U.S. Department of the Interior
Bureau of Land Management

BLM AIR RESOURCES TECHNICAL REPORT FOR OIL AND GAS DEVELOPMENT IN NEW MEXICO, OKLAHOMA, TEXAS, AND KANSAS

2024

Mission statement

The Bureau of Land Management sustains the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

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1. INTRODUCTION

The purpose of this document is to present, discuss, and summarize technical information regarding air quality, air quality-related values, greenhouse gas (GHG) emissions, and climate trends relative to air resources within the Bureau of Land Management (BLM) New Mexico State Office (NMSO) planning areas (New Mexico, Oklahoma, Texas, and Kansas). Much of the information contained in this document is directly related to air quality in the context of oil and gas development; other information is generalized air quality data that can be applied to other development scenarios and assessments. This information can then be incorporated by reference into National Environmental Policy Act (NEPA) documents, such as leasing-level documents, and site-specific documents, such as Applications for Permit to Drill (APDs), as necessary.

Because the BLM manages extensive land holdings in New Mexico, more of its activities are centered there than in other areas. The BLM has jurisdiction over mineral rights on federal lands managed by other agencies and on split estate lands in Kansas, Texas, and Oklahoma. Wherever possible, information for those states is included.

1.1 UPDATES, ADDITIONS, AND CHANGES FROM THE PREVIOUS REPORT

This section provides a list of updates, additions, and changes to the air resources technical report since the previous report.

- Fixed/edited minor grammar, spelling, formatting, and typographical errors
- Added most recent design values for 2024 (Sections 3.1 through 3.9)
- Added nonattainment tables for New Mexico and the other states within the BLM NMSO area of operations (Oklahoma, Kansas, and Texas) (Section 3.11)
- Added Tribal emissions data to National Emissions Inventory (NEI) data (Section 4)
- Added hazardous air pollutants (HAPs) data for select counties in Texas, Oklahoma, and Kansas (Section 4.1.6)
- Added BLM Carlsbad Field Office (CFO) cumulative hazardous air pollutant modeling discussion (Section 5.4)
- Adjusted discussion of 2017 Colorado Air Resources Management Modeling Study (CARMMS) 2.0 northern New Mexico modeling study (Section 6.2)
- Added BLM CFO photochemical air quality modeling discussion (Section 6.4)
- Updated the BLM Farmington Field Office (FFO) reasonably foreseeable development (RFD) scenario to the updated RFD for oil and gas in the BLM FFO (Engler 2025) and the BLM Rio Puerco Field Office (RPFO) RFD (2019 RFD) (Crocker and Glover 2019) (Section 7.1)
- Added well count and spud data for available field offices for 2024 (Section 7.2)
- Added the estimated ultimate recoveries (EURs) for Oklahoma, Texas, and Kansas (Section 7.2)
- Added Earth Surface Mineral Dust Source Investigation (EMIT) soil and climate data (Section 7.3)
- Added Class I areas and Interagency Monitoring for the Protection of Visual Environments (IMPROVE) monitor sites for Texas and Colorado (Section 8.2)

- Updated visibility extinction trends figures for 2023 (Section 8.2)
- Added the nitrogen and sulfur deposition values for the Class I areas (Section 8.3)
- Removed former Section 11.2, Council on Environmental Quality NEPA Guidance
- Removed former Section 11.3, Greenhouse Gases in NEPA
- Removed former Section 11.4, Monetized Impacts from Greenhouse Gas Emissions
- Removed discussion of Executive Orders (EOs) 13990 and 14008
- Modified several GHG-related sections, updating language and incorporating the 2024 GHG Database (BLM 2025)

1.2 AIR RESOURCES

Air quality, GHGs, and climate are components of air resources that may be affected by BLM applications, activities, and resource management. Therefore, the BLM must consider and analyze the potential effects of BLM and BLM-authorized activities on air resources as part of the planning and decision-making process. In particular, the activities surrounding oil and gas development are likely to have impacts related to air resources.

2 AIR QUALITY REGULATORY ANALYSIS

The Clean Air Act (CAA), as amended, is the primary authority for the regulation and protection of air quality in the United States. The Federal Land Policy and Management Act (FLPMA) also charges the BLM with the responsibility to protect air and atmospheric values. Additionally, each state, Tribal, or local government holds additional authority for regulating air quality within their unique jurisdiction.

2.1 CLASS I, II, AND III AREAS AND THE CLEAN AIR ACT

All areas of the United States not specifically classified as Class I by the CAA are considered Class II for air quality. Class I areas are afforded the highest level of protection by the CAA and include all international parks, national wilderness areas and national memorial parks greater than 5,000 acres, and national parks greater than 6,000 acres that were in existence on August 7, 1977. Moderate amounts of air quality degradation are allowed in Class II areas. Although the CAA allows for designation of Class III areas where greater amounts of degradation would be allowed, no areas have been designated as such by the U.S. Environmental Protection Agency (EPA). Figure 1 shows the Class I areas in New Mexico and the surrounding states. Air quality in a given area is determined by comparing monitored air pollution levels using air monitoring equipment operated in accordance with federal regulatory standards with national ambient air quality standards (NAAQS) for six regulated air pollutants defined in the CAA.
In some cases, states have set their own ambient air quality standards in accordance with provisions of the CAA.

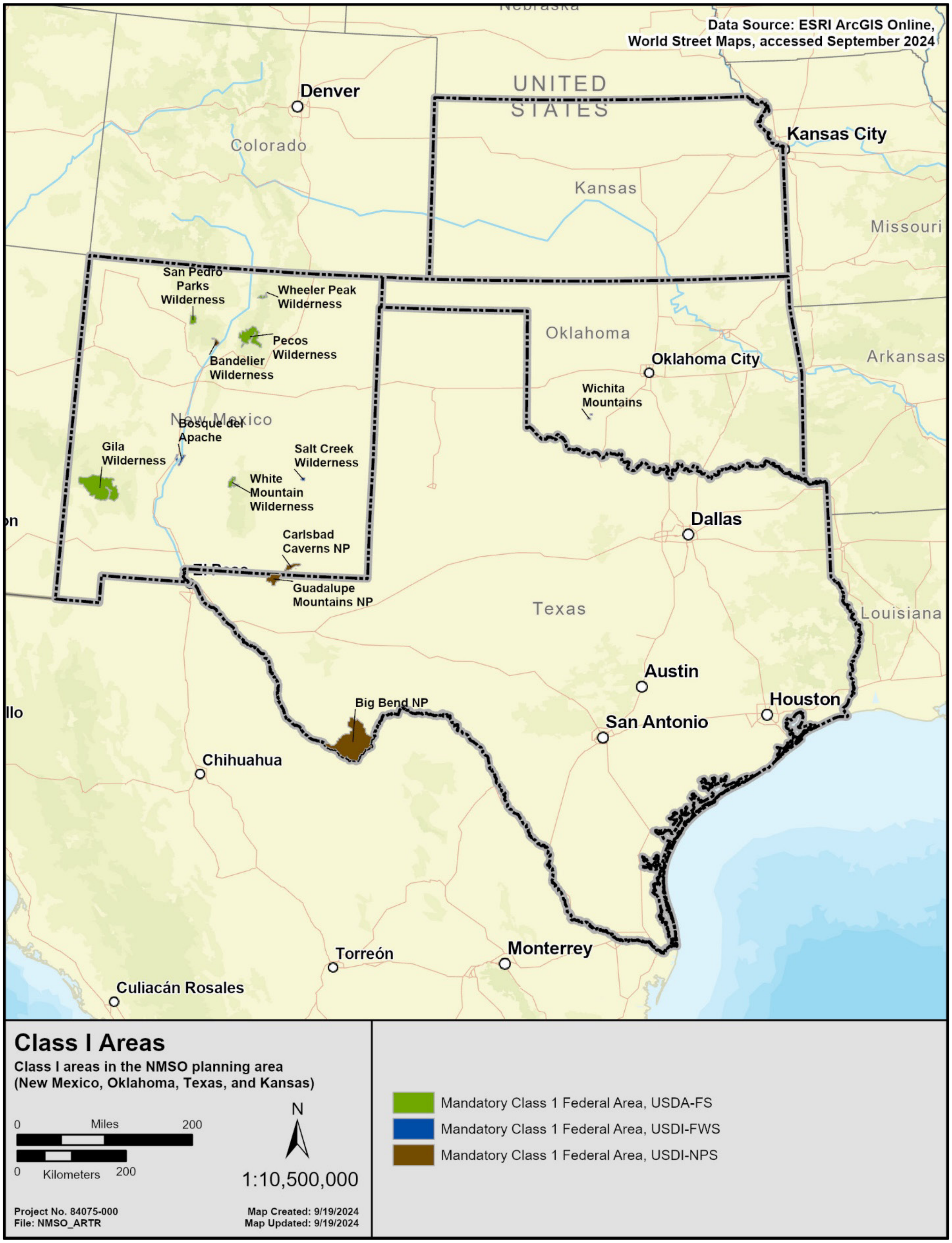

Figure 1. Class 1 areas.

2.2 FEDERAL LAND POLICY AND MANAGEMENT ACT

The FLPMA of 1976 (43 United States Code [U.S.C.] §§ 1701–1785), often referred to as the BLM Organic Act, provides most of the BLM's legislated authority, direction policy, and basic management guidance. This Act outlines the BLM role as a multiple-use land management agency and provides for management of the public lands under principles of multiple-use and sustained yield. The Organic Act directs public lands to be managed "in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values" (Section 102 [43 U.S.C. § 1701] (a) (8)). To fulfill this responsibility, BLM land use plans ensure "compliance with applicable pollution control laws, including state and federal air, water, noise, or other pollution standards or implementation plans" (Section 202 [43 U.S.C. § 1712] (a)(8)). Accordingly, BLM leases and operating permits for fossil fuels require compliance with all state and federal air pollution standards. FLPMA also gives the BLM authority to revoke or suspend any BLM-authorized activity that is found to be in violation of regulations applicable to public lands and/or in noncompliance with applicable state or federal air quality standards or implementation plans, thus ensuring that the BLM can provide for compliance with applicable air quality standards, regulations, and implementation plans (Section 302(c) [43 U.S.C. § 1732]). When authorizing activities, the BLM assumes full compliance with applicable state and federal air quality requirements and emissions standards, and related equipment and performance standards in effect at the time.

2.3 NATIONAL ENVIRONMENTAL POLICY ACT

The NEPA of 1969 (42 U.S.C. § 4321 et seq.) ensures that information on the potential environmental and human impact of federal actions is available to public officials and citizens before decisions are made and before actions are taken. One of the purposes of NEPA is to "promote efforts which will prevent or eliminate damage to the environment and biosphere" and to promote human health and welfare. NEPA requires that agencies prepare a detailed statement on the environmental impact of the proposed action for major federal actions expected to significantly affect the quality of the human environment (Section 102(C) [42 U.S.C. § 4321]). In addition, agencies are required, to the fullest extent possible, to use a "systematic, interdisciplinary approach" in planning and decision-making processes that may have an impact on the environment (Section 102(A) [43 U.S.C. § 4321]).

2.4 ADDITIONAL GUIDANCE

Other guidance and policies are useful for the BLM in managing air resources, although not required by law. Such guidance includes the following:

- The 2010 Federal Land Managers Air Quality Related Values Work Group (FLAG) report
- *2023 BLM Specialist Report on Annual Greenhouse Gas Emissions and Climate Trends* (BLM Specialist Report) (BLM 2024a)
- 2024 GHG Database (BLM 2025)
- The Mineral Leasing Act of 1920 (30 U.S.C. § 181 et seq.)
- BLM guidance for conducting air quality general conformity determinations (Instruction Memorandum No. 2013-025 – *Guidance for Conducting Air Quality General Conformity Determinations* [BLM 2012] and BLM Information Bulletin 2014-084 – *Issuance of the Bureau of Land Management Fact Sheet on the Air Quality General Conformity Rule* [BLM 2014])

For detailed information on many of these laws and policies and their relationship to mitigation of climate trends, refer to Section 2.0 of the BLM Specialist Report (BLM 2024a).

2.5 FEDERAL RULES

The EPA has the primary responsibility for regulating atmospheric emissions, including six nationally regulated air pollutants defined in the CAA. These pollutants, referred to as criteria pollutants, are carbon monoxide (CO); nitrogen dioxide (NO_2) (and nitrogen oxides[1] [NO_x]); ozone (O_3); particulate matter (PM) smaller than 2.5 micrometers in diameter ($PM_{2.5}$) and PM smaller than 10 micrometers in diameter (PM_{10}); sulfur dioxide (SO_2) (and sulfur oxides [SO_x]); and lead (Pb).

The EPA New Source Performance Standards (NSPS) rules, under 40 Code of Federal Regulations (C.F.R.) § 60, are designed to regulate criteria air pollutant and O_3 precursor emissions, as well as GHG emissions. The EPA NSPS regulations that are most likely to have applicability to oil and gas operations are as follows:

- Subpart JJJJ – Standards of Performance for Stationary Spark Ignition Internal Combustion Engines.
- Subpart Kb – Standards of Performance for Volatile Organic Liquid Storage Vessels (including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984.
- Subpart OOOO (amended) – Standards of Performance for Crude Oil and Natural Gas Facilities for Which Construction, Modification, or Reconstruction Commenced After August 23, 2011, and on or Before September 18, 2015.
- Subpart OOOOa – Standards of Performance for Crude Oil and Natural Gas Facilities for Which Construction, Modification, or Reconstruction Commenced after September 18, 2015 and on or Before December 6, 2022.
- Subpart OOOOb – Standards of Performance for Crude Oil and Natural Gas Facilities for Which Construction, Modification or Reconstruction Commenced After December 6, 2022.
- Subpart OOOOc – Emissions Guidelines for Greenhouse Gas Emissions from Existing Crude Oil and Natural Gas Facilities Constructed on or Before December 6, 2022.

Other relevant NSPS requirements under 40 C.F.R. § 60 include the following:

- Subpart GG – Standards of Performance for Stationary Gas Turbines
- Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines
- Subpart K – Standards of Performance for Storage Vessels for Petroleum Liquids for Which Construction, Reconstruction, or Modification Commenced After June 11, 1973, and Prior to May 19, 1978
- Subpart Ka – Standards of Performance for Storage Vessels for Petroleum Liquids for Which Construction, Reconstruction, or Modification Commenced After May 18, 1978, and Prior to July 23, 1984

[1] The nitrogen oxide family of compounds includes nitric oxide (NO), NO_2, nitrous acid (HNO_2), and nitric acid (HNO_3).

- Subpart Kb – Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquids) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984
- Subpart Kc – Standards of Performance for Storage Vessels (Including Petroleum Liquids) for Which Construction, Reconstruction, or Modification Commenced After July 2, 2024
- Subpart KKK – Standards of Performance for Equipment Leaks of VOC From Onshore Natural Gas Processing Plants for Which Construction, Reconstruction, or Modification Commenced After January 20, 1984, and on or Before August 23, 2011
- Subpart KKKK – Standards of Performance for Stationary Combustion Turbines
- Subpart TTTT – Standards of Performance for Greenhouse Gas Emissions for Electric Generating Units for Which Construction Commenced after January 8, 2014. Subpart repeal proposed by EPA on June 17, 2025.
- Subpart TTTTa - Standards of Performance for Greenhouse Gas Emissions for Modified Coal-Fired Steam Electric Generating Units and New Construction and Reconstruction Stationary Combustion Turbine Electric Generating Units. Subpart repeal proposed by EPA on June 17, 2025.

Rules that apply in addition to the EPA's rules include the Waste Prevention, Production Subject to Royalties, and Resource Conservation Rule—also known as the Waste Prevention Rule—finalized by the BLM in April 2024. This rule is currently under review (BLM 2024b).

2.6 STATE RULES

Regulation and enforcement of the NAAQS has been delegated to the states by the EPA. Both the NAAQS and the New Mexico Ambient Air Quality Standards (NMAAQS) are shown in Table 1. Texas has state property line standards for SO_2 and certain non-criteria pollutants. Other than the addition of a 30-minute SO_2 state property line standard, which varies by county, there are no differences between state standards and the NAAQS in Texas. Oklahoma and Kansas do not have state standards that differ from the NAAQS.

The regulatory authority for air quality in New Mexico is the New Mexico Environment Department (NMED) Air Quality Bureau (NMED 2024a), except in Bernalillo County and on Tribal lands. The City of Albuquerque/Bernalillo Air Quality Division has authority over air quality in Bernalillo County.
The regulatory authority for air quality in Kansas is the Kansas Department of Health and Environment, Bureau of Air (Kansas Department of Health and Environment 2024). The regulatory authority for air quality in Oklahoma is the Oklahoma Department of Environmental Quality (ODEQ), Air Quality Division (AQD) (ODEQ 2024). The regulatory authority for air quality in Texas is the Texas Commission on Environmental Quality (TCEQ), Air Division (TCEQ 2024a).

Table 1. NAAQS and NMAAQS

Pollutant	NAAQS Primary Standards		NAAQS Secondary Standards		NMAAQS Level (Averaging Time)
	Level	Averaging Time	Level	Averaging Time	
CO	9 ppm (10 mg/m^3)	8-hour*	None	N/A	8.7 ppm (N/A)
	35 ppm (40 mg/m^3)	1-hour*	None	N/A	13.1 ppm (N/A)
Pb	0.15 $\mu g/m^3$	Rolling 3-month average†	0.15 $\mu g/m^3$	Rolling 3-month average†	None (N/A)
NO_2 (or NO_x)	53 ppb (100 $\mu g/m^3$)	Annual (arithmetic average)	53 ppb (100 $\mu g/m^3$)	Annual (arithmetic average)	50 ppb (N/A)
	100 ppb (188 $\mu g/m^3$)	1-hour‡	None	N/A	100 ppb (24-hour)
PM_{10}	150 $\mu g/m^3$	24-hour§	150 $\mu g/m^3$	24-hour§	N/A§§
$PM_{2.5}$	9.0 $\mu g/m^3$	Annual¶ (arithmetic average)	15.0 $\mu g/m^3$	Annual¶ (arithmetic average)	N/A§§
	35 $\mu g/m^3$	24-hour#	35 $\mu g/m^3$	24-hour#	N/A§§
O_3	0.070 ppm (137 $\mu g/m^3$)	8-hour**	0.070 ppm (137 $\mu g/m^3$)	8-hour**	None (N/A)
SO_2 (or SO_x)	75 ppb (196 $\mu g/m^3$)	1-hour††	10 ppb‡‡	Annual	0.02 ppm (annual)¶¶ 0.10 ppm (24-hour) ¶¶

Source: EPA (2025); New Mexico Administrative Code (N.M.A.C.) 20.2.3

Notes:

N/A = not applicable

$\mu g/m^3$ = micrograms per cubic meter

mg/m^3 = milligrams per cubic meter

ppb = parts per billion

ppm = parts per million

* Not to be exceeded more than once per year

† Not to be exceeded

‡ To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).

§ Not to be exceeded more than once per year on average over 3 years

¶ To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not be exceeded.

To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 $\mu g/m^3$ (effective December 17, 2006).

** To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average O_3 concentrations measured at each monitor within an area over each year must not exceed 0.070 ppm.

†† To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.

‡‡ Annual mean, averaged over 3 years

§§ The New Mexico Environmental Improvement Board repealed the total suspended particle NMAAQS in N.M.A.C. 20.2.3, Ambient Air Quality Standards effective November 30, 2018; therefore, total suspended particles will no longer be reported. A determination was made that the current state and federal air quality standards for PM_{10} and $PM_{2.5}$ are sufficiently protective of public health and that that the repeal of the total suspended particles standard will not result in deterioration of air quality.

¶¶ For additional standards of air quality related to sulfur compounds in specific areas such as Chino Mines Company smelter furnace stack at Hurley and the Pecos-Permian basin intrastate air quality control region, see N.M.A.C. 20.2.3.

On May 25, 2021, in accordance with Governor Michelle Lujan Grisham's EO 2019-003 (January 29, 2019), the New Mexico Energy, Minerals and Natural Resources Department (EMNRD) announced the release of the New Mexico Oil Conservation Division (NMOCD) Statewide Natural Gas Capture Requirements (Waste Prevention Rule), New Mexico Administrative Code (N.M.A.C.) 19.15.27.9, as part of the New Mexico statewide enforceable regulatory framework to secure reductions in oil and gas sector emissions and to prevent natural gas waste from new and existing sources. Key provisions include prohibition of unnecessary venting and flaring of waste natural gas where it is technically feasible to route the gas to a pipeline or to use this gas for some other beneficial purpose (such as on-site fuel consumption). In all cases, operators must flare rather than vent natural gas except where this is technically infeasible or would pose a safety risk. These provisions will reduce VOC emissions due to stringent limitations on natural gas venting, which results in uncombusted VOC emissions. Additionally, it proposes that natural gas be recovered and reused rather than flared, which would result in reductions of VOC, NO_X, CO, SO_2, GHG, and PM emissions.

The NMED has developed the Oil and Natural Gas Regulation for Ozone Precursors (N.M.A.C. 20.2.50), which was published on July 26, 2022, with an effective date of August 5, 2022. Approximately 50,000 wells and associated equipment will be subject to this regulation. It is anticipated that the regulation will annually reduce VOC emissions by 106,420 tons, nitrogen oxide (NO) emissions by 23,148 tons, and CH_4 emissions by 200,000 to 425,000 tons. The regulation includes emissions reduction requirements for compressors, engines and turbines, liquids unloading, dehydrators, heaters, pneumatics, storage tanks, and pipeline inspection gauge launching and receiving. The regulation also encourages operators to stop venting and flaring and use fuel cell technology to convert CH_4 to electricity at the well site and incentivizes new technology for leak detection and repair.

3 CRITERIA AIR POLLUTANTS

The EPA has the primary responsibility for regulating criteria air pollutants (CO, NO_2 [or NO_X], O_3, $PM_{2.5}$, PM_{10}, SO_2 [or SO_X], and Pb). The CAA charges the EPA with establishing and periodically reviewing the NAAQS for each criteria pollutant. Table 1 shows the current primary and secondary NAAQS and averaging time for each pollutant, as well as the New Mexico-specific NMAAQS for select pollutants. Primary standards are set to protect the public health with a margin of safety, and secondary standards are meant to protect environmental concerns such as air quality related values (AQRVs) (visibility, vegetation injury, etc.).

3.1 MONITORING DATA AND DESIGN VALUES

Criteria pollutants are monitored throughout various parts of the country. Monitors measure concentrations of pollutants in the atmosphere, and the results are often presented in parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). The EPA and States periodically analyze and review monitor locations, discontinuing monitoring at locations where pollutant concentrations have been well below the standards and adding monitors in areas where pollutant concentrations may be approaching air quality standards. Air quality data collected from state, local, and Tribal monitoring agencies at outdoor monitors can be obtained from the EPA Air Data webpage and interactive tool (EPA 2025b). Most air monitors are situated to measure air quality in both neighborhoods and industrial areas. A few stations are situated in rural areas by various federal agencies to monitor air quality conditions and trends at national parks and other public lands and to identify background concentrations away from major emission sources.

Another type of monitoring data is *annual average concentration(s)* measured at air monitors, which is then translated to an annual design value to be consistent with the individual NAAQS (as shown in Table 1). A design value is a statistic representing the monitored concentration of a given pollutant in a given location, expressed in the manner of its standard, which can be compared with the NAAQS. Design values are normally updated annually and posted to the EPA Air Quality Design Value website. These design values are intended for informational use only and do not constitute a regulatory determination by the EPA as to whether an area has attained an NAAQS.

3.2 OZONE AND VOLATILE ORGANIC COMPOUNDS

Ground-level O_3 is not emitted directly into the air but is created by chemical reactions between precursors—NO_x and VOCs—in the presence of sunlight (Figure 2). Whereas O_3 and NO_2 are criteria air pollutants, VOCs are not. Figure 2 uses a graphical representation to show how O_3 is created in the atmosphere.

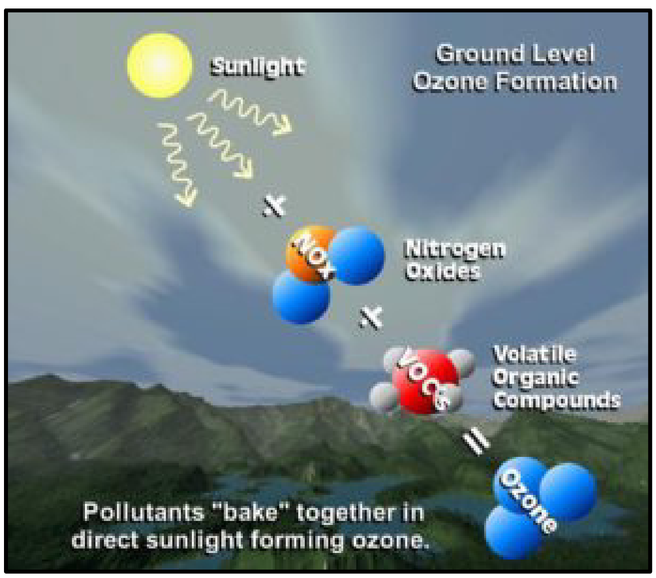

Figure 2. O_3 formation, image courtesy of NASA.

VOCs are organic chemical compounds whose composition makes it possible for them to evaporate under normal atmospheric conditions of temperature and pressure (EPA 2025c). Although there are no NAAQS for VOCs, these are regulated by the EPA to prevent the formation of O_3, a constituent of photochemical smog. Many VOCs are also HAPs. Inhalation of VOCs can cause difficulty breathing, nausea, and damage to the central nervous system and other organs. Some VOCs are also air toxins that can be carcinogenic. VOCs are components of natural gas and may be emitted from well drilling, operations, equipment leaks, valves, pipes, and pneumatic devices. Additionally, VOCs are emitted from a variety of sources, such as refineries, oil and gas production equipment, consumer products, and natural (biogenic) sources, such as trees and plants.

Specifically, VOCs are emitted during well drilling and operations as exhaust from internal combustion engines. VOCs may be emitted from hydraulically fractured oil and gas wells during fracturing and refracturing of the wells. In the hydraulic fracturing process, a mixture of water, chemicals, and proppant is pumped into a well at extremely high pressures to fracture rock and allow oil and gas to flow from the geological formation. During one stage of well completion, fracturing fluids, water, and reservoir gas come to the surface at high velocity and volume (flowback). This flowback mixture contains VOCs, CH_4, benzene, ethylbenzene, and n-hexane; some or all the flowback mixture may be vented, flared, or captured. The typical flowback process lasts from 3 to 10 days, so there is potential for significant VOC emissions from this stage of the well completion process. Most new oil and gas wells drilled today use the hydraulic fracturing process.

O_3 is most likely to reach unhealthy levels on hot, sunny days but can still reach high levels during colder months. O_3 can also be transported long distances by wind (EPA 2025d).

People most at risk from breathing air containing O_3 include people with asthma, children, older adults, and people who are active outdoors, especially outdoor workers. In addition, people with certain genetic characteristics and people with reduced intake of certain nutrients, such as vitamins C and E, are at greater risk from O_3 exposure (EPA 2025e). Deficiencies of vitamin E, a fat-soluble nutrient, are uncommon in developed countries but do occur in individuals with conditions that prevent the body from adequately absorbing fats (e.g., chronic pancreatitis, cholestasis, cystic fibrosis, primary biliary, cirrhosis, Crohn’s disease, or short bowel syndrome). Vitamin C deficiency and scurvy are rare in developed countries, as overt deficiency symptoms occur only if vitamin C intake falls below approximately 10 milligrams per day for many weeks; however, vitamin C deficiency can still occur in people with limited food variety or those with intestinal problems such as ulcerative colitis or Crohn’s disease. Children are at greatest risk from exposure to O_3 because their lungs are still developing and they are more likely to be active outdoors when O_3 levels are high, which increases their exposure. Children are also more likely than adults to have asthma (EPA 2025e).

Depending on the level of exposure, breathing O_3 can trigger a variety of health problems. Effects of O_3 inhalation can include coughing and sore or scratchy throat; difficulty breathing deeply and vigorously and pain when taking deep breaths; inflammation of and damage to the airways; increased susceptibility to lung infections; aggravation of lung diseases such as asthma, emphysema, and chronic bronchitis; and an increase in the frequency of asthma attacks. Some of these effects have been found even in healthy people, but effects are more serious in people with lung diseases such as asthma. O_3 exposure may lead to increased school absences, medication use, visits to doctors and emergency rooms, and hospital admissions. Long-term exposure to O_3 is linked to aggravation of asthma and is likely to be one of many causes of asthma development. Studies in locations with elevated O_3 concentrations also report associations of O_3 with deaths from respiratory causes (EPA 2025e). Asthma often starts during childhood when the immune system is still developing. Multiple factors may work together to cause asthma. These factors include allergens in the environment that affect babies or young children, including cigarette smoke and certain germs; viral infections that affect breathing; and family history, such as a parent (in particular, a mother) who has asthma. Common triggers for asthma include indoor allergens, such as dust mites, mold, and pet dander or fur; outdoor allergens, such as pollens and mold; emotional stress; physical activity (although with treatment, most individuals can still be active); infections, such as colds, influenza (flu), or COVID-19; certain medicines, such as aspirin, which may cause serious breathing problems in people with severe asthma; poor air quality (such as high levels of O_3); or very cold air (National Heart, Lung, and Blood Institute 2024).

The environmental effects of O_3 include damaging sensitive vegetation and ecosystems. In particular, O_3 harms sensitive vegetation during the growing season (EPA 2024a). Plant species that are sensitive to O_3 in terms of growth effects include trees found in many areas of the United States, such as black cherry (*Prunus serotina*), quaking aspen (*Populus tremuloides*), tulip poplar (*Liriodendron tulipifera*), white pine (*Pinus strobus*), ponderosa pine (*Pinus ponderosa*) and red alder (*Alnus rubra*). When sufficient O_3 enters the leaves of a sensitive plant, it can reduce photosynthesis, which is the process by which plants convert sunlight to energy to live and grow. O_3 can also slow a plant's growth and increase its risk of disease, damage from insects, effects of other pollutants, and damage from severe weather. The effects of O_3 on individual plants can then have negative impacts on ecosystems, including loss of species diversity, changes to the specific assortment of plants present in a forest, changes to habitat quality, and changes to water and nutrient cycles (EPA 2024a).

3.2.1 OZONE TRENDS

Nationally, O_3 concentrations at urban and rural sites decreased 26% from 1980 to 2023 (EPA 2023a) and 12% from 2000 to 2023 (EPA 2023b). The increase of O_3-depleting substance (ODS) concentrations caused the large O_3 decline observed from 1980 to the mid-1990s. Since the late 1990s, concentrations of ODS have been declining due to the successful implementation of the Montreal Protocol on Substances that Deplete the Ozone Layer (National Oceanic and Atmospheric Administration [NOAA] 2018). The long-term decrease is also likely driven by reductions in global emissions of substances that lead to the formation of O_3, such as O_3 precursors VOCs and NO_x. From 1980 to 2023, anthropogenic emissions of VOCs and NO_x decreased by 58% and 75%, respectively (EPA 2023b). From 2000 to 2023, anthropogenic emissions of VOCs and NO_x decreased by 26% and 69%, respectively (EPA 2023b). Nevertheless, some areas still experience O_3 exceedances as discussed in Section 3.9. Weather conditions have a significant role in the formation of O_3, which is most readily formed on warm summer days when there is stagnation. Conversely, O_3 production is more limited when it is cloudy, cool, rainy, or windy. EPA uses a statistical model to adjust for the variability in seasonal O_3 concentrations due to weather to provide a more accurate assessment of the underlying trend in O_3 caused by emissions; however, long periods are often required to distinguish between weather effects and the effect of changes in pollutant emissions. Table 2 shows the O_3 trends for all the available counties and monitoring sites in New Mexico and select monitoring stations within the BLM NMSO area of operations (Oklahoma, Kansas, and Texas). Only those counties with monitoring completed in the last 10 years are included in Table 2. Of the eight New Mexico counties in the major oil and gas basin (Eddy, Lea, Rio Arriba, Sandoval, San Juan, McKinley, Chaves, and Roosevelt Counties), three (Chaves, McKinley, and Roosevelt Counties) do not have available O_3 trend data. Table 2 shows that O_3 trends vary between counties.

Table 2. Local 8-Hour O_3 Trends

State/County	Site ID	2013–2015 Design Value (ppm)	2014–2016 Design Value (ppm)	2015–2017 Design Value (ppm)	2016–2018 Design Value (ppm)	2017–2019 Design Value (ppm)	2018–2020 Design Value (ppm)	2019–2021 Design Value (ppm)	2020–2022 Design Value (ppm)	2021–2023 Design Value (ppm)	2022–2024 Design Value (ppm)
New Mexico											
Bernalillo	350011012	0.064	0.064	0.067	0.069	0.071	0.071	0.072	0.073	0.072	0.072
	350010023	0.066	0.065	0.067	0.070	0.070	0.070	0.068	0.069	0.069	0.071
	350010029	0.066	0.065	0.065	0.066	0.067	0.067	0.066	0.067	0.066	0.065
	350012022	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Doña Ana	350130021	0.072	0.072	0.072	0.074	0.077	0.078	0.080	0.081	0.079	0.072
	350130008	0.066	0.066	0.068	0.068	0.070	0.070	0.072	0.076	0.076	0.076
	350130020	0.067	0.066	0.068	0.071	0.073	0.072	0.070	0.071	0.070	0.070
	350130022	0.072	0.068	0.072	0.074	0.076	0.074	0.075	0.075	0.072	N/A
	350130023	0.065	0.065	0.066	0.067	0.070	0.070	0.070	0.066	0.067	0.069
Eddy	350151005	0.069	0.067	0.068	0.074	0.079	0.078	0.077	0.077	0.078	0.079
	350150010	N/A	N/A	N/A	N/A	N/A	N/A	0.074	0.077	0.078	0.080
Grant	350171003	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lea	350250008	0.067	0.066	0.067	0.070	0.071	0.068	0.066	0.066	0.071	0.072
Luna	350290003	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Rio Arriba	350390026	N/A	0.064	0.065	0.067	0.067	0.065	0.064	0.064	0.063	0.063
Sandoval	350431001	0.065	0.064	0.065	0.068	0.068	0.070	0.068	0.070	0.067	0.068
San Juan	350450018	0.067	0.066	0.068	0.070	0.069	0.068	0.068	0.070	0.070	0.068
	350450020	N/A	N/A	N/A	N/A	N/A	0.067	0.068	0.068	0.067	0.066
	350451005	0.063	0.062	0.064	0.069	0.069	0.069	0.068	0.067	0.067	0.067
	350450009	0.064	0.062	0.064	0.069	0.068	0.066	0.063	0.064	0.065	0.067
Santa Fe	350490021	0.064	0.063	0.063	0.066	0.066	0.068	0.066	0.067	0.065	0.066

State/County	Site ID	2013–2015 Design Value (ppm)	2014–2016 Design Value (ppm)	2015–2017 Design Value (ppm)	2016–2018 Design Value (ppm)	2017–2019 Design Value (ppm)	2018–2020 Design Value (ppm)	2019–2021 Design Value (ppm)	2020–2022 Design Value (ppm)	2021–2023 Design Value (ppm)	2022–2024 Design Value (ppm)
Valencia	350610008	0.066	0.064	0.065	0.067	0.068	0.069	0.066	0.066	0.063	0.065
Oklahoma											
Tulsa	401430178	0.065	0.063	0.064	0.065	0.066	0.065	0.064	0.066	0.073	0.073
Caddo	400159008	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Canadian	400170101	0.068	0.065	0.065	0.069	0.070	0.067	0.065	0.067	0.070	0.071
Cleveland	400270049	0.067	0.066	0.066	0.068	0.068	0.066	0.064	0.066	0.069	0.072
Comanche	400310651	0.069	0.065	0.064	0.066	0.068	0.067	0.065	0.066	0.068	0.070
Creek	400370144	0.065	0.064	0.063	0.065	0.066	0.065	0.063	0.065	0.067	0.069
Dewey	400430860	0.067	0.065	0.065	0.068	0.067	0.065	0.061	0.064	0.066	0.069
McClain	400871074	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.071	0.073
Oklahoma	401090033	0.070	0.067	0.067	0.068	N/A	N/A	N/A	N/A	N/A	N/A
	401090096	0.067	0.065	0.067	0.067	0.068	0.065	0.065	0.067	0.069	0.072
	401091037	0.069	0.068	0.069	0.070	0.069	0.069	0.068	0.070	0.071	0.072
Pittsburg	401210415	0.064	0.060	0.060	0.063	0.065	0.063	0.062	0.062	0.067	0.067
Kansas											
Sedgwick	201730010	0.068	0.065	0.063	0.063	0.063	0.061	0.060	0.064	0.066	0.066
Sumner	201910002	0.067	0.064	0.064	0.063	0.063	0.061	0.061	0.063	0.065	0.065
Trego	201950001	0.066	0.063	0.061	0.061	0.061	0.060	0.060	0.062	0.065	0.067
Texas											
El Paso	481410044	0.068	0.067	0.069	0.071	0.074	0.074	0.071	0.069	0.068	0.070
Gregg	481830001	0.068	0.066	0.065	0.065	0.065	0.063	0.062	0.061	0.065	0.066
Denton	481210034	0.083	0.080	0.079	0.075	0.073	0.072	0.074	0.076	0.079	0.080
Galveston	481671034	0.073	0.076	0.077	0.074	0.076	0.074	0.072	0.070	0.074	0.077

State/County	Site ID	2013–2015 Design Value (ppm)	2014–2016 Design Value (ppm)	2015–2017 Design Value (ppm)	2016–2018 Design Value (ppm)	2017–2019 Design Value (ppm)	2018–2020 Design Value (ppm)	2019–2021 Design Value (ppm)	2020–2022 Design Value (ppm)	2021–2023 Design Value (ppm)	2022–2024 Design Value (ppm)
Montgomery	483390078	0.073	0.072	0.074	0.075	0.076	0.074	0.073	0.072	0.071	0.075
Nueces	483550025	0.065	0.064	0.062	0.061	0.061	0.061	0.062	0.062	0.063	0.063
Victoria	484690003	0.064	0.065	0.065	N/A	N/A	N/A	0.061	0.060	0.060	0.062
Tarrant	484390075	0.076	0.072	0.071	0.070	0.073	0.075	0.075	0.076	0.078	0.082
	484391002	0.080	0.074	0.072	0.071	0.072	0.072	0.072	0.077	0.080	0.083
	484392003	0.076	0.073	0.073	0.074	0.074	0.073	0.072	0.072	0.075	0.080
	484393009	0.078	0.075	0.075	0.076	0.075	0.076	0.074	0.076	0.079	0.081
	484393011	0.067	0.065	0.067	0.069	0.070	N/A	N/A	0.072	0.074	0.077
Travis	484530020	0.068	0.066	0.067	0.066	0.066	0.065	0.063	0.064	0.067	0.068

Source: EPA (2025f)

Note: N/A = not available due to lack of monitoring data

3.3 NITROGEN DIOXIDE

NO_2 is both a criteria pollutant and an indicator for the NO_x family of NO compounds that are ground-level O_3 precursors. The NO family of compounds, a group of highly reactive gases, includes NO, NO_2, nitrous acid (HNO_2), and nitric acid (HNO_3). The primary source of NO_x nationally is the burning of fuel. The excess air required for complete combustion of fuels introduces atmospheric nitrogen into the combustion reactions at high temperatures and produces NO_x. Breathing air with a high concentration of NO_2 can cause adverse respiratory impacts in both healthy people and those with asthma (EPA 2025g). High concentration of NO_2 can irritate airways in the human respiratory system. Such exposures over short periods can aggravate respiratory diseases, particularly asthma, leading to respiratory symptoms. Longer exposures to elevated concentrations of NO_2 may contribute to the development of asthma and potentially increase susceptibility to respiratory infections. People with asthma and lung cancer, as well as children and the elderly, are generally at greater risk for the health effects of NO_2. NO_2 exposure has also been strongly associated with heart and lung harm, affected pregnancy and birth outcomes, and was likely associated with increased risk of kidney and neurological harm, autoimmune issues, and cancer (American Lung Association 2023). NO_2 and other NO_x interact with water, oxygen, and other chemicals in the atmosphere to produce acid rain. High levels of NO_2 are also harmful to vegetation, damaging foliage, decreasing growth, and reducing crop yields (Rowland et al. 1985).

3.3.1 NITROGEN DIOXIDE TRENDS

Nationally, NO_2 concentrations decreased substantially (66% reduction) from 1980 to 2023 due to improvements in motor vehicle emissions controls, with a 40% decrease occurring from 2000 to 2023. In the southwest region (Arizona, New Mexico, Colorado, and Utah), NO_2 concentrations decreased 17% between 2010 and 2023; in the south (Texas, Oklahoma, Kansas, Arkansas, Louisiana, and Mississippi), NO_2 concentrations decreased 23% between 2010 and 2023. The EPA expects NO_2 concentrations will continue to decrease (EPA 2023c). Table 3 and Table 4 show the NO_2 trends for all the available counties and monitoring sites in New Mexico and select monitoring stations within the BLM NMSO area of operations (Oklahoma, Kansas, and Texas). Only those counties with monitoring completed in the last 10 years are included in Table 3 and Table 4. Of the eight New Mexico counties in the major oil and gas basin (Eddy, Lea, Rio Arriba, Sandoval, San Juan, McKinley, Chaves, and Roosevelt Counties), only Eddy, Lea, and San Juan Counties have NO_2 trend data available. Table 3 and Table 4 show that NO_2 trends vary between counties.

Table 3. Local Annual NO_2 Trends

State/County	Site ID	2015 Design Value (ppb)	2016 Design Value (ppb)	2017 Design Value (ppb)	2018 Design Value (ppb)	2019 Design Value (ppb)	2020 Design Value (ppb)	2021 Design Value (ppb)	2022 Design Value (ppb)	2023 Design Value (ppb)	2024 Design Value (ppb)
New Mexico											
Bernalillo	350011023	11	10	10	10	9	8	8	9	8	8
	350010029	N/A	N/A	N/A	N/A	9	8	8	7	7	7
	350012022	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10
Doña Ana	350130021	7	7	6	7	7	8	8	8	8	7
	350130022	4	5	4	5	5	6	7	6	7	6
Eddy	350151005	2	2	3	5	5	5	5	5	5	5
Lea	350250008	5	4	4	5	5	5	4	4	5	6
Luna	350290003	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
San Juan	350450009	11	10	10	10	10	10	9	9	9	9
	350450018	6	6	6	6	5	6	6	6	6	5
	350450020	N/A	N/A	1	1	1	1	1	1	1	1
	350451005	5	5	N/A	3	3	3	3	3	2	3
Oklahoma											
Canadian	400170101	5	5	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grady	400510065	N/A	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tulsa	401431127	8	7	7	7	7	6	7	7	6	6
Oklahoma	401091037	N/A	N/A	N/A	N/A	N/A	5	5	5	4	4
	401090033	7	7	7	7	N/A	N/A	N/A	N/A	N/A	N/A
	401090097	N/A	17	16	13	12	11	13	13	12	12
Kansas											
Sedgwick	201730010	7	7	7	8	6	6	7	6	6	N/A

State/County	Site ID	2015 Design Value (ppb)	2016 Design Value (ppb)	2017 Design Value (ppb)	2018 Design Value (ppb)	2019 Design Value (ppb)	2020 Design Value (ppb)	2021 Design Value (ppb)	2022 Design Value (ppb)	2023 Design Value (ppb)	2024 Design Value (ppb)
Sumner	201910002	4	4	3	3	3	3	3	3	3	5
Trego	201950001	2	1	3	2	1	1	2	2	2	2
Texas											
Galveston	481671034	3	3	2	2	3	3	2	2	3	3
Montgomery	483390078	3	3	3	3	2	2	3	3	3	4
El Paso	481410055	11	11	N/A	N/A	10	13	14	13	15	13
Karnes	482551070	N/A	N/A	N/A	N/A	N/A	3	3	3	4	3
Gregg	481830001	4	4	3	4	3	3	3	3	2	2
Denton	481210034	6	5	5	6	6	5	6	7	5	5
Travis	484530014	4	4	5	5	5	N/A	3	3	4	5

Source: EPA (2025f)

Note: N/A = not available due to lack of monitoring data

Table 4. Local 1-Hour NO_2 Trends

State/County	Site ID	2013–2015 Design Value (ppb)	2014–2016 Design Value (ppb)	2015–2017 Design Value (ppb)	2016–2018 Design Value (ppb)	2017–2019 Design Value (ppb)	2018–2020 Design Value (ppb)	2019–2021 Design Value (ppb)	2020–2022 Design Value (ppb)	2021–2023 Design Value (ppb)	2022–2024 Design Value (ppb)
New Mexico											
Bernalillo	350010023	44	43	44	45	45	43	43	43	43	43
	350010029	N/A	N/A	N/A	N/A	N/A	N/A	37	36	36	36
	350012022	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Doña Ana	350130021	44	46	45	45	45	47	47	48	48	47
	350130022	40	40	40	40	41	43	45	46	46	46
Eddy	350151005	19	19	20	23	27	29	29	31	31	32
Lea	350250008	N/A	N/A	N/A	34	35	35	32	31	31	35
Luna	350290003	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
San Juan	350450009	36	35	35	34	34	33	32	31	33	35
	350450018	33	28	N/A	N/A	N/A	23	23	24	22	23
	350450020	N/A	N/A	N/A	N/A	N/A	N/A	4	4	4	4
	350451005	34	33	N/A	N/A	N/A	24	23	22	20	19
Oklahoma											
Canadian	400170101	N/A	39	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tulsa	401431127	39	39	38	37	37	N/A	N/A	N/A	37	34
Oklahoma	401090097	N/A	N/A	N/A	45	N/A	N/A	N/A	43	44	N/A
	401090033	45	45	44	43	N/A	N/A	N/A	N/A	N/A	N/A
	401091037	N/A	N/A	N/A	N/A	N/A	N/A	N/A	37	34	31
Kansas											
Sedgwick	201730010	39	38	N/A	N/A	N/A	36	36	36	36	N/A
Sumner	201910002	23	23	N/A	N/A	N/A	22	22	25	25	23

State/County	Site ID	2013–2015 Design Value (ppb)	2014–2016 Design Value (ppb)	2015–2017 Design Value (ppb)	2016–2018 Design Value (ppb)	2017–2019 Design Value (ppb)	2018–2020 Design Value (ppb)	2019–2021 Design Value (ppb)	2020–2022 Design Value (ppb)	2021–2023 Design Value (ppb)	2022–2024 Design Value (ppb)
Trego	201950001	N/A	N/A	5	6	N/A	N/A	N/A	N/A	N/A	8
Texas											
Galveston	*481671034*	31	31	30	29	28	25	25	26	N/A	N/A
Montgomery	*483390078*	27	27	27	26	24	22	19	22	22	24
Tarrant	*484390075*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	41	41	N/A
	484391002	46	44	44	43	44	44	46	48	49	48
	484391053	N/A	N/A	N/A	43	42	41	42	44	45	N/A
	484392003	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	42
	484393009	43	42	40	38	38	41	40	40	39	38
	484393011	37	37	36	35	N/A	N/A	N/A	N/A	37	37
El Paso	481410055	55	53	N/A	N/A	N/A	N/A	55	56	56	N/A
Gregg	481830001	23	23	21	20	18	18	16	16	18	20
Karnes	482551070	N/A	N/A	N/A	N/A	N/A	N/A	N/A	25	25	27
Denton	481210034	35	32	31	32	33	34	33	34	N/A	N/A
Travis	484530014	32	31	30	30	31	N/A	N/A	N/A	N/A	N/A

Source: EPA (2025f)

Note: N/A = not available due to lack of monitoring data

3.4 CARBON MONOXIDE

CO, a colorless and odorless gas, is produced from the incomplete burning of carbon-containing compounds such as fossil fuels; it forms when there is not enough oxygen to produce carbon dioxide (CO_2). The greatest sources of CO for outdoor air are cars, trucks, and other vehicles or machinery that burn fossil fuels.

Breathing air with a high concentration of CO reduces the amount of oxygen that can be transported in the bloodstream to critical organs like the heart and brain. This can cause specific complications in people who have some types of heart disease as they are especially vulnerable to the effects of CO when exercising or under increased stress. For these individuals, short-term exposure to elevated CO may be accompanied by angina, a type of chest pain caused by reduced blood flow to the heart. Other symptoms of carbon monoxide exposure include headache, nausea, rapid breathing, weakness, exhaustion, dizziness, and confusion. At extremely high levels, CO can cause hypoxia (severe oxygen deficiency) that can lead to brain damage and death due to asphyxiation. Very high levels of CO are not likely to occur outdoors (EPA 2025h).

3.4.1 CARBON MONOXIDE TRENDS

Nationally, CO concentrations decreased 88% from 1980 to 2023 due to improvements in motor vehicle emissions controls, with a 65% decrease from 2000 to 2023. Monitored CO concentrations in the southwest region (New Mexico, Arizona, Colorado, and Utah) decreased 34% between 2010 and 2023. Monitored CO concentrations in the south region (Texas, Oklahoma, Kansas, Arkansas, Louisiana, and Mississippi) decreased 19% between 2010 and 2023 (EPA 2023d). Table 5 and Table 6 show the CO trends for all the available counties and monitoring sites in New Mexico and select monitoring stations within the BLM NMSO area of operations (Oklahoma, Kansas, and Texas). Only those counties with monitoring completed in the last 10 years are included in Table 5 and Table 6. CO trend data are not available for any of the eight New Mexico counties in the major oil and gas basin (Eddy, Lea, Rio Arriba, Sandoval, San Juan, McKinley, Chaves, and Roosevelt Counties). Table 5 and Table 6 show that CO trends vary between counties.

Table 5. Local 8-Hour CO Trends

State/County	Site ID	2014–2015 Design Value (ppm)	2015–2016 Design Value (ppm)	2016–2017 Design Value (ppm)	2017–2018 Design Value (ppm)	2018–2019 Design Value (ppm)	2019–2020 Design Value (ppm)	2020–2021 Design Value (ppm)	2021–2022 Design Value (ppm)	2022–2023 Design Value (ppm)	2023–2024 Design Value (ppm)
New Mexico											
Bernalillo	350010023	1.4	1.4	1.2	1.0	1.0	1.0	0.9	0.9	0.9	0.8
	350012022	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.7
	350010029	1.2	1.9	1.9	1.0	0.9	0.9	1.0	1.7	1.7	1.3
Oklahoma											
Tulsa	401431127	1.1	1.6	1.6	1.0	1.0	0.9	0.9	0.8	1.0	1.0
Oklahoma	401090097	0.9	1.1	1.3	1.6	1.6	1.4	1.4	1.3	1.3	1.4
	401091037	0.9	0.9	0.9	0.8	0.8	1.4	1.4	1.1	0.9	1.2
Kansas											
Wyandotte	202090021	1.2	1.2	1.4	1.4	1.1	1.1	1.1	1.1	0.8	0.6
Texas											
El Paso	481410044	2.4	2.4	2.6	2.6	2.4	2.4	2.6	2.6	2.0	3.0
Tarrant	484391053	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.7	1.7
Travis	484531068	N/A	0.6	1.3	1.3	1.8	1.8	1.6	1.4	1.5	1.5

Source: EPA (2025f)

Note: N/A = not available due to lack of****** monitoring data

Table 6. Local 1-Hour CO Trends

State/County	Site ID	2014–2015 Design Value (ppm)	2015–2016 Design Value (ppm)	2016–2017 Design Value (ppm)	2017–2018 Design Value (ppm)	2018–2019 Design Value (ppm)	2019–2020 Design Value (ppm)	2020–2021 Design Value (ppm)	2021–2022 Design Value (ppm)	2022–2023 Design Value (ppm)	2023–2024 Design Value (ppm)
New Mexico											
Bernalillo	350010023	1.7	1.9	1.9	1.7	1.9	1.9	1.3	1.4	1.4	1.2
	350012022	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.2
	350010029	2.8	2.4	2.2	2.2	1.9	3.7	3.7	3.3	3.3	2.9
Oklahoma											
Tulsa	401431127	1.6	2.4	2.4	1.4	1.4	1.4	1.4	1.2	1.5	1.5
Oklahoma	401090097	1.8	1.8	1.8	1.8	1.8	1.7	1.7	1.9	1.9	1.9
	401091037	2.9	2.9	1.3	1.0	1.0	2.6	2.6	1.2	1.0	1.8
Kansas											
Wyandotte	202090021	1.8	1.8	1.9	1.9	1.8	1.5	1.7	1.7	1.3	1.0
Texas											
El Paso	481410044	4.4	4.4	4.2	5.0	5.0	3.8	4.1	4.1	4.1	4.8
Tarrant	484391053	1.6	1.6	1.6	1.8	1.8	1.8	1.9	1.9	3.7	3.7
Travis	484531068	N/A	0.8	2.2	2.3	2.4	2.4	2.2	2.1	2.5	2.5

Source: EPA (2025f)

Note: N/A = not available due to lack of monitoring data

3.5 PARTICULATE MATTER

PM, also known as particle pollution, is a complex mixture of extremely small particles and liquid droplets. PM is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. PM is measured and regulated according to particle size. Sources of PM include industrial processes, power plants, vehicle exhaust, fugitive dust, construction activities, home heating, and fires. PM_{10} particles derive primarily from crushing, grinding, or abrasion of surfaces. $PM_{2.5}$ particles derive primarily from the incomplete combustion of fuel sources and secondarily formed aerosols. Smaller particles are associated with more negative health effects, including respiratory and cardiovascular problems, because they can become more deeply embedded in the lungs and some may even get into the bloodstream (EPA 2025i). Many scientific studies have linked breathing PM to serious health problems, including aggravated asthma, increased respiratory symptoms, difficult or painful breathing, chronic bronchitis, decreased lung function, nonfatal heart attacks, irregular heartbeat, and premature death. In adults, long-term particle pollution is linked to worsening of heart disease, atherosclerosis, and chronic obstructive pulmonary disease; higher risk of developing diabetes or fatal lung cancer; impaired cognitive functioning; and increased risk of Parkinson's disease, Alzheimer's disease, or other dementias (American Lung Association 2023). PM is a major cause of reduced visibility. It can stain and damage stone and other materials, including culturally important objects, such as monuments and statues (EPA 2025j). Airborne dust can also deposit on snow. This dust deposition accelerates snowmelt by reducing albedo through surface darkening and enhanced snow grain growth (Skiles and Painter 2016). The degree of advanced snowmelt during each water year has a linear relationship with the amount of dust loading on the snowpack, which can affect the availability of late season water in areas dependent on snowmelt to fill their watersheds.

Dust (windblown or from surface disturbance) has also been linked to health effects resulting from pathogens that live in the soil. Valley fever is an infection caused by *Coccidioides*, a fungus that lives in thermic, aridic soil (Dulin 2015). Thermic soil is found in hot, arid areas with limited rainfall, high summer temperatures, and few freezes. Aridic soil can be found in areas where the soil is dry for more than half the year and, when it is wet, it is wet for fewer than 90 consecutive days (Pennsylvania State University 1998). Valley fever is endemic to the southwestern United States. The fungus is transmitted by the inhalation of airborne arthrospores, which can be lofted by the wind after the soil is disturbed. The spores are usually found in the soil at a depth of 2 to 8 inches and have an incubation period of 1 to 4 weeks before symptoms present themselves. Most cases of valley fever are asymptomatic, but the primary symptoms are similar to influenza, tuberculosis, and pneumonia and include cough, fatigue, fever, and chest pains. Patients who are over age 65, immuno-compromised, pregnant, or African American/Filipino are at a higher risk of developing a more serious form of the infection that can attack the bones, joints, skin, brain, and lymph nodes.

3.5.1 PARTICULATE MATTER TRENDS

Nationally, $PM_{2.5}$ concentrations decreased 37% from 2000 to 2023. In that same period, PM_{10} concentrations decreased 36% nationally. In the southwest region (New Mexico, Arizona, Colorado, and Utah), $PM_{2.5}$ concentrations decreased 14% from 2010 to 2023, and PM_{10} concentrations increased 14% during the same period. For the southern region encompassing Texas, Oklahoma, Kansas, Arkansas, Louisiana, and Mississippi, $PM_{2.5}$ concentrations decreased 10% and PM_{10} concentrations increased 19% between 2010 and 2023 (EPA 2023e, 2023f).

PM_{10} design values are available and presented only as average estimated exceedance values for the available counties and monitoring sites in New Mexico and select monitoring stations within the BLM NMSO area of operations (Oklahoma, Kansas, and Texas) (Table 7). Although exceedances are presented, the information listed in this PM_{10} design value report is intended for informational use only and does not constitute a regulatory determination by EPA as to whether an area has attained an NAAQS. PM_{10} monitored outdoor air quality data can be obtained from the EPA Air Data webpage and interactive tool (EPA 2025b). Table 8 and Table 9 show the $PM_{2.5}$ trends for all the available counties and monitoring sites in New Mexico and select monitoring stations within the BLM NMSO area of operations (Oklahoma, Kansas, and Texas). Only those counties with monitoring completed in the last 10 years are included in Table 7, Table 8, and Table 9. Of the eight New Mexico counties in the major oil and gas basin (Eddy, Lea, Rio Arriba, Sandoval, San Juan, McKinley, Chaves, and Roosevelt Counties), only Lea and San Juan Counties have available $PM_{2.5}$ trend data. Table 8 and Table 9 show that $PM_{2.5}$ trends vary between counties.

Table 7. Local 24-Hour PM_{10} Exceedance Trends

State/ County	Site ID	2013–2015 Average Estimated Exceedances	2014–2016 Average Estimated Exceedances	2015–2017 Average Estimated Exceedances	2016–2018 Average Estimated Exceedances	2017–2019 Average Estimated Exceedances	2018–2020 Average Estimated Exceedances	2019–2021 Average Estimated Exceedances	2020–2022 Average Estimated Exceedances	2021–2023 Average Estimated Exceedances	2022–2024 Average Estimated Exceedances
New Mexico											
Bernalillo	350010023	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	350010026*	0.0	0.7	0.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	350010026*	0.0	0.7	0.7	0.7	0.0	0.0	0.7	1.4	1.4	N/A
	350010029	N/A	0.0	0.0	0.0	0.0	1.0	2.3	5.4	5.7	7.5
	350011012	N/A	N/A	N/A	N/A	N/A	N/A	0.0	0.0	0.0	0.0
	350011013	N/A	N/A	N/A	N/A	N/A	N/A	0.0	0.3	0.3	0.7
	350012022	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.0
Doña Ana	350130021*	7.1	5.1	1.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	350130021*	7.1	5.1	1.3	0.4	0.7	0.3	3.7	5.1	6.9	7.5
	350130016*	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0	N/A	N/A
	350130016*	7.7	4.3	0.3	0.0	0.0	0.0	1.4	4.4	5.8	9.1
	350130019*	4.0	1.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	350130019*	4.0	1.3	N/A	0.0	0.0	0.0	1.3	2.3	2.7	4.0
	350130020*	5.5	3.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	350130020*	5.5	3.5	N/A	N/A	0.0	0.0	2.7	4.0	4.4	5.1
	350130024*	4.1	1.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	350130024*	4.1	1.3	N/A	0.0	0.0	0.0	1.0	1.3	1.7	N/A
Luna	350290003	4.0	1.3	N/A	0.0	0.0	0.3	1.3	4.4	4.7	5.1
	350290003	4.0	1.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
San Juan	350451005	N/A	N/A	N/A	N/A	N/A	0.3	0.3	3.0	3.0	3.0
	350450019	2.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

State/ County	Site ID	2013–2015 Average Estimated Exceedances	2014–2016 Average Estimated Exceedances	2015–2017 Average Estimated Exceedances	2016–2018 Average Estimated Exceedances	2017–2019 Average Estimated Exceedances	2018–2020 Average Estimated Exceedances	2019–2021 Average Estimated Exceedances	2020–2022 Average Estimated Exceedances	2021–2023 Average Estimated Exceedances	2022–2024 Average Estimated Exceedances
Santa Fe	350490020*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	350490020*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Oklahoma											
Tulsa	401431127	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A	0.0	0.0
Oklahoma	401091037	N/A	N/A	N/A	N/A	N/A	0.3	0.3	0.3	N/A	N/A
	401090035	N/A	N/A	N/A	0.0	0.0	0.0	N/A	N/A	N/A	N/A
Kansas											
Sedgwick	201730010	0.3	0.3	0.0	0.0	0.0	0.0	N/A	N/A	N/A	N/A
Sumner	201910002	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.8	N/A	N/A
Trego	201950001	N/A	N/A	N/A	N/A	N/A	N/A	1.1	2.2	1.9	1.4
Sherman	201810003	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.2	1.9	1.8
Texas											
Galveston	481670004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A
Tarrant	484393010	0.0	0.0	0.0	0.0	N/A	N/A	N/A	N/A	N/A	N/A
El Paso	481410057	6.7	0.0	0.0	0.0	0.0	2.2	4.2	0.0	0.0	14.8
Gregg	482030002	0.0	0.0	0.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nueces	483550034	0.0	0.0	N/A	N/A	N/A	N/A	2.0	2.0	2.0	N/A
Dallas	481130061	N/A	N/A	N/A	N/A	N/A	N/A	0.0	0.0	0.0	0.0
Travis	484530020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A	N/A

Source: EPA (2025f)

Notes: The level of the 1987 24-hour PM_{10} NAAQS is 150 µg/m^3. The NAAQS metric is the annual estimated number of exceedances, averaged over 3 consecutive years. Only valid average estimated exceedance values are shown.

N/A = not available due to lack of monitoring data.

*Co-located monitors with same Site ID

Table 8. Local Annual $PM_{2.5}$ Trends

State/ County	Site ID	2013–2015 Design Value (µg/m³)	2014–2016 Design Value (µg/m³)	2015–2017 Design Value (µg/m³)	2016–2018 Design Value (µg/m³)	2017–2019 Design Value (µg/m³)	2018–2020 Design Value (µg/m³)	2019–2021 Design Value (µg/m³)	2020–2022 Design Value (µg/m³)	2021–2023 Design Value (µg/m³)	2022–2024 Design Value (µg/m³)
New Mexico											
Bernalillo	350011012	N/A	N/A	N/A	N/A	N/A	3.9	4.4	4.5	4.2	3.8
	350010023	6.2	6.1	5.8	5.3	5.2	5.2	5.4	5.5	5.2	5.0
	350010029	7.5	7.1	6.8	7.1	6.8	7.3	8.0	8.4	8.0	7.7
	350010026	N/A	N/A	N/A	N/A	N/A	N/A	7.3	7.7	7.4	6.4
	350011013	N/A	N/A	N/A	N/A	N/A	7.0	8.0	8.4	7.8	6.7
	350012022	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.2
Doña Ana	350130021	N/A	N/A	9.0	8.3	7.6	7.9	8.4	8.9	8.6	8.7
	350130016	N/A	N/A	7.3	7.8	7.6	7.8	7.9	8.1	7.5	7.4
	350130022	N/A	N/A	N/A	N/A	N/A	N/A	6.4	5.9	5.6	5.8
	350130025	5.6	5.0	5.2	5.2	5.2	5.2	5.5	5.5	5.0	4.4
Lea	350250008	N/A	7.1	7.5	7.6	N/A	7.0	6.5	6.3	6.6	6.5
Santa Fe	350490021	N/A	N/A	N/A	N/A	N/A	3.7	4.3	4.3	N/A	N/A
San Juan	350450019	4.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Taos	350550005	N/A	N/A	N/A	N/A	N/A	5.7	5.6	5.5	4.9	4.0
Oklahoma											
Pittsburg	401210415	N/A	N/A	7.8	N/A	N/A	N/A	8.2	8.1	8.3	8.3
Tulsa	401431127	8.8	8.7	8.6	9.2	8.8	8.3	8.1	8.2	8.8	8.6
Cleveland	400270049	N/A	8.4	7.9	8.1	8.5	8.8	9.1	9.1	9.3	N/A
Comanche	400310651	N/A	7.5	7.1	6.9	7.0	6.8	7.0	7.0	7.1	6.8
Dewey	400430860	N/A	N/A	N/A	N/A	N/A	6.7	6.7	6.7	6.9	7.0

State/ County	Site ID	2013–2015 Design Value (μg/m³)	2014–2016 Design Value (μg/m³)	2015–2017 Design Value (μg/m³)	2016–2018 Design Value (μg/m³)	2017–2019 Design Value (μg/m³)	2018–2020 Design Value (μg/m³)	2019–2021 Design Value (μg/m³)	2020–2022 Design Value (μg/m³)	2021–2023 Design Value (μg/m³)	2022–2024 Design Value (μg/m³)
Kay	400710604	N/A	N/A	N/A	7.7	7.6	7.7	8.5	8.7	9.0	8.6
Oklahoma	401090097	N/A	N/A	N/A	N/A	N/A	8.3	8.8	8.9	9.1	8.8
	401090035	N/A	N/A	N/A	7.7	7.6	7.6	7.6	7.7	N/A	8.3
	401091037	8.6	8.1	7.8	8.0	8.2	8.5	8.9	8.8	N/A	8.2
Kansas											
Sedgwick	201730010	8.7	8.1	N/A	N/A	N/A	N/A	N/A	N/A	9.7	N/A
Sumner	201910002	7.8	7.4	7.0	7.2	7.4	7.7	8.4	8.7	N/A	N/A
Trego	201950001	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.8
Texas											
Denton	481210034	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.5	7.7	7.8
Montgomery	483390078	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10.7
Tarrant	484391002	9.8	8.9	8.4	8.2	8.5	9.0	9.2	9.1	8.9	9.1
	484391006	10.0	9.2	8.7	N/A	N/A	N/A	8.9	8.9	9.6	9.4
	484391053	N/A	N/A	N/A	8.6	8.5	8.4	8.5	8.5	8.7	8.9
El Paso	481410044	9.9	9.4	8.9	9.1	8.8	8.8	8.9	9.2	9.0	9.6
Harrison	481830002	9.0	8.8	8.6	8.5	8.4	8.4	N/A	9.4	9.5	9.5
Nueces	483550032	10.1	9.9	9.3	9.1	9.0	8.8	8.2	8.1	8.4	9.1
Dallas	481130069	9.4	8.8	8.6	8.9	9.2	8.9	8.4	8.2	8.9	9.6
Travis	484530021	9.2	9.6	9.6	9.8	9.8	9.6	9.5	9.2	9.3	9.7

Source: EPA (2025f)

Note: N/A = not available due to lack of monitoring data

Table 9. Local 24-Hour $PM_{2.5}$ Trends

State/ County	Site ID	2013–2015 Design Value (µg/m³)	2014–2016 Design Value (µg/m³)	2015–2017 Design Value (µg/m³)	2016–2018 Design Value (µg/m³)	2017–2019 Design Value (µg/m³)	2018–2020 Design Value (µg/m³)	2019–2021 Design Value (µg/m³)	2020–2022 Design Value (µg/m³)	2021–2023 Design Value (µg/m³)	2022–2024 Design Value (µg/m³)
New Mexico											
Bernalillo	350011012	N/A	N/A	N/A	N/A	N/A	11	13	14	11	9
	350010023	18	19	17	15	13	14	15	15	13	12
	350010029	18	19	18	19	19	20	21	21	19	20
	350010024	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	350010026	N/A	N/A	N/A	N/A	N/A	N/A	20	21	19	16
	350011013	N/A	N/A	N/A	N/A	N/A	19	22	23	20	17
	350012022	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	24
Doña Ana	350130021	N/A	N/A	27	27	24	19	21	22	21	24
	350130016	N/A	N/A	20	22	22	21	21	20	19	19
	350130022	N/A	N/A	N/A	N/A	N/A	N/A	18	18	17	19
	350130025	13	11	12	12	12	12	13	14	13	13
Lea	350250008	N/A	17	15	16	16	17	17	19	20	19
San Juan	350450019	11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Santa Fe	350490021	N/A	N/A	N/A	N/A	N/A	9	11	14	N/A	N/A
Taos	350550005	N/A	N/A	N/A	N/A	N/A	16	16	16	15	13
Oklahoma											
Pittsburg	401210415	20	18	18	21	22	22	22	24	23	20
Tulsa	401431127	20	21	20	23	22	21	22	22	23	20
Cleveland	400270049	N/A	19	17	18	19	21	23	23	22	20
Comanche	400310651	N/A	18	15	16	16	17	18	18	18	16

State/ County	Site ID	2013–2015 Design Value (µg/m³)	2014–2016 Design Value (µg/m³)	2015–2017 Design Value (µg/m³)	2016–2018 Design Value (µg/m³)	2017–2019 Design Value (µg/m³)	2018–2020 Design Value (µg/m³)	2019–2021 Design Value (µg/m³)	2020–2022 Design Value (µg/m³)	2021–2023 Design Value (µg/m³)	2022–2024 Design Value (µg/m³)
Dewey	400430860	N/A	N/A	N/A	N/A	N/A	16	18	18	20	19
Kay	400710604	N/A	N/A	N/A	18	18	19	24	25	26	22
Oklahoma	401090035	N/A	N/A	N/A	18	17	17	16	16	19	17
	401090097	N/A	N/A	N/A	N/A	N/A	19	21	21	21	19
	401091037	21	19	17	18	19	20	22	22	21	19
Kansas											
Sedgwick	201730010	23	22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sumner	201910002	22	21	17	16	17	20	23	25	N/A	21
Wyandotte	202090021	20	20	21	25	N/A	N/A	26	N/A	N/A	N/A
Texas											
Denton	481210034	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20	20	21
Galveston	481671034	N/A	20	22	22	22	24	21	23	21	22
Montgomery	483390078	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	25
Tarrant	484391002	22	19	17	18	18	20	21	23	22	25
	484391006	22	19	17	18	18	21	21	24	25	25
	484391053	N/A	N/A	N/A	18	18	20	21	23	22	22
El Paso	481410044	29	25	23	24	24	24	24	22	22	N/A
Harrison	481830002	20	17	17	18	18	20	N/A	N/A	N/A	N/A
Nueces	483550032	26	25	24	25	24	25	23	23	22	26
Dallas	481130069	21	19	18	20	20	22	19	19	19	22
Travis	484530021	22	19	20	22	23	22	22	22	22	26

Source: EPA (2025f)

Note: N/A = not available due to lack of monitoring data

3.6 SULFUR DIOXIDE

SO_2 is one of a group of highly reactive gases known as oxides of sulfur, commonly referred to as SO_x. The largest sources of SO_2 emissions nationwide are from fossil fuel combustion at power plants (73%) and other industrial facilities (20%). Smaller sources of SO_2 emissions include industrial processes, such as extracting metal from ore, and the burning of high-sulfur fuels by locomotives, large ships, and nonroad equipment. SO_2 is linked with a number of adverse effects on the respiratory system, including wheezing, shortness of breath, chest tightness, and reduced lung function. People with asthma, particularly children, are sensitive to these effects of SO_2. At high concentrations, gaseous SO_x can harm trees and plants by damaging foliage and decreasing growth. SO_2 and other SO_x can contribute to acid rain, which can harm sensitive ecosystems (EPA 2025k).

3.6.1 SULFUR DIOXIDE TRENDS

Nationally, SO_2 concentrations decreased 87% from 2000 to 2023, and substantial decreases (95% reduction) have occurred since 1980 due to implementation of federal rules requiring reductions in SO_2 emissions from power plants and other large sources of SO_2. In the southwest region, SO_2 concentrations decreased 94% between 2010 and 2023. In the southern region (Texas, Oklahoma, Kansas, Arkansas, Louisiana, and Mississippi), SO_2 concentrations decreased 66% between 2010 and 2023 (EPA 2023g). Table 10 shows the SO_2 trends for all the available counties and monitoring sites in New Mexico and select monitoring stations within the BLM NMSO area of operations (Oklahoma, Kansas, and Texas). Only those counties with monitoring completed in the last 10 years are included in Table 10. Of the eight New Mexico counties in the major oil and gas basin (Eddy, Lea, Rio Arriba, Sandoval, San Juan, McKinley, Chaves, and Roosevelt Counties), only San Juan County has available SO_2 trend data. Table 10 show that SO_2 trends vary between counties.

Table 10. Local 1-Hour SO_2 Trends

State/County	Site ID	2013–2015 Design Value (ppb)	2014–2016 Design Value (ppb)	2015–2017 Design Value (ppb)	2016–2018 Design Value (ppb)	2017–2019 Design Value (ppb)	2018–2020 Design Value (ppb)	2019–2021 Design Value (ppb)	2020–2022 Design Value (ppb)	2021–2023 Design Value (ppb)	2022–2024 Design Value (ppb)
New Mexico											
Bernalillo	350010023	5	6	5	5	4	4	3	3	2	2
	350012022	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grant	350171003	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
San Juan	350450009	5	3	2	2	2	1	1	1	1	N/A
	350451005	13	8	N/A	N/A	N/A	N/A	N/A	8	4	N/A
Oklahoma											
Tulsa	401431127	12	6	6	4	3	3	2	3	3	3
Garfield	400470555	N/A	N/A	N/A	N/A	48	40	34	31	33	41
Kay	400710604	34	33	29	29	28	26	24	20	14	7
Oklahoma	401091037	3	3	3	3	2	2	1	1	1	1
Kansas											
Sumner	201910002	6	5	4	4	4	3	3	3	3	3
Trego	201950001	5	5	3	3	N/A	N/A	N/A	N/A	N/A	2
Texas											
Hutchinson	482331073	N/A	N/A	N/A	N/A	209	185	183	163	140	113
El Paso	481410044	9	N/A	N/A	N/A	N/A	N/A	N/A	6	5	5
Gregg	481830001	46	35	30	37	41	49	45	35	23	14
Galveston	482570005	13	11	9	9	8	7	7	10	13	9
Nueces	483550025	N/A	4	4	4	6	6	5	3	3	4
Travis	484530014	5	4	4	3	3	N/A	N/A	N/A	N/A	N/A

Source: EPA (2025f)

Note: N/A = not available due to lack of monitoring data

3.7 NATIONAL TRENDS

The EPA estimates nationwide emissions of ambient air pollutants and the pollutants from which they are formed (their precursors) based on actual monitored readings or engineering calculations of the amounts and types of pollutants emitted by vehicles, factories, and other sources. Table 11 shows that emissions of the common air pollutants and their precursors have been reduced substantially since 1980.

Table 11. National Percentage Changes in Emissions

Pollutant	1980 vs. 2023	1990 vs. 2023	2000 vs. 2023	2010 vs. 2023
CO	−76	−71	−59	−28
Pb	−99	−88	−78	−36
NO_x	−75	−73	−69	−55
VOC	−58	−46	−26	−5
Direct PM_{10}	−62	−27	−24	−14
Direct $PM_{2.5}$	Not available	−28	−35	−11
SO_2	−94	−93	−90	−76

Source: EPA (2024b)

Note: A negative percentage means that concentrations have decreased.

3.8 LEAD

Pb is a metal found naturally in the environment as well as in manufactured products. The major sources of lead emissions have historically been from fuels in on-road motor vehicles (such as cars and trucks) and industrial sources. As a result of EPA regulatory efforts to remove lead from gasoline, emissions of lead from the transportation sector declined by 95% between 1980 and 1999, and levels of lead in the air decreased by 94% during the same period. Major sources of lead emissions to the air today are ore and metals processing and piston-engine aircraft using leaded aviation gasoline (EPA 2025l). Depending on the level of exposure, lead can adversely affect the nervous system, kidney function, immune system, reproductive and developmental systems, and the cardiovascular system. Lead exposure also affects the oxygen-carrying capacity of the blood. Lead can accumulate in the body over time, where it is stored in bones along with calcium. The lead effects most likely to be encountered in current populations are neurological effects in children. Infants and young children are especially sensitive to lead exposures, which may contribute to behavioral problems, learning deficits, lowered IQ, and hyperactivity. Children are also at an increased risk of slowed growth, hearing problems, and anemia. Adults exposed to lead can suffer from cardiovascular effects, decreased kidney function, and both male and female reproductive issues.

3.9 NEW MEXICO DESIGN VALUES

The most recent design values for the measured criteria pollutants from those monitoring stations in New Mexico with 2024 design values are provided in Table 12 through Table 20, and only those counties with monitoring completed in the last 10 years are included. These design values are compared with the NAAQS and NMAAQS for those New Mexico counties with available data. Rural counties, such as

Table 12. 2022–2024 8-Hour O_3 Design Values, New Mexico

County	Site ID	Design Value (ppm)*	NAAQS (ppm)	Exceed NAAQS?
Bernalillo	350011012	0.072	0.070	Yes
	350010023	0.071	0.070	No
	350010029	0.065	0.070	No
Doña Ana	350130021	0.072	0.070	Yes
	350130008	0.076	0.070	Yes
	350130020	0.070	0.070	No
	350130023	0.069	0.070	No
Eddy	350151005	0.079	0.070	Yes
	350150010	0.080	0.070	Yes
Lea	350250008	0.072	0.070	Yes
Rio Arriba	350390026	0.063	0.070	No
Sandoval	350431001	0.068	0.070	No
San Juan	350450018	0.068	0.070	No
	350450020	0.066	0.070	No
	350451005	0.067	0.070	No
	350450009	0.067	0.070	No
Santa Fe	350490021	0.066	0.070	No
Valencia	350610008	0.065	0.070	No

Source: EPA (2025f)

* Annual fourth-highest daily maximum 8-hour concentration averaged over 3 years

Table 13. 2024 Annual NO_2 Design Values, New Mexico

County	Site ID	Design Value (ppb)	NAAQS (ppb)*	Exceed NAAQS?
Bernalillo	350011023	8	53	No
	350010029	7	53	No
	350012022	10	53	No
Doña Ana	350130021	7	53	No
	350130022	6	53	No
Eddy	350151005	5	53	No
Lea	350250008	6	53	No

County	Site ID	Design Value (ppb)	NAAQS (ppb)*	Exceed NAAQS?
San Juan	350450009	9	53	No
	350450018	5	53	No
	350450020	1	53	No
	350451005	3	53	No

Source: EPA (2025f)

* Not to be exceeded during the year

Table 14. 2022–2024 1-Hour NO_2 Design Values, New Mexico

County	Site ID	Design Value (ppb)*	NAAQS (ppb)	Exceed NAAQS?
Bernalillo	350010023	43	100	No
	350010029	36	100	No
Doña Ana	350130021	47	100	No
	350130022	46	100	No
Eddy	350151005	32	100	No
Lea	350250008	35	100	No
San Juan	350450009	35	100	No
	350450018	23	100	No
	350450020	4	100	No
	350451005	19	100	No

Source: EPA (2025f)

* 98th percentile, averaged over 3 years

Table 15. 2023–2024 8-Hour CO Design Values, New Mexico

County	Site ID	Design Value (ppm)	NAAQS (ppm)*	Exceed NAAQS?
Bernalillo	350010023	0.8	9	No
	350012022	1.7	9	No
	350010029	1.3	9	No

Source: EPA (2025f)

* Not to be exceeded more than once per year

Table 16. 2023–2024 Design Values, 1-Hour CO

County	Site ID	Design Value (ppm)	NAAQS (ppm)*	Exceed NAAQS?
Bernalillo	350010023	1.2	35	No
	350012022	2.2	35	No
	350010029	2.9	35	No

Source: EPA (2025f)

* Not to be exceeded more than once per year

Table 17. 2022–2024 24-Hour PM_{10} Average Estimated Exceedances, New Mexico

County	Site ID	Average Estimated Exceedances	NAAQS (µg/m³)*	Exceed NAAQS?†
Bernalillo	350010029	7.5	150	Yes
	350010023	0.0	150	No
	350011012	0.0	150	No
	350011013	0.7	150	No
	350012022	1.0	150	No
Doña Ana	350130021	7.5	150	Yes
	350130016	9.1	150	Yes
	350130019	4.0	150	Yes
	350130020	5.1	150	Yes
Luna	350290003	5.1	150	Yes
San Juan	350451005	3.0	150	No

Source: EPA (2025f)

* Not to be exceeded more than once per year on average over 3 years

† The NMAAQS for total suspended particulates, which was used as a comparison for PM_{10} and $PM_{2.5}$, was repealed as of November 30, 2018. The NAAQS still apply.

Table 18. 2022–2024 Annual $PM_{2.5}$ Design Values, New Mexico

County	Site ID	Design Value (µg/m³)*	NAAQS (µg/m³)	Exceed NAAQS?†
Bernalillo	350011012	3.8	9	No
	350010023	5.0	9	No
	350010029	7.7	9	No
	350010026	6.4	9	No
	350011013	6.7	9	No
	350012022	8.2	9	No
Doña Ana	350130021	8.7	9	No
	350130016	7.4	9	No
	350130022	5.8	9	No
	350130025	4.4	9	No
Lea	350250008	6.5	9	No
Taos	350550005	4.0	9	No

Source: EPA (2025f)

* Annual mean averaged over 3 years

† The NMAAQS for total suspended particulates, which was used as a comparison for PM_{10} and $PM_{2.5}$, was repealed as of November 30, 2018. The NAAQS still apply.

Table 19. 2022–2024 24-Hour $PM_{2.5}$ Design Values, New Mexico

County	Site ID	Design Value (µg/m³)*	NAAQS (µg/m³)	Exceed NAAQS?†
Bernalillo	350011012	9	35	No
	350010023	12	35	No
	350010029	20	35	No
	350010026	16	35	No
	350011013	17	35	No
	350012022	24	35	No
Doña Ana	350130021	24	35	No
	350130016	19	35	No
	350130022	19	35	No
	350130025	13	35	No
Lea	350250008	19	35	No
Taos	350550005	13	35	No

Source: EPA (2025f)

Note: Many rural counties have no monitoring data and are assumed under the CAA to be in attainment. $PM_{2.5}$ monitor stations currently show installed locations in the planning area (San Juan County); however, the monitor status of these stations shows invalid data and cannot be used to represent design values.

* 98th percentile, averaged over 3 years

† The NMAAQS for total suspended particulates, which was used as a comparison for PM_{10} and $PM_{2.5}$, was repealed as of November 30, 2018. The NAAQS still apply.

Table 20. 2022–2024 1-Hour SO_2 Design Values, New Mexico

County	Site ID	Design Value (ppb)*	NAAQS (ppb)	Exceed NAAQS?
Bernalillo	350010023	2	75	No

Source: EPA (2025f)

Note: Although there are no NAAQS for hydrogen sulfide (H_2S), New Mexico has set a 1-hour standard for H_2S at 0.010 ppm for all areas of the state outside of the area within 5 miles of the Pecos-Permian Air Quality Control Region and a 0.5-hour standard for H_2S at 0.100 ppm within the Pecos-Permian Air Quality Control Region and 0.030 ppm for municipal boundaries and within 5 miles of municipalities with populations greater than 20,000 in areas of the state outside the area within 5 miles of the Pecos-Permian Air Quality Control Region (see Table 62).

* 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years

McKinley County, may not have existing monitors and, therefore, no data are available; other counties, such as San Juan County, may have monitors that record only certain pollutants. Design values are typically used to designate and classify nonattainment areas, as well as to assess progress toward meeting the NAAQS. Therefore, when the design values exceed the NAAQS or NMAAQS, actions may be taken to reassess the designations of these areas.

3.10 OKLAHOMA, KANSAS, AND TEXAS DESIGN VALUES

The most recent design values for the measured criteria pollutants from monitoring stations in Oklahoma, Kansas, and Texas with 2024 design values are provided in Table 12 through Table 20, and only those counties with monitoring completed in the last 10 years are included. The counties with the most potential for oil and gas development, or that are representative of these areas, are provided, and these design values are compared with the NAAQS. Rural counties may not have existing monitors and, therefore, no data are available; other counties may have monitors that record only certain pollutants. Design values are typically used to designate and classify nonattainment areas, as well as to assess progress toward meeting the NAAQS. Therefore, when the design values exceed the NAAQS, actions may be taken to reassess the designations of these areas.

Table 21. 2022–2024 8-Hour O_3 Design Values, Oklahoma, Kansas, and Texas

County	Site ID	Design Value (ppm)*	NAAQS (ppm)	Exceed NAAQS?
Oklahoma				
Creek	400370144	0.069	0.070	No
Pittsburg	401210415	0.067	0.070	No
Tulsa	401430178	0.073	0.070	No
Canadian	400170101	0.071	0.070	No
Cleveland	400270049	0.072	0.070	Yes
Comanche	400310651	0.070	0.070	Yes
Dewey	400430860	0.069	0.070	No
McClain	400871074	0.073	0.070	Yes
Oklahoma	401090096	0.072	0.070	Yes
	401091037	0.072	0.070	Yes
Kansas				
Sedgwick	201730010	0.066	0.070	No
Sumner	201910002	0.065	0.070	No
Trego	201950001	0.067	0.070	No
Texas				
Galveston	481671034	0.077	0.070	Yes
Montgomery	483390078	0.075	0.070	Yes
Tarrant	484390075	0.082	0.070	Yes
	484391002	0.083	0.070	Yes
	484392003	0.080	0.070	Yes
	484393009	0.081	0.070	Yes
	484393011	0.077	0.070	Yes
El Paso	481410044	0.070	0.070	No
Gregg	481830001	0.066	0.070	No
Denton	481210034	0.080	0.070	No
Nueces	483550025	0.063	0.070	No

County	Site ID	Design Value (ppm)*	NAAQS (ppm)	Exceed NAAQS?
Victoria	484690003	0.062	0.070	No
Travis	484530020	0.068	0.070	No

Source: EPA (2025f)

* Annual fourth-highest daily maximum 8-hour concentration averaged over 3 years

Table 22. 2024 Annual NO_2 Design Values, Oklahoma, Kansas, and Texas

County	Site ID	Design Value (ppb)	NAAQS (ppb)*	Exceed NAAQS?
Oklahoma				
Tulsa	401431127	6	53	No
Oklahoma	401091037	4	53	No
	401090097	12	53	No
Kansas				
Sumner	201910002	5	53	No
Trego	201950001	2	53	No
Texas				
Galveston	481671034	3	53	No
Montgomery	483390078	4	53	No
El Paso	481410055	13	53	No
Karnes	482551070	3	53	No
Gregg	481830001	2	53	No
Denton	481210034	5	53	No
Travis	484530014	5	53	No

Source: EPA (2025f)

* Not to be exceeded during the year

Table 23. 2022–2024 1-Hour NO_2 Design Values, Oklahoma, Kansas, and Texas

County	Site ID	Design Value (ppb)*	NAAQS (ppb)	Exceed NAAQS?
Oklahoma				
Tulsa	401431127	34	100	No
Oklahoma	401091037	31	100	No
Kansas				
Sumner	201910002	23	100	No
Trego	201950001	8	100	No
Texas				
Montgomery	*483390078*	24	100	No

County	Site ID	Design Value (ppb)*	NAAQS (ppb)	Exceed NAAQS?
Tarrant	*484391002*	48	100	No
	484392003	42	100	No
	484393009	38	100	No
	484393011	37	100	No
Gregg	481830001	20	100	No
Karnes	482551070	27	100	No

Source: EPA (2025f)

* 98th percentile, averaged over 3 years

Table 24. 2023–2024 8-Hour CO Design Values, Oklahoma, Kansas, and Texas

County	Site ID	Design Value (ppm)	NAAQS (ppm)*	Exceed NAAQS?
Oklahoma				
Tulsa	401431127	1.0	9	No
Oklahoma	401090097	1.4	9	No
	401091037	1.2	9	No
Kansas				
Wyandotte	202090021	0.6	9	No
Texas				
El Paso	481410044	3.0	9	No
Tarrant	484391053	1.7	9	No
Travis	484531068	1.5	9	No

Source: EPA (2025f)

* Not to be exceeded more than once per year

Table 25. 2023–2024 1-Hour CO Design Values, Oklahoma, Kansas, and Texas

County	Site ID	Design Value (ppm)	NAAQS (ppm)*	Exceed NAAQS?
Oklahoma				
Tulsa	401431127	1.5	35	No
Oklahoma	401090097	1.9	35	No
	401091037	1.8	35	No
Kansas				
Wyandotte	202090021	1.0	35	No
Texas				
El Paso	481410044	4.8	35	No
Tarrant	484391053	3.7	35	No

County	Site ID	Design Value (ppm)	NAAQS (ppm)*	Exceed NAAQS?
Travis	484531068	2.5	35	No

Source: EPA (2025f)

* Not to be exceeded more than once per year

Table 26. 2022–2024 24-Hour PM_{10} Average Estimated Exceedances, Oklahoma, Kansas, and Texas

County	Site ID	Average Estimated Exceedances	NAAQS (μg/m³)*	Exceed NAAQS?
Oklahoma				
Tulsa	401431127	0.0	150	No
Kansas				
Trego	201950001	1.4	150	No
Sherman	201810003	1.8	150	No
Texas				
El Paso	481410057	14.8	150	Yes
Dallas	481130061	0.0	150	No

Source: EPA (2025f)

* Not to be exceeded more than once per year on average over 3 years

Table 27. 2022–2024 Annual $PM_{2.5}$ Design Values, Oklahoma, Kansas, and Texas

County	Site ID	Design Value (μg/m³)*	NAAQS (μg/m³)	Exceed NAAQS?
Oklahoma				
Pittsburg	401210415	8.3	9	No
Tulsa	401431127	8.6	9	No
Comanche	400310651	6.8	9	No
Dewey	400430860	7.0	9	No
Kay	400710604	8.6	9	No
Oklahoma	401090097	8.8	9	No
	401090035	8.3	9	No
	401091037	8.2	9	No
Kansas				
Trego	201950001	6.8	9	No
Texas				
Denton	481210034	7.8	9	No
Montgomery	483390078	10.7	9	Yes

County	Site ID	Design Value (µg/m³)*	NAAQS (µg/m³)	Exceed NAAQS?
Tarrant	484391002	9.1	9	Yes
	484391006	9.4	9	Yes
	484391053	8.9	9	No
El Paso	481410044	9.6	9	No
Harrison	481830002	9.5	9	No
Nueces	483550032	9.1	9	No
Dallas	481130069	9.6	9	No
Travis	484530021	9.7	9	No

Source: EPA (2025f)

* Annual mean averaged over 3 years

Table 28. 2022–2024 24-Hour $PM_{2.5}$ Design Values, Oklahoma, Kansas, and Texas

County	Site ID	Design Value (µg/m³)*	NAAQS (µg/m³)	Exceed NAAQS?
Oklahoma				
Pittsburg	401210415	20	35	No
Tulsa	401431127	20	35	No
Cleveland	400270049	20	35	No
Comanche	400310651	16	35	No
Dewey	400430860	19	35	No
Kay	400710604	22	35	No
Oklahoma	401090035	17	35	No
	401090097	19	35	No
	401091037	19	35	No
Kansas				
Sumner	201910002	21	35	No
Texas				
Denton	481210034	21	35	No
Galveston	481671034	22	35	No
Montgomery	483390078	25	35	No
Tarrant	484391002	25	35	No
	484391006	25	35	No
	484391053	22	35	No
Nueces	483550032	26	35	No
Dallas	481130069	22	35	No

County	Site ID	Design Value (µg/m³)*	NAAQS (µg/m³)	Exceed NAAQS?
Travis	484530021	26	35	No

Source: EPA (2025f)

* 98th percentile, averaged over 3 years

Table 29. 2022–2024 1-Hour SO_2 Design Values, Oklahoma, Kansas, and Texas

County	Site ID	Design Value (ppb)*	NAAQS (ppb)	Exceed NAAQS?
Oklahoma				
Tulsa	401431127	3	75	No
Garfield	400470555	41	75	No
Kay	400710604	7	75	No
Oklahoma	401091037	1	75	No
Kansas				
Sumner	201910002	3	75	No
Trego	201950001	2	75	No
Texas				
El Paso	481410044	5	75	No
Gregg	481830001	14	75	No
Galveston	482570005	9	75	No
Nueces	483550025	4	75	No

Source: EPA (2025f)

* 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years

3.11 GENERAL CONFORMITY AND NONATTAINMENT

If the concentration of one or more criteria pollutants in a geographic area is found to violate the NAAQS, the area may be classified as a **nonattainment** area. Areas with concentrations of criteria pollutants that are below the levels established by the NAAQS are considered either **attainment** or unclassifiable areas. Areas for which available data are not sufficient to make an attainment status designation are listed as unclassifiable. When a state submits a request to the EPA to redesignate a nonattainment area as an attainment area, it must submit a maintenance plan that demonstrates that the area can maintain the air quality standard for at least 10 years following the effective date of redesignation. An EPA-approved maintenance plan will allow the EPA to redesignate the area as an attainment area. While the plan is being drafted and until it is approved, the area is classified as a maintenance area.

To eliminate or reduce the severity and number of NAAQS violations in nonattainment areas and to achieve expeditious attainment of the NAAQS, the EPA promulgated the Conformity Rule. 40 C.F.R. § 93, Subpart B. The Conformity Rule applies to federal actions and environmental analyses completed after March 15, 1994, in nonattainment and maintenance areas. This rule contains a variety of substantive and procedural requirements to show conformance with both the NAAQS and state implementation plans (SIPs).

Section 176(c) of the CAA prohibits federal agencies from taking actions in nonattainment and maintenance areas unless the emissions from the actions conform to the SIP or Tribal implementation plan for the area. Federal actions must be evaluated for conformity to the local SIP if the project 1) is within an EPA-designated nonattainment or maintenance area, 2) would result in emissions above the de minimis threshold quantities of criteria pollutants listed in 40 C.F.R. § 93, 3) is not a listed exempt action, and 4) has not been accounted for in an EPA-approved SIP.

The Conformity Rule requires that all federal actions in a nonattainment area must demonstrate conformity with the SIP for the pollutant in question. If the agency can demonstrate that emissions for the action will fall below certain established levels, known as de minimis, then no further analysis is necessary. To establish a de minimis claim, an emissions inventory for the project is required. In the case of O_3, the emissions inventory would include NO_x and VOCs. If emissions are projected to be above de minimis levels, a formal Conformity Determination may be required.

3.11.1 NEW MEXICO

Nonattainment designation is classified on six levels depending on the design value and pollutant, with the lowest level starting at marginal and increasing in severity: marginal, moderate, serious, severe-15, severe-17, and extreme. Higher levels reflect increasing difficulty in controlling pollution and stricter regulatory requirements. For example, a severe-15 designation typically applies to areas with very high pollution levels that must meet tighter deadlines and more stringent controls to improve air quality. Nonattainment areas in New Mexico are provided in Table 30.

Table 30. New Mexico Nonattainment Areas by County

County	Full/Partial County	Pollutant	Level	Standard	Location Description
Doña Ana	Partial	O_3	Marginal	2015 8-hour O_3	Sunland Park
Doña Ana	Partial	PM_{10}	Moderate	1987 PM_{10}	Anthony
Grant	Partial	SO_2	Maintenance	1978 SO_2	Phelps Dodge Chino Copper Smelter
Bernalillo*	N/A	N/A	N/A	N/A	N/A

Source: EPA (2025m)

Note: N/A = not applicable

* Bernalillo County is currently designated by the EPA as an attainment area for all air pollutants identified in the NAAQS. However, in 1978 it was designated as a moderate nonattainment area for CO (Ecosphere Environmental Services 2018). The County remained under this designation until 1996, when it was redesignated as an attainment area under limited maintenance for CO. In 2016, after 20 years without violations of the CO standards, the County was redesignated from a limited maintenance area to an attainment area.

More details on the New Mexico nonattainment and maintenance areas and areas exceeding the NAAQS are as follows:

- **O_3 nonattainment area in Doña Ana County (Sunland Park, New Mexico, southwest of the BLM CFO planning area, south of Las Cruces):** In 1995, the EPA declared a 42-square-mile region in the southeast corner of the county on the border of Texas and Mexico as a marginal nonattainment area for the 1-hour O_3 standard. The nonattainment area included the cities of Sunland Park, Santa Teresa, and La Union, New Mexico. The 1-hour O_3 standard was revoked by the EPA in 2004 with the adoption of the new 8-hour O_3 standard. Due to the revocation of the 1979 1-hour O_3 standard and based on monitoring data, Sunland Park was designated as an attainment area for the 1997 8-hour O_3 standard (0.080 ppm).

In October 2015, the EPA lowered the NAAQS for O_3 to 0.070 ppm. As a result, in 2016, the NMED recommended that the EPA designate a portion of Doña Ana County near Sunland Park, New Mexico, as a nonattainment area. Based on 2014 through 2016 O_3 monitoring data, the EPA designated the Sunland Park area in southern Doña Ana County as a marginal nonattainment area for 2015 O_3 NAAQS on June 18, 2018, with an attainment deadline of August 3, 2021 (*Federal Register* 83:25776) (NMED 2020). On November 30, 2021 (*Federal Register* 86:67864), the EPA expanded the marginal nonattainment area that previously covered only the Sunland Park area in Doña Ana County to include El Paso County, Texas, and renamed the marginal nonattainment designated area as the El Paso-Las Cruces, TX-NM nonattainment area.

On December 6, 2018 (*Federal Register* 83:6299), the EPA published the Nonattainment Area SIP Requirements rule that establishes the minimum elements that must be included in all nonattainment SIPs, including the requirements for New Mexico Nonattainment New Source Review (NNSR) permitting. On August 10, 2021, the NMED submitted a SIP to the New Mexico NNSR permitting program to address the requirements of the 2015 8-hour O_3 NAAQS. On November 16, 2022, the EPA approved this SIP, which updated the NNSR permitting program for the 2015 8-hour O_3 NAAQS (*Federal Register* 87:51041, 86:57388).

- **O_3 Design Value Exceedance in Eddy and Lea Counties (Carlsbad, New Mexico):** In May 2025, new design values for NAAQS were published by the EPA for various counties throughout the United States. The monitor at 2811 Holland Street in Eddy County showed an 8-hour O_3 exceedance of 79 parts per billion (ppb) and the monitor at 2320 North Jefferson Street in Lea County showed an 8-hour O_3 exceedance of 72 ppb (EPA 2025f). These areas have not been formally declared nonattainment areas by the EPA through the State's recommendation but may be designated as nonattainment areas in the future.

  New Mexico Statutes Annotated 1978, § 74-2-5, directs the NMED to develop plans that may include regulations that are more stringent than federal rules for areas of the state in which ambient monitoring shows O_3 levels at or above 95% of the NAAQS to control NO_x and VOC emissions to provide for attainment and maintenance of the standard. The NMOCD Statewide Natural Gas Capture Requirements (Waste Prevention Rule) (N.M.A.C. 19.15.27.9) and NMED Oil and Natural Gas Regulation for Ozone Precursors (N.M.A.C. 20.2.50.1) are recent regulations reducing NO_x, VOC, and CH_4 emissions. The 2015 8-hour primary NAAQS for O_3 is 0.070 ppm (70 ppb); 95% of the O_3 NAAQS is 0.067 ppm (67 ppb). This form of the standard requires averaging of 3 years of monitoring data for the fourth-highest 8-hour average, using the most recent year's data to determine the design value. For New Mexico, six counties show 3-year averages (2022–2024) of O_3 levels at or above 95% of the NAAQS or exceeding the NAAQS (EPA 2025f):

  - Bernalillo County (72 ppb)
  - Doña Ana County (76 ppb)
  - Eddy County (80 ppb)
  - Lea County (72 ppb)
  - Sandoval County (68 ppb)
  - San Juan County (68 ppb)

In April 2019, the NMED entered the Ozone Advance Program for the entirety of San Juan (northwestern New Mexico), Lea (southeastern New Mexico), and Eddy (southeastern New Mexico) Counties and for the portion of Doña Ana County that excludes the Sunland Park nonattainment area (south-central New Mexico). O_3 levels in Rio Arriba, Sandoval, Santa Fe, and Valencia Counties either currently exceed or recently have exceeded 95% of the 2015 8-hour O_3 NAAQS (67 ppb) and could soon violate this standard. The Ozone Advance Path Forward and outreach efforts include the following nine counties: Chaves, Doña Ana, Eddy, Lea, Rio Arriba, San Juan, Santa Fe, Sandoval, and Valencia. Although Chaves County does not have O_3 monitors, the NMED includes it in the Ozone Advance Program planning effort as it is part of the Permian Basin with oil and gas emissions that contribute to high O_3 levels in Lea and Eddy Counties. The efforts under the Ozone Advance Program may benefit these areas by potentially 1) reducing O_3 as well as other air pollutants, 2) ensuring continued healthy O_3 levels, 3) maintaining the O_3 NAAQS and helping the Sunland Park nonattainment area attain the 2015 Ozone NAAQS, 4) avoiding violations of the NAAQS that could lead to a future nonattainment designation, 5) increasing public awareness about O_3 as an indirect air pollutant, and 6) targeting limited resources toward actions to address O_3 problems quickly. The NMED goal is to implement measures and programs to reduce O_3 in the near term and, ultimately, to effect changes that will protect community well-being into the future. The NMED will work together and in coordination with stakeholders and the public to proactively pursue this goal (NMED 2022).

- **PM_{10} nonattainment area in Anthony, New Mexico (west of the BLM CFO planning area, south of Las Cruces):** The State of New Mexico submitted the Anthony PM_{10} SIP to the regional EPA headquarters on November 8, 1991. This area was designated as a nonattainment area for PM_{10} by the EPA in 1991. The nonattainment area is bounded by Anthony quadrangle, Anthony, New Mexico-Texas. SE/4 La Mesa 15-minute quadrangle, N32 00 – W106 30/7.5, Sections 35 and 36, Township 26 South, Range 3 East as limited by the New Mexico-Texas state line on the south. The site is in Doña Ana County, which submitted a Natural Events Action Plan for PM_{10} exceedances to the EPA in December 2000. However, Anthony, New Mexico, still exceeds the NAAQS for PM_{10}. Therefore, the EPA has not redesignated the state PM_{10} nonattainment area at this time and has not indicated its plans to do so (NMED 2024b).
- The NMED Air Quality Bureau developed a Fugitive Dust Control Rule (N.M.A.C. 20.2.23) in conjunction with a Dust Mitigation Plan to abate certain controllable sources in Doña Ana and Luna Counties. Mitigation plans are required by the EPA in areas where recurring natural events (in this case, high winds resulting in blowing dust) cause exceedances of the health-based national standards for PM. The NMED developed a single mitigation plan for Doña Ana and Luna Counties and updated this plan on March 10, 2021 (NMED 2021a). The Dust Mitigation Plan and the associated Fugitive Dust Control Rule enhance existing local dust control ordinances and provide coverage where there are gaps. The NMED Air Quality Bureau Fugitive Dust Control Rule was published in conjunction with the original Dust Mitigation Plan and became effective on January 1, 2019. The rule applies to sources of fugitive dust that are not required to obtain a construction permit from the Air Quality Bureau, including areas greater than 1.0 acre that are disturbed by construction/demolition activities and earthmoving. Control measures are required to stabilize surfaces to ensure emissions are not crossing the property line or exceeding opacity limits. Control measures listed in the rule (NMED 2021a) include the following:
    - Watering and/or applying dust suppressant to unpaved surfaces
    - Limiting on-site vehicle speeds
    - Prohibiting activities during high winds

- Watering exposed areas before high winds
- Planting trees or shrubs as a windbreak
- Revegetating disturbed areas with native plants

- **SO_2 Maintenance Area in Grant County (west of the BLM CFO planning area, at the Arizona border):** This maintenance area is at the Phelps Dodge Chino Copper Smelter in Grant County. The maintenance area is defined as a 3.5-mile-radius region around the smelter.
  The maintenance area also includes high-elevation areas within an 8-mile radius. The State of New Mexico submitted a SIP to the regional EPA headquarters in August 1978. The New Mexico Air Quality Bureau submitted a redesignation plan to the EPA in February 2003 seeking to redesignate this portion of Grant County, New Mexico, from nonattainment to attainment for the SO_2 NAAQS. The redesignation plan reported that air monitoring data for this area revealed values lower than the NAAQS for SO_2. The February 2003 submittal also included a contingency measures plan that consisted of monitoring measures and a maintenance plan for this area to ensure that attainment of the SO_2 NAAQS would be maintained through permitting and the applicable SIP rules. The redesignation plan was approved by the EPA in September 2003.
  The Grant County SO_2 Limited Maintenance Plan was submitted to the EPA in November 2013 to fulfill the second 10-year maintenance plan requirement under Section 175A(b) of the CAA to ensure maintenance of the 1971 SO_2 NAAQS through 2025 and was approved by the EPA on July 18, 2014 (NMED 2024b).

3.11.2 TEXAS

Nonattainment areas in Texas are provided in Table 31.

Table 31. Texas Nonattainment Areas by County

County	Full/Partial County	Pollutant	Level*	Standard	Location Description
Anderson	Partial	SO_2	N/A	2010 SO_2	Freestone and Anderson Counties
Bexar	Full	O_3	Serious	2015 8-hour O_3	San Antonio
Brazoria†	Full	O_3	Severe-15	2008 8-hour O_3	Houston-Galveston-Brazoria
Brazoria†	Full	O_3	Serious	2015 8-hour O_3	Houston-Galveston-Brazoria
Chambers†	Full	O_3	Severe-15	2008 8-hour O_3	Houston-Galveston-Brazoria
Chambers†	Full	O_3	Serious	2015 8-hour O_3	Houston-Galveston-Brazoria
Collin‡	Full	O_3	Severe-15	2008 8-hour O_3	Dallas-Fort Worth
Collin‡	Full	O_3	Serious	2015 8-hour O_3	Dallas-Fort Worth
Collin	Partial	Pb	Maintenance	2008 Pb	Frisco
Dallas‡	Full	O_3	Severe-15	2008 8-hour O_3	Dallas-Fort Worth
Dallas‡	Full	O_3	Serious	2015 8-hour O_3	Dallas-Fort Worth
Denton‡	Full	O_3	Severe-15	2008 8-hour O_3	Dallas-Fort Worth
Denton‡	Full	O_3	Serious	2015 8-hour O_3	Dallas-Fort Worth

County	Full/Partial County	Pollutant	Level*	Standard	Location Description
El Paso[§]	Full	O_3	Marginal	2015 8-hour O_3	El Paso-Las Cruces, TX-NM
El Paso[§]	Partial	PM_{10}	Moderate	1987 PM_{10}	El Paso County
El Paso[§]	Partial	CO	Maintenance	1971 CO	El Paso
Ellis[¶]	Full	O_3	Severe-15	2008 8-hour O_3	Dallas-Fort Worth
Ellis[¶]	Full	O_3	Serious	2015 8-hour O_3	Dallas-Fort Worth
Fort Bend[†]	Full	O_3	Severe-15	2008 8-hour O_3	Houston-Galveston-Brazoria
Fort Bend[†]	Full	O_3	Serious	2015 8-hour O_3	Houston-Galveston-Brazoria
Freestone	Partial	SO_2	N/A	2010 SO_2	Freestone and Anderson Counties
Galveston[†]	Full	O_3	Severe-15	2008 8-hour O_3	Houston-Galveston-Brazoria
Galveston[†]	Full	O_3	Serious	2015 8-hour O_3	Houston-Galveston-Brazoria
Hardin[§, #]	Full	O_3	Maintenance	1997 8-hour O_3	Beaumont-Port Arthur
Harris[†]	Full	O_3	Severe-15	2008 8-hour O_3	Houston-Galveston-Brazoria
Harris[†]	Full	O_3	Serious	2015 8-hour O_3	Houston-Galveston-Brazoria
Howard	Partial	SO_2	N/A	2010 SO_2	Howard County
Hutchinson	Partial	SO_2	N/A	2010 SO_2	Hutchinson County
Jefferson[§, #]	Full	O_3	Maintenance	1997 8-hour O_3	Beaumont-Port Arthur
Johnson[¶]	Full	O_3	Severe-15	2008 8-hour O_3	Dallas-Fort Worth
Johnson[¶]	Full	O_3	Serious	2015 8-hour O_3	Dallas-Fort Worth
Kaufman[¶]	Full	O_3	Severe-15	2008 8-hour O_3	Dallas-Fort Worth
Kaufman[¶]	Full	O_3	Serious	2015 8-hour O_3	Dallas-Fort Worth
Liberty[†]	Full	O_3	Severe-15	2008 8-hour O_3	Houston-Galveston-Brazoria
Montgomery[†]	Full	O_3	Severe-15	2008 8-hour O_3	Houston-Galveston-Brazoria
Montgomery[†]	Full	O_3	Serious	2015 8-hour O_3	Houston-Galveston-Brazoria
Navarro	Partial	SO_2	N/A	2010 SO_2	Navarro County
Orange[§, #]	Full	O_3	Maintenance	1997 8-hour O_3	Beaumont-Port Arthur
Panola	Partial	SO_2	N/A	2010 SO_2	Rusk and Panola Counties
Parker[¶]	Full	O_3	Severe-15	2008 8-hour O_3	Dallas-Fort Worth
Parker[¶]	Full	O_3	Serious	2015 8-hour O_3	Dallas-Fort Worth
Rockwall[¶]	Full	O_3	Severe-15	2008 8-hour O_3	Dallas-Fort Worth
Rusk	Partial	SO_2	N/A	2010 SO_2	Rusk and Panola Counties
Tarrant[‡]	Full	O_3	Severe-15	2008 8-hour O_3	Dallas-Fort Worth
Tarrant[‡]	Full	O_3	Serious	2015 8-hour O_3	Dallas-Fort Worth

County	Full/Partial County	Pollutant	Level*	Standard	Location Description
Titus	Partial	SO_2	N/A	2010 SO_2	Titus County
Victoria	Full	O_3	Maintenance	1979 1-hour O_3	Victoria
Waller†	Full	O_3	Severe-15	2008 8-hour O_3	Houston-Galveston-Brazoria
Wise	Full	O_3	Severe-15	2008 8-hour O_3	Dallas-Fort Worth
Wise	Full	O_3	Serious	2015 8-hour O_3	Dallas-Fort Worth

Source: EPA (2025m)

* Classification levels are based on the worst-case general conformity level.

† Greenbook also lists the revoked 1979 1-hour O_3 level (severe-17) and 1997 8-hr O_3 level (severe-15) for this county (EPA 2025m).

‡ Greenbook also lists the revoked 1979 1-hour O_3 level (serious) and 1997 8-hr O_3 level (serious) for this county (EPA 2025m).

§ Greenbook also lists the revoked 1979 1-hour O_3 level (serious) for this county (EPA 2025m).

¶ Greenbook also lists the revoked 1997 8-hour O_3 level (serious) for this county (EPA 2025m).

The Beaumont-Port Arthur area is designated as a maintenance area for 1979 1-hour O_3 and 1997 8-hour O_3 standards until 2032, according to TCEQ (EPA 2025m).

3.11.3 KANSAS

Nonattainment areas in Kansas are provided in Table 32.

Table 32. Kansas Nonattainment Areas by County

County	Full/Partial County	Pollutant	Level*	Standard	Location Description
Johnson	Full	O_3	Maintenance	1979 1-hour O_3	Kansas City, Missouri-Kansas
Saline	Partial	Pb	N/A	2008 Pb	Saline County
Wyandotte[1]	Full	O_3	Maintenance	1979 1-hour O_3	Kansas City, Missouri-Kansas

Source: EPA (2025m)

* Classification levels are based upon the worst-case general conformity level.

3.11.4 OKLAHOMA

There are currently no nonattainment areas for any criteria pollutant in the state of Oklahoma.

4 NATIONAL EMISSIONS INVENTORY DATA

The NEI data present the emissions of each criteria pollutant by national, state, county, and Tribal areas for major source sectors. National emissions trends are reported in the *2020 National Emissions Inventory and Trends Report* (2020 NEI Report) (EPA 2023h). The NEI data are updated every 3 years, with new emissions inventory data incurring a 2- to 3-year data gathering period for final use. The most recent NEI data are for 2020 and were released in March 2023. Emissions data are expressed in tons per year or total volume of pollutant released to the atmosphere. Emissions data are useful in comparing source categories to determine which industries or practices are contributing the most to the general level of pollution in an area.

The anthropogenic sectors mentioned in the report are defined as follows:

(1) Electricity generation is fuel combustion from electric utilities.

(2) Fossil fuel combustion is fuel combustion from industrial boilers, internal combustion engines, and commercial/institutional or residential use.

(3) Industrial processes include manufacturing of chemicals, metals, and electronics; storage and transfer operations; pulp and paper production; cement manufacturing; petroleum refineries; and oil and gas production.

(4) On-road vehicles includes both gasoline- and diesel-powered vehicles for on-road use.

(5) Nonroad equipment includes gasoline- and diesel-powered equipment for nonroad use, as well as planes, trains, and ships.

(6) Road dust includes dust from both paved and unpaved roads.

Presentation of emissions data by source sector provides a better understanding of the activities that contribute to criteria pollutant emissions.

NEI data by pollutant (CO, NO_x, PM_{10} and $PM_{2.5}$, SO_2, and VOCs) for the major sources within New Mexico, Kansas, Oklahoma, and Texas can be found in Appendix D.

The 2020 NEI data are broken down into the following emission source categories:

- Solvents – consumer and commercial solvent use, degreasing, dry cleaning, graphic arts, industrial surface coating and solvent use, and non-industrial surface coating
- Mobile sources – aircraft, commercial marine vessels, locomotives, nonroad equipment, and on-road vehicles
- Industrial processes – cement manufacturing, chemical manufacturing, ferrous metals, mining, not elsewhere classified, nonferrous metals, oil and gas production, petroleum refineries, pulp and paper, and storage and transfer
- Fires – agricultural field burning, prescribed burning, and wildfires
- Biogenic sources – vegetation and soil
- Fuel combustion – institutional, electric generation, industrial boilers, internal combustion engines, and residential (for biomass, coal, natural gas, oil)
- Agriculture – crops and livestock dust, fertilizer application, and livestock waste
- Dust – construction dust, paved road dust, and unpaved road dust

The figures below show the 2020 NEI VOC, NO_X, CO, PM_{10}, $PM_{2.5}$, and SO_2 emissions for the states of New Mexico, Texas, Oklahoma, and Kansas, showing the estimated percentage of total emissions from each of the applicable emission source categories above.

4.1 2020 NATIONAL EMISSIONS INVENTORY DATA

Total emissions within the United States and the BLM NMSO area of operations are reported in Table 33 and are based on 2020 NEI data (EPA 2023h). Table 34 reports total emissions within each county in New Mexico (EPA 2023h).

Table 33. 2020 NEI Air Pollutant Emissions in Tons per Year for the United States and BLM NMSO States

State	NO_X	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	HAPs
United States	**8,814,608**	**66,065,689**	**46,140,059**	**16,761,114**	**5,815,036**	**1,838,518**	**5,964,882**
New Mexico	201,629	616,567	712,766	130,768	43,642	89,168	105,537
Kansas	199,314	927,620	698,701	500,208	146,908	14,794	128,527
Texas	963,226	4,070,107	4,355,399	1,549,000	362,101	248,177	470,542
Oklahoma	239,316	1,236,732	1,190,095	503,476	142,324	34,886	131,286

Source: EPA (2023h). NEI data accessed September 13, 2024.

Note: Table reports both biogenic and human-caused emissions. Values may not always sum correctly if queried on demand as the NEI database updates its emissions periodically with newer emission information. Values include summaries for each county, including combustion, industrial, on-road/nonroad, and miscellaneous sectors. New Mexico emissions include Tribal emissions from the Four Corners Power Plant in San Juan County. There are no Tribal emissions for Texas, Kansas, and Oklahoma.

Table 34. 2020 NEI Air Pollutant Emissions in Tons per Year for New Mexico Counties

County	NO_X	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	HAPs
New Mexico counties in the major oil and gas basin	**121,973**	**219,286**	**394,308**	**46,439**	**13,331**	**87,162**	**45,798**
Chaves	5,008	13,034	17,379	4,038	975	1,202	3,234
Eddy	26,808	45,159	101,008	7,325	2,305	35,502	11,764
Lea	32,702	46,128	126,317	6,245	2,295	46,579	13,507
McKinley	7,019	13,292	20,054	5,140	1,179	444	3,558
Rio Arriba	12,423	26,303	53,474	3,632	919	61	4,829
Roosevelt	1,580	5,156	7,683	2,977	695	238	2,003
Sandoval	4,106	20,065	16,604	8,413	1,885	140	2,618
San Juan	32,327	50,149	51,789	8,669	3,078	2,996	4,285
Remaining New Mexico counties	**70,813**	**392,123**	**317,947**	**84,038**	**30,182**	**1,913**	**59,541**
Bernalillo	14,644	72,054	15,944	21,064	5,189	360	3,504
Catron	1,697	36,857	40,085	4,063	2,924	264	6,328
Cibola	3,515	5,416	16,147	1,411	410	13	2,961

County	NO_X	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2	HAPs
Colfax	2,688	7,911	17,859	1,575	390	10	2,656
Curry	2,292	5,737	6,867	4,297	1,014	28	1,727
De Baca	2,271	5,322	5,086	972	414	22	1,344
Doña Ana	6,768	25,244	12,564	5,467	1,655	92	2,491
Grant	1,881	35,427	21,961	5,118	2,966	255	3,603
Guadalupe	2,853	5,082	6,040	775	208	5	1,722
Harding	752	1,831	5,146	289	68	1	1,359
Hidalgo	1,654	3,013	8,324	538	157	6	1,381
Lincoln	1,790	10,708	15,386	2,597	857	54	2,755
Los Alamos	382	2,211	1,872	909	216	3	319
Luna	2,586	5,988	5,773	1,282	386	40	1,119
Mora	1,071	40,549	17,277	4,531	3,359	244	2,528
Otero	2,017	11,108	22,883	3,989	824	19	3,435
Quay	1,988	5,359	6,092	1,395	354	8	1,704
San Miguel	1,825	15,740	15,886	2,752	1,239	86	3,170
Santa Fe	3,792	31,445	11,567	7,790	2,535	116	2,338
Sierra	1,254	5,771	11,519	755	232	11	2,108
Socorro	2,598	28,870	20,726	3,469	2,244	192	4,181
Taos	1,052	10,897	11,208	3,375	1,000	39	1,623
Torrance	4,738	6,979	7,769	1,611	447	12	1,922
Union	1,402	4,293	9,522	2,202	496	10	2,240
Valencia	3,303	8,311	4,444	1,812	598	23	1,022

Source: EPA (2023h). NEI data accessed September 13, 2024.

Note: Table reports both biogenic and human-caused emissions. Values may not always sum correctly if queried on demand as the NEI database updates its emissions periodically with newer emission information. Values include summaries for each county, including combustion, industrial, on-road/nonroad, and miscellaneous sectors. San Juan County emissions include Tribal emissions (Four Corners Power Plant). Totals may not sum exactly due to rounding..

According to the 2020 NEI data, the largest anthropogenic source of NO_X, SO_2, and VOCs in New Mexico was oil and gas sources (Table 35). Criteria air pollutant emissions in 2008 differed from those in 2020. NO_x increased from 197,830 tons in 2008 to 201,629 tons in 2020, and SO_2 increased from 24,669 to 89,168 tons over the same period. However, from 2008 to 2020, PM_{10} decreased from 821,631 to 130,768 tons, $PM_{2.5}$ decreased from 101,998 to 43,643 tons, CO decreased from 813,515 to 616,567 tons, and VOCs decreased from 1,315,442 to 712,166 tons. Emissions from natural sources (biogenics) decreased from 1,499,241 tons in 2008 to 416,849 tons in 2020, while criteria air pollutant emissions from oil and gas sources increased from 15,451 to 513,566 tons (EPA 2023h).

Table 35. 2020 Air Pollutant Emissions in Tons per Year by Source, New Mexico

Source	CO	NH_3	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
Area sources*	10,322	83,628	2,218	97,936	15,646	434	32,364
Oil and gas sources	100,695	4	67,956	2,171	2,005	83,175	257,560
Nonroad mobile	64,346	15	20,430	969	925	72	5,730
On-road mobile	139,109	794	39,531	2,195	1,115	77	10,074
Point sources	79,958	1,128	50,508	9,741	9,273	2,824	28,385
VOC refueling	5	0	2	0	0	0	5,745
Natural sources (biogenics)	64,591	0	16,459	0	0	0	335,799
Forest wildfires	146,933	2,417	2,196	15,120	12,811	1,164	34,718
Prescribed fires	9,554	158	162	1,000	848	82	2,264
Miscellaneous	0	0	0	0	0	0	0
Tribal†	1,054	7	2,167	1,636	1,019	1,340	127
Total for New Mexico	**616,567**	**88,151**	**201,629**	**130,768**	**43,643**	**89,168**	**712,766**

Source: EPA (2023h). NEI data accessed September 13, 2024.

* Includes all area sources except biogenic (natural) sources, forest wildfires, and prescribed fires

† Tribal emissions are from the Four Corners Power Plant in San Juan County.

According to the 2020 NEI data, the largest anthropogenic source of NO_x and VOCs in Texas was oil and gas sources (Table 36). Criteria air pollutant emissions in 2008 differed from those in 2020. NO_x decreased from 1,717,979 tons in 2008 to 963,226 tons in 2020, SO_2 decreased from 619,281 to 247,177 tons, PM_{10} decreased from 2,514,908 to 1,549,000 tons, $PM_{2.5}$ decreased from 462,178 to 362,101 tons, CO decreased from 5,601,235 to 4,070,107 tons, and VOC decreased from 6,028,204 to 4,355,399 tons. Emissions from natural sources (biogenics) decreased from 4,687,170 tons in 2008 to 2,777,116 tons in 2020, and criteria air pollutant emissions from oil and gas sources decreased from 1,789,026 to 1,686,327 tons (EPA 2023h).

Table 36. 2020 Air Pollutant Emissions Tons per Year by Source, Texas

Source	CO	NH_3	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
Area sources*	256,981	518,847	66,505	1,391,488	233,612	46,988	336,696
Oil and gas sources	188,033	31	236,288	3,237	3,220	47,556	1,207,962
Nonroad mobile	905,234	106	101,950	7,584	7,162	981	67,042
On-road mobile	1,172,835	7,595	210,029	15,969	6,575	805	66,713
Point sources	183,664	7,054	199,302	23,251	20,378	142,378	53,842
VOC refueling	65	1	84	8	7	11	39,449
Natural sources (biogenics)	334,168	0	103,142	0	0	0	2,339,806

Source	CO	NH_3	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
Forest wildfires	80,902	1,330	1,572	8,654	7,337	745	19,224
Prescribed fires	944,525	15,545	15,125	98,088	83,129	7,783	223,470
Miscellaneous	3,700	11	29,229	721	681	930	1,195
Total for Texas	**4,070,107**	**550,520**	**963,226**	**1,549,000**	**362,101**	**247,177**	**4,355,399**

Source: EPA (2023h). NEI data accessed September 13, 2024.

* Includes all area sources except biogenic (natural) sources, forest wildfires, and prescribed fires

According to the 2020 NEI data, oil and gas sources were not the largest anthropogenic source for any criteria air pollutant in Kansas (Table 37). Criteria air pollutant emissions in 2008 differed from those in 2020. NO_x decreased from 357,510 tons in 2008 to 199,314 tons in 2020, SO_2 decreased from 118,860 to 14,794 tons, PM_{10} decreased from 866,070 to 500,208 tons, $PM_{2.5}$ decreased from 193,662 to 146,908 tons, CO decreased from 1,355,031 to 927,620 tons, and VOCs decreased from 771,768 to 698,701 tons. Emissions from natural sources (biogenics) decreased from 688,504 tons in 2008 to 513,882 tons in 2020, while criteria air pollutant emissions from oil and gas sources increased from 854 to 113,371 tons (EPA 2023h).

Table 37. 2020 Air Pollutant Emissions Tons per Year by Source, Kansas

Source	CO	NH_3	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
Area sources*	52,710	202,936	7,664	418,547	71,697	3,568	71,332
Oil and gas sources	33,055	22	22,337	603	603	124	56,627
Nonroad mobile	116,899	12	38,572	2,257	2,150	164	9,495
On-road mobile	177,881	890	34,667	1,918	966	68	11,847
Point sources	47,909	1,049	41,931	6,672	6,115	4,424	7,846
VOC refueling	14	0	7	0	0	0	9,090
Natural sources (biogenics)	70,723	0	37,290	0	0	0	405,869
Forest wildfires	9,605	155	232	1,095	934	101	2,323
Prescribed fires	418,824	6,318	16,612	69,116	64,443	6,345	124,272
Miscellaneous	0	0	2	0	0	0	0
Total for Kansas	**927,620**	**211,382**	**199,314**	**500,208**	**146,908**	**14,794**	**698,701**

Source: EPA (2023h). NEI data accessed September 13, 2024.

* Includes all area sources except biogenic (natural) sources, forest wildfires, and prescribed fires

According to the 2020 NEI data, the largest anthropogenic source of VOCs in Oklahoma was oil and gas sources (Table 38). Criteria air pollutant emissions in 2008 differed from those in 2020. NO_x decreased from 463,786 tons in 2008 to 239,316 tons in 2020, SO_2 decreased from 148,620 to 34,886 tons, PM_{10} decreased from 809,138 to 503,476 tons, $PM_{2.5}$ decreased from 168,525 to 142,324 tons, CO decreased from 1,736,048 to 1,236,732 tons, and VOCs decreased from 1,356,316 to 1,190,095 tons. Emissions from natural sources (biogenics) decreased from 1,045,049 tons in 2008 to 822,989 tons in 2020, and criteria air pollutant emissions from oil and gas sources decreased from 322,241 to 276,709 tons (EPA 2023h).

Table 38. 2020 Air Pollutant Emissions Tons per Year by Source, Oklahoma

Source	CO	NH_3	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC
Area sources*	58,170	184,623	14,030	420,628	71,617	19,298	72,465
Oil and gas sources	45,423	0	46,040	1,134	1,106	958	182,048
Nonroad mobile	176,121	15	26,395	1,699	1,612	287	15,394
On-road mobile	252,943	1,355	50,832	3,026	1,423	131	17,525
Point sources	70,607	1,553	64,174	13,467	12,045	8,498	24,813
VOC refueling	28	0	3	1	1	0	15,235
Natural sources (biogenics)	71,737	0	25,174	0	0	0	726,078
Forest wildfires	62,451	1,034	1,309	6,756	5,724	606	14,861
Prescribed fires	499,242	8,186	11,291	56,763	48,794	5,108	121,674
Miscellaneous	10	0	68	2	2	0	2
Total for Oklahoma	**1,236,732**	**196,766**	**239,316**	**503,476**	**142,324**	**34,886**	**1,190,095**

Source: EPA (2023h). NEI data accessed September 13, 2024.

* Includes all area sources except biogenic (natural) sources, forest wildfires, and prescribed fires

According to the 2020 NEI data, the largest anthropogenic source of CO, NO_x, and VOCs in the San Juan Basin (McKinley, Sandoval, San Juan, and Rio Arriba Counties) was oil and gas (Table 39). Criteria air pollutant emissions in 2008 differed from those in 2020. NO_x decreased from 57,085 tons in 2008 to 55,875 tons in 2020, SO_2 decreased from 13,146 to 3,641 tons, PM_{10} decreased from 221,003 tons to 25,854 tons, $PM_{2.5}$ decreased from 25,868 tons to 7,061 tons, CO emissions decreased from 147,491 to 109,809 tons, and VOCs decreased from 209,861 to 143,021 tons. Emissions from natural sources (biogenics) decreased from 229,692 tons in 2008 to 81,279 tons in 2020, while criteria air pollutant emissions from oil and gas sources increased from 2,309 to 116,232 tons (EPA 2023h). The NEI data by source for each county in the San Juan Basin are presented in Appendix A.

Table 39. 2020 Air Pollutant Emissions Tons per Year by Source, San Juan Basin

Source	CO	NH_3	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOCs
Area sources*	2,064	5,605	322	20,805	2,989	34	4,571
Oil and gas sources	33,662	0	22,582	287	283	289	59,129
Nonroad mobile	7,469	2	2,978	128	124	4	737
On-road mobile	25,162	146	6,826	362	193	14	1,763
Point sources	26,724	206.829	20,758	3,900	3,158	3,266	7,443
VOC refueling	0	0	0	0	0	0	924
Natural sources (biogenics)	11,304	0	2,336	0	0	0	67,639

Source	CO	NH_3	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOCs
Forest wildfires	3,039	51	64	330	279	30	723
Prescribed fires	385	6	9	42	35	4	92
Miscellaneous	0	0	0	0	0	0	0
Total for San Juan Basin	**109,809**	**6,017**	**55,875**	**25,854**	**7,061**	**3,641**	**143,021**

Source: EPA (2023h). NEI data accessed September 13, 2024.

Note: New Mexico point source emissions include Tribal emissions from San Juan County.

* Includes all area sources except biogenic (natural) sources, forest wildfires, and prescribed fires

According to the 2020 NEI data, the largest anthropogenic source of CO, NO_x, SO_2, and VOCs in the Permian Basin (Eddy, Chaves, Lea, and Roosevelt Counties) was oil and gas (Table 40). Criteria air pollutant emissions in 2008 differed from those in 2020. NO_X increased from 31,514 tons in 2008 to 66,098 tons in 2020, SO_2 increased from 9,995 to 83,521 tons, CO increased from 98,963 to 109,477 tons, and VOCs increased from 165,371 to 252,387 tons. However, PM_{10} decreased from 100,800 to 20,585 tons, and $PM_{2.5}$ decreased from 13,332 to 6,270 tons. Emissions from natural sources (biogenics) decreased from 198,891 tons in 2008 to 38,958 tons in 2020, while criteria air pollutant emissions from oil and gas sources increased from 12,974 to 389,973 tons (EPA 2023h). The NEI data by source for each county in the Permian Basin are presented in Appendix A.

Table 40. 2020 Air Pollutant Emissions Tons per Year by Source, Permian Basin

Source	CO	NH_3	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOCs
Area sources*	1,731	26,246	503	16,733	2,786	162	7,755
Oil and gas sources	63,937	3	43,049	1,838	1,689	82,882	196,575
Nonroad mobile	5,131	0	1,257	78	72	10	498
On-road mobile	15,136	88	3,422	213	100	7	999
Point sources	14,521	161	15,632	1,560	1,485	444	15,366
VOC refueling	0	0	0	0	0	0	1,635
Natural sources (biogenics)	7,549	0	2,201	0	0	0	29,208
Forest wildfires	906	14	19	99	83	9	215
Prescribed fires	566	9	15	64	55	7	136
Miscellaneous	0	0	0	0	0	0	0
Total for Permian Basin	**109,477**	**26,521**	**66,098**	**20,585**	**6,270**	**83,521**	**252,387**

Source: EPA (2023h). NEI data accessed September 13, 2024.

* Includes all area sources except biogenic (natural) sources, forest wildfires, and prescribed fires

4.1.1 VOLATILE ORGANIC COMPOUND EMISSIONS

According to the 2020 NEI data, biogenic sources, fires, industrial processes, mobile sources, and solvents were the largest source categories for VOC emissions for the states of New Mexico, Texas, Oklahoma, and Kansas (Figure 3) (EPA 2023h).

The 2020 NEI data for the BLM New Mexico portion of the San Juan Basin (San Juan, Rio Arriba, Sandoval, and McKinley Counties) indicate that biogenic sources and fuel combustion accounted for 47.7% and 3.0% of total VOC emissions, respectively (EPA 2023h). Industrial processes accounted for 43.7%, of which approximately 95.3% was from oil and gas sources.

The 2020 NEI data for the BLM New Mexico portion of the Permian Basin (Eddy, Lea, Chaves, and Roosevelt Counties) indicate that biogenic sources and fuel combustion accounted for 11.6% and 2.7% of total VOC emissions, respectively (EPA 2023h). Industrial processes accounted for 81.5%, of which approximately 95.5% was from oil and gas sources.

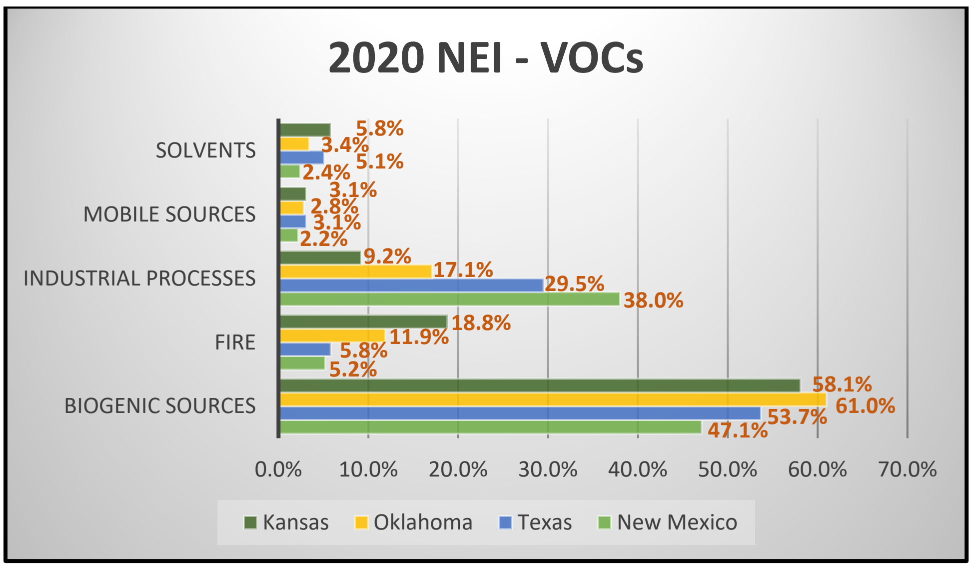

Figure 3. Largest contributors, by percentage, to total VOC emissions in Kansas, Oklahoma, Texas, and New Mexico, 2020 NEI data.

4.1.2 NITROGEN OXIDES EMISSIONS

According to the 2020 NEI data, fuel combustion, biogenic sources, fires, industrial processes, and mobile sources were the largest source categories for total NO_x emissions for the states of New Mexico, Texas, Oklahoma, and Kansas (Figure 4) (EPA 2023h).

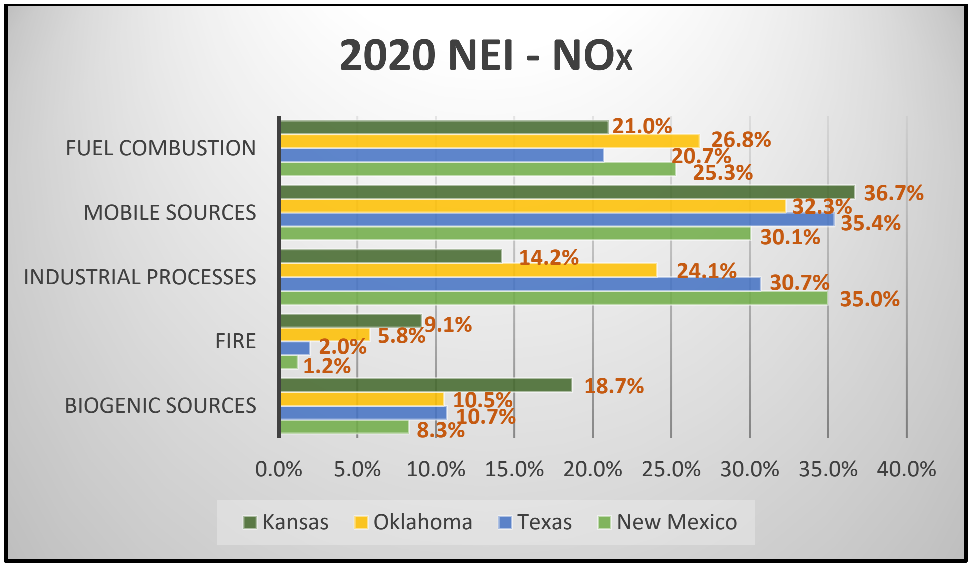

Figure 4. Largest contributors, by percentage, to total NO_X emissions in Kansas, Oklahoma, Texas, and New Mexico, 2020 NEI data.

The 2020 NEI data for the BLM New Mexico portion of the San Juan Basin (San Juan, Rio Arriba, Sandoval, and McKinley Counties) indicate that fuel combustion and mobile sources accounted for 34.6% and 18.3% of total NO_x emissions, respectively (EPA 2023h). Industrial processes accounted for 42.5%, of which approximately 98.9% was from oil and gas sources.

The 2020 NEI data for the BLM New Mexico portion of the Permian Basin (Eddy, Lea, Chaves, and Roosevelt Counties) indicate that fuel combustion and mobile sources accounted for 23.6% and 7.1% of total NO_x emissions, respectively (EPA 2023h). Industrial processes accounted for 65.8%, of which approximately 98.9% was from oil and gas sources.

4.1.3 CARBON MONOXIDE EMISSIONS

According to the 2020 NEI data, fuel combustion, biogenic sources, fires, industrial processes, and mobile sources were the largest source categories for CO emissions for the states of New Mexico, Texas, Oklahoma, and Kansas (Figure 5) (EPA 2023h).

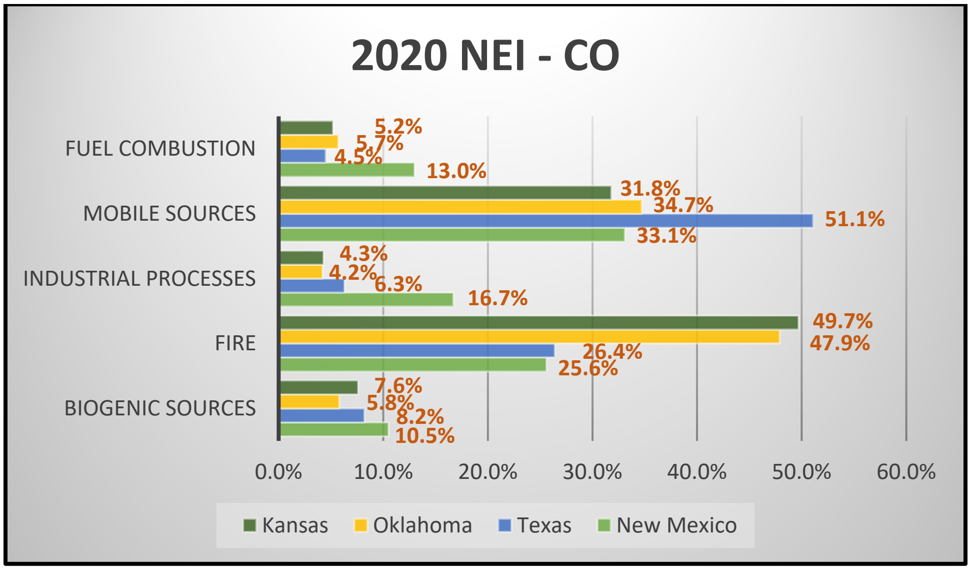

Figure 5. Largest contributors, by percentage, to total CO emissions in Kansas, Oklahoma, Texas, and New Mexico, 2020 NEI data.

The 2020 NEI data for the BLM New Mexico portion of the San Juan Basin (San Juan, Rio Arriba, Sandoval, and McKinley Counties) indicate that fuel combustion and mobile sources accounted for 23.6% and 30.0% of total CO emissions, respectively (EPA 2023h). Industrial processes accounted for 31.2%, of which approximately 99.2% was from oil and gas sources.

The 2020 NEI data for the BLM New Mexico portion of the Permian Basin (Eddy, Lea, Chaves, and Roosevelt Counties) indicate that fuel combustion and mobile sources accounted for 13.3% and 18.5% of total CO emissions, respectively (EPA 2023h). Industrial processes accounted for 59.2%, of which approximately 98.7% was from oil and gas sources.

4.1.4 PARTICULATE MATTER

According to the 2020 NEI data, dust sources, fuel combustion, agriculture, fires, industrial processes, and mobile sources were the largest source categories for PM_{10} and $PM_{2.5}$ emissions for the states of New Mexico, Texas, Oklahoma, and Kansas (Figure 6 and Figure 7) (EPA 2023h).

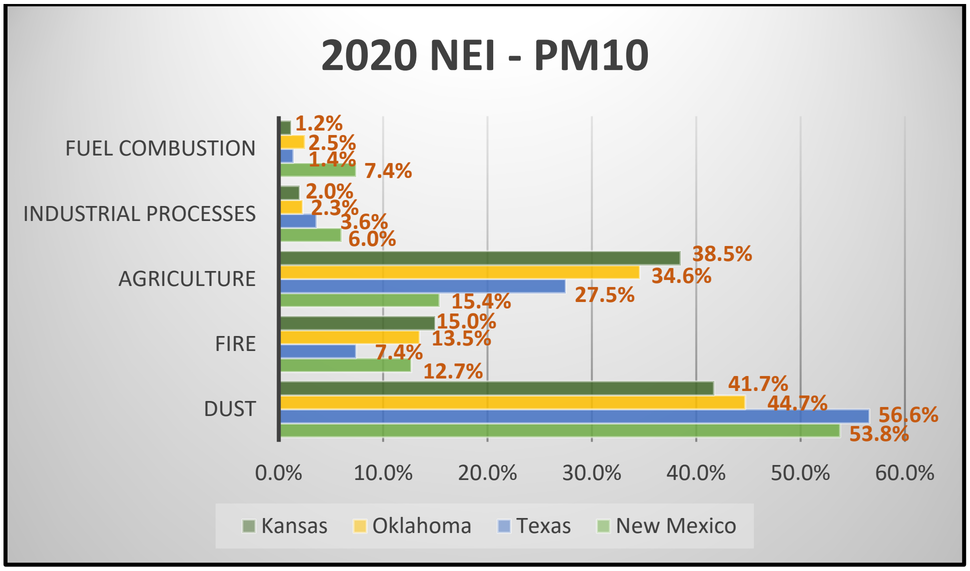

Figure 6. Largest contributors, by percentage, to total PM_{10} emissions in Kansas, Oklahoma, Texas, and New Mexico, 2020 NEI data.

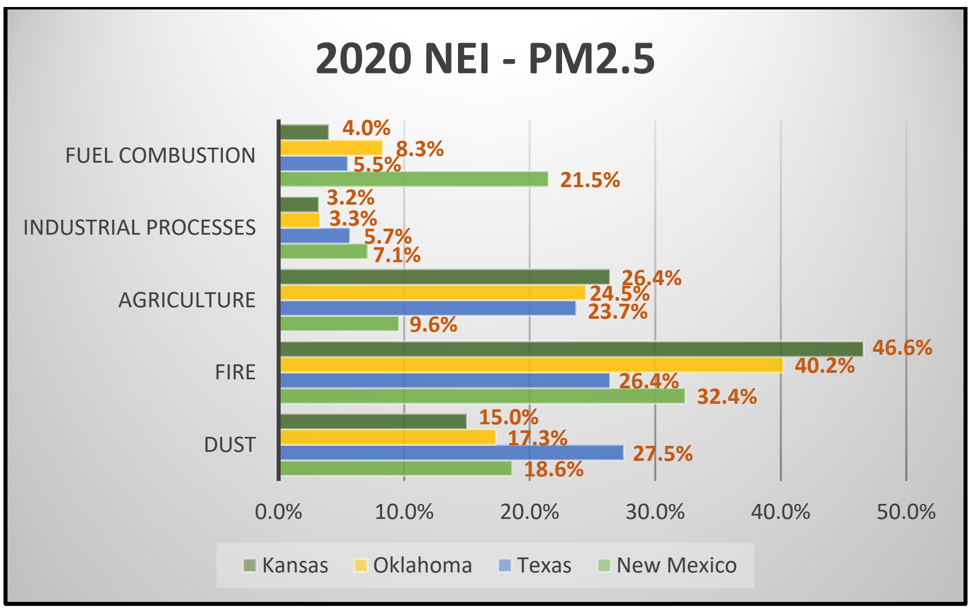

Figure 7. Largest contributors, by percentage, to total $PM_{2.5}$ emissions in Kansas, Oklahoma, Texas, and New Mexico, 2020 NEI data.

The 2020 NEI data for the BLM New Mexico portion of the San Juan Basin (San Juan, Rio Arriba, Sandoval, and McKinley Counties) indicate that dust, fires, and fuel combustion accounted for 66.8%, 1.6%, and 9.2% of total PM_{10} emissions, respectively (EPA 2023h). Industrial processes accounted for 11.7%, of which approximately 10.1% was from oil and gas sources. Dust, fires, and fuel combustion accounted for 30.3%, 5.4%, and 35.3%, respectively, of total $PM_{2.5}$ emissions. Industrial processes accounted for 10.5%, of which approximately 44.6% was from oil and gas sources.

The 2020 NEI data for the BLM New Mexico portion of the Permian Basin (Eddy, Lea, Chaves, and Roosevelt Counties) indicate that dust and agriculture accounted for 47.6% and 27.1% of total PM_{10}

emissions, respectively (EPA 2023h). Industrial processes accounted for 14.0%, of which approximately 63.6% was from oil and gas sources. Dust and agriculture accounted for 17.4% and 18.3%, respectively, of total $PM_{2.5}$ emissions. Industrial processes accounted for 31.5%, of which approximately 85.6% was from oil and gas sources.

4.1.5 SULFUR DIOXIDE EMISSIONS

According to the 2020 NEI data, fuel combustion, fires, industrial processes, and mobile sources were the largest source categories for SO_2 emissions for the states of New Mexico, Texas, Oklahoma, and Kansas (Figure 8) (EPA 2023h).

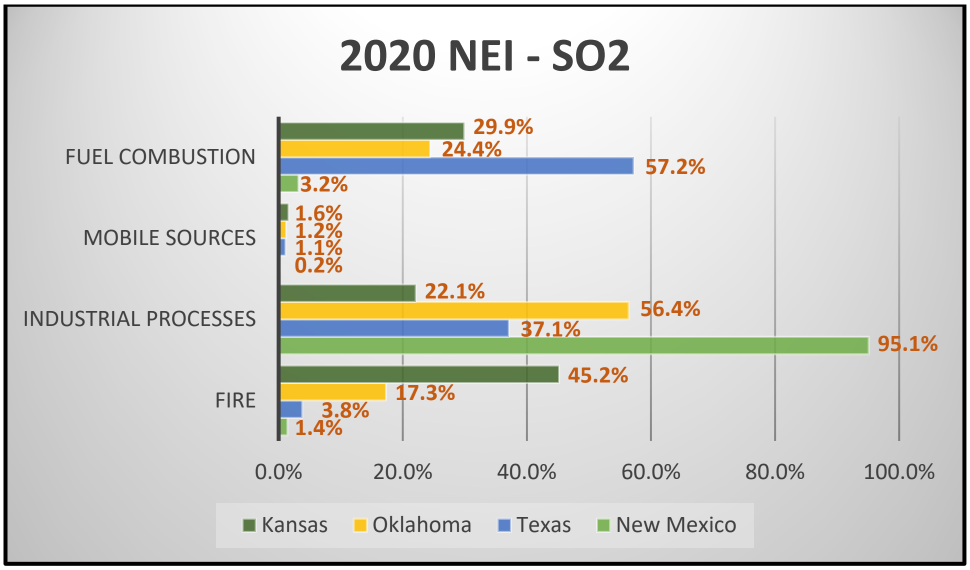

Figure 8. Largest contributors, by percentage, to total SO_2 emissions in Kansas, Oklahoma, Texas, and New Mexico, 2020 NEI data.

The 2020 NEI data for the BLM New Mexico portion of the San Juan Basin (San Juan, Rio Arriba, Sandoval, and McKinley Counties) indicate that fuel combustion and fires accounted for 83.7% and 1.5% of total SO_2 emissions, respectively (EPA 2023h). Industrial processes accounted for 13.3%, of which approximately 94.8% came from oil and gas sources.

The 2020 NEI data for the BLM New Mexico portion of the Permian Basin (Eddy, Lea, Chaves, and Roosevelt Counties) indicate that fuel combustion accounted for 0.5% of total SO_2 emissions (EPA 2023h). Industrial processes accounted for 99.4%, of which approximately 99.8% was from oil and gas sources.

4.1.6 HAZARDOUS AIR POLLUTANTS

According to the 2020 NEI data, biogenics, fuel combustion, fires, industrial processes, and mobile sources were the largest source categories for HAP emissions for the states of New Mexico, Texas, Oklahoma, and Kansas (Figure 9) (EPA 2023h). The NEI HAP emissions by state and county are summarized in Table 41, Table 42, and Table 43.

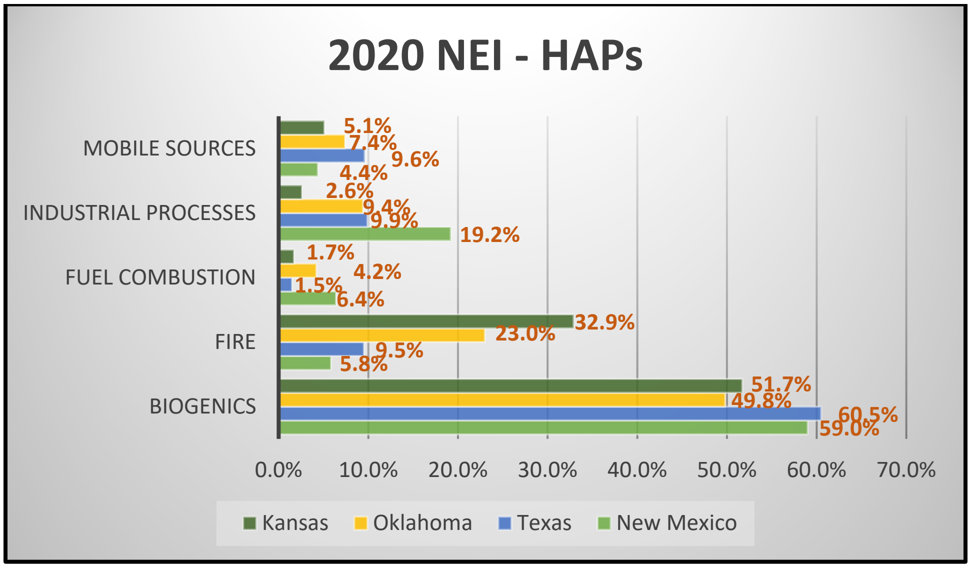

Figure 9. Largest contributors, by percentage, to total HAP emissions in Kansas, Oklahoma, Texas, and New Mexico, 2020 NEI data.

Table 41. HAPs in Tons per Year for BLM NMSO States

State	Acetaldehyde	Benzene	Ethylbenzene	Formaldehyde	Hexane	Methanol	Naphthalene	Toluene	Xylenes	Total HAPs
Kansas	20,514.77	2,736.95	613.791	22,799.94	1,390.88	57,983.92	820.83	4,523.74	2,542.30	128,527
Texas	47,402.85	17,442.72	3896.0755	73,172.96	9,553.91	219,649.11	3,188.44	29,293.32	16,091.20	470,542
Oklahoma	15,708.77	3,299.96	915.802	25,065.93	1,824.73	58,314.69	1,642.04	6,977.34	4,849.26	131,286
New Mexico	11,803.29	4,170.10	489.919	26,168.15	1,221.89	47,572.00	593.74	4,486.80	1,925.96	105,537

Source: EPA (2023h). NEI data accessed September 13, 2024.

Note: New Mexico emissions include Tribal emissions from San Juan County. Total HAPs may not equal the sum of the listed HAPs, as only select HAPs are presented.

Table 42. HAPs in Tons per Year for New Mexico Counties

County	Acetaldehyde	Benzene	Ethylbenzene	Formaldehyde	Hexane	Methanol	Naphthalene	Toluene	Xylenes	Total HAPs
New Mexico counties in the major oil and gas basin	***4,335.8***	***3,370.6***	***226.1***	***15,437.0***	***828.6***	***14,897.8***	***124.9***	***2,486.6***	***777.6***	***45,798.5***
Chaves	346.2	40.6	18.0	583.0	21.9	1,798.6	7.0	90.7	32.9	3,234.0
Eddy	905.6	1,389.9	56.6	5,485.7	242.2	1,668.7	27.4	810.0	219.8	11,764.0
Lea	1,038.2	1,663.1	77.5	5,888.2	377.9	2,124.0	27.9	997.8	255.4	13,507.0
McKinley	428.2	27.4	11.1	637.8	18.0	2,169.5	11.7	73.7	37.0	3,558.5
Rio Arriba	604.0	40.1	12.1	1,075.1	34.9	2,783.1	8.5	80.6	46.9	4,829.0
Roosevelt	218.1	12.8	3.4	285.6	5.4	1,276.8	4.0	26.8	11.8	2,003.0
Sandoval	325.0	44.8	21.3	461.0	30.3	1,261.8	18.7	147.0	68.7	2,618.0
San Juan	470.5	151.9	26.1	1,020.6	98.0	1,815.3	19.7	260.0	105.1	4,285.0
Remaining New Mexico counties	***7,447.0***	***783.8***	***264.0***	***10,636.2***	***392.8***	***32,661.5***	***460.5***	***1,993.9***	***1,144.6***	***59,540.5***
Bernalillo	349.7	147.4	97.2	368.7	121.4	479.2	55.9	654.9	340.5	3,504.0

County	Acetaldehyde	Benzene	Ethylbenzene	Formaldehyde	Hexane	Methanol	Naphthalene	Toluene	Xylenes	Total HAPs
Catron	926.8	63.2	1.0	1,501.8	7.7	3,448.4	66.4	53.0	32.1	6,327.6
Cibola	371.8	11.7	5.2	578.4	8.2	1,872.4	5.8	35.0	18.6	2,961.4
Colfax	335.3	9.7	3.9	532.2	5.5	1,680.7	3.8	24.3	13.6	2,655.6
Curry	178.0	12.3	6.4	183.0	11.6	1,003.5	4.4	47.0	21.2	1,726.9
De Baca	160.5	8.1	1.3	227.1	2.2	887.3	5.6	12.1	7.1	1,343.7
Doña Ana	264.8	50.5	33.3	312.2	55.2	1,033.1	20.0	235.1	111.5	2,490.9
Grant	515.9	64.1	5.7	760.4	13.6	1,816.3	61.8	80.4	44.5	3,603.3
Guadalupe	186.3	5.3	2.9	257.7	5.1	1,208.9	2.7	19.5	11.7	1,721.8
Harding	134.8	34.2	1.7	186.1	0.8	909.3	0.3	19.7	64.3	1,359.1
Hidalgo	157.9	3.3	1.6	217.2	2.6	964.8	1.5	10.4	5.8	1,381.4
Lincoln	348.0	19.7	5.2	532.9	7.7	1,681.7	13.7	40.2	22.0	2,755.4
Los Alamos	41.9	5.3	2.8	52.8	4.3	149.9	2.0	19.1	8.6	319.0
Luna	128.7	9.8	6.2	180.2	13.0	663.8	3.6	41.7	21.1	1,118.9
Mora	375.0	60.4	2.4	555.9	8.3	1,151.7	61.9	55.5	34.5	2,528.1
Otero	498.5	20.2	11.1	804.0	14.5	1,858.3	7.6	75.0	35.7	3,435.2
Quay	196.3	6.9	3.5	261.4	5.7	1,149.5	3.4	23.3	12.9	1,704.3
San Miguel	402.3	33.3	7.5	558.1	11.0	1,900.8	24.7	60.3	32.8	3,169.9
Santa Fe	300.0	69.4	28.7	357.1	39.2	876.0	36.4	198.0	102.9	2,337.6
Sierra	257.9	11.1	6.5	372.8	9.0	1,336.6	2.8	41.2	23.6	2,108.5
Socorro	538.2	49.2	3.6	772.4	10.3	2,464.3	48.9	57.9	33.3	4,181.4
Taos	225.6	21.9	7.3	301.2	9.4	871.3	11.9	50.3	25.8	1,623.3
Torrance	211.3	11.8	4.7	306.4	7.5	1,270.9	5.1	30.8	16.8	1,922.0
Union	229.7	36.4	2.7	313.3	2.4	1,509.8	3.0	27.5	64.5	2,240.0

County	Acetaldehyde	Benzene	Ethylbenzene	Formaldehyde	Hexane	Methanol	Naphthalene	Toluene	Xylenes	Total HAPs
Valencia	111.8	18.5	11.5	142.8	16.6	472.8	6.9	81.4	39.1	1,021.5

Source: EPA (2023h). NEI data accessed September 13, 2024.

Note: New Mexico emissions include Tribal emissions from the Four Corners Power Plant in San Juan County. Total HAPs may not equal the sum of the listed HAPs, as only select HAPs are presented. Totals may not sum exactly due to rounding.

Table 43. HAPs in Tons per Year for Oklahoma, Texas, and Kansas Counties

County	Acetaldehyde	Benzene	Ethylbenzene	Formaldehyde	Hexane	Methanol	Naphthalene	Toluene	Xylenes	Total HAPs
Oklahoma										
Alfalfa	180.9	38.5	4.5	541.9	11.0	648.4	7.2	29.6	28.6	1,595.1
Beaver	155.3	13.3	5.6	272.7	6.7	809.3	5.0	19.3	36.3	1,379.6
Beckham	114.8	24.3	7.5	244.3	34.1	451.5	8.3	51.0	54.1	1,071.2
Blaine	187.0	44.7	5.5	550.7	23.6	544.2	9.6	43.6	108.2	1,637.7
Cleveland	162.7	64.8	40.9	206.4	52.5	494.9	27.5	271.8	144.8	1,817.2
Caddo	189.3	32.5	8.3	291.7	19.5	845.0	14.3	65.0	90.9	1,657.1
Canadian	226.8	74.1	26.7	559.4	56.0	648.5	18.8	184.9	238.4	2,289.2
Cimarron	126.0	4.2	1.9	175.1	4.0	792.3	0.6	12.0	7.0	1,158.3
Coal	179.8	36.7	2.4	309.7	10.1	563.9	25.8	35.1	23.9	1,293.9
Creek	260.5	57.9	15.3	372.4	21.8	929.2	39.1	109.4	60.5	2,084.4
LeFlore	386.6	47.3	8.5	556.5	16.9	1,585.2	36.6	79.4	43.5	2,963.0
Comanche	197.9	44.5	16.8	276.3	28.2	642.9	32.5	126.6	68.4	1,711.9
Custer	128.8	22.5	7.5	270.6	22.3	495.6	8.4	51.3	96.2	1,183.6
Dewey	139.3	24.0	3.5	296.0	10.2	543.2	12.3	26.9	61.4	1,189.8
Ellis	148.1	26.1	3.2	389.6	8.6	660.3	5.9	21.1	39.1	1,374.2
Garvin	172.4	75.0	11.1	354.4	70.2	647.9	19.2	95.3	84.0	1,691.9

County	Acetaldehyde	Benzene	Ethylbenzene	Formaldehyde	Hexane	Methanol	Naphthalene	Toluene	Xylenes	Total HAPs
Grady	261.2	64.8	14.7	674.1	45.5	806.4	19.8	106.7	170.0	2,402.3
Harper	78.9	5.9	2.1	110.1	6.5	414.7	2.9	11.3	17.5	672.9
Hughes	308.3	64.9	4.8	569.4	17.3	874.4	48.2	66.0	41.1	2,206.6
Jackson	98.4	8.8	3.6	143.7	6.9	457.2	2.7	24.7	11.9	810.5
Kingfisher	242.1	70.5	42.5	821.7	26.5	673.7	8.3	56.4	126.8	2,234.5
Oklahoma	251.6	181.8	128.7	344.0	191.8	595.7	59.9	854.4	488.9	4,075.0
Major	171.5	32.1	4.1	308.4	14.9	575.7	17.9	32.9	54.0	1,315.7
McClain	116.9	68.6	10.3	234.3	17.6	423.6	12.8	82.5	100.6	1,172.4
Roger Mills	149.7	31.6	4.4	438.8	17.5	546.4	8.4	27.2	83.4	1,395.5
Payne	161.7	50.9	12.7	232.5	34.4	526.4	28.0	98.1	55.2	1,370.8
Pittsburg	477.3	96.8	13.7	808.7	34.2	1,370.2	74.4	151.9	94.4	3,489.9
Seminole	171.9	41.3	6.8	273.3	39.4	677.1	22.7	57.0	46.3	1,453.9
Woods	184.7	38.0	4.4	502.0	12.1	663.9	13.6	34.5	42.2	1,608.3
Woodward	133.4	21.3	5.3	210.9	20.2	599.0	11.4	38.2	35.6	1,150.4
Texas										
Nueces	221.5	133.4	57.4	363.3	275.7	928.4	14.4	370.9	240.0	3,724.9
Andrews	84.8	245.5	10.3	190.2	10.5	421.2	2.3	179.1	37.2	1,215.2
Burleson	179.0	45.8	6.8	270.8	18.3	787.0	10.9	48.0	25.1	1,465.5
Cherokee	348.7	28.3	6.6	482.8	14.6	1,807.3	14.1	53.0	36.9	2,915.6
Comal	145.1	36.2	21.8	197.4	37.2	607.6	23.4	131.8	79.0	1,556.6
Calhoun	497.6	136.0	19.5	720.6	75.1	1,029.5	110.5	194.7	121.3	3,660.1
Culberson	148.7	260.4	24.1	600.0	6.0	787.0	1.0	209.0	103.9	2,170.8
Cochran	79.5	16.7	1.0	113.1	2.0	475.3	0.6	14.6	4.8	752.1

County	Acetaldehyde	Benzene	Ethylbenzene	Formaldehyde	Hexane	Methanol	Naphthalene	Toluene	Xylenes	Total HAPs
Delta	73.5	4.0	0.9	100.8	1.7	382.2	2.2	6.4	4.1	593.9
Denton	159.7	86.1	71.7	251.9	158.8	675.9	11.9	447.0	266.0	2,883.3
Gaines	175.4	134.3	7.0	264.5	10.1	988.0	2.4	108.1	28.1	1,830.6
Galveston	112.4	81.3	50.4	188.1	117.6	482.1	26.4	239.4	185.8	2,079.3
Grayson	179.8	53.4	21.6	263.2	36.7	797.9	14.4	138.0	81.1	1,820.8
Guadalupe	143.4	41.6	19.8	226.0	31.1	625.0	20.5	111.1	64.4	1,558.2
Hemphill	89.9	13.1	5.5	142.5	13.7	414.9	2.4	22.0	40.0	777.8
Houston	514.3	51.2	3.8	727.9	9.8	2,308.4	46.9	54.1	34.7	3,972.9
Hutchinson	110.3	24.2	7.6	167.5	62.8	499.4	11.8	49.5	31.6	1,140.0
Jackson	255.2	32.0	5.2	364.0	9.5	1,145.2	13.0	39.9	22.5	1,985.1
Jasper	320.8	32.0	7.1	442.4	11.7	1,728.8	10.2	49.2	30.0	2,756.2
Karnes	191.3	271.7	32.5	621.0	34.2	687.4	4.7	220.8	120.9	2,302.2
Kenedy	286.1	54.7	16.6	420.3	28.7	1,303.0	19.3	122.7	71.9	2,542.4
Lee	148.6	18.8	4.4	209.5	8.1	695.3	7.6	28.3	16.9	1,265.2
Victoria	277.3	51.8	13.6	402.7	88.7	1,089.9	22.8	97.2	58.9	2,387.3
Live Oak	185.6	64.9	11.4	343.8	25.4	824.8	8.9	76.6	51.2	1,695.4
Loving	70.5	800.5	44.6	582.1	15.0	186.4	1.5	594.0	177.4	2,509.9
Reeves	191.0	1,244.5	79.0	1,346.3	54.9	611.8	5.9	923.9	329.3	4,900.9
Winkler	49.8	160.3	8.5	175.6	4.8	203.5	2.1	122.0	33.7	783.1
McMullen	175.4	83.9	12.0	358.1	12.6	805.0	3.3	70.6	41.1	1,603.7
Montgomery	416.9	79.0	51.5	581.9	113.8	2,025.9	18.2	319.5	188.3	4,394.1
Martin	115.7	917.5	28.1	305.0	7.9	508.2	2.5	617.4	107.3	2,703.0
Midland	98.6	1,282.2	54.1	371.6	59.6	279.8	11.0	948.9	210.5	3,614.1

County	Acetaldehyde	Benzene	Ethylbenzene	Formaldehyde	Hexane	Methanol	Naphthalene	Toluene	Xylenes	Total HAPs
Sabine	245.2	20.2	4.8	339.3	7.9	1,194.1	13.7	37.1	23.5	1,989.4
San Augustine	263.9	53.9	3.5	442.0	8.0	1,210.9	17.3	43.9	85.0	2,245.0
San Jacinto	257.9	23.1	5.8	357.2	11.6	1,308.4	13.8	42.8	25.2	2,148.2
Shelby	335.8	46.0	5.1	484.3	13.8	1,600.8	27.7	52.1	51.9	2,790.5
Tarrant	235.4	204.9	171.9	397.2	454.7	710.0	21.5	1,174.7	652.1	6,005.9
Trinity	338.4	35.1	4.3	474.4	8.3	1,508.8	31.6	45.3	28.8	2,635.3
Walker	307.8	21.8	10.2	422.3	13.0	1,628.9	12.9	57.5	40.2	2,639.2
Washington	202.6	62.0	12.7	340.7	13.1	867.1	14.5	86.7	56.6	1,777.0
Wise	166.8	55.0	16.6	344.5	32.1	632.8	7.8	91.5	59.4	1,545.8
Zapata	232.1	34.8	9.0	385.8	15.1	1,042.4	4.1	55.2	39.4	1,898.5
Kansas										
Sedgwick	242.7	105.5	79.4	333.7	287.8	644.8	37.4	535.6	266.8	3,332.4
Decatur	57.6	2.3	0.9	77.5	1.3	338.3	0.7	6.1	2.9	507.8
Morton	68.6	8.3	0.9	114.3	3.3	371.1	0.8	8.0	17.2	618.8
Meade	87.2	3.8	1.2	129.0	2.2	511.1	0.8	8.2	6.8	776.2
Finney	125.3	17.1	9.1	188.9	15.6	647.9	2.8	57.8	45.5	1,224.7
Franklin	97.0	13.3	4.9	134.9	8.7	434.4	7.5	34.0	18.5	820.7
Greely	55.2	2.0	0.8	75.0	1.4	328.0	0.2	5.0	3.0	500.8
Lane	61.1	1.6	0.6	85.2	1.2	372.6	0.2	4.0	1.9	548.2
Logan	58.0	2.5	1.3	81.8	1.9	351.9	0.5	7.7	4.3	530.4
Montgomery	98.0	28.3	7.2	152.8	34.7	412.8	8.6	62.1	38.7	945.1
Norton	77.1	4.3	1.3	105.9	2.2	446.0	2.2	9.8	5.0	680.1
Sherman	71.2	3.9	2.2	100.0	49.6	428.5	1.5	13.2	8.5	713.3

County	Acetaldehyde	Benzene	Ethylbenzene	Formaldehyde	Hexane	Methanol	Naphthalene	Toluene	Xylenes	Total HAPs
Stevens	83.8	12.9	1.7	181.6	6.0	422.7	0.5	14.7	39.7	802.6
Stanton	64.9	4.1	0.7	94.8	2.3	371.3	0.3	6.1	14.2	585.3
Sumner	192.5	20.7	5.1	264.9	13.9	834.3	7.4	36.6	22.7	1,467.4
Trego	65.9	3.5	2.0	96.3	3.0	446.6	1.2	11.7	7.2	660.8
Woodson	363.5	51.5	5.3	334.3	5.3	512.0	8.6	30.4	9.1	1,536.8
Cheyenne	65.5	3.2	1.0	93.8	1.7	395.8	0.3	6.4	4.3	599.2

Source: EPA (2023h). NEI data accessed September 13, 2024. Total HAPs may not equal the sum of the listed HAPs, as only select HAPs are presented.

5 HAZARDOUS AIR POLLUTANTS

Currently, there are 187 specific pollutants and chemical groups known as HAPs. The list has been modified over time. HAPs are chemicals or compounds that are known or suspected to cause cancer or other serious health effects, such as compromises to immune and reproductive systems, birth defects, developmental disorders, or adverse environmental effects, that may result from either chronic (long-term) and/or acute (short-term) exposure. CAA Sections 111 and 112 establish mechanisms for controlling HAPs from stationary sources, and the EPA is required to control emissions of the 187 HAPs. The U.S. Congress amended the federal CAA in 1990 to address a number of air pollutants that are known to cause or may reasonably be anticipated to cause adverse effects on human health or adverse environmental effects.

Ambient air quality standards do not exist for HAPs; however, the CAA requires control measures for HAPs. Mass-based emissions limits and risk-based exposure thresholds have been established as significance criteria to require maximum achievable control technologies (MACT) under the EPA promulgated National Emissions Standards for Hazardous Air Pollutants (NESHAPs) for 96 industrial source classes. NESHAPs are issued by the EPA to limit the release of specified HAPs from specific industrial sectors. These standards are technology based, meaning that they represent the MACT that are economically feasible for an industrial sector.

NESHAPs for Oil and Natural Gas Production and Natural Gas Transmission and Storage were published by the EPA on June 17, 1999. These NESHAPs were directed toward major sources and intended to control benzene, toluene, ethylbenzene, and mixed xylenes (BTEX) and n-hexane. An additional NESHAP for Oil and Natural Gas Production Facilities, which was directed toward area sources, was published on January 3, 2007, and specifically addresses benzene emissions from triethylene glycol dehydration units. The EPA issued a final rule revising the NESHAP rule, effective October 15, 2012. The final rule includes revisions to the existing leak detection and repair requirements and established emission limits reflecting MACT for uncontrolled emission sources in oil and gas production and natural gas transmission and storage (*Federal Register* 77[159]:49490).

The EPA NESHAPs that are most likely to have applicability to oil and gas operations (in addition to the NESHAPs common/general provisions) are as follows:

- NESHAP Subpart HH – National Emission Standard for Hazardous Air Pollutants from Oil and Natural Gas Production Facilities
- NESHAP Subpart ZZZZ - National Emission Standard for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines

Note that several of the NSPSs that are potentially applicable to oil and gas operations (listed in Section 2) also regulate emissions of VOCs, a component of which includes HAP emissions. Although the NSPS rules are not designed to directly regulate HAP emissions, control of VOCs results in the co-benefit of HAP reductions.

The CAA defines a major source for HAPs to be one emitting 10 tons per year (tpy) of any single HAP or 25 tpy of any combination of HAPs. Under state regulations, a construction or operating permit may be required for any major source, though some exceptions apply. In New Mexico, these regulations are N.M.A.C. 20.2.70 and 20.2.73; in Texas, the regulation is 30 Texas Administrative Code (T.A.C.) § 122; in Kansas, the regulation is Kansas Administrative Regulations (K.A.R.) 28-19-500; and in Oklahoma, the regulation is Oklahoma Register 252-100-7. Within its definition of a major source in the above-referenced regulations, the State of New Mexico includes the following language:

> *Hazardous emissions from any oil or gas exploration or production well (with its associated equipment) and hazardous emissions from any pipeline compressor or pump station shall not be aggregated with hazardous emissions from other similar units, whether or not such units are in a contiguous area or under common control, to determine whether such units or stations are major sources. (N.M.A.C. 20.2.70.7 R (1)(a))*

In other words, in determining a major source, each oil and gas exploration and production well must be considered singularly. Kansas, Texas, and Oklahoma regulations include similar language.

The State of New Mexico incorporates federal NESHAPs for pollutants through updates to N.M.A.C. 20.2.78, which adopts 40 C.F.R. § 61, and incorporates federal NESHAPs for source categories through updates to N.M.A.C. 20.2.82, which adopts 40 C.F.R. § 63. Similarly, Texas incorporates federal NESHAPs for both 40 C.F.R. § 61 and 40 C.F.R. § 63 through updates to 30 T.A.C. § 113. Kansas incorporates federal NESHAPs by adopting 40 C.F.R. § 61 through updates to K.A.R. 28-19-735 and incorporates NESHAP source categories at 40 C.F.R. § 63 through updates to K.A.R. 28-19-750. Oklahoma incorporates both 40 C.F.R. § 61 and 40 C.F.R. § 63 through Oklahoma Register 252-100-41-2 and the Oklahoma Administrative Code Appendix Q.

Although HAPs do not have federal air quality standards, some states have established “thresholds” to evaluate human exposure for potential chronic inhalation illness and cancer risks. There are no applicable federal or state ambient air quality standards for assessing potential HAP impacts to human health, and monitored background concentrations are rarely available. Therefore, reference concentrations (RfCs) for chronic inhalation exposures and reference exposure levels (RELs) for acute inhalation exposures can be applied as evaluation criteria (Table 44). Both the RfC and REL guideline values are for noncancer effects.

Table 44. HAP RELs and RfCs

HAPs	Acute RELs*	Noncancer Chronic RfC†	Inhalation Unit Risk†
Benzene	27	30	7.8E-06
Toluene	5,000	5,000	N/A
Ethylbenzene	22,000	1,000	2.5E-06
Xylenes	8,700	100	N/A
n-Hexane	180,000	700	N/A
Formaldehyde	55	9.8‡	1.3E-05

Note: N/A = not applicable

* Values referenced from EPA (2021a)

† Values referenced from EPA (2024c)

‡ There is no RfC for formaldehyde. The Agency for Toxic Substances and Disease Registry chronic minimal risk level of 0.008 ppm was used and converted to $\mu g/m^3$.

5.1 COLORADO STATE UNIVERSITY HAZARDOUS AIR POLLUTANT MODELING STUDY

Potential health risks associated with HAPs released into the air from oil and gas operations have been evaluated by review of existing emissions data, air quality monitoring, and modeling studies. For example, a 2019 health assessment study (ICF and Colorado State University [CSU] 2019) included on-site air monitoring for 47 VOCs (including HAPs) during various stages of well development and production at oil and gas extraction facilities in Colorado. The study used tracer gas controlled-release sampling to develop calculated emission rates during various stages of well development and production for well pads of various sizes and at various locations in Colorado. Acetylene was released at a controlled, constant rate while samples were collected in canisters downwind of the well pads. The samples collected were analyzed in a laboratory for acetylene and 47 other VOC species, including a number of HAPs such as acetaldehyde and BTEX, to determine the concentration of each species. The ratio of the known acetylene release rate to the measured downwind sample concentration was then used to calculate emission rates of each VOC species for each sample. Dispersion modeling with the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) was then performed in which rings of receptors were established at various distances from 300 to 2,000 feet from the center of the well pads to estimate short- and long-term chemical air concentrations. The maximum results of the dispersion modeling for each distance were then used in EPA Air Pollutants Exposure Model (APEX) to compare the calculated exposure levels from each scenario and each distance against acute, subchronic, and chronic exposure standards for each VOC species.

Results of the study indicate that acute (1-hour) exposures were below guideline levels (hazard index below 1, indicating short-term health impacts are unlikely to occur) for most chemicals. At the 500-foot distance, for a small number of chemicals (including benzene, toluene, and ethyltoluenes), the highest estimated acute exposures exceeded guideline levels at the most exposed (downwind) locations, in isolated cases by a factor of 10 or more, particularly during flowback activities at smaller well pads. Flowback is defined in the study as the period after the entire well is fracked and the plugs are drilled out to enable the flow of fracking fluid, water, oil, and natural gas to the surface (ICF and CSU 2019).

For a relatively small number of development scenarios, those highest predicted acute exposures decreased rapidly with distance but remained above guideline levels out to 2,000 feet (ICF and CSU 2019). Flowback occurs during well completion when fracturing fluids, water, and reservoir gas come to the surface at high velocity and volume and contain a mixture of VOCs, CH_4, benzene, ethylbenzene, and n-hexane. As noted by the study, the identification of these estimated exceedances of acute health guidelines (hazard index above 1) is highly conservative, and the highest exposures occur rarely (ICF and CSU 2019). Subchronic modeled hazard indices were generally lower than acute modeled hazard indices. Most subchronic (multi-day/lasting less than 1 year) exposures were below subchronic guideline levels (all exposures at the 500-foot distance and beyond) during development activities, although subchronic exposures slightly above guideline levels for combined exposures to multiple chemicals were noted during fracking at distances out to 800 feet. As with acute exposure estimates, the study noted that the subchronic exposure estimates are also conservative (ICF and CSU 2019).

Chronic exposure was estimated for production operations, development and operations, and long flowback operations. Exposures at the 500-foot distance for the flowback periods were far below guideline levels for individual chemicals and only slightly above guideline levels for combined exposures to multiple chemicals (ICF and CSU 2019). The chronic exposures during production operations were generally the lowest, relative to guideline levels, from all modeled scenarios. At the 500-foot distance from the facility, all chronic exposures during production activities were below guideline levels, and the average incremental lifetime cancer risk from chronic benzene exposure was 5 in 1 million or less (dropping below 1 in 1 million before the 2,000-foot distance). When estimates of chronic exposure included exposure to development activities occurring sequentially with exposure to production activities, exposures were only slightly higher than those estimated during the production activities alone.

The hazard index for chronic health impacts was 1 or less, often by more than an order of magnitude, at receptors that were 2,000 feet from the modeled well pad scenarios (ICF and CSU 2019). Table 45 summarizes cancer risks over a lifetime of exposure during oil and gas production operations (ICF and CSU 2019).

Table 45. Cancer Risks Over a Lifetime of Exposure During Production Operations of Oil and Gas Activities

Distance (feet)	Average Incremental Lifetime Cancer Risk	Maximum Exposed Individual Cancer Risk
300	10 in 1 million	N/A
400	N/A	10 in 1 million
500	4 in 1 million	7 in 1 million
1,400	1 in 1 million	N/A
2,000	N/A	1 in 1 million

Source: ICF and CSU (2019)

Note: N/A = not applicable

In summary, simulated cancer risks to average individuals were below 1 in 1 million at distances of 1,400 feet from the well pads, 4 in 1 million at 500 feet from the well pads, and 10 in 1 million at 300 feet from the well pads. Risks to maximum exposed individuals were below 1 in 1 million at 2,000 feet from the well pads, 7 in 1 million at 500 feet from the well pads, and 10 in 1 million at 400 feet from the well pads (ICF and CSU 2019).

5.2 AIR TOXICS SCREENING ASSESSMENT

The EPA developed AirToxScreen as a screening tool for state, local, and Tribal air agencies. AirToxScreen summarizes the EPA's ongoing review of air toxics in the United States, and the results help the EPA and other agencies identify which pollutants, emission sources, and places they may wish to study further to better understand any possible risks to public health from air toxics. AirToxScreen is the successor to the National Air Toxics Assessment (NATA). In May 2024, EPA began rolling out the results of the 2020 AirToxScreen; however, the 2020 results are not complete, and the 2019 AirToxScreen results are presented and discussed below.

AirToxScreen calculates concentration and risk estimates from a single year of emissions data using meteorological data for that same year. The risk estimates assume a person breathes these emissions each year over a lifetime (approximately 70 years). AirToxScreen then provides quantitative estimates of potential cancer risk and five classes of noncancer hazards (grouped by organ/system: immunological, kidney, liver, neurological, and respiratory) associated with chronic inhalation exposure to real-world toxics. The 2019 AirToxScreen assessment includes emissions, ambient concentrations, and exposure estimates for about 181 of the 188 CAA air toxics plus diesel PM. For about 140 of these air toxics (those with health data based on long-term exposure), the assessment estimates cancer risks, noncancer health effects, or both. The assessment includes noncancer health effects for diesel PM.

AirToxScreen potential cancer risk values represent statistical probabilities of developing cancer over a lifetime. AirToxScreen noncancer hazards are expressed as a ratio of an exposure concentration to an RfC associated with observable adverse health effects (i.e., a hazard quotient). “For a given air toxic, exposures at or below the RfC (i.e., hazard quotients are 1 or less) are *not* likely to be associated with adverse health effects. As exposures increase above the RfC (i.e., hazard quotients are greater than 1), the potential for adverse effects also increases” (EPA 2024d).

RfCs are indicators defined by the EPA as the daily inhalation concentrations at which no long-term adverse health impacts are expected. Short-term (1-hour) HAP concentrations are compared with acute RELs. RELs are defined as concentrations at or below which no adverse health effects are expected (California Office of Environmental Health Hazard Assessment 2023). The primary air toxics of concern for oil and gas operations are BTEX, formaldehyde, and n-hexane.

It is important to note that AirToxScreen focuses solely on exposures from inhalation of outdoor ambient air. The AirToxScreen framework does not address inhalation from indoor ambient air, estimate human exposure to chemicals via ingestion or through dermal contact, or account for exposures that may take place via other mechanisms.

In addition, although AirToxScreen reports results at the census tract level, average risk estimates are far more uncertain at this level of spatial resolution than at the county or state level. To analyze air toxics in smaller areas, such as census blocks or in suspected “hotspots,” other tools such as site-specific monitoring and local-scale assessments should be used (EPA 2024d). AirToxScreen results are best used to focus on patterns and ranges of risks across the country. Additional AirToxScreen limitations can be reviewed at https://www.epa.gov/AirToxScreeN/Airtoxscreen-limitations.

In accordance with the AirToxScreen Technical Support Document (EPA 2024e), AirToxScreen is consistent with the EPA definition of a cumulative risk assessment, as stated in the EPA Framework for Cumulative Risk Assessment (EPA 2003:6), as “an analysis, characterization, and possible quantification of the combined risks to health or the environment from multiple agents or stressors.” Table 46 shows the cancer risk (per million) and noncancer risk (hazard index) for the United States, Texas, Oklahoma, Kansas, and New Mexico from 2018 through 2019. Table 47 shows the cancer risk (per million) and noncancer risk (hazard index) for all the New Mexico counties from 2018 through 2019 (EPA 2023i, 2024e). For the eight New Mexico counties in the major oil and gas basin, the EPA has determined that for the four counties in the BLM FFO (San Juan, Sandoval, Rio Arriba, and McKinley), the total cancer risk is a maximum of 18.72 in 1 million. The maximum contribution of the oil and gas industry to the cancer risk in the BLM FFO is 2.06 in 1 million. The EPA has determined that for Eddy and Lea Counties, the total cancer risk is a maximum of 22.25 in 1 million. The maximum contribution of the oil and gas industry to the cancer risk in Eddy and Lea Counties is 3.91 in 1 million. The total cancer risk is a maximum of 27.03 in 1 million for the remaining New Mexico counties, and the maximum contribution of the oil and gas industry to the cancer risk is 0.40 in 1 million. The total cancer risk is within the acceptable range of risk published by the EPA of 100 in 1 million as discussed in the National Contingency Plan, 40 C.F.R. § 300.430.

Table 46. Total Cancer Risk and Noncancer Respiratory Hazard from Existing HAP Emissions for United States and BLM NMSO States

United States and NMSO States	Respiratory Hazard Index			Total Cancer Risk (per million)			Oil and Gas Cancer Risk (per million)		
	2017	2018	2019	2017	2018	2019	2017	2018	2019
United States	0.36	0.32	0.31	28.68	25.00	25.50	0.15	0.19	0.12
Kansas	0.33	0.30	0.28	24.76	21.61	21.70	0.13	0.15	0.10
Oklahoma	0.39	0.34	0.30	28.96	24.70	24.85	0.55	0.64	0.34
Texas	0.35	0.29	0.30	31.33	25.81	28.13	0.27	0.32	0.30
New Mexico	0.24	0.21	0.22	20.27	17.57	19.10	0.24	0.33	0.34

Source: EPA (2023i, 2024e)

Table 47. Total Cancer Risk and Noncancer Respiratory Hazard from Existing HAP Emissions for New Mexico Counties

New Mexico Counties	Respiratory Hazard Index			Total Cancer Risk (per million)			Oil and Gas Cancer Risk (per million)		
	2017	2018	2019	2017	2018	2019	2017	2018	2019
New Mexico Counties in Major Oil and Gas Basin*									
Chaves	0.23	0.21	0.24	19.49	17.37	19.16	0.14	0.20	0.15
Eddy	0.24	0.22	0.23	21.41	20.09	22.25	2.25	3.38	3.91
Lea	0.23	0.20	0.21	20.27	18.30	20.16	2.15	2.86	3.05
McKinley	0.13	0.12	0.12	12.12	10.50	11.12	0.01	0.01	0.01
Rio Arriba	0.15	0.13	0.13	13.55	11.67	12.28	0.03	0.06	0.04
Roosevelt	0.17	0.15	0.15	15.46	13.71	14.63	0.02	0.04	0.03
Sandoval	0.24	0.21	0.22	20.29	17.37	18.72	0.01	0.01	0.01
San Juan	0.29	0.30	0.28	17.57	17.10	17.56	1.73	2.21	2.06
Remaining New Mexico Counties									
Bernalillo	0.32	0.28	0.29	25.09	21.40	23.01	0.00	0.00	0.00

New Mexico Counties	Respiratory Hazard Index			Total Cancer Risk (per million)			Oil and Gas Cancer Risk (per million)		
	2017	**2018**	**2019**	**2017**	**2018**	**2019**	**2017**	**2018**	**2019**
Catron	0.13	0.14	0.09	11.52	11.07	9.84	0.00	0.00	0.00
Cibola	0.15	0.12	0.12	12.89	10.66	11.19	0.00	0.00	0.00
Colfax	0.12	0.12	0.10	11.01	10.41	10.27	0.02	0.03	0.08
Curry	0.19	0.17	0.18	16.44	14.59	15.53	0.00	0.00	0.00
De Baca	0.16	0.15	0.15	14.86	13.28	14.38	0.01	0.01	0.02
Doña Ana	0.26	0.22	0.23	26.40	22.31	27.03	0.00	0.00	0.00
Grant	0.14	0.11	0.11	13.13	10.94	11.74	0.00	0.00	0.00
Guadalupe	0.15	0.13	0.13	13.72	11.86	12.58	0.00	0.00	0.00
Harding	0.12	0.11	0.11	11.82	10.69	11.37	0.36	0.40	0.34
Hidalgo	0.18	0.15	0.15	16.20	13.38	14.45	0.00	0.00	0.00
Lincoln	0.12	0.10	0.10	11.72	9.93	10.54	0.00	0.00	0.00
Los Alamos	0.13	0.11	0.11	12.08	10.49	11.16	0.00	0.00	0.00
Luna	0.20	0.17	0.18	17.40	14.61	16.34	0.00	0.00	0.00
Mora	0.10	0.09	0.09	10.04	8.98	9.18	0.00	0.00	0.00
Otero	0.16	0.14	0.14	16.07	13.68	14.42	0.00	0.00	0.00
Quay	0.16	0.14	0.14	14.71	12.68	13.76	0.01	0.01	0.01
San Miguel	0.13	0.12	0.11	12.37	10.88	11.45	0.00	0.00	0.00
Santa Fe	0.18	0.16	0.16	16.45	14.21	14.75	0.00	0.00	0.00
Sierra	0.17	0.14	0.14	15.25	12.89	13.73	0.00	0.00	0.00
Socorro	0.15	0.13	0.13	13.65	11.92	12.32	0.00	0.00	0.00
Taos	0.14	0.12	0.11	12.25	10.69	11.20	0.00	0.00	0.00
Torrance	0.13	0.12	0.12	12.61	10.88	11.48	0.00	0.00	0.00
Union	0.12	0.11	0.11	11.76	10.76	11.27	0.19	0.22	0.17

New Mexico Counties	Respiratory Hazard Index			Total Cancer Risk (per million)			Oil and Gas Cancer Risk (per million)		
	2017	2018	2019	2017	2018	2019	2017	2018	2019
Valencia	0.22	0.19	0.19	17.45	15.06	16.01	0.00	0.00	0.00

Source: EPA (2023i, 2024e)

*These eight counties are where parcels are regularly nominated for BLM New Mexico Quarterly Oil and Gas Lease Sales.

Table 48. Total Cancer Risk and Noncancer Respiratory Hazard from Existing HAP Emissions for Oklahoma, Texas, and Kansas Counties

County	Respiratory Hazard Index			Total Cancer Risk (per million)			Oil and Gas Cancer Risk (per million)		
	2017	2018	2019	2017	2018	2019	2017	2018	2019
Oklahoma									
Alfalfa	0.38	0.39	0.24	24.13	22.62	19.10	4.14	4.87	0.69
Beaver	0.20	0.17	0.17	16.80	14.44	15.52	0.46	0.67	0.46
Beckham	0.26	0.23	0.21	20.18	17.64	18.08	1.02	1.25	0.32
Caddo	0.28	0.26	0.23	22.05	19.37	19.74	0.80	0.92	0.47
Cleveland	0.38	0.33	0.30	27.98	24.31	24.97	0.50	0.47	0.36
Canadian	0.36	0.33	0.28	26.24	23.02	23.03	1.60	1.69	0.78
Cimarron	0.13	0.13	0.12	13.03	11.86	12.49	0.06	0.09	0.07
Comanche	0.30	0.26	0.25	24.01	20.65	21.89	0.18	0.23	0.09
Coal	0.41	0.34	0.31	28.58	23.42	23.70	0.90	1.25	0.73
Creek	0.41	0.36	0.29	28.97	25.07	24.32	0.41	0.65	0.24
Blaine	0.31	0.30	0.23	22.51	20.11	19.61	1.98	2.44	1.14
Le Flore	0.50	0.38	0.34	34.04	27.14	27.22	0.48	0.57	0.45
Custer	0.28	0.25	0.22	21.34	18.73	18.92	0.81	1.03	0.49
Dewey	0.27	0.29	0.20	20.19	19.42	17.51	1.32	1.62	0.62
Ellis	0.26	0.24	0.18	19.39	17.19	16.59	2.02	2.44	0.46
Garvin	0.35	0.31	0.28	25.77	22.19	23.57	1.59	1.76	1.47

County	Respiratory Hazard Index			Total Cancer Risk (per million)			Oil and Gas Cancer Risk (per million)		
	2017	2018	2019	2017	2018	2019	2017	2018	2019
Grady	0.35	0.33	0.28	25.26	22.44	22.65	2.02	2.15	1.49
Harper	0.25	0.19	0.18	18.75	15.47	16.13	0.79	0.98	0.40
Hughes	0.44	0.35	0.30	29.74	23.91	23.63	0.97	1.43	0.78
Jackson	0.26	0.22	0.22	20.81	17.86	18.99	0.06	0.08	0.07
Kingfisher	0.39	0.38	0.28	25.79	23.40	21.76	3.84	4.33	1.41
Oklahoma	0.39	0.35	0.32	29.33	25.47	26.14	0.63	0.63	0.37
Major	0.31	0.29	0.23	21.75	19.63	18.96	1.48	1.84	0.62
McClain	0.34	0.31	0.28	25.42	22.23	23.12	1.30	1.32	1.43
Roger Mills	0.25	0.23	0.20	19.42	17.22	17.19	1.54	1.86	0.64
Payne	0.33	0.31	0.28	24.97	21.79	22.44	0.66	0.92	0.42
Pittsburg	0.50	0.39	0.33	33.13	26.52	26.28	0.53	0.63	0.56
Seminole	0.38	0.32	0.27	27.38	22.73	22.77	1.04	1.58	0.72
Woods	0.36	0.37	0.24	23.21	21.97	18.85	3.30	4.01	0.67
Woodward	0.26	0.23	0.19	19.53	17.05	17.01	0.43	0.55	0.16
Texas									
Nueces	0.26	0.20	0.19	21.58	16.40	18.01	0.07	0.07	0.03
Andrews	0.24	0.20	0.21	21.03	18.76	19.59	2.63	3.44	2.46
Burleson	0.28	0.23	0.24	24.51	19.57	22.15	0.73	0.93	1.33
Calhoun	0.27	0.19	0.19	27.19	23.82	23.17	0.27	0.27	0.11
Cherokee	0.37	0.31	0.30	30.37	25.44	26.86	0.39	0.52	0.64
Comal	0.31	0.22	0.23	25.53	19.13	21.16	0.07	0.07	0.04
Culberson	0.17	0.14	0.15	16.09	13.49	14.77	0.03	0.05	0.03
Cochran	0.17	0.16	0.16	16.41	14.87	15.66	1.08	1.32	1.07

County	Respiratory Hazard Index			Total Cancer Risk (per million)			Oil and Gas Cancer Risk (per million)		
	2017	2018	2019	2017	2018	2019	2017	2018	2019
Denton	0.38	0.32	0.33	31.55	25.97	29.43	0.21	0.19	0.39
Gaines	0.22	0.18	0.19	20.70	18.57	18.54	3.28	3.92	2.31
Galveston	0.32	0.53	0.46	29.03	27.23	25.84	0.17	0.20	0.05
Grayson	0.34	0.28	0.27	27.41	22.31	23.66	0.27	0.33	0.16
Guadalupe	0.30	0.22	0.24	24.92	18.87	21.14	0.20	0.21	0.15
Hemphill	0.30	0.21	0.22	20.14	15.94	16.55	1.30	1.61	0.69
Houston	0.37	0.31	0.30	30.32	26.61	26.47	0.26	0.35	0.31
Hutchinson	0.22	0.20	0.20	17.40	15.64	16.57	0.24	0.26	0.53
Jackson	0.31	0.21	0.22	23.01	18.25	21.07	0.65	0.74	0.27
Jasper	0.41	0.37	0.35	33.52	29.26	31.00	0.66	0.72	0.21
Karnes	0.37	0.29	0.24	28.30	22.44	22.60	6.02	5.74	3.42
Kenedy	0.26	0.18	0.17	20.90	15.97	17.03	0.57	0.54	0.25
Lee	0.28	0.21	0.22	24.10	20.15	20.83	0.40	0.57	0.59
Loving	0.32	0.34	0.24	28.92	30.71	29.04	10.31	14.92	11.54
Winkler	0.25	0.22	0.22	21.62	19.20	20.75	3.09	3.74	3.44
Martin	0.25	0.21	0.22	23.21	20.87	23.43	4.15	5.57	6.16
Midland	0.28	0.24	0.24	26.11	24.39	25.94	5.16	6.90	6.51
Upton	0.23	0.18	0.20	20.33	16.74	18.52	1.50	1.73	1.26
Reeves	0.27	0.26	0.25	24.01	23.73	29.46	5.09	7.56	11.12
Victoria	0.36	0.26	0.28	30.98	25.85	27.00	0.52	0.66	0.15
Live Oak	0.28	0.20	0.20	23.33	17.96	19.41	1.32	1.32	0.66
McMullen	0.31	0.22	0.22	23.74	18.27	19.79	2.19	2.27	1.59
Montgomery	0.39	0.32	0.34	36.07	29.94	34.81	0.15	0.21	0.10

County	Respiratory Hazard Index			Total Cancer Risk (per million)			Oil and Gas Cancer Risk (per million)		
	2017	2018	2019	2017	2018	2019	2017	2018	2019
Sabine	0.44	0.38	0.36	33.39	28.86	29.95	0.27	0.42	0.61
San Augustine	0.43	0.39	0.35	33.24	29.08	31.12	1.09	1.45	2.63
San Jacinto	0.38	0.33	0.32	31.25	29.65	29.55	0.30	0.48	0.16
Shelby	0.43	0.38	0.35	34.10	29.16	31.20	1.45	1.73	2.37
Tarrant	0.37	0.32	0.34	33.54	27.68	31.82	0.43	0.42	0.83
Trinity	0.38	0.33	0.31	31.83	27.33	27.40	0.09	0.15	0.13
Walker	0.39	0.31	0.31	32.00	28.33	29.53	0.09	0.14	0.09
Washington	0.30	0.23	0.24	24.80	19.69	21.89	0.73	0.93	0.44
Wise	0.35	0.30	0.34	25.96	21.43	24.58	1.14	0.99	1.97
Zapata	0.34	0.21	0.22	28.04	18.97	21.44	1.41	1.36	0.96
Kansas									
Sedgwick	0.38	0.34	0.34	27.62	24.96	24.97	0.06	0.06	0.04
Decatur	0.16	0.14	0.14	14.61	12.70	13.62	0.07	0.10	0.06
Morton	0.16	0.15	0.15	14.26	13.08	13.72	0.36	0.42	0.37
Stevens	0.21	0.19	0.20	16.31	14.76	15.72	0.85	0.91	0.87
Stanton	0.16	0.15	0.15	14.33	13.13	13.79	0.40	0.49	0.40
Finney	0.21	0.18	0.18	16.87	14.45	15.78	0.45	0.50	0.46
Franklin	0.33	0.32	0.25	23.62	21.09	20.06	0.27	0.33	0.21
Greeley	0.14	0.13	0.13	13.47	12.13	12.93	0.20	0.38	0.12
Lane	0.16	0.14	0.14	15.02	12.95	14.15	0.21	0.35	0.18
Logan	0.18	0.15	0.16	15.04	13.19	14.30	0.09	0.12	0.09
Montgomery	0.36	0.35	0.31	26.14	23.14	22.98	0.64	0.81	0.54
Norton	0.17	0.15	0.15	15.38	13.33	14.33	0.04	0.06	0.04

County	Respiratory Hazard Index			Total Cancer Risk (per million)			Oil and Gas Cancer Risk (per million)		
	2017	2018	2019	2017	2018	2019	2017	2018	2019
Woodson	0.37	0.34	0.31	25.34	20.75	20.61	1.07	1.34	0.86
Meade	0.21	0.17	0.17	16.93	14.25	15.37	0.19	0.28	0.17
Sherman	0.15	0.13	0.14	13.68	12.16	13.11	0.13	0.18	0.15
Sumner	0.30	0.26	0.25	22.74	19.49	19.95	0.40	0.40	0.21
Trego	0.17	0.14	0.25	15.52	13.29	14.50	0.09	0.13	0.11
Cheyenne	0.14	0.13	0.13	13.32	11.81	12.91	0.85	0.26	0.35

Source: EPA (2023i, 2024e)

The total risk for the noncancer respiratory hazard index is estimated from a variety of factors from inhalation of air toxics nationwide, in both urban and rural areas. For example, background concentrations include pollutants that exist in the air that do not come from specific sources and may be derived from a natural source (biogenic) or from distance sources or pollutants that persist in the environment due to a long half-life. Background concentrations can explain pollutant concentrations found even without recent human-caused emissions. Oil and gas cancer risks are estimated from emissions from oil and gas operations such as emissions from individual well locations and production equipment such as pumps, dehydrators, tanks, and engines. Total cancer risk for the state of New Mexico (19.1 cases per million) was less than that of the United States (25.5 cases per million) (see Table 46). In addition, the respiratory noncancer hazard quotient values were consistently lower for the state of New Mexico (0.22) than for the nation (0.31).

All eight counties (Chaves, Eddy, Lea, McKinley, Rio Arriba, Sandoval, San Juan, and Roosevelt) had cancer risk values and total hazard quotients less than those of the United States, with all total hazard quotients reported being less than 1.0.

5.3 FARMINGTON FIELD OFFICE AND PECOS DISTRICT OFFICE HAZARDOUS AIR POLLUTANT MODELING

The U.S. Court of Appeals for the Tenth Circuit in *Diné Citizens Against Ruining Our Env't v. Haaland,* 59 F.4th 1016, 1047 (10th Cir. 2023), hereafter Diné CARE II*,* directed the BLM to analyze cumulative HAPs emissions for the San Juan Basin in its oil and gas leasing under NEPA,[2] and the BLM has also created the same analysis for the BLM Pecos District Office (PDO). The BLM's *Cumulative Hazardous Air Pollutant Modeling – Final Report* (Ramboll and BLM 2023) and the BLM's *Summary of Cumulative Oil and Gas Hazardous Air Pollutant Analysis for the Pecos District Office* (BLM 2024c), incorporated by reference and summarized below, detail the modeling methods used and the results of the modeling. The tables below also include information for the BLM FFO, incorporated from the BLM's *Summary of Cumulative Oil and Gas Hazardous Air Pollutant Analysis* for the BLM FFO (BLM 2024d).

The BLM's western United States HAP photochemical modeling assessment was prepared to support the BLM's analysis of cumulative oil and gas impacts to public health from HAPs originating from oil and gas production in Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah, and Wyoming (states where the BLM commonly authorizes federal activities for fossil energy development). The Diné CARE II Court specifically mentioned five HAPs—benzene, toluene, ethylbenzene, mixed xylenes, and n-hexane—as applying to oil and gas development activities based on the NESHAPs, see 43 C.F.R. § 63. The modeling assessment evaluated emissions from existing federal, new federal, and non-federal oil and gas sources and includes six key HAPs—benzene, toluene, ethylbenzene, xylene, n-hexane, and formaldehyde—because these compounds are common in the oil and gas sector and consistent with regulatory requirements described in the EPA's NSPS, see 43 C.F.R. § 60, and NESHAPs. HAP emissions in this study include emission sources associated with wellsite exploration, wellsite production, and midstream sources (Ramboll and BLM 2023). The modeling analysis evaluated air quality out to a future year of 2032[3] using data from the 2028 Western Regional Air Partnership (WRAP)/Western Air Quality Study (WAQS) modeling platform, the EPA SPECIATE 5.14 speciation profiles, the EPA's 2016v2 emissions modeling platform (EPA 2022a), and the BLM oil and gas development projections to quantify

[2] The CAA defines a HAP as "any air pollutant" of which "emissions, ambient concentrations, bioaccumulation or deposition of the substance are known to cause or may reasonably be anticipated to cause adverse effects to human health or adverse environmental effect;" see 42 U.S.C. § 7412.

[3] EPA's 2016v2 modeling platform (EPA 2022a), the most advanced dataset at the time of model development, includes emissions for the years 2016, 2023, 2026, and 2032. Future year 2032 was used in this modeling assessment.

and apportion federal and non-federal oil and gas emissions (Ramboll and BLM 2023). The model output allows the BLM to compare concentrations of HAPs to calculated risk-based thresholds in order to provide the hard look at the effects on public health required by NEPA.

Carcinogenic and noncarcinogenic chronic risks from modeled oil and gas concentrations were calculated for future year 2032. The emissions inventory for the BLM PDO was based on Annual Energy Outlook (AEO) oil and gas projections for the Permian Basin. These projections describe the reasonably foreseeable oil and gas development anticipated to occur within the Permian Basin by 2032 and reflect the best currently available information. Health-based inhalation thresholds and cancer unit risk estimate threshold values were obtained from the weight of evidence for carcinogenicity under the 2005 EPA cancer guidelines (without revisions) (EPA 2021b, 2022b). A residency exposure adjustment factor was applied to the cancer inhalation risk by multiplying the annual modeled concentration by the cancer unit risk factor and multiplying this product by an applicable exposure adjustment factor. The residency exposure adjustment factor[4] is computed by taking the average residency of the county where development is proposed (Table 49) and dividing that by the length of exposure over an assumed 70-year life span. For example, for Eddy County, the residency exposure adjustment factor would be 15.0/70. All other values in Table 49 and Table 50 are raw model outputs with no adjustment applied.

Table 49. United States, State, and County Residency Information

United States/State/*County*	Residency (years)
United States	13.4
New Mexico	15.9
Bernalillo	13.1
Catron	19.8
Chaves	14.9
Cibola	16.9
Colfax	15.1
Curry	12.6
De Baca	15.0
Dona Ana	13.2
Eddy	15.0
Grant	15.2
Guadalupe	18.9
Harding	15.7
Hidalgo	15.9
Lea	14.0
Lincoln	14.3
Los Alamos	13.4

[4] EPA’s Exposure Assessment Tools by Routes – Inhalation; https://www.epa.gov/expobox/exposure-assessment-tools-routes-inhalation.

United States/State/*County*	**Residency (years)**
Luna	14.7
McKinley	18.5
Mora	22.1
Otero	13.2
Quay	15.6
Rio Arriba	19.8
Roosevelt	14.1
Sandoval	14.1
San Juan	15.5
San Miguel	18.3
Santa Fe	14.3
Sierra	15.9
Socorro	17.9
Taos	17.6
Torrance	16.1
Union	16.4
Valencia	16.1

Source: U.S. Census Bureau (2023)

Table 50 shows the oil and gas cancer risk from federal sources (existing and new) and from all mineral designations together from the combination of benzene, ethylbenzene, and formaldehyde. The risk analysis was performed only for these three HAPs because these pollutants had EPA-provided non-zero unit risk estimate values based on the weight-of-evidence approach (EPA 2021b). The non-adjusted (70-year) cancer risk from all oil and gas sources for all New Mexico counties is less than 30 in 1 million (maximum of 27.48 in San Juan County). The maximum total oil and gas residency exposure-adjusted cancer risk for all New Mexico counties, as described above, is below 6.15 in 1 million.

Risk characterization is a description of the nature and, often, magnitude of human risk, including resulting uncertainties. Risk characterization is accomplished by integrating information from the components of the risk assessment and synthesizing an overall conclusion about risk that is complete, informative, and useful for decision makers (EPA 2000). A “bright line” in risk characterization refers to a threshold value that separates acceptable and unacceptable levels of risk. It is regarded as a clear and unambiguous limit used to determine whether a particular level of exposure to a hazardous substance is safe. Bright lines were not used in the analysis of the cumulative oil and gas HAP results to determine if a particular risk level was acceptable or not, as no such construct for risk exists within the CAA framework akin to the NAAQS (that is, there are no NAAQS against which to compare modeled HAP concentrations). Rather, values or ranges of values published by the EPA (e.g., AirToxScreen [NATA] or 40 C.F.R. § 300.430 [Remedial Investigation/Feasibility Study]) were used to provide useful context to risk estimates associated with the cumulative oil and gas HAP study. As described in the BLM’s *Cumulative Hazardous Air Pollutants Modeling – Final Report* (Ramboll and BLM 2023), while no explicit risk thresholds are available, EPA uses a 1 in 1 million and 100 in 1 million risk for context (EPA 2022b).

As a result, both the 70-year cancer risk and the adjusted cancer risk in Table 50 are within the contextual range published by the EPA. It is important to note that the cancer risks estimated by this assessment only consider cumulative oil and gas sources and six common oil and gas HAPs. While the cumulative oil and gas contribution is within the contextual range published by the EPA (1 in 1 million and 100 in 1 million), additional HAPs from non-oil and gas sources could increase the overall risk in the project area. This modeling assessment looked at cumulative oil and gas sources to address the Court's holding in regard to analysis of cumulative HAP emissions. It was beyond the scope of this modeling assessment to determine cumulative HAP values from non-oil and gas sources.

Table 50. Estimated Cancer Risk from 2032 Oil and Gas Production in New Mexico by Mineral Designation

County	Cancer Risk* from Existing Federal Wells (per million)	Cancer Risk* from New Federal Wells (per million)	Cancer Risk* from Total Federal Wells (per million)	Cancer Risk* from Non-federal Wells (per million)	Cancer Risk* from Cumulative Oil and Gas Production (per million)	Adjusted Cancer Risk† From Cumulative Oil and Gas Production (per million)
BLM CFO						
Chaves‡	0.20 to 2.51	0.07 to 1.54	0.26 to 3.95	0.20 to 3.53	0.46 to 7.48	0.10 to 1.59
Eddy	0.20 to 6.91	0.08 to 2.95	0.28 to 7.57	0.22 to 8.95	0.51 to 15.10	0.11 to 3.24
Lea	0.45 to 4.65	0.25 to 4.86	0.72 to 7.10	0.79 to 6.46	1.61 to 13.11	0.32 to 2.62
BLM FFO						
McKinley§	0.04 to 0.84	0.02 to 0.55	0.06 to 1.39	0.05 to 0.88	0.11 to 2.21	0.03 to 0.58
Rio Arriba¶	0.29 to 15.51	0.13 to 2.75	0.42 to 18.26	0.25 to 4.27	0.67 to 21.74	0.19 to 6.15
Sandoval§	0.12 to 2.76	0.07 to 3.11	0.19 to 5.87	0.13 to 3.91	0.32 to 9.60	0.06 to 1.93
San Juan	0.07 to 16.70	0.04 to 4.02	0.11 to 20.72	0.09 to 7.18	0.20 to 27.48	0.04 to 6.09
BLM RPFO						
Bernalillo	0.10 to 0.20	0.06 to 0.12	0.16 to 0.32	0.12 to 0.20	0.28 to 0.52	0.05 to 0.10
Cibola	0.03 to 0.10	0.02 to 0.06	0.04 to 0.16	0.04 to 0.11	0.08 to 0.27	0.02 to 0.07
Torrance	0.11 to 0.17	0.06 to 0.10	0.18 to 0.28	0.14 to 0.24	0.32 to 0.47	0.07 to 0.11
Valencia	0.07 to 0.14	0.04 to 0.09	0.12 to 0.23	0.09 to 0.16	0.21 to 0.39	0.05 to 0.09
BLM RFO						
Curry	0.19 to 0.30	0.13 to 0.18	0.32 to 0.47	0.33 to 0.52	0.64 to 0.99	0.12 to 0.18
De Baca	0.19 to 0.48	0.10 to 0.24	0.29 to 0.70	0.24 to 0.70	0.52 to 1.40	0.11 to 0.30
Guadalupe	0.16 to 0.25	0.09 to 0.14	0.25 to 0.39	0.19 to 0.37	0.44 to 0.76	0.12 to 0.20
Lincoln	0.11 to 0.44	0.05 to 0.11	0.16 to 0.56	0.14 to 0.48	0.29 to 0.93	0.06 to 0.19
Quay	0.15 to 0.29	0.12 to 0.16	0.28 to 0.45	0.26 to 0.43	0.54 to 0.88	0.12 to 0.20
Roosevelt	0.22 to 0.62	0.15 to 0.32	0.36 to 0.93	0.45 to 12.8	0.87 to 13.45	0.18 to 2.71

County	Cancer Risk* from Existing Federal Wells (per million)	Cancer Risk* from New Federal Wells (per million)	Cancer Risk* from Total Federal Wells (per million)	Cancer Risk* from Non-federal Wells (per million)	Cancer Risk* from Cumulative Oil and Gas Production (per million)	Adjusted Cancer Risk† From Cumulative Oil and Gas Production (per million)
BLM Las Cruces DO						
Doña Ana	0.05 to 0.11	0.03 to 0.05	0.08 to 0.15	0.08 to 0.23	0.16 to 0.34	0.03 to 0.06
Grant	0.03 to 0.05	0.02 to 0.03	0.05 to 0.08	0.05 to 0.07	0.09 to 0.15	0.02 to 0.03
Hidalgo	0.02 to 0.04	0.01 to 0.02	0.04 to 0.06	0.03 to 0.06	0.07 to 0.12	0.02 to 0.03
Luna	0.04 to 0.06	0.02 to 0.03	0.06 to 0.09	0.06 to 0.31	0.12 to 0.40	0.02 to 0.08
Otero	0.09 to 0.42	0.04 to 0.11	0.13 to 0.53	0.12 to 0.36	0.25 to 0.89	0.05 to 0.17
Sierra	0.04 to 0.10	0.02 to 0.05	0.05 to 0.15	0.05 to 0.13	0.11 to 0.29	0.02 to 0.07
BLM SFO						
Catron	0.02 to 0.05	0.01 to 0.03	0.03 to 0.07	0.03 to 0.06	0.07 to 0.13	0.02 to 0.04
Socorro	0.04 to 0.12	0.02 to 0.07	0.06 to 0.19	0.06 to 0.16	0.12 to 0.35	0.03 to 0.09
BLM TFO						
Colfax	0.14 to 0.30	0.10 to 0.13	0.25 to 0.43	0.22 to 0.54	0.48 to 0.85	0.10 to 0.18
Harding	0.14 to 0.18	0.10 to 0.13	0.25 to 0.30	0.22 to 0.28	0.48 to 0.58	0.11 to 0.13
Los Alamos	0.27 to 0.27	0.13 to 0.13	0.40 to 0.40	0.25 to 0.25	0.66 to 0.66	0.13 to 0.13
Mora	0.17 to 0.28	0.10 to 0.13	0.26 to 0.41	0.20 to 0.26	0.47 to 0.67	0.15 to 0.21
San Miguel	0.16 to 0.22	0.09 to 0.12	0.25 to 0.33	0.18 to 0.29	0.43 to 0.62	0.11 to 0.16
Santa Fe	0.16 to 0.36	0.10 to 0.15	0.27 to 0.52	0.18 to 0.29	0.44 to 0.81	0.09 to 0.16
Taos	0.26 to 0.43	0.12 to 0.17	0.38 to 0.60	0.24 to 0.35	0.61 to 0.93	0.15 to 0.23
Union	0.11 to 0.16	0.11 to 0.13	0.24 to 0.28	0.22 to 0.26	0.46 to 0.54	0.11 to 0.13

Notes: SFO = Socorro Field Office; TFO = Taos Field Office; RFO = Roswell Field Office; Las Cruces DO = Las Cruces District Office

*Cancer risk from emissions of benzene, ethylbenzene, and formaldehyde

†Adjusted residency risk based on residency factors by county from Table 49

‡Chaves County is split between the BLM CFO and the BLM RFO but presented in the BLM CFO.

§McKinley County and Sandoval County are split between the BLM FFO and the BLM RPFO but presented in the BLM FFO.

¶Rio Arriba County is split between the BLM FFO and the BLM TFO but presented in the BLM FFO.

AirToxScreen is consistent with the EPA's definition of a cumulative risk assessment. The contribution, based on the EPA's most recent AirToxScreen results (2019), of the oil and gas industry to the cancer risk in New Mexico counties ranged from 0 to 3.91 in 1 million, and overall in the state of New Mexico was 0.34 in 1 million (EPA 2024e). While not paired in time, the BLM's cumulative oil and gas study showed the contribution of the oil and gas industry to cancer risk (ca. 2032) statewide will range from 0.02 to 6.15 in 1 million. While different methods were used by EPA and the BLM to determine cumulative oil and gas contributions and this could result in inconsistencies when comparing the data, the overall trend projects cumulative oil and gas contribution will be steady to slightly decreasing between 2019 and ca. 2032. The overall HAPs trend could be further affected by projected declines in other sectors from increased electrification, equipment efficiency, and renewable technologies for electricity generation (U.S. Energy Information Administration [EIA] 2025). To have an entirely consistent analysis between the BLM and the EPA would require the BLM to project the entire NEI forward to a common future year (2032 in the BLM study) and use the Community Multiscale Air Quality Modeling System (CMAQ) model with the unique chemical mechanism within the CMAQ used in AirToxScreen. To the BLM's knowledge, in the nearly 30-year history of the EPA's NATA, of which AirToxScreen is a part, a future-year projection for NATA has never been attempted. Therefore, using the AirToxScreen results described above, if one were to add the risk values for the respective counties from the EPA's and the BLM's modeling (which would not be scientifically valid given the varying methodologies), the addition of the other source categories places the total risk from other sources, in addition to future projections of HAPs impacts from oil and gas development, still well within the 1 in 1 million and 100 in 1 million risk range.

Table 51 through Table 57 show the hazard quotients (HQs) for each compound and the hazard index (HI). EPA estimates chronic noncancer HQs by dividing a chemical's estimated long-term exposure concentration by the RfC for that chemical for each field office. Chronic noncancer hazards from multiple air toxics were assessed by calculating an HI through the summation of individual HAP HQs that share similar adverse health effects, resulting in a target organ-specific HI representing the risk to a specific organ or organ system. An HQ or HI value less than 1 indicates that the exposure is not likely to result in adverse noncancer effects (EPA 2022b; Ramboll and BLM 2023). Statewide HQ and HI values are below 1 for all mineral designations except for Rio Arriba and San Juan Counties, indicating that cumulative oil and gas-source exposure is not likely to result in adverse noncancer effects.
The maximum HIs from total oil and gas production for Rio Arriba and San Juan Counties are 0.1679 and 0.2082, respectively. It is important to note that the noncancer risks estimated by this assessment only consider cumulative oil and gas sources and the six common oil and gas pollutants. While the cumulative oil and gas contribution is below 1, additional HAPs from non-oil and gas sources could increase the overall risks in the project area. This modeling assessment looked at cumulative oil and gas sources to address the Court's holding in regard to analysis of cumulative HAP emissions. It was beyond the scope of this modeling assessment to determine cumulative HAP values from non-oil and gas sources.

Table 51. Estimated HQs and HI from ca. 2032 Oil and Gas Production in the BLM CFO by Mineral Designation

	HQ						HI
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
Chaves County							
Existing federal	<0.0001 to 0.0008	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0001	Range is <0.0001	0.0015 to 0.0181	0.0015 to 0.0191
New federal	<0.0001 to 0.0019	Range is <0.0001	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0004	0.0005 to 0.0085	0.0005 to 0.0109
Total federal	<0.0001 to 0.0026	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	<0.0001 to 0.0004	0.0019 to 0.0263	0.002 to 0.0294
Non-federal	<0.0001 to 0.0017	Range is <0.0001	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0004	0.0015 to 0.0259	0.0015 to 0.027
Total	*0.0001 to 0.0034*	*Range is <0.0001*	*Range is <0.0001*	*<0.0001 to 0.0003*	*<0.0001 to 0.0005*	*0.0034 to 0.0522*	*0.0035 to 0.0564*

			HQ				HI
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
Eddy County							
Existing federal	<0.0001 to 0.0039	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0004	<0.0001 to 0.0006	0.0015 to 0.0470	0.0016 to 0.0516
New federal	<0.0001 to 0.0037	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0001	<0.0001 to 0.0008	0.0005 to 0.0162	0.0006 to 0.0208
Total federal	<0.0001 to 0.0052	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0005	<0.0001 to 0.0008	0.0021 to 0.0528	0.0021 to 0.0563
Non-federal	<0.0001 to 0.0043	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0004	<0.0001 to 0.0008	0.0017 to 0.0632	0.0017 to 0.0679
Total	*0.0001 to 0.0069*	*Range is <0.0001*	*Range is <0.0001*	*<0.0001 to 0.0007*	*<0.0001 to 0.0009*	*0.0037 to 0.1066*	*0.0039 to 0.1145*
Lea County							
Existing federal	0.0001 to 0.0014	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	<0.0001 to 0.0002	0.0033 to 0.0353	0.0034 to 0.0361
New federal	0.0002 to 0.012	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	<0.0001 to 0.0029	0.0015 to 0.0156	0.0018 to 0.0309
Total federal	0.0004 to 0.0127	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0003	<0.0001 to 0.003	0.0049 to 0.0491	0.0054 to 0.0511
Non-federal	0.0003 to 0.0016	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	<0.0001 to 0.0003	0.0057 to 0.0477	0.006 to 0.0496
Total	*0.0008 to 0.0133*	*Range is <0.0001*	*Range is <0.0001*	*<0.0001 to 0.0003*	*<0.0001 to 0.003*	*0.0111 to 0.0968*	*0.0121 to 0.1007*

Note: HQ and HI values may vary slightly due to the rounding of these very small values.

Table 52. Estimated HQs and HI from ca. 2032 Oil and Gas Production in the BLM FFO by Mineral Designation

			HQ				HI
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
McKinley County							
Existing federal	<0.0001 to 0.0003	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0003 to 0.0060	0.0003 to 0.0064
New federal	<0.0001 to 0.0005	Range is <0.0001	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0001	0.0001 to 0.0033	0.0002 to 0.0040
Total federal	<0.0001 to 0.0008	Range is <0.0001	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	0.0004 to 0.0093	0.0004 to 0.0103
Non-federal	<0.0001 to 0.0005	Range is <0.0001	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	0.0003 to 0.0060	0.0004 to 0.0067
Total	*<0.0001 to 0.0012*	*Range is <0.0001*	*Range is <0.0001*	*<0.0001 to 0.0001*	*<0.0001 to 0.0003*	*0.0007 to 0.0150*	*0.0008 to 0.0167*

	HQ						HI
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
Rio Arriba County							
Existing federal	<0.0001 to 0.0046	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0005	<0.0001 to 0.0021	0.0022 to 0.1130	0.0022 to 0.1203
New federal	<0.0001 to 0.0035	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0003	<0.0001 to 0.0007	0.0009 to 0.0168	0.0010 to 0.0214
Total federal	<0.0001 to 0.0071	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0007	<0.0001 to 0.0022	0.0031 to 0.1271	0.0032 to 0.1372
Non-federal	<0.0001 to 0.0033	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0004	<0.0001 to 0.0005	0.0019 to 0.0311	0.0019 to 0.0353
Total	*0.0002 to 0.0083*	*Range is <0.0001*	*<0.0001 to 0.0001*	*<0.0001 to 0.0009*	*<0.0001 to 0.0022*	*0.0049 to 0.1564*	*0.0051 to 0.1679*
Sandoval County							
Existing federal	<0.0001 to 0.0017	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	<0.0001 to 0.0004	0.0009 to 0.0186	0.0009 to 0.0209
New federal	<0.0001 to 0.0046	Range is <0.0001	<0.0001 to 0.0001	<0.0001 to 0.0006	<0.0001 to 0.0007	0.0005 to 0.0155	0.0005 to 0.0215
Total federal	<0.0001 to 0.0054	Range is <0.0001	<0.0001 to 0.0001	<0.0001 to 0.0007	<0.0001 to 0.0011	0.0014 to 0.0341	0.0014 to 0.0414
Non-federal	<0.0001 to 0.0026	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0003	<0.0001 to 0.0005	0.001 to 0.0257	0.001 to 0.0291
Total	*<0.0001 to 0.0079*	*Range is <0.0001*	*<0.0001 to 0.0002*	*<0.0001 to 0.0010*	*<0.0001 to 0.0016*	*0.0023 to 0.0598*	*0.0024 to 0.0705*
San Juan County							
Existing federal	<0.0001 to 0.0055	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0006	<0.0001 to 0.0010	0.0005 to 0.1210	0.0006 to 0.1282
New federal	<0.0001 to 0.005	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0006	<0.0001 to 0.0008	0.0003 to 0.0220	0.0003 to 0.0285
Total federal	<0.0001 to 0.0082	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0009	<0.0001 to 0.0011	0.0008 to 0.1430	0.0008 to 0.1534
Non-federal	<0.0001 to 0.0037	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0004	<0.0001 to 0.0006	0.0006 to 0.0516	0.0006 to 0.0563
Total	*<0.0001 to 0.0107*	*Range is <0.0001*	*<0.0001 to 0.0001*	*<0.0001 to 0.0012*	*<0.0001 to 0.0015*	*0.0014 to 0.1946*	*0.0015 to 0.2082*

Note: HQ and HI values may vary slightly due to the rounding of these very small values.

Table 53. Estimated HQs and HI from ca. 2032 Oil and Gas Production in the RPFO by Mineral Designation

	HQ						HI
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
Bernalillo County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0008 to 0.0015	0.0008 to 0.0015
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0004 to 0.0008	0.0004 to 0.0009
Total federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0012 to 0.0023	0.0012 to 0.0024
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0008 to 0.0015	0.0009 to 0.0015
Total	*<0.0001 to 0.0002*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0020 to 0.0037*	*0.0021 to 0.004*
Cibola County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0002 to 0.0008	0.0002 to 0.0008
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0001 to 0.0004	0.0001 to 0.0004
Total federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0003 to 0.0011	0.0003 to 0.0012
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0003 to 0.0008	0.0003 to 0.0009
Total	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0006 to 0.0020*	*0.0006 to 0.0021*
Torrance County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0008 to 0.0013	0.0009 to 0.0013
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0004 to 0.0007	0.0005 to 0.0008
Total federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0013 to 0.0020	0.0014 to 0.0021
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0010 to 0.0018	0.0011 to 0.0019
Total	*0.0001 to 0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0023 to 0.0034*	*0.0025 to 0.0036*
Valencia County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0006 to 0.0011	0.0006 to 0.0011

	HQ						HI
Source	Benzene	Toluene	Ethylbenzene	Xylene	n-Hexane	Formaldehyde	
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0003 to 0.0006	0.0003 to 0.0007
Total federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0009 to 0.0017	0.0009 to 0.0017
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0007 to 0.0011	0.0007 to 0.0012
Total	*<0.0001 to 0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0015 to 0.0028*	*0.0016 to 0.0029*

Note: HQ and HI values may vary slightly due to the rounding of these very small values.

Table 54. Estimated HQs and HI from ca. 2032 Oil and Gas Production in the Roswell Field Office by Mineral Designation

	HQ						HI
Source	Benzene	Toluene	Ethylbenzene	Xylene	n-Hexane	Formaldehyde	
Curry County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0014 to 0.0022	0.0014 to 0.0023
New federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0009 to 0.0012	0.0010 to 0.0013
Total federal	0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0023 to 0.0034	0.0024 to 0.0036
Non-federal	0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0024 to 0.0037	0.0025 to 0.0039
Total	*0.0002 to 0.0004*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0046 to 0.0071*	*0.0049 to 0.0075*
De Baca County							
Existing federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0014 to 0.0035	0.0015 to 0.0036
New federal	<0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0007 to 0.0016	0.0007 to 0.0018
Total federal	<0.0001 to 0.0003	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0021 to 0.0051	0.0022 to 0.0054
Non-federal	<0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0017 to 0.0051	0.0018 to 0.0053
Total	*0.0002 to 0.0005*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0038 to 0.0101*	*0.004 to 0.0107*
Guadalupe County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0012 to 0.0019	0.0012 to 0.0019

	HQ						HI
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0006 to 0.0010	0.0006 to 0.0011
Total federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0018 to 0.0029	0.0019 to 0.0030
Non-federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0014 to 0.0027	0.0015 to 0.0028
Total	*0.0001 to 0.0002*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0032 to 0.0055*	*0.0033 to 0.0058*
Lincoln County							
Existing federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0008 to 0.0033	0.0008 to 0.0034
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0004 to 0.0008	0.0004 to 0.0009
Total federal	<0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0012 to 0.0041	0.0012 to 0.0043
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0010 to 0.0036	0.0010 to 0.0037
Total	*<0.0001 to 0.0002*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0021 to 0.0068*	*0.0022 to 0.0071*
Quay County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0011 to 0.0022	0.0012 to 0.0022
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0009 to 0.0011	0.0009 to 0.0012
Total federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0020 to 0.0032	0.0021 to 0.0034
Non-federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0019 to 0.0031	0.0020 to 0.0033
Total	*0.0002 to 0.0003*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0039 to 0.0064*	*0.0041 to 0.0067*
Roosevelt County							
Existing federal	<0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0016 to 0.0047	0.0017 to 0.0048
New federal	<0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0010 to 0.0022	0.0011 to 0.0024
Total federal	0.0001 to 0.0004	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0026 to 0.0068	0.0027 to 0.0071
Non-federal	0.0001 to 0.0097	Range is <0.0001	<0.0001 to 0.0001	<0.0001 to 0.0011	<0.0001 to 0.0024	0.0032 to 0.0837	0.0034 to 0.0955

	HQ						HI
Source	Benzene	Toluene	Ethylbenzene	Xylene	n-Hexane	Formaldehyde	
Total	*0.0003 to 0.0101*	*Range is <0.0001*	*<0.0001 to 0.0001*	*<0.0001 to 0.0011*	*<0.0001 to 0.0025*	*0.0061 to 0.0882*	*0.0066 to 0.1004*

Note: HQ and HI values may vary slightly due to the rounding of these very small values.

Table 55. Estimated HQs and HI from ca. 2032 Oil and Gas Production in the Las Cruces District Office by Mineral Designation

	HQ						HI
Source	Benzene	Toluene	Ethylbenzene	Xylene	n-Hexane	Formaldehyde	
Doña Ana County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0004 to 0.0008	0.0004 to 0.0008
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0002 to 0.0003	0.0002 to 0.0004
Total federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0006 to 0.0011	0.0006 to 0.0012
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0006 to 0.0018	0.0006 to 0.0018
Total	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0012 to 0.0025*	*0.0012 to 0.0026*
Grant County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0002 to 0.0004	0.0003 to 0.0004
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0001 to 0.0002	0.0001 to 0.0002
Total federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0004 to 0.0006	0.0004 to 0.0006
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0003 to 0.0005	0.0004 to 0.0006
Total	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0007 to 0.0011*	*0.0007 to 0.0011*
Hidalgo County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0002 to 0.0003	0.0002 to 0.0003
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0001	0.0001 to 0.0002
Total federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0003 to 0.0004	0.0003 to 0.0005
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0002 to 0.0004	0.0003 to 0.0005

			HQ				HI
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
Total	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0005 to 0.0009*	*0.0005 to 0.0009*
Luna County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0003 to 0.0005	0.0003 to 0.0005
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0001 to 0.0002	0.0002 to 0.0002
Total federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0004 to 0.0007	0.0005 to 0.0007
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0004 to 0.0024	0.0004 to 0.0024
Total	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0009 to 0.003*	*0.0009 to 0.0031*
Otero County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0006 to 0.0031	0.0007 to 0.0032
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0003 to 0.0008	0.0003 to 0.0008
Total federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0009 to 0.0039	0.0010 to 0.0041
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0009 to 0.0026	0.0009 to 0.0027
Total	*<0.0001 to 0.0002*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0018 to 0.0065*	*0.0019 to 0.0068*
Sierra County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0003 to 0.0008	0.0003 to 0.0008
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0001 to 0.0004	0.0001 to 0.0004
Total federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0004 to 0.0011	0.0004 to 0.0012
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0004 to 0.0010	0.0004 to 0.001
Total	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0008 to 0.0021*	*0.0008 to 0.0022*

Note: HQ and HI values may vary slightly due to the rounding of these very small values.

Table 56. Estimated HQs and HI from ca. 2032 Oil and Gas Production in the Socorro Field Office by Mineral Designation

	HQ						HI
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
Catron County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0002 to 0.0003	0.0002 to 0.0004
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	<0.0001 to 0.0002	<0.0001 to 0.0002
Total federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0002 to 0.0005	0.0003 to 0.0005
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0002 to 0.0004	0.0002 to 0.0005
Total	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0005 to 0.0009*	*0.0005 to 0.001*
Socorro County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0003 to 0.0009	0.0003 to 0.0010
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0001 to 0.0005	0.0002 to 0.0005
Total federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0004 to 0.0014	0.0005 to 0.0014
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0004 to 0.0012	0.0004 to 0.0013
Total	*<0.0001 to 0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0008 to 0.0026*	*0.0009 to 0.0027*

Note: HQ and HI values may vary slightly due to the rounding of these very small values.

Table 57. Estimated HQs and HI from ca. 2032 Oil and Gas Production in the Taos Field Office by Mineral Designation

	HQ						HI
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
Colfax County							
Existing federal	<0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0011 to 0.0023	0.0011 to 0.0023
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0007 to 0.0010	0.0008 to 0.0010
Total federal	<0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0018 to 0.0032	0.0019 to 0.0033
Non-federal	<0.0001 to 0.0013	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0015 to 0.0020	0.0016 to 0.0032

	HQ						HI
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
Total	*0.0002 to 0.0014*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0034 to 0.0052*	*0.0036 to 0.0056*
Harding County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0011 to 0.0013	0.0011 to 0.0014
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0007 to 0.0009	0.0008 to 0.0009
Total federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0019 to 0.0022	0.0019 to 0.0023
Non-federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0016 to 0.0020	0.0017 to 0.0022
Total	*0.0002 to 0.0002*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0034 to 0.0042*	*0.0036 to 0.0044*
Los Alamos County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0020 to 0.0020	0.0021 to 0.0021
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0009 to 0.0009	0.0010 to 0.0010
Total federal	0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.003 to 0.003	0.0031 to 0.0031
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0019 to 0.0019	0.0019 to 0.0019
Total	*0.0002 to 0.0002*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0048 to 0.0048*	*0.0050 to 0.0050*
Mora County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0012 to 0.0021	0.0013 to 0.0022
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0007 to 0.0009	0.0007 to 0.0010
Total federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0019 to 0.0030	0.002 to 0.0031
Non-federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0015 to 0.0019	0.0015 to 0.0020
Total	*0.0001 to 0.0002*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0034 to 0.0049*	*0.0036 to 0.0051*
San Miguel County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0012 to 0.0016	0.0012 to 0.0017

				HQ			HI
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0006 to 0.0009	0.0007 to 0.0009
Total federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0018 to 0.0024	0.0019 to 0.0025
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0013 to 0.0021	0.0014 to 0.0022
Total	*0.0001 to 0.0002*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0032 to 0.0045*	*0.0033 to 0.0047*
Santa Fe County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0012 to 0.0027	0.0013 to 0.0028
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0007 to 0.0011	0.0008 to 0.0011
Total federal	<0.0001 to 0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0019 to 0.0038	0.0020 to 0.0040
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0013 to 0.0021	0.0013 to 0.0022
Total	*0.0001 to 0.0002*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0032 to 0.0059*	*0.0034 to 0.0062*
Taos County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0020 to 0.0032	0.0020 to 0.0033
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0008 to 0.0012	0.0009 to 0.0013
Total federal	<0.0001 to 0.0002	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0028 to 0.0044	0.0029 to 0.0046
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0018 to 0.0026	0.0018 to 0.0027
Total	*0.0001 to 0.0002*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0046 to 0.0068*	*0.0047 to 0.0071*
Union County							
Existing federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0008 to 0.0012	0.0008 to 0.0012
New federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0008 to 0.0009	0.0008 to 0.0010
Total federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0017 to 0.0021	0.0018 to 0.0021
Non-federal	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	Range is <0.0001	0.0015 to 0.0019	0.0017 to 0.0020

			HQ				HI
Source	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylene**	**n-Hexane**	**Formaldehyde**	
Total	*0.0002 to 0.0002*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*Range is <0.0001*	*0.0032 to 0.0040*	*0.0034 to 0.0041*

Note: HQ and HI values may vary slightly due to the rounding of these very small values.

5.4 CARLSBAD FIELD OFFICE CUMULATIVE HAZARDOUS AIR POLLUTANTS MODELING

The *BLM Carlsbad Field Office Cumulative Hazardous Air Pollutants Modeling - Final Report* (Ramboll 2025a), incorporated by reference and summarized below, details the modeling methods used and the results of the modeling. The report presents a modeling study of the cumulative HAPs originating from oil and gas production in the BLM CFO air resources planning area and the rest of the Permian Basin outside the BLM CFO. The study employed photochemical modeling to estimate the cumulative ambient air concentrations of six key HAPs (i.e., BTEX, n-hexane, and formaldehyde) and compares them to health-based thresholds. The emissions inventory development and photochemical modeling of HAPs were based on the same modeling platform developed for the BLM CFO for a ca. 2032 future year to assess the air quality impacts of oil and gas development and other cumulative sources on criteria pollutant air concentrations and air quality related values (Ramboll 2024).

As discussed in Section 5.3, there has been previous HAPs modeling completed for the FFO and PDO HAPs modeling, with the BLM's *Cumulative Hazardous Air Pollutant Modeling – Final Report* (Ramboll and BLM 2023), the BLM's *Summary of Cumulative Oil and Gas Hazardous Air Pollutant Analysis for the Pecos District Office* (BLM 2024c), and BLM's *Summary of Cumulative Oil and Gas Hazardous Air Pollutant Analysis* for the BLM FFO (BLM 2024e). The difference between HAPs modeling results of the previous modeling and the 2025 CFO HAPs modeling can be attributed to the differences in inputs and assumptions. The 2025 CFO HAPs modeling used EPA 2016v3 emissions inventory whereas the prior models used 2016v2 emissions inventory. Furthermore, they used different grid spacing, with the 2025 CFO HAPs modeling using a 4-kilometer (km) grid spacing and the previous modeling using a 12-km grid. The expected 2023 RFD well counts from previous modeling were increased in the 2025 CFO HAPs modeling which most likely contributes to the larger differences in the modeling results.

The BLM CFO criteria pollutant photochemical air quality modeling included four emission scenarios; however, of these four scenarios, two emission scenarios, namely Scenario 1 (Base Reasonable Foreseeable Development [Base RFD] scenario) and Scenario 4 (Annual Energy Outlook [AEO] Southwest Forecast scenario) were modeled in the *BLM Carlsbad Field Office Cumulative Hazardous Air Pollutants Modeling - Final Report* (Ramboll 2025a) to assess the HAP impacts. The HAP modeling and analysis methods are discussed in Section 3 of the *BLM Carlsbad Field Office Cumulative Hazardous Air Pollutants Modeling - Final Report*, and the results are provided in Section 4 and the appendices of that report. The modeling platforms from the BLM 2032 Cumulative HAPs Modeling Study (Ramboll 2024) and the BLM CFO Photochemical Air Quality Modeling Study (Ramboll and BLM 2023) were the starting points for this analysis.

Table 58 summarizes the maximum HAP concentrations and associated hazard/risk estimates for Scenario 1 across each mineral designation within the BLM CFO planning area. For new federal sources, formaldehyde exhibited the highest concentration among all HAPs, with a maximum value of 0.702 ppb observed in Eddy County, New Mexico. This is followed by n-hexane, which had a peak concentration of 0.266 ppb, also in Lea County. The remaining HAPs showed their maximum concentrations in grid cells in

Eddy County, New Mexico. The total HI for new federal sources was 0.095, while the maximum total cancer risk was 12.58 per million, primarily driven by formaldehyde.

For existing federal sources, the maximum concentrations for all six HAPs were observed in Lea County, New Mexico. Formaldehyde again dominated with a peak concentration of 0.193 ppb, contributing significantly to the hazard (HQ of 2.42E-02) and cancer risk (3.09 per million). Benzene followed, with a concentration of 0.067 ppb, contributing an HQ of 7.10E-03 and a cancer risk of 1.66 per million. The remaining HAPs had lower concentrations, and their contributions to hazard and risk metrics were minor. The total HI for existing federal sources was 0.034, and the total cancer risk was 4.81 per million.

For non-federal sources, which include emissions from the Permian Basin in Texas, the highest cumulative concentrations were often observed outside the BLM CFO planning area boundaries (Figures C-13 through C-18), with the exception of n-hexane, whose maximum concentration was in Lea County, New Mexico. Within the BLM CFO planning area, the highest maximum concentrations for formaldehyde and benzene were 0.638 and 0.226 ppb, respectively. These compounds contributed substantially to the overall hazard and cancer risk estimates, with formaldehyde accounting for an HQ of 7.99E-02 and a cancer risk of 10.19 per million. The maximum total HI for non-federal sources was 0.095, and the total cancer risk was 13.21 per million, the highest among the three mineral designations.

When all three mineral designations were combined, formaldehyde and n-hexane remained the top two dominant HAPs, with maximum concentrations of 1.483 and 0.696 ppb, respectively. Formaldehyde accounted for an HQ of 1.86E-01 and a cancer risk of 23.68 per million, which was significantly higher than for other HAPs. Benzene, with a concentration of 0.266 ppb, contributed an HQ of 2.83E-02 and a cancer risk of 6.63 per million. The total cancer risk for all combined sources was 28.3 per million. The total HI for all combined sources was 0.209, which was well below the threshold of 1, suggesting a low likelihood of non-cancer health effects within the BLM CFO planning area.

Table 59 presents the cumulative results, which both combine contributions from all three mineral designations and account for lateral boundary condition influences, including HAPs transported from neighboring states. Formaldehyde (1.483 ppb) and n-hexane (0.777 ppb) were the most prominent HAPs in the cumulative totals. The cumulative HI (0.214) and HQs for individual HAPs were well below 1, indicating a low likelihood of non-cancer health effects within the BLM CFO planning area. The combined maximum cumulative cancer risk was 29.31 per million, with formaldehyde being the largest contributor.

Table 58. Maximum HAP Concentrations and Associated Hazards and Risks in the BLM CFO Planning Area by Mineral Designation in Scenario 1

Compound	Concentration in ppb (county)	HQ (individual compounds) and HI (total)*	Risk (1 in 1 million)
New Federal BLM CFO			
Formaldehyde	0.702 (Eddy)	8.80E-02	11.21
Benzene	0.056 (Eddy)	5.93E-03	1.39
Toluene	0.034 (Lea)	2.59E-05	N/A
Ethylbenzene	0.005 (Lea)	6.75E-05	0.05
Xylene	0.013 (Lea)	5.58E-04	N/A

Compound	**Concentration in ppb (county)**	**HQ (individual compounds) and HI (total)***	**Risk (1 in 1 million)**
n-Hexane	0.266 (Lea)	1.34E-03	N/A
Total*	**1.037**	**0.095**	**12.58**
Existing Federal BLM CFO			
Formaldehyde	0.193 (Lea)	2.42E-02	3.09
Benzene	0.067 (Lea)	7.10E-03	1.66
Toluene	0.043 (Lea)	3.26E-05	N/A
Ethylbenzene	0.006 (Lea)	8.82E-05	0.07
Xylene	0.017 (Lea)	7.50E-04	N/A
n-Hexane	0.036 (Lea)	1.79E-03	N/A
Total*	**0.683**	**0.034**	**4.81**
Non-federal, includes Permian Basin			
Formaldehyde	0.638	7.99E-02	10.19
Benzene	0.226	2.41E-02	5.64
Toluene	0.112	8.41E-05	N/A
Ethylbenzene	0.012	1.68E-04	0.13
Xylene	0.041	1.76E-03	N/A
n-Hexane	0.294	1.48E-03	N/A
Total*	1.091	0.095	13.21
All (mineral designations combined for three counties)			
Formaldehyde	1.483	1.86E-01	23.68
Benzene	0.266	2.83E-02	6.63
Toluene	0.132	9.97E-05	N/A
Ethylbenzene	0.014	2.02E-04	0.15
Xylene	0.046	2.01E-03	N/A
n-Hexane	0.696	3.51E-03	N/A
Total*	**2.326**	**0.209**	**28.30**

* Total represents the maximum value of the summed concentrations of all HAPs within a single grid cell. It does not correspond to the sum of the maximum concentrations of individual HAPs across all grid cells because the maximum values do not occur at the same grid cells among all HAPs.

Note: N/A = not applicable

Table 59. Cumulative Maximum HAP Concentrations and Associated Hazards and Risks in the BLM CFO Planning Area in Scenario 1

Compound	Concentration (ppb)	HQ (individual compounds) and HI (total*)	Risk (1 in 1 million)
Formaldehyde	1.483	1.86E-01	23.68
Benzene	0.277	2.95E-02	6.90
Toluene	0.138	1.04E-04	N/A
Ethylbenzene	0.018	2.58E-04	0.19
Xylene	0.049	2.14E-03	N/A
n-Hexane	0.777	3.91E-03	N/A
Total*	**2.478**	**0.214**	**29.31**

* Total represents the maximum value of the summed concentrations of all HAPs within a single grid cell. It does not correspond to the sum of the maximum concentrations of individual HAPs across all grid cells.

Note: N/A = not applicable

Table 60 summarizes the maximum HAP concentrations and associated hazard/risk estimates for Scenario 4 across each mineral designation within the BLM CFO planning area. For new federal sources, formaldehyde exhibited the highest concentration among all HAPs, with a maximum value of 0.96 ppb observed in Eddy County, New Mexico. This is followed by n-hexane, which had a peak concentration of 0.344 ppb, observed in Lea County, New Mexico and benzene, which had a peak concentration of 0.073 ppb, observed in Eddy County, New Mexico. The remaining HAPs showed their maximum concentrations in grid cells in Lea County, New Mexico. The total HI for new federal sources was 0.130, while the maximum total cancer risk was 17.05 per million, primarily driven by formaldehyde.

For existing federal sources, the maximum concentrations for all six HAPs were observed in Lea County, New Mexico. Formaldehyde again dominated with a peak concentration of 0.249 ppb, contributing significantly to the hazard (HQ of 3.12E-02) and cancer risk (3.98 per million). Benzene followed, with a concentration of 0.086 ppb, contributing an HQ of 9.14E-03 and a cancer risk of 2.14 per million. The remaining HAPs had lower concentrations, and their contributions to hazard and risk metrics were minor. The total HI for existing federal sources was 0.044, and the total cancer risk was 6.21 per million.

For non-federal sources, which include emissions from the Permian Basin in Texas, the highest cumulative concentrations were often observed outside the BLM CFO planning area boundaries (Ramboll 2025a:Figures C-31 through C-36), with the exception of n-hexane, whose maximum concentration was in Lea County, New Mexico. Within the BLM CFO planning area, the highest maximum concentrations for formaldehyde and benzene were 0.837 and 0.232 ppb, respectively. These compounds contributed substantially to the overall hazard and cancer risk estimates, with formaldehyde accounting for an HQ of 1.05E-01 and a cancer risk of 13.37 per million. The maximum total HI for non-federal sources was 0.122, and the total cancer risk was 16.79 per million, the highest among the three mineral designations.

When all three mineral designations were combined, formaldehyde and n-hexane remained the top two dominant HAPs with maximum concentrations of 1.992 and 0.899 ppb, respectively. Formaldehyde accounted for an HQ of 2.50E-01 and a cancer risk of 31.81 per million, which was significantly higher than for other HAPs. Benzene, with a concentration of 0.285 ppb, contributed an HQ of 3.03E-02 and a cancer risk of 7.09 per million. The total cancer risk for all combined sources was 37.33 per million.

The total HI for all combined sources was 0.278, which was well below the threshold of 1, suggesting a low likelihood of non-cancer health effects within the CFO planning area.

Table 60. Maximum HAP Concentrations and Associated Hazards and Risks in the BLM CFO Planning Area by Mineral Designation in Scenario 4

Compound	Concentration in ppb (county)	HQ (individual compounds) and HI (total)*	Risk (1 in 1 million)
New Federal BLM CFO			
Formaldehyde	0.960 (Eddy)	1.20E-01	15.33
Benzene	0.073 (Eddy)	7.80E-03	1.82
Toluene	0.045 (Lea)	3.38E-05	N/A
Ethylbenzene	0.006 (Lea)	9.01E-05	0.07
Xylene	0.018 (Lea)	7.67E-04	N/A
n-Hexane	0.344 (Lea)	1.73E-03	N/A
Total*	**1.392**	**0.130**	**17.05**
Existing Federal BLM CFO			
Formaldehyde	0.249 (Lea)	3.12E-02	3.98
Benzene	0.086 (Lea)	9.14E-03	2.14
Toluene	0.056 (Lea)	4.21E-05	N/A–
Ethylbenzene	0.008 (Lea)	1.17E-04	0.09
Xylene	0.024 (Lea)	1.03E-03	N/A
n-Hexane	0.459 (Lea)	2.31E-03	N/A
Total*	**0.881**	**0.044**	**6.21**
Non-federal, which includes Permian Basin			
Formaldehyde	0.837	1.05E-01	13.37
Benzene	0.232	2.47E-02	5.78
Toluene	0.116	8.76E-05	N/A
Ethylbenzene	0.012	1.77E-04	0.13
Xylene	0.043	1.85E-03	N/A
n-Hexane	0.379	1.91E-03	N/A
Total*	**1.396**	**0.122**	**16.79**
All (mineral designations combined for three counties)			
Formaldehyde	1.992	2.50E-01	31.81
Benzene	0.285	3.03E-02	7.09
Toluene	0.146	1.10E-04	N/A
Ethylbenzene	0.018	2.60E-04	0.20

Compound	Concentration in ppb (county)	HQ (individual compounds) and HI (total)*	Risk (1 in 1 million)
Xylene	0.053	2.29E-03	N/A
n-Hexane	0.899	4.53E-03	N/A
Total*	**3.055**	**0.278**	**37.33**

* Total represents the maximum value of the summed concentrations of all HAPs within a single grid cell. It does not correspond to the sum of the maximum concentrations of individual HAPs across all grid cells because the maximum values do not occur at the same grid cells among all HAPs.

Note: N/A = not applicable

Table 61 presents the cumulative results, which combine contributions from all three mineral designations and account for lateral boundary condition influences, including HAPs transported from neighboring states. Formaldehyde (1.992 ppb) and n-hexane (1.007 ppb) were the most prominent HAPs in the cumulative totals. The cumulative HI (0.283) and HQs for individual HAPs were well below 1, indicating a low likelihood of non-cancer health effects within the BLM CFO planning area.
The combined maximum cumulative cancer risk was 38.64 per million, with formaldehyde being the largest contributor. The AEO Southwest Forecast scenario (Scenario 4) had the highest emissions across all four scenarios.

Table 61. Cumulative Maximum HAP Concentrations and Associated Hazards and Risks in the BLM CFO Planning Area in Scenario 4

Compound	Conc. (ppb)	HQ (individual compounds) and HI (total)*	Risk (1 in a million)
Formaldehyde	1.992	2.50E-01	31.81
Benzene	0.298	3.18E-02	7.43
Toluene	0.167	1.26E-04	N/A
Ethylbenzene	0.023	3.32E-04	0.25
Xylene	0.065	2.82E-03	N/A
n-Hexane	1.007	5.07E-03	N/A
Total*	**3.261**	**0.283**	**38.64**

* Note that "Total" represents the maximum value of the summed concentrations of all HAPs within a single grid cell. It does not correspond to the sum of the maximum concentrations of individual HAPs across all grid cells

Note: N/A = not applicable

5.5 HYDROGEN SULFIDE

Hydrogen sulfide (H_2S) is a colorless flammable gas with a rotten egg smell that is a naturally occurring by-product of oil and gas development in some areas, including the New Mexico portion of the Permian Basin. H_2S is both an irritant and a chemical asphyxiant with effects on both oxygen utilization and the central nervous system. Its health effects can vary depending on the level and duration of exposure. Effects may range from eye, nose, and throat irritation to dizziness, headaches, and nausea. High concentrations can cause shock, convulsions, inability to breathe, extremely rapid unconsciousness, coma, and death. Effects can occur within a few breaths and possibly a single breath.

H_2S was originally included in the list of Toxic Air Pollutants defined by Congress in the 1990 amendments to the CAA. It was later determined that H_2S was included through a clerical error, and it was removed by Congress from the list. H_2S was addressed under the accidental release provisions of the CAA. Congress also tasked the EPA with assessing the hazards to public health and the environment from H_2S emissions associated with oil and gas extraction. That report was published in October 1993 (EPA 1993).

H_2S was added to the Emergency Planning and Community Right-to-Know Act list of toxic chemicals in 1993. In 1994, the EPA issued an administrative stay of reporting requirements for H_2S while further analysis was conducted. The administrative stay was lifted, and Toxic Release Inventory reporting due in July 2013 for calendar year 2012 emissions required reporting of H_2S.

Although there are no NAAQS for H_2S, a number of states, especially those with significant oil and gas production, have set standards at the state level. Table 62 summarizes these standards for states under the BLM NMSO area of operation.

Table 62. State Ambient Air Quality Standards for H_2S

State	Standard	Averaging time	Remarks
Kansas	None	N/A	N/A
Oklahoma	200 ppb (0.2 ppm)	24-hour	N/A
New Mexico	0.010 ppm (10 ppb)	1-hour*	Statewide except in the Pecos-Permian Basin Intrastate Air Quality Control Region‡
	0.100 ppm (100 ppb)	0.5-hour†	Pecos-Permian Basin Intrastate Air Quality Control Region
	0.030 ppm (30 ppb)	0.5-hour	Within municipal boundaries and within 5 miles of municipalities with a population greater than 20,000 in the Pecos-Permian Basin Air Quality Control Region
Texas	0.08 ppm (80 ppb)	0.5-hour	If downwind concentration affects a property used for residential business or commercial purposes
	0.12 ppm (120 ppb)	0.5-hour	If downwind concentration affects only property not normally occupied by people

Source: Skrtic (2006)

Note: N/A = not applicable

* The Pecos-Permian Basin Intrastate Air Quality Control Region is composed of Quay, Curry, De Baca, Roosevelt, Chaves, Lea, and Eddy Counties in New Mexico.

† Not to be exceeded more than once per year.

‡ Pecos-Permian Basin intrastate air quality control region has a 0.5-hour standard of 0.10 ppm.

The NMED has no routine monitors for H_2S. However, a one-time study in 2002 sheds some light on the levels that can be expected near oil and gas facilities (Skrtic 2006). These readings are averaged over 3-minute periods and are not comparable with the standard, which has longer averaging periods. The New Mexico data indicate that ambient concentrations of H_2S at the sampling locations, which included both oil and gas facilities and sites without oil and gas facilities, are at least an order of magnitude greater than 0.11 to 0.33 ppb, which are the ambient levels of H_2S that can be expected in urban areas. The ambient levels recorded at the two sites without expected sources of H_2S—Indian Basin Hilltop, no facility, and Carlsbad City Limits, Tracy-A—both averaged 7 ppb, indicating that H_2S

concentrations in this part of New Mexico are higher than normal urban background levels (Skrtic 2006) (Table 63).

H_2S levels measured at flaring, tank storage, and well drilling sites, averaging from approximately 100 to 200 ppb, are significantly elevated compared with usual background H_2S concentrations in this area of New Mexico (Skrtic 2006). Although these concentrations generally produce a nuisance due to odors that may translate into headaches, nausea, and sleep disturbances if exposure is constant, one study found central nervous system, respiratory system, and ear, nose, and throat symptoms were associated with annual average H_2S levels ranging from 7 to 27 ppb (Skrtic 2006). Overall, the data show that concentrations of H_2S vary widely, even at similar facilities; at one compressor/dehydrator, the average concentration over the course of monitoring was 4 ppb, whereas at another, the average was 1,372 ppb. The data further demonstrate that H_2S is present, often at elevated levels, at oil and gas facilities (Skrtic 2006).

Table 63. Summary of Monitoring Data from New Mexico Study

Facility Type	H_2S Concentration Measured at Monitoring Site (ppb)	
	Range	Average
Indian Basin hilltop, no facility	5–8	7
Indian Basin compressor station	3–9	6
Indian Basin active well drilling site	7–190	114
Indian Basin flaring, production, and tank storage site	4–1,200	203
Marathon Indian Basin refining and tank storage site	2–370	16
Carlsbad city limits, near 8 to 10 wells and tank storage sites	5–7	6
Carlsbad city limits, Tracy-A	5–8	7
Compressor station, dehydrators – Location A	4–5	4
Compressor station, dehydrators – Location B	2–15,000	1,372
Huber flare/dehydrating facility	4–12	77
Snyder oil well field	2–5	4
Empire Abo gas processing plant	1–1,600	300
Navajo oil refinery	3–14	7–8

Source: Skrtic (2006)

In Oklahoma, routine monitoring downwind of two refineries in Tulsa showed H_2S levels that were within state standards but above normal background levels. The levels of H_2S in both neighborhoods, although not very high, are nevertheless above the EPA RfC of 1.4 ppb and are elevated well above normal background levels of 0.11 to 0.33 ppb. It is possible that continuous exposure to these levels poses health risks. Although the ODEQ is monitoring H_2S levels, there is no concurrent community health or exposure study investigating the health effects of chronic exposure to these levels of H_2S (Skrtic 2006). In Texas, which has 12 routine monitors, H_2S levels generally ranged from 0.1 to 5 ppb. One monitor at a compressor station, however, showed frequent levels exceeding the state standard of 0.8 ppm (Skrtic 2006). In December 2005, the last month for which the data have been validated by the TCEQ, 20% of the hourly readings exceeded the state standard of 0.8 ppm. Chronic exposure to such levels, generally considered a nuisance due to odor, has also been shown to adversely affect human health (Skrtic 2006).

6 AIR QUALITY MODELING

Traditional air quality modeling generally falls into three categories: 1) near-field dispersion modeling is applied to criteria pollutants, HAPs, and AQRVs, where a small to medium number of sources are involved to cover an area within 50 km of a proposed project; 2) far-field or transport modeling is used to provide regional assessments of cumulative and incremental impacts at distances greater than 50 km; and 3) photochemical modeling may be used for large-scale projects with a large number of sources or with complex issues including O_3 and secondary particulate impacts.

6.1 NEW MEXICO OZONE ATTAINMENT INITIATIVE PHOTOCHEMICAL MODELING STUDY

The State of New Mexico initiated the New Mexico Ozone Attainment Initiative (OAI) Photochemical Modeling Study (New Mexico OAI Study) in the spring of 2018 to address the high O_3 concentrations in the state, protect the O_3 attainment status of the state, and ensure health and welfare of the residents of the state for future generations (NMED 2021b). Based on the WRAP/WAQS Comprehensive Air Quality Model with extensions (CAMx) 2014 36/12-km modeling platform, a CAMx 2014 36/12/4-km O_3 modeling platform was developed with the 4-km domain focused on New Mexico and adjacent states. The New Mexico OAI Study also looked at 2028 future-year base case modeling and oil and gas control sources. The 2028 oil and gas control strategy reduced oil and gas NO_x emissions by approximately 21,000 tpy (or by 64% compared to the 2028 base case) and reduced oil and gas VOC emissions by approximately 53,000 tpy (or by 46% compared to the 2028 base case) (NMED 2021b). This study has been incorporated by reference.

6.1.1 2028 OZONE MODELING RESULTS

The 2028 base case and 2028 oil and gas control strategy modeling results followed EPA guidance, which recommended using a current year design value based on an average of three O_3 design values centered on the base modeling year (2014 in the New Mexico OAI Study). As a result, this part of the New Mexico OAI Study used a current year design value from 2012 through 2016.

To develop the 2028 O_3 future-year design values for the specific scenarios, the current year design value (2012–2016, average of three design values over 5 years) was scaled by relative response factors (RRFs), which are model-derived scaling factors. In the New Mexico OAI Study, the RRFs are the ratio of the 2028 future scenario (base case or oil and gas control strategy scenario) over the 2014v2 base case CAMx O_3 results (RRF = Σ Model2028 / Σ Model2014). This method allowed for the development of a projected 2028 O_3 future-year design value for the respective scenarios (base case or oil and gas control strategy). The current 2012 through 2016 O_3 design values for sites in the counties in the major oil and gas basins of New Mexico (Eddy, Lea, Rio Arriba, Sandoval, San Juan, McKinley, Chaves, and Roosevelt Counties) range from 61.0 to 71.0 ppb. The 2028 base case had future O_3 design value reductions ranging from 2.0 to 5.6 ppb in the oil and gas New Mexico counties, including reductions of 2.3 ppb at Carlsbad in Eddy County, 2.0 ppb at Hobbs in Lea County, 5.6 ppb at Bernalillo in Sandoval County, and 2.2 and 3.3 ppb at Bloomfield and Navajo Lake, respectively, in San Juan County. The 2028 base case future O_3 design values in the oil and gas New Mexico counties ranged from 58.4 to 66.7 ppb. The 2028 oil and gas control strategy saw future O_3 design value reductions ranging from 0.3 to 0.8 ppb, including reductions of 0.3 ppb at Carlsbad, 0.7 ppb at Hobbs, 1.5 and 0.8 ppb at Navajo Lake and Bloomfield, respectively, and 0.3 ppb at Bernalillo, compared to the 2028 base case. The 2028 projected oil and gas control strategy O_3 design values in the oil and gas New Mexico counties ranged from 58.1 to 66.4 ppb. Using this method and following EPA guidance, all 2028 projected O_3 future design values at monitoring sites in New Mexico were below the 2015 NAAQS for O_3 of 70 ppb using the 2012 through 2016 design value (NMED 2021b).

With the recent upward trend in O_3 values in southeastern New Mexico, the New Mexico OAI Study also looked at more recent design values (2015–2019 and 2017–2019). A similar method to that described above was used to determine the future 2015 through 2019 and 2017 through 2019 design values; however, it should be noted that because the New Mexico OAI Study used the CAMx 2014v2 base case results as the denominator in the RRF equation (RRF = Σ Model2028 / Σ Model2014) to develop 2028 O_3 future design value projections, any emission changes (increase or decreases) between 2014 and the end of the 2010 decade will not be accounted for (e.g., increases in oil and gas source emissions and decreases in mobile source emissions). This will result in uncertainties and will likely overstate the 2028 O_3 future design values in the Permian Basin emissions, as emissions from oil and gas sources were higher at the end of the 2010 decade than in 2014 (NMED 2021b).

The current 2015 through 2019 O_3 design values at the sites in the oil and gas New Mexico counties selected for this sensitivity test ranged from 62.0 to 79 ppb and included Carlsbad (79 ppb), Hobbs (71 ppb), Bernalillo (69 ppb), Bloomfield (69 ppb), and Navajo (70 ppb). The 2028 base case had future O_3 design value reductions ranging from 1.7 to 6.6 ppb, including reductions of 2.5 ppb at Carlsbad, 2.1 ppb at Hobbs, 2.3 ppb at Navajo Lake, 5.8 ppb at Bernalillo, and 3.4 ppb at Bloomfield. The 2028 projected base case O_3 design values at all sites in the oil and gas New Mexico counties selected for this sensitivity test ranged from 61.0 to 71.2 ppb. Note that the 2015 through 2019 future O_3 design value had one monitoring site (Carlsbad) that exceeded the 2015 NAAQS for O_3 at 71.2 ppb. The 2028 oil and gas control strategy had future O_3 design value reductions ranging from 0.0 to 1.5 ppb, including reductions of 0.3 ppb at Carlsbad, 0.7 ppb at Hobbs, 0.8 ppb at Coyote Ranger District, 0.3 ppb at Bernalillo, 0.8 ppb at Bloomfield, and 1.5 ppb at Navajo Lake, compared to the 2028 base case. The 2028 projected oil and gas control strategy O_3 design values at all New Mexico sites selected for this sensitivity test ranged from 60.5 to 70.9 ppb. Emission controls in the 2028 oil and gas control strategy were sufficient to reduce the 2028 future O_3 value at Carlsbad (70.9 ppb) to below the NAAQS for O_3 (NMED 2021b).

The current 2017 through 2019 O_3 design values at all sites in the oil and gas New Mexico counties selected for this sensitivity test ranged from 66.0 to 79.0 ppb and included Carlsbad (79.0 ppb), Hobbs (71.0 ppb), Coyote Ranger District (67.0 ppb), Bloomfield (68.0 ppb), Navajo Lake (69.0 ppb) and Bernalillo (68.0 ppb). The 2028 base case had future O_3 design value reductions ranging from 2.1 to 6.7 ppb, including reductions of 2.6 ppb at Carlsbad, 2.1 ppb at Hobbs, 2.3 ppb at Navajo Lake, 5.9 ppb at Bernalillo, 3.4 ppb at Bloomfield, and 3.4 ppb at Coyote Ranch District. The 2028 projected base case O_3 design values at all sites in the oil and gas New Mexico counties selected for this sensitivity test ranged from 61.9 to 76.4 ppb. Note that the 2017 through 2019 future O_3 design value had one monitoring site in the oil and gas New Mexico counties (Carlsbad, 76.4 ppb) and one other monitoring site in Doña Ana County (Desert View, 71.6 ppb) that exceeded the 2015 NAAQS for O_3. The 2028 oil and gas control strategy had future O_3 design value reductions ranging from 0.0 to 1.5 ppb, including reductions of 0.4 ppb at Carlsbad, 0.8 ppb at Hobbs, 1.5 ppb at Navajo Lake, 0.3 ppb at Bernalillo, 0.9 ppb at Bloomfield, and 0.8 ppb at Coyote Ranch District, compared to the 2028 base case. The 2028 projected oil and gas control strategy O_3 design values at all sites in the oil and gas New Mexico counties selected for this sensitivity test ranged from 61.4 to 76.0 ppb. The 2028 future design value at Carlsbad of 76.0 ppb (with the oil and gas control strategy) exceeds the 2008 and 2015 NAAQS for O_3. However, as mentioned above, the design of this sensitivity study will result in uncertainties and will likely overstate the 2028 O_3 future design values in the Permian Basin, as emissions from oil and gas sources were higher at the end of the 2010 decade than in 2014 (NMED 2021b). The final part of the New Mexico OAI Study investigated source apportionment and was conducted to determine the contributions of source sectors to 2028 future-year O_3 design values under the oil and gas control strategy scenario. One investigation involved international emissions. The speciated modeled attainment test (SMAT) O_3 projection tool was run without the contributions of international anthropogenic emissions for current 2012 through 2016, 2015 through 2019, and 2017 through 2019 design values. In New Mexico, international anthropogenic emissions contributed from 11 to 26 ppb to the projected 2028 future design values. The Bloomfield site, in the northern part of the state and in San Juan County, had reductions of 13.8 ppb, 14.5 ppb, and 14.6 ppb, respectively. Bloomfield, which had not produced a projected 2028 O_3 exceedance for either the 2008 or 2015 NAAQS for O_3 under the current 2017 through 2019 design value scenario (68 ppb), was below 50 ppb for a future design value under all three design value scenarios (2012–2016, 2015–2019, and 2017–2019). The Carlsbad site had reductions of 20.3 ppb, 21.7 ppb, and 23.2 ppb, respectively. Carlsbad, which had produced a projected 2028 exceedance for both the 2008 and 2015 NAAQS for O_3 under the current 2017 through 2019 design value scenario, was below 55 ppb for a future design value under all three design value scenarios (2012–2016, 2015–2019, and 2017–2019) (NMED 2021b).

6.2 CARMMS 2.0 NORTHERN NEW MEXICO MODELING STUDY

The CAMx photochemical grid model is used in the CARMMS 2.0 to assess the air quality and AQRV impacts associated with BLM-authorized mineral development on federal lands within the BLM Colorado and the BLM FFO planning areas. CARMMS 2.0 uses data from the modeling platform of WAQS from the Intermountain West Data Warehouse for the 2011 base year and 2025 future-year air quality modeling and has adopted a two-way nested 12/4-km horizontal resolution domain. Three 2025 future-year oil and gas levels were developed for a range of potential outcomes: a high-development scenario, a low-development scenario, and a medium-development scenario (which is a mitigated version of the high-development scenario where additional emission controls were applied). Additional information on CARMMS 2.0 methodology can be found in the CARMMS 2.0 *Air Impact Assessment for BLM Farmington Field Office Oil and Gas Development Report* (BLM and Ramboll 2018), incorporated by reference.
The estimated emissions, air quality, and AQRV impacts from oil and gas development from the Mancos Shale modeled in CARMMS 2.0 (BLM and Ramboll 2018) are used to estimate impacts from development by the BLM FFO in the Air Impact Assessment for *BLM Farmington Field Office Oil and Gas Development Report* (BLM and Ramboll 2018), incorporated by reference. In CARMMS 2.0, 74% of Mancos Shale gas well activity is assumed to occur in New Mexico, with the remaining Mancos Shale gas well activity occurring in Colorado. All Mancos Shale oil well activity is assumed to occur in New Mexico. Most Mancos Shale activity in New Mexico occurs in the BLM FFO; a small portion of the southeastern part of Mancos Shale activity is outside the BLM FFO (in the BLM RPFO). The Mancos Shale was treated as a separate source group in the CARMMS 2.0 modeling, and air quality and AQRV impacts from the Mancos Shale were separately quantified, enabling this analysis for the BLM FFO.

The updated RFD for oil and gas in the BLM FFO (Engler 2025) estimates that there could be an additional 1,000 (federal and non-federal) wells drilled within the BLM FFO by 2054, of which 680 would be federal (Engler 2025). In addition, the BLM RPFO RFD (2019 RFD) estimates that an additional 200 wells could be built within the analysis area by 2039, of which 129 would be federal (Crocker and Glover 2019). Combined, there would be an estimated 1,200 wells drilled within the New Mexico portion of the San Juan Basin by 2054, with an average of 55 wells per year (of which 37 would be federal) between 2025 and 2039, an average of 45 wells per year (of which 30 would be federal) between 2040 and 2044, and an average of 10 wells per year (of which eight would be federal) between

2045 and 2054. The RFD scenarios attempt to predict the development scenario without factoring in economics and demand; therefore, the predicted numbers may not represent actual development. In contrast, CARMMS 2.0 modeling estimates that between 2016 and 2025 there will be 2,756 new oil and gas wells for the high scenario and 1,378 new oil and gas wells for the low scenario in the Mancos Shale in New Mexico.

CARMMS 2.0 predicts that an additional 178 total wells under the low scenario and an additional 1,556 total wells under the high scenario would be developed by 2025 compared to those predicted by the RFDs. As a result, the low and high scenarios of CARMMS 2.0 well development estimates are conservatively high relative to those in the RFDs. Therefore, the low scenario can be used to represent a conservative estimate of federal and planning area-wide impacts through 2025.

The NAAQS for O_3 is defined as the 3-year average of the fourth-highest daily maximum 8-hour (DMAX8) O_3 concentration. Because CARMMS 2.0 only uses 1 year of meteorology (2011), the 2025 fourth-highest DMAX8 O_3 concentration was used as a pseudo-NAAQS comparison metric. For the 2011 base case, there were vast regions where the modeled fourth-highest DMAX8 O_3 level exceeded the NAAQS (all source groups). In the 2025 high-, low-, and medium-development scenarios, the amount of area showing O_3 exceedances decreased from the 2011 base case, with the 2025 O_3 levels being lower than the 2011 O_3 levels in almost all areas. The large contribution of natural emissions (natural wildfires) to the modeled fourth-highest DMAX8 O_3 concentrations was noted in the analysis. Maximum O_3 contributions to the 2025 fourth-highest DMAX8 O_3 from the BLM FFO were 1.7 ppb, 0.9 ppb, and 1.0 ppb for the 2025 high-, low-, and medium-development scenarios, respectively. Maximum contributions of the BLM FFO to the fourth-highest DMAX8 O_3 level above the current NAAQS for O_3 (71.0 ppb and higher) for the 2025 high-, low-, and medium-development scenarios were 2.01%, 0.84%, and 0.90%, respectively (BLM and Ramboll 2017).

There are two NAAQS for $PM_{2.5}$, one for a 24-hour averaging time that is expressed as a 3-year average of the 98th percentile value in a year with a threshold of 35 $\mu g/m^3$, and an annual average over 3 years with a threshold of 12 $\mu g/m^3$. With a complete year of modeling results, the 98th percentile corresponds to the eight highest daily $PM_{2.5}$ concentrations in a year. The modeling of the differences between the 2025 scenarios and the 2011 base case (all sources) showed decreases of $PM_{2.5}$ concentrations in most of the domain but also increases in a number of regions, including Denver, eastern Utah, and central and northwestern New Mexico. Maximum $PM_{2.5}$ contributions to the eight highest daily $PM_{2.5}$ concentrations were 0.8, 0.4, and 0.4 $\mu g/m^3$ in the 2025 high-, low-, and medium-development scenarios, respectively. Compared to 2011, 2025 annual $PM_{2.5}$ concentrations for all sources were lower in most of the domain but higher in a number of regions, including near Denver. Maximum contributions to the annual average $PM_{2.5}$ concentrations for the BLM FFO were 0.3, 0.1, and 0.1 $\mu g/m^3$ in the 2025 high-, low-, and medium-development scenarios, respectively. Maximum contributions to the second highest daily average PM_{10} for the BLM FFO were 2.7, 1.3, and 1.1 $\mu g/m^3$ in the 2025 high-, low-, and medium-development scenarios, respectively (BLM and Ramboll 2017).

The 1-hour NO_2 concentrations for the 2011 and 2025 emission scenarios (all sources) indicated increases at various regions throughout the domain, including large increases in New Mexico and northern and eastern Arizona. Maximum contributions to the 1-hour NO_2 concentrations for the BLM FFO were 5.8, 3.0, and 3.2 $\mu g/m^3$ in the 2025 high-, low-, and medium-development scenarios, respectively. Maximum contributions to the annual average NO_2 concentrations for the BLM FFO were 1.5, 0.8, and 0.9 $\mu g/m^3$ in the 2025 high-, low-, and medium-development scenarios, respectively (BLM and Ramboll 2017).

Contributions of the CAA Prevention of Significant Deterioration (PSD) pollutant concentrations across all PSD Class I and sensitive Class II areas due to emissions from the BLM FFO for each development scenario were also estimated. Contributions of BLM FFO emissions to PSD pollutant concentrations at Class I and sensitive Class II areas for the 2025 high-, low-, and medium-development scenarios can be found in the *Air Impact Assessment for BLM Farmington Field Office Oil and Gas Development Report* (BLM and Ramboll 2017) and have been incorporated by reference. All BLM FFO contributions were below the PSD Class I and sensitive Class II pollutant increments at the high-, low-, and medium-development scenarios.

In summary, the CARMMS 2.0 low-development scenario, which represents a conservative estimate of federal impacts through 2025, did not exceed the indicator thresholds for any of the NAAQS, the PSD Class I or Class II increment thresholds, the sulfur deposition threshold, the change in visibility threshold at any Class I area, or the thresholds for acid-neutralizing capacity at sensitive lakes. The low-development scenario exceeded the indicator threshold for change in visibility at one Class II area, the Aztec Ruins National Monument, and exceeded the nitrogen deposition threshold at Mesa Verde National Park, San Pedro Parks Wilderness, Weminuche Wilderness, Aztec Ruins National Monument, Chama River Canyon Wilderness, South San Juan Wilderness, and Cruces Basin Wilderness.
The CARMMS 2.0 high-development scenario did not exceed any of the PSD Class I or Class II increment thresholds, the change in visibility threshold at Class I areas, the sulfur deposition threshold, or the thresholds for acid-neutralizing capacity at sensitive lakes. It exceeded the NAAQS indicator thresholds for O_3, annual average $PM_{2.5}$, and annual average NO_2; the change in visibility threshold at one Class II area, Aztec Ruins National Monument; and the nitrogen deposition threshold at Bandelier Wilderness, Mesa Verde National Park, San Pedro Parks Wilderness, Weminuche Wilderness, Aztec Ruins National Monument, Chama River Canyon Wilderness, Cruces Basin Wilderness, Dome Wilderness, Monte Vista National Wildlife Refuge, South San Juan Wilderness, and Sandia Mountain Wilderness.

6.3 2032 BLM REGIONAL CRITERIA AIR POLLUTANT PHOTOCHEMICAL MODELING STUDY

The BLM developed a photochemical model using the CAMx photochemical modeling platform and 12-km grid spacing to assess the impacts of oil and gas development and coal production and other cumulative sources on air quality in the western United States (Utah, Colorado, New Mexico, Wyoming, Montana, North Dakota, and South Dakota). The modeling analysis evaluated air quality and AQRVs out to a future year of ca. 2032 using data from the WRAP/WAQS modeling platform, the EPA's 2016v2 emissions modeling platform (EPA 2022b), and the BLM oil and gas development projections to quantify and apportion federal and non-federal oil and gas emissions (Ramboll 2024). The photochemical modeling was conducted using a scenario that included coal, oil and gas development, and natural and other anthropogenic emissions, representative of the cumulative sources around the year 2032. Additional methodology can be found in the *BLM Western US Photochemical Air Quality Modeling for 2032* (Ramboll 2024), incorporated by reference. Future modeling will include counties in Texas, Oklahoma, and Kansas, but currently these are modeled on a case-by-case basis. Specific county data are not available; however, a general discussion of Texas and Kansas is included below as they are part of the extended modeled domain.

The modeled cumulative concentrations of O_3 ranged between 50 and 65 ppb in New Mexico, with the higher concentrations in the San Juan Basin and isolated regions on the western side of the state (Ramboll 2024). The modeled values did not lead to any O_3 NAAQS exceedances in the state, including for the Pecos District or Farmington area. Modeled Farmington area O_3 cumulative concentrations ranged from 55 to 65 ppb (highest value of 64.4 ppb), while the those of the Carlsbad area ranged from 50 to 60 ppb. The largest contributions to O_3 were due to the modeled boundary conditions, followed by other anthropogenic sources (i.e., those not including oil, gas, or coal source groups) and natural sources. Kansas modeled values did not lead to any O_3 NAAQS exceedances in the state. Modeled O_3 cumulative concentrations over Kansas ranged between 40 and 65 ppb, with the higher concentrations on the east side of the state and lower concentrations on the west side of the state. The model domain also included most of Texas (excluding the southern and eastern counties). O_3 cumulative concentrations over the modeled portion of Texas ranged between 45 and 80 ppb, with the higher concentrations in the southeastern, eastern, and mid-northern portions and along the western edge of the state; lower concentrations were generally in the western to central part of the state. Most of the modeled portion of Texas had concentrations that did not exceed 70 ppb, except for one location in northeast Texas (near Dallas). Oklahoma modeled values did not lead to any O_3 NAAQS exceedances in the state. Results show that the O_3 cumulative concentrations over Oklahoma ranged between 45 and 60 ppb, with the higher concentrations on the east side of the state and lower concentrations in the middle and western parts of the state.

The 1-hour NO_2 modeled cumulative concentrations showed the highest concentrations over the San Juan Basin (highest value of 60.0 ppb); the El Paso and Dallas, Texas, area; and the Permian Basin. The modeled values did not lead to any 1-hour NO_2 NAAQS exceedances in New Mexico, including for the Pecos District (values ranged from 0.50 to 50 ppb) or Farmington area (values ranged from 0.5 to 60 ppb). The largest contributions to 1-hour NO_2 were due to federal, non-federal, and Tribal oil and gas development. For Kansas, the 1-hour NO_2 modeled cumulative concentrations were highest over eastern and southern Kansas. Values ranged from less than 2 ppb to 30 ppb across Kansas, and the modeled values did not lead to any 1-hour NO_2 NAAQS exceedances in Kansas. For Texas, the 1-hour NO_2 modeled cumulative concentrations were highest over northeast, southeast, and west Texas, excluding the southern and eastern portions of Texas that were not included in the model. Values ranged from less than 2 ppb to 60 ppb across Texas, and the modeled values did not lead to any 1-hour NO_2 NAAQS exceedances in the modeled portion of Texas. For Oklahoma, the 1-hour NO_2 modeled cumulative concentrations were highest concentrations in central Oklahoma. Values ranged from 2 to 30 ppb across Oklahoma, and the modeled values did not lead to any 1-hour NO_2 NAAQS exceedances in Oklahoma.

The annual NO_2 modeled cumulative concentrations showed the highest concentrations over the San Juan Basin (highest value of 23.9 ppb); the Dallas, Texas, area; and the Permian Basin. The modeled values did not lead to any annual NO_2 NAAQS exceedances in New Mexico, including for the Pecos District (values ranged from 0.1 to 15 ppb) or Farmington area (values ranged from 0.1 to 24 ppb). The largest contributions to annual NO_2 were due to federal, non-federal, and Tribal oil and gas development. For Kansas, the annual NO_2 modeled cumulative concentrations were highest over eastern and southern Kansas. Values ranged from less than 2 ppb to 15 ppb across Kansas, and the modeled values did not lead to any annual NO_2 NAAQS exceedances in Kansas. For Texas, the annual NO_2 modeled cumulative concentrations were highest over west, northeast, and southeast Texas, excluding the southern and eastern portions of Texas that were not included in the model. Values ranged from less than 2 ppb to 23 ppb across Texas, and the modeled values did not lead to any annual NO_2 NAAQS exceedances in the modeled portion of Texas. For Oklahoma, the annual NO_2 modeled cumulative concentrations were highest over northeast and central Oklahoma. Values ranged from less than 2 ppb to 15 ppb across Oklahoma, and the modeled values did not lead to any annual NO_2 NAAQS exceedances in Oklahoma.

The 24-hour $PM_{2.5}$ modeling showed a gradient from northwest to southeast, with higher $PM_{2.5}$ concentrations on the southeast side of New Mexico. The largest 24-hour $PM_{2.5}$ concentration in the state was 47.2 $\mu g/m^3$ in Socorro County (primarily due to wildfires). As a result, the modeled values exceeded the 24-hour $PM_{2.5}$ NAAQS in Socorro County but nowhere else in New Mexico. The largest contributors to 24-hour $PM_{2.5}$ were wildfires and non-coal, oil, or gas anthropogenic sources. Annual $PM_{2.5}$ modeled values showed that cumulative concentrations over New Mexico led to an annual $PM_{2.5}$ NAAQS exceedance in the Albuquerque area based on the new $PM_{2.5}$ NAAQS standard of 9.0 μg/m^3, but nowhere else in New Mexico was the NAAQS exceeded. Cumulative annual $PM_{2.5}$ concentrations were highest near Albuquerque (9.2 μg/m^3) and were due to other anthropogenic sources (i.e., those not including oil, gas, or coal source groups) and generally less than 4 μg/m^3 within the rest of New Mexico. Farmington area annual $PM_{2.5}$ cumulative concentrations ranged from 0.7 to 6 μg/m^3, while those for the Carlsbad area ranged from 0.7 to 4 μg/m^3. The largest contributors to annual $PM_{2.5}$ were anthropogenic and wildfire sources. For Kansas, the 24-hour $PM_{2.5}$ modeling showed a gradient from west to east across the state, with higher $PM_{2.5}$ concentrations on the east side of Kansas. Values ranged from 4 μg/m^3 in western Kansas to 25 μg/m^3 in eastern Kansas. The modeled values did not lead to any $PM_{2.5}$ NAAQS exceedances in Kansas. Annual $PM_{2.5}$ modeled values showed that cumulative concentrations over Kansas led to an annual $PM_{2.5}$ NAAQS exceedance over the Kansas City area based on the new $PM_{2.5}$ NAAQS standard of 9.0 μg/m^3, but nowhere else in the state was the NAAQS exceeded. Cumulative annual $PM_{2.5}$ concentrations were highest on the east side of the state, with lower concentrations on the west side of Kansas. Values ranged from less than 2 μg/m^3 in the western part of Kansas to 10 μg/m^3 on the east side of the state. For Texas, the 24-hour $PM_{2.5}$ modeling showed a gradient from west to east across the state, with higher $PM_{2.5}$ concentrations on the east side of the modeled portion of Texas. Values ranged from 2 μg/m^3 in western Texas to 25 μg/m^3 in eastern Texas. The 24-hour $PM_{2.5}$ modeled values did not lead to any 24-hour $PM_{2.5}$ NAAQS exceedances in the modeled portion of Texas. Cumulative annual $PM_{2.5}$ concentrations were highest on the east side of Texas, with lower concentrations on the west side of the state. Values ranged from less than 2 μg/m^3 in the western part of Texas to 10 μg/m^3 on the east side of the state. Annual $PM_{2.5}$ modeled values did not lead to any NAAQS exceedances in the modeled portion of the state, except for potentially around the Houston area. For Oklahoma, the 24-hour $PM_{2.5}$ modeling showed a gradient from west to east across the state, with higher $PM_{2.5}$ concentrations on the east side of Oklahoma. Values ranged from 2 μg/m^3 in western Oklahoma to 80 μg/m^3 in eastern Oklahoma. The largest 24-hour $PM_{2.5}$ concentration in the state was around 80 μg/m^3 in Latimer, Haskell, and Le Flore Counties. As a result, the modeled values exceeded the 24-hour $PM_{2.5}$ NAAQS in Latimer, Haskell, and Le Flore Counties, Oklahoma, but nowhere else in Oklahoma was the NAAQS exceeded. Annual $PM_{2.5}$ modeled values showed cumulative concentrations over Oklahoma led to an annual $PM_{2.5}$ NAAQS exceedance over the Sequoyah County area based on the new $PM_{2.5}$ NAAQS standard of 9.0 μg/m^3 and potential exceedances in the Osage County and Tulsa County area, but nowhere else in the state was the NAAQS exceeded. Cumulative annual $PM_{2.5}$ concentrations were highest on the east side of the state, with lower concentrations on the west side of Oklahoma. Values ranged from less than 2 μg/m^3 in the western part of Oklahoma to 12 μg/m^3 on the north and east side of the state.

The 24-hour PM_{10} cumulative concentrations showed PM_{10} NAAQS exceedances in a few grid cells in southwestern New Mexico (primarily due to wildfires), but nowhere else in the state, including in the Pecos District, was the NAAQS exceeded. PM_{10} cumulative concentrations over most of New Mexico ranged between 2 and 30 μg/m^3, with smaller areas of concentrations between 30 and 150 μg/m^3. Farmington area 24-hour PM_{10} cumulative concentrations ranged from 2 to 30 μg/m^3, while those of the Carlsbad area ranged from 5 to 50 μg/m^3. The largest contributors to annual PM_{10} were wildfires and other anthropogenic sources (i.e., those not including oil, gas, or coal source groups). For Kansas, the 24-hour PM_{10} modeling showed a gradient from west to east across the state, with higher PM_{10} concentrations on the south and east side of Kansas. Values ranged from 20 μg/m^3 in western Kansas to 150 μg/m^3 in southern Kansas. The modeled values did not lead to any 24-hour PM_{10} NAAQS exceedances in Kansas. For Texas, the 24-hour PM_{10} modeling showed a gradient from west to east across the state, with higher PM_{10} concentrations on the east side of the modeled portion of Texas. Values range from 10 µg/m^3 in western Texas to 150 µg/m^3 in eastern Texas. The 24-hour $PM_{2.5}$ modeled values did not lead to any 24-hour PM_{10} NAAQS exceedances in the modeled portion of Texas. For Oklahoma, the 24-hour PM_{10} modeling showed a gradient from west to east across the state, with higher PM_{10} concentrations on the east side of Oklahoma. Values ranged from 10 µg/m3 in western Oklahoma to 200 µg/m3 in eastern Oklahoma, although most of eastern Oklahoma was below 200 µg/m^3. The modeled values showed that cumulative concentrations over Oklahoma led to a 24-hour PM_{10} exceedance over the Pittsburg County area, but nowhere else in the state was the NAAQS exceeded.

The 1-hour SO_2 modeled cumulative concentrations over New Mexico did not lead to any 1-hour SO_2 NAAQS exceedances. Most of the state had concentrations that did not exceed 10 ppb, except for a few southeastern counties (e.g., Eddy, Lea, and Roosevelt Counties) where concentrations ranged from 5 to 69 ppb. The Farmington area 1-hour SO_2 cumulative concentrations ranged from <0.1 to 5 ppb. The largest contributors to 1-hour SO_2 concentrations in New Mexico were oil and gas activities and wildfires. The 3-hour SO_2 modeled cumulative concentrations showed no exceedances of the 3-hour SO_2 NAAQS in the state of New Mexico. Farmington area 3-hour SO_2 cumulative concentrations ranged from <0.1 to 5 ppb, while those of the Carlsbad area ranged from <0.1 to 69 ppb. The largest contributors to the 3-hour SO_2 concentrations in New Mexico were oil and gas activities, other anthropogenic sources (i.e., those not including oil, gas, or coal source groups), and wildfires. For Kansas, the 1-hour SO_2 modeled cumulative concentrations did not lead to any 1-hour SO_2 NAAQS exceedances. Most of Kansas had concentrations that did not exceed 5 ppb. The 3-hour SO_2 modeled cumulative concentrations in Kansas showed no exceedances of the 3-hour SO_2 NAAQS. Most of Kansas had concentrations that did not exceed 10 ppb, except for one location in south-central Kansas. For Texas, the 1-hour SO_2 modeled cumulative concentrations over the modeled portion of the state did not lead to any 1-hour SO_2 NAAQS exceedances. All of the modeled portion of Texas had concentrations that did not exceed 20 ppb. The 3-hour SO_2 modeled cumulative concentrations in Texas showed no exceedances of the 3-hour SO_2 NAAQS. None of the modeled portion of Texas had concentrations that exceeded 20 ppb. For Oklahoma, the 1-hour SO_2 modeled cumulative concentrations did not lead to any 1-hour SO_2 NAAQS exceedances. All of Oklahoma had concentrations that did not exceed 20 ppb. The 3-hour SO_2 modeled cumulative concentrations in Oklahoma showed no exceedances of the 3-hour SO_2 NAAQS. No part of Oklahoma had concentrations that exceeded 20 ppb.

The 1-hour CO modeled cumulative concentrations over New Mexico did not lead to any 1-hour CO NAAQS exceedances. Most of the state had concentrations less than 5 ppm, although Socorro County had concentrations up to 10 ppm. Farmington area 1-hour CO cumulative concentrations ranged from 0.1 to 3 ppm, while those of the Carlsbad area ranged from 0.1 to 3 ppm. The 8-hour CO modeled cumulative concentrations over New Mexico did not lead to any 8-hour CO NAAQS exceedances. Most of the state had concentrations less than 5 ppm, although Socorro County had concentrations up to 6.9 ppm. Farmington area 8-hour CO cumulative concentrations ranged from 0.1 to 0.8 ppm, while those of the Carlsbad area ranged from 0.1 to 1.0 ppm. The higher 1-hour and 8-hour CO concentrations were in the same location as the PM_{10} peak, indicating that natural sources (likely fires) were responsible for the higher 1-hour and 8-hour CO concentrations in this area (Ramboll 2024). For Kansas, the 1-hour CO modeled cumulative concentrations did not lead to any 1-hour CO NAAQS exceedances. Most of Kansas had concentrations less than 5 ppm, although a couple of locations in southwestern and south-central Kansas had concentrations to up 10 ppm. The 8-hour CO modeled cumulative concentrations over Kansas led to an exceedance of the 8-hour CO NAAQS over southwestern Kansas, but nowhere else in the state was the NAAQS exceeded. Most of Kansas had concentrations less than 5 ppm, although southwestern Kansas had concentrations up to 20 ppm (Ramboll 2024). For Texas, the

1-hour CO modeled cumulative concentrations over the modeled portion of Texas did not lead to any 1-hour CO NAAQS exceedances. All modeled portions of the state had concentrations less than 5 ppm. The 8-hour CO modeled cumulative concentrations over the modeled portion of Texas did not lead to an exceedance of the 8-hour CO NAAQS and were less than 3 ppm (BLM and EMPSi 2023). For Oklahoma, the 1-hour CO modeled cumulative concentrations did not lead to any 1-hour CO NAAQS exceedances. Most of Oklahoma had concentrations less than 5 ppm, although a couple locations in western and central Oklahoma had concentrations to up 8 ppm. The 8-hour CO modeled cumulative concentrations over Oklahoma did not lead to an exceedance of the 8-hour CO NAAQS. Oklahoma had concentrations less than 3 ppm, although eastern Oklahoma had concentrations up to 5 ppm. Additional modeling results can be found in the *BLM Western US Photochemical Air Quality Modeling for 2032* (Ramboll 2024).

Cumulative annual nitrogen deposition over most of New Mexico varied between around 1 and 6 kilograms of nitrogen per hectare per year (kg N/ha-year) and showed a gradient from west to east. Nitrogen deposition in the west side of the state generally ranged from 1 to 4 kg N/ha-year (although higher deposition was present in a few grid cells in San Juan County), and the eastern part of New Mexico had nitrogen deposition generally between 2 and 6 kg N/ha-year. Nitrogen critical loads for the Class I areas in the New Mexico analysis area range from 3.0 to 7.54 kg N/ha. The cumulative average nitrogen deposition ranged from 1.2 kg N/ha-year at Petrified Forest National Park to 2.7 kg N/ha-year at Carlsbad Caverns National Park. None of the areas exceed the critical load thresholds for cumulative average nitrogen deposition. The largest contributors to the cumulative average nitrogen deposition were other anthropogenic sources (i.e., those not including oil, gas, or coal source groups), which ranged from 40% to 60% of the total, depending on the area of interest. The cumulative maximum nitrogen deposition values in all Class I areas of interest were below their critical loads for atmospheric nitrogen deposition, except for Carlsbad Caverns National Park. Cumulative annual sulfur deposition over most of New Mexico ranged between 0.1 and 2.0 kilograms of sulfur per hectare per year (kg S/ha-year), with higher concentrations between 1 and 4 kg S/ha-year (although a few grid cells had concentrations between 4 and 9 kg S/ha-year in Roosevelt, Eddy, and Lea Counties) in the southeastern part of the state. For total sulfur deposition, the 5 kg/ha-year threshold published by Fox et al. (1989) is used as critical load for each area of interest. The cumulative average sulfur deposition ranged from 0.1 kg S/ha-year at Petrified Forest National Park/Great Sand Dunes National Park to 1.8 kg S/ha-year at Carlsbad Caverns National Park. None of the areas exceeded the critical load thresholds for cumulative average and maximum sulfur deposition. The largest contributors to sulfur deposition in New Mexico were oil and gas non-federal and existing federal sources (Ramboll 2024).

Visibility impacts in New Mexico are discussed in Section 5.3.3 of the *BLM Western US Photochemical Air Quality Modeling for 2032* (Ramboll 2024). The cumulative visibility design values were calculated by Software for Model Attainment Test- Community Edition (SMAT-CE) and presented in Table 5.3-20 of the BLM Regional Criteria Air Pollutant Modeling Study. The future-year design values for both haze index (in deciviews [dv]) and the corresponding light extinction (in inverse megameters) are provided for both the 20% clearest days and most impaired days (MID). The area with the highest cumulative values in ca. 2032 for the MID was Salt Creek Wilderness. This was also the only area in this table that had visibility design values for the MID that were projected to be above (by 1.6 dv) the uniform rate of progress toward the 2064 visibility goals.

The contribution to the cumulative design value (as light extinction) for both the 20% best and MID, respectively, are presented in Table 5.3-21 and Table 5.3-22 of the BLM Regional Criteria Air Pollutant Modeling Study. During the MID, the contributions of natural sources were small, while wildfire contributions ranged between 1% and 9%. The maximum impacts were observed at Bandelier

Wilderness. The contributions from oil and gas sectors to visibility impacts were usually less than 4%, except for the existing federal oil and gas from the rest of New Mexico, which contributed up to 17% of the total light extinction at Carlsbad Caverns National Park. Among the coal source groups, coal electric generating units (EGUs) affected Class I areas the most, with contributions between 1% and 4%. Impacts from other anthropogenic sources (both inside and outside the state) had significant impacts between 13% and 44%. This is not unexpected given the large number of urban and industrial emissions typically associated with this group. The maximum impact from this sector occurred at Salt Creek Wilderness.

Table 64, Table 65, and Table 66 show ca. 2032 state total oil and gas activity estimates by mineral designation, ca. 2032 state total oil and gas activity estimates for federal existing and new activities, and ca. 2032 emission inventory estimates by state and mineral designation and by new and existing activity for federal emissions from the BLM Regional Criteria Air Pollutant Modeling Study (Ramboll 2024:Appendix A). Figures showing maps of county-level ca. 2032 oil and gas activity by well type and mineral designation for oil production, gas production, active well count, and spuds (drilled wells) in the seven Intermountain West states are also available in the BLM Regional Criteria Air Pollutant Modeling Study (Ramboll 2024:Appendix A).

Table 64. Modeled Federal Existing and New ca. 2032 Oil and Gas Activity by Mineral Ownership and State

State	Existing Wells	New Wells
Oil production (million barrels per year)		
Colorado	4	17
Montana	4	16
North Dakota	12	43
New Mexico	38	96
South Dakota	0	1
Utah	2	15
Wyoming	18	89
Gas production (billion cubic feet per year)		
Colorado	210	267
Montana	9	17
North Dakota	26	89
New Mexico	661	241
South Dakota	1	0
Utah	106	35
Wyoming	668	736
Well count (number of wells)		
Colorado	11,918	2,894
Montana	3,908	1,993
North Dakota	1,247	1,441

State	Existing Wells	New Wells
New Mexico	33,663	13,019
South Dakota	110	30
Utah	8,757	2,784
Wyoming	28,729	9,047
Spud count (number of spuds)		
Colorado	-	223
Montana	-	153
North Dakota	-	150
New Mexico	-	1,001
South Dakota	-	2
Utah	-	214
Wyoming	-	627

Source: Appendix A in Ramboll (2024)

Table 65. Modeled ca. 2032 (new plus existing) Oil and Gas Emissions by State and Mineral Designation

State	Criteria Air Pollutant Emissions (short tons per year)					
	NO_x	VOC	CO	SO_2	$PM_{2.5}$	PM_{10}
Federal (excluding Tribal)						
Colorado	10,150	36,565	8,456	199	246	250
Montana	3,592	15,952	4,688	269	87	87
North Dakota	13,580	34,843	15,398	10,129	1,435	1,586
New Mexico	52,216	94,069	119,401	19,118	2,353	2,380
South Dakota	282	1,273	204	7	21	21
Utah	10,113	117,584	9,540	288	489	489
Wyoming	27,956	148,617	14,149	4,598	1,139	1,139
Tribal						
Colorado	8,339	1,035	6,863	15	82	87
Montana	639	2,343	836	23	12	12
North Dakota	8,177	38,035	12,793	3,217	258	278
New Mexico	5,528	13,646	16,972	44	279	285
South Dakota	23	1	8	0	2	2
Utah	5,449	26,535	5,670	185	267	267
Wyoming	269	1,370	254	464	12	12

State	Criteria Air Pollutant Emissions (short tons per year)					
	NO_x	VOC	CO	SO_2	$PM_{2.5}$	PM_{10}
Non-federal						
Colorado	28,363	68,325	28,615	290	835	863
Montana	5,250	25,733	6,708	418	100	100
North Dakota	85,737	412,034	136,940	31,448	2,232	2,383
New Mexico	33,790	46,998	50,228	18,898	1,201	1,214
South Dakota	390	1,792	269	10	53	53
Utah	3,763	30,953	3,651	156	189	189
Wyoming	8,870	46,817	4,730	1,419	408	408
Totals						
Colorado	46,851	105,925	43,934	504	1,164	1,200
Montana	9,482	44,027	12,232	711	199	199
North Dakota	107,494	484,912	165,131	44,794	3,925	4,247
New Mexico	91,533	154,713	186,601	38,059	3,833	3,880
South Dakota	695	3,066	482	18	77	77
Utah	19,325	175,071	18,861	629	944	944
Wyoming	37,096	196,804	19,133	6,481	1,559	1,559

Source: Appendix A in Ramboll (2024)

Table 66. Modeled ca. 2032 "New" Oil and Gas Emissions: Federal (excluding Tribal), Tribal, and Combined

State	Criteria Air Pollutant Emissions (short tons per year)					
	NOx	VOC	CO	SO_2	$PM_{2.5}$	PM_{10}
Federal (excluding Tribal)						
Colorado	4,734	25,215	3,701	103	150	152
Montana	2,328	8,055	3,071	160	55	55
North Dakota	8,705	24,805	11,250	6,447	912	1,008
New Mexico	13,922	35,214	26,608	4,028	492	499
South Dakota	169	491	84	4	13	13
Utah	2,420	71,667	1,995	28	121	121
Wyoming	19,331	118,696	7,417	3,208	584	584
Tribal						
Colorado	1,865	292	1,509	4	22	23
Montana	208	765	329	11	5	5

State	Criteria Air Pollutant Emissions (short tons per year)					
	NOx	VOC	CO	SO_2	$PM_{2.5}$	PM_{10}
North Dakota	5,260	27,248	9,813	2,036	161	173
New Mexico	2,305	6,975	5,477	20	78	80
South Dakota	14	0	5	0	1	1
Utah	1,904	15,803	1,925	34	90	90
Wyoming	149	421	139	288	7	7
Non-federal						
Colorado	28,363	68,325	28,615	290	835	863
Montana	5,250	25,733	6,708	418	100	100
North Dakota	85,737	412,034	136,940	31,448	2,232	2,383
New Mexico	33,790	46,998	50,228	18,898	1,201	1,214
South Dakota	390	1,792	269	10	53	53
Utah	3,763	30,953	3,651	156	189	189
Wyoming	8,870	46,817	4,730	1,419	408	408
Combined federal (including Tribal)						
Colorado	6,598	25,508	5,210	108	172	175
Montana	2,536	8,819	3,400	172	60	60
North Dakota	13,965	52,053	21,063	8,483	1,073	1,181
New Mexico	16,227	42,190	32,084	4,048	569	579
South Dakota	183	491	90	4	15	15
Utah	4,324	87,470	3,920	62	212	212
Wyoming	19,480	119,117	7,557	3,496	591	591

Source: Appendix A in Ramboll (2024)

6.4 BLM CARLSBAD FIELD OFFICE PHOTOCHEMICAL AIR QUALITY MODELING

The BLM CFO air modeling study was based on projected oil and gas development potential presented in the most recent RFD scenario prepared for the BLM CFO (Engler 2023) and three other scenarios that provide a range of development potential across the BLM CFO planning area over a 20-year time horizon (2023 to 2043) from federal and non-federal sources. Engler (2023) presents a base RFD scenario, a low RFD scenario, and a high RFD scenario. A fourth scenario, which estimated a higher level of oil and gas development than Engler’s high RFD scenario, was also developed as part of the study (Ramboll 2025b). The spud count and oil and gas production projections by scenario are summarized in Section 2.3.5 of the BLM CFO Air Resources Technical Support Document (ARTSD) (Ramboll and EMPS 2025).

A Permian Basin-wide 2032 future-year oil and gas emissions inventory, including nonpoint and point sources, was developed for Permian Basin counties in New Mexico and Texas. The ca. 2032 BLM CFO emissions inventories for criteria air pollutants, VOCs, and HAPs were then developed for each of the four scenarios. The emission inventories included emissions controls for all on-the-books regulatory programs, including those required under the 2022 Oil and Natural Gas Regulation for Ozone Precursors final rule. See N.M.A.C. 20.2.50. The BLM CFO ARTSD summarizes the ca. 2032 Permian Basin-wide emissions inventory and the emissions inventories for criteria air pollutants, VOCs, and HAPs for each of the four scenarios (Ramboll and EMPS 2025:Tables 2-11 through 2-16).

Photochemical modeling was then conducted for each scenario using a regional photochemical grid model to estimate potential ca. 2032 future impacts on air quality and AQRVs within the planning area and nearby Class I areas of interest. The photochemical modeling included oil and gas development, natural sources, and other anthropogenic emissions representative of the cumulative (all) sources for year 2032. The modeling domain encompassed the BLM CFO and the rest of southeastern New Mexico, most of the Permian Basin, and the cities of El Paso, Texas, and Ciudad Juarez, Mexico. This allowed the BLM to assess the air quality and AQRV impacts from all sources in the region and to understand the contributions of pollutant concentrations from a variety of source categories. These source categories included existing federal oil and gas development in the BLM CFO, new federal oil and gas development in the BLM CFO, non-federal oil and gas development in the BLM CFO, oil and gas development in the Texas portion of the Permian Basin, other anthropogenic sources in the BLM CFO, anthropogenic sources and fires originating in Mexico, anthropogenic sources in the remainder of the modeling domain, natural emissions (except lightning NO_X), wildfires, and lightning NO_X.

The full modeling results are detailed in Chapter 5 of the BLM CFO Photochemical Air Quality Modeling Study (Ramboll 2025b). A summary of the results from new federal and cumulative (all) sources are provided in Chapter 2 of the BLM CFO ARTSD (Ramboll and EMPS 2025). As shown in those sections, the 2032 modeling study projected that criteria air pollutant concentrations would be below the current NAAQS and NMAAQS in the BLM CFO and at the Class I areas of interest for all criteria pollutants except 1-hour SO_2 under all four scenarios. The SO_2 concentrations were modeled to substantially exceed the 1-hour SO_2 NAAQS in the BLM CFO planning area but not in the Class I areas of interest. The high 1-hour SO_2 concentrations were due to SO_2 emissions from gas processing plants in the BLM CFO as listed in the EPA 2032 modeling platform (Ramboll and EMPS 2025).

Modeled nitrogen and sulfur deposition values were below critical loads at all Class I areas of interest under all four scenarios. New federal oil and gas was modeled to contribute up to 4% of the total light extinction at modeled Class I areas of interest except for Salt Creek Wilderness, where new federal oil and gas contributed up to 10% of total light extinction under the highest scenario (Scenario 4). These values were similar across scenarios. The impact of O_3 exposure on trees, plants, and ecosystems often is assessed using a seasonal index known as a W126 index. The modeled W126 values from cumulative (all) sources exceeded the threshold of 6 ppm-hours specified by the National Park Service for ponderosa pine (second harvest) in Guadalupe Mountains National Park; it did not exceed the threshold of 9.6 ppm-hours for ponderosa pine (first harvest). The maximum new federal oil and gas development contribution was 0.46 ppm-hours at Guadalupe Mountains National Park under the base RFD scenario and 0.61 ppm-hours under the highest scenario (Scenario 4). The boundary conditions outside the modeling domain were the largest contributor to the W126 index (Ramboll and EMPS 2025).

Cumulative HAPs modeling and a discussion of potential downstream health effects from the combustion of oil and gas produced from the BLM CFO's federal mineral estate were also prepared (Ramboll and EMPS 2025:Chapters 3 and 4). As shown in those sections, the non-cancer and cancer risk under all four scenarios was found to be below the contextual risk defined by EPA as 1 in 1 million and 100 in 1 million, respectively. Furthermore, GHG emissions from the development, transport, and downstream combustion of oil and gas produced in the planning area were estimated for the four scenarios based on projected annual oil and gas activity from 2023 to 2043 (Ramboll and EMPS 2025:Chapter 5).

6.5 FOUR CORNERS AIR QUALITY TASK FORCE

In 2002, the NMED and local governments convened to sign an Early Action Compact for O_3 under an EPA program that required commitment for state and local action to resolve O_3 issues prior to a nonattainment designation. In 2005, the States of Colorado and New Mexico convened a group of stakeholders, then known as the Four Corners Air Quality Task Force (FCAQTF), to address air quality issues in the Four Corners region in light of continued energy development and growth in the region and consider options for mitigating air pollution. A report detailing a wide range of mitigation options was published in November 2007 (FCAQTF 2007).

In 2008, its task complete, the group became known as the Four Corners Air Quality Group (FCAQG) and continued as a forum for discussion of existing air quality issues and potential solutions. The FCAQG is currently composed of more than 100 members and 150 interested parties representing a wide range of perspectives on air quality in the Four Corners region. Members include private citizens; public interest groups; universities; industry; state, Tribal, and local governments; and federal agencies. The BLM has been an active participant from the beginning and maintains a representative on the steering committee. The most recent FCAQG meeting was in person and virtually on November 7 and 8, 2023, in Durango, Colorado. For more information visit the FCAQG at the NMED website at https://www.env.nm.gov/air-quality/four-corners-air-quality-group/.

6.6 AIR QUALITY MODELING FOR TEXAS

Numerous reports on air quality modeling projects done by and for the TCEQ, including modeling done for the several Texas county nonattainment areas, can be accessed on the Air Division website (TCEQ 2024a). The TCEQ has convened advisory groups in southeast Texas and Dallas-Fort Worth to assist the agency in addressing photochemical modeling issues.

7 OIL AND GAS SINGLE-WELL EMISSIONS

The per-well emissions factors (GHGs and non-GHGs) are estimated by phase (well development and production operations) on an annual basis. An emissions factor is a value that relates the quantity of a pollutant released into the atmosphere with an activity that generates the pollutant. They are typically expressed in units of weight or mass (e.g. pounds, kg, tons) per activity (e.g. duration of equipment operation, construction of an oil or gas well). Emissions factors are the basis for developing emissions inventories that are used for air quality management decisions. The BLM uses emissions inventories to evaluate the change to county-level emissions, compare NEPA alternatives, and provide input to air quality models if modeling is warranted. Emissions factors may change over time due to new emissions regulations, development of control technologies, or data and information improvements for emissions.

Air pollutant emissions from oil and gas activities occur during construction and operations of a well. Construction-related emissions occur from the use of heavy machinery during pad construction, drilling, testing and completion, venting and flaring, interim reclamation, and vehicles. Construction emissions are typically a one-time occurrence. Operations-related emissions occur from well workovers, pump engines, heaters, tanks, truck loading, fugitive leaks, pneumatics, dehydrators, compressor engines, reclamation, and vehicle traffic. Emissions from operational activities occur throughout the life of a well.

Several factors may influence actual emissions including location, geological formation, well depth, equipment used, supporting infrastructure, and other factors.

7.1 FIELD OFFICE

7.1.1 FARMINGTON FIELD OFFICE

The updated RFD for the BLM FFO predicts fewer wells drilled and lower production values compared to the previous RFD. Based on this, no additional modeling was completed, and the existing modeling is considered conservative because the previous RFD was used in the 2032 BLM Western Regional Modeling.

The BLM FFO emissions estimates were developed from the BLM Single Oil and Gas Well Emission Inventory Tool. The BLM Single Oil and Gas Well Emission Inventory Tool uses the EPA Compilation of Air Pollutant Emissions Factors (AP-42), EPA Motor Vehicle Emission Simulator (MOVES), EPA Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling – Compression-Ignition, and other sources. The tool has also been modified to account for San Juan Basin gas profiles, typical project details, and recent EMNRD and NMED rules and regulations (Waste Prevention Rule [43 C.F.R §§ 3160 and 3170] and Ozone Precursor Rule [N.M.A.C. 20.2.50]). Production data from the Standard & Poor's Global database (commercial source), including an estimate of the total potential mineral yield, or EUR, and the associated decline rates were included in the BLM Single Oil and Gas Well Emission Inventory Tool. Single-well estimates and associated production data were based on horizontal drilling (Max Emissions from Oil and Gas Scenarios–Single Well Emissions in the San Juan Basin). The horizontal oil emissions were based on the deep oil with high gas scenario. The horizontally drilled single-well emissions could be used in cases when well types are unknown, such as during leasing, providing a conversative estimate for vertically drilled wells. This information provides an estimate of emissions based on typical development occurring in New Mexico, but actual emissions from the development of any given well may differ. Table 67 summarizes horizontally drilled single-well emissions for the BLM FFO and BLM RPFO. The BLM FFO and BLM RPFO calculate project-specific emissions on a project-specific basis. A weighted average single-well emissions estimate based on project-specific data is currently being developed to be used for future lease sales.

Table 67. BLM FFO and BLM RPFO Horizontal Single-Well Emissions

Well Type	Total Emissions (tons per year)						
	CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOCs	HAPs
Single-well construction/ development phase	3.69	14.50	9.45	1.48	0.0008	1.07	0.02
Single-well operation phase	5.75	2.54	4.35	0.56	0.0013	12.19	0.49
Single-well total	**9.44**	**17.04**	**13.80**	**2.04**	**0.0021**	**13.26**	**0.51**

Source: BLM Single Oil and Gas Well Emission Inventory Tool.

Note: Max Emissions from Oil and Gas Scenarios - Single Well Emissions in the San Juan Basin

7.1.2 PECOS DISTRICT OFFICE

The RFD scenario for oil and gas in the BLM CFO (Engler 2023) projects that, on average, 980 oil and gas wells would be completed within the BLM CFO planning area each year over the 20-year scenario (2023–

2043), for approximately 19,600 new wells (federal and non-federal), most of which are expected to be horizontally drilled. Of this, at least 12,500 wells in the BLM CFO planning area alone would be federal (Engler 2023). BLM CFO well spud projections by year vary from 1,208 new federal and non-federal well spuds (770 federal) in 2023 to 769 new federal and non-federal well spuds (490 federal) in 2043. The BLM CFO planning area encompasses Lea and Eddy Counties and portions of Chaves County. The BLM CFO RFD does not account for future well development in the BLM Roswell Field Office (RFO) portion of the BLM PDO planning area (which encompasses portions of Chaves and Roosevelt Counties); therefore, well projections for the BLM RFO planning area were extracted from the BLM PDO RFD (Engler et al. 2012; Engler and Cather 2014). The BLM PDO RFD projects that 800 oil and gas wells would be completed within the BLM PDO each year for the 20-year scenario (2015–2035), for a total of approximately 16,000 new wells (federal and non-federal), most of which are expected to be horizontally drilled. Based on the review of cumulative production volumes through 2010 (see Summary Table 1 [page 49] in Engler et al. [2012]), most of the production has occurred in Eddy and Lea Counties, and development in Chaves and Roosevelt Counties represents approximately 4% of the cumulative production volumes for the BLM PDO planning area. Assuming that this proportion of development in Chaves and Roosevelt Counties relative to the larger BLM PDO planning area remains relatively stable in the future, the number of projected wells from the BLM PDO RFD that are likely to occur within Chaves and Roosevelt Counties would be approximately 640. When combined, the total number of projected wells for the BLM PDO planning area is 20,240 (including 19,600 wells in the BLM CFO and 640 wells in the BLM RFO). BLM PDO RFD projections over a 20-year period show well development with an average of 1,012 wells per year (of which at least 625 would be federal).

The BLM PDO emissions estimates were developed from the BLM Single Oil and Gas Well Emission Inventory Tool. The BLM Single Oil and Gas Well Emission Inventory Tool uses the EPA AP-42, EPA MOVES, EPA Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling – Compression-Ignition, and other sources. The tool has also been modified to account for Permian Basin gas profiles, typical project details, and recent EMNRD and NMED rules and regulations (Waste Prevention Rule and Ozone Precursor Rule). Production data from the Standard & Poor's Global database (commercial source), including an estimate of the total potential mineral yield, or EUR, and the associated decline rates were included in the BLM Single Oil and Gas Well Emission Inventory Tool. Single-well estimates and associated production data were based on horizontal drilling. The horizontally drilled single-well emissions could be used in cases when well types are unknown, such as during leasing, providing a conversative estimate for vertically drilled wells. This information provides an estimate of emissions based on typical development occurring in New Mexico, but actual emissions from the development of any given well may differ. Table 68 summarizes horizontally drilled single-well emissions for the BLM PDO based on updated, project-averaged travel distances and paved verses unpaved measurements.

Table 68. BLM PDO Horizontally Drilled Single-Well Emissions

Phase	Total Emissions (tons per year)						
	CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOCs	HAPs
Single-well construction/ development phase	3.16	13.21	2.73	0.75	1.11E-02	0.69	0.02
Single-well operation phase	1.21	0.97	1.40	0.51	4.50E-03	10.53	0.93
Single-well total	4.37	14.18	4.13	1.26	1.56E-02	11.21	**0.95**

Source: BLM Single Oil and Gas Well Emission Inventory Tool

7.1.3 OKLAHOMA FIELD OFFICE

Table 69 presents the current single-well emissions estimates for the BLM Oklahoma Field Office (OFO) from the *Reasonably Foreseeable Development Scenario – Kansas, Oklahoma, and Texas* (BLM 2016) and *Oklahoma, Kansas and Texas BLM Record of Decision and Approved Resource Management Plan* (BLM 2020).

Table 69. BLM OFO Single-Well Emissions

Factor Type	Total Emissions (tons per year)						
	CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOCs*	HAPs
Single-well oil emission factors†	2.06	4.53	0.58	0.27	0.12	4.46	0.31
Single-well gas emission factors†	1.87	5.53	0.67	0.33	0.11	0.77	0.06

Source: BLM (2016, 2020).

* VOC emissions at the operational phase represent uncontrolled emissions and estimate potential emissions representing the contribution for "one oil well" from the emissions at storage tanks, gathering facilities, etc. However, federally enforceable regulations, such as NSPS Subparts OOOO and OOOOa, require emission reduction of VOCs from well completions following hydraulic fracturing or refracturing and storage tanks with emissions greater than 6 tpy after federally enforceable controls. Therefore, actual emissions from the one-well scenario are likely to be lower than represented.

† The representative well used to calculate emissions is a horizontal oil well. Emissions for vertical wells were not used from this analysis due to current predominance in horizontal technological drilling methods and because presenting horizontal oil wells emissions estimates represents a more conservative summary of emissions compared with emissions from a vertical well, with the exception of SO_2, which could be four to five times greater in a vertical well scenario. However, SO_2 emissions are still estimated to be within the same magnitude and less than 1 tpy of SO_2 emissions per well. Estimated emissions from a typical horizontal gas well are higher for the criteria pollutants PM_{10}, $PM_{2.5}$, and NO_x. However, estimated emissions from horizontal oil wells are higher for CO, VOC, and HAP emissions. Because the overall magnitude of emissions from oil wells is estimated to be higher than gas wells in terms of total criteria pollutant emissions, an oil well is evaluated for the purpose of this analysis.

7.1.4 ADDITIONAL INFORMATION REGARDING SINGLE-WELL EMISSION FACTORS

The single-well emissions in this document can be used to estimate emissions for all project types. Over time, calculators may be developed, or single-well emissions may be modified to capture new or more regionally specific oil and gas development parameters (through ongoing modeling efforts associated with Resource Management Plan revisions), or new project-specific calculators may emerge (such as those related to oil and gas leasing, e.g., the lease sale emissions tool). As new or more refined tools become available, they may be used to make emissions projections as warranted.

7.2 WELL COUNTS

The number of active wells can vary greatly from year to year; in addition, counts are not static or logarithmic by nature. Well count data can be obtained from many sources, such as state oil and gas commission databases, university and research databases, and proprietary databases, as well as public federal databases. The sources reporting well counts may also differ in reporting methods. Reporting of well counts may include various types of wells such as active, new, temporarily abandoned, and inactive (shut in or temporarily abandoned). For the purposes of this report, the BLM uses the Petroleum Recovery Research Center, Automated Fluid Minerals Support System (AFMSS) and state oil and gas well count reporting. Table 70 show the active wells within each field office (NMOCD 2025).

Table 70. Active Wells

Field Office	Total (federal and non-federal)	Federal
BLM PDO	48,868	28,383
BLM FFO	21,843	15,624
BLM RFO	2,729	1,325
BLM CFO	45,957	27,058

Source: NMOCD (2025).

To facilitate quantification, most project-level analyses tend to assume that all wells would be developed concurrently and in the same year, though it is possible that future potential development would not occur in this manner. Table 71 provides past well spud data (BLM 2024e). The BLM chose to report well spud data instead of completion data based on technical expertise of the petroleum engineers within the BLM.

Table 71. Past and Present Well Spud Data

	Number of BLM Well Spuds							
Region	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
BLM CFO	522	650	785	823	1,150	1,195	1,431	1,601
BLM RFO	3	9	6	1	3	7	13	10
BLM PDO*	525	659	791	824	1,153	1,202	1,444	1,611
BLM FFO – Federal	34	24	14	8	24	39	19	39
BLM FFO – Indian	33	19	19	3	25	32	16	23
BLM RPFO – Federal	0	0	0	0	1	1	0	0
BLM RPFO – Indian	0	0	0	0	0	1	0	1
BLM FFO and BLM RPFO†	67	43	33	11	50	73	35	63
Oklahoma	10	14	12	4	5	13	6	8
Texas	0	7	5	7	8	18	6	9
Kansas	0	0	0	1	0	0	0	0

Source: BLM (2024e)

* Total of BLM CFO and BLM RFO

† Total of BLM FFO and BLM RPFO

The EURs summarized in Table 72 are generated by performing decline curve analyses of existing production within each field district. To calculate the volumes of oil, natural gas, and water expected to be produced from future parcels, the projected number of wells are multiplied by the EURs of oil, natural gas, and produced water per well.

Table 72. EURs for New Mexico

Basin	Average Production Lifetime (years)	Well Type	Oil EUR (bbl)	Gas EUR (mcf)
San Juan Basin	30	Horizontal	592,354	1,777,000
		Vertical	10,044	406,555
	20	Horizontal	520,243	1,561,000
		Vertical	9,108	334,678
Permian Basin	30	Horizontal	359,533	1,190,311
		Vertical	51,404	197,934
	20	Horizontal	347,292	1,189,482
		Vertical	51,183	196,268

Note: bbl = barrels; mcf = thousand cubic feet. Data from the integrated air resource tool, using Standard & Poor's global data, except for San Juan Basin horizontal oil and gas EUR values which are taken from the Updated BLM FFO RFD (New Mexico Tech 2025).

Table 73. EURs for Oklahoma, Texas, and Kansas

State	Average Production Lifetime (years)	Well Type	Oil EUR (bbl)	Gas EUR (mcf)
Oklahoma	30	Horizontal	119,621	1,601,688
		Vertical	119,621	1,601,688
	20	Horizontal	114,942	1,596,018
		Vertical	114,942	1,596,018
Texas	30	Horizontal	325,305	1,834,632
		Vertical	325,305	1,834,632
	20	Horizontal	324,861	1,829,617
		Vertical	324,861	1,829,617

State	Average Production Lifetime (years)	Well Type	Oil EUR (bbl)	Gas EUR (mcf)
Kansas	30	Horizontal	42,707	376,752
		Vertical	42,707	376,752
	20	Horizontal	38,091	328,910
		Vertical	38,091	328,910

Note: bbl = barrels; mcf = thousand cubic feet. Data from the integrated air resource tool, using Standard & Poor's global data.

7.3 EMIT SOIL AND CLIMATE DATA

Table 74 shows the surface and climate data for various locations, for use in EMIT for cities across New Mexico, Oklahoma, Texas, and Kansas.

Table 74. EMIT Soil and Climate Data

Location (Station)	Soil Silt Content (%)	Soil Moisture Content (%)*	Average Temperature (degrees Fahrenheit)†	Days with Precipitation >0.01 inch†	Fastest wind gust (miles per hour)‡	Solar Radiation (kilowatt-hours/square meter/day)§
San Juan Basin (Farmington Regional Airport USW00023090)	8.5¶	7.9	53.2	60.3	60	6.5–7.4
Permian Basin (Carlsbad USC00291469)	10.0#	7.9	64.4	45.8	60	6.5–7.4
Taos (Northeast NM USC00298668)	8.5¶	7.9	48.5	61.0	60	6.0–7.4
Las Cruces (Southwest NM USC00298535)	8.5¶	7.9	63.2	47.1	60	>7.0
Albuquerque (Central NM USW00023050)	8.5¶	7.9	57.9	56.1	60	6.5–7.4
Socorro (Central NM USC00298387)	8.5¶	7.9	57.5	53.7	60	>6.5

Location (Station)	Soil Silt Content (%)	Soil Moisture Content (%)*	Average Temperature (degrees Fahrenheit)†	Days with Precipitation >0.01 inch†	Fastest wind gust (miles per hour)‡	Solar Radiation (kilowatt-hours/square meter/day)§
Roswell (Southeast NM USC00297605)	10.0#	7.9	59.4	42.9	60	7.0–7.4
Woods County, Oklahoma (North OK USC00340193)	8.5¶	7.9	58.6	65.4	60	5.5–6.4
Ellis County, Oklahoma (Northwest OK USC00340332)	8.5¶	7.9	56.7	63.4	60	6.0–6.4
McCurtain, Oklahoma (Southeast OK USC00340567)	8.5¶	7.9	59.5	101.9	60	4.5–5.4
Clark County, Kansas (South KS USC00140365)	8.5¶	7.9	56.9	64.1	60	5.5–6.4
Andrews County, Texas (East TX USC00410248)	8.5¶	7.9	64.9	38.9	60	7.0–7.4
Jim Wells County, Texas (South TX USW00012932)	8.5¶	7.9	72.8	81.4	60	5.0–5.4

Notes: The select area terrain and vegetation is sloped with small scrub (less than 10 feet tall). The percentage of paved primary and secondary road lengths is calculated per project.

* AP-42:Table 11.9-3

† Monthly Climate Normals 1991–2020: https://www.ncei.noaa.gov/access/us-climate-normals/#dataset=normals-monthly&timeframe=30&location=NM

‡ 60 miles per hour should be used unless better data are available.

§ https://wecanfigurethisout.org/ENERGY/Web_notes/Solar/Solar_Thermal_Heat_Storage_Files/Map%20of%20US%20Direct%20Normal%20Solar%20Irradiance%20-%202018%20-%20NREL.pdf

¶ AP-42:Table 13.2.2-1

Silt content from National Cooperative Soil Survey - Kermit Series; soil type in southern New Mexico and southwestern Texas

8 AIR QUALITY-RELATED VALUES

AQRVs are resources sensitive to air quality and can include a wide variety of atmospheric chemistry-related indicators. AQRVs include visibility and specific scenic, cultural, physical, biological, ecological, and recreational resources identified for a particular area. The NAAQS secondary standards are promulgated to ensure non-health related air quality impacts, such as AQRVs, are protected. The BLM can reasonably rely on compliance with the secondary NAAQS to prevent adverse impacts to these resources. Monitoring and modeling of AQRVs help to provide a level of protection to sensitive areas such as Class I parks and wilderness areas. Congress established certain national parks and wilderness areas as mandatory Class I areas where only a small amount of air quality degradation is allowed. Defined by the CAA, Class I areas include national parks greater than 6,000 acres, wilderness areas and national memorial parks greater than 5,000 acres, and international parks. These areas must have been in existence at the time the CAA was passed by Congress in August 1977.

The goal of Class I management is to protect natural conditions, rather than the conditions when first monitored. That is, if initial monitoring in a Class I area identifies human-caused changes, appropriate actions should be taken to remedy them to move toward a more natural condition. The goal of Class I management is to protect not only resources with immediate aesthetic appeal (i.e., sparkling clean streams) but also unseen ecological processes (such as natural biodiversity and gene pools) (U.S. Forest Service [USFS] et al. 2000). The FLAG issued a revised Phase 1 report in 2010 (USFS et al. 2010). This report was developed as a tool to provide consistent approaches to the analysis of the effects of air pollution on AQRVs. The FLAG report focuses on three areas of potential impact: visibility, aquatic and terrestrial effects of wet and dry pollutant deposition, and terrestrial effects of O_3. This report is structured to address these same three areas of potential impact. The requirement to assess impacts to AQRVs is established in the PSD rules. PSD is a permitting program for new and modified major sources of air pollution that are in attainment areas. The majority of facilities that the BLM analyzes are not a major source of emissions.

The BLM goals include managing jurisdictional field office activities and development to protect and improve air quality and, within the scope of the BLM authority, minimize emissions that cause or contribute to violations of air quality standards or that negatively impact AQRVs (e.g., acid deposition, visibility).

8.1 PREVENTION OF SIGNIFICANT DETERIORATION

Although the PSD rule is only applicable to major stationary sources of air pollution, a PSD increment analysis can provide a useful measure for estimating how a new source of pollution would likely impact regional air quality. A PSD increment is the additional amount of pollution allowed in an area while preventing air quality in the airshed from deteriorating to the level set by the NAAQS. The NAAQS is a maximum allowable concentration ceiling, whereas a PSD increment is the maximum allowable increase in concentration allowed to occur above a baseline concentration for a pollutant within the PSD area boundary. The baseline concentration for a pollutant is defined as the ambient concentration existing at the time that the first complete PSD permit application affecting the boundary is submitted. An analysis for PSD-applicable sources must be provided to the state agency with jurisdiction to ensure that new emissions, in conjunction with other applicable emissions increases and decreases within an area, will not cause or contribute to a violation of any applicable NAAQS or PSD increment. Significant deterioration occurs when the amount of new pollution exceeds the applicable PSD increment.
An official PSD increment analysis is the sole responsibility of the respective air district. Any subsequent

analysis performed for NEPA purposes will be used for informational purposes only. PSD increments for Class I and Class II areas are listed in Table 75.

Table 75. PSD Increments

Pollutant	Period	Maximum Allowable Increase ($\mu g/m^3$)	
		Class I	Class II
SO_2	3-hour	25	512
	24-hour	5	91
	Annual	2	20
NO_2	Annual	2.5	25
PM_{10}	24-hour	8	30
	Annual	4	17
$PM_{2.5}$	24-hour	2	9
	Annual	1	4

Source: 40 C.F.R. § 52 Subpart C, Chapter 1

8.2 VISIBILITY

Pollution in the atmosphere can impair scenic views by degrading the contrast, colors, and distance an observer is able to see. Visibility can be assessed in terms of the distance that a person can distinguish a large dark object on the horizon and is measured as the standard visual range in miles. Visibility is of greatest concern in Class I areas, which are afforded the highest level of air quality protection by the CAA. Average natural visual range conditions for Class I areas can be found in the FLAG report (USFS et al. 2010). Visibility impairment is a result of regional haze, which is caused by the accumulation of pollutants from multiple sources in a region. Emissions from industrial and natural sources may undergo chemical changes in the atmosphere to form particles of a size that scatter or absorb light and result in reductions in visibility.

The EPA and other agencies have been monitoring visibility in national parks and wilderness areas since 1988. In 1999, the EPA announced a major effort to improve air quality in national parks and wilderness areas. The Regional Haze Rule—see 40 C.F.R. § 51, Subpart P, Protection of Visibility—calls for state and federal agencies to work together to improve visibility in 156 national parks and wilderness areas.

The rule requires the states, in coordination with the EPA, National Park Service (NPS), U.S. Fish and Wildlife Service (USFWS), USFS, and other interested parties, to develop and implement air quality protection plans to reduce the pollution that causes visibility impairment. The first state plans for regional haze were due in December 2007. States, Tribes, and five multijurisdictional regional planning organizations worked together to develop the technical basis for these plans. Comprehensive periodic revisions to these initial plans were due July 31, 2021, again in 2028, and every 10 years thereafter (EPA 2025n). As of August 25, 2022, 15 states failed to submit 2021 regional haze plans to the EPA by both the first and second deadlines, July 31, 2021, and August 15, 2022. Therefore, New Mexico and 14 other states are included in the Findings of Failure to Submit (EPA 2023j). States implement the Regional Haze Program through SIPs in accordance with the Regional Haze Rule.

Texas proposed a 2021 regional haze SIP revision that is designed to address regional haze in Big Bend and Guadalupe Mountains National Parks in Texas and Class I areas outside Texas that may be affected by emissions from within the state. On June 30, 2021, the commission adopted the 2021 regional haze SIP revision (Project No. 2019-112-SIP-NR). The SIP revision demonstrates compliance with the regional haze requirements of Section 169A of the CAA and the Regional Haze Rule for the second planning period (TCEQ 2024b). On December 18, 2024, the commission approved adoption of the executive director's recommended 2025 Regional Haze Progress Report (Non-Rule Project No. 2024-007-OTH-NR) for the second planning period. This progress report contains the core federal Regional Haze Rule (40 C.F.R. § 51.308) requirements, including: the status of the state’s control strategies included in the 2021 Regional Haze SIP Revision for achieving reasonable progress goals; a summary of the emissions reductions; assessment of significant changes in human-made emissions; and a determination of the adequacy of the current implementation plan elements and strategies and a declaration to the EPA concerning whether a SIP revision is needed (TCEQ 2025).

As part of the process of developing the Oklahoma 2021 regional haze SIP, the ODEQ AQD identified 12 facilities in Oklahoma and 21 sources in neighboring states (including sources in Texas) that are reasonably anticipated to impact visibility conditions at the Wichita Mountains Wilderness Area and asked these states to consider the potential impact of the sources identified within their states for further analysis as part of the process for developing their 2021 regional haze SIP. The SIP was submitted to EPA Region 6 on August 9, 2022 (ODEQ AQD 2022).

In 1985, the EPA initiated a network of monitoring stations to measure impacts to visibility in Class I wilderness areas. These monitors are known as the IMPROVE monitors and exist in some but not all Class I wilderness areas. Table 76 shows the Class I areas in the BLM NMSO area of operations and whether they have an IMPROVE monitor and, if not, which monitor is considered representative for that area. There are no Class I areas in Kansas.

Table 76. Class I Areas and IMPROVE Monitors

State	Class I Area	Agency	IMPROVE
New Mexico	Bandelier	NPS	Yes
	Bosque del Apache	USFWS	Yes
	Carlsbad Caverns	NPS	Guadalupe Mountains
	Gila	USFS	Yes
	Pecos	USFS	Wheeler Peak
	Salt Creek	USFWS	Yes
	San Pedro Parks	USFS	Yes
	Wheeler Peak	USFS	Yes
	White Mountain	USFS	Yes
Texas	Big Bend	NPS	Yes
	Guadalupe Mountains	NPS	Yes
Colorado	Mesa Verde	NPS	Yes
	Weminuche	USFS	Yes

Visibility is monitored using methodologies established by the IMPROVE program. The particulates that contribute to haze are collected on filters at each IMPROVE site. Samples are then measured to determine how visibility is impacted over time and by which pollutants.

A deciview is a unit of measurement to quantify human perception of visibility. It is derived from the natural logarithm of the atmospheric light extinction coefficient. A 1-dv change is roughly the smallest perceptible change in visibility. Because visibility at any one location is highly variable throughout the year, it is characterized by three groupings: the clearest 20% days, average 20% days, and haziest 20% days. Visibility degradation is primarily due to sulfates, nitrates, and PM in the atmosphere, with contributions from both anthropogenic and natural sources. Measuring progress in air pollution control can be challenging because natural sources largely beyond human control such as dust storms and wildfires can produce significant visibility impairment over large areas for days to weeks at a time. Under the auspices of the 2017 Regional Haze Rule revisions, the EPA proposed a new visibility tracking—MID—to better characterize visibility conditions and trends. The MID are those with the most impairment from anthropogenic sources, whereas the haziest grouping now better represents days with haze from natural sources. Total haze on the MID is used to track progress toward Regional Haze Rule goals. Comparing trends in the 20% haziest days with the 20% MID provides a method to assess impacts from episodic events, like wildfires, which have greatly affected visibility throughout the western United States in recent years (Burke et al. 2021). More information about the EPA impairment framework can be found at http://vista.cira.colostate.edu/Improve/impairment/.

Also required by the Regional Haze Rule, reasonable progress goals must provide for an improvement in visibility for the 20% most anthropogenically impaired days relative to baseline visibility conditions and ensure no degradation in visibility for the 20% clearest days relative to baseline visibility conditions (EPA 2019). Model simulations were used by the EPA to project visibility by using the baseline for each Class I area as the average visibility (in dv) for the years 2014 through 2017. The visibility conditions in these years are the benchmark for the "provide for an improvement" and "no degradation" requirements. A line drawn from the end of the 2000 through 2004 baseline period to 2064 (dv/year) shows a uniform, linear rate of progress, or glidepath, between these two points. The glidepath represents the amount of visibility improvement needed in each implementation period; there is no rule requirement to be on or below the glidepath. Results for the Class I areas in the BLM FFO showed improving visibility trends for both the base (2014–2017) and future-year (2028) deciview values on the 20% clearest and MID. Results for the Class I areas in the BLM CFO show improving visibility trends for both the base (2014–2017) and future-year (2028) deciview values on the 20% clearest and MID, although some locations show 2028 projections above the linear uniform rate of progress value of the glidepath. More information can be found in the *Technical Support Document for EPA's Updated 2028 Regional Haze Modeling* (EPA 2019), incorporated by reference.

Visibility information can be found at the Federal Land Managers Environmental Database (FED) (FED Cooperative Institute for Research in the Atmosphere [CIRA] 2025). Figure 10 through Figure 20 illustrate visibility trends based on air monitoring data for the IMPROVE sites in the BLM NMSO area of operation for the clearest, haziest, and most impaired categories (FED CIRA 2025). Note that peaks such as those seen for Bandelier National Monument in 2000 may be accounted for by the occurrence of large wildfires. A downward sloping line means less reduction of visibility and therefore an improvement. Figure 24 through Figure 26 illustrate visibility trends based on air monitoring data for the IMPROVE sites at Class I areas in Colorado potentially affected by sources in northwestern New Mexico. In most cases, visibility trends have been flat or improving. Implementation of best available retrofit technology (BART) strategies as required under the Regional Haze Rule over the next few years should result in further improvements.

Trends for Class I areas affected by sources in northern New Mexico (see Figure 11, Figure 14, and Figure 15) are similar to trends for Class I areas in southern New Mexico (see Figure 10, Figure 12, Figure 13, Figure 16 and Figure 17). Although visibility on worst days at Guadalupe Mountains National Park may have diminished, a careful analysis of fire activity in the area would be necessary to draw conclusions about the cause of some peaks in recent years (CSU 2020).

A qualitative discussion of visibility impacts from oil and gas development in the *Farmington Resource Management Plan with Record of Decision* concludes that for the scenario modeled, which projected greater development than has occurred, there could potentially be significant impacts to visibility at Mesa Verde National Park, a Class I area in southwestern Colorado (BLM 2003). Occasional impacts to San Pedro Parks (northern New Mexico) and Weminuche (southern Colorado) Wilderness Areas were also thought possible. However, visibility trends shown for San Pedro Parks, Mesa Verde, and Weminuche indicate that visibility on the best days has been flat to improving and visibility on the worst days has shown little change over the period of record.

Visibility modeling performed for the BLM CFO area is discussed further in Section 6.3.

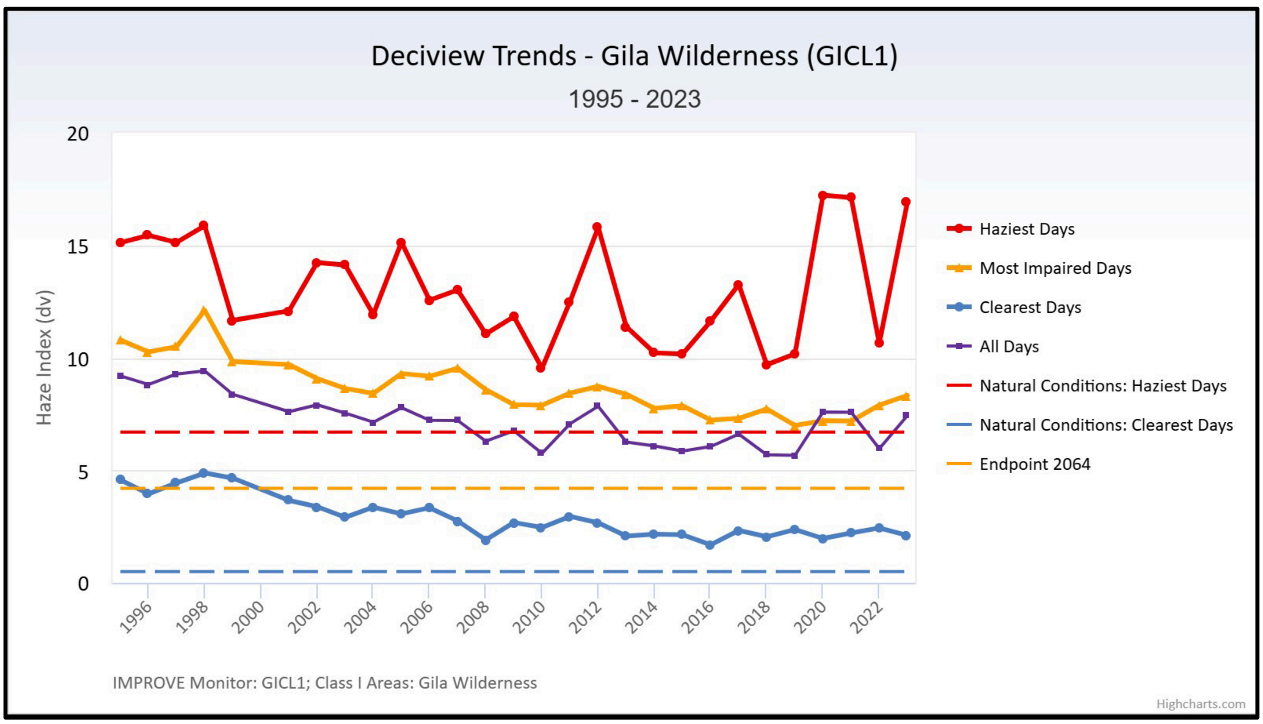

Figure 10. Visibility extinction trends for Gila Wilderness Area, New Mexico (FED CIRA 2025).

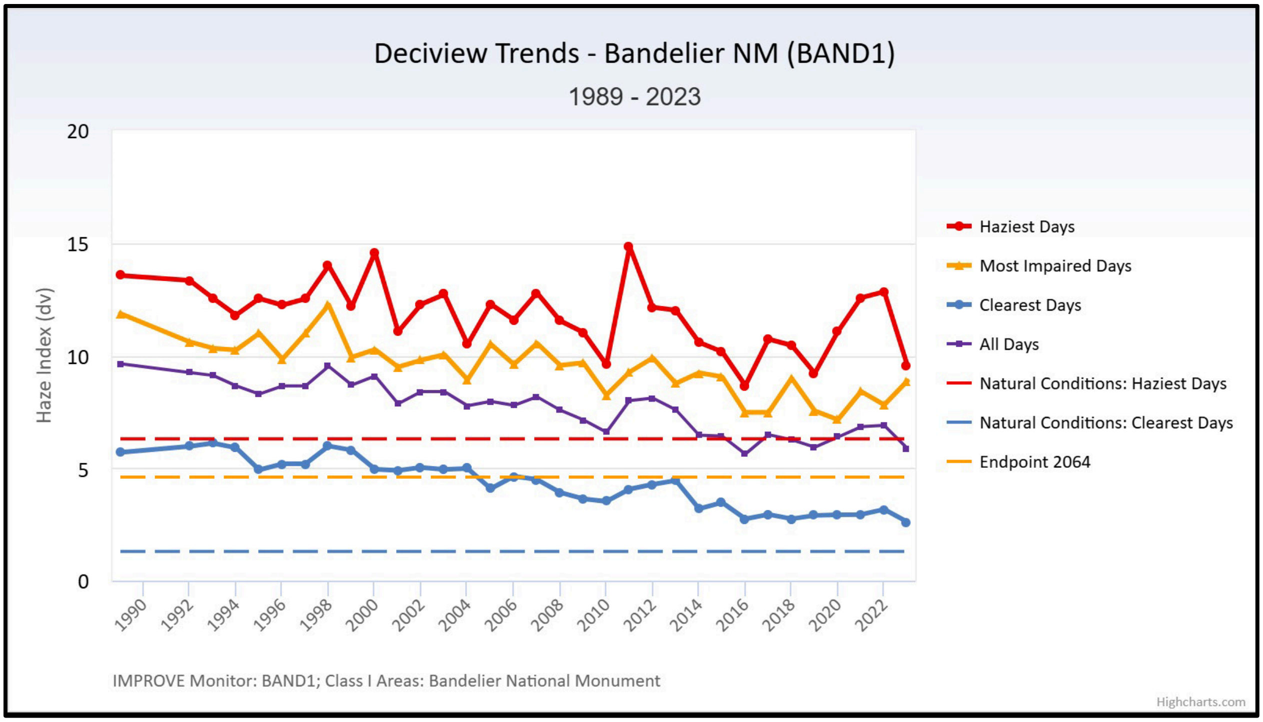

Figure 11. Visibility extinction trends for Bandelier National Monument, New Mexico (FED CIRA 2025).

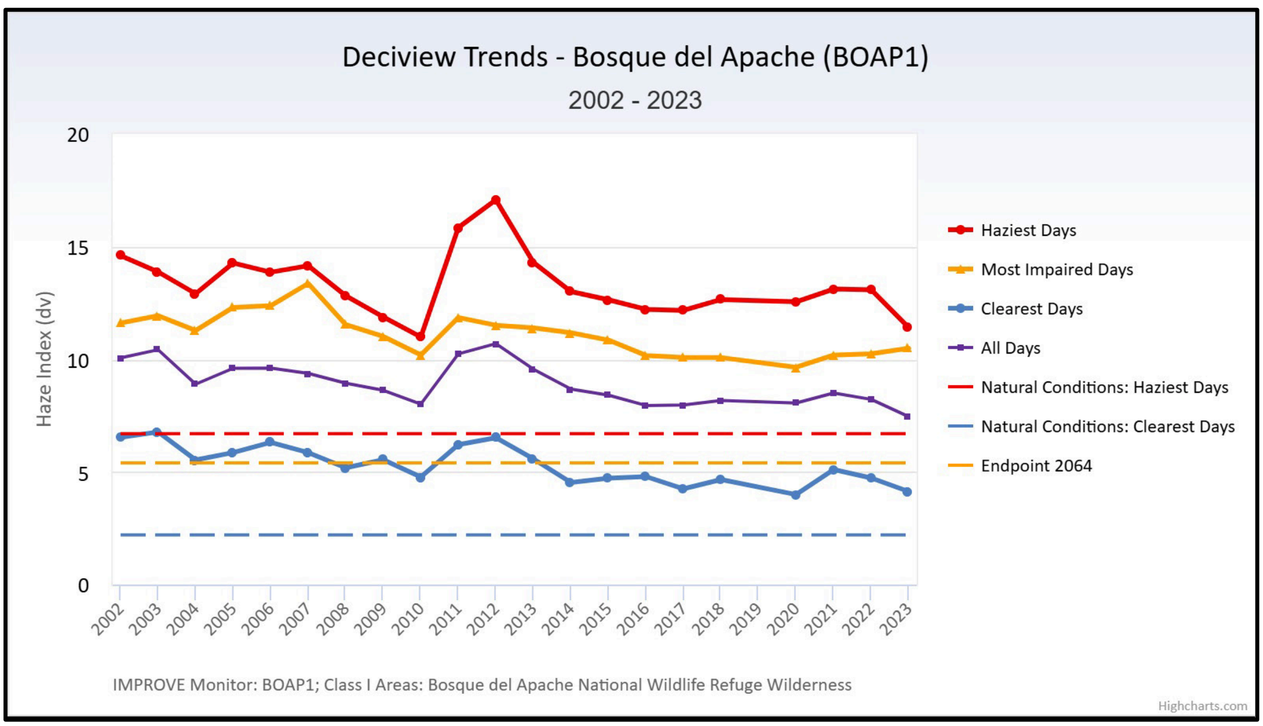

Figure 12. Visibility extinction trends for Bosque del Apache, New Mexico (FED CIRA 2025).

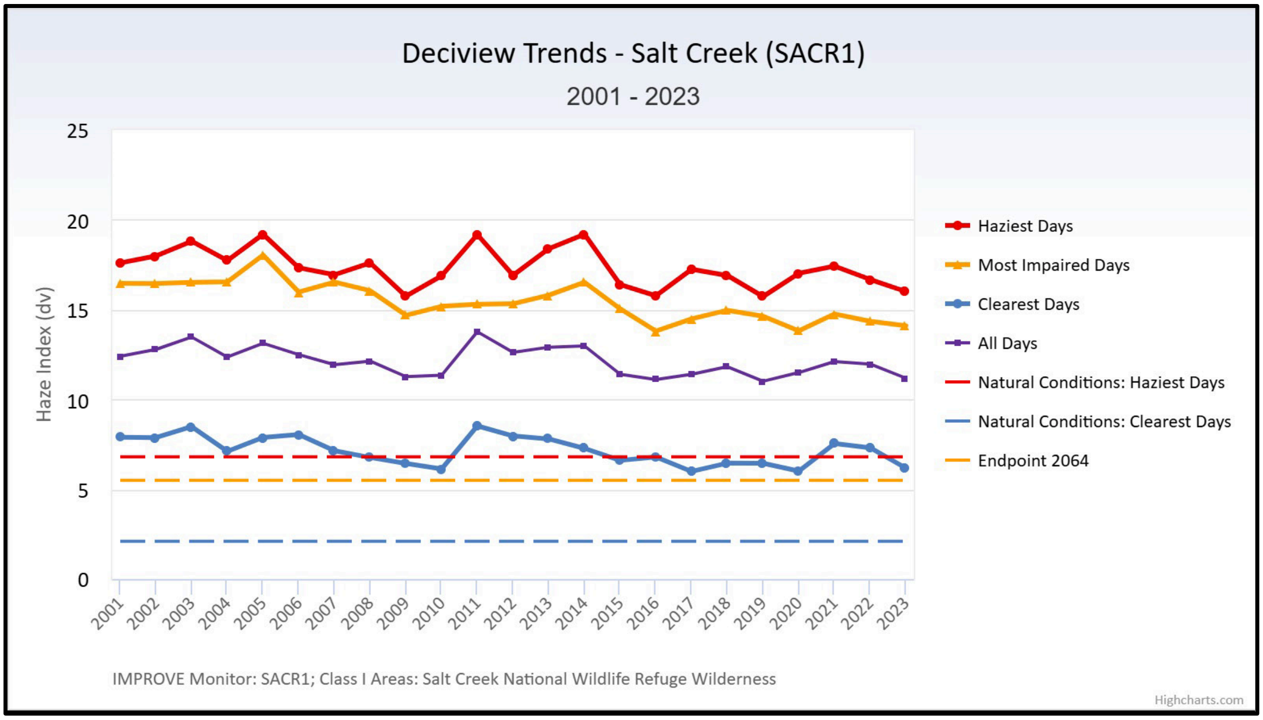

Figure 13. Visibility extinction trends for Salt Creek, New Mexico (FED CIRA 2025).

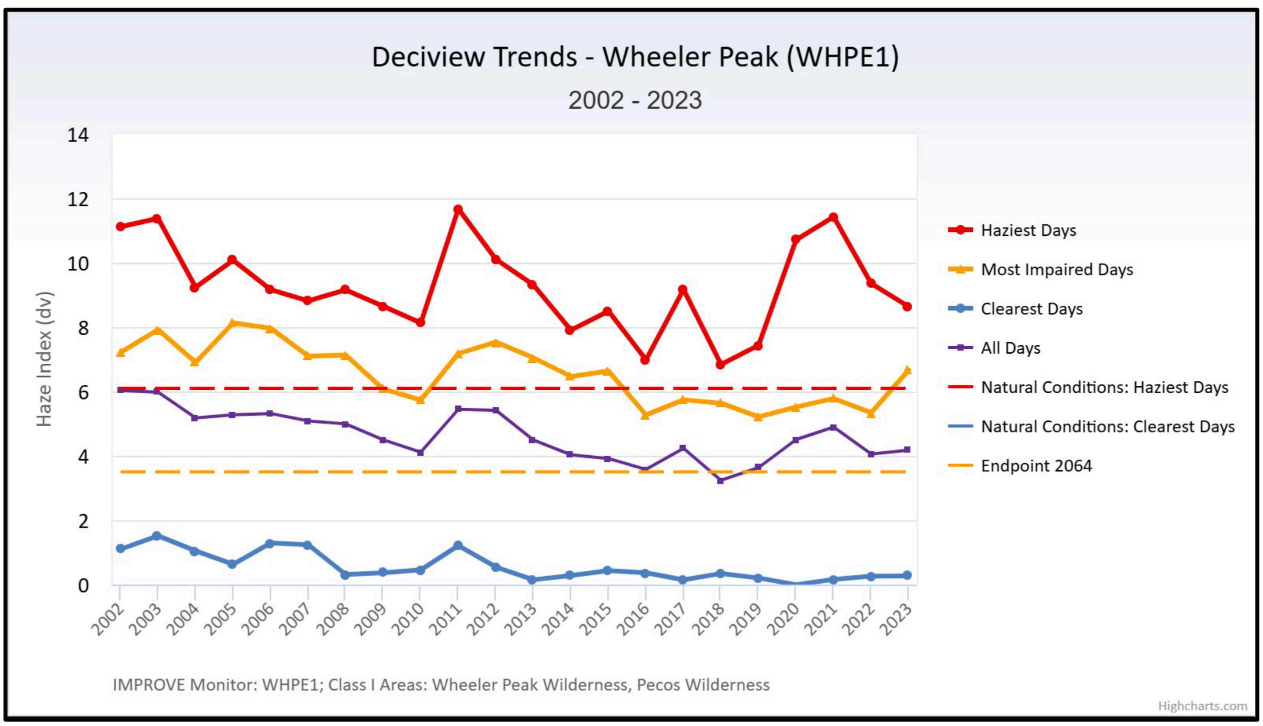

Figure 14. Visibility extinction trends for Wheeler Peak, New Mexico (FED CIRA 2025).

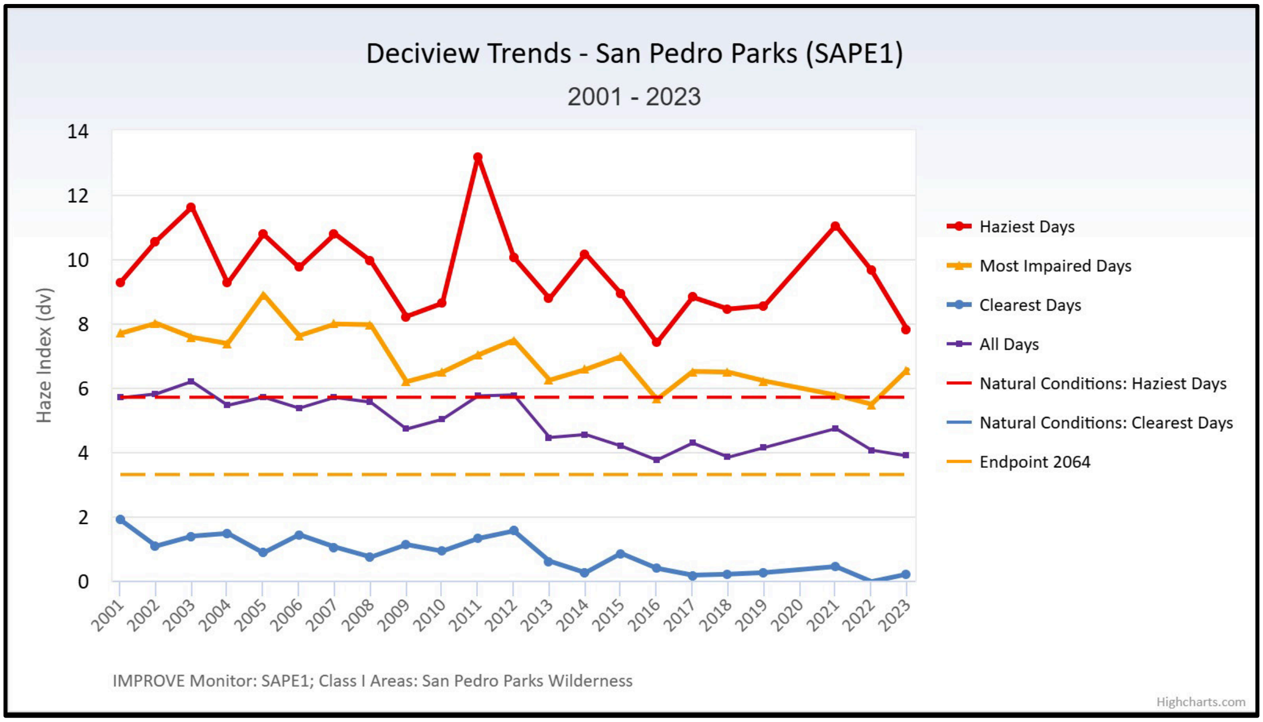

Figure 15. Visibility extinction trends for San Pedro Parks, New Mexico (FED CIRA 2025).

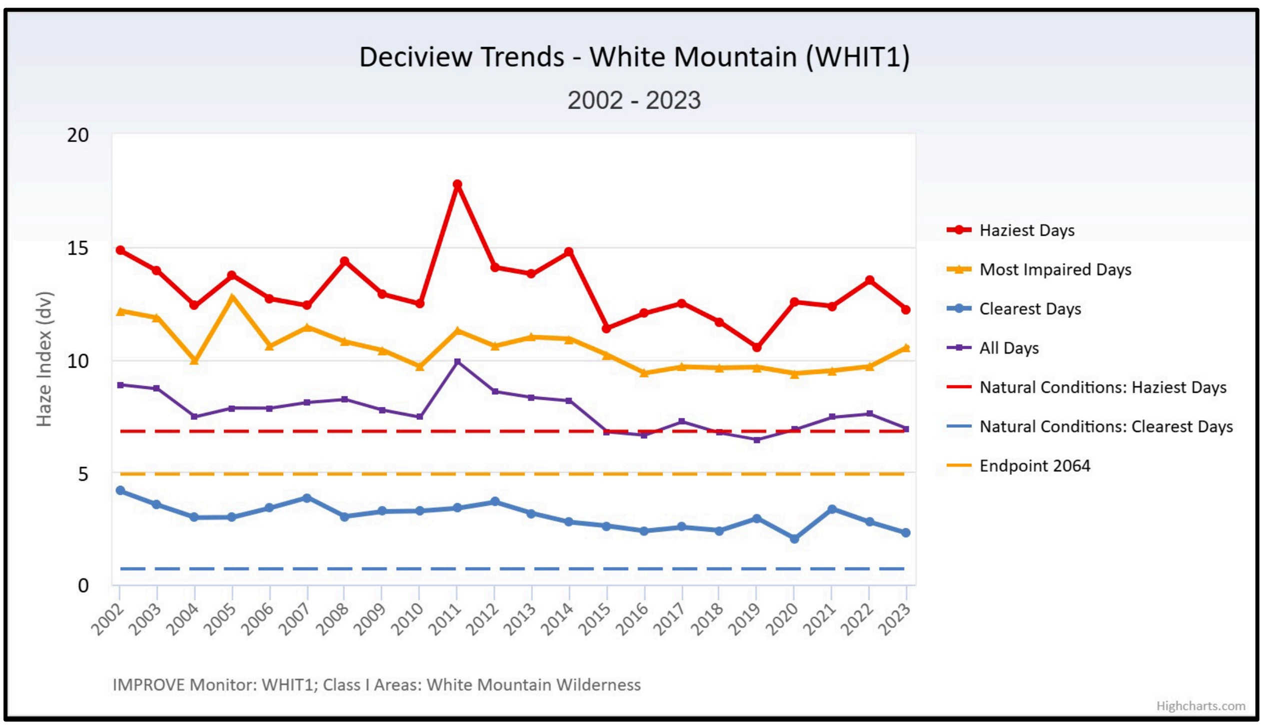

Figure 16. Visibility extinction trends for White Mountain, New Mexico (FED CIRA 2025).

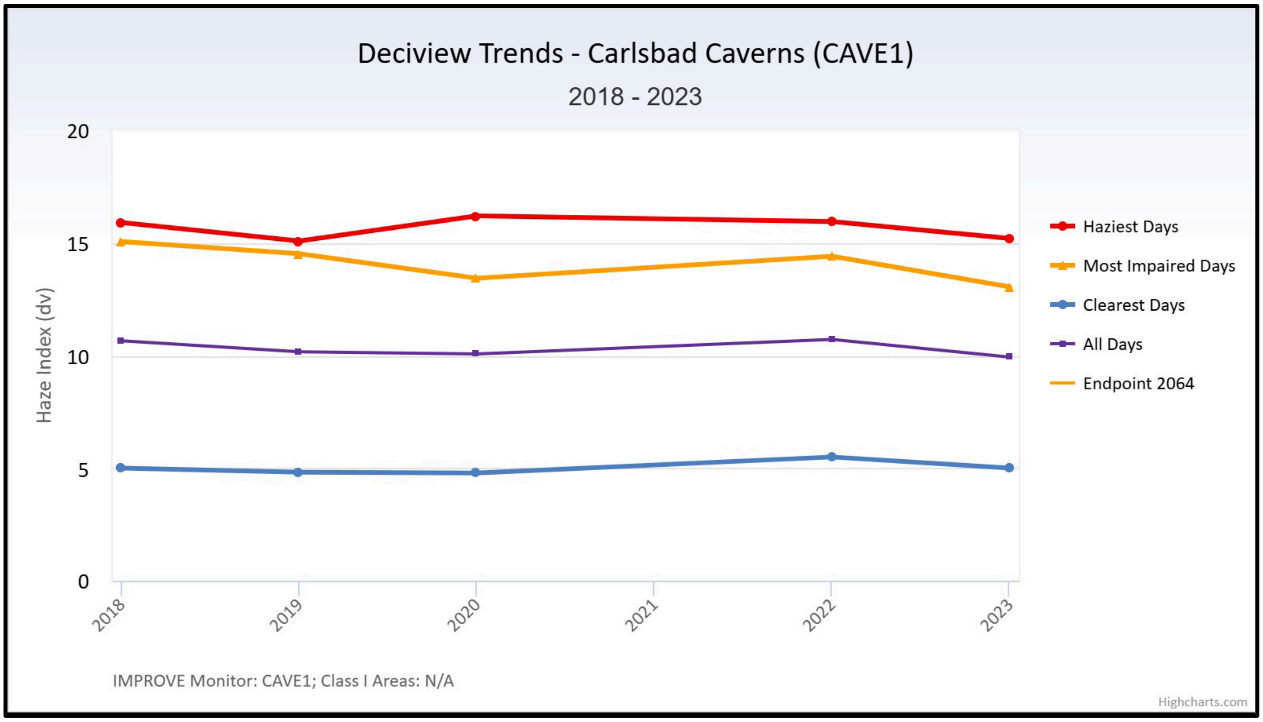

Figure 17. Visibility extinction trends for Carlsbad Caverns National Park, New Mexico (FED CIRA 2025).

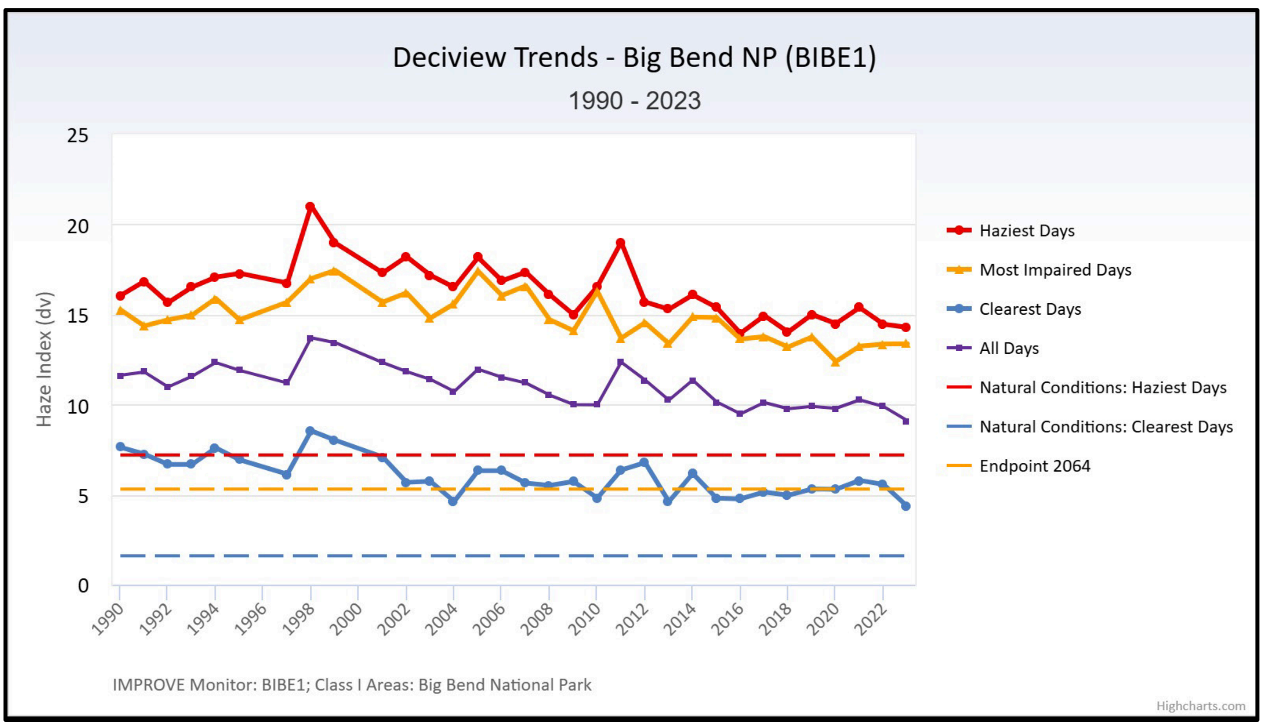

Figure 18. Visibility extinction trends for Big Bend National Park, Texas (FED CIRA 2025).

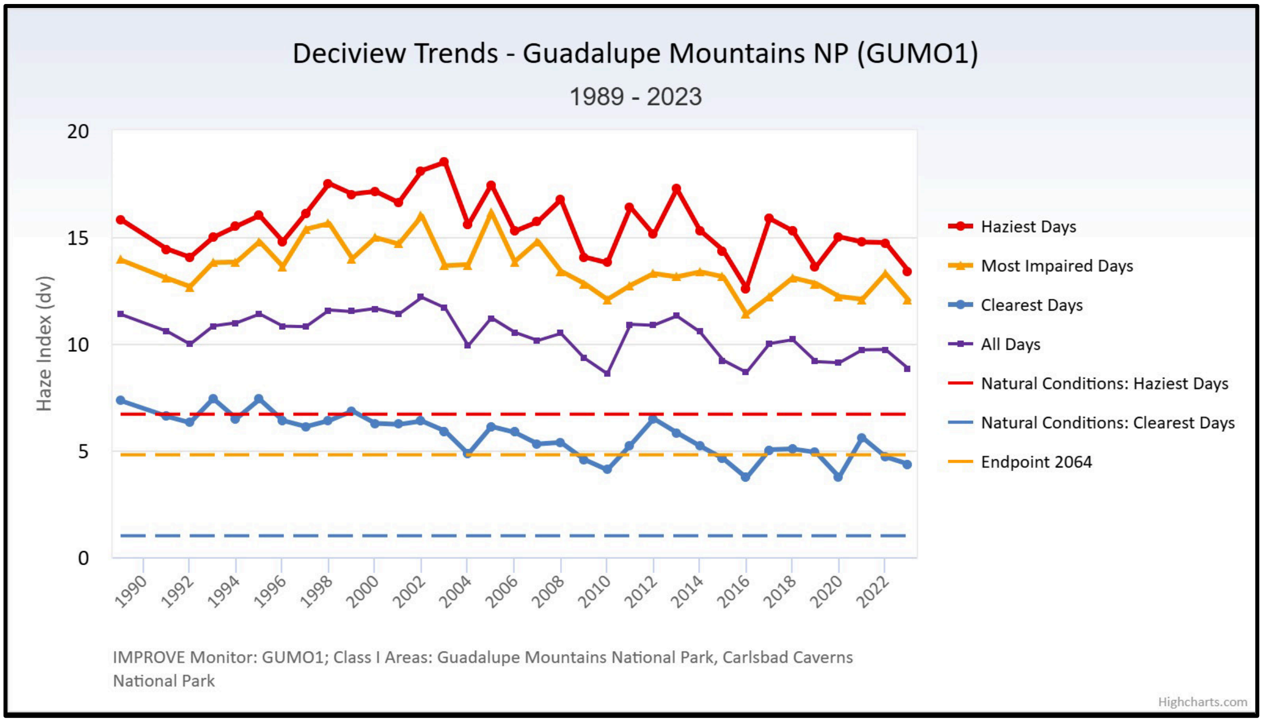

Figure 19. Visibility extinction trends for Guadalupe Mountains National Park, Texas (FED CIRA 2025).

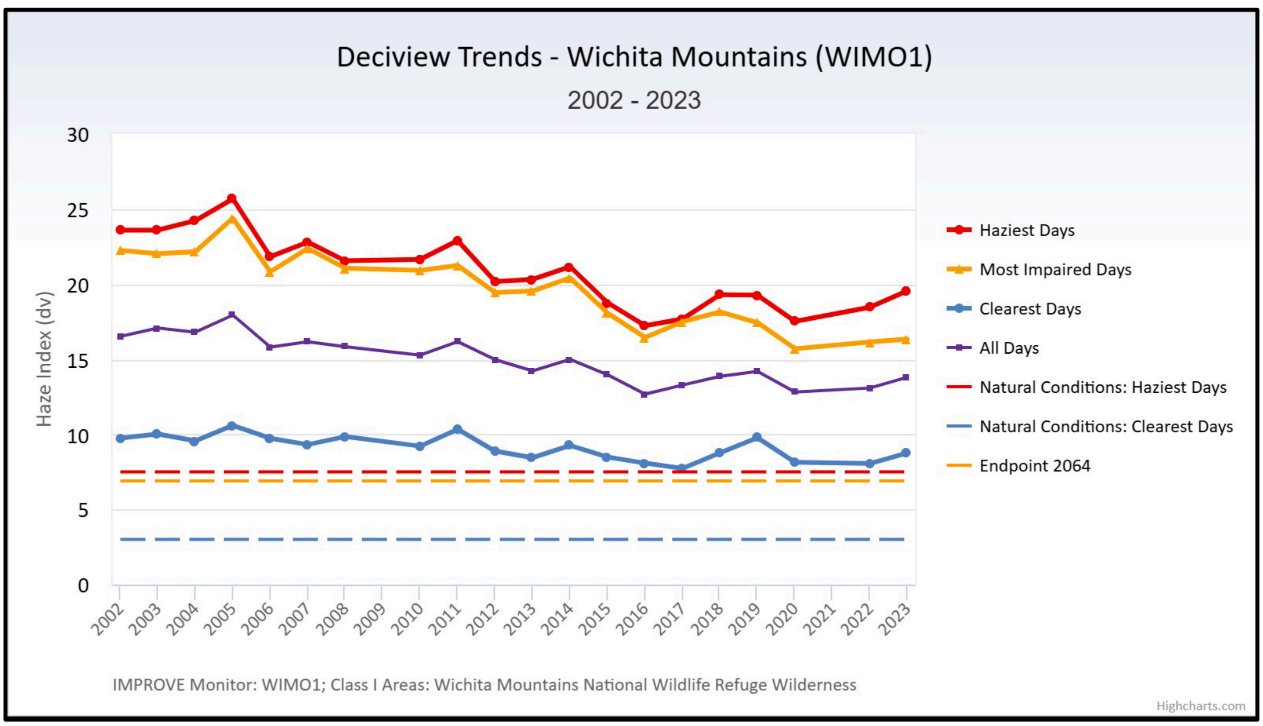

Figure 20. Visibility extinction trends for Wichita Mountains, Oklahoma (FED CIRA 2025).

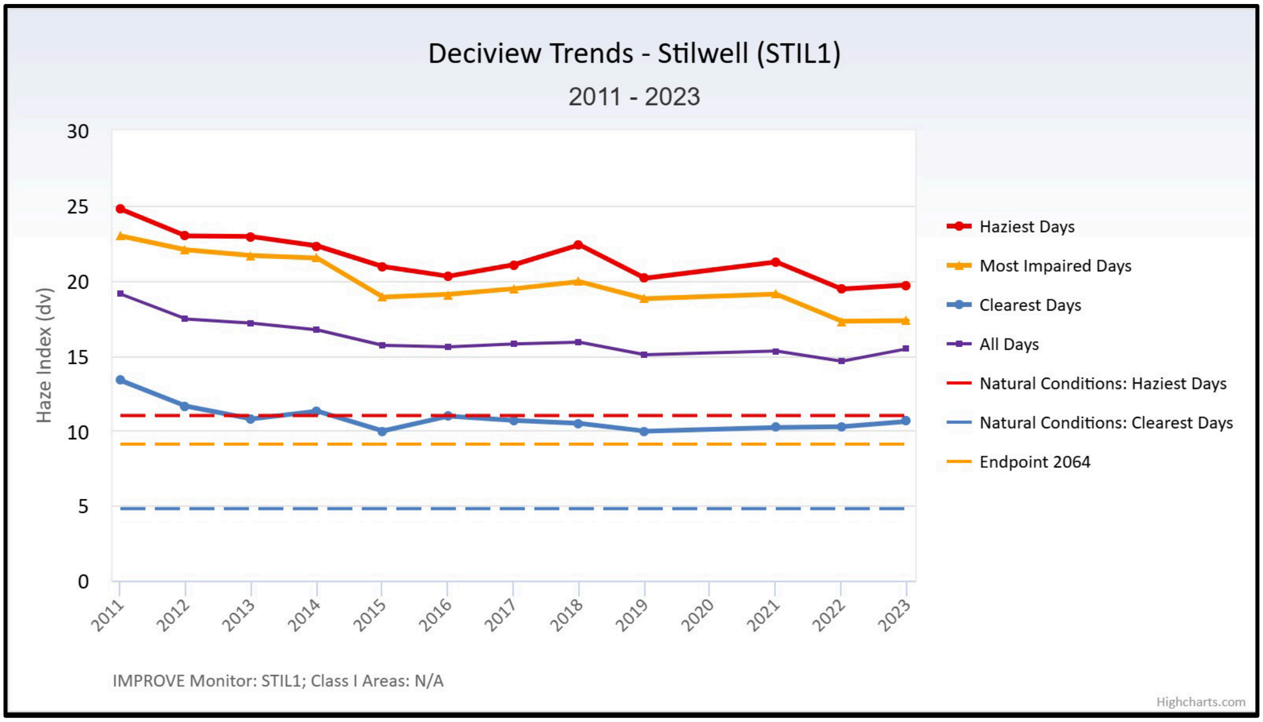

Figure 21. Visibility extinction trends for Kay County (Stilwell), Oklahoma (FED CIRA 2025).

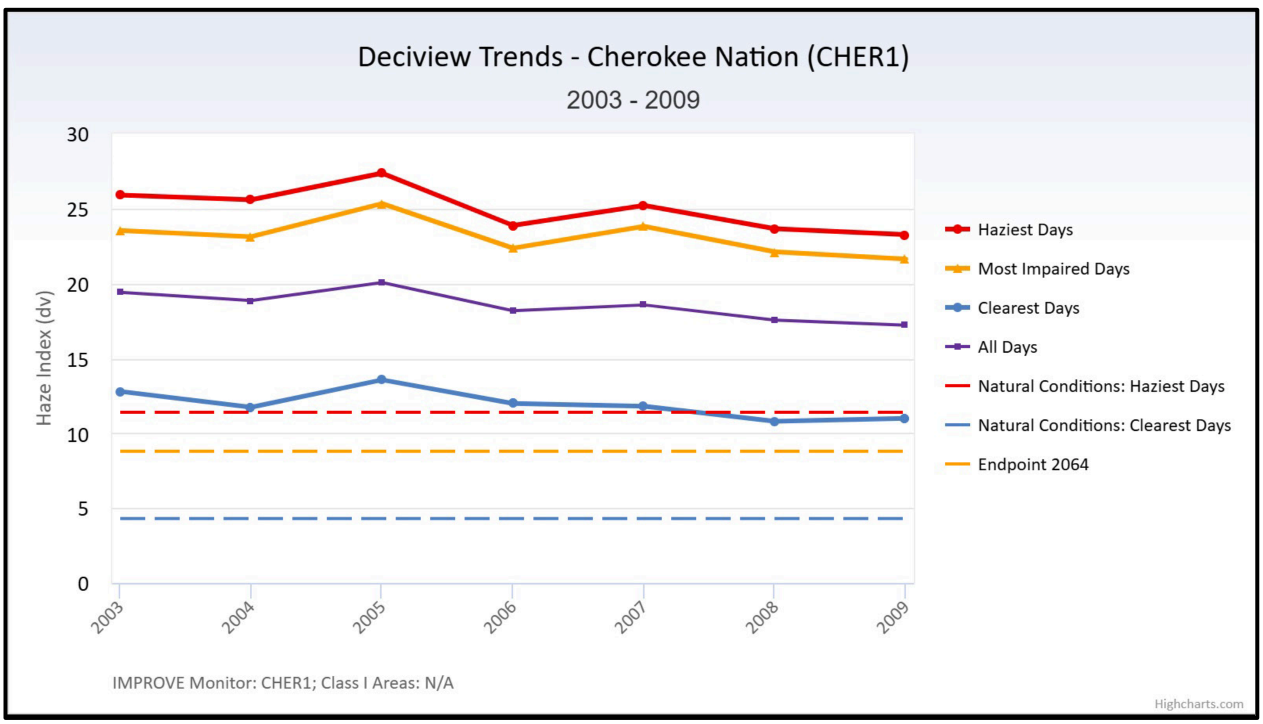

Figure 22. Visibility extinction trends for Kay County (Cherokee Nation), Oklahoma (FED CIRA 2025).

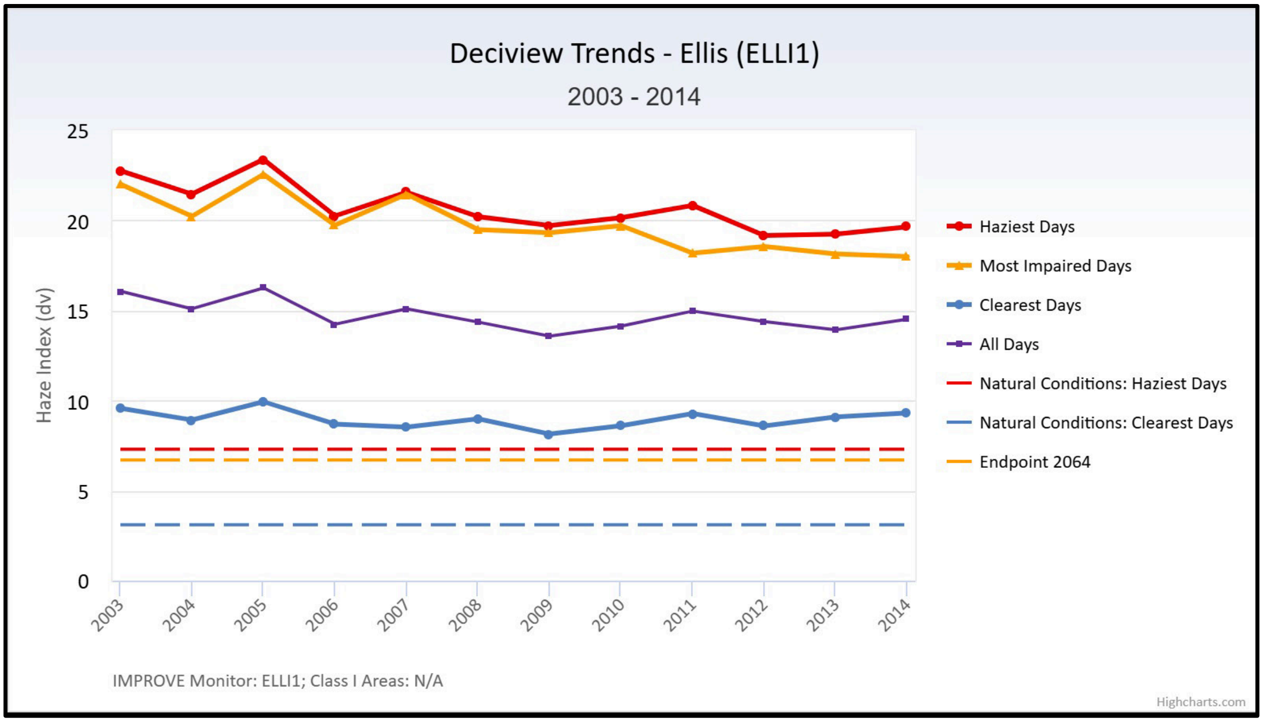

Figure 23. Visibility extinction trends for Ellis County, Oklahoma (FED CIRA 2025).

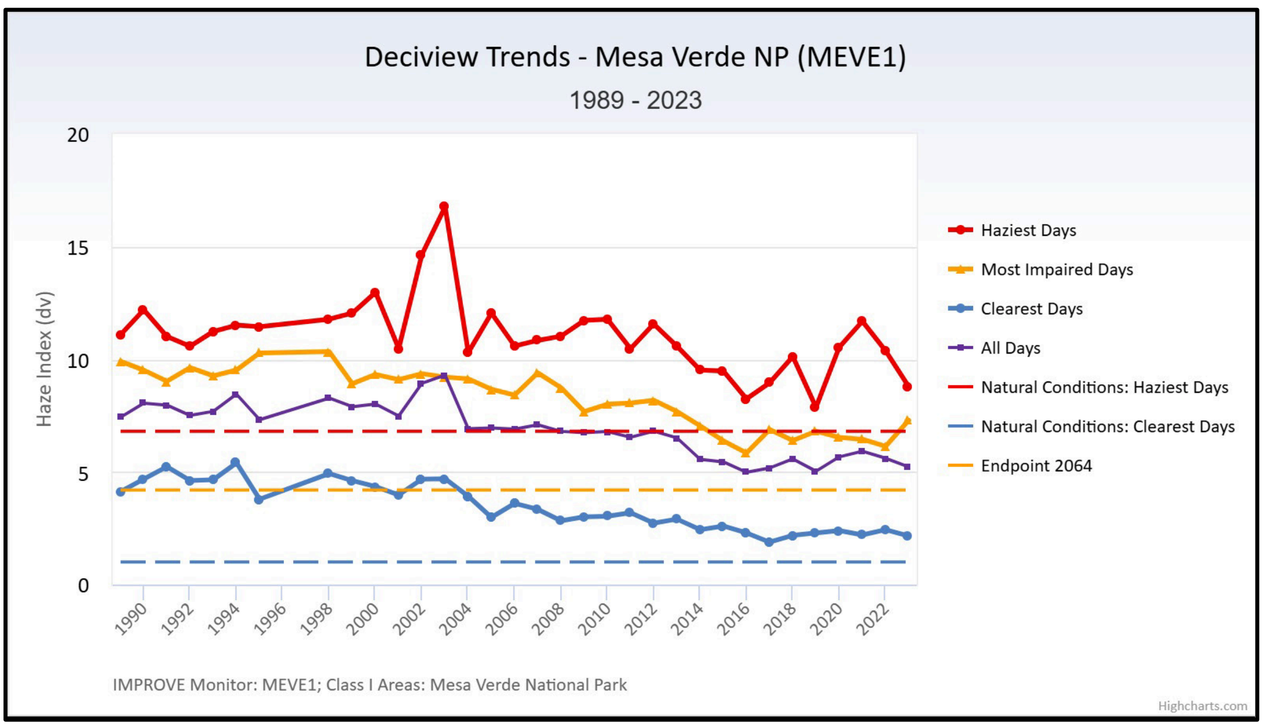

Figure 24. Visibility extinction trends at Class I areas affected by sources in northwestern New Mexico – Mesa Verde National Park, Colorado (FED CIRA 2025).

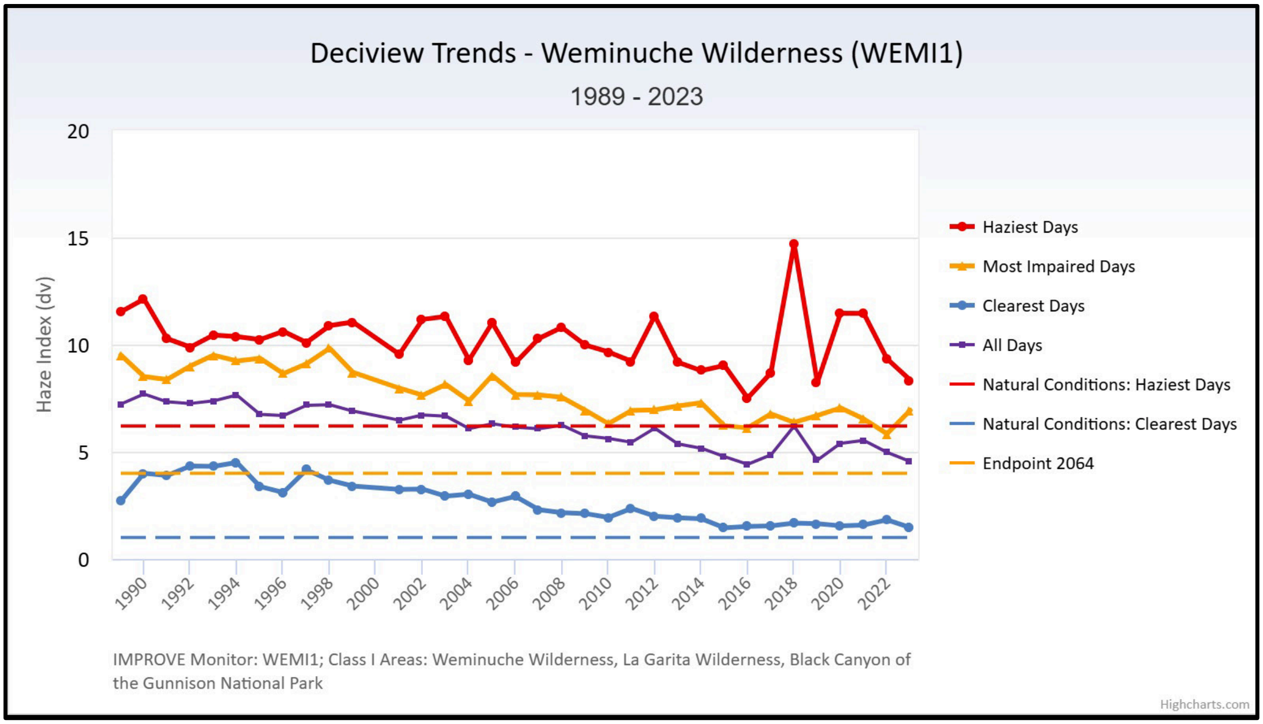

Figure 25. Visibility extinction trends at Class I areas affected by sources in northwestern New Mexico – Weminuche Wilderness, Colorado (FED CIRA 2025).

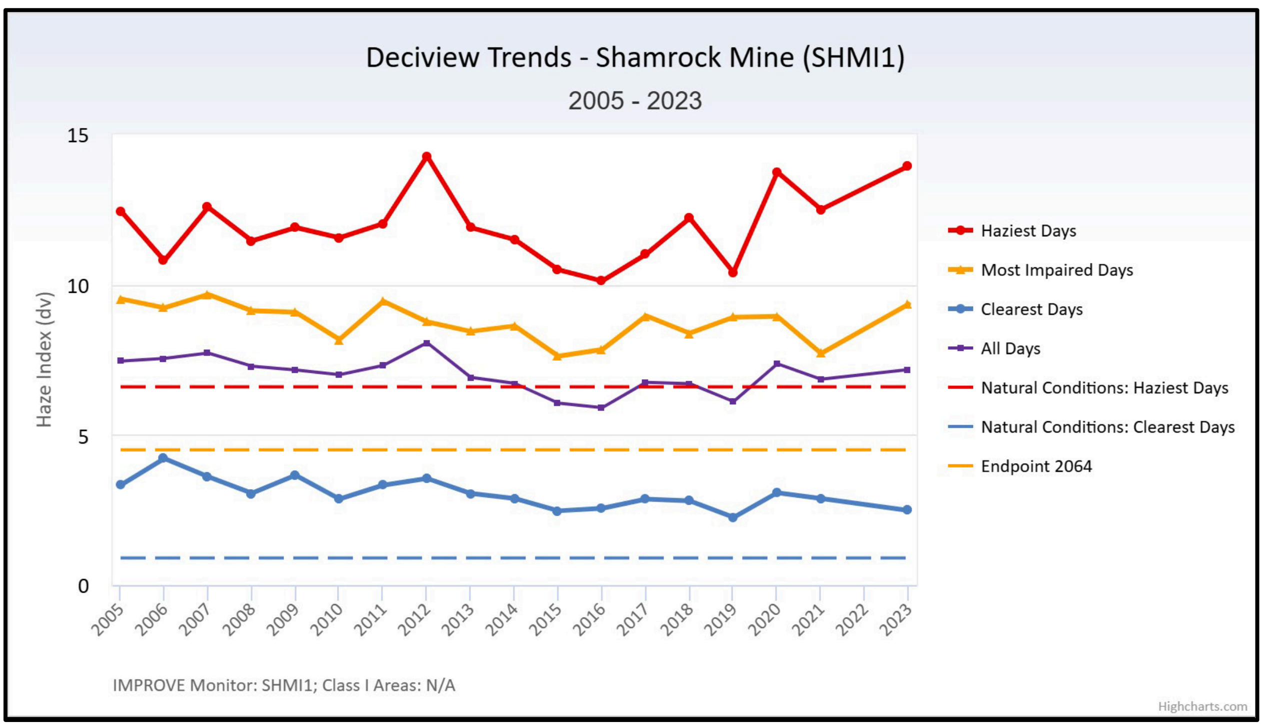

Figure 26. Visibility extinction trends at Class I areas affected by sources in northwestern New Mexico – La Plata County (Shamrock Mine), Colorado (FED CIRA 2025).

Additional monitoring can be found in the *National Atmospheric Deposition Program 2022 Annual Summary* (National Atmospheric Deposition Program [NADP] 2023).

8.3 WET AND DRY POLLUTANT DEPOSITION

Atmospheric deposition occurs when gaseous and particulate air pollutants are deposited on the ground, water bodies, or vegetation. The pollutants may settle as dust or be washed from the atmosphere in rain, fog, or snow. When air pollutants such as sulfur and nitrogen are deposited into ecosystems, they may cause acidification or enrichment of soils and surface waters. Atmospheric nitrogen and sulfur deposition may affect water chemistry, resulting in impacts to aquatic vegetation, invertebrate communities, amphibians, and fish. Deposition can also cause chemical changes in soils that alter soil microorganisms, plants, and trees. Excess nitrogen from atmospheric deposition can stress ecosystems by favoring some plant species and inhibiting the growth of others.

In general, the soils in New Mexico have a high acid-neutralizing capacity and surface water is scarce, resulting in minimal impacts in this area. Also, the EPA Acid Rain Program has resulted in greatly reduced levels of the most damaging pollutants. There are currently two active wet deposition monitors in New Mexico: Mayhill and Bandelier National Monument. In addition, monitors near the New Mexico border at Mesa Verde National Park in Colorado and Guadalupe Mountains National Park in Texas may shed some light on conditions in New Mexico. Data can be accessed through the NADP at https://nadp.slh.wisc.edu/networks/national-trends-network/. Wet deposition data are also available for monitoring sites in Kansas, Oklahoma, and Texas at this website (NADP 2024).

The EPA has operated the Clean Air Status and Trends Network (CASTNET) since 1991 to provide data to assess trends in air quality, deposition, and ecological effects due to changes in air emissions. Sites are in areas where urban influences are minimal. There are currently two CASTNET observation sites in New Mexico, three in Texas, two in Kansas, and one in Oklahoma. There is also a CASTNET site at Mesa Verde National Park in the Four Corners region. National maps of pollutant concentrations can be found at https://www3.epa.gov/castnet/airconc.html. These maps show that New Mexico and most of the western states have much lower concentrations of all monitored pollutants than the eastern states and Southern California. Nitrates are somewhat elevated in eastern Kansas and eastern Oklahoma, but this is likely associated with agricultural activities rather than oil and gas development. The maps also show that the trend over the past 30 years has been for decreases in all pollutants in most areas of the country. As an example, Figure 27 and Figure 28 show particulate nitrate and sulfate levels for 2000 and 2023 (EPA 2025o). All areas of the eastern United States have shown significant improvement, with an overall 73% reduction in wet sulfate deposition from 2000–2002 to 2020–2022. Between 2000–2002 and 2020–2022, the Northeast and Mid-Atlantic experienced a 78% reduction in wet sulfate deposition, and the south-central region experienced a 44% reduction. SO_2 emissions reductions and the consequent decrease in the formation of sulfates that are transported long distances have resulted in significantly reduced sulfate deposition in the Northeast. The sulfate reductions documented in the region, particularly across New England and portions of New York, were also affected by SO_2 emissions reductions in eastern Canada. Wet deposition of inorganic nitrogen decreased an average of 29% in the Mid-Atlantic and 37% in the Northeast but stayed neutral in the Rocky Mountain and north and south-central regions from 2000–2002 to 2020–2022. These neutral trends in the Rocky Mountain and north and south-central regions reflect increases in wet deposition of reduced nitrogen, combined with decreases in deposition of oxidized nitrogen between 2000 and 2022. Reductions in nitrogen deposition recorded since the early 1990s have been less pronounced than those for sulfur. Emissions from other source categories (e.g., mobile sources, agriculture, biomass burning, and manufacturing) contribute to air concentrations and deposition of nitrogen. The reduction in total sulfur deposition (wet plus dry) in

the eastern United States was 82% from 2000–2002 to 2020–2022, a change of similar magnitude to that of wet sulfate deposition. In the south-central region, total sulfur deposition experienced a 51% reduction. Total NO_X deposition decreased 59% in the East and 40% in the south-central region.
In contrast, total deposition of NH_X increased by an average of 43% in the East and 91% in the south-central region from 2000–2002 to 2020–2022 (EPA 2024f). Figure 29 through Figure 32 show the total nitrate and total dry and wet sulfur deposition trends through 2021. These trends in deposition levels are discussed in depth in the 2025 CASTNET annual network plan (EPA 2025p), *CASTNET 2021 Annual Report* (EPA 2021c) and *CASTNET 2023 Annual Report* (EPA 2025q).

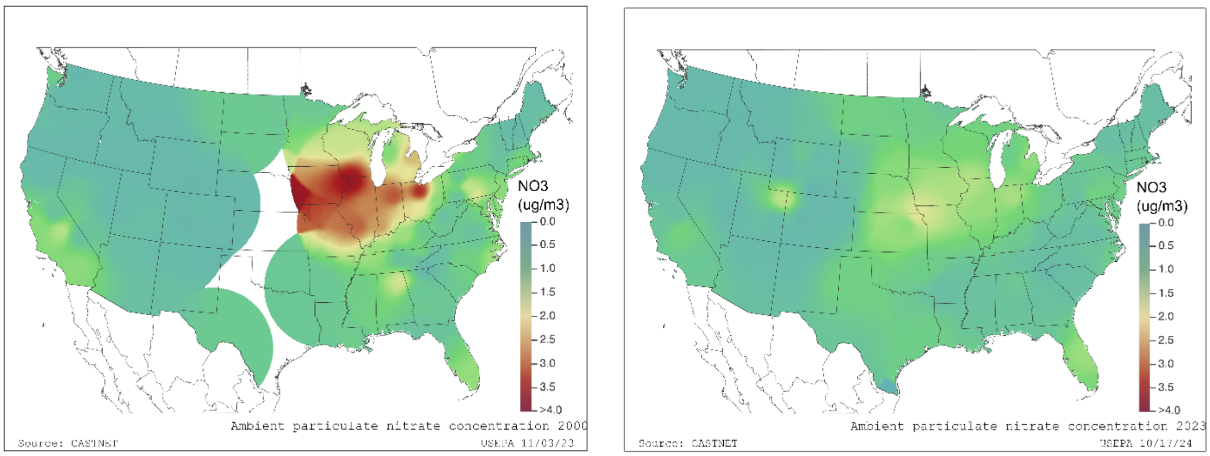

Figure 27. Particulate nitrate in 2000 (left) and 2023 (right) (EPA 2025q).

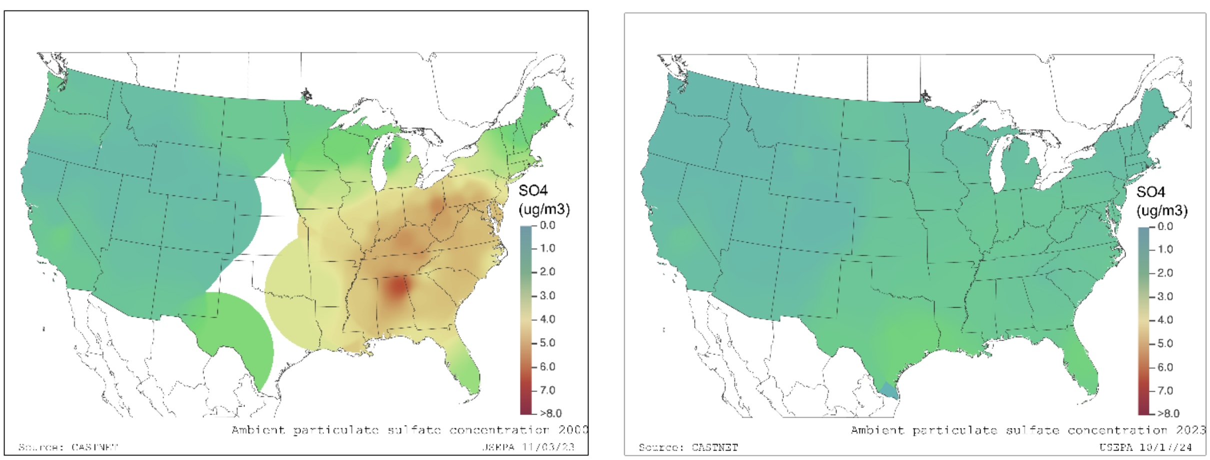

Figure 28. Particulate sulfate in 2000 (left) and 2023 (right) (EPA 2025q).

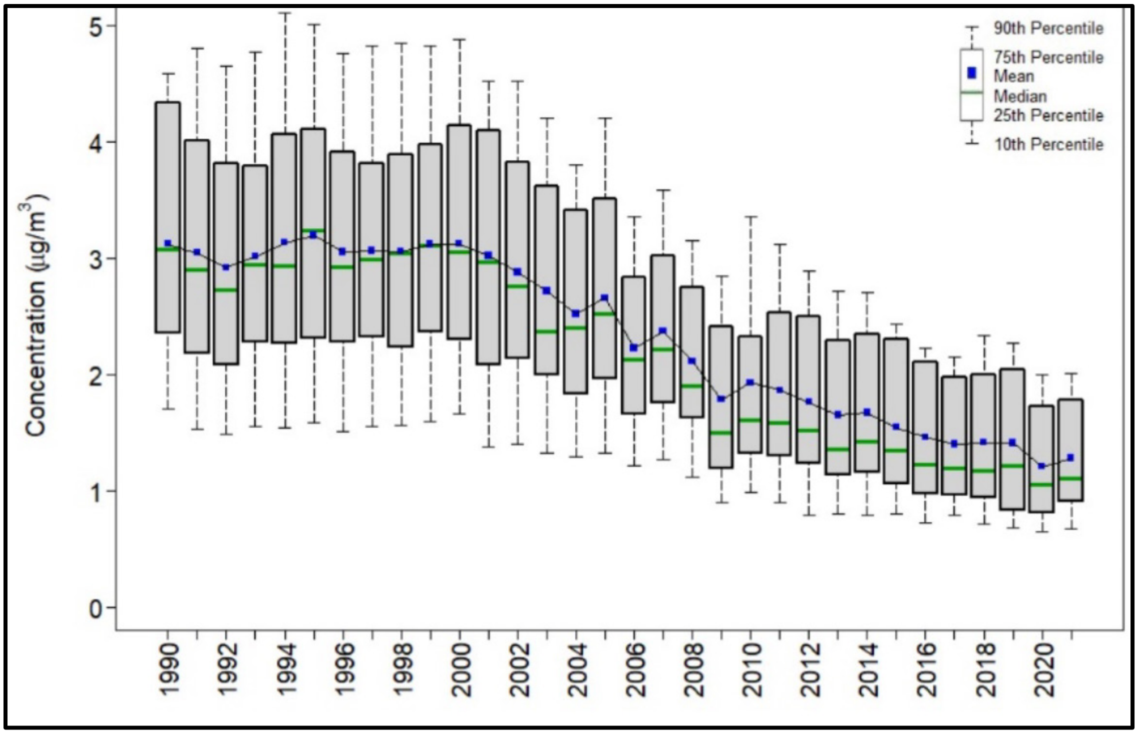

Figure 29. Annual mean total nitrate concentration, eastern reference sites, 1990–2021 (EPA 2021c).

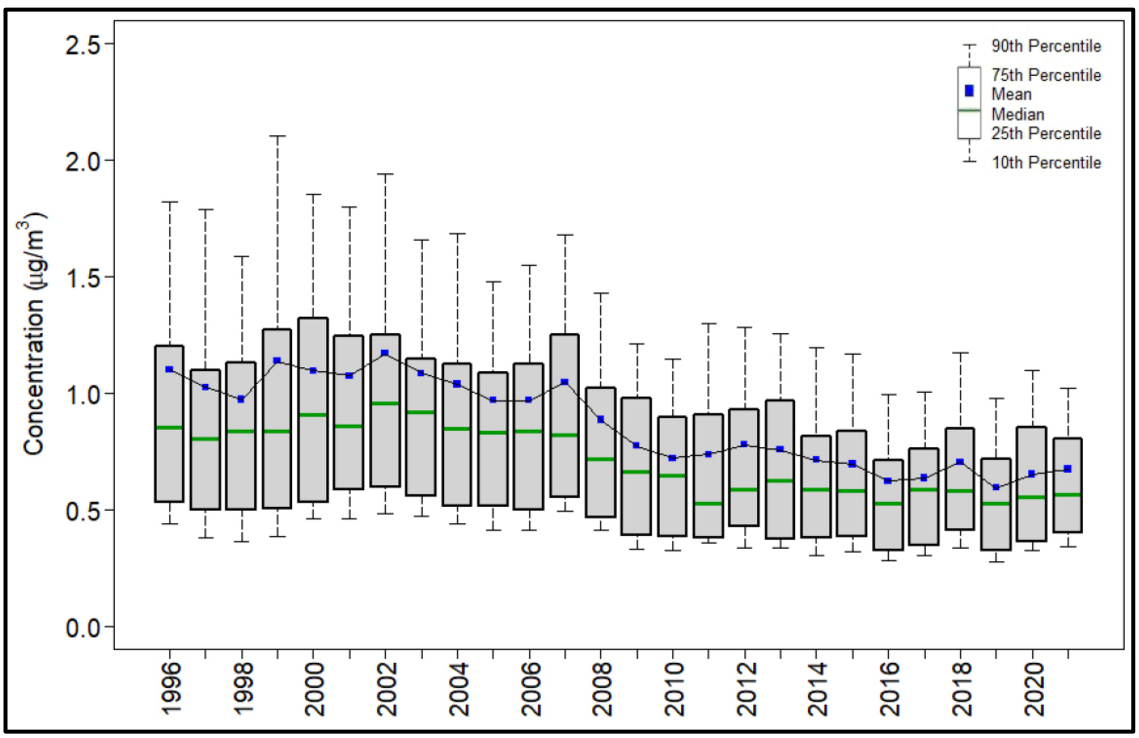

Figure 30. Annual mean total nitrate concentration, western reference sites, 1996–2021 (EPA 2021c).

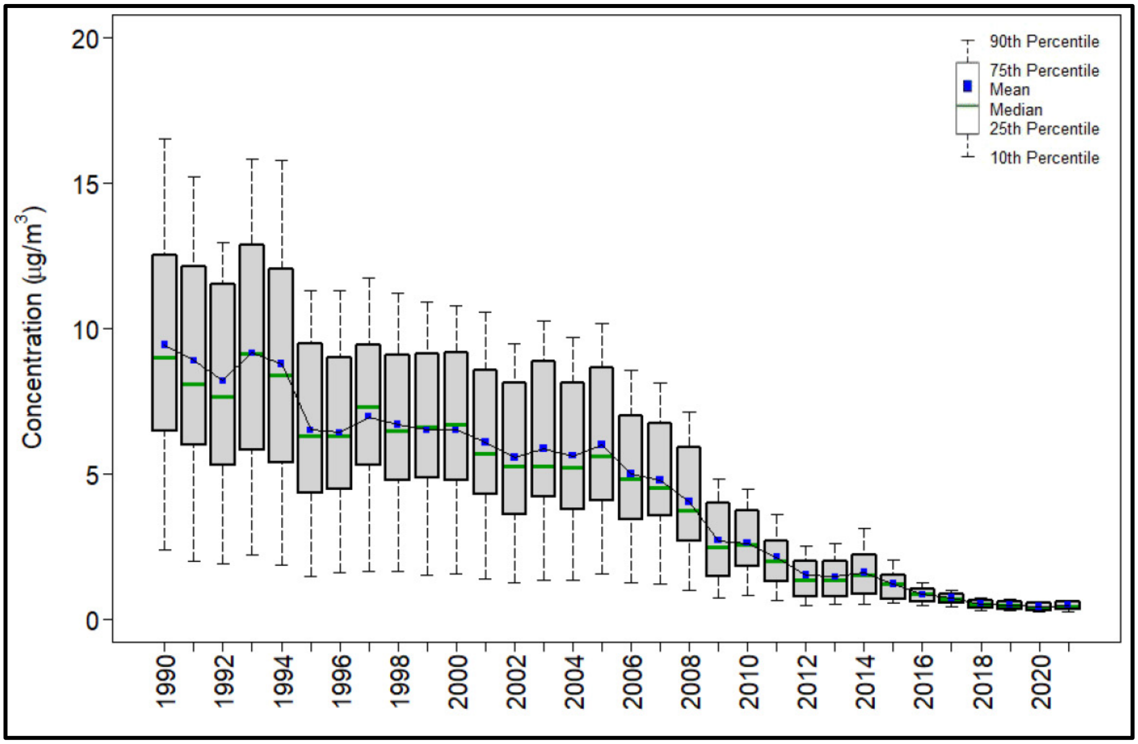

Figure 31. Annual mean SO_2 concentration, eastern reference sites, 1990–2021 (EPA 2021c).

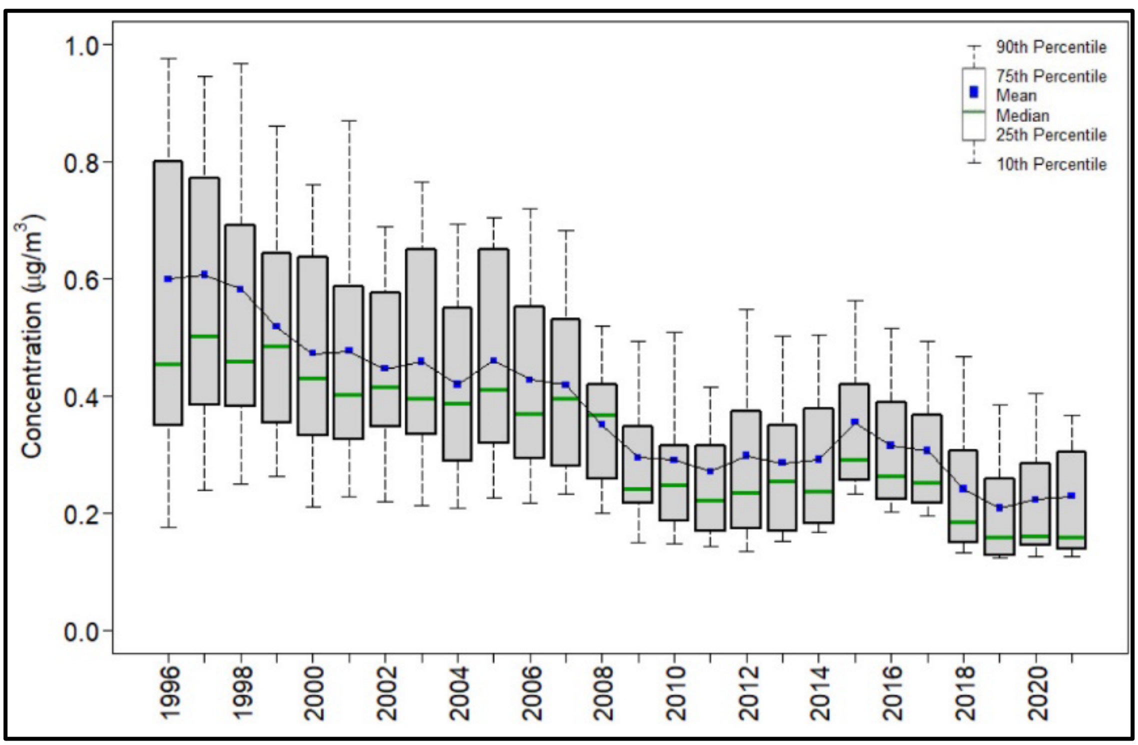

Figure 32. Annual mean SO_2 concentration, western reference sites, 1996–2021 (EPA 2021c).

The NPS also monitors and evaluates deposition to identify the national parks and monuments that are most at risk and to determine where conditions are declining or improving (NPS 2022). Nitrogen deposition conditions, which are 5-year averages from 2018 through 2022, were fair to poor, though trend data were unavailable for many locations (Table 77). Sulfur deposition conditions were good to poor with trend data also unavailable for most locations. Additional deposition information can be found at http://www.nationalforestairqualityconditions.com/ for USFS lands.

Table 77. Nitrogen and Sulfur Deposition Conditions at Class I Areas

State	Class I Area	Nitrogen (conditions/trend)	Nitrogen Deposition*† (kg/ha/yr)	Sulfur (conditions/trend)	Sulfur Deposition*† (kg/ha/yr)
New Mexico	Bandelier National Monument	Fair / Relatively unchanging	2.7	Good / Improving	0.7
	Bosque del Apache National Wildlife Refuge	N/A	N/A	N/A	N/A
	Carlsbad Caverns National Park	Poor / N/A	2.0	Poor / N/A	1.0
	Gila Wilderness	Poor / N/A	1.7	Good / N/A	0.5
	Pecos Wilderness	Poor / N/A	1.8	Good / N/A	0.5
	Salt Creek Wilderness	N/A	N/A	N/A	N/A
	San Pedro Parks Wilderness	N/A	N/A	N/A	N/A
	Wheeler Peak Wilderness	N/A	N/A	N/A	N/A
	White Mountain Wilderness	N/A	N/A	N/A	N/A
Texas	Big Bend National Park	Poor / Relatively unchanging	2.3	Fair / Relatively unchanging	1.1
	Guadalupe Mountains National Park	Poor / Relatively unchanging	2.6	Fair / Relatively unchanging	1.3
Oklahoma	Wichita Mountains Wilderness	N/A	N/A	N/A	N/A
Colorado	Mesa Verde National Park	Fair / Relatively unchanging	2.3	Good / Improving	0.6
	Weminuche Wilderness	N/A	N/A	N/A	N/A

Source: NPS (2022)

Note: N/A = not available due to lack of monitoring data

* The NPS sulfur and nitrogen deposition benchmarks are good (<1.0 kilogram per hectare per year [kg/ha/yr]), fair (1.1–2.9 kg/ha/yr), and poor (>3.0 kg/ha/yr).

† These values are based on the 5-year average (2018–2022) maximum estimated kilograms per hectare per year of wet sulfur and nitrogen deposition compared to NPS deposition benchmarks (NPS 2022).

9 PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS

More specific information about sources in New Mexico oil and gas producing regions that have the greatest impacts on air quality and GHGs is included below. The Department of Interior defines affected environment as "the environmental conditions that would prevail in the absence of the implementation of the proposed action or action alternatives. It includes any reasonably foreseeable environmental trends and planned actions in the area to be affected by implementation of the proposed action or action alternatives"—see 516 Departmental Manual (DM) 1, *U.S. Department of the Interior Handbook of National Environmental Policy Act Implementing Procedures* page 23 (DOI 2025).

9.1 CURRENT AND REASONABLY FORESEEABLE CONTRIBUTIONS TO CUMULATIVE EFFECTS

A list of major sources (sources emitting more than 100 tpy of CO, VOC, NO_x, SO_2, $PM_{2.5}$, or PM_{10}) in New Mexico, Kansas, Oklahoma, and Texas can be found in Appendix D. Any of these sources may contribute to cumulative effects within a local or regional context. All major sources represent emissions from the 2020 NEI Report (EPA 2023h).

10 CLIMATE, CLIMATE TRENDS, AND GREENHOUSE GASES

The BLM Specialist Report (BLM 2024a) presents the estimated emissions of GHGs attributable to fossil fuels produced on land and mineral estate managed by the BLM and will be referenced throughout this report. The BLM Specialist Report is focused on estimating GHG emissions from coal, oil, and gas development that is occurring and is projected to occur on the federal onshore mineral estate.
The report includes a summary of emissions estimates from reasonably foreseeable federal fossil fuel development and production over the next 12 months, as well as longer-term assessments of potential federal fossil fuel GHG emissions and the anticipated climate trend resulting from the cumulative global GHG burden. The report can provide context by disclosing cumulative impacts of GHG emissions from fossil fuel energy leasing and development authorizations on the federal onshore mineral estate relative to several emission scopes and base years. A detailed discussion of climate trend science and predicted impacts (Section 4.0), including past and present climate impacts (Section 4.2) and climate trends in select states with BLM-authorized fossil fuels (Section 4.4), as well as the existing and reasonably foreseeable GHG emissions associated with BLM actions (Section 7.0), are included in the BLM Specialist Report.

10.1 CLIMATE AND CLIMATE TRENDS

Climate refers to atmospheric conditions (e.g., temperature, humidity, pressure, precipitation, solar radiation, wind) at a particular location averaged over a long period of time. Climatologists commonly use 30-year averages of variables, such as temperature and precipitation, as benchmarks for historical comparison and climate trend assessment. NOAA National Centers for Environmental Information (NCEI) Climate Normals are 3-decade averages of climatological variables, including temperature and precipitation, updated every 10 years, with the 1991–2020 U.S. Climate Normals dataset serving as the latest release. It contains average daily and monthly temperature, precipitation, snowfall, heating and cooling degree days, frost/freeze dates, and growing degree days calculated from observations at approximately 15,000 stations (NCEI 2023a). Climate Normals representative for each field office are found in the Climate Normals section of Appendix C. Prevailing wind information is also presented in wind roses in Appendix C but is available only for airports with continuous measurements. Wind roses are polar plots that visually present wind speed and direction.

Trend analysis is a technique used to estimate future conditions based on historical trends. The main assumption behind trend analysis is that what happened in the past is expected to happen in the future. Average temperature and precipitation and trend information for each New Mexico, Kansas, Oklahoma, and Texas climate division is compiled from the Climate at a Glance website (NCEI 2024a). The averages for the most recent climate normal period (1991–2020) are also presented for comparison to the average of all data from 1895 to 2024. Graphical representation of historical annual total precipitation (1895–2024) and trends and historical annual average temperature (1895–2024) and trends are provided in Appendix C.

The driver for the buildup of heat within the climate system is best described in terms of radiative forcing (RF). The term describes the energy balance (i.e., equilibrium), or the difference between solar radiation absorbed by Earth and the energy radiated back to space that will occur given the heliophysics of the sun-earth system and the basic laws of thermodynamics.

Earth's climate system is complex and interwoven in ways that are not yet fully understood. There are several known climate feedback mechanisms that add uncertainty in terms of timing (fast and slow feedbacks) and overall sensitivity within the evaluation of the climate system. Sensitivity refers to the amount of positive or negative feedback that occurs in response to a given forcing. The feedbacks and processes connecting RF to a climate response can operate on a wide range of time scales. Reaching temperature equilibrium in response to anthropogenic activities (emissions and land use changes) takes decades or longer because some of the climate components—in particular, the oceans—are slow to respond due to their large thermal masses and the long time scale of circulation between the ocean surface and the deep ocean. Some of the latest available climate feedback research indicates that relatively small changes in RF can initiate strong responses in some feedback components. This suggests that some of these mechanisms, and the climate in general, may have a higher sensitivity than is currently understood. As with the forcing components, there are also positive and negative feedback mechanisms, and there is a relatively wide range of uncertainty concerning estimates of climate sensitivity that leaves the subject open to further investigation. Section 4.1 of the BLM Specialist Report provides additional information on climate forcing and feedback.

10.2 GREENHOUSE GASES

Anthropogenic GHGs are commonly emitted air pollutants that include CO_2, CH_4, nitrous oxide (N_2O), and several fluorinated species of gases such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). CO_2 is by far the most abundant, and more than two-thirds of human-made CO_2 emissions in the United States come primarily from the transportation and electricity production sectors. CH_4 from human activities accounts for approximately 10% of total U.S. GHG emissions and results primarily from agriculture and natural gas and petroleum systems. N_2O emissions from agriculture, fuel combustion, and industrial sources account for approximately 7% of the U.S. total GHG emissions. Sections 3.1 through 3.3 of the BLM Specialist Report provide more details on these three GHG pollutants.

Atmospheric concentrations of naturally emitted GHGs have varied for millennia, and Earth's climate fluctuated accordingly. However, since the beginning of the industrial revolution around 1750, human activities have significantly increased GHG concentrations and introduced human-made compounds that act as GHGs in the atmosphere. Concentrations of CO_2, CH_4, and N_2O are now substantially higher than concentrations found in various ice cores dating back to the past 800,000 years. From preindustrial times until today, the global average concentrations of CO_2, CH_4, and N_2O in the atmosphere have increased by around 51%, 166%, and 25%, respectively. Table 78 shows the average global concentrations of CO_2, CH_4, and N_2O in 1750, 2011, and 2024. Atmospheric concentrations of GHGs are reported in ppm and ppb. Section 4.1 of the BLM Specialist Report provides additional information on historical GHG estimates and the NOAA-published Annual Greenhouse Gas Index (AGGI). The AGGI was developed to provide an easily understood standard for expressing the climate-warming influence of long-lived GHGs. Specifically, the AGGI is the ratio of the total direct climate forcing from measured long-lived GHG concentrations compared to the 1990 baseline year. The AGGI for 2023 was 1.52, which corresponds to a CO_2 equivalent atmospheric concentration of 534 ppm. This represents a 52% increase to climate forcing since 1990 and a 1.6% increase over 2022 levels. Whereas the AGGI does not predict the amount Earth's climate has warmed, it does provide a measure of the effect of GHG emissions on the climate system.

Table 78. Average Global Concentrations of GHGs in Select Years

Greenhouse Gas	Preindustrial 1750	2011	2024	Increase 1750–2024
CO_2	278 ppm	391 ppm	425 ppm*	53%
CH_4	722 ppb	1,803 ppb	1,930 ppb†	167%
N_2O	270 ppb	324 ppb	338 ppb†	25%

* The atmospheric CO_2 concentration is the 2024 annual average at the Mauna Loa, Hawaii, station (NOAA 2025). The global atmospheric CO_2 concentration, computed using an average of sampling sites across the world, was 423 ppm in 2024 (NOAA 2025).

† The values presented for CH_4 and N_2O are global 2024 annual average mole fractions (NOAA 2025).

10.3 OTHER GASES, ATMOSPHERIC AEROSOLS, AND PARTICULATES

Several gases do not have a direct effect on climate trends but indirectly affect the absorption of radiation by impacting the formation or destruction of GHGs. These gases include CO, NO_X, and non-CH_4 VOCs. Fossil fuel combustion and industrial processes account for most emissions of these indirect GHGs. Unlike other GHGs, these gases are short-lived in the atmosphere.

Atmospheric aerosols (PM) also contribute to climate trends. Aerosols directly affect climate by scattering and absorbing radiation (aerosol-radiation interactions) and indirectly affect climate by altering cloud properties (aerosol-cloud interactions). PM_{10} typically originates from natural sources and settles out of the atmosphere in hours or days. $PM_{2.5}$ often originates from human activities such as fossil fuel combustion. These so-called fine particles can exist in the atmosphere for several weeks and have local short-term impacts on climate. Aerosols can also act as cloud condensation nuclei, the particles upon which cloud droplets form.

Light-colored particles, such as sulfate aerosols, reflect and scatter incoming solar radiation, having a mild cooling effect, while dark-colored particles (often referred to as soot or black carbon) absorb radiation and have a warming effect (NASA 2010). There is also the potential for black carbon to deposit on snow and ice, altering the surface albedo (or reflectivity), and enhancing melting (Kang et al. 2020).

10.4 THE NATURAL GREENHOUSE EFFECT

The natural greenhouse effect is critical to the discussion of climate trends. The greenhouse effect refers to the process by which GHGs in the atmosphere absorb heat energy radiated by Earth's surface. Water vapor is the most abundant GHG, followed by CO_2, CH_4, N_2O, and several trace gases. Each of these

GHGs exhibit a particular "heat trapping" effect, which retains additional heat in the atmosphere that would otherwise be radiated into space. The greenhouse effect is responsible for Earth's warm atmosphere and temperatures suitable for life on Earth. Different GHGs can have different effects on Earth's warming due to their ability to absorb energy (radiative efficiency) and how long they stay in the atmosphere (lifetime). Without the natural greenhouse effect, the average surface temperature of Earth would be about zero degrees Fahrenheit (°F). Water vapor is often excluded from the discussion of GHGs and climate trends since its atmospheric concentration is largely dependent upon temperature rather than being emitted by specific sources.

11 GREENHOUSE GAS REGULATORY ANALYSIS

11.1 FEDERAL RULES

Originally, the NSPS OOOOa – Crude Oil and Natural Gas Facilities for Which Construction, Modification, or Reconstruction Commenced after September 18, 2015, and on or Before December 6, 2022, draft and rule were promulgated to regulate VOCs and GHG (CH_4) emissions from specific sources within the oil and natural gas industry, which would have included new, modified, and reconstructed compressors, pneumatic controllers, pneumatic pumps, storage vessels, well completions, fugitive emissions from well sites and compressor stations, and equipment leaks at natural gas processing plants. NSPS OOOO – Crude Oil and Natural Gas Facilities for Which Construction, Modification, or Reconstruction Commenced after August 23, 2011, and on or Before September 18, 2015, requires reduction of VOCs from well completion operations and storage tanks constructed after August 23, 2011. NSPS OOOOa requires reduction of VOCs from well completion operations from new or refractured hydraulically fractured wells and requires reduction of storage tank emissions by 95% for tanks constructed after September 18, 2015, with emissions greater than 6 tpy of VOCs (which has the co-benefit of reducing CH_4 emissions as well). NSPS OOOOa also imposes semiannual leak detection and repair requirements for the collection of fugitive emission components at well sites constructed after September 18, 2015, that produce more than 15 barrels of oil equivalent (boe) per day. NSPS OOOOa also requires scheduled maintenance and/or emission control devices for reciprocating and centrifugal compressor venting at compressor stations and includes provisions to limit emissions from natural gas pneumatic devices and pumps. In September 2018 and August 2019, the EPA proposed changes to the rule to modify, amend, and/or rescind requirements for the 2012 and 2016 NSPS for the oil and gas industry, which have been incorporated into the final rule as of September 14, 2020. Following the 2020 amendment to OOOO and OOOOa, fugitive emissions monitoring is required only for those wells producing greater than 15 boe per day. These provisions aim to reduce fugitive emissions of VOCs at oil and gas facilities.

On March 8, 2024, the EPA published a final rule, NSPS OOOOb—Standards of Performance for Crude Oil and Natural Gas Facilities for Which Construction, Modification or Reconstruction Commenced After December 6, 2022, that will sharply reduce emissions of CH_4 and other harmful air pollution from oil and natural gas operations—including, for the first time, from existing sources nationwide. The final action includes NSPS to reduce CH_4 and smog-forming VOCs from new, modified, and reconstructed sources. It also includes emissions guidelines, which set procedures for states to follow as they develop plans to limit CH_4 from existing sources (Subpart OOOOc). In May 2024, the EPA notified petitioners that it is granting reconsideration on two aspects of its final NSPS OOOOb in response to petitions from industry. The reconsideration will address narrow technical issues raised by industry petitioners related to monitoring and emergency operations for flares that were included in the final rule, which was published March 8, 2024. Through the reconsideration process, the EPA intends to propose and take public comment on minor changes to the final rule in response to these petitions. Together, 40 C.F.R. §

60, Subparts OOOO thru OOOOc, serve to control CH_4 emissions from oil and natural gas industry sources by requiring reduced emissions completions ("green" completions) on new hydraulically fractured gas wells as well as emissions controls on pneumatic controllers, pumps, storage vessels, and compressors. The EPA estimates the updated rules will avoid 58 million tons of CH_4 emissions, 16 million tons of VOCs, and approximately 590,000 tons of air toxics until 2038. On July 28, 2025, the EPA issued an interim final rule to extend certain compliance deadlines associated with NPS OOOOb and NPS OOOOc. In this interim final rule, the EPA is establishing more practical timelines for owners and operators of new and modified oil and natural gas sources nationwide. The agency is also extending the deadline for states to submit plans under the 2024 Emissions Guidelines, which aim to reduce CH_4 emissions from hundreds of thousands of existing sources across the country.

11.2 PREVENTION OF SIGNIFICANT DETERIORATION AND TITLE V

GHGs became regulated pollutants on January 2, 2011, under the PSD and Title V Operating Permit programs because of their contribution to global climate trend effects. These gases absorb energy emitted from Earth's surface and re-emit a larger portion of the heat back to Earth, rather than allowing the heat to escape into space, than would be the case under more natural conditions. The EPA GHG Tailoring Rule (40 C.F.R. §§ 51, 52, 70, et al.) set initial emissions thresholds for PSD and Title V permitting based on carbon dioxide equivalent (CO_2e). These thresholds apply to stationary sources that emit greater than 100,000 tons CO_2e per year (e.g., power plant, landfill) or modifications of major sources with a resulting emissions increase greater than 75,000 tons CO_2e per year. However, it is important to note that PSD requirements only apply to GHG emissions from sources that are otherwise required to obtain a PSD permit because they have the potential to emit large amounts of conventional pollutants.

In addition to the Tailoring Rule, the EPA requires reporting of GHGs from facilities with stationary sources that emit 25,000 tons of CO_2e per year or more in the United States. The Mandatory Reporting Rule (40 C.F.R. § 98, Subpart C) does not require control of GHGs; it only requires that sources above the threshold levels monitor and report emissions. Facilities used for injecting CO_2 for geological sequestration must report net emissions regardless of quantity (40 C.F.R. § 98, Subpart RR). This provides a basis for future EPA policy decisions and regulatory initiatives regarding GHGs. Section 2 of the BLM Specialist Report provides additional regulations and policies for GHGs (BLM 2024a).

12 GREENHOUSE GAS EMISSIONS

Common air emissions related to oil and gas activities include CO_2, CH_4, and N_2O. Other industries emit more potent GHGs, including several fluorinated species of gases, such as HFCs, PFCs, and SF_6. CO_2 is emitted from the combustion of fossil fuels (oil, natural gas, and coal), solid waste, and trees and wood products and as a result of other chemical reactions (e.g., manufacture of cement). The production and transport of coal, natural gas, and oil emit CH_4, which can also be emitted from coal mining operations, naturally occurring coal CH_4 seepages, releases/leaks from the oil and gas industry, livestock and other agricultural practices, and the decay of organic waste in municipal solid waste landfills. Agricultural and industrial activities emit N_2O, as does the combustion of fossil fuels and solid waste. Fluorinated gases are powerful GHGs that are emitted from a variety of industrial processes and are often used as substitutes for ODS (i.e., chlorofluorocarbons [CFCs], hydrochlorofluorocarbons [HCFCs], and halons), but they are typically not emitted from oil and gas operations. SF_6 is the most potent (highest radiative efficiency) GHG known and is typically used as an insulator in circuit breakers, gas-insulated substations, and switchgear used in the transmission system to manage the high voltages carried between power-generating stations and customer load centers.

The impact of a given GHG depends both on its RF and how long it lasts in the atmosphere. Each GHG varies with respect to its concentration in the atmosphere and the amount of outgoing radiation absorbed by the gas relative to the amount of incoming radiation it allows to pass through (i.e., RF). Different GHGs also have different atmospheric lifetimes. Some, such as CH_4, react in the atmosphere relatively quickly (on the order of 12 years); others, such as CO_2, typically last for hundreds of years or longer. Climate scientists have calculated a factor for each GHG that accounts for these effects and, when applied, results in CO_2e emissions. This factor is discussed in more detail in the EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990–2022* (EPA Inventory) (EPA 2024g).

Conversion factors for the 20-year time horizon were used to convert the different GHG emissions into CO_2e. CO_2e account for changes in radiative properties, atmospheric lifetimes, and indirect contributions of the different gases. The atmospheric lifetimes and conversion factors for the major GHGs over the 20-year and 100-year time horizons are listed in Table 79.

Table 79. Conversion Factors for CO_2e

Greenhouse Gas	Conversion Factors for 20-Year Time Horizon	Conversion Factors for 100-Year Time Horizon
CO_2	1	1
CH_4	Fossil origin: 82.5 Nonfossil origin: 79.7	Fossil origin: 29.8 Nonfossil origin: 27.0
N_2O	273	273
Select HFCs	N/A	HFC-32: 771 HFC-134a: 4,144
SF_6	N/A	N/A

Sources: EPA (2024g, 2024m, 2025r)*****

Note: N/A = not applicable

12.1 NATIONAL GREENHOUSE GAS EMISSIONS BY SECTOR

It is useful to compare the relative and absolute contributions to climate trends of different GHG emissions, as well as emissions from different regions and countries or sources and sectors. There are several different metrics that can be used for this comparison. A GHG emissions inventory is used to identify and quantify the anthropogenic GHG emissions from different regions and countries or sources and sectors. Using a conversion factor, GHG emissions are often reported in terms of CO_2e.

The EPA publishes the EPA Inventory annually (EPA 2024g). The lowest GHG emissions since reporting began, 6,026.0 million metric tons (megatonnes) (Mt) CO_2e, occurred in 2020, and the peak GHG emissions, 7,477.4 Mt CO_2e, occurred in 2005. The largest source of GHG emissions from human activities in the United States is from burning of fossil fuels for electricity, heat, and transportation. Total gross U.S. emissions decreased by 3.0% from 1990 to 2022; down from a high of 15.2% above 1990 levels in 2007. The latest national GHG emissions are for calendar year 2022, in which total gross U.S. GHG emissions were reported at 6,343.2 Mt CO_2e, representing an increase of approximately 0.2% from the previous year and corresponding to an increase of 14.4 Mt CO_2e from 2021. Net emissions (including sinks) were 5,489.0 Mt CO_2e in 2022. Net emissions increased by 1.3% from 2021 to 2022 and decreased by 16.7% from 2005 to 2022. Between 2021 and 2022, the increase in total GHG emissions was driven largely by an increase in CO_2 emissions from fossil fuel combustion across most end-use sectors due in part to increased energy use from the continued rebound of economic activity after the height of the coronavirus (COVID-19) pandemic. The CO_2 emissions from fossil fuel combustion increased by 1.0%, CO_2 emissions form natural gas use increased by 5.2%, and CO_2 emissions from petroleum increased by 0.9% from 2021 to 2022. Carbon sequestration in the land use, land-use change, and forestry sector offset 14.5% of total emissions in 2022 (EPA 2024g). Figure 5.4 in Section 5.3 of the BLM Specialist Report provides an illustration of U.S. GHG emissions (Mt/year) from fossil fuel combustion between 1990 through 2022 (BLM 2024a).

Section 5.3, Table 5-1 of the BLM Specialist Report further breaks down GHG emissions by major source category and shows GHG trends from 1990 to 2022. The pollutant categories reported in the annual inventory report include CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, and nitrogen trifluoride (NF_3); source categories vary for each pollutant. The primary GHG emitted by human activities in the United States was CO_2, representing approximately 79.7% of total 2022 GHG emissions on a GWP-weighted basis. The largest source of CO_2 and of overall GHG emissions in 2022 was fossil fuel combustion (4,699 Mt). CH_4 emissions from all sectors (760.8 Mt) accounted for 11.1% of U.S. emissions in 2022. The major sources of CH_4 include natural gas systems, enteric fermentation and manure management associated with domestic livestock, and decomposition of wastes in landfills. N_2O emissions accounted for 6.1% of total GHG emissions in 2022 (398.8 Mt). The agricultural sector, including fertilizers and soil management and manure management, was the largest source of N_2O emissions (BLM 2024a).

The energy sector includes three different subcategories—coal mining, natural gas and petroleum systems, and fossil fuel combustion. The emissions itemized under the coal mining and natural gas and petroleum systems subcategories include emissions for all U.S. sources in each of the categories and are not differentiated by mineral ownership (i.e., federal, state, or private minerals). In 2022, GHG emissions from the coal mining subcategory were 46.1 Mt, a decrease of 2.1% from the previous year (BLM 2024a). The coal mining sector includes emissions from underground mining, surface mining, and post-mining activities. In 2022, GHG emissions from the natural gas and petroleum systems subcategory were 271.3 Mt, a decrease of 4.2% from the previous year. The natural gas and petroleum systems sector includes emissions from oil and gas exploration, production, and processing, as well as other sources. In 2022, the total GHG emissions from the fossil fuel combustion subcategory were 4,699.4 Mt, up 1.0% from the previous year. The fossil fuel combustion sector includes emissions from the use of fossil fuels in transportation, electricity generation, industry, and residential use. Approximately 82% (5,199.8 Mt) of the total emissions was from the energy sector, primarily fossil fuel combustion for transportation and electricity generation (BLM 2024a).

12.2 GLOBAL, NATIONAL, STATE, AND COUNTY GREENHOUSE GAS EMISSIONS

Global and national annual GHG emissions and projections, as well as state annual GHG emissions, are discussed in Section 5.0 of the BLM Specialist Report (BLM 2024a) and calculated in the 2024 GHG Database (BLM 2025). The global, national, and state annual gross GHG emissions are presented in Table 80. Global emissions were obtained from the Emissions Database for Global Atmospheric Research (EDGAR) (EDGAR 2025). National emissions are from the EPA Inventory (EPA 2024g) and Section 5.3, Table 5-1 of the BLM Specialist Report. State emissions for 2022 are from the 2024 GHG Database (BLM 2025) and the EPA interactive tool, the Greenhouse Gas Inventory Data Explorer (EPA 2024h). State emissions for 1990, 2005, and 2017 through 2021 are available in Table 5-2, Section 5.5 of the BLM Specialist Report. Note that national- and state-level data are not yet available for 2023 and 2024.

Table 80. Annual Global, National, and State Gross GHG Emissions (CO_2e) for 2022

Area	CO_2e (Mt)
Global	53,786.00
Global fossil fuel CO_2	38,522.00
United States	6,343.20
United States fossil fuel CO_2	4,699.40
New Mexico	75.84
New Mexico fossil fuel CO_2	46.74
Oklahoma	133.48
Oklahoma fossil fuel CO_2	82.11
Kansas	109.01
Kansas fossil fuel CO_2	59.27
Texas	873.11
Texas fossil fuel CO_2	594.82

Sources: BLM (2025); EDGAR (2025); EPA (2024g, 2024h [retrieved September 16, 2024]).

County-level GHG emissions information for New Mexico is available in the 2020 NEI and from the EPA Facility Level Information on GHG Tool (FLIGHT) (EPA 2023h, 2024i). The NEI includes emissions data for mobile sources, prescribed fires, and wildfires, whereas FLIGHT includes emissions data for major industrial facilities. Although FLIGHT emissions data are updated annually, the 2020 reporting year is shown here to match the 2020 NEI data. The combined county-level anthropogenic GHG emissions from the NEI and FLIGHT datasets are provided in Table 81. At the county level, emissions information is not readily available for residential, commercial, agriculture, and fugitive sources, but these sources account for the difference in state and county total emissions shown in Table 80 and Table 81. Detailed emissions from all source types for each county are also provided in Appendix A.

Table 81. County-Level GHG Emissions (CO_2e) for the 2020 Reporting Year, New Mexico Counties in the Major Oil and Gas Basin

County	Data Source	CO_2 (tons)	CH_4 (tons)	N_2O (tons)	20-year Total CO_2e (tons)	100-year Total CO_2e (tons)
Chaves	NEI	384,360	30	6	**388,360**	**386,802**
	FLIGHT	84,247	40	48	**100,651**	**98,543**
Total		**468,607**	**70**	**54**	**489,011**	**485,345**
Eddy	NEI	607,292	59	6	**1,231,284**	**1,197,081**
	FLIGHT	844,135	649	1,222	**676,468**	**674,254**
Total		**1,451,427**	**708**	**1,228**	**1,907,752**	**1,871,335**
Lea	NEI	671,095	42	7	**951,197**	**947,621**
	FLIGHT	4,162,410	1,940	2,327	**1,801,179**	**1,703,262**

County	Data Source	CO_2 (tons)	CH_4 (tons)	N_2O (tons)	20-year Total CO_2e (tons)	100-year Total CO_2e (tons)
Total		**4,833,505**	**1,982**	**2,334**	**2,752,376**	**2,650,883**
McKinley	NEI	942,776	68	10	**25,325**	**24,797**
	FLIGHT	760,371	1,858	3,251	**1,086,609**	**1,082,134**
Total		**1,703,147**	**1,926**	**3,261**	**1,111,934**	**1,106,931**
Rio Arriba	NEI	284,211	76	4	**827,552**	**820,271**
	FLIGHT	21,223	10	12	**35,952,691**	**33,902,872**
Total		**305,434**	**86**	**16**	**36,780,243**	**34,723,143**
Sandoval	NEI	1,076,013	85	13	**35,320**	**34,582**
	FLIGHT	32,530	16	21	**388,360**	**386,802**
Total		**1,108,543**	**101**	**34**	**423,680**	**421,384**
San Juan	NEI	812,711	138	13	**613,868**	**610,774**
	FLIGHT	14,220,175	38,896	67,852	**1,231,284**	**1,197,081**
Total		**15,032,886**	**39,034**	**67,865**	**1,845,152**	**1,807,855**
Roosevelt	NEI	168,213	44	3	**4,985,031**	**4,855,493**
	FLIGHT	29,251	14	18	**951,197**	**947,621**
Total		**197,464**	**58**	**21**	**5,936,228**	**5,803,114**

Sources: EPA (2023h, 2024i)

12.3 NATIONAL GREENHOUSE GAS EMISSIONS GREENHOUSE GAS REPORTING PROGRAM

The Greenhouse Gas Reporting Program (GHGRP) is codified by regulation (40 C.F.R. § 98) and requires reporting of GHG data and other relevant information from large GHG emission sources, fuel and industrial gas suppliers, and CO_2 injection sites in the United States. In total, 41 categories are covered by the program. Facilities are generally required to submit annual reports under 40 C.F.R. § 98 if

- GHG emissions from covered sources exceed 25,000 tons (t) CO_2e per year;
- the supply of certain products would result in over 25,000 t CO_2e of GHG emissions if those products were released, combusted, or oxidized; or
- the facility receives 25,000 t or more of CO_2 for underground injection.

The reported data are usually made available to the public in October of each year. It should be noted that the GHGRP does not represent total U.S. GHG emissions but provides facility-level data for large sources of direct emissions, thus representing most of U.S. GHG emissions. The GHGRP data collected from direct emitters represent about half of all U.S. emissions. When including GHG information reported to the GHGRP by suppliers, emissions coverage reaches approximately 85% to 90% (EPA 2024j). The EPA Inventory contains information on all GHG emissions sources and sinks in the United States (EPA 2024g). For more information, please visit https://www.epa.gov/ghgreporting.

12.3.1 COMPRESSOR ENGINES AND STATIONS (MIDSTREAM) REPORTED GREENHOUSE GAS EMISSIONS

Compressor engines link the natural gas pipeline infrastructure that transports natural gas from its source to points of consumption. Table 82 shows the GHG emissions from transmission compressor stations and gas plants for each state where the BLM NMSO has mineral estate (from FLIGHT). Some gas plants and compressor stations emissions may not be reported to FLIGHT because emissions from the plant or station do not exceed the EPA GHG reporting threshold. Additionally, there are gathering compression stations that are not considered point sources under the Mandatory Reporting Rule and are instead reported under the oil and gas gathering and boosting industry segment.

Table 82. 2022 Midstream GHG from Gas Plants and Compressor Stations

State	Number of Reporting Transmission Compressor Stations*	Total GHG Emissions from Reporting Compressor Stations (Mt CO_2e)*	% U.S. Total Reported Compressor Station GHG Emissions*	Number of Reporting Gas Plants**	Total GHG Emissions from Reporting Gas Plants (Mt CO_2e)**	% U.S. Total Reported Gas Plant GHG Emissions**
New Mexico	17	0.74	2.11%	24	3.60	6.10%
Texas	112	5.90	16.86%	208	27.00	45.76%
Oklahoma	20	0.54	1.54%	45	2.50	4.24%
Kansas	22	0.60	1.71%	5	0.70	1.19%

Source: EPA (2024i). Data accessed September 17, 2024.

*Selected petroleum and natural gas systems and natural gas transmission/compression for transmission compressor station values. Total United States GHG emissions from reporting compressor stations is 35 Mt CO2e.

**Selected petroleum and natural gas systems and natural gas processing for gas plants values. Total United States GHG emissions from reporting gas plants is 59 Mt CO2e.

Emissions from the United States oil and gas point sources, which include natural gas processing, natural gas transmission and compression, onshore natural gas transmission pipelines, natural gas local distribution companies, underground natural gas storage, and liquified natural gas storage totaled 109 Mt CO_2e in 2022, which was about 4.04% of the total 2,695 Mt CO_2e emissions reported to EPA for the United States in 2022 (EPA 2024i). Emissions from the onshore oil and gas gathering and boosting segment, which includes compressor stations, meter stations, gathering pipelines, and other miscellaneous midstream oil and gas support facilities, totaled 86 Mt CO_2e in 2022 (EPA 2024i).

12.3.2 REFINERIES (MIDSTREAM) REPORTED GREENHOUSE GAS EMISSIONS

Crude oil produced throughout the BLM NMSO area of operations is transported by pipeline or tanker truck to refineries where the oil is processed into various types of fuel. Table 83 shows the GHG emissions from refineries in each BLM NMSO state.

There are three refineries in New Mexico: one in Jamestown (Gallup Refinery), one in Artesia, and one in Lovington. Kansas has three refineries, Oklahoma has five refineries, and Texas has 31 refineries. Transportation and processing of crude oil and petroleum products result in emissions of various HAPs, criteria pollutants, and GHGs. In 2022, GHG emissions from refineries (total of 135 reporting) accounted for 164 Mt CO_2e emitted, which is 6.09% of the 2022 total of 2,695 Mt CO_2e emissions reported to EPA (EPA 2024j).

Table 83. 2022 GHG Emissions from Refineries

State	Number of Reporting Refineries	Total GHG Emissions from Reporting Refineries (Mt CO_2e)	% U.S. Total Reported Refinery GHG Emissions
New Mexico	3	0.79n	0.48
Texas	31	55.00	32.73
Oklahoma	5	4.40	2.48
Kansas	3	3.20	1.88

Source: EPA (2024i)

12.3.3 OTHER MAJOR INDUSTRIES GENERATING GREENHOUSE GAS EMISSIONS

Potash mining is another major industry in the BLM CFO planning area. The two potash minerals mined in New Mexico are sylvite (potassium chloride) and langbeinite (potassium-magnesium sulfate). The minerals are mined from two underground mines and one solution mine that involve federal potassium leases in southeastern New Mexico. Potash production produces emissions of various HAPs, criteria pollutants, and GHGs. In 2015, potash mines in southeastern New Mexico emitted 97,140 t CO_2e collectively. This is 0.002% of total U.S. GHG emissions (EPA 2023h). In 2016, CO_2e emissions from other major industries decreased significantly, as some facilities discontinued reporting GHG emissions for valid reasons: operations had ceased, operations were changed such that a process or operation no longer met the reporting criteria, the entire facility or supplier was merged into another facility or supplier that already reports to the GHGRP, the facility reported emissions or quantity of GHG supplied of less than 15,000 t CO_2e for 3 consecutive years, or the facility reported emissions or quantity of GHG supplied of less than 25,000 t CO_2e for 5 consecutive years. For example, in 2019, the reported emissions from intrepid potash were only 8,109 t CO_2e, which is 0.0001% of total U.S. GHG emissions. As of 2021, 0 t CO_2e were reported.

Coal mining and coal-fired power generation are major industries in San Juan County, New Mexico. Coal production produces emissions of various HAPs, criteria pollutants, and GHGs. In 2022, the San Juan Mine reported 0.37 Mt CO_2e, whereas data for the Navajo Mine were not available. In 2022, underground coal mining in the United States contributed 26.5 Mt CO_2e, which is 0.42% of total U.S. GHG emissions (EPA 2024j).

The 2020 NEI data for San Juan County include emissions from the San Juan Generating Station near Waterflow, New Mexico, and the Four Corners Power Plant on Navajo Nation land in Fruitland, New Mexico. Both were major sources under the PSD program and subject to BART requirements to comply with the Regional Haze Rule. Two EGUs at the San Juan Generating Station were shut down in December 2017, and new selective catalytic reduction (SCR) technology was installed on the two remaining EGUs. The 2020 NEI data take into account the EGU shutdowns and the new SCR system technology; subsequently, the San Juan Generating Station was closed in September 2022, removing all EGUs associated with this facility. Two EGUs have been shut down at the Four Corners Power Plant, and the remaining two EGUs had SCR technology installed in 2018. The shutdown of San Juan Generating Station and two EGUs at the Four Corners Power Plant and the installation of SCR technology at the Four Corners Power Plant are expected to result in significant emissions reductions.

In Texas, EGUs in O_3 nonattainment areas (Beaumont-Port Arthur, Dallas-Fort Worth, and Houston-Galveston-Brazoria) are required to limit NO_x emissions from utility boilers, auxiliary steam boilers, stationary gas turbines, and duct burners under 30 T.A.C. § 117(c). The Texas-proposed regional haze SIP did not require BART-eligible EGUs to install controls because the State of Texas determined the impact of each plant's emissions did not significantly degrade visibility in a Class I area or facilities had already reduced emissions or shut down units. On December 16, 2014, the EPA proposed to partially disapprove the Texas regional haze SIP and also proposed a Federal Implementation Plan to require SO_2 emissions reductions at 15 Texas BART-eligible sources.

In Oklahoma, Tulsa Public Service Company of Oklahoma retired one coal-fired EGU in Oologah, Oklahoma, and installed a dry sorbent injection system on a second coal-fired EGU in April 2016. These actions resulted in a 78% reduction in SO_2 emissions and an 81% reduction in NO_2 emissions. A second EGU will be shut down by December 31, 2026, to meet the requirements of the Regional Haze Rule.

In 2011, EPA disapproved the Oklahoma SIP revision regarding controls at the Oklahoma Gas and Electric Sooner and Muskogee Units and the American Electric Power (AEP)–Public Service Company of Oklahoma (PSO) Northeastern Plant Units 3 and 4. The EPA determined that dry scrubber control technology was needed at these units to meet Regional Haze Rule requirements. The disapproval was challenged by the State of Oklahoma, upheld by the courts, and has been appealed to the Supreme Court by the State of Oklahoma. Oklahoma submitted a SIP revision in 2013 that was approved by the EPA in March 2014, which revises the BART determination for AEP-PSO Units 3 and 4. The revised determination includes short-term compliance with emissions limits, shutdown of one of the units by April 16, 2016, and shutdown of the other unit by December 31, 2026.

In Kansas, emissions at four coal-fired EGUs were significantly reduced as a result of the Regional Haze Rule. At the Kansas City Power and Electric La Cygne Power Plant, an SCR system was installed on both units, and air scrubbers were installed. These actions resulted in an 83% reduction in NO_x emissions and an 82% reduction in SO_2 emissions. Installing low-NO_x burners and switching to natural gas combustion at the Westar Energy Jeffrey Energy Center coal-fired EGUs resulted in an 82% reduction in NO_x emissions and a 34% reduction in SO_2 emissions. In addition, the EPA has issued final carbon pollution standards for power plants that set CO_2 limits for new gas-fired combustion turbines and CO_2 emission guidelines for existing coal, oil- and gas-fired steam generating units, securing important climate benefits and protecting public health (NSPS TTTTa).

13 CLIMATE TREND PROJECTIONS

13.1 STATE CLIMATE TRENDS AND OBSERVATIONS

The NOAA NCEI released its climate summaries by state in 2022. The key messages bulleted below in Sections 13.4.1.1 through 13.1.1.4 represent climate summary information for each state within the BLM NMSO area of operations. More detailed climate discussions for each state can be found through the State Climate Summaries webpage (NOAA 2022). Section 4.4 of the BLM Specialist Report also discusses the climate indicators, impacts, and trends, including NOAA precipitation and temperature data, specific to states where the BLM conducts most of its fossil fuel authorizations (BLM 2024a).

13.1.1 NEW MEXICO

- Average annual temperature has increased by almost 2°F since the beginning of the twentieth century, and the number of extremely hot days and warm nights has also increased.
- The summer monsoon rainfall, which provides much needed water for agricultural and ecological systems, varies greatly from year to year.
- Droughts are a serious threat in this water-scarce state. Precipitation is highly variable from year to year and decade to decade. Unlike many areas of the United States, New Mexico has not experienced an upward trend in the frequency of extreme precipitation events (Frankson, Kunkel, Stevens, and Easterling 2022).

13.1.2 OKLAHOMA

- Average annual temperature has increased by about 0.6°F since the beginning of the twentieth century. Winter warming has been characterized by the occurrence of extremely cold days being much below average since 1990.
- Precipitation can vary greatly from year to year in this region of transition from humid to semi-arid conditions. The frequency of 2-inch extreme precipitation events has increased since 1985, with the highest number of events occurring in 2015.
- The agricultural economy of Oklahoma makes the state particularly vulnerable to droughts, several of which have occurred in recent years. In addition to devastating impacts on the agricultural economy, severe droughts also increase the risk of wildfires (Frankson, Kunkel, Stevens, Champion, et al. 2022).

13.1.3 KANSAS

- Average annual temperature has increased about 1.5°F since the beginning of the twentieth century, with greater warming in the winter and spring than in the summer and fall. The number of very cold nights has been much below average since 1990.
- Precipitation has varied greatly from year to year in this region of transition from humid conditions in the east of the state to semi-arid conditions in the west. The frequency of extreme precipitation events has been highly variable but shows a general increase; the number of 2-inch precipitation events was well above average in 2015 through 2020.
- Due to the state's geography, which allows cold, dry air from the north to combine with warm, moist air from the Gulf of America, severe thunderstorms are common in Kansas. Some of these thunderstorms can produce large hail, high winds, and tornadoes.
- The agricultural economy of Kansas makes the state vulnerable to droughts and heat waves, several of which occurred in the 1930s, 1950s, and in recent years (Frankson, Kunkel, Stevens, Easterling, Lin, et al. 2022).

13.1.4 TEXAS

- Mean annual temperature has increased by almost 1.5˚F since the beginning of the twentieth century.

- Precipitation is widely variable across Texas, with normal amounts ranging from less than 10 inches in the far west to more than 60 inches in the extreme southeast.
- Texas is consistently ranked in the top 10 states affected by extreme events. From 1900 through 2020, Texas endured more than 85 tropical storms and hurricanes (about three storms every 4 years) (Runkle et al. 2022).

13.2 NEW MEXICO GREENHOUSE GAS TRENDS

Overall, total New Mexico statewide gross GHG emissions are expected to decrease (Energy and Environmental Economics, Inc. [E3] 2020). The *New Mexico Greenhouse Gas (GHG) Emissions Inventory and Forecast* (E3 2020) projects the following for year 2030 in New Mexico for emissions produced within the state (i.e., production-based emissions):

- Gross GHG emissions of 96.6 Mt CO_2e—an increase of 22% relative to 2005 and a decrease 15% relative to 2018. New Mexico emissions are more than twice the national average of GHG emissions per capita. High per-capita emissions for New Mexico are largely the result of a GHG-intensive oil and gas industry, which makes up a significant portion of the overall GHG emissions profile.
- Top sources of GHG emissions are transportation fuel use (15.4 Mt CO_2e,), electricity generation (12.9 Mt CO_2e), and oil and gas (fugitive and fuel emissions) (32.5 Mt CO_2e). GHG emissions from transportation fuel and electricity generation decrease from 2005 estimates, but GHG emissions from oil and gas increase.
- Approximately 43 Mt CO_2e are projected as a result of oil and natural gas production, processing, transmission, and distribution. This is 44.5% of the gross New Mexico emissions, a slight decrease compared with the relative contribution of oil and gas production in 2018 (53.0%), and an increase compared with the relative contribution of oil and gas production in 2005 (25.0%).

All scenarios show a significant rise in emissions from 2005 to 2018, as well as a significant drop from 2018 to 2023, driven primarily by the NSPS for the oil and gas sector (E3 2020). Additional projections of emissions for New Mexico, Texas, Oklahoma, and Kansas are found in Section 7 of the BLM Specialist Report (Figure 7-1 and 7-2), which is discussed in more detail in Sections 16.1 and 16.2 of this report.

13.3 CUMULATIVE CLIMATE TREND SUMMARY

Existing conditions of climate trends in any given location are the result of numerous complex factors, both natural and human caused. Natural factors contributing to the current condition of air resources include existing climate resulting from long-term atmospheric weather patterns, soil types, and vegetation types. Anthropogenic factors contributing to the current condition of air resources include long-term human habitation, growing human populations, transportation methods and patterns, recreational activities, economic patterns, and the presence of power plants and other industrial sources. The presence of natural resource (primarily oil and natural gas) extraction and processing on some BLM lands also affects air quality and GHG emissions.

The EIA 2025 AEO (EIA 2025) projects that U.S. total energy consumption will decline through 2040 before gradually increasing toward 2050, reflecting the interplay between efficiency gains, electrification, and changing demand dynamics. Despite efficiency improvements, population and economic growth ultimately drive the overall energy use higher by mid-century. Production of natural gas and petroleum liquids will continue to rise—driven largely by international demand and expanded export capacity—keeping the United States a net exporter through 2050. Specifically, natural gas production increases modestly from about 40 quads in 2024 to approximately 43.5 quads by 2050, while oil production grows through the mid-2020s before leveling off. Renewables remain the fastest-growing U.S. energy source, with wind and solar generation expected to surge—wind and solar together are projected to reach over 4,200 terrawatt-hours by 2050, compared with around 1,000 terrawatt-hours in 2025. As the electricity sector shifts toward renewables, natural gas-fired generation holds steady for a decade before beginning a pronounced decline in the early 2030s, dropping nearly 37% by 2039 to about 22.7 billion cubic feet per day and then stabilizing. Consequently, energy-related CO_2 emissions are projected to continue declining, reaching 33% to 35% below 2005 levels by 2050 in the AEO reference case. Further discussion of past, present, and projected global and state GHG emissions can be found in Chapter 5 of the BLM Specialist Report (BLM 2024a).

14 GREENHOUSE GAS ANALYSIS AND METHODOLOGIES

As stated, the BLM Specialist Report presents the estimated emissions of GHGs attributable to fossil fuels produced on land and mineral estate managed by the BLM. Fossil fuel extraction, construction, and operation (well development), and processing and end-use production activities all contribute to air pollutants and GHG emissions in the BLM FFO, BLM RFO, and BLM CFO areas, especially San Juan, northwest Sandoval, Eddy, Lea, and Chaves Counties, as well as in parts of Oklahoma, Kansas, and Texas. This includes midstream sources from the natural gas compressor stations and pipelines, gas plants, and petroleum refining as well as final downstream end-use by the consumer. Coal mining is also occurring in the BLM FFO and BLM OFO areas. Potash mining in the BLM CFO area also contributes to air contaminant and GHG emissions.

The BLM Specialist Report contains estimates of both direct and indirect (including downstream combustion) emissions from BLM-authorized fossil fuel development on the federal mineral estate for the three primary GHGs of concern (CO_2, CH_4, and N_2O). In addition, the estimated emissions are aggregated at different scales for comparison with emissions reports and inventories completed by other entities at state, national, and global scales and for relevant industrial sectors.

14.1 DIRECT AND INDIRECT OIL AND GAS EMISSIONS

The term direct is used to describe emissions from fossil fuel mineral development and production-related activities authorized by the BLM that typically take place on leased acres of the federal mineral estate. Direct emissions could result from a variety of activities, such as lease exploration, access road construction, well pad or coal mine development, well drilling and completions, recurring maintenance and production equipment operations, and site reclamation.

Indirect emissions occur as a consequence of the authorized action and can include activities such as the processing, transportation, and any end-use combustion of the fossil fuel mineral products. They are a consequence of the produced fossil fuels but occur downstream from the point of production on federal lands and/or are outside of BLM approval authority. End-use emissions make up most of GHG emissions related to federal energy resource development. The sum of the direct and indirect GHG emissions from fossil fuel mineral production is also known as a life cycle assessment (LCA).

The emissions estimates are also presented at two cumulative scales: geographic and temporal.
The geographic cumulative scale is the entire onshore federal mineral estate managed by the BLM.

The temporal cumulative scales include estimated emissions from total federal onshore mineral production projected for the next 12 months, the life-of-project emissions estimates associated with the 12-month projections, and the long-term emissions from the portion of energy demand estimated to be met from the federal mineral estate out to year 2050 using data from the EIA. The estimates provide a baseline for comparing emissions from BLM-authorized development with those of the broader economy (national and global) and illustrate the degree to which federal fossil fuel mineral development contributes to projected GHG emissions and therefore to climate trends.

To account for the full LCA, estimates of projected emissions are included on both a short-term and long-term basis. The short-term estimates are based on RFD trends derived from leasing and production statistics, and the long-range estimates are based on the analysis of energy market dynamics developed by the EIA in its AEO report. Together, the estimates are designed to provide relevant, well-supported, and factual information that is intended to fully account for GHG emissions from BLM authorizations to develop the federal mineral estate (BLM 2024a).

Section 6.1 of the BLM Specialist Report contains emission factors and production data applying a combination of published LCA data, other studies and statistics, and assumptions for each fossil fuel type. In general, this means that the total federal GHG burden on the environment is best described by the end use, or downstream combustion portion of the disclosed accounting, plus any fugitive emissions that result from fossil mineral processes prior to end use. Some of the referenced LCA sources contain estimates for systemic losses of CH_4 (i.e., fugitive emissions), such that when these data are available the BLM back-calculates the fugitive losses from the direct emissions to more fully provide transparency for emissions resulting from BLM-authorized development.

The end-use phase emissions for coal, oil, and gas (assumed combustion) are estimated using EPA emissions factors from Tables C-1 and C-2 of 40 C.F.R. § 98, Subpart C, as shown in Tables 6-2, 4-7, and 4-9 of the BLM Specialist Report. The EPA factors were chosen to represent the downstream portion of these life-cycle emissions since they provide a relatively straightforward basis for estimating the consumption of each fuel for which the actual downstream transformation or use is relatively unknown compared to the assumptions and specificity used in the referenced LCA data.

Fossil fuel production is the primary input used in the LCA methodology and generally in this report. The BLM uses data and statistics from the EIA and the Department of the Interior Office of Natural Resources Revenue (ONRR), both of which provide production accounting services for domestic fossil fuel minerals to estimate report year emissions on a fiscal year basis (when such data exist). Details on the coal, oil, and gas emission factors are in Sections 6.2, 6.4, and 6.5 of the BLM Specialist Report. Table 84 through Table 87 present emissions data from reasonably foreseeable projects involving federal fossil fuel production and authorizations from BLM NMSO area of operation.

Table 84. Emissions from Reasonably Foreseeable Projected 12-Month Projects Involving Federal Fossil Fuel Production and Authorizations in New Mexico

BLM-Authorized	Direct (Mt CO_2e/year)	Indirect (Mt CO_2e/year)	Combustion (Mt CO_2e/year)	Total Mt (CO_2e/year)	Life-of-Project (Mt CO_2e)
Existing Federal Production					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	29.99	24.74	176.21	230.94	1,967.41
Gas	11.05	28.05	106.25	145.35	1,331.41

BLM-Authorized	Direct (Mt CO_2e/year)	Indirect (Mt CO_2e/year)	Combustion (Mt CO_2e/year)	Total Mt (CO_2e/year)	Life-of-Project (Mt CO_2e)
Total	41.04	52.79	282.46	376.29	3,298.82
Permitted but Not Yet Developed Oil, Gas, and Coal Leases					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	22.83	18.84	134.17	175.84	539.40
Gas	6.13	15.56	58.94	80.63	256.37
Total	28.96	34.40	193.11	256.47	795.77
Potential New Leases in the Next 12 Months					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	2.57	2.12	15.12	19.81	60.79
Gas	0.69	1.75	6.64	9.08	28.89
Total	3.26	3.87	21.76	28.89	89.68
Total Projected Emissions by Mineral Type					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	55.39	45.70	325.50	426.59	2,567.60
Gas	17.87	45.36	171.83	235.06	1,616.67
Total	73.26	91.06	497.33	661.65	4,184.27

Source: BLM (2025). Information can be found on the tab labeled emis at https://docs.google.com/spreadsheets/d/1ozP2Bf-0GSp--gVoxPodO3e7HfAYS8lNUM5qjaRotXY/edit?usp=sharing.

Table 85. Emissions from Reasonably Foreseeable Projected 12-Month Projects Involving Federal Fossil Fuel Production and Authorizations in Kansas

BLM-Authorized	Direct (Mt CO_2e/year)	Indirect (Mt CO_2e/year)	Combustion (Mt CO_2e/year)	Total Mt (CO_2e/year)	Life-of-Project (Mt CO_2e)
Existing Federal Production					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	0.00	0.00	0.03	0.03	0.51
Gas	0.01	0.03	0.12	0.17	2.74
Total	**0.01**	**0.03**	**0.15**	**0.19**	**3.25**
Permitted but Not Yet Developed Oil, Gas, and Coal Leases					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	0.00	0.00	0.00	0.00	0.03
Gas	0.00	0.00	0.00	0.00	0.03
Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.06**

BLM-Authorized	Direct (Mt CO_2e/year)	Indirect (Mt CO_2e/year)	Combustion (Mt CO_2e/year)	Total Mt (CO_2e/year)	Life-of-Project (Mt CO_2e)
Potential New Leases in the Next 12 Months					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	0.00	0.00	0.02	0.02	0.13
Gas	0.00	0.01	0.02	0.03	0.14
Total	**0.00**	**0.01**	**0.04**	**0.05**	**0.27**
Total Projected Emissions by Mineral Type					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	0.00	0.00	0.05	0.05	0.67
Gas	0.01	0.04	0.14	0.19	2.91
Total	**0.01**	**0.04**	**0.19**	**0.24**	**3.58**

Source: BLM (2025). Information can be found on the tab labeled emis at https://docs.google.com/spreadsheets/d/1ozP2Bf-0GSp--gVoxPodO3e7HfAYS8lNUM5qjaRotXY/edit?usp=sharing.

Table 86. Emissions from Reasonably Foreseeable Projected 12-Month Projects Involving Federal Fossil Fuel Production and Authorizations in Texas

BLM-Authorized	Direct (Mt CO_2e/year)	Indirect (Mt CO_2e/year)	Combustion (Mt CO_2e/year)	Total Mt (CO_2e/year)	Life-of-Project (Mt CO_2e)
Existing Federal Production					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	0.01	0.01	0.07	0.07	1.44
Gas	0.17	0.44	1.67	2.73	28.67
Total	**0.18**	**0.45**	**1.74**	**2.37**	**30.11**
Permitted but Not Yet Developed Oil, Gas, and Coal Leases					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	0.17	0.14	1.01	1.69	8.24
Gas	0.06	0.15	0.58	1.03	3.55
Total	**0.23**	**0.29**	**1.59**	**2.11**	**11.79**
Potential New Leases in the Next 12 Months					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	0.05	0.04	0.28	0.14	2.29
Gas	0.02	0.04	0.16	0.08	0.99
Total	**0.07**	**0.08**	**0.44**	**0.59**	**3.28**
Total Projected Emissions by Mineral Type					
Coal	0.00	0.00	0.00	0.00	0.00

BLM-Authorized	Direct (Mt CO_2e/year)	Indirect (Mt CO_2e/year)	Combustion (Mt CO_2e/year)	Total Mt (CO_2e/year)	Life-of-Project (Mt CO_2e)
Oil	0.23	0.19	1.36	1.78	11.97
Gas	0.25	0.63	2.41	3.29	33.21
Total	**0.48**	**0.82**	**3.77**	**5.07**	**45.18**

Source: BLM (2025). Information can be found on the tab labeled emis at https://docs.google.com/spreadsheets/d/1ozP2Bf-0GSp--gVoxPodO3e7HfAYS8lNUM5qjaRotXY/edit?usp=sharing.

Table 87. Emissions from Reasonably Foreseeable Projected 12-Month Projects Involving Federal Fossil Fuel Production and Authorizations in Oklahoma

BLM-Authorized	Direct (Mt CO_2e/year)	Indirect (Mt CO_2e/year)	Combustion (Mt CO_2e/year)	Total Mt (CO_2e/year)	Life-of-Project (Mt CO_2e)
Existing Federal Production					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	0.03	0.02	0.17	0.69	2.40
Gas	0.05	0.14	0.52	0.82	8.34
Total	**0.08**	**0.16**	**0.69**	**0.93**	**10.74**
Permitted but Not Yet Developed Oil, Gas, and Coal Leases					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	0.02	0.02	0.14	0.15	0.55
Gas	0.02	0.05	0.20	0.24	1.10
Total	**0.04**	**0.07**	**0.34**	**0.45**	**1.65**
Potential New Leases in the Next 12 Months					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	0.02	0.01	0.10	0.13	0.40
Gas	0.01	0.04	0.14	0.18	0.79
Total	**0.03**	**0.05**	**0.24**	**0.32**	**1.19**
Total Projected Emissions by Mineral Type					
Coal	0.00	0.00	0.00	0.00	0.00
Oil	0.07	0.05	0.41	0.53	3.35
Gas	0.08	0.23	0.86	1.17	10.23
Total	**0.15**	**0.28**	**1.27**	**1.70**	**13.58**

Source: BLM (2025). Information can be found on the tab labeled emis at https://docs.google.com/spreadsheets/d/1ozP2Bf-0GSp--gVoxPodO3e7HfAYS8lNUM5qjaRotXY/edit?usp=sharing.

14.2 COAL, OIL, AND GAS PRODUCTION

Estimates of production (or downstream/end-use) GHG emissions depend on projected oil and gas production volumes. The BLM does not direct or regulate the end use of produced oil or gas. The challenge for estimating downstream emissions comes with understanding when and how oil and gas would be distributed and used for energy. It can be reasonably assumed that oil and gas produced on leases would be combusted primarily for electricity generation, transportation, industry, agriculture, commercial, and residential uses. From this assumption, the BLM provides potential GHG emissions estimates using currently available GHG emissions data. Section 6.2 (Coal) Table 6-6 (Federal Coal Production [tons]), Section 6.4 (Crude Oil) Table 6-9 (Federal Oil Production [bbl]), and Section 6.5 (Natural Gas) Table 6-11 (Federal Gas Production [Mcf]) of the BLM Specialist Report present emissions for year 2023 from BLM coal, crude oil, and gas leasing authorizations, which are based on ONRR records of actual coal, oil, and gas production (BLM 2024a). These tables show the total U.S. coal, oil, and gas production (federal and non-federal) and ONRR production data from the United States, federal authorizations, and the BLM NMSO area of operation to illustrate the percentage of federal coal relative to the U.S. total (percent U.S. total) and the percentage of federal coal, oil, and gas that comes from the various federal producing states (percent federal). The end-use phase emissions for coal, oil, and gas (assumed combustion) are shown in BLM Specialist Report Tables 6-2, 6-8, and 6-10 and ONRR production data.

14.3 UNCERTAINTIES OF GREENHOUSE GAS CALCULATIONS

Section 6.8 of the BLM Specialist Report discusses uncertainties that could impact the GHG estimates. The BLM acknowledges that operational diversity, product variations, and broad geographic distribution of the federal mineral estate introduces some uncertainty into the simplifying assumptions and approximation methodologies used to estimate emissions for the BLM Specialist Report, which could have relatively small impacts, while other uncertainties could have a larger impact on the estimates. The best available data were used and presented for the emissions estimates in this report, and as new information becomes available, the BLM will continue to improve and revise its emissions estimates, methodologies, and assumptions as appropriate. Ultimately, these estimates are subject to many influences that are largely beyond BLM practical control. Section 6.8 of the BLM Specialist Report discusses these uncertainties in more detail.

15 OIL AND GAS SINGLE-WELL GREENHOUSE GAS EMISSIONS

15.1 FIELD OFFICE

15.1.1 FARMINGTON FIELD OFFICE

The GHG single-well emission factors in Table 88 use the same methodology discussed in Section 7.1.1.

Table 88. BLM FFO and BLM RPFO Horizontal Single-Well GHG Emissions

Phase	Total Emissions (metric tons per year)			
	CO_2	CH_4	N_2O	CO_2e
Single-well construction/ development phase	1,607.50	0.66	0.013	1,630.72

Phase	Total Emissions (metric tons per year)			
	CO_2	CH_4	N_2O	CO_2e
Single-well operation phase	937.31	5.40	0.002	1,099.03
Single-well total	**2,544.81**	**6.06**	**0.015**	**2,729.75**

Source: BLM Single Oil and Gas Well Emission Inventory Tool

Note: These are the maximum emissions from oil and gas scenarios – single-well emissions in the San Juan Basin.

15.1.2 PECOS DISTRICT OFFICE

The GHG single-well emission factors in Table 89 use the same methodology discussed in Section 7.1.2.

Table 89. BLM PDO Horizontal Single-Well GHG Emissions

Phase	Total Emissions (metric tons per year)				
	CO_2	CH_4	N_2O	100-yr CO_2e	20-yr CO_2e
Single-well construction/ development phase	1,686.74	0.45	1.34E-02	1,703.89	1,727.76
Single-well operation phase	358.51	1.41	2.18E-03	401.07	475.28
Single-well total	**2,045.25**	**1.86**	**1.56E-02**	**2,104.96**	**2,203.05**

Source: BLM Single Oil and Gas Well Emission Inventory Tool

15.1.3 OKLAHOMA FIELD OFFICE

The GHG single-well emission factors in Table 90 use the GHG Lease Sale Tool default emissions for a deep oil/high gas scenario.

Table 90. BLM OFO Horizontal Oil Single-Well GHG Emissions

Phase	Total Emissions (metric tons per year)			
	CO_2	CH_4	N_2O	CO_2e
Single-well construction/ development phase	1,767.40	1.010	0.0140	1,801.32
Single-well operation phase	1,113.70	16.860	0.0030	1,616.95
Single-well total	**2,881.10**	**17.870**	**0.0170**	**3,418.27**

Source: BLM Single Oil and Gas Well Emission Inventory Tool

16 GREENHOUSE GAS EMISSIONS AND PROJECTIONS FROM BLM-AUTHORIZED ACTIONS

The estimates presented here provide direct and indirect GHG emissions estimates for the existing federal fossil fuel production. Existing emissions estimates show the GHGs emitted from the assumed consumption of each fossil fuel based on production statistics from the previous fiscal year for all producing wells and mines. The projected emissions include both short- and long-term estimates based on the methodologies discussed in Chapter 6 of the BLM Specialist Report.

16.1 SHORT TERM

Table 7-1 of the BLM Specialist Report presents the emissions from coal production on the federal mineral estate in fiscal year (FY) 2023, which result from multiplying the representative emission factors from Tables 6-1 (Coal Production Emissions Factors and Statistics), 6-3 (Derived Downstream Coal Emissions Factors), and 6-4 (Coal Transport Emissions Factors) in the BLM Specialist Report by the state-specific shipping and production data contained in Tables 6-5 (Coal Transport Data) and 6-6 (Federal Coal Production [tons]). The short-term emissions projections (12-month and life-of-project) from reasonably foreseeable coal production in the eight states where federal coal is presently being produced are also included in the BLM Specialist Report as Table 7-2 (Federal Coal Emissions - Projected 12-Months [Mt]) and Table 7-3 (Federal Coal Emissions - Projected Short-Term Life-of-Project [Mt]).

Table 7-4 (Federal Oil Emissions - Held-By-Production Lands 2023 [Mt]) of the BLM Specialist Report shows the FY 2023 held-by-production emissions from oil production on the federal mineral estate. The emissions are calculated by multiplying the emission factors from Tables 6-8 (GHG Emissions Factors for Federal Oil Production [tonnes/bbl]) of the BLM Specialist Report by the state-specific production amounts from emission factors Table 6-9 (Federal Oil Production [bbl]) of the same report.

Table 7-11 (Federal Gas Emissions - Held-By-Production Lands 2023 [Mt]) of the BLM Specialist Report shows the FY 2023 held-by-production emissions from gas production on the federal mineral estate. The emissions are calculated by multiplying the emission factors from Table 6-10 (GHG Emissions Factors for Federal Gas Production [tonnes/Mcf]) of the BLM Specialist Report by the state-specific production amounts from Table 6-11 (Federal Gas Production [Mcf]). These estimates include emissions from the full oil and gas life cycle, including emissions arising from activities outside of BLM jurisdiction (such as emissions associated with refining and processing). The emissions from oil and gas projected APD approvals and leasing within the next 12 months on both a maximum annual and life-of-project basis are also included in the BLM Specialist Report. Figure 7-1 of the BLM Specialist Report also shows the cumulative sum of all the state series (i.e., the federal sum), which is also displayed in the BLM Specialist Report Table 7-18 (Federal Summary - Projected Short-Term Life-of-Project Emissions [Mt]).

The 2023 BLM Specialist Report is still the most recent published report. However, the GHG data has been updated in the 2024 GHG Database, and Figure 33 through Figure 36 show an annualized timeline of the projected short-term life-of-project CO_2e emissions from existing producing wells and projected wells from new APDs and leasing (12 months) for each state within the BLM NMSO area of operation from the 2024 GHG Database (BLM 2025).

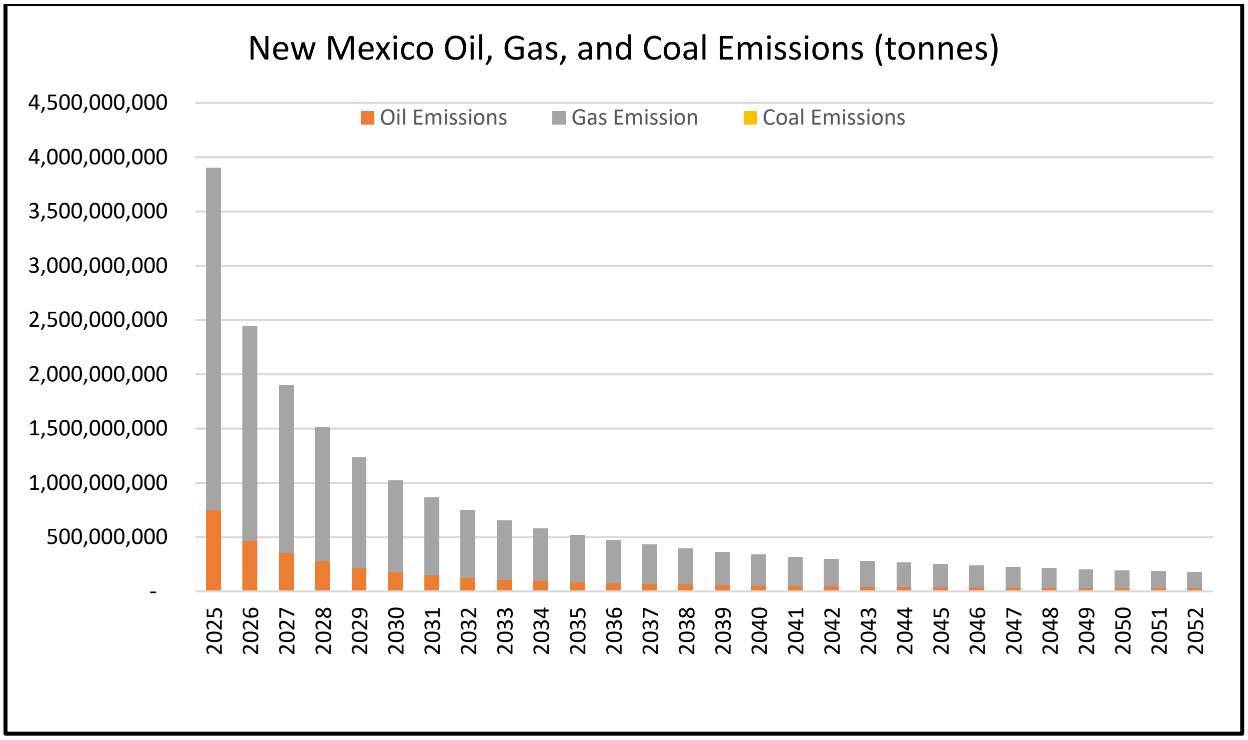

Figure 33. Projected New Mexico oil, gas, and coal CO_2e emissions (metric tons) (BLM 2025).

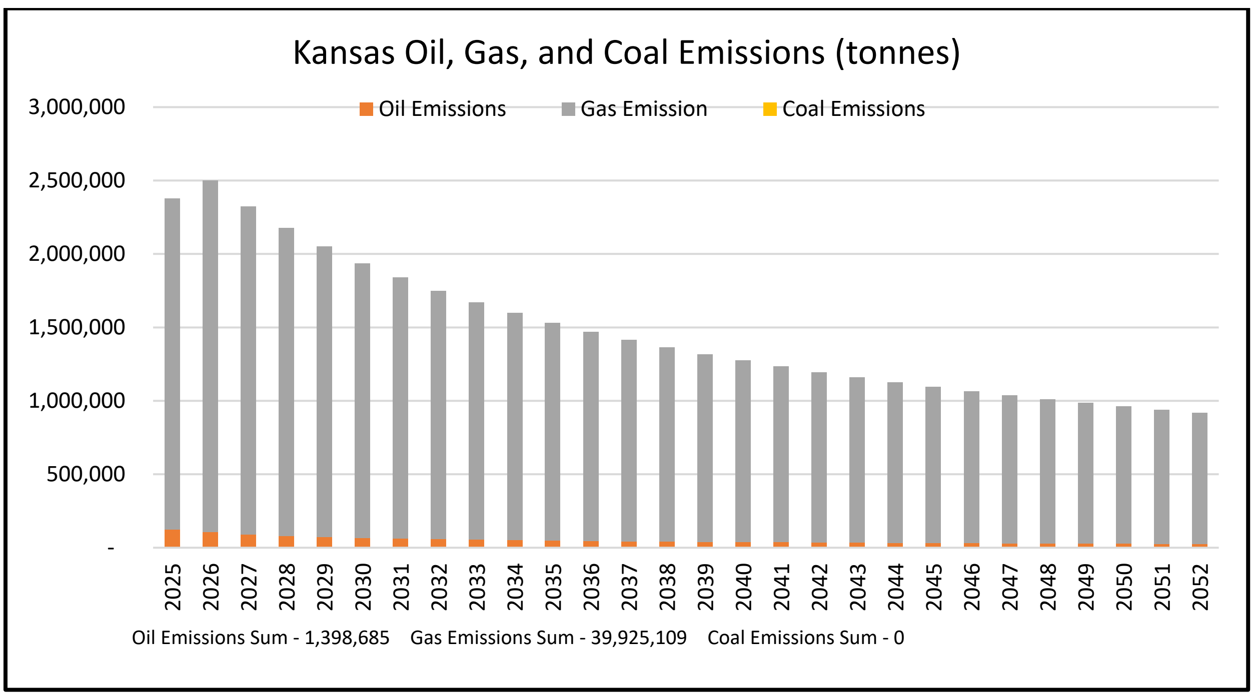

Figure 34. Projected Kansas oil, gas, and coal CO_2e emissions (metric tons) (BLM 2025).

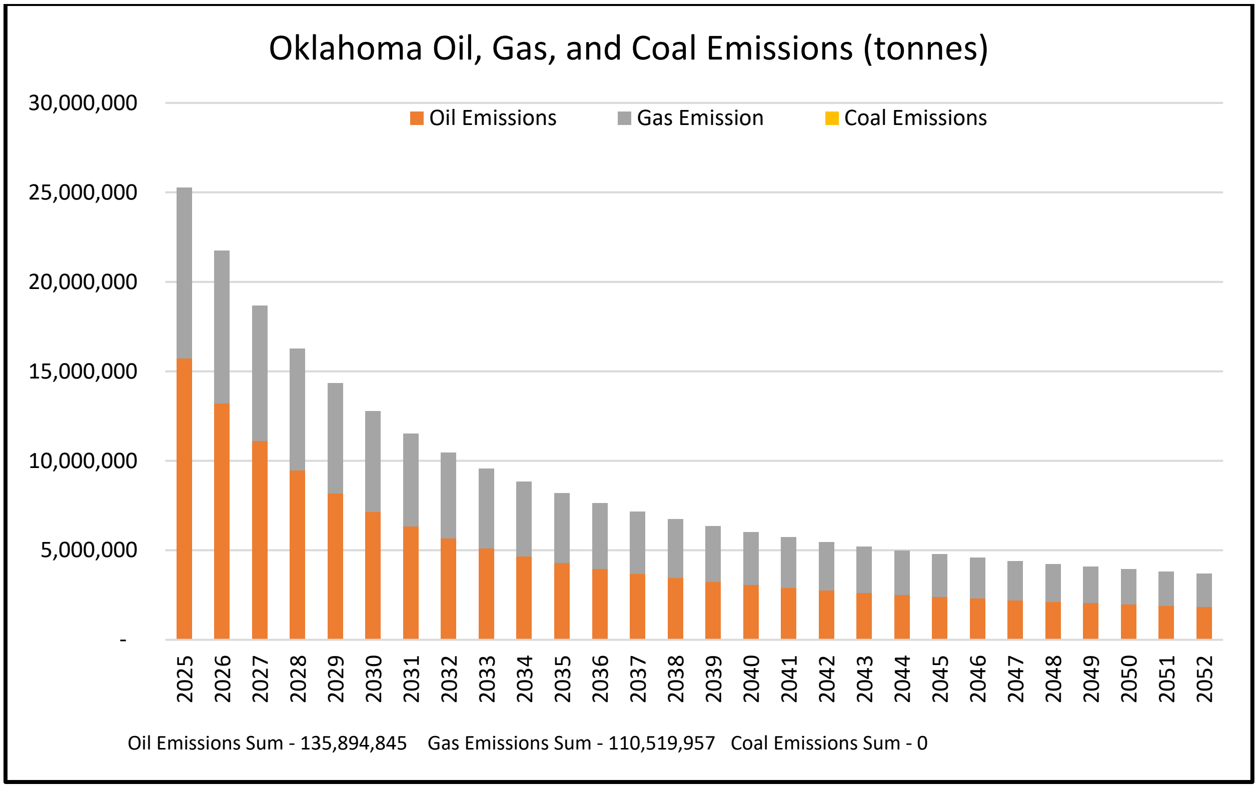

Figure 35. Projected Oklahoma oil, gas, and coal CO_2e emissions (metric tons) (BLM 2025).

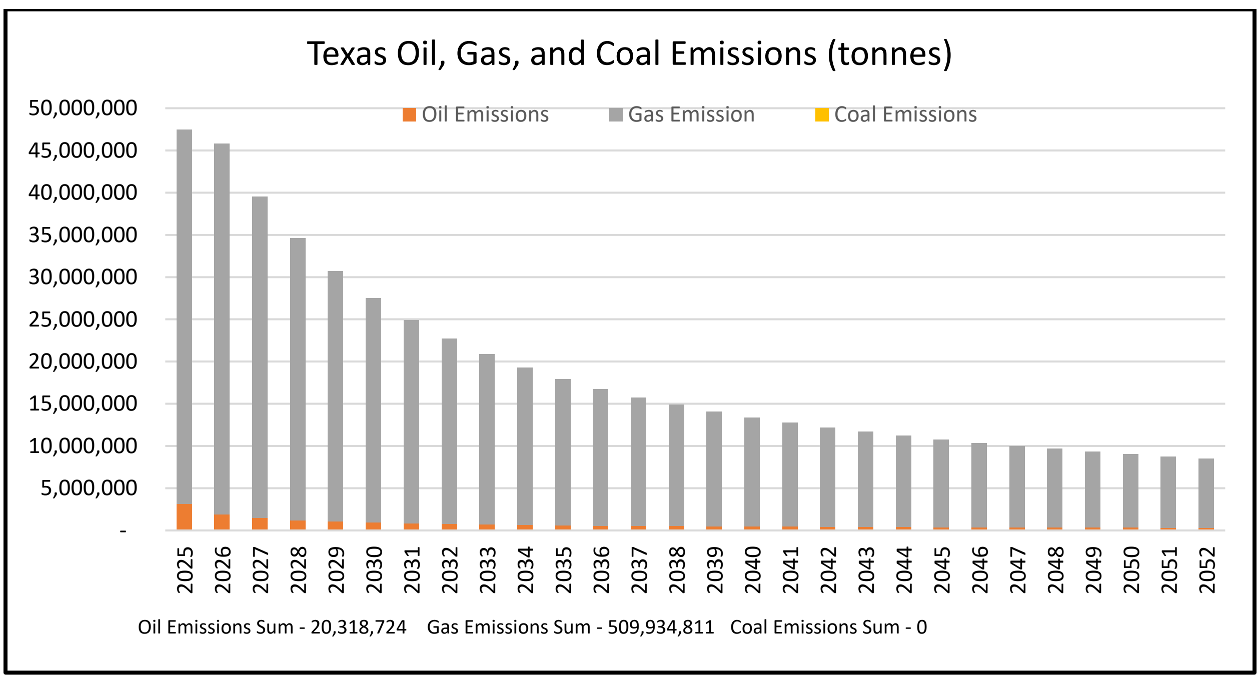

Figure 36. Projected Texas oil, gas, and coal CO_2e emissions (metric tons) (BLM 2025).

16.2 LONG-TERM PROJECTED TRENDS

The BLM Specialist Report also discusses long-term projected annual trends in federal fossil fuel production, energy values, and GHG emissions to year 2050 based on data obtained from the EIA AEO report (EIA 2023). The BLM Specialist Report provides access to most of the AEO cases, as these explore a variety of market conditions, including varying production, price, and overall economic growth rates, and the AEO scenario selection controls in Figure 7-2 (Long-Term Onshore Federal Mineral Emissions [Mt CO_2e]) of the BLM Specialist Report can be used to view the projected emissions from federal fossil fuel production. Table 7-19 of the BLM Specialist Report provides the long-term cumulative sums of production, energy values, and GHG emissions projected out to year 2050 for the AEO reference case. GHG emissions data for future projections for all growth scenarios are available in the BLM Specialist Report (BLM 2024a).

The 2024 GHG Database also provides the current long-term cumulative sums of production, energy values, and GHG emissions. At the national level, these long-term projections estimate that there will be emissions of 18,538 Mt CO_2e from federal oil and gas combined and 23,818 Mt CO_2e from all federal fossil fuel minerals (oil, gas, and coal) (Table 91). Current GHG emissions data for future projections for all growth scenarios are available in the 2024 GHG Database (BLM 2025).

Table 91. Estimated Projected Long-Term Oil and Gas GHG Emissions from Federal Leases

Area	Oil (Mt CO_2e per year)	Gas (Mt CO_2e per year)	Coal (Mt CO_2e per year)	Total (Mt CO_2e per year)
BLM total	8,967	9,571	5,280	23,818
New Mexico	7,078	5,244	N/A	12,322
Oklahoma	6	24	N/A	30
Kansas	1	5	N/A	6
Texas	2	78	N/A	80

Source: BLM (2025). Information can be found in column AJ of tab eia at https://docs.google.com/spreadsheets/d/1ozP2Bf-0GSp--gVoxPodO3e7HfAYS8lNUM5qjaRotXY/edit?usp=sharing.

Note: N/A = not applicable

17 GHG EMISSIONS ANALYSIS

17.1 NATURAL GAS SYSTEMS AND PETROLEUM SYSTEMS

Within the fossil fuel combustion sector in 2022, the contribution by fuel type shows that petroleum represents 44.5% of the fuel type, natural gas 36.3%, and coal 19.1% as shown in Section 3.1 Table 3-5 of the EPA Inventory (EPA 2024g).

The EPA Inventory (EPA 2024g) describes natural gas systems and petroleum systems as two of the major sources of U.S. GHG emissions. The inventory identifies the major contributions of natural gas and petroleum systems as total CO_2 and CH_4 emissions. Natural gas and petroleum systems do not produce noteworthy amounts of any other GHGs.

Within the category of natural gas systems, the EPA identifies emissions occurring during distinct stages of operation, including field production, processing, transmission and storage, and distribution. Petroleum systems sub-activities include production field operations, crude oil transportation, and crude oil refining. Within natural gas and petroleum systems, the BLM has authority to regulate those field production operations that are related to oil and gas measurement and prevention of waste (via leaks, spills, and unauthorized flaring and venting).

Total GHG emissions (CH_4, CO_2, and N_2O) from natural gas systems in 2022 were 209.7 Mt CO_2e, a decrease of 17% from 1990 and a decrease of 0.3% from 2021, both primarily due to decreases in CH_4 emissions. Of the overall GHG emissions (209.7 Mt CO_2e), 83% was CH_4 emissions as expressed as CO_2e (173.1 Mt CO_2e), 17% was CO_2 emissions (36.5 Mt), and less than 0.1% was N_2O emissions as expressed as CO_2e (0.15 Mt CO_2e) (EPA 2024g).

CH_4 and CO_2 emissions from natural gas systems include those resulting from normal operations, routine maintenance, and system upsets. Emissions from normal operations include natural gas engine and turbine uncombusted exhaust, flaring, and leak emissions from system components. Routine maintenance emissions originate from pipelines, equipment, and wells during repair and maintenance activities. Pressure surge relief systems and accidents can lead to system upset emissions. In the EPA reported data, emissions of N_2O from flaring activities are included, with most of the emissions occurring in the processing and production segments. Note that in the EPA reported data, CO_2 emissions exclude all combustion emissions (e.g., engine combustion) except for flaring CO_2 emissions.

Section 3.7 of the EPA Inventory provides a characterization of the six emission subcategories of natural gas systems: exploration, production (including gathering and boosting), processing, transmission and storage, distribution, and post-meter (EPA 2024g). Each of the segments is described, and the different factors affecting CH_4, CO_2, and N_2O emissions are discussed.

Total GHG emissions (CH_4, CO_2, and N_2O) from petroleum systems in 2022 were 61.6 Mt CO_2e, an increase of 4% from 1990, primarily due to increases in CO_2 emissions. Since 2021, total emissions from petroleum systems decreased by 15%. Of the overall GHG emissions (61.6 Mt CO_2e), 22.0 Mt were CO_2 emissions, 39.6 Mt CO_2e were CH_4 emissions, and 0.05 Mt CO_2e were N_2O emissions from petroleum systems. In 2022, U.S. oil production was 163% higher than in 2010 and 7% higher than in 2021 (EPA 2024g).

CH_4 emissions from petroleum systems are primarily associated with onshore and offshore crude oil production, transportation, and refining operations. During these activities, CH_4 is released to the atmosphere as emissions from leaks, venting (including emissions from operational upsets), and flaring. Note that in the EPA reported data, petroleum systems CO_2 emissions exclude all combustion emissions (e.g., engine combustion) except for flaring CO_2 emissions. All combustion CO_2 emissions (except for flaring) are accounted for in the fossil fuel combustion category. Emissions of N_2O from petroleum systems are primarily associated with flaring.

Section 3.6 of the EPA Inventory provides a characterization of the four emission subcategories of petroleum systems: exploration, production (including well drilling, testing, and completion), crude oil transportation, and crude oil refining. Each of the segments is described, and the different factors affecting CH_4, CO_2, and N_2O emissions are discussed.

Table 92 displays GHG emissions (CO_2, CH_4, and N_2O) related to natural gas systems, petroleum systems, and coal mining; CO_2 emissions listed represent those that are not otherwise captured in the fossil fuel combustion category. The natural gas and petroleum subsectors are the stages of production outlined in Table 92.

Table 92. 2022 GHG Emissions for Oil and Gas Subsectors and Coal Mining

Sector	Subsector	2022 GHG Emissions (Mt CO_2e)				% of U.S. Total Gross GHGs
		CO_2	CH_4*	N_2O	Total Gross GHGs	
U.S. total		**5,053.0**	**702.4**	**389.7**	**6,343.2¶**	**100**
Natural gas systems	Total	36.5	173.1	0.2	209.7	3.31
	Exploration†	<0.05	0.2	<0.05	0.2	0.00
	Production field operations	8.6	89.7	<0.05	98.3	1.55
	Onshore production	N/A	46.2	N/A	N/A	NE
	Offshore production	N/A	0.6	N/A	N/A	NE
	Gathering and boosting‡	N/A	42.8	N/A	N/A	NE
	Processing	26.7	15.1	<0.05	41.8	0.66
	Transmission and storage	1.2	39.6	<0.05	40.7	0.64
	Post-meter	<0.05	13.4	NO	13.4	0.21
	Distribution	<0.05	15.2	NO	15.3	0.24
Petroleum systems	Total	22.0	39.6	<0.05	61.6	0.97
	Exploration†	0.3	0.1	0.0001	0.4	0.01
	Production field operations	18.8	38.6	0.04	57.4	0.90
	Crude oil transportation	<0.05	0.2	NE	0.2	0.00
	Crude refining	2.9	0.7	0.008	3.6	0.06
Coal mining	–	2.5	43.6§	NE	46.1	0.73

Source: EPA (2024g:Table 2-1)

Notes: NE = not estimated; NO = not occurring; N/A = not applicable

* Values represent CH_4 emitted to the atmosphere. CH_4 that is captured, flared, or otherwise controlled (and not emitted to the atmosphere) has been calculated and removed from emission totals.

† Includes well drilling, testing, and completions.

‡ Includes gathering and boosting station routine vented and leak sources, gathering pipeline leaks and blowdowns, and gathering and boosting station episodic events.

§ Does not include data from abandoned coal mines.

¶ Includes U.S. emissions of four additional minor classes of GHGs not listed here (HFC, PFCs, SF_6, and NF_3).

In summary, CO_2 is produced during the burning of fossil fuels to run internal combustion engines that may be used in drilling, transportation, pumping, and compression. CO_2 may be a significant component of natural gas, especially coal-bed CH_4, and is vented during field operations or processing. CO_2 is also used in enhanced oil production processes and may be released or escape to the atmosphere during those processes. CH_4 is the primary component of natural gas and is released to the atmosphere during both oil and gas production, either intentionally during production when it cannot be captured, or accidentally through leaks and fugitive emissions.

Emissions from production (including gathering and boosting) accounted for 52% of CH_4 emissions and 23% of CO_2 emissions from natural gas systems in 2022. Emissions from gathering and boosting and pneumatic controllers in onshore production accounted for most of the production segment CH_4 emissions in 2022. Within gathering and boosting, the largest sources of CH_4 were compressor exhaust slip, compressor venting and leaks, and tanks. Flaring emissions accounted for most of the CO_2 emissions from production, with the highest emissions coming from flare stacks at gathering stations, miscellaneous onshore production flaring, and tank flaring. CH_4 emissions from production increased by 38% from 1990 to 2022, due primarily to increases in emissions from pneumatic controllers (due to an increase in the number of controllers, particularly in the number of intermittent bleed controllers) and increases in emissions from compressor exhaust slip in gathering and boosting. CH_4 emissions decreased 3% from 2021 to 2022 due to decreases in emissions from pneumatic controllers and liquids unloading. CO_2 emissions from production increased by approximately a factor of 2.6 from 1990 to 2022 due to increases in emissions at flare stacks in gathering and boosting and miscellaneous onshore production flaring and decreased 8% from 2021 to 2022 due primarily to decreases in emissions at flare stacks in miscellaneous onshore production flaring and tank venting. N_2O emissions from production were 36.9 times higher in 2022 than in 1990 and 17.5 times higher in 2022 than in 2021. The increase in N_2O emissions from 1990 to 2022 and from 2021 to 2022 was primarily due to increases in emissions from condensate tank flaring (EPA 2024g).

Production emissions accounted for 86% of the total CO_2 emissions (including leaks, vents, and flaring) from petroleum systems in 2022. The principal sources of CO_2 emissions were associated gas flaring, miscellaneous production flaring, and oil tanks with flares. In 2022, these three sources together accounted for 96% of the CO_2 emissions from production. In 2022, CO_2 emissions from production were 3.1 times higher than in 1990, due to increases in flaring emissions from associated gas flaring, miscellaneous production flaring, and tanks. Overall, in 2022, production segment CO_2 emissions decreased by 8% from 2021 levels primarily due to decreases in associated gas flaring in the Williston Basin and oil tanks with flares. Production emissions accounted for 84% of the total N_2O emissions from petroleum systems in 2022. The principal sources of N_2O emissions were oil tanks with flares and associated gas flaring, accounting for 90% of N_2O emissions from the production segment in 2022. In 2022, N_2O emissions from production were 8.0 times higher than in 1990 and were 3.5 times higher than in 2021 (EPA 2024g).

Distribution system CH_4 emissions in 2022 were 70% lower than 1990 levels and 1% lower than 2021 emissions. Annual CO_2 emissions from this segment were less than 0.1 Mt CO_2e across the time series. CH_4 emissions from the post-meter segment accounted for approximately 8% of emissions from natural gas systems in 2022. Post-meter CH_4 emissions increased by 65% from 1990 to 2022 and increased by less than 3% from 2021 to 2022, due to increases in the number of residential houses using natural gas and increased natural gas consumption at industrial facilities and power plants. CO_2 emissions from post-meter accounted for less than 0.01% of total CO_2 emissions from natural gas systems.

18 MITIGATION

Section 10.0 of the BLM Specialist Report discusses various forms of mitigation, including controlling emissions (best management practices [BMPs]), preventing emissions, and offsetting emissions (carbon sequestration, plugging orphaned and abandoned wells, energy substitution, carbon capture, and compensatory mitigation). In addition to controlling or preventing emissions, strategies to offset emissions could be used to align BLM decision-making with the goal of achieving net-zero emissions by 2050. Much of the current policy on mitigating emissions in the United States comes from individual states and municipalities, as well as market forcing that results when institutions move assets and future investments away from fossil fuel projects (BLM 2024a).

The EPA Natural Gas STAR Program was established in 1993 to identify and share information on cost-effective ways to mitigate CH_4 emissions from oil and gas operations, demonstrating that it is possible to achieve important reductions in CH_4 emissions while also enhancing safety, improving performance, increasing natural gas supplies, and saving money (EPA 2024k). These reductions can help to control not only GHGs but also VOCs, which contribute to O_3 formation. Each year, partners submitted reports documenting their previous year's CH_4 emission reduction activities. In 2022, the EPA transitioned the Natural Gas STAR Partnership, ending the partnership agreements and annual reporting elements of the program while retaining a focus on technology transfer and stakeholder engagement. The EPA continues to collaborate with operators through the Natural Gas STAR Program providing a framework for technical support and stakeholder engagement, as well as sharing information on the EPA Natural Gas STAR website about opportunities for reducing CH_4 emissions from the oil and gas industry. Since the inception of the program cumulative through 2020, partners have eliminated 1.72 trillion cubic feet of CH_4 emissions by implementing 150 cost-effective technologies and practices.

The Natural Gas STAR Methane Challenge Partnership is a voluntary program founded by the EPA in 2016 in collaboration with oil and natural gas companies. The program recognizes companies that make specific and transparent commitments to reduce CH_4 emissions. Throughout the course of this partnership, more than 70 companies from all segments of the industry—production, gathering and boosting, transmission and storage, and distribution—were program partners. Given recent regulatory efforts in the oil and gas sector and the passage of the Inflation Reduction Act providing a new approach for CH_4 reduction, EPA ended the Methane Challenge Partnership at the end of 2023, following publication of the sixth Methane Challenge Report for Calendar Year 2022 data (reporting season 2023) (EPA 2024l). In addition, as part of the Inflation Reduction Act, a new program called the Methane Emissions Reduction Program has been started. The Methane Emissions Reduction Program will provide $1.36 billion in financial and technical assistance through multiple funding opportunities, establishes a Waste Emissions Charge for CH_4, and requires the EPA to revise the GHGRP subpart W regulations for the oil and gas sector.

The BLM has two infrared cameras that are being used to detect leaks and fugitive emissions. BLM inspectors carry these cameras into the field and have been able to alert operators of equipment requiring repair or maintenance. At this time, the cameras are being used in an advisory rather than a regulatory role.

Cumulatively, it is expected that future levels of criteria pollutant, VOC, HAP, and GHG emissions related to oil and gas operations would be lower than current levels due to the aforementioned factors. However, there will be increases in emissions associated with reasonably foreseeable oil and gas development and future potential development of leases.

Although it is beyond the scope of this report to detail the wide range of mitigation strategies available, it must be noted that, for the most part, these strategies must be applied on a case-by-case basis at the project level.

19 REFERENCES AND SOURCES CITED

American Lung Association. 2023. What Makes Outdoor Air Unhealthy – Nitrogen Dioxide. Available at: https://www.lung.org/clean-air/outdoors/what-makes-air-unhealthy/nitrogen-dioxide. Accessed June 2024.

Bureau of Land Management (BLM). 2003. Farmington Resource Management Plan with Record of Decision. Available at: www.oilandgasbmps.org/docs/NM16-FarmingtonResourceManagementPlanwithRecordofDecision.pdf. Accessed July 2023.

———. 2012. *Guidance for Conducting Air Quality General Conformity Determinations*. Instruction Memorandum No. 2013-025. Available at: https://www.blm.gov/policy/im-2013-025. Accessed July 2025.

———. 2014. *Issuance of the Bureau of Land Management Fact Sheet on the Air Quality General Conformity Rule*. Information Bulletin 2014-084. Available at: https://www.blm.gov/policy/ib-2014-084. Accessed July 2025.

———. 2016. *Air Quality Technical Support Document Prepared for Environmental Assessment DOI-BLM-NM-P020-2016-1434-EA Chevron U.S.A., Inc*. Hayhurst Master Development Plan. Available at: https://eplanning.blm.gov/public_projects/nepa/64242/87807/105116/Chevron_Hayhurst_MDP_EA_AQTSD.pdf. Accessed September 2023.

———. 2016. *Reasonably Foreseeable Development Scenario – Kansas, Oklahoma, & Texas*. Norman: U.S. Department of the Interior, Bureau of Land Management, Oklahoma Field Office.

———. 2020. *Oklahoma, Kansas and Texas BLM Record of Decision and Approved Resource Management Plan*. Norman: U.S. Department of the Interior, Bureau of Land Management, Oklahoma Field Office.

———. 2024a. *2023 BLM Specialist Report on Annual Greenhouse Gas Emissions and Climate Trends.* Available at: https://www.blm.gov/content/ghg/. Accessed July 2025.

———. 2024b. Waste Prevention Rule. Available at: https://www.blm.gov/2024-waste-prevention-rule. Accessed July 2025.

———. 2024c. Bureau of Land Management Summary of Cumulative Oil and Gas Hazardous Air Pollutant Analysis for the Pecos District Office. Available at: https://www.blm.gov/sites/default/files/docs/2024-07/cumulative-haps-summary-pecos-district-nm-2024v2.pdf. Accessed June 2024.

———. 2024d. Bureau of Land Management Summary of Cumulative Oil and Gas Hazardous Air Pollutant Analysis for FFO. Available at: https://www.blm.gov/sites/default/files/docs/2024-07/cumulative-haps-summary-paper-FFO-nm-2024v2.pdf. Accessed June 2024.

———. 2024e. AFMSS I and II. Available at: https://reports.blm.gov/reports/AFMSS/. Accessed October 2023.

———. 2025. GHG DB (2024). Available at: https://docs.google.com/spreadsheets/d/1ozP2Bf-0GSp--gVoxPodO3e7HfAYS8lNUM5qjaRotXY/edit?gid=1221314382#gid=1221314382. Accessed August 2025.

Bureau of Land Management (BLM) and Ramboll. 2017. Colorado Air Resource Management Modeling Study (CARMMS 2.0). Available at: https://www.blm.gov/sites/default/files/documents/files/program_natural%20resources_soil%20air%20water_airco_quicklins_CARMMS2.0_with%20Appendices.pdf. Accessed September 2023.

———. 2018. *Air Impact Assessment for BLM Farmington Field Office Oil and Gas Development*. On file, the Bureau of Land Management Farmington Field Office, Farmington, New Mexico.

Burke, M., A. Driscoll, S. Heft-Neal, J. Burney, and M. Wara. 2021. The changing risk and burden of wildfire in the United States. *Proceedings of the National Academy of Sciences of the United States of America* 118(2).

California Office of Environmental Health Hazard Assessment. 2023. OEHHA Acute, 8-hour and Chronic Reference Exposure Level (REL) Summary. Available at: https://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary. Accessed June 2024.

Colorado State University (CSU). 2020. VIEWS 2.0. Available at: http://vista.cira.colostate.edu/Improve/?s=best+20. Accessed July 2022.

Crocker, K., and J.F. Glover. 2019. *Reasonable Foreseeable Development Scenario for Oil and Gas Activities: Rio Puerco Field Office, New Mexico*. United States Department of the Interior Bureau of Land Management New Mexico State Office.

Dulin, P. 2015. *Coccidioidomycosis ("Valley Fever"): An Environmental Health Risk Endemic to the U.S.-Mexico Binantional Border Region*. Available at: https://19january2017snapshot.epa.gov/sites/production/files/2016-01/documents/p_dulin_cocci_presentation_september_2015.pdf. Accessed July 2025.

Ecosphere Environmental Services. 2018. Air Quality Analysis Report Sunport Boulevard Extension and Woodward Road Improvements. Available at: https://www.bernco.gov/public-works/wp-content/uploads/sites/76/2021/04/Sunport_Woodward_Air_Quality_Analysis_July_7_2018.pdf. Accessed July 2025.

Emissions Database for Global Atmospheric Research (EDGAR). 2025. Global Emissions. Available at: https://edgar.jrc.ec.europa.eu/emissions_reports. Accessed July 2025.

Energy and Environmental Economics, Inc. (E3). 2020. *New Mexico Greenhouse Gas (GHG) Emissions Inventory and Forecast*. Prepared for Center for the New Energy Economy at Colorado State University. San Francisco, California: Energy and Environmental Economics, Inc. Available at: https://cnee.colostate.edu/wp-content/uploads/2020/10/New-Mexico-GHG-Inventory-and-Forecast-Report_2020-10-27_final.pdf. Accessed October 2023.

Engler, T.W., R. Balch, and M. Cather. 2012. *Reasonable Foreseeable Development (RFD) Scenario for the B.L.M. New Mexico Pecos District*. Final Report. Submitted to U.S. Department of the Interior, Bureau of Land Management, Carlsbad Field Office, Carlsbad, New Mexico. Socorro: New Mexico Institute of Mining and Technology. Available at: https://eplanning.blm.gov/public_projects/lup/64444/77502/86228/Final_Report-BLM-NMT-RFD.pdf. Accessed July 2022.

Engler, T.W., and M. Cather. 2014. *Update to the Reasonable Foreseeable Development (RFD) for the BLM Pecos District, SENM*. Final Report. Submitted to U.S. Department of the Interior, Bureau of Land Management, Farmington Field Office, Farmington, New Mexico. Socorro: New Mexico Institute of Mining and Technology. Available at: https://eplanning.blm.gov/public_projects/lup/64444/80056/93025/Final_Report-SENM-DEC2014_updated_RFD.pdf. Accessed July 2022.

Engler. 2023. CFO Reasonably Foreseeable Development Scenario for Oil and Gas Activities. Available at: https://eplanning.blm.gov/public_projects/64444/200120011/20082347/250088529/Reasonable%20Foreseeable%20Development%20(RFD)%20Scenario%20(2023).pdf. Accessed September 2024.

Engler, T.W. 2025. *Update to the Reasonably Foreseeable Development Scenario (RFD) for Oil and Gas Activities in the Farmington Field Office, Northwestern New Mexico*. United States Department of the Interior Bureau of Land Management Final Report July 2025. Available at: https://www.blm.gov/programs/energy-and-minerals/oil-and-gas/about/new-mexico. Accessed July 2025.

Federal Land Manager Environmental Database (FED) Cooperative Institute for Research in the Atmosphere (CIRA). 2025. Visiblity and AQRV Summaries. Available at: https://views.cira.colostate.edu//fed/. Accessed July 2025.

Four Corners Air Quality Task Force (FCAQTF). 2007. *Report of Mitigation Options*. Available at: https://www.env.nm.gov/wp-content/uploads/sites/2/2016/11/4CAQTF_Report_FINAL_OilandGas.pdf. Accessed July 2022.

Fox, D., A. Bartuska, J.G. Byrne, E. Cowling, and R. Fisher. 1989. *A Screening Procedure to Evaluate Air Pollution Effects on Class I Wilderness 1304 Areas*. General Technical Report RM-168. Fort Collins, Colorado: U.S. Department of Agriculture, U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station.

Frankson, R., K.E. Kunkel, L.E. Stevens, S.M. Champion, B.C. Stewart, J. Nielsen-Gammon. 2022. Oklahoma State Climate Summary 2022 Silver Spring, Maryland: National Oceanic and Atmospheric Administration National Environmental Satellite, Data, and Information Service.

Frankson, R., K.E. Kunkel, L.E. Stevens, and D.R. Easterling. 2022. New Mexico State Climate Summary 2022. NOAA Technical Report NESDIS 150-NM. Silver Spring, Maryland: National Oceanic and Atmospheric Administration National Environmental Satellite, Data, and Information Service.

Frankson, R., K.E. Kunkel, L.E. Stevens, D.R. Easterling, X. Lin, M. Shulski, N.A. Umphlett, and C.J. Stiles. 2022. Kansas State Climate Summary 2022. NOAA Technical Report NESDIS 150-KS. Silver Spring, Maryland: National Oceanic and Atmospheric Administration National Environmental Satellite, Data, and Information Service.

ICF and Colorado State University (CSU). 2019. Final Report: Human Health Risk Assessment for Oil and Gas Operations in Colorado. October 17, 2019. Available at: https://drive.google.com/file/d/1pO41DJMXw9sD1NjR_OKyBJP5NCb-AO0l/view. Accessed June 2023.

Kang, Shichang; Zhang, Yulan; Qian, Yun; and Wang, Hailong. 2020. A review of black carbon in snow and ice and its impact on the cryosphere. Available at: https://www.sciencedirect.com/science/article/pii/S0012825220303925. Accessed July 2025. Kansas Department of Health and Environment. 2024. Bureau of Air. Available at: https://www.kdhe.ks.gov/166/Air. Accessed June 2024.

Kansas Department of Health and Environment. 2024. Kansas Department of Health and Environment, Bureau of Air. Available at: https://www.kdhe.ks.gov/166/Air. Accessed June 2024.

NASA Earth Observatory (NASA). 2010. Aerosols and Incoming Sunlight (Direct Effects). Available at: ttps://earthobservatory.nasa.gov/features/Aerosols/page3.php#:~:text=Broadly%20speaking%2C%20bright-colored%20or%20translucent%20particles%20tend%20to,nearly%20all%20radiation%20they%20encounter%2C%20cooling%20the%20atmosphere. Accessed August 2025.

National Atmospheric Deposition Program (NADP). 2023. 2022 Annual Summary. Available at: https://nadp.slh.wisc.edu/wp-content/uploads/2023/10/2022as2.pdf. Accessed September 2024.

———. 2024. National Trends Network. Available at: nadp.slh.wisc.edu/networks/national-trends-network/. Accessed June 2024.

National Heart, Lung, and Blood Institute. 2024. Asthma Causes and Triggers. Available at: https://www.nhlbi.nih.gov/health/asthma/causes. Accessed July 2025.

National Centers for Environmental Information (NCEI). 2023a. U.S. Climate Normals. Available at: https://www.ncei.noaa.gov/products/land-based-station/us-climate-normals. Accessed September 2023.

———. 2024a. Climate at a Glance: Divisional Time Series, Available at: https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/divisional/time-series. Accessed June 2024.

National Oceanic and Atmospheric Administration (NOAA). 2018. Scientific Assessment of Ozone Depletion: 2018, Executive Summary. Available at: https://csl.noaa.gov/assessments/ozone/2018/executivesummary/. Accessed June 2024.

———. 2022. NOAA State Climate Summaries. 2022 Version. Available at: https://statesummaries.ncics.org/. Accessed July 2025.

———. 2025. Trends in globally-averaged CH_4, N_2O, and SF_6. Available at: https://gml.noaa.gov/ccgg/trends/. Accessed July 2025.

National Park Service (NPS). 2022. Air Quality Conditions & Trends. Available at: https://www.nps.gov/subjects/air/park-conditions-trends.htm. Accessed June 2024.

New Mexico Environment Department (NMED). 2020. 2015 Ozone NAAQS - Sunland Park Nonattainment Area SIP Revision. Available at: https://www.env.nm.gov/air-quality/wp-content/uploads/sites/2/2017/02/SLP-SIP-Revision-Certification-Final.pdf. Accessed September 2023.

———. 2021a. *High Wind Fugitive Dust Mitigation Plan, Doña Ana and Luna Counties*. Available at: https://www.env.nm.gov/air-quality/wp-content/uploads/sites/2/2017/02/NM_draft2020_DMP-Final-Draft-secured.pdf. Accessed September 2023.

———. 2021b. *New Mexico Ozone Attainment Initiative Photochemical Modeling Study – Draft Final Air Quality Technical Support Document*. Available at: https://www.env.nm.gov/wp-content/uploads/sites/2/2021/06/NM_OAI_2028_AQTSD_v8.pdf. Accessed September 2023.

———. 2022. Ozone Advance Path Forward. Available at: https://www.env.nm.gov/air-quality/wp-content/uploads/sites/2/2022/06/Ozone-Advance-Path-Forward-2022-03-29.pdf. Accessed September 2023.

———. 2024a. Air Quality Bureau. Available at: https://www.env.nm.gov/air-quality/. Accessed June 2024.

———. 2024b. Nonattainment Areas. Available at: https://www.env.nm.gov/air-quality/nonattainment-areas/. Accessed June 2024.

New Mexico Oil Conservation Division (NMOCD). 2025. Existing well count data. Accessed July 2025.

New Mexico Tech. 2025. Update to the Reasonably Foreseeable Development Scenario (RFD) for Oil and Gas Activities in the Farmington Field Office, Northwestern New Mexico. Available at: https://www.blm.gov/sites/default/files/docs/2025-07/rfd-oil-and-gas-blm-nm-ffo-071725.pdf. Accessed July 2025.

Oklahoma Department of Environmental Quality (ODEQ). 2024. Air Quality Division. Available at: https://www.deq.ok.gov/divisions/aqd/. Accessed June 2024.

Oklahoma Department of Environmental Quality, Air Quality Division (ODEQ AQD). 2022. Regional Haze. Available at: https://www.deq.ok.gov/air-quality-divisioN/Air-quality-rules-planning/regional-haze/. Accessed June 2024.

Pennsylvania State University. 1998. Soil Information for Environmental Modeling and Ecosystem Management. Available at: http://www.soilinfo.psu.edu/index.cgi?soil_clim&information&general&taxonomy_defs&soil_moist_regimes&classes&aridic. Accessed June 2024.

Ramboll. 2024. BLM Western US Photochemical Air Quality Modeling For 2032. Available at upon request.

———. 2025a. BLM Carlsbad Field Office Cumulative Hazardous Air Pollutants Modeling - Final Report. Available at: https://eplanning.blm.gov/public_projects/64444/200120011/20141048/251041029/BLM%20CFO_Cumulative%20HAPs%20Modeling%20Report_202503_508.pdf. Accessed July 2025.

———. 2025b. BLM Carlsbad Field Office Photochemical Air Quality Modeling Report. Prepared for Bureau of Land Management. Carlsbad, New Mexico. Available at: https://eplanning.blm.gov/public_projects/64444/200120011/20141047/251041027/BLM%20CFO_Air%20Modeling%20Report_202502_508.pdf. Accessed July 2025.

Ramboll and Bureau of Land Management (BLM). 2023. BLM Cumulative Hazardous Air Pollutants Modeling - Final Report, Cumulative HAPs. Available at: https://eplanning.blm.gov/eplanning-ui/project/1505069/570. Accessed June 2024.

Ramboll and EMPS (Environmental Management Planning Solutions, LLC). 2025. BLM Carlsbad Field Office Draft Air Resources Technical Support Document. Prepared for Bureau of Land Management. Carlsbad, New Mexico.

Rowland. A., A.J. Murray, and A.R. Wellburn. 1985. Oxides of nitrogen and their impact upon vegetation. *Reviews on Environmental Health* 5(4):295–342.

Runkle, J., K.E. Kunkel, J. Nielson-Gammon, R. Frankson, S.M. Champion, B.C. Stewart, L. Romolo, and W. Sweet. 2022. Texas State Climate Summary 2022. NOAA Technical Report NESDIS 150-TX. Silver Spring, Maryland: National Oceanic and Atmospheric Administration National Environmental Satellite, Data, and Information Service.

Skiles, S.M. and T.H. Painter. 2016. Toward Understanding Direct Absorption and Grain Size Feedbacks by Dust Radiative Forcing in Snow with Coupled Snow Physical and Radiative Transfer Modeling. *Water Resources Research* 55:7362–7378.

Skrtic, L. 2006. Hydrogen Sulfide, Oil and Gas, and People's Health. Berkeley: University of California. Available at: https://earthworks.org/assets/uploads/archive/files/publications/hydrogensulfide_oilgas_health.pdf. Accessed September 2023.

Texas Commission on Environmental Quality, Air Division (TCEQ). 2024a. Air. Available at: https://www.tceq.texas.gov/agency/air_main.html. Accessed June 2024.

———. 2024b. 2021 SIP Revision: Regional Haze. Available at: https://www.tceq.texas.gov/downloads/air-quality/sip/haze/revisions/2021rhsip_ado.pdf. Accessed July 2025.

———. 2025. 2025 SIP Revision: Regional Haze. Available at: https://www.tceq.texas.gov/airquality/sip/bart/haze_sip.html. Accessed July 2025.

U.S. Census Bureau. 2023. 2018-2022 American Community Survey 5-Year Estimates, Table S2502 Demographic Characteristics for Occupied Housing Units. Available at: https://data.census.gov/table/ACSST5Y2022.S2502?q=S2502. Accessed December 2023.

U.S. Department of Interior (DOI). 2025. 516 Departmental Manual (DM) 1, U.S. Department of the Interior Handbook of National Environmental Policy Act Implementing Procedures, Part 6 page 23. Available at: https://www.bing.com/ck/a?!&&p=ca622bd95c76da686fb30bcd287033248505f8b37bb7bceb3c12dc315757b81aJmltdHM9MTc1ODY3MjAwMA&ptn=3&ver=2&hsh=4&fclid=2134f94e-d28c-6335-2ea0-ef1fd34c626b&psq=516+DM+1+%e2%80%93+U.S.+Department+of+the+Interior+Handbook+of+National+Environmental+Policy+Act+Implementing+Procedures&u=a1aHR0cHM6Ly9kb3dubG9hZHMucmVndWxhdGlvbnMuZ292L0RPSS0yMDI1LTAwMDQtMDAwNC9jb250ZW50LnBkZg. Accessed September 2025.

U.S. Energy Information Administration (EIA). 2023. Annual Energy Outlook 2023. Available at: https://www.eia.gov/outlooks/aeo/. Accessed October 2023.

———. 2025. Annual Energy Outlook 2025. Available at: https://www.eia.gov/outlooks/aeo/. Accessed June 2025.

U.S. Environmental Protection Agency (EPA). 1993. U.S. Environmental Protection Agency. Report to Congress on Hydrogen Sulfide Air Emissions Associated with the Extraction of Oil and Gas. Research Triangle Park: U.S. Environmental Protection Agency. Available at: https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=00002WG3.txt. Accessed September 2023.

———. 2000. *Science Policy Council Handbook, "Risk Characterization",* EPA 100-B-00-002, December 2000. Available at: https://www.epa.gov/sites/default/files/2015-10/documents/osp_risk_characterization_handbook_2000.pdf. Accessed June 2024.

———. 2003. Framework for Cumulative Risk Assessment. EPA/630/P-02/001F. EPA ORD/NCEA, Washington, DC. Available at: https://www.epa.gov/sites/default/files/2014-11/documents/frmwrk_cum_risk_assmnt.pdf. Accessed September 2023.

———. 2019. Technical Support Document for EPA'S Updated 2028 Regional Haze Modeling. Available at: https://www.epa.gov/visibility/technical-support-document-epas-updated-2028-regional-haze-modeling. Accessed July 2025.

———. 2021a. Sources of Acute Dose-Response Information. Available at: https://www.epa.gov/fera/sources-acute-dose-response-information. Accessed September 2023.

———. 2021b. Dose-Response Assessment for Assessing Health Risks Associated With Exposure to Hazardous Air Pollutants, Table 1, Chronic. Available at: https://www.epa.gov/system/files/documents/2021-09/chronicfinaloutput_9_29_2021-12- 46-18-pm_0.pdf. Accessed June 2024.

———. 2021c. *CASTNET 2021 Annual Report*. Available at: https://www.epa.gov/system/files/documents/2023-10/castnet_2021-ar_final_20231011.pdf. Accessed June 2024.

———. 2022a. Air Quality Modeling for the 2016v2 Emissions Platform Technical Support Document. Available at: https://gaftp.epa.gov/aqmg/2016v2_Platform_Modeling_Data/AQ%20Modeling%20TSD_2016v2%20Platform_rev_2022_0119a.pdf. Accessed June 2024.

———. 2022b. Technical Support Document EPA's Air Toxics Screening Assessment 2018 AirToxScreen TSD. Available at: https://www.epa.gov/system/files/documents/2023-02/AirToxScreen_2018%20TSD.pdf. Accessed May 2025.

———. 2023a. *Ozone Trends*. Available at: https://www.epa.gov/air-trends/ozone-trends#:~:text=Air%20quality%20monitors%20measure%20concentrations%20of%20ozone%20throughout,1990%27s%2C%20and%20showed%20a%20notable%20decline%20after%202002.. Accessed June 2024.

———. 2023b. *Overview of Ozone (O_3) Air Quality in the United States*. Available at: https://www.epa.gov/system/files/documents/2023-06/O3_2022.pdf. Accessed June 2024.

———. 2023c. Nitrogen Dioxide Trends. Available at: https://www.epa.gov/air-trends/nitrogen-dioxide-trends. Accessed September 2024.

———. 2023d. Carbon Monoxide Trends. Available at: https://www.epa.gov/air-trends/carbon-monoxide-trends. Accessed September 2024.

———. 2023e. Particulate Matter (PM2.5) Trends. Available at: https://www.epa.gov/air-trends/particulate-matter-pm25-trends. Accessed September 2024.

———. 2023f. Particulate Matter (PM10) Trends. Available at: https://www.epa.gov/air-trends/particulate-matter-pm10-trends. Accessed September 2024.

———. 2023g. Sulfur Dioxide Trends. Available at: https://www.epa.gov/air-trends/sulfur-dioxide-trends. Accessed September 2024.

———. 2023h. 2020 National Emissions Inventory Supporting Data and Summaries. Available at: https://www.epa.gov/air-emissions-inventories/2020-nei-supporting-data-and-summaries. Accessed September 2023.

———. 2023i. AirToxScreen Mapping Tool. Available at: https://experience.arcgis.com/experience/a2eea9c204004158a85a18371d6883bc. Accessed September 2023.

———. 2023j. *Findings of Failure to Submit Regional Haze State Implementation Plans for the Second Planning Period*. Available at: https://www.epa.gov/visibility/findings-failure-submit-regional-haze-state-implementation-plans-second-planning-period. Accessed September 2023.

———. 2024a. Ecosystem Effects of Ozone Pollution. Available at: https://www.epa.gov/ground-level-ozone-pollution/ecosystem-effects-ozone-pollution. Accessed July 2025.

———. 2024b. Air Quality – National Summary. Available at: https://www.epa.gov/air-trends/air-quality-national-summary. Accessed September 2024.

———. 2024c. Sources of Chronic Dose-Response Information Available at: https://www.epa.gov/fera/sources-chronic-dose-response-information. Accessed June 2024.

———. 2024d. *Technical Support Document EPA's Air Toxics Screening Assessment, 2020 AirToxScreen TSD*. Available at: https://www.epa.gov/system/files/documents/2024-05/airtoxscreen_2020-tsd.pdf. Accessed June 2024.

———. 2024e. 2020 AirToxScreen: Assessment Results. Available at: https://www.epa.gov/AirToxScreen/2020-airtoxscreen-assessment-results. Accessed June 2024.

———. 2024f. Progress Report - Atmospheric Deposition. Available at: https://www.epa.gov/power-sector/progress-report-atmospheric-deposition. Accessed July 2025.

———. 2024g. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2022*. U.S. Environmental Protection Agency, EPA 430-R-24-004. Available at: https://www.epa.gov/system/files/documents/2024-04/us-ghg-inventory-2024-main-text_04-18-2024.pdf. Accessed July 2025.

———. 2024h. Greenhouse Gas Inventory Data Explorer. Available at: https://cfpub.epa.gov/ghgdata/inventoryexplorer/#iallsectors/allsectors/allgas/gas/all. Accessed July 2025.

———. 2024i. Facility Level Information on Greenhouse Gases Tool. Available at: https://ghgdata.epa.gov/ghgp/main.do. Accessed July 2025.

———. 2024j. Greenhouse Gas Reporting Program (GHGRP). Available at: https://www.epa.gov/ghgreporting/ghgrp-reported-data. Accessed July 2025.

———. 2024k. Natural Gas STAR Partnership. Available at: https://www.epa.gov/natural-gas-star-program/natural-gas-star-partnership-1993-2022#:~:text=EPA%20launched%20the%20Natural%20Gas%20STAR%20Partnership%20Program,mitigate%20methane%20emissions%20from%20oil%20and%20gas%20operations. Accessed July 2025.

———. 2024l. Methane Challenge Partnership. Available at: https://www.epa.gov/natural-gas-star-program/methane-challenge-partnership-2016-2024. Accessed July 2025.

———. 2024m. Annex 6 Additional Information. Available at: https://www.epa.gov/system/files/documents/2024-04/us-ghg-inventory-2024-annex-6-additional-information.pdf. Accessed July 2025.

———. 2025a. NAAQS Table. Available at: https://www.epa.gov/criteria-air-pollutants/naaqs-table. Accessed July 2025.

———. 2025b. Air Data: Air Quality Data Collected at Outdoor Monitors Across the US. Available at: https://www.epa.gov/outdoor-air-quality-data. Accessed July 2025.

———. 2025c. Technical Overview of Volatile Organic Compounds. Available at: https://www.epa.gov/indoor-air-quality-iaq/technical-overview-volatile-organic-compounds#3. Accessed July 2025.

———. 2025d. Ground-Level Ozone Basics. Available at: https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics. Accessed July 2025.

———. 2025e. Health Effects of Ozone Pollution. Available at: https://www.epa.gov/ground-level-ozone-pollution/health-effects-ozone-pollution. Accessed July 2025.

———. 2025f. Air Quality Design Values. Available at: https://www.epa.gov/air-trends/air-quality-design-values. Accessed July 2025.

———. 2025g. Basic Information about NO_2. Available at: https://www.epa.gov/no2-pollution/basic-information-about-no2. Accessed July 2025.

———. 2025h. Basic Information about Carbon Monoxide Outdoor Air Pollution. Available at: https://www.epa.gov/co-pollution/basic-information-about-carbon-monoxide-co-outdoor-air-pollution. Accessed July 2025.

———. 2025i. Particulate Matter Basics. Available at: https://www.epa.gov/pm-pollution/particulate-matter-pm-basics. Accessed July 2025.

———. 2025j. Health and Environmental Effects of Particulate Matter (PM). https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm. Accessed July 2025.

———. 2025k. Sulfur Dioxide Basics. Available at: https://www.epa.gov/so2-pollution/sulfur-dioxide-basics. Accessed July 2025.

———. 2025l. Basic Information about Lead Air Pollution. Available at: https://www.epa.gov/lead-air-pollution/basic-information-about-lead-air-pollution. Accessed July 2025.

———. 2025m. U.S. Environmental Protection Agency. New Mexico, Oklahoma and Texas Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants. Available at: https://www3.epa.gov/airquality/greenbook/anayo_tx.html. Accessed July 2025.

———. 2025n. Regional Haze Program. Available at: https://www.epa.gov/visibility/regional-haze-program. Accessed July 2025.

———. 2025o. Ambient Air Concentration Maps. Available at: https://www.epa.gov/castnet/ambient-air-concentration-maps. Accessed July 2025.

———. 2025p. *2025 CASTNET Annual Network Plan.* Available at: https://www.epa.gov/system/files/documents/2025-06/castnet_annual_network_plan_2025_final.pdf. Accessed July 2025.

———. 2025q. *2023 CASTNET Annual Report.* Available at: https://www.epa.gov/system/files/documents/2025-06/ar_2023_executive-summary_final_0.pdf. Accessed July 2025.

———. 2025r. Frequent Questions About eGRID. Available at: https://www.epa.gov/egrid/frequent-questions-about-egrid#What%20are%20GWPs%20and%20which%20GWPs%20does%20eGRID%20use. Accessed July 2025.

U.S. Forest Service (USFS), National Park Service, and U.S. Fish and Wildlife Service. 2000. Federal Land Managers Air Quality Related Values Workgroup Phase I Report (FLAG 2000). Denver, Colorado: U.S. Forest Service.

———. 2010. Federal Land Managers Air Quality Related Values Workgroup (FLAG) Phase I Report–Revised. Available at: https://www.nrc.gov/docs/ML2211/ML22118A305.pdf. Accessed October 2023.

20 APPENDICES

20.1 APPENDIX A NATIONAL EMISSIONS INVENTORY (NEI)

20.2 APPENDIX B AIRTOXSCREEN RESULTS

20.3 APPENDIX C CLIMATE NORMALS, WIND ROSES, AND TRENDS

20.4 APPENDIX D MAJOR SOURCES (NEI)