6.0 STATE AND CLASS I AREA SUMMARIES

As described in Section 2.0, each state is required to submit progress reports at interim points between submittals of Regional Haze Rule (RHR) State Implementation Plans (SIPs), which assess progress towards visibility improvement goals in each state's mandatory Federal Class I areas (CIAs). Data summaries for each CIA in each Western Regional Air Partnership (WRAP) state, which address Regional Haze Rule (RHR) requirements for visibility measurements and emissions inventories are provided in this section. These summaries are intended to provide individual states with the technical information they need to determine if current RHR implementation plan elements and strategies are sufficient to meet all established reasonable progress goals, as defined in their respective initial RHR implementation plans.

6.7 MONTANA

The goal of the RHR is to ensure that visibility on the 20% most impaired, or worst, days continues to improve at each Federal Class I area (CIA), and that visibility on the 20% least impaired, or best, days does not get worse, as measured at representative Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring sites. Montana has 4 mandatory Federal CIAs, which are depicted in Figure 6.7-1 and listed in Table 6.7-1, along with the associated IMPROVE monitor locations.

This section addresses differences between the 2000-2004 baseline and 2005-2009 period, for both monitored data and emission inventory estimates. Monitored data are presented for the 20% most impaired, or worst, days and for the 20% least impaired, or best, days, as per Regional Haze Rule (RHR) requirements. Annual average trend statistics for the 2000-2009 10-year period are also presented here to support assessments of changes in each monitored species that contributes to visibility impairment. Some of the highlights regarding these comparisons are listed below, and more detailed state specific information is provided in monitoring and emissions sub-sections that follow.

- For the best days, the 5-year average deciview metric decreased at all Montana Federal CIA IMPROVE sites.
- For the worst days, the 5-year average deciview metric decreased at the CABI1, GAMO1, GLAC1, ULBE1, and YELL2 sites, and increased at the MELA1, MONT1, and SULA1 sites.
- The largest increase in individual aerosol extinction species was due to particulate organic mass, with high measurements coinciding with several large wildfires during the progress period. The largest wildfire events affecting the MELA1, MONT1, and SULA1 sites occurred between August and September 2007.
- Decreasing trends in ammonium nitrate were measured at several sites. This was consistent with comparisons of baseline and progress period emissions inventories, tracking of annual sums from electrical generating unit (EGU) sources, which showed decreases in oxides of nitrogen for mobile and point sources.
- Comparisons of 5-year averages showed some increases in ammonium sulfate, but an increasing annual average trend was only measured at the MELA1 site in northeastern Montana. Increasing averages and trends were not consistent with comparisons of emissions inventories and tracking of annual EGU emissions, which showed decreased SO_2 due to point, area and mobile sources. Increasing ammonium sulfate trends were also observed at the nearby LOST1 site in northwestern North Dakota. Both of these sites are near the Canadian border, so it is possible that international emissions affected these measurements.

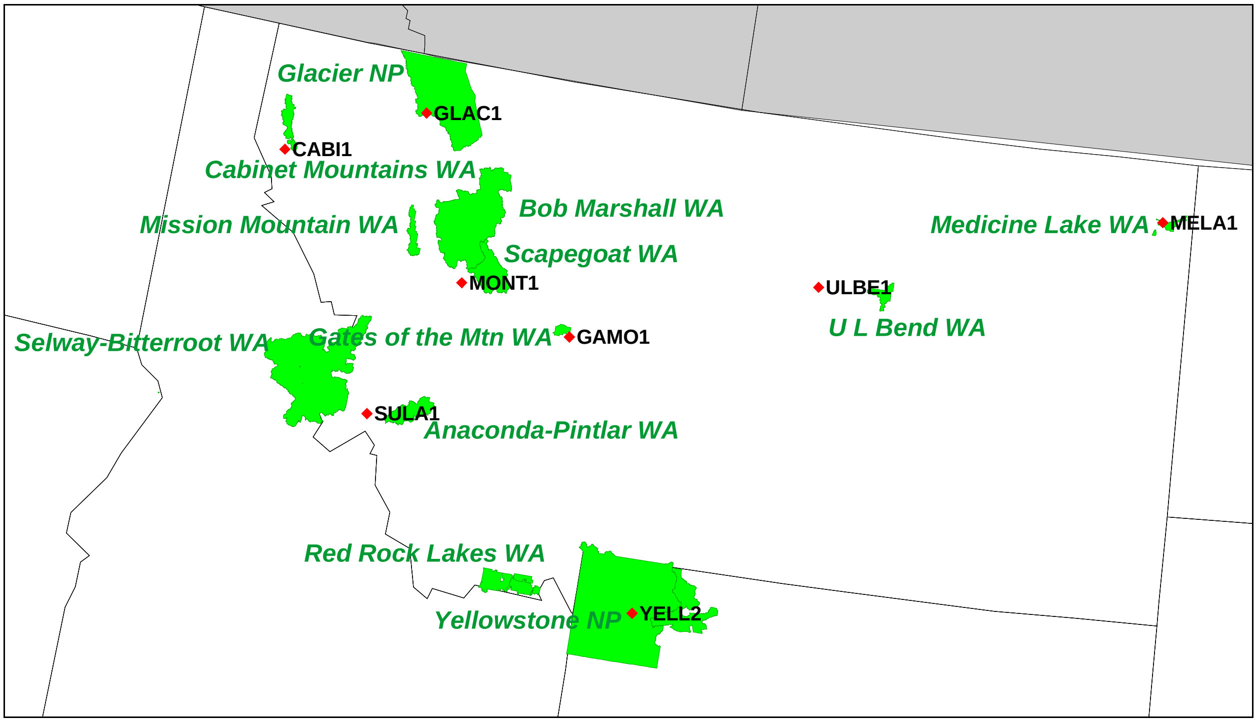

Figure 6.7-1. Map Depicting Federal CIAs and Representative IMPROVE Monitors in Montana.

Table 6.7-1
Montana CIAs and Representative IMPROVE Monitors

Class I Area	Representative IMPROVE Site	Latitude	Longitude	Elevation (m)
Cabinet Mountains WA	CABI1	47.95	-115.67	1441
Gates of the Mountain WA	GAMO1	46.83	-111.71	2387
Glacier NP	GLAC1	48.51	-114.00	975
Medicine Lake WA	MELA1	48.49	-104.48	606
Bob Marshall WA Mission Mountain WA Scapegoat WA	MONT1	47.12	-113.15	1282
Anaconda-Pintlar WA Selway-Bitterroot WA	SULA1	45.86	-114.00	1895
U L Bend WA	ULBE1	47.58	-108.72	891
Yellowstone NP	YELL2	44.57	-110.40	2425

6.7.1 Monitoring Data

This section addresses RHR regulatory requirements for monitored data as measured by IMPROVE monitors representing Federal CIAs in Montana. These summaries are supported by regional data presented in Section 4.0 and by more detailed site specific tables and charts in Appendix G.

As described in Section 3.1, regional haze progress in Federal CIAs is tracked using calculations based on speciated aerosol mass as collected by IMPROVE monitors. The RHR calls for tracking haze in units of deciviews (dv), where the deciview metric was designed to be linearly associated with human perception of visibility. In a pristine atmosphere, the deciview metric is near zero, and a one deciview change is approximately equivalent to a 10% change in cumulative species extinction. To better understand visibility conditions, summaries here include both the deciview metric, and the apportionment of haze into extinction due to the various measured species in units of inverse megameters (Mm^{-1}).

6.7.1.1 Current Conditions

This section addresses the regulatory question, ***what are the current visibility conditions for the most impaired and least impaired days (40 CFR 51.308 (g)(3)(i))?*** RHR guidance specifies that 5-year averages be calculated over successive 5-year periods, i.e. 2000-2004, 2005-2009, 2010-2014, etc.[93] Current visibility conditions are represented here as the most recent successive 5-year average period available, or the 2005-2009 period average, although the most recent IMPROVE monitoring data currently available includes 2010 data.

Tables 6.7-2 and 6.7-3 present the calculated deciview values for current conditions at each site, along with the percent contribution to extinction from each aerosol species for the 20% most impaired, or worst, and 20% least impaired, or best, days for each of the Federal CIA IMPROVE monitors in Montana. Figure 6.7-2 presents 5-year average extinction for the current progress period for both the 20% most impaired and 20% least impaired days. Note that the percentages in the tables consider only the aerosol species which contribute to extinction, while the charts also show Rayleigh, or scattering due to background gases in the atmosphere.

Specific observations for the current visibility conditions on the 20% most impaired days are as follows:

- The largest contributors to aerosol extinction at Montana sites were particulate organic mass and ammonium sulfate.
- The highest aerosol extinction (18.7 dv) was measured at the GLAC1 site, where particulate organic mass was the largest contributor to aerosol extinction, followed by ammonium sulfate. The lowest aerosol extinction (11.2 dv) was measured at the GAMO1 site.

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[93] EPA's September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule* specifies that progress is tracked against the 2000-2004 baseline period using corresponding averages over successive 5-year periods, i.e. 2005-2009, 2010-2014, etc. (See page 4-2 in the Guidance document.)

Specific observations for the current visibility conditions on the 20% least impaired days are as follows:

- The aerosol contribution to total extinction on the best days was less than Rayleigh, or the background scattering that would occur in clear air. Average extinction (including Rayleigh) ranged from 0.9 dv (GAMO1) to 7.0 deciview (GLAC1).
- For all sites, ammonium sulfate was the largest contributor to the non-Rayleigh aerosol portion of extinction.

Table 6.7-2
Montana 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**
CABI1	13.5	23% (2)	5% (5)	**51% (1)**	9% (4)	3% (6)	9% (3)	0% (7)
GAMO1	11.2	25% (2)	7% (5)	**49% (1)**	8% (3)	3% (6)	7% (4)	0% (7)
GLAC1	18.7	20% (2)	12% (3)	**48% (1)**	10% (4)	2% (6)	8% (5)	0% (7)
MELA1	18.0	**36% (1)**	30% (2)	18% (3)	4% (5)	1% (6)	8% (4)	1% (7)
MONT1	15.3	13% (2)	3% (6)	**66% (1)**	9% (3)	3% (5)	6% (4)	0% (7)
SULA1	17.0	6% (3)	2% (5)	**75% (1)**	11% (2)	1% (6)	5% (4)	0% (7)
ULBE1	14.9	28% (2)	15% (3)	**36% (1)**	6% (5)	2% (6)	11% (4)	1% (7)
YELL2	11.5	17% (2)	6% (5)	**57% (1)**	8% (4)	3% (6)	9% (3)	0% (7)

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

Table 6.7-3
Montana 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**
CABI1	3.2	**45% (1)**	14% (3)	21% (2)	7% (4)	3% (7)	7% (5)	4% (6)
GAMO1	0.9	**46% (1)**	13% (3)	19% (2)	7% (5)	3% (6)	9% (4)	2% (7)
GLAC1	7.0	**34% (1)**	9% (4)	31% (2)	16% (3)	2% (6)	8% (5)	1% (7)
MELA1	6.5	**42% (1)**	13% (4)	15% (3)	6% (5)	4% (6)	19% (2)	1% (7)
MONT1	3.1	**40% (1)**	8% (4)	31% (2)	10% (3)	2% (6)	6% (5)	2% (7)
SULA1	2.5	**46% (1)**	10% (4)	22% (2)	6% (5)	3% (6)	12% (3)	1% (7)
ULBE1	4.3	**40% (1)**	8% (5)	22% (2)	8% (4)	4% (6)	19% (3)	1% (7)
YELL2	2.0	**42% (1)**	16% (3)	25% (2)	8% (4)	2% (6)	7% (5)	1% (7)

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

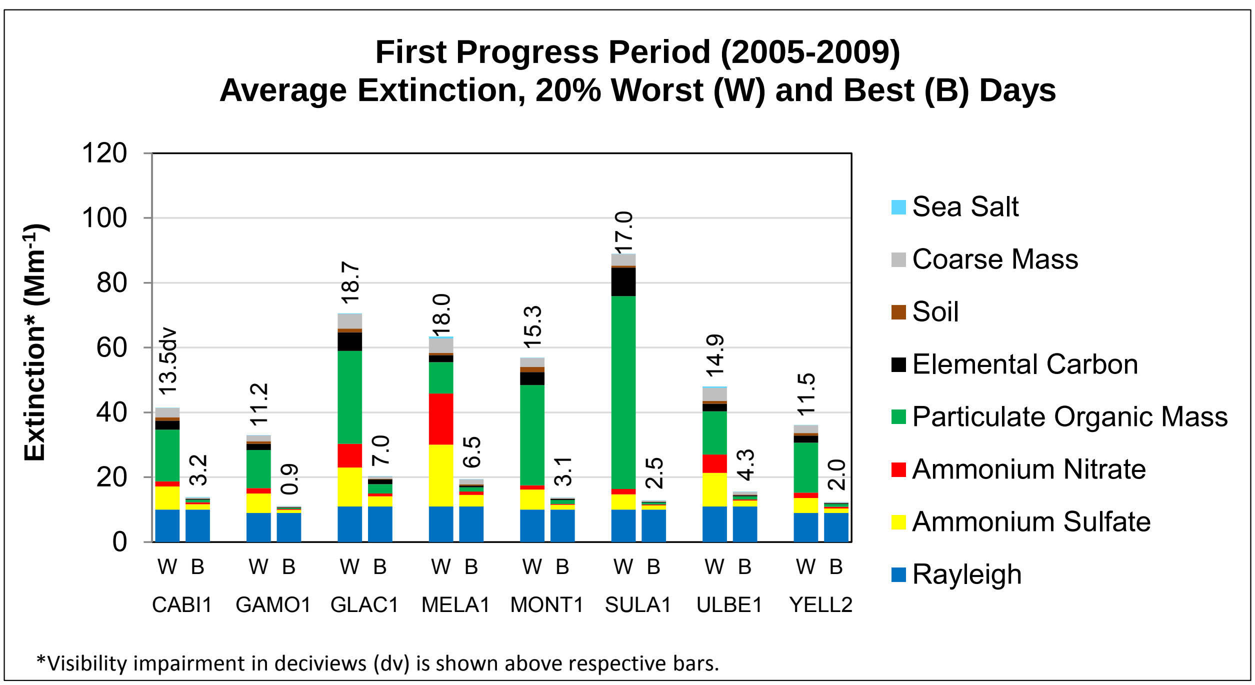

Figure 6.7-2. Average Extinction for Current Progress Period (2005-2009) for the Worst (Most Impaired) and Best (Least Impaired) Days Measured at Montana Class I Area IMPROVE Sites.

6.7.1.2 Differences Between Current and Baseline Conditions

This section addresses the regulatory question, ***what is the difference between current visibility conditions for the most impaired and least impaired days and baseline visibility conditions (40 CFR 51.308 (g)(3)(ii))?*** Included here are comparisons between the 5-year average baseline conditions (2000-2004) and current progress period extinction (2005-2009).

Table 6.7-4 presents the differences between the 2000-2004 baseline period average extinction and the 2005-2009 progress period average for each site in Montana for the 20% most impaired days, and Table 6.7-5 presents similar data for the least impaired days. Averages that increased are depicted in red text and averages that decreased in blue.

Figure 6.7-3 presents the 5-year average extinction for the baseline and current progress period averages for the worst days and Figure 6.7-4 presents the differences in averages by aerosol species, with increases represented above the zero line and decreases below the zero line. Figures 6.7-5 and 6.7-6 present similar plots for the best days.

For the 20% most impaired days, the 5-year average RHR deciview metric increased between the 2000-2004 and 2005-2009 periods at the MELA1, MONT1 and SULA1 sites and decreased at all other Montana sites. Notable differences for individual species averages were as follows:

- Increases in deciview averages at the MONT1 and SULA1 sites were due, in large part, to increases in particulate organic mass.
- Increases in deciview averages at the MELA1 site were mostly due to increased ammonium sulfate.
- All sites except SULA1 measured increases in ammonium sulfate and decreases in ammonium nitrate.

For the 20% least impaired days, the 5-year average deciview metric decreased at all sites. Notable differences for individual species averages on the 20% least impaired days were as follows:

- All species either decreased or stayed the same at all sites, with the exception of ammonium sulfate at SULA1 and YELL2, and coarse mass at SULA1.

Table 6.7-4
Montana 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})*						
	2000-2004 Baseline Period	2005-2009 Progress Period	Change in dv*	Amm. Sulfate	Amm. Nitrate	POM	EC	Soil	CM	Sea Salt
CABI1	14.1	13.5	-0.6	+0.6	-0.4	-1.0	0.0	0.0	+0.1	0.0
GAMO1	11.3	11.2	-0.1	+0.6	-0.3	+0.6	+0.1	0.0	+0.1	-0.1
GLAC1	22.3	18.7	-3.6	+0.6	-2.0	-59.0	-5.5	-0.3	-0.6	-0.1
MELA1	17.7	18.0	+0.3	+2.1	-0.5	+0.1	-0.2	0.0	0.0	+0.6
MONT1	14.5	15.3	+0.8	+1.1	-0.1	+8.6	+1.2	+0.2	-0.8	+0.1
SULA1	13.4	17.0	+3.6	-0.1	+0.2	+39.5	+6.3	-0.3	+1.1	-0.2
ULBE1	15.1	14.9	-0.2	+0.5	-2.3	+0.6	+0.2	+0.1	0.0	+0.5
YELL2	11.8	11.5	-0.3	+0.3	-0.1	+2.0	-0.3	-0.1	-0.2	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 6.7-5
Montana 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})*						
	2000-2004 Baseline Period	2005-2009 Progress Period	Change in dv*	Amm. Sulfate	Amm. Nitrate	POM	EC	Soil	CM	Sea Salt
CABI1	3.6	3.2	-0.4	-0.1	-0.2	-0.2	-0.1	0.0	-0.1	0.0
GAMO1	1.7	0.9	-0.8	-0.1	-0.2	-0.3	-0.1	0.0	-0.2	0.0
GLAC1	7.2	7.0	-0.2	+0.1	0.0	-0.4	0.0	-0.1	-0.1	0.0
MELA1	7.3	6.5	-0.8	0.0	-0.1	-0.7	-0.1	0.0	-0.5	0.0
MONT1	3.9	3.1	-0.8	0.0	-0.2	-0.7	-0.1	0.0	-0.1	0.0
SULA1	2.6	2.5	-0.1	+0.2	-0.1	-0.3	-0.1	0.0	+0.1	0.0
ULBE1	4.7	4.3	-0.4	0.0	-0.2	-0.3	-0.1	0.0	-0.1	0.0
YELL2	2.6	2.0	-0.6	-0.1	-0.2	-0.3	-0.1	0.0	0.0	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.

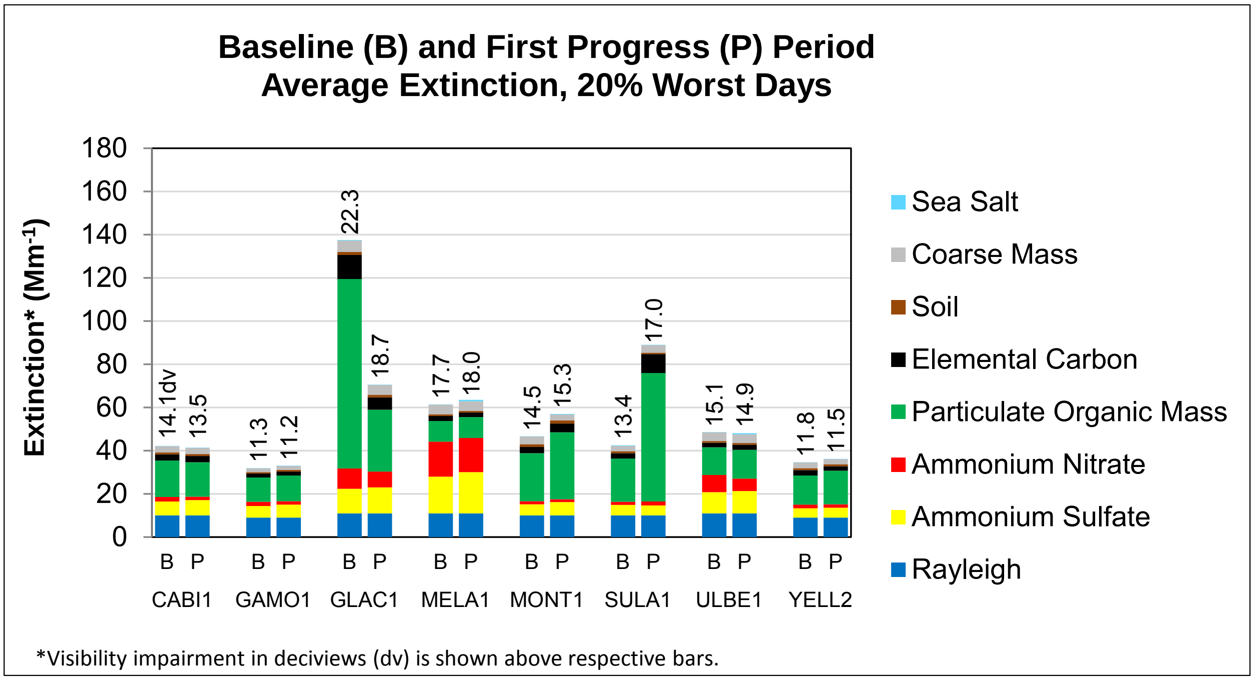

Figure 6.7-3. Average Extinction for Baseline and Progress Period Extinction for Worst (Most Impaired) Days Measured at Montana Class I Area IMPROVE Sites.

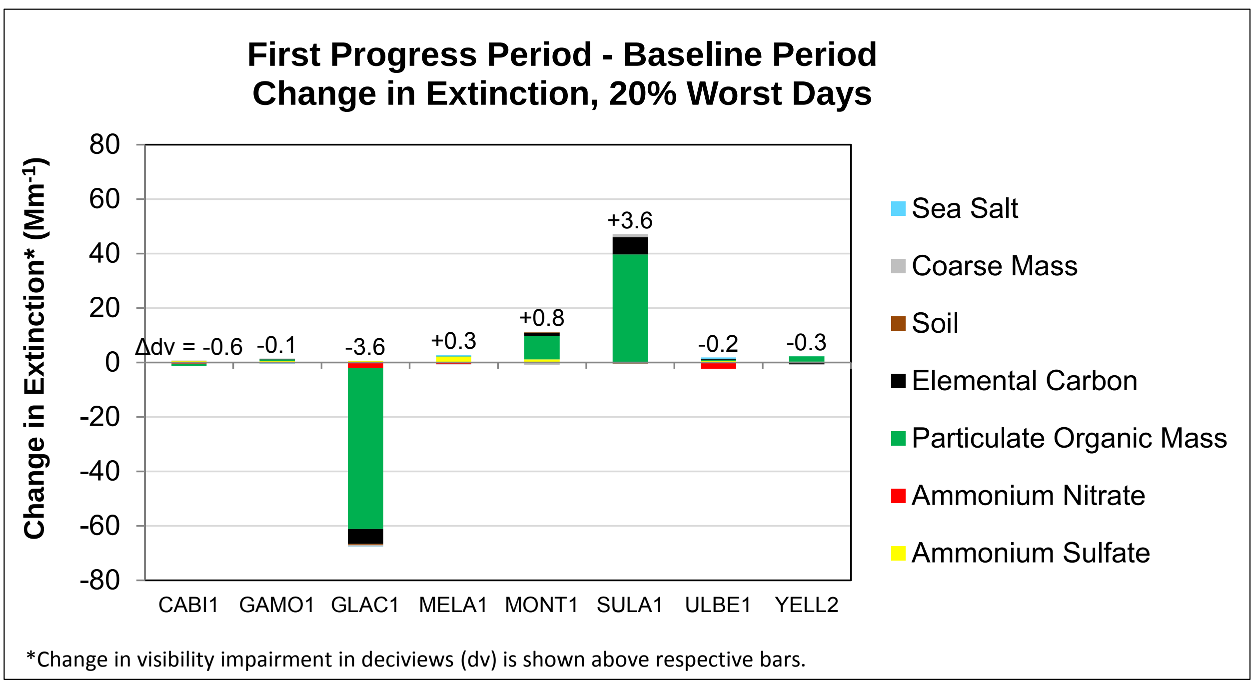

Figure 6.7-4. Difference Between Average Extinction for Current Progress Period (2005-2009) and Baseline Period (2000-2004) for the Worst (Most Impaired) Days Measured at Montana Class I Area IMPROVE Sites.

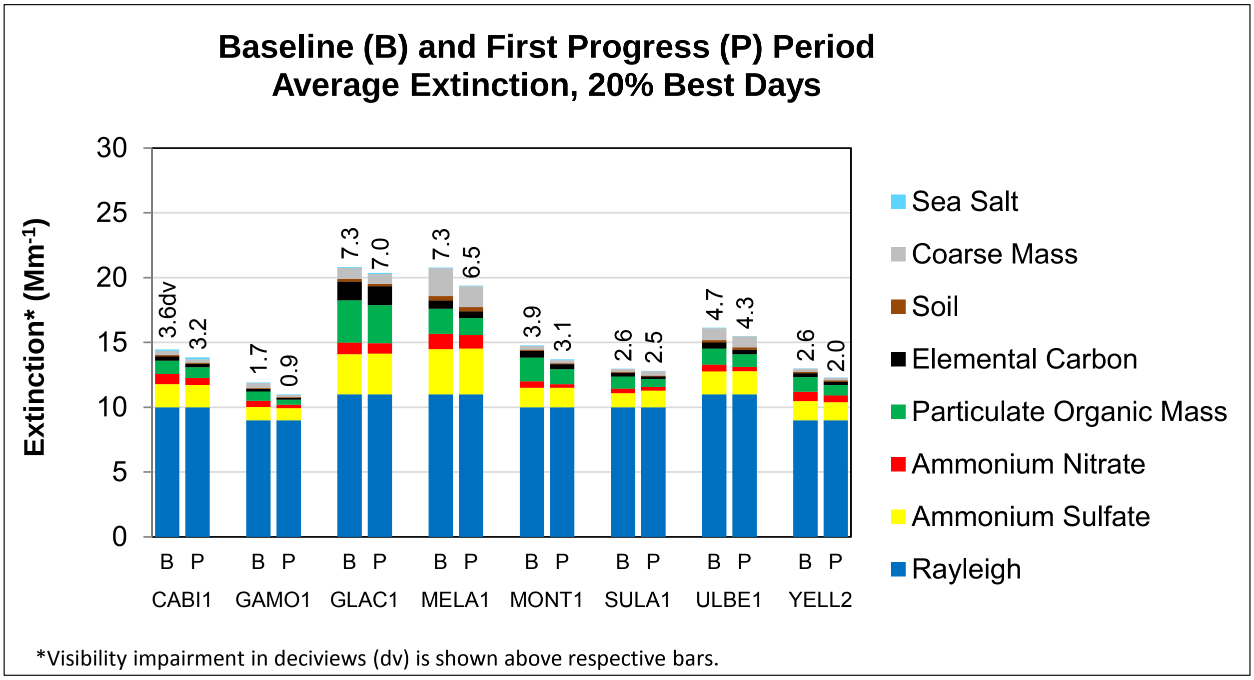

Figure 6.7-5. Average Extinction for Baseline and Progress Period Extinction for Best (Least Impaired) Days Measured at Montana Class I Area IMPROVE Sites.

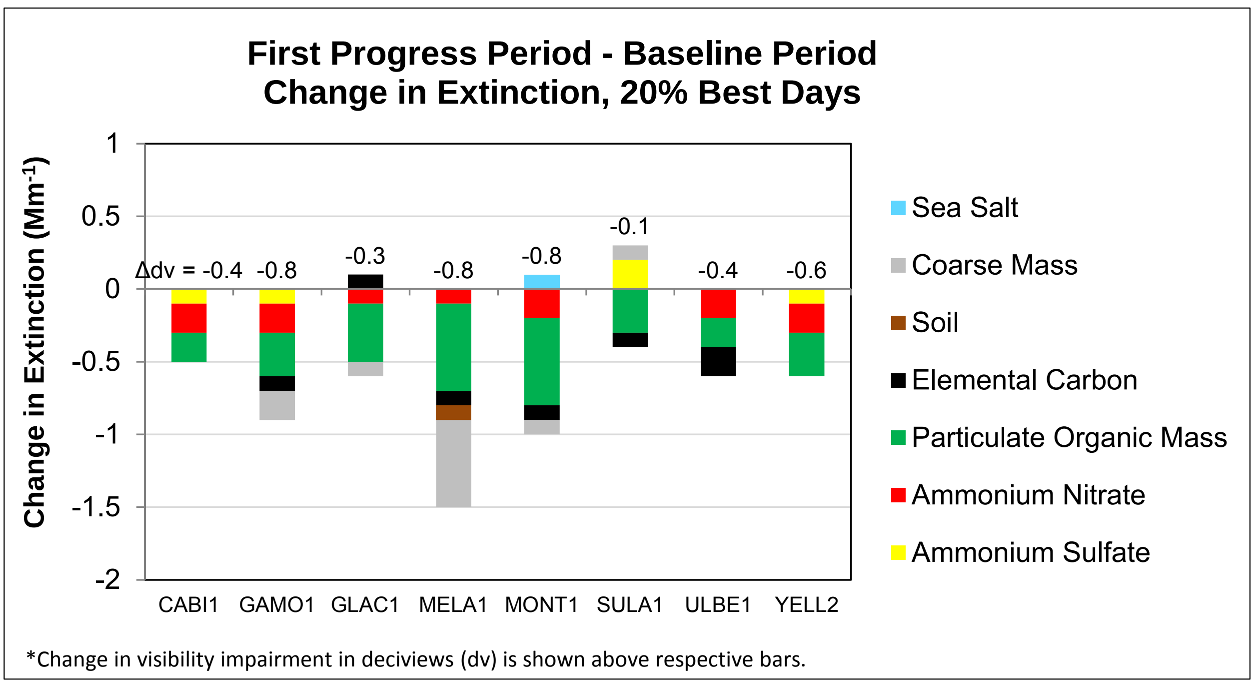

Figure 6.7-6. Difference between Average Extinction for Current Progress Period (2005-2009) and Baseline Period (2000-2004) for the Best (Least Impaired) Days Measured at Montana Class I Area IMPROVE Sites.

6.7.1.3 Changes in Visibility Impairment

This section addresses the regulatory question, ***what is the change in visibility impairment for the most impaired and least impaired days over the past 5 years (40 CFR 51.308 (g)(3)(iii))?*** Included here are changes in visibility impairment as characterized by annual average trend statistics, and some general observations regarding local and regional events and outliers on a daily and annual basis that affected the current 5-year progress period. The regulatory requirement asks for a description of changes over the past 5-year period, but trend analysis is better suited to longer periods of time, so trends for the entire 10-year planning period are presented here.

Trend statistics for the years 2000-2009 for each species at each site in Montana are summarized in Table 6.7-6 and regional trends were presented earlier in Section 4.1.1.[94] 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.[95] In some cases, trends may show decreasing tendencies while the difference between the 5-year averages do not (or vice versa), as discussed in Section 3.1.2.2. In these cases, the 5-year average for the best and worst days is the important metric for RHR regulatory purposes, but trend statistics may be of value to understand and address visibility impairment issues for planning purposes.

For each site, a more comprehensive list of all trends for all species, including the associated p-values, is provided in Appendix G. Additionally, this appendix includes plots depicting 5-year, annual, monthly, and daily average extinction for each site. These plots are intended to provide a fairly comprehensive compilation of reference information for individual states to investigate local and regional events and outliers that may have influenced changes in visibility impairment as tracked using the 5-year deciview metrics. Note that similar summary products are also available from the WRAP TSS website (http://vista.cira.colostate.edu/tss/). Some general observations regarding changes in visibility impairment at sites in Montana are as follows:

- The largest changes in 5-year averages for particulate organic mass were measured at the GLAC1 and SULA1 sites. The 2000-2004 baseline average at the GLAC1 site was influenced by a large fire event in August, 2003 and the 2005-2009 progress period average at the SULA1 site was influenced by a large fire event in August 2007. A regional map depicting the spatial extent of a 2007 fire is depicted in Section 4.1.2. The GUMO1 5-year average was missing the year 2007, which likely biased

[94] 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 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)
[95] 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.

progress period measurements of particulate organic mass low, as compared to other Montana sites.

- For ammonium nitrate, decreasing trends were measured at the western Montana GAMO1, GLAC1, and MONT1 sites, and at the MELA1 site in eastern Montana.
- For ammonium sulfate, annual average trend statistics for all measured days indicated slightly decreasing trends at the GLAC1 site. Increasing trends in ammonium sulfate were measured at the MELA1 site, and also at the nearby LOST1 site in western North Dakota.

Table 6.7-6
Montana Class I Area IMPROVE Sites
Change in Aerosol Extinction by Species
2000-2009 Annual Average Trends

Site	**Group**	**Annual Trend* (Mm^{-1}/year)**						
		Ammonium Sulfate	**Ammonium Nitrate**	**Particulate Organic Mass**	**Elemental Carbon**	**Soil**	**Coarse Mass**	**Sea Salt**
CABI1	20% Best	--	0.0	-0.1	0.0	--	0.0	--
	20% Worst	--	--	--	--	--	0.1	--
	All Days	0.0	0.0	--	--	--	--	--
GAMO1	20% Best	--	0.0	-0.1	0.0	--	0.0	--
	20% Worst	--	--	--	--	--	0.1	--
	All Days	--	-0.1	--	--	--	--	--
GLAC1	20% Best	--	--	-0.1	--	--	--	0.0
	20% Worst	--	-0.5	-3.0	-0.3	-0.1	--	--
	All Days	-0.1	-0.1	-0.9	-0.1	0.0	--	0.0
MELA1	20% Best	--	--	-0.1	0.0	--	-0.1	--
	20% Worst	--	--	--	-0.1	--	-0.2	0.0
	All Days	0.1	-0.1	--	-0.1	--	--	0.0
MONT1	20% Best	--	0.0	-0.1	0.0	0.0	0.0	--
	20% Worst	0.1	-0.1	--	--	--	--	0.0
	All Days	--	-0.1	--	--	--	--	0.0
NOCH1	20% Best	0.1	--	--	--	--	--	--
	20% Worst	--	--	--	-0.4	--	--	--
	All Days	--	--	--	-0.1	--	--	--
SULA1	20% Best	--	0.0	-0.1	0.0	--	0.0	--
	20% Worst	--	--	--	--	0.0	--	--
	All Days	--	--	--	--	--	--	--
ULBE1	20% Best	--	0.0	-0.1	0.0	--	--	--
	20% Worst	--	--	--	--	--	--	0.0
	All Days	--	--	--	--	--	--	0.0
YELL2	20% Best	--	0.0	-0.1	--	0.0	--	0.0
	20% Worst	--	--	--	--	--	0.0	0.0
	All Days	--	--	--	0.0	--	--	0.0

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

6.7.2 Emissions Data

Included here are summaries depicting differences between two emission inventory years that are used to represent the 5-year baseline and current progress periods. The baseline period is represented using a 2002 inventory developed by the WRAP for use in the initial WRAP state SIPs, and the progress period is represented by a 2008 inventory which leverages recent WRAP inventory work for modeling efforts, as referenced in Section 3.2.1. For reference, Table 6.7-7 lists the major emitted pollutants inventoried, the related aerosol species, some of the major sources for each pollutant, and some notes regarding implications of these pollutants. Differences between these baseline and progress period inventories, and a separate summary of annual emissions from electrical generating units (EGUs), are presented in this section.

Table 6.7-7
Montana
Pollutants, Aerosol Species, and Major Sources

Emitted Pollutant	Related Aerosol	Major Sources	Notes
Sulfur Dioxide (SO_2)	Ammonium Sulfate	Point Sources; On- and Off-Road Mobile Sources	SO_2 emissions are generally associated with anthropogenic sources such as coal-burning power plants, other industrial sources such and refineries and cement plants, and both on- and off-road diesel engines.
Oxides of Nitrogen (NO_X)	Ammonium Nitrate	On- and Off-Road Mobile Sources; Point Sources; Area Sources	NO_X emissions are generally associated with anthropogenic sources. Common sources include virtually all combustion activities, especially those involving cars, trucks, power plants, and other industrial processes.
Ammonia (NH_3)	Ammonium Sulfate and Ammonium Nitrate	Area Sources; On-Road Mobile Sources	Gaseous NH_3 has implications in particle formation because it can form particulate ammonium. Ammonium is not directly measured by the IMPROVE program, but affects formation potential of ammonium sulfate and ammonium nitrate. All measured nitrate and sulfate is assumed to be associated with ammonium for IMPROVE reporting purposes.
Volatile Organic Compounds (VOCs)	Particulate Organic Mass (POM)	Biogenic Emissions; Vehicle Emissions; Area Sources	VOCs are gaseous emissions of carbon compounds, which are often converted to POM through chemical reactions in the atmosphere. Estimates for biogenic emissions of VOCs have undergone significant updates since 2002, so changes reported here are more reflective of methodology changes than actual changes in emissions (see Section 3.2.1).
Primary Organic Aerosol (POA)	POM	Wildfires; Area Sources	POA represents organic aerosols that are emitted directly as particles, as opposed to gases. Wildfires in the west generally dominate POA emissions, and large wildfire events are generally sporadic and highly variable from year-to-year.
Elemental Carbon (EC)	EC	Wildfires; On- and Off-Road Mobile Sources	Large EC events are often associated with large POM events during wildfires. Other sources include both on- and off-road diesel engines.
Fine soil	Soil	Windblown Dust; Fugitive Dust; Road Dust; Area Sources	Fine soil is reported here as the crustal or soil components of $PM_{2.5}$.
Coarse Mass (PMC)	Coarse Mass	Windblown Dust; Fugitive Dust	Coarse mass is reported by the IMPROVE Network as the difference between PM_{10} and $PM_{2.5}$ mass measurements. Coarse mass is not separated by species in the same way that $PM_{2.5}$ is speciated, but these measurements are generally associated with crustal components. Similar to crustal $PM_{2.5}$, natural windblown dust is often the largest contributor to PMC.

6.7.2.1 Changes in Emissions

This section addresses the regulatory question, ***what is the change over the past 5 years in emissions of pollutants contributing to visibility impairment from all sources and activities within the State (40 CFR 51.308 (g)(4))?*** For these summaries, emissions during the baseline years are represented using a 2002 inventory, which was developed with support from the WRAP for use in the original RHR SIP strategy development (termed plan02d). Differences between inventories are represented as the difference between the 2002 inventory, and a 2008 inventory which leverages recent inventory development work performed by the WRAP for the WestJumpAQMS and DEASCO$_3$ modeling projects (termed WestJump2008). Note that the comparisons of differences between inventories does not necessarily reflect a change in emissions, as a number of methodology changes and enhancements have occurred between development of the individual inventories, as referenced in Section 3.2.1. Inventories for all major visibility impairing pollutants are presented for major source categories, and categorized as either anthropogenic or natural emissions. State-wide inventories totals and differences are presented here, and inventory totals on a county level basis are available on the WRAP Technical Support System website (http://vista.cira.colostate.edu/tss/).

Table 6.7-8 and Figure 6.7-7 present the differences between the 2002 and 2008 sulfur dioxide (SO_2) inventories by source category. Tables 6.7-9 and Figure 6.7-8 present data for oxides of nitrogen (NO_X), and subsequent tables and figures (Tables 6.7-10 through 6.7-15 and Figures 6.7-9 through 6.7-14) present data for ammonia (NH_3), volatile organic compounds (VOCs), primary organic aerosol (POA), elemental carbon (EC), fine soil and coarse mass. General observations regarding emissions inventory comparisons are listed below.

- Largest differences for point source inventories were decreases in SO_2, NO_X, and VOCs
- Area source inventories showed decreases in SO_2, VOCs, and NH_3 and increases in NO_X. These changes may be due to a combination of population changes and differences in methodologies used to estimate these emissions, as referenced in Section 3.2.1. One methodology change was the reclassification of some off-road mobile sources (such as some types of marine vessels and locomotives) into the area source category in 2008, which may have contributed to increases in area source inventory totals, but decreases in off-road mobile totals.
- On-road mobile source inventory comparisons showed decreases in most parameters, especially NO_X and VOCs, with slight increases in POA, EC, and coarse mass. Reductions in NO_X and VOC are likely influenced by federal and state emissions standards that have already been implemented. The increases in POA, EC, and coarse mass occurred in all of the WRAP states for on-road mobile inventories, regardless of reductions in NO_2 and VOCs, indicating that these increases were likely due to use of different on-road models, as referenced in Section 3.2.1.
- Off-road mobile source inventories showed decreases in NO_X, SO_2, and VOCs, and increases in fine soil and coarse mass, which was consistent with most contiguous WRAP states. These differences are likely due to a combination of actual changes in source contributions and methodology differences, as referenced in Section 3.2.1. As

noted previously, one major methodology difference was the reclassification of some off-road mobile sources (such as some types of marine vessels and locomotives) into the area source category in 2008, which may have contributed to decreases in the off-road inventory totals, but increases in area source totals.

- For all parameters, especially POAs, VOCs, and EC, natural fire emission inventory estimates decreased, and anthropogenic fire inventories increased. Note that these differences are not necessarily reflective of changes in monitored data, as the baseline period is represented by an average of 2000-2004 fire emissions, and the progress period is represented only by the fires that occurred in 2008, as referenced in Section 3.2.1.
- Comparisons between VOC inventories showed large decreases in biogenic emissions, which was consistent with other contiguous WRAP states. Estimates for biogenic emissions of VOCs have undergone significant updates since 2002, so changes reported here are more reflective of methodology changes than actual changes in emissions, as referenced in Section 3.2.1.
- Fine soil and coarse mass increased for the windblown dust inventory comparisons and the combined fugitive/road dust inventories. Large variability in changes in windblown dust inventories was observed for the contiguous WRAP states, which was likely due in large part to enhancements in dust inventory methodology, as referenced in Section 3.2.1, rather than changes in actual emissions.

Table 6.7-8
Montana
Sulfur Dioxide Emissions by Category

Source Category	Sulfur Dioxide Emissions (tons/year)		
	2002 (Plan02d)	2008 (WestJump2008)	Difference (Percent Change)
Anthropogenic Sources			
Point	36,879	27,402	-9,477
Area	3,072	584	-2,488
On-Road Mobile	1,770	229	-1,540
Off-Road Mobile	4,193	336	-3,857
Area Oil and Gas	225	21	-204
Fugitive and Road Dust	0	0	0
Anthropogenic Fire	404	1,121	717
Total Anthropogenic	**46,543**	**29,694**	**-16,848 (-36%)**
Natural Sources			
Natural Fire	3,655	324	-3,331
Biogenic	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**3,655**	**324**	**-3,331 (-91%)**
All Sources			
Total Emissions	**50,198**	**30,019**	**-20,179 (-40%)**

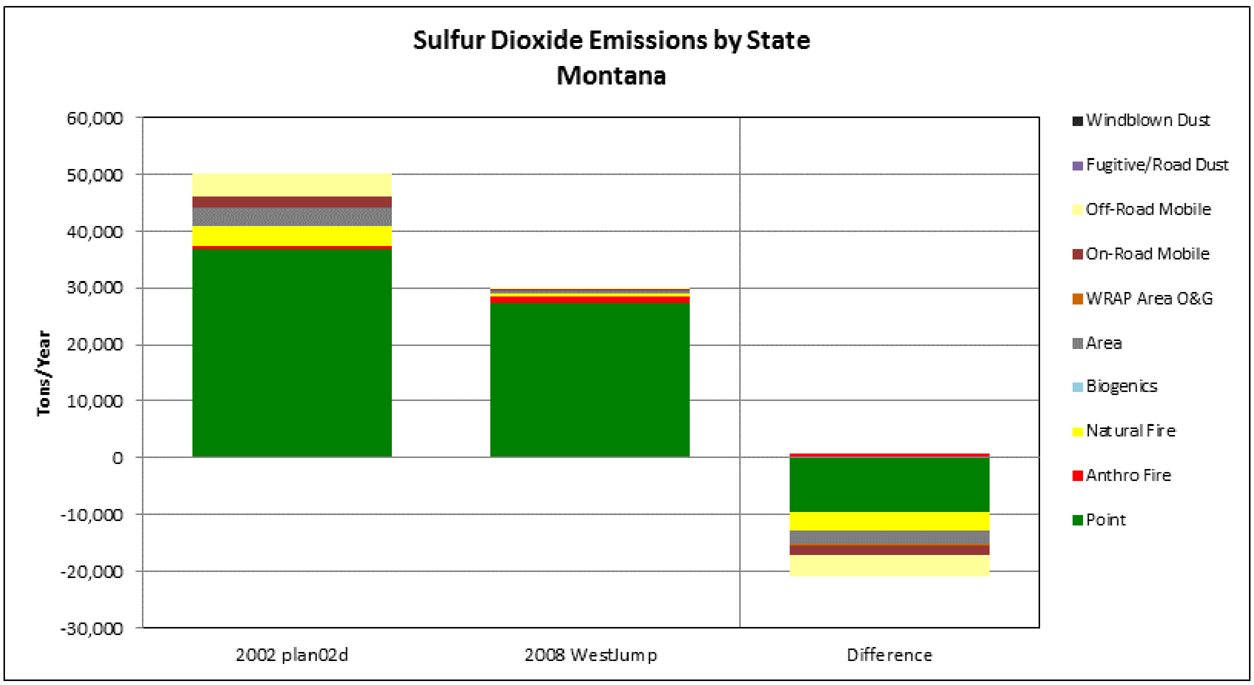

Figure 6.7-7. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Sulfur Dioxide by Source Category for Montana.

Table 6.7-9
Montana
Oxides of Nitrogen Emissions by Category

Source Category	Oxides of Nitrogen Emissions (tons/year)		
	2002 (Plan02d)	**2008 (WestJump2008)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point	53,416	42,943	-10,473
Area	4,280	25,777	21,497
On-Road Mobile	53,597	31,590	-22,007
Off-Road Mobile	50,604	16,910	-33,694
Area Oil and Gas	7,557	332	-7,225
Fugitive and Road Dust	0	0	0
Anthropogenic Fire	1,503	8,016	6,513
Total Anthropogenic	**170,957**	**125,568**	**-45,389 (-27%)**
Natural Sources			
Natural Fire	13,668	2,293	-11,375
Biogenic	58,354	12,953	-45,400
Wind Blown Dust	0	0	0
Total Natural	**72,021**	**15,247**	**-56,775 (-79%)**
All Sources			
Total Emissions	**242,978**	**140,815**	**-102,164 (-42%)**

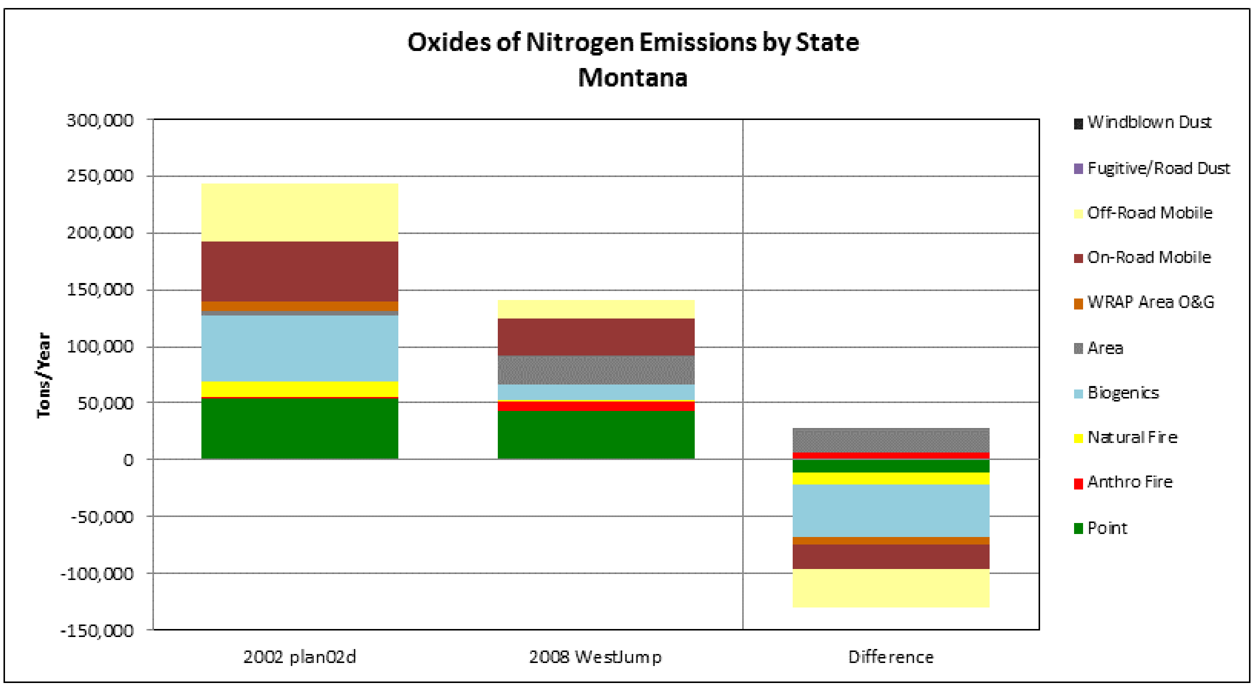

Figure 6.7-8. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Oxides of nitrogen by Source Category for Montana.

Table 6.7-10
Montana
Ammonia Emissions by Category

Source Category	Ammonia Emissions (tons/year)		
	2002 (Plan02d)	2008 (WestJump2008)	Difference (Percent Change)
Anthropogenic Sources			
Point	318	53	-264
Area	61,240	55,254	-5,986
On-Road Mobile	1,293	458	-835
Off-Road Mobile	29	16	-13
Area Oil and Gas	0	0	0
Fugitive and Road Dust	0	0	0
Anthropogenic Fire	289	5,507	5,208
Total Anthropogenic	**63,169**	**61,289**	**-1,880 (-3%)**
Natural Sources			
Natural Fire	3,060	1,599	-1,462
Biogenic	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**3,060**	**1,599**	**-1,462 (-48%)**
All Sources			
Total Emissions	**66,229**	**62,888**	**-3,342 (-5%)**

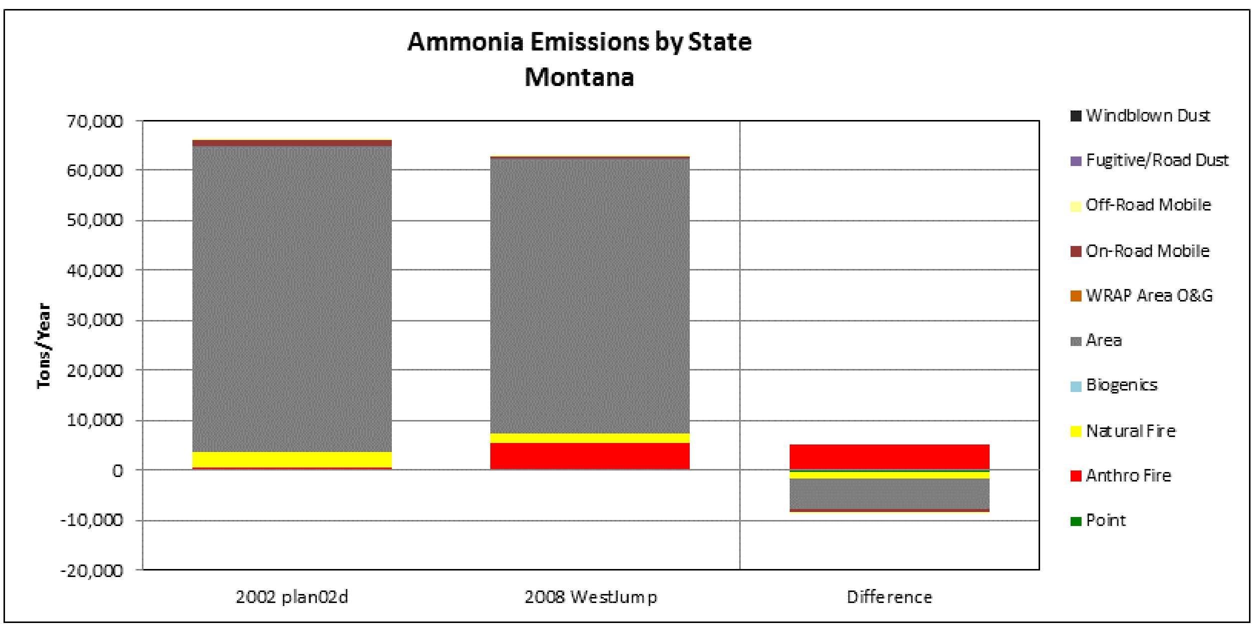

Figure 6.7-9. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Ammonia by Source Category for Montana.

Table 6.7-11
Montana
Volatile Organic Compound Emissions by Category

Source Category	Volatile Organic Compound Emissions (tons/year)		
	2002 (Plan02d)	**2008 (WestJump2008)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point	7,577	4,670	-2,907
Area	47,408	18,512	-28,897
On-Road Mobile	43,467	13,231	-30,235
Off-Road Mobile	12,748	12,449	-300
Area Oil and Gas	5,444	204	-5,240
Fugitive and Road Dust	0	0	0
Anthropogenic Fire	2,895	7,643	4,749
Total Anthropogenic	**119,539**	**56,710**	**-62,829 (-53%)**
Natural Sources			
Natural Fire	30,101	1,546	-28,555
Biogenic	1,031,678	305,432	-726,246
Wind Blown Dust	0	0	0
Total Natural	**1,061,779**	**306,978**	**-754,801 (-71%)**
All Sources			
Total Emissions	**1,181,318**	**363,688**	**-817,630 (-69%)**

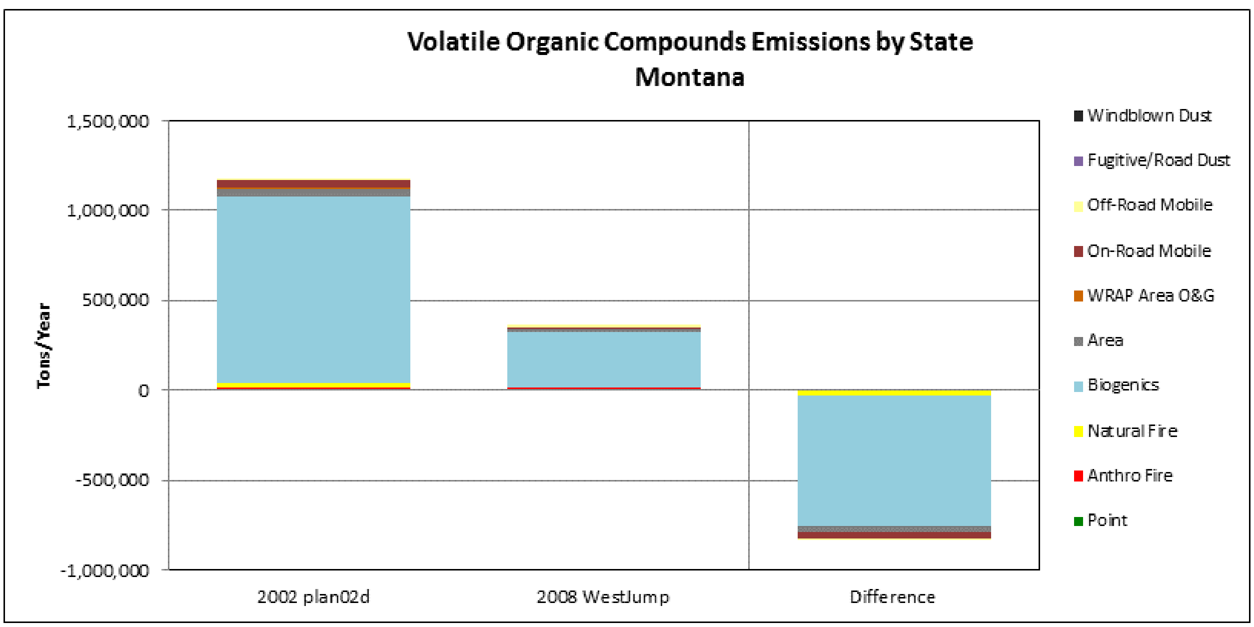

Figure 6.7-10. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Volatile Organic Compounds by Source Category for Montana.

Table 6.7-12
Montana
Primary Organic Aerosol Emissions by Category

Source Category	Primary Organic Aerosol Emissions (tons/year)		
	2002 (Plan02d)	2008 (WestJump2008)	Difference (Percent Change)
Anthropogenic Sources			
Point*	101	13	-87
Area	2,788	1,847	-941
On-Road Mobile	455	846	391
Off-Road Mobile	718	523	-195
Area Oil and Gas	0	1	1
Fugitive and Road Dust	1,958	1,211	-747
Anthropogenic Fire	3,745	17,360	13,615
Total Anthropogenic	**9,764**	**21,801**	**12,037 (>100%)**
Natural Sources			
Natural Fire	38,324	4,765	-33,559
Biogenic	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**38,324**	**4,765**	**-33,559 (-88%)**
All Sources			
Total Emissions	**48,089**	**26,566**	**-21,522 (-45%)**

*Point source data includes only oil and gas and regulated CEM sources. More comprehensive point source data were not available at the time this report was prepared but will be made available through the WRAP TSS (http://vista.cira.colostate.edu/tss/).

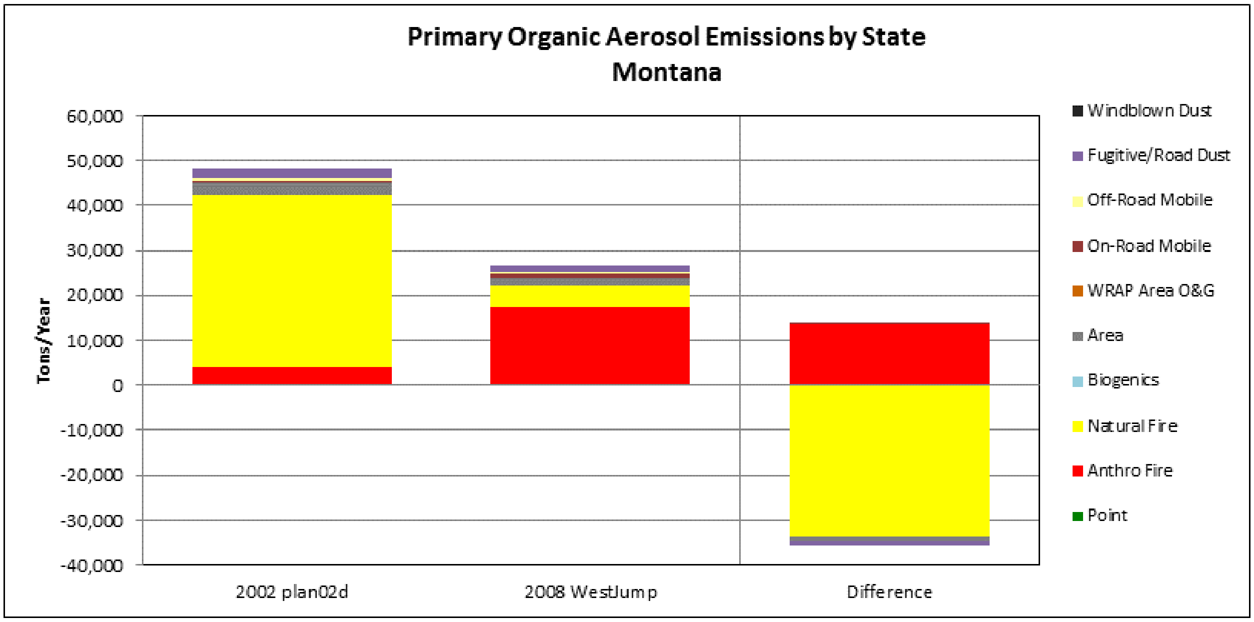

Figure 6.7-11. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Primary Organic Aerosol by Source Category for Montana.

Table 6.7-13
Montana
Elemental Carbon Emissions by Category

Source Category	Elemental Carbon Emissions (tons/year)		
	2002 (Plan02d)	**2008 (WestJump2008)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point*	17	5	-12
Area	413	774	360
On-Road Mobile	519	1,403	884
Off-Road Mobile	2,288	1,126	-1,162
Area Oil and Gas	0	0	0
Fugitive and Road Dust	134	22	-112
Anthropogenic Fire	759	2,738	1,979
Total Anthropogenic	**4,129**	**6,066**	**1,937 (47%)**
Natural Sources			
Natural Fire	7,743	1,102	-6,641
Biogenic	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**7,743**	**1,102**	**-6,641 (-86%)**
All Sources			
Total Emissions	**11,873**	**7,168**	**-4,705 (-40%)**

*Point source data includes only oil and gas and regulated CEM sources. More comprehensive point source data were not available at the time this report was prepared but will be made available through the WRAP TSS (http://vista.cira.colostate.edu/tss/).

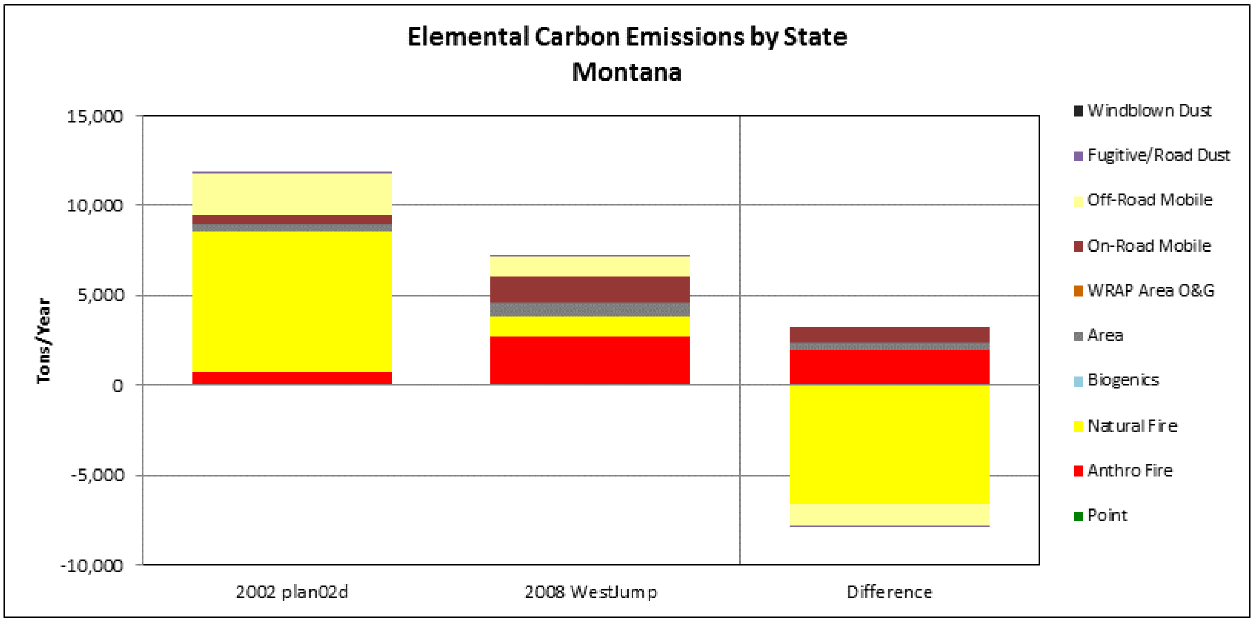

Figure 6.7-12. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Elemental Carbon by Source Category for Montana.

Table 6.7-14
Montana
Fine Soil Emissions by Category

Source Category	Fine Soil Emissions (tons/year)		
	2002 (Plan02d)	**2008 (WestJump2008)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point*	182	181	-1
Area	2,472	932	-1,540
On-Road Mobile	268	126	-142
Off-Road Mobile	0	36	36
Area Oil and Gas	0	16	16
Fugitive and Road Dust	34,947	23,921	-11,026
Anthropogenic Fire	279	6,377	6,098
Total Anthropogenic	**38,148**	**31,591**	**-6,558 (-17%)**
Natural Sources			
Natural Fire	2,911	1,763	-1,148
Biogenic	0	0	0
Wind Blown Dust	36,448	26,475	-9,973
Total Natural	**39,359**	**28,238**	**-11,121 (-28%)**
All Sources			
Total Emissions	**77,507**	**59,829**	**-17,679 (-23%)**

*Point source data includes only oil and gas and regulated CEM sources. More comprehensive point source data were not available at the time this report was prepared but will be made available through the WRAP TSS (http://vista.cira.colostate.edu/tss/).

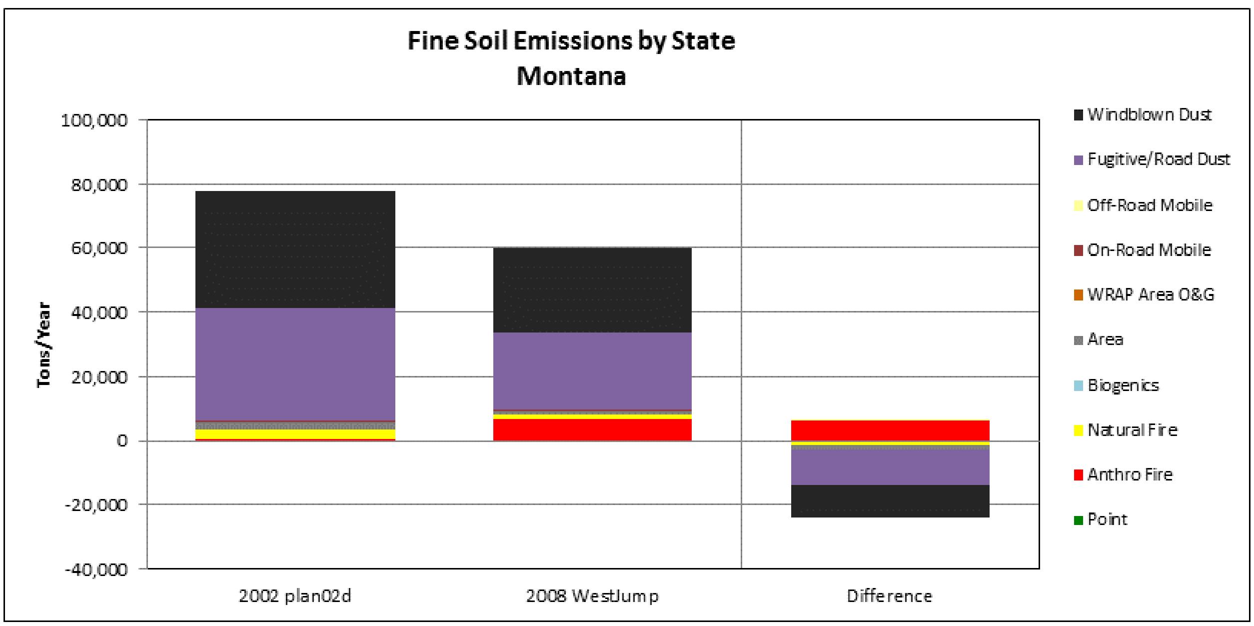

Figure 6.7-13. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Fine Soil by Source Category for Montana.

Table 6.7-15
Montana
Coarse Mass Emissions by Category

Source Category	Coarse Mass Emissions (tons/year)		
	2002 (Plan02d)	**2008 (WestJump2008)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point	7,818	3,125	-4,693
Area	706	286	-421
On-Road Mobile	270	1,475	1,205
Off-Road Mobile	0	67	67
Area Oil and Gas	0	0	0
Fugitive and Road Dust	275,235	146,607	-128,629
Anthropogenic Fire	713	3,326	2,612
Total Anthropogenic	**284,743**	**154,885**	**-129,858 (-46%)**
Natural Sources			
Natural Fire	8,496	914	-7,582
Biogenic	0	0	0
Wind Blown Dust	328,036	238,275	-89,761
Total Natural	**336,533**	**239,189**	**-97,344 (-29%)**
All Sources			
Total Emissions	**621,276**	**394,074**	**-227,202 (-37%)**

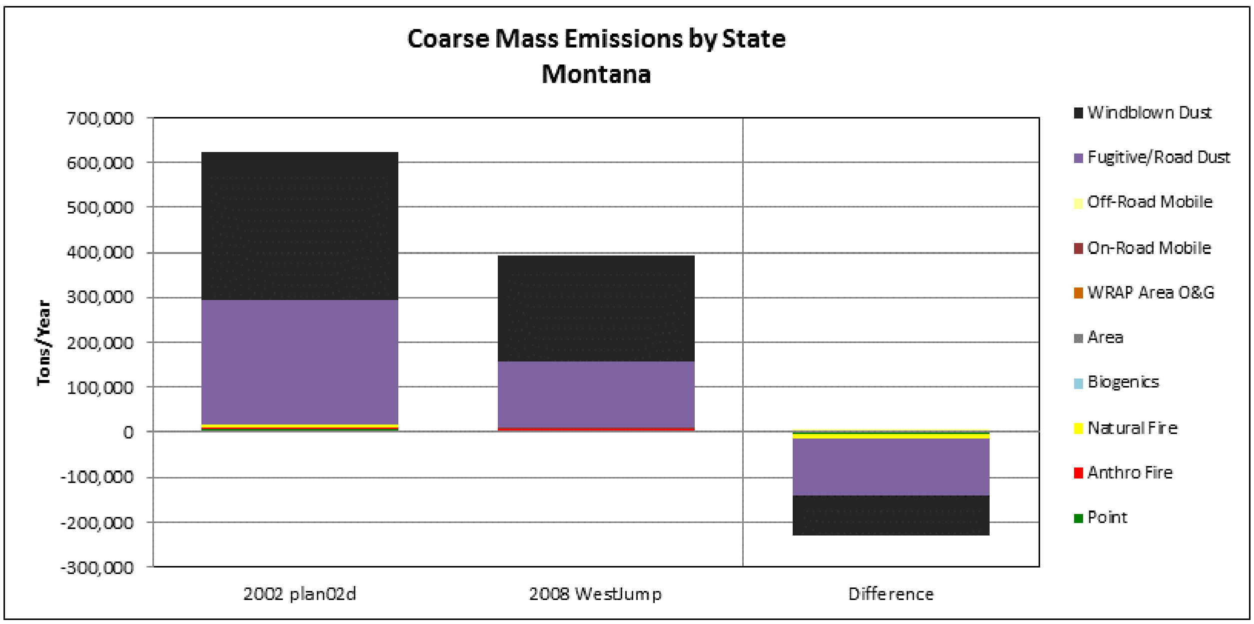

Figure 6.7-14. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Coarse Mass by Source Category for Montana.

6.7.2.2 EGU Summary

As described in previous sections, differences between the baseline and progress period inventories presented here do not necessarily represent changes in actual emissions because numerous updates in inventory methodologies have occurred between the development of the separate inventories. Also, the 2002 baseline and 2008 progress period inventories represent only annual snapshots of emissions estimates, which may not be representative of entire 5-year monitoring periods compared. To better account for year-to-year changes in emissions, annual emission totals for Montana electrical generating units (EGU) are presented here. EGU emissions are some of the more consistently reported emissions, as tracked in EPA's Air Markets Program Database for permitted Title V facilities in the state (http://ampd.epa.gov/ampd/). RHR implementation plans are required to pay specific attention to certain major stationary sources, including EGUs, built between 1962 and 1977.

Figure 6.7-17 presents a sum of annual NO_X and SO_2 emissions as reported for Montana EGU sources between 1996 and 2010. While these types of facilities are targeted for controls in state regional haze SIPs, it should be noted that many of the controls planned for EGUs in the WRAP states had not taken place yet in 2010, while other controls separate from the RHR may have been implemented. The chart shows periods of decline for both SO_2 and NO_X. The chart shows a sharp decline in NO_X between 2007 and 2009, while SO_2 emissions remained fairly constant.

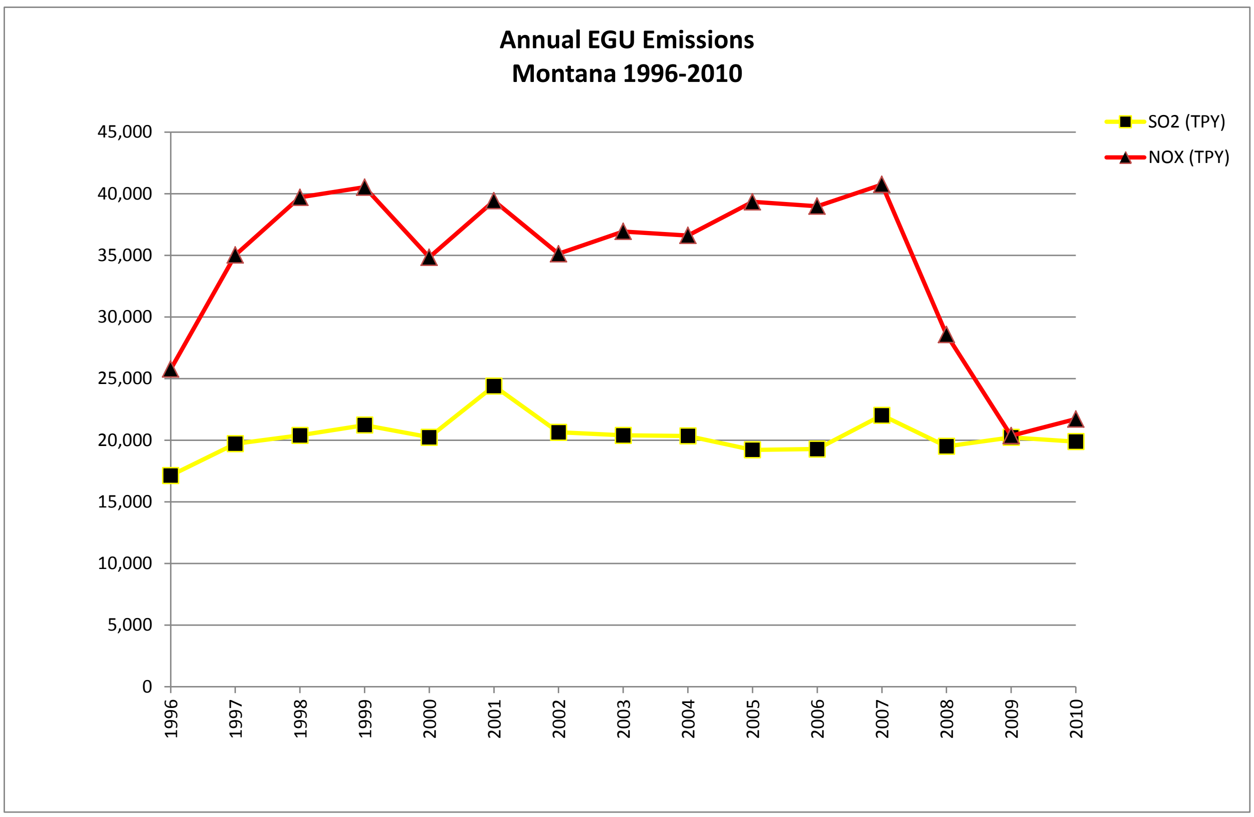

Figure 6.7-17. Sum of EGU Emissions of SO_2 and NOx reported between 1996 and 2010 for Montana.