

APPENDIX I—AIR QUALITY TECHNICAL SUPPORT DOCUMENT

CLIMATE

Climatological data were not readily available for all locations throughout the Little Snake Resource Management Plan Planning Area (RMPPA). Available data used in the analysis are denoted in the following tables and figures.

Table I-1. Little Snake RMPPA Regional Temperature Data (in °F)

Station	Elevation (Feet)	Annual			Extreme		Frost-Free Period						Years of Record	
		Mean	Summer Mean Max	Winter Mean Min	Max	Min	32° F		24° F					
							Days	Date		Days	Date			
								Begin	End		Begin	End		
Dinosaur Nat. Mon	5,921	47	87	12	--	--	--	--	--	--	--	--	--	--
Brown's Park	5,354	45	86	10	--	--	--	--	--	--	--	--	--	--
Maybell	5,925	42	84	4	101	-61	--	--	--	--	--	--	--	--
Meeker	6,242	44	83	9	100	-43	91	6/11	9/10	143	5/12	10/2	30	
Craig	6,285	43	82	8	99	-45	94	6/8	9/10	151	5/5	10/3	10	
Hayden	6,375	43	82	8	100	-45	76	6/11	8/26	145	5/9	10/1	28	
Steambo at Springs	6,770	39	79	3	96	-50	28	6/23	7/21	123	5/18	9/18	30	
Yampa	7,892	39	75	8	88	-24	--	--	--	--	--	--	--	--
Rangely	5,230	47	89	7	--	--	--	--	--	--	--	--	--	--

Source: Little Snake Draft EIS 1988, updated by Western Regional Climatic Center, 2002

-- indicates that data are not available

Figure I-1. Monthly Average Temperatures for Craig, Colorado

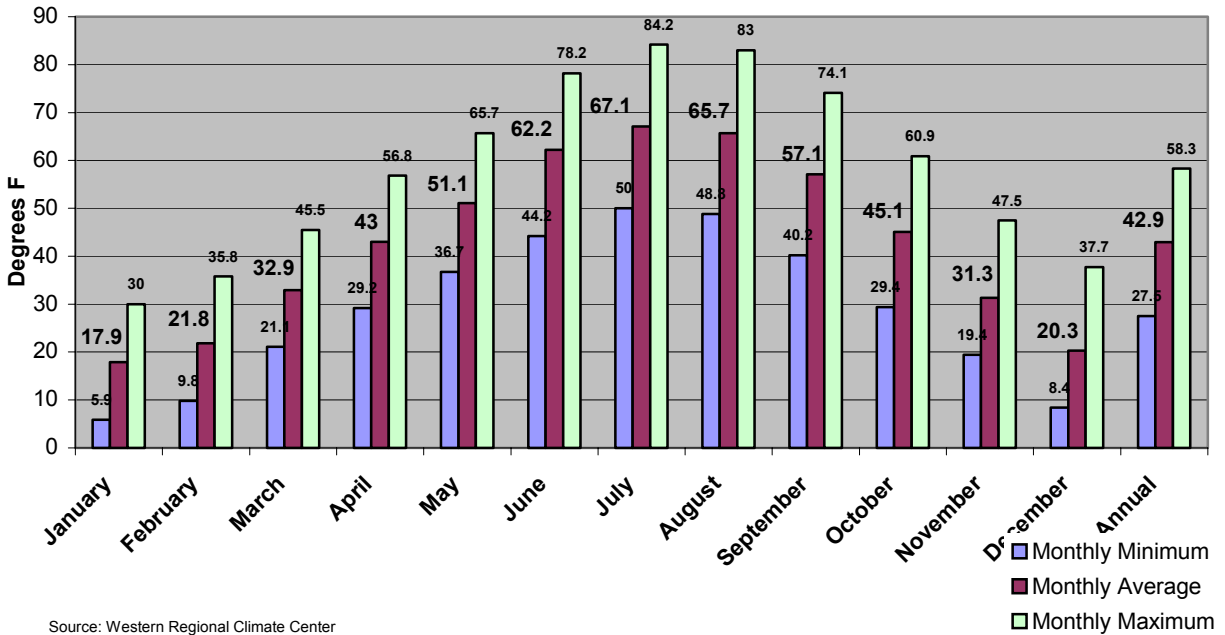


Table I-2. Little Snake Regional Precipitation Data

Station	Elev. Feet	Annual				Extreme				Years of Record
		Mean	Snow		Hail	High	Date	Low	Date	
			Inches	Days	Days					
Dinosaur Nat. Mon	5,921	11.8	43	85	1.6	--	--	--	--	--
Brown's Park	5,354	8.5	17	--	--	--	--	--	--	--
Maybell	5,925	12.3	54	97	0.8	--	--	--	--	--
Meeker	6,242	16.4	87	93	--	--	--	--	--	30
Craig	6,285	16.0	76	103	3.1	18.7	1957	7.4	1958	10
Hayden	6,375	16.8	113	118	1.9	24.6	1957	11.6	1958	28
Steamboat Springs	6,770	23.3	165	143	0	35.9	1957	17.2	1966	30
Yampa	7,892	16.4	120	142	4.3	4.1	1957	10.4	1966	30
Rangely	5,230	10.1	26	--	--	--	--	--	--	--

Source: Little Snake Draft EIS 1988, updated by Western Regional Climatic Center, 2002
 -- indicates that data are not available

Figure I-2. Average Monthly Precipitation for Craig, Colorado

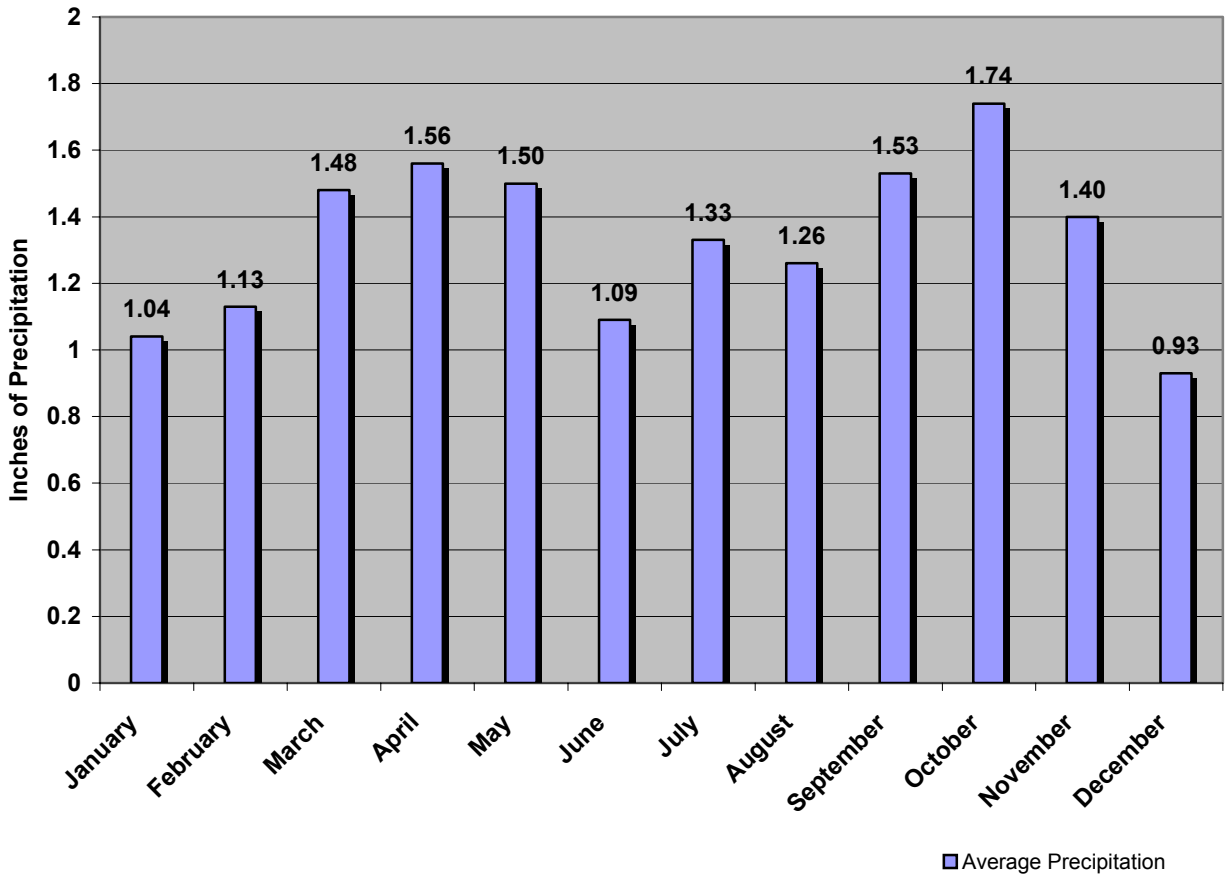


Table I-3. Selected Atmospheric Dispersion Values for Craig, Colorado

Season	Stability Frequency (percentage)			Approximate Mixing Height	
	Unstable	Neutral	Stable	Morning	Afternoon
Annual	9	51	40	380	2,540
Spring	18	55	27	610	3,080
Summer	7	43	50	340	3,770
Fall	7	53	40	240	2,120
Winter	3	54	43	320	1,170

Source: BLM 1983 (GRHF II Draft EIS)

**Table I-4. Monthly Average Wind Speed and Direction for Craig and Hayden, Colorado
(wind speeds in miles per hour)**

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Craig, CO												
Wind Speed	3.9	4.4	5.5	6.7	6.5	8.1	7.4	5.7	5.1	4.9	4.0	5.5
Wind Direction	W	W	W	W	W	W	E	E	W	W	W	W
Hayden, CO												
Wind Speed	6.6	6.7	7.0	8.2	8.2	8.4	8.1	8.0	8.0	7.4	6.7	7.5
Wind Direction	ESE	ESE	ESE	ESE	ESE	ESE	ESE	ESE	ESE	ESE	E	E

APPLICABLE AIR QUALITY REGULATORY ISSUES

Air quality is regulated under the 1970 Clean Air Act (CAA) (42 U.S.C. 7401 et seq.), as amended in 1977 and 1990, and the 1999 Regional Haze Regulations. The purpose of the CAA is to protect and enhance air quality to promote public health, welfare, and the productive capacity of the nation. The CAA addresses criteria air pollutants, National Ambient Air Quality Standards (NAAQS) for criteria air pollutants, and the Prevention of Significant Deterioration (PSD) program. The Regional Haze Regulations address visibility impairment.

The Colorado Department of Public Health and Environment (CDPHE) have been delegated authority by the Environmental Protection Agency (EPA) to administer the State’s Clean Air Act. CDPHE has adopted the NAAQS, so there are no ambient air quality standards specific to Colorado.

Ambient Air Quality Standards for Criteria Pollutants

The EPA has promulgated regulations implementing the CAA in 40 Code of Federal Regulations (CFR) Parts 50 through 99, and it has established NAAQS (40 CFR Part 50) for the following six criteria pollutants:

- ❑ Ozone (O₃)
- ❑ Carbon Monoxide (CO)
- ❑ Particulate Matter (PM₁₀ and PM_{2.5})
- ❑ Nitrogen Dioxide (NO₂)
- ❑ Sulfur dioxide (SO₂)
- ❑ Lead (Pb).

For each criteria pollutant, health-based (or primary) standards have been established to protect public health with an adequate margin of safety, and welfare-based (or secondary) standards have been established to protect the public welfare (e.g., crops, vegetation, wildlife, buildings and national monuments, and visibility) from adverse effects of air pollution. Table I-5 lists typical sources and effects of criteria pollutants.

Table I-5. Sources and Effects of Criteria Pollutants

Pollutants	Health and Welfare Effects
<p>Ozone—Ozone is not directly emitted, but it forms as a result of an atmospheric chemical reaction between oxides of nitrogen (NO_x) and volatile or reactive organic compounds (so-called ozone precursors), and the energy of the sun. Various factors affect this process, including the quantity of gases present, volume of air available for dilution, temperature, and intensity of the ultraviolet light. Ideal conditions occur in the summer and early fall on warm, windless, sunny days. Typical sources of ozone precursors include motor vehicle exhaust and industrial processes, including processes using solvents.</p>	<p>Ozone is a highly reactive gas that irritates the mucous membranes and lung tissues, aggravates respiratory processes, causes eye irritation, reduces visibility, damages vegetation, and weakens rubber and fabrics. Elevated ambient ozone concentrations are known to affect those with existing respiratory illnesses, such as asthma. Acute exposures can cause bronchial constriction, lung edema, and abnormal lung development.</p>
<p>Carbon Monoxide—Carbon monoxide is a colorless, odorless gas that is formed by the incomplete combustion of fuels. It is a site-specific pollutant with high levels typically found in the vicinity of emission sources, such as heavily congested intersections, industrial processes, and power plants. EPA estimates that in urban areas, from 85 to 95 percent of all CO emissions could come from motor vehicle exhaust.</p>	<p>Carbon monoxide can cause harmful health effects by combining with hemoglobin and reducing the amount of oxygen that is delivered to the body's organs. The health threat from lower levels of CO is most serious for those who suffer from heart disease, such as angina, clogged arteries, or congestive heart failure. High levels of CO can affect even healthy people. People who breathe high levels of CO can develop vision problems, reduced ability to work or learn, reduced manual dexterity, and difficulty performing complex tasks.</p>
<p>Sulfur Dioxide—Sulfur dioxide belongs to the family of sulfur oxide gases (SO_x). These gases dissolve easily in water. Sulfur is present, to some degree, in all raw materials and fuels, and SO₂ is formed when sulfur-containing fuels, such as coal, oil, and gasoline are burned, and when gasoline is extracted from oil. Coal-burning power plants generate more than 65 percent of all SO₂ emissions, although locomotives, large ships, and some non-road diesel equipment currently burn high sulfur fuel and contribute to large releases of SO₂.</p>	<p>Because of the way it reacts in the atmosphere, SO₂ can cause a wide variety of health and environmental impacts. Particularly sensitive groups include people with asthma who are active outdoors, children, the elderly, and people with heart or lung disease. Sulfate particles are the major cause of reduced visibility in many parts of the United States, including our national parks. In addition, SO₂ and NO_x react with other substances in the atmosphere to form atmospheric deposition, fog, snow, or dry particles, which can damage forests and crops, change the makeup of soil, and make lakes and streams acidic and unsuitable for fish.</p>
<p>Nitrogen Dioxide—Nitrogen dioxide is formed from the combustion of fuel, with higher combustion temperatures generating more NO₂. Major sources of NO₂ and other oxides of nitrogen (NO_x) include industrial processes, boilers, power plants, mobile sources, and commercial and residential sources that burn fuels. NO_x is one of the main ingredients involved in the formation of ground-level ozone.</p>	<p>Nitrogen oxides, primarily as nitrogen dioxide, are a respiratory irritant and can be harmful on the lungs. NO_x and sulfur dioxide react with other substances in the air to form atmospheric deposition, fog, snow, or dry particles. Nitrate particles and NO₂ can also reduce visibility in urban areas and on a regional scale, and accelerates the eutrophication (or oxygen depletion) of water bodies, particularly coastal estuaries.</p>
<p>Particulate Matter (PM₁₀ and PM_{2.5})—Airborne particulate matter consists of tiny coarse-mode or fine-mode particles or aerosols combined with dust, dirt, smoke, and liquid droplets. Fine-mode PM is derived primarily from the incomplete combustion of fuel sources, whereas, coarse-mode PM is formed from crushing, grinding, or abrasion of surfaces. Sources of PM include industrial processes, power plants, mobile sources, construction activities, and fires. With regard to mobile sources, more PM is emitted into the atmosphere from the use of diesel fuel than the use of gasoline.</p>	<p>PM causes a wide variety of health and environmental impacts. Many scientific studies have linked breathing PM to significant health problems, including aggravated asthma, increased respiratory symptoms, such as coughing, and difficult or painful breathing, chronic bronchitis, decreased lung function, and premature death. PM is the major cause of reduced visibility and can stain and damage stone and other materials, including culturally significant objects, such as monuments and statues.</p>

Pollutants	Health and Welfare Effects
<p>Lead—The primary source of airborne lead used to be motor vehicles operating on leaded gasoline. The introduction of unleaded gasoline has dramatically reduced lead emissions.</p>	<p>Lead causes damage to the kidneys, liver, brain and nerves, and other organs. Exposure to lead could also affect the brain and nerves. Excessive exposure to lead could cause seizures, mental retardation, behavioral disorders, memory problems, and mood changes. Low levels of lead damage the brain and nerves in fetuses and young children, resulting in learning deficits and lowered IQ. It can also affect animals and plants. Wild and domestic animals can ingest lead while grazing and experience the same type of effects as people who are exposed to lead. Elevated levels of lead in the water can cause reproductive damage, and blood and neurological changes in some aquatic life.</p>

Ambient air concentration refers to the mass of pollutants present in a volume of air and can be reported in units of micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) or parts per billion (ppb). The EPA has developed ambient air quality standards for each criteria pollutant for a specific averaging time (Table I-6). Short averaging times (1, 3, 8, and 24 hours) addresses short-term exposure while the annual standards address long-term exposure. Longer term standards are set to lower allowable concentrations than are short-term standards to recognize the cumulative effects of long-term exposure.

Table I-6. National Ambient Air Quality Standards

Pollutant	Averaging Time	NAAQS		
		$(\mu\text{g}/\text{m}^3)$	(ppm)	(ppb)
Ozone (O_3)	1 hour	235	0.12	120
	8 hour	157	0.08	80
Carbon Monoxide (CO)	1 hour	40,000	35	35,000
	8 hour	10,000	9	9,000
Sulfur Dioxide (SO_2)	3 hour	1,300	0.5	266
	24 hour	365	0.14	99
	Annual	80	0.030	23
Nitrogen Dioxide (NO_2)	Annual	100	0.053	53
Particulate Matter (PM_{10})	24 hour	150		
	Annual	50		
Particulate Matter ($\text{PM}_{2.5}$)	24 hour	65		
	Annual	15		
Lead (Pb)	Calendar quarter	1.5		

Hazardous or Toxic Air Pollutants

Hazardous or toxic air pollutants (HAP) are those pollutants hazardous to human health or the environment but that are not specifically covered under another portion of the CAA. HAPs cause, or contribute to air pollution that could reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible or incapacitating reversible illness (42 U.S.C. 74212). EPA administers the National Emission Standards for Hazardous Air Pollutants (NESHAP) program, which targets

emissions of toxic air pollutants. EPA has developed a list of sources and source categories that emit any of 189 identified HAPs and is developing emission standards for these source categories based on the application of maximum achievable control technology (MACT). MACT is emission control technology that achieves a level of emission control and reduction that is at least equivalent to the level of control achieved by the best-controlled source for the category. MACT is required for any stationary source that emits more than 10 tons per year (TPY) of any one HAP, or 25 TPY of any combination of HAPs. HAPs data do not exist for the Little Snake RMPPA.

Prevention of Significant Deterioration

In areas meeting the NAAQS (attainment areas), or in areas for which there is insufficient information to determine whether they meet the NAAQS (unclassifiable areas), New Source Review (NSR) and permitting are implemented under the EPA-administered PSD program. The goal of the PSD program is to ensure that air quality in attainment or unclassifiable areas does not significantly deteriorate, while maintaining a margin for future industrial growth. Proposed new or modified sources are required to apply Best Available Control Technology (BACT), the maximum degree of emission reduction achievable given economic, energy, and environmental factors. Such sources are required to demonstrate that their emissions would not significantly affect the air quality or result in the attainment area being reclassified as nonattainment. The PSD major source threshold level for 28 specific source categories is 100 TPY of potential emissions of any air pollutant. For other source categories, the PSD major source threshold level is 250 TPY of any air pollutant, with the exception of modifications to existing sources that would result in a net emissions increase greater than 40 tons per year.

Under the PSD program, each area in the United States is classified by the air quality in that region according to the following system:

- ❑ **PSD Class I Areas.** Areas with pristine air quality, such as wilderness areas, national parks, and some Indian reservations, are accorded the strictest protection. Only very small incremental increases in concentration are allowed to maintain very clean air quality in these areas.
- ❑ **PSD Class II Areas.** Moderate incremental increases in concentration are allowed, although the concentrations are not allowed to reach the concentrations set by NAAQS.
- ❑ **PSD Class III Areas.** No areas have yet been designated Class III. Concentrations would be allowed to increase to established NAAQS concentrations.

To enforce the PSD program, the EPA developed incremental ambient air quality standards (Table I-7). Comparisons of potential PM₁₀, NO₂, and SO₂ concentrations with PSD increments are intended only to evaluate a threshold of concern and do not represent a regulatory PSD Increment Consumption analysis. Regulatory PSD Increment Consumption analyses are the sole responsibility of the State of Colorado, which has been granted primacy (with EPA oversight).

In project-specific environmental impact statements (EIS), the Bureau of Land Management (BLM) does not expect that a PSD analysis will be performed; rather, the PSD standards are used only as a reference to give the public a better understanding of the level of potential impact.

Table I-7. PSD Incremental Standards

Pollutant	Averaging Time	PSD Increment					
		Class I			Class II		
		($\mu\text{g}/\text{m}^3$)	(ppm)	(ppb)	($\mu\text{g}/\text{m}^3$)	(ppm)	(ppb)
Nitrogen Dioxide (NO ₂)	Annual	2.5	0.0013	1.3	25	0.013	13
Particulate Matter (PM ₁₀)	24 hour	8			30		
	Annual	4			17		
Sulfur Dioxide (SO ₂)	3 hour	25	0.0096	9.6	512	0.1956	196
	24 hour	5	0.0019	1.9	91	0.0348	35
	Annual	2	0.0008	0.8	20	0.0076	8

Regional Haze and Visibility

Visibility impairment in the form of regional haze obscures the clarity, color, texture, and form of what can be seen. Some haze-causing pollutants are emitted directly into the atmosphere from stationary and mobile sources, and others are formed during secondary reactions when gases emitted into the air are carried downwind and form particles as they are transported. Emissions from human-caused and natural sources can be carried great distances, contributing to regional haze. Examples of haze-causing pollutants include sulfate formed from sulfur dioxide (SO₂) and nitrate formed from nitrogen oxides (NO_x).

EPA proposed regional haze regulations in 1997, issuing them in conjunction with the new PM_{2.5} NAAQS because the same particulate matter that causes serious respiratory health effects also degrades visibility. The regional haze regulations are intended to maintain visibility on the least impaired days and improve visibility on the most impaired days in mandatory federal Class I areas across the United States, so that visibility in these areas is returned to natural conditions by the year 2064. EPA's 1999 Regional Haze rule (40 CFR Part 51.300–309) requires the States, in coordination with EPA, the National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service, and other interested parties, to develop and implement air quality protection plans to reduce the pollution that causes visibility impairment in 156 national parks and wilderness areas across the country and to ensure that future visibility impairment does not occur in those areas. The first State plans for regional haze are due in 2003 to 2008 and are expected to have the additional benefit of improving visibility in broad areas across the country that are beyond the targeted national parks and wilderness areas.

Visual range, one of several ways to express visibility, is the farthest distance a person can distinguish a dark landscape feature from a light background, such as the sky. Visibility is typically expressed in terms of deciviews (dv), a measure for describing perceived changes in visibility. One dv is defined as a change in visibility that is just perceptible to an average person—about a 10 percent change in light extinction. Without human-caused visibility impairment, natural visual range is estimated to average about 8 dv (visual range of about 110–115 miles) in the Western United States, and about 13 dv (visual range of about 60–80 miles) in the eastern United States (Malm 1999).

Interagency Monitoring of Protected Visual Environments (IMPROVE) has measured visibility in national parks and wilderness areas in the United States since the 1980s. There are two IMPROVE monitoring stations in Colorado—Mount Zirkel and Rocky Mountain National Park. Monitored aerosol concentrations are used to reconstruct visibility conditions for each day monitored, ranked from clearest to haziest. Conditions are reported in the following three categories:

- ❑ 20 percent clearest—Mean visibility for the 20 percent of days with the best visibility
- ❑ Average—Annual mean visibility
- ❑ 20 percent haziest—Mean visibility for the 20 percent of days with the poorest visibility.

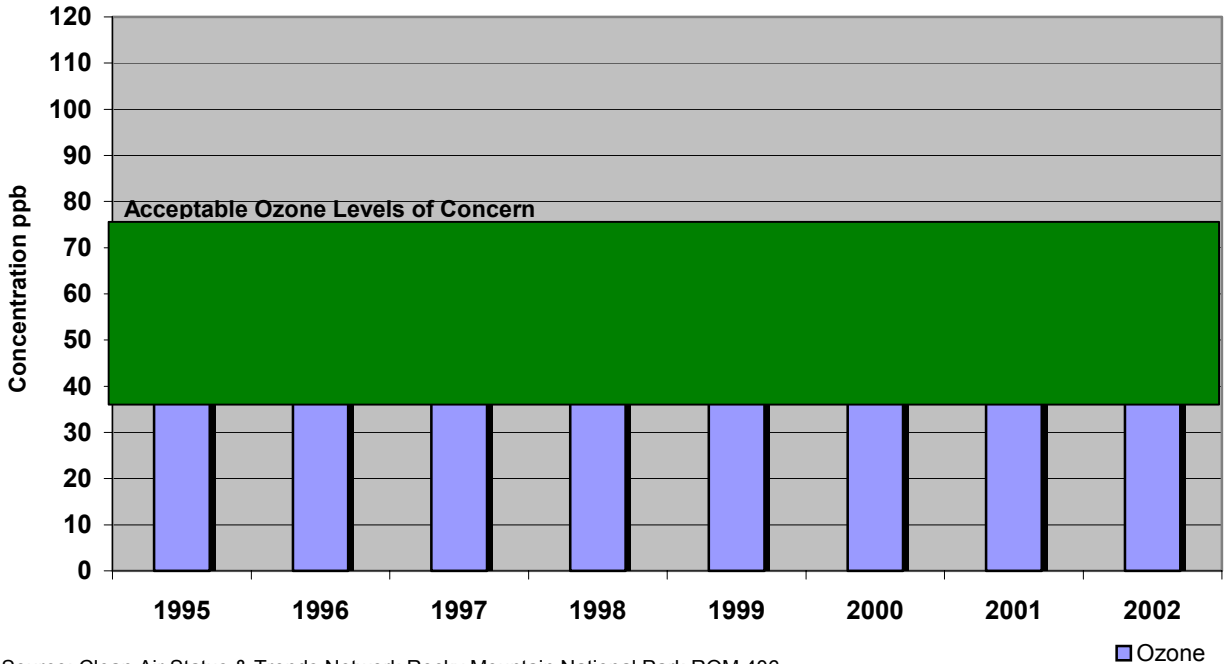
AIR QUALITY MONITORING DATA

Data provided by CDPHE are used to establish background air quality levels. Information collected from the nearest applicable monitoring stations indicate that current concentrations are in compliance with applicable standards; however, current and complete data on the concentrations of criteria air pollutants for the Little Snake RMPPA are not available. Additional sources have more recent information for some pollutants, such as the Clean Air Status and Trends Network (CASTNet); however, the data are not collected in compliance with applicable standards. Information from the additional sources is listed below, where applicable, to provide a basis for comparison.

- ❑ **Ozone.** Ozone concentration data in compliance with applicable standards were collected at various rural sites throughout Colorado, including Ute Mountain Ute Reservation, Mesa Verde National Park, and Great Sand Dunes National Monument. Ozone 1-hour and 8-hour maximum values from Mesa Verde National Park were chosen because they represented the highest rural values and were the most conservative. Non-compliant data for O₃ was available from the CASTNet station in Rocky Mountain National Park. Mean annual O₃ concentrations in Rocky Mountain National Park are typical for remote areas in the Western United States (Singh et al. 1978), and are within the acceptable ozone levels of concern (LOC) established for the Bridger Wilderness in Wyoming (Figure I-3, Fox et al. 1989).
- ❑ **Carbon Monoxide (CO).** The only carbon monoxide (CO) data available are more than two decades old for areas along Interstate 70, south of the Little Snake RMPPA; however, CO levels in the Little Snake RMPPA are expected to be well below standards given the undeveloped and remote nature of the area.
- ❑ **Sulfur Dioxide and Other Sulfur Compounds.** Data for sulfur-containing pollutants (sulfur dioxide [SO₂], sulfate [SO₄-2]), and ozone [O₃]) were available from Craven Creek, Wyoming, in 1981 to 1982. More recent non-compliant data from CASTNet were available for Mount Zirkel Wilderness and Rocky Mountain National Park (Figure I-4). SO₂ concentrations typically range from 1 to 10 ppb in remote areas (Seinfeld 1986). The CASTNet data indicated significantly lower values (averaging greater than or equal to 1.0 ppb) of SO₂ concentrations than acceptable recorded data from Craven Creek, Wyoming; however, data from both sources indicate acceptable levels of SO₂ concentrations in remote areas. SO₄⁻² concentrations from CASTNet were only available for Rocky Mountain National Park. SO₄⁻² concentrations are typically about 0.6 ppb in remote areas and about 2.5 ppb in urban areas (Stern 1973). Although SO₄⁻² concentrations are well below urban levels, concentrations in Rocky Mountain National Park are slightly above levels typical of remote areas.
- ❑ **Nitrogen Dioxide and Other Nitrogen Compounds.** Concentrations of nitrogen-containing pollutants (HNO₃, NO₃⁻, and NH₄⁺) applicable to the Little Snake RMPPA are only available from the Green River Basin Visibility Study site from January to December 2001. Non-compliant data from CASTNet station in Rocky Mountain National Park are available from 1995 through 2001. Although nitrogen-containing pollutants recorded in Rocky Mountain National Park are well below the standards and typical urban levels, they are slightly higher than levels typical of remote areas (Figure I-5).
- ❑ **Particulate Matter.** The only particulate matter (PM₁₀, PM_{2.5}) data available from CDPHE represent urban particulate measurements in Steamboat Springs. Rural particulate values in the Little Snake RMPPA are anticipated to be significantly lower because of lower population concentrations and fewer people.

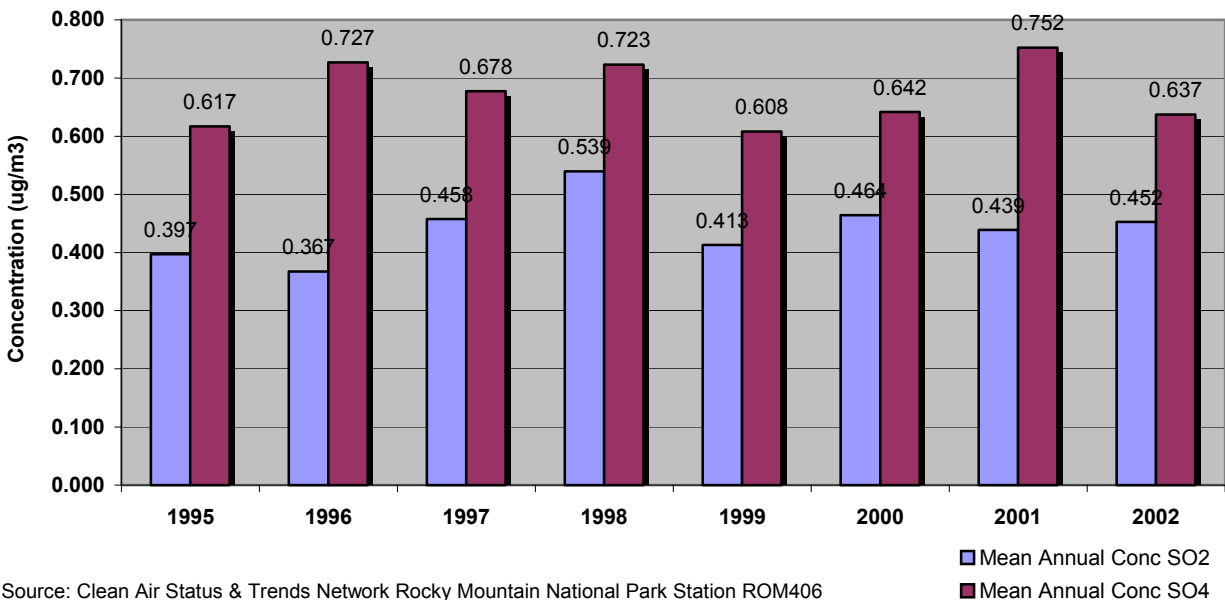
- ❑ **Lead (Pb).** Lead (Pb) is also a criteria pollutant; however, because lead is no longer used as a gasoline additive, it is not considered to be a pollutant of concern from any activities in the area.

Figure I-3. Mean Annual Ozone Concentrations in Rocky Mountain National Park



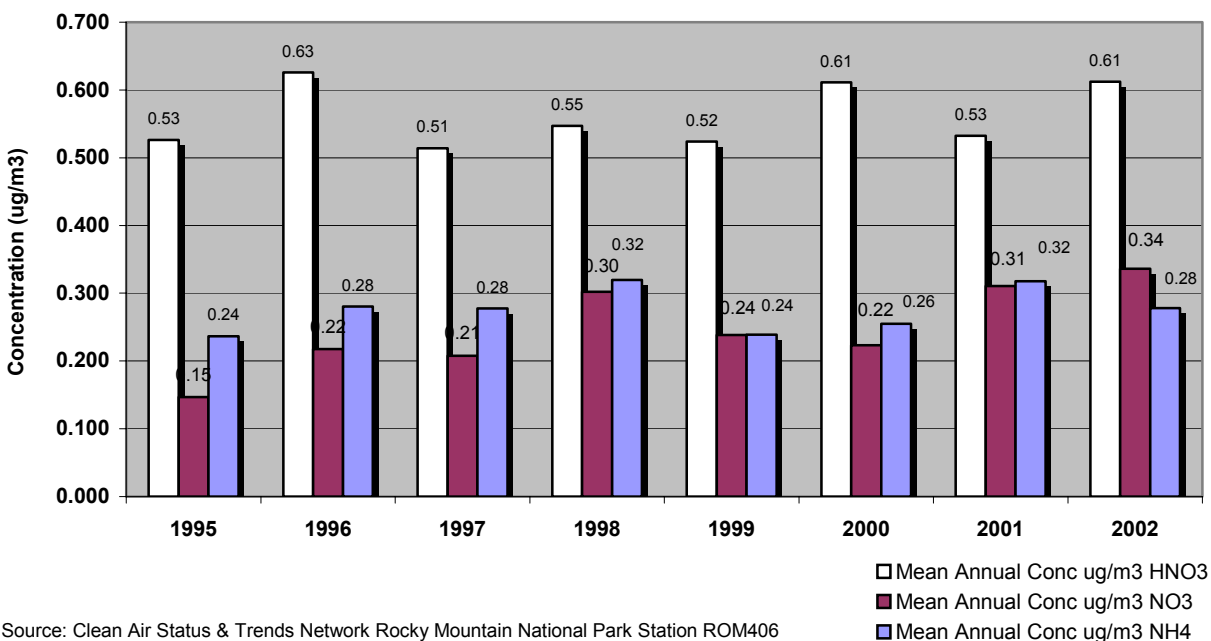
Source: Clean Air Status & Trends Network Rocky Mountain National Park ROM 406

Figure I-4. Mean Annual Concentrations of Sulfur Compounds in Rocky Mountain National Park, Colorado



Source: Clean Air Status & Trends Network Rocky Mountain National Park Station ROM406

Figure I-5. Mean Annual Concentrations of Nitrogen Compounds in Rocky Mountain National Park, Colorado



Atmospheric Deposition

Atmospheric deposition refers to the processes by which air pollutants are removed from the atmosphere and deposited in terrestrial and aquatic ecosystems. It is reported as the mass of material deposited in an area (kilograms per hectare [kg/ha]) per year (yr). Air pollutants are deposited by wet deposition (precipitation) and dry deposition (gravitational settling of particles and adherence of gaseous pollutants to soil, water, and vegetation). Substances deposited include—

- ❑ Nitrogen and sulfur compounds (nitrates, nitrites, and sulfates and sulfites)
- ❑ Acids (sulfuric acid [H₂SO₄] and nitric acid [HNO₃]), also known as acid rain
- ❑ Air toxics (such as pesticides, herbicides, and volatile organic compounds [VOC])
- ❑ Nutrients (such as nitrate [NO₃⁻] and ammonium [NH₄⁺]).

Estimation of atmospheric deposition is complicated by the contribution to deposition of several components—rain, snow, cloud water, particle settling, and gaseous pollutants. Deposition varies with precipitation, which in turn, varies with elevation and time.

There are no established regulations for atmospheric deposition; however, guidelines, or identified LOCs, set for the Bridger Wilderness in Wyoming (Fox et al. 1989) are widely accepted and used to determine concentrations.

Wet Deposition

The National Atmospheric Deposition Program (NADP) assesses wet deposition by measuring the chemical composition of precipitation (rain and snow). Precipitation acidity (pH) data was obtained from three NADP stations in or near the Little Snake RMPPA—Sand Spring in Moffat County, Buffalo Pass Dry Lake in Routt County, and Buffalo Pass Summit Lake in Routt County.

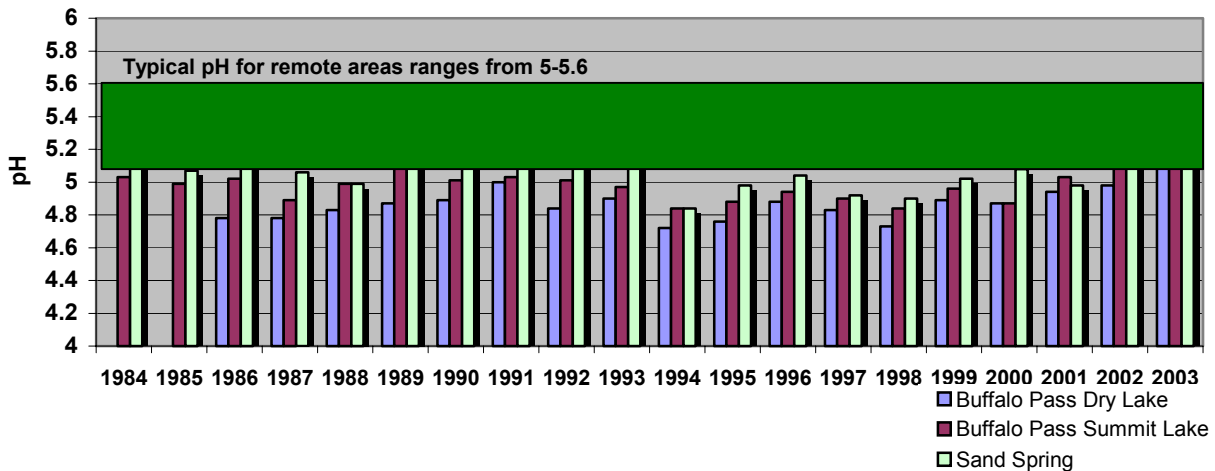
The natural acidity of rainwater is generally considered to be within a range of pH from 5.0 to 5.6 (Seinfeld 1986). All three monitoring stations dropped below a pH of 5.0, which indicated acidification of precipitation, starting in 1994 and continuing through 2001.

Data from all the monitoring stations were used to determine trends in the deposition of NH_4 , NO_3 , and SO_4 in the Little Snake RMPPA from 1986 through 2003 shown on Figures I-6 through I-9. Wet ammonium (NH_4^+) deposition values shown in Figure I-7 are low for all three monitoring stations. Wet deposition of both nitrate (NO_3^-) and sulfate (SO_4^{2-}) at Buffalo Pass Dry Lake and Buffalo Pass Summit Lake stations are moderately elevated, while nitrate and sulfate data at Sand Spring are low (Figure I-8 and I-9). A steady decrease in SO_4^{2-} wet deposition has been occurring at the Buffalo Pass stations from 1995 to early 2000s.

Dry Deposition

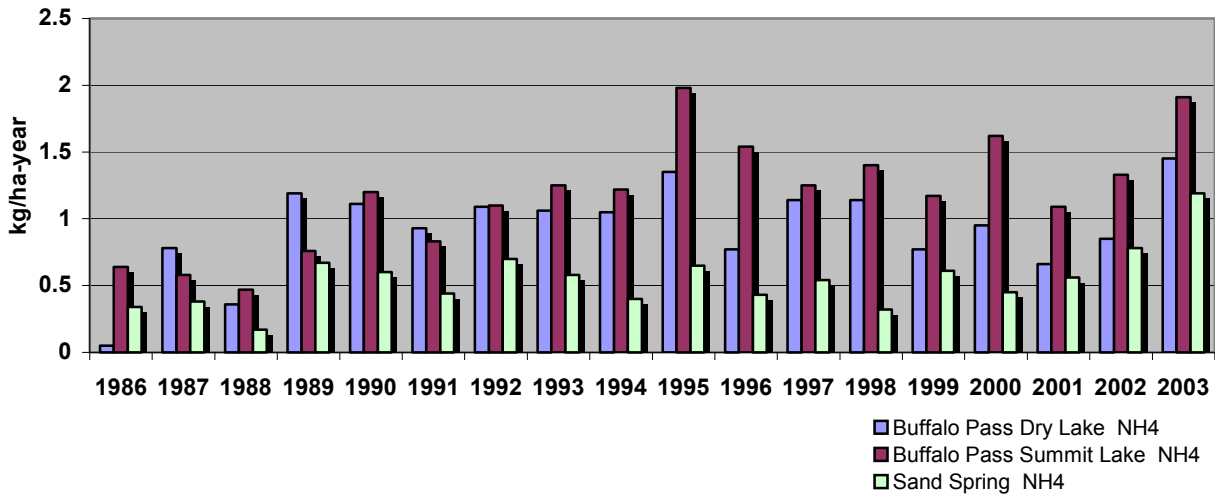
CASTNet measures dry deposition of sulfur- and nitrogen-containing compounds (SO_2 , HNO_3 , SO_4^{2-} , NO_3^- , and NH_4^+) for Rocky Mountain National Park (Figure I-10). Dry deposition values in Rocky Mountain National Park are low (less than 1 kg/ha-yr) and steady for all pollutants, except for HNO_3 , which ranged from 1.5 to 4.6 kg/ha-yr.

Figure I-6. Mean Annual Precipitation pH in the Little Snake RMPPA



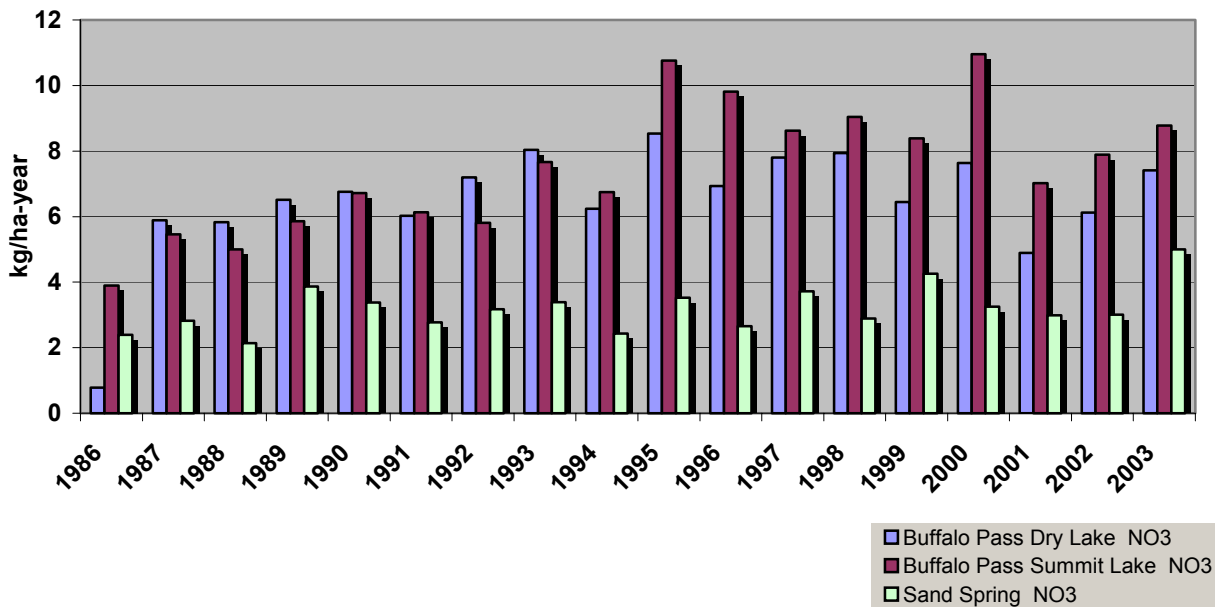
Source: National Atmospheric Deposition Program Buffalo Pass Dry Lake, Buffalo Pass Summit Lake and Sand Spring Stations

Figure I-7. Mean Annual Wet Deposition of NH₄ in the Little Snake RMPPA



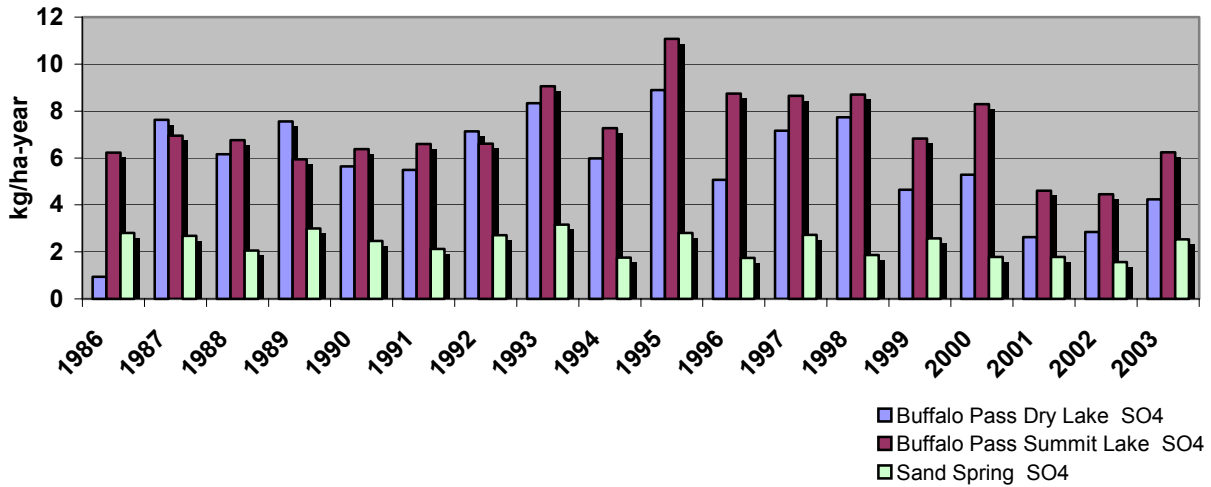
Source: National Atmospheric Deposition Program Buffalo Pass Dry Lake, Buffalo Pass Summit Lake and Sand Spring Monitoring Stations

Figure I-8. Mean Annual Wet Deposition of NO₃ in the Little Snake RMPPA



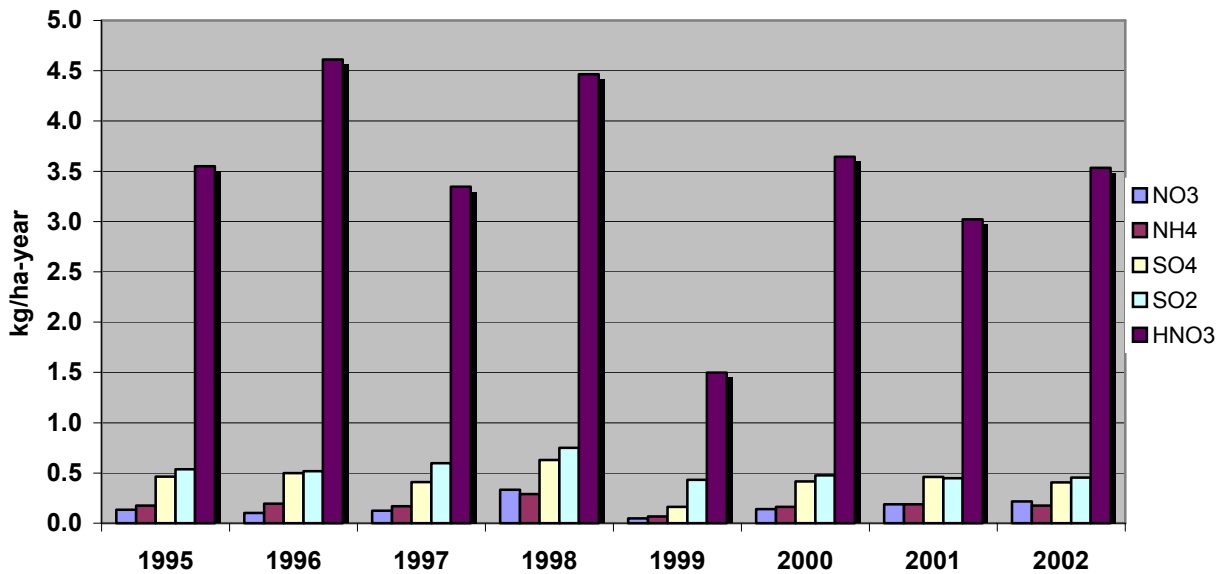
Source: National Atmospheric Deposition Program Buffalo Pass Dry Lake, Buffalo Pass Summit Lake and Sand Spring Monitoring Stations

Figure I-9. Mean Annual Wet Deposition of SO₄ in the Little Snake RMPPA



Source: National Atmospheric Deposition Program Buffalo Pass Dry Lake, Buffalo Pass Summit Lake and Sand Spring Monitoring Stations

Figure I-10. Mean Annual Dry Deposition of Sulfur and Nitrogen Compounds in Rocky Mountain National Park, Colorado



Source: Clean Air Status & Trends Network Rocky Mountain National Park Station ROM406

EMISSIONS CALCULATIONS

A summary of emission inventories for each of the BLM activities for the base year (2006), and long-term scenarios for all of the alternatives are found below. These emissions were calculated from data provided by the Little Snake Field Office and used best available information, BACT, AP-42, and the emission studies from other BLM documents.

The numbers of oil and gas wells assumed are provided by the Little Snake Field Office and are shown in Table I-8. (These tables account for net wells in operation and exclude abandoned wells.)

Table I-8. Number of Oil and Gas Wells for Little Snake Field Office

Well Type	Existing (Producing) Wells Through 2006 ^a	Newly Proposed Wells	2026 Operational Wells
Alternative A (No Action Alternative)			
Total CBM Wells	109	300	409
Total Conventional Wells	772	2,125	2,897
Total Combined Wells	881	2,425	3,306
Alternative B			
Total CBM Wells	109	300	409
Total Conventional Wells	772	2,125	2,897
Total Combined Wells	881	2,425	3,306
Alternative C (Preferred Alternative)			
Total CBM Wells	109	300	409
Total Conventional Wells	772	2,125	2,897
Total Combined Wells	881	2,425	3,306
Alternative D			
Total CBM Wells	109	225	334
Total Conventional Wells	772	1,593	2,365
Total Combined Wells	881	1,818	2,699

^a Current producing wells from LSFO RFD p. 64

Little Snake RMP BLM Emissions

Using the well numbers, individual tables for all BLM activities were calculated in linked spreadsheets. Because oil and gas field activities consist of many phases (e.g., exploration, development, production, and closure), the components that need to be included in emission calculations are complex. These assumptions and calculations are available on an emissions CD. To understand the elements and assumptions used in the emissions please refer to the emissions CD which is available from the BLM Little Snake Field Office. The assumptions and inputs used for each resource area are identified in the first two tabs of each major spreadsheet.

Tables B-6 through B-8 display summaries of total BLM emissions, estimated for the base year (2006), and the long term (2026). The tables are organized by activity and show emissions for the time frame referenced (e.g., base year and long term). Emissions are calculated on an annual basis (TPY). In

addition, for both the base year and the long-term time frames, emissions were calculated for each alternative. (Because the base year is the same for all alternatives, only one set of base year emissions was needed.)

Table I-9. Total Emissions for Alternatives (tons per year)

Alternative	2006	2026
Alternative A	16,387	43,184
Alternative B	16,387	43,272
Alternative C (Preferred Alternative)	16,387	43,105
Alternative D	16,387	35,468

Note: Totals are all pollutants minus PM_{2.5} and HAPs, because PM_{2.5} is a subset of PM₁₀, and HAPs are a subset of VOCs.

Table I-10. Base Year (2006) Emissions Inventory for BLM-Administered Lands Within Little Snake Field Office Area (tons per year)

Activity	PM ₁₀ Tons	PM _{2.5} Tons	NOx Tons	SO ₂ Tons	CO Tons	VOC Tons	HAPs ^b Tons
Oil and Gas Well Development and Exploration							
Coalbed Natural Gas	141	87	746	2	1,424	802	80
Subtotal: Conventional Natural Gas	563	360	2,468	30	2,954	3,991	399
Subtotal: Oil and Gas Well Activities	704	448	3,214	32	4,378	4,793	479
Non-Oil and Gas Well Activities							
Coal Mining ^a	131	131	169	19	298	16	2
Lands & Realty	66	13	48	5	14	4	0
Livestock Grazing	25	6	28	3	8	3	0
Off-Highway Vehicles (OHV) ^a	20	20	8	-	1,712	628	63
Resource Roads	0	0	0	0	0	0	0
Saleable Minerals	0	0	-	-	-	-	-
Vegetation	4	1	0	0	0	0	0
Prescribed Fire Emissions ^c	56	50	-	-	-	-	-
Subtotal: Non-Oil and Gas Well Activities	303	221	253	27	2,032	651	65
Total: Base Year (2026)	1,006	669	3,467	58	6,410	5,445	545

Table I-11. Long-Term (2026) Emissions Inventory for BLM-Administered Lands Within Little Snake Field Office Area (tons per year)

Activity	PM ₁₀ Tons	PM _{2.5} Tons	NO _x Tons	SO ₂ Tons	CO Tons	VOC Tons	HAPs ^b Tons
ALTERNATIVE A							
Oil and Gas Well Development and Exploration							
Coalbed Natural Gas	306	226	1,569	5	2,915	2,024	202
Subtotal: Conventional Natural Gas	1,344	1,043	6,818	49	10,366	13,574	1,357
Subtotal: Oil and Gas Well Activities	1,650	1,268	8,387	54	13,282	15,599	1,560
Non-Oil and Gas Well Activities							
Coal Mining ^a	131	131	169	19	298	16	2
Lands & Realty	66	13	48	5	14	4	0
Livestock Grazing	25	6	28	3	8	3	0
Off-Highway Vehicles (OHV) ^a	28	28	12	-	2,396	880	88
Resource Roads	0	0	0	0	0	0	0
Saleable Minerals	0	0	-	-	-	-	-
Vegetation	4	1	0	0	0	0	0
Prescribed Fire Emissions ^c	56	50	-	-	-	-	-
Subtotal: Non-Oil and Gas Well Activities	311	230	256	27	2,717	902	91
Total: Alternative A Long-Term Development (2026)	1,961	1,498	8,643	80	15,998	16,501	1,650
ALTERNATIVE B							
Oil and Gas Well Development and Exploration							
Coalbed Natural Gas	306	226	1,569	5	2,915	2,024	202
Subtotal: Conventional Natural Gas	1,344	1,043	6,818	49	10,366	13,574	1,357
Subtotal: Oil and Gas Well Activities	1,650	1,268	8,387	54	13,282	15,599	1,560
Non-Oil and Gas Well Activities							
Coal Mining ^a	131	131	169	19	298	16	2
Lands & Realty	66	13	48	5	14	4	0
Livestock Grazing	25	6	28	3	8	3	0
Off-Highway Vehicles (OHV) ^a	28	28	12	-	2,396	880	88
Resource Roads	0	0	0	0	0	0	0
Saleable Minerals	0	0	-	-	-	-	-
Vegetation	5	1	0	0	0	0	0
Prescribed Fire Emissions ^c	143	120	-	-	-	-	-
Subtotal: Non-Oil and Gas Well Activities	399	300	256	27	2,717	902	91
Total: Alternative B Long-Term Development (2026)	2,049	1,568	8,643	80	15,998	16,501	1,650

Activity	PM ₁₀ Tons	PM _{2.5} Tons	NOx Tons	SO ₂ Tons	CO Tons	VOC Tons	HAPs ^b Tons
ALTERNATIVE C (PREFERRED ALTERNATIVE)							
Oil and Gas Well Development and Exploration							
Coalbed Natural Gas	306	226	1,569	5	2,915	2,024	202
Subtotal: Conventional Natural Gas	1,344	1,043	6,818	49	10,366	13,574	1,357
Subtotal: Oil and Gas Well Activities	1,650	1,268	8,387	54	13,282	15,599	1,560
Non-Oil and Gas Well Activities							
Coal Mining ^a	131	131	169	19	298	16	2
Lands & Realty	66	13	48	5	14	4	0
Livestock Grazing	25	6	28	3	8	3	0
Off-Highway Vehicles (OHV) ^a	28	28	11	-	2,328	854	85
Resource Roads	0	0	0	0	0	0	0
Saleable Minerals	0	0	-	-	-	-	-
Vegetation	0	0	0	0	0	0	0
Prescribed Fire Emissions ^c	76	64	-	-	-	-	-
Subtotal: Non-Oil and Gas Well Activities	326	242	256	27	2,648	877	88
Total: Alternative C (Preferred Alternative) Long-Term Development (2026)	1,977	1,511	8,643	80	15,930	16,476	1,648
ALTERNATIVE D							
Oil and Gas Well Development and Exploration							
Coalbed Natural Gas	255	191	1,361	4	2,542	1,718	172
Subtotal: Conventional Natural Gas	1,079	856	5,507	38	8,446	11,048	1,105
Subtotal: Oil and Gas Well Activities	1,334	1,047	6,868	42	10,987	12,766	1,277
Non-Oil and Gas Well Activities							
Coal Mining ^a	131	131	169	19	298	16	2
Lands & Realty	66	13	48	5	14	4	0
Livestock Grazing	25	6	28	3	8	3	0
Off-Highway Vehicles (OHV) ^a	21	21	9	-	1,780	653	65
Resource Roads	0	0	0	0	0	0	0
Saleable Minerals	0	0	-	-	-	-	-
Vegetation	5	1	0	0	0	0	0
Prescribed Fire Emissions ^c	164	137	-	-	-	-	-
Subtotal: Non-Oil and Gas Well Activities	413	310	253	27	2,101	676	68
Total: Alternative D Long-Term Development (2026)	1,747	1,356	7,122	69	13,088	13,443	1,345

a PM_{2.5} assumed = PM₁₀ for this activity
 b HAP = Hazardous air pollutants; assumed = VOCs * 0.1
 c From SASEM model