APPENDIX A

Regional Haze State Implementation Plan

Periodic Review of Colorado RAVI Long Term Strategy

LONG-TERM STRATEGY REVIEW

OF

COLORADO'S STATE IMPLEMENTATION PLAN FOR CLASS I AREA VISIBILITY PROTECTION ADDRESSING REASONABLY ATTRIBUTABLE IMPAIRMENT

July 2007
(updated October 2007)

I. STATE OF COLORADO'S PHASE I STATE IMPLEMENTATION PLAN FOR CLASS I VISIBILITY PROTECTION ADDRESSING REASONABLY ATTRIBUTABLE IMPAIRMENT

The various elements of Phase I of Colorado's Class I Visibility State Implementation Plan are spread throughout Colorado Air Quality Control Commission Regulation No. 3. All of the components of the Visibility SIP are important to long-term visibility protection of Class I areas in the State and are integrated in varying degrees into the LTS review and revision protocol. Therefore, each of the components is briefly discussed in this section.

A. Existing Impairment.

The AQCC's Regulation No. 3, *Stationary Source Permitting and Air Pollution Emission Notice Requirements*, includes provisions to address impairment within Class I areas reasonably attributable to existing major sources.

Regulation No. 3 Part D §XIV.D provides for an affected FLM or the Division to certify visibility impairment in a Class I area due to an existing stationary source. Existing sources regulated under this program are those that were not in operation prior to August 7, 1962 nor for which construction was commenced on or after August 7, 1977, which have the potential to emit 250 tons or more of an air pollutant regulated by the Division.

The FLM or the Division may certify at any time that impairment exists in any Class I area.

If the Division reasonably attributes the impairment to an existing source, the Division must conduct a BART analysis and determine if additional emission limitations are required. If so, the source must apply for a BART permit from the Division. Once the permit is granted, the source must limit its emissions on a schedule not to exceed five years. At the time of Colorado's Visibility SIP development, the FLMs did not indicate that potentially reasonably attributable types of visibility impairment were present in any of Colorado's Class I areas. The Division concurred with the finding. However, in 1993 the USFS certified visibility impairment in the Mt. Zirkel Wilderness in northwest Colorado.[1] The certification has subsequently been resolved and is discussed below in section II.B.1.a.

B. New Source Review.

Applicants for permits to operate as a major source must demonstrate that the proposed source will not have an adverse impact on visibility in any Class I area. Regulation 3 Part D §XIII.A sets forth a schedule for the participation of affected FLMs and consultation with the Division in the review process of such an analysis as part of the Prevention of Significant Deterioration (PSD) permitting application process.

The Division is required to consider any FLM determinations that the proposed source would have an adverse impact on visibility in the Class I area (Regulation 3 Part D §V.A.6 and XIII.C). The Division may independently make its own determination. If the Division does determine that its own or the FLM's analysis demonstrates that an adverse impact would occur, the Division shall not issue the permit.

In addition to the analysis, a source may be required to conduct monitoring to establish the condition of, and impact on, air quality related values (AQRVs) in the Class I area that may be affected. Monitoring can be required both before completing a permit application to construct and during the construction and operation of the source (Regulation 3 Part D §VI.A.3, §VI.A.4, §XIII.B).

C. Consultation With Federal Land Managers.

Regulation No. 3 provides for participation by the FLMs in the new source review process. The FLMs may also make recommendations to the Division concerning integral vistas, identify impairment in any Class I area, and provide consultation concerning elements considered for inclusion in the monitoring strategy. The Division also is required to consult with the FLMs during development and review of the Phase I Long-Term Strategy (Regulation 3 Part D §XIV.F.1.a).

D. Monitoring Strategy.

The monitoring strategy in the SIP is based on the following four goals:

1. To provide information for new source visibility impact analysis.

2. To determine existing conditions in Class I areas and the source(s) of any certified impairment.

3. To determine actual effects from the operation of new major sources or modifications to major sources on nearby Class I areas.

4. To establish visibility trends in Class I areas to evaluate progress towards meeting the national visibility goal.

Potential new major sources must conduct visibility analyses utilizing existing visibility data. If data are adequate and/or representative of the potentially impacted Class I area(s), the permitees will be notified of the visibility levels against which impacts are to be assessed. If visibility data are not adequate, pre-construction monitoring of visibility may be required.

If the FLMs or the Division certify existing impairment in a Class I area, the Division will determine if the documented visibility impairment can be reasonably attributed to emissions from an existing local stationary source. In making this determination, the Division will consider all available data, including the following:

1. Data supplied by the FLM;

2. The number and type of sources likely to impact visibility in the Class I area;

3. The existing emissions and control measures on the source(s);

4. The prevailing meteorology near the Class I area; and

5. Any modeling that may have been done for other air quality programs.

If available information is not sufficient to make a decision regarding "reasonable attribution" of visibility impairment from an existing source(s), the Division will initiate cooperative studies. Such studies could involve the FLMs, the potentially affected source(s), the EPA, and others.

E. Phase I Long-Term Strategy.

The Phase I LTS is that portion of the Visibility SIP that is the State's long-term strategy for making reasonable progress toward remedying existing and preventing future visibility impairment within the context of the Phase I program.

EPA regulations require the State to: (1) develop a long-term strategy; (2) coordinate its LTS with existing plans and goals, including those of federal land managers, that may affect impairment in any Class I area; (3) demonstrate why the LTS is adequate for making reasonable progress toward the national goal and state why the minimum factors (listed in the next paragraph) were or were not addressed in developing the LTS; (4) consider the time necessary for compliance as well as the economic, energy, and non-air quality environmental impacts of compliance, the remaining useful life of any affected existing source, as well as the effect of new sources; (5) review its strategy no less frequently than every 5 years and consult with federal land managers during this process; and (6) report to EPA and the public on progress achieved toward the national visibility goal.

During development of the LTS the State must consider, at a minimum, the following six factors:

- *Emission reductions due to ongoing air pollution control programs*. For example, the attainment and maintenance of National Ambient Air Quality Standards in the Denver metropolitan area and other non-attainment areas throughout Colorado may reduce visibility impairment in a number of Class I areas in the State. If this is the case, the State should explain how this would contribute to reasonable progress.

- *Additional emission limitations and schedules for compliance*. For example, states may have to control other sources causing impairment not covered by BART to make reasonable progress toward the national goal.

- *Measures to mitigate the impacts of construction activities*. This recognizes that nearby construction activities can contribute to impairment in Class I areas. If this appears to be a problem in Colorado, then the State should explain in its LTS what measures it will take to mitigate these impacts.

- *Source retirement and replacement schedules*. The construction of new sources, which will ensure the early or scheduled retirement of older, less well-controlled sources, can greatly aid progress toward the national visibility goal over the long term.

- *Smoke management techniques for agricultural and forestry management purposes including such plans as currently exist within the State for this purpose.* The LTS should discuss measures that would constitute reasonable progress in relation to this issue.

- *Enforceability of emission limitations and control measures*. In some situations the enforceability of proposed or actual emission limitations and control measures on sources causing existing impairment may be an issue.

F. Colorado's LTS History and the Current Review and Revision.

Since the time the Colorado Visibility SIP was adopted by the AQCC in 1987, the LTS has been amended and/or reviewed on eight occasions:

- The original 1987 LTS was reviewed and revised in August 1992.

- After the 1993 certification of impairment at the Mt. Zirkel Wilderness Area, the EPA requested an informal LTS status report, which was supplied in December 1993.

- The 1996-97 LTS was completed in two stages:

    - August 1996 -- focusing entirely on the Mt. Zirkel Wilderness Area certification of impairment and the incorporation of emission limitations for the Hayden Generating Station; and

- April 1997 -- addressing all other issues.

- The LTS was comprehensively reviewed again in January 1999, but a SIP revision was not found to be necessary.

- Following the Craig Consent Decree in early 2001, the LTS was again amended in April 2001 incorporating emission limitations, schedules, and reporting requirements for Craig Units 1 and 2. The State, the USFS, and EPA concluded that the 1993 certification of visibility impairment involving Mt. Zirkel Wilderness Area was resolved.[2,3]

- The February 2002 LTS was comprehensively reviewed and the LTS portion of the SIP was updated and reorganized into a more readable format.

- The November 2004 LTS was also a comprehensive review and minor SIP revision update.

Past LTS reviews and SIP revisions are available from the Division.

This current review is a report on the activities, actions, processes, and progress made with respect to the seven review categories within the context of the existing Phase I LTS, adopted by the Commission in November 2004. Colorado believes, based on an assessment of the State's achievements with respect to these seven categories, that the current Reasonably Attributable Class I visibility program of the State of Colorado achieves reasonable progress toward the national visibility goal under Phase I of the visibility protection program.

In a separate document is a SIP revision to the reasonably attributable part of the LTS. The revision is a relatively small series of amendments intended to reflect current conditions and plans.

II. REVIEW OF COLORADO'S LONG-TERM STRATEGY

A. STATE AND EPA REQUIREMENTS

State regulations require the Division to periodically report to the AQCC on the progress made toward the national visibility goal via the Phase I SIP. This report to the AQCC and the public is being submitted to fulfill these requirements. A SIP revision is contained in a separate document.

EPA regulations require that the State provide this report to the public and the Administrator of EPA. Both EPA and State regulations require the report to include an assessment of:

1. The progress achieved in remedying existing impairment of visibility in any Class I area.

2. The ability of the long-term strategy to prevent future impairment of visibility in any Class I area.

3. Any change in visibility since the last such report, or in the case of the first report, since plan approval, including an assessment of existing conditions.

4. Additional measures, including the need for SIP revisions that may be necessary to ensure reasonable progress toward the national visibility goal.

5. The progress achieved in implementing BART and meeting other schedules set forth in the long-term strategy.

6. The impact of any exemption from BART granted to any facility.

7. The need for BART to remedy existing impairment in an integral vista declared since plan approval.

B. STEP-BY-STEP REVIEW

Each element of the review is presented in detail below.

1. PROGRESS IN REMEDYING EXISTING IMPAIRMENT OF VISIBILITY IN ANY CLASS I AREA.

The Phase I Class I Visibility SIP is focused on source-specific or plume-type impairment from single or small groups of stationary sources, consistent with Phase I of the implementation of EPA's visibility program.

a. Visibility Impacts in the Mt. Zirkel Wilderness.

In July 1993, the USFS certified visibility impairment in the Mt. Zirkel Wilderness Area and named the Hayden and Craig power stations as suspected sources.[1] As noted, upon certification by a federal land manager of visibility impairment in a Class I area, the Division must determine if it can "reasonably attribute" the visibility impairment to one or more existing stationary

sources. If so, the Division must conduct a BART analysis and as a result may order emission limitations for each pollutant at the facilities.

The Division considered existing information available at the time of the USFS certification of impairment to determine if it could make a decision to reasonably attribute visibility impairment within the MZWA to the Hayden and/or Craig generating stations. The Division concluded that existing information was insufficient to reasonably attribute. The Division's response was to collaboratively develop with other stakeholders the $3.5 million Mt. Zirkel Visibility Study (MZVS) in order to collect additional information. The MZVS was concluded in July 1996.[4]

For a complete review of the activities, studies, and events that have occurred in relation to this environmental matter, see the April 1997 and January 1999 LTS reviews (available from the Division). Below is a summary of the how the certification of impairment has been resolved.

(i). Hayden Station.

The certification of impairment made by the USFS regarding the Hayden Station was resolved through a settlement process that began in late 1995. On May 21, 1996, the Sierra Club, State of Colorado, owners of Hayden Station, and Environmental Protection Agency/Department of Justice executed an agreement -- the Hayden Consent Decree.[5] On May 22, 1996, the Decree was filed in federal district court. The court approved it on August 19, 1996. The Decree was intended to resolve a number of issues, including a successful Sierra Club lawsuit against the Hayden Station, the needs of the State's visibility regulatory program in relation to Hayden, and an EPA complaint against the facility. In addition, the Decree was intended to make progress toward reducing acid deposition in the Mt. Zirkel Wilderness.

Emission limitations, construction schedules, and reporting requirements taken from the Hayden Consent Decree were incorporated into the Visibility SIP by the AQCC on August 15, 1996. The State believes that these significant emission reductions effectively eliminate the sulfate and primary plume related visibility impairment in the MZWA that could be associated with the Hayden Station. The State further believes that the Hayden Consent Decree effectively resolves the certification of impairment brought by the USFS against the Hayden Station. The Forest Service has concluded that its complaint against Hayden has been satisfied. EPA approved this SIP amendment on January 16, 1997.[6]

The construction of Hayden's control equipment progressed ahead of schedule. All compliance dates in the SIP and Consent Decree were met and the emission limitations for NOx, SO_2, opacity, and particulate matter have been consistently achieved in actual operation. The relevant emission limitations and monitoring requirements have been moved into the facility's Title V operating permit and the permit has been issued and the Consent Decree has been terminated.

(ii). Craig Generating Station (Yampa Project).

The certification of impairment made by the USFS regarding the Craig Station Units 1 and 2 was also resolved through a settlement process that began in Fall 1999. After Hayden was

resolved in August 1996, attention turned to Craig Station Units 1 and 2. The Mt. Zirkel Visibility Study (MZVS) indicated to the Division that sulfate haze from Yampa Valley power plants occasionally entered the MZWA and along with regional haze contributed to visibility impairment. Thus, the focus to resolving the Craig Station portion of the certification was on reducing SO_2, the precursor pollutant of sulfate, from Craig Station Units 1 and 2. The State preferred to resolve the visibility certification through negotiated settlement. If settlement seemed unlikely, the State was prepared to resolve the certification using the available regulatory tools. At a meeting in late 1996 between the State, Craig Owners, and EPA, the State agreed to temporarily delay pursuing regulatory action in order to foster the collaboration needed to jointly develop additional information on various SO_2 emission reduction options and associated cost. Craig Station Units 1 and 2 at the time achieved 65% SO_2 control; both EPA and the State believed that an improvement in the degree of control would resolve the certification. A joint study, known as the Craig Station Flue Gas Desulfurization Study (Craig FGD Study), became the focus for a negotiated settlement. The information could also be used as part of a BART determination if needed. The study was completed in August 1999.[7]

There were other issues involved and parties concerned with emissions from Craig Station Units 1 and 2. The USFS has strong concerns about local emissions of SO_2 and NOx that may be associated with acid deposition and aquatic and terrestrial ecosystem effects in the MZWA. A 1996 Colorado statute provides FLMs with an opportunity to assert impairment to Class I areas by air pollution adversely affecting non-visibility related qualities of the area, such as the aquatic ecosystem.[8] The USFS did not trigger the law with an assertion related to MZWA and was awaiting the outcome of the resolution of the visibility certification and/or global settlement of all issues. In addition, the Sierra Club initiated a citizen lawsuit under the Clean Air Act in late 1996 directed against Craig Station Units 1 and 2 regarding opacity issues.

In Fall 1999, the Sierra Club, Craig Owners, EPA, the State, and the USFS began global settlement talks with an independent mediator. On September 22, 1999, EPA issued a SIP call to Colorado indicating the State had twelve months to resolve the certification regarding Craig Station Units 1 and 2.[9] The Craig Owners and Sierra Club concluded a Consent Decree and filed it with the federal district court on January 10, 2001. The court approved the agreement on March 19, 2001. The State resolved the certification of impairment for Units 1 and 2 of Craig Station by adopting emission limitations, schedules, and reporting requirements from the Craig Consent Decree into the Visibility SIP. The USFS concluded that, "the proposed reductions of both sulfur dioxide and nitrogen oxides will resolve all Forest Service issues relative to the Craig Stations and our 1993 Certification of Impairment."[10] The SIP was amended by the AQCC on April 19, 2001[2] and EPA published final approval of the SIP amendment after a public comment period.[3] Work was completed on Unit 1 during 2003 and on Unit 2 in 2004. All compliance dates in the SIP and Consent Decree were met and the emission limitations for NOx, SO_2, opacity, and particulate matter have been consistently achieved in actual operation. The relevant emission limitations and monitoring requirements have been moved into the facility's Title V operating permit. The permit has been issued and the Consent Decree terminated.

(iii). Other Stationary Sources and the MZWA.

The Division has found no evidence that other stationary sources potentially subject to

BART may reasonably be attributed to cause or contribute to visibility impairment at MZWA under Phase I of the EPA visibility program. The USFS certification of visibility impairment, related to the Phase I program, has been completely resolved. Regional haze that impacts any Colorado Class I area**s**, including MZWA, are addressed in the regional haze SIP.

(iv). Monitoring and the MZWA.

It is important to track the effect of the emission reductions at Hayden and Craig generating stations on visibility impairment near the Wilderness as well as on acid levels in sensitive lakes and the snowpack. Funding for and the collection of these data are provided variously by the USFS, U.S. Geological Survey, EPA, and the Division. Table 1 below provides a brief overview of monitoring activities in and around MZWA.

Table 1
Long-Term Visibility and Non-Visibility Air Quality Related Value Measurements In and Near the Mt. Zirkel Wilderness Area

Instrument, Measurement, or Sampler	**1. Sponsor 2. Funding 3. History**	**Purpose**
Continuous SO_2 monitor at Buffalo Pass Tower*	1. Colorado Air Pollution Control Division 2. $9,800/year by CAPCD 3. 9/97 through present.	Measures frequency and magnitude of SO_2 "hits" at Buffalo Pass as an indicator of the presence of Craig and Hayden emissions and potential impacts at the Mt. Zirkel Wilderness Area. The monitor provides hourly average SO_2. The purpose of the monitor is to determine whether trends are occurring as emissions change at Hayden and Craig 20 and 40 miles away, respectively, in the Yampa Valley.
Continuous ambient nephelometer at Buffalo Pass Tower*	1. US Forest Service 2. $9,600/year by USFS 3. 1994 through present.	Measures frequency and magnitude of visibility episodes (the nephelometer measures light scattering, a component of visibility) at Buffalo Pass. This measurement provides hourly average light scattering but is subject to significant weather interferences.
Automatic camera system	1. US Forest Service 2. $5,280/year by USFS 3. 10/90 through present	Three 35mm slides are taken each day and archived. The visual information can be used to document various types of visibility conditions and matched/collated with instrumental measurements.
IMPROVE aerosol monitor at Buffalo Pass Tower*	1. Initially USFS, now EPA, as part of the national IMPROVE visibility monitoring network. 2. $14,000/year by EPA (for supplies and analysis) $33,000/year by USFS (for support of all Buffalo Pass Tower monitoring operations)	Measurements include 1-in-3 day sampling, 24-hour filter based PM2.5 (chemically speciated) and PM10 (mass only). Light extinction reconstruction is calculated from the various aerosol constituents. Measurement of overall reconstructed light extinction is used for episode identification as well as trends. These reconstructed extinction data will be compared between the before and after periods. While this measure is not as prone to weather interferences as the nephelometer, other challenges in analyzing these data include changes in regional emissions, climatic variation, wildfire, and the nature

Instrument, Measurement, or Sampler	1. Sponsor 2. Funding 3. History	Purpose
	3. 1994 through present	of trying to distinguish episodic change in a 24-hour average.
National Acid Deposition Program (NADP) sampler at Buffalo Pass Tower*.	1. USFS 2. $12,288/year by USFS 3. 1984 through present	Measurement of acid precipitation-related chemical constituents. The network collects data on the chemistry of precipitation for monitoring of geographical and temporal long-term trends. The precipitation at each station is collected weekly. It is then sent to the Central Analytical Laboratory where it is analyzed for hydrogen (acidity as pH), sulfate, nitrate, ammonium, chloride, and base cations (such as calcium, magnesium, potassium and sodium).
Mercury deposition sampler at Buffalo Pass Tower*	1. USFS 2. $12,000/year by USFS 3. 1997 through present	Mercury deposition sampling is done through the NADP program. This site is sponsored and funded by USFS. The purpose is to measure mercury deposition. The sample is collected weekly and sent to the NADP's Central Analytical Laboratory.
Snowpack chemistry sampling in March or April of each year prior to spring snowmelt.	1. USGS, NPS, USFS 2. $115,000/year 3. 1990 through present	Annual measurement of snowpack chemistry prior to spring snowmelt and the release of acids during the "spring acid pulse." The U.S. Geological Survey has been monitoring snowpack chemistry at more than 50 locations throughout the Rocky Mountain region, extending from northern New Mexico to northern Montana, annually since 1993. There are 20 sites in Colorado, including several in and near the Mt. Zirkel Wilderness. Some sites in Colorado have been monitored since 1990. The purpose of the monitoring is to: 1) have an integrated measurement of acid deposition and snow chemistry over the snow accumulation months in high altitude areas associated with sensitive high altitude aquatic ecosystems; 2) determine whether trends are occurring in the snowpack chemistry; and 3) provide indicators of regional and/or local source emission changes.
Lake sampling in Mt. Zirkel Wilderness (and 2 other wilderness areas) during summer and fall.	1. USFS/CDPHE/ USGS 2. $62,000 3. 1983 through present	Measurements of acid precipitation-related chemical constituents as well as overall measures such as hydrogen ion, pH, and buffering capacity of 3 lakes in the Mt. Zirkel Wilderness. The purpose of the long-term monitoring of these lakes is to: 1) determine the natural variance in chemistry of the lakes; 2) determine whether trends are occurring in the chemistry of lakes in the Mt. Zirkel Wilderness, and 3) provide information on the ambient chemistry of lakes in the Wilderness.

*Buffalo Pass monitoring tower is at the southern end of the Mt. Zirkel Wilderness.

The measurements provide a reasonably comprehensive network to track the emission changes through different parts of key environmental systems, including atmospheric emissions,

visibility, precipitation, acid deposition, mercury deposition, snowpack and aquatic ecosystems.

(v). Analysis of the Effects of the Hayden Generating Station Emission Reductions.

Using the data collected from the network described above, the Division and the USGS completed an analysis during 2004-2005 of the effects of the emission reductions at the Hayden Generating Station. At that time, Craig had just completed its emission capture upgrade and there were insufficient data to analyze to assess the additional effects of the Craig project. Therefore, the analysis focused on the reductions at the Hayden Generating Station. A final report will be completed during 2009 on the effects of the reductions at Craig as well as an assessment of the combined effect of the decreases in emissions from both facilities.

Study Design. Environmental data were compared between a period "before" Hayden was controlled versus a period "after" Hayden was controlled**.**

The period before controls were installed at Hayden is defined as 1995 through 9/24/98. 1995 is chosen as the beginning of the before period even though data extends earlier for a number of data sets. The before period is purposely constrained to limit the influence of regional emission changes over time as well as climate variation.

Unit 1's boiler was brought down on 9/25/98 to begin the tieing-in and integration of its various air pollution control systems. Unit 1 was re-started with emission controls on December 21, 1998. Unit 2's boiler was brought down on 3/7/99. It was re-started on May 20, 1999. However, intermittent problems with the SO_2 controls could not be fixed until November 16, 1999. The Craig Generating Station (Yampa Project) began its upgrades on September 13, 2003. The three periods (i.e., before, during, after) are summarized in Table 2 below. Only the before and after periods were analyzed and compared.

Table 2
The Before, During and After Periods

Period	**Dates**	**What**
Before	1995 through 9/24/98	This is the period before Hayden's pollution controls began operating
During (not analyzed)	9/25/98 through 11/16/99	Pollution control equipment was being tied-in, integrated and de-bugged.
After	11/17/99 through 9/12/03	Hayden's equipment in routine operation and Craig had not yet begun its tie-in period.

Confounding Factors. Because the collection of environmental data occurs in the real world, rather than in a laboratory where other changes can be held constant, there are several influences

the data analysts were aware might confound or mask the signal of Hayden's emission change. All of the factors below contribute to make it more difficult to find and attribute the changes due solely to Hayden.

- Climate
  - The before period was wetter than average and the after period was drier than average. There was a 30-40% decrease in precipitation between the two periods depending on measurement location.
- Regional Haze
  - The after period was 17% more hazy. This is largely due to the decrease in precipitation and associated drought. Chemical analyses showed that almost all of the change between the two periods was due to particles from wildfires and increased dust.
- Overall Yampa Valley Emissions
  - Hayden and Craig are in the same valley, therefore, emissions from both must be considered together since analysis techniques can't identify the pollutants from one plant versus the other. Given Hayden's specific reduction and the ongoing operation at Craig (before its upgrade), SO_2 decreased in the Yampa Valley by 48% and NOx increased 7%.
- Regional Emission Changes
  - Not only was there an emission change at Hayden, but large emission reductions of SO_2 also occurred in the southwestern part of the U.S. For example: Arizona/39%, New Mexico/27%, Wyoming/18%, Texas/15%.
- Atmospheric Chemistry
  - The atmospheric chemistry converting invisible SO_2 gas to visible sulfate particles is not linear. That is, a one unit decrease in SO_2 may not lead to a one unit decrease in sulfate.

Results.

- Emissions
  - Sulfur dioxide (SO_2) removal at Hayden has always been at least 85% over 30 and 90 day rolling averages since the compliance period began. Nitrogen oxides (NOx) have decreased approximately 50% annually. The new particulate control system has completely eliminated the occasional black smoke-plume episodes that previously occurred.
- Ambient SO_2 as measured at Mt. Zirkel Wilderness Area
  - Decreased 40% due to the reductions at Hayden.
- Haze at Mt. Zirkel Wilderness Area
  - Increased 17% due to the drought and increases in regional haze. This would have been worse without the reductions at Hayden.
- Sulfate Particulate Haze
  - Overall decrease of 20% at Mt. Zirkel Wilderness Area.
  - Peak sulfate episodes were eliminated in the after data. This is a very important finding because it is the worst days that hamper enjoyment of clear visibility.
  - It is estimated that approximately half of the overall decrease is due to

Hayden's reductions. The other half is due to the regional scale reductions in SO_2.

- Acid Deposition Measurements
  - Decrease in sulfuric acid deposition of approximately 20%.
    - Looking at other measurement sites, this decrease in sulfuric acid *only* occurred at acid deposition sites downwind of Hayden.
  - Overall decrease in acid deposition at all sites, however, most of this is drought related due to an increase in dust elements in the rain and snow that buffer acids.
- Snowpits
  - Small decrease in sulfuric acid at pits downwind from Hayden.
  - Overall decrease in acidity, again due to more dust elements in the snowpack.
- Lakes
  - No change due to emission reductions in before versus after periods. This is expected because response time to an emission reduction of SO_2 in a watershed is several years. Effects of drought were also visible in lake acidity (i.e., less acid due to increased dust elements).

In spite of the big challenges nature and other anthropogenic changes piled onto the study design, the USGS and the APCD see a strong signal decrease in episodic visibility impairing sulfate and acidic wet sulfate in and near the Mt. Zirkel Wilderness Area from the emission reductions at Hayden Generating Station.

b. Regional haze.

EPA published its final regional haze rule in July 1999.[11] This review of the Phase I SIP is not related formally to the regional haze program. Nevertheless, such haze exists at all Colorado Class I areas and is the subject of the larger regional haze SIP document within which this LTS review is embedded and coordinated.

c. Ongoing Air Pollution Control Programs.

Since the November 2004 LTS review/report several activities in ongoing air pollution control programs have occurred that are relevant to this review.

(i). Rocky Mountain National Park Initiative.

The National Park Service (NPS), other federal agencies, and academic researchers have actively pursued ecosystem and air quality monitoring and data collection programs in and near the Park for over twenty years. Through these efforts significant amounts of data have been collected. Findings from these data published in over 80 peer reviewed research articles document ecosystem changes from nitrogen (N) deposition on the east side of the Continental Divide including changes in the type and abundance of aquatic plant species, elevated levels of nitrate in surface waters, elevated levels of N in spruce tree chemistry, long-term accumulation of N in forest soils, and a shift in alpine tundra plant communities favoring sedges and grasses over the natural wildflower flora.

Two-thirds of the Park is near or above treeline with shallow soils and granitic bedrock that are indicative of a fragile ecosystem environment. This environment is highly susceptible to changes induced by chemical contributions to soils and waters through atmospheric deposition. The Park's enabling legislation and other key Congressional statutes mandate that natural resources at RMNP are to remain unimpaired for future generations. Thus, the Rocky Mountain National Park Initiative was created to study and promote action to remedy air quality issues facing the Park, primarily the adverse ecosystem impacts from increasing nitrogen deposition. Other air quality issues are being addressed by other means: visibility impairment by the regional haze program development and ozone by the Early Action Compact and SIP development process.

Using a collaborative approach, the participating agencies -- the Colorado Department of Public Health and Environment (CDPHE), the U.S. Environmental Protection Agency Region 8 (EPA), and the NPS -- have worked effectively to develop a Nitrogen Deposition Reduction Plan (Plan or NDRP). A public participation process facilitated by a Colorado Air Quality Control Commission (AQCC) Subcommittee has helped to involve the public, and a memorandum of understanding (MOU) has been used by the involved agencies to guide the Initiative's progress leading to development of the Plan.

The agencies have initially focused their efforts in developing the Plan on voluntary approaches first, together with programs that are pending or under way, in lieu of developing a new regulatory program to achieve nitrogen deposition reductions. The agencies believe this strategy has the potential to provide benefits in the near term to reducing nitrogen deposition. However, the agencies support a process to require regulatory measures specific to reducing nitrogen deposition if voluntary and anticipated reductions prove insufficient in making planned progress goals under this Plan. Development and implementation of a contingency plan is one mechanism supported by the agencies to ensure reduction of adverse ecosystem impacts in RMNP.

The NDRP works to: (1) consider all available emission reduction options and programs for nitrogen-related emissions (primarily nitrogen oxides (NOx) and ammonia (NH3)); (2) provide a technical assessment of the state-of-knowledge of deposition components and trends, the emission sources, source areas, and atmospheric transport; (3) determine implementation measures for making progress and mechanisms to evaluate effectiveness of, and incorporation of new, control measures; (4) make recommendations for future needs as necessary to assure continued progress and achievement of Park goals; and (5) incorporate adaptive management principals for the consideration and use of new data and analyses as they become available.

The Plan includes a critical load determination for nitrogen affecting the high alpine ecosystems in the Park that was established prior to the development of this Plan. The critical load for wet nitrogen deposition, set at 1.5 kg/ha/yr, is a threshold value above which significant harmful effects to sensitive ecosystem components occur. The critical load for wet nitrogen deposition east of the Continental Divide in RMNP represents an estimation of the concentration at which excess nitrogen deposition began causing harmful impacts on RMNP ecosystems. The Plan relies on a "glidepath" management approach to achieve the critical load goal in the Park by

the year 2032 with interim milestones to be measured at five-year intervals. The first milestone, set for 2012, works to achieve a reduction that is consistent with an average rate of deposition reduction that will achieve the critical load by the year 2032 and reflects the potential benefit from planned state and federal emission reduction programs.

The NDRP was approved by the AQCC in April 2007. Implementation of the Plan will likely benefit visibility at RMNP to an unknown degree. The Division maintains a website that is a clearinghouse for information related to the Initiative. The full NDRP and other technical documents may be found at
http://www.cdphe.state.co.us/ap/rmnp.html

(ii). The Four Corners Task Force.

After many years of concern about emissions growth in the Four Corners area and impacts on nearby Class I areas, the States of New Mexico and Colorado have convened an Air Quality Task Force to work on the air quality issues and challenges facing the Four Corners region. The Four Corners region is rich in coal and oil & gas reserves. Oil & gas production and coal-fired power plants result in large emissions of air pollution that may be degrading air quality. Specific concerns include National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) increment compliance, degradation of visibility, and increased deposition.

The U.S. Department of Interior - Bureau of Land Management (BLM) and the U.S. Department of Agriculture - Forest Service (USFS) are currently responding to industry proposals for expanded development of oil and gas production in the region. There are two proposed coal-fired power plants: a 1,500 megawatt plant proposed on Navajo Nation lands and a 300 megawatt plant proposed north of Grants, New Mexico. Additionally, the population in the Four Corners region likely will continue to grow in coming years, resulting in even more air pollution and, specifically, more nitrogen oxide emissions.

In response to these challenges, the affected states, tribes and federal land managers in the region have come together to begin to plan for control strategies for future air quality impacts from development. The concept of a Task Force emerged that would allow for a broad and inclusive collaborative process to regional air quality planning.

The Task Force work groups are:

- Oil and Gas,
- Power Plants,
- Other Sources,
- Cumulative Effects, and
- Monitoring.

These workgroups are studying issues and creating lists of options to the Task Force about how to proceed. An executive/steering committee that includes representatives from the states of

Colorado, New Mexico, and Utah, the U.S. Environmental Protection Agency, the U.S. Department of Agriculture - Forest Service, and the U.S. Department of the Interior - National Park Service and the Bureau of Land Management has been formed to help guide the Task Force's progress. Timelines for workgroup deliverables are being developed to ensure that all options developed are timely. The task force will work over a two-year period and deliver a final report by December 2007.

The Task Force's website is
http://www.nmenv.state.nm.us/aqb/4C/index.html

(iii). New Oil and Gas Controls.

On December 17, 2006, the Colorado Air Quality Control Commission (AQCC) adopted changes to oil & gas industry regulations to reduce emissions of volatile organic compounds (VOCs) from condensate tanks. VOCs are a precursor to ozone formation and secondary organic carbon particulate – a component of visibility degradation.

New control requirements were established for condensate tanks in both the Front Range Early Action Compact Area and statewide. New reporting and recordkeeping requirements were also established. The new requirements are summarized below:

Control Requirements: Front Range Ozone Early Action Compact (EAC) Area

- Commencing May 1, 2007, companies in the EAC region must increase the control of VOCs from current 47.5 percent level to 75 percent for the summertime ozone season.
- In addition, there are new reporting and recordkeeping requirements.

Control Requirements: Statewide

- Tanks standards: New and existing condensate tanks emitting 20 tons per year or more of VOCs required to control emissions by 95 percent commencing May 1, 2008.
- Glycol Dehydrator controls: New and existing glycol dehydrators emitting more than 15 tons per year of VOCs are required to control emissions by 90 percent commencing May 1, 2008.
- Table 3 contains engine standards for new or relocated engines from out-of-state commencing July 1, 2007.

Table 3
Engine Standards

Maximum engine horsepower	Construction or relocation date	NOx g/hp-hr	CO g/hp-hr	NMHC g/hp-hr
100 - 500 hp	January 1, 2008 January 1, 2011	2.0 1.0	4.0 2.0	1.0 0.7
Greater than 500 hp	July 1, 2007 July 1, 2010	2.0 1.0	4.0 2.0	1.0 0.7

Additional information about the new emission controls can be found at http://www.cdphe.state.co.us/ap/oilgas.html

(iv). Review of Ongoing Programs and Status of Redesignations.

The most comprehensive review of existing and ongoing programs as well as monitoring data and trends is contained in the Colorado Air Quality Control Commission's 2006-2007 Report to the Public. This report in its entirety is included as Attachment 1.

As recently as 1995 Colorado had 12 "non-attainment" areas within the State for carbon monoxide, ozone, and/or PM10 health standards. Generally, all of these areas now maintain good air quality. This progress reflects the effects of local, statewide, regional, and national emission control strategies. This clean-up of Colorado's non-attainment areas has also benefited Class I visibility conditions to some unknown degree.

In the summer of 2003, the Denver metropolitan area violated the 8-hour ozone standard. EPA has designated all or parts of 9 counties in northeastern Colorado as nonattainment for the 8-hour ozone, though the nonattainment designation has been deferred with the adoption of the Ozone Action Plan by the Colorado Air Quality Control Commission in March 2004 under EPA's Early Action Compact provisions. High concentrations of ground-level ozone on Friday, July 20, 2007 appear to have put the nine-county Denver region in violation of the federal health-based, eight-hour standard for ozone. If monitoring results are verified, the region will likely be designated as "nonattainment" for ozone by the U.S. Environmental Protection Agency. A detailed plan to reduce ozone will be developed for submission to the EPA in 2008 by the Colorado Air Pollution Control Division, along with the Regional Air Quality Council and the North Front Range Metropolitan Planning Organization. This new plan, a federally -required State Implementation Plan for ozone, will require further reductions in ozone levels beyond what was required through an earlier Ozone Early Action Compact.

The table below shows the designation status for Colorado non-attainment areas.

Table 4
REDESIGNATION and PLAN AMENDMENT STATUS REPORT – 4/2/07

	Redesignations	**Plan Amendments**
PM10		
Aspen	AQCC approved 1/11/01; EPA approved 5/15/03, effective 7/14/03	None
Canon City	AQCC approved 10/17/96; EPA approved 5/30/00, effective 7/31/00	None
Denver	AQCC approved 4/19/01; EPA approved 9/16/02, effective 10/16/02	Plan amendment developed with MOBILE6 to remove I/M from SIP; AQCC approved 12/15/05; Governor submitted to EPA 9/25/06
	AQCC approved 11/15/01; EPA	None

	Redesignations	**Plan Amendments**
Lamar	approved 10/25/05, effective 11/25/05	
Pagosa Springs	AQCC approved 3/16/00; EPA approved 6/15/01, effective 8/14/01	None
Steamboat Springs	AQCC approved 11/15/01; EPA approved 10/25/04, effective 11/24/04	None
Telluride	AQCC approved 3/16/00; EPA approved 6/15/01, effective 8/14/01	None
Carbon Monoxide		
Colorado Springs	AQCC approved 1/15/98; EPA approved 8/25/99, effective 9/24/99	- Amendment to drop oxyfuels approved by AQCC 2/17/00; EPA approved 12/22/00, effective 2/20/01 - Amendment using MOBILE6 to eliminate I/M from SIP and revise emission budget approved by AQCC 12/18/03; EPA approved 9/07/04, effective 11/08/04
Denver	AQCC approved 1/10/00; EPA approved 12/14/01, effective 1/14/02	- Amendment using MOBILE6 to revise emission budgets approved by AQCC 6/19/03; EPA approved 9/16/04, effective 11/15/04 - Amendment developed with MOBILE6 to remove I/M & oxyfuels from SIP; AQCC approved 12/15/05; Governor submitted to EPA 9/25/06
Ft. Collins	AQCC approved 7/18/02; EPA approved 7/22/03, effective 9/22/03	
Greeley	AQCC approved 9/19/96; EPA approved 3/10/99, effective 5/10/99	- Amendment using MOBILE6 to revise emission budget & to eliminate oxyfuels from the regulation/SIP & I/M from the SIP approved by AQCC 12/19/02; EPA approved 8/19/05, effective 9/19/05
Longmont	AQCC approved 12/19/97; EPA approved 9/24/99, effective 11/23/99	- Amendment using MOBILE6 to revise emission budget approved by AQCC 12/18/03; EPA approved 9/30/04, effective 11/29/04 - Amendment developed with MOBILE6 to remove I/M & oxyfuels from SIP; AQCC approved 12/15/05; Governor submitted to EPA 9/25/06
Ozone		
	AQCC approved 1-hour redesignation	- 8-hour OAP updated to include periodic

	Redesignations	**Plan Amendments**
Denver /Northern Front Range	request and maintenance plan 1/11/01; EPA approved 9/11/01, effective 10/11/01 Early Action Compact 8-hour Ozone Action Plan approved by AQCC 3/12/04; EPA approved 8/19/05, effective 9/19/05	assessments; AQCC approved 12/15/05; Governor submitted to EPA 10/06 - 8-hour OAP updated 12/17/06 by AQCC to incorporate Reg 7 oil and gas condensate tank and engine requirements. Governor's submittal anticipated -Additional exceedances in 2007. SIP preparation in 2008.
Lead		
Denver	EPA redesignated Denver attainment in 1984	
Nitrogen Dioxide		
Denver	EPA redesignated Denver attainment in 1984	

2. THE ABILITY OF THE LONG-TERM STRATEGY TO PREVENT FUTURE IMPAIRMENT OF VISIBILITY IN ANY CLASS I AREA.

Generally, the State of Colorado considers its New Source Review and Prevention of Significant Deterioration (PSD) programs as meeting the long-term strategy requirements for preventing future impairment from proposed major stationary sources or major modifications to existing facilities. In addition, there are specific activities the Division has undertaken.

a. Modeling Guidance.

The Division has published modeling guidance that presents methods for estimating impacts from stationary sources of air pollution. The guidance is intended to help permit applicants, air quality specialists, and others understand the Division's expectations for the ambient air impact analysis and to prevent unnecessary delays in the permit process. It provides a starting point for modeling, but allows the use of professional judgment. The guidance contains sections on visibility modeling. In 2001, a technical peer review of the guidance was completed. A more general public review process was finished toward the end of that year. The finalized and updated (as of December 27, 2005) guidance document is available via the Air Pollution Control Division's web site at: http://apcd.state.co.us/permits/cmg.html

b. Smoke Management.

Colorado believes its smoke management program is protective of public health and welfare as well as Class I visibility. In 2005, the Division certified its smoke management program as consistent with EPA's *Interim Air Quality Policy on Wildland Prescribed Fire*, May 1998. The program is described below.

(i). Regulation No. 9.

Regulation No. 9 (Open Burning, Prescribed Fire, and Permitting) is the main vehicle in Colorado for addressing smoke management and preventing unacceptable smoke impacts. In addition to its permitting requirements, it implements Colorado Senate Bill 01-214 ("Concerning the Application of State Air Quality Standards to the Use of Prescribed Fire for Management Activities Within the State and Making an Appropriation Therefor") that became law in 2001. The regulation also incorporates permitting and reporting requirements for all users of prescribed fire similar to those in the State's past Smoke Management Memorandum of Understanding (MOU). The AQCC adopted the regulation on January 17, 2002.

Regulation No. 9 is in eight sections:

I. Scope
II. Definitions
III. Open Burning Permit Requirement
IV. General Open Burning Permits
V. Planned Ignition Fire Permits
VI. Unplanned Ignition Fire Permits
VII. Additional Requirements for Significant Users of Prescribed Fire
VIII. Fees

The rule applies to all open burning activity within Colorado, with certain exceptions. Section III specifically exempts agricultural open burning from the permit requirement.

After the scope and definitions sections, the rule has several sections regarding permitting and other requirements applicable to open burning of various types. Section IV contains requirements for a general open burning permit and associated permit conditions. Sections V and VI contain the permitting, information, modeling and reporting requirements, as well as a smoke risk categorization, and permit conditions for planned ignition prescribed fires to insure that prescribed fires neither violate National Ambient Air Quality Standards nor have unacceptable visibility impacts. These provisions are similar to the past voluntary agreements among signatories of the expired Colorado Smoke Management MOU for prescribed fire. The regulation, however, applies to <u>all</u> users of prescribed fire above a de minimus level project. The rule also specifies requirements regarding suppression of prescribed fire if monitoring and/or air pollution levels indicate that permit conditions, the burn prescription, and/or air quality standards have been or will be exceeded. The Division's draft permits for large burns with a high smoke-risk are subject to a 30-day public comment period and the opportunity for a public comment hearing before the Commission. The Division will disclose potential visibility impacts of these proposed fires and must consider comments when determining whether to grant, conditionally grant, or deny the final permit.

Sections VII and VIII are the elements of the regulation that implement SB01-214. Section VII addresses how significant users of prescribed fire (i.e., those that own or manage 10,000 acres and generate at least 10 tons of PM_{10} annually from use of prescribed fire) must submit planning documents to the Commission. The regulation identifies the contents of the planning documents. The rule further requires that all such prescribed fire activities of significant users

shall conform to the State standard to "minimize emissions using all available, practicable methods that are technologically feasible and economically reasonable." SB 01-214 directs the Commission to hold a public hearing regarding each planning document and to develop any necessary comments and recommendations to bring the plans into consistency with the State goal. After July 1, 2002 the Division cannot issue open burning permits to significant users for lands whose planning documents and fuel management decision-making are inconsistent with Commission recommendations and comments. The Commission has had hearings on the planning documents of the U.S.D.A. Forest Service, U.S.D.I. Bureau of Land Management, Colorado Division of Wildlife, U.S.D.I. National Park Service, U.S.D.O.D. Fort Carson, U.S.D.I. Fish and Wildlife Service, U.S.D.O.D. Air Force Academy, Jefferson County, Banded Peak Area Ranches, Colorado State Parks, Colorado State Land Board, the Forbes/Trinchera Ranch, and the Denver Water Board.

Fees are discussed in section VIII. No fees are charged for general permits (local authorities may charge fees under their own authority). Significant users of prescribed fire pay fees of $59.98/hour to the Division for review of planning documents. Prescribed fire permitees pay for the cost of the prescribed fire program based on a cost distribution methodology. The Division's Fiscal Officer calculated the cost of the program at the outset of the program beginning in calendar year 2002. The Statement of Basis, Specific Statutory Authority and Purpose of the regulation also specifies the Commission's intent that the Division annually calculate the cost to administer the program and report to the Commission each August on program costs, projections, and revenues. If the cumulative cost varies more than 5% from the total fee amount in regulation, the Division will seek a fee change before the Commission in a properly noticed public hearing. In addition, the Statement indicates that any deficits not be funded by stationary source fees. The current cost of the program as stated in Regulation No. 9 is $174,585.08.

While not included in the rule, it is important to note that the statute also finds the prescribed fires of significant users conducted on lands the primary purpose of which is nonagricultural to be for "commercial purposes". The effect is to subject any such activity conducted without a permit to significantly higher fines than previously (i.e., up to $100/day for "noncommercial purposes" and up to $10,000/day for "commercial purposes").

In March 2004, the Commission approved changes to Regulation No. 9 allowing the permitting of Air Curtain Destructors (ACD) to be used for the narrow purpose of burning wildland fuels generated as a result of projects to reduce the risk of wildfire. The use of ACDs in lieu of pile burning will significantly reduce emissions from defensible space and other types of wildfire risk reduction projects.

(ii). The Regulation and Visibility Protection.

Section III.A of the regulation requires anyone seeking to conduct open burning to obtain a permit from the Division. Regulation No. 9 also contains a number of factors the Division must consider in determining whether and, if so, under what conditions, a permit may be granted. Many of these factors relate to potential visibility impacts in Class I areas. For example,

- the potential contribution of such burning to air pollution in the area;

- the meteorological conditions on the day or days of the proposed burning;
- the location of the proposed burn and smoke-sensitive areas and Class I areas that might be impacted by the smoke and emissions from the burn;
- whether the applicant will conduct the burn in accordance with a smoke management plan or narrative that requires:
    - that best smoke management methods will be used to minimize or eliminate smoke impacts at smoke-sensitive receptors (including Class I areas);
    - that the burn will be scheduled outside times of significant visitor use in smoke-sensitive receptor areas that may be impacted by smoke and emissions from the fire; and
    - a monitoring plan to allow appropriate evaluation of smoke impacts at smoke-sensitive receptors.

The regulation requires all prescribed fire permitees to submit an application to the Division. Proposed planned ignition burns are compared to computer model output that indicates the air pollution (including visibility) impacts. A permit is granted only if the modeling run demonstrates that under the prescribed meteorological conditions for the burn there will be no unacceptable air pollution (including visibility) impacts. The Division reviews each permit application and determines if the burn can be conducted without causing unacceptable visibility impacts within Class I areas, as well as other smoke sensitive sites. In addition, the regulation provides that the Division may impose "permit conditions necessary to ensure that the burn will be conducted so as to minimize the impacts of the fire on visibility and on public health and welfare."

Permitees are also required to report actual activity to the Division. Depending on the size and type of fire, reporting may be a daily requirement. At a minimum, each year all permitees must indicate whether or not there was any activity in the area covered by the permit and, if so, how many acres were burned. The Division annually prepares a report on prescribed burning activity and estimated emissions. Reports from 1990 through 2006 are available by contacting the Division.

As mentioned above, the regulation requires that the draft permit for any proposed prescribed fire rated as having a "high" smoke risk rating be subject to a 30-day public comment period. The notice for the public comment period must contain information relating to the potential air quality and visibility impacts at smoke sensitive receptors, including Class I areas.

The Division's web site contains information about the various aspects of Colorado's Smoke Management Program, downloadable forms and instructions, and links. It is also used to contain the notices for public comment periods for the draft permits subject to public comment. The web site underwent a major revision and updating during 2005. It is located at: http://www.cdphe.state.co.us/ap/smoke/

3. CHANGES IN VISIBILITY SINCE SIP APPROVAL AND ASSESSMENT OF EXISTING CONDITIONS

Visibility monitoring is being performed in or near a number of Colorado's Class I areas.

The specific purposes of monitoring may vary, but generally include assessing existing conditions and trends as well as learning more about the sources of visibility impairment in Colorado's Class I areas.

The routine visibility monitoring performed in Colorado's Class I areas are at IMPROVE, IMPROVE Protocol or IMPROVE Look Alike sites. IMPROVE is an acronym that stands for Interagency Monitoring of PROtected Visual Environments. IMPROVE is a cooperative visibility monitoring effort of the EPA, NPS, USF&WS, BLM, USFS, Western States Air Resources Council (WESTAR), Mid-Atlantic Regional Air Management Association (MARAMA), North Eastern States for Coordinated Air Use Management (NESCAUM), and the National Association of Clean Air Agencies (NAACA). IMPROVE Protocol sites are operated using the same equipment, procedures and analytical labs as other sites in the IMPROVE network across the country, allowing comparisons of data from all these sites. IMPROVE Look Alike sites are operated using the same equipment and procedures but may utilize different labs. IMPROVE sites are funded by EPA. IMPROVE Protocol sites are funded by a sponsoring federal land management agency or state. IMPROVE Look Alike sites may be funded by private industry or other entity. IMPROVE and IMPROVE Protocol sites are operated by the NPS, BLM, or the USFS. The State of Colorado has funded a short-term IMPROVE Look Alike site but does not fund other IMPROVE or IMPROVE Protocol sites. IMPROVE has an extensive web site at: http://vista.cira.colostate.edu/improve. Graphically processed IMPROVE data as well as links to photographic images of various haze levels at Class I areas and meteorological data are found on the Visibility Information Exchange Web System (VIEWS) at: http://vista.cira.colostate.edu/views/

The types of visibility monitoring being performed in Colorado's Class I areas and some of the results of this monitoring are summarized later in this section of the LTS review. The section is divided into three major parts:

a. Monitoring Methods and Network -- a very brief discussion of each of the types of routine visibility monitoring performed in Colorado and a description of the monitoring network in place as of December 2006.

b. Site-By-Site Data Summaries -- summaries of the routine data available as of April 2007 collected by these methods, a short discussion of the data, and of possible data trends of each site (park or wilderness area).

c. Overall Conclusions from the Routine Monitoring -- statements about visibility levels, sources, and trends in Colorado's Class I areas.

a. Monitoring Methods and the Network.

Routine visibility monitoring consists of three general components. The first, view monitoring, is used to document the visual quality of a scene. The second component, atmospheric optical monitoring, measures basic optical properties of the atmosphere (e.g., atmospheric extinction, light scattering) that relate to the atmosphere's ability to cause visibility impairment. In some of Colorado's Class I areas atmospheric extinction has been directly

measured with a transmissometer. At one of the monitoring sites, a nephelometer monitors the scattering coefficient of ambient air. The third component of most routine visibility monitoring systems, particle monitoring, measures fine atmospheric particles that are responsible for visibility impairment. This third component is considered the core method for IMPROVE and at each site, at a minimum, is a chemically speciated fine particle monitor. Each general component of monitoring is described in more detail below.

(i). View Monitoring.

Camera systems are used to document visibility in a view from a fixed location. A specially constructed camera system automatically takes slides or digital images of a view at regularly scheduled times each day (usually three times per day). The images provide a qualitative record of visibility conditions that exist at a site.

Automated camera systems are in place at the following sites to monitor visibility conditions in or near the following Class I areas (the letters in parentheses below are how each site is referenced within the FLM and IMPROVE data and image management systems):

- Shamrock Mines (SHMI) near the Weminuche Wilderness;
- Maroon Bells-Snowmass Wilderness site in the White River National Forest (MABE); and
- Mt. Zirkel Wilderness (ZIRK).

In the past automated camera systems operated at the following sites (the letters in parentheses below are how each site is referenced within the IMPROVE data management system):

- Colorado National Monument (COLM);
- Dinosaur National Monument (DINO);
- Great Sand Dunes National Park (GRSA);
- Mesa Verde National Park (MEVE);
- Rocky Mountain National Park (ROMO);
- West Elk Wilderness (WEEL);
- La Garita Wilderness (LAGA);
- Eagles Nest Wilderness (EANE); and
- Weminuche Wilderness (WEMI).

In addition, camera systems have monitored at the following Class II wilderness areas:

- Lost Creek Wilderness (at the Devil's Head Fire Tower) (DEHE); and
- Mount Massive Wilderness (MOMA).

Once a multi-year visual record of site conditions is collected, the camera systems are removed and installed to document conditions at another site. A spectrum of various visibility conditions seen on the slides taken at a given site and relationship to other monitoring if

available are archived onto a photo CD and/or uploaded to web sites. Images are available at:
http://www.fsvisimages.com/
and
http://vista.cira.colostate.edu/views/Web/IMPROVE/Data_IMPRPhot.htm

(ii). Atmospheric Optical Monitoring.

Atmospheric extinction describes the ability of particles and gases in the atmosphere to attenuate light over a given distance (e.g., per kilometer). Extinction occurs due to the scattering and absorption of light from gaseous and aerosol constituents of the atmosphere. A transmissometer is an optical visibility monitoring device, which can continuously measure atmospheric extinction. The instrument accomplishes the measurement by sending a light beam of known intensity to a distant receiver and measuring the resulting loss of light. A nephelometer directly measures the scattering component of atmospheric extinction.

High relative humidity, rain and fog events reduce visibility. Data collected during periods experiencing such events are often excluded from transmissometer and nephelometer data in order that it reflect anthropogenic influences. Transmissometer data were collected at the following IMPROVE sites (the letters in parentheses below are how each site is referenced within the IMPROVE data management system):

- Mesa Verde National Park (MEVE), through May 1993; and
- Rocky Mountain National Park (ROMO), through October 2006.

Nephelometer data are collected at:

- Mt. Zirkel Wilderness (MOZI).

(iii). Particle Monitoring.

Atmospheric particle monitoring is accomplished by a combination of particle sampling and sample analysis. Simultaneous particulate samples are collected in the four channels of the IMPROVE Particle Sampler: three $PM_{2.5}$ samples (particles less than 2.5 microns in diameter) on different filter types (Teflon, nylon, and quartz) and one PM_{10} sample (particles less than 10 microns in diameter) on a Teflon filter. The filters are subsequently analyzed for total mass, elements, organic and light absorbing carbon, ions, and optical absorption. Particulate monitoring is used to quantify and identify the air pollutants responsible for visibility degradation. Atmospheric extinction can be mathematically reconstructed from these chemically speciated aerosol samples – this is the core method EPA has selected for monitoring haze. Typically, an IMPROVE Sampler takes a 24-hour sample once every three days. The IMPROVE web site contains literature that indicates[12] the overall uncertainty (defined as the ratio of the mean precision from all sources divided by the mean concentration) is 4% to 7% for most variables and >15% for organic carbon. These numbers reflect precision; accuracy is unknown.

Particulate monitoring with an IMPROVE Sampler is performed in or near the following

Colorado Class I areas (the letters in parentheses below are how each site is referenced within the IMPROVE data management system):

- Great Sand Dunes National Monument (GRSA).
- Mesa Verde National Park (MEVE).
- Weminuche Wilderness Area (WEMI).
    - This monitoring site also represents visibility conditions in La Garita Wilderness and Black Canyon of the Gunnison Wilderness.
- Shamrock Mines (SHMI).
    - This site was installed in 2005 and is a supplemental site for assessing impacts to the Weminuche Wilderness Area from emissions activity in the Four Corners Area.
- Snowmass/Maroon Bells Wilderness site in the White River National Forest (WHRI).
    - This monitoring site also represents visibility conditions in West Elk Wilderness, Eagles Nest Wilderness, and Flat Tops Wilderness.
- Mount Zirkel Wilderness Area (MOZI).
    - This site also represents visibility conditions in the Rawah Wilderness.
- Rocky Mountain National Park (ROMO).
- Ripple Creek Pass (RICR).
    - This site is to the north of the Flat Tops Wilderness. It is funded privately by Shell Oil Company and operated by Air Sciences, Incorporated.
- Douglas Pass (DOPA).
    - This site operated at the top of Douglas Pass near the Utah border for over 2 years. It was funded by the Colorado Governor's Office of Energy Management and Conservation and operated by Air Sciences, Incorporated.

b. Routine Monitoring Data Summary.

A number of the visibility monitoring sites in Colorado's Class I areas have been in operation for several years. Table 5 below is a summary of the types of monitoring and the dates when monitoring has occurred at each of the sites.

Table 5
Routine Visibility Monitoring

SITE	CAMERA	TRANSMIS-SOMETER	NEPHELO-METER	IMPROVE PARTICULATE MONITORING	SITE TYPE[1]
BLCA Black Canyon NP	2/85-11/93				BLM - IMPROVE PROTOCOL

1 IMPROVE Protocol sites are operated using the same equipment and procedures as other sites in the IMPROVE network across the country, allowing comparisons of data from all these sites. IMPROVE sites are funded by EPA. IMPROVE Protocol sites are funded by the sponsoring federal land management agency or state. Sites are operated by the NPS, BLM, or the USFS.

SITE	CAMERA	TRANSMIS-SOMETER	NEPHELO-METER	IMPROVE PARTICULATE MONITORING	SITE TYPE[1]
COLM Colorado NM	7/81-9/91				NPS – IMPROVE PROTOCOL
COLP Louisiana-Pacific	7/92-1/97				NPS - IMPROVE PROTOCOL
DEHE Devil's Head Fire Tower Lost Creek WA	5/94-1/02				USFS-IMPROVE PROTOCOL
DINO Dinosaur NM	9/79-2/81 6/85-9/91				NPS-IMPROVE PROTOCOL
DOPA Douglas Pass				9/03-1/06	Colorado-IMPROVE Look Alike
EANE Eagle's Nest WA	6/93-9/00				USFS-IMPROVE PROTOCOL
GRSA Great Sand Dunes NP	7/87-4/95			5/88-present	NPS - IMPROVE
LAGA La Garita WA	9/97-10/01				USFS-IMPROVE PROTOCOL
MEVE Mesa Verde NP	9/79-4/95	9/88-7/93		3/88-present	NPS - IMPROVE
MOMA Mt. Massive WA	7/97-11/01				USFS - IMPROVE PROTOCOL
MOZI Mt. Zirkel	10/90-present (on		12/93-present	12/93-present	USFS - IMPROVE

SITE	CAMERA	TRANSMIS-SOMETER	NEPHELO-METER	IMPROVE PARTICULATE MONITORING	SITE TYPE[1]
WA	Storm Peak)				
RICR Ripple Creek Pass Flat Tops WA				12/02-present	Shell Oil-IMPROVE Look Alike
ROMO Rocky Mtn. NP	10/85-1/95	12/87-10/06		10/87-present	NPS - IMPROVE
SHMI Shamrock Mines Weminuche WA	11/05-present				USFS – IMPROVE PROTOCOL
WEEL West Elk WA	7/92-11/96				USFS - IMPROVE PROTOCOL
WEMI Weminuche WA	7/86-8/93			3/88-present	USFS - IMPROVE
WHRI/ MABE Maroon Bells/ Snowmass WA	12/91-present			7/93-9/99 (channel A only) 9/99- (full IMPROVE)	USFS – IMPROVE PROTOCOL USFS – IMPROVE

In 2003, two temporary sites were installed in Western Colorado. The sites use IMPROVE protocols and equipment but are unable to utilize one of the analytical laboratories under contract to the long-term sites. As such, these temporary sites are known as IMPROVE Look Alike sites. One is at the north end of the Flat Tops Wilderness at Ripple Creek Pass and is funded by Shell Exploration and Production Company. The other was to the west of the first site nearly on the border with Utah at Douglas Pass. It has been discontinued. This site was funded by the Colorado Governor's Office of Energy Management and Conservation. The sites were installed and operated by a consulting firm, Air Sciences, Incorporated. The Division has provided technical support and advice as needed. As data are processed from these sites, they are uploaded to the VIEWS site annually. Data analysis from these sites are included in the Regional Haze SIP Technical Support Documents (TSDs).

A new IMPROVE protocol site has recently (Fall 2005) been added to the network within Colorado by the USFS. The Shamrock Mines site near Vallecito and the Weminuche Wilderness is intended to supplement the existing Weminuche Wilderness site. Shamrock Mines is at a much lower altitude than the current site. NOx and ozone are also monitored at the new site. The USFS is concerned with the cumulative impacts of oil and gas development in the 4-corners region and believes the new location will better capture pollutants in the area.

For IMPROVE and IMPROVE Protocol sites in Colorado the camera, transmissometer, and nephelometer based data are collected, analyzed, and archived by Air Resource Specialists, Inc. (ARS), the contractor to IMPROVE, NPS, USFS and BLM for optical data. The particle data are collected, analyzed and archived by the University of California at Davis, the contractor to IMPROVE, NPS, USFS and BLM for particle measurements. For the IMPROVE Look Alike sites, Air Sciences, Inc. operates the sites and uses the same lab except for the University of California at Davis. Instead, RTI, Inc. is utilized. For all sites, the raw data may be downloaded from the IMPROVE or VIEWS web sites.

c. Site-By-Site Data Summaries.

Due to the extensive data analyses and displays within the Technical Support Documents and other sections of the Regional Haze SIP submittal, this LTS Review's focus is solely on trends at sites with more than 3 years of data. Trends in the haze index, known as deciview (dv) are provided for both the Best 20% days each year and Worst 20% days each year. These plots have been copied from the VIEWS web site. An additional focus is on the data since the last LTS Review in 2004.

(i). Mesa Verde National Park.

Processed IMPROVE Sampler data are available beginning in 1989 through 2004 at Mesa Verde National Park. Figure 1 presents annual average deciview for the best and worst days for each year of available data at the Park.

The Best Days show no particular trend but are not degrading. The Worst Days appear to have an overall steady increase in impairment beginning in 1992 through 2000. 2001 is the lowest year on record and 2002/2003 are the worst years on record. 2004 again returns to low values similar to 2001. To explore these trends and the recent extreme variability further, Figure 2 contains a speciated look at the Worst Days from 1989 through 2004. A qualitative summary of Figure 2 by pollutant shows that:

- ammNO3f_bext (ammonium nitrate extinction) is an anthropogenic pollutant and a minor contributor to visibility impairment at Mesa Verde. Nitrate shows an increasing trend beginning around 1999 and continuing through 2004.
- ammSO4f_bext (ammonium sulfate extinction) is an anthropogenic pollutant and a major contributor at the Park. Sulfate shows an overall decreasing trend over the years.
- CM_bext (coarse mass extinction) is a moderate contributor and mostly consists of natural sources (e.g., wind blown dust). Coarse mass shows a lot of variability early in the record and again after 1999 likely corresponding to dust events and overall dry conditions.
- ECf_bext (elemental carbon extinction) is both an anthropogenic and naturally occurring

(e.g., wildfire) pollutant. It is a minor contributor at Mesa Verde with no particular trend but demonstrates more variability beginning in 2000.

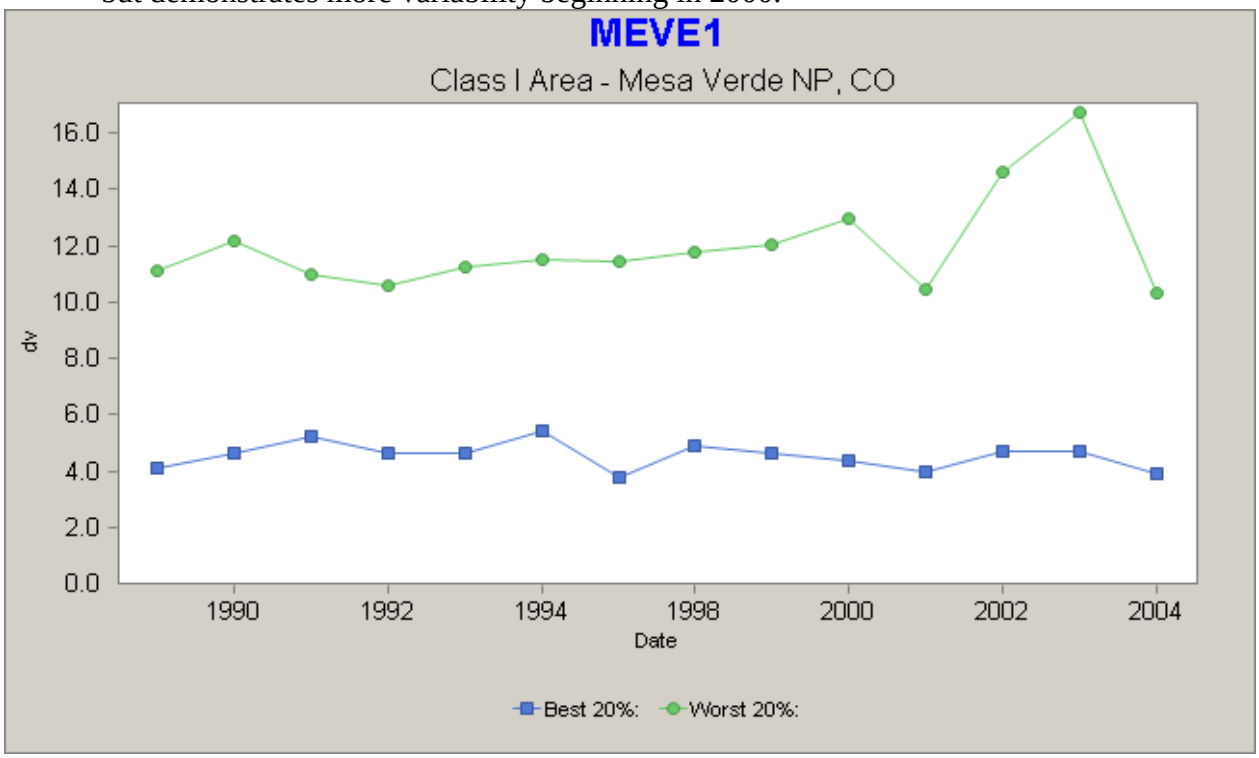

Figure 1: Mesa Verde National Park, Best and Worst Days, 1989 through 2004

- OMCf_bext (organic carbon extinction) is largely a naturally occurring pollutant (e.g., wildfire). Over the period of monitoring at Mesa Verde, it starts fairly high early in the record then drops and begins a slow increase until 2000. Beginning in 2000, there is a period of "ups and downs" corresponding to the period of drought and wildfire in the West. Organic carbon emerges in recent years as the most important contributor to impairment and variability in impairment at Mesa Verde NP.
- SOILf_bext (fine soil extinction) is largely natural (e.g., dust) with very low values early in the record at the Park with increases corresponding to the drought period.

The influence of drought and related emissions from wildfire and dust events is evident. Figure 3 examines precipitation at Mesa Verde National Park from 1990-1997 versus 1998-2004. Average precipitation is around 6 inches lower in the more recent period and several years (1999-2002) have annual averages between 11.6 and 13.8 inches, reflecting the profound drought in the area.

(ii). Weminuche Wilderness Area.

Processed IMPROVE Sampler data are available beginning in 1989 through 2004 at Weminuche Wilderness Area. Figure 5 presents annual average deciview for the best and worst days for each year of available data at the Wilderness.

The Best Days show no degradation and a steady trend toward less impairment. The

Worst Days appear to have a slight increase in impairment beginning in 1993 through 2000. 2001 is the lowest year on record and 2002/2003 are the 3rd and 4th worst years on record. 2004 again returns to low values similar to 2001. To explore these trends and the recent extreme variability further, Figure 6 contains a speciated look at the Worst Days from 1989 through 2004. A qualitative summary of Figure 6 by pollutant shows that:

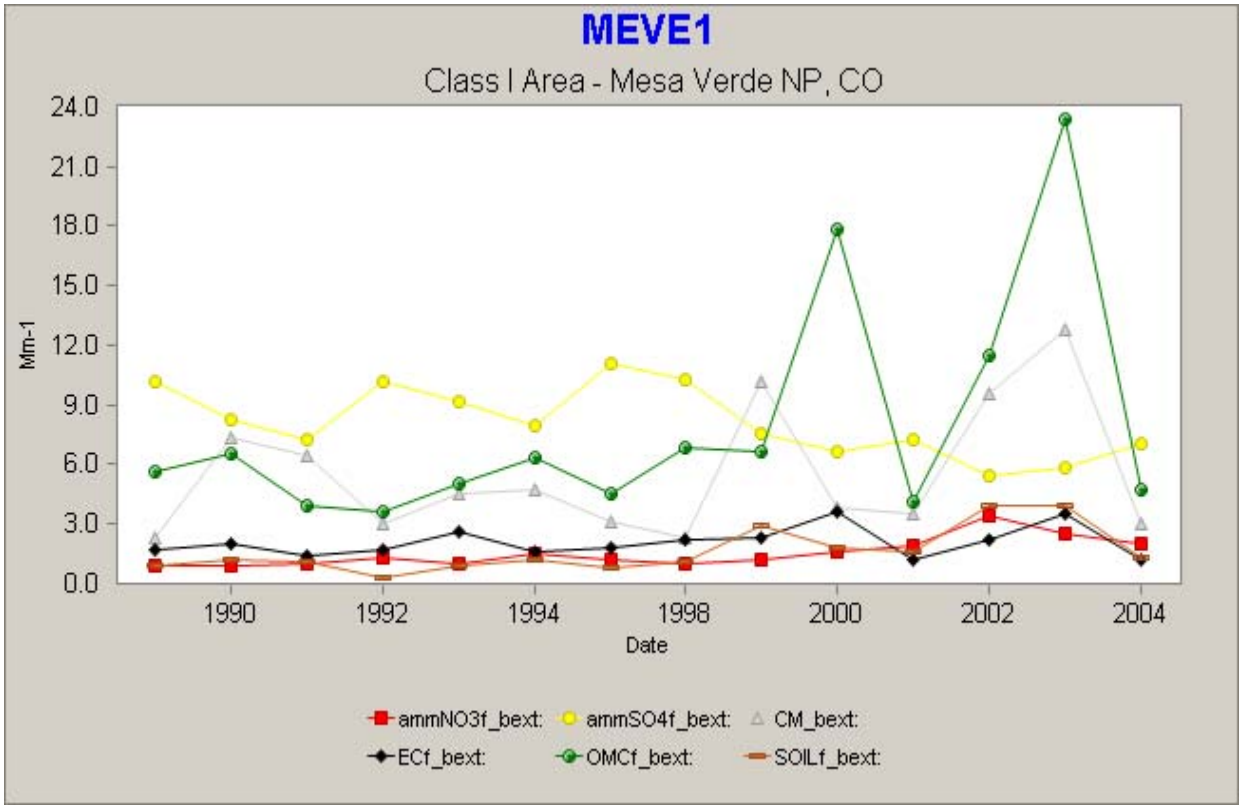

Figure 2: Mesa Verde National Park, Annual Extinction Values by Aerosol Species, Worst Days 1989 through 2004

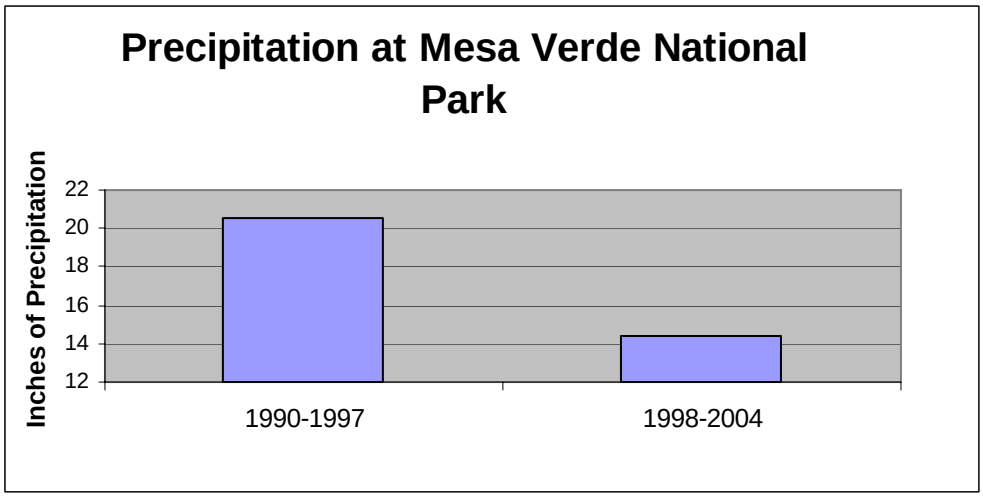

Figure 3: Precipitation At Mesa Verde National Park, 1990-1997 vs 1998-2004

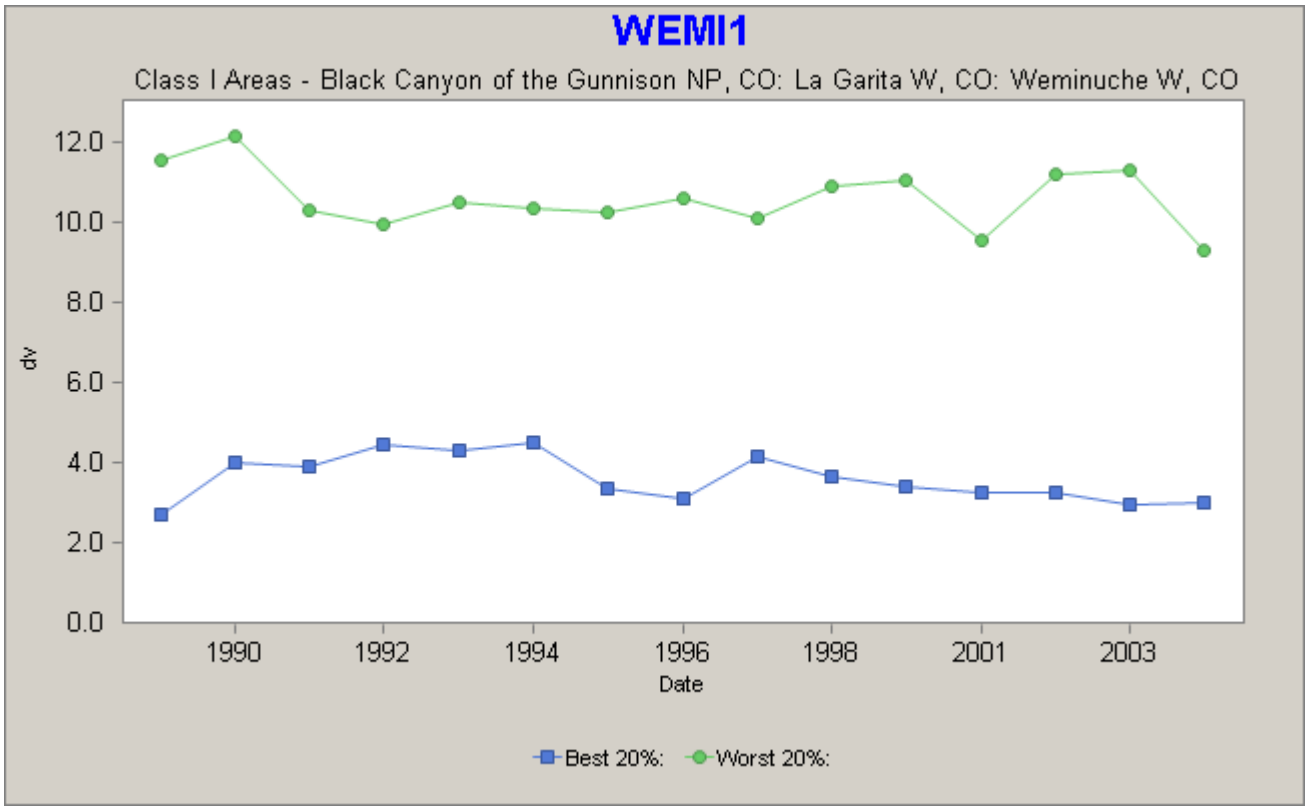

Figure 5: Weminuche Wilderness Area, Best and Worst Days 1989 through 2004

- ammNO3f_bext (ammonium nitrate extinction) is an anthropogenic pollutant and a minor contributor to visibility impairment at Weminuche. Nitrate shows an increasing trend beginning around 1997 and continuing through 2003. The 2004 value is less than recent years and is similar to what was measured in 2001.
- ammSO4f_bext (ammonium sulfate extinction) is an anthropogenic pollutant and a major contributor at the Park. Sulfate shows an overall decreasing trend since 1998.
- CM_bext (coarse mass extinction) is a moderate contributor and mostly consists of natural sources (e.g., wind blown dust). Coarse mass shows a lot of variability early in the record and again after 1999 likely corresponding to dust events and overall dry conditions.
- ECf_bext (elemental carbon extinction) is both an anthropogenic and naturally occurring (e.g., wildfire) pollutant. It is a moderate contributor at Weminuche with a slight shift to lower values beginning in 1997.
- OMCf_bext (organic carbon extinction) is largely a naturally occurring pollutant (e.g., wildfire). Over the period of monitoring at Weminuche, it starts fairly high early in the record then drops and begins a slow increase until 2001. Beginning in 2001, there is a period of large variability corresponding to the period of drought and wildfire in the West and particular fires near and in the Weminuche Wilderness. Organic carbon emerges in

recent years as the most important contributor to impairment and variability in impairment at Weminuche.

- SOILf_bext (fine soil extinction) is largely natural (e.g., dust) with very low values (similar to nitrate) early in the record at the Park with increases corresponding to the drought period.

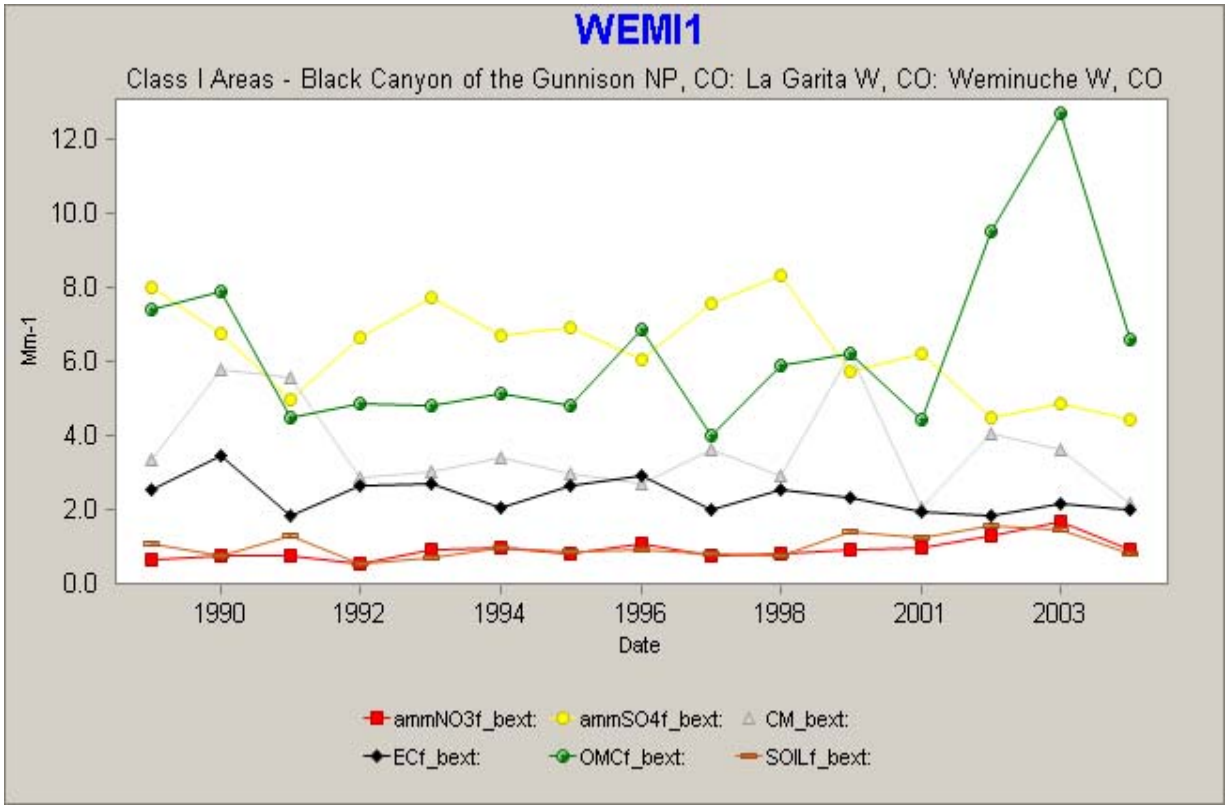

Figure 6: Weminuche Wilderness Area, Annual Extinction Values by Aerosol Species, Worst Days 1989 through 2004

(iii). Great Sand Dunes National Park.

Processed IMPROVE Sampler data are available beginning in 1989 through 2004 at Great Sand Dunes National Park. Figure 7 presents annual average deciview for the best and worst days for each year of available data at the Park.

The Best Days show a little change and overall no degradation since 1999. The Worst Days appear to have a slight increase in impairment beginning in 1996 through 2000. 2001 is among the lowest years on record, followed by 2002: the highest on record. 2003 is the 4th worst and 2004 again returns to low values similar to 2001 and among the lowest on record. To explore these trends and the recent extreme variability further, Figure 8 contains a speciated look at the Worst Days from 1989 through 2004. A qualitative summary of Figure 8 by pollutant shows that:

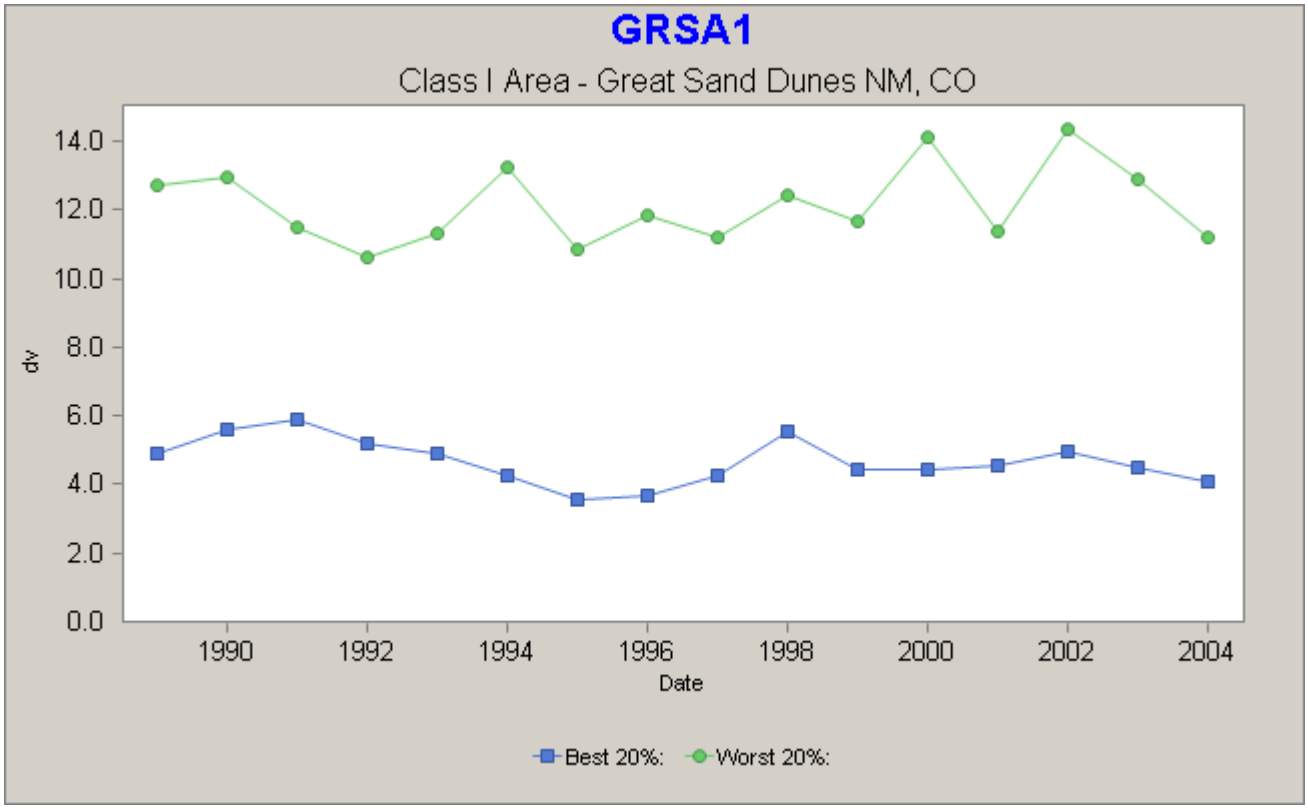

Figure 7: Great Sand Dunes National Park, Best and Worst Days 1989 through 2004

- ammNO3f_bext (ammonium nitrate extinction) is an anthropogenic pollutant and a minor contributor to visibility impairment at Great Sand Dunes. Nitrate shows a slight increasing trend beginning around 2000 and continuing through 2004, with a dramatic exception in 2003 (among the lowest values on record). The 2004 value is the highest on record.
- ammSO4f_bext (ammonium sulfate extinction) is an anthropogenic pollutant and a major contributor at the Park. Sulfate shows an overall decreasing trend since 1998.
- CM_bext (coarse mass extinction) is a major contributor and mostly consists of natural sources (e.g., wind blown sand/dust). Coarse mass shows a huge amount of variability over its record with the "ups and downs" tracking closely with Organic Carbon in recent years.
- ECf_bext (elemental carbon extinction) is both an anthropogenic and naturally occurring (e.g., wildfire) pollutant. It is a minor contributor at Great Sand Dunes NP with no discernable trend.
- OMCf_bext (organic carbon extinction) is largely a naturally occurring pollutant (e.g., wildfire). Over the period of monitoring at Great Sand Dunes, it begins an "up and down" pattern in 1995 thru 2003. The pattern is broken by 2004 as its value continues in 2003's declining direction.
- SOILf_bext (fine soil extinction) is largely natural (e.g., sand/dust) with very low values (similar to nitrate) early in the record at the Park with increases corresponding to the

drought period. Fine soil, coarse mass and organic carbon emerge in recent years as the most important contributors to impairment and variability in impairment at Sand Dunes.

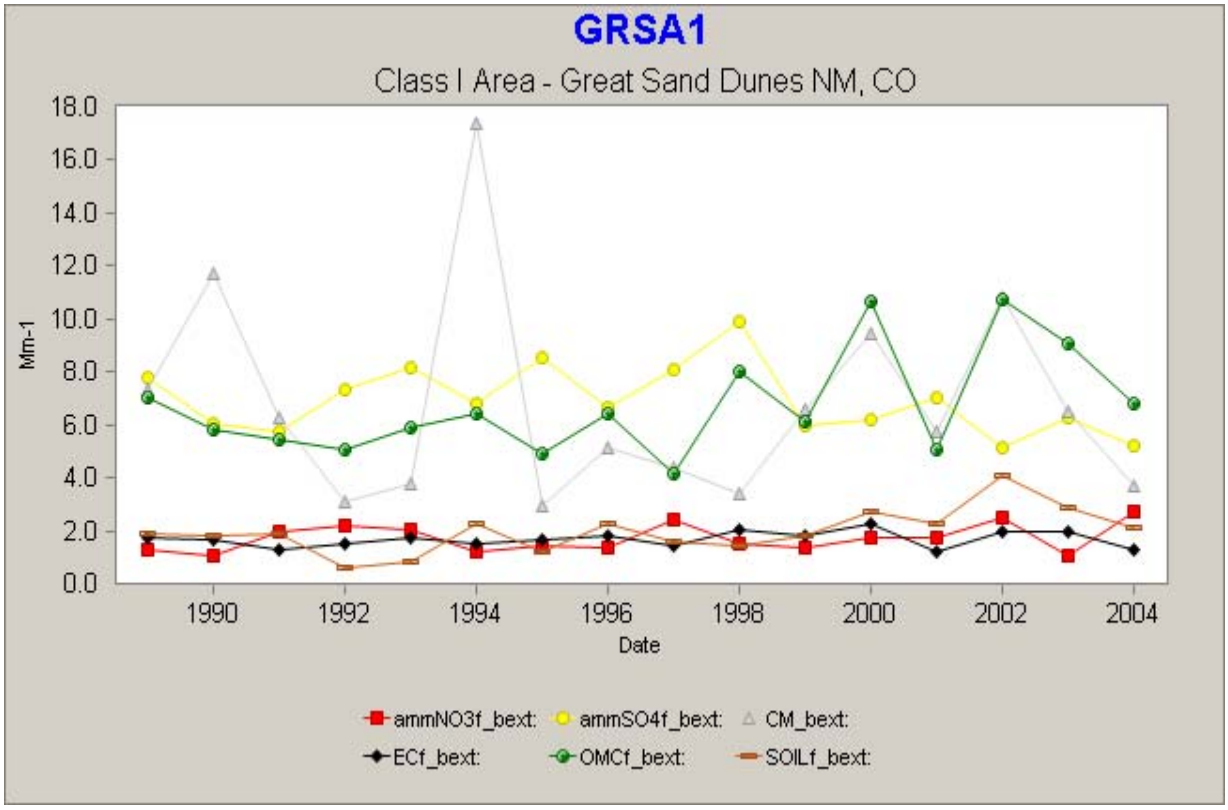

Figure 8: Great Sand Dunes National Park, Annual Extinction Values by Aerosol Species, Worst Days 1989 through 2004

(iv). White River National Forest - Maroon Bells/Snowmass Wilderness.

Processed IMPROVE Sampler data are available beginning in 2001 through 2004 at the White River site. Figure 9 presents annual average deciview for the best and worst days for each year of available data at the site. All other IMPROVE sites in Colorado have much longer data records, in most cases over 15 years. However, the White River site was installed during 2000, with the first complete data year in 2001. Based on the four years of processed data, White River is Colorado's least impaired site compared to other IMPROVE locations in the state.

The Best Days show a no degradation trend over the four years of data. The Worst Days spike-up in 2002 but return to the 2001 value in 2003 and decline further in 2004. To explore these trends, Figure 10 contains a speciated look at the Worst Days from 1981 through 2004. A qualitative summary of Figure 10 by pollutant shows that:

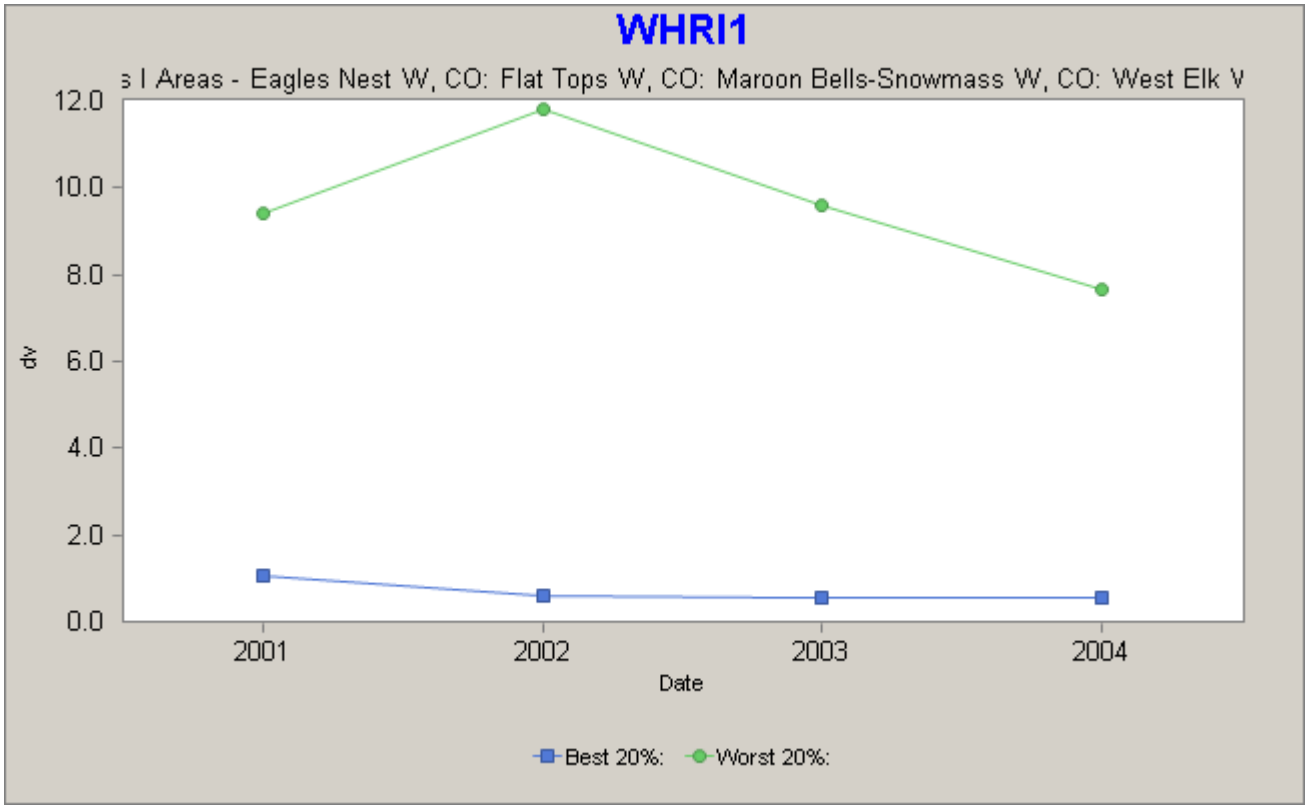

Figure 9: White River National Forest, Best and Worst Days 2001 through 2004

- ammNO3f_bext (ammonium nitrate extinction) is an anthropogenic pollutant and a minor contributor to visibility impairment at the White River site. Nitrate shows a slight decreasing trend through 2004.
- ammSO4f_bext (ammonium sulfate extinction) is an anthropogenic pollutant and a moderate contributor at the White River site. Sulfate shows an overall decreasing trend.
- CM_bext (coarse mass extinction) is fairly moderate contributor and mostly consists of natural sources (e.g., wind blown sand/dust). Compared to other sites in Colorado examined previously, there has been little relative variability in course mass and it declined in 2003 and 2004.
- ECf_bext (elemental carbon extinction) is both an anthropogenic and naturally occurring (e.g., wildfire) pollutant. It is a minor contributor at the wilderness areas represented by the White River site and has had only a small amount of variability in the four years monitored.
- OMCf_bext (organic carbon extinction) is largely a naturally occurring pollutant (e.g., wildfire). Organic carbon is a moderate contributor at White River, with the exception of 2002 when it spiked (likely due to upwind wildfire) and influenced impairment at the site more than the sum of the other pollutants combined.
- SOILf_bext (fine soil extinction) is largely natural (e.g., sand/dust) with very low values (similar to nitrate).

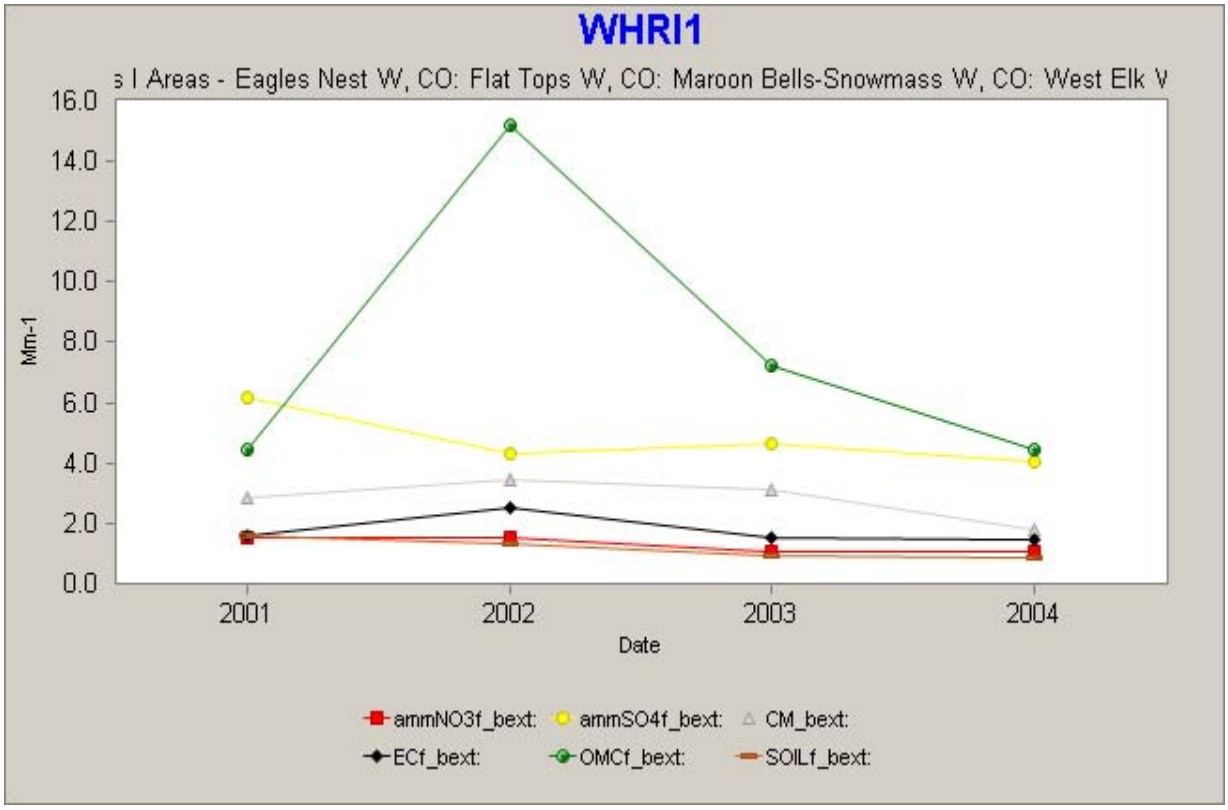

Figure 10: White River National Forest, Annual Extinction Values by Aerosol Species, Worst Days 2001 through 2004

(v). Mt Zirkel Wilderness Area.

Processed IMPROVE Sampler data are available beginning in 1995 through 2004 at Mt. Zirkel Wilderness Area. Figure 11 presents annual average deciview for the best and worst days for each year of available data at the Wilderness.

The Best Days show a no degradation trend over the 9 years of data (2000 was incomplete) with a fairly dramatic decline in impairment in recent years. The Worst Days do not exhibit any obvious trend; however, 2004 was the lowest on record. To explore these data further, Figure 12 contains a speciated look at the Worst Days from 1995 through 2004. A qualitative summary of Figure 12 by pollutant shows that:

- ammNO3f_bext (ammonium nitrate extinction) is an anthropogenic pollutant and a minor contributor to visibility impairment at Mt. Zirkel Wilderness Area. In recent years nitrate has increased and appears to be a moderate level contributor.
- ammSO4f_bext (ammonium sulfate extinction) is an anthropogenic pollutant and a major contributor at the Park. Sulfate shows an overall decreasing trend since 1998.
- CM_bext (coarse mass extinction) is a moderate contributor and mostly consists of natural sources (e.g., wind blown sand/dust). Compared to the more southern sites, coarse mass at Mt. Zirkel shows little variability over its record and an overall declining trend.

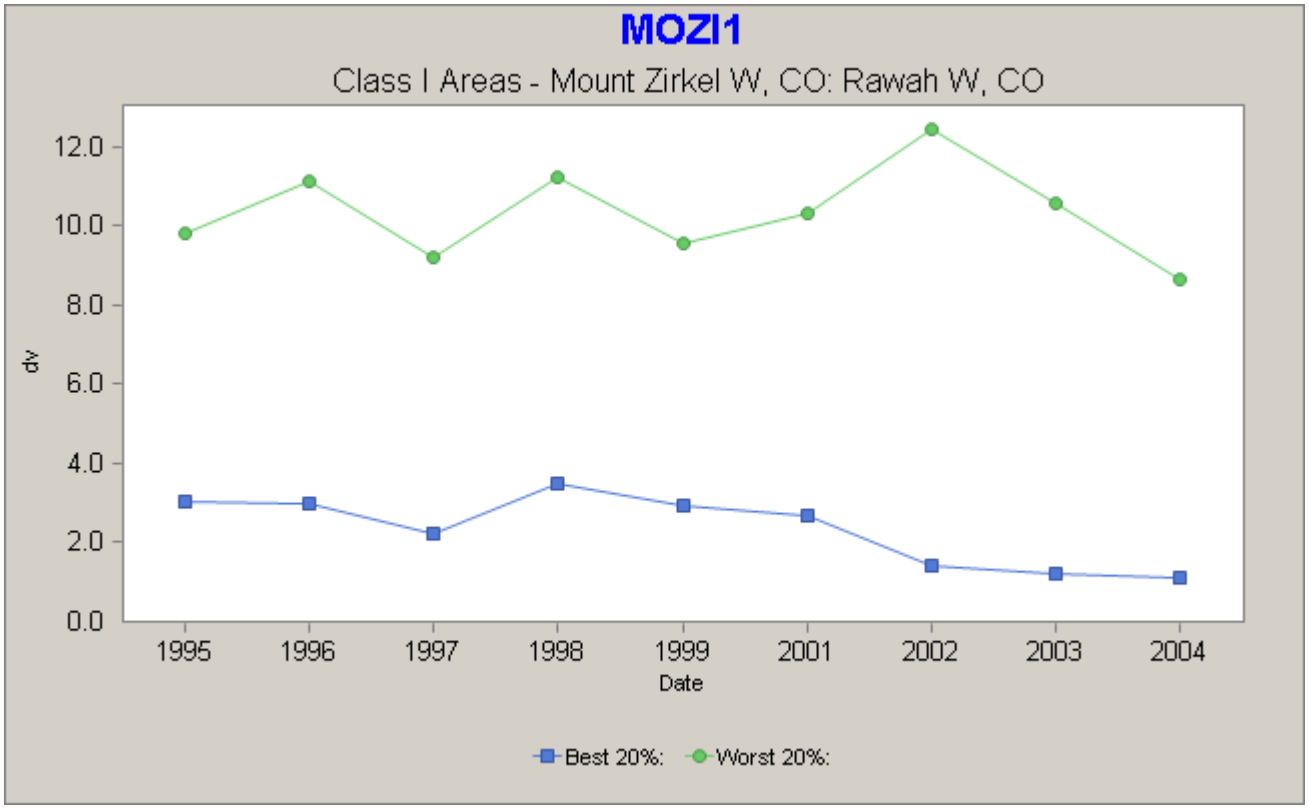

Figure 11: Mt. Zirkel Wilderness Area, Best and Worst Days 1995 through 2004

- ECf_bext (elemental carbon extinction) is both an anthropogenic and naturally occurring (e.g., wildfire) pollutant. It is a minor contributor at Mt. Zirkel Wilderness Area with no discernable trend.
- OMCf_bext (organic carbon extinction) is largely a naturally occurring pollutant (e.g., wildfire) and a major contributor to impairment at this site. Over the period of monitoring at Mt. Zirkel Wilderness, organic carbon exhibits considerable variability and, similar to most other Colorado sites, had large annual worst day values for 2002 and 2003.
- SOILf_bext (fine soil extinction) is largely natural (e.g., sand/dust) with very low values (similar to nitrate).

(vi). Rocky Mountain National Park.

Processed IMPROVE Sampler data are available beginning in 1991 through 2004 at Rocky Mountain National Park. Figure 13 presents annual average deciview for the best and worst days for each year of available data at the Park.

The Best Days show no degradation over time and a trend toward less impairment. The most recent years are the cleanest on record. The Worst Days reflect the drought and shift up from 2000 through 2003. To explore these trends and the recent increase on the Worst Days further, Figure 14 contains a speciated look at the Worst Days from 1991 through 2004. A qualitative

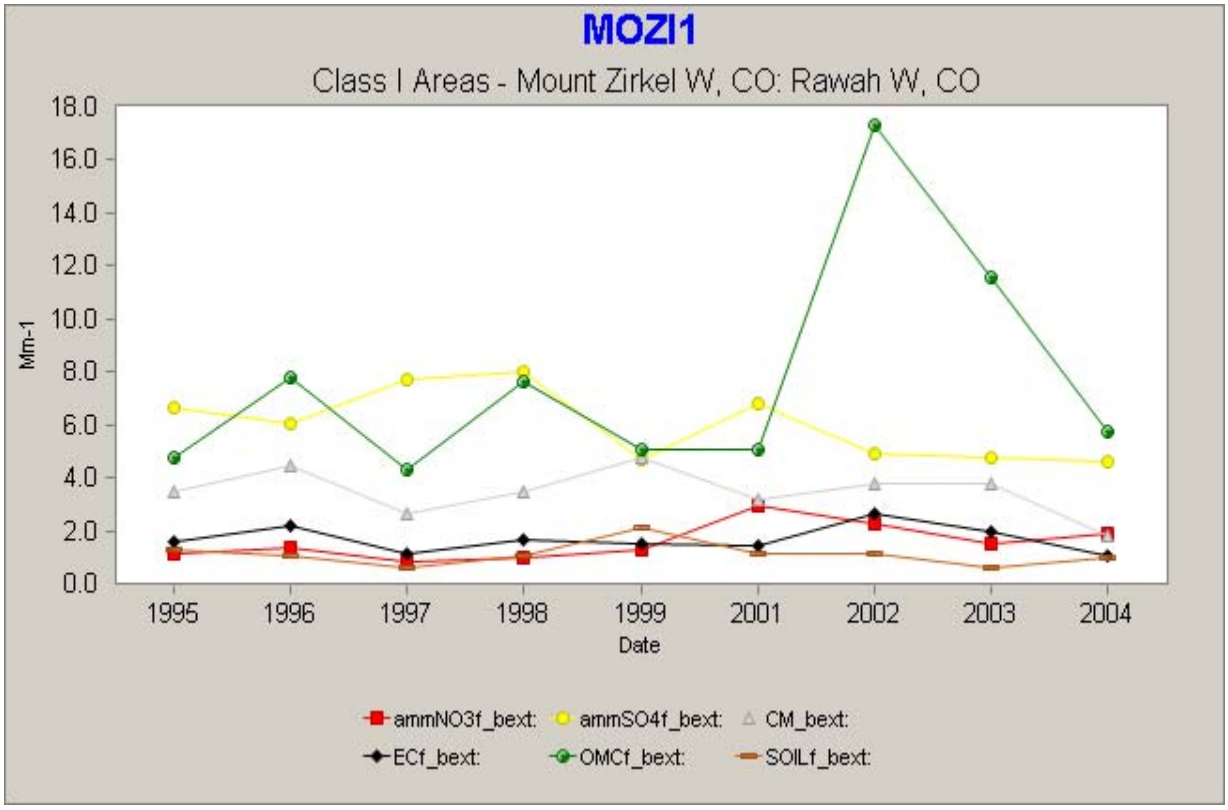

Figure 12: Mt. Zirkel Wilderness Area, Annual Extinction Values by Aerosol Species, Worst Days 1995 through 2004

summary of Figure 14 by pollutant shows that:

- ammNO3f_bext (ammonium nitrate extinction) is an anthropogenic pollutant and shifts from a moderate contributor to visibility impairment at Rocky to a major contributor in 2001 and 2002. Values for 2003 and 2004 drop to more typical levels. Nitrate shows a decreasing trend from the beginning of the record through 2000 then the two-year spike occurs. Rocky Mountain National Park's nitrate levels are higher overall than other IMPROVE sites in Colorado. The two-year spike is unusual given that nitrate is largely an anthropogenic pollutant.
- ammSO4f_bext (ammonium sulfate extinction) is an anthropogenic pollutant and a major contributor at the Park. In contrast with other IMPROVE sites in Colorado, sulfate does not demonstrate an obvious declining trend over the data record. However, considering the period 1999 through 2004, there are 4 of the 5 lowest values in the data record. Similar to what was seen for nitrate, the sulfate spike in 2001 and 2002 may need further exploration.
- CM_bext (coarse mass extinction) is a moderate contributor. In 2000, it spiked and for that single year it was a major contributor, along with organic carbon. Coarse mass emissions mostly consist of natural sources (e.g., wind blown dust). Coarse mass does not reveal an obvious trend over the record and there is a lesser reflection, compared to

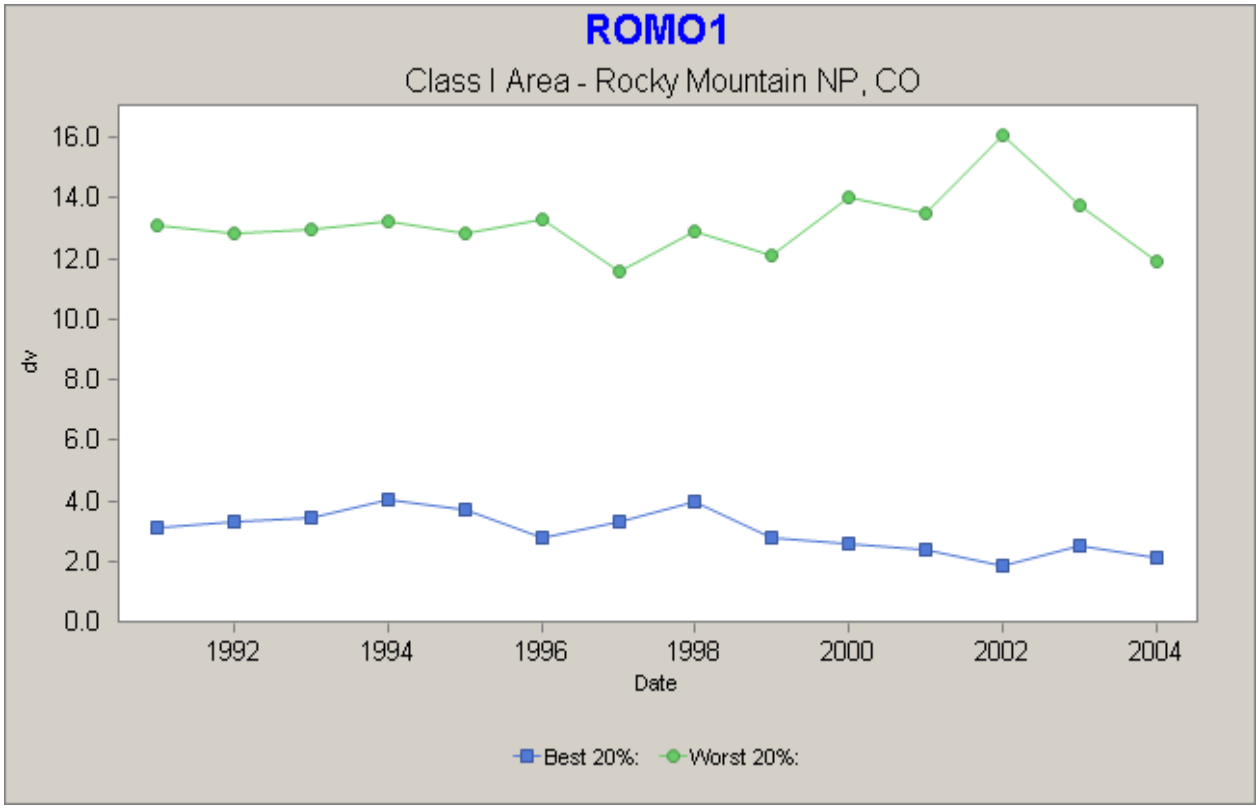

Figure 13: Rocky Mountain National Park, Best and Worst Days 1991 through 2004

many other sites in Colorado, of the drought in recent years.

- ECf_bext (elemental carbon extinction) is a both an anthropogenic (e.g., diesel emissions) and naturally occurring (e.g., wildfire) pollutant. It is a minor contributor at Rocky Mountain NP with no particular trend.
- OMCf_bext (organic carbon extinction) is largely a naturally occurring pollutant (e.g., wildfire). Over the period of monitoring at Rocky Mountain National Park, the "ups and downs" seen at other sites also have occurred at Rocky as well as the large values during the peak drought years.
- SOILf_bext (fine soil extinction) is largely natural (e.g., dust) with low values throughout the record at the Park.

In order to explore further the unusual nitrate and sulfate levels in 2001 and 2002, additional plots are presented below from the VIEWS website. They are the 2000, 2001 and 2002 annual composition plots for Rocky Mountain National Park. Each stacked bar represents a 24-hour sample. Each bar component is one of the species listed on the plot legend. The "W" over a bar means that sample is among the worst 20% impaired during that year. A "B" over a bar indicates that sample is in the 20% best visibility days during that year. Figure 15 is 2000 data. This is a fairly typical year for sulfate and nitrate at Rocky. There are no combined sulfate and nitrate episodes above 20/Mm-1 of extinction. Figure 16 is 2001 data. There are 9 sample days with combined sulfate and nitrate above 20/Mm-1. Figure 17 is 2002 data. There appear to be 7 or 8

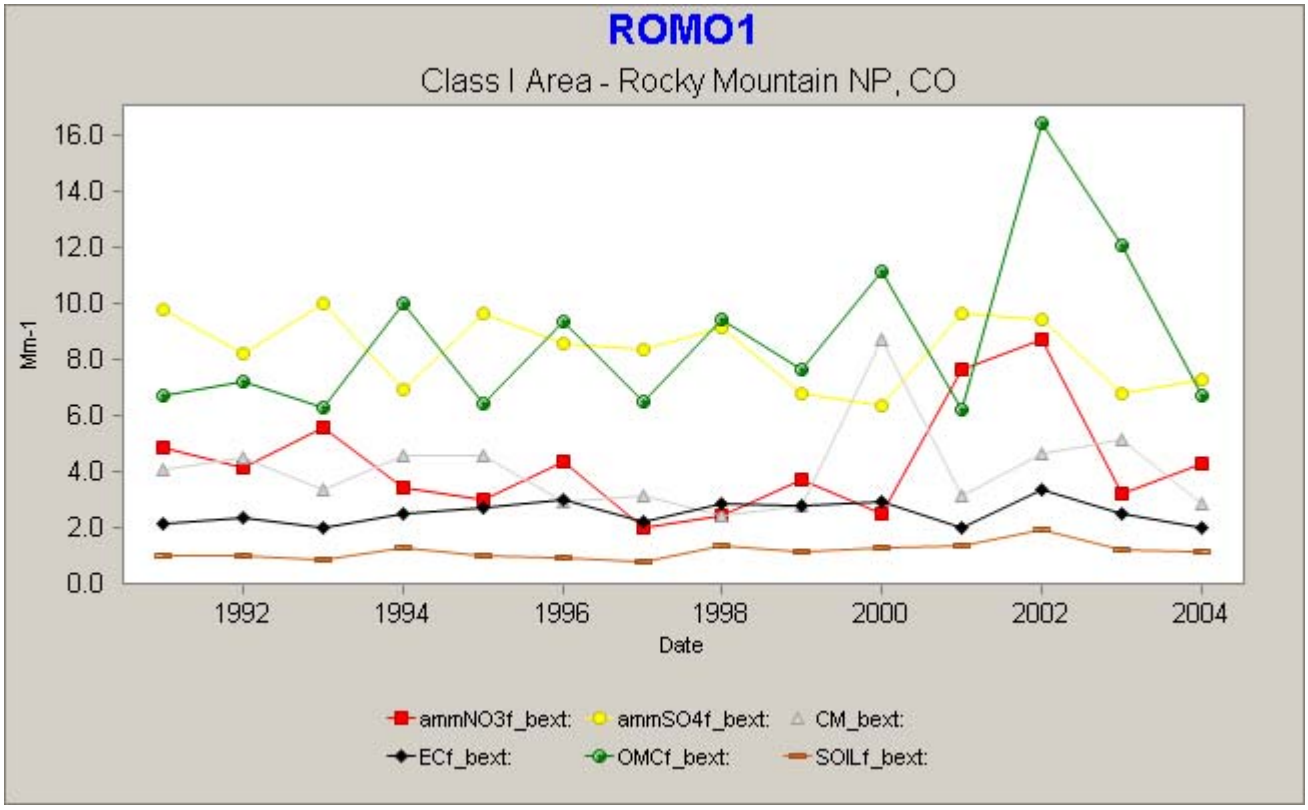

Figure 14: Rocky Mountain National Park, Annual Extinction Values by Aerosol Species, Worst Days 1991 through 2004

such days in 2002. It is important to note that these episodes, with 1 or 2 minor exceptions, do not occur when other pollutants are also peaking. The Division is hopeful that results from the ROMANS study, conducted by the National Park Service to examine nitrogen and sulfate emissions and precursors at Rocky Mountain National Park, will provide some insight about the sources and meteorological conditions that occurred in 2001 and 2002 that led to the 7-9 peaks of sulfate and nitrate per year. For more information about the ROMANS study see **http://www.cira.colostate.edu/publications/newsletter/fall2006.pdf**

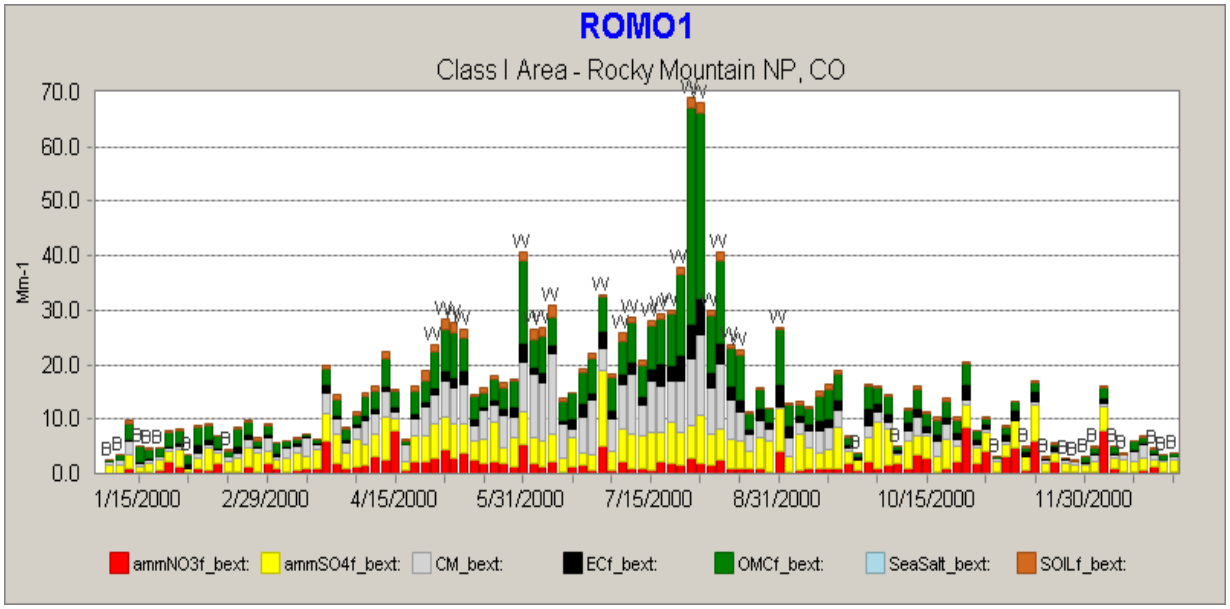

Figure 15: Rocky Mountain National Park, Composition Plot by Aerosol Species for Each Sample in 2000

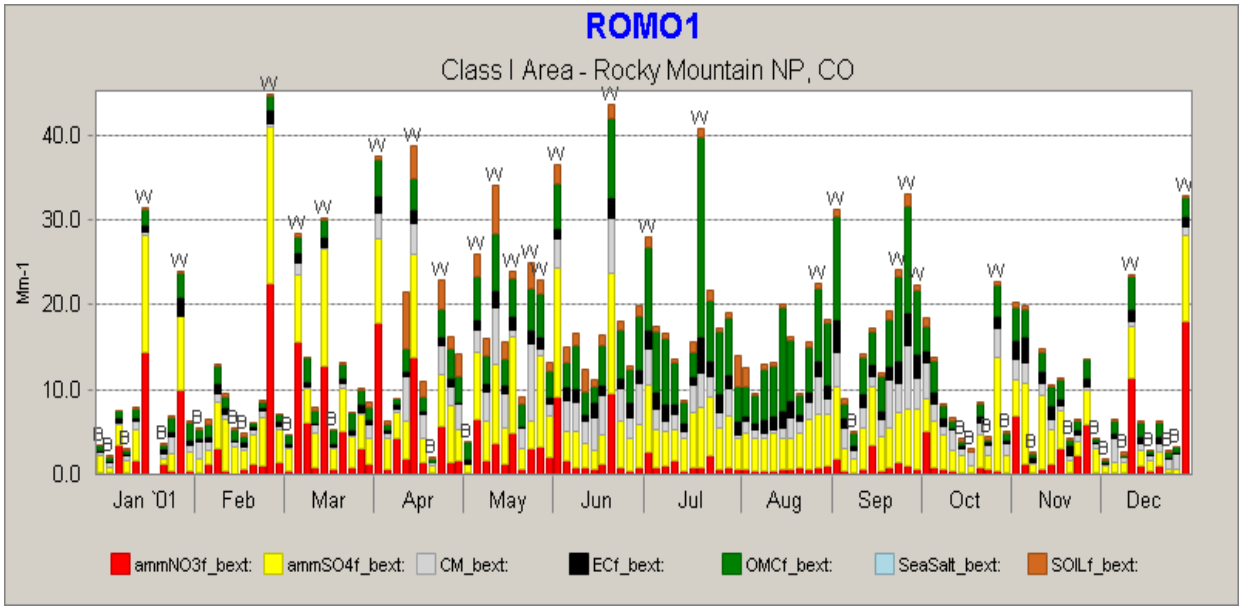

Figure 16: Rocky Mountain National Park, Composition Plot by Aerosol Species for Each Sample in 2001

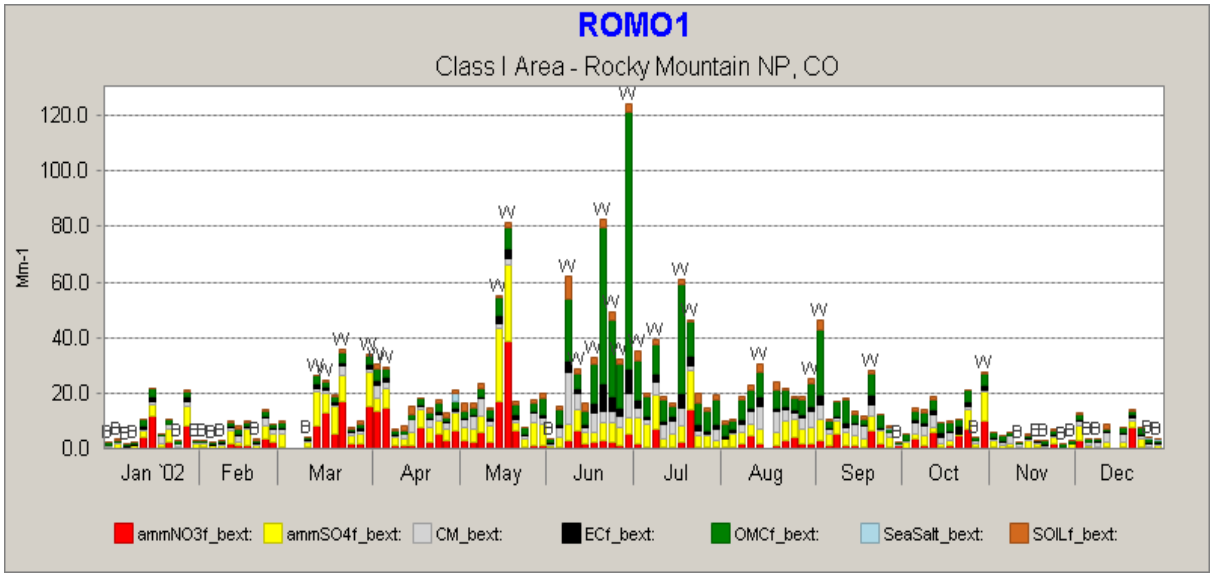

Figure 17: Rocky Mountain National Park, Composition Plot by Aerosol Species for Each Sample in 2002

d. Overall Conclusions.

Colorado has among the best visibility in the country at its Class I areas and throughout other scenic and pristine parts of the State. However, on an episodic basis visibility can become impaired at all sites monitored.

Visibility on the best days is not degrading over time at any site in Colorado. This is good and important news as protecting the cleanest days is a critical aspect of the Class I visibility protection program.

Visibility on the worst days is a more complex assessment. Mesa Verde NP shows a slow and steady increase in impairment over time. Weminuche and Great Sand Dunes show a very slight increase in impairment. Rocky Mountain and Mt. Zirkel show little apparent trend. At all these sites the most recent years of complete data have large variation from year-to-year driven largely by the sustained drought in the West. In addition to direct impacts from the drought, fewer precipitation events equate to less of a potential for natural removal mechanisms (i.e., rain and snow storms) scrubbing particles out of the air. The data record for White River is too short to draw conclusions at this time regarding trends.

4. ADDITIONAL MEASURES, INCLUDING SIP REVISIONS, THAT MAY BE NECESSARY TO ENSURE REASONABLE PROGRESS TOWARD THE NATIONAL GOAL.

Substantive LTS SIP revisions occurred in August 1996, April 1997, and April 2001. The 2002 SIP revision was to update outdated language and create a better overall organization of the LTS portion of the SIP. A minor update occurred in 2004. The Division does not believe extensive and substantive revisions are necessary at this time to ensure reasonable progress toward the national goal under Phase I of the Class I Visibility Protection Program. However, once again, small updates and edits are proposed in order that this part of the SIP does not

become outdated.

5. THE PROGRESS ACHIEVED IN IMPLEMENTING BART AND MEETING OTHER SCHEDULES SET FORTH IN THE LONG-TERM STRATEGY.

Hayden. Emission limitations and schedules for Hayden Generating Station were adopted into the SIP on August 15, 1996 based on the Hayden Consent Decree. By terms of the Decree, Hayden Station must provide progress reports to the State concerning construction of new equipment and compliance with new emission limitations. The particulate and SO_2 control equipment for Units 1 & 2 have been installed and are operating. All schedules in both the Decree and in the SIP regarding Hayden were met, some up to six months ahead of deadlines in the SIP and Consent Decree. Both units were in compliance for all pollutants by November 16, 1999. The emission limits and reporting requirements have been integrated into Hayden's Title V permit, as envisioned by the Consent Decree. As such, the court terminated the Decree in late-2001. Since then Hayden has continued to operate the facility within its emission limits and has remained in compliance.

Craig. Emission limitations and schedules for Units 1 and 2 of the Craig Station were adopted into the SIP on April 19, 2001 based on the Craig Consent Decree. By the terms of the SIP, progress reports must be provided to the State.

Unit 1's tie-in with its new equipment began on September 13, 2003 and completion of PM, NOx and SO_2 upgrades were finished by December 19, 2003. Testing of the NOx upgrades continued through the end of 4^{th} quarter 2003. SO_2 removal has consistently been above 90% since mid-December 2003 (limit is 90%). The NOx limit is 0.30 lbs/Mmbtu annual average and the end of 2005 actual average was 0.279 lbs/Mmbtu.

Unit 2's tie-in began on March 13, 2004. The compliance period began on October 1, 2004 for all subject pollutants. SO_2 emissions from Unit 2 have also consistently achieved better than 90% removal and the NOx annual average has been below the required 0.30 lbs/Mmbtu.

The emission limits and reporting requirements have been integrated into Craig's Title V permit, as envisioned by the Consent Decree. As such, the court terminated the Decree in late-2005. Since then Craig has continued to operate the facility within its emission limits and has remained in compliance.

6. THE IMPACT OF ANY EXEMPTION FROM BART.

The Division has not made a reasonable attribution decision. The need for a BART analysis has not been triggered, therefore, exemptions were neither requested nor granted.

7. THE NEED FOR BART TO REMEDY EXISTING IMPAIRMENT IN AN INTEGRAL VISTA DECLARED SINCE PLAN APPROVAL.

There have been no integral vistas listed by either the federal land managers or the State since the plan was approved. Therefore, a discussion on the need for BART in such integral vistas is not necessary.

IV. CONSULTATION WITH FEDERAL LAND MANAGERS

The Division is required by federal and state law to provide at least 60 days to consult with the federal land managers during periodic reviews of the LTS. The Division is sending this report to the USFS and NPS at the time of the request for hearing before the Air Quality Control Commission. These agencies are the managers of all of Colorado's Class I areas.

V. ENDNOTES AND REFERENCES

1. Letter to Honorable Roy Romer, Governor of Colorado, from Elizabeth Estill, Regional Forester, U.S. Forest Service Rocky Mountain Region, July 14, 1993.

2. "Revision of Colorado's State Implementation Plan for Class I Visibility Protection, Craig Station Units 1 and 2 Requirements," adopted by the Colorado Air Quality Control Commission, April 19, 2001.

3. "Clean Air Act Approval and Promulgation of Air Quality Implementation Plan Revision for Colorado; Long-Term Strategy of State Implementation Plan for Class I Visibility Protection: Craig Station Requirements," 66 Federal Register, 35374.

4 . Watson, J.G. and D. Blumenthal 1996, *Mt. Zirkel Wilderness Area, Reasonable Attribution Study of Visibility Impairment; Volume II: Results of Data Analysis and Modeling, Part 1 of 2 -- Final Report*; July 1, 1996. Desert Research Institute, University and Community College System of Nevada, 5625 Fox Avenue, Reno, Nevada 89506.

5. In the United States District Court for the District of Colorado, Civil Action No. 93-B-1749, Sierra Club, Plaintiff, vs. Public Service Company of Colorado, Inc., Salt River Project Agricultural Improvement and Power District, and PacifiCorp, Defendants, United States of America and State of Colorado, Plaintiff-Intervenors, Consent Decree, date lodged in Court, May 22, 1996, date entered in Court, August 19, 1996.

6. "Clean Air Act Approval and Promulgation of Air Quality Implementation Plan Revision for Colorado; Long-Term Strategy of State Implementation Plan for Class I Visibility Protection, Part I: Hayden Station Requirements," January 16, 1997, 62 Federal Register, 2305.

7. "Craig Station FGD System Modifications – Analyses of Potential Alternatives, Project Design Basis and Cost Estimates", EPA Contract #'s 68-D7-0001 – Phase # 1-005 & 9X-0264-NALX, dated August 31, 1999.

8. C.R.S. 25-7 Part 10, "Air Quality Related Values – Class I Federal Areas."

9. Letter to Honorable Bill Owens, Governor of Colorado from William P. Yellowtail, Regional Administrator, EPA Region 8; September, 22, 1999.

10. Letter from Tom L. Thompson, Acting Regional Forester, U.S.D.A. Forest Service, Rocky Mountain Region to Margie Perkins, Director, Colorado Air Pollution Control Division, December 14, 2000.

11. "Regional Haze Regulations," July 1, 1999, 64 Federal Register 35714, (codified at Part 40 Code of Federal Regulations sections 51.308 and 309).

12 . “IMPROVE Data Guide: A Guide to Interpret Data”, University of California Davis, August 1995.