS
	Solar radiation	1	Apr 2018	P.O. Neigh	KIPP&ZONEN - CMP11	SLAMS
	PM _{2.5}	3	Jul 2023	P.O. Neigh	TAPI - 640	SLAMS
	PM ₁₀	1	Apr 2024	P.O. Neigh	Met One - E-Seq	SLAMS
	PM ₁₀	2	Apr 2024	P.O. Neigh	Met One - E-Seq	SLAMS
	PM _{2.5}	1	Apr 2024	P.O. Neigh	Met One - E-Seq	SLAMS
080310027	I-25	971 Yuma Street	Jun 2013	1583	39.73217	-105.0153
	CO	1	Jun 2013	P.O. Micro	Thermo - 48i-TL	SLAMS
	Wind Speed	1	Jun 2013	P.O.	RM Young - 05305V	OTHER
	Wind Direction	1	Jun 2013	P.O.		OTHER
	Temperature	1	Jun 2013	P.O.	RM Young - 41372V	OTHER
	PM _{2.5}	3	Jan 2014	P.O. Micro	Grimm - EDM 180	SLAMS
	Relative Humidity	1	May 2020	P.O.	RM Young - 41372V	OTHER
	NO ₂	1	May 2021	P.O. Micro	TAPI - T200	SLAMS
080310028	PM _{2.5}	1	Sep 2023	P.O. Micro	Met One - E-Seq	SLAMS
	Globeville	4903 Acoma St.	Oct 2015	1587	39.7861	-104.9886
	NO ₂	1	Oct 2015	P.O. Micro	TAPI - T200	SLAMS
	Temperature	1	Oct 2015	P.O.	RM Young - 41372V	OTHER
	Relative Humidity	1	Oct 2015	P.O.	RM Young - 41372V	OTHER
	PM _{2.5}	3	Oct 2015	P.O. Micro	Grimm - EDM 180	SLAMS
080350004	Wind Speed	1	Mar 2020	P.O.	RM Young - 05305V	OTHER
	Wind Direction	1	Mar 2020	P.O.		OTHER
Douglas						
080350004	Chatfield State Park	11500 N. Roxborough Park Rd.	Apr 2004	1676	39.534488	-105.070358
	Wind Speed	1	Apr 2004		Met One - 010C	OTHER
	Wind Direction	1	Apr 2004		Met One - 020C	OTHER
	Temperature	1	Apr 2004			OTHER
	PM _{2.5}	3	Jul 2023	P.O. Neigh	TAPI - 640	SLAMS
	O ₃	1	Aug 2024	H.C. Urban	TAPI - T265	SLAMS
El Paso						
080410013	U.S. AIR FORCE ACADEMY	ROAD 640, USAF ACADEMY	Jun 1996	1971	38.958341	-104.817215
	O ₃	1	Aug 2010	H.C. Urban	TAPI - T400	SLAMS
080410016	MANITOU SPRINGS	101 BANKS PL.	Apr 2004	1955	38.853097	-104.901289
	O ₃	1	Oct 2007	H.C. Neigh	TAPI - T400	SLAMS
080410017	COLORADO SPRINGS - COLLEGE COLLEGE	130 W. CACHE LA POUFRE	Jun 2016	1832	38.848014	-104.828564
	PM _{2.5}	3	Jun 2016	P.O. Neigh	Grimm - EDM 180	SLAMS
	CO	1	Dec 2023	P.O. Neigh	Thermo - 48i-TL	SLAMS
	PM ₁₀	1	Sep 2024	P.O. Neigh	Met One - E-Seq	SLAMS
Fremont						
080430003	CANON CITY - CITY HALL	128 MAIN ST.	Oct 2023	1626	38.43829	-105.24504
	PM ₁₀	3	Oct 2023	P.O. Neigh	TAPI - 640X	SLAMS
	PM _{2.5}	3	Jan 2025	P.O. Neigh	TAPI - 640X	SLAMS
Garfield						
	Rifle-Health Dept	195 W. 14th St.	Jun 2008	1640	39.54182	-107.784125

AQS #	Site Name	Address	Site Start	Elevation (m)	Latitude	Longitude
	Parameter	POC	Start	Orient/Scale	Monitor	Type
080450012	O ₃	1	Jun 2008	P.O. Neigh	TAPI - T400	SLAMS
Gilpin						
080470003	Black Hawk	831 Miners Mesa Road, Black Hawk Colorado 80422	Jul 2019	2633	39.792519	-105.49127
	O ₃	1	Jul 2019	P.O. Urban	TAPI - 400E	SLAMS
Jefferson						
080590006	ROCKY FLATS-N	16600 W COLO #128	Jun 1992	1802	39.912799	-105.188587
	Wind Speed	1	Jun 1992		RM Young - 05305V	OTHER
	Wind Direction	1	Jun 1992			OTHER
	Temperature	1	Jun 1992		RM Young - 41372V	OTHER
	Temperature	2	May 2018		RM Young - 41372V	OTHER
	Relative Humidity	1	Jun 2018	Back Neigh	RM Young - 41372V	OTHER
	Barometric pressure	1	Jun 2018	Back Neigh	RM Young - 61402V	OTHER
	NOy	1	Feb 2019	H.C. Urban	TAPI - 501Y	SLAMS
	NO ₂	1	Feb 2019	Urban	TAPI - T500U	SLAMS
	NOy - NO	1	Feb 2019	H.C. Urban	TAPI - T200U-NOY	SLAMS
	Solar radiation	1	Jun 2019	Urban	KIPP&ZONEN - CMP11	SLAMS
	O ₃	1	Jul 2024	H.C. Urban	TAPI - T265	SLAMS
080590011	NATIONAL RENEWABLE ENERGY LABS - NREL	2054 QUAKER ST.	Jun 1994	1832	39.743724	-105.177989
	O ₃	1	Jul 2024	H.C. Urban	TAPI - T265	SLAMS
080590014	Evergreen	5124 South Hatch Drive	Oct 2020	2225	39.620408	-105.33872
	O ₃	1	Oct 2020	P.O. Urban	TAPI - T400	SLAMS
	Wind Speed	1	Oct 2020	P.O. Urban	RM Young - 05305V	OTHER
	Wind Direction	1	Oct 2020	P.O. Urban		OTHER
	Temperature	1	Oct 2020	P.O. Urban	RM Young - 41372V	OTHER
	Relative Humidity	1	Oct 2020	P.O. Urban	RM Young - 41372V	OTHER
Larimer						
080690009	FORT COLLINS - CSU - Edison	251 EDISON DR.	Jun 2009	1524	40.571288	-105.079693
	PM _{2.5}	3	Jun 2015	P.O. Neigh	Grimm - EDM 180	SLAMS
080690011	FORT COLLINS - WEST	3416 LA PORTE AVE.	Aug 2023	1571	40.592543	-105.141122
	Wind Speed	1	Aug 2023	Urban	RM Young - 05305V	SPM
	Wind Direction	1	Aug 2023	Urban		SPM
	Temperature	1	Aug 2023	Urban	RM Young - 41372V	SPM
	Temperature	2	Aug 2023	Urban	RM Young - 41372V	SPM
	Relative Humidity	1	Aug 2023	Urban		SPM
	Solar radiation	1	Aug 2023	Urban	KIPP&ZONEN - CMP11	SPM
	Barometric pressure	1	Aug 2023	Urban	RM Young - 61402V	SPM
080690015	O ₃	1	Jul 2024	H.C. Urban	TAPI - T265	SLAMS
	Fossil Creek	3340 CO 392	Jan 2024	1489	40.48346	-105.01618
	NO ₂	1	Jan 2024	H.C. Urban	TAPI - T200	SLAMS
	O ₃	1	Jan 2024	H.C. Urban	TAPI - T400	SLAMS
	Wind Speed	1	Jan 2024	Urban	RM Young - 05305V	SPM
	Wind Direction	1	Jan 2024	Urban		SPM
	Temperature	1	Jan 2024	Urban	RM Young - 41372V	SPM
	Temperature	2	Jan 2024	Urban	RM Young - 41372V	SPM
	Relative Humidity	1	Jan 2024	Urban	RM Young - 41372V	SPM
	Solar radiation	1	Jan 2024	Urban	Apogee - SP300	SPM
	Barometric pressure	1	Jan 2024	Urban	RM Young - 61402V	SPM
080690016	Bethke	5100 School House Dr	Jun 2024	1472	40.515109	-104.949932
	NO ₂	1	Jun 2024	H.C. Urban	TAPI - T200	SLAMS
	O ₃	1	Jun 2024	H.C. Urban	TAPI - T400	SLAMS
	PM _{2.5}	3	Oct 2024	P.O. Urban	TAPI - 640X	SLAMS
080690017	Mehaffey Park	2601 Rio Blanco Ave	Jun 2025	1573	40.41883	-105.12796
	O ₃	1	Jun 2025	P.O. Urban	TAPI - T400	SLAMS
080691004	Fort Collins - CSU - S. Mason	708 S. Mason St.	Jan 1981	1524	40.57747	-105.07892
	Temperature	1	Jan 1981		Met One - 062	OTHER
	Wind Speed	1	Jan 1992		RM Young - 05305V	OTHER
	Wind Direction	1	Jan 1992			OTHER
	O ₃	1	May 2004	P.O. Neigh	TAPI - T400	SLAMS
	CO	1	May 2016	P.O. Neigh	Thermo - 48i-TL	SLAMS
Mesa						
	GRAND JUNCTION - POWELL BLDG	650 SOUTH AVE.	Jan 2014	1398	39.063798	-108.561173

AQS #	Site Name	Address	Site Start	Elevation (m)	Latitude	Longitude
	Parameter	POC	Start	Orient/Scale	Monitor	Type
080770017	PM _{2.5}	3	Jan 2014	P.O. Neigh	Grimm - EDM 180	SLAMS
	PM ₁₀	1	Jul 2024	P.O. Neigh	R&P - Partisol 2025	SLAMS
080770018	GRAND JUNCTION - PITKIN	645 1/4 PITKIN AVE.	Jan 2004	1398	39.064289	-108.56155
	Wind Speed	1	Jan 2004		RM Young - 05305V	OTHER
	Wind Direction	1	Jan 2004			OTHER
	Temperature	1	Jan 2004		RM Young - 41372V	OTHER
	Relative Humidity	1	Nov 2014			OTHER
	Barometric pressure	1	Sep 2020		RM Young - 61402V	OTHER
080770020	Palisade-Water Treatment	865 Rapid Creek Rd.	May 2008	1521	39.130575	-108.313835
	O ₃	1	May 2008	P.O. Urban	TAPI - T400	SLAMS
	Wind Speed	1	May 2008	P.O. Urban	RM Young - 05305V	SPM
	Wind Direction	1	May 2008	P.O. Urban		SPM
	Temperature	1	May 2008	P.O. Urban	RM Young - 41342VC	SPM
Montezuma						
080830006	Cortez - Health Dept	106 W. North Street	Jun 2008	1890	37.350054	-108.592334
	O ₃	1	Jun 2008	P.O. Neigh	TAPI - T400	SLAMS
Pitkin						
080970008	Aspen Yellow Brick Building	215 N. Garmisch	Jun 2024	2408	39.19296	-106.82323
	PM ₁₀	3	Jun 2024	P.O. Neigh	TAPI - 640X	SLAMS
	PM _{2.5}	3	Jun 2024	P.O. Neigh	TAPI - 640X	SLAMS
Prowers						
080990002	Lamar Municipal Bldg	104 E. PARMENTER ST.	Oct 2023	1107	38.084688	-102.618641
	PM ₁₀	3	Oct 2023	P.O. Neigh	TAPI - 640X	SLAMS
	PM _{2.5}	3	Oct 2023	P.O. Neigh	TAPI - 640X	SLAMS
Pueblo						
081010015	Pueblo - Fountain School	925 N. GLENDALE AVE.	Sep 2023	1433	38.276099	-104.597613
	PM ₁₀	3	Sep 2023	P.O. Neigh	TAPI - 640X	SLAMS
	PM _{2.5}	3	Sep 2023	P.O. Neigh	TAPI - 640X	SLAMS
081010016	Pueblo West	803 South Cellini Circle	Feb 2023	1564	38.30333	-104.7225
	O ₃	1	Feb 2023	H.C. Neigh	TAPI - T400	SLAMS
	Wind Speed	1	Mar 2023	H.C. Neigh	RM Young - 05305V	SLAMS
	Wind Direction	1	Mar 2023	H.C. Neigh		SLAMS
	Temperature	1	Mar 2023	H.C. Neigh	RM Young - 41372V	SLAMS
Routt						
081070003	Steamboat Springs	136 6TH ST.	Sep 2023	2054	40.485201	-106.831625
	PM ₁₀	4	Sep 2023	P.O. Neigh	TAPI - 640X	SLAMS
	PM _{2.5}	4	Jan 2025	P.O. Neigh	TAPI - 640X	SLAMS
San Miguel						
081130004	Telluride	333 W. COLORADO AVE.	Nov 2023	2684	37.937872	-107.813061
	PM ₁₀	3	Nov 2023	P.O. Neigh	TAPI - 640X	SLAMS
	PM _{2.5}	3	Jan 2025	P.O. Neigh	TAPI - 640X	SLAMS
Weld						
081230006	Greeley - Hospital	1516 HOSPITAL RD.	Jun 2016	1441	40.414877	-104.70693
	PM _{2.5}	3	Jun 2016	P.O.	Grimm - EDM 180	SLAMS
081230008	Platteville - Middle School	1004 MAIN ST.	Jun 2024	1469	40.209387	-104.82405
	PM _{2.5}	3	Jun 2024	P.O. Region	TAPI - 640	SLAMS
081230009	Greeley - Weld County Tower	3101 35TH AVE.	Jun 2002	1484	40.386368	-104.73744
	O ₃	1	Jan 2004	P.O. Neigh	TAPI - T400	SLAMS
	Wind Speed	1	Feb 2012	P.O.	Met One - 010C	OTHER
	Wind Direction	1	Feb 2012	P.O.	Met One - 020C	OTHER
	Temperature	1	Feb 2012	P.O.	Met One - 060A	OTHER
	CO	1	Apr 2016	P.O. Neigh	Thermo - 48i-TL	SLAMS
081230015	La Salle Tower	18490 County Road 38	Feb 2024	1719	40.2614	-104.70645
	NO ₂	1	Feb 2024	S.O. Region	TAPI - T200U	SLAMS
	O ₃	1	Feb 2024	S.O. Region	TAPI - T400	SLAMS

APPENDIX B

Public Comments and Responses

Comment #1 (Dr. Annareli Morales, PhD, Air Quality Policy Analyst, Weld County)

I have a few comments/questions on the 2025 monitoring network assessment:

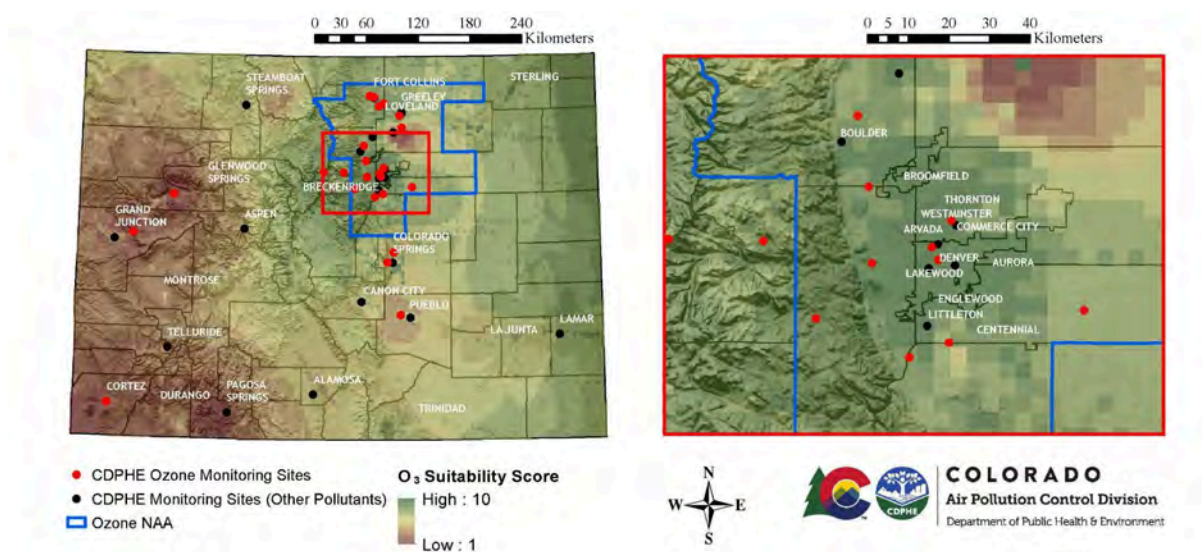
- Typos
 - pg 42 - shouldn't that say 70 ppb instead of 50?
This sentence is referring to the annual average, not the design value (50 ppb is high for an annual average).
 - Can units be added to Tables 33, 34, and 35? Or maybe included in the caption?
Corrected.
 - pg 76 - comparison is misspelled
Corrected.
 - pg 89 - should be "Indicator map" not "Indicators map"
Corrected.
 - pg 103 - first paragraph should be "which may require" instead of "which has may require"
Corrected.
 - In section 4.1.4, what modeling data is being referenced? Is there a citation or link that can be provided? Or was this internal data analysis and so "not shown"?
This refers to our internal photochemical modeling that we do for the SIP.
- Questions/comments
 - Section 2 is great! Really appreciate the descriptions of advantages and disadvantages for each method.
We appreciate and thank you for the feedback.
 - Section 2.1 - Is wind direction/speed considered as one "parameter" being measured?
Yes, all meteorological measurements (wind speed, wind direction, temperature, relative humidity, etc.) are combined as one parameter (this is also true in Table 6).
 - Section 2.9 - can text be added to explain that using an EnviroScreen Score of 80 and above is one of several options in the definition for DIC in statute?
Since this section relies solely on the percentile score and does not address the various definitions of "DIC," we've chosen not to include further details here. However, we have provided a link to a complete description of the different definitions.
 - How far east of I-25 for an NO₂ monitor were y'all thinking? Do you have a north/south location in mind?
As the Assessment indicates, several NO₂ sites are being added to the network in an overall effort to better understand precursor contributions to ozone formation, particularly in the North Front Range. The inclusion of another NO₂ monitor east of I-25 may be the result of the findings from the currently added NO₂ monitors and will be developed to further assist in that effort as necessary.

- Is wind direction incorporated in the determination of where to place monitors beyond that it is a measured parameter? Are predominant wind directions and/or unique wind directions being captured by the ozone network?

Yes, meteorological data is always considered and APCD meteorologists consulted during site selection.

- Can the suitability map for ozone (Fig. 39) be provided for the ozone NAA? This could help with further discussions of our group as to where NO₂ monitors could go.

We've shared that map below:



We appreciate you taking the time to review our network assessment and provide your feedback. Your interest and involvement in Colorado's air quality monitoring efforts are truly valued.