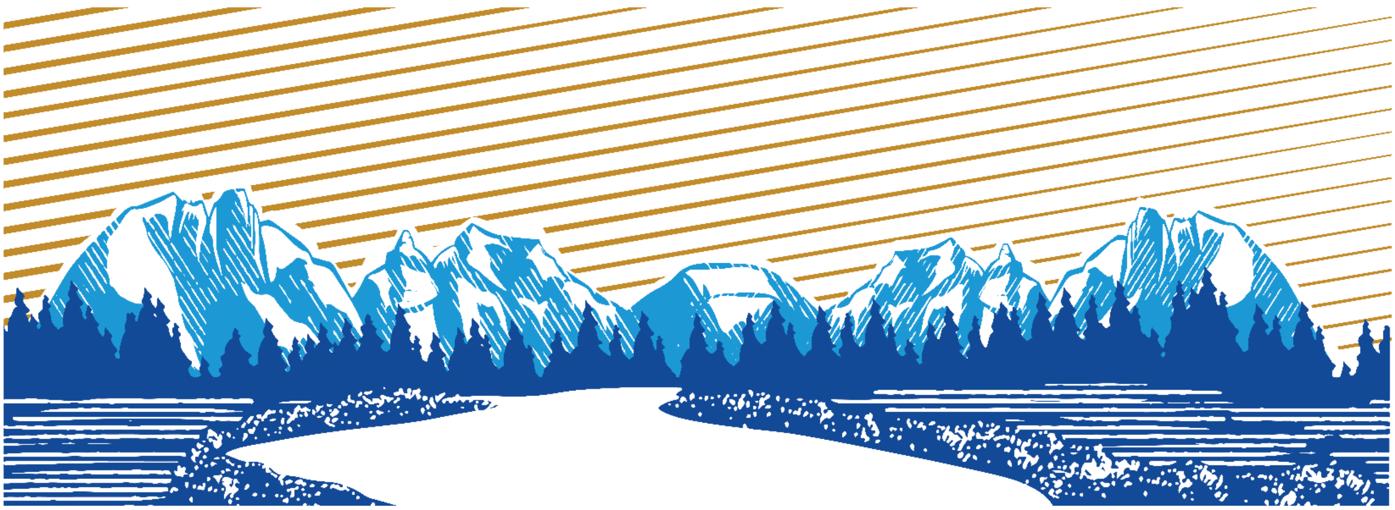
Montana Department of Environmental Quality
Ambient Air Quality Monitoring

5-YEAR NETWORK ASSESSMENT
and
ANNUAL MONITORING NETWORK PLAN

2025



June 24, 2025

Montana Department of Environmental Quality
Air Quality Bureau

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I. Introduction

The Montana Department of Environmental Quality (MTDEQ) Air Quality Bureau conducts scientific measurements of specific pollutants in the ambient air across Montana. MTDEQ continuously evaluates its air measurement or “monitoring” efforts to ensure they remain valid, effective, efficient, high quality, and in-step with the changing realities of the state. On an annual basis, MTDEQ’s evaluations and any proposed monitoring changes are formally documented and made available for review.

In conformity with federal rules, MTDEQ’s evaluation of its ambient air monitoring program is documented in two forms. First, each year MTDEQ produces an Air Quality Monitoring Network Plan (Plan) in accordance with the requirements of Title 40 of the Code of Federal Regulations Part 58.10(a), (b), and (c), (40 CFR 58.10(a)(b) and (c)). Second, every five years MTDEQ produces an assessment of its ambient air monitoring network (Assessment) per the requirements of 40 CFR 58.10(d). Both documents must be submitted to the EPA Regional Administrator by July 1 of the reporting year. Because of the common deadline, MTDEQ has elected to combine its Plan and Assessment evaluations for 2025 into this single document.

The intent and required content between the annual Plan and the 5-year Assessment are somewhat nuanced and contain a measure of overlap. Generally, both documents must accurately describe the ambient air monitoring sites in MTDEQ’s statewide network, identify each site’s monitoring purpose and history, describe how and to what degree the sites fulfill national Network Design Criteria requirements (40 CFR 58, Appendix D) and state goals, and describe any deviations in physical characteristics or operation from regulatory requirements. Within that context, MTDEQ evaluates its existing ambient air monitoring network and assesses how to tailor the network based on both long- and short-term data needs, changing regulatory requirements, impacted human populations, changes to air pollutant impacts, and available resources. The results of monitoring conducted previously are summarized, and needed changes to the monitoring network are identified and proposed. The evaluation process provides an opportunity for MTDEQ to solicit, evaluate, and respond to comments and input regarding the monitoring network from the public, county agencies, internal staff, state and federal decision makers, and other interested parties.

The Assessment and Annual Plan requirements offer unique but complementary perspectives for evaluating Montana’s statewide air monitoring network as broadly summarized in the following table:

Table I.1, Unique Monitoring Network Evaluation Perspectives

5-Year Assessment	Annual Plan
Discovering the most effective, efficient, and appropriate monitoring approach for all monitoring objectives	*Deploying,* operating, and managing required and desired monitors
Long term context	Short term details
Doing the right things	Doing things right
Planning the work	Working the plan
Defining Needs	Fulfilling Needs
Resource Definition	Resource Deployment
Data Analysis	Data Collection
Vision	Action
Potentials	Kinetics

Both sets of perspectives are addressed in this document.

In addition, MTDEQ established key principles from EPA's network assessment guidance[1] to focus and direct the development of this air monitoring network assessment and evaluation. Those key principles are as follows:

1. "The purposes of a monitoring network… are the benchmarks against which the strengths and weaknesses of the network are measured."

2. The implemented purpose of the National Ambient Air Monitoring Strategy "is to optimize U.S. air monitoring networks to achieve, with limited resources, the best possible scientific value and protection of public and environmental health and welfare."

3. "Air monitoring agencies should, therefore, refocus monitoring resources on pollutants that are new or persistent challenges… and should deemphasize pollutants that are steadily becoming less problematic and better understood. In addition, monitoring agencies need to adjust networks to protect today's population and environment, while maintaining the ability to understand long-term historical air quality trends"

4. "The network assessment is intended to provide a comprehensive review of your agency's monitoring network... The annual monitoring network plan is intended to be the yearly update of the planned changes to your network in consideration of the latest assessment your agency has performed."

5. In the guidance, EPA provides an array of tools to objectively assess monitoring networks. Given the unique characteristics of Montana (see Section III) the assessment tools most useful in evaluating the MTDEQ network include the following:

    a. **"Area Served by Each Monitor**." Sites that are used to represent a large area score high in this analysis.
    b. **"Population Change**." High rates of population increase are associated with potential increased emissions activity and exposure. Sites are ranked based on population increase in the area of representation.
    c. **"Population Served**." Sites are ranked based on the number of people they represent.
    d. **"Measured Concentration**." Individual monitors are ranked based on the concentration of pollutants they measure.

In reflection of that approach, this document consists of six broad sections following this introduction:

- **Section II** provides a general background of key concepts and terms associated with ambient air monitoring.

- **Section III** provides an overview of the unique regional features that most influence the need for and implementation of air monitoring in Montana.

- **Section IV** describes MTDEQ's regulatory monitoring network including pollutant-specific ambient air monitoring design requirements, how and why MTDEQ has addressed each requirement, the results and trends of conducted monitoring, and evaluations of the effectiveness of that monitoring.

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[1] See: *Ambient Air Monitoring Network Assessment Guidance, Analytical Techniques for Technical Assessments of Ambient Air Monitoring Networks*, EPA-454/D-07-001, and *Designing a Network Assessment for an Ambient Air Monitoring Program*, v1.0, 2020.

- **Section V** describes MTDEQ's network of air pollutant sensors deployed to provide more local air pollutant information to the public, and to establish screening level measurements in unmonitored areas.
- **Section VI** summarizes proposed changes to the monitoring network and a schedule for implementing those changes.
- **Section VII** provides appendices containing supplemental information in support of specific elements outlined within this document.

II. Background

Ambient Air and Criteria Pollutants

The term ambient air is defined in 40 CFR 50.1 as "that portion of the atmosphere, external to buildings, to which the general public has access." The Federal Clean Air Act requires the United States Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for six common air pollutants in the ambient air known as "criteria air pollutants." Criteria air pollutants are the most common air pollutants with known harmful human health effects. The six criteria pollutants are Ozone (O_3), Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Lead (Pb), and Particulate Matter (PM). PM concentrations in ambient air are currently regulated and measured in two size fractions, those with an aerodynamic diameter of 10 microns and less (PM_{10}), and those with an aerodynamic diameter of 2.5 microns and less ($PM_{2.5}$). At one Montana monitoring station MTDEQ measures concentrations of an additional PM fraction referred to as PM_{coarse} or $PM_{10-2.5}$, which is the airborne portion of PM_{10} larger in aerodynamic diameter than $PM_{2.5}$.

For each criteria air pollutant, NAAQS limits are established and implemented to protect public health and the environment. Two types of federally mandated air quality standards may exist. Primary standards set limits to protect *public health*, including the health of at-risk populations such as people with pre-existing heart or lung disease (e.g., asthma or COPD), children, and older adults. Secondary standards set limits to protect *public welfare*, including protection against visibility impairment and damage to animals, crops, vegetation, and buildings. Montana has, in the past, adopted similar air quality standards known as the Montana Ambient Air Quality Standards (MAAQS). These standards have generally, but not completely, been superseded by more stringent NAAQS. Unique, Montana-specific MAAQS for fluoride in forage, hydrogen sulfide, and settleable PM remain in place.

Measuring Criteria Pollutants

To determine if the NAAQS are being met, federal rules implemented by the EPA require each state to establish a network of monitors to measure concentrations of the criteria pollutants in ambient air. The types, locations and numbers of required monitors within each state are based primarily on population size and density and, to a lesser degree, on measured air quality concentrations in comparison to the NAAQS. However, air pollution impacts unique to an individual state, or localities within a state, can lead to the operation of monitors beyond those that are required by federal rule. This dynamic is true in the state of Montana, most particularly in regard to the impacts of $PM_{2.5}$ as discussed in detail in Section IV.B of this document. As a result, MTDEQ's statewide air monitoring network is established and operated in conformance with the federal requirements as a baseline, with other types, locations and numbers of monitors added to meet the specific needs of Montana. Increasingly, new and developing monitoring technology known as "air sensors" are proving to be of value in MTDEQ's statewide monitoring efforts. As a result, this document describes MTDEQ's monitoring network in two broad types: the "regulatory" monitoring network and the "sensor" monitoring network.

Overall, MTDEQ's aggregate air monitoring network design and operations are conducted in conformity with three essential overall objectives as detailed in 40 CFR 58 Appendix D Section 1.1:

1. Provide air pollution data to the general public in a timely manner.
2. Support compliance with ambient air quality standards (the NAAQS) and emissions strategy development.
3. Support air pollution research studies.

The content of this Assessment reflects the pursuit of these three objectives.

Metrics for NAAQS Compliance

The means of assessing whether monitored ambient air pollution concentrations are within the federal NAAQS limits is reflected in a concept referred to as a "design value." A design value is a statistic that describes the air quality status of a criteria pollutant at a given location relative to the level and form of the NAAQS. For example, if a NAAQS limit is in the form of a *three-year* average, then monitored *hourly* values cannot be directly compared to that standard to determine if the ambient air quality complies with the NAAQS. To make such a comparison, hourly measurements must be mathematically transformed into the same units as the NAAQS. In the example above, the hourly measured values must be assembled into a three-year average (the design value) so that a direct comparison may be made with the corresponding NAAQS limits. Design values for each criteria pollutant are communicated in detail in 40 CFR Part 50 and are referred to throughout this Plan document.

III. Regional Description of the State of Montana

Distinct regional characteristics form the context within which air quality monitoring is established, operated, and evaluated in Montana. Four attributes are summarized here that most contribute to that context: topography and geography, climate, population and demographics, and sources of air pollution.

A. Topography and Geography

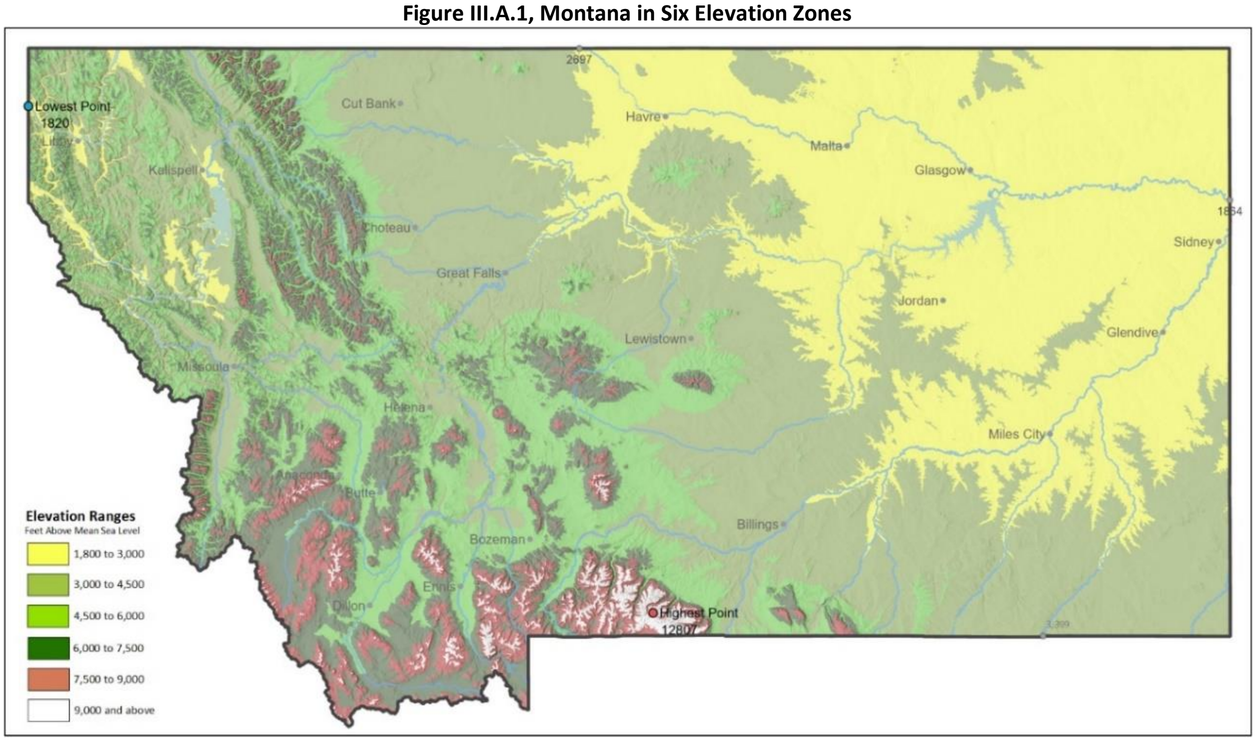
The physical structure of Montana is its most defining regional characteristic. While significant by itself, it also directly influences all other regional attributes of Montana such as climate, demographics, land use, and economics. Understanding its influence is thereby a requisite in any discussion of air monitoring in Montana.

Two distinctives of Montana's physical structure form defining elements for all of Montana's air monitoring efforts:

1. **Size**. Montana is the fourth largest state in the United States, covering 147,042 square miles. For comparison, its size is roughly comparable to the nations of Japan or Norway, and it is approximately 1-½ times the size of the entire Isle of Great Britain.

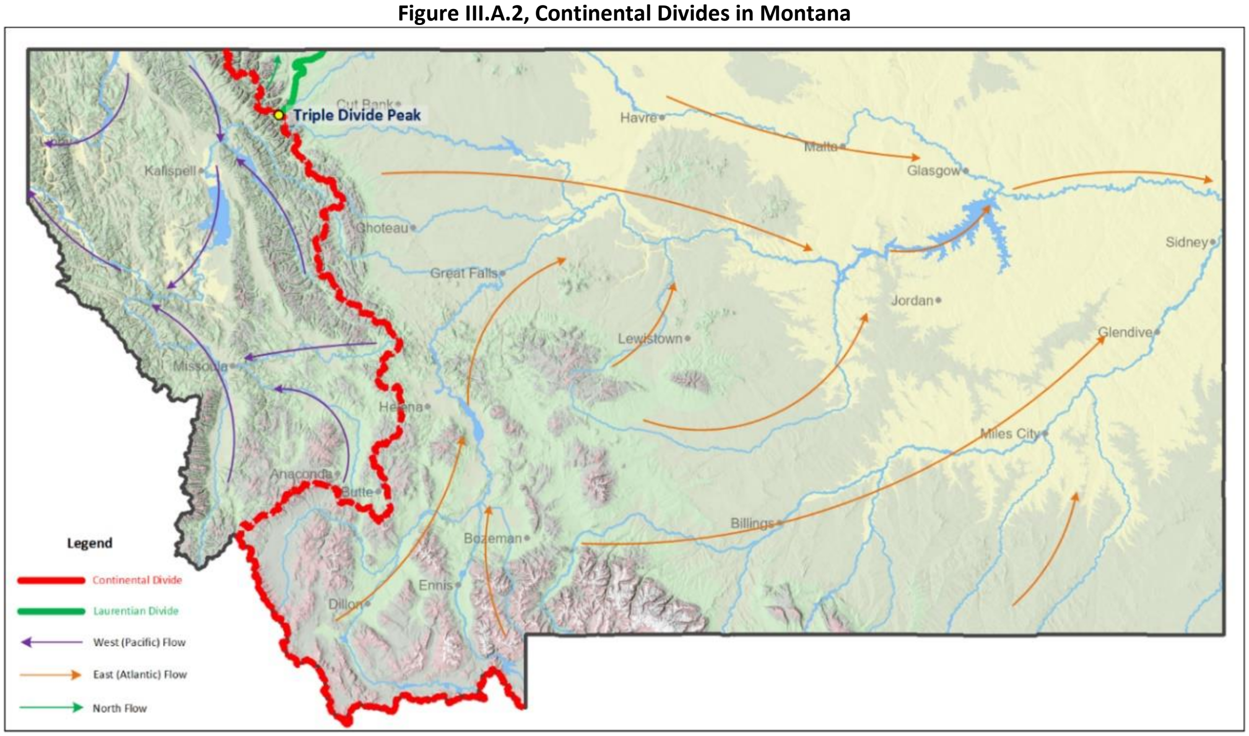
2. **Geographic Diversity**. The name "Montana" (originally *Montaña del Norte*, the Spanish description of this entire "north mountains" region) clearly communicates a historic focus on the state's renowned mountains. However, approximately 60% of the state's land area is comprised of Great Plains grasslands and prairies. In aggregate, Montana is made up of a broad diversity of geologic formation processes and resulting landforms including high mountains, distinct mountain valleys, foothills, grasslands, river valleys, prairies, and badlands. Figure III.A.1 depicts this diversity in six representative elevation zones.

Figure III.A.1, Montana in Six Elevation Zones



A significant topographic feature that most notably defines and contributes to the geographic diversity of Montana is the spine of the Rocky Mountains running from northwest to southeast at the western third of the state. This feature, known as the Continental Divide, establishes a distinct hydrologic boundary that effects not only Montana, but a great deal of the North American continent. As represented in Figure III.A.2, watersheds west of the divide are gathered and flow into the Pacific Ocean, while watersheds east of the divide are gathered and flow into the Atlantic Ocean. Significantly, the headwaters for the entire Missouri River hydrologic drainage are formed in Montana. In addition, a lesser known but still continentally important feature in Montana is a point on the Continental Divide that forms the western terminus of the Laurentian or “Northern” Divide. This divide feature proceeds easterly from this terminus point named Triple Divide Peak in Montana’s Glacier National Park, forming a north-south watershed boundary that has significant influence in Montana’s neighbors of Alberta, Saskatchewan, and North and South Dakota. Watersheds south of this boundary flow into the Atlantic Ocean, while watersheds north of this boundary flow into Hudson’s Bay and the Arctic Ocean. Thus, Montana’s topography establishes a north-south, east-west hydrological flow definition within the North American continent. The same topographic features that exert both local- and continental-scale hydrologic influences also exert profound influence on the movement of air masses and the climate of Montana, as discussed in Section III.B.

Figure III.A.2, Continental Divides in Montana

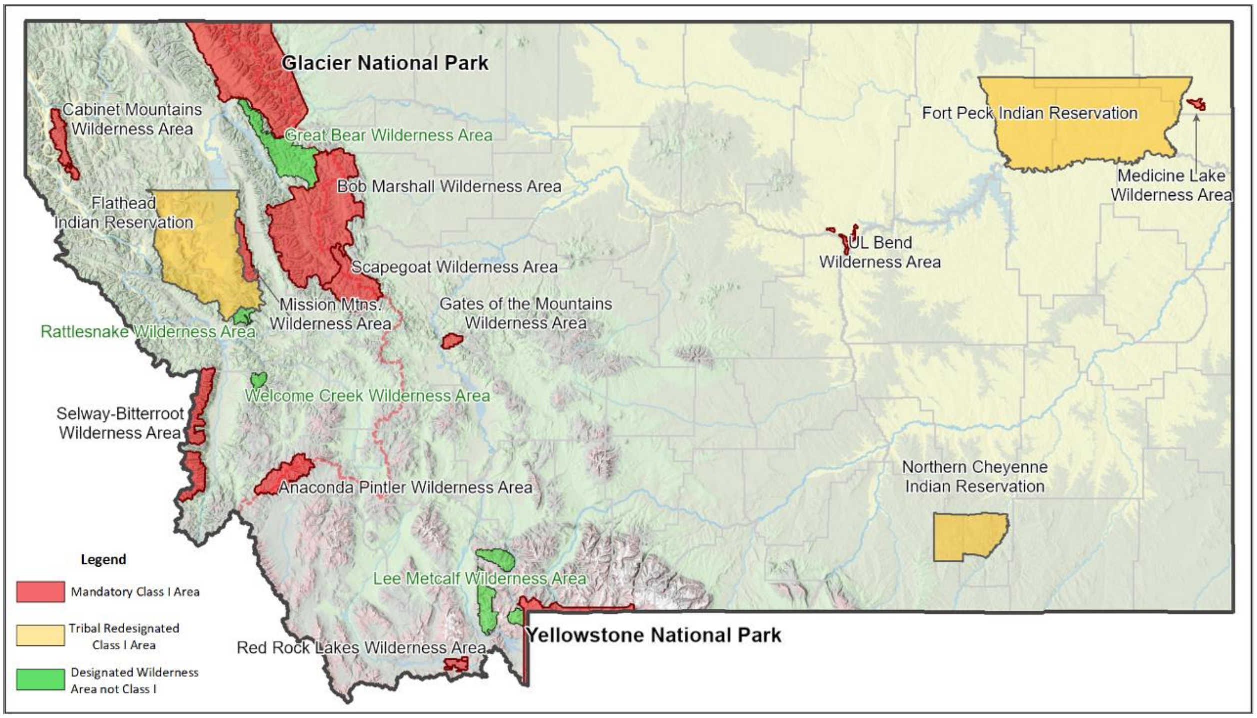


An additional feature of topographic and geographic diversity that directly influences air quality management and monitoring in Montana is the protection of specific “Class I” areas. In the Clean Air Act (CAA) amendments of 1977, Congress included provisions to limit air quality degradation from large air pollutant emitting sources. These provisions, known as the Prevention of Significant Deterioration (PSD) program, directed the categorization of areas in attainment with the NAAQS as either Class I, Class II, or Class III to reflect different degrees to which air quality would be allowed to be degraded. Class I areas are the most protected against air quality degradation. They include all international parks, national wilderness areas and national memorial parks that exceed 5,000 acres, and national parks that exceed 6,000 acres; all of which are designated as “mandatory” Class I areas for the preservation, protection, and enhancement of air quality. Further, the CAA amendments provided a process by which states and Native American tribes may request redesignation of areas from Class II to Class I. Montana contains significant Class I areas of both types, that is, both mandatory and redesignated areas. In addition, Montana contains national wilderness areas that are smaller than the 5,000-acre designation threshold and therefore not mandatory Class I areas, but that are also worthy of air quality protection.

Beyond the PSD Program, in 1999 EPA partnered with other federal agencies such as the National Park Service, Forest Service, and Fish and Wildlife Service to establish a national rule to protect visibility in Class I Areas. The resulting program is known as the Regional Haze Program and uses the same area classification system described above.

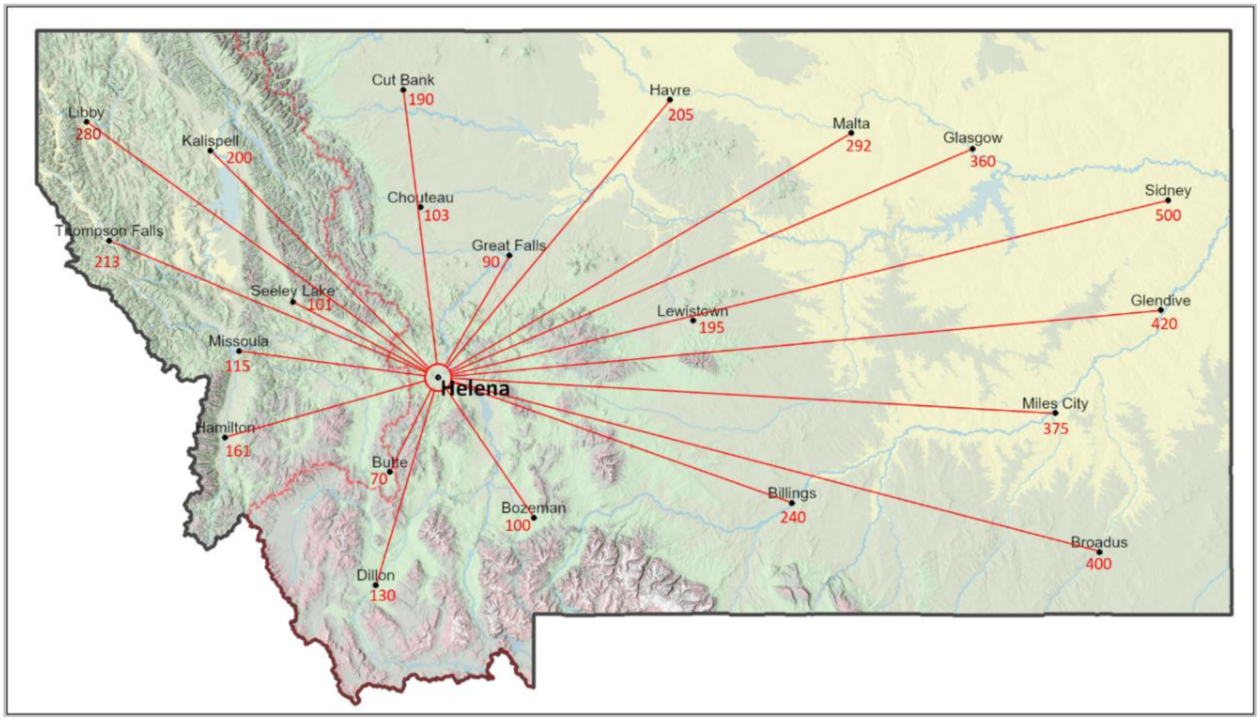
Figure III.A.3 displays the mandatory and redesignated Class I Areas in Montana; as well as the additional (non-Class I) national wilderness areas.

Figure III.A.3, Montana Class I and Wilderness Areas



Finally, the physical size and geographic diversity of Montana produces often-underestimated impacts and resource demands associated with the establishment, maintenance, and quality control of ambient air monitoring stations across this state. MTDEQ’s air monitoring program is operated out of a central location in the capital city of Helena. Consequently, site visits require considerable travel every month of the year, often in demanding weather conditions. Figure III.A.4 displays the highway miles between Helena and exiting air monitoring stations across the state.

Figure III.A.4, Approximate Highway Miles from Helena to Existing Monitoring Stations



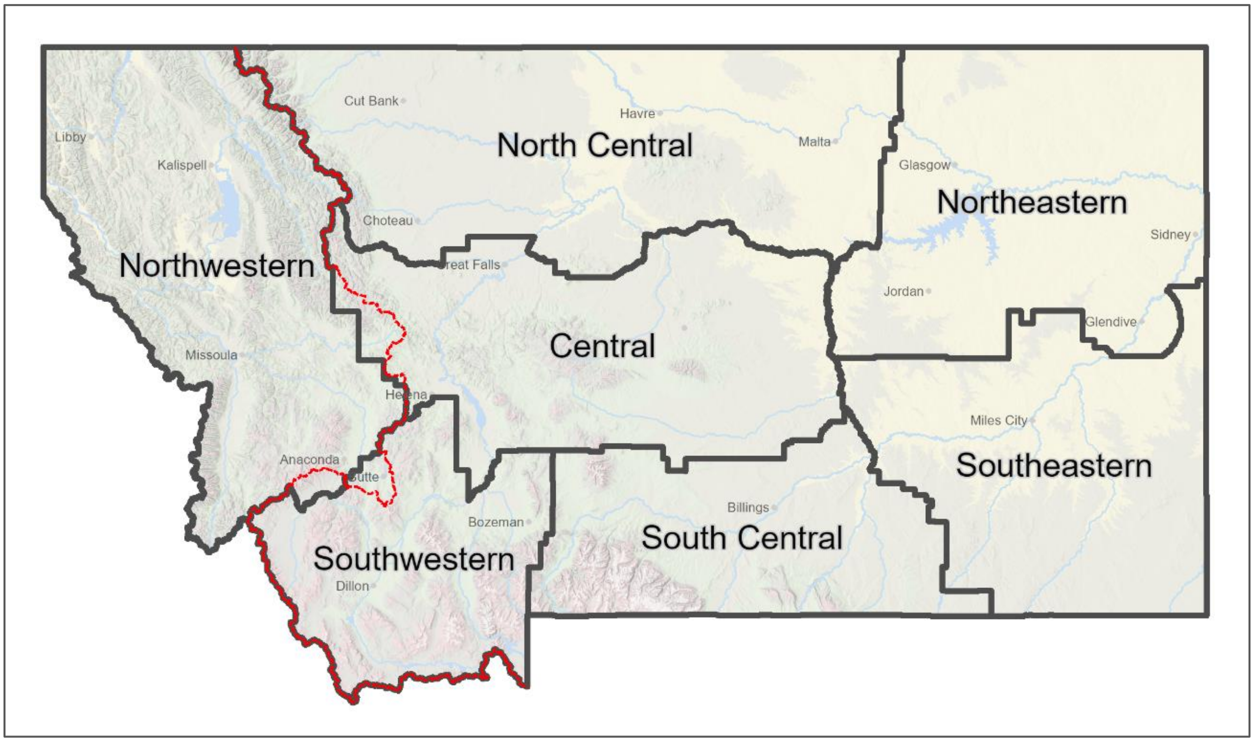
B. <u>Climate</u>

Background

Three broad influences interact to form wide and often dramatic climate variations across Montana. First is Montana's geographic diversity distributed across its expansive size as introduced in the previous section. Second is Montana's position on the North American continent. Its north-south position is at a fairly high latitude (from roughly the 45th parallel up to the 49th), thus Montana receives less solar energy gain on average, and generally experiences lower temperatures than most of the lower 48 states. This, in combination with its east-west continental location, positions Montana to receive weather systems from diverse origins: from the Pacific, the Arctic, and on some occasions, the Gulf of America and subtropical regions. Third is the punctuating influence of the Continental Divide, a mountain barrier that wrings-out Pacific moisture onto the western third of the state, resulting in rain shadows on its eastern lee side. That same divide allows the colder influences of the Arctic and drier influences of the midwestern prairies to impact the eastern two-thirds of the state.

The collective impacts of these three influences have led some researchers and writers to refer to the "Three Montanas"[1]: the area west of the Rockies, the Rocky Mountains and foothills, and the eastern plains. Others, including the National Oceanic and Atmospheric Administration (NOAA)[2] and the *Montana Climate Assessment* (2017)[3], describe Montana based on seven zones that reflect areas of similar climate, but whose boundaries are also influenced by a combination of political, agricultural, and watershed factors. The description of Montana in seven climate divisions (or Zones) is helpful in the air monitoring Network Assessment process because such a description provides useful definition to areas with mostly homogeneous influences from both natural and socio-economic factors that can be used to evaluate appropriate air monitoring approaches. Montana's seven climate divisions are displayed in Figure III.B.1.

Figure III.B.1. Montana's Seven Climate Divisions[2]



The following sections provide overviews of three climactic components in Montana: precipitation, temperature and wind. In each case, average conditions are used to communicate that overview. However, Montana's climate might be more accurately understood from its extremes than its averages, a dynamic that is particularly true when assessing the impact of climate on Montana's needs for air quality monitoring. Therefore, a section on "extremes" is included in the discussion of each of the three climate factors.

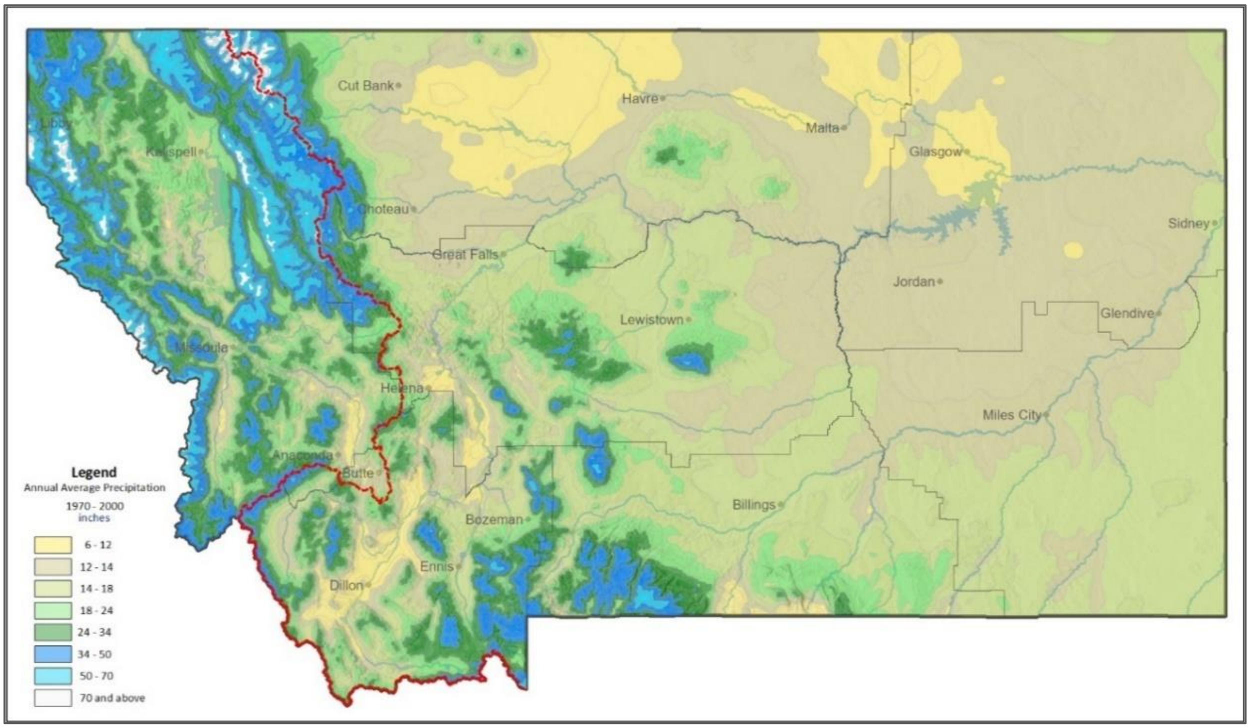
Precipitation

Montana receives a statewide average of 18.7 inches of precipitation each year. However, that average betrays a much more complex precipitation dynamic distinctly reflective of the three influences introduced above. Precipitation variability is dictated by a combined spatial-temporal-altitude distribution around the state. Western Montana is wetter by two-fold than the rest of the state east of the Continental Divide, with the north central division as the driest part of the state. Similarly, the western division receives precipitation from the Pacific in the winter, spring, and fall—along with some convective storms in the summer. Eastern and central Montana receives 65 to 75% of total precipitation in late spring and summer from the subtropical Pacific and Gulf of America. In addition, higher elevations receive most precipitation in the form of snow, while lower elevations receive most precipitation in the form of rain. Table III.B.1 presents average annual and seasonal precipitation in each of the seven climate zones for the period 1981 through 2010. Figure III.B.2 represents annual average precipitation across Montana during the period 1970 through 2000.

Table III.B.1. Montana's Distribution of Precipitation in inches, by Climate Zone, 1981 through 2010[3]

Climate Division	Annual	Winter	Spring	Summer	Fall
Northwestern	32.4	9.4	8.9	6.1	8.1
Southwestern	21.2	4.1	7.1	5.5	4.6
South Central	18.4	2.7	6.4	5.2	4.2
Central	17.6	2.4	5.8	5.9	3.5
North Central	15.1	1.9	4.6	5.5	3.1
Northeastern	12.8	1.0	3.7	5.7	2.4
Southeastern	13.8	1.2	4.6	5.1	2.9

Figure III.B.2. Montana's Annual Average Precipitation in Inches, 1970 through 2000[4]



<u>Precipitation Extremes</u>

- Most of Montana's snow falls during the months of November through March. However, snow showers are relatively common in some parts of the state from September into May, and snow has been known to fall even in summer months.

- Heavy rains sometimes coincide with the spring ice breakup on surface waters, causing heavy flooding.

- Convective summer storms can result in heavy and damaging hail, particularly in the eastern parts of the state.

Temperature

Montana's statewide ambient air temperatures vary in reflection of the three influences introduced in the Background section above. Areas west of the Continental Divide, while still experiencing four distinct seasons, are moderated by the influence of the Pacific, and generally experience conditions similar to the climate of the Pacific Northwest. Areas east of the Divide can experience bitter arctic cold from the north in the winter, and hotter, drier influences from the plains in the summer. The spring and fall seasons are often widely variable as they reflect a climatic transition between these influences. Temperature variations are also reflective of elevation, with higher terrain generally cooler than surrounding lowlands or valleys.

Table III.B.2 presents average annual and seasonal precipitation in each of the seven climate zones for the period 1981 through 2010.

Table III.B.2. Montana's Ambient Temperature Variability by Climate Zone, 1981 through 2010[3], in °F

Climate Division	Annual	Winter		Spring	Summer		Fall
		Average	Avg Min		Average	Avg Max	
Northwestern	40.6	23.7	16.5	39.4	58.5	72.0	40.6
Southwestern	38.9	21.2	12.4	37.3	57.5	71.5	39.4
North Central	42.8	21.8	10.9	42.1	63.8	78.3	43.1
Central	43.3	24.8	14.6	41.8	62.7	77.1	43.5
South Central	44.0	24.6	14.2	42.5	64.3	78.8	44.2
Northeastern	43.4	18.3	7.9	43.3	67.4	81.6	44.0
Southeastern	45.5	22.8	11.7	44.6	68.6	83.2	45.8

Figures III.B.3 and III.B.4 represent Montana's annual mean maximum and minimum temperatures for the period from 1991 through 2020.

Figure III.B.3. Average Annual Maximum Temperatures in Montana in °F, 1991 through 2020[5]

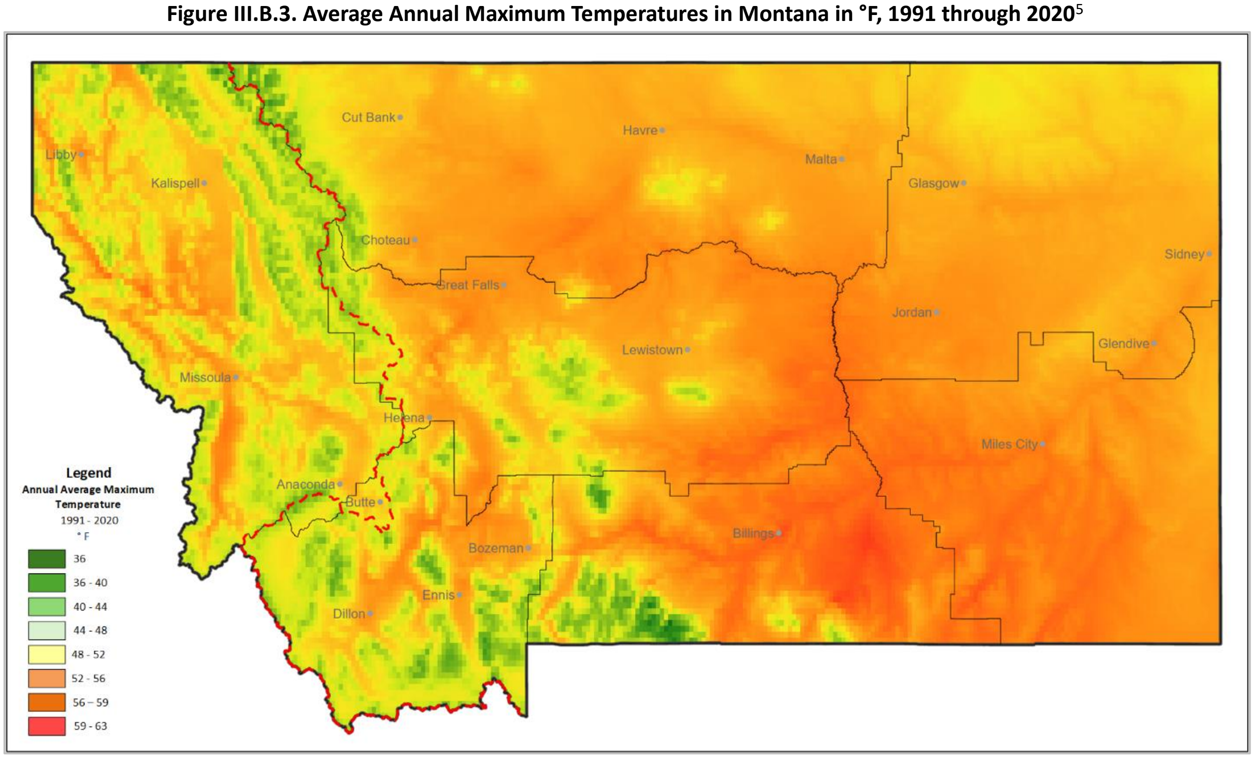
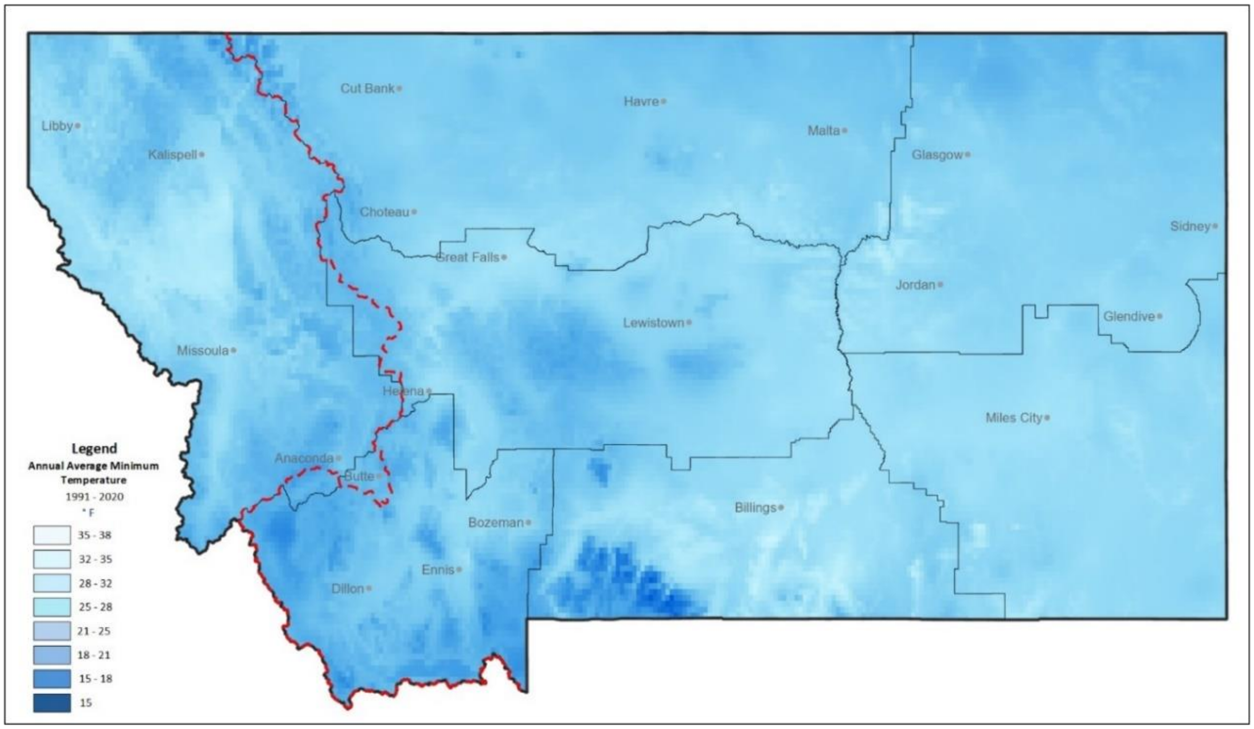


Figure III.B.4. Average Annual Minimum Temperatures in Montana in °F, 1991 through 2020[6]



Temperature Extremes

- During winter periods of arctic air influence, ambient temperatures can reach dangerously low levels, particularly in the North Central and Northeastern climate zones, but often across all of the state east of the Divide. Air temperatures may drop to -30 °F or even -50 °F, with wind chills significantly lower.

- The coldest air temperature ever observed in the lower 48 states was -70 °F at Rogers Pass northwest of Helena on January 20, 1954.

- The highest temperature recorded in Montana was 117° F recorded at Glendive on July 20, 1893, and at Medicine Lake on July 5, 1937.

- Montana is noted for record extreme temperature changes:
  - From -54 to +49 °F within 24 hours (a 103° increase) at Loma, Montana, on January 15, 1972; a world record 24-hour temperature increase.
  - From 63 to -21 °F within 12 hours (an 84° decrease) at Fairfield, Montana, on December 14, 1924; a United States record 12-hour decrease.
  - From -32 to +15 °F within seven minutes (a 47° increase) at Great Falls, Montana, on January 11, 1980; a United States record for the most rapid temperature change.

- Wintertime “chinook” winds (see the section on “Wind” below) can produce periods of rapid temperature increase (sometimes in the 40° F range) between cold fronts, particularly in the North Central climate zone.

- In the wintertime, Montana’s mountain valleys on both sides of the Divide can experience prolonged periods of temperature inversions in which warmer air aloft traps colder air at ground level. During these stagnation periods emitted air pollutants, particularly wood smoke from home heating fires, cannot mix out and accumulates in these basins, sometimes to unhealthy levels.

Wind

Montana is a notoriously windy state. While measured wind impacts change slightly from year to year based on broad weather patterns, Montana is normally one of the top five windiest states in the United States; in 2024 it was number two. All of Montana's physical attributes interact to produce unique wind patterns across the different regions of the state. Air systems of differing origins (e.g., Pacific, Arctic, etc.) produce different wind impacts in Montana. This, along with resulting jet stream modifications and broader climate patterns like El Niño and La Niña oscillations, all influence the way air masses interact with Montana's terrain to produce varying regional wind. One notable, and fairly common, dynamic weather pattern involves air masses from the Pacific releasing moisture as they are lifted and cooled over the Rockies. The resulting drier air is then compressed and accelerated on the down sloping eastern side of the Continental Divide. Winds formed in this fashion are quite strong. In the right conditions the adiabatic compression effect heats the air, and a wintertime chinook warmup is produced. In other conditions, the winds encounter arctic air masses, and brutally cold and dangerous conditions result. Both scenarios can impact wind patterns extending from the Divide into the central part of the state.

Montana's windiest months are April and May. However, summertime thunderstorms from air masses traveling up from the Gulf of Mexico into the central and eastern portions of the state can produce strong winds, and in some cases, even tornadoes.

Figure III.B.5 represents Montana's statewide annual mean wind speeds during the period 1991 - 2020.

Figure III.B.5. Average Annual Wind Speeds in Montana in MPH, 1991 through 2020[7]

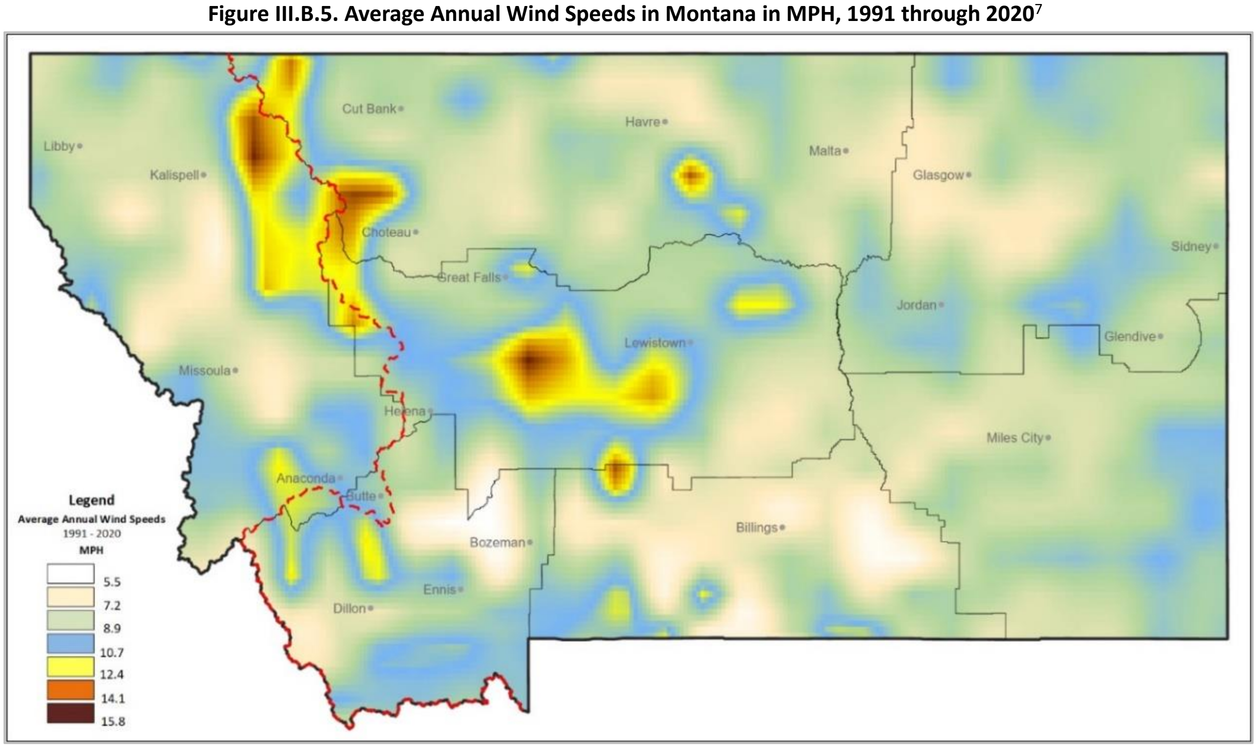


Figure III.B.6 represents the average wind direction and figure III.B.7 provides average wind speeds at twenty representative regional airports across the state for the periods 1992 – 2002 and 1998 -2006 respectively. In each case, the annual average is most prominently displayed, accompanied by smaller representations of winter and summer month averages.

Figure III.B.6. Montana Average Prevailing Wind Directions at Twenty Representative Airports, 1992 – 2002[8]

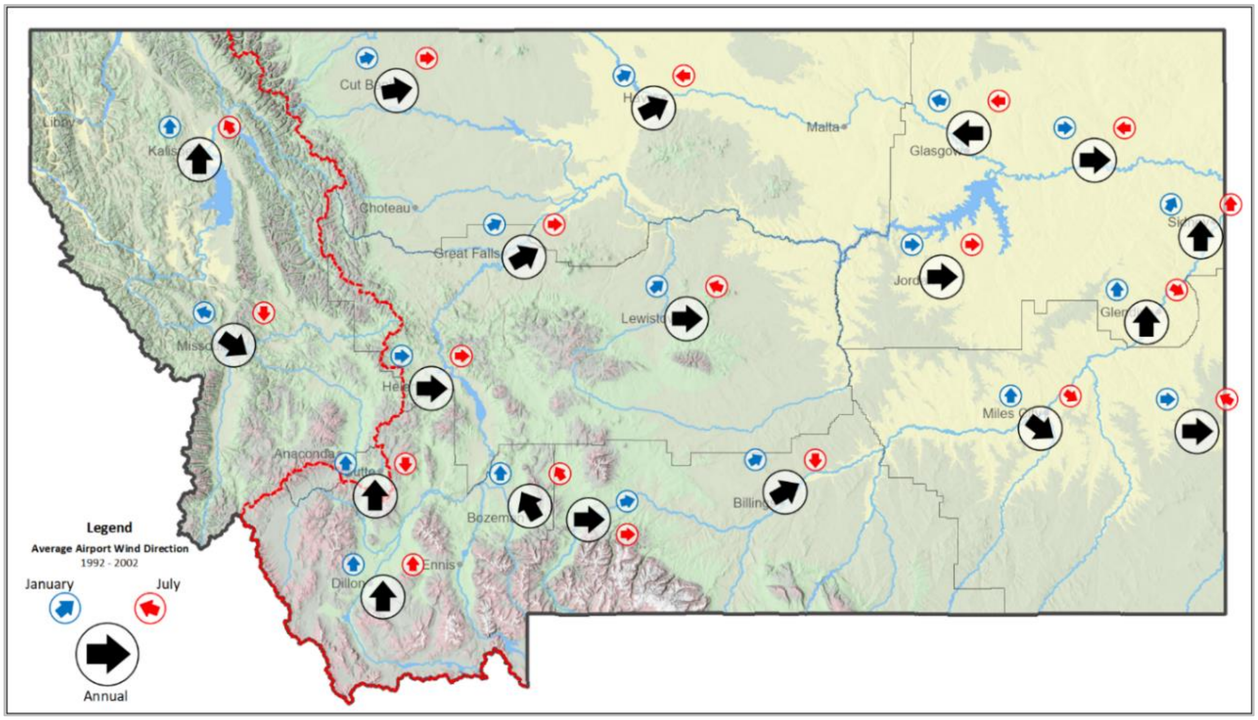
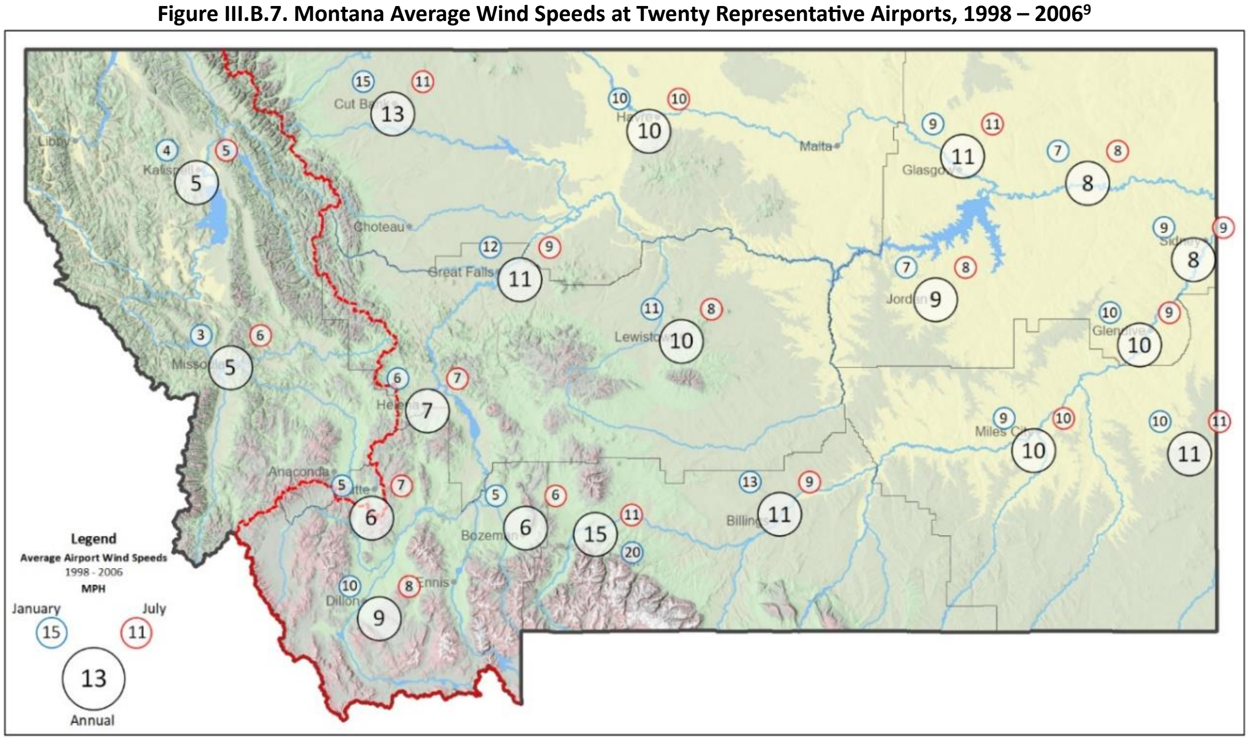


Figure III.B.7. Montana Average Wind Speeds at Twenty Representative Airports, 1998 – 2006[9]



Wind Extremes

- The highest recorded wind gust in Montana was 143 miles per hour (mph) in 2002 in Teton County. Wind gusts of 125 mph on Sentinel Peak above Missoula, 90 mph in Browning, 82 mph in Livingston, 76 mph in Great Falls, 74 mph in Helena, and 72 mph in Havre have also been recorded.
- From an air quality standpoint, two wind factors are of great significance:
    1. Periods of stagnation where there is no wind. In the wintertime Montana's mountain valleys on both sides of the Divide can experience prolonged periods of temperature inversions in which warmer air aloft traps colder air at ground level. During these periods emitted air pollutants, particularly wood smoke from home heating fires, cannot mix out and accumulates in these basins, sometimes to unhealthy levels.

    2. Synoptic scale winds that bring wildfire smoke from fires in surrounding states into Montana. Through this mechanism Montana can be impacted by high levels of smoke from California, Oregon, Washington, Idaho, the Provinces of Canada, and the desert southwest. See Figure III.D.8 for a satellite view recorded in 2024 that displays this dynamic.

Historically, wildfire smoke impacts were considered to be almost exclusively a western Montana issue, related to the predominant forestation in that region. However, wildfire smoke from outside the state impacts Montana statewide, and has resulted in the need for increased $PM_{2.5}$ monitoring in central and eastern Montana.

Climate Change

Three significant studies and resulting reports are pertinent in this Monitoring Assessment in reflection of the current understanding of how climate change is believed to be affecting Montana and the health of its citizens.

1. 2017 Montana Climate Assessment[3]

The Montana Climate Assessment (MCA) was produced in "an effort to synthesize, evaluate, and share credible and relevant scientific information about climate change in Montana with the citizens of the State." The MCA research and report was organized by the Montana Institute on Ecosystems at Montana State University and the University of Montana and "reports on climate trends and their consequences for three of Montana's vital sectors: water, forests, and agriculture."

From the *2017 Montana Climate Assessment:*

- "Annual temperatures have risen 2-3° F (1.1-1.7°C) since 1950, and our growing season is now 12 days longer. Montana has experienced an increase in warm days and nights, both in summer and winter. There is no trend in precipitation since 1950. [high agreement, robust evidence]"
- "Climate models project that temperatures will continue to increase and by the end of the century average annual temperature may be 9.8°F (5.4°C) higher than those recorded between 1971-2000, given our present rate of greenhouse gas emissions. [high agreement, robust evidence]"

- “The number of days >90°F (>32°C) will increase significantly by the end of the of the century, with the greatest warming in eastern Montana. The eastern part of the state will also experience more extreme heat (i.e., days when the heat index exceeds 105°F [41°C]). [high agreement, moderate evidence]”

- “Precipitation received at a state level may increase slightly in the future, but these gains will be offset by evaporation and transpiration due to higher temperatures. More precipitation will be received in winter, spring, and fall; summers will become drier than at present. [moderate agreement, moderate evidence]

- Rising temperatures will result in a shift from snow to rain earlier in the year than at present. In turn, this shift will result in earlier dates for the onset of snowmelt and associated peak stream runoff by the end of the century. [high agreement, robust evidence]”

- “Increased wildfires are expected as wetter springs result in increased fuel accumulation, and drier summers lead to fuel desiccation. The size of fires and the length of the fire season will increase in both forest and grassland. [high agreement, robust evidence]”

- “Unforeseen climate-related weather events will occur with projected increases in temperature and drought in the coming decades, including greater likelihood of spring flooding, severe summer drought, and extreme storm events. [high agreement, moderate evidence]”

2. Climate Change and Human Health in Montana, A Special Report of the Montana Climate Assessment.[10] This document, published in January 2021, built on seven of the thirty-five key messages in the MCA. The conclusions of this document may be summarized in the following key messages, each with an assessment of the degree of confidence in that message (contained in [brackets]):

From *Climate Change and Human Health in Montana*[10]

- “Three aspects of projected climate change are of greatest concern for human health in Montana: 1) increased summer temperatures and periods of extreme heat, with many days over 90°F (32°C); 2) reduced air quality from smoke, as wildfires will increase in size and frequency in the coming decades; and 3) more unexpected climate-related weather events (i.e., climate surprises), including rapid spring snowmelt and flooding, severe summer drought, and more extreme storms. [high agreement, robust evidence]”

- “The most vulnerable individuals to the combined effects of heat, smoke, and climate surprises will be those with existing chronic physical and mental health conditions, as well as individuals who are very young, very old, or pregnant. Montana’s at-risk populations include those exposed to prolonged heat and smoke, living in poverty, having limited access to health services, and/or lacking adequate health insurance. [high agreement, robust evidence].”

- “Projected increased summer temperatures and wildfire occurrence will worsen heat- and smoke-related health problems such as respiratory and cardiopulmonary illness, and these potential problems are of most immediate concern. [high agreement, robust evidence]”

- “Earlier snowmelt, more intense precipitation events, and projected increases in floods will endanger lives and lead to more gastrointestinal disease due to contaminated water supplies, as well as increased opportunities for other water-borne, food-borne, and mold-related diseases. [high agreement, moderate evidence]”

- “Increased summer drought will likely increase cases of West Nile virus in Montana, but the impact of climate change on other vector-borne diseases is less clear. [high agreement, moderate evidence]”

- “Longer growing seasons, warmer temperatures and elevated carbon dioxide (CO_2) levels are leading to increased pollen levels, worsening allergies and asthma. [high agreement, moderate evidence]”

- “Summer drought poses challenges to local agriculture, resulting in decreased food availability and nutritional quality, and to the safety and availability of public and private water supplies, especially for individuals and communities relying on surface water and shallow groundwater. [high agreement, robust evidence]”

- “Climate changes, acting alone or in combination, are reducing the availability of wild game, fish, and many subsistence, ceremonial, and medicinal plants, which threatens food security, community health, and cultural well-being, particularly for tribal communities. [high agreement, moderate evidence]”

- “Increased stress and increased mental illness are under recognized but serious health consequences of climate change. [high agreement, robust evidence].”

3. NOAA National Centers for Environmental Information, State Climate Summaries 2022, Montana[11]

NOAA initially produced this report in 2014. The 2022 report included new and updated information, and summarized its analysis of Montana in “Three Key Messages”:

- Key Message 1: “Temperatures in Montana have risen almost 2.5°F since the beginning of the 20th century, higher than the warming for the contiguous United States as a whole. The first 21 years of this century represent the warmest period on record for Montana.” “This increase is most evident in winter warming, characterized by fewer very cold days since 1990.”

- Key Message 2: “Montana's mountains and river systems provide critical water resources for the state, as well as other downstream states. Projected increases in spring precipitation may have both positive (increased water supplies) and negative (increased flooding) impacts.”

- Key Message 3: “Higher temperatures, and possible decreased summer precipitation, will increase the rate of soil moisture loss during dry spells, leading to an increase in the intensity of naturally occurring droughts. The frequency and severity of wildfires are projected to increase in Montana.”

Resources for the Climate Section

FOOTNOTES

[1] **Montana: One State with Three Changing Regions**: University of Montana O'Connor Center for the Rocky Mountain West at the University of Montana https://www.umt.edu/this-is-montana/columns/stories/montana_regions_1of3.php

[2] **NOAA Climate Divisions**: https://www.ncei.noaa.gov/access/monitoring/reference-maps/conus-climate-divisions

[3] **Montana Climate Assessment**
Whitlock C, Cross W, Maxwell B, Silverman N, Wade AA. 2017. 2017 Montana Climate Assessment. Bozeman and Missoula MT: Montana State University and University of Montana, Montana Institute on Ecosystems. 318 p. doi:10.15788/m2ww8w.

[4] **Montana State Library, Geographic Information, Montana Average Precipitation, 1971-2000**
https://mslservices.mt.gov/geographic_information/data/datalist/datalist_Details.aspx?did=%7B56375D06-3CBF-4B12-9D7B-B26166024E71%7D

[5] **Montana State Library MSDI Climate, Max Temps**: https://data.climate.umt.edu/mt-normals/cog/tmmx/

[6] **Montana State Library MSDI Climate, Min Temp**s: https://data.climate.umt.edu/mt-normals/cog/tmmn/

[7] **Montana State Library, Geographic Information, Montana Wind Speed** https://data.climate.umt.edu/mt-normals/cog/vs/
[8] **Western Regional Climate Center Prevailing Wind Direction Table** https://wrcc.dri.edu/Climate/comp_table_show.php?stype=wind_dir_avg

[9] **Western Regional Climate Center Average Wind Speed Table** https://wrcc.dri.edu/Climate/comp_table_show.php?stype=wind_speed_avg

[10] **Climate Change and Human Health in Montana, January 2021**
Adams A, Byron R, Maxwell B, Higgins S, Eggers M, Byron L, Whitlock C. 2021. Climate change and human health in Montana: a special report of the Montana Climate Assessment. Bozeman MT: Montana State University, Institute on Ecosystems, Center for American Indian and Rural Health Equity. 216 p. https:// doi.org/10.15788/c2h22021.

[11] **NOAA (NCICS) Climate summary Montana**
Frankson, R., K.E. Kunkel, S.M. Champion, D.R. Easterling, K. Jencso, 2022: Montana State Climate Summary 2022. NOAA Technical Report NESDIS 150-MT. NOAA/NESDIS, Silver Spring, MD, 5 pp.

REFERENCES

Climate of Montana
Western Regional Climate Center Website, Historical Data, Narratives by State, Montana, https://wrcc.dri.edu/Climate/narrative_mt.php

MT State Library MSDI Climate: https://msl.mt.gov/geoinfo/msdi/climate/

Montana Climate Office: https://climate.umt.edu/

Montana's top 10 Windiest Cities and Other Wind Facts
https://www.greatfallstribune.com/story/news/local/2016/10/20/listen-montanas-wind-deserves-respect/92459142/

Montana Wind
https://outsidebozeman.com/nature/montana-wind#:~:text=Montana%20lies%20beneath%20a%20giant,eastern%20slope%20of%20the%20Rockies

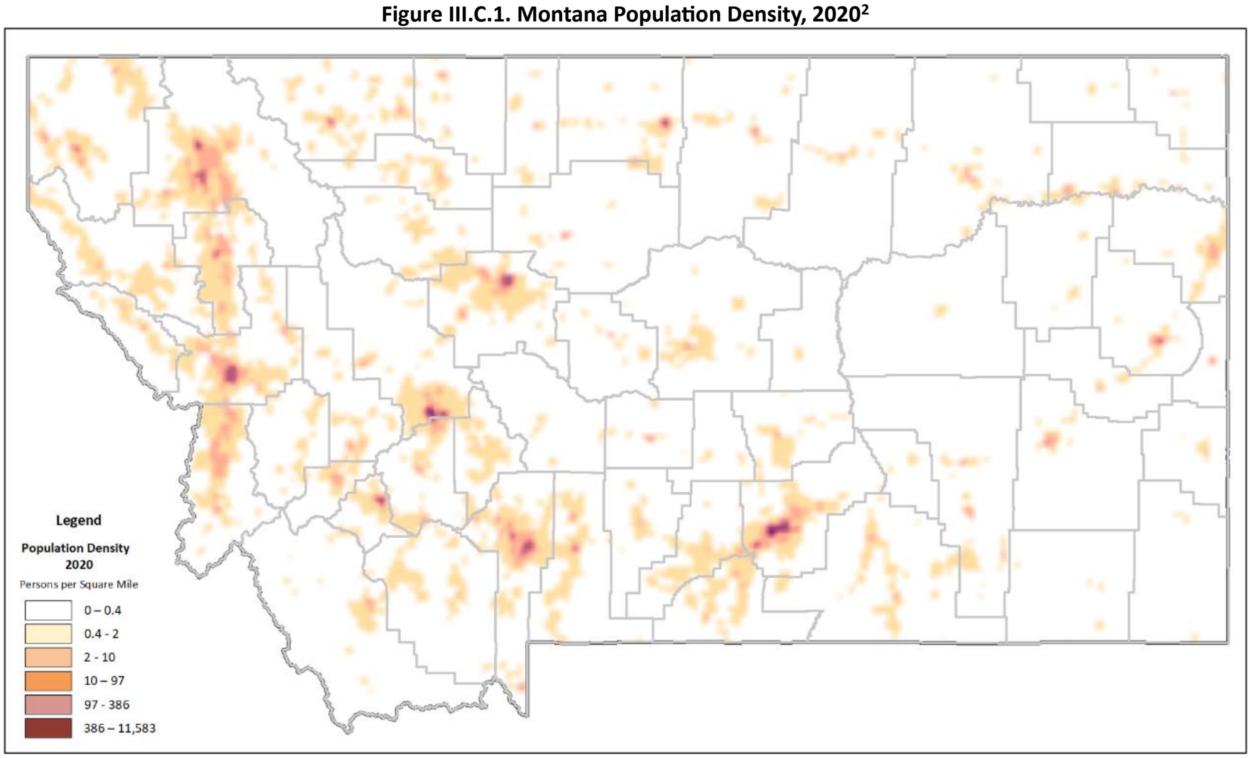
C. Population and Demographics

Background

All of Montana's history is marked by gains and losses in human population in relationship with shifting cultural, welfare, seasonal, industrial, climate, and economic changes. This population dynamic is the single regional characteristic that most influences the location and operation of ambient air monitors in Montana.

As illustrated in Figure III.C.1, the state's population distribution reflects a pattern in which regional centers[1] of commerce, trade and community life are surrounded by a distinct local population. The regional centers are often isolated within large land areas in which the population density is less than one person per square mile, and the pattern holds irrespective of the size of the total population of the regional centers. MTDEQ's approach to locating regulatory monitors is influenced by a desire to provide accurate, local air pollutant concentration data in the larger regional centers that also represents the surrounding area and human population, particularly regarding $PM_{2.5}$.

Figure III.C.1. Montana Population Density, 2020[2]



The regional centers are typically made up of one or more incorporated cities or townships surrounded by unincorporated statistical population areas referred to by the U.S. Census Bureau as Census Designated Places (CDPs). In several cases, the resulting population center extends across county boundaries. As a result, it is challenging to assign a distinct identifier or name to each regional center for communication and discussion purposes. For clarity, this Assessment refers to population characterizations within distinct county boundaries or groups of counties.

Montana's population remains modest among the United States-- at present, ranking 43rd out of the 50 states in terms of human population. Figure III.C.2 highlights Montana's ten highest populated counties in 2024. Approximately 75% of Montana's population resided in these counties in 2024.

Figure III.C.2. Montana's Ten Highest Populated Counties, 2024[4]

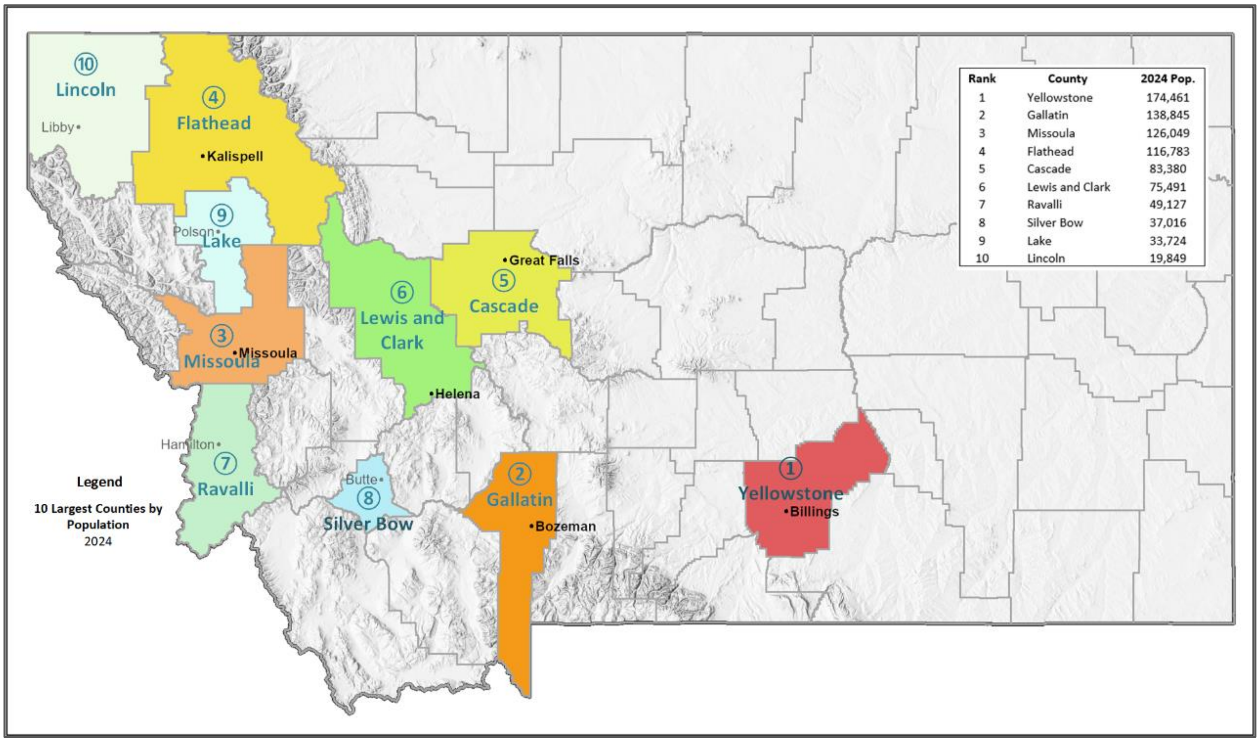
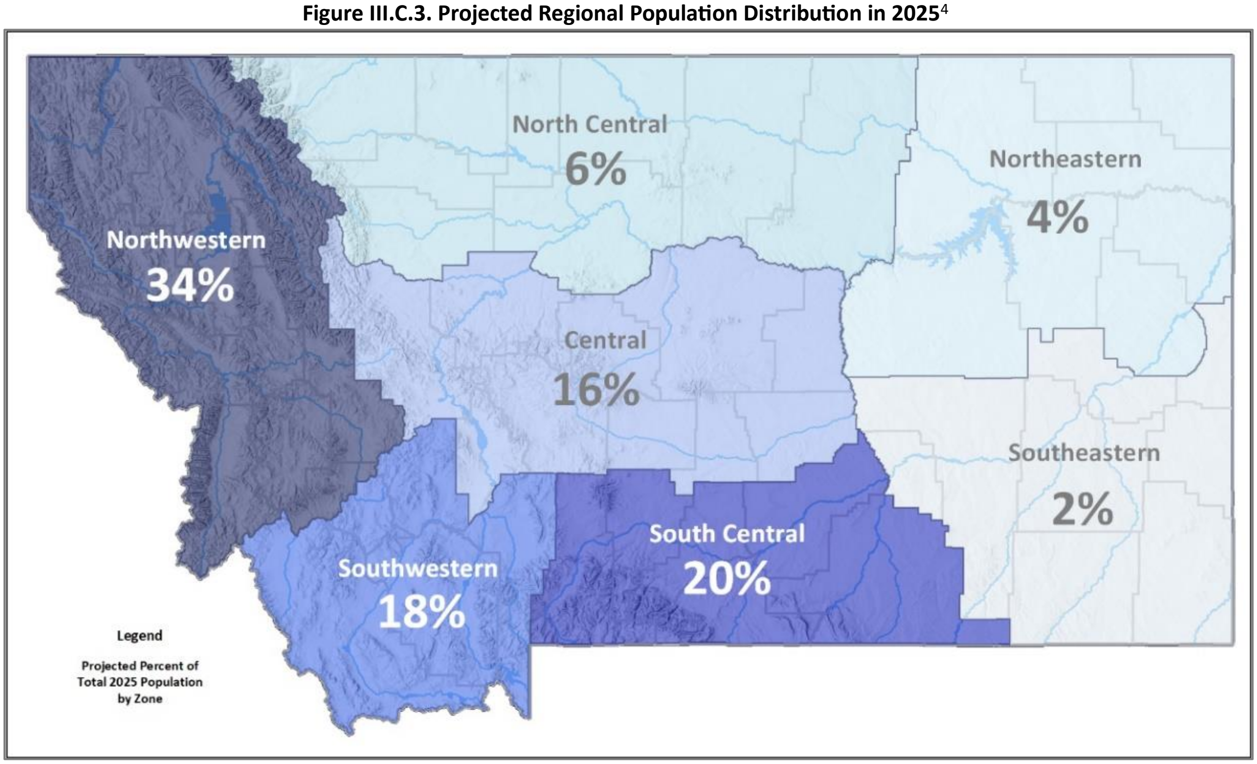


Figure III.C.3 displays the projected regional distribution of Montana's population in 2025.

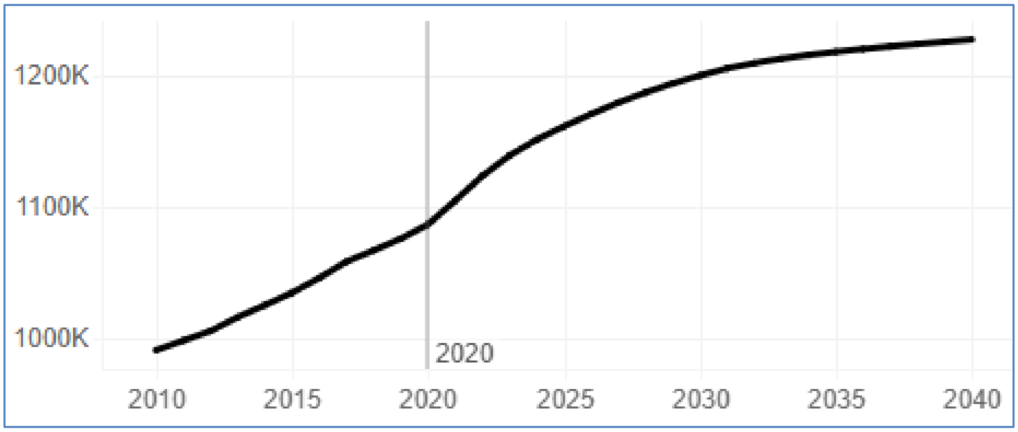
Figure III.C.3. Projected Regional Population Distribution in 2025[4]



Population Change

Montana has experienced a relatively consistent period of growth since the 2010 census population of 989,415 and through the 2020 census at 1,084,255. The Montana Department of Commerce projected a population of 1,150,588[4] in 2024 and 1,160,666 in 2025. Those figures project an increase of 171,251 people between 2010 through 2025. The Montana Department of Commerce[5] provides helpful insight into Montana's population changes through an estimate of the state's growth from 2010 into 2040, as demonstrated in Figure III.C.4.

Figure III.C.4. Projected Population Total for State of Montana[5]



This population growth is significant for Montana, and for the purposes of this monitoring network assessment it is essential to evaluate where, and to what degree, specific population change is occurring. The following two figures portray Montana's population change by county in two time periods. Figure III.C.5 represents population change between 2020 and 2024, while Figure III.C.6 represents projected population change from 2024 through 2030.

Figure III.C.5. Montana Population Change by County, 2020-2024[4]

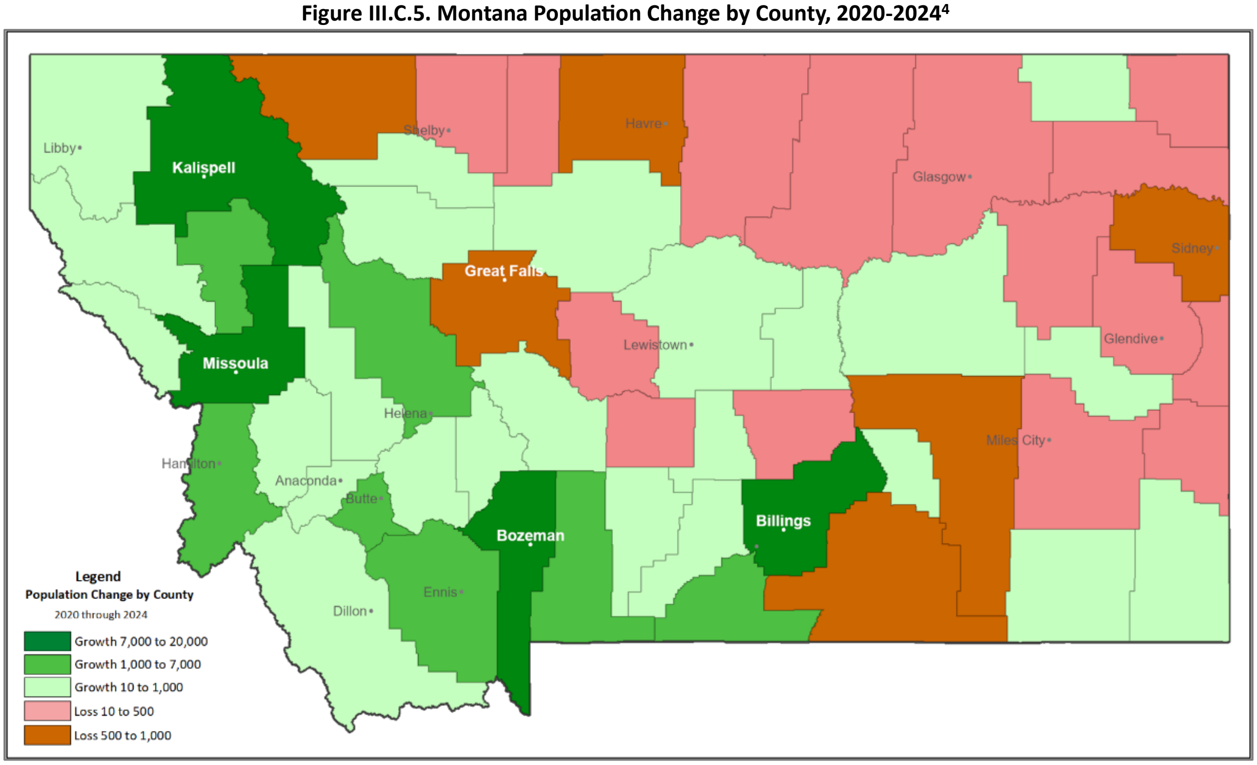
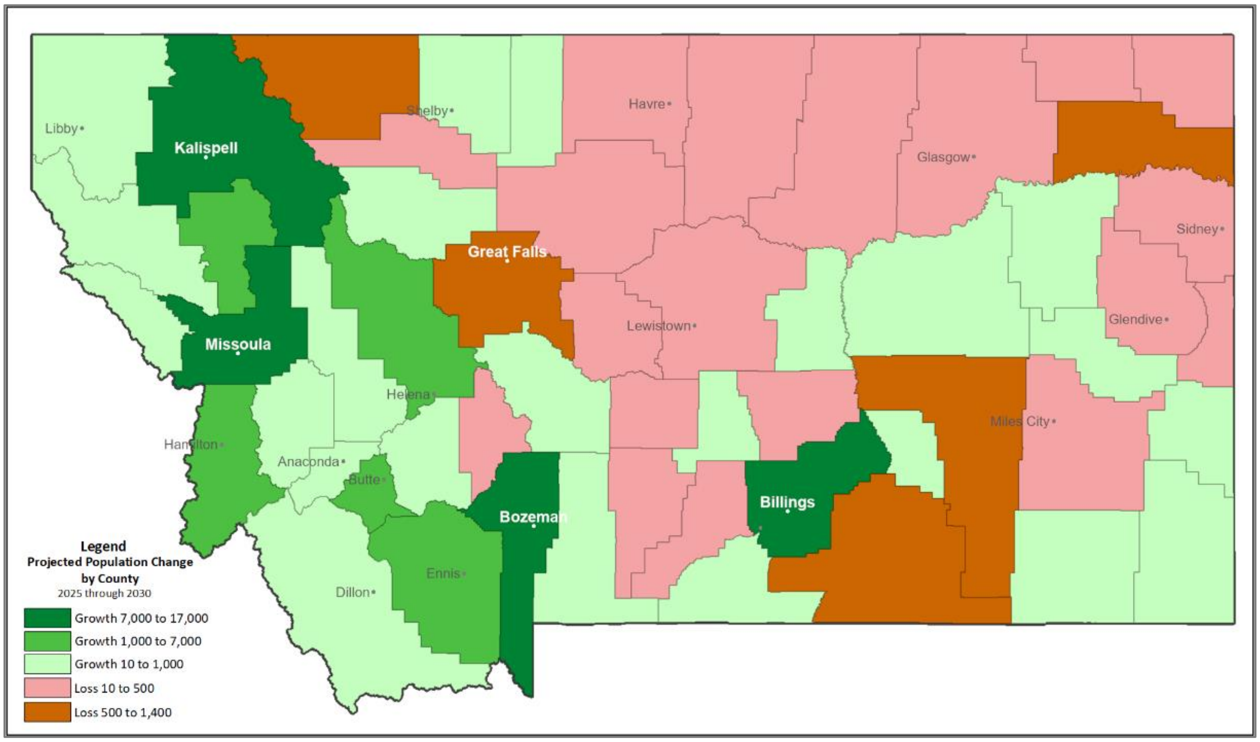


Figure III.C.6. Montana Projected Population Change by County, 2025-2030[4]



A visual comparison between Figures III.C.5 and III.C.6 leads to four important findings. First, Montana's population growth has been, and is projected to be greatest in its already most populated counties. Second, population decline is occurring in Montana's more rural and less populated counties. Third, this overall trend is expected to continue and probably intensify into 2030. Fourth, Cascade County is a notable exception to all the above.

The Montana Department of Commerce provides a more detailed view of these findings projected out to 2040, as demonstrated in Figures III.C.7 and III.C.8. The projected population trend for Gallatin County is especially notable.

Figure III.C.7. Projected Population Totals for Selected Counties[5]

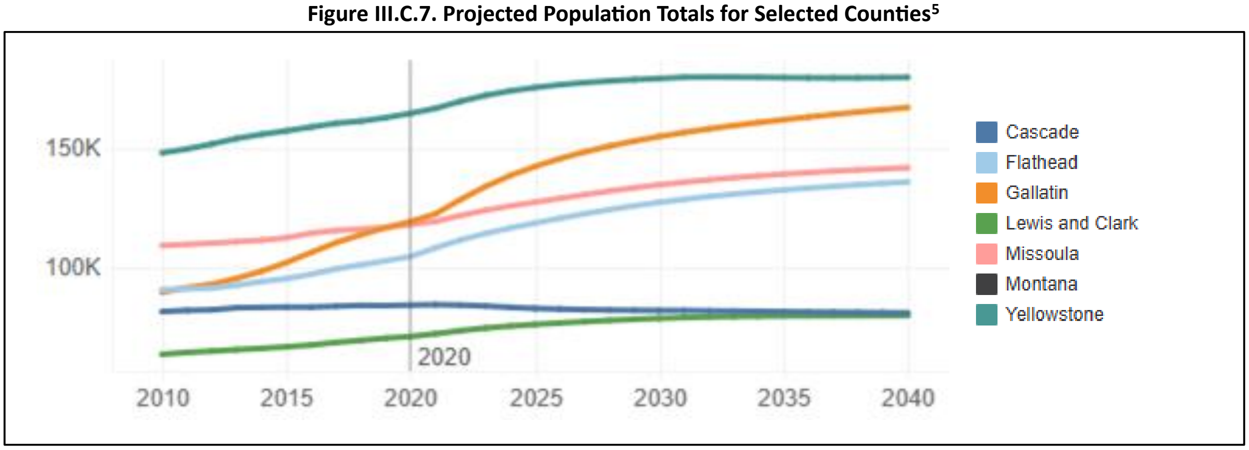
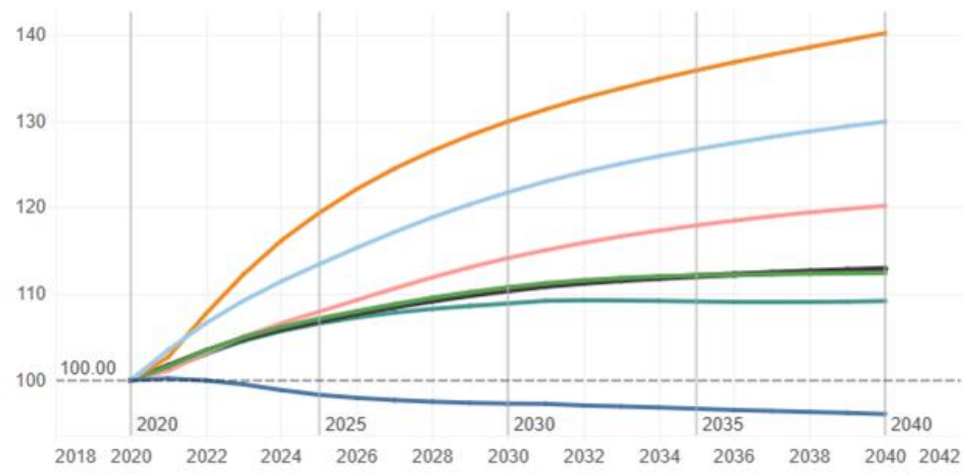


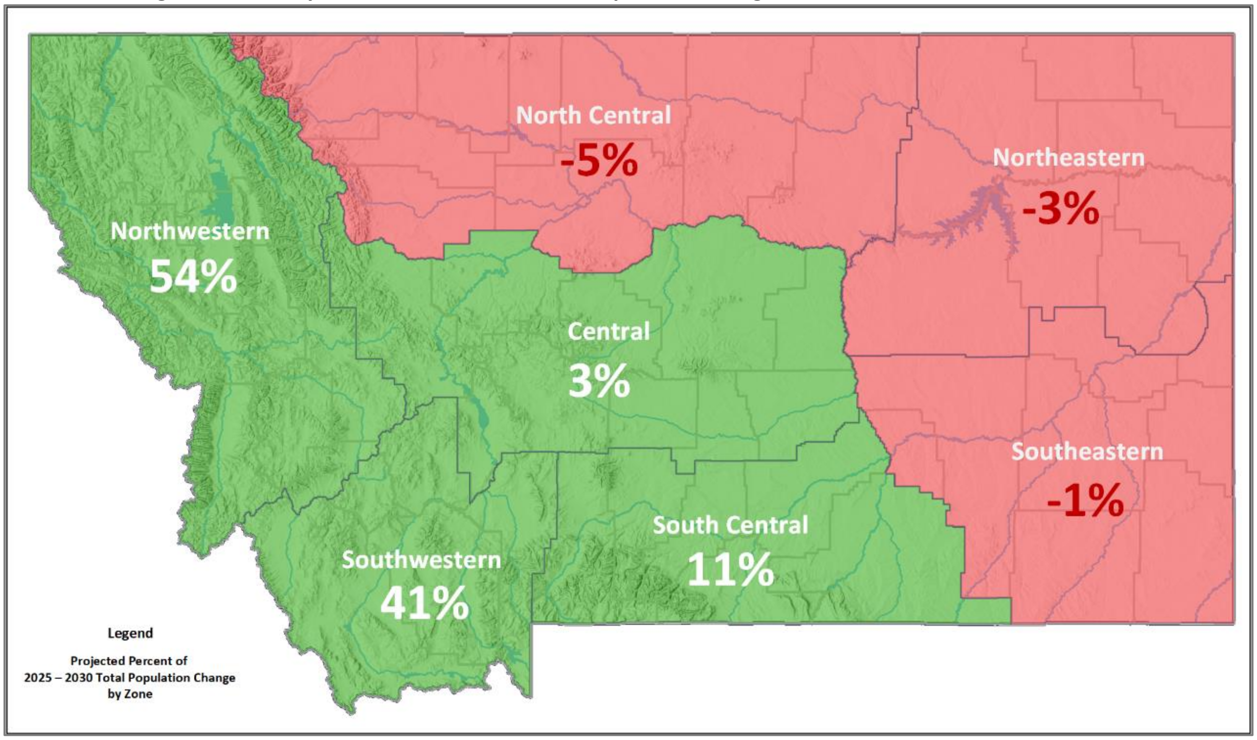
Figure III.C.8. Change in Projected Population from 2020 (Indexed)[5]



Projected population change is indexed to the data release year of 2020. Indexing the rate of change enables the comparison of data with different magnitudes.

Figure III.C.9 provides a reflection of how projected population changes in the seven climatic zones fit into the broader, regional context of population change across the state.

Figure III.C.9. Projected Percent of Statewide Population Change in Each Climate Zone, 2025-2030[4]



Population Density

As noted previously, Montana is a spatially large state with a modest population. A reflection of statewide population density is an additional and informative perspective in understanding the state's population changes. Figures III.C.10 and III.C.11 display the statewide population density by county in 2020 and 2024, respectively. Figure III.C.12 projects the population density in 2030.

Figure III.C.10. Montana Population Density by County, 2020, Persons per Square Mile[4]

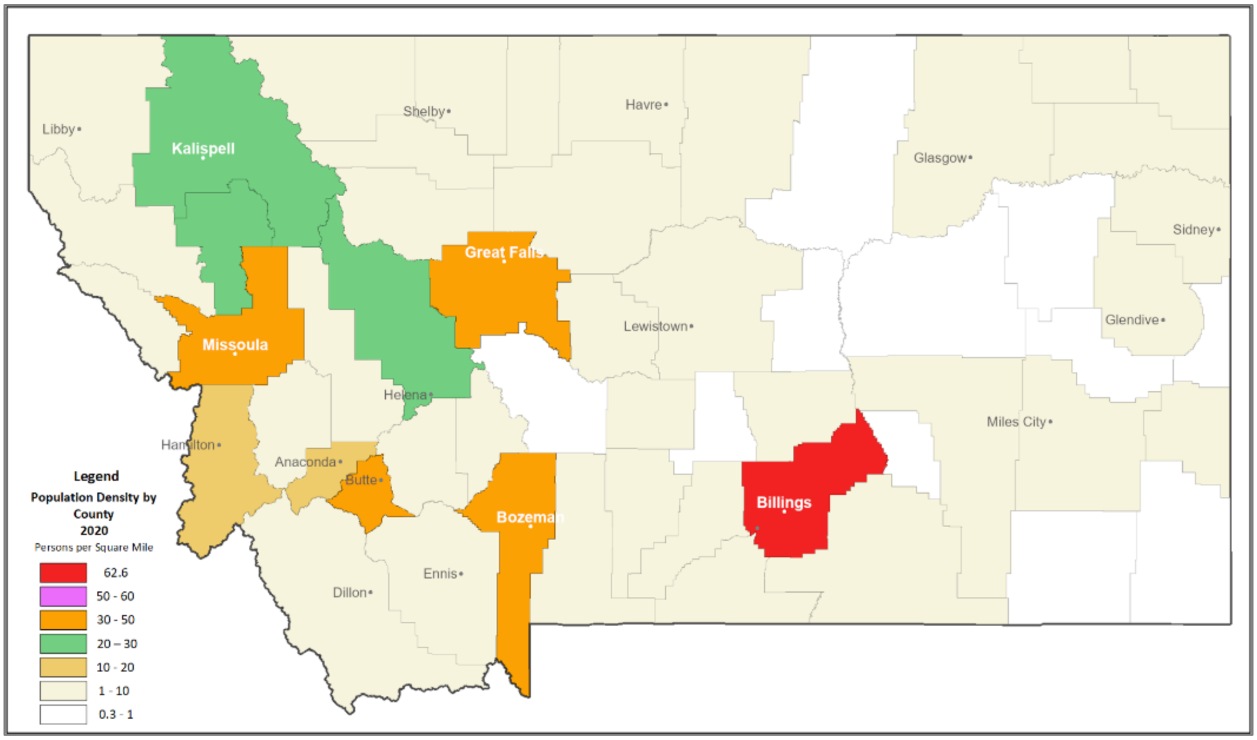


Figure III.C.11. Montana Population Density by County, 2024, Persons per Square Mile[4]

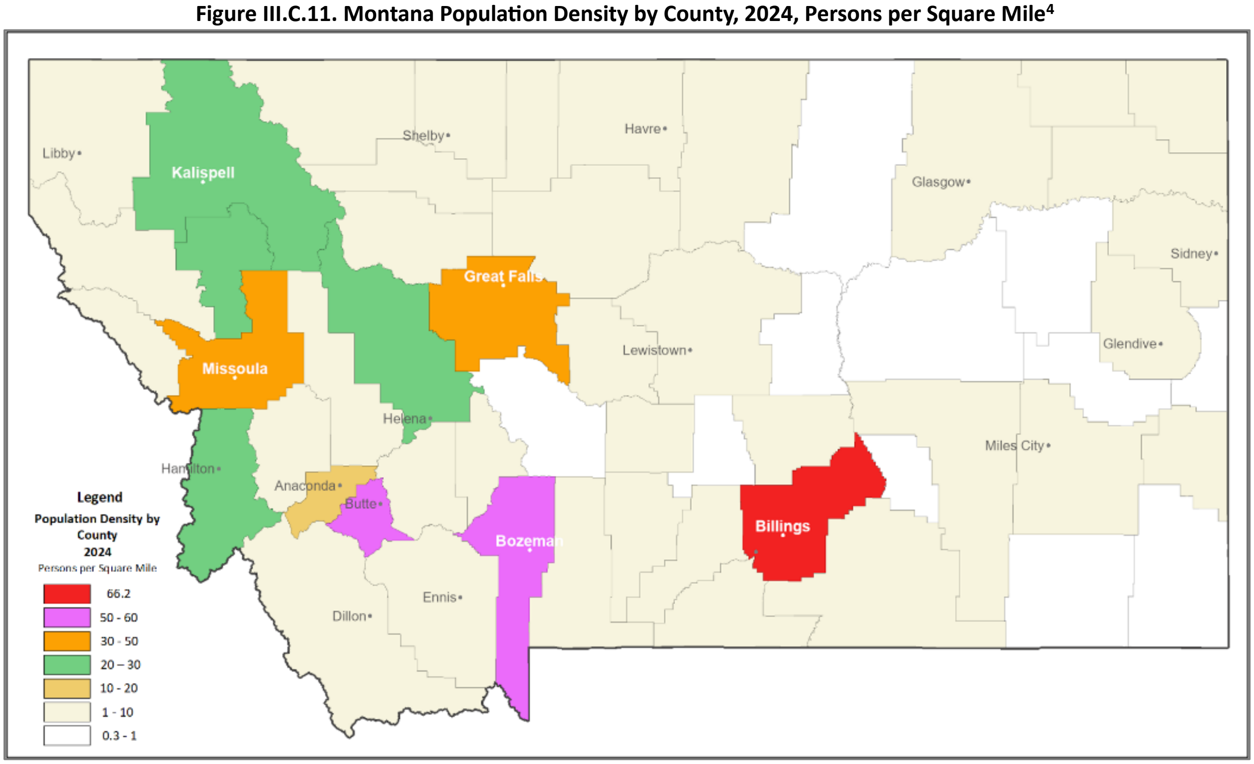
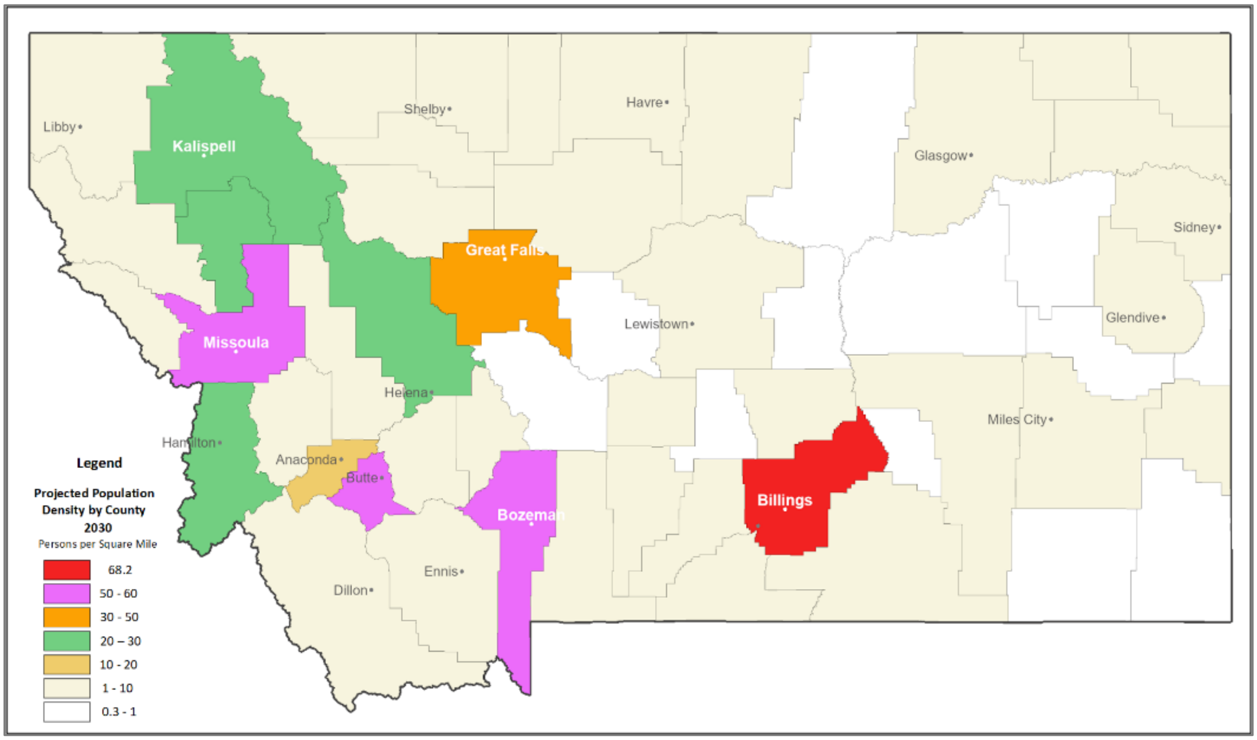


Figure III.C.12. Montana Projected Population Density by County, 2030, Persons per Square Mile[4]



Designations of Higher-Populated Areas (CBSAs)

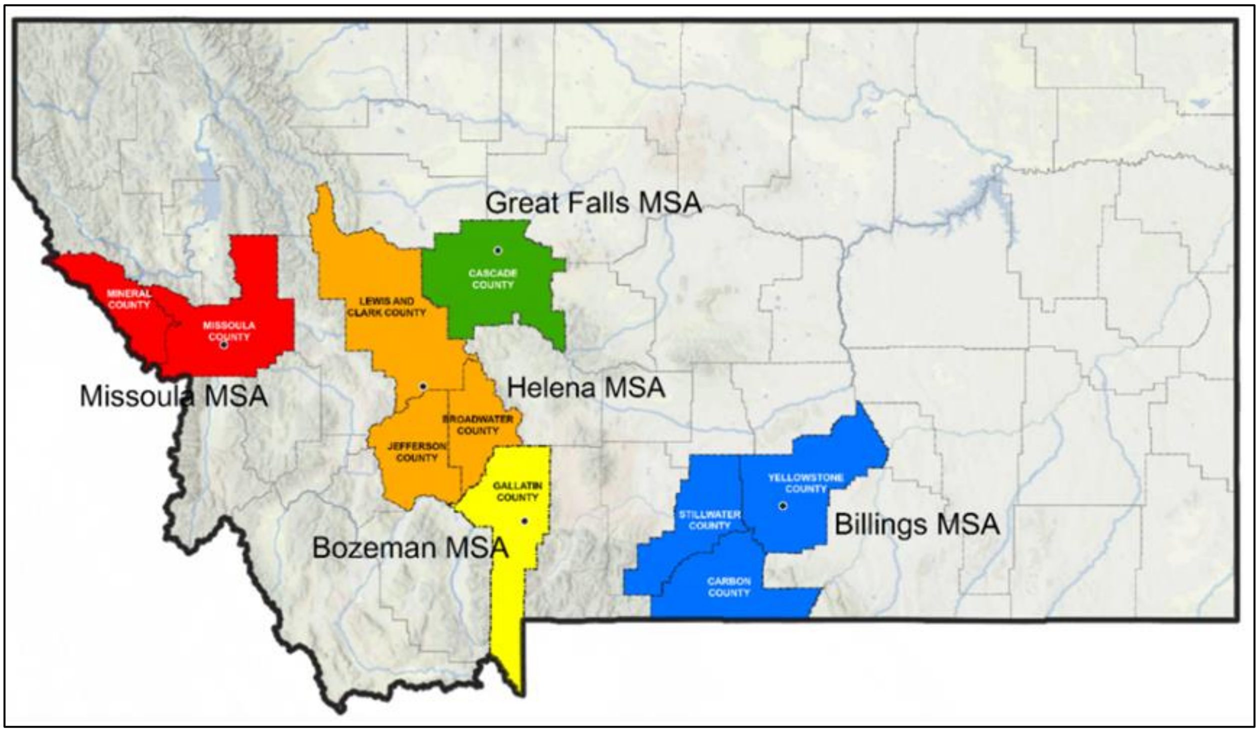
The federal rules directing monitoring network design focus significantly on human population size and density. When assessing these factors, the rules use population-based designations established by the federal Office of Management and Budget (OMB) and the United States Census Bureau summarized together as "Core Based Statistical Areas" (CSBAs). The federal definition of a CBSA, as it applies to ambient air monitoring, is embodied in 40 CFR 58.1 as follows:

> "*Core-based statistical area (CBSA)* is defined by the U.S. Office of Management and Budget, as a statistical geographic entity consisting of the county or counties associated with at least one urbanized area/urban cluster of at least 10,000 population, plus adjacent counties having a high degree of social and economic integration. Metropolitan Statistical Areas (MSAs) and micropolitan statistical areas are the two categories of CBSA (metropolitan areas have populations greater than 50,000; and micropolitan areas have populations between 10,000 and 50,000). In the case of very large cities where two or more CBSAs are combined, these larger areas are referred to as combined statistical areas (CSAs)".

Until July 21, 2023, Montana had three federally designated MSAs: Billings, Great Falls, and Missoula; and four Micropolitan Statistical Areas: Kalispell, Helena, Butte-Silver Bow, and Bozeman. Montana has no CSAs. The OMB revised many CBSA designations across the U.S. on July 21, 2023. That revision specifically reflected the population changes discussed above, resulting in the designation of five MSAs in Montana: Billings, Bozeman, Great Falls, Helena, and Missoula. Two of the federally designated Micro Statistical Areas in the state: Kalispell, and Butte-Silver Bow, were retained. These population-summarizing designations are used throughout this document.

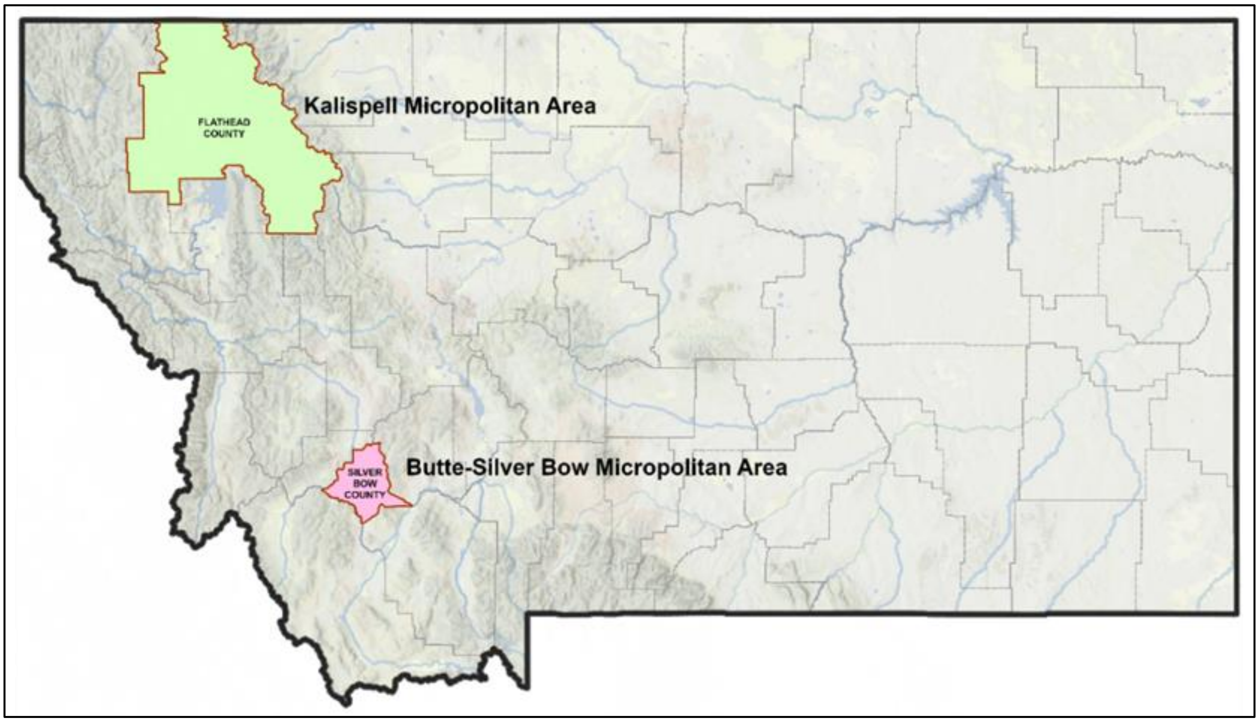
Figure III.C.13 describes the five MSAs currently designated in Montana. Figure III.C.14 describes the two Micro SAs in Montana.

Figure III.C.13, Montana Metropolitan Statistical Areas (MSAs)



Map Color Code	Name	Description	Population Estimate 2024
	Billings, MT 13740	**Metropolitan Statistical Area**	**195,248**
	Carbon County, MT	County or equivalent	11,538
	Stillwater County, MT	County or equivalent	9,249
	Yellowstone County, MT	County or equivalent	174,461
	Missoula, MT 33540	**Metropolitan Statistical Area**	**131,099**
	Mineral County, MT	County or equivalent	5,050
	Missoula County, MT	County or equivalent	126,049
	Bozeman, MT 14580	**Metropolitan Statistical Area**	**138,845**
	Gallatin County, MT	County or equivalent	138,845
	Helena, MT 25740	**Metropolitan Statistical Area**	**95,851**
	Broadwater County, MT	County or equivalent	7,331
	Jefferson County, MT	County or equivalent	13,029
	Lewis and Clark County, MT	County or equivalent	75,491
	Great Falls, MT 24500	**Metropolitan Statistical Area**	**83,380**
	Cascade County, MT	County or equivalent	83,380

Figure III.C.14, Montana Micropolitan Statistical Areas



Map Color Code	Name	Description	Population Estimate 2023
	Kalispell, MT 28060	**Micropolitan Statistical Area**	**116,783**
	Flathead County, MT	County or equivalent	116,783
	Butte-Silver Bow, MT 15580	**Micropolitan Statistical Area**	**37,016**
	Silver Bow County, MT	County or equivalent	37,016

Footnotes for the Population Section

1 **Montana: One State with Three Changing Regions**: University of Montana O'Connor Center for the Rocky Mountain West at the University of Montana https://www.umt.edu/this-is-montana/columns/stories/montana_regions_2of3.php

2 Center for International Earth Science Information Network - CIESIN - Columbia University. 2018. Gridded Population of the World, Version 4 (GPWv4): Population Density, Revision 11. Palisades, New York: NASA Socioeconomic Data and Applications Center (SEDAC)
Data from Census Bureau ESRI Maps

3 Annual Estimates of the Resident Population for the United States, Regions, States, District of Columbia, and Puerto Rico: April 1, 2020 to July 1, 2024 (NST-EST2024-POP). Source: U.S. Census Bureau, Population Division. Release Date: December 2024

4 Data from Montana Department of Commerce, PopulationProjection:https://dataportal.mt.gov/t/DOC/views/CEIC_REMI_POPULATION_PROJECTION_COUNTY_AGE_RACE_SFE/Trend?%3Aorigin=card_share_link&%3Aembed=y

5 Montana Department of Commerce Trend:https://dataportal.mt.gov/t/DOC/views/CEIC_REMI_POPULATION_PROJECTION_COUNTY_AGE_RACE_SFE/Table?%3Aorigin=card_share_link&%3Aembed=y

D. Sources of Air Pollution

Air pollutants in the ambient air originate from both human-caused (anthropogenic) and natural causes. The following sections summarize both within Montana.

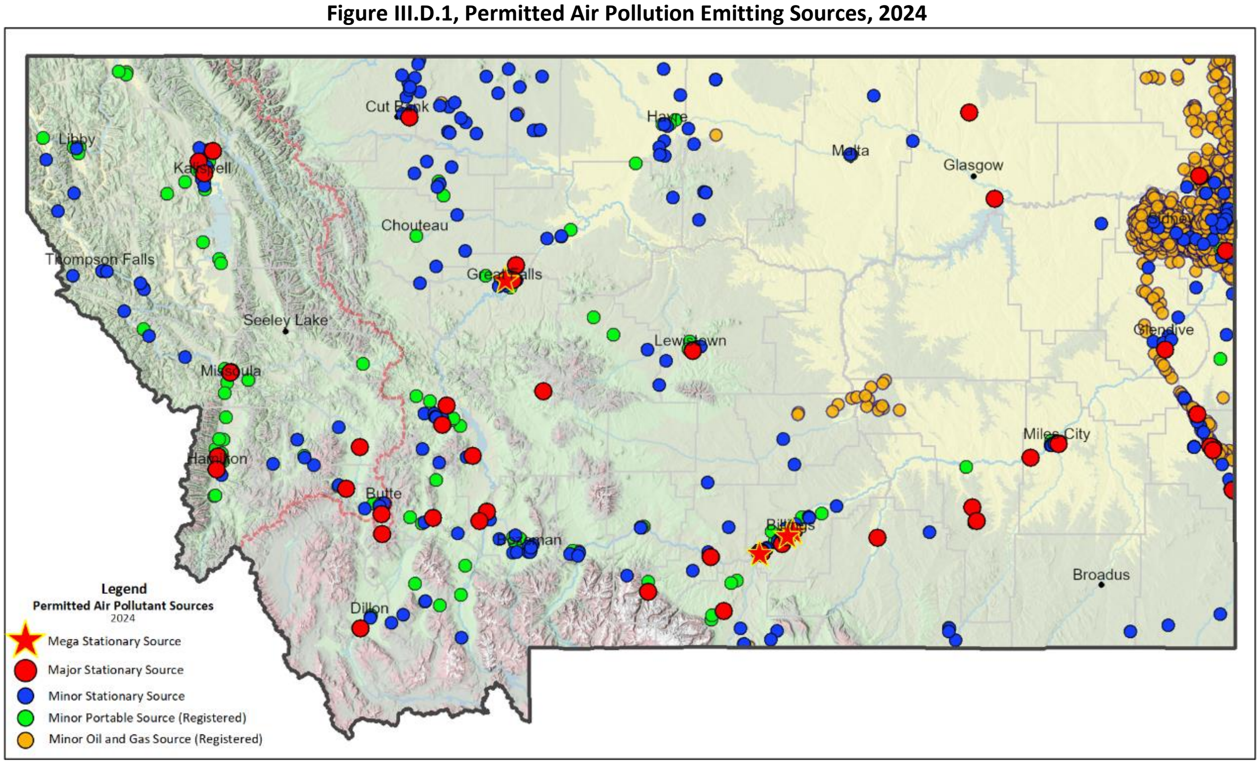
Anthropogenic Air Pollution

The two principal human-caused emissions of air pollutants into the ambient air result from industrial processes or the open burning of vegetation. These sources are discussed below.

Industrial Sources

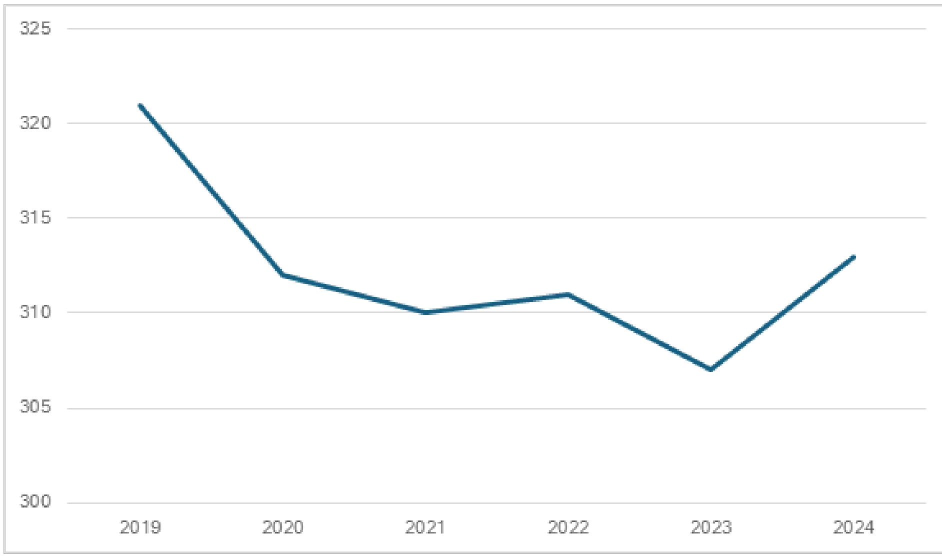
Industrial processes of various sizes and operational characteristics can generate air pollutants. The MTDEQ regulates these emissions through a permitting process that identifies and evaluates the emitting processes and ensures that the air emissions do not result in an exceedance of the NAAQS (see Section II.). The permitting process takes on different forms depending on the magnitude of the *potential* air pollutant emissions (normally higher than the *actual* emissions) from each process and facility above a protective threshold amount (see the MTDEQ Air Permitting Website). Larger facilities with higher potential emissions (generally more than 100 tons per year (tpy) of any NAAQS pollutant, more than 10 tpy of any hazardous pollutant, or more than 25 tpy of all combined hazardous pollutants) are regulated as *major* sources. Large, complex major sources that include multiple emitting units are classified as *mega* sources. Facilities that have the potential to emit (PTE) less than 100 tpy but more than 25 tpy (or > 5 tpy of lead, or are an incinerator) are classified as *minor* sources. The permitting and emission-limiting process takes on different forms depending on the type of facility and whether the equipment is stationary or may be moved around to different job sites. Figure III.D.1 represents the types and numbers of permitted industrial sources in Montana through 2024.

Figure III.D.1, Permitted Air Pollution Emitting Sources, 2024



Over the five years from 2019 through 2023 the number of permitted stationary sources in Montana declined, but then increased slightly in 2024. Figure III.D.2 displays this trend graphically.

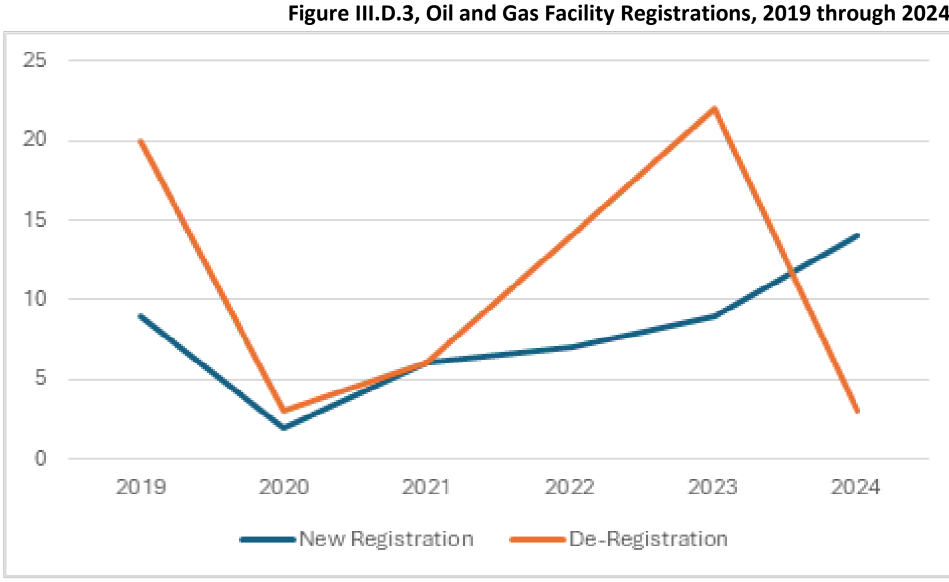
Figure III.D.2, Permitted Air Pollution Emitting Sites, 2019 through 2024



Year	Permitted Sites
2019	321
2020	312
2021	310
2022	311
2023	307
2024	313

Figure III.D.3 represents the numbers of new oil and gas facility registrations/de-registrations from 2019 through 2024 and the net impact of that activity on the total of regulated sources. Overall, the net total number of registered oil and gas facilities has remained relatively consistent within this period.

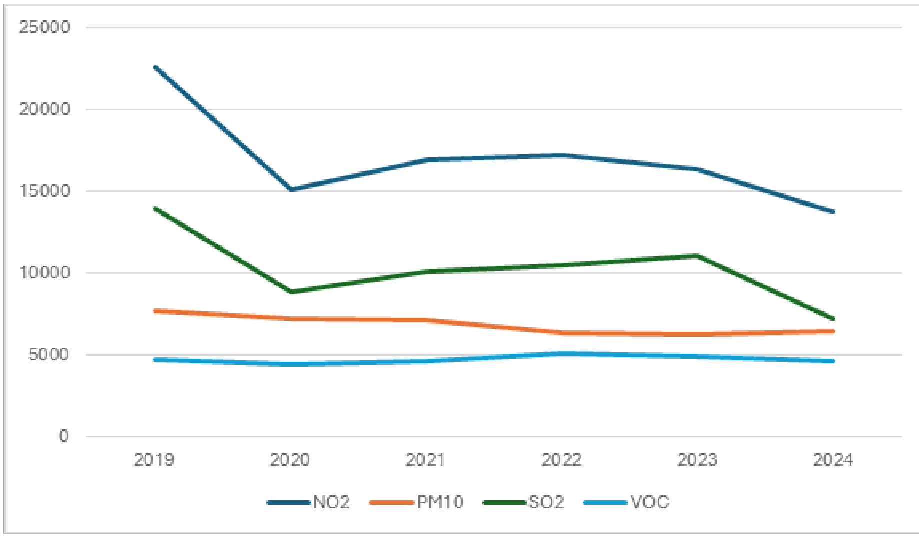
Figure III.D.3, Oil and Gas Facility Registrations, 2019 through 2024.



Year	New Reg.	De-Reg.	Net Change	Total Sites
2019	9	20	-11	1,167
2020	2	3	-1	1,166
2021	6	6	0	1,166
2022	7	14	-7	1,159
2023	9	22	-13	1,146
2024	14	3	11	1,157

On an annual basis, the MTDEQ Air Quality Bureau (AQB) collects air pollution emission data from stationary permitted sources and registered oil and gas sources for four pollutants. Figure III.D.4 graphically represents the overall emission trends of those pollutants during the period from 2019 through 2024. Emissions dropped off sharply in the 2019-2020 year, then essentially leveled out in the subsequent years.

Figure III.D.4, Total Reported Air Pollution Emissions in Tons, 2019 through 2024.

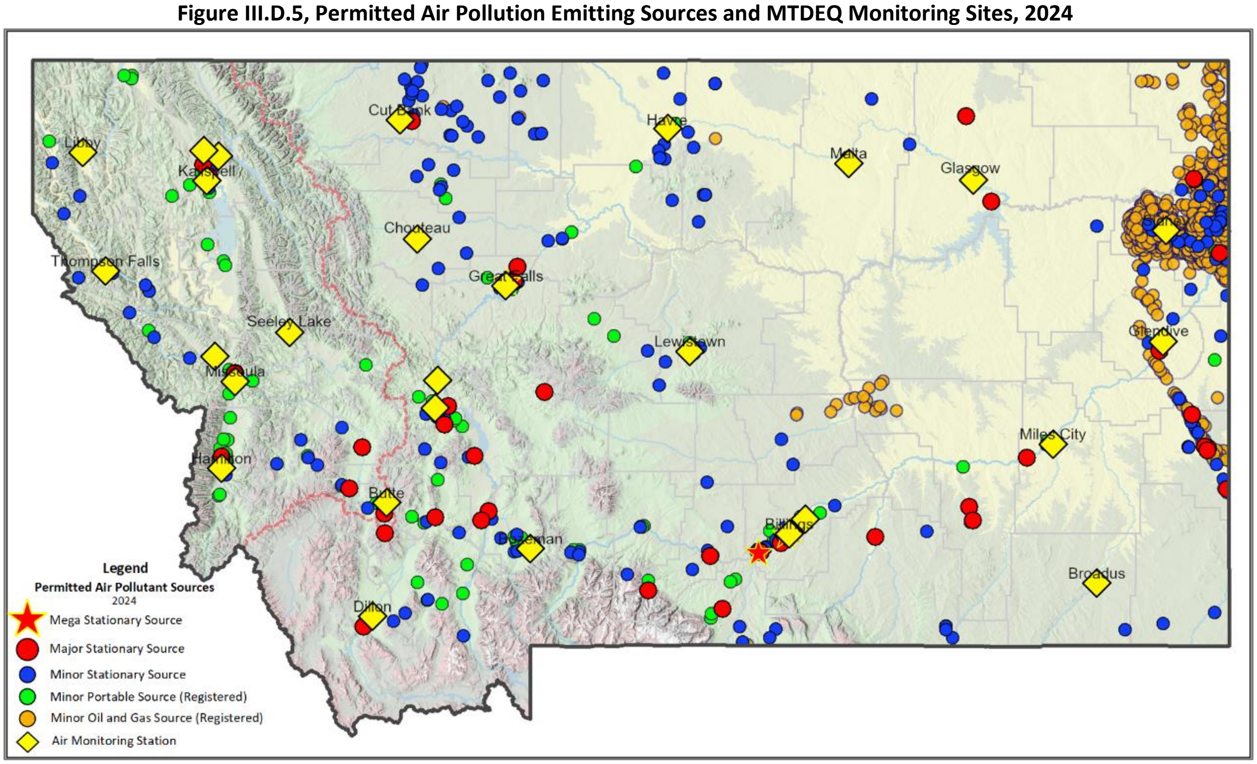


Year	NO_2	PM_{10}	SO_2	VOC
2019	22,576	7,675	13,926	4,719
2020	15,123	7,198	8,857	4,451
2021	16,944	7,152	10,145	4,465
2022	17,227	6,379	10,474	5,144
2023	16,341	6,282	11,062	4,921
2024	13,784	6,429	7,262	4,608

Total emissions trends showed an overall decrease in 2020, which reflects the trends in source numbers over the same period. Since that time, total emissions have remained constant.

Figure III.D.5 correlates the statewide industrial emission sources with MTDEQ's ambient air monitoring network.

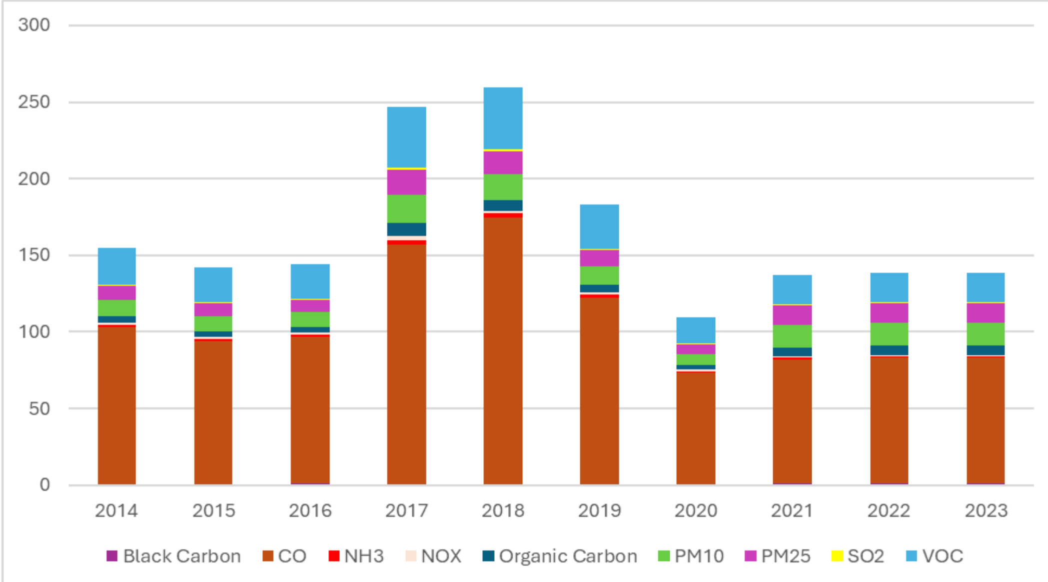
Figure III.D.5, Permitted Air Pollution Emitting Sources and MTDEQ Monitoring Sites, 2024



Open Burning Sources

Air pollutant emissions also result from the intentional combustion of wood products and other vegetation. MTDEQ regulates these activities through an Open Burning program, often in collaboration with various counties in Montana. A distinction is made between small, local (minor) burners wishing to reduce waste vegetation, and large corporate or government (major) burners who conduct extensive burning to enhance the health of forests and grasslands. Figure III.D.6 displays estimated air pollutant emissions from major burners for the period 1990 through 2023.

Figure III.D.6, Estimated Major Burner Air Pollution Emissions in Thousands of Tons, 2014-2023

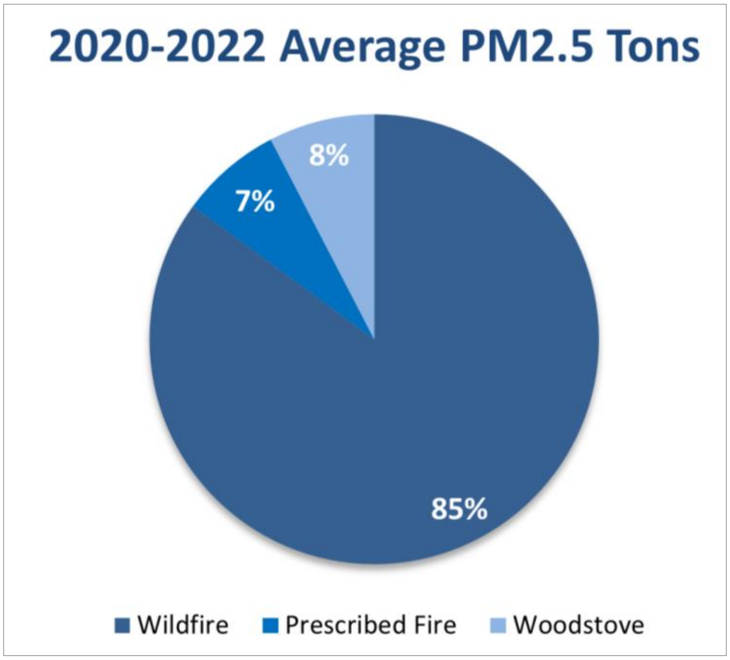


Naturally Caused Air Pollution - Wildfires

Wildfires are a naturally occurring component of the lifecycle of forest and grassland ecosystems and have always impacted Montana. However, wildfires, particularly throughout the western regions of the North American continent, are increasing in number, size and intensity. Montana is negatively impacted by the harmful components in smoke resulting from wildfires within the state and, as introduced in Section III.B. above, by the smoke from fires in California, Oregon, Washington, Idaho, the Provinces of Canada, and the desert southwest. Therefore, wildfire smoke is Montana's greatest air pollution challenge, and as a result, the largest focus of MTDEQ's air monitoring efforts.

Wildfire smoke generated from within Montana's state borders and advected into the state from other areas dwarfs all other natural, industrial and anthropogenic sources of ambient pollution. Of all smoke-derived $PM_{2.5}$ emitted from within the state's borders, wildfire smoke accounts for about 85% of the total according to averages calculated for fire seasons 2020-2022 (Figure III.D.7). For this timeframe, an average of ~121,000 tons per year of $PM_{2.5}$ was generated from wildfires, compared to ~10,000 tons per year of $PM_{2.5}$ from prescribed burning and ~10,000 tons per year from woodstoves. In other words, $PM_{2.5}$ contributions from in-state wildfires are about twelve times the contribution of $PM_{2.5}$ generated from either prescribed burning or woodstoves. For comparison, all industrial $PM_{2.5}$ emissions in the state total approximately 9,600 tons of $PM_{2.5}$ annually. So, the contribution of wildfire smoke is estimated to be over twelve times the contribution from all Montana's industrial sources.

Figure III.D.7, Smoke-derived $PM_{2.5}$ Emissions Breakdown by Smoke Type



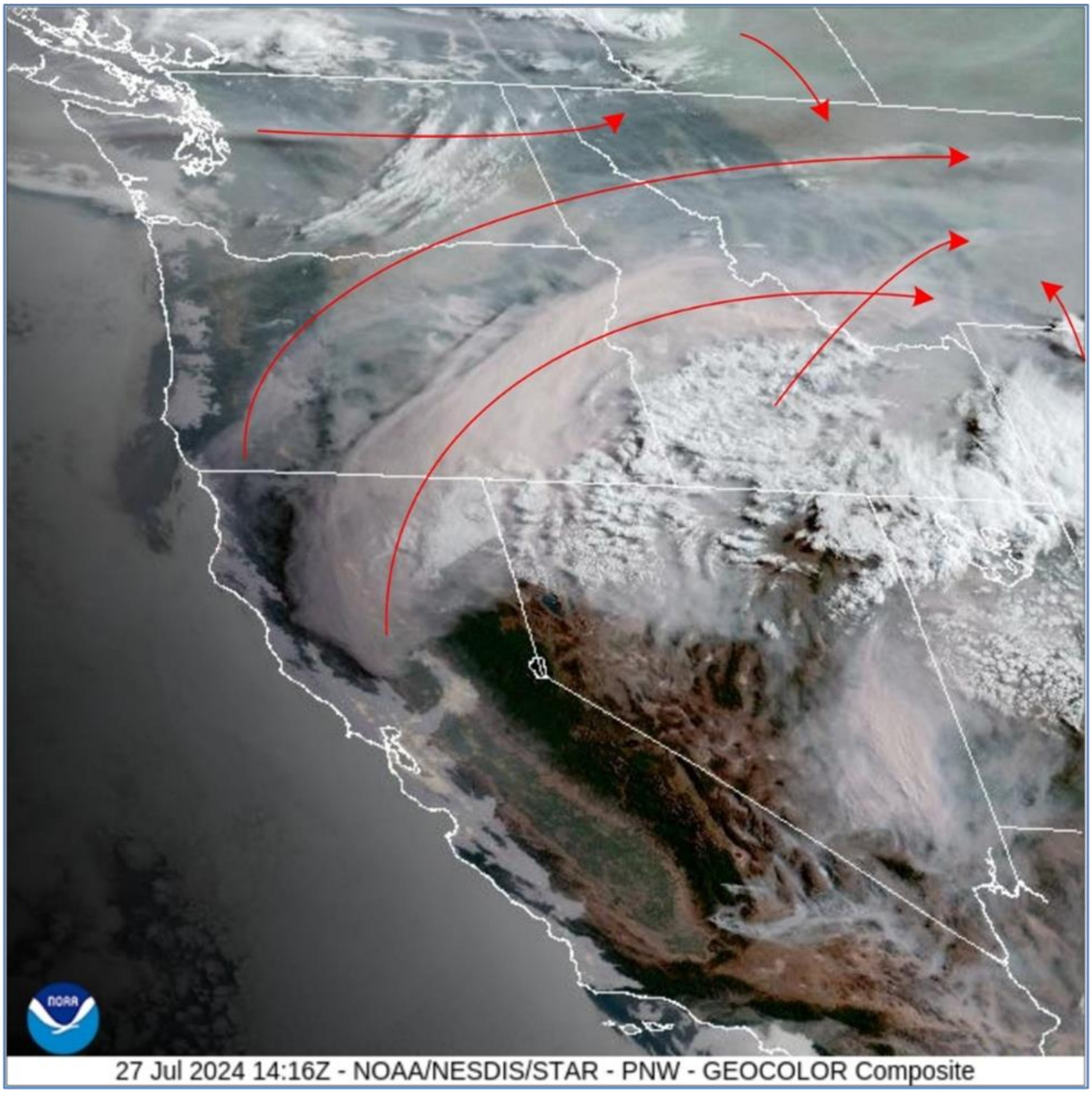
MTDEQ has documented a moderately increasing, but also highly variable, trend in monitor design values over the last decade, which is largely attributable to the growing impact of wildfires in the Western U.S. and Canada. The main criteria pollutants of concern in wildfire smoke are PM, CO, and O_3. When considering overall health impacts, exposure to fine particles ($PM_{2.5}$) from wildfire smoke is the principal public health threat compared to the other pollutants. For this reason, and because we have no control over wildfire smoke emissions, MTDEQ has pursued the creation of a $PM_{2.5}$-focused ambient monitoring and sensor network to provide the best possible near real-time data to inform personal health and safety decisions of Montanans with respect to wildfire smoke exposure.

Montanans in every corner of the state are subjected to unhealthy levels of wildfire smoke on a regular basis. The large size, diverse geography and topography of Montana means that its residents in different regions experience vastly different air quality conditions on a day-by-day, or even hour-by-hour, basis. The landscape of the western third of the state is characterized by rugged, forested mountainous terrain punctuated by narrow valleys. The eastern two thirds of the state is dominated by semi-arid rolling prairies and, while mountains aren't entirely absent, there is notably less severe vertical relief as compared to the western part of the state. Historically, the greatest in-state smoke impacts from wildfire smoke are experienced by residents on the western side of the state, where large wildfires tend to set up and where smoke can become trapped in tight mountain valleys.

Residents in the eastern portion of the state are also subjected to wildfire smoke every year. During active wildfire seasons in Canada, as observed during the summer fire seasons of 2023 and 2024, the eastern side of the state may sporadically be subjected to the highest $PM_{2.5}$ levels in the state brought in on low pressure systems from Canada. In-state fires burning in the eastern portion of the state tend to have less dense fuels dominated by grasses and sage brush compared to the heavily forested western portion of the state. These fires often occur on rural grasslands that normally pose no threat to communities or structures but can grow to large size and may be targeted with fewer resources than fires in western Montana. This can lead to longer burn and smoke emission timelines for smoldering grassfires.

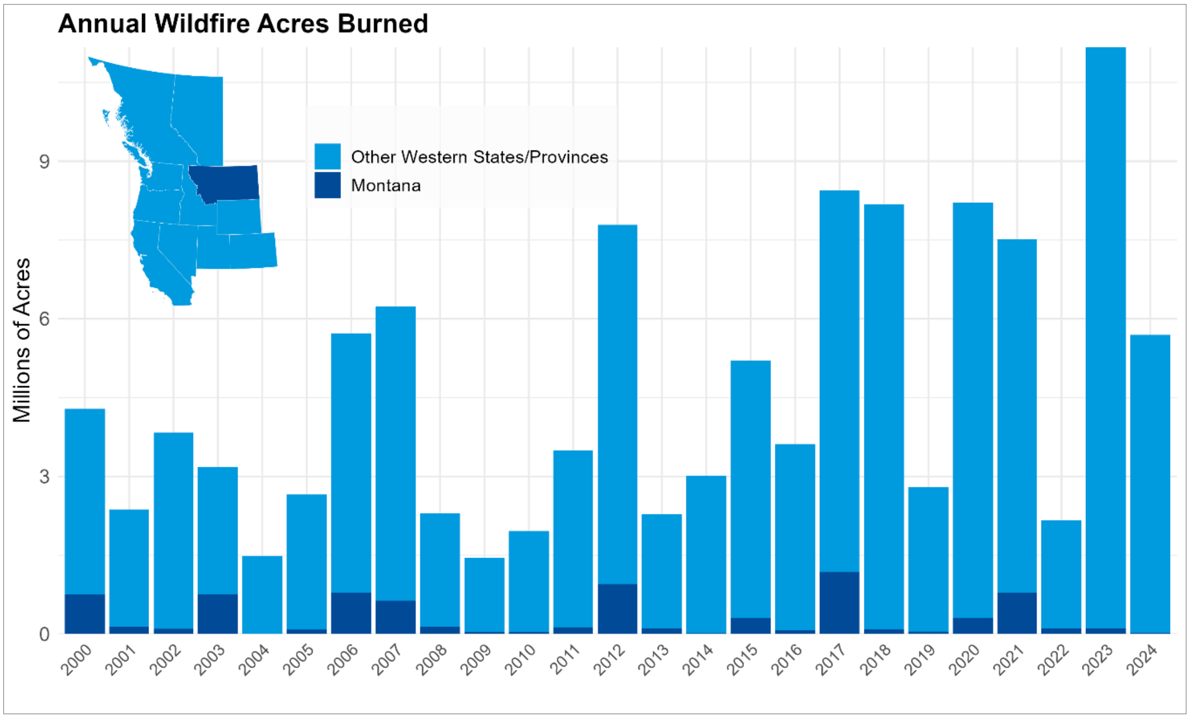
Smoke that is transported over long-distances from surrounding states and provinces significantly impacts air quality for all Montanans as well. Prevailing winds and weather patterns generally move west to east over Montana; however, complex meso- and synoptic-scale weather patterns also deliver wildfire smoke of both southerly and/or northerly origin. Canadian smoke is most often transported from the north into Montana on low pressure systems that originate in the Gulf of Alaska, known as "Aleutian Lows". Weather patterns dominated by high pressure ridges over Montana favor southwesterly winds that transport wildfire smoke in from states south and west of Montana. For example, satellite imagery from July 2024 (Figure III.D.8), illustrates simultaneous long-distance wildfire smoke transport from fires in Washington, Oregon and California, and the convergence of smoke from western Canada.

Figure III.D.8, Satellite imagery from July 2024. Smoke advection into Montana from multiple sources in the Western U.S. and Canada.



Examples such as this underscore the difficulty and impracticality of identifying discrete wildfire smoke sources and events that result in $PM_{2.5}$ concentrations at specific monitors. This is due to large-scale transport and coalescence of smoke plumes often originating from multiple states and provinces. A single wildfire smoke "event" in Montana can last for days to weeks, and the primary source of wildfire smoke during prolonged events is often dynamic due to natural shifts in atmospheric transport and the ever-changing nature of wildfire smoke origin and fire activity. Even if Montana has a relatively inactive fire season, smoke transport from outside the state's borders can still make for an unusually bad smoke-impact year in Montana. The following plot (Figure III.D.9), depicts the annual number of acres burned by wildfire for the Western U.S. and Canada versus Montana for the last twenty-four years. This figure demonstrates the high variability in acres burned year to year and shows that a low fire year in Montana does not necessarily correspond to a good year for the entire region that contributes to Montana's air quality.

Figure III.D.9, Satellite imagery from July 2024, shows smoke advection into Montana from multiple sources in the Western U.S. and Canada.



While smoke transport and mixing makes it more difficult to parse and flag exceptional events, measured concentrations of individual pollutants at each monitoring station reflect the actual total concentration of each criteria pollutant. Hence, regardless of the smoke source(s), the measured concentrations accurately reflect public exposure for each pollutant and location.

Resources for the Naturally Caused Air Pollution Section

National Interagency Fire Center, https://www.nifc.gov/fire-information/statistics

EPA Emissions Inventories, https://www.epa.gov/air-emissions-inventories

Pie chart: $PM_{2.5}$ data is from Montana's National Emissions Inventory and the Emissions Modeling Platform

IV. MTDEQ Regulatory Air Monitoring Network

A. Background and Scope

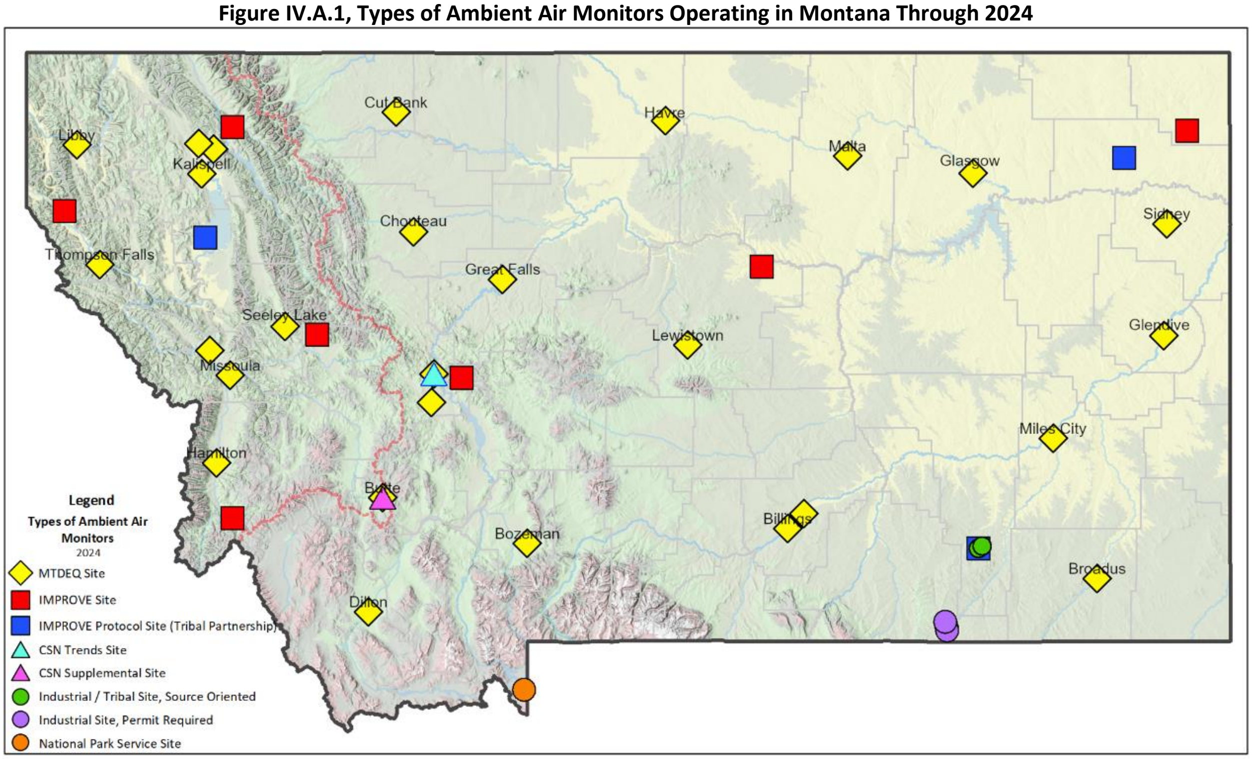
An abundance of ambient air monitoring has been conducted across the state of Montana since measurement technology was developed and made available for field use. The monitoring was conducted by a variety of entities for an array of purposes on a decades-long timescale. Previous versions of the MTDEQ 5-Year Network Assessment summarize a great deal of that history. These documents are available for review on the [MTDEQ Web Page]

At present, five types of ambient air monitors are being operated across Montana as summarized in the following paragraphs and graphically presented in Figure IV.A.1. The five types of monitors are all operated to assess compliance with NAAQS or NAAQS-related limits.

1. **MTDEQ Regulatory Air Monitoring Network.** These monitors are established to fulfill all three objectives discussed in the introduction to this document. Specifically, though, they are established and operated according to federal design criteria for monitors intended to demonstrate compliance with the NAAQS.

2. **Chemical Speciation Network (CSN) monitors**. These monitors are established as part of a nationwide effort to measure and understand the chemical makeup of $PM_{2.5}$ (see section IV.B). MTDEQ operates these monitors, but the chemical analysis and reporting of results is conducted by the CSN laboratories.

Figure IV.A.1, Types of Ambient Air Monitors Operating in Montana Through 2024



3. **IMPROVE Network monitors.** The third type of monitoring is a network of monitors operated to assess air visibility impacts to pristine/protected areas such as national parks and wilderness areas designated as "Class 1" areas. These monitors are associated with the IMPROVE Network (Interagency Monitoring of Protected Visual Environments). IMPROVE "is a cooperative measurement effort managed by a Steering Committee that consists of representatives from

EPA, NPS, USFS, FWS, BLM, NOAA, four organizations representing state air quality organizations (NACAA, WESTAR, NESCAUM, and MARAMA), and three Associate Members: AZ DEQ, Env. Canada, and the South Korea Ministry of Environment" (see the IMPROVE website: [IMPROVE Website](#)). Of the ten IMPROVE monitors in Montana, three are operated as "Protocol" or partnership monitors operated in connection with organizations in addition to those listed above, in this case several tribal entities.

4. **Industrial monitors.** Eight monitors are currently operating in Montana by corporate and tribal entities to measure the ambient air quality impacts of industrial facilities. This monitoring is conducted in accordance with air permit activities, programs, and related agreements. It must be noted that this category/number does NOT include rule-required fence line monitors at Montana's petroleum refineries.

5. **National Park Service (NPS) monitor**. This is a single monitoring site operated by the NPS at the west gate to Yellowstone National Park. This monitor provides particulate exposure data to the public in association with MTDEQ, but also assesses the air quality impacts of gaseous pollutants from motor vehicles entering and leaving the park.

Increasingly, an additional air pollutant measurement technology is providing significant value in the objective to provide community- and local-scale pollutant data to the public. These devices, referred to as "air sensors," are typically small and of low cost, enabling their use in large numbers and many locations. MTDEQ's air sensor network is described in Section V.

Scope

The intent and objectives of this Assessment and Plan are laid out in the Introduction and Background sections of this document. Within that context only the first type of monitoring listed in the preceding paragraphs, the MTDEQ Regulatory Air Monitoring Network, will be reviewed and discussed in this section as directed by 40 CFR Part 58. The following sub-sections summarize the ambient air monitoring requirements for each criteria air pollutant and explain MTDEQ's implementation of those requirements through calendar year 2024. Proposed changes to the monitoring network are described by pollutant then summarized together in Section IV.C of this document.

B. Network Design and Results

O_3 Monitoring

Required O_3 Monitoring

The minimum number of ozone (O_3) monitors required in a network is defined by the federal Design Criteria found in Section 4.1 of Appendix D to 40 CFR Part 58. Table IV.B.1 summarizes those requirements.

Table IV.B.1. - Minimum O_3 Monitoring Requirements (1)

Metropolitan Statistical Area (MSA) population (2)(3)	Number of Monitors per MSA	
	Most recent 3-year design value concentrations ≥ 85 percent (%) of any O_3 NAAQS (4)	Most recent 3-year design value concentrations < 85% of any O_3 NAAQS (4,5)
>10 million	4	2
4 – 10 million	3	1
350,000 – <4 million	2	1
50,000 – <350,000(6)	1	0

(1) From Table D-2 of Appendix D to 40 CFR Part 58.
(2) Minimum monitoring requirements apply to Metropolitan Statistical Areas (MSAs).
(3) Population based on latest available census figures.
(4) O_3 NAAQS levels and forms are defined in 40 CFR Part 50.
(5) These minimum monitoring requirements apply in the absence of a design value.
(6) An MSA must contain an urbanized area of 50,000 or more people.

As described in Section II.C to this Plan, Montana had three designated MSAs through most of 2023, and all three of those MSAs fell within the 50,000 to 350,000 population range listed in Table IV.A.1. through 2024. In the Billings MSA, MTDEQ conducted O_3 monitoring from 2005 to 2007 (station number 30-111-0086). Because the resulting 8-hour O_3 design value was less than 85% of the primary and secondary NAAQS, the monitoring was discontinued. However, because Billings remains Montana's largest metropolitan area and continues to grow in population, MTDEQ re-initiated O_3 monitoring in the Billings area, as approved by EPA in the MTDEQ 2022 Network Plan. This monitor began reporting to the EPA Air Quality System (AQS) database on January 1, 2024, and operated throughout 2024.

In the Missoula MSA, O_3 monitoring has been conducted continuously since June 1, 2010, and continued throughout 2024.

In the Great Falls MSA, historical monitoring data, meteorological patterns including consistently windy conditions, and professional judgment indicate that O_3 monitoring in this MSA is not warranted given the low O_3 levels monitored in the two larger MSAs. In addition, the population of Great Falls is declining and has been surpassed by other communities in Montana. Thus, MTDEQ resources for O_3 monitoring in the state were focused elsewhere through 2024.

On July 21, 2023, the OMB added two new MSAs in Montana, the Bozeman and Helena MSAs, both of which also fall within the 50,000 to 350,000 population range listed in Table IV.A.1. O_3 has been monitored within the Helena MSA at Montana's NCore site since January 1, 2011. However, no O_3 monitoring has been conducted within the Bozeman MSA to determine whether design value concentrations exceed or are less than 85% of the NAAQS. Therefore, in its 2024 Annual Monitoring Network Plan (AMNP) MTDEQ proposed the addition of O_3 monitoring in Bozeman. EPA approved this proposal on September 3, 2024. The proposed location of the monitor was to be at the existing $PM_{2.5}$ site, but this location proved unsuitable for this application. Therefore, MTDEQ has engaged in a search for a suitable location for installation of a monitoring shelter for this and additional air pollutant monitoring.

Additional O_3 Monitoring

Beyond the required monitoring efforts related to MSAs, MTDEQ has endeavored to define and track background levels of O_3 across Montana and to evaluate air quality impacts from petroleum exploration and production within the eastern portion of the state. To assess these data needs O_3 monitoring was conducted through 2024 at the additional sites listed in Table IV.B.2.

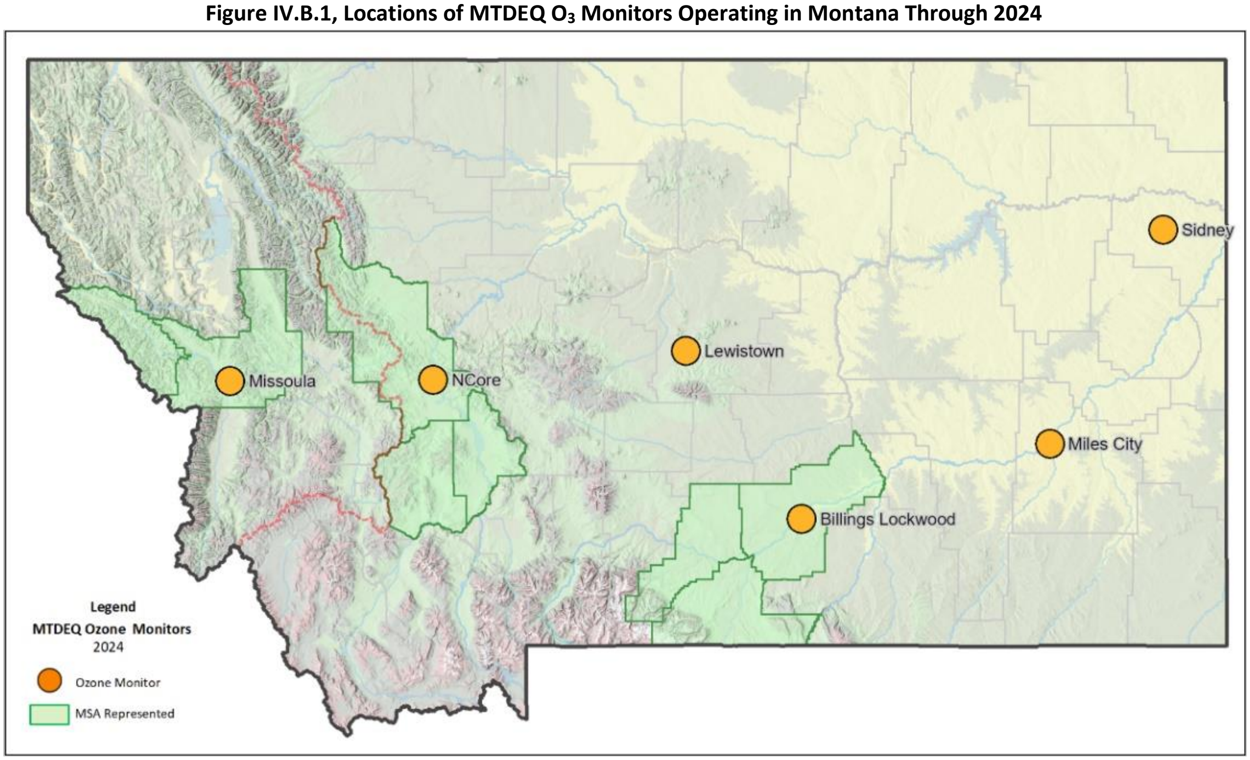
Table IV.B.2 – Montana MTDEQ 2024 O_3 Monitoring Sites

Station	AQS Code
Lewistown	30-027-0006
Miles City	30-017-0005
Sidney	30-083-0002

Note that as proposed in the 2024 AMNP, and subsequently approved by EPA, MTDEQ ended O_3 monitoring in Malta (30-071-0010) and Broadus (30-075-0001) on December 31, 2023.

Figure IV.B.1 displays the locations of all MTDEQ O_3 monitoring sites that operated in 2024. Appendix A provides a table listing their physical addresses and GPS locations.

Figure IV.B.1, Locations of MTDEQ O_3 Monitors Operating in Montana Through 2024



O_3 Monitoring Results

Table IV.B.3 summarizes the 8-hour rolling average O_3 values measured at the monitoring sites operated by MTDEQ during the federally designated 2024 ozone season (April through September for Montana). Table IV.B.4 summarizes the 8-hour O_3 values measured at monitoring sites operated by MTDEQ during the entire 2024 calendar year.

Table IV.B.3 – 8-Hour Rolling Monitored O_3 Values for the 2024 Ozone Season [1]

Station	Concentrations (ppm)			NAAQS Design Values (ppm) [2]		NAAQS (ppm)
	Minimum	Maximum	Average	2024 [3]	2022 – 2024	
Billings-Lockwood [4]	0.001	0.072	0.0467	0.069	-- [4]	
Missoula	0.001	0.060	0.0406	0.057	0.056	**0.070**
NCore [5]	0.008	0.074	0.0482	0.067	0.061	
Lewistown	0.008	0.066	0.0449	0.059	0.058	85% = 0.0595
Miles City	0.002	0.060	0.0432	0.057	0.058	
Sidney	0.011	0.059	0.0446	0.056	0.058	

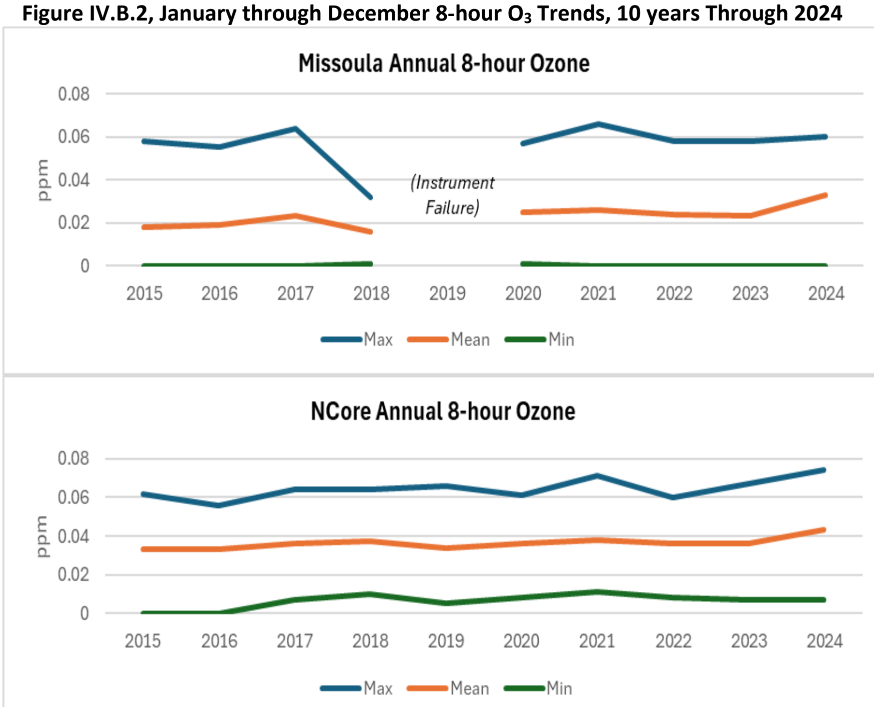
[1] Ozone Monitoring Season for Montana is April through September as established under 40 CFR Part 58, Table D-3.
[2] Design Values calculated by the US EPA Air Quality System (AQS) database.
[3] The 2024 design value is the 4th-high max value for the year.
[4] The Billings-Lockwood monitoring station began reporting data to AQS as of January 1, 2024. Therefore, a complete 3-year design value is not yet available.
[5] By rule O_3 monitoring at NCore must be conducted year-round. Therefore, design values are calculated by EPA on that basis, not on ozone season.

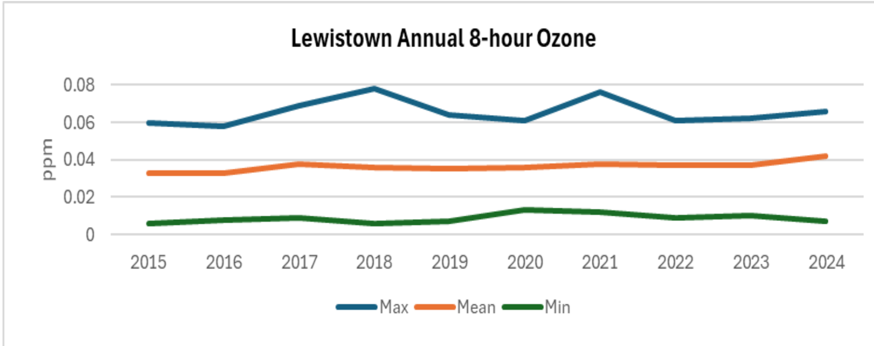
Table IV.B.4 – 8-Hour Rolling Monitored O_3 2024 Annual Values

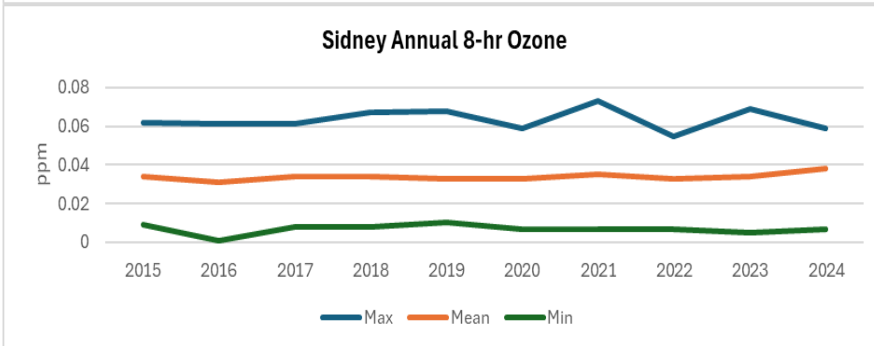
Station	Concentrations (ppm)		
	Minimum	Maximum	Average
Billings-Lockwood	0.000	0.072	0.0381
Missoula	0.000	0.060	0.0326
NCore	0.007	0.074	0.0432
Lewistown	0.007	0.066	0.0422
Miles City	0.000	0.060	0.0376
Sidney	0.007	0.059	0.0383

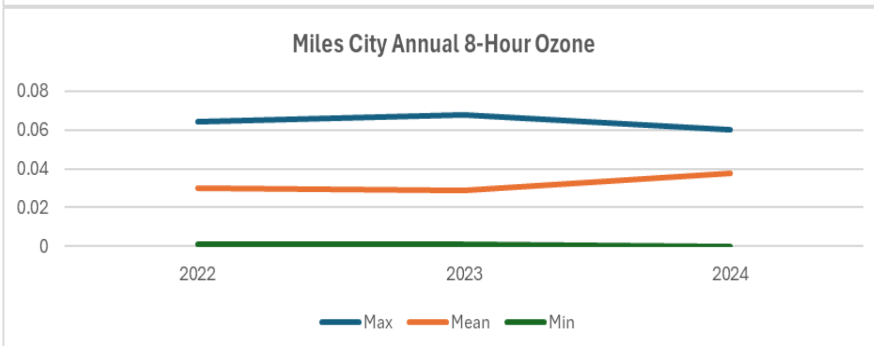
Figure IV.B.2 includes graphs of ten-year tends of annual maximum, mean, and minimum 8-hour average O_3 values at four monitoring stations spaced west to east across Montana; as well as a similar representation of 8-hour O_3 monitoring results at Miles City for the three years it has been operating.

Figure IV.B.2, January through December 8-hour O_3 Trends, 10 years Through 2024









The O_3 data summaries provided above in both tabular and graphic forms demonstrate that relatively minor variability continues to be observed in the monitored ambient O_3 concentrations across the state. This is particularly interesting given the spatial breadth, the significant topographic variability, and the population diversity of the sites. The six monitoring sites are established in very diverse locations including large-population communities, small towns, a rural oilfield, and a pristine background location adjacent to a federal wilderness area. This siting diversity indicates that monitored O_3 concentrations in the ambient air across Montana represent general background levels produced principally from natural sources, stratospheric intrusion, or transported in from sources outside the state, with little anthropogenic source input from within Montana. With only one year of monitoring in Billings, the largest population center and the industrial center of Montana, it is too soon to tell if measured O_3 concentrations there will reflect that trend. In addition, increasing numbers, duration, and severity of wildfires both inside and outside state boundaries appear to be episodically impacting measured O_3 concentrations across the state. MTDEQ has observed a positive correlation between wildfire smoke and ozone concentrations.

Changes to O_3 Monitoring

As stated in Section II.C, the overall population of Montana is increasing. The most notable experienced and projected population growth is in the Bozeman MSA. As noted above, in its 2024 AMNP MTDEQ proposed, and EPA approved, the addition of O_3 monitoring in Bozeman to evaluate the air quality impacts of this population growth, and to determine if long-term monitoring will be required. MTDEQ is engaging in a search for a suitable location for installation of a monitoring shelter for this and additional air pollutant monitoring in that community (see Section IV.C, NO_2, and $PM_{2.5}$).

At the same time, existing O_3 monitors in Sidney and Miles City have produced a body of data that demonstrates consistent background concentrations well below the O_3 NAAQS. Those monitors were established to evaluate ambient air quality impacts from oil well development and potential coal bed methane development, respectively, and to define regional pollutant concentrations. The monitors have fulfilled their intended investigatory purposes and there is no substantial air quality benefit to be gained by their continued operation. Montana's modest monitoring resources can be better invested elsewhere. Therefore, MTDEQ is proposing to end O_3 monitoring at Sidney and Miles City. With the closure of these sites, equipment and personnel resources associated with their operation can be shifted to the new Bozeman site and the rest of the existing, aging, O_3 monitoring network.

O_3 Related PAMS Monitoring

The monitoring directives in 40 CFR 58 Appendix D, Section 5 contain specific requirements for the operation of Photochemical Assessment Monitoring Stations (PAMS) for ozone precursor monitoring at NCore sites located in CBSAs with a population of one million or more people. In addition, the CFR requirements call for each state with O_3 nonattainment areas classified as moderate or above and states in the Ozone Transport Region to develop and implement an Enhanced Monitoring Plan (EMP) for O_3. Montana does not meet any of the aforementioned criteria, therefore neither PAMS monitoring nor an EMP is required within the state. No PAMS monitoring is conducted in the MTDEQ network.

CO Monitoring

Required CO Monitoring

As detailed in 40 CFR 58 Appendix D Section 4.2, the requirements for CO monitoring sites are closely related to the requirements for near-road NO_2 monitoring sites (see Section IV.C. of this Plan). Table IV.B.5 summarizes the number of required CO monitoring sites in a monitoring network.

Table IV.B.5 – Minimum CO Monitoring Requirements [1]

Criteria [2]	Number of Near-Road CO Monitors Required
CBSA Population ≥ 1,000,000	One, collocated with an NO_2 monitor or in an alternative location approved by the EPA Regional Administrator.

(1) From Appendix D to 40 CFR Part 58, Sec 4.2.1.
(2) CBSA populations must be based on latest available census figures.

As documented in Section III.C, no Montana CBSAs meet the criteria listed in Table IV.B.5, and no CO monitors are required in Montana on this basis.

Historically, MTDEQ and local county air programs have conducted CO monitoring in various larger communities in the state where motor vehicle emissions had caused ambient air concerns. However, because of improved urban traffic patterns and the gradual upgrade of Montana's vehicle fleet to newer, cleaner-burning engines, monitored CO concentrations in Montana's ambient air were reduced and remain extremely low. As a result, with EPA approval, MTDEQ discontinued its last traffic-related CO monitor in 2011, and no further community CO monitoring is being conducted.

MTDEQ continues to operate one trace-level CO monitor at the NCore station north of Helena to track background concentrations of this pollutant over time. This Plan describes NCore monitoring requirements and efforts in a subsequent section. Table IV.B.6 summarizes the CO values measured at the NCore monitoring site during 2024.

Table IV.B.6 –Monitored CO Values for 2024 at NCore

Station	Concentrations (ppm)			NAAQS
	Min	Max	Average	
NCore 1-hour averages	0.0	0.455	0.132	35
NCore 8-hour averages	0.0	0.416	0.137	9

Changes to CO Monitoring

No modifications to MTDEQ's CO monitoring network are proposed for 2024.

NO_2 Monitoring

Required NO_2 Monitoring

The minimum number of NO_2 monitoring sites required by 40 CFR 58 Appendix D Section 4.3 is summarized in Table IV.B.7.

Table IV.B.7 – Minimum NO_2 Monitoring Requirements

Requirement Type	Criteria [1]	Minimum NO_2 Monitors Required
Near Road Monitors [2]	CBSA Population ≥ 1 million	1, for hourly maximum concentrations
	CBSA Population ≥ 2.5 million	1, plus the station above for a total of 2
	CBSA Population ≥ 1 million and with 1 or more roadway segments with annual average daily traffic counts (AADT) ≥250,000	2, as in the description above
Area-Wide Monitoring [3]	CBSA Population ≥ 1 million	1, for expected highest area concentration
Protection of Susceptible and Vulnerable Populations [4]	Any area inside or outside CBSAs, nation wide	As Required by EPA Regional Administrator.
Areas not required to have a monitor, where NO_2 concs. may be approaching or exceeding the NAAQS [5]	Any area inside or outside CBSAs, nation wide	As Required by EPA Regional Administrator.

[1] CBSA populations must be based on the latest available census figures.
[2] 40 CFR Part 58, Appendix D Sec 4.3.2.
[3] 40 CFR Part 58, Appendix D Sec 4.3.3.
[4] 40 CFR Part 58, Appendix D Sec 4.3.4(a).
[5] 40 CFR Part 58, Appendix D Sec 4.3.4(b).

As presented in Section II.C, no Montana communities meet any of the population criteria listed in Table IV.C.1, and no NO_2 monitoring has been required of MTDEQ by the Regional EPA Administrator; therefore, no ambient NO_2 monitors are currently required in Montana.

Additional NO_2 Monitoring

In an effort to determine NO_2 background concentrations, potential air quality impacts associated with the oil and gas industry in the eastern part of the state, and impacts of nitrogen oxides on ambient ozone concentrations, MTDEQ conducted NO_2 monitoring through 2024 at the sites listed in Table IV.B.8.

Table IV.B.8 – Montana MTDEQ 2024 NO_2 Monitoring Sites

Station Name	AQS Code
Billings-Lockwood	30-111-0087
Lewistown	30-027-0006
Miles City	30-017-0005
Sidney	30-083-0002

Note that as proposed in the 2024 AMNP, and subsequently approved by EPA, MTDEQ ended NO_2 monitoring in Malta (30-071-0010) and Broadus (30-075-0001) on December 31, 2023.

Figure IV.B.3 displays the locations of all the MTDEQ NO_2 monitoring sites that operated in 2024. Appendix A provides a table listing their physical addresses and GPS locations.

Figure IV.B.3, Locations of MTDEQ NO_2 Monitors Operating in Montana Through 2024

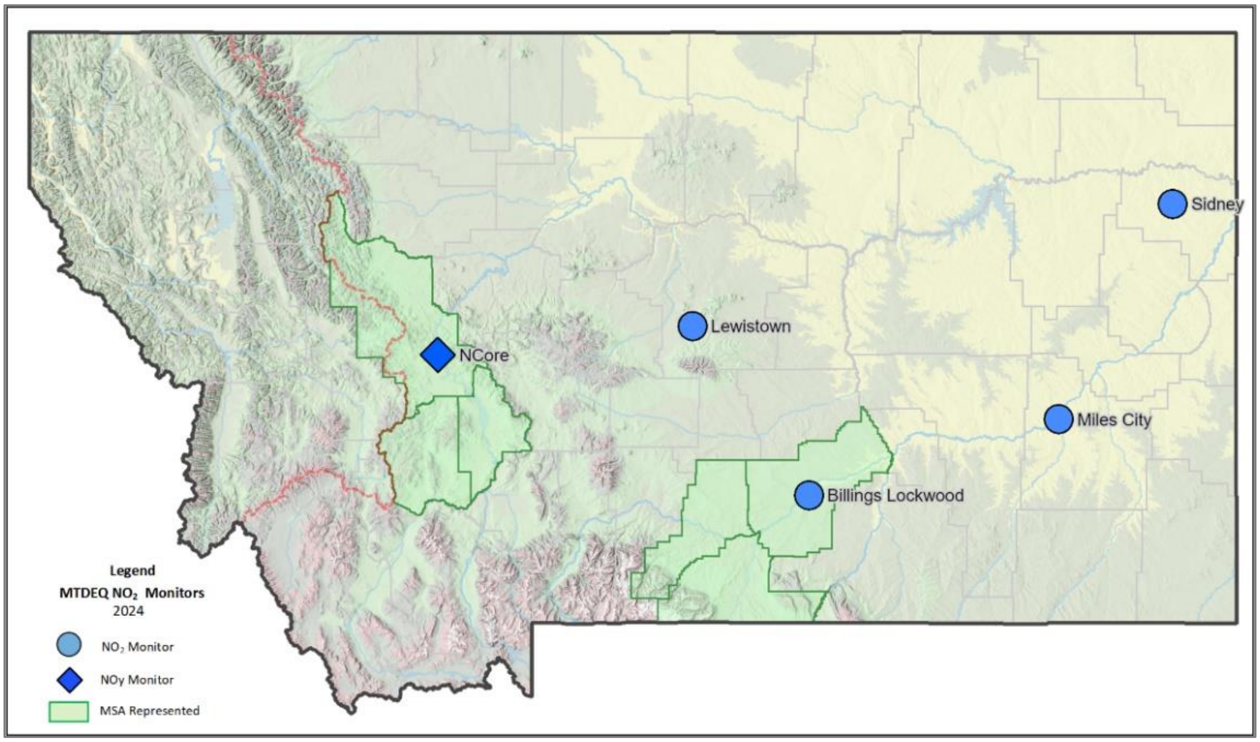


Table IV.B.9 summarizes the 1-hour NO_2 values measured at monitoring sites operated by MTDEQ during 2024.

Table IV.B.9 – 1-Hour Monitored NO_2 Values for 2024

Site	Concentrations (ppb)			NAAQS Design Values (ppb) (1)		NAAQS
	Min	Max	Average	2024(2)	2022 – 2024	
Billings-Lockwood	0	35.0	16.03	30	-- (3)	100 ppb hourly
Lewistown	0	21.0	3.14	12	10	
Miles City	0	28.0	9.35	25	26	
Sidney	0	15.0	4.04	12	12	

(1) Design Values are calculated by the USEPA AQS database.

(2) The 2024 design value is the 98th percentile value for the year.

(3) The Billings Lockwood monitoring station began reporting data to AQS as of January 1, 2024. Therefore, a 3-year design value is not yet available.

NOy Monitoring

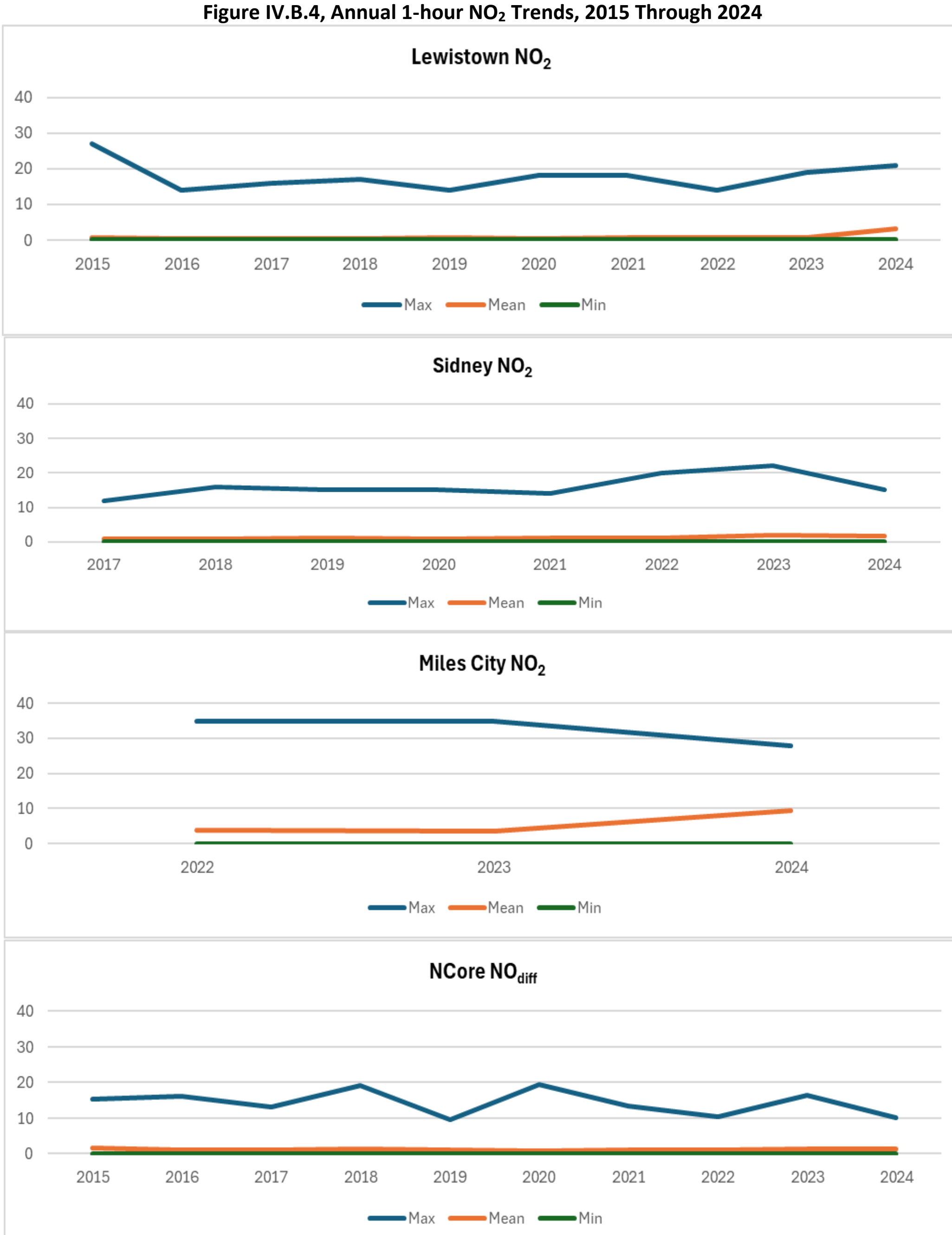
Related to NO_2 monitoring, Section 4.3.6 of 40 CFR 58 Appendix D, requires monitoring of NO/NO_y at NCore and PAMS monitoring sites. Per that rule, NO/NO_y monitoring: “will produce conservative estimates for NO_2 that can be used to ensure tracking continued compliance with the NO_2 NAAQS;” and for providing “data on total reactive nitrogen species for understanding O_3 photochemistry.” As noted in the ozone monitoring discussion above (Section I.A), PAMS monitoring is not required nor currently conducted in the MTDEQ network. However, MTDEQ is required to operate an NCore monitoring site that includes measurement of NO/NO_y. Table IV.B.10 summarizes the 1-hour NO_{diff} values measured at the MTDEQ NCore station in calendar year 2024. NO_{diff} provides a NO_2 comparative value from the NO/NOy monitoring process.

Table IV.B.10 – 1-Hour Monitored NO Values at NCore for 2024, in ppb.

Pollutant	Min	Max	Average
NO_{diff}	0	10.1	1.5

Figure IV.B.4 includes trend graphs of available data from the past ten-years of annual maximum, mean, and minimum 1-hour NO_2 measurements from the Lewistown and Sidney monitors, along with data from the last three years at Miles City. In addition, a trend graph of annual maximum, mean, and minimum 1-hour NO_{diff} measurements from NCore is provided.

Figure IV.B.4, Annual 1-hour NO_2 Trends, 2015 Through 2024



The NO_2 data summaries provided above in both tabular and graphic forms demonstrate that measured NO_2 concentrations are relatively consistent and well below the NAAQS limits.

Changes to NO_2 Monitoring

MTDEQ's Annual Network Plan for 2022 proposed, and received EPA concurrence, to install an NO_2 monitor in Billings. The NO_2 monitor, along with an O_3 monitor, were installed at the existing Lockwood monitoring site (30-111-0087) during calendar year 2023 and began reporting data to the EPA AQS database on January 1, 2024.

In its 2024 AMNP, MTDEQ proposed, and EPA approved, the addition of an NO_2 monitor at the Missoula Boyd Park monitoring station. As noted in that document, O_3 monitoring has been near-continuously conducted at the Missoula Boyd Park Site since June 1, 2010. Typically, wherever MTDEQ conducts O_3 monitoring it also operates a corresponding NO_2/NO/NO_X monitor to contribute to the understanding of O_3 formation and destruction at that location. However, this effort was never pursued in Missoula. MTDEQ intends to complete the installation of a NO_2/NO/NO_X monitor at Missoula Boyd Park as resources allow.

As previously stated in the discussion on O_3 monitoring, (see Section IV.A) the overall population of Montana is increasing. The most notable realized and projected population growth is in the Bozeman MSA. Thus, in its 2024 AMNP MTDEQ proposed, and EPA approved, the addition of NO_2 along with O_3 monitoring in Bozeman to evaluate the air quality impacts of population growth in the Bozeman MSA, and to determine if long-term monitoring will be required. MTDEQ is currently engaged in a search for a suitable location for installation of a monitoring shelter for these air pollutants and as a permanent site for $PM_{2.5}$ monitoring in that community.

As discussed in the section on O_3, existing NO_2 monitors in Sidney and Miles City have produced a body of data that demonstrates consistent background concentrations well below the NAAQS. Those monitors were established to evaluate ambient air quality impacts from oil well development and potential coal bed methane development, respectively, and to define regional pollutant concentrations. The monitors have fulfilled their intended investigatory purposes and there is no substantial air quality benefit to be gained by their continued operation. Montana's modest monitoring resources can be better invested elsewhere. Therefore, MTDEQ is proposing to end NO_2 monitoring at Sidney and Miles City. With the closure of these sites, equipment and personnel resources associated with their operation can be shifted to the new Bozeman and Missoula sites and the rest of the existing, aging, NO_2 monitoring network.

SO_2 Monitoring

Required SO_2 Monitoring

The minimum number of SO_2 monitoring sites required by Section 4.4 of Appendix D to 40 CFR 58 is summarized in Table IV.B.11.

Table IV.B.11 – Minimum SO_2 Monitoring Requirements [1]

Requirement Type	Population	Minimum SO_2 Monitors Required per CBSA
Population Weighted Emissions Index (PWEI [2][3])	≥1,000,000	3
	≥100,000 - <1,000,000	2
	≥5,000 - <100,000	1

(1) From Appendix D to 40 CFR Part 58, Sec. 4.4.2.
(2) CBSA populations must be based on latest available census figures.
(3) CBSA PWEI means Core Based Statistical Area Population Weighted Emissions Index in units of million person-tons per year.

The EPA criteria used to determine the number of required SO_2 monitors is similar to other pollutants in that it is based upon population and pollutant concentration. However, additional statistical formulations for analyzing those impacts are required for SO_2. Two metrics are used in this analysis: the population and the total emissions of SO_2 in a defined CBSA (see Section III.C). The product of those factors is a metric defined as the Population Weighted Emissions Index (PWEI). The PWEI is the population in the CBSA multiplied by the annual tons of SO_2 emitted in the CBSA (using the most recent aggregated emissions data available in the National Emissions Inventory (NEI)); divided by 1,000,000. Of the CBSAs in the state of Montana, the Billings MSA has both the highest population and the highest total SO_2 emissions. It is therefore the only CBSA where SO_2 monitoring could potentially be required based on these metrics. Table IV.B.12 summarizes the current PWEI for the five Montana MSAs using the latest published (2020) NEI values and most recent US Census Bureau population estimates.

Table IV.B.12 –SO_2 PWEI Calculation by MSA

MSA	Population [1] (a)	Reported Emissions [2] (b)	PWEI [3] (c)
Billings	192,531	4,295	826.9
Helena	96,735	399.86	38.7
Bozeman	126,984	101.58	12.9
Missoula	127,741	98.82	12.6
Great Falls	84,523	56.51	4.8

(1) US Census Bureau *Population Estimate* as of July 1, 2024.
(2) Aggregate tons of SO_2 per 2020 National Emissions Inventory.
(3) PWEI (c) = (a) x (b) ÷ 1,000,000.

SO_2 monitoring is required within a CBSA when the calculated PWEI value is equal to or greater than 5,000 as reflected in Table IV.B.12. Based on the prescribed criteria, neither Billings nor any of the other Montana CBSAs present an SO_2 PWEI that approaches or exceeds 5,000. Based on this criterion, no MTDEQ SO_2 monitoring is required in Montana.

Additional SO_2 Monitoring

Beyond the CFR-required monitoring, MTDEQ continues to operate one long-term SO_2 monitor at the Coburn Road site in Billings (30-111-0066) as part of an approved Maintenance Plan, to provide an on-going assessment of SO_2 compliance in the Billings area (81 FR 28718, *Re-designation Request and*

Associated Maintenance Plan for Billings, MT 2010 SO_2 Nonattainment Area). The Coburn Road site, located within the former SO_2 Nonattainment Area inside Yellowstone County, has been in continuous operation since 1981 as a State or Local Air Monitoring Station (SLAMS) site for NAAQS comparison purposes.

Additionally, MTDEQ operates one required trace-level background SO_2 monitor at the NCore station (30-049-0004). Section IV.H describes NCore monitoring requirements in more detail.

Figure IV.D.1 displays the locations of all the MTDEQ NO_2 monitoring sites that operated in 2024.

Figure IV.B.5, Locations of MTDEQ SO_2 Monitors Operating in Montana Through 2024

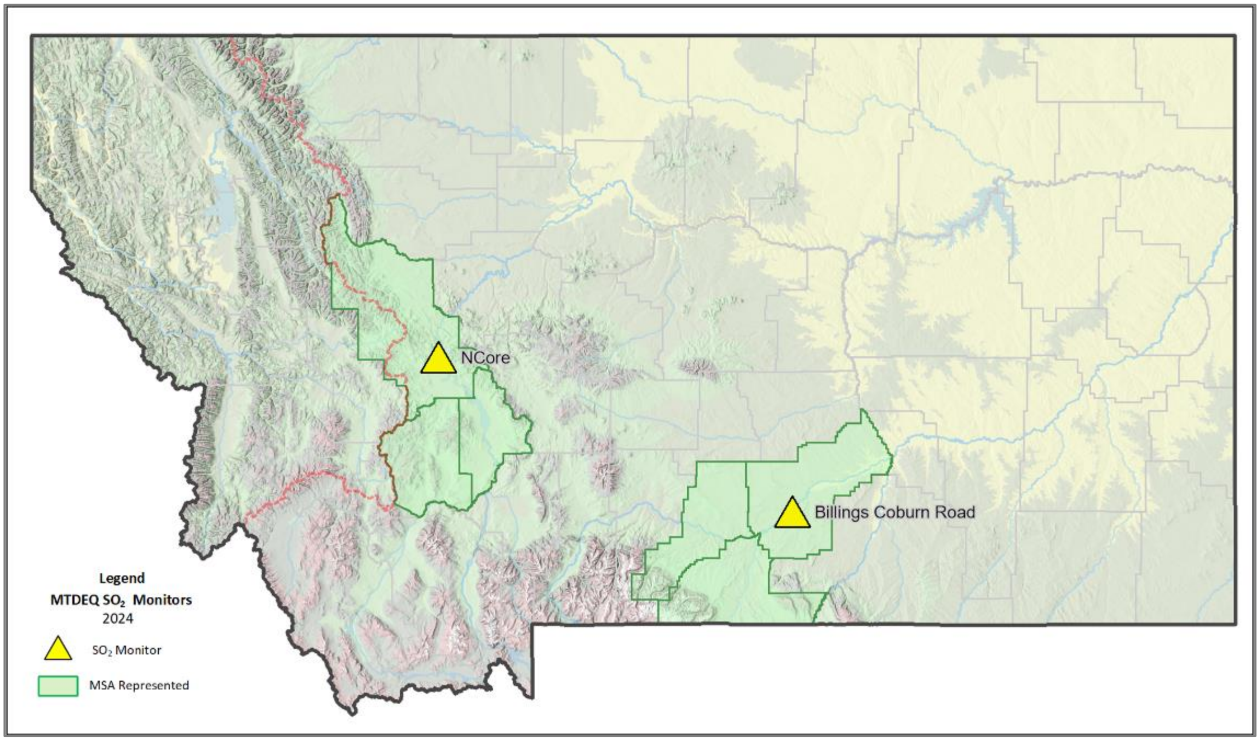


Table IV.B.13 summarizes the 1-hour values measured at the SO_2 monitoring sites operated by MTDEQ during calendar year 2024.

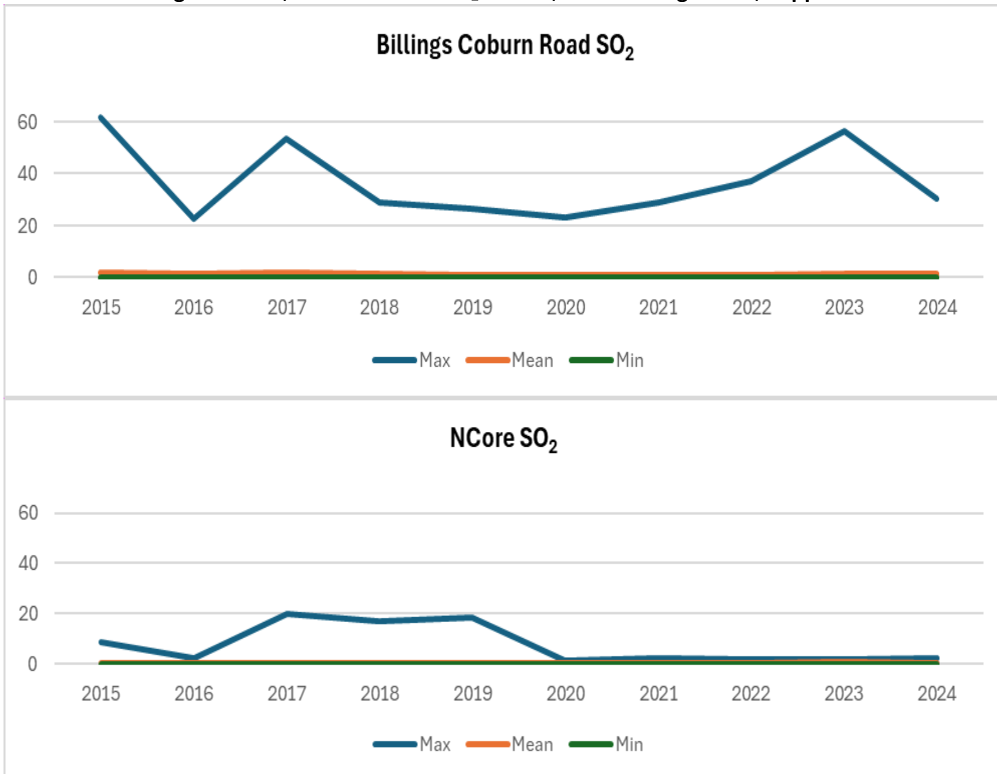
Table IV.B.13 – 1-Hour Monitored SO_2 Values for 2024

Site	Concentrations (ppb)			NAAQS Design Values (ppb) [1]		NAAQS
	Min	Max	Average	2024[2]	2022 - 2024	
Billings - Coburn Road	0.0	30.4	1.6	22.3	22	75
NCore - Sieben's Flat	0.0	2.5		1.5	1	

[1] Design Values are calculated by the USEPA AQS database.
[2] The 2024 design value is the 99th percentile value for the year.

Figure IV.B.6 provides 10-year trend graphs of the annual maximum, mean, and minimum SO_2 data from the Billings Coburn and NCore monitoring sites.

Figure IV.B.6, Annual 1-hour SO_2 Trends, 2015 Through 2024, in ppb



The SO_2 data summaries provided above in both tabular and graphic forms demonstrate the unique environments in which the two monitors are located. Maximum measured values are much higher in the industrial area of Billings, and quite low in the pristine, background area of NCore. Similarly, the overall mean concentrations at Billings and NCore are 1.3 and 0.37 ppb respectively. Measured SO_2 concentrations are well below the NAAQS in both locations.

Changes to SO_2 Monitoring

No modifications to MTDEQ's SO_2 monitoring network are proposed for 2024.

Pb Monitoring

Required Pb Monitoring

The minimum number of Pb monitoring sites required by 40 CFR 58 Appendix D Section 4.5 is summarized in Table IV.B.14.

Table IV.B.14 – Minimum Pb Monitoring Requirements (1)

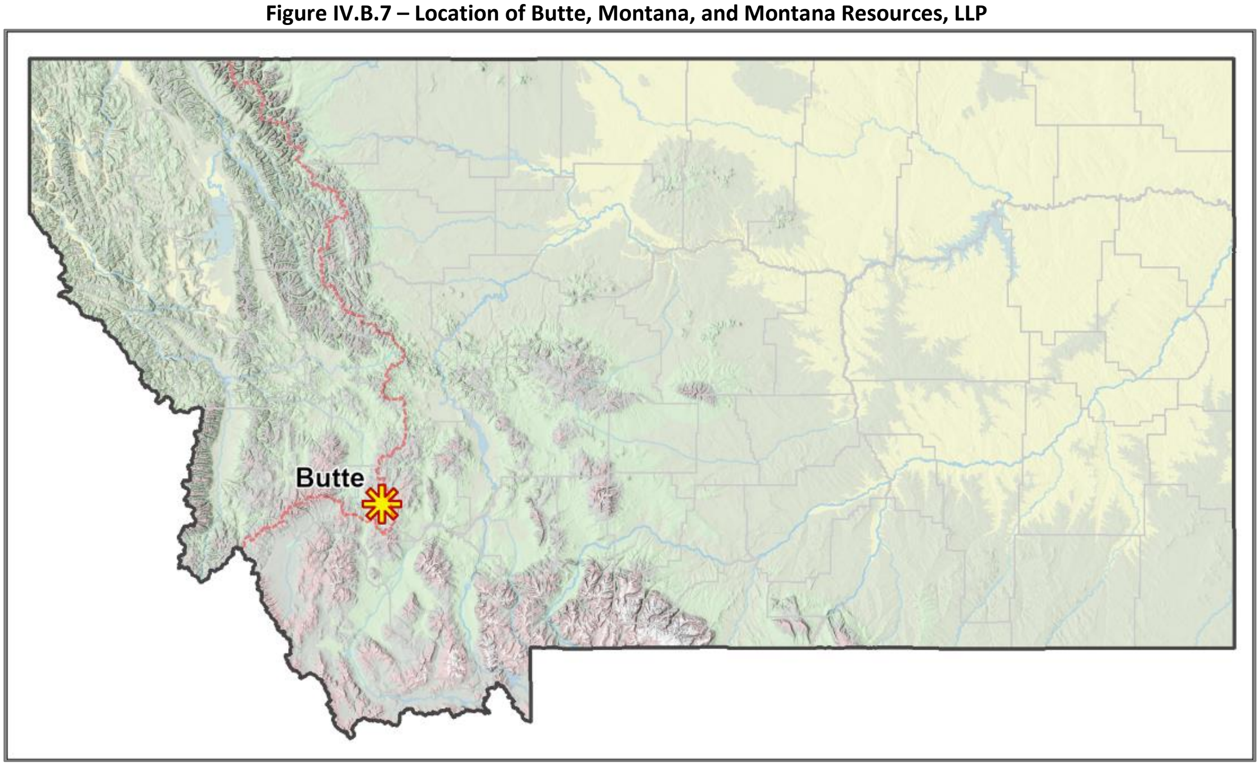
Criteria	Minimum Number of Pb Monitors Required
Non-Airport Source emitting ≥ 0.50 tons of Pb per year	1 each
Airport Source emitting ≥ 1.0 tons of Pb per year	1 each

(1) From Appendix D to 40 CFR Part 58, Sec 4.5(a). Monitoring must be "near" the Pb source.

The requirements in Section 4.5(a) of Appendix D to 40 CFR Part 58 specify that Pb emissions assessments for monitoring determination be based on either "the most recent National Emission Inventory (NEI) or other scientifically justifiable methods and data (such as improved emissions factors or site-specific data) taking into account logistics and the potential for population exposure."

The most recent NEI (from 2020) indicates that one non-airport source in the state of Montana reported Pb emissions in excess of the 0.50 ton/year threshold, triggering the monitoring requirement. Montana Resources, LLP, operates an open pit copper and molybdenum mine and associated processing facilities in Butte, Montana. Montana Resources reported estimated Pb emissions of 0.82 tons to the 2020 NEI. Figure IV.B.7 displays the location of this facility.

Figure IV.B.7 – Location of Butte, Montana, and Montana Resources, LLP



As communicated in the 2023 Monitoring Network Plan, in July 2023 MTDEQ engaged Montana Resources to clearly define the most appropriate path forward to address their reported Pb emissions and the related source-oriented monitoring requirement. The EPA Region 8 response to the MTDEQ 2023 Monitoring Network Plan received on October 6, 2023, appropriately summarizes this matter:

"Every year Montana Resources estimates their total annual lead emissions and reports this value to the Toxics Release Inventory (TRI). The TRI data are then ingested and reported in the NEI when the NEI is updated. Montana Resources has been using a contractor to estimate their Pb emissions with published emission factors, but the reported values in the TRI have been relatively inconsistent since 2016. Subsequent to submitting the 2023 AMNP, MTDEQ investigated the emission calculations to see if the reported values were reasonable and reproducible. This exercise revealed calculation errors that resulted in the overestimation of the Pb emissions. EPA Region 8 and MTDEQ confirmed this information with Montana Resources. Although Region 8 and MTDEQ have not obtained the revised emission calculations, it is our understanding the new values will be well below the 0.50 tpy threshold. As a result, Montana Resources will be correcting the TRI emissions back to 2017, and the NEI should eventually reflect these lower values upon the next update."

Subsequently, on October 9, 2023, Montana Resources submitted a 37-page technical review of its lead emissions to EPA and MTDEQ, covering the years from 2017 through 2022. The corrected Pb emissions results were summarized in a table, reproduced here as Table IV.B.15:

Table IV.B.15 – Montana Resources, LLC, Updated Pb Emission Releases

Reporting Year	Combined Lead Emissions (Stack + Fugitive)	
	lb/yr	tons/yr
2017	134.24	0.067
2018	140.08	0.070
2019	123.17	0.062
2020	138.96	0.069
2021	140.52	0.070
2022	121.94	0.061

MTDEQ reviewed and confirmed Montana Resources' analysis and their corrected annual Pb emission totals. In addition, the corrected emission values are well-aligned with the results of independent ambient Pb monitoring conducted by an independent contractor (as described in the MTDEQ 2023 Monitoring Network Plan). Because all the reported emissions are less than the 0.50 ton/year threshold, no Pb monitoring is required near this facility or any non-airport facility in Montana.

The most recent NEI (from 2020) also indicates that no airports in Montana reported emissions more than the 1.0 tons per year of Pb threshold; thus, no airport source requires Pb monitoring in the state of Montana.

Changes to Pb Monitoring

No establishment of Pb monitors in Montana is proposed by MTDEQ for 2025.

PM_{10} Monitoring

Required PM_{10} Monitoring

The approximate minimum number of permanent PM_{10} monitoring sites required by Section 4.6 of Appendix D to 40 CFR 58 is shown in Table IV.B.16.

Table IV.B.16 - Minimum PM_{10} Monitoring Requirements (1)

Population category	Number of Monitors per MSA (1)		
	High concentration (2)	Medium concentration (3)	Low concentration (4)(5)
>1,000,000	6–10	4–8	2–4
500,000–1,000,000	4–8	2–4	1–2
250,000–500,000	3–4	1–2	0–1
100,000–250,000	1–2	0–1	0

(1) From Table D-4 of Appendix D to 40 CFR Part 58 -- Selection of urban areas and actual numbers of stations per MSA within the ranges shown in this table will be jointly determined by EPA and the MTDEQ.
(2) High concentration areas are those for which data exceeds the PM_{10} NAAQS by 20 percent or more (≥ 180 µg/m^3).
(3) Medium concentration areas are those for which data exceeds 80 percent of the PM_{10} NAAQS (120 to 180 µg/m^3).
(4) Low concentration areas are those for which data is less than 80 percent of the PM_{10} NAAQS (< 120 µg/m^3).
(5) The low concentration requirements are the minimum which apply in the absence of a design value.

As presented in Section II.C, all designated MSAs in Montana are within the lowest population category. In addition, historical monitoring has consistently demonstrated measured 24-hour PM_{10} concentrations in the low concentration category listed in Table IV.B.16. Therefore, no PM_{10} monitors are required in the state. The present PM_{10} network, as described in Tables IV.B.17 through IV.B.18 and displayed in Figures IV.B.8 and IV.B.9, exceeds the PM_{10} network design criteria.

MTDEQ operates PM_{10} monitors in seven areas previously designated as nonattainment for the 24-hour PM_{10} NAAQS. This monitoring is required by EPA to demonstrate the adequacy of Montana's PM_{10} maintenance plans for those areas which have been re-designated to a NAAQS attainment status. Table IV.B.17 provides a list of those sites:

Table IV.B.17 – Montana MTDEQ 2024 PM_{10} Maintenance Plan Monitoring Sites

Station Name	AQS Code
Butte	30-093-0005
Columbia Falls	30-029-0049
Kalispell	30-029-0047
Libby	30-053-0018
Missoula	30-063-0024
Thompson Falls	30-089-0007
Whitefish	30-029-0009

Additional PM_{10} Monitoring

Beyond the CFR and Maintenance Plan required monitoring, MTDEQ also operated PM_{10} monitors at two additional sites through 2024 to define and track background concentrations and spatial distribution of this pollutant within the state of Montana. These sites are listed in Table IV.B.18:

Table IV.B.18 – Montana MTDEQ 2024 Additional PM_{10} Monitoring Sites

Station Name	AQS Code
Lewistown	30-027-0006
Sidney	30-083-0002

Figure IV.B.8 displays the locations of the two types of PM_{10} monitors MTDEQ operated in Montana in 2024.

Figure IV.B.8, Locations of MTDEQ PM_{10} Monitors Operating in Montana Through 2024

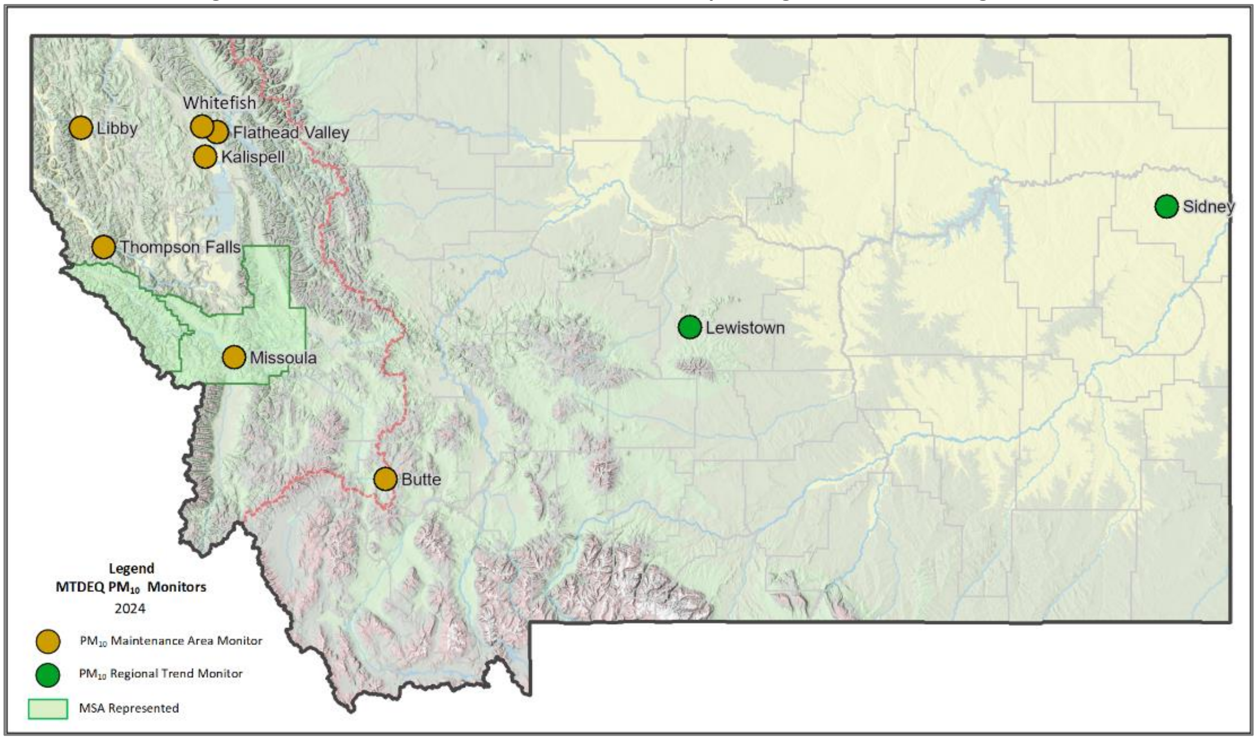


Table IV.B.19 summarizes the 24-hour average values measured at all PM_{10} monitoring sites operated by MTDEQ in 2024 (exceptional events included).

Table IV.B.19 – 24-Hour Average Monitored PM_{10} Values for 2024 (1)

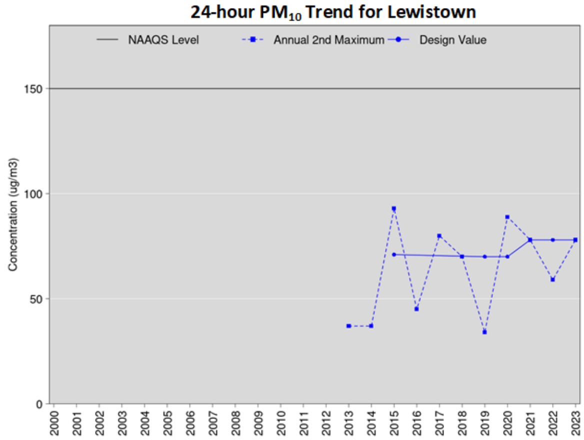
Site	Concentration (µg/m³)				NAAQS Comparison			
	Max	Conc. Area (4)	Average	Conc. Area (4)	AQS Estimated Exceedances (2) 2024	AQS Estimated Exceedances (2) 3-Year	3-Year Est. DV Conc. (3)	Conc. Area (4)
Butte	116	L	21.7	L	0	0	105	L
Flathead Valley	65	L	12.9	L	0	0	65	L
Kalispell	82	L	18.5	L	0	0	84	L
Whitefish	108	L	17.6	L	0	0	108	L
Lewistown	80	L	10.0	L	0	0	60	L
Libby	42	L	15.2	L	0	0	75	L
Missoula	90	L	15.1	L	0	0	90	L
Sidney	80	L	13.6	L	0	0.3	80	L
Thompson Falls	77	L	22.0	L	0	0	77	L

(1) Dataset includes all values (flagged exceptional events *included*).
(2) PM_{10} Design Values are in the form of numbers of estimated exceedances as calculated by the US EPA AQS database in accordance with the procedure in 40 CFR 50 Appendix K.
(3) Estimated Design Value based on PM_{10} SIP Development Guideline-Table Look-up Method (See EPA-450/2-86-001 Sec. 6.3.1).
(4) High, Medium or Low from Table IV.F.1. The CFR does not specify whether maximum or average measured concentrations or calculated estimated design values are to be used for this classification. For purposes of this document an evaluation is presented for all three data types.

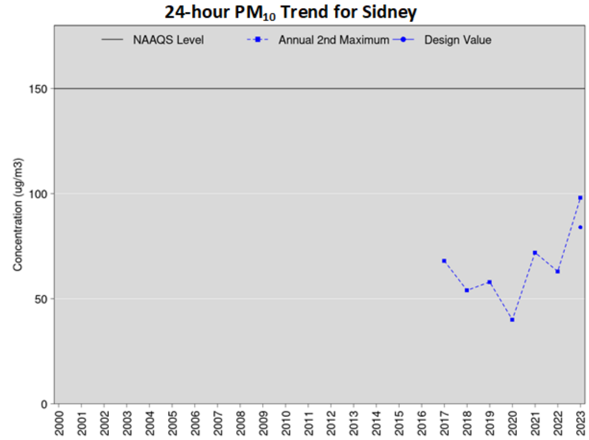
Figure IV.B.9 provides long term trend graphs of measured PM_{10} concentrations at the monitors listed above. These data are extracted from EPA's "NetAsses2025" web tools.

Figure IV.B.9, Measured PM_{10} Concentration Trends

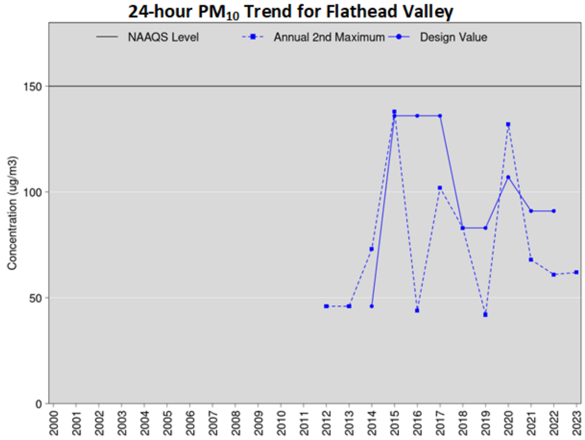
24-hour PM_{10} Trend for Lewistown



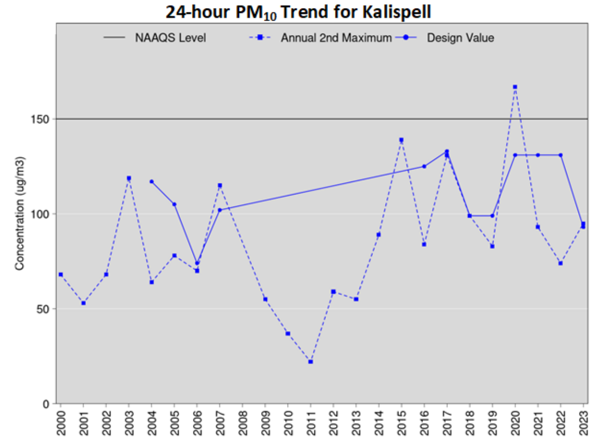
24-hour PM_{10} Trend for Sidney



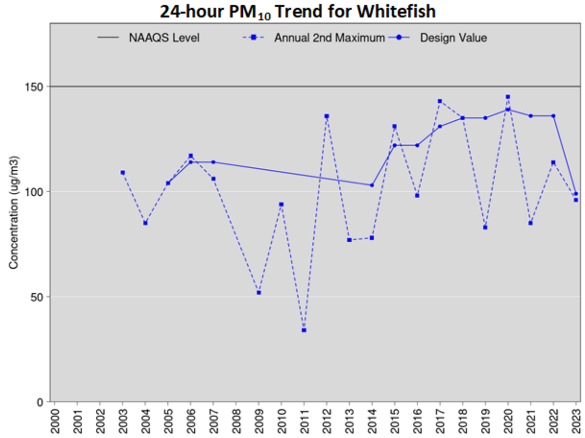
24-hour PM_{10} Trend for Flathead Valley



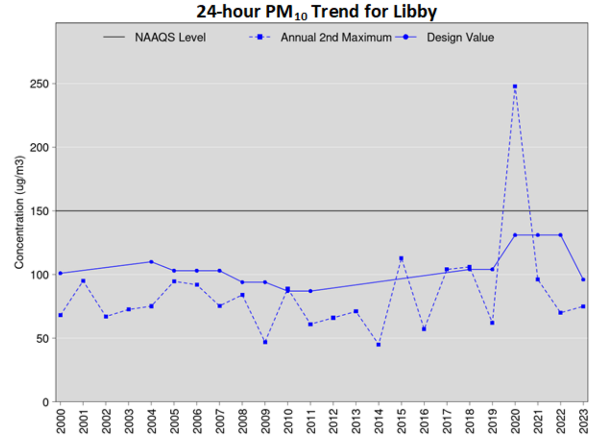
24-hour PM_{10} Trend for Kalispell



24-hour PM_{10} Trend for Whitefish



24-hour PM_{10} Trend for Libby



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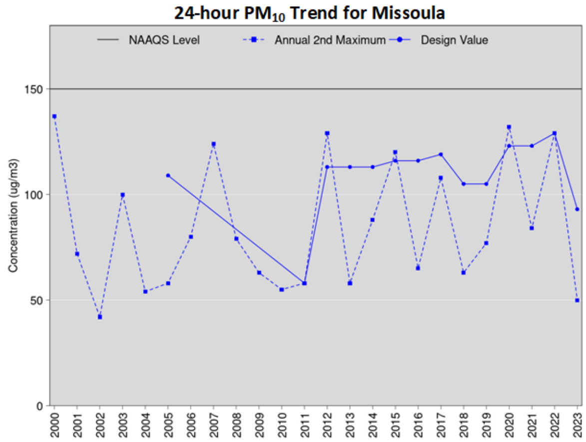
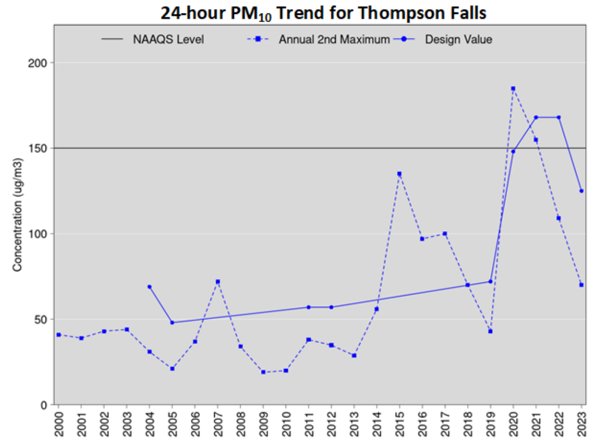
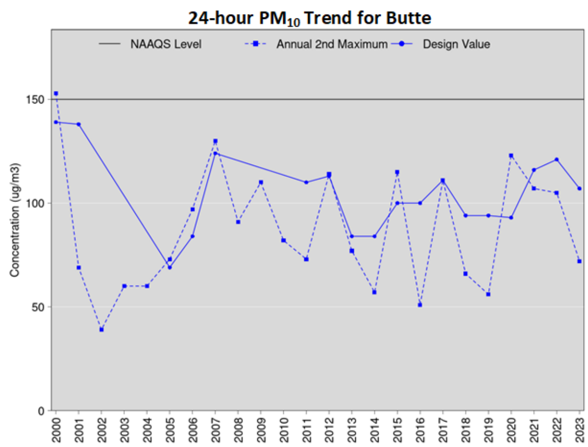






Changes to PM_{10} Monitoring

Recently Completed Changes

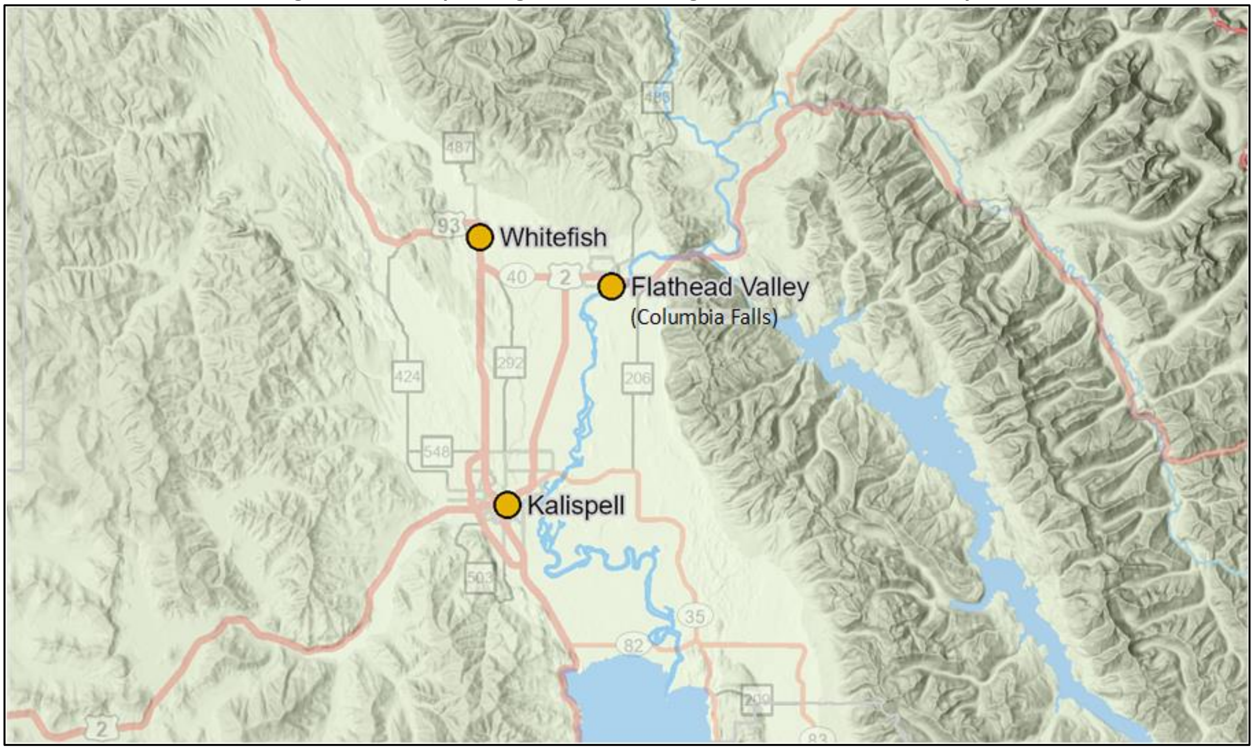
MTDEQ has a long-term dataset of measured PM_{10} values across the state. When higher values are measured, they are normally found to result from vehicle travel down dirt roads, nearby agricultural tillage, or wildfire smoke. In June of 2023, MTDEQ proposed to reduce the number of PM_{10} monitors in the state. This was done in an effort to continue appropriate and representative PM_{10} monitoring while adjusting limited monitoring resources to focus more specifically on other criteria pollutants whose concentrations and impacts are not adequately characterized across the state, such as $PM_{2.5}$ and ozone. The MTDEQ proposal focused on ending PM_{10} monitoring at Broadus, Miles City, and Malta at the end of 2023. EPA Region 8 concurred with this proposal and communicated approval on January 9, 2024. Submission of PM_{10} monitoring data from these sites to the EPA AQS database ended with measurements through December 31, 2023, and the equipment was removed later in 2024.

Proposed Changes

The existing PM_{10} monitor in Sidney has produced a body of data that demonstrates consistent background concentrations well below the PM_{10} NAAQS. This monitor was established to evaluate ambient air quality impacts from oil well development and has fulfilled its intended investigatory purpose. There is no substantial air quality benefit to be gained by its continued operation and Montana's modest monitoring resources can be better invested elsewhere. Therefore, MTDEQ is proposing to end PM_{10} monitoring at the remote Sidney station and to install a multi-pollutant sensor, including PM_{10}, in the community of Sidney.

Examination of the map in Figure IV.B.8 above shows the nine currently operating MTDEQ PM_{10} monitors spatially distributed in Montana at fairly substantial distances from one another except in one significant case. In the greater Kalispell area in Flathead County, three PM_{10} monitoring sites are clustered together as represented in Figure IV.B.10.

Figure IV.B.10, Operating PM_{10} Monitoring Sites in the Flathead Valley



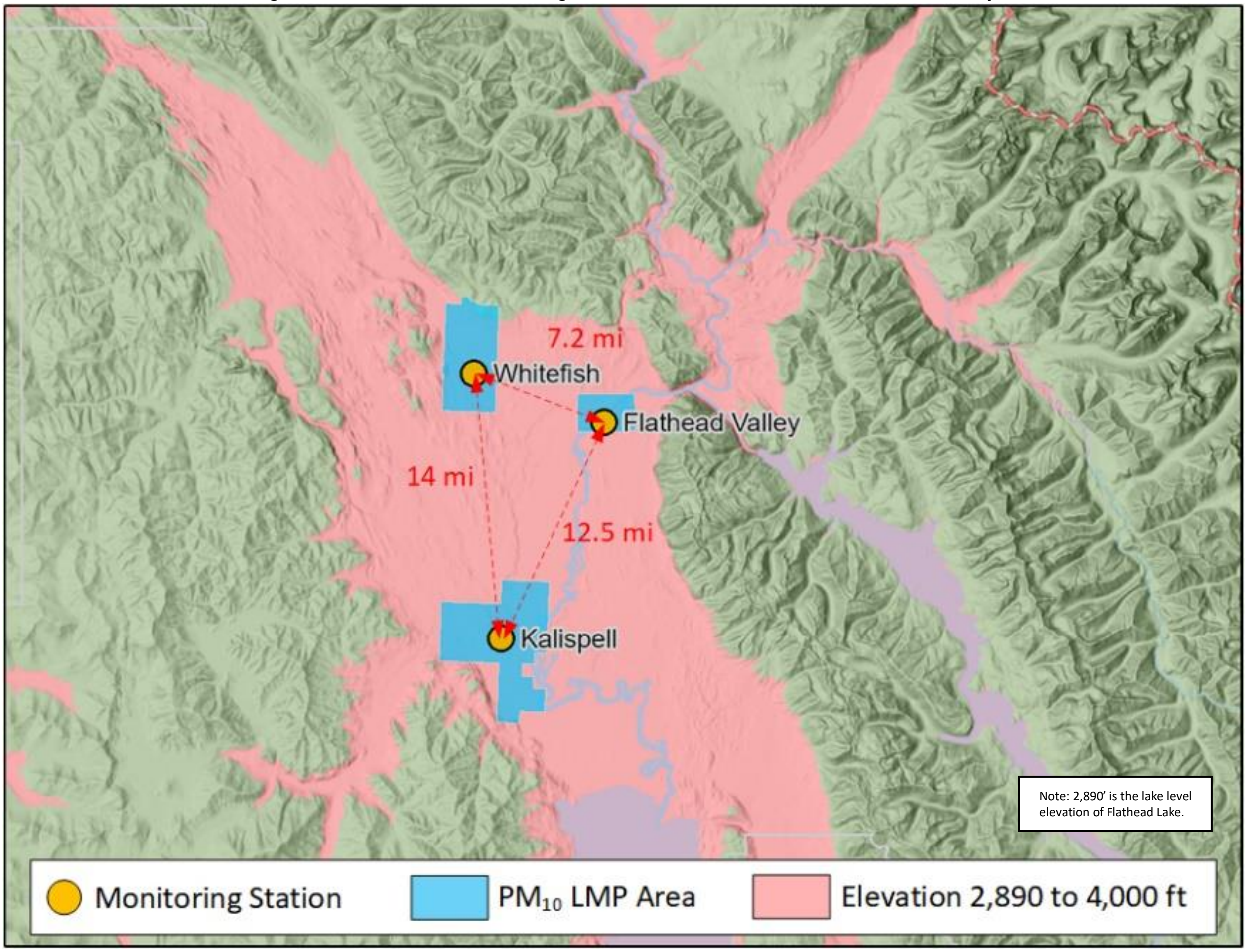
Each of the three sites was established to monitor PM_{10} in an area designated as nonattainment for the 1987 PM_{10} standard and subsequently redesignated as a Limited Maintenance Plan (LMP) area. MTDEQ has operated eight different PM_{10} monitoring sites in the Flathead Valley for various time periods since 1991, but over time consolidated those efforts into the three locations that are currently operating. Table IV.B.20 summarizes the history of both the nonattainment/LMP areas and the three monitoring sites.

Table IV.B.20, Flathead Valley PM_{10} LMP Areas and Operating Monitors

Area	NA Desig'n. Date	LMP Re-desig'n. Date	Monitoring Station	AQS Number	Monitor Start Date
Flathead-Columbia Falls	11/15/1990	6/26/2020	Flathead Valley	30-029-0049	2011
Flathead-Kalispell	11/15/1990	6/26/2020	Kalispell Flathead Electric	30-029-0047	1997
Flathead-Whitefish	11/19/1993	3/8/2022	Whitefish Dead End	30-029-0009	2001

Figure IV.B.11 displays the geographic proximity of the three monitoring sites and the LMP areas within the terrain-defined airshed.

Figure IV.B.11, PM$_{10}$ Monitoring Sites and LMP Areas in the Flathead Valley



It is noteworthy that PM$_{2.5}$ has also been monitored at five sites in the Flathead Valley since 1999, including at the Whitefish and Kalispell sites. In 2011, all PM$_{2.5}$ monitoring in the valley was consolidated, with EPA approval, at the new Flathead Valley site in Columbia Falls. At that same time, PM$_{10}$ monitoring was moved from the Columbia Falls Ballpark Site (30-029-0007) to the Flathead Valley site, in an effort to establish a single PM monitoring site in the valley that appropriately represented both PM$_{10}$ and PM$_{2.5}$ concentrations for that entire airshed. PM$_{10}$ monitoring was continued at the Kalispell and Whitefish sites only because it was required by LMP requirements.

Over the last several years a number of factors combine to strongly challenge the continued operation of the Kalispell and Whitefish PM$_{10}$ monitoring sites, including the following:

- Land use changes. Modifications have taken place that significantly modify the suitability of both the Kalispell and Whitefish sites. At Kalispell, the landowner no longer maintains the surrounding property, making the site inaccessible by automobile and undesirable for walk-in access. At Whitefish, commercial building and parking lot construction isolated the monitoring site from operator vehicle access and introduced siting-related questions of the representativeness of air quality measurements conducted at that location.

- Lack of an air quality motive. As demonstrated in Table IV.B.19, Figure IV.B.9, and several decades of previously reported monitoring data, no probability exists for the two locations to demonstrate an exceedance of the PM$_{10}$ NAAQS. The population and related activities around each site, while growing, does not warrant PM$_{10}$ monitoring.

- Lack of spatial variability. As demonstrated in Figure IV.B.11, the three sites are a maximum of fourteen miles apart in the same airshed defined by significant surrounding mountains. Operating three separate monitors in this environment is excessive and unwarranted.

- Reduced operating and staff resources. Both MTDEQ and the Flathead County Health Department are operating with diminished resources. Continued operation of these sites wastes resources needed elsewhere while providing no air quality benefit.

MTDEQ respects the administrative need to continue to monitor PM_{10} to validate the LMP process and document attainment with the PM_{10} NAAQS in the Flathead Valley airshed. Therefore, MTDEQ is proposing to discontinue PM_{10} monitoring at the Kalispell and Whitefish sites but continue monitoring PM_{10} (along with $PM_{2.5}$) at the consolidated Flathead Valley PM monitoring site in Columbia Falls.

$PM_{2.5}$ Monitoring

Required $PM_{2.5}$ Monitoring

$PM_{2.5}$ monitoring may be required under three types of criteria:

1. **Network Design Requirements**

The minimum number of $PM_{2.5}$ monitoring sites required by 40 CFR 58 Appendix D Section 4.7 is shown in Table IV.B.21.

Table IV.B.21 – Minimum $PM_{2.5}$ Monitoring Requirements [1]

MSA population [2]	Number of Monitors per MSA	
	Most recent 3-year design value ≥85% of any $PM_{2.5}$ NAAQS [3]	Most recent 3-year design value <85% of any $PM_{2.5}$ NAAQS [3][4]
>1,000,000	3	2
500,000 - 1,000,000	2	1
50,000 - <500,000	1	0

[1] From Table D-5 of Appendix D to 40 CFR Part 58. Minimum monitoring requirements per MSA.
[2] Population based on latest available census figures.
[3] $PM_{2.5}$ NAAQS levels and forms are defined in 40 CFR part 50.
[4] These minimum monitoring requirements apply in the absence of a design value.

As introduced in Section II.C above Montana had three federally designated MSAs (Billings, Missoula, and Great Falls) through much of 2023, and five MSAs through the remainder of 2023 and all of 2024 (the Helena and Bozeman MSA designations were added on July 21, 2023). All five of those MSAs fall within the 50,000-to-500,000-person population range listed in Table IV.B.21.

The $PM_{2.5}$ NAAQS exists in both long term (annual) and short term (24-hour) limits. Through calendar year 2023, the primary annual NAAQS for $PM_{2.5}$ was 12.0 µg/m^3 as an annual mean averaged over three years. The primary and secondary 24-hour NAAQS was 35 µg/m^3 as a 98th percentile averaged over three years. Within the three MSAs existing through mid-2023, only the monitors in the Missoula MSA measured values in excess of either of these NAAQS limits, therefore one monitor is required in this MSA. The continuous $PM_{2.5}$ monitor operating at Boyd Park in Missoula (30-063-0024) fulfills this requirement. Subsequent monitoring by the three monitors in the Missoula MSA reflect design value measurements that exceed 85% of both the annual and 24-hour NAAQS (see Table IV.B.24); therefore, one monitor continues to be required in this MSA. The Boyd Park monitor will continue to fulfill this requirement.

Two significant changes occurred in mid-2023 and early 2024 that modified the MTDEQ's evaluation of the monitoring network design requirements reflected in Table IV.B.21. First, as discussed previously, two additional areas of the state (Helena and Bozeman) were designated as MSAs on July 21, 2023. Second, on February 7, 2024, (effective May 6, 2024), EPA lowered the annual $PM_{2.5}$ NAAQS from 12.0 to 9.0 µg/m^3. An analysis of MTDEQ $PM_{2.5}$ monitoring within the context of these two changes (see Table IV.B.24) indicates that both the annual and 24-hour design values at the Helena monitor (30-049-0026) are greater than 85% (i.e., 7.65 µg/m^3) of the newly adopted NAAQS for the 2024 design period; therefore, this monitor is now a required monitor. In a related matter, the non-regulatory $PM_{2.5}$ monitor at Great Falls (30-013-0001) has demonstrated an annual design value greater than 85% of the NAAQS. As discussed in the "Changes to $PM_{2.5}$ Monitoring" section below, MTDEQ is already in the process of installing a Federal Equivalent Method (FEM) $PM_{2.5}$ monitor in Great Falls. Operation of this monitor will provide regulatory-quality data to determine if a $PM_{2.5}$ monitor is required in the Great Falls MSA.

Beyond the requirements in Table IV.B.21, MTDEQ operates informational $PM_{2.5}$ monitors in each MSA in the state as discussed later in this section.

2. <u>Specific Network Component Requirements</u>

NCore. MTDEQ conducts required $PM_{2.5}$ monitoring at its NCore site (30-049-0004 per the requirements of 40 CFR 58 Appendix D Section 4.7.1(a).

Nonattainment/Maintenance Plans. MTDEQ operates a $PM_{2.5}$ monitor in the community of Libby (30-053-0018) as required by EPA to demonstrate the adequacy of Montana's $PM_{2.5}$ maintenance plan for this area. The maintenance plan was established as part of the re-designation of the Libby area from nonattainment to attainment for the 24-hour $PM_{2.5}$ NAAQS.

Regional Background and Transport Sites. Section 4.7.3 of 40 CFR 58 Appendix D requires each state to install and operate at least one $PM_{2.5}$ site to monitor *regional background* and at least one $PM_{2.5}$ site to monitor *regional transport*. In its 2022 Network Plan MTDEQ proposed the establishment of its NCore site (30-049-004) as a background and regional transport site for Montana. EPA concurred with this proposal in its response to that Network Plan submittal. The NCore site will continue to fulfill the regional and transport site criteria.

Chemical Speciation. Section 4.7.4 of 40 CFR 58 Appendix D requires each state to conduct $PM_{2.5}$ chemical speciation monitoring at locations designated as part of the national Speciation Trends Network (STN) and operated as part of the Chemical Speciation Network (CSN). Two sites in Montana are currently included in the CSN: Butte (30-093-0005) and NCore (30-049-0004). Appendix C to this Plan contains a list of the chemical components for which analysis is performed on filters collected at these stations.

3. <u>Quality Control Requirements</u>

Collocated Monitors. Section 3.2.3 of 40 CFR 58 Appendix A requires that states operate a specific number of side-by-side ("collocated") monitor pairs for each $PM_{2.5}$ monitoring method employed in its network. Additionally, a proportion of the collocations must be with a Federal Reference Method (FRM) monitor. The collocation of $PM_{2.5}$ monitors is the means by which monitor measurement bias and precision is determined. MTDEQ currently operates three different $PM_{2.5}$ monitoring methods in its network (see Appendix B). Therefore, three collocations are conducted, one method each at its NCore (30-049-004), Helena (30-049-0026), and Butte (30-093-0005) monitoring sites.

Continuous Analyzers. Section 4.7.2 of 40 CFR 58 Appendix D requires that at least one-half of the <u>*required*</u> $PM_{2.5}$ monitoring sites (per Table IV.B.21, above) operate *continuous* analyzers. The continuous devices must be designated as FEM analyzers or be collocated with an FRM or FEM analyzer. Per the following paragraph, all the required (or potentially required in the case of Great Falls) monitors are continuous monitors. Therefore, MTDEQ complies with this requirement.

$PM_{2.5}$ is a significant pollutant in Montana. Impacts from summer wildfires, prescribed burning and wintertime inversions have established a strong need and demand for continuous, near-real time $PM_{2.5}$ data for assessing and communicating public health impacts in addition to determining NAAQS compliance. To meet this need, MTDEQ's $PM_{2.5}$ pollutant measurement network is comprised solely of continuous monitors. However, MTDEQ also operates an appropriate number of manual FRM $PM_{2.5}$ monitors exclusively for quality assurance (QA) collocation and validation of its continuous $PM_{2.5}$ monitoring network.

Table IV.B.22 lists MTDEQ's required $PM_{2.5}$ monitoring sites.

Table IV.B.22 – Montana MTDEQ 2024 Required $PM_{2.5}$ Monitoring Sites

SLAMS Sites	
Station Name	**AQS Code**
Helena	30-049-0026
Libby	30-053-0018
Missoula Boyd Park	30-063-0024
NCore	30-049-0004
[Great Falls ?]	30-013-0001

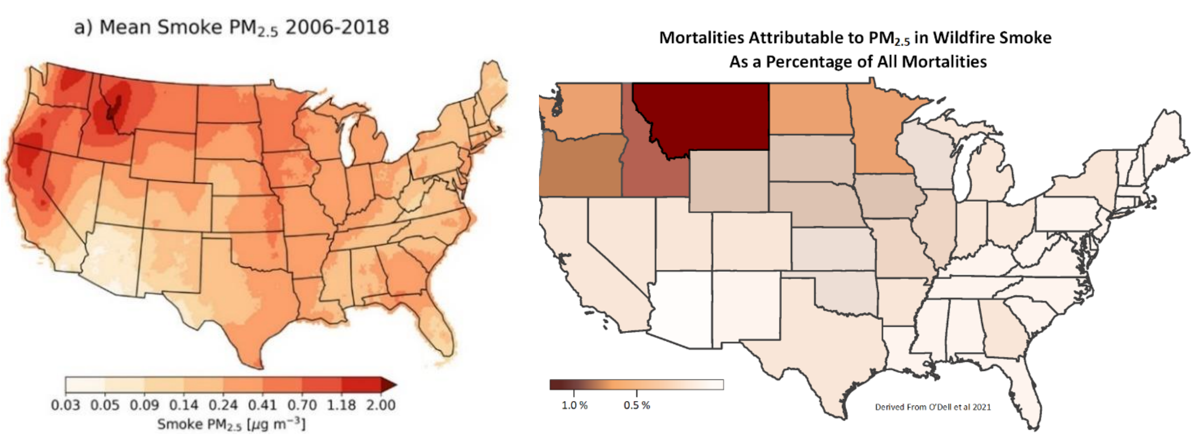
$PM_{2.5}$ Collocation Sites	
Station Name	**AQS Code**
Helena	30-049-0026
Butte	30-093-0005
NCore	30-049-0004
$PM_{2.5}$ Chemical Speciation Sites*	
NCore	30-049-0004

*Speciation monitoring is also conducted at Butte (30-093-0005) but is not required there.

Additional $PM_{2.5}$ Monitoring

As discussed above in section III.D, Montana is an outlier for smoke-derived $PM_{2.5}$ emissions and therefore MTDEQ has made an intentional effort to expand $PM_{2.5}$ monitoring efforts beyond what is required over the past 3 years. Plots adapted from O'Dell et al., 2021, demonstrate that Montanans are routinely exposed to some of the highest concentrations of wildfire smoke-derived $PM_{2.5}$ in the nation and that the state is an outlier for number of moralities attributable to $PM_{2.5}$ from wildfire smoke.

Figure IV.B.12, Mean Smoke-derived $PM_{2.5}$ concentrations and mortalities attributed to $PM_{2.5}$ from 2006-2018. Adapted from O'Dell et al., 2021.



O'Dell, Katelyn, et al. "Estimated mortality and morbidity attributable to smoke plumes in the United States: Not just a western US problem." *GeoHealth* 5.9 (2021): e2021GH000457.

Because $PM_{2.5}$ is a pollutant of significant concern within Montana, MTDEQ's $PM_{2.5}$ monitoring network goes well beyond the minimum requirements summarized in Table IV.B.21. MTDEQ, sometimes in partnership with county air quality programs, operates $PM_{2.5}$ monitors in a number of locations statewide, typically in regional population centers as defined in Section C. These stations are operated to communicate potential $PM_{2.5}$-related health impacts to the public, to demonstrate continuing NAAQS compliance, and to inform local health departments' $PM_{2.5}$ control strategies (see also Section V. which describes MTDEQ's Sensor Monitoring Network operated to complement these efforts). Table IV.B.23 lists MTDEQ's additional (non-required) $PM_{2.5}$ monitoring sites:

Table IV.B.23 – Montana MTDEQ 2024 Additional $PM_{2.5}$ Monitoring Sites

Station Name	AQS Code	Station Name	AQS Code
Billings-Lockwood	30-111-0087	Glendive	30-021-0005
Bozeman	30-031-0019	Hamilton	30-081-0007
Broadus	30-075-0001	Havre	30-041-0002
Butte	30-093-0005	Lewistown	30-027-0006
Choteau	30-099-0005	Malta	30-071-0010
Columbia Falls	30-029-0049	Miles City	30-017-0005
Cut Bank	30-35-0022	Seeley Lake	30-063-0038
Dillon	30-001-0003	Sidney	30-083-0002
Frenchtown	30-063-0037	Thompson Falls	30-089-0007
Glasgow	30-105-0003		

MTDEQ's $PM_{2.5}$ monitors are intentionally located, established and operated to address any or all three of the program monitoring objectives defined in the Background section of this Plan. For the additional $PM_{2.5}$ monitoring described above, MTDEQ employs different methods of continuous $PM_{2.5}$ monitoring and assigns different geographical spatial scales that sites are designed to represent depending on the monitoring objectives for each site.

$PM_{2.5}$ Monitoring Methods

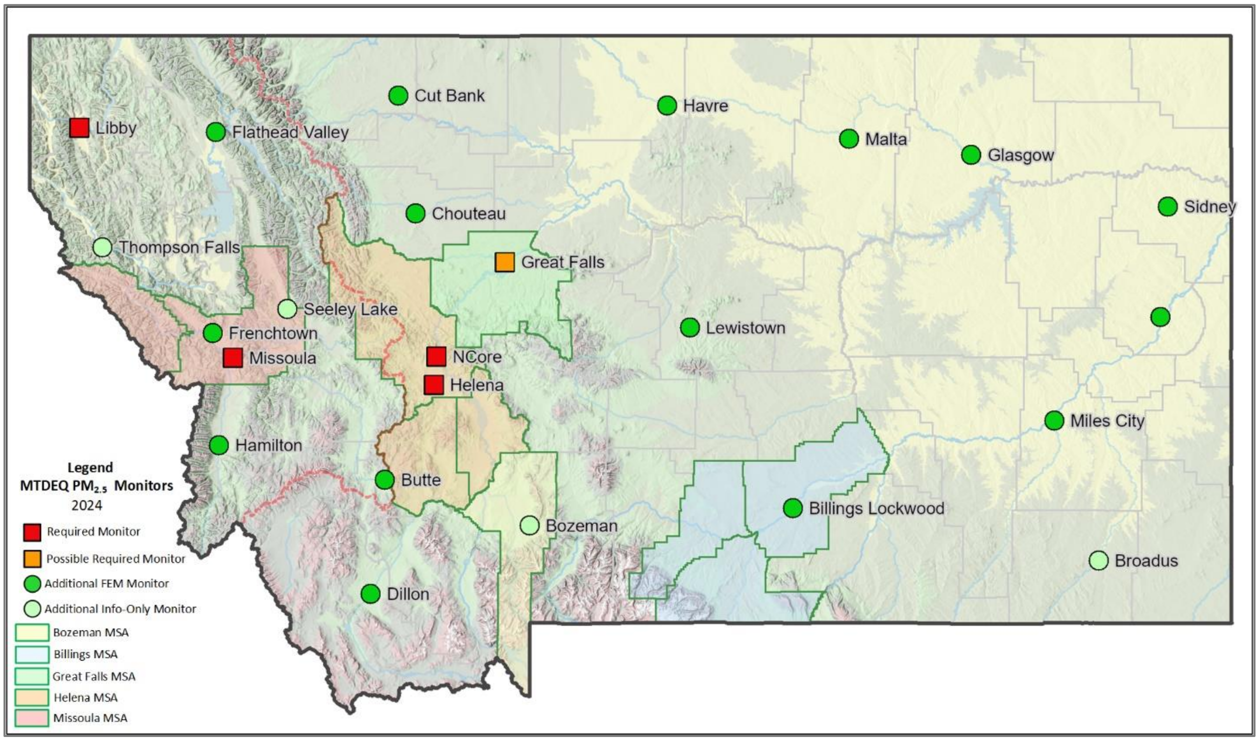
$PM_{2.5}$ monitors federally designated as FRM or FEM generate data suitable for determining compliance with the $PM_{2.5}$ NAAQS. $PM_{2.5}$ monitors designated as "non-FEM" provide reliable general information but cannot be used for NAAQS compliance purposes. The $PM_{2.5}$ monitoring data summarized in Table IV.B.24 below represents this distinction between site method types. In addition, the network description table in Appendix B of this Plan indicates a notation of the monitor method classification for all $PM_{2.5}$ monitors operated by MTDEQ in the column labeled "PM".

$PM_{2.5}$ Spatial Scales

MTDEQ's continuous $PM_{2.5}$ monitors are sited to represent "regional" or "neighborhood" areas (spatial scales) as established in Section 4.7.1(c) of Appendix D to 40 CFR 58. Data from $PM_{2.5}$ monitoring sites with spatial scales designated as smaller than "neighborhood" are generally not used for $PM_{2.5}$ NAAQS compliance review purposes in MTDEQ's network. Currently, the only $PM_{2.5}$ site in the Montana network of this nature is the Great Falls station (30-013-0001) which is designated a "middle" range spatial scale remaining from historical CO monitoring purposes. This designation will change with the installation of a new $PM_{2.5}$ monitor in that community and MSA.

Figure IV.B.13 displays the locations of the two types of $PM_{2.5}$ monitors (required and additional) that MTDEQ operated in Montana in 2024.

Figure IV.B.13, Locations of MTDEQ $PM_{2.5}$ Monitors Operating in Montana Through 2024



$PM_{2.5}$ Monitoring Results

Table IV.B.24 summarizes the 24-hour average values along with the annual and 24-hour NAAQS design values, where appropriate, as measured at the $PM_{2.5}$ monitoring sites operated by MTDEQ during 2024.

Table IV.B.24 – 24-Hour Average Monitored $PM_{2.5}$ Values for 2024[1]

Site	2024 Concentrations (µg/m3)			2022 - 2024 Design Values (µg/m³)		NAAQS through CY 2024
	Max	Average	98th Percentile	24-hour	Annual	
MSAs						
Billings–Lockwood	35.2	6.65	24.5	25	6.7	24-hour 35 µg/m3 (85% = 29.75)
Bozeman [2]	55.0	5.9	14.8	18	6.1	
Great Falls [2]	51.3	10.0	23.8	27	**8.8**	
Helena [5]	68.4	8.99	30.3	**31**	**8.6**	
Missoula Boyd Park [5]	55.3	5.42	24.6	26	5.7	
Frenchtown (Msla.)	58.4	7.87	28.7	**30**	**9.5**	
Seeley Lake [2] (Msla.)	38.8	8.9	24.7	**25**	**10.7**	
Non-MSAs						Annual 9.0 µg/m3 (85% = 7.65)
Broadus [2]	42.1	8.85	32.6	**34**	**8.1**	
Butte	80.3	8.35	31.4	**32**	**7.8**	
Choteau [3]	35.7	3.81	16.4	16	3.9	
Columbia Falls	32.5	7.95	22.6	**31**	**8.6**	
Cut Bank [3]	34.9	5.45	21.6	27	4.8	
Dillon [3]	96.5	4.36	24.0	17	3.6	
Glasgow [4]	--	--	--	--	--	
Glendive [3]	43.2	4.33	28.2	28	4.3	
Hamilton	99.4	9.04	52.0	**46**	**7.8**	
Havre [3]	44.6	3.88	13.0	27	5.8	
Lewistown	60.7	5.06	27.4	27	4.8	
Libby [5]	41.6	10.66	28.5	**30**	**11.6**	
Malta	54.1	5.05	24.8	29	5.6	
Miles City	58.5	5.33	18.1	26	6.4	
NCore [5]	55.8	4.7	22.8	24	4.4	
Sidney	42.3	5.88	28.3	**32**	6.1	
Thompson Falls [2]	33.5	7.6	21.8	23	**7.9**	

(1) Dataset includes all values (exceptional events are included).

(2) These monitors are non-FEM monitors operated for informational purposes only and are not certified to produce NAAQS-comparison data.

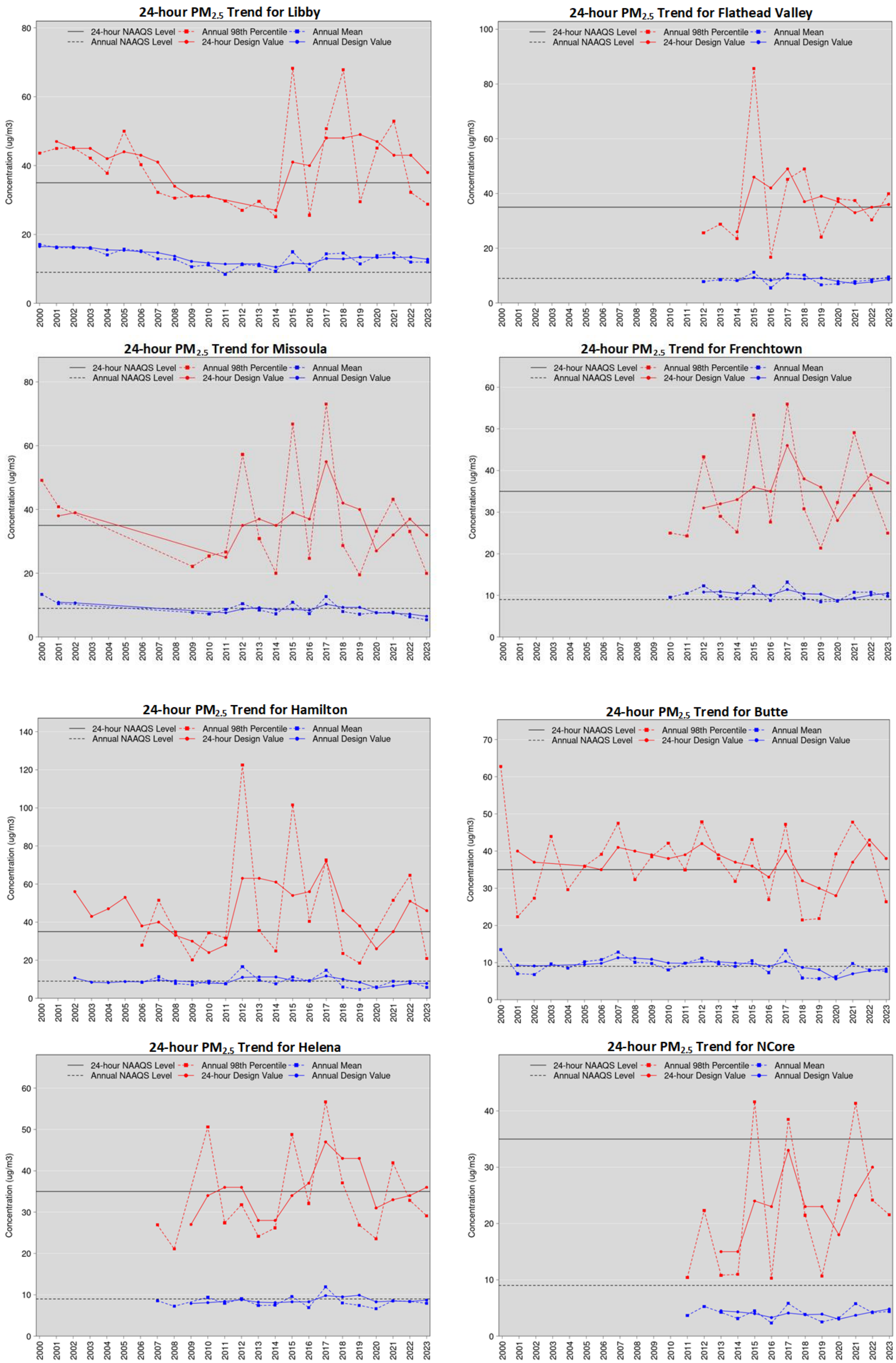
(3) These sites have been in operation for less than three years; therefore, calculated design values are for informational purposes only.

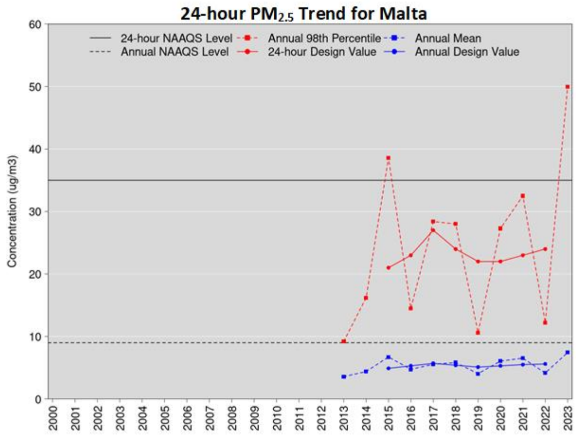
(4) The Glasgow monitor began operation in late September 2024. Therefore, no summary data for this site is available for this Assessment document.

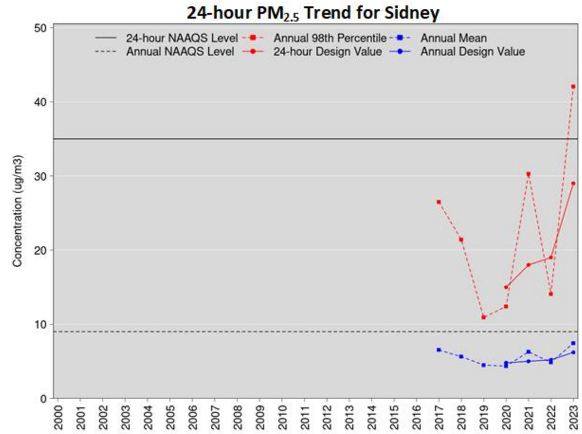
(5) Required monitor.

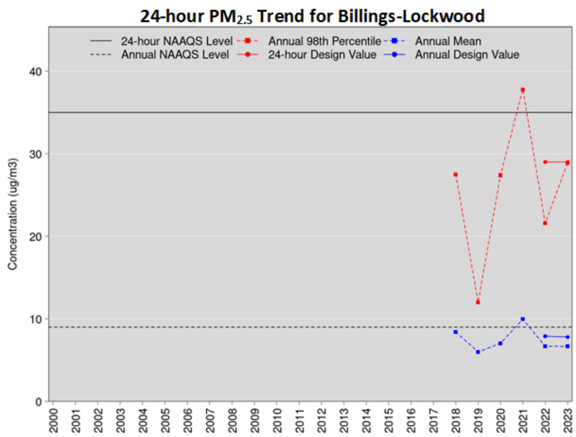
Figure IV.B.14 provides long term trend graphs of measured $PM_{2.5}$ concentrations from the years 2000 through 2024 at monitors for which data is available in EPA's "NetAsses2025" web tools.

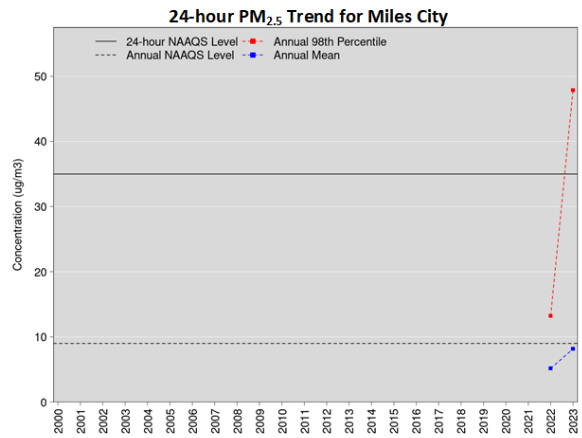
Figure IV.B.14, Measured $PM_{2.5}$ Concentration Trends

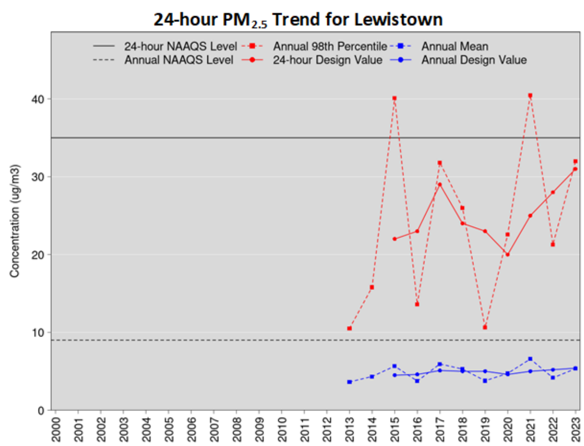












The high variability of the 24-hour values displayed in the charts above is reflective of the significance of wildfire smoke impacts on the measured $PM_{2.5}$ values across the state. Figures IV.B.15 and 16 further illustrate the wildfire smoke impacts of measured $PM_{2.5}$ design values in 2024.

Figure IV.B.15, Smoke and Non-Smoke Components of 2024 $PM_{2.5}$ *Annual* Design Values

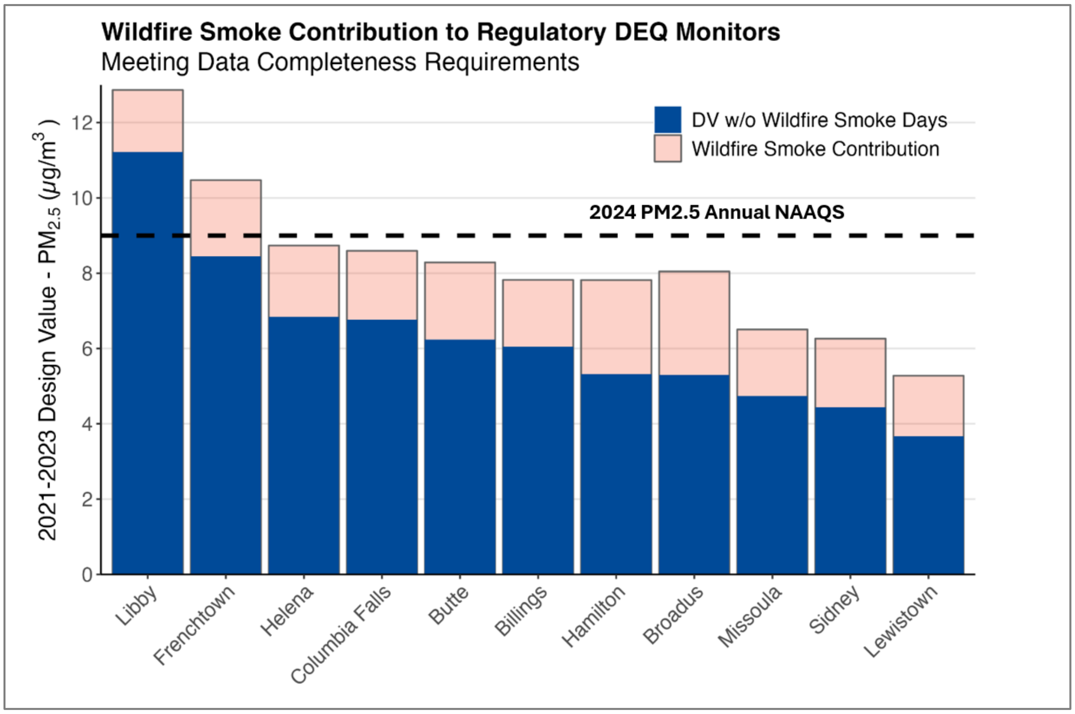
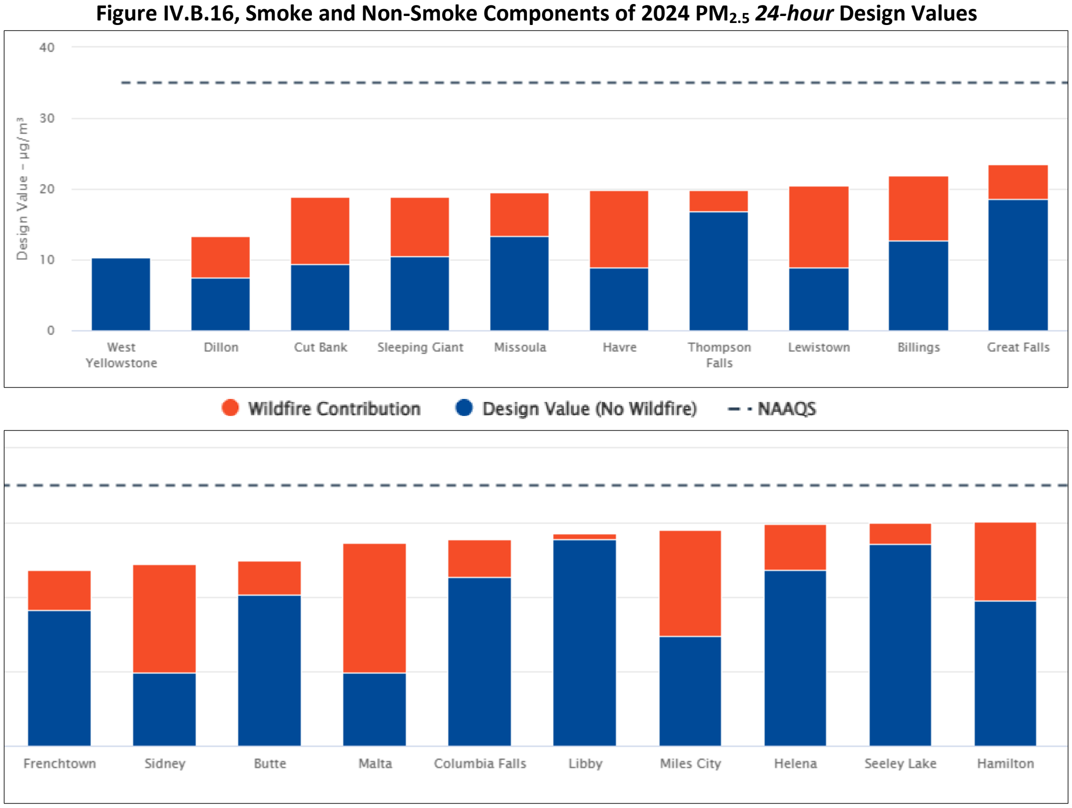


Figure IV.B.16, Smoke and Non-Smoke Components of 2024 $PM_{2.5}$ *24-hour* Design Values



Changes to $PM_{2.5}$ Monitoring

Recently Completed Changes

In June of 2023, MTDEQ proposed discontinuation of FEM $PM_{2.5}$ monitoring at the Broadus site. Monitoring continued through December 10, 2024, when the FEM instrument was replaced with a non-FEM E-BAM, in anticipation of installation of a $PM_{2.5}$ sensor at that location. As proposed, and later approved by EPA, MTDEQ plans to continue to measure $PM_{2.5}$ concentrations in the Broadus area to represent the southeast corner of the state, and to inform the public of any related health impacts, but to do so via a method that does not require regular, resource-intensive site visits for flow checks and maintenance.

MTDEQ completed the installation of FEM $PM_{2.5}$ monitors at Choteau and Glendive in 2023, and these monitors began reporting to AQS on January 1, 2024. As proposed and approved in MTDEQ's 2024 AMNP, an FEM $PM_{2.5}$ monitor was installed at Glasgow in September of 2024.

MTDEQ changed the "monitor type" designation of the Billings-Lockwood $PM_{2.5}$ monitor from "SPM" (special purpose monitor) to "SLAMS" (State or Local Air Monitoring Station). This designation was updated in the EPA AQS database per direction from EPA in its 2024 AMNP approval letter to MTDEQ dated 09/03/2024.

Ongoing Changes

In the 2024 AMNP, MTDEQ initiated plans to address challenges at the existing $PM_{2.5}$ monitoring sites at Bozeman, Great Falls, and Seeley Lake:

- **Bozeman**. Design values published in the 2024 AMNP reflected that an FEM monitor in Bozeman would be required in the newly created Bozeman MSA. While the updated design values included in this document (see Table IV.B.24) do not reflect a *requirement* to do so, MTDEQ is continuing the process to install an FEM $PM_{2.5}$ monitor in the Bozeman MSA. However, because of significant site constraints the existing Bozeman High School monitoring site was determined to be unsuitable for the installation of a monitoring shelter. Therefore, a process is currently underway to identify and secure a new site and to complete installation of equipment in that site.

- **Great Falls**. The Great Falls site was noted in the 2024 AMNP as no longer meeting siting criteria and as experiencing a dilapidated and now unsuitable monitoring shelter. An alternate monitoring location in eastern Great Falls has been identified and approved by EPA. Processes are ongoing to secure the site and install an FEM $PM_{2.5}$ monitor that does not require a full monitoring shelter.

- **Seeley Lake**. The 2024 AMNP discussed ongoing concerns that the Seeley Lake monitoring site is inappropriately impacted by nearby woodstove smoke and therefore not producing measurements reflective of air quality in the entire airshed. As proposed in 2024, research has begun to determine whether that concern is valid, and if so, to research and propose an appropriate response. MTDEQ is working in collaboration with the Missoula County Health Department to analyze and compare data from two community-wide saturation monitoring studies and an on-going study with multiple PurpleAir sensors, to determine the most appropriate location of future $PM_{2.5}$ monitoring in the Seeley Lake area.

Proposed Changes

As introduced in sections above regarding O_3 and NO_2, MTDEQ proposes the termination of $PM_{2.5}$ monitoring at the Sidney (30-083-0002) and Miles City (30-017-0005) monitoring sites. Those monitors were established to evaluate ambient air quality impacts from oil well development and potential coal bed methane development, respectively, and to define regional pollutant concentrations. The monitors have fulfilled their intended investigatory purposes and there is no substantial air quality benefit to be gained by their continued operation. Montana's modest monitoring resources can be better invested elsewhere. Therefore, MTDEQ is proposing to end $PM_{2.5}$ monitoring at Sidney and Miles City. However, MTDEQ believes that there *is* significant benefit to providing health-related $PM_{2.5}$ data to the public in these communities. Therefore, MTDEQ proposes to close the Sidney and Miles City stations and to install multi-pollutant air sensors, including $PM_{2.5}$, in the community of Sidney and in replacement of the existing Miles City FEM site.

In addition, MTDEQ will continue to place particular emphasis on sensor-based community and local-scale $PM_{2.5}$ monitoring in Montana's historically underserved and at-risk populations. MTDEQ is continuing to expand its $PM_{2.5}$ sensor-based monitoring capabilities in 2025 and in the foreseeable future to provide more local-based $PM_{2.5}$ information to Montana's population. Section V discusses MTDEQ's sensor monitoring network.

NCore Monitoring

Section 3 of Appendix D to 40 CFR 58 requires that each state operate at least one NCore multipollutant monitoring site. By definition, each NCore site must include monitoring equipment to measure $PM_{2.5}$, speciated $PM_{2.5}$, $PM_{10-2.5}$, O_3, SO_2, CO, NO (nitric oxide), NO_Y (a range of nitrogen oxide compounds), and meteorology. The majority of NCore sites across the nation are established in urban areas. In Montana however, the NCore site was established near a wilderness area as a long-term trend background site in an area believed to be relatively pristine and un-impacted by anthropogenic pollutant sources. Montana's NCore site (Sieben's Flat (a.k.a. Sleeping Giant), 30-049-0004) was established in late 2010. Data is continuously being acquired from all required monitors. Previous sections of this Plan include summaries of pollutant data monitored at NCore.

In addition to criteria pollutants, the monitoring directives in 40 CFR Appendix D Section 4.8.1 contain specific requirements for the operation of monitors for $PM_{10-2.5}$ at NCore sites. This requirement is fully met at Montana's NCore site. Table IV.B.25 summarizes the $PM_{10-2.5}$ data collected at the MTDEQ NCore site during 2024.

Table IV.B.25 – 1-Hour Monitored $PM_{10-2.5}$ Values at NCore for 2024, in $\mu g/m^3$

Pollutant	Min	Max	Average
$PM_{10-2.5}$	0	73	1.5

General Monitoring Network Design Considerations

A. Monitors Not Meeting Siting Criteria

MTDEQ designs its network and operates its air monitoring sites in compliance with EPA's national requirements for ambient air monitoring sites (40 CFR Part 58, Appendices A, C, D and E). Within MTDEQ's network there are two sites that do not meet all the siting requirements of 40 CFR Part 58, Appendix E.

First, the Hamilton $PM_{2.5}$ site (30-081-0007) is located within 15 meters of paved city streets but is operated as a neighborhood-scale site and not established as a "traffic corridor" monitor as discussed in 40 CFR 58 Appendix E Section 6.3. The roads receive low traffic counts, and EPA has approved (granted a waiver) for the continued operation of this site as a neighborhood-scale site in response to previous AMNP documents submitted by MTDEQ.

Second, the Great Falls $PM_{2.5}$ site (Overlook Park, 30-013-0001) does not meet siting requirements for distance from obstructing trees. As discussed in previous sections MTDEQ is engaged in a project to move the Great Falls $PM_{2.5}$ monitoring site and anticipates that the new site will be operational before the end of 2025.

B. Quality Assurance Project Plan (QAPP)

Federal rules and associated guidance establish a detailed and appropriate system of quality requirements and direction with respect to ambient monitoring; and MTDEQ operates its monitoring network within these requirements. Of note is the requirement in 40 CFR 58 Appendix A, Section 2, for each monitoring organization to develop and describe its quality system within a written QAPP. The Administrative Rules of Montana (ARM) establish similar QAPP requirements for all compliance-related ambient air monitoring conducted in the state (ARM 17.8.204). MTDEQ completed a 5-year update of its QAPP on June 15, 2023, and a subsequent annual update on December 11, 2024. Both documents were submitted to EPA Region 8 and posted for public access on the MTDEQ website. MTDEQ intends to continue performing annual reviews of its QAPP.

C. Summary of Proposed Regulatory Network Changes

Overview

MTDEQ regards the requirement to develop and submit an AMNP and a 5-Year Network Assessment as opportunities to review its existing air monitoring network and to plan for future needs. In the process of producing this document, MTDEQ reviews air pollutant trends, known and projected emission changes, revisions to the NAAQS and monitoring rules, and the needs of Montana's population to receive appropriate and timely information related to ambient air quality impacts. Based on that breadth of understanding, MTDEQ attempts to balance monitoring requirements and needs against available resources.

Depending on the immediacy of the need for programmatic changes, near-term network modifications are typically proposed in the AMNP while longer-term or broader programmatic evaluation and direction of MTDEQ's air quality surveillance system is addressed within the 5-year Network Assessment. MTDEQ also anticipates occasional changes to the focus and direction of Montana's air monitoring network in response to federal rulemaking, available funding, and nation-wide policy direction; with resulting network modification proposals following within an appropriate time window. In this document, all those focuses are woven together.

Proposed Changes

MTDEQ proposes the following changes to its air monitoring network for the 2025 through 2030 planning period. The proposals are listed by pollutant and summarized from descriptions and details in previous sections in the document. Links are provided to make reference back to those sections easier for the reader. Figure IV.C.1 provides a map of the stations at which changes are being proposed.

O_3 Changes [Click to link to the O_3 Section]

1. **Sidney** (30-083-0002). End O_3 monitoring. Add an O_3 sensor in the Sidney community.
2. **Miles City** (30-017-0005). End O3 monitoring.
3. **Bozeman** (New Site). Add a new O_3 monitor.

NO_2 Changes [Click to link to the NO2 Section]

1. **Sidney** (30-083-0002). End NO_2 monitoring. Add an O_3/NO_2/$PM_{2.5}$ sensor in the Sidney community.
2. **Miles City** (30-017-0005). End NO_2 monitoring.
3. **Bozeman** (New Site). Add a new NO_2 monitor. Approved by EPA in 2024.
4. **Missoula** (30-063-0024). Add a new NO_2 monitor. Approved by EPA in 2024.

PM_{10} Changes [Click to link to the PM_{10} Section]

1. **Kalispell** (30-029-0047). End PM_{10} monitoring. Consolidate all PM_{10} monitoring in the valley at the existing Flathead Valley site (30-029-0049).

2. **Whitefish** (30-029-0009). End PM_{10} monitoring. Consolidate all PM_{10} monitoring in the valley at the existing Flathead Valley site (30-029-0049).

3. **Sidney** (30-083-0002). End PM_{10} monitoring at this remote site and install a sensor monitor in the community of Sidney.

$PM_{2.5}$ Changes [Click to link to the $PM_{2.5}$ Section]

1. **Bozeman** (New Site). End the existing information-only $PM_{2.5}$ monitoring at the Bozeman High School site (30-031-0019) and install and operate an FEM $PM_{2.5}$ monitor at a new, regionally representative site. Approved by EPA in 2024.

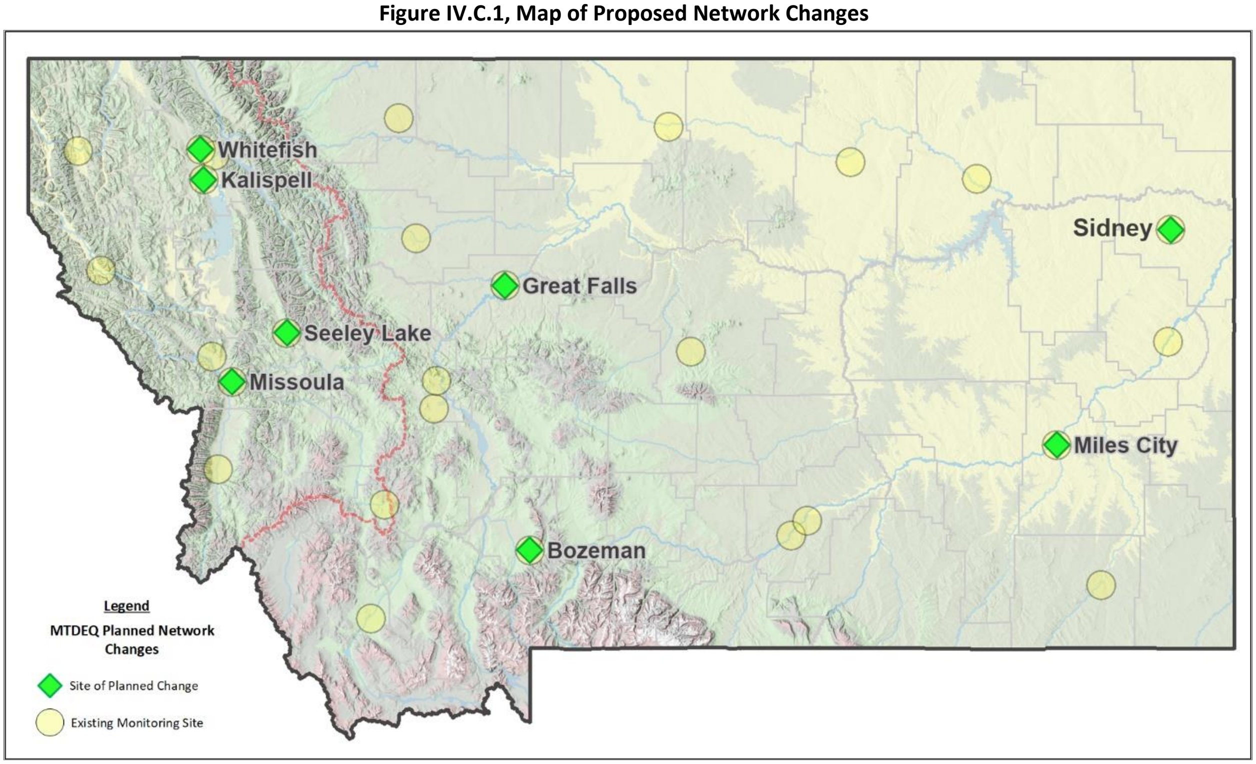
2. **Sidney** (30-083-0002). End $PM_{2.5}$ monitoring. Add an O_3/NO_2/$PM_{2.5}$ sensor in the Sidney community.

3. **Miles City** (30-017-0005). End $PM_{2.5}$ monitoring. Add an O_3/NO_2/$PM_{2.5}$ sensor in place of the existing FEM monitoring station.

4. **Great Falls** (30-013-0001). End $PM_{2.5}$ monitoring at the existing site and establish a new FEM/SLAMS site in eastern Great Falls that meets siting criteria. Approved by EPA.

5. **Seeley Lake** (30-063-0038). Continue research into the representativeness of the existing $PM_{2.5}$ monitoring site. Based on the results of the study either leave the existing site in place or propose a new site more representative of the Seeley airshed and install an FEM monitor there.

Figure IV.C.1, Map of Proposed Network Changes



V. MTDEQ Sensor Monitoring Network

A. Background

As introduced in Section II and referenced throughout this document, MTDEQ designs, establishes and operates its statewide air monitoring network in pursuit of three essential objectives:

1. Provide air pollution data to the general public in a timely manner.

2. Support compliance with ambient air quality standards (the NAAQS) and emissions strategy development.

3. Support air pollution research studies.

New and developing monitoring technology is proving to be of increasing value in achieving these objectives, particularly with objectives 1 and 3: to provide quality air pollution data to the public, and to support research to better understand air pollution dynamics in the state of Montana. The new technology includes devices referred to as “air sensors” that are typically small and of low cost, enabling their use in large numbers and many locations at greatly reduced acquisition and operating costs. These attributes make sensors an ideal monitoring option for Montana because of the state’s large size and low population density. Sensor measurements can provide monitoring data in spatial gaps to provide a more comprehensive understanding of Montana’s air quality.

$PM_{2.5}$ continues to be the pollutant of greatest concern in Montana, and MTDEQ is committed to continuously improving its efforts to measure and communicate local $PM_{2.5}$ concentrations and related potential health impacts to all the state’s citizens. Of particular focus are under-served communities where air quality information is not currently available; sensor technology is ideal for addressing this data need. Section V.B summarizes MTDEQ’s efforts to deploy PurpleAir sensors for this purpose.

The data quality of sensor devices is known to be less precise and accurate compared to regulatory-grade instrumentation. To increase data quality assurance from $PM_{2.5}$ sensor devices, MTDEQ deploys sensor equipment as part of a three-tiered quality assurance spatial network that allows for data comparison and confirmation between nearby devices of different types and quality. The tiered approach to $PM_{2.5}$ monitoring in the state of Montana includes the following components:

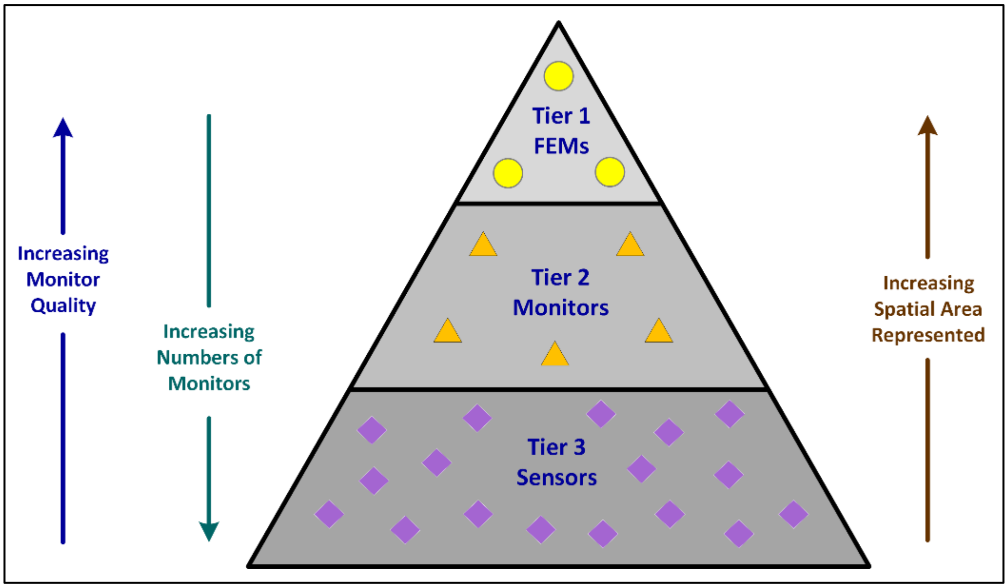
- Tier 1 – SLAMS/FEM continuous $PM_{2.5}$ Monitors,

- Tier 2 – Intermediate monitors such as EBAMs and higher technology sensors, and

- Tier 3 – Personal or consumer-grade air sensors such as PurpleAir devices.

Figure V.A.1 displays this relationship graphically.

Figure V.A.1, MTDEQ $PM_{2.5}$ Measurement Quality Hierarchy



MTDEQ's pursuit of the Tier 2 sensors listed in Figure V.A.1 has resulted in the identification and use of a sensor device type that is capable of measuring several gaseous pollutants in addition to $PM_{2.5}$. These devices, the MODULAIR™ air quality sensor manufactured by QuantAQ, Inc., will also likely be valuable in providing cost-effective, screening-level monitoring for gaseous pollutants around the state.

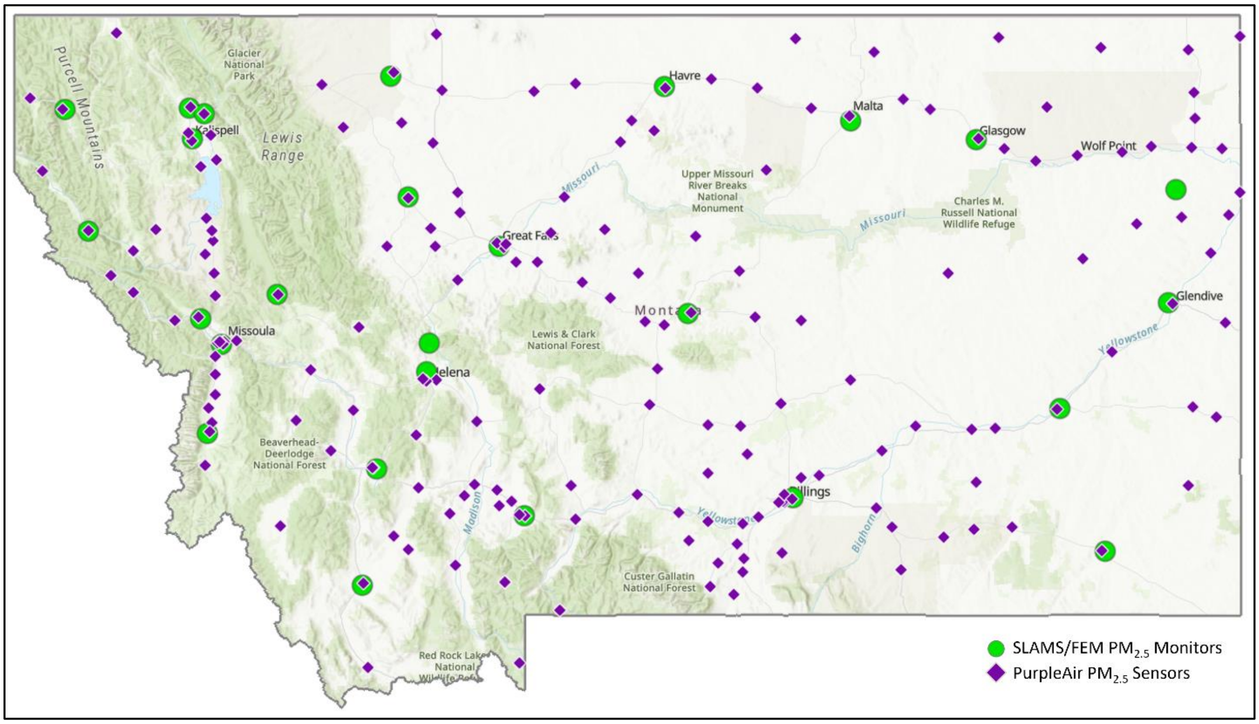
The following sections provide background and detail for MTDEQ's two sensor network programs: the Tier 3 PurpleAir Sensor Network, and the Tier II MODULAIR™ Sensor Network.

B. PurpleAir Sensor Network

MTDEQ is partnering with the Research Education on Air and Cardiovascular Health (REACH) program at the University of Montana School of Public and Community Health Sciences (UM SPCHS) to conduct the PurpleAirs in Schools program. This initiative focuses on filling the air quality data gaps in rural and underserved Montana communities by installing non-regulatory PurpleAir PM sensors (PurpleAir, Inc, USA) at high schools across the state. The sensor project builds upon the four core objectives of the REACH program: citizen science, science communication, student mentoring and teacher professional development. The overall project goal is to improve access to local air quality data and facilitate better public health messaging in communities that have previously had no local data available. Through the cross-sector collaboration between MTDEQ and the UM SPCHS REACH program, a direct effort is being made to tackle public and environmental health disparities linked to air pollution in underserved rural and tribal regions of Montana.

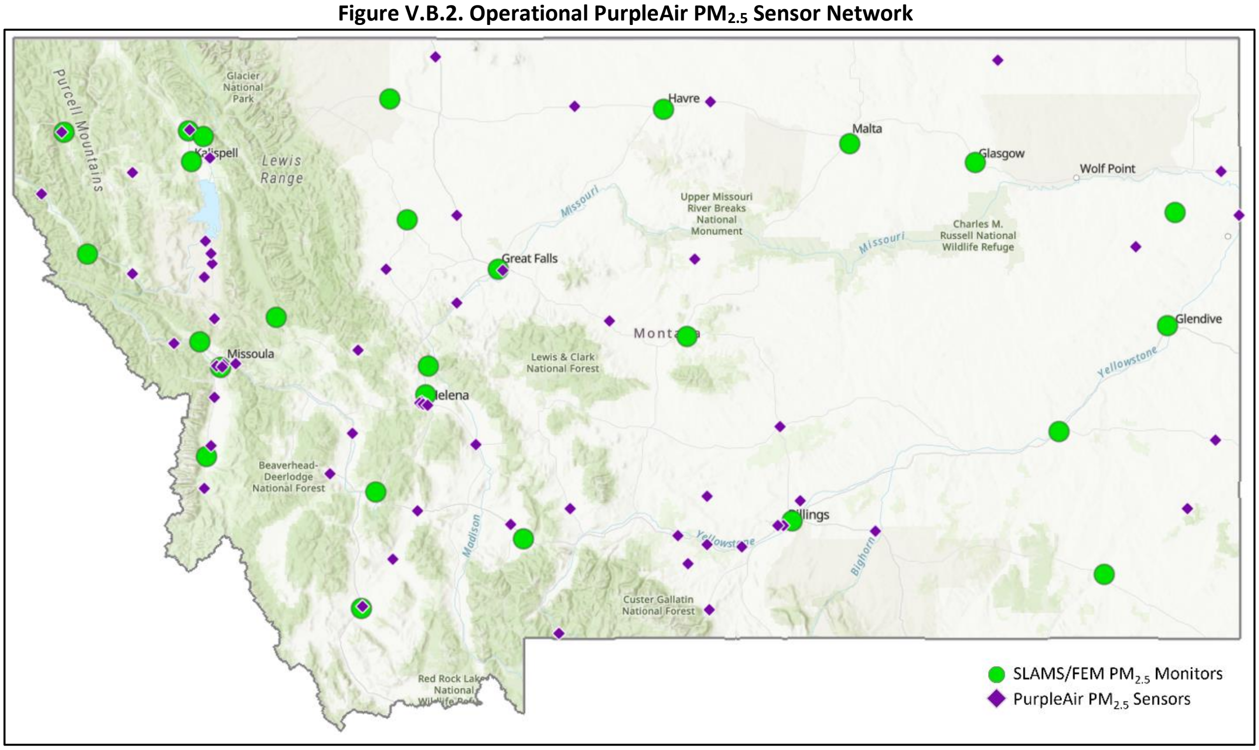
The aim of the PurpleAirs in Schools program is to install two PurpleAir sensors (one indoor and one outdoor), free of charge, at every high school in the state, totaling 182 schools. Figure V.A.2 shows the proposed locations of the PurpleAir sensors across Montana. The sensors are deployed and operated within the measurement quality hierarchy described in Figure V.B.1. To further ensure the quality of data reported by the PurpleAirs in Schools program, MTDEQ has collocated PurpleAir sensors at each of its 26 FEM continuous $PM_{2.5}$ monitors to facilitate direct data comparisons.

Figure V.B.1. Proposed Locations, PurpleAir $PM_{2.5}$ Sensors



Two years into the expected three-year project period, the PurpleAirs in Schools program has deployed paired PurpleAir sensors to 117 schools. Of those 117 schools, 64 schools have installed the sensors and are reporting real-time data. Figure V.B.2 shows the locations of the operational PurpleAir sensors installed as part of this program.

Figure V.B.2. Operational PurpleAir $PM_{2.5}$ Sensor Network



In the final year of the project period, MTDEQ will focus on getting the remaining 53 already-deployed school sensors online, as well as recruiting the remaining schools that are interested in participating in this program. Table V.B.1 summarizes the current status of program implementation.

Table V.B.1. PurpleAir $PM_{2.5}$ Sensor Network Implementation

Network	Number of Proposed Sensors	Number of Deployed Sensors	Number of Operational Sensors
PurpleAirs in Schools	182	117	64
Collocation	26	26	26

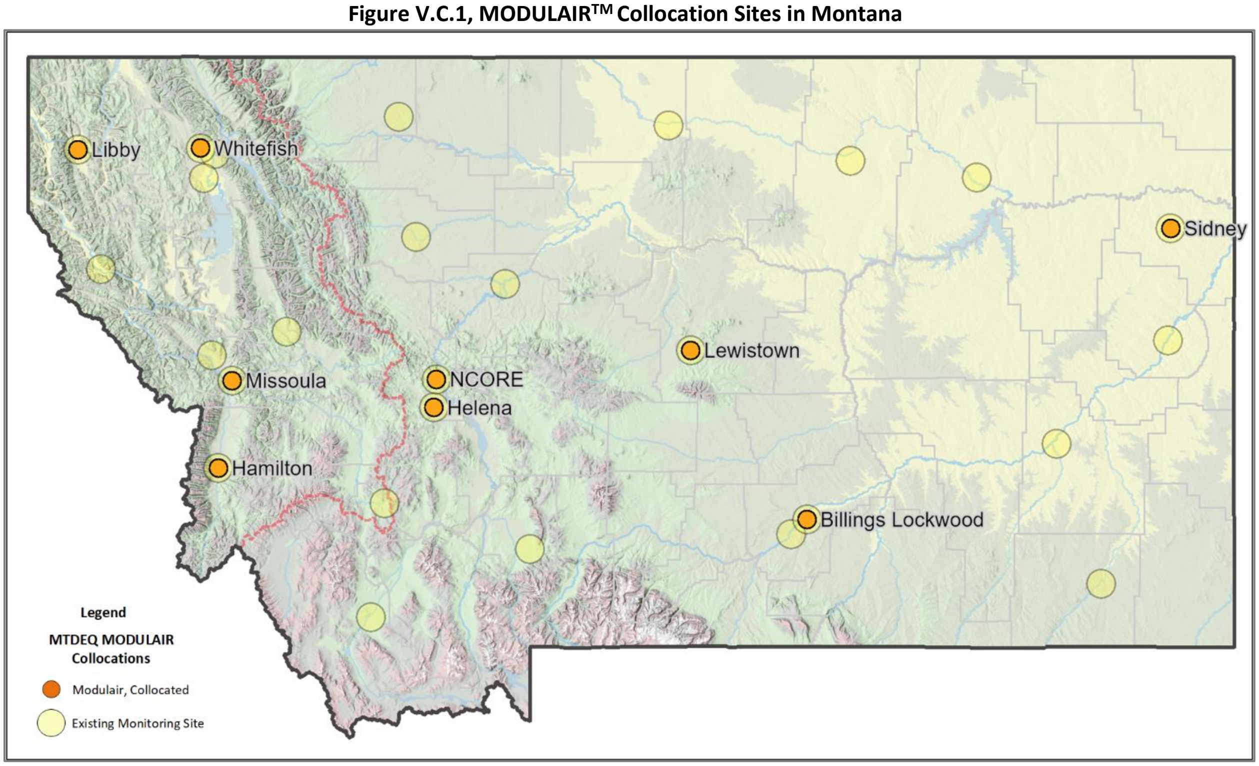
C. MODULAIR™ Sensor Network

The MODULAIR™ device is a non-regulatory air quality sensor manufactured by QuantAQ, Inc. It measures multiple sizes of particulate matter: PM_1, $PM_{2.5}$ and PM_{10}, as well as four gaseous air pollutants: CO, NO, NO_2 and O_3. This sensor is planned for deployment as an informational multipollutant monitor to improve the spatial resolution of MTDEQ's monitoring network. Testing and deployment of the MODULAIR™ sensors by MTDEQ is being conducted in three phases as described in the following.

Phase 1- Collocation

The first phase of this network development is to build a robust collocation dataset across all pollutant parameters by collocating MODULAIR™ units at select PM and gaseous pollutant FEM measurement sites. This effort is intended to collect multiple months of data across different seasons and locations throughout Montana. Figure V.C.1 displays MTDEQ's MODULAIR™ current collocation sites across Montana.

Figure V.C.1, MODULAIR™ Collocation Sites in Montana



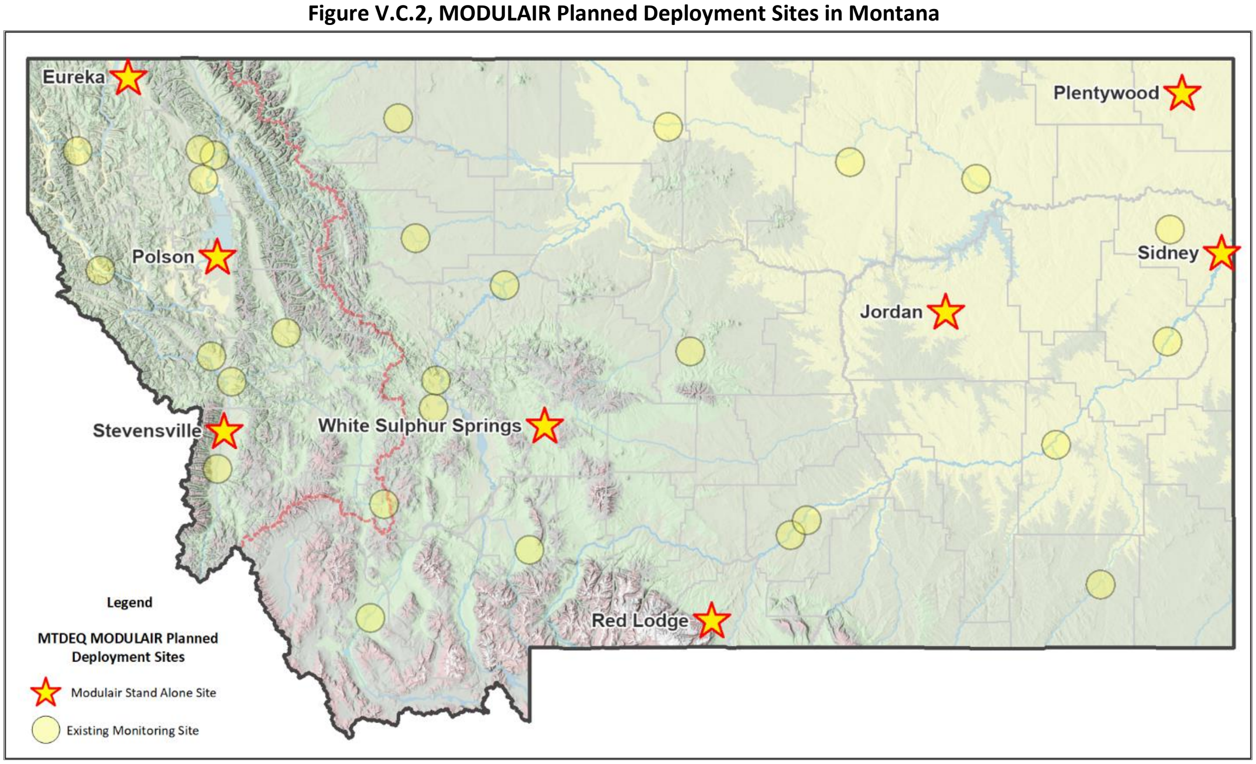
Phase 2- Analysis

The second phase of this network development is to perform statistical analysis and modeling on the collected data. The intent is to determine the size and direction of any bias between the sensors and the collocated regulatory-grade monitors across a wide range of spatial locations, environmental conditions and concentration ranges. The desired product of this analysis is to quantify and then improve the accuracy of the MODULAIR™ sensor measurements using only onboard sensor inputs from each monitored pollutant and two meteorological sensors measuring relative humidity and temperature. As such, increased confidence in MODULAIR™'s accuracy and reliability can be obtained before the units are deployed for real-time community-level monitoring. This project will follow studies and guidance developed by the EPA related to sensor collocation, performance and accuracy. MTDEQ's MODULAIR™ collocation, assessment and correction began in the 4th quarter of 2023 at several $PM_{2.5}$ monitoring sites and will likely continue through 2025 for the other MODULAIR™-measured pollutants.

Phase 3- Deployment

The third phase of this project will begin once MODULAIR™ accuracy has been assessed and corrected as necessary. At that time, MODULAIR™ units will be deployed as stand-alone units in strategic locations to enhance the spatial representation of pollutant monitoring across Montana. Some site locations will be established as Tier 2 $PM_{2.5}$ monitors as described in Section V.A., while others will serve as screening-level monitoring for gaseous pollutants, providing background concentration data and informing the need for future FEM monitoring. Figure V.C.2 displays MTDEQ's currently planned MODULAIR™ stand-alone deployments.

Figure V.C.2, MODULAIR Planned Deployment Sites in Montana



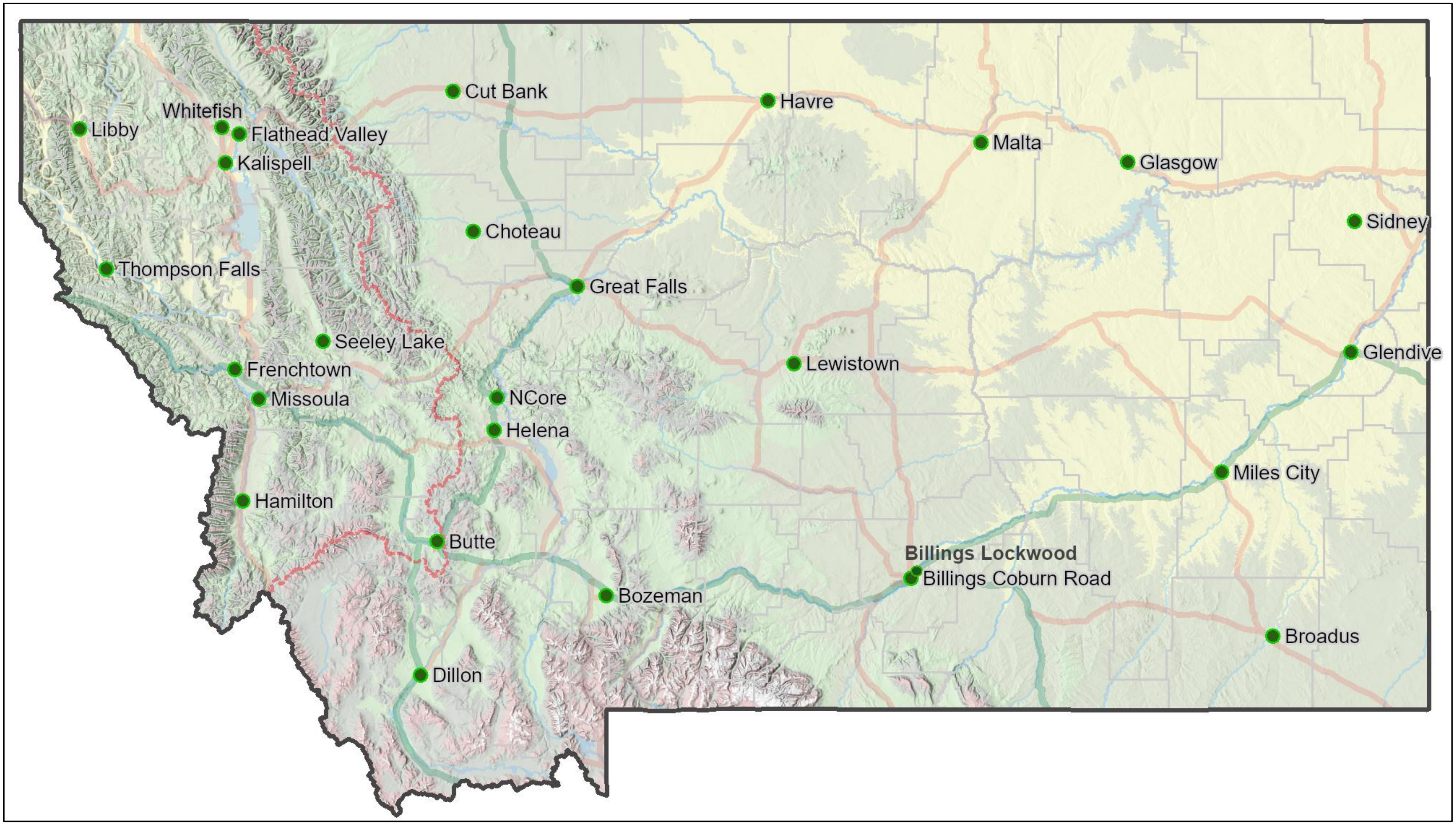
VII. Appendices

Appendix A – Regulatory Monitoring Site Locations

Montana Ambient Air Monitoring Site Location Summary

AQS No.	City - Site Name	Site Extended Name	Montana Address	Longitude	Latitude	CBSA Designation	CBSA Name and ID #
30-111-0066	Billings	Coburn Road	624 Coburn Rd.	-108.4588044	45.78658967	Metro	Billings, MT, 13740
30-111-0087	Billings	Lockwood	2320 Old Hardin Road	-108.4259778	45.80631194	Metro	Billings, MT, 13740
30-031-0019	Bozeman	High School	N 15th Avenue, H.S. Parking Lot	-111.0563273	45.6837732	Metro	Bozeman, MT, 14580
30-075-0001	Broadus	Powder River	Big Powder River Road East	-105.3702829	45.440296	--	--
30-093-0005	Butte	Greeley School	Alley Btwn N. Park Pl. and S. Park Pl.	-112.5012714	46.0025949	Micro	Butte-Silver Bow, MT, 15580
30-099-0005	Chouteau		1098 10th St NW	-112.193629	47.82031	--	--
30-035-0022	Cut Bank		Cut Bank Airport, 2705 Valier Hwy	-112.3670368	48.6065497	--	--
30-001-0003	Dillon		State Hwy 91 S. and Barrett St.	-112.6425161	45.2064423	--	--
30-029-0049	Columbia Falls	Flathead Valley	610 13th St West	-114.1892571	48.3637028	Micro	Kalispell, MT, 28060
30-063-0037	Frenchtown	Beckwith	16134 Beckwith Street	-114.2242651	47.0129068	Metro	Missoula, MT, 33540
30-105-0003	Glasgow		54059 U.S. Hwy 2	-106.641553	48.211816	--	--
30-021-0005	Glendive		Corner of 8th St. and B Ave.	-104.751716	47.120696	--	--
30-013-0001	Great Falls	Overlook Park	10th Ave. S. and 2nd St. E.	-111.3033456	47.4943197	Metro	Great Falls, MT, 24500
30-081-0007	Hamilton	PS#46	Madison and 3rd St. S.	-114.1588734	46.2436362	--	--
30-041-0002	Havre		Btwn 13th Street and College Rd, MSUI	-109.684505	48.540334	--	--
30-049-0026	Helena	Rossiter Pump House	1497 Sierra Rd. East	-112.0130838	46.6587565	Metro	Helena, MT, 25740
30-029-0047	Kalispell	Flathead Electric	E Center St. and Woodland Ave.	-114.3054439	48.2004933	Micro	Kalispell, MT, 28060
30-027-0006	Lewistown		303 East Aztec Drive	-109.4553425	47.048515	--	--
30-053-0018	Libby	Courthouse Annex	418 Mineral Ave.	-115.552457	48.3917035	--	--
30-071-0010	Malta		2309 Short Oil Road	-107.8622736	48.3175183	--	--
30-017-0005	Miles City	Pine Hills	3636 Leighton Blvd.	-105.8127117	46.4114565	--	--
30-063-0024	Missoula	Boyd Park	3100 Washburn Rd.	-114.0205593	46.842296	Metro	Missoula, MT, 33540
30-049-0004	NCore	Sieben's Flat	I-15 Exit 209, then Sperry Dr.	-111.9871778	46.8505192	Metro	Helena, MT, 25740
30-063-0038	Seeley Lake	Elementary School	School Lane	-113.476182	47.1756297	Metro	Missoula, MT, 33540
30-083-0002	Sidney	201	Intersection of Hwy 201 and Cnty R 326	-104.6769911	47.8679845	Micro	Helena, MT, 25740
30-089-0007	Thompson Fall	High School	Golf St and Haley Ave	-115.3237609	47.594403	--	--
30-029-0009	Whitefish	Dead End	End of 10th St.	-114.335976	48.4005325	Micro	Kalispell, MT, 28060

Montana Ambient Air Monitoring Network 2025



Appendix B -- Monitoring Network Parameter and Equipment Summary

Site Abr.	Site Name	AQS Number	Pollutant	Parameter-POC	Method			Operating Schedule[4]	Type[5]	Monitoring Objective[6]	Spatial Scale	Proposed Change ?
					Code	Note[2]	PM[3]					
CB	Billings-Coburn	30-111-0066	SO_2	42401-1	600	37		Continuous	SLAMS	H,S	Neigh.	
			SO_2 - 5 min	42406-1	600	37		Continuous	SLAMS	H,S	Neigh.	
LW	Billings-Lockwood	30-111-0087	$PM_{2.5}$	88101-3	170	3	FEM	Continuous	SPM	P	Neigh.	
			NO	42601-1	599	32		Continuous	SLAMS	P	Neigh.	
			NO2	42602-1	599	32		Continuous	SLAMS	P	Neigh.	
			NOX	42603-1	599	32		Continuous	SLAMS	P	Neigh.	
			O3	44201-1	87	35		Continuous	SLAMS	P	Neigh.	
BH	Bozeman	30-031-0019	NO	Planned								✓
			NO_2	Planned								✓
			NO_x	Planned								✓
			O_3	Planned								✓
			$PM_{2.5}$	88101		5	Non	Continuous	E-BAM	P	Neigh.	✓
BD	Broadus	30-075-0001	$PM_{2.5}$	88101-3			*Non*	Continuous	NR	B	Regional	✓
BN	Butte	30-093-0005	PM_{10}	81102-4	122	2	FEM	Continuous	SLAMS	H,P	Neigh.	
			$PM_{2.5}$	88101-3	209	8	FEM	Continuous	SLAMS	H,P, QA Coll-2	Neigh.	
			$PM_{2.5}$	88101-2	116	1	FRM	1 in 6 Coll	SLAMS	H,P QA Coll	Neigh.	
			$PM_{2.5}$ Spc'n	Various		7		1 in 6	SLAMS CSN	H,P	Neigh.	
CH	Choteau	30-099-0005	$PM_{2.5}$	88101-3	209	8	FEM	Continuous	SLAMS	P	Neigh.	
CK	Cut Bank	30-035-0022	$PM_{2.5}$	88101-3	209	8	FEM	Continuous	SLAMS	P	Neigh.	
DN	Dillon	30-001-0003	$PM_{2.5}$	88101-3	209	8	FEM	Continuous	SLAMS	P	Neigh.	
FV	Flathead Valley	30-029-0049	PM_{10}	81102-1	122	2	FEM	Continuous	SLAMS	P	Neigh	
			$PM_{2.5}$	88101-3	170	3	FEM	Continuous	SLAMS	P	Neigh	
FT	Frenchtown	30-063-0037	$PM_{2.5}$	88101-3	170	3	FEM	Continuous	SLAMS	P	Neigh.	
GW	Glasgow	30-105-0003	$PM_{2.5}$	88101-3	209	8	FEM	Continuous	SLAMS	P	Neigh.	
GL	Glendive	30-021-0005	$PM_{2.5}$	88101-3	209	8	FEM	Continuous	SLAMS	P	Neigh.	
OP	Great Falls	30-013-0001	$PM_{2.5}$	88502-3	731	4	Non	Continuous	SPM-NR	P	Middle	✓
PS	Hamilton	30-081-0007	$PM_{2.5}$	88101-3	170	3	FEM	Continuous	SLAMS	H,P	Neigh.	
HV	Havre	30-041-0002	$PM_{2.5}$	88101-1	209	8	FEM	Continuous	SLAMS	P	Neigh.	
RP	Helena	30-049-0026	$PM_{2.5}$	88101-3	183	10	FEM	Continuous	SLAMS	H,P, QA Coll-3	Neigh.	
			$PM_{2.5}$	88101-4	170	3	FEM	Continuous	SPM	H,P QA Cont-Coll	Neigh.	
			$PM_{2.5}$	88101-2	116	1	FRM	1 in 6 Coll	SLAMS	H,P QA Coll	Neigh.	
FE	Kalispell	30-029-0047	PM_{10}	81102-1	122	2	FEM	Continuous	SLAMS	H,P	Neigh.	✓
LT	Lewistown	30-027-0006	NO	42601-1	599	32		Continuous	SPM	B	Regional	
			NO_2	42602-1	599	32		Continuous	SPM	B	Regional	
			NO_x	42603-1	599	32		Continuous	SPM	B	Regional	
			O_3	44201-1	47	36		Continuous	SPM	B	Regional	
			PM_{10}	81102-1	150	9	FEM	Continuous	SPM	B	Neigh.	
			$PM_{2.5}$	88101-3	183	10	FEM	Continuous	SPM	B	Regional	
LB	Libby	30-053-0018	PM_{10}	81102-1	150	9	FEM	Continuous	SLAMS	H,P	Neigh.	
			$PM_{2.5}$	88101-3	183	10	FEM	Continuous	SLAMS	H,P	Neigh.	
ML	Malta	30-071-0010	$PM_{2.5}$	88101-3	183	10	FEM	Continuous	SPM	B	Regional	
MC	Miles City	30-017-0005	NO	42601-1	599	32		Continuous	SLAMS	B	Regional	✓
			NO_2	42602-1	599	32		Continuous	SLAMS	B	Regional	✓
			NO_x	42603-1	599	32		Continuous	SLAMS	B	Regional	✓
			O_3	44201-1	87	35		Continuous	SLAMS	B	Regional	✓
			$PM_{2.5}$	88101-3	183	10	FEM	Continuous	SLAMS	B	Regional	✓
MS	Missoula	30-063-0024	NO	Planned								✓
			NO_2	Planned								✓
			NO_x	Planned								✓
			O_3	44201-1	47	36		Continuous	SLAMS	P	Urban	
			PM_{10}	81102-6	122	2	FEM	Continuous	SLAMS	H,P	Neigh.	
			$PM_{2.5}$	88101-3	170	3	FEM	Continuous	SLAMS	H,P	Neigh.	
NC	NCore	30-049-0004	CO	42101-1	554	30		Continuous	SLAMS	B	Region	
			NO	42601-1	674	34		Continuous	SLAMS	B	Region	
			NOy	42600-1	674	34		Continuous	SLAMS	B	Region	
			NO_{diff}	42600-1	674	34		Continuous	SLAMS	B	Region	
			O_3	44201-1	47	36		Continuous	SLAMS	B	Region	
			SO_2	42401-1	600	37		Continuous	SLAMS	B	Region	
			SO_2 - 5 min	42406-1	600	37		Continuous	SLAMS	B	Region	
			$PM_{2.5}$	88101-3	170	3	FEM	Continuous	SLAMS	B, QA Coll-1	Region	
			$PM_{2.5}$	88101-1	116	1	FRM	1 in 6 / 3	SLAMS	B, QA Coll	Region	
			$PM_{2.5}$	88101-2	116	1	FRM	1 in 6 / 3	SLAMS	B, QA Coll	Region	
			$PM_{2.5}$ Spc'n	Various		7		1 in 3	SLAMS CSN	B	Region	
			$PM_{10\text{-}2.5}$	86101-1	185	6	FEM	Continuous	SLAMS	B	Region	
SE	Seeley Lake	30-063-0038	$PM_{2.5}$	88502-3	731	4	Non	Continuous	SPM-NR	P	Neigh.	✓
SD	Sidney 201	30-083-0002	NO	42601-1	599	32		Continuous	SLAMS	S	Neigh.	✓
			NO_2	42602-1	599	32		Continuous	SLAMS	S	Neigh.	✓
			NO_x	42603-1	599	32		Continuous	SLAMS	S	Neigh.	✓
			O_3	44201-1	47	36		Continuous	SLAMS	S	Neigh.	✓
			PM_{10}	81102-1	150	9	FEM	Continuous	SLAMS	S	Neigh.	✓
			$PM_{2.5}$	88101-3	183	10	FEM	Continuous	SLAMS	S	Neigh.	✓
TF	Thompson Falls	30-089-0007	PM_{10}	81102-3	122	2	FEM	Continuous	SLAMS	P	Neigh.	
			$PM_{2.5}$	88502-3	731	4	Non	Continuous	SPM-NR	P	Neigh.	
DE	Whitefish	30-029-0009	PM_{10}	81102-1	122	2	FEM	Continuous	SLAMS	P	Neigh.	✓

See notes next page…

Footnotes

Method

(2) Note

Note	Poll.	Mth'd	Description
1	PM	116	BGI-PQ200 with very sharp cut cyclone (FRM)
2	PM	122	Met One BAM 1020 Beta Attenuation Monitor (PM10 FEM)
3	PM	170	Met One FEM BAM 1020 Beta Attenuation Monitor with PM2.5 very sharp cut cyclone (PM2.5 FEM ***regulatory***)
4	PM	731	Met One BAM 1020 Beta Attenuation Monitor with PM2.5 sharp cut cyclone (SCC) ("FRM-like," ***non-regulatory***)
6	Coarse	185	Met One BAM 1020 PM10-2.5 measurement system -- Paired beta attenuation monitors (FEM)
7	PM		Met One SASS / URG Speciation Air Sampling System
8	PM	209	Met One 1022 FEM E-BAM Beta Attenuation Monitor with PM2.5 very sharp cut cyclone (VSCC)
9	PM	150	Thermo Scientific 5014i Beta Attenuation Monitor for PM10 (FEM)
10	PM	183	Thermo Scientific, 5014i Beta Attenuation Monitor for PM2.5 (FEM)
30	CO	554	Thermo Model 48i-TLE Enhanced **Trace Level** CO analyzer
31	NOx	256	Teledyne API Model N500 **Trace Level** Cavity-Attenuated Phase-Shift (CAPS) spectroscopy NO2
32	NOx	599	Teledyne API Model T200U **Trace Level** Chemiluminescence analyzer NO/NOx/NO2 (FRM)
34	NOy	674	Thermo Model 42i-Y. NO-DIF-NOy chemiluminescent specialty **Trace Level** gas analyzer
35	O_3	87	Teledyne API Model T400 UV Photometric O3 analyzer (FEM)
36	O_3	47	Thermo Model 49i UV Photometric O3 analyzer (FEM)
37	SO_2	600	Teledyne API Model T100U **Trace Level** Ultraviolet SO2 fluorescence (FEM)

Not Currently in the ARMS Network

Note	Poll.	Mth'd	Description
5	PM		Met One E-BAM Beta Attenuation Monitor with PM2.5 sharp cut (SCC) or very sharp cut cyclone (VSCC)
33	NOx	574	Thermo Model 42i TL **Trace Level** Chemiluminescence NO/NOx/NO2 analyzer (FRM)

(3) PM

Particulate Matter Monitor Type:

FRM	Federal Reference Method,
FEM	Federal Equivalent Method
Non	Public Info Only - Not FEM or FRM method (not usable for NAAQS comparisons)

(4) Operating Schedule

Continuous	Samples continuously, reports a result at the end of each hour
1 in 6	Collects a 24-hour sample every 6 days
1 in 6 / 3	One of a pair of FRM samplers. Each collects a sample every 6 days, but the pair are staggered by three days.
1 in 6 Coll	Collects a 24-hour sample every 6 days as a collocated monitor comparison
1 in 3	Collects a 24-hour sample every 3 days

(5) Type

Monitor Site Type:

SLAMS	State or Local Air Monitoring Station
SPM	Special Purpose Monitor
SLAMS CSN	Chemical Speciation Network
SPM-NR	Special Purpose Monitor, Exists in AQS, but produces Non-Regulatory Data
NR	Nonregulatory, Public Info Only - Not FEM or FRM method (not usable for NAAQS comparisons)

(6) Monitoring Objective Descriptions

B	Background
H	Highest Concentration
P	Population Exposure
S	Source Impact
QA Coll	FRM of a FEM / FRM Collocation
QA Coll-1	BAM 1020 for an FRM Collocation
QA Coll-2	BAM 1022 for an FRM Collocation
QA Coll-3	Thermo 5014i for an FRM Collocation
QA Cont-Coll	Continuous Thermo 5014i / Continuous BAM 1020 Collocation

Appendix C -- $PM_{2.5}$ Speciation Analytes

CSN Parameters

Param Code	Parameter Description	Filter Type	Sampler	Method Code	Unit Code	Unit Description
88401	Reconstructed Mass PM2.5 LC	All	Calculated	819	105	ug/m3 (LC)
68105	Avg. Ambient Temp	Teflon & Nylon	MetOne SASS/SuperSASS	810	017	Degrees C
68108	Avg. Ambient Pressure	Teflon & Nylon	MetOne SASS/SuperSASS	810	059	Millimeters (Hg)
68112	Sample Flow Rate CV	Nylon	MetOne SASS/SuperSASS	812	107	Percent
68115	Sample Volume	Nylon	MetOne SASS/SuperSASS	812	065	Cubic meter
88203	Chloride Ion	Nylon	MetOne SASS/SuperSASS	812	105	ug/m3 (LC)
88301	Ammonium Ion	Nylon	MetOne SASS/SuperSASS	812	105	ug/m3 (LC)
88302	Sodium Ion	Nylon	MetOne SASS/SuperSASS	812	105	ug/m3 (LC)
88303	Potassium Ion	Nylon	MetOne SASS/SuperSASS	812	105	ug/m3 (LC)
88306	Total Nitrate	Nylon	MetOne SASS/SuperSASS	812	105	ug/m3 (LC)
88403	Sulfate	Nylon	MetOne SASS/SuperSASS	812	105	ug/m3 (LC)
88502	PM2.5 mass	Teflon	MetOne SASS/SuperSASS	810	105	ug/m3 (LC)
68111	Sample Flow Rate CV	Teflon	MetOne SASS/SuperSASS	810	107	Percent
68114	Sample Volume	Teflon	MetOne SASS/SuperSASS	810	065	Cubic meter
88348	Soil PM2.5 LC	Teflon	Calculated (SASS)	818	105	ug/m3 (LC)
88102	Antimony (Sb)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88103	Arsenic (As)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88104	Aluminum (Al)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88107	Barium (Ba)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88109	Bromine (Br)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88110	Cadmium (Cd)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88111	Calcium (Ca)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88112	Chromium (Cr)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88113	Cobalt (Co)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88114	Copper (Cu)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88115	Chlorine (Cl)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88117	Cerium (Ce)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88118	Cesium (Cs)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88126	Iron (Fe)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88128	Lead (Pb)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88131	Indium (In)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88132	Manganese (Mn)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88136	Nickel (Ni)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88140	Magnesium (Mg)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88152	Phosphorous (P)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88154	Selenium (Se)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88160	Tin (Sn)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88161	Titanium (Ti)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88164	Vanadium (V)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88165	Silicon (Si)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88166	Silver (Ag)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88167	Zinc (Zn)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88168	Strontium (Sr)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88169	Sulfur (S)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88176	Rubidium (Rb)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88180	Potassium (K)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88184	Sodium (Na)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
88185	Zirconium (Zr)	Teflon	MetOne SASS/SuperSASS	811	105	ug/m3 (LC)
68113	Sample Flow Rate CV	Quartz	URG 3000N	838	107	Percent
68116	Sample Volume	Quartz	URG 3000N	838	065	Cubic meter
68117	Avg. Ambient Temp	Quartz	URG 3000N	838	017	Degrees C
68118	Avg. Ambient Pressure	Quartz	URG 3000N	838	059	Millimeters (Hg)
88320	OC PM2.5 LC TOR	Quartz	URG 3000N	838	105	ug/m3 (LC)
88321	EC PM2.5 LC TOR	Quartz	URG 3000N	838	105	ug/m3 (LC)
88324	OC1 PM2.5 LC	Quartz	URG 3000N	838	105	ug/m3 (LC)
88325	OC2 PM2.5 LC	Quartz	URG 3000N	838	105	ug/m3 (LC)
88326	OC3 PM2.5 LC	Quartz	URG 3000N	838	105	ug/m3 (LC)
88327	OC4 PM2.5 LC	Quartz	URG 3000N	838	105	ug/m3 (LC)
88328	OP PM2.5 LC TOR	Quartz	URG 3000N	838	105	ug/m3 (LC)
88329	EC1 PM2.5 LC	Quartz	URG 3000N	838	105	ug/m3 (LC)
88330	EC2 PM2.5 LC	Quartz	URG 3000N	838	105	ug/m3 (LC)
88331	EC3 PM2.5 LC	Quartz	URG 3000N	838	105	ug/m3 (LC)
88355	OC CSN Unadj. PM2.5 LC TOT	Quartz	URG 3000N	838	105	ug/m3 (LC)
88357	EC CSN Unadj. PM2.5 LC TOT	Quartz	URG 3000N	838	105	ug/m3 (LC)
88370	OC CSN Unadj. PM2.5 LC TOR	Quartz	URG 3000N	838	105	ug/m3 (LC)
88374	OC1 CSN Unadj. PM2.5 LC	Quartz	URG 3000N	838	105	ug/m3 (LC)
88375	OC2 CSN Unadj. PM2.5 LC	Quartz	URG 3000N	838	105	ug/m3 (LC)
88376	OC3 CSN Unadj. PM2.5 LC	Quartz	URG 3000N	838	105	ug/m3 (LC)
88377	OC4 CSN Unadj. PM2.5 LC	Quartz	URG 3000N	838	105	ug/m3 (LC)
88378	OP CSN Unadj. PM2.5 LC TOR	Quartz	URG 3000N	838	105	ug/m3 (LC)
88379	OP PM2.5 LC TOT	Quartz	URG 3000N	838	105	ug/m3 (LC)
88380	EC CSN Unadj. PM2.5 LC TOR	Quartz	URG 3000N	838	105	ug/m3 (LC)
88381	EC PM2.5 LC TOT	Quartz	URG 3000N	838	105	ug/m3 (LC)
88382	OC PM2.5 LC TOT	Quartz	URG 3000N	838	105	ug/m3 (LC)
88383	EC1 CSN Unadj. PM2.5 LC	Quartz	URG 3000N	838	105	ug/m3 (LC)
88384	EC2 CSN Unadj. PM2.5 LC	Quartz	URG 3000N	838	105	ug/m3 (LC)
88385	EC3 CSN Unadj. PM2.5 LC	Quartz	URG 3000N	838	105	ug/m3 (LC)
88388	OP CSN Unadj. PM2.5 LC TOT	Quartz	URG 3000N	838	105	ug/m3 (LC)

OC	Organic Carbon	Teflon filters are for elements.	LC: Local Conditions of Temp and Press
EC	Elemental Carbon	Nylon filters are for ions.	
OP	Organic Pyrolized Carbon (?)	Quartz filters are for carbon.	

SASS: 40 URG: 26 Total Params: 66

Appendix D -- National and Montana Ambient Air Quality Standards

National Ambient Air Quality Standards						Montana Ambient Air Quality Standards *
Pollutant		Primary/ Secondary	Averaging Time	Level	Form	
CO	Carbon Monoxide	primary	8-hour (Average Backward)	9 ppm	Not to be exceeded more than once per year	9 ppm
			1-hour	35 ppm		23 ppm
NO_X	Oxides of Nitrogen with NO_2 as the Indicator	primary	1-hour	100 ppb 40 CFR 50.11	98th percentile of 1-hr daily max conc., avg'd over 3 years	0.30 ppm
		primary and secondary	Annual	53 ppb (2)	Annual Mean	0.05 ppm
O_3	Ozone	primary and secondary	8-hour (Average Foreward)	0.070 ppm (3) 40 CFR 50.19	Annual fourth-highest daily maximum 8-hr concentration,	--
						1-hour 0.10 ppm
SO_2	Sulfur Dioxide	primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily max concentrations, avg'd over 3 years	0.50 ppm
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year	--
						24-hour 0.10 ppm
						Annual 0.02 ppm
Pb	Lead	primary and secondary	Rolling 3 month average	0.15 $\mu g/m^3$ (1)	Not to be exceeded	--
		primary	*Quarterly Average*	***1.5 $\mu g/m^3$*** (1)	*Remains in effect only in E. Helena N.A. Area*	1.5 $\mu g/m^3$
$PM_{2.5}$	Particulate Matter	primary	Annual	9.0 $\mu g/m^3$ (5) 40 CFR 50.20	annual mean, averaged over 3 years	--
		secondary	Annual	15.0 $\mu g/m^3$ 40 CFR 50.13	annual mean, averaged over 3 years	--
		primary and secondary	24-hour	35 $\mu g/m^3$ 40 CFR 50.18	98th percentile, averaged over 3 years	--
PM_{10}		primary and secondary	24-hour	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years	150 $\mu g/m^3$
						Annual 50 $\mu g/m^3$

*** MAAQS** also include: **Fluoride in forage,** monthly: 50 µg/g & grazing season: 35 µg/g; **H_2S** hourly: 0.05 ppm; **Settleable PM** 30-day avg: 10 g/m^2

(**1**) In areas designated nonattainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (15 µg/m3 as a calendar quarter average) also remain in effect.

(**2**) The level of the annual NO2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.

(**3**) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O3 standards additionally remain in effect in some areas. Revocation of the previous (2008) O3 standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.

(**4**) The previous SO2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2)any area for which an implementation plan providing for attainment of the current (2010) standard has not been submitted and approved and which is designated nonattainment under the previous SO2 standards or is not meeting the requirements of a SIP call under the previous SO2 standards (40 CFR 50.4(3)). A SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the required NAAQS.

(**5**) Changed from 12.0 µg/m3 on Feb 7, 2024.

Appendix E -- Annual SO_2 Data Requirements Rule Report

Annual SO_2 Data Requirements Rule Report

On August 10, 2015, EPA finalized the Data Requirements Rule (DRR) for the 2010 1-hour SO_2 primary NAAQS (40 CFR 51, Subpart BB). The SO_2 DRR required that air agencies identify and characterize air quality around large sources. Talen Montana, LLC's Colstrip Steam Electric Generating Station, a coal-fired power plant located in Rosebud County, was the sole source in Montana to which this rule applied. As required in the rule for characterizing air quality for the primary 2010 SO_2 NAAQS, Montana MTDEQ submitted the appropriate designation of attainment for Rosebud County to the EPA, as demonstrated through modeling, on December 20, 2016. On January 9, 2018, EPA classified Rosebud County as Attainment/Unclassifiable (40 CFR Part 81) for the 2010 SO_2 NAAQS.

The SO_2 DRR (40 CFR 51.1205), requires MTDEQ to submit an annual report of SO_2 emissions at Talen Montana, LLC's Colstrip Steam Electric Generating Station; an assessment of the cause of any emission increases compared with modeled emissions; and a recommendation regarding if additional modeling is needed to ensure compliance with the rule. The report may be submitted directly or included as an Appendix to the agency's Annual Network Plan document. The following information is provided to meet those requirements.

1. Summary of Emissions

Table G-1 shows a summary of the three years of actual emissions modeled for the DRR compared to 2024 actual emissions as provided by Talen Montana, LLC for each of its coal-fired emitting units.

TableG-1. Emission Summary at Colstrip Steam Electric Generating Station

Modeled Emission Sources	Modeled Actual SO_2 Emissions (tons/year)				2024 Actual SO_2 Emissions (tons/year)	% Difference, Modeled Average - Actual Emissions
	2012	2013	2014	Average (2012-2014)		
Unit 1	2,212.03	4,109.70	2,467.51	2,929.74	0.0	-100%
Unit 2	2,589.72	4,889.66	3,393.30	3,624.23	0.0	-100%
Unit 3	2,144.72	2,533.16	2,057.54	2,245.14	2,130.59	-5.1%
Unit 4	2,257.88	942.34	2,303.83	1,834.68	1,987.99	+8.4%
Colstrip Total	**9,204.35**	**12,474.86**	**10,222.18**	**10,633.79**	**4,118.58**	**-61.3%**

2. Recommendation Regarding Additional Modeling

Total actual emissions from the Colstrip plant are significantly less than the modeled emissions; therefore, no further modeling is recommended to show compliance with the 1-hour SO_2 NAAQS.

Appendix F -- Public Inspection and Comments

Public Inspection and Comments

This Plan was made available for a 30-day period of public inspection and comment beginning on May 23, 2025. Received comments are presented here.

Received via email, June 4, 2025:

Dear Hobby Rash and Air Quality Bureau,

I am an 18 year old from Bozeman, Montana, I am in an AP Environmental Science class and one of our assignments is to respond to a public comment for a Management plan.

I was looking at the 2025 Air Monitoring Network Assessment, and I agree with this management plan to monitor air quality with testing for specific pollutants.

According to John Hopkins Medicine, there are a lot of short term causes of pollutants in the air, such as eye and throat irritation, nausea, coughing, wheezing and shortness of breath. The American Lung Association also talked about the long term effects that can come from air pollution such as, respiratory disease, cardiovascular disease, and even cancer.

In my AP Environmental class we try to relate everything to the 3 lenses of sustainability (social, economic, environmental). For air pollution it can cause **economic** damage by an increase in health care cost, due to people having more health issues, and an impact on agricultural industries because of how it will affect their products. According to the Clean Air Fund, it will cause huge **environmental** damage by degrading ecosystems and affecting biodiversity within them.

In conclusion, I support your efforts to keep monitoring our air quality to ensure that we have clean and ambient air. According to the Environmental Protection Agency (EPA), ambient air is important for the protection of human health and environment, as well as the economy.

Thanks for your time!!

From,
Izabel Barr

DEQ Response via Email on June 5, 2025

Izabel,

Montana DEQ has received your comments on our 2025 5-Year Air Monitoring Network Assessment. Thank you so much for taking the time to review this document and to provide your support and insightful evaluation.

Our Air Quality Bureau is committed to the protection of human health and the environment from negative impacts resulting from air pollutants. However, the task is much too big and much too significant to be addressed by government alone. The active and educated involvement of people throughout our society can help keep a clean and healthy environment in a sustainable and beneficial way. Your engagement here is a great investment in that effort.

Please feel free to contact me if you have any questions.

Again, thank you,

DEQ MONTANA

Hoby Rash | *Quality Assurance Manager*
Air Research and Monitoring Section
Montana Department of Environmental Quality
Desk: 406-444-6674
Website | Facebook | Twitter | YouTube
How did we do? Let us know here: Feedback Survey

Received via email, June 4, 2025:

Dane Brailsford
Bozeman, MT
dane.brailsford@bsd7students.org
June 4, 2025

I support the Montana DEQ's 2025 Air Monitoring Network Assessment. While I don't personally check air quality reports, I recognize the importance of reliable data to protect public health and Montana's environment.

Environmental sustainability: Monitoring helps identify harmful pollutants from wildfire smoke and emissions that damage ecosystems (Environmental Defense Fund).

Social sustainability: Clean air is a health issue. The American Lung Association shows that air pollution affects millions of Americans, especially children, the elderly, and people with asthma ("State of the Air 2024").

Economic sustainability: Montana's outdoor economy, worth over $2.5 billion, depends on clean air. Monitoring prevents long-term costs tied to poor health and lost tourism (Montana Environmental Information Center).

Some argue that expanding air monitoring is too expensive or unnecessary for a rural state. But smoke from wildfires now affects even smaller towns, and Montana Health Professionals for a Healthy Climate say under-monitoring leaves people unaware and vulnerable ("Air Quality Flags"). More data leads to better decisions and fewer emergencies.

Thanks for considering my comment.

Sincerely,
Dane Brailsford

DEQ Response via Email on June 6, 2025

Dane,

Montana DEQ has received your comments on our 2025 5-Year Air Monitoring Network Assessment. Thank you so much for taking the time to review this document and to provide your support. Your analysis of environmental, social, and economic stability issues surrounding air quality and air monitoring is well summarized.

Our Air Quality Bureau is committed to the protection of human health and the environment from negative impacts resulting from air pollutants. However, the task is much too big and much too significant to be addressed by government alone. The active and educated involvement of people throughout our society can help keep a clean and healthy environment in a sustainable and beneficial way. Your engagement here is a great investment in that effort.

You noted a significant issue in your comment associated with the expense of air monitoring. As noted in our 5- Year Assessment document, we're working hard to make local smoke-related air quality data available to all the citizens of Montana, and to do so in as cost-efficient a manner as possible. In a related matter, if you *do* want to begin personally checking air quality reports, here are two good websites to help you do so: Montana Today's Air and EPA AirNow Fire and Smoke .

Please feel free to contact me if you have any questions.

Again, thank you,

DEQ MONTANA

Hoby Rash | *Quality Assurance Manager*
Air Research and Monitoring Section
Montana Department of Environmental Quality
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How did we do? Let us know here: Feedback Survey