

5.0 SECTION 309 REGIONAL SUMMARIES

As described in Section 2.2, some states in the Western Regional Air Partnership (WRAP) qualify for Section 309 requirements for submittal of Regional Haze Rule (RHR) progress reports, but have the option of compliance with Section 308 regulations. Section 309 rules were based on recommendations from the Grand Canyon Visibility Transport Commission (GCVTC) Recommendations report,⁵⁹ specific to visibility impacts at the 16 Class I areas (CIAs) on the Colorado Plateau. Of the nine western states originally eligible for Section 309 RHR implementation, only the states of New Mexico, Utah, and Wyoming and the city of Albuquerque/Bernalillo County currently exercise this option.

The 16 CIAs on the Colorado Plateau are depicted in Figure 5.0-1 and listed in Table 5.0-1. Note that the ZION1 site, which originally represented Zion Canyon National Park, has since been replaced with the ZICA1 site, as described in Section 6.13.1.1. This section presents regional progress summaries specific to monitoring and emissions data at these Colorado Plateau sites. Additionally, regional summaries for the entire WRAP region are presented in Section 4.0, and state and site specific summaries are presented in Section 6.0.

⁵⁹ The Grand Canyon Visibility Transport Commission Recommendations for Improving Western Vistas Report is archived on the WRAP website at www.wrapair.org/WRAP/reports/GCVTCFinal.PDF.

Table 5.0-1
Colorado Plateau CIAs and Representative IMPROVE Monitors

Class I Area	Representative IMPROVE Site	Latitude	Longitude	Elevation (m)
Arizona				
Grand Canyon NP	GRCA2	35.97	-111.98	2267
Mount Baldy WA	BALD1	34.06	-109.44	2508
Petrified Forest NP	PEFO1	35.08	-109.77	1766
Sycamore Canyon WA	SYCA1	35.14	-111.97	2046
Colorado				
Black Canyon of the Gunnison NP Weminuche WA	WEMI1	37.66	-107.80	2750
Flat Tops WA Maroon Bells-Snowmass WA West Elk WA	WHRI1	39.15	-106.82	3413
Mesa Verde NP	MEVE1	37.20	-108.49	2172
New Mexico				
San Pedro Parks WA	SAPE1	36.01	-106.84	2935
Utah				
Bryce Canyon NP	BRCA1	37.62	-112.17	2481
Canyonlands NP Arches NP	CANY1	38.46	-109.82	1798
Capitol Reef NP	CAP11	38.30	-111.29	1896
Zion NP	ZICA1*	37.20	-113.15	1215

*Replaced the ZION1 monitoring site in 2003.

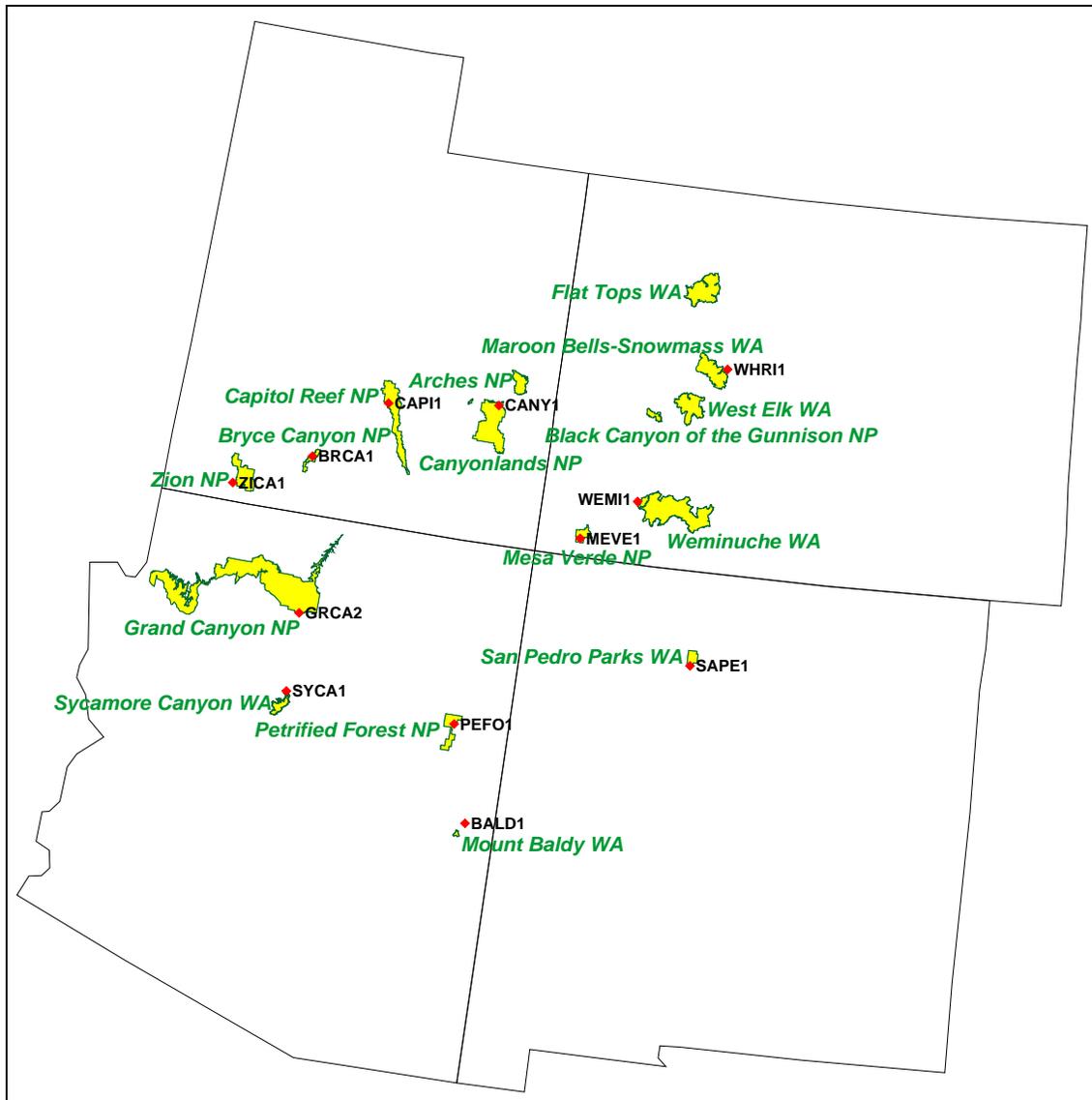


Figure 5.0-1. Map Depicting Colorado Plateau CIAs and Representative IMPROVE Monitors in Arizona, Colorado, New Mexico, and Utah.

5.1 MONITORING DATA

As described previously, the goal of the RHR is to ensure that visibility on the 20% most impaired, or worst, days continues to improve at each Federal CIA, and that visibility on the 20% least impaired, or best, days does not get worse. Progress is determined by comparing current monitored conditions to the baseline average, beginning with the 2000-2004 baseline, and proceeding with each subsequent 5-year average (e.g. 2005-2009, 2010-2014, etc.)⁶⁰, as measured at representative IMPROVE monitoring sites.

⁶⁰ See page 4-2 in EPA's September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule*.

Figures 5.1-1 and 5.1-2 present the 2005-2009 visibility averages for the most impaired (20% worst) and least impaired (20% best) days, respectively, for the IMPROVE sites representing CIAs on the Colorado Plateau. The size of the pie chart is related to the magnitude of visibility impairment, and colors represent the relative contribution of the pollutants which are measured by the IMPROVE Network.

Tables 5.1-1 and 5.1-2 present the calculated deciview values for current conditions at each site, along with the percent contribution to extinction from each aerosol species for the worst and best days, respectively, for each site. Tables 5.1-3 and 5.1-4 present the difference between the 2000-2004 baseline period average and the 2005-2009 first progress period average for the 20% worst and 20% best days, respectively, for the CIA sites in the Colorado Plateau region. Also, trend statistics for the years 2000-2009 for each species at each site are summarized in Table 5.1-5.⁶¹ Only trends for aerosol species trends with p-value statistics less than 0.15 (85% confidence level) are presented in the table here, with increasing slopes in red and decreasing slopes in blue.⁶² Some general observations for the current visibility conditions, and the difference between current and baseline conditions listed below:

- The largest contributors to aerosol extinction at the Colorado Plateau sites were particulate organic mass, ammonium sulfate, and coarse mass.
- For all sites, the 5-year average as measured in deciview metric decreased for the best days decreased between the baseline and first progress period.
- For most sites, the 5-year average as measured in deciview metric decreased for the worst days between the baseline and first progress period. Exceptions included GRCA2 and BALD1 in Arizona and BRCA1 and CAPI1 in Utah. Some contributing factors for aerosol measurements that affected increased in 5-year average deciviews are listed below.
 - The increase at GRCA2 was due to increases in ammonium sulfate, elemental carbon, particulate organic mass and soil, partially offset by decreases in ammonium nitrate and coarse mass. The particulate organic carbon increase was associated with high measurements due to fire events in June and August of 2009. No statistically significant increasing annual trends were measured for any of the species at the GRCA2 site.
 - Extinction remained relatively unchanged in terms of deciviews for the worst days measured at the BALD1 site. Increases in coarse mass, soil, and ammonium sulfate were offset by decreases in particulate organic mass, elemental carbon,

⁶¹ Annual trends were calculated for the years 2000-2009, with a trend defined as the slope derived using Theil statistics. Trends derived from Theil statistics are useful in analyzing changes in air quality data because these statistics can show the overall tendency of measurements over long periods of time, while minimizing the effects of year-to-year fluctuations which are common in air quality data. Theil statistics are also used in EPA's National Air Quality Trends Reports (<http://www.epa.gov/airtrends/>) and the IMPROVE program trend reports (http://vista.cira.colostate.edu/improve/Publications/improve_reports.htm)

⁶² The significance of the trend is represented with p-values calculated using Mann-Kendall trend statistics. Determining a significance level helps to distinguish random variability in data from a real tendency to increase or decrease over time, where lower p-values indicate higher confidence levels in the computed slopes.

and ammonium nitrate. Trend statistics showed an increasing coarse mass trend at the BALD1 and PEFO1 sites in eastern Arizona.

- At the BRCA1 and CAPI1 sites, the largest contributor to increases was particulate organic mass which, similar to GRCA2, was associated with large fires events in July and August 2009. These increases were offset by decreases in ammonium nitrate and ammonium sulfate. An increasing soil trend was measured for the worst days at the CAPI1 site.
- Increases in 5-year average ammonium sulfate were measured at many regional sites, although most sites showed decreasing annual average ammonium sulfate trends. The 5-year average was influenced by relatively high regional measurements of ammonium sulfate in 2005. Figure 5.1.3 presents a plot of the annual averages for all Colorado Plateau sites, showing the high values measured in 2005, followed by generally decreasing trends.

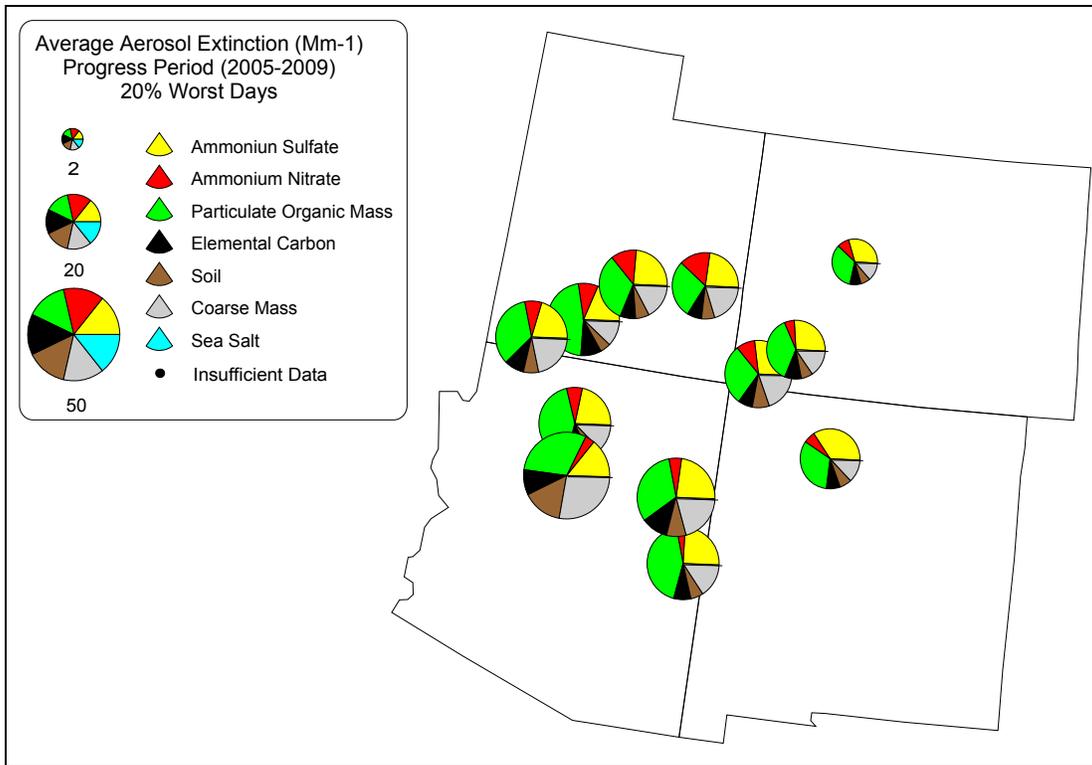


Figure 5.1-1. Regional Average of Aerosol Extinction by Pollutant for the First Progress Period Average (2005-2009) for 20% Worst Days.

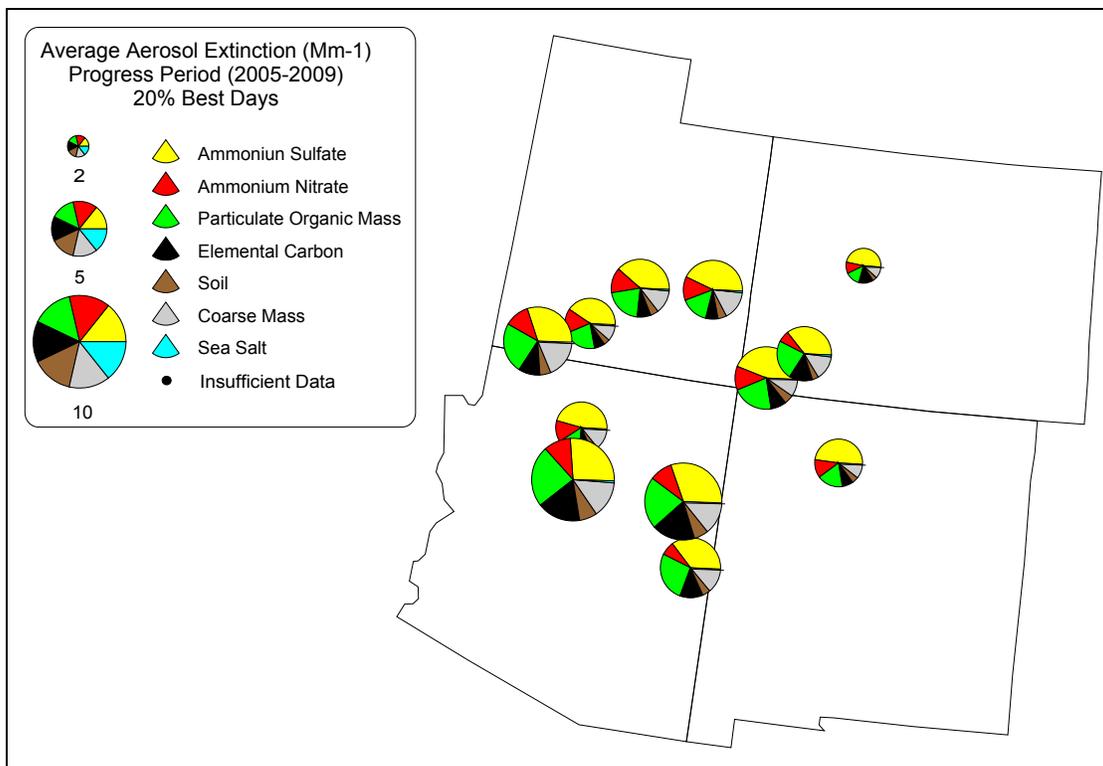


Figure 5.1-2. Regional Average of Aerosol Extinction by Pollutant for First Progress Period Average (2005-2009) for 20% Best Days.

Table 5.1-1
Colorado Plateau Class I Area IMPROVE Sites
Current Visibility Conditions
2005-2009 Progress Period, 20% Most Impaired Days

Site	Deciviews (dv)	Percent Contribution to Aerosol Extinction by Species (Excludes Rayleigh) (% of Mm ⁻¹) and Rank*						
		Ammonium Sulfate	Ammonium Nitrate	Particulate Organic Mass	Elemental Carbon	Soil	Coarse Mass	Sea Salt
Arizona								
GRCA2	12.0	22% (2)	7% (5)	41% (1)	11% (4)	6% (6)	12% (3)	0% (7)
BALD1	11.8	25% (2)	4% (6)	42% (1)	8% (4)	6% (5)	16% (3)	0% (7)
PEFO1	13.0	23% (2)	5% (6)	31% (1)	11% (4)	8% (5)	21% (3)	1% (7)
SYCA1	15.2	15% (4)	4% (6)	29% (1)	9% (5)	15% (3)	28% (2)	0% (7)
Colorado								
WEMI1	10.0	27% (2)	5% (6)	36% (1)	10% (4)	7% (5)	15% (3)	0% (7)
WHRI1	8.9	30% (2)	8% (5)	33% (1)	8% (4)	7% (6)	13% (3)	0% (7)
MEVE1	11.3	27% (2)	9% (4)	28% (1)	7% (6)	9% (5)	20% (3)	0% (7)
New Mexico								
SAPE1	9.9	34% (1)	6% (6)	32% (2)	8% (4)	7% (5)	13% (3)	0% (7)
Utah								
BRCA1	11.9	19% (2)	9% (5)	45% (1)	10% (4)	5% (6)	12% (3)	0% (7)
CANY1	11.0	23% (2)	14% (4)	27% (1)	7% (5)	7% (6)	20% (3)	0% (7)
CAPI1	11.3	24% (2)	12% (4)	32% (1)	8% (5)	7% (6)	17% (3)	0% (7)
ZICA1	12.3	21% (3)	7% (5)	33% (1)	9% (4)	7% (6)	22% (2)	0% (7)

*Highest aerosol species contribution per site is highlighted in bold.

Table 5.1-2
Colorado Plateau Class I Area IMPROVE Sites
Current Visibility Conditions
2005-2009 Progress Period, 20% Least Impaired Days

Site	Deciviews (dv)	Percent Contribution to Aerosol Extinction by Species (Excludes Rayleigh) (% of Mm ⁻¹) and Rank*						
		Ammonium Sulfate	Ammonium Nitrate	Particulate Organic Mass	Elemental Carbon	Soil	Coarse Mass	Sea Salt
Arizona								
GRCA2	2.2	45% (1)	13% (4)	15% (2)	9% (5)	4% (6)	14% (3)	1% (7)
BALD1	2.9	35% (1)	7% (5)	26% (2)	13% (4)	5% (6)	13% (3)	1% (7)
PEFO1	4.6	31% (1)	9% (5)	21% (2)	19% (3)	6% (6)	14% (4)	0% (7)
SYCA1	5.1	27% (1)	10% (5)	23% (2)	17% (3)	7% (6)	15% (4)	1% (7)
Colorado								
WEMI1	2.4	36% (1)	6% (5)	23% (2)	15% (4)	4% (6)	15% (3)	1% (7)
WHRI1	0.2	46% (1)	10% (5)	14% (3)	15% (2)	5% (6)	11% (4)	0% (7)
MEVE1	3.1	44% (1)	12% (3)	21% (2)	9% (5)	5% (6)	9% (4)	0% (7)
New Mexico								
SAPE1	1.0	47% (1)	12% (3)	18% (2)	8% (5)	5% (6)	10% (4)	1% (7)
Utah								
BRCA1	11.9	19% (2)	9% (5)	45% (1)	10% (4)	5% (6)	12% (3)	0% (7)
CANY1	11.0	23% (2)	14% (4)	27% (1)	7% (5)	7% (6)	20% (3)	0% (7)
CAPI1	11.3	24% (2)	12% (4)	32% (1)	8% (5)	7% (6)	17% (3)	0% (7)
ZICA1	12.3	21% (3)	7% (5)	33% (1)	9% (4)	7% (6)	22% (2)	0% (7)

*Highest aerosol species contribution per site is highlighted in bold.

Table 5.1-3
Colorado Plateau Class I Area IMPROVE Sites
Difference in Aerosol Extinction by Species
2000-2004 Baseline Period to 2005-2009 Progress Period
20% Most Impaired Days

Site	Deciview (dv)			Change in Extinction by Species (Mm ⁻¹)*						
	2000-04 Baseline Period	2005-09 Progress Period	Change in dv*	Amm. Sulfate	Amm. Nitrate	POM	EC	Soil	CM	Sea Salt
Arizona										
GRCA2	11.7	12.0	+0.3	+0.5	-0.4	+0.1	+0.5	+0.1	-0.3	0.0
BALD1	11.8	11.8	0.0	+0.3	-0.1	-2.1	-0.7	+0.4	+1.3	+0.1
PEFO1	13.2	13.0	-0.2	+0.5	-0.3	-1.4	+0.5	+0.6	-1.0	+0.1
SYCA1	15.3	15.2	-0.1	+0.7	-0.7	-0.5	+0.4	-1.0	+1.4	0.0
Colorado										
WEMI1	10.3	10.0	-0.3	+0.1	-0.2	-1.4	-0.2	+0.1	0.0	-0.1
WHRI1	9.6	8.9	-0.7	+0.3	0.0	-2.3	-0.3	+0.1	-0.5	0.0
MEVE1	13.0	11.3	-1.7	-0.2	-0.3	-5.8	-0.7	-0.5	-2.0	0.0
New Mexico										
SAPE1	10.2	9.9	-0.3	+1.0	-0.4	-1.4	-0.1	-0.1	-0.2	0.0
Utah										
BRCA1	11.6	11.9	+0.3	-0.2	-0.3	+2.5	+0.2	+0.1	-0.9	0.0
CANY1	11.2	11.0	-0.2	-0.3	+0.3	-0.9	-0.1	+0.1	+0.8	0.0
CAPI1	10.9	11.3	+0.4	-0.2	-0.7	+1.8	+0.2	+0.3	+0.7	+0.1
ZICA1	12.5	12.3	-0.2	+0.2	-0.3	-0.8	-0.1	+0.1	0.0	+0.1

*Change is calculated as progress period average minus baseline period average. Values in red indicate increases in extinction and values in blue indicate decreases.

Table 5.1-4
 Colorado Plateau Class I Area IMPROVE Sites
 Difference in Aerosol Extinction by Species
 2000-2004 Baseline Period to 2005-2009 Progress Period
 20% Least Impaired Days

Site	Deciview (dv)			Change in Extinction by Species (Mm ⁻¹)*						
	2000-04 Baseline Period	2005-09 Progress Period	Change in dv*	Amm. Sulfate	Amm. Nitrate	POM	EC	Soil	CM	Sea Salt
Arizona										
GRCA2	2.2	2.2	0.0	+0.1	0.0	-0.1	0.0	0.0	0.0	0.0
BALD1	3.0	2.9	-0.1	-0.1	-0.1	-0.1	0.0	0.0	+0.1	0.0
PEFO1	5.0	4.6	-0.4	-0.1	-0.2	-0.4	0.0	+0.1	0.0	0.0
SYCA1	5.6	5.1	-0.5	+0.1	-0.1	-0.6	-0.2	-0.1	+0.1	0.0
Colorado										
WEMI1	3.1	2.4	-0.7	-0.1	-0.1	-0.4	-0.2	0.0	-0.1	0.0
WHRI1	0.7	0.2	-0.5	0.0	-0.1	-0.3	-0.1	0.0	0.0	0.0
MEVE1	4.3	3.1	-1.2	-0.3	-0.3	-0.5	-0.2	-0.2	-0.3	0.0
New Mexico										
SAPE1	1.5	1.0	-0.5	-0.1	-0.1	-0.2	-0.1	0.0	0.0	0.0
Utah										
BRCA1	2.8	2.1	-0.7	-0.1	-0.2	-0.3	-0.2	0.0	-0.1	0.0
CANY1	3.7	2.8	-0.9	-0.3	-0.1	-0.5	-0.1	-0.1	-0.2	0.0
CAP11	4.1	2.7	-1.4	-0.3	-0.4	-0.5	-0.2	-0.1	-0.4	0.0
ZICA1	5.0	4.3	-0.7	-0.1	-0.2	-0.5	-0.2	0.0	-0.1	0.0

*Change is calculated as progress period average minus baseline period average. Values in red indicate increases in extinction and values in blue indicate decreases.

Table 5.1-5
 Colorado Plateau Class I Area IMPROVE Sites
 Change in Aerosol Extinction by Species
 2000-2009 Annual Average Trends

Site	Group	Annual Trend* (Mm ⁻¹ /year)						
		Amm. Sulfate	Amm. Nitrate	POM	EC	Soil	CM	Sea Salt
Arizona								
GRCA2	20% Best	--	--	--	0.0	--	--	0.0
	20% Worst	--	-0.1	--	--	--	--	--
	All Days	--	0.0	--	--	--	--	--
BALD1	20% Best	--	0.0	--	0.0	--	0.0	0.0
	20% Worst	-0.2	--	--	--	0.1	0.3	0.0
	All Days	-0.1	0.0	--	--	--	0.1	0.0
PEFO1	20% Best	--	0.0	-0.1	--	--	--	0.0
	20% Worst	--	--	--	--	0.1	--	0.0
	All Days	--	0.0	--	--	0.0	0.1	0.0
SYCA1	20% Best	--	--	-0.1	--	--	--	0.0
	20% Worst	--	--	--	0.1	-0.3	--	--
	All Days	--	0.0	--	--	-0.1	--	--
Colorado								
WEMI1	20% Best	-0.1	0.0	-0.1	-0.1	--	--	--
	20% Worst	--	--	--	0.0	--	--	--
	All Days	--	0.0	--	-0.1	--	--	--
WHRI1	20% Best	--	0.0	-0.1	0.0	--	--	--
	20% Worst	--	--	--	-0.1	--	--	0.0
	All Days	--	--	-0.1	0.0	--	--	0.0
MEVE1	20% Best	-0.1	0.0	-0.1	0.0	0.0	0.0	--
	20% Worst	--	--	--	-0.2	--	--	0.0
	All Days	-0.1	--	-0.3	-0.1	--	--	0.0
New Mexico								
SAPE1	20% Best	--	0.0	0.0	0.0	--	--	--
	20% Worst	--	-0.1	--	--	--	--	--
	All Days	--	0.0	-0.1	0.0	--	0.0	0.0
Utah								
BRCA1	20% Best	--	0.0	-0.1	0.0	--	0.0	0.0
	20% Worst	-0.2	--	0.5	0.1	--	--	0.0
	All Days	-0.1	0.0	--	--	--	--	--
CANY1	20% Best	-0.1	--	-0.1	0.0	--	-0.1	0.0
	20% Worst	-0.1	--	--	--	--	--	0.0
	All Days	-0.1	0.0	--	0.0	0.0	--	0.0
CAPI1	20% Best	-0.1	-0.1	-0.1	0.0	--	-0.1	--
	20% Worst	--	-0.2	--	--	0.1	--	0.0
	All Days	-0.1	-0.1	--	0.0	--	--	0.0
ZICA1	20% Best	0.0	--	--	0.0	0.0	--	0.0
	20% Worst	-0.5	--	--	--	--	--	--
	All Days	-0.2	--	--	-0.1	0.1	--	--

*(--) Indicates statistically insignificant trend (<85% confidence level). Annual averages and complete trend statistics for all significance levels are included for each site in state specific appendices.

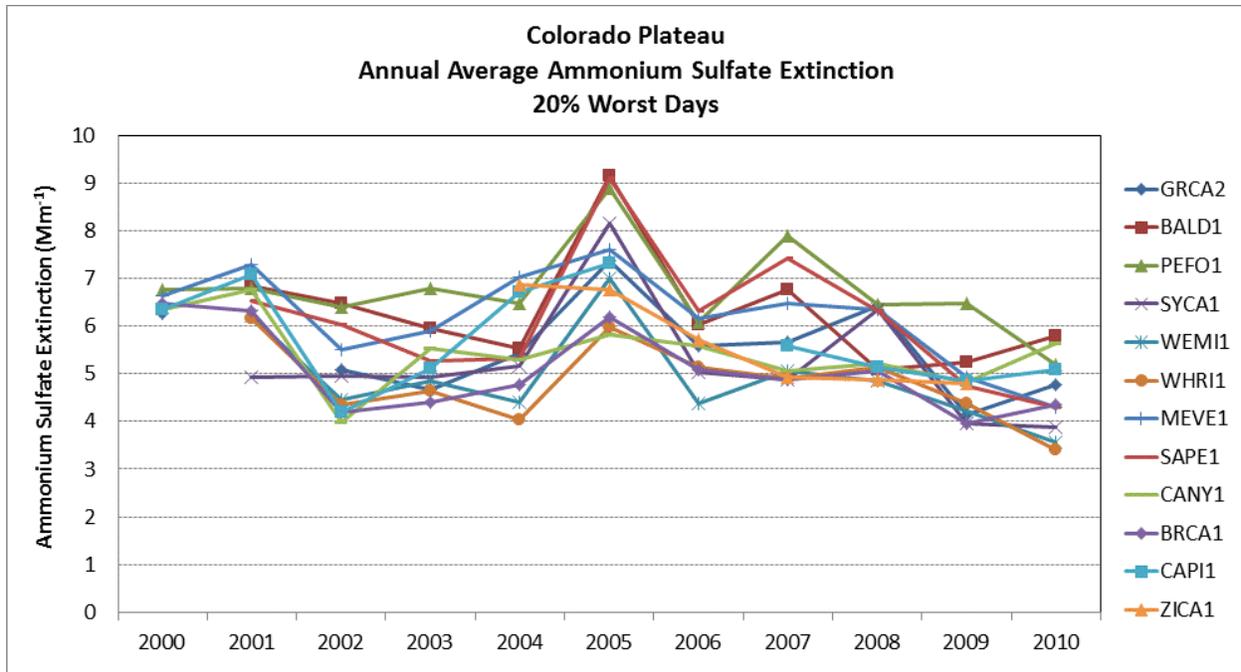


Figure 5.1-3. Chart Depicting Annual Average Ammonium Sulfate Concentrations for the 20% Worst Days as Measured at the Colorado Plateau CIA IMPROVE Sites.

5.2 EMISSIONS DATA

Similar to Section 308 requirements, Section 309 states are required to address how total emissions state have changes over the past 5 years (51.309(d)(10)(i)(D)). Summaries depicting differences between emission inventories are included for all WRAP states in Section 3, and for each state individually in Section 6.0, using 2002 and 2008 inventories to represent changes between the baseline and progress periods. These inventories are described in detail in Section 3.2.

In addition to tracking these differences in inventories, for the initial SIPS, Section 309 states were required to identify “clean air corridors” and track emissions inside and outside of these corridors that may affect impairment on the cleanest days.⁶³ In these initial 309 SIPs, an area covering major portions of Nevada, southern Utah, eastern Oregon and southwestern Idaho was defined as a “clean air corridor,” which was intended to represent a region from which clean air transport influences many of the clean air days at Grand Canyon National Park. As noted in Section 5.1, visibility has improved for the best days at all of the CIA sites on the Colorado Plateau, so emissions specific to the “clean air corridor” counties are not presented separately here.

⁶³ Section 51.309(d)(3) states, for treatment of clean-air corridors, “the plan must describe and provide for implementation of comprehensive emission tracking strategies for clean-air corridors to ensure that the visibility does not degrade on the least-impaired days at any of the 16 Class I areas.”

Also, under Section 309 of the RHR, the participating states (and county) are required to identify sulfur dioxide (SO₂) emissions milestones, where a milestone is a maximum level of annual emissions for a given year (51.309(d)(4)(i)). In general, SO₂ emissions are specified in Section 309 because they are more instructive to track than most other pollutants, as they are generally associated with a small number of large sources, and can be measured and tracked with more certainty than some of the other pollutants that impact visibility. Separate work by the WRAP supports the submittal of annual regional SO₂ and emission milestone reports for the 309 states which compare actual emissions estimates to the pre-defined milestones.⁶⁴ Figure 5.1-4 presents a plot from the most recent WRAP SO₂ milestone report, showing the 3-year average of current emissions through 2010, which indicated that actual emissions were below SO₂ milestone. Additionally, SO₂ emissions specific to EGU sources are presented in Section 6.0 on an annual basis showing changes in these sources between 1996 and 2010 for each WRAP state.

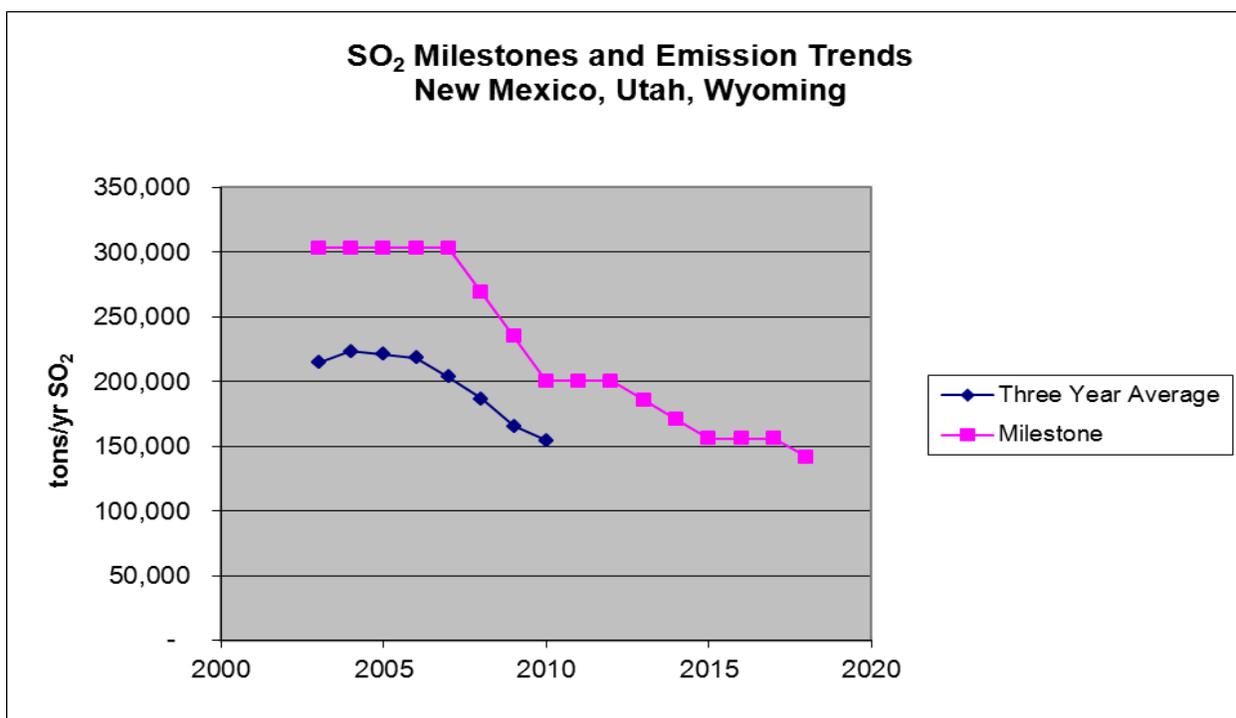


Figure 5.1-4. Chart Depicting 3-Year Average Sum of SO₂ emissions for New Mexico, Utah, and Wyoming and the city of Albuquerque/Bernalillo County as compared to the 309 SIP SO₂ Milestones.

⁶⁴ Annual regional SO₂ emissions and milestone reports are located on the WRAP website at <http://www.wrapair2.org/reghaze.aspx>.