

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

**AGENDA ITEM REQUEST**

for Adoption of State Implementation Plan Revision


**AGENDA REQUESTED:** February 25, 2009

**DATE OF REQUEST:** February 6, 2009

**NAME & NUMBER OF PERSON TO CONTACT REGARDING CHANGES TO THIS REQUEST, IF NEEDED:** Kerry Howard, 239-0556

**CAPTION:** Docket No. 2007-1539-SIP. Consideration of the adoption of a revision to the State Implementation Plan (SIP) to address visibility impairment due to regional haze in Class I Federal areas.

The adopted revision would implement Federal Clean Air Act requirements to make reasonable progress in reducing visibility impairment at Class I Federal areas, including Big Bend and Guadalupe Mountains National Parks, resulting from anthropogenic pollution. (Margaret Earnest, John Minter) (Project No. 2007-016-SIP-NR)

  
\_\_\_\_\_  
Chief Engineer

  
\_\_\_\_\_  
Division Director

  
\_\_\_\_\_  
Agenda Coordinator

Copy to CCC Secretary? NO X YES \_\_\_\_\_

# Texas Commission on Environmental Quality

INTEROFFICE MEMORANDUM

**To:** Commissioners **Date:** February 6, 2009  
**Thru:** LaDonna Castañuela, Chief Clerk  
Mark R. Vickery, P.G., Executive Director  
**From:** *inf for* David C. Schanbacher, P.E., Chief Engineer  
Chief Engineer's Office  
**Docket No.:** 2007-1539-SIP  
**Subject:** Regional Haze State Implementation Plan (SIP) Revision  
Regional Haze SIP Submission  
Project No. 2007-016-SIP-NR

## Scope of the SIP revision:

The 1990 Federal Clean Air Act (FCAA) Amendments together with the United States Environmental Protection Agency's (EPA) Regional Haze Rule set the goal of reducing "man-made" impacts on visibility in Class I areas to zero (i.e., to "natural" conditions) by 2064 for the worst 20 percent visibility days and preventing any degradation for the best 20 percent visibility days.

The Central Regional Air Planning Association (CENRAP) and other Regional Air Planning Organizations have cooperated to calculate the base period (2000-2004) worst 20 percent and best 20 percent visibility for each Class I area. CENRAP has developed projections of visibility impairment in 2018, the initial year for which each state's long-term strategy is to be evaluated. The state must reduce its visibility impairment impact at all Class I areas it impacts by as much as is reasonable. The format of this SIP revision follows a prescribed template developed by the CENRAP states.

The TCEQ used a refined estimate of natural conditions for Class I areas in Texas and other states as permitted by EPA guidance. These refined estimates account for natural dust storms, which explain a significant number of impaired days at the Texas Class I areas.

The Clean Air Interstate Rule (CAIR) program was designed to reduce interstate transport of emissions that affect fine particulate matter and ozone. Because these precursor emissions also affect visibility, the CAIR program is also an integral part of reducing regional haze. Following the legislature's statutory direction, the TCEQ adopted CAIR requirements applicable to electric generating units in Texas. Upon several challenges to CAIR, the rule has been remanded back to EPA by a federal appeals court in order for EPA to promulgate a new rule that is consistent with the court's decision, CAIR is still in effect until such time as the new rule is adopted. The TCEQ expects that a replacement program will be in place that makes comparable reductions in pollutants causing regional haze prior to 2018.

The commission has also adopted the requirements of the BART program, which requires certain older sources with a visibility impairment impact on any Class I area to apply BART to the source to reduce its impact on those Class I areas. This SIP revision contains a list of BART-eligible sources and a summary of the results of the BART modeling analyses. The appendix contains reports documenting the modeling results for sources that were potentially BART eligible; the modeling results showed that the visibility impacts of those sources were below the threshold established by EPA and adopted by the TCEQ.

Each state must evaluate and determine if additional emissions reductions are necessary. The statute and EPA rules and guidance set criteria for determining whether additional reductions are reasonable. These criteria are based on the cost of control and other related factors.

Re: Docket No. 2007-1539-SIP

**Reasons for the SIP revision:**

The FCAA and the EPA regulations require states to submit a SIP to make "reasonable progress" in reducing visibility impairment at Federal Class I areas resulting from anthropogenic pollution. FCAA, §169A(a)(1), "declares as a national goal the prevention of any future, and the remedying of any existing impairment of visibility in mandatory Federal Class I areas which impairment results from man-made air pollution." Class I areas are national parks over 6,000 acres and wilderness areas over 5,000 acres that Congress has recognized as significant sites. These SIPs must "contain such emission limits, schedules of compliance and other measures as may be necessary to make reasonable progress toward meeting the national goal" including requiring installation, operation, and maintenance of Best Available Retrofit Technology (BART), "as determined by the State" on certain existing stationary sources.

The EPA Regional Haze Rule strongly encourages states to work together in regional partnerships to reduce haze. There are five regional planning organizations in the United States. Texas is a member of CENRAP, which includes nine states; Texas, Louisiana, Oklahoma, Arkansas, Kansas, Missouri, Nebraska, Iowa, and Minnesota. The deadline for Texas and states participating in a regional air planning organization to submit their Regional Haze SIP was December 17, 2007. CENRAP provides analysis, modeling results, and informational exchange among states, but each state will submit its own regional haze SIP.

**Statutory Authority:**

Texas Health and Safety Code (THSC), §382.002, Policy and Purpose; §382.011, General Powers and Duties; §382.012, State Air Control Plan; FCAA, §110(a)(2)(D)(i)(II), 169A and 169B (42 U.S.C., §§7410(a)(2)(D)(i)(II); 7491 and 7492).

**Potentially controversial matters:**

On July 11, 2008, the Clean Air Interstate Rule (CAIR) was vacated by the DC Circuit Court of Appeals (*State of North Carolina v. U.S. EPA*). CAIR was a major federal rule to reduce emissions from electric generating units and is a significant element of Texas's planned reductions of both sulfur dioxide and nitrogen oxides from these sources. Upon a motion for rehearing, the appeals court issued a decision December 23, 2008, remanding CAIR to EPA to initiate rulemaking consistent with its opinion, but the court did not vacate CAIR, allowing it to remain in effect until replaced by EPA rule. EPA has also been sued for failing to act on the December 17, 2007, due date for Regional Haze plans. An EPA notice of finding of failure to submit is anticipated in January 2009, starting a 24-month Federal Implementation Plan (FIP) clock, and possible subsequent sanctions. In December 2008, the EPA recommended that Texas submit its SIP assuming CAIR or CAIR replacement. If EPA finalizes a new rule to meet the appeals court directive, Texas will need to consider new state rulemaking or implementation of the federal CAIR replacement.

If EPA issues a finding of failure to submit notice in the *Federal Register* before Texas submits the Regional Haze SIP revision, the FIP clock can only be stopped by full approval by EPA. If the plan revision is submitted prior to EPA's finding of failure to submit the TCEQ can avoid start of the FIP clock until EPA acts on the Texas submittal.

National parks in surrounding states of Oklahoma, Arkansas, Louisiana, and New Mexico may want more input on permit applications for major new sources as covered in the Prevention of Significant Deterioration (PSD) program if these proposed sites are in proximity to their Class I areas. Presently, the rules and EPA guidance allow these states and Federal Land Managers (FLMs) to review new sources within 100 kilometers. Oklahoma has requested the opportunity to examine and comment on some new source applications within 300 kilometers of Oklahoma's Wichita Mountains Class I area. FLMs for the Forest Service (FS), Fish and Wildlife Service (FWS), and the National Park Service (NPS) have also requested a

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change in our PSD procedures so that more permit applications undergo a visibility impact review. The agency plans to work directly with the FLMs and the states to try to resolve their concerns.

On February 13, 2008, the TCEQ approved the renewal of Air Quality Permit Number 20345 for the American Smelting and Refining Company (ASARCO) El Paso smelter. As of the date this SIP revision was finalized, the TCEQ has not yet made a final determination regarding the BART status of ASARCO's facilities. Due to this and other permitting and operational readiness issues raised by ASARCO in their status report required by TCEQ order, there is uncertainty about the amount of allowable emissions the ASARCO El Paso facility would have should it begin operation. Because of this uncertainty in addition to time limitations, it is not possible for the TCEQ to account for possible future ASARCO El Paso emissions in this Regional Haze SIP revision. When the TCEQ has determined the allowable emissions from the ASARCO El Paso facility, the TCEQ will model the visibility impacts of these emissions at affected Class I areas. The TCEQ plans to consult with affected states and Federal Land Managers and include ASARCO's emissions and impacts in its next Regional Haze SIP revision.

Pollution transport from Mexico and Central America is a major factor in visibility impairment at Texas' Class I areas. The goal of natural visibility will not be met unless international transport is addressed by the federal government.

The public may express concern that this SIP does not make sufficient progress toward natural visibility. The national goal is to reach natural visibility by 2064. At the rate of improvement proposed in this SIP, natural visibility levels would not be reached until 2081 at the Guadalupe Mountains and 2155 at Big Bend.

**Public comment:**

Comments were received from the USEPA, FS, FWS, NPS, Sierra Club, Citizens League for Environmental Action Now, and citizens. Additional information was provided in the SIP to address the comments.

**Significant changes from proposal:**

Two significant additions were made to the adopted SIP after public comments:

- Additional consultations along with area of influence maps and formal letters were sent to adjacent states to discuss the Texas impact on Class I areas outside of Texas (see Chapter 4 and Appendix 4-3).
- All Class I areas in adjacent states were added in tables, including worst and best 20 percent of visibility days, and the pollutant breakdown of Texas' apportioned contribution at each area (see Chapter 11).

**Key points in adoption SIP revision schedule:**

<b>Proposal date:</b>	December 5, 2007
<b>Public hearing date:</b>	February 19, 2008
<b>Public comment period:</b>	December 21, 2007 through February 22, 2008 (includes mandated 60-day review by FLMs)
<b>Anticipated adoption date:</b>	February 25, 2009

Commissioners  
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February 6, 2009

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**Agency contacts:**

Greg Nudd, P.E., Technical Specialist, 239-1247, Air Quality Planning  
Margaret Earnest, SIP Project Manager, 239-4581, Air Quality Planning  
John Minter, Staff Attorney, 239-0663

**Attachments**


cc: Chief Clerk, 5 copies  
Executive Director's Office  
David C. Schanbacher, P.E.  
Daniel Womack  
Kevin Patteson  
Betsy Bird  
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Margaret Earnest  
Richard Hyde, P.E.

# **Texas Commission on Environmental Quality**

INTEROFFICE MEMORANDUM

**To:** Commissioners

**Thru:** LaDonna Castañuela, Chief Clerk  
Glenn Shankle, Executive Director

**From:** David C. Schanbacher, P.E., Chief Engineer  
Chief Engineer's Office 

**Docket No.:** 2007-1539-SIP

**Subject:** Regional Haze State Implementation Plan (SIP) Revisions  
Regional Haze SIP Submission  
Project No. 2007-016-SIP-NR

**Date:** November 16, 2007

## **Reasons for the SIP revision:**

The Federal Clean Air Act (FCAA) and the United States Environmental Protection Agency (EPA) regulations require states to submit SIPs to make "reasonable progress" in reducing visibility impairment at Class I Federal areas resulting from anthropogenic pollution. FCAA, 169A(a)(1), "declares as a national goal the prevention of any future, and the remedying of any existing impairment of visibility in mandatory Class I Federal areas which impairment results from man-made air pollution". Class I areas are national parks over 6,000 acres and wilderness areas over 5,000 acres that Congress has recognized at significant sites. These SIPs must "contain such emission limits, schedules of compliance and other measures as may be necessary to make reasonable progress toward meeting the national goal" including requiring installation, operation, and maintenance of Best Available Retrofit Technology (BART), "as determined by the State" on certain existing stationary sources.

The EPA Regional Haze Rule strongly encourages states to work together in regional partnerships to reduce haze. There are five regional planning organizations in the United States. Texas is a member of the Central Regional Air Planning Association (CENRAP), which includes nine states, Texas, Louisiana, Oklahoma, Arkansas, Kansas, Missouri, Nebraska, Iowa, and Minnesota. The deadline for Texas and states participating in a regional air planning organization to submit their Regional Haze SIPs is December 17, 2007. CENRAP provides analysis, modeling results, and informational exchange among states, but each state will submit its own regional haze SIP.

- **Under what authority are we proposing these changes?** Texas Health and Safety Code (THSC), §382.002, Policy and Purpose; §382.011, General Powers and Duties; §382.012, State Air Control Plan; FCAA, §110(a)(2)(D)(i)(II), 169A and 169B (42 U.S.C., §§7410(a)(2)(D)(i)(II); 7491 and 7492).
- **Is this SIP revision required by federal rule or state statute? Which ones?** Yes, two federal rules require this SIP revision. The EPA adopted Regional Haze regulations in 40 Code of Federal Regulations (CFR) Part 51, Subpart P, on July 1, 1999, and adopted amendments to Subpart P and a new Appendix Y (BART guidelines) to Part 51 on July 6, 2005.
- **Are there any legal deadlines by which this SIP revision must be proposed, adopted, or effective?** Yes. The Regional Haze SIP deadline is December 17, 2007. Due to federal suits regarding the BART rule, the states delayed implementation for approximately five years. However, the Regional Haze SIP deadline remained unchanged. Many states will not meet the deadline. The commission is scheduled to consider the proposal of this SIP revision on December 5, 2007, and adoption in July 2008.

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- **What issue(s) or problem(s) are we trying to solve?** Make reasonable further progress in returning visibility at Class I areas to natural conditions and meeting federal requirements. Since air emissions do not recognize state boundaries, all states must work together to reduce emissions that impact each state and surrounding states.
- **Why is it important that we do this SIP revision?** Not submitting a SIP could lead to federal sanctions (emission offsets and highway funding sanctions) or a Federal Implementation Plan (FIP) or both.
- **Other important background or historical information.** The FCAA, Section 169A and B require the EPA to adopt regulations to reduce visibility impairment resulting "from man-made air pollution" in 156 Class I Federal areas. The regulations require each state SIP to contain control measures, including BART, to make reasonable progress toward the national goal of natural visibility conditions by 2064 in all Class I areas. The two Class I areas in Texas are Big Bend and Guadalupe Mountains National Parks. Each state bordering Texas has one or more Class I Federal areas designated for visibility protection. Where Texas' emissions impact visibility in Class I Federal areas in other states, the Texas SIP must include plans to reduce Texas' visibility impacts in those areas too.

The EPA adopted Regional Haze regulations in 40 Code of Federal Regulations (CFR) Part 51, subpart P, on July 1, 1999, and adopted amendments to Subpart P and a new Appendix Y (BART guidelines) to Part 51 on July 6, 2005.

**Scope of the SIP revision:**

The 1990 FCAA Amendments together with EPA's Regional Haze Rule set the goal of reducing "man-made" impacts on visibility in Class I areas to zero (i.e., to "natural" conditions) by 2064 for the worst 20 percent visibility days and preventing any degradation for the best 20 percent visibility days.

CENRAP and other Regional Air Planning Organizations have cooperated to calculate the base period (2000-2004) worst 20 percent and best 20 percent visibility for each Class I area. CENRAP is contracting projections of visibility impairment in 2018, the initial year for which each state's long-term strategy is to be evaluated. The state must reduce its visibility impairment impact at all Class I areas it impacts by as much as is reasonable. The format of this SIP revision follows a prescribed template developed by the CENRAP states.

The TCEQ used a refined estimate of natural conditions for Class I areas in Texas and other states as permitted by EPA guidance. These refined estimates account for natural dust storms, which explain a significant number of impaired days at the Texas Class I areas.

The Clean Air Interstate Rule (CAIR) program is expected to reduce regional haze impact. Following the legislature's statutory direction, the TCEQ adopted CAIR requirements applicable to electric generating units in Texas. Interstate trading of CAIR emission reduction credits makes the prediction of CAIR's visibility improvement benefits uncertain for each Class I area.

Additionally, the commission adopted the requirements of the BART program, which requires certain older sources with a visibility impairment impact on a Class I area to apply BART to the

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source to reduce its impact on a nearby Class I area. The SIP must contain a list of BART-eligible sources and the determination of BART for each source that is reasonably anticipated to contribute to visibility impairment (BART-subject).

Each state must evaluate and determine if additional emissions reductions are necessary. The statute and EPA rules and guidance set criteria for determining whether additional reductions are reasonable. These criteria are based on the cost of control and other related factors.

- **Changes required by federal rule:** The proposed SIP revision is intended to satisfy federal requirements. States are required to submit Regional Haze SIPs under FCAA, §169A, Visibility Protection for Federal Class I Areas, and §169B, Visibility; and 40 CFR Part 51, Subpart P.
- **Changes required by state statute:** N/A
- **Staff recommendations that are not expressly required by federal rule or state statute:** None.

**Impact on the regulated community:**

- **Who will be affected?** Some BART-eligible sources were required to submit modeling reports demonstrating impacts below threshold on Class I areas. No additional controls were added to this revision.
- **Does it create a group of affected persons who were not affected previously? How?** No.
- **Will there be a fiscal impact? If so, estimate.** No impact is estimated under the initial Regional Haze SIP.

**Impact on the public:**

- **Who will be affected?** Texas will benefit from increased visibility at Big Bend National Park and Guadalupe Mountains National Park. Visibility could also potentially improve at Class I Areas in surrounding states.
- **Does it create a group of affected persons who were not affected previously? How?** N/A
- **Will there be a fiscal impact? If so, estimate.** N/A

**Impact on agency programs:**

- The continued cost of participating in CENRAP.
- No new rules have been added.

**Informational meetings:**

- **Have any informational meetings been held?** Yes, November 2007
- **With whom?** Persons or companies currently interested in SIP changes.



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- **What were the general sentiments?** Some apprehension and uncertainty is expected with the implementation of a new federal program and concern about the long schedule.
- **Were any changes made in response to stakeholder concerns?** None are expected. The TCEQ is following federal guidance.

**Policy issues:**

- **What policy issues are affected?** Pollution transport from Mexico and Central America is a major factor in visibility impairment at Texas' Class I areas. The goal of natural visibility will not be met unless international transport is addressed by the federal government.
- **Are any policies that are not currently based on rule being made into a rule?** No.
- **What are the consequences if this SIP revision is not approved to go forward?** Not submitting a SIP could lead to federal sanctions (emission offsets and highway funding sanctions) or a Federal Implementation Plan (FIP) or both.
- **Are there alternatives?** Federal sanctions.

**Potentially controversial matters:**

- National parks in surrounding states of Oklahoma, Arkansas, Louisiana, and New Mexico may want more input on potentially permitted new sources in proximity to their Class I areas. Presently, the rules allow these states and federal land managers (FLMs) to review new sources within 100 kilometers. Oklahoma has requested the opportunity to examine and comment on new source applications greater than 100 kilometers from Class I areas that may impact its parks. FLMs for the Forest Service, Fish and Wildlife Service, and the National Park Service have also requested the opportunity to examine new source applications greater than 100 kilometers from their Class I areas.
- There will likely be some concern from the public that this SIP does not make sufficient progress toward natural visibility. The national goal is to reach natural visibility by 2064. At the rate of improvement proposed in this SIP, natural visibility levels would not be reached until 2080 at the Guadalupe Mountains and 2148 at Big Bend.

**Key points in proposed SIP revision schedule:**

- **Anticipated proposal date:** December 5, 2007
- **Public hearing date (if any):** February 19, 2008
- **Public comment period:** December 21, 2007 through February 22, 2008 (includes mandated 60-day review by FLMs)
- **Anticipated adoption date:** July 9, 2008

**Agency contacts:**

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Margaret Earnest, SIP Project Manager, 239-4581, Air Quality Planning  
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11/16/2007

Re: Docket No. 2007-1539-SIP

Attachments

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Daniel Womack  
Office of General Counsel  
Greg Nudd, P.E.  
Kelly Keel  
Margaret Earnest  
Joyce Spencer

**REVISIONS TO THE STATE IMPLEMENTATION PLAN (SIP)  
CONCERNING REGIONAL HAZE**

**TEXAS COMMISSION ON ENVIRONMENTAL QUALITY  
P.O. BOX 13087  
AUSTIN, TEXAS 78711-3087**

**PROJECT NO. 2007-016-SIP-NR**

**Adopted**

**February 25, 2009**

## SECTION VI. CONTROL STRATEGY

- A. Introduction (No change.)
- B. Ozone (No change.)
- C. Particulate Matter (No change.)
- D. Carbon Monoxide (No change.)
- E. Lead (No change.)
- F. Oxides of Nitrogen (No change.)
- G. Sulfur Dioxide (No change.)
- H. Conformity with the National Ambient Air Quality Standards (No change.)
- I. Site Specific (No change.)
- J. Mobile Source Strategies (No change.)
- K. Clean Air Interstate Rule (No change.)
- L. Transport (Proposed.)
- M. Regional Haze (New.)

## EXECUTIVE SUMMARY

The Federal Clean Air Act (FCAA) and United States Environmental Protection Agency (EPA) regulations require states to submit State Implementation Plans (SIPs) to make “reasonable progress” in reducing visibility impairment at Federal Class I areas resulting from anthropogenic pollution. FCAA, 169A(a)(1), “declares as a national goal the prevention of any future, and the remedying of any existing impairment of visibility in mandatory Federal Class I areas which impairment results from man-made air pollution.” Class I areas are national parks over 6,000 acres and wilderness areas over 5,000 acres. These SIPs must “contain such emission limits, schedules of compliance and other measures as may be necessary to make reasonable progress toward meeting the national goal” including requiring installation, operation, and maintenance of Best Available Retrofit Technology (BART), “as determined by the State” on certain existing stationary sources.

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The FCAA, Section 169A and B require the EPA to adopt regulations to reduce visibility impairment resulting “from man-made air pollution” in 156 Federal Class I areas. The regulations require each state SIP to contain control measures, including BART, to make reasonable progress toward the national goal of natural visibility conditions by 2064 in all Class I areas. The two Class I areas in Texas are Big Bend and Guadalupe Mountains National Parks. Each state bordering Texas has one or more Federal Class I areas designated for visibility protection. Where Texas’ emissions impact visibility in Federal Class I areas in other states, the Texas SIP must include plans to reduce Texas’ visibility impacts in those areas too.

The EPA adopted Regional Haze regulations in 40 Code of Federal Regulations (CFR) Part 51, subpart P, on July 1, 1999, and adopted amendments to Subpart P and a new Appendix Y (BART guidelines) to Part 51 on July 6, 2005.

The 1990 FCAA Amendments together with EPA’s Regional Haze Rule set the goal of reducing “man-made” impacts on visibility in Class I areas to zero (i.e., to “natural” conditions) by 2064 for the worst 20 percent visibility days and preventing any degradation for the best 20 percent visibility days. CENRAP and other Regional Air Planning Organizations have cooperated to calculate the base period (2000-2004) worst 20 percent and best 20 percent visibility for each Class I area. CENRAP has developed projections of visibility impairment in 2018, the initial year for which each state’s long-term strategy is to be evaluated. The state must reduce its visibility impairment impact at all Class I areas it impacts by as much as is reasonable. The format of this SIP revision follows a prescribed template developed by the CENRAP states.

The TCEQ used a refined estimate of natural conditions for Class I areas in Texas as permitted by EPA guidance. These refined estimates account for natural dust storms, which explain a significant number of impaired days at the Texas Class I areas.

The Clean Air Interstate Rule (CAIR) program was designed to reduce interstate transport of emissions that affect fine particulate matter and ozone. Because these precursor emissions affect visibility, the CAIR program is also an integral part of reducing regional haze. Following the legislature’s statutory direction, the TCEQ adopted CAIR requirements applicable to electric generating units in Texas. On July 11, 2008, the United States Court of Appeals for the District of Columbia Circuit vacated CAIR in its entirety. Upon a motion for rehearing, the appeals court issued a decision remanding CAIR to EPA to initiate rulemaking consistent with its opinion, but the court did not vacate CAIR, allowing it to remain in effect until replaced by EPA rule. The

TCEQ expects that a replacement program will be in place that makes comparable reductions in pollutants causing regional haze prior to 2018.

The commission has also adopted the requirements of the BART program, which requires certain older sources with a visibility impairment impact on a Class I area to apply BART to the source to reduce its impact on a nearby Class I area. This SIP revision contains a list of BART-eligible sources and another list of BART modeling outcomes. The appendix contains modeling summaries of sources that were reasonably anticipated to contribute to visibility impairment; however, after modeling, these sources were below the EPA threshold.

Each state must evaluate and determine if additional emissions reductions are necessary. The statute and EPA rules and guidance set criteria for determining whether additional reductions are reasonable. These criteria are based on the cost of controls and other related factors. The TCEQ has determined that no additional controls will be implemented with this SIP revision.

Reductions at Big Bend are dependent upon reducing emissions from Mexico and Central America. The TCEQ specifically asks the EPA for federal efforts to reduce the international transport impacts on regional haze coming into the United States across Texas' southern border. CENRAP modeling estimates of the base period visibility impairment at the two Texas Class I areas from the United States and foreign contributions indicate 52 percent of the visibility impairment at Big Bend National Park and 20 percent of the visibility impairment at Guadalupe Mountains National Park on the worst 20 percent of regional haze days comes from international transport. The preamble to the July 1, 1999, issuance of the Regional Haze Rule clearly says that states are not required to carry out compensatory overcontrol to make up for the lack of progress in reducing the impacts of international transport. The TCEQ expects that the EPA will pursue international emission reductions to improve visibility at Texas' Class I areas.

In conclusion, the TCEQ has implemented rules that limit and minimize emissions causing both Texas and regional visibility impairment. The Texas SIP includes numerous rules that minimize emissions that cause or contribute to Texas and regional visibility impairment. The TCEQ plans to continue to implement all these rules that protect visibility at Class I areas in Texas and other states.

## SECTION V: LEGAL AUTHORITY

### A. General

The TCEQ has the legal authority to implement, maintain and enforce the National Ambient Air Quality Standards (NAAQS) and to control the quality of the state's air, including maintaining adequate visibility.

The first air pollution control act, known as the Clean Air Act of Texas, was passed by the Texas Legislature in 1965. In 1967, the Clean Air Act of Texas was superseded by a more comprehensive statute, the Texas Clean Air Act (TCAA), found in Article 4477-5, Vernon's Texas Civil Statutes. The Legislature amended the TCAA in 1969, 1971, 1973, 1979, 1985, 1987, 1989, 1991, 1993, 1995, 1997, 1999, 2001, 2003 and 2005. In 1989, the TCAA was codified as Chapter 382 of the Texas Health & Safety Code.

Originally, the TCAA stated that the Texas Air Control Board (TACB) is the state air pollution control agency and is the principal authority in the state on matters relating to the quality of air resources. In 1991, the Legislature abolished the TACB effective September 1, 1993, and its powers, duties, responsibilities and functions were transferred to the Texas Natural Resource Conservation Commission (TNRCC). With the creation of the TNRCC, the authority over air quality is found in both the Texas Water Code and the TCAA. Specifically, the authority of the TNRCC is found in Chapters 5 and 7. Chapter 5, Subchapters A - F, H - J, and L, include the general provisions, organization and general powers and duties of the TNRCC, and the responsibilities and authority of the Executive Director. This Chapter also authorizes the TNRCC to implement action when emergency conditions arise and to conduct hearings. Chapter 7 gives the TNRCC enforcement authority. In 2001, the 77<sup>th</sup> Texas Legislature continued the existence of the TNRCC until September 1, 2013, and changed the name of the TNRCC to the Texas Commission on Environmental Quality (TCEQ).

The TCAA specifically authorizes the TCEQ to establish the level of quality to be maintained in the state's air and to control the quality of the state's air by preparing and developing a general, comprehensive plan. The TCAA, Subchapters A - D, also authorize the TCEQ to collect information to enable the commission to develop an inventory of emissions; conduct research and investigations; enter property and examine records; prescribe monitoring requirements; institute enforcement proceedings; enter into contracts and execute instruments; formulate rules; issue orders taking into consideration factors bearing upon health, welfare, social and economic factors, and practicability and reasonableness; conduct hearings; establish air quality control regions; encourage cooperation with citizens' groups and other agencies and political subdivisions of the state as well as with industries and the Federal Government; and establish and operate a system of permits for construction or modification of facilities.

Local government authority is found in Subchapter E of the TCAA. Local governments have the same power as the TCEQ to enter property and make inspections. They also may make recommendations to the commission concerning any action of the TCEQ that affects their territorial jurisdiction, may bring enforcement actions, and may execute cooperative agreements with the TCEQ or other local governments. In addition, a city or town may enact and enforce ordinances for the control and abatement of air pollution not inconsistent with the provisions of the TCAA or the rules or orders of the commission.

Subchapters F, G, and H of the TCAA authorize the TCEQ to establish low emission vehicle requirements for mass transit authorities, local government fleets, and private fleets; create a mobile emissions reduction credit program; establish vehicle inspection and maintenance programs in certain areas of the state, consistent with the requirements of the Federal Clean Air Act; establish gasoline volatility and low emission diesel standards; and fund and authorize participating counties to implement low-income vehicle repair assistance, retrofit and accelerated vehicle retirement programs.

## B. Applicable Law

The following statutes and rules provide necessary authority to adopt and implement the SIP. The rules listed below have previously been submitted as part of the SIP.

### Statutes

TEXAS HEALTH & SAFETY CODE, Chapter 382 September 1, 2005

TEXAS WATER CODE September 1, 2005

All sections of each subchapter are included, unless otherwise noted.

Chapter 5: Texas Natural Resource Conservation Commission

Subchapter A: General Provisions

Subchapter B: Organization of the Texas Natural Resource Conservation Commission

Subchapter C: Texas Natural Resource Conservation Commission

Subchapter D: General Powers and Duties of the Commission

Subchapter E: Administrative Provisions for Commission

Subchapter F: Executive Director (except §§ 5.225, 5.226, 5.227, 5.2275, 5.232, and 5.236)

Subchapter H: Delegation of Hearings

Subchapter I: Judicial Review

Subchapter J: Consolidated Permit Processing

Subchapter L: Emergency and Temporary Orders (§§ 5.514, 5.5145 and 5.515 only)

Chapter 7: Enforcement

Subchapter A: General Provisions (§§ 7.001, 7.002, 7.0025, 7.004, 7.005 only)

Subchapter B: Corrective Action and Injunctive Relief (§ 7.032 only)

Subchapter C: Administrative Penalties

Subchapter E: Criminal Offenses and Penalties: §§ 7.177, 7.179-7.181

### Rules

All of the following rules are found in Title 30, Texas Administrative Code, as of the following effective dates:

Chapter 7, Memoranda of Understanding, §§ 7.110 and 7.119 May 2, 2002

Chapter 35, Subchapters A-C, K: Emergency and Temporary Orders and Permits; Temporary Suspension or Amendment of Permit Conditions December 10, 1998

Chapter 39, Public Notice, §§ 39.201; 39.401; 39.403(a) and (b)(8)-(10); 39.405(f)(1) and (g); 39.409; 39.411 (a), (b)(1)-(6) and (8)-(10) and (c)(1)-(6) and (d); 39.413(9), (11), (12) and (14); 39.418(a) and (b)(3) and (4); 39.419(a), (b),(d) and (e); 39.420(a), (b) and (c)(3) and (4); 39.423 (a) and (b); 39.601; 39.602; 39.603; 39.604; and 39.605 August 15, 2002

Chapter 55, Request for Contested Case Hearings; Public Comment, §§ 55.1; 55.21(a) - (d), (e)(2), (3) and (12), (f) and (g); 55.101(a), (b), (c)(6) - (8); 55.103; 55.150; 55.152(a)(1), (2) and (6) and (b); 55.154; 55.156; 55.200; 55.201(a) - (h); 55.203; 55.205; 55.206; 55.209 and 55.211 August 29, 2002

Chapter 101: General Air Quality Rules August 16, 2007



Chapter 106: Permits by Rule, Subchapter A	June 30, 2004
Chapter 111: Control of Air Pollution from Visible Emissions and Particulate Matter	July 19, 2006
Chapter 112: Control of Air Pollution from Sulfur Compounds	July 12, 2001
Chapter 113: Standards of Performance for Hazardous Air Pollutants and for Designated Facilities and Pollutants	June 15, 2005
Chapter 114: Control of Air Pollution from Motor Vehicles	July 19, 2007
Chapter 115: Control of Air Pollution from Volatile Organic Compounds	July 19, 2007
Chapter 116: Permits for New Construction or Modification	March 15, 2007
Chapter 117: Control of Air Pollution from Nitrogen Compounds	June 14, 2007
Chapter 118: Control of Air Pollution Episodes	March 5, 2000
Chapter 122, § 122.122: Potential to Emit	December 11, 2002
Chapter 122, § 122.215: Minor Permit Revisions	June 3, 2001
Chapter 122, § 122.216: Applications for Minor Permit Revisions	June 3, 2001
Chapter 122, § 122.217: Procedures for Minor Permit Revisions	December 11, 2002
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## LIST OF ACRONYMS

AEO	Annual Energy Outlook, forecasts by Department of Energy
AOI	Area of influence
B20%	Best 20 percent (days of visibility)
BACT	Best Available Control Technology
BADL	Badlands Wilderness Area
BAND	Bandelier Wilderness Area
BART	Best Available Retrofit Technology
BC	Boundary conditions
BEIS3	Biogenic Emissions Inventory System Version 3
Bext	Light extinction
BIBE	Big Bend National Park
bnatural	Clean natural conditions
BOAP	Bosque del Apache Wilderness Area
BOWA	Boundary Waters Canoe Area Wilderness
BRAVO	Big Bend Regional Aerosol and Visibility Observational study
BRET	Breton Wilderness Area
bsource	Total light extinction due to a source
CACR	Caney Creek Wilderness Area
CAIR	Clean Air Interstate Rule
CALPUFF	California Puff Model
CAMx	Comprehensive Air Quality Model with extensions
CENRAP	Central Regional Air Planning Association
CFR	Code of Federal Regulations
CM	Coarse mass
CMAQ	Community Multiscale Air Quality Modeling System
DRI	Desert Research Institute
dv	deciviews
EC	Elemental carbon
EGAS	Economic Growth Analysis System
EGU	Electric generating unit
ENVIRON	ENVIRON International Corporation
EPA	United States Environmental Protection Agency
ERCOT	Electric Reliability Council of Texas
f(RH)	Relative Humidity adjustment factor
FCAA	Federal Clean Air Act
FIPS	Federal Information Processing Standard
FLAG	Federal Land Managers' Air Quality Related Values Work Group
FLM	Federal Land Manager
FS	United States Forest Service
FWS	United States Fish and Wildlife Service
FR	Federal Register
GEOS-Chem	Goddard Earth Observing System - Chemistry model
GICL	Gila Wilderness Area
GRSA	Great Sand Dunes Wilderness Area
GUMO	Guadalupe Mountains National Park
HEGL	Hercules-Glades Wilderness Area
HI	Haze Index

IC	Initial conditions
IDNR	Iowa Department of Natural Resources
IMPROVE	Interagency Monitoring of Protected Visual Environments
IPM	Integrated Planning Model
ISLE	Isle Royale National Park
JPROC	Photolysis Rates Processor
km	kilometers
LAER	Lowest Achievable Emission Rate
LOST	Lostwood Wilderness Area
LTS	Long-term strategy
MACA	Mammoth Cave National Park
MATS	Modeled Attainment Test Software
mb	millibars
MEVE	Mesa Verde National Park
MING	Mingo Wilderness Area
Mm <sup>-1</sup>	Inverse Megameters
MM5	Mesoscale Meteorological Model, 5 <sup>th</sup> Generation (developed by Pennsylvania State University / National Center for Atmospheric Research PSU/NCAR)
MMS	Minerals Management Service
MOBILE5	MOBILE Vehicle Emission Modeling Software Version 5
MOZI	Mount Zirkel Wilderness Area
MPE	Model performance evaluation
MPI	Message passing interface
MRPO	Midwest Regional Planning Organization
NAAQS	National ambient air quality standards
NARSTO	North American Research Strategy for Tropospheric Ozone
NH <sub>4</sub>	Ammonium
NO <sub>3</sub>	Nitrate
NO <sub>x</sub>	Nitrogen oxides
non-EGU	Non-electrical generating units
NPS	National Park Service, United States Department of the Interior
NSPS	New source performance standards
NSR	New Source Review
OC	Organic carbon
OMC	Organic mass carbon
PGM	Photochemical Grid Model
PiG	Plume-in-Grid
PLUVUE	Plume Visibility Model
PM	Particulate matter
PM <sub>10</sub>	Particulate matter with aerodynamic diameters less than 10 microns
PM <sub>2.5</sub>	Particulate matter with aerodynamic diameters less than 2.5 microns
POA	Primary organic aerosol
PPM	Piecewise-Parabolic Method
PSAT	Particulate Matter Source Apportionment Technology
PSD	Prevention of significant deterioration
PTE	Potential to emit

Q/D	Emissions over distance (to Class I area)
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Program Plan
RH	Relative Humidity
ROMO	Rocky Mountain National Park
RPG	Reasonable progress goal
RPO	Regional Planning Organization
RRF	Relative response factor
SACR	Salt Creek Wilderness Area
SAPE	San Pedro Parks Wilderness Area
SIP	State Implementation Plan
SIPS	Sipsey Wilderness Area
SMOKE	Sparse Matrix Operator Kernel Emissions
SO <sub>2</sub>	Sulfur dioxide
SO <sub>4</sub>	Sulfate
SOA	Secondary organic aerosol
SOAA	Secondary organic aerosols anthropogenic (human-made)
SOAB	Secondary organic aerosols biogenic (from plants)
TAC	Texas Administrative Code
TCAA	Texas Clean Air Act
TCEQ	Texas Commission on Environmental Quality
TEOM	Tapered Element Oscillating Microbalance
TERP	Texas Emissions Reduction Program
THRO	Theodore Roosevelt National Park
TIP	Tribal Implementation Plan
TOMS	Total Ozone Mapping Spectrometer satellite data
tpy	tons per year
TSD	Technical Support Document
TUV	Tropospheric Ultraviolet and Visible (Radiation Model)
UCR	University of California at Riverside
UPBU	Upper Buffalo Wilderness Area
URP	Uniform rate of progress
VIEWS	Visibility Information Exchange Web System
VISTAS	Visibility Improvement State and Tribal Association of the Southeast
VOC	Volatile organic compounds
VOYA	Voyageurs National Park
W20%	Worst 20 percent (days of visibility)
WEMI	Weminuche Wilderness Area
WHIT	White Mountain Wilderness Area
WHPE	Wheeler Peak Wilderness Area
WHRI	White River National Forest
WICA	Wind Cave National Park
WIMO	Wichita Mountains Wilderness Area
WRAP	Western Regional Air Partnership

## **CHAPTER 1. BACKGROUND AND OVERVIEW OF THE FEDERAL REGIONAL HAZE REGULATION**

### **1.1 GENERAL BACKGROUND**

Regional haze is visibility impairment that is produced by a multitude of sources and activities. These emission sources and activities are located across a broad geographical area. The emissions consist of fine particles and their precursors. Visibility impairment caused by air pollution occurs virtually all of the time at most Class I visibility protected national park and wilderness area monitoring stations (VIEWS 2007). A significant factor in visibility impairment is regional transport of fine particles that contribute to elevated particulate matter (PM) levels.

Haze-forming pollution comes from both human and natural sources. Windblown dust and soot from wildfires contribute to haze, as do motor vehicles, electric generating facilities, industrial fuel burning, and manufacturing operations. PM and PM precursor emissions are the major cause of reduced visibility (haze) in the United States and at many of our national parks and wilderness areas. Some haze-forming particles are directly emitted into the air. The usual term for directly emitted particles is primary particles. Secondary particles, created when emitted gases form particles downwind of the emission sources, usually dominate the causes of regional haze. Nitrates and sulfates, which result from NO<sub>2</sub> and SO<sub>2</sub> emissions, are examples of secondary particles that contribute to regional haze.

In many scenic areas, haze substantially reduces visual range. In eastern Class I areas, haze from human activity reduces average visual range from the natural condition of approximately 90 miles to 15-to-25 miles. In the West, haze from human activity reduces visual range from the natural condition of approximately 140 miles to 35-to-90 miles. Visibility impairment is expressed in deciviews (dv). A deciview is a unit of visibility impairment proportional to the logarithm of the atmospheric light extinction. One deciview is approximately the minimum amount of change in visibility that a human observer can detect.

### **1.2 VISIBILITY-IMPAIRING EMISSIONS**

The Central Regional Air Planning Association (CENRAP) and the Texas Commission on Environmental Quality (TCEQ) data analysis and modeling show that several types of emissions are involved in reducing visibility, including sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), and particulate matter (PM). Table 1-1: *Visibility-Impairing Pollutants* and Table 1-2: *Comparison of Ambient Fine Particles (Ultrafine plus Accumulation-Mode) and Coarse Particles* discuss some of the emissions, different variations of the molecules in the atmosphere, and various sources of the emissions. Unlike pollutants like ozone, PM<sub>2.5</sub>, and carbon monoxide, visibility is not a measurable concentration for which a standard, like the national ambient air quality standard (NAAQS) could be set. Instead, the Regional Haze Rule sets out procedures states must follow to decide how much emissions reductions are reasonable to move toward the national goal that Congress has established under the Federal Clean Air Act (FCAA): returning Class I areas to natural visibility conditions. The United States Environmental Protection Agency (EPA) has set 2064 as the target date to reach the goal set by Congress to reach natural conditions at all Class I areas. To accomplish this goal, a state must first determine what “natural conditions” are and then plan how to reach those conditions.

Table 1-1 provides information about particulate matter components that contribute to regional haze.

**Table 1-1: Visibility-Impairing Pollutants**

Major Components of Particles	Symbol	Directly Emitted?	Formed in the Air?	Formed From	In which Size Range? micrometers ( $\mu\text{m}$ )	Major Sources
Sulfates	SO <sub>4</sub>	(Yes)*	Yes	SO <sub>2</sub>	PM <sub>2.5</sub>	Coal-fired power plants, oil fields and refineries, paper mills
Nitrates	NO <sub>3</sub>	(No)*	Yes	NO <sub>2</sub>	PM <sub>2.5</sub>	All combustion
Secondary Organic Carbon	OC	No	Yes	VOC**	PM <sub>2.5</sub>	Gasoline, organic solvents, biogenics
Primary Organic Carbon	OC	Yes	No	--	PM <sub>2.5</sub>	Incomplete combustion
Elemental Carbon (i.e., black carbon)	EC	Yes	No	--	PM <sub>2.5</sub>	Incomplete combustion
Fine Soil Dust	FS	Yes	No	--	PM <sub>2.5</sub>	Wind blowing over loose soil, motor vehicles running on paved and unpaved roads
Coarse Mass, which is normally ~ 100% Coarse Soil Dust	CM	Yes	No	--	PM <sub>COARSE</sub> , i.e. PM <sub>10-2.5</sub>	Wind blowing over loose soil, motor vehicles running on paved and unpaved roads

\*There are few significant, direct sulfate sources; direct nitrate sources are rare.

\*\*Volatile organic compounds

Table 1-2 provides additional information about particles. The table breaks down the fine particles into ultrafine particles that are less than 0.1  $\mu\text{m}$  in diameter and accumulation mode particles that are generally between 0.1 and 1.0  $\mu\text{m}$  in diameter. Ultrafine particles agglomerate to form accumulation mode particles. Some of the accumulation mode particles, most notably sulfates, grow above 1.0  $\mu\text{m}$  in diameter, as the humidity becomes high. A relatively small percentage of the soil and dust particles are smaller than 2.5  $\mu\text{m}$  in aerodynamic diameter, so samplers collect them with the fine particles. Table 1-1 lists only typical, major sources of each component. Table 1-2 provides a more inclusive listing of sources.

**Table 1-2: Comparison of Ambient Fine Particles (Ultrafine plus Accumulation-Mode) and Coarse Particles**

	<b>Ultrafine</b>	<b>Accumulation</b>	<b>Coarse</b>
Formation Processes:	Combustion, high-temperature processes, and atmospheric reactions		Break-up of large solids/droplets
Formed by:	<ul style="list-style-type: none"> <li>• Nucleation</li> <li>• Condensation</li> <li>• Coagulation</li> </ul>	<ul style="list-style-type: none"> <li>• Condensation</li> <li>• Coagulation</li> <li>• Reactions of gases in or on particles</li> <li>• Evaporation of fog and cloud droplets in which gases have dissolved and reacted</li> </ul>	<ul style="list-style-type: none"> <li>• Mechanical disruption (crushing, grinding, abrasion of surfaces)</li> <li>• Evaporation of sprays</li> <li>• Suspension of dusts</li> <li>• Reactions of gases in or on particles</li> </ul>
Composed of:	<ul style="list-style-type: none"> <li>• Sulfate</li> <li>• Elemental carbon</li> <li>• Metal compounds</li> <li>• Organic compounds with very low saturation vapor pressure at ambient temperature</li> </ul>	<ul style="list-style-type: none"> <li>• Sulfate, nitrate ammonium, and hydrogen ions</li> <li>• Elemental carbon</li> <li>• Large variety of organic compounds</li> <li>• Metals: compounds of Pb, Cd, V, Ni, Cu, Zn, Mn, Fe, etc.</li> <li>• Particle-bound water</li> </ul>	<ul style="list-style-type: none"> <li>• Suspended soil or street dust</li> <li>• Fly ash from uncontrolled combustion of coal, oil, and wood</li> <li>• Nitrates/chlorides/sulfates from <math>\text{HNO}_3</math>/HCl/<math>\text{SO}_2</math> reactions with coarse particles</li> <li>• Oxides of crustal elements (Si, Al, Ti, Fe)</li> <li>• <math>\text{CaCO}_3</math>, <math>\text{CaSO}_4</math>, NaCl, sea salt</li> <li>• Pollen, mold, fungal spores</li> <li>• Plant and animal fragments</li> <li>• Tire, brake pad, and road wear debris</li> </ul>
Sources:	<ul style="list-style-type: none"> <li>• Combustion</li> <li>• Atmospheric transformation of <math>\text{SO}_2</math> and some organic compounds</li> <li>• High temperature processes</li> </ul>	<ul style="list-style-type: none"> <li>• Combustion of coal, oil, gasoline, diesel fuel, wood</li> <li>• Atmospheric transformation products of <math>\text{NO}_x</math>, <math>\text{SO}_2</math>, and organic compounds, including biogenic organic species (e.g., terpenes)</li> <li>• High-temperature processes, smelters, steel mills, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Resuspension of industrial dust and soil tracked onto roads and streets</li> <li>• Suspension from disturbed soil (e.g., farming, mining, unpaved roads)</li> <li>• Construction and demolition</li> <li>• Uncontrolled coal and oil combustion</li> <li>• Ocean spray</li> <li>• Biological sources</li> </ul>
Atmospheric half-life:	Minutes to hours	Days to weeks	Minutes to hours
Atmospheric Removal Processes:	<ul style="list-style-type: none"> <li>• Grows into accumulation mode</li> <li>• Diffuses to raindrops</li> </ul>	<ul style="list-style-type: none"> <li>• Forms cloud droplets and rains out (Organic carbon and elemental carbon particles may not take up water until they have aged.)</li> <li>• Dry deposition</li> </ul>	<ul style="list-style-type: none"> <li>• Dry deposition by fallout</li> <li>• Scavenging by falling rain drops</li> </ul>
Travel distance:	<1 to 10s of km	100s to 1000s of km	<1 to 10s of km (small size tail, 100s to 1000s in dust storms)

Source: Adapted from Wilson and Suh (1997), CD, p. 2-52.

### **1.3 HISTORY OF FEDERAL REGIONAL HAZE RULE**

In the FCAA amendments of 1977, Congress added §169 (42 United States Code (USC), §7491), setting forth a national visibility goal of restoring natural conditions in certain national parks and wilderness areas. The EPA designated national parks and wilderness areas meeting certain criteria and containing vistas as an important feature, as Class I areas for visibility protection under regional haze state implementation plan (SIP) provisions.

In response to the 1977 FCAA amendments, the EPA required control measures to address plume blight and reasonably attributable visibility impairment. These plume blight and reasonably attributable visibility impairment control measures did little to address regional haze throughout the contiguous 48 states.

When Congress amended the FCAA again in 1990, it added §169B (42 USC, §§7492) requiring further research and regular assessments of the progress made toward visibility goals. In 1993, the National Academy of Sciences concluded that “current scientific knowledge is adequate and control technologies are available for taking regulatory action to improve and protect visibility” (NRC 1993).

In addition to authorizing the creation of visibility transport commissions and setting forth their duties, §169B(f) of the FCAA specifically mandated the creation of the Grand Canyon Visibility Transport Commission (GCVTC) to make recommendations to the EPA for the region affecting visibility in Grand Canyon National Park. After four years of research and policy development, the GCVTC submitted its report to the EPA in June 1996 (GCVTC 1996). This report, as well as other research reports prepared by the GCVTC, contributed information to the EPA’s development of the federal Regional Haze Rule.

The EPA promulgated the Regional Haze Rule on July 1, 1999 (Appendix 1-1: *EPA Regional Haze Rule 1999*). The federal rule’s objective is to achieve the national visibility goal of restoring natural visibility conditions to Class I areas by 2064. Generally, the EPA’s default estimates of natural conditions are 8 deciviews for the western states and 12 deciviews for the eastern states. States may calculate the natural conditions for each Class I area instead of using the default goal. Chapter 5: *Assessment of Baseline and Current Conditions and Estimate of Natural Conditions in Class I Areas* discusses natural conditions in more detail. The rulemaking addressed the combined visibility effects of sources over a broad geographic region, meaning that many states, including all those without Class I areas, must participate in haze reduction efforts.

The EPA designated five Regional Planning Organizations (RPOs) to assist with the coordination and cooperation needed to address visibility and haze issues. Those states and tribes that make up the midsection of the contiguous United States, including Texas, were designated as the CENRAP.

### **1.4 CLASS I AREAS**

Texas has two Class I areas within its borders, both located in West Texas (Figure 1-1: *Regional Class I Areas*). Big Bend National Park (Big Bend), in Brewster County, borders the Rio Grande and Mexico. Guadalupe Mountains National Park (Guadalupe Mountains), in Culberson County, borders New Mexico. Chapter 11: *Long-Term Strategies* addresses Texas’ impacts and long-term strategies for Class I areas outside of Texas.





**Figure 1-1: Regional Class I Areas**

### **Big Bend National Park**

Big Bend was authorized as a national park on June 20, 1935, and then established and signed into law on June 12, 1944, as the nation's 27th national park. The park gets its name from the course of the Rio Grande, which makes a great bend from a southeasterly to a northerly direction in the western portion of Texas. Big Bend receives approximately 350,000 visitors annually.

The park is slightly larger than Rhode Island and comprises more than 801,000 acres (1,252 square miles). The boundary includes 118 miles of the Rio Grande, which is also the international border between the United States and Mexico. In 1978, Congress designated a 196-mile portion of the Rio Grande, from the Chihuahua and Coahuila state line to the Terrell and Val Verde county line, as a Wild and Scenic River. The upper 69 miles are within the boundaries of Big Bend.

The park exhibits dramatic contrasts; its climate is one of extremes. As a result of the range in altitude from 1,700 feet along the river to 7,800 feet in the Chisos Mountains, a wide variation in available moisture and in temperatures exists throughout the park. These variations contribute to the great diversity in plant and animal habitats.

Big Bend has national significance as the largest protected area of Chihuahuan Desert in the continental United States. The park's river, desert, and mountain environments support an extraordinary richness of biological diversity and provide unparalleled recreation opportunities. Few areas exceed the park's values for the protection and study of geologic and paleontologic resources. Archeologists have discovered artifacts estimated to be 9,000 years old, and historic buildings and landscapes offer graphic illustration of life along the international border at the turn of the century. Big Bend is rich in economic, cultural, and military history from its extensive use by the Comanches, miners, farmers, ranchers, United States cavalry units, and Poncho Villa's revolutionaries.

Big Bend was designated a Biosphere Reserve in 1976, under the Man and the Biosphere Program. Big Bend is one of only 250 such areas in the world whose ecosystems are particularly well preserved (National Park Service (NPS) 2007).

### **Guadalupe Mountains National Park**

Guadalupe Mountains was established on September 30, 1972, and contains Guadalupe Peak, the highest point in Texas at 8,749 feet (2,667 meters) in elevation, as well as the next three highest peaks in the state. The park covers 86,416 acres and is in the same mountain range as Carlsbad Caverns National Park, which is located about 40 miles to the northeast in New Mexico. The park also contains a congressionally designated wilderness of 46,850 acres called the Guadalupe Mountains Wilderness. The terrain is rough and natural with mountain peaks steeply rising up to 3,000 feet above the canyon floors.

The mountains are a “sky island” rising more than a mile above the floor of the Salt Basin on the west. The slopes extend through three major ecological zones from desert to remnants of a high altitude forest. Ponderosa pine, Douglas fir, white pine, and quaking aspen grow side by side with desert species such as agaves and cacti. The altitude encourages relatively high amounts of rainfall that quickly drain into the porous limestone bedrock and recharge the Capitan Aquifer.

The Guadalupe Mountains preserve the 2,000-foot thick limestone layer of the Capitan Reef, one of the finest examples of an ancient marine fossil reef on earth. Outcrops in the park expose rocks from the entire range of associated depositional environments from shallow lagoon to reef, forereef debris slopes, and deep basin deposits. The park contains the world standard section that represents the middle part of the Permian Period of geologic time. Geologists from around the world study the 280 to 260 million year old rocks preserved there (NPS 2007).

## CHAPTER 2. GENERAL PLANNING PROVISIONS

### 2.1 INTRODUCTION

In accordance with 40 CFR §51.308(a) and (b), the TCEQ submits this state implementation plan (SIP) revision to meet the requirements of the EPA's Regional Haze Rule. This plan addresses the core requirements of 40 CFR §51.308(d) and the Best Available Retrofit Technology (BART) components of 40 CFR §50.308(e). In addition, this SIP revision addresses coordination with regional planning groups, states and tribes, and the Federal Land Managers (FLMs). Texas also commits to plan revisions and adequacy determinations as outlined in this SIP.

### 2.2 PUBLIC HEARING AND COMMENT INFORMATION

The TCEQ provided notice to the public of the opportunity to comment on the proposed Regional Haze SIP after the commission approval for publication on December 5, 2007. The TCEQ announced and held a public hearing. Notice of both the public hearing and the comment period were published in newspapers around the state (Appendix 2-1: *Public Participation Process*). The public comment period began December 21, 2007, and ended February 22, 2008. The public hearing was held in Austin on February 19, 2008. The length of the comment period was longer to give sufficient time for the FLMs to provide recommendations on the proposed SIP revision that could be provided to the general public, as well as meet the requirement that FLMs are consulted at least 60 days prior to the public hearing on the SIP revision. The FLM comment period was November 16, 2007, through January 16, 2008. The TCEQ web site provided the complete FLM comments 30 days prior to the hearing date.

The TCEQ accepted comments electronically through the eComments system, fax, and mail. All comments referenced the "Regional Haze SIP" and project number 2007-016-SIP-NR.

Comments went to:

Margaret Earnest  
MC 206  
State Implementation Plan Team, Chief Engineer's Office  
Texas Commission on Environmental Quality  
P. O. Box 13087  
Austin TX 78711-3087  
Fax: (512)-239-5687

#### Public Hearing

City	Date	Time	Location
Austin	February 19, 2008	2:00 PM	Texas Commission on Environmental Quality 12100 Park 35 Circles, Austin TX 78753 Building E, Room 201S

Public comments, including those made by staff of federal agencies, were summarized and addressed in Appendix 2-2: *Public Comments and Responses on SIP Draft*. The final SIP incorporated public comments as appropriate.

## CHAPTER 3. REGIONAL PLANNING

### 3.1 OVERVIEW

In the preamble to the Regional Haze Rule, the EPA acknowledged the key role of regional pollutant transport in contributing to haze in federal Class I areas and recognized the value of multi-state coordination for planning and implementing regional haze programs (EPA 1999). The EPA established grant funding for five RPOs as follows:

- Central Regional Air Planning Association
- Western Regional Air Partnership
- Midwest Regional Planning Organization
- Visibility Improvement State and Tribal Association of the Southeast
- Mid-Atlantic/Northeast Visibility Union.

Figure 3-1: *Map of the Regional Planning Organizations* shows the geographic areas of the five RPOs. Texas is a member of CENRAP, as are Oklahoma, Louisiana, Arkansas, Missouri, Kansas, Nebraska, Iowa, and Minnesota. Some tribes, including the Alabama Coushatta of eastern Texas, also participate in CENRAP.

The CENRAP's planning process was initiated in late 1999 with the first in a series of workshops held to develop the organization's charter and bylaws, to conduct initial long-range planning, and to prepare its first grant application. The organization's charter can be found at CENRAP's web site: [www.cenrap.org](http://www.cenrap.org).

The CENRAP defines the purposes of the organization as follows.

- Identify regional, common air management issues, and develop and identify strategies to address these issues.
- Promote policies that ensure fair and equitable treatment of all participating members.
- Coordinate science and technology to support air quality policy issues in the central states.
- Promote the implementation of federal visibility rules.
- Recommend strategies on regional haze and other air quality issues for use by member states and tribes in developing implementation programs, regulations, and laws.
- Conduct research and undertake other activities as necessary to provide the membership with information to support the development of sound state and tribal air pollution policies.

In concurrence with EPA policy, the CENRAP's bylaws state that "the CENRAP has no regulatory authority and recognizes that its members, in accordance with existing law, retain all legal authority" (CENRAP 2000). While Texas participates in CENRAP and benefits from the technical work coordinated by the RPO, Texas has sole responsibility and authority for the development and content of its Regional Haze SIP.



**Figure 3-1: Map of the Regional Planning Organizations**

The Policy Oversight Group (POG) is the governing body for CENRAP. The POG establishes internal policies, protocols, strategies, and budgets and provides guidance to the various CENRAP workgroups. Voting membership on the POG includes:

- designee of governor or environmental commissioner from each member state; and
- one tribal representative for each of the EPA Regions V, VI, and VII.

Ex-officio membership on the POG includes the following:

- United States Secretary of the Interior or designee;
- United States Secretary of Agriculture or designee;
- Administrator of the EPA or designee;
- two representatives from local programs that are members of the Central States Air Resources Agencies (CenSARA); and
- additional tribal representatives designated in accordance with the bylaws

The POG established five CENRAP workgroups that work in particular disciplines and facilitate the development of the regional haze implementation plans. The workgroups are as follows.

- Modeling
- Emissions Inventory
- Monitoring
- Implementation and Control Strategies
- Communications

The Communications workgroup establishes internal communication protocols, assists with contract development, manages the CENRAP web site, and conducts public outreach. The other four workgroups conduct strategic planning for their subject matter areas and conduct and document the work of contractors or the in-kind services of CENRAP participants.

A Technical Steering Committee comprised of representatives from the states, tribes, and other stakeholder groups discusses complex technical issues and provides technical guidance to the workgroups. Also, representatives from CENRAP participate in discussions with other RPOs about issues that affect some or all of the RPOs and that require close communication among these organizations.

The POG and workgroups meet quarterly or biannually, depending on the need. The technical steering committee meets biannually. The POG usually holds conference calls once per month. The frequency of workgroup and steering committee conference calls varies.

The CENRAP may remain active following the initial submission of implementation plans by the states, since the Regional Haze Rule requires periodic progress reports and implementation plan revisions. The extent to which the CENRAP remains active will depend on the usefulness of the organization to its members and the availability of continuing, adequate funding to cover the organization's expenses.

### **3.2 HISTORY OF TEXAS PARTICIPATION**

The TCEQ has participated in the planning process for regional haze since December 1999, when a workshop was convened by CenSARA to begin developing the charter, bylaws, and initial long-range plan for the CENRAP. After workgroups were formed, the TCEQ participated in the Modeling, Emissions Inventory, Monitoring, and Implementation and Control Strategies workgroups. The TCEQ designated appropriate workgroup representatives based on their areas of expertise. For approximately three years, a TCEQ staff member dedicated time as co-chair of the Emissions Inventory workgroup. For more than two years, four TCEQ staff members have dedicated time to monthly CENRAP conference calls with four of the technical workgroups and dedicated additional time to activities that include analyzing modeling changes, participating in quality control checks, and more. In addition, the TCEQ has one SIP coordinator dedicated solely to regional haze issues. The TCEQ has represented the state on the POG and technical steering committee from their inception.

Significant portions of this SIP were developed based on emissions inventories, modeling, and SIP protocols created by the CENRAP and its contractors. Through its participation, the TCEQ provided data to the CENRAP in order to produce emissions inventories and modeling that the states could use when drafting their Regional Haze SIPs.

The Regional Haze Rule does not require states and tribes to participate in RPOs. However, Texas will continue participation in the CENRAP as necessary to fulfill the state's legal obligations in meeting the requirements of the rule. Texas' continued participation is contingent on CENRAP's receiving continued, adequate funding from the EPA.

## CHAPTER 4. STATE, TRIBE, AND FEDERAL LAND MANAGER CONSULTATION

### 4.1 INTRODUCTION

Title 40 CFR §51.308(i) requires each state to consult with identified FLMs prior to the proposal of the Regional Haze SIP. In development of this plan, the FLMs were consulted in accordance with the provisions of §51.308(i)(2). In developing its reasonable progress goals (RPGs), states are required to consult with other states reasonably anticipated to cause or contribute to visibility impairment in their Class I areas. If a state determines it has emissions that are reasonably anticipated to contribute to visibility impairment in any Class I area in another state, that state must consult with the other states when developing its long-term strategy. The TCEQ provided other states, tribes, FLMs, and other stakeholders an opportunity for consultation through teleconference calls and notified the FLMs of their opportunity to consult in person at least 60 days prior to holding public hearings.

During the consultation process, the states, FLMs, and stakeholders were given the opportunity to address the assessment of the visibility impairment in any Class I areas, materials presented to stakeholders prior to the consultation calls, recommendations on the development of RPGs, and recommendations on the development of strategies to address visibility impairment. Throughout the consultation calls, the TCEQ encouraged participants to continue coordination and consultation during the development of the SIP prior to adoption. The FLMs must be consulted in the following instances: development and review of implementation plan revisions; review of five-year progress reports; and development and implementation of other programs that may contribute to impairment of visibility in Class I areas.

### 4.2 CONSULTATION ON CLASS I AREAS IN TEXAS

The TCEQ held Regional Haze SIP consultation meetings by conference call with FLMs for the Class I visibility areas in Texas, Big Bend and Guadalupe Mountains, other states that impact the Texas Class I areas, the EPA, and stakeholders such as industry and environmental representatives. Table 4-1: *Consultation Calls* contains the dates and times of the consultation calls.

**Table 4-1: Consultation Calls**

Call	Date	Time
1 <sup>st</sup> Consultation call	July 11, 2007	2:30-4:00 p.m.
2 <sup>nd</sup> Consultation call	July 18, 2007	10:00-11:30 p.m.
3 <sup>rd</sup> Consultation call	July 31, 2007	10:00-11:30 p.m.

The first consultation call primarily addressed four technical papers. These papers discussed natural conditions, the impacts of dust storms in Big Bend and Guadalupe Mountains, Integrated Planning Model (IPM) emission projections, and glide path and RPGs. A summary paper of these technical papers was provided to consultation participants.

The second and third consultation calls consisted of open dialogue between the states and FLMs to gather input on the content of the technical papers. Additionally, the FLMs suggested that the TCEQ revise the prevention of significant deterioration (PSD) permit process to include FLM notification provisions. Texas has committed to further consultations with the FLMs aimed at a mutually agreeable set of procedures to address their concerns about the Texas PSD program.

More detailed summaries from all three calls are provided in Appendix 4-1: *Summary of Three Texas Consultation Calls*.

A list of persons or entities contacted to participate in the consultation process is provided in Appendix 4-2: *Contact List for Consultation Calls*. Chapter 11 of this SIP also discusses the consultation process regarding development of the long-term strategy.

The TCEQ has determined which states contribute to visibility impairment at the Texas Class I area by using the results from the CENRAP particulate matter source apportionment technology (PSAT) modeling. These states are New Mexico, Oklahoma, Kansas, and Louisiana. Appendix 8-1: *Technical Support Document for CENRAP Emissions and Air Quality Modeling to Support Regional Haze State Implementation Plans* shows the pertinent modeling results. Texas is not requesting additional reductions from other states at this time.

### **4.3 CONSULTATIONS ON CLASS I AREAS IN OTHER STATES**

The TCEQ has participated in the CENRAP since its inception in 1999. The TCEQ has cooperated with all CENRAP states, tribes, and FLMs that participated in:

- developing information on base period 2002 visibility impairment;
- developing projections of 2018 emissions and visibility impairment considering all adopted emissions reductions required in Texas and federal rules; and
- developing estimates of 2064 natural conditions.

Texas and federal rules that specifically reduce visibility-impairing pollutants include the Clean Air Interstate Rule (CAIR), BART requirements, the emissions reductions from the federal motor vehicle emission control program (FMVCP), the EPA refinery consent decrees, and the EPA requirements for cleaner non-road diesel and gasoline-powered engines.

The TCEQ participated in the Modeling, Emissions Inventory, Monitoring, and Implementation and Control Strategies workgroups of CENRAP. The TCEQ designated appropriate workgroup representatives based on their areas of expertise. For more than two years, the TCEQ has dedicated time to monthly technical workgroups through CENRAP conference calls. Since 1999, Texas has actively participated in regional planning (Chapter 3). The TCEQ also participated in inter-regional planning organization calls related to modeling. The FLMs, EPA, tribes, states, and industry were encouraged to participate in workgroup calls, workshops, and meetings.

The TCEQ reviewed CENRAP modeling to assess which Class I areas in other states might be impacted by Texas' emissions. Modeling indicated that Texas impacts Breton Wilderness Area in Louisiana, the Great Sand Dunes in Colorado, and several Class I sites in New Mexico. The TCEQ also consulted the adjacent states in which the modeling data indicated no significant impact by Texas, including Arkansas, Missouri, and Oklahoma.

Through conference calls, Arkansas and Missouri consulted with Texas about the impact of Texas' emissions on regional haze at the Class I areas in those states. They accepted Texas' planned emissions and regional haze impact reductions as adequate for their Class I areas for this initial SIP (Appendix 4-3).

Oklahoma invited Texas to consult about Oklahoma's Class I area, the Wichita Mountains National Wildlife Refuge. The TCEQ attended Oklahoma's three consultation calls held in August and September 2007. In August 2007, the TCEQ received a letter from Oklahoma regarding visibility improvements in the Wichita Mountains National Wildlife Refuge. The letter requested that Oklahoma be able to comment on best available control technology determinations for PSD sources that significantly impact Wichita Mountains and a request that Class I impact reviews be required for all proposed PSD sources within 300 kilometers of a Class I area. In an October 2007, response letter the TCEQ has agreed to notify Oklahoma, along with the relevant



FLM, whenever modeling indicates that a proposed source significantly impacts Wichita Mountains. In regards to the 300 kilometer request, the TCEQ is urging the EPA to adopt significant impact levels for Class I reviews so that there is a standard review process across the country. During the interim, the TCEQ is committed to working with the FLMs on mutually acceptable criteria for determining when a proposed PSD source should conduct a Class I review. Appendix 4-3: *Additional Consultation with States* contains a copy of these letters.

In response to comments from the EPA and FLMs in March 2008, the TCEQ sent consultation letters to Oklahoma, Louisiana, Missouri, Arkansas, Colorado and New Mexico. Included with the letters were a discussion and data of the CENRAP Particulate Matter Source Apportionment Technology (PSAT) modeling determining the contribution from each Texas source area to visibility impairment at Class I areas in the given state. The TCEQ participated fully in the analysis of this data, base period visibility impairment, natural visibility condition estimates, and 2018 projections based on current and anticipated future state and federal controls. The PSAT modeling indicates that the probable impact of Texas sources will be reduced by 2018 in all of the affected Class I Areas due to the expected emissions reductions from current and planned controls. Also included with the consultation letter, where applicable, were area of influence maps for each Class I area in the CENRAP states. For reference purposes, the map showed the portions of Texas that are in the first and second order sulfate and nitrate areas of influence for the given Class I Area. The sulfur dioxide and nitrogen oxide sources shown on the map are Texas sources the TCEQ identified as high priority due to the fact that they have an emissions over distance equal to or greater than five ( $q/d \geq 5$ ) for one or more Class I areas. Also included was a table of sources of particular interest to the affected Class I Area(s) due to their emissions and their positions within the area of influence. The TCEQ also requested recipients of the letters to confirm they are not expecting any additional emission reductions. These letters and associated documents are included in Appendix 4-3.

In an April 21, 2008, letter, Missouri's Department of Natural Resources responded that no further emissions reductions were requested of Texas (Appendix 4-3). In a June 10, 2008, letter, Arkansas' Department of Environmental Quality responded that no further emissions reductions were requested of Texas (Appendix 4-3). In a June 24, 2008 letter, Colorado's Department of Public Health and Environment responded that no further emissions reductions were requested of Texas at this time (Appendix 4-3). Louisiana sent confirmation that "the Louisiana Department of Environmental Quality has determined that emissions from the State of Texas do not contribute to visibility impairment at Breton Wilderness Class I Area." New Mexico has not responded to the letter as of December 2008.

## CHAPTER 5. ASSESSMENT OF BASELINE AND CURRENT CONDITIONS AND ESTIMATE OF NATURAL CONDITIONS IN CLASS I AREAS

### 5.1 VISIBILITY REQUIREMENTS

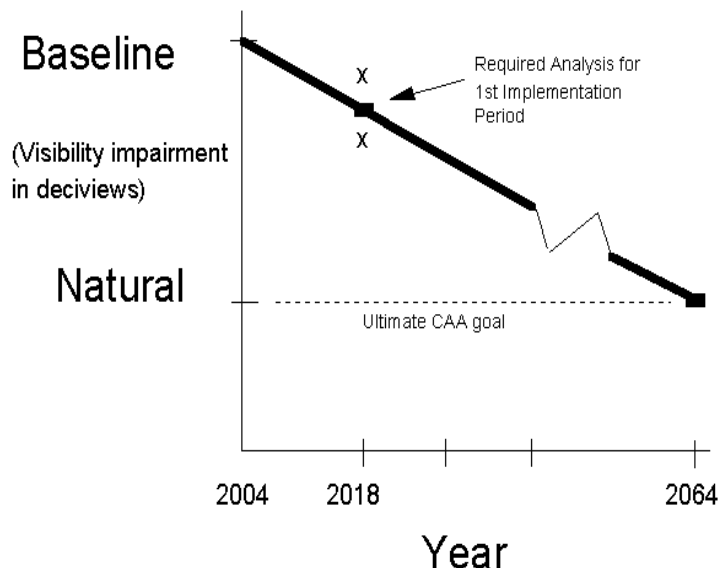
The goal of the Regional Haze Rule is to restore natural visibility conditions to the 156 Class I areas identified in the 1977 Federal Clean Air Act Amendments. Title 40 Code of Federal Regulations (CFR) §51.301 defines natural conditions as including “naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration.” State regional haze plans must contain measures that make “reasonable progress” toward this goal by reducing anthropogenic emissions that cause haze. Three metrics of visibility are part of the determination of progress toward this goal:

- baseline conditions, i.e., conditions observed during the baseline period, 2000 through 2004;
- natural conditions, i.e., those conditions existing in the absence of human-induced visibility impairment; and
- current conditions, i.e., conditions observed during the current period, which is the same as the baseline, for this initial period.

To calculate these metrics the concentrations of visibility-impairing pollutants are included as distinct terms in a light extinction algorithm with respective extinction coefficients and relative humidity factors. Total light extinction when converted to a haze index in deciviews is calculated for the average of the best 20 percent and worst 20 percent visibility days. Title 40 CFR §51.301 defines a deciview as “a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions, from pristine to highly impaired.”

Texas and other CENRAP states have elected to perform their primary visibility projections using the new Interagency Monitoring of Protected Visual Environments (IMPROVE) algorithm to calculate visibility metrics for developing RPGs because this algorithm is based on more recent science and the updated algorithm better fits the observed light extinction values. Appendix 5-1: *Discussion of the Original and Revised IMPROVE Algorithms* provides a discussion on the choice of the IMPROVE algorithm comparing the old and new equations. For more detailed documentation on the original (old) and revised (new) algorithm changes, please visit the IMPROVE web site at <<http://vista.cira.colostate.edu/improve>>.

Baseline visibility, the starting point for the improvement of visibility conditions, is the average obtained by using monitoring data for 2000 through 2004 and represents current visibility conditions for this initial period. Comparison of initial baseline conditions to natural visibility conditions shows the improvement necessary to attain natural visibility by 2064. Natural visibility is determined by estimating the natural concentrations of visibility-impairing pollutants and then calculating total light extinction with the chosen light extinction algorithm (Figure 5-1: *Generic Glide Path to Achieve Natural Conditions in 60 Years*). Each state must estimate natural visibility levels for Class I areas within its borders in consultation with FLMs and other states that impact the Class I areas (40 CFR §51.308(d)(2)). Current conditions are assessed every five years as part of the plan review where actual progress in reducing visibility impairment is compared to reduction commitments in the plan.



**Figure 5-1: Generic Glide Path to Achieve Natural Conditions in 60 Years**

Source: EPA

### 5.1.1 Default and Refined Values for Natural Visibility Conditions

The EPA's *Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Program* (EPA 2003) provides states a "default" estimate of natural visibility. The default values of concentrations of visibility pollutants are based on a 1990 National Acid Precipitation Assessment Program report (Trijonis, 1990). In the EPA's guidance, the United States is divided into East and West regions approximately along the western boundary of the states one tier west of the Mississippi River. This division divides the CENRAP states into its own East region (Arkansas, Iowa, Louisiana, Minnesota, and Missouri), containing seven Class I areas, and West region (Kansas, Nebraska, Oklahoma, and Texas), containing three Class I areas. In comparing the two regions, only sulfate ( $\text{SO}_4$ ) and organic carbon have different values, but the calculated deciview difference is significant.

However, the ultimate responsibility for calculating natural conditions lies with each state (40 CFR §51.308(d)(2)). The TCEQ determined that the default estimates were insufficiently accurate and that data and methods were available to improve these estimates. Therefore, TCEQ chose to develop its own refined estimates.

### 5.1.2 Consultation Regarding the Visibility Metrics

Consultation among states is required by the Regional Haze Rule. As part of a long-term strategy for regional haze, a state whose emissions are "reasonably anticipated" to contribute to impairment in other states' Class I areas must consult with those states (40 CFR §51.308(d)(3)). Likewise, states with Class I areas are to consult with any states whose emissions affect their Class I areas. Consultation among states is facilitated through RPOs, though some required consultations cross RPO boundaries. For example, Texas and New Mexico must collaborate on planning for the Guadalupe Mountains, though the two states participate in different RPOs.

A chief purpose of the RPOs is to provide a means for states to confer on all aspects of the regional haze issue, including consultation on RPGs and long-term strategies, which are based on the baseline, current, and natural visibility determinations. This process is described in Chapter 3: *Regional Planning*. The CENRAP provides a forum for member states and tribes to consult on determinations of baseline and natural visibility conditions in subject Class I areas. States in the CENRAP have also conferred with neighboring Class I area states outside CENRAP, both individually and by way of the appropriate RPO.

Title 40 CFR §51.308(i) requires Class I area states to coordinate with the FLMs, including consultation on implementation, assessment of visibility impairment, and recommendations regarding RPGs and strategies for improvement. This consultation requirement is discussed in Chapter 4: *State, Tribe, And Federal Land Manager Consultation*. Through participation in the CENRAP and individually, Texas has completed this regulatory requirement.

## 5.2 BASELINE VISIBILITY CONDITIONS

For the five-year baseline period, 2000 through 2004, sites are required to have three valid years of data from which baseline conditions can be constructed. The Visibility Information Exchange Web System (VIEWS) <http://vista.cira.colostate.edu/views/> has posted haze index values, based on the revised IMPROVE algorithm, for the 20 percent worst and best days for each complete year of the baseline period. From these values, the baseline haze index is calculated by averaging over the baseline period. Table 5-1: *Baseline Haze Indices* shows this calculation for both Big Bend and Guadalupe Mountains using the VIEWS summary data updated August 2007.

Baseline visibility for the Big Bend Class I area is 5.78 deciviews for the best 20 percent of the sample days and 17.30 deciviews for the worst 20 percent of the sample days. This baseline visibility is based on sampling data collected at the Big Bend IMPROVE monitoring site.

Baseline visibility for the Guadalupe Mountains Class I area is 5.95 deciviews for the best 20 percent of the sample days and 17.19 deciviews for the worst 20 percent of the sample days. This baseline visibility is based on sampling data collected at the Guadalupe Mountains IMPROVE monitoring site.

**Table 5-1: Baseline Haze Indices**

Class I Area	Site ID	Year	Haze Index (deciviews)	
			Most Impaired	Least Impaired
Big Bend*	BIBE1	2001	17.31	7.09
		2002	18.21	5.68
		2003	17.18	5.74
		2004	16.51	4.62
		Average	17.30	5.78
Guadalupe Mountains	GUMO1	2000	17.14	6.26
		2001	16.61	6.34
		2002	18.12	6.38
		2003	18.50	5.91
		2004	15.57	4.83
		Average	17.19	5.95

\* The fourth quarter of 2000 for Big Bend was not sufficiently complete for use in calculating a baseline average for regulatory purposes: The fourth quarter had only ten complete days.

## 5.3 NATURAL VISIBILITY CONDITIONS

Using the revised IMPROVE algorithm and the methodology detailed in Appendix 5-2: *Estimate of Natural Visibility Conditions*, the TCEQ has determined, subject to significant uncertainties in natural concentrations of organic carbon, that natural visibility conditions for the Big Bend Class I area are best represented by 10.09 deciviews for the worst 20 percent days. The Guadalupe Mountains Class I area is best represented by 12.26 deciviews for the worst 20 percent days. Appendix 5-2 provides calculations, methodologies, a discussion of the reasons for the selection of the methodology, and a demonstration of the appropriateness of these values for both Class I areas. Table 5-2: *Visibility Metrics for the Class I Areas in Texas* reports the visibility metrics computed for Big Bend and Guadalupe Mountains.

**Table 5-2: Visibility Metrics for the Class I Areas in Texas**

<b>Estimate of Natural Visibility Conditions</b>		
<b>Class I Area</b>	<b>Haze Index (deciviews)</b>	
	<b>Most Impaired</b>	<b>Least Impaired</b>
Big Bend	10.09	2.19
Guadalupe Mountains	12.26	2.10
<b>Baseline Visibility Conditions, 2000–2004</b>		
<b>Class I Area</b>	<b>Haze Index (deciviews)</b>	
	<b>Most Impaired</b>	<b>Least Impaired</b>
Big Bend	17.30	5.78
Guadalupe Mountains	17.19	5.95
<b>Estimate of Extent Baseline Exceeds Natural Visibility Conditions</b>		
<b>Class I Area</b>	<b>Haze Index (deciviews)</b>	
	<b>Most Impaired</b>	<b>Least Impaired</b>
Big Bend	7.21	3.59
Guadalupe Mountains	4.93	3.85

Analysis of the dust storms that dominate high dust events at Guadalupe Mountains and significantly impact Big Bend suggests that the dust originates from dry desert and dry lake bed areas with little or no human activity, almost all of which are situated in the Chihuahuan Desert. For instance, Gill, et al. conclude that “Field campaigns revealed that ... the vast majority of source points were natural desert landscapes” (Gill et al. 2005).

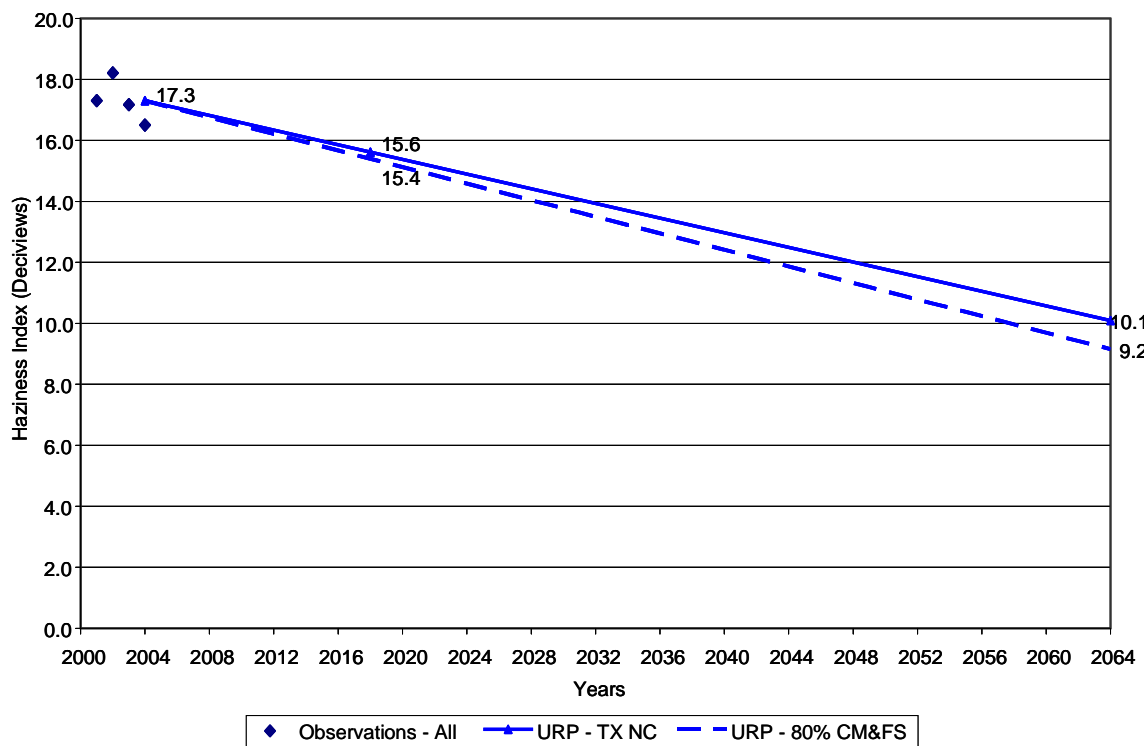
The times when human-caused dust is likely to be more important at these sites are on days with less visibility impairment than on the worst dust impaired days, since the most dust impaired days are dominated by dust storms and other blowing dust from the surrounding desert landscape. As shown in the dust storm paper of Appendix 5-2a, there are enough dust storm days at Guadalupe Mountains to make a reasonable estimate of the worst 20 percent natural visibility conditions. In other words, there were enough dust storms documented at Guadalupe Mountains to account for all of the worst 20 percent days. This lends credence to the assumption that natural dust dominates on those days and that human-caused dust is of minimal importance for the low visibility days.

The situation at Big Bend is a little more uncertain because the dust impact is less from major dust storms and more from “locally”<sup>1</sup> windblown dust, as shown by the studies by Kavouras, et al. (2006 and 2007). However, the area of the park is approximately 801,000 acres, and broad restrictions on human use of the park are in place to minimize human impact on its desert environment. Additionally, the Big Bend IMPROVE monitoring site is surrounded by the park, with the closest park boundary approximately ten miles away, while land use and soil erodibility indicates the landscape surrounding Big Bend (and even Guadalupe Mountains) is overwhelmingly dominated by highly erodible soils in scrub/scrubland areas.

As explained in Appendix 5-2: *Estimate of Natural Visibility Conditions*, the estimates for what portion of each visibility component is to be considered as natural, at least for the estimation of natural visibility values for Texas’ Class I areas, is taken to be essentially the same as used by the Natural Conditions II (NC II) committee (Pitchford, et al. 2006), with the exception of fine soil (FS) and coarse mass (CM). As justified within that appendix and within the other referenced

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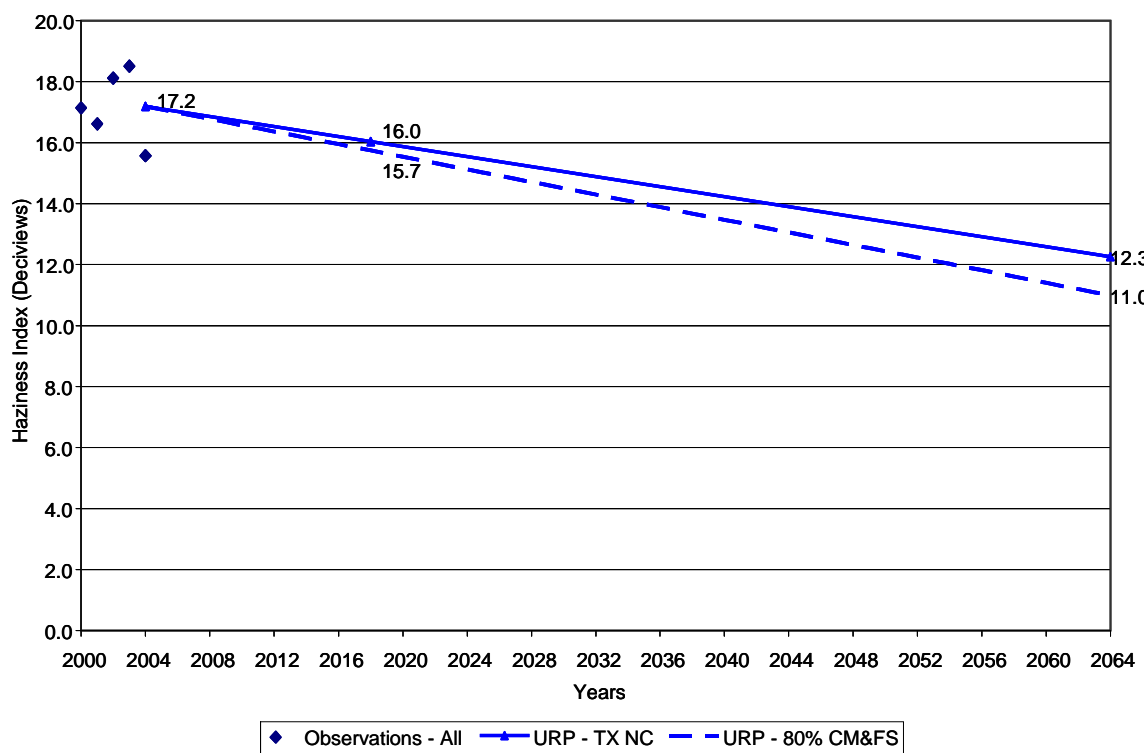
<sup>1</sup> Note that “local” as used in the Kavouras work does not correspond with any distance measure, but with how well the dust dominated days in the 20 percent worst measured visibility days correlated with local wind speed and direction.



**Figure 5-2: Big Bend Uniform Rate of Progress (URP)**

TX NC is Texas' estimate of natural conditions.

80 % CM&FS is a comparison where 80 percent of fine soil and coarse mass is taken as natural.



**Figure 5-3: Guadalupe Mountains Uniform Rate of Progress**

work, the TCEQ estimate takes essentially all fine soil and course mass concentrations to be approximated as natural, at least for the estimation of the least and most impaired natural visibility values for Texas' Class I areas. (The actual computations are carried out using each area's own data.)

Since the estimate has some degree of uncertainty, just as there is uncertainty in the estimates used by the NC II, the TCEQ provides in Figure 5-2: *Big Bend Uniform Rate of Progress (URP)* and Figure 5-3: *Guadalupe Mountains Uniform Rate of Progress* graphs of the Uniform Rate of Progress (URP) for the worst 20 percent days both with the estimate approximating 100 percent fine soil and course mass as natural (TX NC) along with a calculation treating only 80 percent fine soil and course mass as natural (80% CM&FS), for both Texas Class I areas. This 80 percent calculation is displayed due to a request from some Federal Land Managers to illustrate how sensitive this natural visibility estimate is to approximating 100 percent of the fine soil and course mass as natural; there is no other significance to this 80 percent calculation for this SIP.

#### **5.4 NATURAL VISIBILITY CONDITIONS, AN ONGOING EFFORT**

Because natural visibility estimates are calculated from complex environmental chemistry, require significant assumptions in the calculation and are ultimately calculated without a directly observable measurement, there remains considerable potential for improvement in estimation. Since the natural concentrations and statistics of all components important for Regional Haze have significant uncertainties, the TCEQ will be continuing to evaluate data, modeling, and any other sources of information, as well as potentially devising additional monitoring, sampling and/or analysis schemes, in order to further improve these estimates. Furthermore, the TCEQ plans to work with the EPA, FLMs, and other experts and researchers to refine natural conditions estimates for future five-year reports and major regional haze SIP revisions.

At this point, the component that most likely needs improved estimation is organic carbon.<sup>2</sup> Improved sampling and/or analysis techniques are likely methods in the pursuit of an improved characterization of the natural contributions to this component. However, the application of such methods will depend upon available resources and estimates of potential benefits.

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<sup>2</sup> Additionally, there is significant regulatory uncertainty with regard to what prescribed fires should or should not be considered as "natural." When the EPA revises the *Interim Air Quality Policy on Wildland and Prescribed Fires*, it is expected such issues will be clarified.

## **CHAPTER 6. MONITORING STRATEGY**

### **6.1 INTRODUCTION**

Title 40 CFR §51.308(d)(4) of the Regional Haze Rule requires a monitoring strategy for measuring, characterizing, and reporting regional haze visibility impairment that is representative of all mandatory Class I areas within Texas. The monitoring strategy relies upon data from the Interagency Monitoring of Protected Visual Environments (IMPROVE) program. A steering committee with representatives from federal, regional, and state organizations governs the program. These organizations include the United States Environmental Protection Agency (EPA), the National Park Service (NPS), the United States Fish and Wildlife Service (FWS), the United States Forest Service, the Bureau of Land Management (BLM), the National Association of Clean Air Agencies, and other entities. The IMPROVE Steering Committee allocates IMPROVE monitoring resources, which come from a number of agencies including the EPA, NPS, FWS, and BLM. The IMPROVE program arranges for the operation of IMPROVE monitors, the analysis of samples from the monitors, and the validation and internet posting of the IMPROVE data as well as maintenance of the Visibility Information Exchange Web System (VIEWS) web site <http://vista.cira.colostate.edu/views>, which makes the data easily available to states, regional planning organizations, and the public. The state regional planning organizations (RPOs) contribute financial support to the VIEWS program and web site.

### **6.2 MONITORING AT CLASS I AREAS IN TEXAS**

Currently, the IMPROVE program provides an IMPROVE monitor at each of the two Class I areas in Texas, Big Bend and Guadalupe Mountains. Because of their location, the monitors are appropriate for determining progress in reducing visibility impairment in the Texas Class I areas. The monitoring strategy relies on continuation of IMPROVE monitoring at these sites. The Texas Commission on Environmental Quality (TCEQ) plans to continue to participate in the IMPROVE network through the financial support of the EPA. The TCEQ also plans to continue supporting the VIEWS work and the VIEWS web site by urging CENRAP to continue its funding of VIEWS. No additional monitoring beyond the IMPROVE network is required or necessary for assessing visibility conditions at the two Class I areas in Texas or at the Class I areas that Texas' emissions affect in other states.

The IMPROVE program reviewed its aerosol monitoring sites in 2006 to set priorities for maintaining the sites, in the event of federal budget cuts affecting the IMPROVE program. This review determined that the IMPROVE aerosol samplers at Texas' two Class I areas represent conditions different from the conditions at the nearest Class I area IMPROVE monitors. Texas' two Class I IMPROVE monitors are not candidates for discontinuation since other IMPROVE monitors cannot represent conditions at Big Bend or Guadalupe Mountains.

The TCEQ considers that continued IMPROVE monitoring at all current Class I IMPROVE sites that Texas' emissions impact and continued VIEWS services are all centrally important to the effort to monitor reductions in anthropogenic haze impacts at these sites. If funding for these IMPROVE sites or the VIEWS program is threatened, the TCEQ plans to work closely with the EPA, the FLMS, and neighboring states to attempt to find the funding to continue the current Class I IMPROVE monitoring and VIEWS services for these sites.

### **6.3 ASSESSMENT OF VISIBILITY IMPROVEMENT AT CLASS I AREAS**

Future assessments of visibility impairment and progress in reducing visibility impairment at Texas' two Class I areas, and at Class I areas in other states that Texas' emissions affect, will use the new IMPROVE equation and will use data as prescribed in the EPA's Regional Haze Rule (40 CFR Part 51, Subpart P). The assessment will follow, as appropriate, the EPA's official guidance including *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM<sub>2.5</sub>, and Regional Haze* (EPA 2007).



#### **6.4 REPORTING VISIBILITY MONITORING DATA TO THE ADMINISTRATOR**

The TCEQ does not directly collect or handle IMPROVE data. The TCEQ plans to continue to participate in VIEWS through CENRAP. The TCEQ considers VIEWS to be a core part of the overall IMPROVE program. The TCEQ plans to continue to report IMPROVE data from the two Class I areas in Texas to the EPA by continuing to support its posting on the VIEWS web system. The TCEQ's support will be through continuing membership in CENRAP and through requesting that both the EPA and this multi-state organization continue to support VIEWS.

If Texas collects any visibility monitoring data through the state's air quality monitoring networks, the TCEQ will report those data to the EPA as specified under the Performance Partnership Grant agreement negotiated with the EPA Region 6. All validated data and data analysis results from any TCEQ visibility-related special studies are public information. TCEQ plans to continue its practice of sharing the data and information with the EPA, the Federal Land Managers, and the public.

The TCEQ currently has a TEOM (tapered element oscillating microbalance) continuous monitor for PM<sub>2.5</sub>, an every-sixth-day chemical speciation monitor, and meteorological equipment operating at Big Bend. The data from these monitors is available from the TCEQ. Additionally, the TCEQ hosts the National Park Service's Big Bend ozone data on the TCEQ web site.

#### **6.5 ASSESSING THE IMPACT OF EMISSIONS FROM TEXAS ON CLASS I AREAS**

Chapters 5, 8, 10, and 11 describe the procedures used in developing this SIP revision. These chapters include the procedures to assess the quantitative impact of emissions from Texas on Class I areas in Texas and on Class I areas that Texas' emissions affect in other states.

Chapter 7 describes the procedures used for this SIP revision to produce the statewide emissions inventory of pollutants reasonably anticipated to cause or contribute to visibility impairment in all the mandatory Class I areas that Texas' emissions affect. Chapter 12 describes the plans for the five-year implementation plan review and for the 2018 regional haze SIP revision.

The Performance Partnership Grant agreement negotiated with the EPA Region 6 and the quality assurance procedures for collecting and reporting periodic emissions inventories to the EPA describe the collection, quality assurance, record keeping, maintenance, availability, and reporting of emissions and monitoring data to the EPA.

## CHAPTER 7. EMISSIONS INVENTORY

Title 40 CFR §51.308(d)(4)(v) requires a statewide emissions inventory of pollutants that are reasonably anticipated to cause or contribute to visibility impairment in any Class I area. As specified in this section, the pollutants to be inventoried include volatile organic compounds (VOC), nitrogen oxides (NO<sub>x</sub>), fine particulate matter (PM<sub>2.5</sub>), particulate matter less than ten microns in diameter (PM<sub>10</sub>), ammonia (NH<sub>3</sub>), and sulfur dioxide (SO<sub>2</sub>). In accordance with the EPA guidance, the TCEQ developed a baseline Texas inventory for the year 2002, and submitted the inventory to the Central Regional Air Planning Association (CENRAP) for use in photochemical modeling supporting the Regional Haze SIP. A summary of the CENRAP developed 2002 Texas inventory is provided in Table 7-1: *CENRAP's 2002 Base Year Emissions Inventory Summary for Texas*. Details for the 2002 emissions inventory are provided in Appendix 7-1: *Texas Emissions Inventory Development: Base Year 2002 and Projected Year 2018*.

**Table 7-1: CENRAP's 2002 Base Year Emissions Inventory Summary for Texas**

Category	CO (tpy)	NO <sub>x</sub> (tpy)	SO <sub>2</sub> (tpy)	TOG* (tpy)	PM <sub>2.5</sub> (tpy)	PM <sub>10</sub> (tpy)	NH <sub>3</sub> (tpy)
Area	908,407	280,811	111,853	1,163,549	347,490	1,552,824	380,057
Point	498,467	600,725	821,961	207,695	46,789	80,947	2,609
Non-Road	1,210,158	242,551	21,828	148,952	15,089	15,556	56
On-Road	4,098,391	664,163	18,814	309,707	11,275	15,476	21,599
Total	6,715,423	1,788,250	974,457	1,829,902	420,642	1,664,803	404,321

\*TOG is total organic gas, which includes total hydrocarbons.

The 2002 baseline inventory is composed of several different categories. The point sources are defined as industrial, commercial, or institutional sites that meet the reporting requirements of 30 Texas Administrative Code (TAC) §101.10. Area sources include commercial, small-scale industrial, and residential categories of sources that use materials or operate processes that can generate emissions. These sources of emissions fall below the point source reporting levels and are too numerous or too small to identify individually. The area source fires inventory is also included in the area source category. This category includes agricultural burning, prescribed burning of forests, and prescribed burning of rangeland. The fugitive dust inventory includes dust from construction, mining, quarrying, bulk materials storage (such as coal and gravel), and feedlots.

The area source SO<sub>2</sub> emissions used by the CENRAP in their modeling are significantly higher than the 15,633 tons per year (tpy) reported by the TCEQ. The difference is industrial and residential coal combustion which was erroneously included in the CENRAP inventory. The TCEQ has been working with CENRAP to correct this error for future modeling, but there was not sufficient time to remodel with the more accurate TCEQ-supplied inventory. CENRAP's modeled emissions estimate is not expected to significantly impact visibility estimates for 2018 because of the relatively small contribution from these Texas sources on Class I areas.

Non-road mobile sources include aircraft operations, marine vessels, recreational boats, railroad locomotives, and a broad category of non-road equipment that include everything from 600-horsepower engines mounted on construction equipment to one-horsepower string trimmers.

On-road mobile sources of emissions consist of automobiles, trucks, motorcycles, and other motor vehicles traveling on public roadways. On-road mobile source emissions are usually

categorized as either combustion-related emissions or evaporative hydrocarbon emissions. Combustion-related emissions are estimated for vehicle engine exhaust. Evaporative hydrocarbon emissions are estimated for the fuel tank and other evaporative leak sources on the vehicle.

Biogenic sources include hydrocarbon emissions from crops, lawn grass, and trees as well as a small amount of NO<sub>x</sub> emissions from soils. These emissions are listed in Table 7-2: *Statewide Biogenic Emissions*.

**Table 7-2: Statewide Biogenic Emissions**

<b>Biogenic</b>	<b>Nitrogen Oxide (tpy)</b>	<b>Carbon Monoxide (tpy)</b>	<b>Volatile Organic Compounds (tpy)</b>
	184,896	755,941	4,033,760

Methodologies used in developing the 2002 emissions inventory are documented in Appendix 7-1. The technical support documents are available in Appendix 8-1: *Technical Support Document for CENRAP Emissions and Air Quality Modeling to Support Regional Haze SIP*.

The CENRAP projected the 2002 base year emissions for Texas and other central states to the 2018 future planning year primarily using the Economic Growth Analysis System (EGAS5) for non-electric generating unit point sources, area sources, and non-road mobile sources; MOBILE6 for on-road mobile sources; and the Integrated Planning Model Version (IPM) 2.19 for electric generating units (Appendix 7-2: *Integrated Planning Model Projections of Electric Generating Unit Emissions for the Regional Haze State Implementation Plan*). Emissions from recently permitted electric generating units were incorporated into the IPM file. Only the units that will be shut down under enforceable actions are removed from the future inventory.

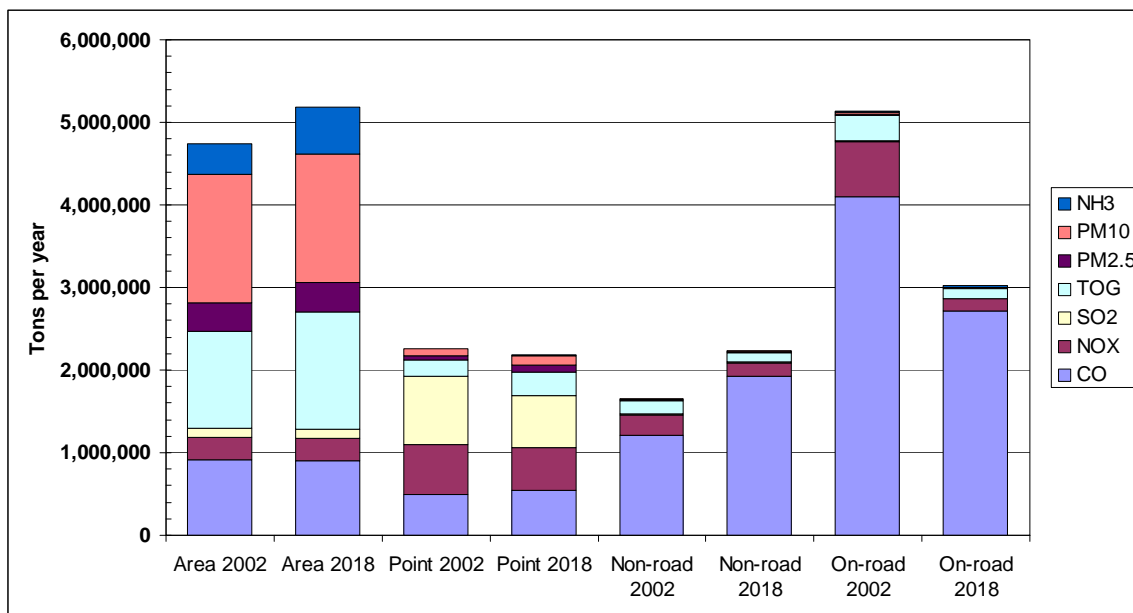
From 2002 to 2018, the CENRAP projected point source emissions increases in the organic compounds, CO, and particulate matter (PM) categories. For non-EGU industrial sources, CENRAP predicted increases in all contaminant categories (ranging from slight increases in NO<sub>x</sub> and SO<sub>2</sub> to significant increases in CO and organic compounds). The increases predicted by CENRAP's inventory are contra-indicated by the actual decreases represented in the annual inventory data collected between 2002 and 2005. See Appendix 7-2 for a summary of the 2005 inventory. Between 2002 and 2005, the historical data indicate actual source emissions have decreased or held approximately constant for the point sources in all categories except CO from EGUs. Based on historical decreases in emissions, CENRAP's predicted increase is considered conservative and likely over predicts Texas point source emissions for 2018. Statewide point source emissions have declined every year in Texas in an environment of significant economic growth. A summary of Texas emissions projected to 2018 is provided in Table 7-3: *CENRAP's 2018 Emissions Inventory Summary for Texas*.

**Table 7-3: CENRAP's 2018 Emissions Inventory Summary for Texas**

Category	CO (tpy)	NO <sub>x</sub> (tpy)	SO <sub>2</sub> (tpy)	TOG (tpy)	PM <sub>2.5</sub> (tpy)	PM <sub>10</sub> (tpy)	NH <sub>3</sub> (tpy)
<b>Area</b>	899,497	274,663	114,138	1,420,681	354,712	1,557,089	562,379
<b>Point</b>	542,128	525,174	625,068	283,290	80,577	121,733	6,790
<b>Non-Road</b>	1,921,674	167,451	6,988	119,855	10,588	11,498	239
<b>On-Road</b>	2,710,631	148,387	2,925	125,234	5,337	5,337	32,191
<b>Total</b>	6,073,930	1,115,676	749,119	1,949,060	451,214	1,695,657	601,598

\*TOG is total organic gas, which includes total hydrocarbons

Methodologies used by the CENRAP in developing the 2018 emissions inventory are documented in Appendix 7-1. Technical support documents detailing the inventory development are available in Appendix 8-1. These documents are available at [www.tceq.state.tx.us/implementation/air/sip/bart/haze\\_appendices.html](http://www.tceq.state.tx.us/implementation/air/sip/bart/haze_appendices.html). A comparison of the change in emissions by source category is shown in Figure 7-1: *Comparison of Base and Projected Annual Emissions by Source Category*. Even though PM<sub>2.5</sub> is a subcategory of PM<sub>10</sub>, both are shown for purposes of comparison.

**Figure 7-1: Comparison of Base and Projected Annual Emissions by Source Category**

## CHAPTER 8. MODELING ASSESSMENT

### 8.1 OVERVIEW

The Texas Commission on Environmental Quality (TCEQ) participated in the Central Regional Air Planning Association (CENRAP) regional planning process, as described in Chapter 3: *Regional Planning* and is using the technical work conducted by CENRAP in support of this state implementation plan (SIP) revision (Table 8-1: *Federal Mandated Class I Areas in the CENRAP States*). The CENRAP 2002 and projected 2018 annual emissions and air quality modeling was performed by the CENRAP modeling team. Where necessary, the TCEQ also conducted analyses specific to Texas. For instance, the TCEQ conducted Best Available Retrofit Technology (BART) screening modeling analyses independently from CENRAP, but used the databases developed by CENRAP as the basis for the analyses. The BART screening modeling analyses are described further in Chapter 9: *Best Available Retrofit Technology*.

This chapter describes CENRAP regional emissions and air quality modeling that was conducted to support the central states' regional haze SIPs. The information contained in this chapter draws from the Technical Support Document (TSD) developed by the CENRAP modeling team. The TSD, contained in Appendix 8-1: *Technical Support Document for CENRAP Emissions and Air Quality Modeling to Support Regional Haze SIP*, provides further detail on the modeling analyses. Chapter 1 of the TSD presents the background, an overview of the approach, and a summary of the results of the CENRAP meteorological, emissions, and air quality modeling. Appendix A of the TSD contains more details on the meteorological model evaluation. Details on the emissions modeling are provided in Chapter 2 and Appendix B of the TSD. The model performance evaluation is presented in Chapter 3 and Appendix C of the TSD. The 2018 visibility projections and comparisons with the 2018 uniform rate of progress (URP) point are provided in Chapter 4 of the TSD, with more details given in Appendix D. Chapter 5 of the TSD contains additional supporting analysis with details on the particulate matter (PM) source apportionment modeling and alternative projections provided in Appendices E and F of the TSD, respectively. Chapter 6 lists the references cited in TSD.

### 8.2 BACKGROUND

The 1977 Federal Clean Air Act (FCAA) amendments added the protection of visibility in Federal Class I areas and established the national goal for visibility protection. The FCAA requires states to submit SIPs containing emission limits and schedules of compliance. In response to these mandates, the United States Environmental Protection Agency (EPA) promulgated the Regional Haze Rule requiring states to establish goals that provide for reasonable progress towards achieving natural visibility conditions at Class I areas. CENRAP has used regional air quality models to determine the level of visibility improvement expected by 2018.

The CENRAP Emissions and Air Quality Modeling Team consists of staff from ENVIRON and University of California at Riverside (UCR), with assistance and coordination from the CENRAP states, tribes, federal agencies, and stakeholders. The team performed the emissions and air quality modeling simulations for states and tribes within the CENRAP region, which provided analytical results used in developing implementation plans under the Regional Haze Rule. The CENRAP team performed emissions and air quality modeling used by the TCEQ to determine the 2018 reasonable progress goals (RPGs).

**Table 8-1: Federal Mandated Class I Areas in the CENRAP States**

<b>Class I Area</b>	<b>Acreage</b>	<b>Federal Land Manager</b>	<b>Public Law</b>
<b>Arkansas</b>			
Caney Creek Wilderness Area	14,460	USDA-FS	93-622
Upper Buffalo Wilderness Area	12,018	USDA-FS	93-622
<b>Louisiana</b>			
Breton Wilderness Area	5,000+	USDI-FWS	93-632
<b>Minnesota</b>			
Boundary Waters Canoe Area Wilderness	810,088	USDA-FS	99-577
Voyageurs National Park	114,964	USDI-NPS	99-261
<b>Missouri</b>			
Hercules-Glades Wilderness Area	12,314	USDA-FS	94-557
Mingo Wilderness Area	8,000	USDI-FWS	95-557
<b>Oklahoma</b>			
Wichita Mountains Wilderness Area	8,900	USDI-FWS	91-504
<b>Texas</b>			
Big Bend National Park	708,118	USDI-NPS	74-157
Guadalupe Mountains National Park	76,292	USDI-NPS	89-667

### 8.3 CENRAP MODELING TEAM

The CENRAP goals included support to states and tribes to meet the requirements of the Regional Haze Rule and development of scientifically supportable, cost-effective control strategies that the states and tribes may adopt to reduce anthropogenic effects on visibility impairment at Class I areas. One component of CENRAP's support to states and tribes as part of compliance with the Regional Haze Rule is performing emissions and air quality modeling. The CENRAP implemented modeling projects to:

- obtain a better understanding of the causes of visibility impairment;
- identify potential mitigation measures for visibility impairment at Class I areas;
- evaluate the effects of alternative control strategies for improving visibility; and
- project future-year air quality and visibility conditions.

The CENRAP Emissions and Air Quality Modeling Team performed the following activities:

- emissions processing and modeling;
- air quality and visibility modeling simulations;
- analysis, display, and reporting of modeling results; and
- storage and quality assurance of the modeling input and output files.

The team performed work for the CENRAP Modeling Workgroup under the supervision from the CENRAP technical director, the CENRAP executive director, and the chair of the Modeling Workgroup.

## **8.4 THE 2002 ANNUAL EMISSIONS AND AIR QUALITY MODELING**

The CENRAP 2002 annual emissions and air quality modeling started on October 16, 2004. The effort involved the preparation of numerous databases, model simulations, presentations, and reports. Many of the modeling analyses are posted on the CENRAP modeling website at: <http://pah.cert.ucr.edu/aqm/cenrap/index.shtml>. The TCEQ also has many of these modeling analyses available on request only, as these are very large files <http://www.tceq.state.tx.us/implementation/air/sip/sipcontact.html>.

### **8.4.1 Modeling Protocol**

A modeling protocol following EPA guidance was prepared at the outset of the study to serve as an outline for performing the CENRAP emissions and air quality modeling and to communicate the modeling plans to the CENRAP participants. The modeling protocol took into account CENRAP's long-term plan (CENRAP 2003) and the modeling needs of the regional haze SIPs. This modeling protocol is included in this SIP revision as Appendix 8-2: *Modeling Protocol for the CENRAP 2002 Annual Emissions and Air Quality Modeling*.

### **8.4.2 Quality Assurance Project Plan (QAPP)**

A QAPP was prepared for the CENRAP emissions and air quality modeling study (Appendix 8-3: *Quality Assurance Project Plan for Central Regional Air Planning Association Emissions and Air Quality Modeling*) and describes the quality management functions performed by the modeling team. The QAPP is based on the national consensus standards for quality assurance (ANSI/ASQC 1994). It follows EPA's guidelines for quality assurance project plans for modeling (EPA 2002) and for QAPPs (EPA 2001), and takes into account the recommendations from the North American Research Strategy for Tropospheric Ozone (NARSTO) Quality Handbook for modeling projects (NARSTO 1998). The EPA and NARSTO guidance documents were developed specifically for modeling projects, which have different quality assurance concerns than environmental monitoring data collection projects. The work performed in this project involved modeling at the basic research level and for regulatory and planning applications. In order to use model outputs for these purposes, the modeling team must establish that each model is scientifically sound, robust, and defensible by following a project planning process that incorporates the following elements as described in the EPA modeling guidance document.

- A systematic planning process including identification of assessments and related performance criteria.
- Peer-reviewed theory and equations.
- A carefully designed life-cycle development process that minimizes errors.
- Documentation of any changes from original plans.
- Clear documentation of assumptions, theory, and parameterization.
- Input data and parameters that are accurate and appropriate for the analysis.
- Output data.

A key component of the CENRAP emissions and air quality modeling QAPP is the graphical display of model inputs and outputs and multiple peer review of each step of the modeling process. Work products (e.g., emissions plots, model outputs, etc.) have been displayed on the CENRAP modeling website for review by the CENRAP modeling team, modeling workgroup, and others. This website is at: <http://pah.cert.ucr.edu/aqm/cenrap/index.shtml>.

### **8.4.3 Model Selection**

The selection of the meteorological, emissions, and air quality models for the CENRAP regional haze modeling was based on a review of previous regional haze modeling studies performed in the CENRAP region (e.g., Pitchford et al. 2004; Pun, Chen, and Seigneur 2004; Tonnesen and Morris 2004) as well as elsewhere in the United States (e.g., Morris et al 2004a; Tonnesen et al. 2003; Baker 2004). The CENRAP emissions and air quality modeling protocol (Morris et al.

2004a) provides details on the justification for model selection and the formulation of the different models.

Based on previous work by other Regional Planning Organizations (RPOs) and EPA, CENRAP selected the following models for use in modeling PM and regional haze in the central states:

- **MM5:** The Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Meteorological Model (MM5 Version 3.6 Massively Parallel Processing (MPP)) is a non-hydrostatic, prognostic meteorological model routinely used for urban- and regional-scale photochemical, fine particulate, and regional haze regulatory modeling studies (Anthes and Warner 1978; Chen and Dudhia 2001; Stauffer and Seaman 1990, 1991; Xiu and Pleim 2000).
- **SMOKE:** The Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system is an emissions modeling system that generates hourly gridded speciated emission inputs of mobile, non-road, area, point, fire, and biogenic emission sources for photochemical grid models (Coats 1995; Houyoux and Vukovich 1999). As with most "emissions models," SMOKE is principally an *emission processing system* and not a true *emissions modeling system*. With the exception of mobile and biogenic sources, the purpose of SMOKE is to provide an efficient tool for converting existing base emissions inventory data into the hourly, gridded, speciated, and formatted emission files required by an air quality model.
- **CMAQ:** EPA's Models-3/Community Multiscale Air Quality (CMAQ) modeling system is a "One-Atmosphere" photochemical grid model capable of simulating ozone, PM, visibility, and acid deposition at a regional scale for extended periods of time (Dennis, et al. 1996; Byun et al. 1998a; Byun and Ching 1999; Pleim et al. 2003).
- **CAMx:** ENVIRON's Comprehensive Air Quality Model with Extensions (CAMx) modeling system is also a state-of-science "One-Atmosphere" photochemical grid model capable of simulating ozone, PM, visibility, and acid deposition at a regional scale for extended periods of time. (ENVIRON 2006).

#### 8.4.4 MM5 Meteorological Model Configuration

The Iowa Department of Natural Resources (IDNR) performed the 2002 annual MM5 modeling on a 36 kilometer (km) grid for the continental United States (Johnson 2007). The TCEQ and EPA Region VII carried out MM5 modeling on a 12 km grid covering the central states for portions of 2002.

The MM5 Version 3.63 configuration used in the generation of the meteorological modeling datasets consists of the following (see Table 8-2: *MM5 34 Vertical Layer Definitions for more details*):

- 36 km grid with 34 vertical layers;
- 12 km nested grid for episodic modeling;
- Two-way nesting (without feedback) within the 36 km grid for 12 km runs;
- Initialization and boundary conditions were established using analysis fields generated by the Eta model. The Eta model is a hydrostatic mesoscale model that uses a pressure-based coordinate system, allowing for easier solutions to the equations of motion. The Eta model excels in capturing small-scale meteorological phenomena, especially those induced by terrain, thus improving precipitation forecasts compared to previous mesoscale models (Black 1994);
  - Eta 3D and surface analysis data (ds609.2);
  - NCEP global tropospheric SST data (ds083.0) not used;
  - Observational enhancement (LITTLE\_R);
    - NCEP ADP surface obs (ds464.0);
    - NCEP ADP upper-air obs (ds353.4);
- Pleim-Xiu (P-X) land-surface model (LSM);



- Pleim-Chang Asymmetric Convective Mixing (ACM) PBL model;
- Kain-Fritsch 2 cumulus parameterization;
- Mixed phase (Reisner 1) cloud microphysics;
- Rapid Radiative Transfer Model (RRTM) radiation;
- No shallow convection (ISHALLO=0);
- Standard 3D FDDA analysis nudging outside of PBL; and
- Surface nudging of the winds only.

#### **8.4.5 SMOKE Emissions Model Configuration**

SMOKE supports area, mobile, fire, and point source emission processing and includes biogenic emissions modeling through a rewrite of the Biogenic Emission Inventory System, Version 3 (BEIS3) (see <<http://www.epa.gov/ttn/chief/software.html#pcbeis>>). SMOKE has been available since 1996, and has been used for emissions processing in a number of regional air quality modeling applications. In 1998 and 1999, SMOKE was redesigned and improved with the support of the EPA, for use with EPA's Models-3/CMAQ <<http://www.epa.gov/asmdnerl/models3>>. The primary purposes of the SMOKE redesign were support of: (a) emissions processing with user-selected chemical mechanisms; and (b) emissions processing for reactivity assessments.

As an emissions processing system, SMOKE has far fewer "science configuration" options compared with the MM5 and CMAQ models. Appendix 8-1 summarizes the version of the SMOKE system used and the sources of data used in constructing the required modeling inventories.

#### **8.4.6 CMAQ Air Quality Model Configuration**

CENRAP used CMAQ Version 4.5 with the "SOAmuds enhancement," or modifications to the secondary organic aerosol (SOA) chemical mechanism as described below, and used the model configuration as shown in Table 8-4. The model was set up and exercised on the same 36 km RPO national grid that Western Regional Air Partnership (WRAP) and Visibility Improvements State and Tribal Association of the Southeast (VISTAS) used. CENRAP performed 12 km CMAQ sensitivity tests and found little change in model performance with a large penalty in computation time. Consequently, on February 7, 2006, the CENRAP Modeling Workgroup decided to proceed with the CENRAP emissions and air quality modeling using just the 36 km national RPO grid (Morris et al. 2006a).

Initial CMAQ 2002 simulations that VISTAS ran found that the model greatly underestimates organic mass carbon (OMC) concentrations, especially in the summer. A review of the CMAQ formulation found that it failed to treat SOA formation from sesquiterpenes and isoprene and also failed to account for the fact that SOA can become polymerized so that it is no longer volatile and stays in the particle form. Thus, VISTAS updated the CMAQ SOA module to include these missing processes and found much improved OMC model performance (Morris et al. 2006c). CENRAP tested the CMAQ Version 4.5 with SOA modification enhancement and found it performed much better for OMC than the standard versions of CMAQ Version 4.5. Therefore, CENRAP adopted CMAQ Version 4.5, with the enhanced SOA modifications (Morris et al. 2006c). CMAQ Version 4.5 is available from the CMAS center <[www.cmascenter.org](http://www.cmascenter.org)>.

#### **8.4.7 CAMx Air Quality Model Configuration**

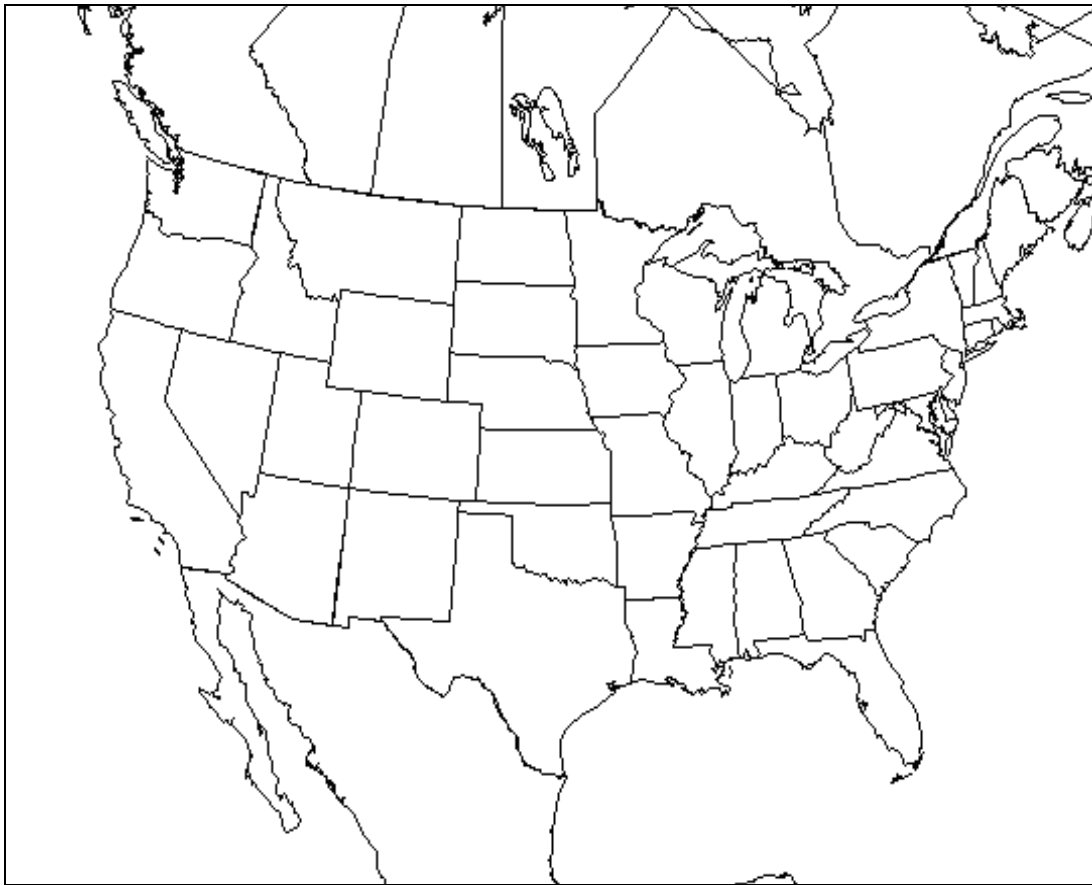
The CENRAP used CAMx Version 4.40 options similar to those used for CMAQ. The CENRAP initially ran CAMx in side-by-side comparisons with CMAQ. The CENRAP reviewed comparative model performance results and other factors for CAMx Version 4 and CMAQ Version 4.4 with SOA modifications presented at the February 7, 2006, CENRAP Modeling Workgroup meeting. The results indicated that:

- No one model consistently performed better than the other over all species and averaging times;
- Both models performed well for sulfate;
- CMAQ's winter nitrate over-prediction tendency was not as large as CAMx's;
- CAMx performed slightly better than CMAQ for elemental carbon (EC);
- CMAQ performed much better than CAMx for OMC;
- Both models over-predicted fine soil and under-predicted coarse mass (CM);
- CMAQ ran faster than CAMx due to message passing interface (MPI) multi-processing capability;
- CAMx required much less disk space than CMAQ (Morris et al. 2006b).

Based on these factors, the CENRAP selected CMAQ as the lead air quality model for the CENRAP regional haze modeling with CAMx as the secondary corroborative model. However, CAMx also contained a PM Source Apportionment Technology (PSAT) capability that was used widely in the CENRAP modeling. CMAQ does not have this capability. Appendix 8-1 lists the main CAMx configuration for the annual modeling. The CENRAP selected it, in part, to be consistent with the CMAQ model configuration. One exception was that the CAMx PSAT simulations used the Bott advection solver rather than the Piecewise-Parabolic Method (PPM) advection solver. The PPM advection solver is typically used in the standard CAMx and CMAQ runs. However, the Bott advection solver is more computationally efficient and the high computational requirements of the CAMx PSAT runs dictated this choice.

#### **8.4.8 Modeling Domains**

The CENRAP conducted emissions and air quality modeling on the 36 km national RPO domain as depicted in Figure 8-1: *National Inter-RPO Modeling Domain*. This domain consists of a 148 by 112 array of 36 km by 36 km grid cells covering the continental United States. Sensitivity simulations were also performed for episodes on a 12 km modeling domain covering the central states; however, the results were very similar to the 36 km results so CENRAP elected to proceed with the 2002 annual modeling using the 36 km domain for computational efficiency (Morris et al. 2006a).



**Figure 8-1: National Inter-RPO Modeling Domain**

Note: 36 km grid used for the CENRAP 2002 annual SMOKE, CMAQ, and CAMx modeling

#### **8.4.9 Vertical Structure of Modeling Domain**

The MM5 meteorological model ran using 34 vertical layers from the surface to a pressure level of 100 millibars (mb) (approximately 15 km above ground level). Both the CMAQ and CAMx air quality models can employ layer collapsing in which vertical layers in the MM5 are combined in the air quality model, which improves computational efficiency. WRAP and VISTAS evaluated the sensitivity of the CMAQ model estimates to the number of vertical layers (Tonnesen et al. 2005, 2006; Morris et al. 2004a). CMAQ model simulations were performed with no layer collapsing (i.e., the same 34 layers as used by MM5) and with various levels of layer collapsing. These studies found that using 19 vertical layers up to 100 mb (i.e., same model top as MM5) and matching the eight lowest MM5 vertical layers near the surface produced nearly identical results as with no layer collapsing. They also found that very aggressive layer collapsing (e.g., 34 to 12 layers) produced results with substantial differences compared to no layer collapsing. Therefore, based on the WRAP and VISTAS sensitivity analysis, CENRAP adopted the 19 vertical layer configuration up to the 100 mb model top. Figure 8-2 displays the definition of the 34 MM5 vertical layers and how they collapsed to 19 vertical layers in the CENRAP air quality modeling.

**Table 8-2: MM5 34 Vertical Layer Definitions**

<b>MM5</b>					<b>CMAQ 19L</b>				
Layer	Sigma	Pres(mb)	Height(m)	Depth(m)	Layer	Sigma	Pres(mb)	Height(m)	Depth(m)
<b>34</b>	<b>0.000</b>	<b>100</b>	<b>14662</b>	<b>1841</b>	<b>19</b>	<b>0.000</b>	<b>100</b>	<b>14662</b>	<b>6536</b>
33	0.050	145	12822	1466		0.050	145		
32	0.100	190	11356	1228		0.100	190		
31	0.150	235	10127	1062		0.150	235		
30	0.200	280	9066	939		0.200	280		
<b>29</b>	<b>0.250</b>	<b>325</b>	<b>8127</b>	<b>843</b>	<b>18</b>	<b>0.250</b>	<b>325</b>	<b>8127</b>	<b>2966</b>
28	0.300	370	7284	767		0.300	370		
27	0.350	415	6517	704		0.350	415		
26	0.400	460	5812	652		0.400	460		
<b>25</b>	<b>0.450</b>	<b>505</b>	<b>5160</b>	<b>607</b>	<b>17</b>	<b>0.450</b>	<b>505</b>	<b>5160</b>	<b>1712</b>
24	0.500	550	4553	569		0.500	550		
23	0.550	595	3984	536		0.550	595		
<b>22</b>	<b>0.600</b>	<b>640</b>	<b>3448</b>	<b>506</b>	<b>16</b>	<b>0.600</b>	<b>640</b>	<b>3448</b>	<b>986</b>
21	0.650	685	2942	480		0.650	685		
<b>20</b>	<b>0.700</b>	<b>730</b>	<b>2462</b>	<b>367</b>	<b>15</b>	<b>0.700</b>	<b>730</b>	<b>2462</b>	<b>633</b>
19	0.740	766	2095	266		0.740	766		
<b>18</b>	<b>0.770</b>	<b>793</b>	<b>1828</b>	<b>259</b>	<b>14</b>	<b>0.770</b>	<b>793</b>	<b>1828</b>	<b>428</b>
17	0.800	820	1569	169		0.800	820		
<b>16</b>	<b>0.820</b>	<b>838</b>	<b>1400</b>	<b>166</b>	<b>13</b>	<b>0.820</b>	<b>838</b>	<b>1400</b>	<b>329</b>
15	0.840	856	1235	163		0.840	856		
<b>14</b>	<b>0.860</b>	<b>874</b>	<b>1071</b>	<b>160</b>	<b>12</b>	<b>0.860</b>	<b>874</b>	<b>1071</b>	<b>160</b>
13	0.880	892	911	158	<b>11</b>	<b>0.880</b>	<b>892</b>	<b>911</b>	<b>158</b>
<b>12</b>	<b>0.900</b>	<b>910</b>	<b>753</b>	<b>78</b>	<b>10</b>	<b>0.900</b>	<b>910</b>	<b>753</b>	<b>155</b>
11	0.910	919	675	77		0.910	919		
<b>10</b>	<b>0.920</b>	<b>928</b>	<b>598</b>	<b>77</b>	<b>9</b>	<b>0.920</b>	<b>928</b>	<b>598</b>	<b>153</b>
9	0.930	937	521	76		0.930	937		
<b>8</b>	<b>0.940</b>	<b>946</b>	<b>445</b>	<b>76</b>	<b>8</b>	<b>0.940</b>	<b>946</b>	<b>445</b>	<b>76</b>
<b>7</b>	<b>0.950</b>	<b>955</b>	<b>369</b>	<b>75</b>	<b>7</b>	<b>0.950</b>	<b>955</b>	<b>369</b>	<b>75</b>
<b>6</b>	<b>0.960</b>	<b>964</b>	<b>294</b>	<b>74</b>	<b>6</b>	<b>0.960</b>	<b>964</b>	<b>294</b>	<b>74</b>
<b>5</b>	<b>0.970</b>	<b>973</b>	<b>220</b>	<b>74</b>	<b>5</b>	<b>0.970</b>	<b>973</b>	<b>220</b>	<b>74</b>
<b>4</b>	<b>0.980</b>	<b>982</b>	<b>146</b>	<b>37</b>	<b>4</b>	<b>0.980</b>	<b>982</b>	<b>146</b>	<b>37</b>
<b>3</b>	<b>0.985</b>	<b>986.5</b>	<b>109</b>	<b>37</b>	<b>3</b>	<b>0.985</b>	<b>986.5</b>	<b>109</b>	<b>37</b>
<b>2</b>	<b>0.990</b>	<b>991</b>	<b>73</b>	<b>36</b>	<b>2</b>	<b>0.990</b>	<b>991</b>	<b>73</b>	<b>36</b>
<b>1</b>	<b>0.995</b>	<b>995.5</b>	<b>36</b>	<b>36</b>	<b>1</b>	<b>0.995</b>	<b>995.5</b>	<b>36</b>	<b>36</b>
<b>0</b>	<b>1.000</b>	<b>1000</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1.000</b>	<b>1000</b>	<b>0</b>	<b>0</b>

Note: Scheme for collapsing the 34 layers down to 19 layers for the CENRAP CMAQ, and CAMx 2002 annual modeling.

#### 8.4.10 2002 Calendar Year Selection

The CENRAP selected the calendar year 2002 for regional haze annual modeling as described in the modeling protocol (Morris et al. 2004a). The EPA's applicable guidance on PM<sub>2.5</sub> and regional haze modeling at that time (EPA 2001) identified specific goals to consider when selecting modeling periods for use in demonstrating reasonable progress in attaining the regional haze goals. Since there is much in common with the goals for selecting episodes for annual and episodic PM<sub>2.5</sub> attainment demonstrations as well as regional haze, EPA's current guidance addresses all three in a common document (EPA 2007). At the time of the modeling period selection, EPA had also published an updated summary of PM<sub>2.5</sub> and Regional Haze Modeling Guidance (Timin 2002) that served, in some respects, as an interim placeholder until issuance of the final guidance as part of the PM<sub>2.5</sub> and regional haze National Ambient Air Quality Standards

implementation process published in April 2007 (EPA 2007). The interim EPA modeling guidance for episode selection (EPA 2001; Timin 2002) was consistent with the final EPA regional haze modeling guidance (EPA 2007).

EPA recommends that the selection of a modeling period derive from three principal criteria:

- a variety of meteorological conditions should be covered that include the types of meteorological conditions that produce the worst 20 percent and best 20 percent visibility days at Class I areas in the CENRAP states during the 2000 through 2004 baseline period;
- to the extent possible, the modeling data base should include days for which enhanced databases (i.e., beyond routine aerometric and emissions monitoring) are available; and
- sufficient days should be available such that relative response factors (RRFs) can be based on several (i.e., >15) days.

For regional haze modeling, the guidance goes further by suggesting that the preferred approach is to model a full, *representative* year (EPA 2001, pg. 188). Moreover, calculations of the required RRF values should be based on model results averaged over the 20 percent worst and 20 percent best visibility days determined for each Class I area based on monitoring data from the 2000 through 2004 baseline period. More recent EPA guidance (Timin 2002) suggests that states should model at least the 10 worst and 10 best visibility days at each Class 1 area. EPA also lists several "other considerations" to bear in mind when choosing potential PM and regional haze episodes including:

- choose periods that have already been modeled;
- choose periods that are drawn from the years upon which the current design values are based;
- include weekend days among those chosen; and
- choose modeling periods that meet as many episode selection criteria as possible in the maximum number of nonattainment or Class I areas as possible.

Due to limited available resources, CENRAP modeled a single calendar year. The Regional Haze Rule uses the five-year baseline period of 2000 through 2004 as the starting point for projecting future-year visibility. Thus, the modeling year should be selected from this five-year baseline period. The CENRAP selected the 2002 calendar year, which lies in the middle of the 2000 through 2004 baseline, for the following reasons.

- Based on available information, 2002 appears to be a fairly typical year in terms of meteorology for the five-year baseline period of 2000 through 2004.
- 2003 and 2004 appeared to be colder and wetter than typical in the eastern United States.
- The enhanced Interagency Monitoring of Protected Visual Environments (IMPROVE) and IMPROVE protocol sites and supersites PM monitoring data were fully operational by 2002. Much less IMPROVE monitoring data was available during 2000 through 2001, especially in the CENRAP region.
- IMPROVE data for 2003 and 2004 were not yet available at the time that the CENRAP modeling was initiated.
- The other RPOs were using 2002.

#### **8.4.11 Initial Concentrations and Boundary Conditions**

The CMAQ and CAMx models were operated separately for each of four quarters of the 2002 year using an approximate 15-day spin-up period (i.e., the models started approximately 15 days before the first day of interest in each quarter to limit the influence of the assumed initial concentrations, e.g., start June 15 for the third quarter, whose first day of interest is July 1). Sensitivity simulations demonstrated that with fifteen initialization days, the influence of initial

concentrations was minimal using the 36 km Inter-RPO continental United States modeling domain. Consequently, clean initial concentrations were specified in the CMAQ and CAMx modeling using a 15-day spin-up period.

Boundary conditions (i.e., the assumed concentrations along the later edges of the 36 km modeling domain, see Figure 8-1) used the results from a 2002 simulation by the GEOS-Chem global circulation/chemistry model. GEOS-Chem is a three-dimensional global chemistry model driven by assimilated meteorological observations from the Goddard Earth Observing System (GEOS) of the NASA Global Modeling and Assimilation Office. Research groups around the world apply it to a wide range of atmospheric composition problems, including future climates and planetary atmospheres using general circulation model meteorology to drive the model. The Atmospheric Chemistry Modeling Group at Harvard University provides central management and support of the model.

VISTAS coordinated a joint RPO study in which Harvard University applied the GEOS-Chem global model for the 2002 calendar year (Jacob, Park, and Logan 2005). The University of Houston was retained to process the 2002 GEOS-Chem output into boundary conditions for the CMAQ model (Byun 2004).

There were several quality assurance (QA) checks of the boundary conditions generated from the 2002 GEOS-Chem output. The first QA check was a range check to assure reasonable values. The boundary conditions were compared against the GEOS-Chem outputs to assure the mapping and interpolation were performed correctly. The University of Houston supplied the code to map the GEOS-Chem output to the CMAQ boundary conditions format. Environ reviewed the code and duplicated generation of the boundary conditions for several time periods during 2002.

#### **8.4.12 Emission Input Preparation**

The CENRAP SMOKE emissions modeling used updated 2002 emissions data for the United States (Pechan 2005c,e; Reid et al. 2004a,b), 1999 emissions data for Mexico (ERG 2006), and 2000 emissions data for Canada. These data were used to generate a final 2002 Base G Typical (Typ02G) annual emissions database. Numerous iterations of the emissions modeling were conducted using interim databases before arriving at the final Base G emission inventories (e.g., Morris et al. 2005). The 2018 Base G base case emissions (Base18G) for most source categories in the United States were based on projections of the 2002 inventory assuming growth and control (Pechan 2005d). 2018 EGU emissions were based on the run 2.1.9 of the Integrated Planning Model (IPM) updated by the CENRAP states. Canadian emissions for the Base18G scenario were based on a 2020 inventory. The Mexican 1999 inventory was held constant for 2018.

The Typ02G and Base18G emission inventories represent significant improvements to the preliminary emissions modeling CENRAP performed (Morris et al. 2005). While the preliminary 2002 modeling served to develop the infrastructure for modeling large emissions data sets and producing annual emissions simulations, much of the input data (both as inventories and ancillary data) were placeholders for actual 2002 data being prepared through calendar year 2005. As actual 2002 data sets became available, they were integrated into the SMOKE modeling and QA system that was developed during the preliminary modeling, to produce a high-quality emissions data set for use in the final CMAQ and CAMx modeling. The addition of entirely new inventory categories, like marine shipping, added complexity to the modeling. By the end of the emissions data collection phase, there were 23 separate emissions processing streams covering a variety of source categories necessary to generate model-ready emission inputs for the 2002 calendar year. Details on the emissions modeling are in Chapter 2 and Appendix B of the TSD (Appendix 8-1).

#### **8.4.13 Meteorological Data Input Preparation**

The IDNR conducted the 2002 36 km MM5 meteorological modeling and also performed a preliminary model performance evaluation (Johnson, 2007). CENRAP performed an additional MM5 evaluation of the CENRAP 2002 36 km MM5 simulation that included a comparative evaluation against the final VISTAS 2002 36 km MM5 and an interim WRAP 2002 36 km simulation (Kemball-Cook et al. 2004). Kemball-Cook and co-workers (2004) found the following in the comparative evaluation of the CENRAP, WRAP, and VISTAS 2002 36 km MM5 simulations (details in Appendix A of the TSD):

##### Surface Meteorological Performance within the CENRAP Region

- The three MM5 simulations (CENRAP, VISTAS, and WRAP) obtained comparable model performance for winds and humidity that were within model performance benchmarks.
- The WRAP MM5 simulation obtained better temperature model performance than the other two simulations due to the use of surface temperature data assimilation.
  - In the final WRAP MM5 simulation the use of surface temperature assimilation was dropped because it introduced instability in the vertical structure of the atmosphere.
- For all three runs, the northern portion of CENRAP domain (e.g. Minnesota) had a cold bias in winter and a warm bias in summer.

##### Surface Meteorological Performance outside the CENRAP Region

- All three runs had similar surface wind model performance in the western United States that was outside the model performance benchmarks.
- For temperature, the WRAP MM5 simulation had the best performance overall due to the surface temperature data assimilation that was dropped in the final WRAP run.
- The three runs had comparable humidity performance, although WRAP exhibited a larger wet bias in the summer and in the southwestern United States.

##### Upper-Air Meteorological Performance

- The VISTAS and CENRAP MM5 simulations were better able to reproduce the deep convective summer boundary layers compared to the WRAP MM5 simulations, which exhibited a smoother decrease in temperature with increase in altitude.
- CENRAP and VISTAS MM5 simulations better simulated the surface temperature inversions than WRAP.
- WRAP was better able to simulate the surface temperature.
- All three models exhibited similar vertical wind profiles.

##### Precipitation Performance

- In winter, all three MM5 simulations exhibited similar, fairly good performance in reproducing the spatial distribution and magnitudes of the monthly average observed precipitation.
- In summer, all runs had a wet bias, particularly in the desert southwest where the interim WRAP run had the largest wet bias.

In conclusion, the VISTAS simulation appeared to perform best, and the CENRAP MM5 model performance was generally between the VISTAS and WRAP performance, with performance more similar to VISTAS than WRAP. Although the interim WRAP MM5 simulation performed best for surface temperature due to the surface temperature data assimilation, the surface temperature assimilation degraded the MM5 upper-air performance including the ability to assimilate surface inversions and was ultimately dropped from the final WRAP MM5 simulations (Kemball-Cook et al. 2005).

The IDNR 12 km MM5 simulations were also evaluated and compared with the performance of the 36 km MM5 simulation (Johnson et al. 2007). The IDNR 36 km and 12 km MM5 model performance was similar (Johnson 2007), which supported the findings of the CMAQ and CAMx 36 and 12 km sensitivity simulations that there was little benefit of using a 12 km grid for simulating regional haze at rural Class I areas (Morris et al. 2006a). However, as noted by Tonnesen and co-workers (2005; 2006) and EPA modeling guidance (1991; 1999; 2001; 2007) this finding does not necessarily hold for eight-hour ozone and PM<sub>2.5</sub> modeling that is characterized by sharper concentration gradients and frequently occurs in the urban environment as compared to the more rural nature of regional haze.

#### **8.4.14 Photolysis Rate Model Input**

Several chemical reactions in the atmosphere are initiated by the photodissociation of various trace gases. To accurately represent the complex chemical transformations in the atmosphere, accurate estimates of these photodissociation rates must be made. The Models-3/CMAQ system includes the JPROC processor, which calculates a table of clear-sky photolysis rates (or J-values) for a specific date. JPROC uses default values for total aerosol loading and provides the option to use default ozone column data or to use measured total ozone column data. These data come from the Total Ozone Mapping Spectrometer (TOMS) satellite data. TOMS data that is available at 24-hour averages was obtained from <http://toms.gsfc.nasa.gov/eptoms/ep.html>. Day-specific TOMS data was used in the CMAQ radiation model (JPROC) to calculate photolysis rates. The TOMS data were missing or erroneous for several periods in 2002: August 2-12, June 10, and November 18-19. Thus, the TOMS data for August 1, 2002, was used for August 2-7 and TOMS data for August 13 was used for August 8-12. Similarly, TOMS data for June 9 was used for June 10 and data for August 17 was used for August 18-19. Note that the total column of ozone in the atmosphere is dominated by stratospheric ozone, which has very little day-to-day variability, so the use of TOMS data within a week or two of an actual day introduces minimal uncertainties in the modeling analysis.

JPROC produces a "look-up" table that provides photolysis rates as a function of latitude, altitude, and time (in terms of the number of hours of deviation from local noon, or hour angle). In the current CMAQ implementation, the J-values are calculated for six latitudinal bands (10°, 20°, 30°, 40°, 50°, and 60° N), seven altitudes (0 km, 1 km, 2 km, 3 km, 4 km, 5 km, and 10 km), and hourly values up to plus or minus 8 hours of deviation from local noon. During model calculations, photolysis rates for each model grid cell are estimated by first interpolating the clear-sky photolysis rates from the look-up table using the grid cell latitude, altitude, and hour angle, followed by applying a cloud correction (attenuation) factor based on the cloud inputs from MM5.

The photolysis rates input file was prepared as separate look-up tables for each simulation day. Photolysis files are ASCII files that were visually checked for selected days to verify that photolysis rates are within the expected ranges.

The Tropospheric Ultraviolet and Visible (TUV) Radiation Model

(<http://cprm.acd.ucar.edu/Models/TUV/>) is used to generate the photolysis rates input file for CAMx. TOMS ozone data and land use data were used to develop the CAMx Albedo/Haze/Ozone input file for 2002. As for CMAQ, the missing TOMS data period in the fall of 2002 was filled in using observed TOMS data on either side of the missing period using the same procedures as described above for CMAQ. Default land use specific albedo values were used and a constant haze value used, corresponding to rural conditions over North America.

#### **8.4.15 Air Quality Data Input Preparation**

Air quality data used with the CMAQ and CAMx modeling systems include: (1) initial concentrations that are the assumed initial three-dimensional concentrations throughout the modeling domain; (2) the boundary conditions that are the concentrations assumed along the



lateral edges of the RPO national 36 km modeling domain; and (3) air quality observations that are used in the model performance evaluation (MPE). The MPE is discussed in Chapter 3 and Appendix C of the TSD.

As previously noted, CMAQ default clean initial concentrations were used along with an approximately 15-day spin up (initialization) period to eliminate any significant influence of the initial concentrations on the modeled concentrations for the days of interest. The same initial concentrations were used with CAMx. Both CMAQ and CAMx were run for each quarter of the year. Each quarter's model run was initialized 15 days prior to the first day of interest (e.g., for the third quarter, July-August-September, the model was initialized on June 15, 2002, with the first modeling day of interest July 1, 2002). The CMAQ boundary conditions for the inter-RPO 36 km continental United States grid (Figure 8-1) were based on day-specific three-hour averages from the output of the GEOS-Chem global simulation model of 2002 (Jacob, Park, and Logan 2005). The 2002 GEOS-Chem output was mapped to the species and vertical layer structure of CMAQ and interpolated to the lateral boundaries of the 36 km grid shown in Figure 8-1 (Byun 2004).

Table 8-3 summarizes the surface air quality monitoring networks and the number of sites available in the CENRAP region that were used in the model performance evaluation. Data from these monitoring networks were also used to evaluate the CMAQ and CAMx models outside of the CENRAP region.

**Table 8-3: Ground-level Ambient Data Monitoring Networks and Stations for 2002**

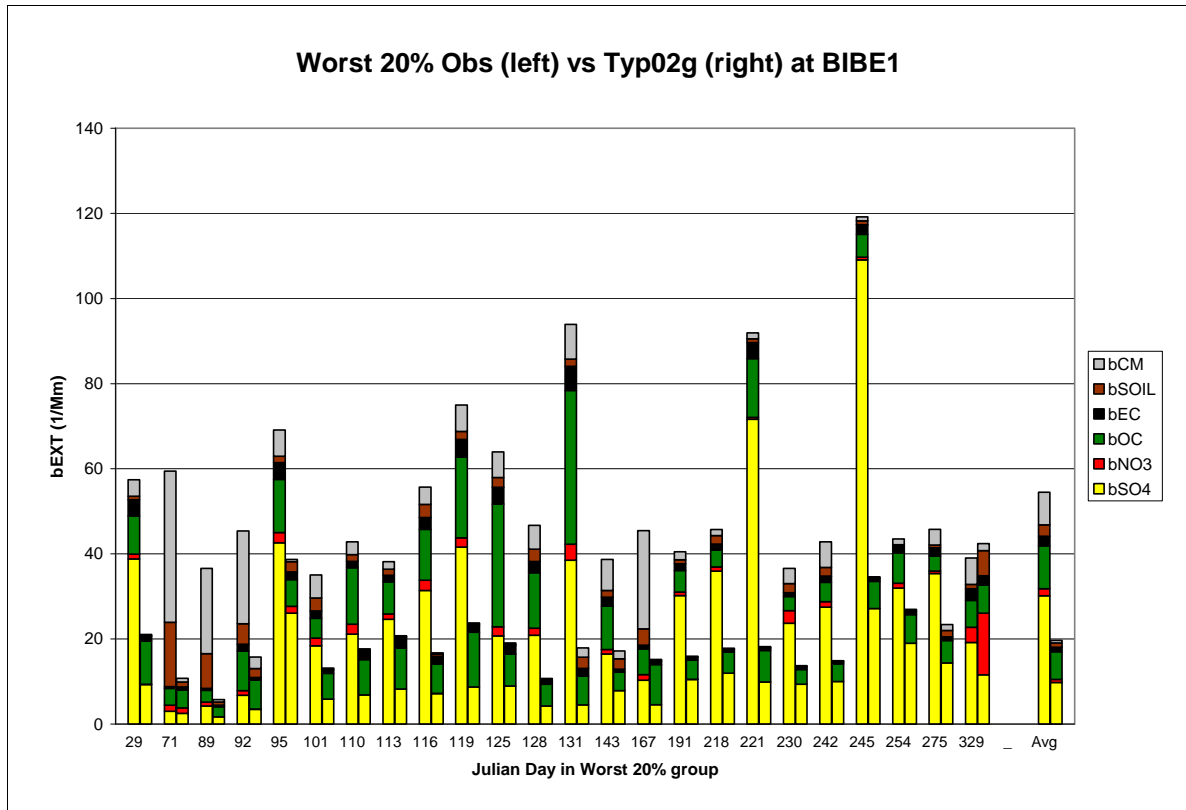
<b>Monitoring Network</b>	<b>Chemical Species Measured</b>	<b>Sampling Frequency; Duration</b>	<b>Approximate Number of Monitors</b>
<b>IMPROVE</b>	Speciated PM <sub>2.5</sub> and PM <sub>10</sub>	1 in 3 days; 24 hr	11
<b>CASTNET</b>	Speciated PM <sub>2.5</sub> and Ozone	Hourly, Weekly; 1 hr, 1 Week	3
<b>NADP</b>	Wet SO <sub>4</sub> , Wet NO <sub>3</sub> , and Wet NH <sub>4</sub>	Weekly	23
<b>EPA-STN</b>	Speciated PM <sub>2.5</sub>	Varies; Varies	12
<b>AIRS/AQS</b>	CO, NO, NO <sub>2</sub> , NO <sub>x</sub> , and Ozone	Hourly; Hourly	25

Note: Available in the CENRAP states for calendar year 2002 and used in the model performance evaluation.

#### **8.4.16 2002 Base Case Modeling and Model Performance Evaluation**

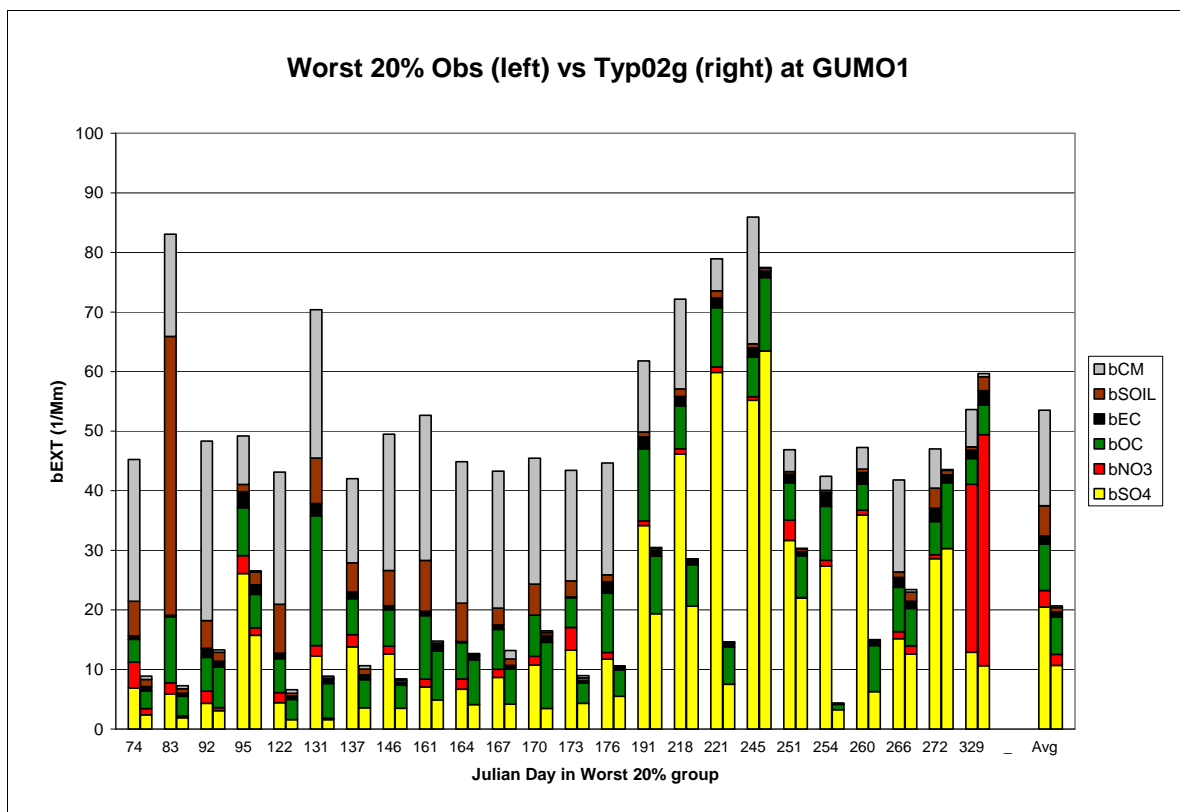
CENRAP's modeling contractors evaluated the CMAQ and CAMx modeling results against ambient measurements of PM species, gas-phase species, and wet deposition. Table 8-6 summarizes the networks used in the model evaluation, the species measured, and the averaging times and frequency of the measurements. CENRAP carried out numerous iterations of CMAQ and CAMx 2002 base case simulations and model performance evaluations during the course of the CENRAP modeling study. Most of them are posted on the CENRAP modeling website (<http://pah.cert.ucr.edu/aqm/cenrap/cmaq.shtml>), and summaries of the work are in previous reports and presentations for CENRAP (e.g., Morris et al. 2005; 2006a, b). Chapter 3 and Appendix C of the TSD provide details on the final 2002 Base F 36 km CMAQ base case modeling performance evaluation. Because of the similarity between 2002 Base F and 2002 Base G and resource constraints, CENRAP did not repeat the model evaluation for Base G. In general, the model performance of the CMAQ and CAMx models for sulfate (SO<sub>4</sub>) and elemental carbon (EC) was good. Model performance for nitrate (NO<sub>3</sub>) was variable, with a summer underestimation and winter overestimation bias. Performance for organic carbon mass (OMC) was also variable, with the inclusion of the SOA modification enhancement in CMAQ Version 4.5 greatly improving the CMAQ summer OMC model performance (Morris et al., 2006c). Model performance for soil and CM was generally poor. Part of the poor performance for fine soil and coarse mass appear to be due to measurement-model incommensurability. The

IMPROVE measured values are due, in part, to local blowing dust sources that are not captured in the model's emission inputs and the 36 km grid resolution is not conducive to modeling localized events. Also, the model usually fails to simulate locally high winds creating dust clouds in one part of the Chihuahuan Desert that later move with lower speed winds to affect Guadalupe Mountains National Park or other Class I areas. Figures 8-2 and 8-3 show the observed light extinction compared to the modeled light extinction at Big Bend National Park and Guadalupe Mountains National Park.



**Figure 8-2: Observed and Base Case Modeled Concentrations at Big Bend**

Note: Extinction calculated using the new IMPROVE equation using observed concentrations and base case modeled concentrations at Big Bend National Park. The new IMPROVE equation calculations relied on 2002 IMPROVE data for the worst 20 percent of monitored days and the modeling used the 2002 Base F emission inventory.



**Figure 8-3: Observed and Base Case Modeled Concentrations at Guadalupe Mountains**

Note: Extinction calculated using the new IMPROVE equation using observed concentrations and base case modeled concentrations at Guadalupe Mountains National Park. The new IMPROVE equation calculations relied on 2002 IMPROVE data for the worst 20 percent of monitored days and the modeling used the 2002 Base F emission inventory.

#### 8.4.17 2018 Modeling and Visibility Projections

Emissions for the 2018 base case were generated following the procedures discussed in Chapter 2 of the TSD. Emissions in 2018 for electrical generating units (EGUs) were based on simulations of the Integrated Planning Model (IPM) that took into account the effects of the Clean Air Interstate Rule (CAIR) on emissions from EGUs in CAIR states using an IPM realization of a CAIR cap and trade program. For the purposes of this SIP revision, the TCEQ is assuming that the federal appellate court remand of CAIR to EPA will result in a replacement program providing comparable emissions reductions at EGUs before 2018. Emissions for on-road and non-road mobile sources were based on activity growth and emissions factors from the EPA MOBILE Vehicle Emission Modeling Software Version 6 (MOBILE6) and NONROAD models, respectively. Area sources and non-EGU point sources were grown to 2018 levels using Economic Growth Analysis System (EGAS) (Pechan 2005d). The Canadian year 2000 emissions inventory was replaced by a Canadian 2020 emissions inventory for the 2018 CMAQ/CAMx simulations.

The following sources were assumed to remain constant between the 2002 and 2018 base case simulations:

- biogenic VOC and NO<sub>x</sub> emissions from the Biogenic Emissions Inventory System Version 3 (BEIS3) model;
- wind-blown dust associated with non-agricultural sources (i.e., natural wind-blown fugitive dust);

- off-shore emissions associated with off-shore marine and oil and gas production activities;
- emissions from wildfires;
- emissions from Mexico; and
- global transport (i.e., emissions due to boundary conditions from the 2002 GEOS-Chem global chemistry model).

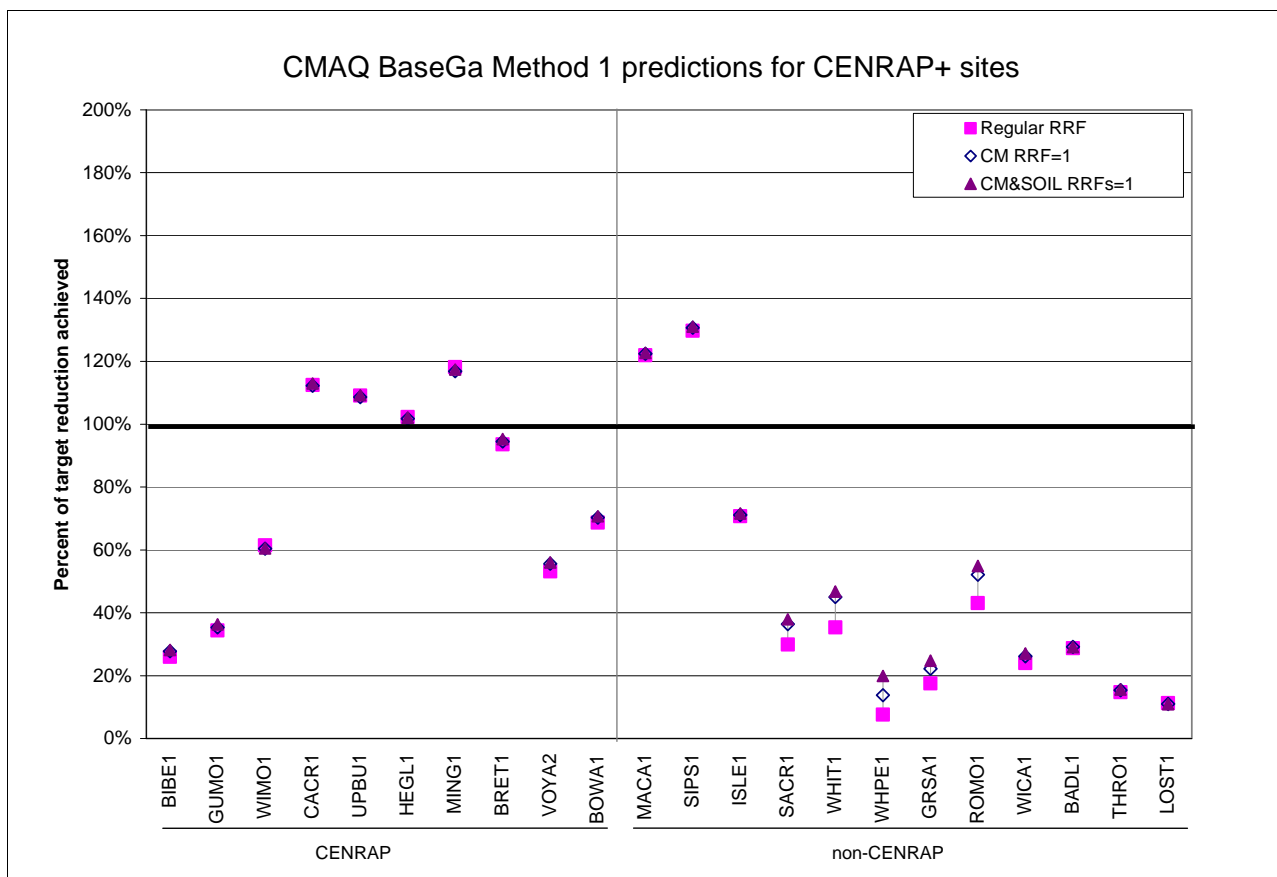
The results from the 2002 and 2018 CMAQ and CAMx simulations were used to project 2018 PM levels from which 2018 visibility estimates were obtained. The 2002 and 2018 modeling results were used in a relative sense to scale the observed PM concentrations from the 2000 through 2004 baseline and the IMPROVE monitoring network to obtain the 2018 PM projections. The modeled scaling factors are called relative response factors (RRFs) and are constructed as the ratio of modeling results for the 2018 model simulation to the 2002 model simulation. Two important regional haze metrics are the average visibility for the worst 20 percent and best 20 percent days from the 2000 through 2004 five-year baseline. For the 2018 visibility projections, EPA guidance recommends developing Class I area and PM species specific RRFs using the average modeling results for the worst 20 percent days during the 2002 modeling period and the 2002 and 2018 emission scenarios. The results of the CENRAP 2018 visibility projections following EPA guidance procedures (EPA 2007a) are provided in Chapter 4 and Appendix D of the TSD in Appendix 8-1 of this SIP revision. CENRAP has also developed alternative procedures for visibility projections that are discussed in Chapter 5 and Appendix D of the TSD. For example, much of the CM impact at Class I area IMPROVE monitors are believed to be natural and primarily from local sources that are subgrid-scale to the modeled 36 km grid so are not represented in the modeling. Thus, one alternative visibility projection approach is to set the RRF for CM to 1.0. That is, the CM impacts in 2018 are assumed to be the same as in the observed 2000-2004 baseline. Similarly, the soil impacts at IMPROVE monitors are likely mainly due to local dust sources so another alternative approach is to set the RRFs for both CM and soil to 1.0.

The 2018 visibility projections for the worst 20 percent days are compared against a 2018 point on the uniform rate of progress (URP) glide path or the “2018 URP point.” The 2018 URP point is obtained by constructing a linear visibility glide path in deciviews from the observed 2000 through 2004 baseline (EPA 2003a) for the worst 20 percent days to the 2064 natural conditions (EPA 2003b). Where the linear glide path crosses the year 2018 is the 2018 URP point. States may use the modeled 2018 visibility to help define their 2018 RPG in their Regional Haze SIPs. The 2018 URP point is used as a benchmark to help judge the 2018 modeled visibility projections and the state’s RPG. However, as noted in EPA’s RPG guidance, “The glide path is not a presumptive target, and states may establish a RPG that provides for greater, lesser, or equivalent visibility improvement as that described by the glide path” (EPA 2007b). Chapter 4 and Appendix D of the TSD present the 2018 visibility projections for the CENRAP Class I areas and their comparisons with the 2018 URP point using EPA default visibility projection procedures (EPA 2007a) and EPA default URP glide paths (EPA 2003a,b; 2007b).

Various techniques have been developed to display the 2018 visibility modeling results including “DotPlots” that display the 2018 visibility projections as a percentage of meeting the 2018 point on the URP glide path. A value of 100 percent on the DotPlot indicates that the Class I area is predicted to meet the 2018 point on the URP glide path. Over 100 percent means the 2018 visibility projection obtains more visibility improvements (reductions) than required to meet the 2018 point on the URP glide path (i.e., projected value is below the glide path). Less than 100 percent indicates that fewer visibility improvements are projected than are needed to meet the 2018 point URP on the glide path (i.e., above the glide path). Figure 8-4 displays a DotPlot that compares the 2018 visibility projections from the CENRAP 2018 Base G CMAQ simulation with the 2018 URP point using the EPA default RRFs and alternative RRFs that set the CM and soil RRFs to unity (i.e., assume CM and soil are natural so remain unchanged from the 2000-2004

baseline). For these results, the 2018 visibility projections at the Hercules Glades (HEGL1) Class I area meets the 2018 point on the URP glide path (100 percent), whereas the 2018 visibility projections at Caney Creek (CACR), Mingo (MING), and Upper Buffalo (UPBU) achieve more visibility improvements than needed to meet the 2018 URP point so are below the 2018 URP glide path. However, the 2018 visibility projections at Breton come up slightly short (approximately 5 percent) of meeting the 2018 point on the URP glide path and Wichita Mountains (WIMO) comes up approximately 40 percent short of meeting the 2018 point on the URP glide path. Class I areas at the northern (e.g., VOYA, BOWA, and ISLE) and southern (e.g., BIBE and GUMO) boundaries of the United States also fall short of achieving the 2018 URP point.

High contributions of international transport and/or natural sources (e.g., windblown dust) affect the ability of these Class I areas to be on the URP glide path calculated using the default estimates produced by the Natural Conditions II Committee (NC-II). Chapters 4 and 5 of the TSD in Appendix 8-1 discuss these issues in more detail.



**Figure 8-4: 2018 Visibility Projections Expressed as Percent of Meeting the 2018 URP Point**

Note: Using the default NC-II estimates of natural conditions.

- BADL Badlands Wilderness Area
- BOWA Boundary Waters Canoe Area Wilderness
- CACR Caney Creek Wilderness Area
- HEGL Hercules-Glades Wilderness Area
- ISLE Isle Royale National Park
- LOST Lostwood Wilderness Area
- MACA Mammoth Cave National Park
- SIPS Sipsy Wilderness Area
- THRO Theodore Roosevelt National Park
- UPBU Upper Buffalo Wilderness Area
- VOYA Voyageurs National Park
- WICA Wind Cave National Park

#### 8.4.18 Additional Supporting Analysis

CENRAP performed numerous supporting analyses of its modeling results including analyzing alternative glide paths and 2018 projection approaches and performing confirmatory analysis of the 2018 visibility projections. Details on the additional supporting analysis are contained in Chapter 5 of the TSD, which include:

- The CENRAP 2018 visibility projections were compared with those generated by VISTAS and MRPO. There was close agreement between the CENRAP and VISTAS 2018 visibility projections at almost all common Class I areas, with the exception of Breton Island where the CENRAP's projections were slightly more optimistic than VISTAS'. The MRPO 2018 visibility projections were less optimistic than CENRAP's at the four Arkansas-Missouri Class I areas. This difference may have been due to CENRAP's BART emission controls in CENRAP states that were not included in the 2018 MRPO inventory.
- Extinction based glide paths were developed and the CENRAP 2018 visibility projections were shown to produce nearly identical estimates of achieving the 2018 URP point when using total extinction glide paths as when the linear deciview glide paths were used. With the extinction based glide paths the analysis of 2018 URP could be made on a PM species-by-species basis where it was shown that 2018 extinctions due to SO<sub>4</sub> and, to a lesser extent, NO<sub>3</sub> and EC, achieve the URP, but the other species do not and, in fact, extinction due to soil and CM is projected to get worse.
- 2018 visibility projections were made using EPA's Modeled Attainment Test Software (MATS) and the CENRAP Typ02G and Base18G modeling results. The CENRAP 2018 visibility projections agreed with those generated by MATS with three exceptions: Breton, Boundary Waters, and Mingo Class I areas. At these three Class I areas MATS did not produce any 2018 visibility projections due to insufficient observed 2000-2004 data in the raw IMPROVE database to produce a valid baseline. CENRAP used filled data for these three Class I areas.
- PM PSAT modeling was conducted to estimate the contributions to visibility impairment at Class I areas by source region (e.g., states) and major source category. Source contributions were obtained for a 2002 and 2018 base case and the PSAT modeling results were implemented in a PSAT Visualization Tool that was provided to CENRAP states and others. Major findings from the PSAT source apportionment modeling include the following:
  - Sulfate from elevated point sources was the highest source category contribution to visibility impairment at CENRAP Class I areas for the worst 20 percent days.
  - International transport contributed significantly to visibility impairment at CENRAP Class I areas on the southern (BIBE and GUMO) and northern (BOWA and VOYA) borders of the United States and to a lesser extent at WIMO.
- Alternative visibility projections were made, assuming that CM alone, and CM and soil were natural in origin.
- Visibility projections were made using an alternative model (CAMx) that verified the projections made by CMAQ.
- The effects of international transport were examined several ways indicating that the inability of the 2018 visibility projections to achieve the 2018 URP point at the northern and southern border Class I areas was due to high contributions due to International Transport.

Visibility trends for the worst 20 percent days, best 20 percent days, and all monitored days were analyzed at CENRAP Class I areas using the period of record IMPROVE observations. At most Class I areas there were insufficient years of data to produce a discernable trend. In addition, there was significant year-to-year variability in visibility impairment with episodic events (e.g., wildfires and windblown dust) confounding the analysis.

## CHAPTER 9. BEST AVAILABLE RETROFIT TECHNOLOGY

On July 6, 2005, the EPA published final amendments to its 1999 Regional Haze Rule including Appendix Y, the final guidance for Best Available Retrofit Technology (BART) determinations in the Federal Register (70 FR 39104-39172). The BART rule requires the installation of BART on emission sources that fit specific criteria and “may reasonably be anticipated to cause or contribute” to visibility impairment in any Class I area (Appendix 9-1: U.S. EPA BART Rule).

### 9.1 BART-ELIGIBLE SOURCES IN TEXAS

The Texas Commission on Environmental Quality’s (TCEQ) BART rule adopted on January 10, 2007, identifies potentially affected sources as those:

- belonging to one of 26 industry source categories;
- having the potential to emit (PTE) 250 tons per year (tpy) or more of any visibility-impairing pollutant; and
- not operating prior to August 7, 1962, and in existence on August 7, 1977 (Appendix 9-2: *Texas BART Rule*).

The state is not required to make a determination of BART for SO<sub>2</sub> or NO<sub>x</sub> if a BART-eligible source has the PTE less than 40 tons per year of such pollutant(s) or less than 15 tons per year for PM<sub>10</sub>.

Texas has made the determination that participation in CAIR is equivalent to BART. This exempts EGUs impacted by CAIR from a BART analysis for SO<sub>2</sub> and NO<sub>x</sub>. As of the date of this SIP revision, CAIR remains in effect until replaced by EPA rule consistent with the D.C. Circuit Court of Appeals’ remand of CAIR back to EPA. As a result, EGUs subject to the cap and trade system established by CAIR have not been evaluated for BART for SO<sub>2</sub> and NO<sub>x</sub>. The TCEQ will take appropriate action if CAIR is not replaced with a system that the US EPA considers to be equivalent to BART.

The TCEQ has also adopted the model plants, or option 2, developed by the EPA; this is an approach for using model plants to exempt individual sources with common characteristics (70 FR 39162-3). Sources which meet this model plant exemption are considered not to be negatively impacting visibility at Class I areas and are therefore not required to complete a BART analysis.

The TCEQ manages emissions and emissions-related data in the State of Texas Air Reporting System (STARS). The STARS was used to determine which sources were potentially BART-eligible. This database does not store any permit related information such as build dates or permitted allowable emission levels. As a result of these database limitations the TCEQ surveyed companies regarding their potential to emit and construction dates in order to complete the initial BART determination (Appendix 9-3: *A Sample Survey*).

#### Texas Source Survey

Each of the 26 BART source categories were addressed for Texas. The Standard Industrial Codes (SIC) as well as the applicable Source Classifications Codes (SCC) were identified by TCEQ staff using the 26 applicable source categories listed in Section III(H) of the 40CFR Part 51, Regional Haze Regulations. This list was compared with other states and regional planning organization lists for completeness. The initial survey population was based on this SIC/SCC list only.

As provided for in the EPA guidance document for BART, the TCEQ chose to adopt a model plant analysis to reasonably eliminate smaller sources of NO<sub>x</sub> and SO<sub>2</sub> emissions which were distant from a Class I area. The EPA guidance provides exemption of sources from consideration



if their actual emission of NO<sub>x</sub> or SO<sub>2</sub> (or combination of NO<sub>x</sub> and SO<sub>2</sub>) were less than 500 tpy as long as they were located more than 50 kilometers (km) from any Class I area; sources were also exempted if their 2002 emissions of NO<sub>x</sub> or SO<sub>2</sub> (or combination of NO<sub>x</sub> and SO<sub>2</sub>) were less than 1,000 tpy as long as they were located more than 100 km from any Class I area. The TCEQ reduced the emission threshold to 750 tpy for sources greater than 100 km and 375 tpy for sources greater than 50 km to capture sources that might not have met EPA's threshold based only on their 2002 emissions levels. Given their distance from Class I areas, the relatively low emissions from the screened out sources are unlikely to significantly impact visibility at those areas.

Based on an estimate by TCEQ staff, the actual emissions are typically 80 percent of the permitted amount. Using this estimate, staff assumed that companies with actual volatile organic compounds (VOC) emissions of 200 tpy would reasonably have a permitted potential to emit of 250 tpy. Companies with the applicable source categories and actual emissions at their sites of 200 tpy or more of VOC or PM<sub>10</sub> were also asked to complete the survey. In 2002, PM<sub>2.5</sub> data were collected but a review of the database indicated that some companies did not fully report fine particulate matter until later inventories. As allowed by the BART guidelines, PM<sub>10</sub> was used as a surrogate in order to fully capture sources of particulate matter.

A county level distance screen was employed to avoid removing sources that barely exceeded distance calculations. If any portion of the county was within the applicable distance to the nearest Class I area, then all the sites within that county were considered within the applicable distance. Additionally, all BART category sites within counties within 50 km of a Class I area were surveyed. The Class I areas considered for the Texas screening included the Guadalupe Mountains, Big Bend, Carlsbad Caverns, Wichita Mountains, Caney Creek, Breton Island, and Salt Creek.

As a result of the screening analysis, 254 sites (approximately 12 percent of the 2,165 sources in the 2002 emissions inventory) were identified as potentially BART-eligible based on distance and actual emissions. A survey was sent to these sites to ask for site representatives to help in identifying construction or reconstruction dates and whether the PTE of the BART-eligible equipment exceeded 250 tpy.

The emissions represented by the surveyed sites are summarized in Table 9-1: *Emissions from Companies Surveyed as a Percentage of State Total Point Source Emissions*. Sources emitting a large percentage of the actual emissions in the state were in the survey population. Emissions covered in the survey ranged from 61.7 percent of the 2002 VOC inventory to 97.7 percent of the SO<sub>2</sub> inventory.

**Table 9-1: Emissions from Companies Surveyed as a Percentage of State Total Point Source Emissions**

Source	Emissions (tpy)			
	PM <sub>10</sub>	SO <sub>2</sub>	NO <sub>x</sub>	VOC
<b>BART Survey</b>	49,638	786,274	467,534	95,442
<b>2002 State Total</b>	66,064	805,133	601,447	154,665

Surveys were sent to 254 companies. The survey was a two step process. Companies were first asked to identify if they have any equipment built or reconstructed during the applicable time period or if the PTE of their site were less than 250 tpy. Companies that did not have BART applicable equipment based on low emissions or construction dates were not asked to supply any further information and were considered not BART-eligible.

If the site did possibly have BART applicable equipment, they were asked to complete a detailed survey of all operating and idle equipment at each site. The detailed survey asked whether each piece of equipment at the site was built or reconstructed between the applicable dates. The companies were asked if the PTE of their BART-eligible equipment exceeded the 250 tpy threshold for the applicable emissions. Any source with a PTE from equipment built during the applicable period was considered BART-eligible.

Based on results from the surveys completed by potentially BART-eligible sources and submitted to the TCEQ in 2005, over 100 sources were identified as BART-eligible. Table 9-2: *BART-Eligible Sources Based on Results of TCEQ Survey* presents the sources that were determined to be BART-eligible.

**Table 9-2: BART-Eligible Sources Based on Results of TCEQ Survey**

<b>No.</b>	<b>Account</b>	<b>Source</b>	<b>Regulated Entity</b>	<b>SIC</b>
1	AC0017B	ABITIBI CONSOLIDATED CORP	RN100220110	2621
2	TG0044C	AEP TEXAS	RN101531226	4911
3	CD0013K	AEP TEXAS CENTRAL COMPANY	RN102560687	4911
4	NE0024E	AEP TEXAS CENTRAL COMPANY	RN100642040	4911
5	NE0026A	AEP TEXAS CENTRAL COMPANY	RN100552181	4911
6	JI0030K	AEP TEXAS NORTH COMPANY	RN100215557	4911
7	CB0003M	ALCOA ALUMINA & CHEMICALS	RN100242577	2819
8	MM0001T	ALCOA INC	RN100221472	3334
9	HT0011Q	ALON USA LP	RN100250869	2911
10	ED0034O	ASH GROVE (formerly NORTH TEXAS CEMENT)	RN100225978	3241
11	HG0558G	ATOFINA CHEMICALS INC	RN100209444	2869
12	BL0021O	BASF CORPORATION	RN100218049	2869
13	GB0001R	BP AMOCO CHEMICAL COMPANY	RN102536307	2869
14	GB0004L	BP PRODUCTS NORTH AMERICA IN TEXAS	RN102535077	2911
15	GH0003Q	CABOT CORPORATION	RN100221761	2895
16	BG0045E	CAPITOL CEMENT DIV CAPITOL	RN100211507	3241
17	GH0004O	CELANESE CHEMICAL	RN101996395	2869
18	MH0009H	CELANESE LIMITED	RN100258060	2869
19	ED0011D	CHAPARRAL STEEL MIDLOTHIAN	RN100216472	3312
20	BJ0001T	CHEMICAL LIME LTD	RN100219856	3274
21	HG0310V	CHEVRON PHILLIPS CHEMICAL	RN103919817	2869
22	BL0758C	CHEVRON PHILLIPS CHEMICAL	RN100825249	2869
23	HW0013C	CHEVRON PHILLIPS CHEMICAL CO	RN102320850	2869
24	NE0027V	CITGO REFINING & CHEMICALS	RN102555166	2911
25	BG0057U	CITY PUBLIC SERVICE	RN100217975	4911
26	BG0186I	CITY PUBLIC SERVICE	RN100217835	4911
27	HW0018P	CONOCO PHILLIPS (formerly PHILLIPS 66)	RN102495884	2911
28	CR0020C	COPANO PROCESSING LP	RN101271419	1321
29	AB0012W	DCP (formerly DUKE ENERGY FIELD SERVICES)	RN100218684	1321
30	HW0008S	DEGUSSA ENGINEERED CARBONS	RN100209659	2895
31	HGA005E	DOW	RN104150123	2869
32	HG0126Q	DOW	RN100227016	2869

33	CI0022A	DYNEGY MIDSTREAM SERVICES	RN100222900	1321
34	HH0042M	EASTMAN CHEMICAL COMPANY	RN100219815	2869
35	HG0218K	EI DUPONT	RN100225085	2869
36	OC0007J	EI DUPONT DENEMOURS & CO	RN100542711	2869
37	EE0029T	EL PASO ELECTRIC CO	RN100211309	4911
38	TH0004D	ELECTRIC UTILITY DEPT	RN100219872	4911
39	CG0012C	ENBRIDGE PIPELINES	RN102166964	1321
40	MQ0009F	ENTERGY GULF STATES INC	RN100226877	4911
41	OC0013O	ENTERGY GULF STATES INC	RN102513041	4911
42	BL0113I	EQUISTAR	RN100218601	2869
43	BL0268B	EQUISTAR CHEMICALS LP	RN100237668	2821
44	HG0033B	EQUISTAR CHEMICALS LP	RN100542281	2869
45	HG0228H	EXXON CHEMICAL CO	RN102212925	2869
46	JE0065M	EXXON MOBIL CHEMICAL CO	RN100211903	2821
47	HG0229F	EXXONMOBIL CHEMICAL CO	RN102574803	2869
48	HG0232Q	EXXONMOBIL CORP	RN102579307	2911
49	JE0067I	EXXONMOBIL OIL CORP	RN102450756	2911
50	NE0120H	FLINT HILLS RESOURCES	RN102534138	2911
51	NE0122D	FLINT HILLS RESOURCES LP	RN100235266	2911
52	JE0052V	HUNTSMAN CORPORATION	RN100219252	2869
53	JE0135Q	HUNTSMAN PETROCHEMICAL CORP	RN100217389	2869
54	EB0057B	HUNTSMAN POLYMERS	RN101867554	2869
55	BL0002S	INEOS OLEFINS & POLYMERS	RN100238708	2869
56	CG0010G	INTERNATIONAL PAPER CO	RN100543115	2621
57	OCA002B	INVISTA	RN104392626	2869
58	VC0008Q	INVISTA (formerly DU PONT DE NEMOURS)	RN102663671	2869
59	WE0005G	LAREDO POWER	RN100213909	4911
60	MB0123F	LEHIGH CEMENT COMPANY	RN100218254	3241
61	NE0025C	LON C HILL POWER	RN100215979	4911
62	BC0015L	LOWER COLORADO RIVER AUTHORITY	RN102038486	4911
63	FC0018G	LOWER COLORADO RIVER AUTHORITY	RN100226844	4911
64	HG1575W	LYONDELL CHEMICAL	RN100633650	2869
65	HG0048L	LYONDELL CITGO REFINING	RN100218130	2911
66	GB0055R	MARATHON ASHLAND PETROLEUM	RN100210608	2911
67	HH0019H	NORIT AMERICAS INC	RN102609724	2819
68	GB0037T	NRG TEXAS (formerly TEXAS GENCO LP)	RN101062826	4911
69	ED0051O	OWENS CORNING	RN100223585	3296
70	HG1451S	OXYVINYLSP	RN102518065	2821
71	HG0175D	PASADENA REFINING	RN100716661	2911
72	JE0042B	PREMCOR REFINING GROUP	RN102584026	2911
73	MC0002H	REGENCY TILDEN GAS (formerly ENBRIDGE)	RN100216621	2819
74	HG0697O	RHODIA INC	RN100220581	2819
75	HG0632T	ROHM & HAAS TEXAS	RN100223205	2869
76	HG0659W	SHELL OIL CO	RN100211879	2911
77	HW0017R	SID RICHARDSON CARBON	RN100222413	2895
78	HT0027B	SID RICHARDSON CARBON CO	RN100226026	2895
79	BL0038U	SOLUTIA INC	RN100238682	2869
80	TF0012D	SOUTHWESTERN ELECTRIC POWER	RN100213370	4911
81	GJ0043K	SOUTHWESTERN ELECTRIC POWER	RN102156916	4911
82	ME0006A	SOUTHWESTERN ELECTRIC POWER	RN100542596	4911
83	PG0040T	SOUTHWESTERN PUBLIC SERVICE	RN100224641	4911
84	PG0041R	SOUTHWESTERN PUBLIC SERVICE	RN100224849	4911

85	LN0081B	SOUTHWESTERN PUBLIC SERVICE	RN100224765	4911
86	JE0091L	SUN MARINE TERMINAL	RN100214626	4226
87	WN0042V	TARGA	RN102552387	1311
88	CY0019H	TARGA (formerly DYNEGY MIDSTREAM)	RN102551785	1311
89	OC0019C	TEMPLE-INLAND	RN100214428	2621
90	CI0012D	TEXAS GENCO LP	RN100825371	4911
91	FG0020V	TEXAS GENCO LP	RN100888312	4911
92	HK0014M	TEXAS LEHIGH CEMENT CO	RN102597846	3241
93	HG0562P	TEXAS PETROCHEMICALS LP	RN100219526	2869
94	BL0082R	THE DOW CHEMICAL CO	RN100225945	2869
95	JE0039N	THE GOODYEAR TIRE AND RUBBER CO	RN102561925	2822
96	NE0022I	TICONA POLYMERS INC	RN101625721	2869
97	JE0005H	TOTAL PETROCHEMICALS	RN102457520	2911
98	ED0066B	TXI OPERATIONS LP	RN100217199	3241
99	FI0020W	TXU BIG BROWN COMPANY LP	RN101198059	4911
100	DB0251U	TXU ELECTRIC COMPANY	RN101559854	4911
101	FB0025U	TXU GENERATION COMPANY LP	RN102285855	4911
102	HQ0012T	TXU GENERATION COMPANY LP	RN100664812	4911
103	MB0116C	TXU GENERATION COMPANY LP	RN102566494	4911
104	MM0023J	TXU GENERATION COMPANY LP	RN102147881	4911
105	MO0014L	TXU GENERATION COMPANY LP	RN102285848	4911
106	RL0020K	TXU GENERATION COMPANY LP	RN102583093	4911
107	TA0352I	TXU GENERATION COMPANY LP	RN100693308	4911
108	WC0028Q	TXU GENERATION COMPANY LP	RN102183969	4911
109	YB0017V	TXU GENERATION COMPANY LP	RN102563426	4911
110	TF0013B	TXU GENERATION COMPANY LP	RN102285921	4911
111	GB0076J	UNION CARBIDE CORP	RN100219351	2869
112	CB0028T	UNION CARBIDE CORPORATION	RN102181526	2869
113	HR0018T	VALENCE MIDSTREAM LTD	RN100213685	1321
114	GB0073P	VALERO REFINING CO TEXAS	RN100238385	2911
115	NE0043A	VALERO REFINING COMPANY	RN100211663	2911
116	MR0008T	VALERO MCKEE	RN100210517	2911
117	WH0014S	VETROTEX WICHITA FALLS PLANT	RN100218601	3229
118	VC0003D	VICTORIA POWER	RN100214980	4911
119	JB0016M	VINTAGE PETROLEUM INC	RN100214592	1311
120	JC0003K	WESTVACO	RN102157609	2631

## 9.2 DETERMINATION OF SOURCES SUBJECT TO BART

Under the EPA's BART guidelines, the state has two options regarding its BART-eligible sources:

- make BART determinations for all sources; or
- consider exempting some sources from BART because they do not cause or contribute to visibility impairment in a Class I area.

The TCEQ chose the second option that considers exempting some sources.

When exempting sources from BART because they do not cause or contribute to visibility impairment in a Class I area, the guidelines suggest three sub-options for determining that certain sources are not subject to BART:

- the use of model plants to exempt sources with common characteristics (70 FR 39162-3);
- a cumulative modeling analysis to show that groups of sources are not subject to BART;
- and finally; an individual source attribution approach.

The TCEQ exercised all three sub-options above to determine which sources were subject to BART. These options are explained further below, in the order in which the TCEQ and the sources performed the analyses.

Section 9.2.1 describes the cumulative modeling analyses that the TCEQ performed for the sources identified as BART-eligible. Since there was such a large number of BART-eligible sources in Texas, the TCEQ performed cumulative modeling analyses using CAMx PSAT technology. Once the TCEQ had completed the CAMx modeling analysis, several BART-eligible sources were determined to be insignificant (screened out) and several remained potentially BART-eligible (did not screen out). Screening out is a process that further examines and evaluates sources for inclusion or exclusion in the BART program. Sources that did not screen out through the cumulative modeling analysis were required to perform source-specific screening modeling analyses using either the CALPUFF or the CAMx model setup developed by the TCEQ. These source-specific modeling analyses are described in Section 9.2.2. BART-eligible sources that did not screen out in any of the modeling analyses had the option of reducing the emissions from their BART-eligible units using an enforceable mechanism, such as a permit, or performing an engineering analysis. The BART-eligible sources that chose to reduce potential emissions are discussed in Section 9.3. The emission reductions are presented in Section 9.5.

### 9.2.1 Cumulative Modeling Using CAMx PSAT

The TCEQ conducted screening modeling analyses as described in the CAMx modeling protocol, *Screening Analysis of Potentially BART-Eligible Sources in Texas*, and the final CAMx modeling report, *Final Report, Screening Analysis of Potential BART-Eligible Sources in Texas*, presented in Appendixes 9-3 and 9-4, respectively. In addition to the CAMx modeling, the TCEQ developed Texas model plants based on the CAMx modeling results. The model plants are discussed in the addendums to the CAMx modeling report, Addendum I, *BART Exemption Screening Analysis*, and Addendum II, *BART Exemption Screening Analysis*. Both addendums are contained in Appendix 9-5. Sources that successfully screened out in the CAMx screening modeling analyses or by using the Texas model plants were required to review the modeling analysis and data used and to certify that they agree with the screening modeling analyses and inputs. Copies of these certifications are contained in Appendix 9-6. Table 9-3 shows the BART-eligible sources that successfully screened out in the cumulative modeling analyses. BART-eligible sources that did not screen out of the cumulative modeling were required to conduct their own screening modeling analysis using either the CALPUFF or the CAMx

modeling setup developed by the TCEQ. The single source modeling analyses are outlined in Section 9.2.2.

**Table 9-3: BART-Eligible Sources Screened Out Using Cumulative CAMx Modeling**

<b>No.</b>	<b>Account</b>	<b>Source</b>	<b>Regulated Entity</b>	<b>SIC</b>
1	TG0044C	AEP TEXAS	RN101531226	4911
2	CD0013K	AEP TEXAS CENTRAL COMPANY	RN102560687	4911
3	NE0024E	AEP TEXAS CENTRAL COMPANY	RN100642040	4911
4	NE0026A	AEP TEXAS CENTRAL COMPANY	RN100552181	4911
5	J10030K	AEP TEXAS NORTH COMPANY	RN100215557	4911
6	CB0003M	ALCOA ALUMINA & CHEMICALS	RN100242577	2819
7	HG0558G	ATOFINA CHEMICALS INC	RN100209444	2869
8	BL0021O	BASF CORPORATION	RN100218049	2869
9	GB0001R	BP AMOCO CHEMICAL COMPANY	RN102536307	2869
10	MH0009H	CELANESE LIMITED	RN100258060	2869
11	ED0011D	CHAPARRAL STEEL MIDLOTHIAN	RN100216472	3312
12	BJ0001T	CHEMICAL LIME LTD	RN100219856	3274
13	BL0758C	CHEVRON PHILLIPS CHEMICAL	RN100825249	2869
14	HG0310V	CHEVRON PHILLIPS CHEMICAL	RN103919817	2869
15	HW0013C	CHEVRON PHILLIPS CHEMICAL	RN102320850	2869
16	BG0057U	CITY PUBLIC SERVICE	RN100217975	4911
17	BG0186I	CITY PUBLIC SERVICE	RN100217835	4911
18	CR0020C	COPANO PROCESSING LP	RN101271419	1321
19	CI0022A	DYNEGY MIDSTREAM SERVICES	RN100222900	1321
20	HG0218K	EI DUPONT	RN100225085	2869
21	EE0029T	EL PASO ELECTRIC CO	RN100211309	4911
22	TH0004D	ELECTRIC UTILITY DEPT	RN100219872	4911
23	MQ0009F	ENTERGY GULF STATES INC	RN100226877	4911
24	OC0013O	ENTERGY GULF STATES INC	RN102513041	4911
25	BL0113I	EQUISTAR	RN100218601	2869
26	BL0268B	EQUISTAR CHEMICALS LP	RN100237668	2821
27	HG0228H	EXXON CHEMICAL CO	RN102212925	2869
28	JE0065M	EXXON MOBIL CHEMICAL CO	RN100211903	2821
29	HG0229F	EXXONMOBIL CHEMICAL CO	RN102574803	2869
30	NE0120H	Flint Hills Resources	RN102534138	2911
31	NE0122D	FLINT HILLS RESOURCES LP	RN100235266	2911
32	JE0052V	HUNTSMAN CORPORATION	RN100219252	2869
33	JE0135Q	HUNTSMAN PETROCHEMICAL	RN100217389	2869
34	BL0002S	Ineos Olefins & Polymers	RN100238708	2869
35	WE0005G	LAREDO POWER	RN100213909	4911
36	MB0123F	LEHIGH CEMENT COMPANY	RN100218254	3241
37	NE0025C	LON C HILL POWER	RN100215979	4911
38	BC0015L	Lower Colorado River Authority	RN102038486	4911
39	FC0018G	Lower Colorado River Authority	RN100226844	4911

<b>No.</b>	<b>Account</b>	<b>Source</b>	<b>Regulated Entity</b>	<b>SIC</b>
40	HG1575W	Lyondell Chemical	RN100633650	2869
41	HG1451S	OXYVINYLSP	RN102518065	2821
42	JE0042B	PREMCOR REFINING GROUP	RN102584026	2911
43	HG0632T	ROHM & HAAS TEXAS	RN100223205	2869
44	BL0038U	SOLUTIA INC	RN100238682	2869
45	GJ0043K	SOUTHWESTERN ELECTRIC POWER	RN102156916	4911
46	LN0081B	SOUTHWESTERN PUBLIC SERVICE (FORMERLY XCEL)	RN100224765	4911
47	ME0006A	SOUTHWESTERN ELECTRIC POWER	RN100542596	4911
48	PG0040T	SOUTHWESTERN PUBLIC SERVICE	RN100224641	4911
49	PG0041R	SOUTHWESTERN PUBLIC SERVICE	RN100224849	4911
50	JE0091L	SUN MARINE TERMINAL	RN100214626	4226
51	WN0042V	TARGA	RN102552387	1311
52	CI0012D	TEXAS GENCO LP	RN100825371	4911
53	FG0020V	TEXAS GENCO LP	RN100888312	4911
54	HG0562P	TEXAS PETROCHEMICALS LP	RN100219526	2869
55	BL0082R	THE DOW CHEMICAL CO	RN100225945	2869
56	NE0022I	TICONA POLYMERS INC	RN101625721	2869
57	FI0020W	TXU BIG BROWN COMPANY LP	RN101198059	4911
58	DB0251U	TXU ELECTRIC COMPANY	RN101559854	4911
59	FB0025U	TXU GENERATION COMPANY LP	RN102285855	4911
60	HQ0012T	TXU GENERATION COMPANY LP	RN100664812	4911
61	MB0116C	TXU GENERATION COMPANY LP	RN102566494	4911
62	MM0023J	TXU GENERATION COMPANY LP	RN102147881	4911
63	MO0014L	TXU GENERATION COMPANY LP	RN102285848	4911
64	RL0020K	TXU GENERATION COMPANY LP	RN102583093	4911
65	TA0352I	TXU GENERATION COMPANY LP	RN100693308	4911
66	WC0028Q	TXU GENERATION COMPANY LP	RN102183969	4911
67	YB0017V	TXU GENERATION COMPANY LP	RN102563426	4911
68	GB0076J	UNION CARBIDE CORP	RN100219351	2869
69	CB0028T	UNION CARBIDE CORPORATION	RN102181526	2869
70	GB0073P	VALERO REFINING CO TEXAS	RN100238385	2911
71	VC0003D	VICTORIA POWER	RN100214980	4911
72	JB0016M	VINTAGE PETROLEUM INC	RN100214592	1311

Distances from the BART-eligible sources to Class I areas were determined and are shown in Table 9-4 that follows.

**Table 9-4: BART-Eligible Source Distance to Each Class I**

Regulated Entity	Company	Distance to Class I (km)									
		Big Bend	Breton Isle	Caney Creek	Carlsbad Caverns	Guadalupe Mtns	Salt Creek	Upper Buffalo	Wheeler Peak	White Mtn	Wichita Mtns
RN100220110	ABITIBI CONSOLIDATED CORP	851	580	343	937	968	946	514	1148	1070	533
RN102560687	AEP TEXAS CENTRAL CO	652	957	979	945	953	1054	1152	1374	1132	962
RN100642040	AEP TEXAS CENTRAL CO	608	862	815	860	874	951	988	1255	1041	805
RN100552181	AEP TEXAS CENTRAL CO	590	865	797	838	852	926	970	1229	1018	780
RN100215557	AEP TEXAS NORTH CO	497	1071	556	460	495	455	681	688	579	257
RN101531226	AEP TEXAS NORTH CO	351	1125	684	393	420	442	821	733	549	408
RN100221472	ALCOA INC	609	792	510	731	758	769	679	1022	884	490
RN100242577	ALCOA WORLD ALUMINA LLC	652	759	680	859	878	927	854	1209	1030	708
RN100250869	ALON USA LP	373	1223	720	295	329	316	837	604	431	372
RN100225978	ASH GROVE TEXASLP	693	827	342	710	744	700	496	893	827	294
RN100209444	ATTOFINA CHEMICALS INC	780	609	526	932	957	972	698	1217	1086	647
RN100219872	AUSTIN ENERGY	553	843	563	690	715	738	731	1005	849	505
RN100218049	BASF CORPORATION	760	641	613	942	965	996	785	1258	1105	711
RN102536307	BP AMOCO CHEMICAL CO	804	590	566	969	993	1014	736	1264	1127	697
RN102535077	BP PRODUCTS NORTH AMERICA	805	562	564	970	994	1014	735	1264	1127	696
RN100221761	CABOT CORPORATION	721	1296	642	497	535	377	686	414	494	225
RN100211507	CAPITOL CEMENT DIV	466	924	677	652	672	724	843	1017	824	579
RN101996395	CELANESE CHEMICAL	717	1297	645	492	531	373	689	413	489	226
RN100258060	CELANESE LTD	702	703	642	894	915	955	816	1227	1061	703
RN100216472	CHAPARRAL STEEL	687	828	348	707	741	699	503	894	825	299
RN100219856	CHEMICAL LIME LTD	603	858	443	658	689	672	601	901	793	354
RN103919817	CHEVRON PHILLIPS CHEMICAL	805	584	515	953	979	990	686	1231	1106	654
RN102320850	CHEVRON PHILLIPS CHEMICAL	733	1332	676	494	531	365	715	379	477	261
RN100825249	CHEVRON PHILLIPS CHEMICAL	726	673	612	908	930	964	785	1229	1072	690
RN102555166	CITGO REFINING & CHEMICALS	557	866	798	837	852	926	971	1229	1018	781
RN100217975	CITY PUBLIC SERVICE	475	917	693	673	692	748	861	1044	847	606
RN100217835	CITY PUBLIC SERVICE	470	923	701	671	689	748	868	1045	845	611
RN102495884	CONOCO PHILLIPS	732	1333	677	492	530	363	716	378	475	262
RN101271419	COPANO PROCESSING LP	640	751	598	813	835	868	771	1138	977	619
RN100218684	DCP MIDSTREAM LP	350	1355	837	167	204	198	943	519	303	457



Regulated Entity	Company	Distance to Class I (km)									
		Big Bend	Breton Isle	Caney Creek	Carlsbad Caverns	Guadalupe Mtns	Salt Creek	Upper Buffalo	Wheeler Peak	White Mtn	Wichita Mtns
RN100209659	DEGUSSA ENG CARBONS	728	1337	683	486	524	357	722	373	469	266
RN100227016	DOW CHEMICAL CO	791	600	539	947	972	988	710	1235	1102	665
RN104150123	DOW CHEMICAL CO	796	598	536	951	975	987	717	1238	1113	668
RN100222900	DYNEGY MIDSTREAM SERVICES	807	583	513	954	980	991	684	1231	1107	653
RN100219815	EASTMAN CHEMICAL COMPANY	886	623	224	927	960	915	397	1084	1042	452
RN100225085	EI DUPONT DE NEMOURS & CO	794	596	530	947	972	987	701	1232	1102	660
RN100542711	EI DUPONT DE NEMOURS & CO	918	472	484	1053	1080	1080	646	1303	1199	699
RN100211309	EL PASO ELECTRIC CO	428	1689	1178	178	146	260	1273	518	175	778
RN102166964	ENBRIDGE PIPELINES LP	940	647	135	952	987	924	308	1067	1053	428
RN100226877	ENTERGY GULF STATES INC	753	643	461	878	906	908	634	1143	1026	565
RN102513041	ENTERGY GULF STATES INC	907	484	487	1043	1070	1071	650	1295	1190	695
RN100210574	EQUISTAR	777	619	582	948	971	996	753	1252	1108	694
RN100237668	EQUISTAR CHEMICALS LP	777	618	582	948	972	997	754	1252	1108	695
RN100542281	EQUISTAR CHEMICALS LP	787	603	517	935	961	973	688	1216	1088	643
RN100211903	EXXON MOBIL CHEMICALS	889	501	482	1024	1051	1053	647	1279	1171	680
RN102212925	EXXONMOBIL CHEMICAL CO	796	594	524	947	972	986	695	1229	1101	655
RN102574803	EXXONMOBIL CHEMICAL CO	795	594	525	947	972	986	696	1229	1101	656
RN102579307	EXXONMOBIL CORP	796	598	526	944	970	982	697	1236	1112	658
RN102450756	EXXONMOBIL OIL CORP	888	502	482	1023	1050	1052	647	1278	1170	679
RN102534138	FLINT HILLS RESOURCES LP	590	865	798	838	852	927	971	1230	1018	781
RN100235266	FLINT HILLS RESOURCES LP	580	874	800	829	843	918	972	1222	1009	777
RN100219252	HUNTSMAN CORP	899	491	492	1037	1064	1067	656	1293	1185	694
RN100217389	HUNTSMAN CORP	897	493	501	1038	1065	1069	666	1297	1187	700
RN101867554	HUNTSMAN POLYMERS CORP	293	1303	819	212	241	277	936	600	373	467
RN100238708	INEOS USA LLC	779	617	584	951	974	1000	756	1255	1111	698
RN100543115	INTERNATIONAL PAPER CO	974	619	128	988	1023	960	296	1099	1089	460
RN104392626	INVISTA	918	472	484	1053	1080	1080	646	1303	1199	700
RN102663671	INVISTA S.A.R.L.	614	797	693	824	842	896	866	1182	996	696
RN100213909	LAREDO WLE LP	411	1069	918	703	710	818	1086	1145	890	802
RN100218254	LEHIGH CEMENT COMPANY	623	820	438	694	725	712	601	942	832	388
RN100215979	LON C HILL LP	571	882	802	820	834	911	974	1216	1001	774

Regulated Entity	Company	Distance to Class I (km)									
		Big Bend	Breton Isle	Caney Creek	Carlsbad Caverns	Guadalupe Mtns	Salt Creek	Upper Buffalo	Wheeler Peak	White Mtn	Wichita Mtns
RN102038486	LCRA	583	810	559	727	752	775	729	1040	886	529
RN100226844	LCRA	630	760	558	783	807	831	730	1094	942	568
RN100633650	LYONDELL CHEMICAL CO	787	603	518	936	962	975	690	1218	1090	645
RN100218130	LYONDELL CITGO REFINING	775	615	529	928	953	969	703	1216	1083	648
RN100210608	MARATHON PETROLEUM	806	587	564	971	995	1015	734	1265	1128	697
RN102609724	NORIT AMERICAS INC	915	603	209	954	988	940	381	1104	1067	470
RN101062826	NRG TEXAS LP	799	593	552	960	984	1003	723	1251	1117	682
RN100223585	OWENS-CORNING	701	811	336	724	758	717	494	910	843	310
RN102518065	OXY VINYLs LP	789	601	528	941	966	981	699	1226	1096	654
RN100716661	PASADENA REFINING SYSTEM	777	613	528	930	955	971	703	1217	1085	649
RN102584026	PREMCOR REFINING GROUP	897	493	505	1039	1066	1070	669	1299	1188	703
RN100216621	REGENCY FS (FIELD SERVICES)	468	953	788	711	725	804	957	1113	892	705
RN100223205	RHODIA, INC.	797	593	524	948	973	987	695	1230	1102	657
RN100223205	ROHM & HAAS TEXAS	788	602	528	940	965	980	699	1225	1095	654
RN100211879	SHELL OIL CO	785	604	530	938	964	979	701	1224	1093	654
RN100222413	SID RICHARDSON CARBON	727	1337	683	486	524	357	722	373	468	266
RN100226026	SID RICHARDSON CARBON	218	1407	945	142	153	275	1063	618	329	590
RN100238682	SOLUTIA INC	777	618	582	948	972	997	754	1252	1108	695
RN102156916	SOUTHWESTERN ELEC POWER	888	616	231	932	965	921	403	1092	1048	461
RN100542596	SOUTHWESTERN ELEC POWER	915	632	178	941	975	921	351	1077	1049	440
RN100213370	SOUTHWESTERN ELEC POWER	900	668	165	914	949	890	338	1041	1019	404
RN100224641	SOUTHWESTERN PUBLIC SERV	679	1346	705	435	473	308	754	362	423	281
RN100224849	SOUTHWESTERN PUBLIC SERV	681	1347	705	436	474	309	754	361	424	282
RN100224765	SOUTHWESTERN PUBLIC SERV	490	1282	712	304	344	248	803	477	377	309
RN100214626	SUN MARINE TERMINAL	896	494	505	1038	1065	1070	670	1299	1188	703
RN102551785	TARGA MIDSTREAM SERVICES	251	1327	859	196	219	288	979	621	370	513
RN102552387	TARGA MIDSTREAM SERVICES	684	925	361	647	684	617	488	786	745	182
RN100214428	TEMPLE-INLAND	921	471	466	1050	1077	1074	628	1293	1194	687
RN100888312	TEXAS GENCO	736	656	565	901	925	949	738	1205	1060	653
RN100825371	TEXAS GENCO	804	585	523	955	980	993	694	1236	1109	660
RN102597846	TEXAS LEHIGH CEMENT CO	525	867	599	678	701	734	767	1009	841	528

Regulated Entity	Company	Distance to Class I (km)									
		Big Bend	Breton Isle	Caney Creek	Carlsbad Caverns	Guadalupe Mtns	Salt Creek	Upper Buffalo	Wheeler Peak	White Mtn	Wichita Mtns
RN100219526	TEXAS PETROCHEMICALS LP	772	617	534	927	952	968	706	1216	1083	649
RN102561925	THE GOODYEAR TIRE & RUBBER	874	516	492	1013	1040	1044	659	1273	1161	679
RN101625721	TICONA POLYMERS INC	562	911	839	824	836	920	1011	1230	1006	803
RN102457520	TOTAL PETROCHEMICALS USA	904	485	493	1043	1070	1072	657	1298	1190	698
RN100217199	TXI OPERATIONS LP	688	827	347	708	742	700	503	895	826	299
RN101198059	TXU BIG BROWN CO LP	741	719	340	802	833	806	511	1010	930	409
RN101559854	TXU GENERATION COMPANY	720	841	312	716	751	695	459	871	823	257
RN102285855	TXU GENERATION COMPANY	809	822	227	781	818	745	366	887	874	250
RN100664812	TXU GENERATION COMPANY	630	886	402	645	678	640	550	846	765	277
RN102566494	TXU GENERATION COMPANY	651	797	413	719	750	733	578	957	854	389
RN102147881	TXU GENERATION COMPANY	610	791	509	732	758	770	679	1022	884	490
RN102285848	TXU GENERATION COMPANY	403	1178	674	343	376	355	793	627	473	336
RN102583093	TXU GENERATION COMPANY	889	604	242	939	972	930	414	1104	1057	474
RN100693308	TXU GENERATION COMPANY	680	865	352	680	715	665	498	852	792	256
RN102285921	TXU GENERATION COMPANY	885	685	170	897	932	872	342	1024	1001	387
RN102183969	TXU GENERATION COMPANY	255	1360	884	162	186	261	1001	599	339	528
RN102563426	TXU GENERATION COMPANY	612	991	441	567	603	541	563	730	669	180
RN102181526	UNION CARBIDE CORP	634	783	702	848	867	921	876	1208	1021	718
RN100219351	UNION CARBIDE CORP	802	591	565	967	991	1012	735	1262	1125	695
RN100213685	VALENCE MIDSTREAM	842	717	204	853	888	831	372	990	959	356
RN100210517	VALERO MCKEE	751	1387	728	490	527	350	760	326	453	316
RN100238385	VALERO REFINING CO TEXAS	806	588	565	971	995	1015	735	1265	1128	697
RN100211663	VALERO REFINING CO TEXAS	559	867	798	836	851	925	971	1229	1017	780
RN100218601	VETROTEX AMERICA	671	1019	419	587	625	539	521	690	668	99
RN100214980	VICTORIA WLE LP	607	799	682	813	832	883	855	1169	985	682
RN100214592	VINTAGE PETROLEUM LLC	646	761	669	847	867	914	842	1195	1017	693
RN102157609	WESTVACO	891	503	451	1016	1044	1040	617	1260	1160	656

### **9.2.2 Individual Source Attribution Approach**

One of the air quality modeling approaches suggested by the EPA in the BART guidance is an individual source attribution approach. Specifically, this entails modeling source-specific BART-eligible units and comparing modeled impacts to a particular deciview threshold.

#### **CALPUFF**

The CALPUFF modeling protocol, *Best Available Retrofit Technology (BART) Modeling Protocol to Determine Sources Subject to BART in the State of Texas*, developed by the TCEQ for determining which sources are subject to BART is included in Appendix 9-7: *CALPUFF Modeling Guidelines*. Appendix 9-7 also contains a summary report for each modeling demonstration. Table 9-5: *BART-Eligible Sources Exempt Based on CALPUFF Modeling Results* lists the BART-eligible sources that are exempt from BART based on CALPUFF modeling results.

**Table 9-5: BART-Eligible Sources Exempt Based on CALPUFF Modeling Results**

<b>Regulated Entity</b>	<b>Account</b>	<b>Source</b>	<b>SIC</b>
RN100221472	MM0001T	ALCOA INC	3334
RN100250869	HT0011Q	ALON USA LP	2911
RN100225978	ED0034O	ASH GROVE (formerly NORTH TEXAS CEMENT)	3241
RN100221761	GH0003Q	CABOT CORPORATION	2895
RN101996395	GH0004O	CELANESE CHEMICAL	2869
RN102495884	HW0018P	CONOCO PHILLIPS (formerly PHILLIPS 66 CO)	2911
RN100218684	AB0012W	DCP (formerly DUKE ENERGY FIELD SERVICES)	1321
RN100209659	HW0008S	DEGUSSA ENGINEERED CARBONS	2869
RN100219815	HH0042M	EASTMAN CHEMICAL COMPANY	2869
RN100542281	HG0033B	EQUISTAR CHEMICALS LP	2869
RN102579307	HG0232Q	EXXONMOBIL CORP	2911
RN102450756	JE0067I	EXXONMOBIL OIL CORP	2911
RN101867554	EB0057B	HUNTSMAN POLYMERS	2869
RN100543115	CG0010G	INTERNATIONAL PAPER CO	2621
RN104392626	OCA002B	INVISTA	2869
RN102663671	VC0008Q	INVISTA (formerly DU PONT DE NEMOURS)	2869
RN101062826	GB0037T	NRG TEXAS (formerly TEXAS GENCO LP)	4911
RN100223585	ED0051O	OWENS CORNING	3296
RN100220581	HG0697O	RHODIA INC	2819
RN100211879	HG0659W	SHELL OIL CO	2911
RN100222413	HW0017R	SID RICHARDSON CARBON	2895
RN100226026	HT0027B	SID RICHARDSON CARBON CO	2895
RN100213370	TF0012D	SOUTHWESTERN ELECTRIC POWER	4911
RN100214428	OC0019C	TEMPLE-INLAND	2621
RN102597846	HK0014M	TEXAS LEHIGH CEMENT CO	3241
RN102457520	JE0005H	TOTAL PETROCHEMICALS INC (formerly ATOFINA PETROCHEMICALS INC)	2911
RN100217199	ED0066B	TXI OPERATIONS LP	3241
RN102285921	TF0013B	TXU GENERATION COMPANY LP	4911
RN102157609	JC0003K	WESTVACO	2631

## CAMx

The CAMx modeling guideline, *Guidance for the Application of the CAMx Hybrid Photochemical Grid Model to Assess Visibility Impacts of Texas BART Sources at Class I Areas*, developed by the TCEQ is in Appendix 9-8. This appendix also contains the modeling summary reports for each modeling demonstration. Table 9-6 presents the BART-eligible sources that screened out on an individual basis using CAMx.

**Table 9-6: BART-Eligible Sources Screened Out on Individual Basis Using CAMx**

Reference Number	Reference Number	Nearest Class I Area	Distance to Nearest Class I area (km)	Emission Rate Data Source	Highest Impact (dv)	Class I Area with Highest Impact
RN102535077	BP Products North American	BRET	562	Permit Allowables	0.28	CACR
RN102555166	CITGO Corpus Christi Refinery	BIBE	557	Permit Allowables	0.16	BIBE
RN104150123	Dow Chemical Company	CACR	536	Permit Allowables	0.21	BRET
RN100218130	Houston Refining LP	CACR	529	PTE, Permit Allowables	0.10	UPBU/ CACR
RN100716661	Pasadena Refining System Inc.	CACR	528	Permit Allowables	0.42	CACR
RN100211663	Valero Corpus Christi East Plant	BIBE	554	Facility Wide Emission Cap	0.11	BIBE/ CACR

### 9.3 SITES REMOVED FROM FURTHER BART CONSIDERATION

The TCEQ BART rule was published January 10, 2007. Companies requested removal from further BART consideration per the exemptions in the rule or based on updated information on the site. To be removed from the list, a site had to be exempted for all potential haze causing pollutants, NO<sub>x</sub>, SO<sub>2</sub>, and fine particulate matter. A site may be exempted if the combined NO<sub>x</sub> and SO<sub>2</sub> potential to emit are less than 1,000 tpy, and the site is greater than 100 km from a Class I area. Some sites may be exempted if the combined NO<sub>x</sub> and SO<sub>2</sub> potential to emit are less than 500 tpy, and the site is greater than 50 km from a Class I area. Several sites requested exemption for combined SO<sub>x</sub> and NO<sub>x</sub> limits and certified that the TCEQ-sponsored modeling adequately represented particulate emissions. One site requested PM<sub>2.5</sub> exemption due to de minimis levels of emissions.

Updated site information included construction dates and potential emission rates of equipment. Two sites requested removal because the operating equipment did not meet a BART category. The results of granted exclusions are also shown in Table 9.7: *Sites Removed From BART Due to Exemption Requests*.

**Table 9-7: Sites Removed From BART Due to Exemption Requests**

<b>No.</b>	<b>Regulated Entity</b>	<b>Company</b>	<b>Reason</b>	<b>Account</b>	<b>SIC</b>
1	RN100220110	ABITIBI CONSOLIDATED CORP	PTE*<1,000, de minimis PM	AC0017B	2621
2	RN102559291	BMC HOLDINGS INC	PTE<1,000, PM certification	JE0343H	2869
3	RN100211507	CAPITOL CEMENT	Shut down kiln	BG0045E	3241
4	RN100227016	CELANESE	PTE<250	HG0126Q	2869
5	RN100825249	CHEVRON PHILLIPS CHEMICAL	met TCEQ model plant	BL0758C	2869
6	RN100542711	EI DUPONT DENEMOURS & CO	PTE<1,000, PM certification	OC0007J	2869
7	RN102166964	ENBRIDGE PIPELINES	PTE<250	CG0012C	1321
8	RN104579487	INEOS USA	PTE<250	GBA007G	2869
9	RN100212018	J.L. DAVIS GAS PROCESSING	No BART sources	CA0011B	1321
10	RN100213719	JOHNS MANVILLE INTERNATIONAL	PTE<250	JH0025O	3296
11	RN100633650	LYONDELL PETROCHEMICAL	PTE<1,000, PM certification	HG1575W	2869
12	RN100210608	MARATHON ASHLAND PETROLEUM	PTE<250	GB0055R	2911
13	RN102609724	NORIT AMERICAS INC	PTE<1,000, PM certification	HH0019H	2819
14	RN102643327	PUEBLO MIDSTREAM GAS CORP	recheck dates, not BART	AG0024G	1321
15	RN100211408	REGENCY GAS SERVICES	No BART equip	PE0024Q	1321
16	RN100216621	REGENCY TILDEN GAS	PTE<1,000, PM certification	MC0002H	2819
17	RN102551785	TARGA	Shut down	CY0019H	1311
18	RN102561925	THE GOODYEAR TIRE AND RUBBER CO	PTE<250	JE0039N	2822
19	RN100213685	VALENCE MIDSTREAM LTD	plant shut down	HR0018T	1321
20	RN100210517	VALERO MCKEE REFINERY	PTE<1,000, PM certification	MR0008T	2911
21	RN100219310	VALERO REFINING TEXAS LP	PTE<1,000, PM certification	HG0130C	2911
22	RN100218601	VETROTEX AMERICA ST. GOBAIN	PTE<500, PM certification	WH0014S	3229

Note: \*PTE is potential to emit

#### 9.4 DETERMINATION OF BART FOR SOURCES SUBJECT TO BART

Upon conclusion of all BART screening analyses and review of exclusion requests, no Texas sources remained subject to BART. Some EGUs may become subject to BART pending resolution of CAIR at the federal level. Table 9-8: *Summary of BART-Eligible Source Determination* summarizes where a determination was made for all sources in the BART determination process. Several sources were added to the process after the BART survey, either at the site's request or as a result of recent activity at the site. Their status is reflected in this table. Site activity included transfer of equipment or corporate reorganization resulting in site splits. Although not used thus far for any sources, the TCEQ's Engineering Analysis Guidance and forms are in Appendix 9-9.

**Table 9-8: Summary of BART-Eligible Source Determinations**

Account	Company	BART-eligible <sup>1</sup>	Reason for Removal			
			Cum. Model CAMx	CAL-PUFF	Single Source CAMx	Exemption Request
TG0044C	AEP TEXAS	y	y			
CD0013K	AEP TEXAS CENTRAL COMPANY	y	y			
NE0024E	AEP TEXAS CENTRAL COMPANY	y	y			
NE0026A	AEP TEXAS CENTRAL COMPANY	y	y			
JI0030K	AEP TEXAS NORTH COMPANY	y	y			
CB0003M	ALCOA ALUMINA & CHEMICALS	y	y			
BL0002S	INEOS OLEFINS & POLYMERS	y	y			
HG0558G	ATOFINA CHEMICALS INC	y	y			
BL0021O	BASF CORPORATION	y	y			
GB0001R	BP AMOCO CHEMICAL COMPANY	y	y			
MH0009H	CELANESE LIMITED	y	y			
ED0011D	CHAPARRAL STEEL MIDLOTHIAN	y	y			
BJ0001T	CHEMICAL LIME LTD	y	y			
HG0310V	CHEVRON PHILLIPS CHEMICAL	y	y			
HW0013C	CHEVRON PHILLIPS CHEMICAL CO	y	y			
BG0057U	CITY PUBLIC SERVICE	y	y			
BG0186I	CITY PUBLIC SERVICE	y	y			
CR0020C	COPANO PROCESSING LP	y	y			
CI0022A	DYNEGY MIDSTREAM SERVICES	y	y			
WN0042V	TARGA	y	y			
HG0218K	EI DUPONT	y	y			
EE0029T	EL PASO ELECTRIC CO	y	y			
TH0004D	ELECTRIC UTILITY DEPT	y	y			
MQ0009F	ENTERGY GULF STATES INC	y	y			
OC0013O	ENTERGY GULF STATES INC	y	y			
BL0113I	EQUISTAR	y	y			
BL0268B	EQUISTAR CHEMICALS LP	y	y			
HG0033B	EQUISTAR CHEMICALS LP	y			y	
HG0228H	EXXON CHEMICAL CO	y	y			
JE0065M	EXXON MOBIL CHEMICAL CO	y	y			
HG0229F	EXXONMOBIL CHEMICAL CO	y	y			
NE0122D	FLINT HILLS RESOURCES LP	y	y			
JE0052V	HUNTSMAN CORPORATION	y	y			
JE0135Q	HUNTSMAN PETROCHEMICAL	y	y			



Account	Company	BART-eligible <sup>1</sup>	Reason for Removal			
			Cum. Model CAMx	CAL-PUFF	Single Source CAMx	Exemption Request
	CORP					
EB0057B	HUNTSMAN POLYMERS	y		y		
GBA007G	INEOS					y
NE0120H	FLINT HILLS RESOURCES LP	y	y			
WE0005G	LAREDO POWER	y	y			
MB0123F	LEHIGH CEMENT COMPANY	y	y			
NE0025C	LON C HILL POWER	y	y			
BC0015L	LOWER COLORADO RIVER AUTHORITY	y	y			
FC0018G	LOWER COLORADO RIVER AUTHORITY	y	y			
HG1575W	LYONDELL CITGO REFINING	y	y			y
HG1451S	OXYVINYLSLP	y	y			
JE0042B	PREMCOR REFINING GROUP	y	y			
HG0632T	ROHM & HAAS TEXAS	y	y			
BL0038U	SOLUTIA INC	y	y			
GJ0043K	SOUTHWESTERN ELECTRIC POWER	y	y			
ME0006A	SOUTHWESTERN ELECTRIC POWER	y	y			
PG0040T	SOUTHWESTERN PUBLIC SERVICE	y	y			
PG0041R	SOUTHWESTERN PUBLIC SERVICE	y	y			
JE0091L	SUN MARINE TERMINAL	y	y			
CI0012D	TEXAS GENCO LP	y	y			
FG0020V	TEXAS GENCO LP	y	y			
GB0037T	NRG Texas	y		y		
HG0562P	TEXAS PETROCHEMICALS LP	y	y			
BL0082R	THE DOW CHEMICAL CO	y	y			
NE0022I	TICONA POLYMERS INC	y	y			
ED0066B	TXI OPERATIONS, L.P.	y		y		
FI0020W	TXU BIG BROWN COMPANY LP	y	y			
DB0251U	TXU ELECTRIC COMPANY	y	y			
FB0025U	TXU GENERATION COMPANY LP	y	y			
HQ0012T	TXU GENERATION COMPANY LP	y	y			
MB0116C	TXU GENERATION COMPANY LP	y	y			
MM0023J	TXU GENERATION COMPANY LP	y	y			
MO0014L	TXU GENERATION COMPANY LP	y	y			
RL0020K	TXU GENERATION COMPANY LP	y	y			
TA0352I	TXU GENERATION COMPANY LP	y	y			
WC0028Q	TXU GENERATION COMPANY LP	y	y			
YB0017V	TXU GENERATION COMPANY LP	y	y			
GB0076J	UNION CARBIDE CORP	y	y			
CB0028T	UNION CARBIDE CORPORATION	y	y			
GB0073P	VALERO REFINING CO TEXAS	y	y			
VC0003D	VICTORIA POWER	y	y			
JB0016M	VINTAGE PETROLEUM, INC.	y	y			
LN0081B	SOUTHWESTERN PUBLIC SERVICE	y	y			
AC0017B	ABITIBI CONSOLIDATED CORP	y				y

Account	Company	BART-eligible <sup>1</sup>	Reason for Removal			
			Cum. Model CAMx	CAL-PUFF	Single Source CAMx	Exemption Request
TF0012D	SOUTHWESTERN ELECTRIC POWER	y		y		
MM0001T	ALCOA INC	y		y		
HT0011Q	ALON USA LP	y		y		
ED0034O	ASH GROVE	y		y		
JE0343H	BMC HOLDINGS INC					y
GB0004L	BP PRODUCTS NORTH AMERICA IN TEXAS	y			y	
GH0003Q	CABOT CORPORATION	y		y		
BG0045E	CAPITOL CEMENT DIV CAPITOL	y				y
GH0004O	CELANESE CHEMICAL	y			y	
BL0758C	CHEVRON PHILLIPS CHEMICAL	y				y
NE0027V	CITGO REFINING & CHEMICALS	y			y	
HW0018P	CONOCOPHILLIPS	y		y		
AB0012W	DCP	y		y		
HW0008S	DEGUSSA ENGINEERED CARBONS	y		y		
MR0008T	DIAMOND SHAMROCK REFINING	y				y
HGA005E	DOW	y			y	
HG0126Q	DOW	y				y
HH0042M	EASTMAN CHEMICAL COMPANY	y		y		
OC0007J	EI DUPONT DENEMOURS & CO	y				y
MC0002H	ENBRIDGE PIPELINE					y
CG0012C	ENBRIDGE PIPELINES	y				y
HG0033B	EQUISTAR CHEMICALS LP			y		
HG0232Q	EXXONMOBIL CORP - Baytown	y		y		
JE0067I	EXXONMOBIL OIL CORP - Beaumont	y		y		
EB0057B	HUNTSMAN POLYMERS			y		
CG0010G	INTERNATIONAL PAPER CO	y		y		
OCA002B	INVISTA	y		y		
VC0008Q	INVISTA	y		y		
JH0025O	JOHNS MANVILLE INTERNATIONAL					y
HG0048L	LYONDELL CITGO REFINING	y			y	
GB0055R	MARATHON ASHLAND PETROLEUM	y				y
HH0019H	NORIT AMERICAS INC	y				y
GB0037T	NRG Texas			y		
ED0051O	OWENS CORNING	y		y		
HG0175D	PASADENA REFINING	y		y		
AG0024G	PUEBLO MIDSTREAM GAS CORP					y
PE0024Q	REGENCY GAS SERVICES					y
HG0697O	RHODIA, INC.	y		y		
HG0659W	SHELL OIL CO	y		y		
HW0017R	SID RICHARDSON CARBON	y		y		
HT0027B	SID RICHARDSON CARBON	y		y		
CY0019H	TARGA	y				y
OC0019C	TEMPLE-INLAND	y		y		
HK0014M	TEXAS LEHIGH CEMENT CO	y		y		

Account	Company	BART-eligible <sup>1</sup>	Reason for Removal			
			Cum. Model CAMx	CAL-PUFF	Single Source CAMx	Exemption Request
JE0039N	THE GOODYEAR TIRE AND RUBBER CO	y				y
JE0005H	TOTAL PETROCHEMICALS	y		y		
ED0066B	TXI OPERATIONS, L.P.			y		
TF0013B	TXU GENERATION COMPANY LP	y		y		
HR0018T	VALENCE MIDSTREAM LTD	y				y
NE0043A	VALERO REFINING COMPANY	y			y	
HG0130C	VALERO REFINING TEXAS LP					y
WH0014S	VETROTEX WICHITA FALLS PLANT	y				y
JC0003K	WESTVACO	y		y		

Note:

1. Some sources were added to the determination process after the BART survey, either by their request or as a result of equipment transfers. These are indicated with a blank.

## 9.5 POST-BART EMISSIONS REDUCTIONS

Subsequent to the 2002 base year inventory, some BART-eligible sources reduced their permitted emissions. Documentation of the emission reductions is in Appendix 9-11: *Documentation of Emission Reductions*. The sources and the estimated reductions are presented in Table 9-9. Reduction estimates are conservative because they are from the 2002 actual emissions level to a potential to emit level. Capitol Cement shut down their BART units. The final list of all BART-eligible sources is in Appendix 9-13: *BART-Eligible List*.

**Table 9-9: Post-BART Emissions Reductions at Texas Sources**

No.	Regulated Entity	Source	Account*	NO <sub>x</sub> Reduced from Baseline 2002 (tpy)	SO <sub>2</sub> Reduced from Baseline 2002 (tpy)	PM Reduced from Baseline 2002 (tpy)
1	RN100211507	CAPITOL CEMENT DIV	BG0045E	1,328	1,193	100
2	RN100227016	DOW	HG0126Q	694	0	0
3	RN102450756	EXXONMOBIL OIL***	JE0067I	2.7	290	0
4	RN102609724	NORIT AMERICAS INC	HH0019H**	16.6	+5.4	0
5	RN100216621	REGENCY TILDEN GAS (FORMERLY ENBRIDGE PIPELINE)	MC0002H	2	2,276	0.2
6	RN102551785	TARGA (FORMERLY DYNEGY MIDSTREAM SERVICES)	CY0019H	336	0.3	0.5
7	RN102561925	THE GOODYEAR TIRE AND RUBBER CO	JE0039N	89.1	+11.3	2.9
8	RN100213685	VALENCE MIDSTREAM LTD	HR0018T	247.1	2,743.5	5.6
9	RN100218601	VETROTEX AMERICA ST. GOBAIN	WH0014S	62.6	16.4	59.0
<b>Total estimated reductions in haze emissions = 9,485.2 tpy</b>				2,778.1	6,535.9	168.2

\*The first two letters in account number are the abbreviation for the source's county location. See Appendix 9-11 for the list of county abbreviations.

\*\*Company has permit limiting combined SO<sub>2</sub> and NO<sub>x</sub> to 841 tpy on previously grandfathered BART sources. This limit is lower than actual emissions in previous years. For example, the facility emitted 1,266 tpy of NO<sub>x</sub> and SO<sub>2</sub> in 1990.

\*\*\*ExxonMobil numbers are preliminary and subject to change. These estimates are based on reductions from the 2002 EI and pre- and post-BART hourly emissions rates submitted. (Emission reductions as a result of the completion of permit 49138 (FCCU) will be updated when they become available.)

## CHAPTER 10. REASONABLE PROGRESS GOALS

### 10.1 INTRODUCTION

The national goal for regional haze is to achieve natural visibility levels at Class I areas by 2064. The Texas Commission on Environmental Quality (TCEQ) must show reasonable progress toward the national goal by 2018. The uniform rate of progress (URP) named in the United States Environmental Protection Agency (EPA) guidance (described as uniform rate of improvement in 40 Code of Federal Regulations (CFR) §51.308(d)(1)(i)(B)) is a straight line between base period conditions on the worst 20 percent days and estimated natural visibility conditions. Chapter 5: *Assessment of Baseline and Current Conditions and Estimate of Natural Conditions in Class I Areas* details the calculation of base period conditions and estimations of 2064 natural conditions. The URP is a tool for comparing the reasonable progress goals (RPGs) set by the state with the visibility improvement that would be needed to reach natural conditions by 2064. Table 10-1: *Uniform Rate of Progress for Class I Areas in Texas (Worst 20 Percent Days)* shows the URP 2018 deciview values for the two Texas Class I areas.

Table 10-1 shows Texas' calculation of natural conditions using the approximation that 100 percent of the dust (coarse mass and fine soil) at both Big Bend and Guadalupe Mountains National Parks is natural. As Chapter 5 discusses in more detail, analysis indicated that the approximation that all the dust is natural is a better approximation than an estimate using any substantively lower percentage.

The TCEQ plans to work with the EPA, Federal Land Managers (FLMs), and other experts and researchers as Texas continues to refine natural condition estimates for future five-year reports and ten-year Regional Haze SIP revisions.

**Table 10-1: Uniform Rate of Progress for Class I Areas in Texas (Worst 20 Percent Days)**

Class I Area	Improvement Needed by 2018 Assuming URP (dv)	Annual Progress Needed to Meet URP (dv)	Improvement Needed by 2064 (dv)
Big Bend	1.7	0.12	7.2
Guadalupe Mountains	1.2	0.08	4.9

### 10.2 REASONABLE PROGRESS GOALS FOR TEXAS CLASS I AREAS

The TCEQ has determined that the rate of visibility improvement by 2018, shown in Table 10-2: *Reasonable Progress Goals for Class I Areas (Worst 20 Percent Days)*, is reasonable and will be implemented as the RPGs for the listed Class I areas.

**Table 10-2: Reasonable Progress Goals for Class I Areas (Worst 20 Percent Days)**

Class I Area	Improvement Projected by 2018 using RPG (dv)	Improvement by 2018 at URP (dv)	Projected Improvement by 2064 (dv)	Date Natural Visibility Attained at RPG Rate
Big Bend	0.7	1.7	2.9	2155
Guadalupe Mountains	0.9	1.2	3.8	2081

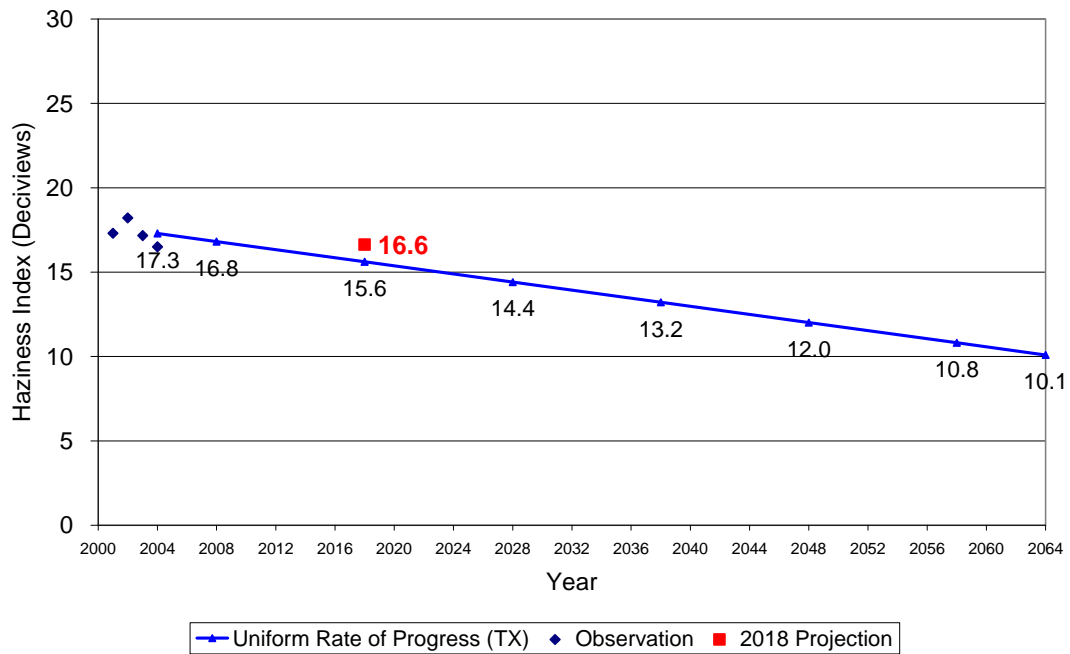
These RPGs are derived from the CENRAP modeling and reflect emissions reductions programs already in place, including CAIR and additional refinery SO<sub>2</sub> reductions as a result of the EPA refinery consent decrees. These RPGs assume that either CAIR will remain in place or will be replaced by a comparable program to reduce visibility impairing pollution from EGUs in Texas and in the eastern United States. As Chapter 11: *Long-Term Strategy to Reach Reasonable Progress Goals* details, the TCEQ's emissions reduction requirements have often gone beyond the Federal Clean Air Act (FCAA) requirements for the past 35 years and continue to go beyond many federal requirements today. Texas programs include:

- opacity limits on grandfathered facilities;
- Best Available Control Technology (BACT) requirements that typically go beyond EPA's New Source Performance Standards (NSPS) for new and modified sources;
- extensive NO<sub>x</sub> emission limits on existing and new sources including major, minor, and area sources including some on a statewide basis;
- Texas Emissions Reduction Program (TERP), which provides financial incentives to accelerate the implementation of new, cleaner diesel engine technologies in on-road and non-road applications; and
- Air Check Texas Repair and Replacement Assistance Program, which provides financial incentives for scrapping of older gasoline-powered on-road vehicles.

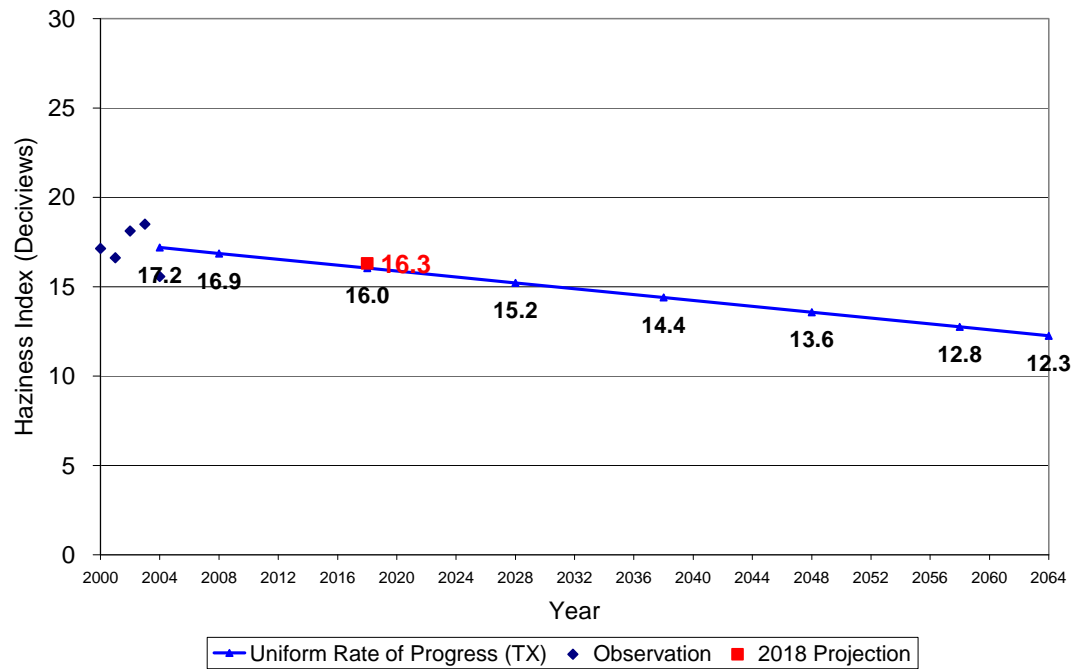
The reasonable progress goals were developed after considering the statutory factors: cost and time of compliance, the energy and non-air quality impacts of compliance, and the remaining useful life of existing sources. Appendix 10-1: *Analysis of Control Strategies and Determination of Reasonable Progress Goals* provides an analysis showing that these goals are reasonable.

The TCEQ focused its control strategy analysis on point source emissions of SO<sub>2</sub> and NO<sub>x</sub>. Chapter 11: *Long-Term Strategy to Reach Reasonable Progress Goals* demonstrates that these are the main anthropogenic pollutants that affect visibility at Class I areas in Texas and in neighboring states. For SO<sub>2</sub>, point sources make up over 90 percent of the projected 2018 statewide emissions. Point sources are clearly the issue for this pollutant. For NO<sub>x</sub>, point sources comprise over 45 percent of the projected statewide emissions. This is the largest single component. The next largest is area sources. Of that, the greatest component also has the greatest uncertainty: emissions from upstream oil and gas production. Working with CENRAP, the TCEQ plans to refine its understanding of those emissions and options for controls over the next few years. Nevertheless, Texas is moving aggressively to reduce those emissions through the \$4 million grant program to pay for retrofits on rich burn compressor engines. Texas is going beyond federal requirements in an effort to reduce NO<sub>x</sub> emissions from on-road and non-road mobile sources through the Texas Emissions Reduction Program (TERP). As a result, the TCEQ elected to focus the control strategy analysis on point sources.

Figures 10-1: *Glide Path for Big Bend Worst 20 Percent Days* and 10-2: *Glide Path for Guadalupe Mountains Worst 20 Percent Days* graphically illustrate how these RPGs compare to the URP or the glide path for the Texas Class I areas.



**Figure 10-1: Glide Path for Big Bend Worst 20 Percent Days**



**Figure 10-2: Glide Path for Guadalupe Mountains Worst 20 Percent Days**

The figures and tables above address the TCEQ's RPGs for the worst 20 percent days at Big Bend and Guadalupe Mountains. These figures use the TCEQ's refined estimate for natural conditions, rather than the EPA default values. Appendix 10-3: *Uniform Rate of Progress Curves Using Default Natural Conditions Estimates* shows the glide paths using the EPA default values. The natural condition estimate was not a factor in setting the RPG. Table 10-3:

*Reasonable Progress Goals for Class I Areas (Best 20 Percent Days)* provides the state's RPGs for the 20 percent days with the best visibility at the Texas Class I areas.

**Table 10-3: Reasonable Progress Goals for Class I Areas (Best 20 Percent Days)**

Class I Area	Baseline Visibility (dv)	Projected 2018 Visibility (RPG) (dv)	Improvement by 2018 at RPG (dv)
Big Bend	5.8	5.6	0.2
Guadalupe Mountains	5.9	5.7	0.2

These RPGs reflect visibility improvements from emissions reductions associated with the FCAA, the Texas Clean Air Act, Texas' ozone SIP revisions and rules, and agreements between EPA and oil refineries for SO<sub>2</sub> emissions reductions. These RPGs do not include additional emissions reductions from implementing the Texas BART rule and new rules adopted in the recent May 23, 2007, Dallas-Fort Worth eight-hour ozone attainment demonstration SIP revision. The TCEQ considered additional controls beyond those already adopted. Given the cost and imperceptible effect of additional controls, and significant international sources of visibility impairment (all discussed in the following section), it is not reasonable to require additional controls at this time to reduce the impact of Texas' emissions on the two Class I areas in Texas.

### 10.3 CONSIDERATION OF ADDITIONAL POLLUTION CONTROL

#### **Development of Area of Influence (AOI) Based Cost Data**

The TCEQ participated in its regional air planning organization, CENRAP, to develop emission inventories for 2002 and 2018, model the results of the emission reductions for each state, and draw areas of influence for each Class I area in the CENRAP domain. To draw the areas of influence CENRAP combined results from three techniques: 1) residence time difference plots for each pollutant that has a substantial effect on visibility impairment at each Class I area, 2) a combination of backward trajectory analysis, emissions information, and monitored concentrations, and 3) tagged species source apportionment within reactive photochemical grid modeling. Appendix 10-1: *Analysis of Control Strategies RPG* provides more detailed information about CENRAP's work to define areas of influence.

For the Class I areas that emissions from Texas affect, the main visibility impairing pollutants resulting from human activity are sulfate and nitrate. The emissions that react to form these pollutants are, respectively, sulfur dioxide and nitrogen oxides. Because of the differences between conditions that lead to high sulfate and high nitrate conditions, the areas of influence for sulfur dioxide and nitrogen oxides are substantially different for several Class I areas that Texas emissions affect.

The TCEQ used the control strategy analysis completed by the CENRAP as the starting point for the analysis of additional controls. The CENRAP analysis used the EPA AirControlNET tool to develop cost per ton estimates for the relevant pollutants. The TCEQ reviewed this information and made changes based on knowledge of the particular facilities and agency experience with implementing ozone control strategies. The analysis focused on moderate cost controls for sources that were likely to contribute to visibility impairment at Class I areas.

Texas assessed the costs of potential controls and reductions for Texas sources at ten Class I areas. These are Big Bend, Breton Island, Caney Creek, Carlsbad Caverns, Guadalupe Mountains, Salt Creek, Upper Buffalo, Wheeler Peak, White Mountain, and Wichita Mountains.



Texas used the second level area of influence for each Class I area to determine sources that met the emissions over distance threshold and were within that Class I area's AOI. The cost associated with potential controls for each Class I area are listed in Table 10-4: *Cost of Controls for Class I Areas*. The significant point sources within each AOI are in Appendix 4-3: *Additional Consultation Letters to Adjacent States*. A master list of potential additional control costs associated with these units for each Class I area were determined and are in Appendix 10-1.

**Table 10-4: Cost of Controls for Class I Areas**

<b>Class 1</b>	<b>Big Bend</b>	<b>Breton Isle</b>	<b>Caney Creek</b>	<b>Carlsbad Caverns</b>	<b>Guadalupe Mountains</b>
NO <sub>x</sub>	\$ 24,100,000	\$ 27,000,000	\$ 28,600,000	\$ 24,100,000	\$ 33,800,000
SO <sub>2</sub>	\$215,900,000	\$231,000,000	\$245,900,000	\$255,500,000	\$254,900,000
<b>Class 1</b>	<b>Salt Creek</b>	<b>Upper Buffalo</b>	<b>Wheeler Peak</b>	<b>White Mountain</b>	<b>Wichita Mountains</b>
NO <sub>x</sub>	\$ 27,000,000	\$ 24,100,000	\$ 22,700,000	\$ 23,000,000	\$ 28,100,000
SO <sub>2</sub>	\$251,900,000	\$233,800,000	\$229,500,000	\$244,500,000	\$269,500,000

Many of these controls are in more than one area of influence. The total cost of all state-wide point source controls are summarized in Table 10-5: *TCEQ Point Source Control Strategy Summary*.

**Table 10-5: TCEQ Point Source Control Strategy Summary**

<b>Pollutant</b>	<b>Tons Per Year (tpy) Reduced</b>	<b>Estimated Cost</b>
Sulfur Dioxide (SO <sub>2</sub> )	155,873	\$270,800,000
Nitrogen Oxides (NO <sub>x</sub> )	27,132	\$53,500,000
Total Costs		\$324,300,000

The TCEQ used the CENRAP modeling to estimate the impact that the control strategy would have on the Class I areas impacted by Texas' emissions. The CENRAP conducted a modeling analysis presuming an aggressive set of additional controls above and beyond CAIR and BART. Texas used the results of this modeling analysis to determine an effectiveness ratio for NO<sub>x</sub> and SO<sub>2</sub> reductions. The effectiveness ratio provides an estimate of improvement in visibility for every ton of NO<sub>x</sub> and SO<sub>2</sub> reduced. Using these ratios, the TCEQ was able to develop an order-of-magnitude estimate of the likely visibility improvements resulting from the point source control strategy (see Table 10-6: *Estimated Haze Index Improvements for Affected Class I Areas*). This analysis can be found in Appendix 10-2: *Estimating Visibility Impacts from Additional Point Source Controls* and in Appendix 10-4: *Detailed Calculations for Estimating Visibility Impacts*.

**Table 10-6: Estimated Haze Index Improvements for Affected Class I Areas**

<b>Class 1</b>	<b>Big Bend</b>	<b>Breton Isle</b>	<b>Caney Creek</b>	<b>Carlsbad Caverns</b>	<b>Guadalupe Mountains</b>
Haze Index Improvement (dv)	0.16	0.05	0.33	0.22	0.22
<b>Class 1</b>	<b>Salt Creek</b>	<b>Upper Buffalo</b>	<b>Wheeler Peak</b>	<b>White Mountain</b>	<b>Wichita Mountains</b>
Haze Index Improvement (dv)	0.18	0.16	0.04	0.24	0.36

As Tables 10-5 and 10-6: *Estimated Haze Index Improvements for Affected Class I Areas* show, the analysis identified controls costing well over \$300 million, yet the projected benefit of those controls on each Class I is not perceptible. A single (1.0) deciview is the smallest perceptible improvement in visibility. In the TCEQ's Best Available Retrofit Technology (BART) rule, the state considered 0.5 deciviews as the threshold under which a facility was not considered to meaningfully contribute to visibility impairment. A difference improvement of 0.05 deciviews is well within the uncertainty of the modeling techniques and is much lower than perceptible.

#### **10.4 FOUR FACTOR ANALYSIS**

The Federal Regional Haze Rule requires states to set reasonable progress goals (RPGs) toward meeting a national goal of natural visibility conditions in Class I areas by the year 2064. The first RPG is to be established for the planning period 2008 to 2018. The State of Texas worked with CENRAP to develop RPGs for Texas Class I areas.

The Federal Regional Haze Rule (§51.308(d)(1)(i)(A)) requires states to consider the factors listed in section 169A(g)(1) of the FCAA when setting reasonable progress goals. These factors are the cost of compliance, the time for compliance, the energy and non-air quality impacts of compliance, and the remaining useful life of any potentially affected sources (EPA 1999).

- **Cost of Compliance**

The cost of compliance is a factor used to determine whether compliance costs for sources are reasonable compared to the emission reduction and visibility improvement they will achieve.

- **Time Necessary for Compliance**

The time necessary for compliance factor may be used to adjust the reasonable progress goals to reflect the degree of improvement achievable within the first planning period, as opposed to the improvement expected at full implementation of a control measure.

- **Energy and Non-Air Quality Environmental Impacts of Compliance**

The energy and non-air quality environmental impacts of compliance factor is meant to consider whether the energy requirements of the control technology result in energy penalties or benefits, or whether there are non-air quality impacts such as water quality and solid waste impacts resulting from the technology.

- **Remaining Useful Life of the Source**

The remaining useful life of the source factor is applicable only to those measures which would require retrofitting of control devices (or possibly production changes) at *existing* sources. Shutdowns of sources were only counted if the shutdowns were enforceable.

#### **10.4.1 Applying the Statutory Factors**

Because the pollutants of primary concern were determined to be SO<sub>2</sub> and NO<sub>x</sub> from point sources, the 2018 emissions inventory was assessed to determine the sources that would have the most impact on Class I areas from these pollutants. All units in the inventory were assessed. An emissions over distance to any Class I area analysis ratio with a threshold of five or greater ( $Q/d \geq 5$  in tpy/kilometers) was applied to the projected 2018 emissions for both SO<sub>2</sub> and NO<sub>x</sub> to eliminate sources so far away from a Class I area that any reduction in emissions would be unlikely to have a perceptible impact on visibility. Also, any source with predicted 2018 emissions less than 100 tpy was excluded, since the regulatory and logistical overhead associated with controlling these small sources would not be justified by the likely benefit.

The TCEQ also excluded additional NO<sub>x</sub> controls on cement kilns from consideration since Texas has already required all the measures determined to be reasonable to control NO<sub>x</sub> emission from these sources in the latest Dallas-Fort Worth ozone SIP revision. See Appendix 10-1: *Analysis of Control Strategies and Determination of Reasonable Progress Goals* for further discussion of Texas cement kilns.

#### **Determination of Proposed Controls**

The 2018 inventory included the on-the-books controls for each of the states in the CENRAP region. The list of proposed controls is for controls beyond those already included in the baseline level used in the modeling. This is necessary to provide a frame of reference to estimate the amount of emissions available for additional control and estimate the effect of control measures. Additionally, the progress toward the RPG with only on-the-books controls can also be assessed.

CENRAP used the latest revised version of the EPA AirControlNET model (Alpine 2007) to analyze potential add-on control device strategies. AirControlNET is a control technology analysis tool developed to support the EPA in analyses of air pollution policies and regulations. The tool provides data on emission sources, potential pollution control measures and emission reductions, and the costs of implementing those controls. Every available SO<sub>2</sub> and NO<sub>x</sub> control strategy in AirControlNET was run against the electric generating units (EGUs) and non-EGU point source inventories to develop a master list of available incremental control strategies for the entire CENRAP 36 kilometer domain.

Texas reviewed the resulting data curves and some additional individual sources were selected from source-types that were not part of the CENRAP AirControlNET dataset. The analyses of these facilities were designed to ensure that opportunities for cost-effective visibility improvements were not overlooked. The first step in the technical evaluation of control measures for a source category was to establish the future emissions baseline with on-the-books regulations. This baseline was used to assess the potential emissions reductions with the proposed control. The TCEQ added flue gas desulfurization at nine carbon black units based on this analysis.

#### **10.4.2 Four Factor Analysis Process**

##### **Cost of Compliance**

At a total estimated cost exceeding \$300 million and no perceptible visibility benefit, Texas has determined that it is not reasonable to implement additional controls at this time. All units in Texas that met the emissions over distance threshold were assessed. The cost per ton of controls from EPA CAIR and existing TCEQ control programs were used as a threshold value for determining a proposed set of controls. The EPA estimated the cost of implementing CAIR was up to \$2,700 per ton. This limiting threshold was used to limit the proposed controls group to cost effective measures. The annualized cost values, additional emissions reductions based on proposed efficiency, as listed in the AirControlNET files, were used. Modifications for Texas included the consideration of flue gas desulfurization for carbon black units.

### **Time Necessary for Compliance**

The time necessary for compliance was not a critical factor for the determination of applicable additional controls for Texas sources. The focus of the time necessary for compliance analysis for on-the-books controls will be to quantify the magnitude of emissions reductions that will occur prior to 2018. The EPA in its CAIR regulatory impact statement estimated that approximately 30 months is required to design, build, and install SO<sub>2</sub> scrubbing technology for a single EGU boiler. The total time for a single facility to comply with one of the NO<sub>x</sub> caps would be about five years. Shortage of skilled labor as a result of increased design and construction of pollution control units required to meet deadlines in CAIR or its eventual replacement could increase times for some construction but completion by 2018 would still be anticipated.

For mobile sources, MOBILE and NONROAD model runs were completed for the 2018 emissions inventory. These model runs incorporate the degree of fleet and expected engine replacement prior to 2018. The completion of other proposed controls are anticipated by 2018.

### **Energy and Non-Air Quality Environmental Impacts of Compliance**

To the extent energy impacts are quantifiable for a particular control, they have been included in the cost estimates. Including impacts on a source-by-source basis would have added further weight against finding that the potential additional controls were reasonable to apply.

Scrubbers, Selective Catalytic Reduction (SCR) systems, and Selective Non-Catalytic Reduction (SNCR) systems installed under the EGU control strategies would require electricity to operate fans and other ancillary equipment. In addition, steam would be required for some scrubbers and SCR systems. Additional fuel will be consumed at the utilities to produce this electricity and steam, resulting in the lowering of the energy efficiency of the plant. Estimates have given the electricity and steam required by controls installed to meet SO<sub>2</sub> and NO<sub>x</sub> emission caps would be less than 1 percent of the total electricity and steam production of EGUs (EPA 1999).

Source-by-source review of the non-air quality impacts of the potential controls would possibly have lead to a different determination about the unreasonableness of the set of potential additional controls. Scrubbers, coal washing, and spray dryers will require additional safeguards for fuel handling and waste handling systems to avoid additional non-air environmental impacts such as increased effluents in waste water discharges and storm water runoff. Solid waste disposal and wastewater treatment costs are expected to be less than five percent of the total operating costs of pollution control equipment. These factors will need to be considered specific to individual sources.

Pilot testing of SNCR on wet and dry kilns in 2006 demonstrated that 30 to 40 percent reductions were achievable without hazardous by-product formation. In July 2006, ERG submitted a report to TCEQ entitled *Assessment of NO<sub>x</sub> Emissions Reduction Strategies for Cement Kilns - Ellis County: Final Report* (ERG 2006).

Some low-NO<sub>x</sub> combustion technologies require electricity for turbo charging, or steam for steam injection. Systems that require only modifications to alter fuel-air mixing and combustion temperatures are not expected to produce any additional electricity or steam demands, or generate wastewater or solid waste.

### **Remaining Useful life**

CENRAP considered remaining useful life in modeling for mobile sources that assumes reduced emissions per vehicle mile traveled due to the turnover of the on-road mobile source fleet. For sources with a relatively short remaining useful life, this consideration would have weighed more heavily against a determination that controlling those sources would have been reasonable. In general, this factor is not critical for sector analyses for the 2018 timeline. For the purposes of

initial analyses, no limited useful equipment life was assumed. A site-specific analysis would be needed to determine any units with limited useful life. Only units that were scheduled for shutdown under enforceable decrees were eliminated from the 2018 inventory and further analysis.

### 10.5 UNCERTAINTY IN THE REASONABLE PROGRESS GOALS

The majority of the emissions reductions underlying the predicted visibility improvements are from the CAIR program or its eventual replacement. The TCEQ presumes that any eventual replacement for CAIR will include interstate trading of emissions allowances. Although CAIR or its replacement program should result in substantial reductions in SO<sub>2</sub> and NO<sub>x</sub> emissions from EGUs, there is uncertainty regarding how visibility will be improved at individual Class I areas because of trading of emissions allowances. Because emission allowances can be purchased by EGUs relatively close to the Texas Class I areas from EGUs far from the Texas Class I areas, the visibility improvement may not be as great as predicted by the CENRAP's modeling. Conversely, nearby EGUs may elect to control beyond their emission caps and sell emission allowances out of state, resulting in reduced emissions closer to the Texas Class I areas.

CENRAP used the Integrated Planning Model (IPM) that the EPA employed to predict the emissions reductions expected from CAIR in 2018. This SIP revision presumes that those results would be comparable under any program to replace CAIR. The IPM model predicts the effect of emission trading programs considering economics, logistics, and the specific regulatory environment for each EGU. Table 10-7: *Comparison of Sulfur Dioxide Emissions* compares current emissions of SO<sub>2</sub> to the CAIR caps and the IPM results for the 2018 planning year.

**Table 10-7: Comparison of Sulfur Dioxide Emissions**

SO <sub>2</sub> Emissions	Texas SO <sub>2</sub> Emissions (tpy)*
Current (2002 base case)	550,000
EPA's CAIR budget for Texas EGUs for 2015	225,000
IPM projection CENRAP modeled for 2018	350,000

Sources: EPA, CENRAP

\*Rounded to the nearest thousand

The CAIR cap is the total allowable emissions of SO<sub>2</sub> from EGUs in Texas under CAIR. The IPM model analysis used by CENRAP predicts that by 2018 EGUs in Texas will purchase approximately 125,000 tpy of emissions allowances from out of state. The TCEQ requested that key EGUs in Texas review and comment on the predictions of the IPM model. However, no EGU made an enforceable commitment to any particular pollution control strategy and preferred to retain the flexibility offered by the CAIR program.

In the five-year periodic progress report required by 40 CFR §51.308(g), the TCEQ plans to review emissions inventory and permit information to evaluate the accuracy of the predicted emissions used in the CENRAP modeling.

### 10.6 INTERNATIONAL SOURCES OF VISIBILITY IMPAIRMENT

The Texas Class I areas are close to Mexico, and international transport of emissions from Mexico and Central America significantly influence regional haze at these areas. CENRAP conducted a Particulate Matter Source Apportionment Technology (PSAT) analysis on the modeling conducted for the 2018 projections. The PSAT modeling apportioned all the particulate

pollutant contributions to extinction except for secondary organic aerosol. The pollutants apportioned by geographic areas are sulfate, nitrate, primary organic carbon, elemental carbon, fine soil, and coarse mass. Table 10-8: *Contributions to Visibility in the Texas Class I Areas on Worst 20 Percent Day* summarizes the contribution from these areas to visibility impairment at the Texas Class I areas.

**Table 10-8: Contributions to Visibility in the Texas Class I Areas on Worst 20 Percent Days**

<b>Contribution by Area</b>	<b>Big Bend (%)</b>	<b>Guadalupe Mountains (%)</b>
Texas	24.8	34.8
Mexico	26.7	16.5
Boundary Conditions	25.7	8.7
Other US	11.9	18.9
Miscellaneous	5.8	9.6
Neighboring States	5.1	11.5

Boundary conditions are the conditions at the model's geographic boundaries. These are visibility-impairing emissions from Central Mexico and further south into Central America. The analysis indicates that 52 percent of the impairment at Big Bend and 25 percent of the impairment at Guadalupe Mountains is from Mexico and further south. The national goal of natural visibility at these Class I areas cannot be met without substantial reductions in emissions from outside of the United States.

## 10.7 REDUCTIONS REQUIRED TO MEET THE UNIFORM RATE OF PROGRESS

The TCEQ's analysis of point source reductions can be extrapolated to estimate the amount of reductions that would be required for the RPG to meet the URP for the Texas Class I areas.

**Table 10-9: Emissions Reductions Required to Meet Uniform Rate of Progress**

<b>Class I Area</b>	<b>Additional Improvement Needed to Meet URP (dv)</b>	<b>Approximate Additional Pollutant Reductions SO<sub>2</sub> and NO<sub>x</sub> (tpy)</b>	<b>Estimated Cost of Additional Reductions</b>
Big Bend	1.0	3,700,000	\$6,500,000,000
Guadalupe Mountains	0.3	1,100,000	\$1,900,000,000

Table 10-9: *Emissions Reductions Required to Meet Uniform Rate of Progress* assumes that all of the reductions needed to meet the URP would come from Texas. These additional reductions would require significant over-control in order to compensate for the impacts of international pollution. The preamble to the July 1, 1999, issuance of the Regional Haze Rule clearly says that states are not required to carry out compensatory over-control to make up for the lack of progress in reducing the impacts of international transport.

Table 10-9 illustrates that to meet the goal of natural visibility at Big Bend a better understanding of how pollutants are brought into the area is needed so that the correct sources can be addressed. This also reinforces the point that progress at the Texas Class I areas, especially at Big Bend, is dependent upon reducing emissions from Mexico and Central America. In Chapter 11: *Long-Term Strategy to Reach Reasonable Progress Goals*, the TCEQ specifically asks the EPA for federal efforts to reduce the international transport impacts on regional haze coming into the United States across Texas' southern border.

Given the significant impact from international emissions, the uncertainty in the impact of CAIR and the poor cost-effectiveness of additional, reasonable point source controls, the TCEQ has determined that additional controls for regional haze are not appropriate at this time.

## **10.8 CONSULTATION**

In determining a reasonable progress rate for each Class I area discussed previously, the TCEQ has consulted with the other states and tribes that are reasonably anticipated to cause or contribute to visibility impairment in each of the Texas Class I areas. Similarly, the TCEQ has consulted with other states whose Class I areas are impacted by pollution sources in Texas. The TCEQ invited tribes in the CENRAP states to the consultation calls, but no tribes participated in the consultation on Big Bend and Guadalupe Mountains. A full description of the consultation process is in Chapter 4: *State, Tribe, and Federal Land Manager Consultation*.

## **10.9 REPORTING**

The TCEQ will report progress to the EPA Administrator every five years in accordance with 40 CFR §51.308(g). Chapter 12: *Comprehensive Periodic Implementation Plan Revisions and Adequacy of the Existing Plan*, provides more detail on five-year reporting and ten-year SIP submittal requirements.

## CHAPTER 11. LONG-TERM STRATEGY TO REACH REASONABLE PROGRESS GOALS

### 11.1 INTRODUCTION

The long-term strategy for the Regional Haze SIP revision incorporates planning for the next ten years, from 2008 through 2018. Title 40 CFR §51.308.308(d)(3) specifies the requirements for the long-term strategy for regional haze (Appendix 1-1).

The main anthropogenic emissions that affect visibility in Class I areas in Texas and neighboring states are SO<sub>2</sub> and NO<sub>x</sub>. There is a much smaller anthropogenic particulate matter (PM) impact in Texas from stack, engine exhaust, and fine soil emissions compared to SO<sub>2</sub> and NO<sub>x</sub>. Although the contribution of anthropogenic VOC to the formation of secondary organic carbon PM is small, there is a contribution. The impact of coarse mass and fine soil at the two Texas Class I areas comes primarily from natural dust storms and dust blowing from the Chihuahuan Desert, which the modeling does not represent well. Chapter 5: *Assessment of Baseline and Current Conditions and Estimate of Natural Conditions in Class I Areas* discusses and documents the predominance of these natural impacts. The modeled impact of wild fire and prescribed burning emissions on primary organic carbon is uncertain because of questions about the accuracy of fire emission inventories. However, the modeled projections show that fires are the main source of the impacts.

Bar charts in this chapter show the apportioned impact of different areas and pollutants to visibility impairment at Big Bend and Guadalupe Mountains National Parks and at the Class I areas Texas emissions impact in other states (Figures 11-2 through 11-31). There are separate graphs to show the impacts of different source areas on the worst 20 percent of monitored days and on the best 20 percent of monitored days in 2002. The apportioned impacts shown in the figures use the modeling results scaled to measured pollutant concentrations according to the EPA's modeling guidelines as detailed in Chapter 8: *Modeling Assessment*. As Chapter 5 explains, the projections for 2018 set the relative response factors (RRFs) for coarse mass (dust) and fine soil equal to one based on analysis showing that dust storms and wind blown desert dust are the dominant cause of the coarse mass and fine soil pollution at Big Bend and Guadalupe Mountains National Parks. Since the dominant source of these pollutants is natural, the TCEQ does not expect that to change between the base period and 2018.

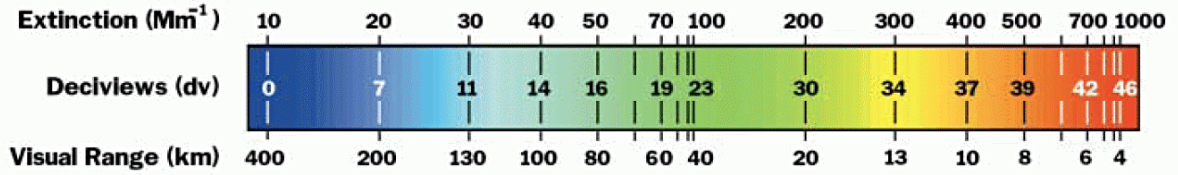
The primary organic carbon and elemental carbon (i.e., black carbon) captured in the modeling are largely from fire. The term "primary" refers to a pollutant emitted directly to the atmosphere. The term "secondary" refers to a pollutant formed in the atmosphere by reaction, condensation, or both. The modeling indicates that primary organic carbon and black carbon at Big Bend on the worst 20 percent days come overwhelmingly from boundary conditions, which include the areas of southern Mexico, the Yucatan, and Central America with extensive agricultural burning and sometimes wildfire emissions each April and May. The TCEQ's air pollution meteorologists have documented many of these episodes over the past decade. The data and satellite images of the smoke moving into Texas confirm the large impact of smoke from the fires in southern Mexico, the Yucatan, and Central America.

The haze pollutants shown in the bar graphs and tables include: sulfate (SO<sub>4</sub>), nitrate (NO<sub>3</sub>), primary organic aerosols (POA), elemental carbon (EC), other inorganic fine particulate matter (soil), coarse mass (CM), anthropogenic secondary organic aerosols (SOAA), which result from human activity, and biogenic secondary organic aerosols (SOAB), which form from hydrocarbon emissions from vegetation. Initial conditions (IC) are the assumed initial three-dimensional concentrations throughout the modeling domain. Except on the first few days of the model runs, the contribution of initial conditions is vanishingly small. Boundary conditions (BC) are the concentrations imported into the modeling domain along the lateral edges and the top of the



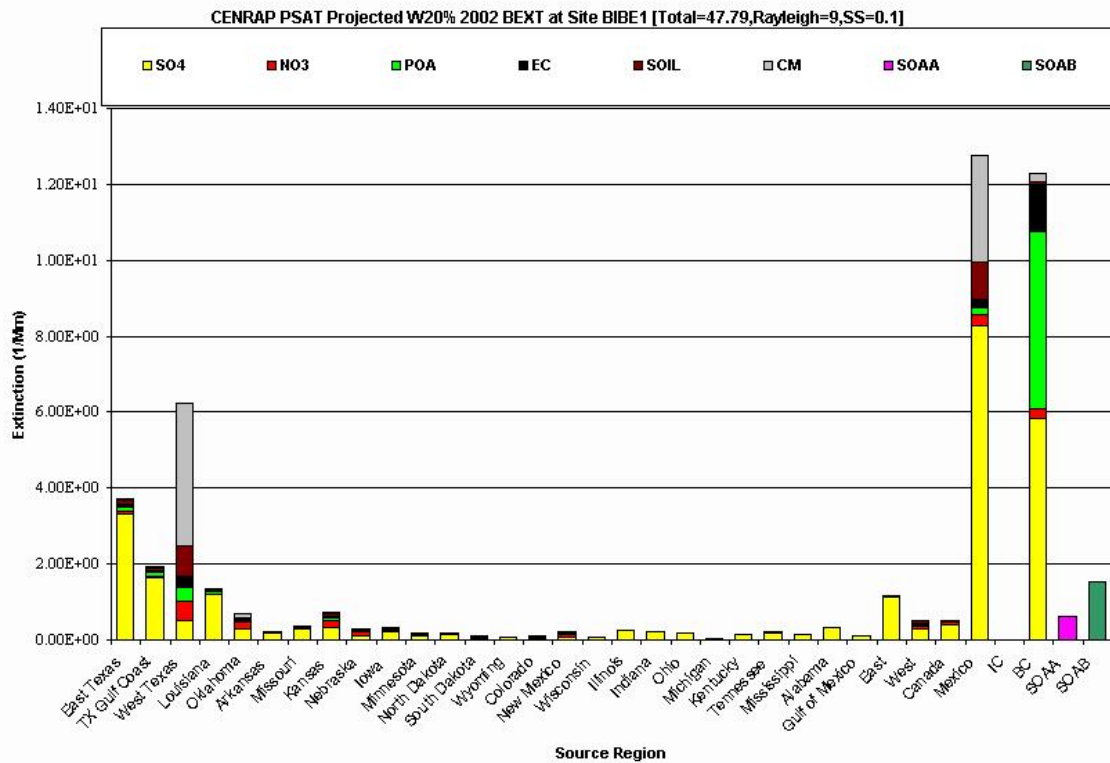
CENRAP modeling domain. These boundary conditions come from a year-long run of the global model GEOS-Chem.

Figures 11-2 through 11-31 also refer to extinction (abbreviated as  $B_{\text{ext}}$ ) and Rayleigh. In the case of visibility, extinction or  $B_{\text{ext}}$  refers to the loss of image-forming light as it passes from an object to the observer. Rayleigh scattering is the scattering of light by air molecules (Malm 1999). Figure 11-1 compares extinction to deciviews (dv) and visual range (in kilometers).

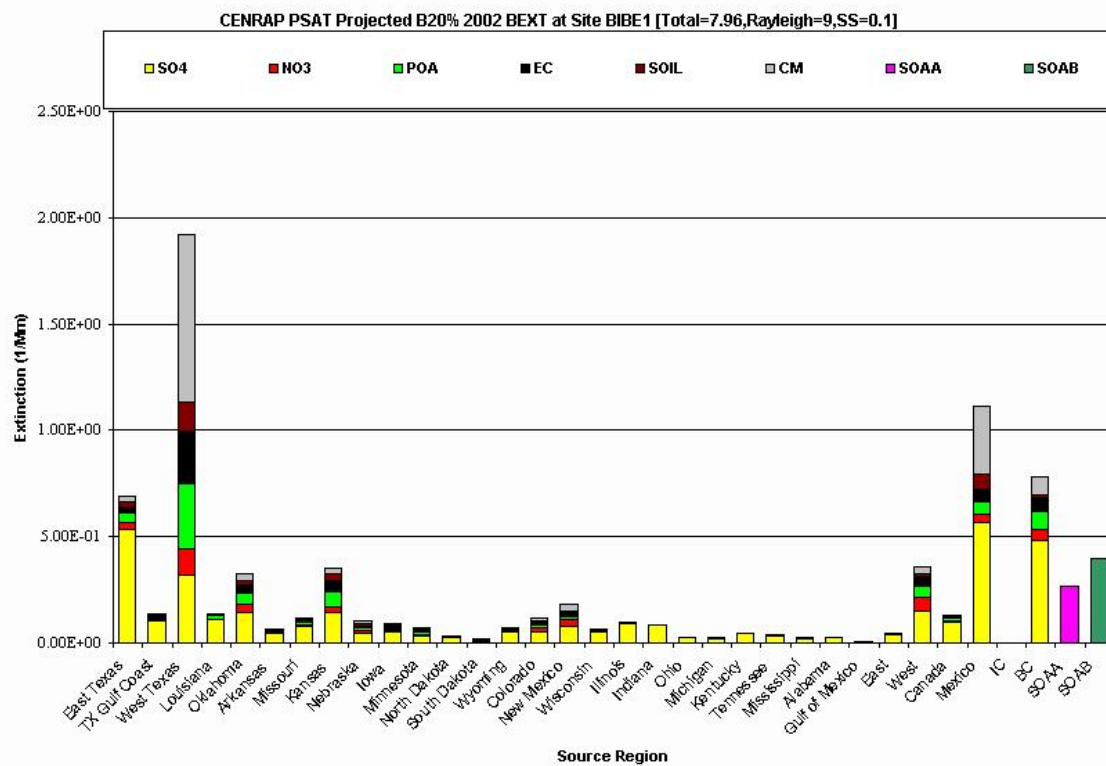


Source: William Malm, *Introduction to Visibility*, 1999, National Park Service

**Figure 11-1: Comparison of Extinction, Deciviews and Visual Range**



**Figure 11-2: Areas and Pollutants Causing Regional Haze at Big Bend (BIBE) on Worst 20 Percent Days in 2002**



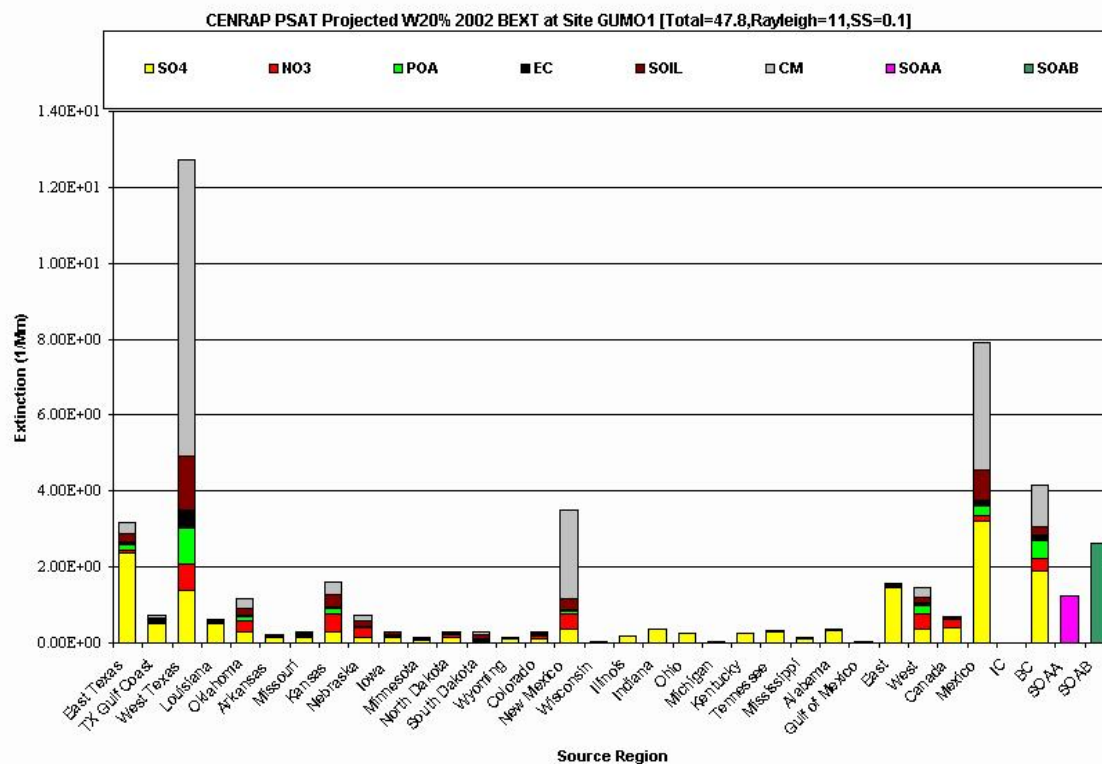
**Figure 11-3: Areas and Pollutants Causing Regional Haze at Big Bend (BIBE) on Best 20 Percent Days in 2002**

Note the change in scale on the y-axis.

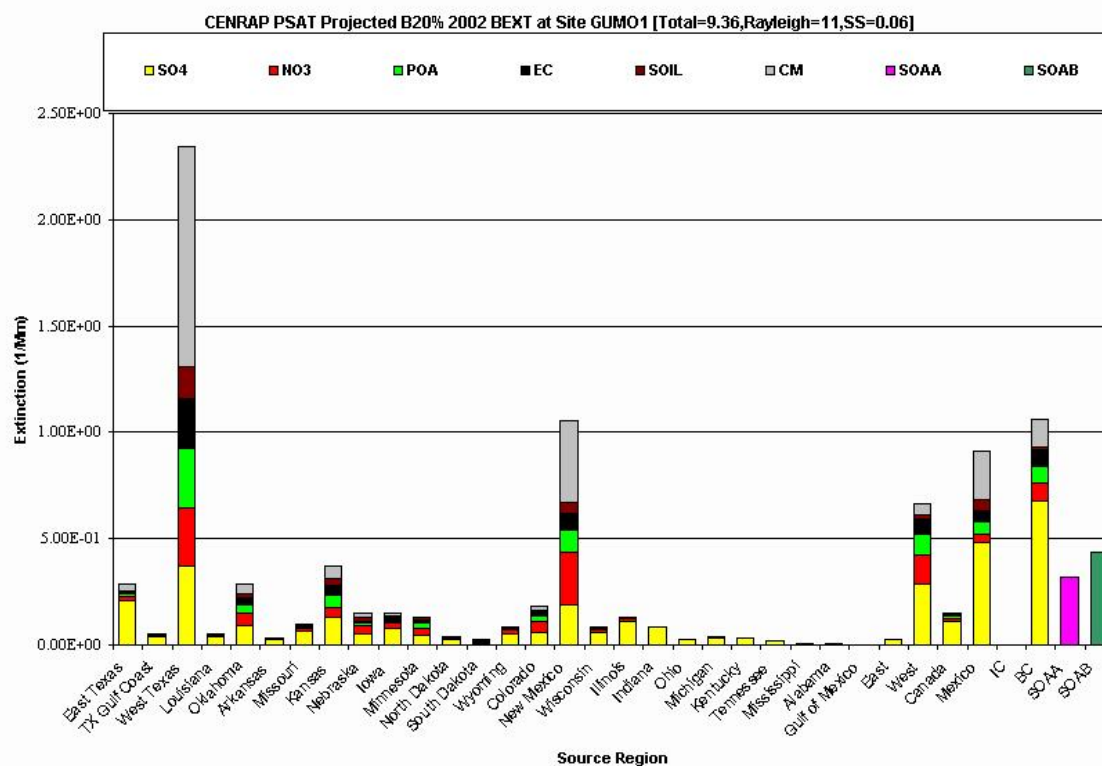
**Table 11-1: Pollutant Contributions to Extinction at Big Bend from Texas and from All Areas on Worst 20 Percent Days in 2002 and 2018**

Particulate Matter Constituent	2002 Impacts at Big Bend (inverse megameters)		2018 Impacts at Big Bend (inverse megameters)	
	Texas Total	Total, All Source Areas	Texas Total	Total, All Source Areas
Sulfate	5.50	26.10	3.95	23.00
Nitrate	0.59	2.05	0.56	1.99
Primary Organic Aerosol	0.55	5.81	0.41	5.61
Elemental Carbon	0.42	2.12	0.20	1.81
Fine Soil	0.99	2.54	0.98	2.54
Coarse Mass	3.82	7.03	3.87	7.03
Secondary Organic Aerosol, Anthropogenic	not available <sup>1</sup>	0.64	not available <sup>1</sup>	0.59
Secondary Organic Aerosol, Biogenic	not available <sup>1</sup>	1.52	not available <sup>1</sup>	1.49
Total	11.87	47.79	9.97	44.06

<sup>1</sup> The CENRAP PSAT modeling did not apportion either the anthropogenic or the biogenic secondary organic aerosol (SOA). The reasons are (1) that sulfate and nitrate are generally the main causes of visibility impairment resulting from human activity and (2) that tracking the multiple volatile organic compound constituents and reaction products necessary to apportion SOA would have extended the modeling run times far beyond the time that was available for the modeling.



**Figure 11-4: Areas and Pollutants Causing Regional Haze at Guadalupe Mountains (GUMO) on the Worst 20 Percent Days in 2002**



**Figure 11-5: Areas and Pollutants Causing Regional Haze at Guadalupe Mountains (GUMO) on Best 20 Percent Days in 2002**

Note the change on the y-axis.

**Table 11-2: Pollutant Contributions to Extinction at Guadalupe Mountains from Texas and from All Areas on Worst 20 Percent Days in 2002 and 2018**

Particulate Matter Constituent	2002 Impacts at Guadalupe Mountains (inverse megameters)		2018 Impacts at Guadalupe Mountains (inverse megameters)	
	Texas Total	Total, All Source Areas	Texas Total	Total, All Source Areas
Sulfate	4.28	15.94	3.65	13.65
Nitrate	0.78	3.67	0.68	3.32
Primary Organic Aerosol	1.16	2.75	0.87	2.38
Elemental Carbon	0.53	1.19	0.28	0.86
Fine Soil	1.71	4.37	1.66	4.37
Coarse Mass	8.16	16.04	8.19	16.02
Secondary Organic Aerosol, Anthropogenic	not available <sup>1</sup>	1.23	not available <sup>1</sup>	1.16
Secondary Organic Aerosol, Biogenic	not available <sup>1</sup>	2.61	not available <sup>1</sup>	2.56
Total	16.62	47.80	15.33	44.32

#### 11.1.1 Reasonably Attributable Visibility Impairment

Reasonably attributable visibility impairment (RAVI) is a specifically defined term from EPA's early efforts to protect visibility at Class I areas. Limitations in RAVI requirements for improving visibility at many Class I areas led to provisions in the 1990 Clean Air Act Amendments that added the broader requirements for to reduce regional haze impacts at Class I areas. The EPA implemented these provisions in the Regional Haze Regulations first issued July 1, 1999.

The FLMs for Big Bend and Guadalupe Mountains National Parks have not identified any reasonably attributable visibility impairment from Texas or other United States sources. The FLMs for the Class I areas that Texas' emissions impact in other states have not identified any reasonably attributable visibility impairment caused by Texas sources. For these reasons, the TCEQ does not have any measures in place or a requirement to address reasonably attributable visibility impairment.

#### 11.2 CONSULTATION

The TCEQ has participated in the CENRAP since its inception in 1999. The TCEQ has cooperated with all CENRAP states and tribes through participation in the process of developing information on base period emission inventories and visibility impairment, estimates of 2064 natural conditions, and projections of 2018 emissions and visibility impairment considering all emission reduction requirements in Texas, including state and federal rules. These rules include the Clean Air Interstate Rule (CAIR), BART requirements, emission reductions from the Federal Motor Vehicle Emission Control Program (FMVCP), EPA refinery consent decrees, and EPA requirements for cleaner non-road diesel and gasoline-powered engines. Detailed information on consultation is in Chapter 3: *Regional Planning* and Chapter 4: *State, Tribe, and Federal Land*

*Manager Consultation.* Information on base period emissions inventory development is in Chapter 7: *Emissions Inventory*, and information on modeling is in Chapter 8: *Modeling Assessment*.

### **11.2.1 Consultation on Class I Areas in Texas**

The TCEQ used CENRAP Particulate Matter Source Apportionment Technology (PSAT) modeling to determine that the states contributing to visibility impairment at Texas' Class I areas are Kansas, Louisiana, New Mexico, and Oklahoma. Each of these states has adopted or is in the process of adopting emissions reductions it has determined to be reasonable under the factors listed in 40 CFR §51.308(d)(1), Reasonable Progress Goals. Based on their plans and commitments elicited through the consultation process, the commission has determined that the emissions reductions these states are projecting are reasonable for contributing to progress in reducing their contributions to visibility impairment at the two Class I areas in Texas. Chapter 4 discusses consultations with these states in detail.

### **11.2.2 Consultation on Class I Areas Impacted by Emissions from Texas**

Arkansas, Missouri, and Oklahoma have each included Texas in consultations concerning regional haze impacts on the Class I areas in these states. The TCEQ reviewed CENRAP PSAT modeling to assess how Texas' emissions might affect other states' Class I areas. Pursuant to this review, Texas has written to Arkansas, Missouri, Oklahoma, New Mexico, Louisiana, and Colorado to ask whether emission reductions projected in Texas by 2018 are sufficient to meet Texas' apportionment of the impact reduction needed to meet the reasonable progress goal for each Class I area in each state. Texas has completed its consultation with Louisiana, Arkansas, Missouri, Oklahoma, and Colorado, and none of these states has asked Texas for further emission reductions to help the state meet its reasonable progress goals for its Class I area(s). Chapter 4 discusses these consultations in more detail. Appendix 4-3 contains the official communications from these states to Texas.

### **11.2.3 Texas' Impacts and 2018 Impact Reduction for Class I Areas Outside Texas**

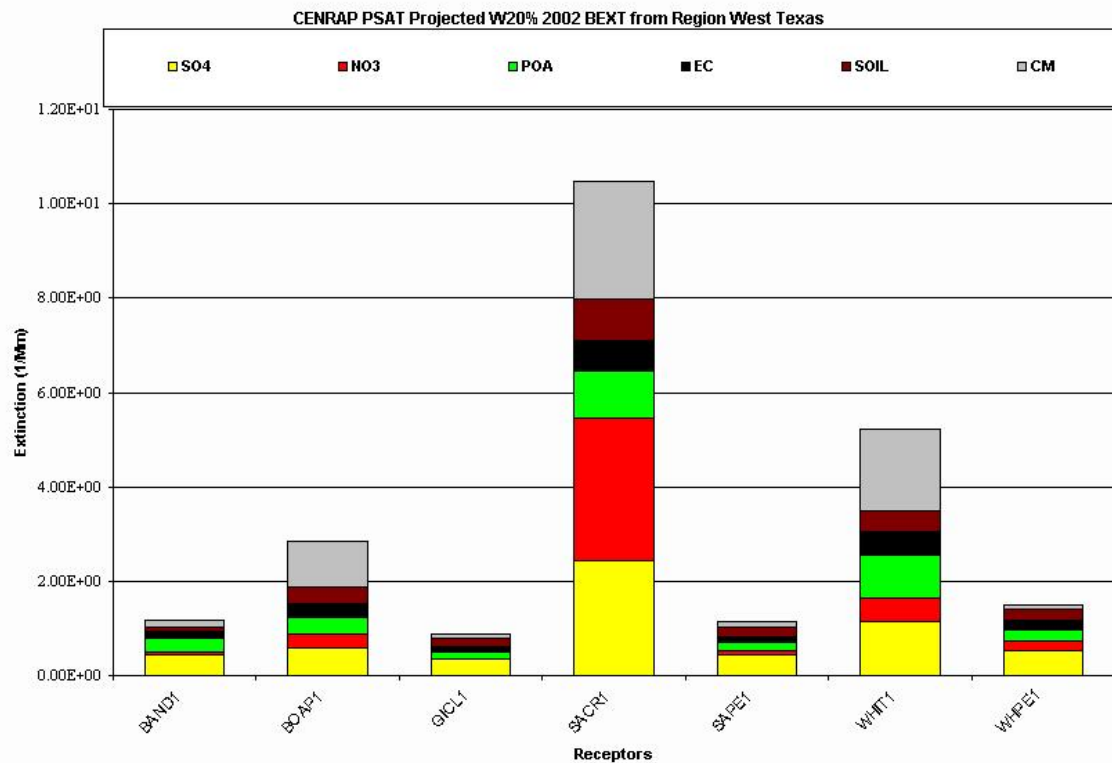
The TCEQ's review of the CENRAP PSAT modeling results to assess how Texas' emissions might affect other states' Class I areas in 2002 indicated that Texas' emissions affect one or more Class I areas in New Mexico, Oklahoma, Colorado, Arkansas, Missouri, and Louisiana. This subsection presents the results of this review.

#### **11.2.3.1 New Mexico**

Emissions from the western portion of Texas account for most of Texas' impact on the Class I areas in New Mexico. The following graph in Figure 11-6 shows the impacts of the western portion of Texas on the Class I areas in New Mexico that are included in the CENRAP PSAT modeling. The graph provides the basis for choosing the New Mexico Class I areas for more detailed examination of Texas' impacts. Carlsbad Caverns National Park is not included in this graph since it has no regional haze monitor; instead, it uses data measured at Guadalupe Mountains National Park to assess the impact of regional haze on the park.

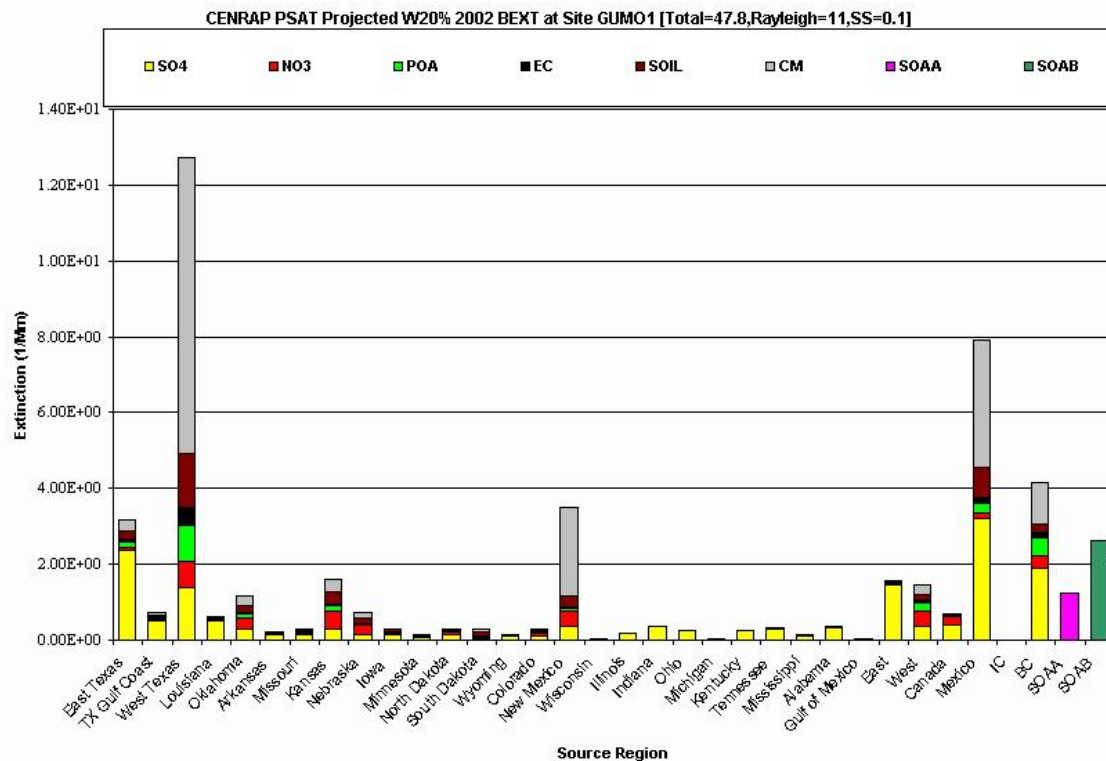
On February 13, 2008, the TCEQ approved the renewal of Air Quality Permit Number 20345 for the American Smelting and Refining Company (ASARCO) El Paso smelter. As of the date this SIP revision was finalized, the TCEQ has not yet made a final determination regarding the BART status of ASARCO's facilities. Due to this and other permitting and operational readiness issues raised by ASARCO in its status report required by TCEQ order, there is uncertainty about the amount of allowable emissions the ASARCO El Paso facility would have should it begin operation. Because of this uncertainty in addition to time limitations, it is not possible for the TCEQ to account for possible future ASARCO El Paso emissions in this Regional Haze SIP revision. When the TCEQ has determined the allowable emissions from the ASARCO El Paso facility, the TCEQ will model the visibility impacts of these emissions at affected Class I areas.

The TCEQ plans to consult with affected states and Federal Land Managers and include ASARCO's emissions and impacts in its next Regional Haze SIP revision.



**Figure 11-6: Calculated Regional Haze Impacts of Emissions from Western Areas of Texas at Class I Areas in New Mexico on Worst 20 Percent Days in 2002**

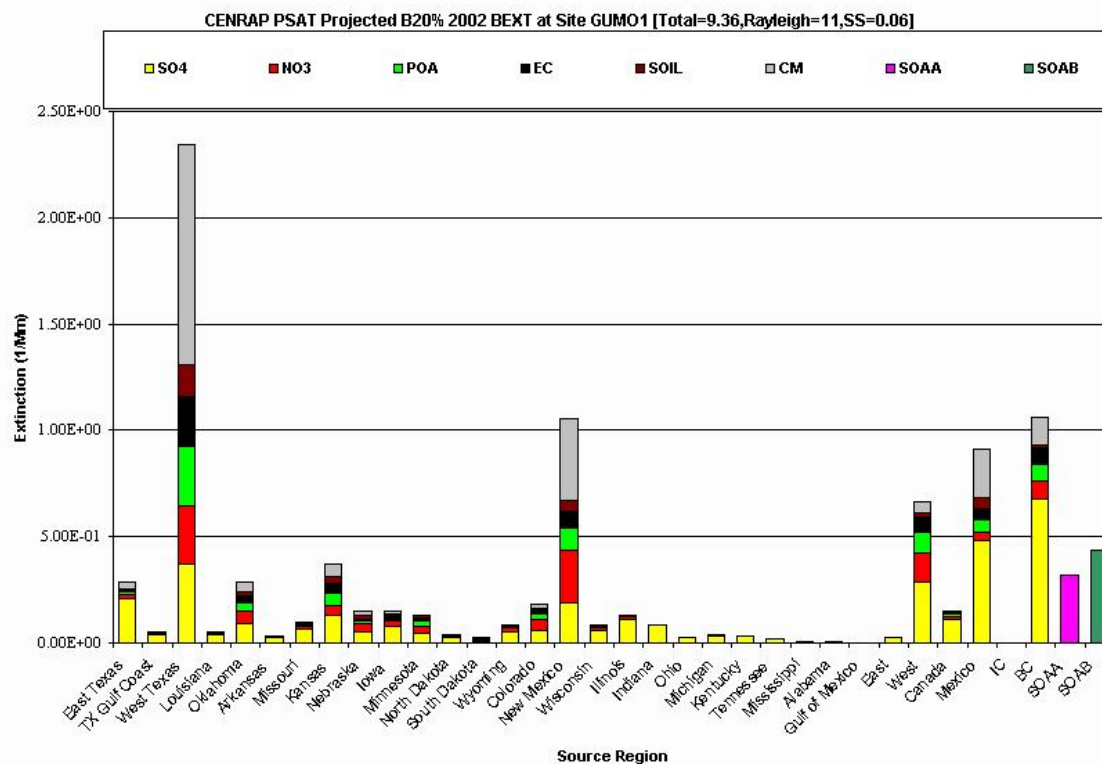
BAND1 - Bandelier National Monument  
 BOAP1 - Bosque del Apache Wilderness Area  
 GICL1 - Gila Wilderness Area  
 SACR1 - Salt Creek Wilderness Area  
 SAPE1 - San Pedro Parks Wilderness Area  
 WHIT1 - White Mountain Wilderness Area  
 WHPE1 - Wheeler Peak Wilderness Area



**Figure 11-7: Areas and Pollutants Causing Regional Haze at Carlsbad Caverns National Park on Worst 20 Percent Days in 2002**

Note: The impacts at Carlsbad Caverns National Park are calculated using the CENRAP PSAT tool for Guadalupe Mountains but using the EPA guidance for applying relative response factors (RRFs) since New Mexico is using modeled apportionment of coarse mass (CM) and fine soil (soil or FS). These calculations do not use the Texas assumptions for Guadalupe Mountains and Big Bend National Parks that the RRFs for CM and FS both equal one.





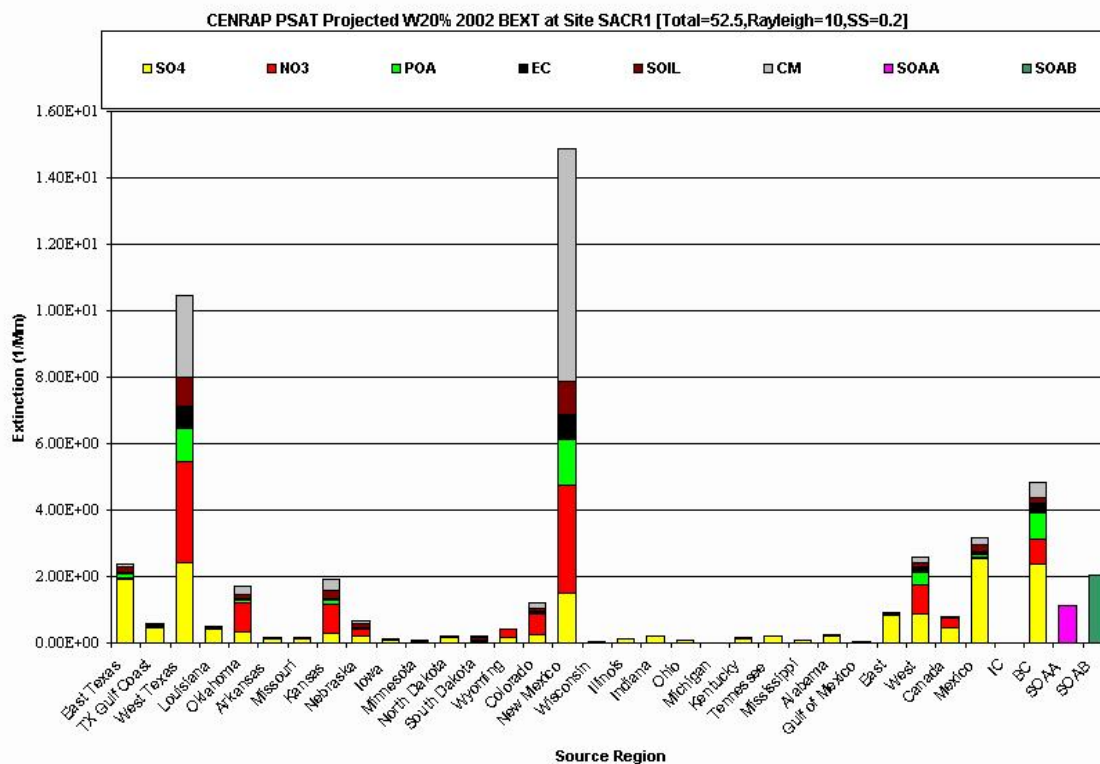
**Figure 11-8: Areas and Pollutants Causing Regional Haze at Carlsbad Caverns National Park on Best 20 Percent Days in 2002**

Note the change on the y-axis.

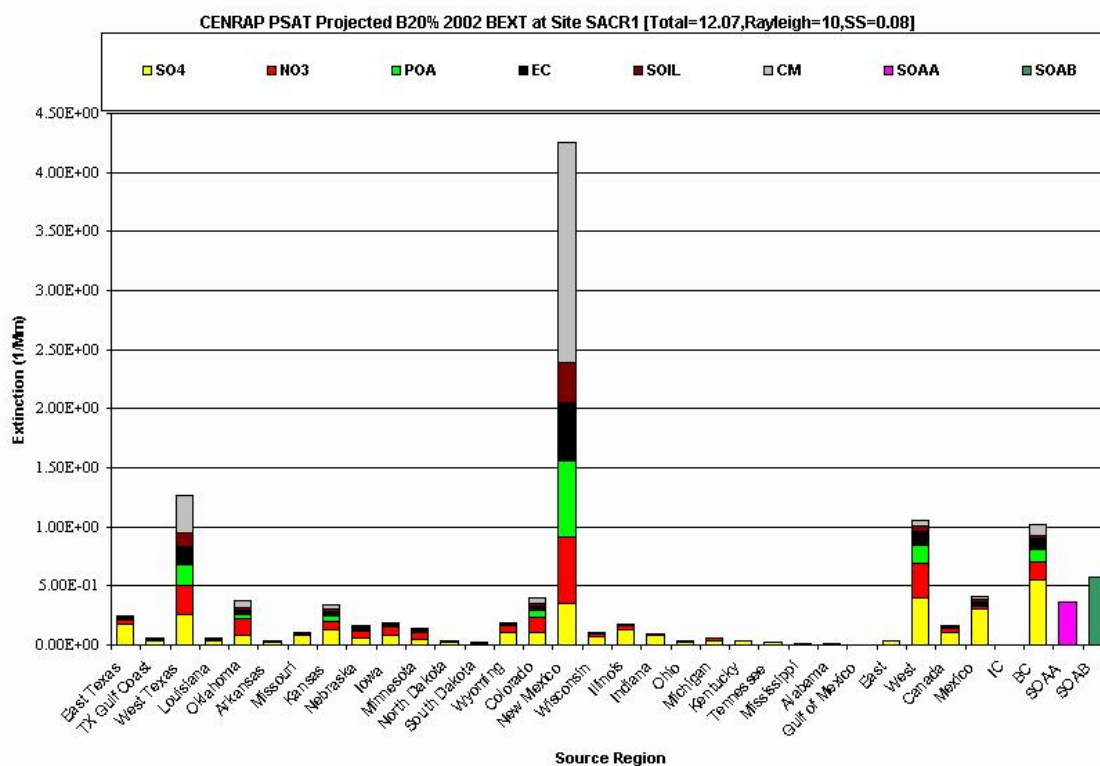
**Table 11-3: Texas' Apportioned Contribution to the Measured 2002 and Projected 2018 Total Visibility Extinction at Carlsbad Caverns National Park on Worst 20 Percent Days**

Particulate Matter Constituent	2002 Impacts at Carlsbad Caverns <sup>2</sup> (inverse megameters)		2018 Impacts at Carlsbad Caverns <sup>2</sup> (inverse megameters)	
	Texas Total	Total, All Source Areas	Texas Total	Total, All Source Areas
Sulfate	4.28	15.94	3.65	13.65
Nitrate	0.78	3.67	0.68	3.32
Primary Organic Aerosol	1.16	2.75	0.87	2.38
Elemental Carbon	0.53	1.19	0.28	0.86
Fine Soil	1.71	4.37	1.66	4.37
Coarse Mass	8.16	16.04	8.24	16.13
Secondary Organic Aerosol, Anthropogenic	not available <sup>1</sup>	1.23	not available <sup>1</sup>	1.16
Secondary Organic Aerosol, Biogenic	not available <sup>1</sup>	2.61	not available <sup>1</sup>	2.56
Total	16.62	47.80	15.39	44.43

<sup>1</sup> The CENRAP PSAT modeling did not apportion either the anthropogenic or the biogenic secondary organic aerosol (SOA). The reasons are (1) that sulfate and nitrate are generally the main causes of visibility impairment resulting from human activity and (2) that tracking the multiple volatile organic compound constituents and reaction products necessary to apportion SOA would have extended the modeling run times far beyond the time that was available for the modeling.



**Figure 11-9: Areas and Pollutants Causing Regional Haze at Salt Creek (SACR) in New Mexico on Worst 20 Percent Days in 2002**

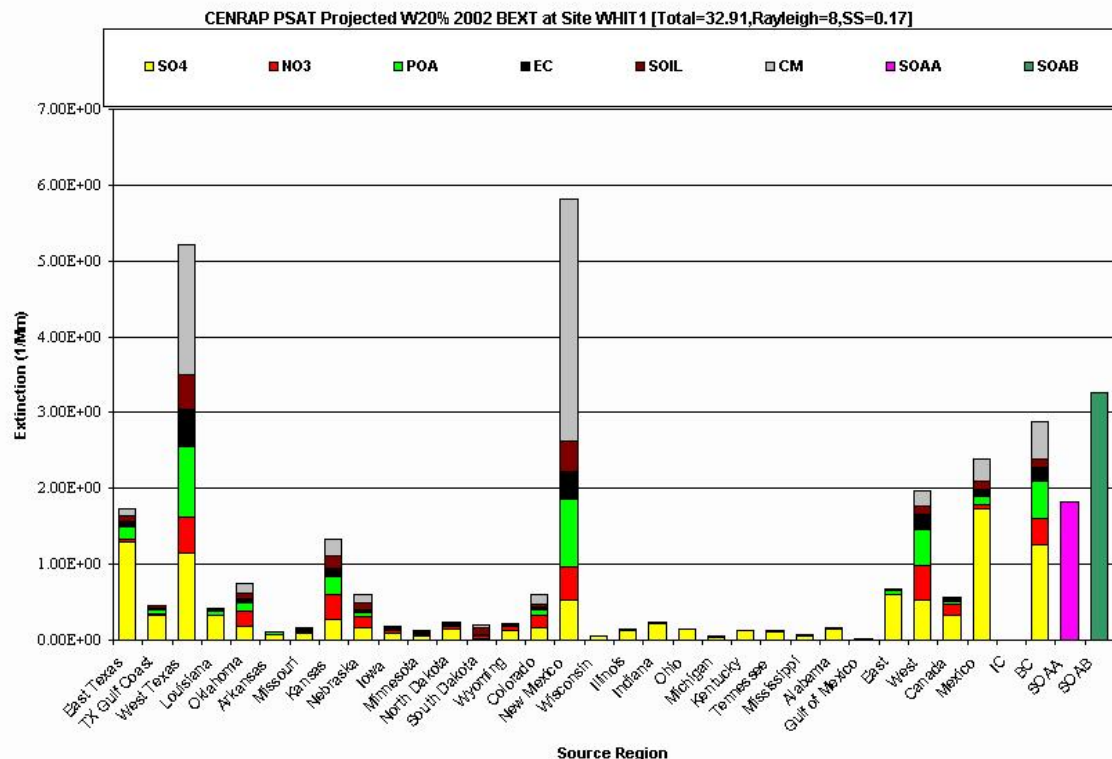


**Figure 11-10: Areas and Pollutants Causing Regional Haze at Salt Creek (SACR) in New Mexico on Best 20 Percent Days in 2002**

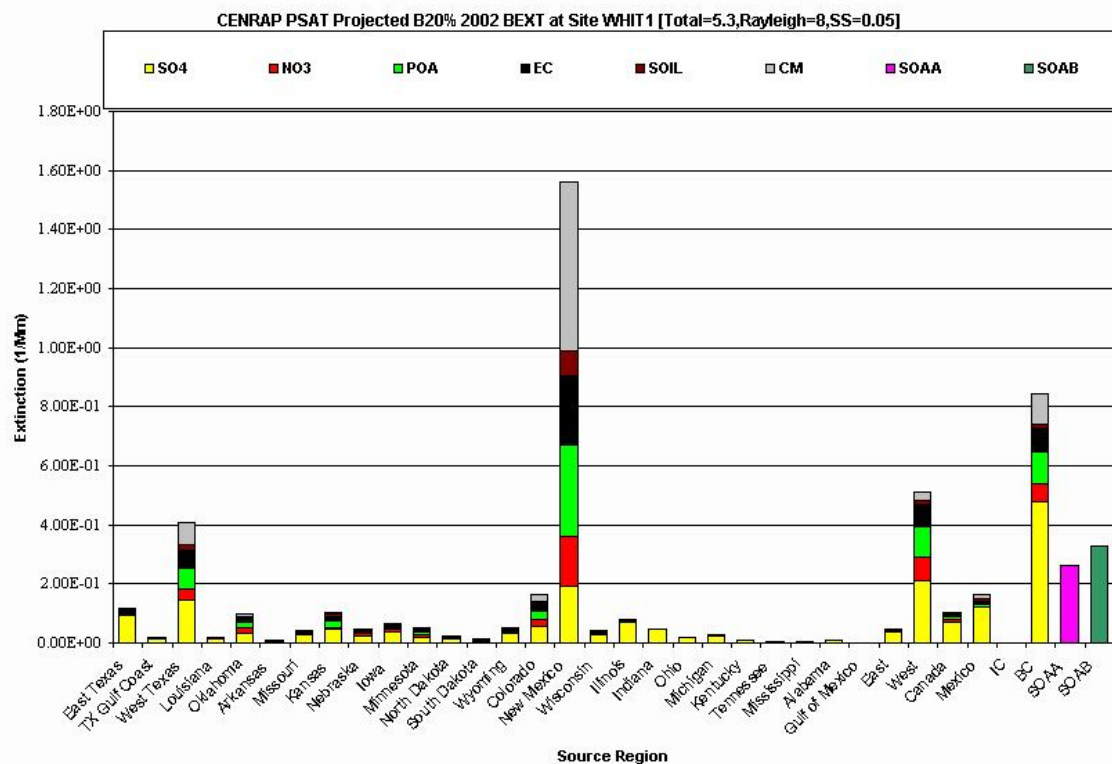
Note the change in scale on the y-axis.

**Table 11-4: Texas' Apportioned Contribution to the Measured 2002 and Projected 2018 Total Visibility Extinction at Salt Creek Wilderness Area on Worst 20 Percent Days**

Particulate Matter Constituent	2002 Impacts at Salt Creek (inverse megameters)		2018 Impacts at Salt Creek (inverse megameters)	
	Texas Total	Total, All Source Areas	Texas Total	Total, All Source Areas
Sulfate	4.79	16.75	3.50	13.75
Nitrate	3.05	11.15	2.43	9.81
Primary Organic Aerosol	1.17	4.31	0.69	2.99
Elemental Carbon	0.76	2.31	0.30	1.23
Fine Soil	1.06	3.34	0.96	3.41
Coarse Mass	2.58	11.47	2.36	12.52
Secondary Organic Aerosol, Anthropogenic	not available <sup>1</sup>	1.12	not available <sup>1</sup>	1.00
Secondary Organic Aerosol, Biogenic	not available <sup>1</sup>	2.06	not available <sup>1</sup>	1.95
Total	13.41	52.50	10.24	46.67



**Figure 11-11: Areas and Pollutants Causing Regional Haze at White Mountain (WHIT) in New Mexico on Worst 20 Percent Days in 2002**

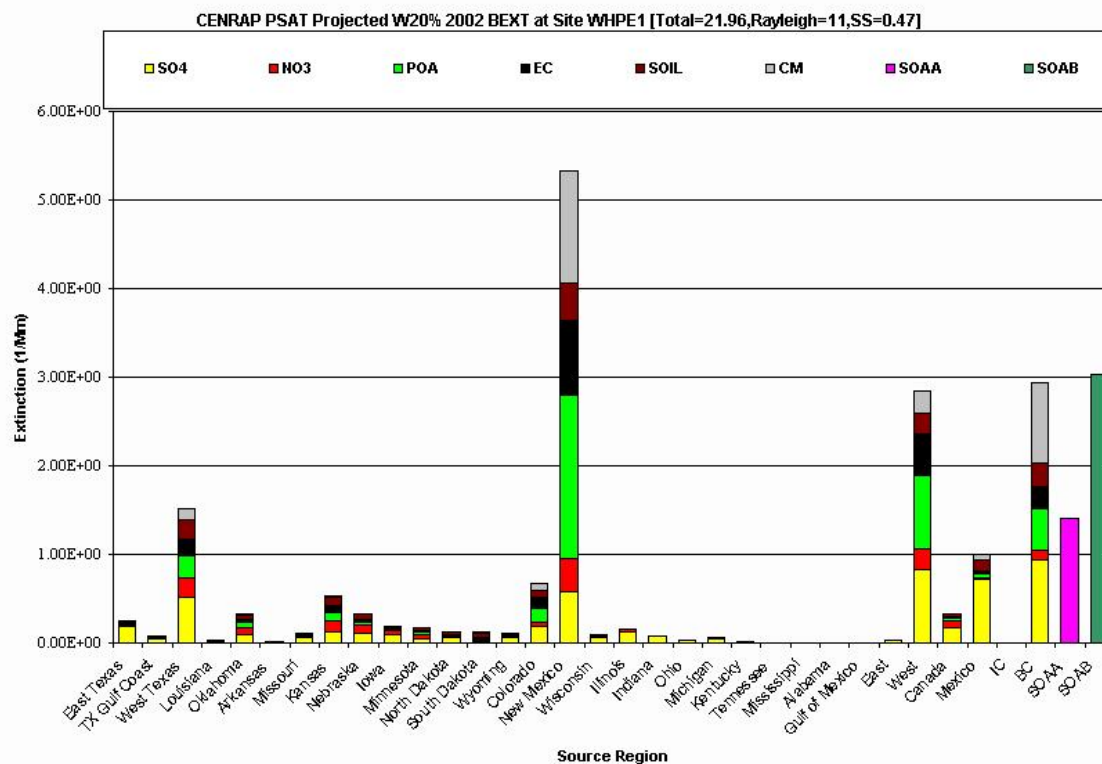


**Figure 11-12: Areas and Pollutants Causing Regional Haze at White Mountain (WHIT) in New Mexico on Best 20 Percent Days in 2002**

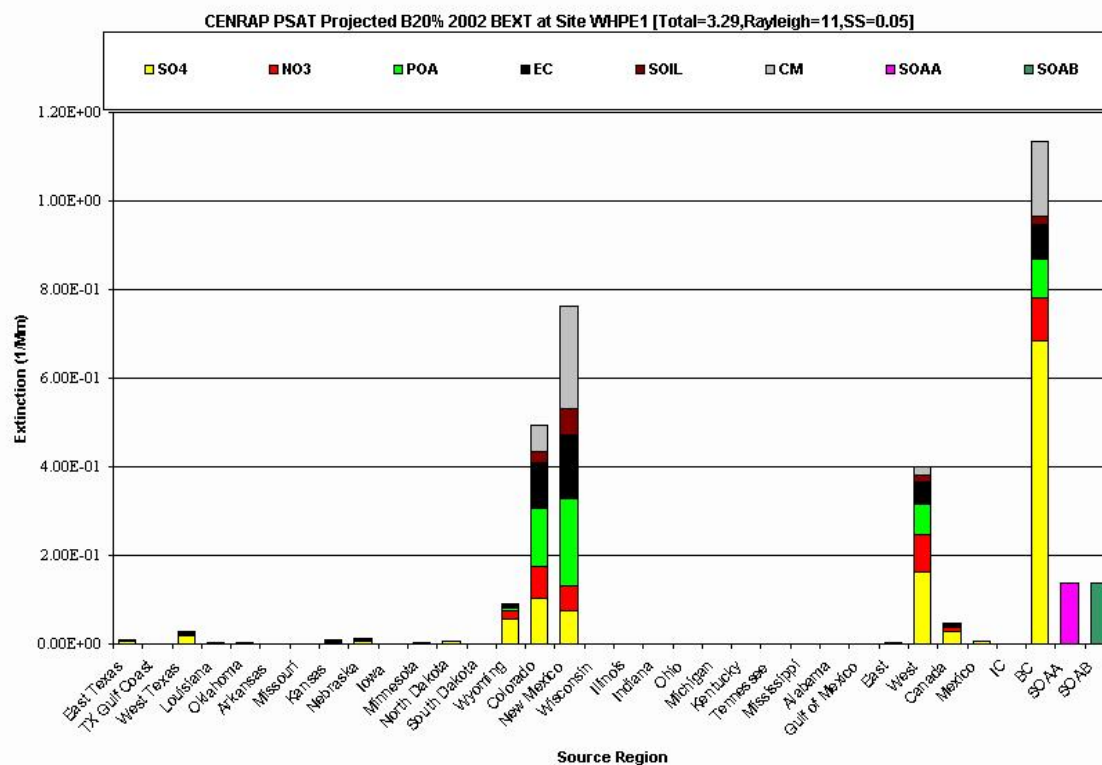
Note the change in scale on the y-axis.

**Table 11-5: Texas' Apportioned Contribution to the Measured 2002 and Projected 2018 Total Visibility Extinction at White Mountain Wilderness Area on Worst 20 Percent Days**

Particulate Matter Constituent	2002 Impacts at White Mountain (inverse megameters)		2018 Impacts at White Mountain (inverse megameters)	
	Texas Total	Total, All Source Areas	Texas Total	Total, All Source Areas
Sulfate	2.78	10.51	2.37	8.92
Nitrate	0.53	3.05	0.47	2.68
Primary Organic Aerosol	1.14	3.87	0.78	3.13
Elemental Carbon	0.59	1.82	0.27	1.08
Fine Soil	0.55	1.89	0.53	1.95
Coarse Mass	1.81	6.68	1.80	7.29
Secondary Organic Aerosol, Anthropogenic	not available <sup>1</sup>	1.83	not available <sup>1</sup>	1.64
Secondary Organic Aerosol, Biogenic	not available <sup>1</sup>	3.27	not available <sup>1</sup>	3.11
Total	7.40	32.91	6.22	29.80



**Figure 11-13: Areas and Pollutants Causing Regional Haze at Wheeler Peak Wilderness Area on Worst 20 Percent Days in 2002**



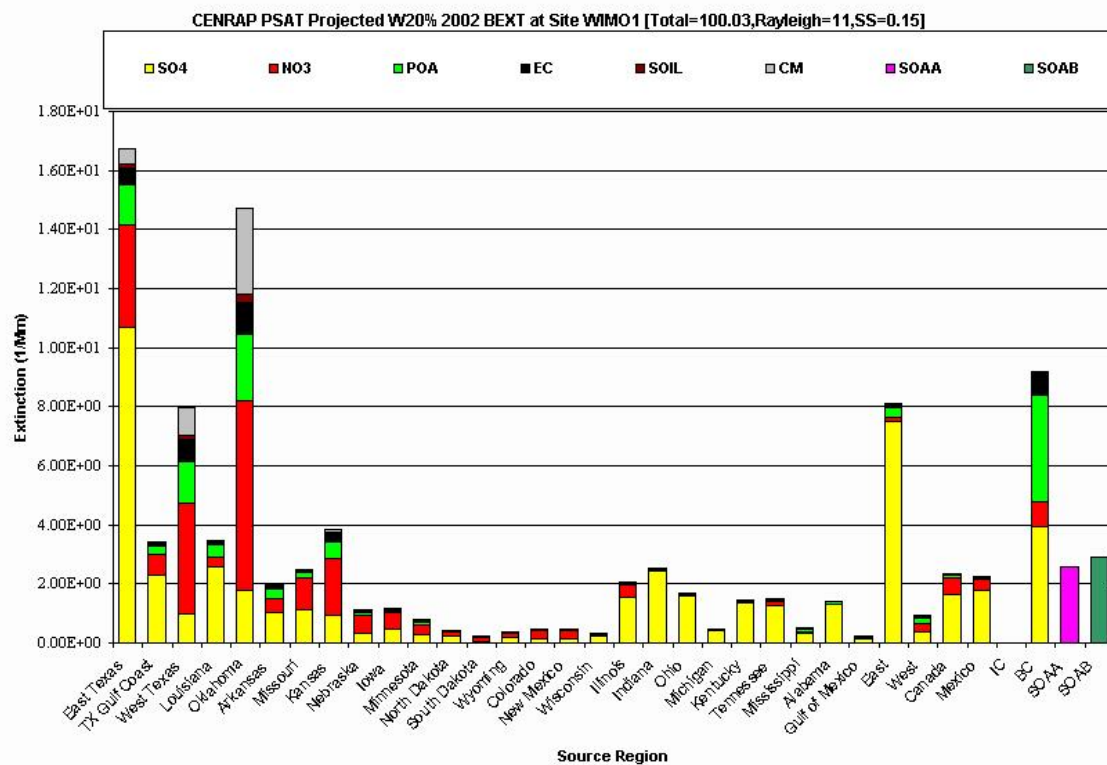
**Figure 11-14: Areas and Pollutants Causing Regional Haze at Wheeler Peak Wilderness Area on Best 20 Percent Days in 2002**

Note the change in scale on the y-axis.

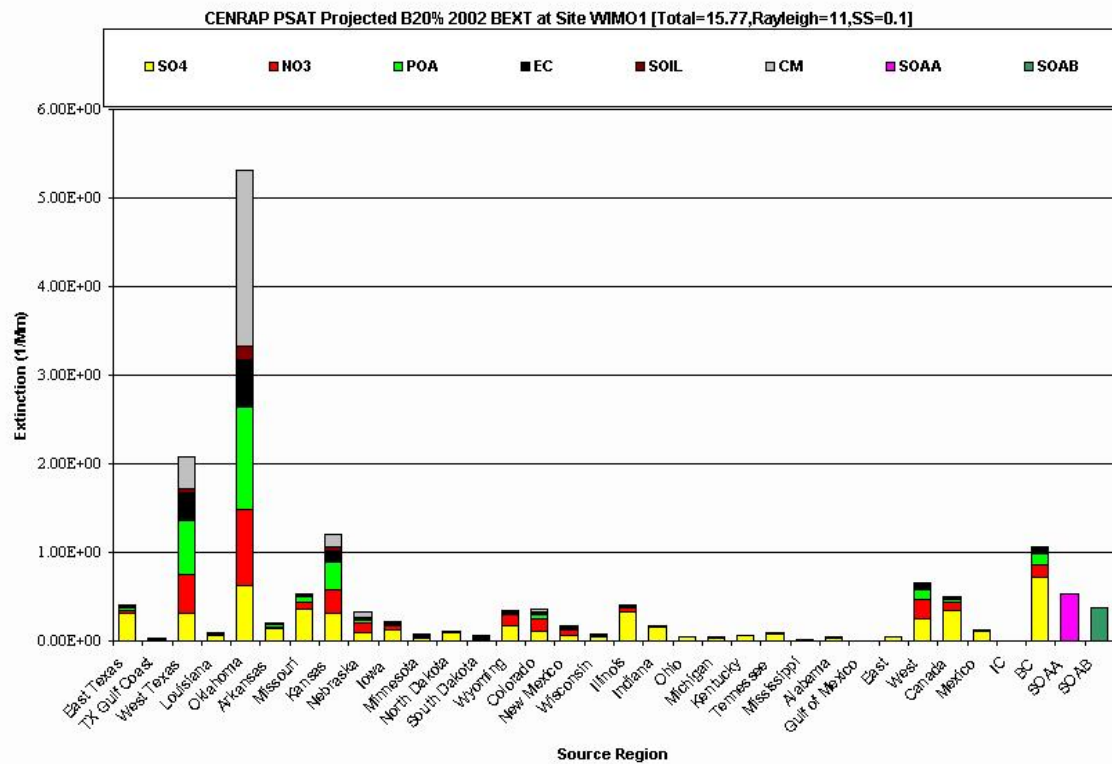
**Table 11-6: Texas' Apportioned Contribution to the Measured 2002 and Projected 2018 Total Visibility Extinction at Wheeler Peak Wilderness Area on Worst 20 Percent Days**

Particulate Matter Constituent	2002 Impacts at Wheeler Peak (inverse megameters)		2018 Impacts at Wheeler Peak (inverse megameters)	
	Texas Total	Total, All Source Areas	Texas Total	Total, All Source Areas
Sulfate	0.76	5.27	0.79	5.00
Nitrate	0.22	1.64	0.19	1.48
Primary Organic Aerosol	0.28	3.93	0.18	3.64
Elemental Carbon	0.21	2.18	0.08	1.48
Fine Soil	0.25	1.75	0.23	1.88
Coarse Mass	0.12	2.77	0.12	3.09
Secondary Organic Aerosol, Anthropogenic	not available <sup>1</sup>	1.41	not available <sup>1</sup>	1.28
Secondary Organic Aerosol, Biogenic	not available <sup>1</sup>	3.03	not available <sup>1</sup>	2.96
Total	1.85	21.96	1.59	20.80

### 11.2.3.2 Oklahoma



**Figure 11-15: Areas and Pollutants Causing Regional Haze at Wichita Mountains (WIMO) in Oklahoma on Worst 20 Percent Days in 2002**



**Figure 11-16: Areas and Pollutants Causing Regional Haze at Wichita Mountains (WIMO) in Oklahoma on Best 20 Percent Days in 2002**

Note the change in scale on the y-axis.

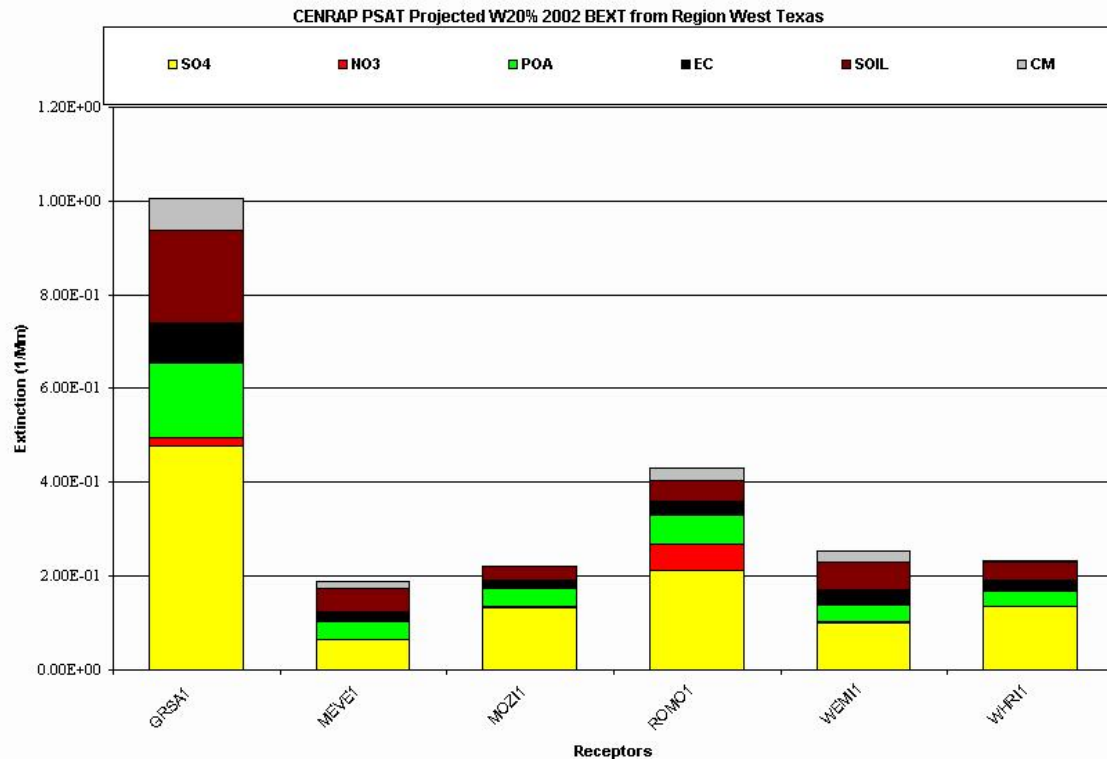
**Table 11-7: Texas' Apportioned Contribution to the Measured 2002 and Projected 2018 Total Visibility Extinction at Wichita Mountains Wilderness Area on Worst 20 Percent Days**

Particulate Matter Constituent	2002 Impacts at Wichita Mountains (inverse megameters)		2018 Impacts at Wichita Mountains (inverse megameters)	
	Texas Total	Total, All Source Areas	Texas Total	Total, All Source Areas
Sulfate	13.98	49.12	9.68	33.33
Nitrate	7.89	23.72	6.08	18.10
Primary Organic Aerosol	3.05	11.81	2.57	10.92
Elemental Carbon	1.42	4.47	0.68	3.00
Fine Soil	0.29	0.79	0.30	0.79
Coarse Mass	1.51	4.64	1.49	4.35
Secondary Organic Aerosol, Anthropogenic	not available <sup>1</sup>	2.57	not available <sup>1</sup>	2.22
Secondary Organic Aerosol, Biogenic	not available <sup>1</sup>	2.91	not available <sup>1</sup>	2.84
Total	28.15	100.03	20.79	75.56



### 11.2.3.3 Colorado

Emissions from the western portion of Texas account for most of Texas' impact on the Class I areas in Colorado. The following graph in Figure 11-17 shows the impacts of the western portion of Texas on the Class I areas in Colorado that are included in the CENRAP PSAT modeling. The graph is to show the basis for choosing Great Sand Dunes as the Colorado Class I area for more detailed examination of Texas' impacts.



**Figure 11-17: Calculated Regional Haze Impacts of West Texas Emissions at Each Class I Area in Colorado Included in CENRAP PSAT Modeling on Worst 20 Percent Days in 2002**

GRSA - Great Sand Dunes National Park

MEVE - Mesa Verde National Park

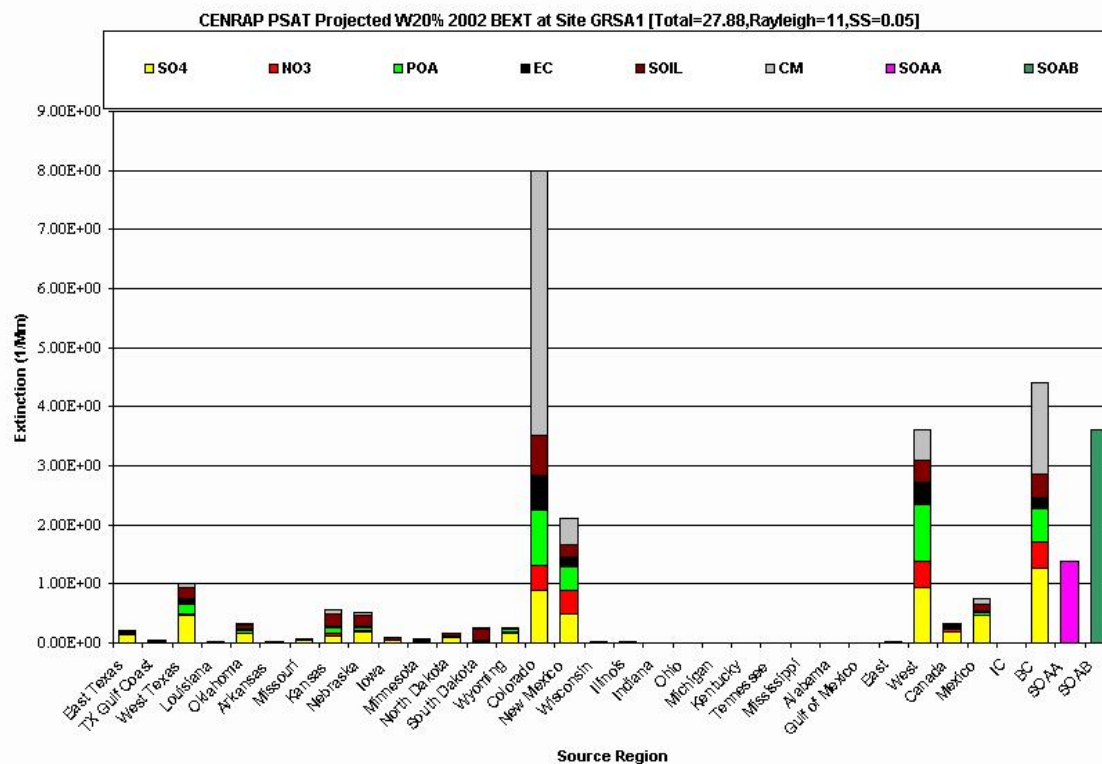
MOZI - Mount Zirkel Wilderness Area

ROMO - Rocky Mountain National Park

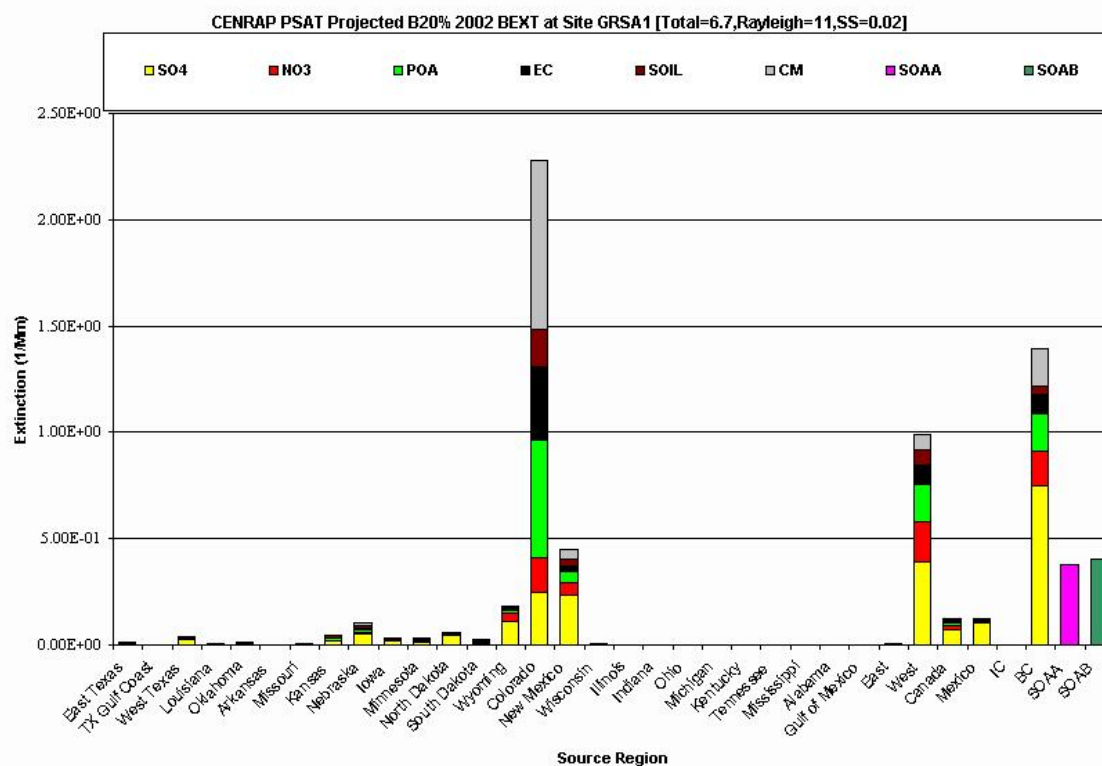
WEMI - Weminuche Wilderness Area

WHRI - White River National Forest





**Figure 11-18: Areas and Pollutants Causing Regional Haze at Great Sand Dunes (GRSA) in Colorado on Worst 20 Percent Days in 2002**

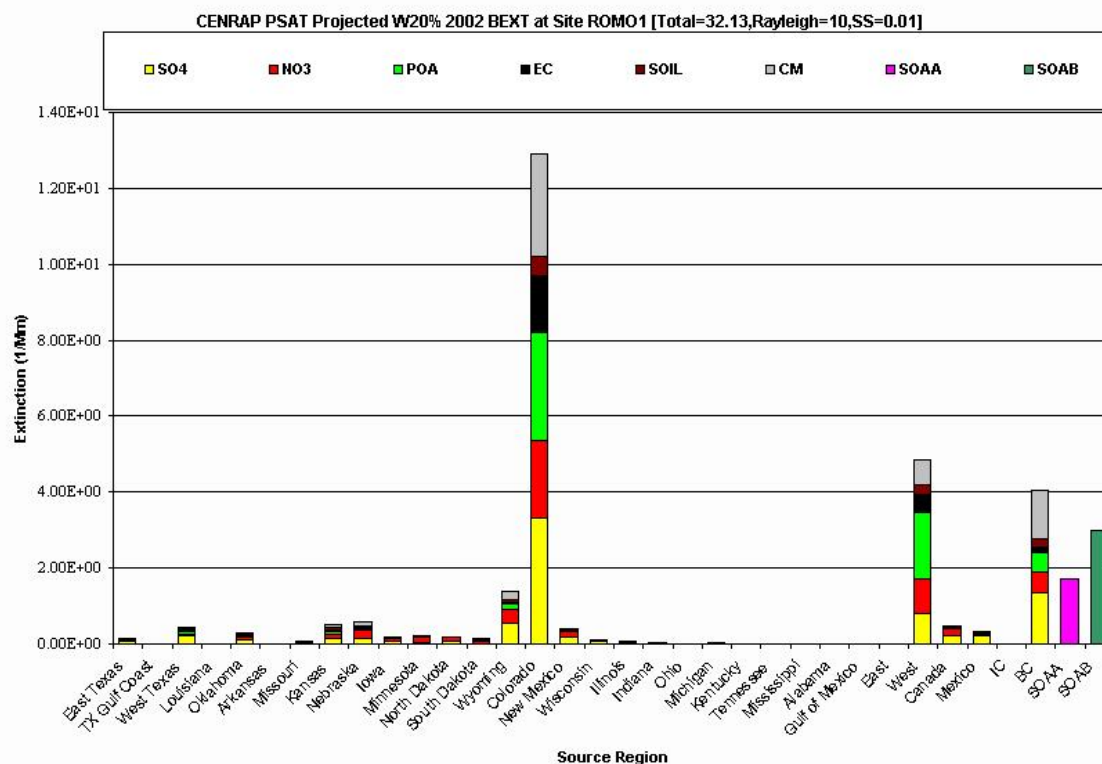


**Figure 11-19: Areas and Pollutants Causing Regional Haze at Great Sand Dunes (GRSA) in Colorado on Best 20 Percent Days in 2002**

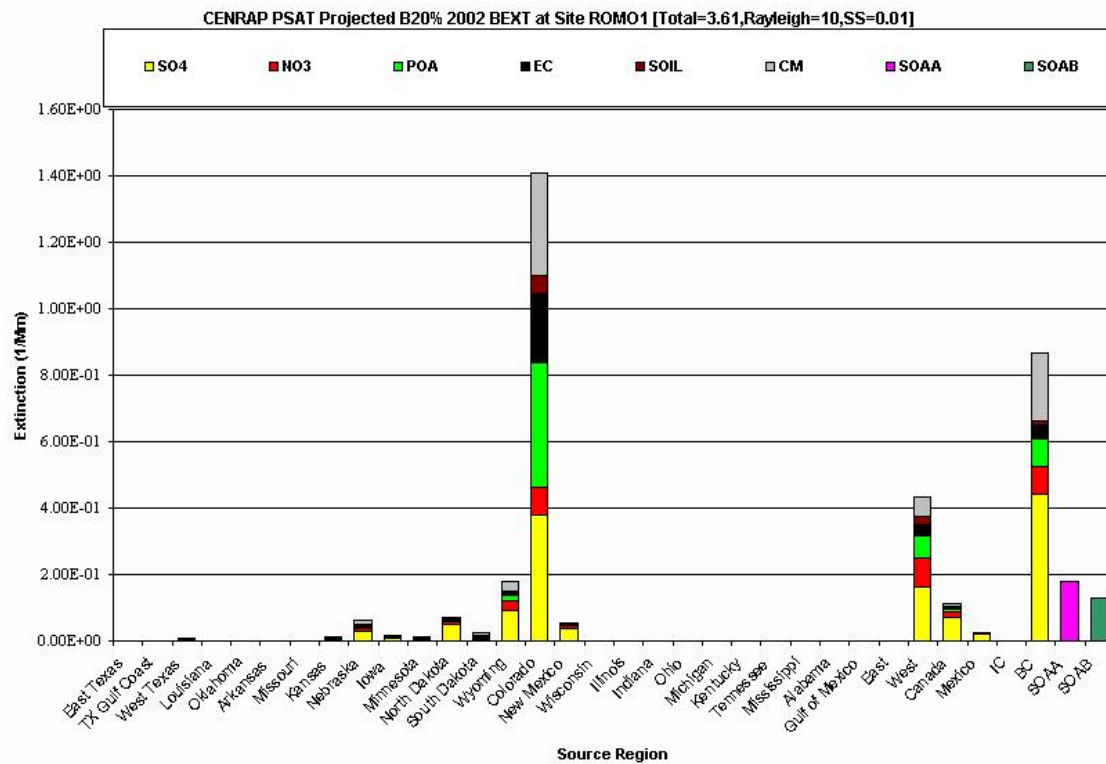
Note the change in scale on the y-axis.

**Table 11-8: Texas' Apportioned Contribution to the Measured 2002 and Projected 2018 Total Visibility Extinction at Great Sand Dunes Wilderness Area on Worst 20 Percent Days**

Particulate Matter Constituent	2002 Impacts at Great Sand Dunes (inverse megameters)		2018 Impacts at Great Sand Dunes (inverse megameters)	
	Texas Total	Total, All Source Areas	Texas Total	Total, All Source Areas
Sulfate	0.66	5.84	0.65	5.32
Nitrate	0.02	1.94	0.02	1.83
Primary Organic Aerosol	0.18	3.34	0.12	3.07
Elemental Carbon	0.10	1.57	0.04	1.08
Fine Soil	0.23	2.84	0.21	2.95
Coarse Mass	0.07	7.36	0.07	7.69
Secondary Organic Aerosol, Anthropogenic	not available <sup>1</sup>	1.38	not available <sup>1</sup>	1.28
Secondary Organic Aerosol, Biogenic	not available <sup>1</sup>	3.61	not available <sup>1</sup>	3.56
Total	1.25	27.88	1.11	26.77



**Figure 11-20: Areas and Pollutants Causing Regional Haze at Rocky Mountains National Park (ROMO) in Colorado on Worst 20 Percent Days in 2002**



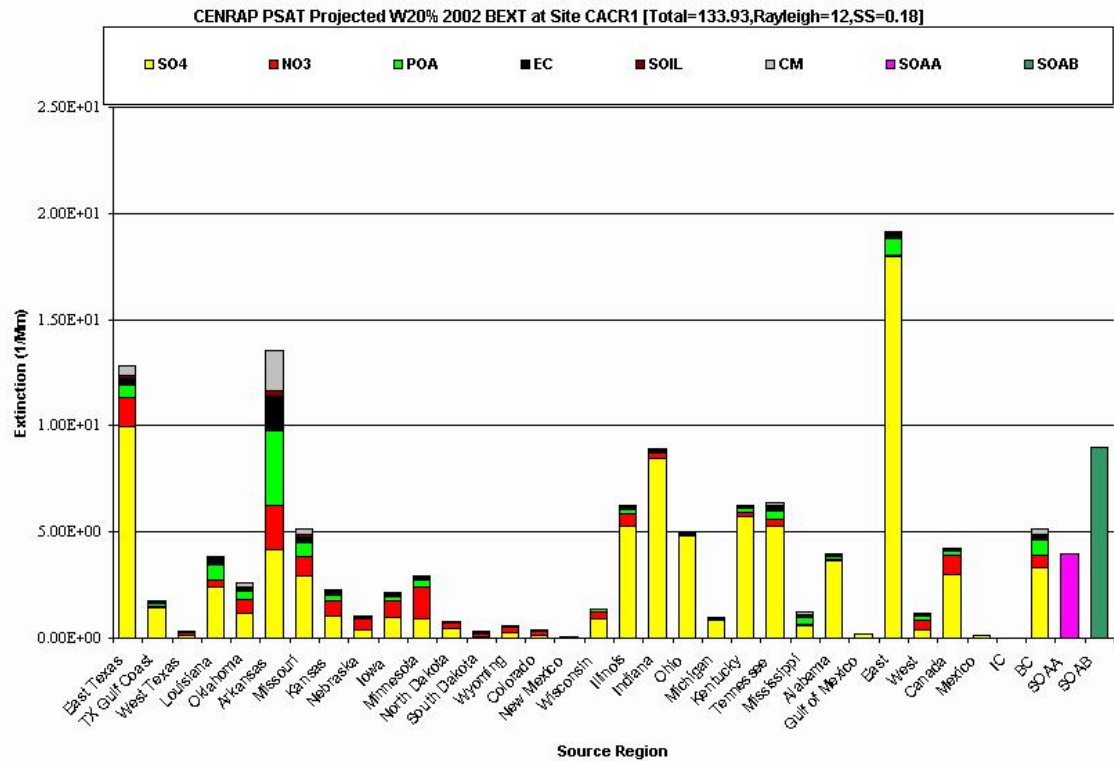
**Figure 11-21: Areas and Pollutants Causing Regional Haze at Rocky Mountains National Park (ROMO) in Colorado on Best 20 Percent Days in 2002**

Note the change in scale on the y-axis.

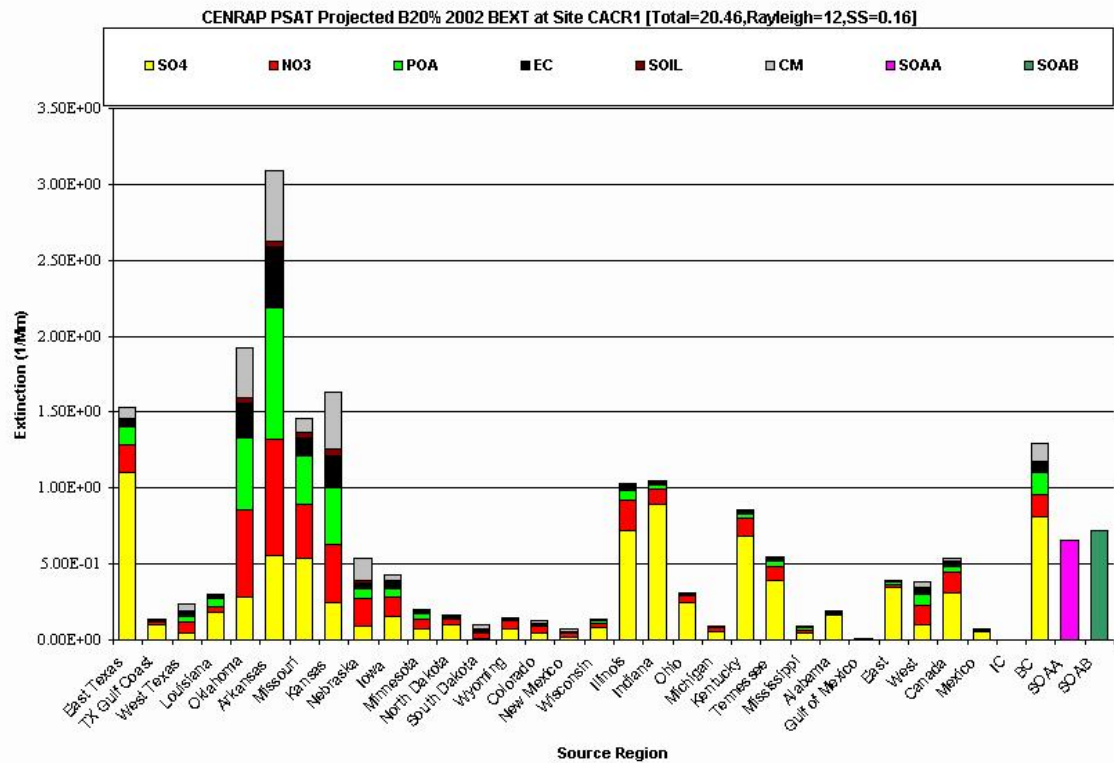
**Table 11-9: Texas' Apportioned Contribution to the Measured 2002 and Projected 2018 Total Visibility Extinction at Rocky Mountain National Park on Worst 20 Percent Days**

Particulate Matter Constituent	2002 Impacts at Rocky Mountain National Park (inverse megameters)		2018 Impacts at Rocky Mountain National Park (inverse megameters)	
	Texas Total	Total, All Source Areas	Texas Total	Total, All Source Areas
Sulfate	0.30	7.69	0.30	6.52
Nitrate	0.08	5.17	0.06	4.28
Primary Organic Aerosol	0.07	5.65	0.05	5.37
Elemental Carbon	0.03	2.33	0.02	1.54
Fine Soil	0.06	1.39	0.05	1.52
Coarse Mass	0.03	5.17	0.03	5.66
Secondary Organic Aerosol, Anthropogenic	not available <sup>1</sup>	1.73	not available <sup>1</sup>	1.60
Secondary Organic Aerosol, Biogenic	not available <sup>1</sup>	3.00	not available <sup>1</sup>	2.91
Total	0.58	32.13	0.51	29.41

#### 11.2.3.4 Arkansas



**Figure 11-22: Areas and Pollutants Causing Regional Haze at Caney Creek (CACR) in Arkansas on Worst 20 Percent Days in 2002**

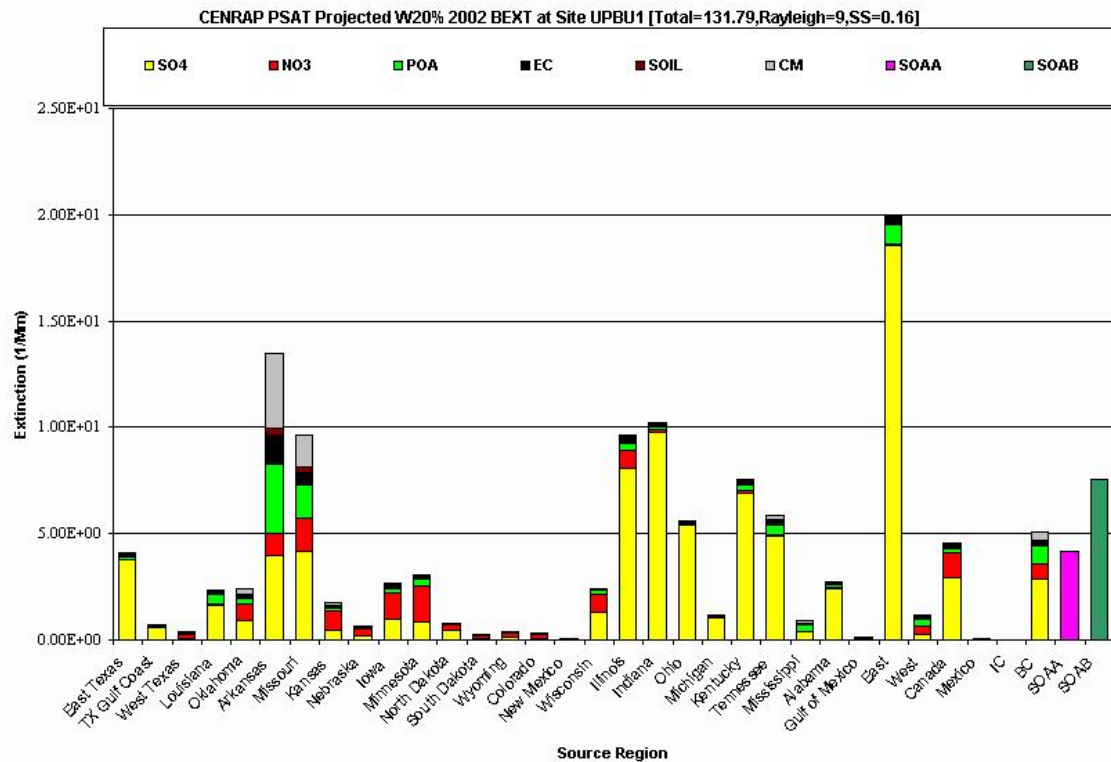


**Figure 11-23: Areas and Pollutants Causing Regional Haze at Caney Creek (CACR) in Arkansas on Best 20 Percent of Days in 2002**

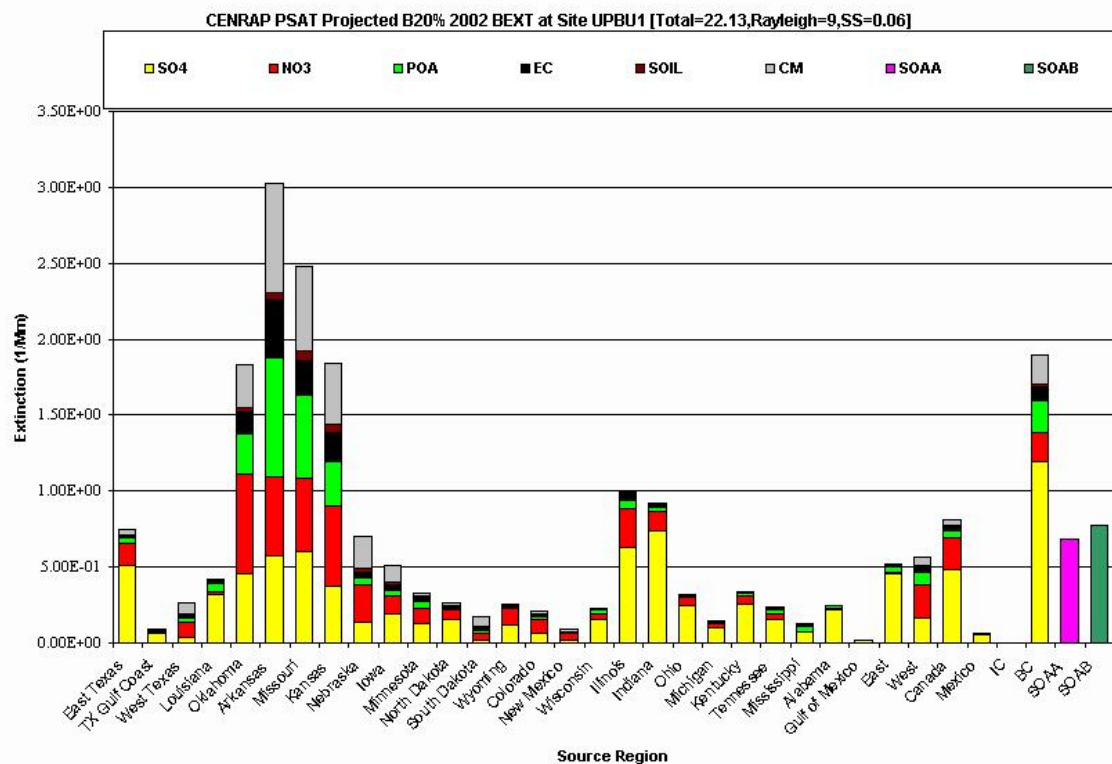
Note the change in scale on the y-axis.

**Table 11-10: Texas' Apportioned Contribution to the Measured 2002 and Projected 2018 Total Visibility Extinction at Caney Creek Wilderness Area on Worst 20 Percent Days**

Particulate Matter Constituent	2002 Impacts at Caney Creek (inverse megameters)		2018 Impacts at Caney Creek (inverse megameters)	
	Texas Total	Total, All Source Areas	Texas Total	Total, All Source Areas
Sulfate	11.55	87.05	7.24	48.95
Nitrate	1.49	13.78	0.83	7.57
Primary Organic Aerosol	0.83	10.50	0.83	9.93
Elemental Carbon	0.36	4.80	0.20	3.17
Fine Soil	0.15	1.12	0.17	1.29
Coarse Mass	0.50	3.73	0.47	3.58
Secondary Organic Aerosol, Anthropogenic	not available <sup>1</sup>	3.94	not available <sup>1</sup>	3.21
Secondary Organic Aerosol, Biogenic	not available <sup>1</sup>	9.00	not available <sup>1</sup>	8.14
Total	14.89	133.93	9.74	85.84



**Figure 11-24: Areas and Pollutants Causing Regional Haze at Upper Buffalo (UPBU) in Arkansas on Worst 20 Percent Days in 2002**



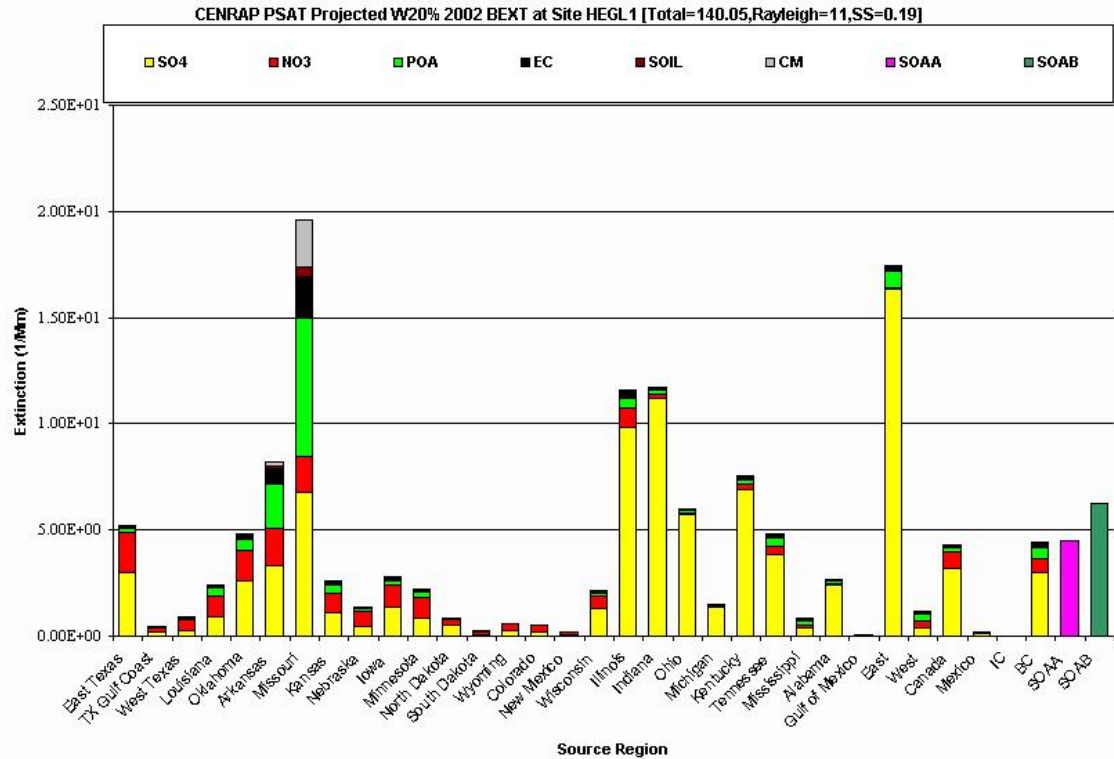
**Figure 11-25: Areas and Pollutants Causing Regional Haze at Upper Buffalo (UPBU) in Arkansas on Best 20 Percent Days in 2002**

Note the change in scale on the y-axis.

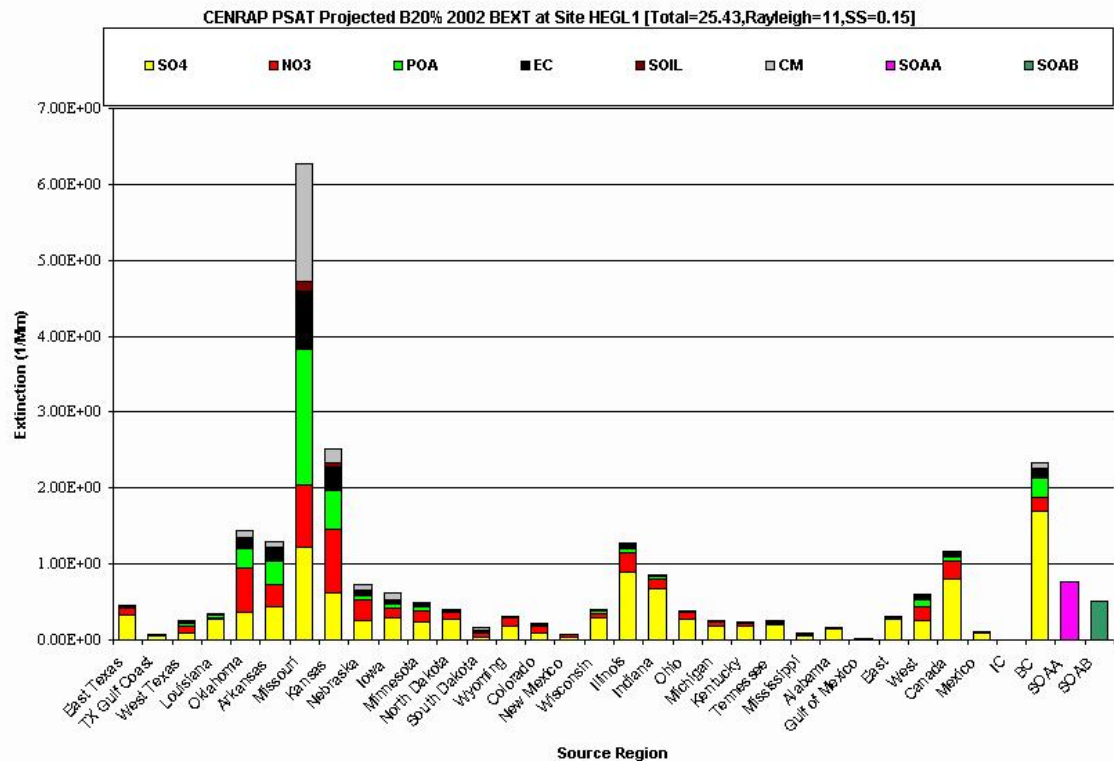
**Table 11-11: Texas' Apportioned Contribution to the Measured 2002 and Projected 2018 Total Visibility Extinction at Upper Buffalo Wilderness Area on Worst 20 Percent Days**

Particulate Matter Constituent	2002 Impacts at Upper Buffalo (inverse megameters)		2018 Impacts at Upper Buffalo (inverse megameters)	
	Texas Total	Total, All Source Areas	Texas Total	Total, All Source Areas
Sulfate	4.41	83.18	2.74	45.38
Nitrate	0.27	13.30	0.18	9.22
Primary Organic Aerosol	0.24	10.85	0.24	10.17
Elemental Carbon	0.10	4.72	0.05	3.07
Fine Soil	0.04	1.21	0.05	1.40
Coarse Mass	0.12	6.85	0.11	6.53
Secondary Organic Aerosol, Anthropogenic	not available <sup>1</sup>	4.14	not available <sup>1</sup>	3.36
Secondary Organic Aerosol, Biogenic	not available <sup>1</sup>	7.55	not available <sup>1</sup>	7.02
Total	5.19	131.79	3.38	86.16

### 11.2.3.5 Missouri



**Figure 11-26: Areas and Pollutants Causing Regional Haze at Hercules-Glades (HEGL) in Missouri on Worst 20 Percent Days in 2002**



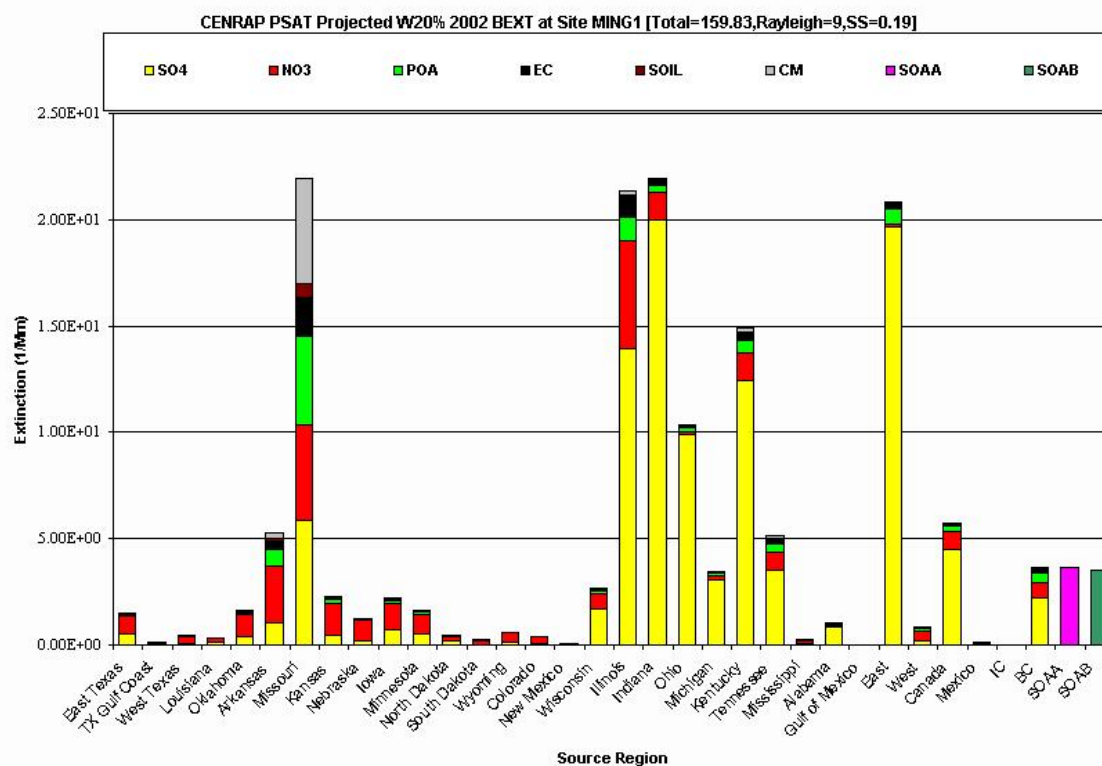
**Figure 11-27: Areas and Pollutants Causing Regional Haze at Hercules-Glades (HEGL) in Missouri on the Best 20 Percent of Days 2002**

Note the change in scale on the y-axis.



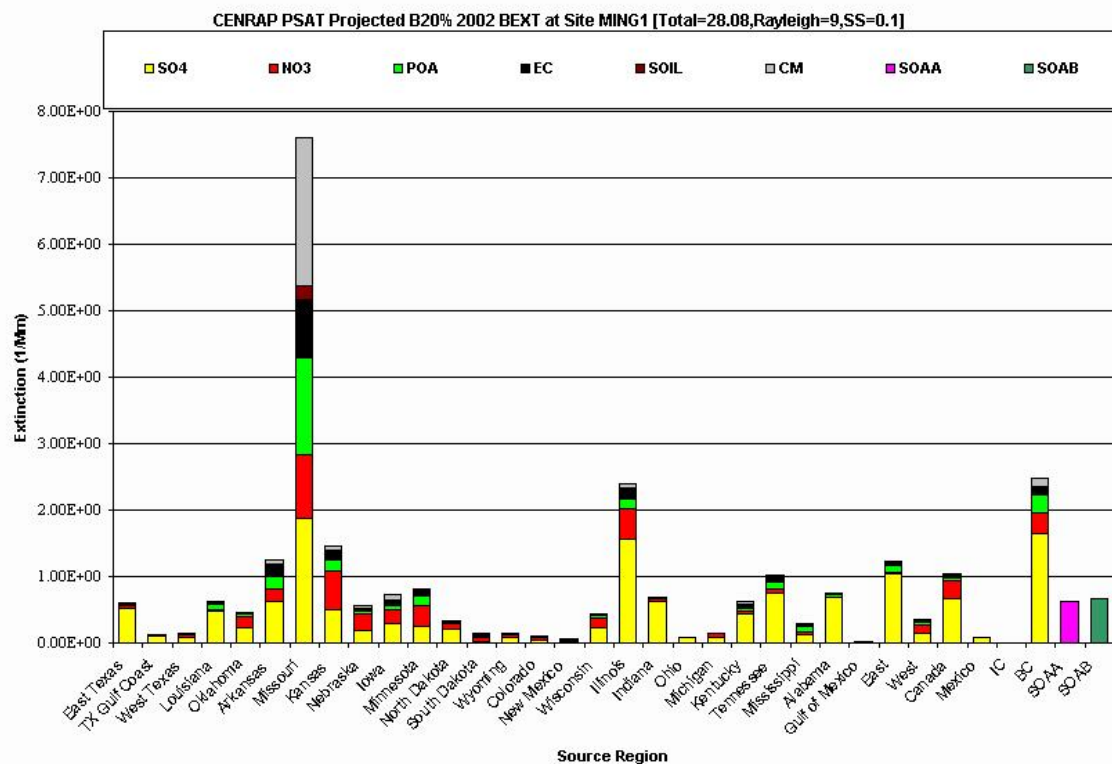
**Table 11-12: Texas' Apportioned Contribution to the Measured 2002 and Projected 2018 Total Visibility Extinction at Hercules-Glades Wilderness Area on Worst 20 Percent Days**

Particulate Matter Constituent	2002 Impacts at Hercules-Glades (inverse megameters)		2018 Impacts at Hercules-Glades (inverse megameters)	
	Texas Total	Total, All Source Areas	Texas Total	Total, All Source Areas
Sulfate	3.48	87.94	2.51	50.63
Nitrate	2.56	17.91	1.51	12.35
Primary Organic Aerosol	0.33	14.55	0.28	12.95
Elemental Carbon	0.12	5.22	0.06	3.51
Fine Soil	0.03	0.92	0.03	1.00
Coarse Mass	0.06	2.78	0.06	2.48
Secondary Organic Aerosol, Anthropogenic	not available <sup>1</sup>	4.50	not available <sup>1</sup>	3.76
Secondary Organic Aerosol, Biogenic	not available <sup>1</sup>	6.22	not available <sup>1</sup>	5.83
Total	6.59	140.05	4.45	92.49



**Figure 11-28: Areas and Pollutants Causing Regional Haze at Mingo (MING) in Missouri on Worst 20 Percent Days in 2002**





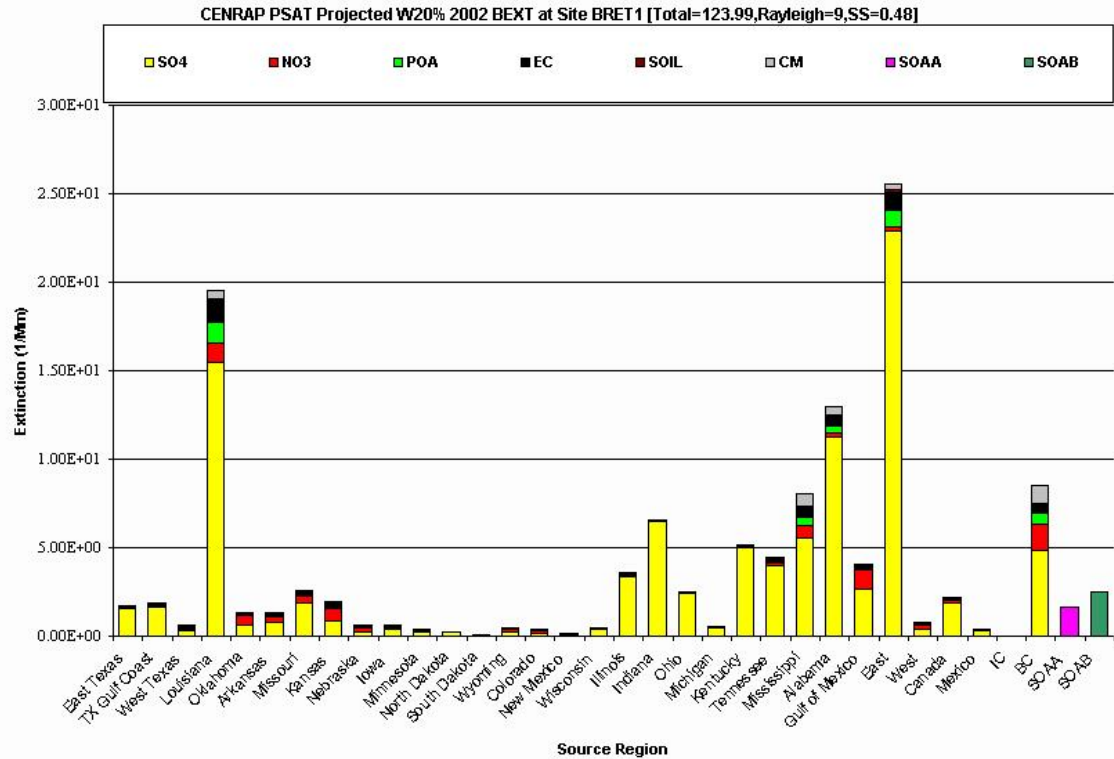
**Figure 11-29: Areas and Pollutants Causing Regional Haze at Mingo (MING) in Missouri on Best 20 Percent Days in 2002**

Note the change in scale on the y-axis.

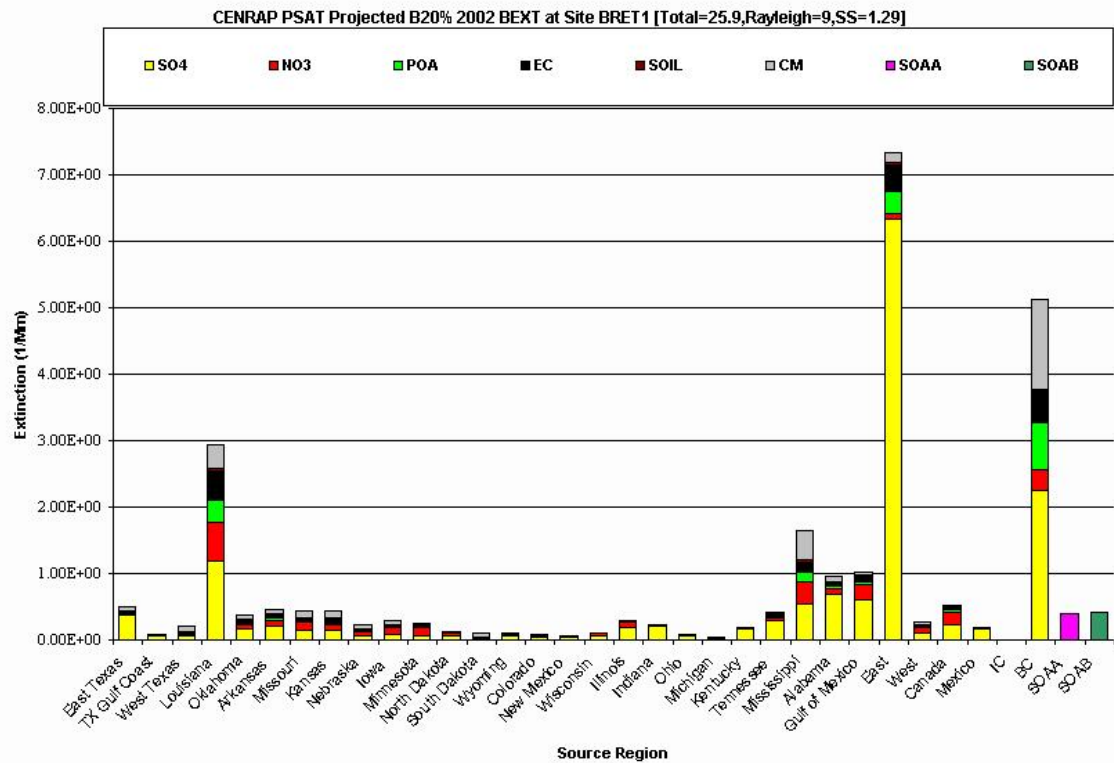
**Table 11-13: Texas' Apportioned Contribution to the Measured 2002 and Projected 2018 Total Visibility Extinction at Mingo Wilderness Area on Worst 20 Percent Days**

Particulate Matter Constituent	2002 Impacts at Mingo (inverse megameters)		2018 Impacts at Mingo (inverse megameters)	
	Texas Total	Total, All Source Areas	Texas Total	Total, All Source Areas
Sulfate	0.69	102.52	0.53	54.45
Nitrate	1.18	27.24	0.64	19.14
Primary Organic Aerosol	0.07	10.21	0.06	9.09
Elemental Carbon	0.03	5.49	0.02	3.53
Fine Soil	0.01	1.26	0.01	1.44
Coarse Mass	0.02	5.95	0.02	5.31
Secondary Organic Aerosol, Anthropogenic	not available <sup>1</sup>	3.66	not available <sup>1</sup>	3.04
Secondary Organic Aerosol, Biogenic	not available <sup>1</sup>	3.50	not available <sup>1</sup>	3.25
Total	2.01	159.83	1.28	99.24

### 11.2.3.6 Louisiana



**Figure 11-30: Areas and Pollutants Causing Regional Haze at Breton Wilderness Area (BRET) in Louisiana on Worst 20 Percent Days in 2002**



**Figure 11-31: Areas and Pollutants Causing Regional Haze at Breton Wilderness Area (BRET) in Louisiana on Best 20 Percent Days in 2002**

Note the change in scale on the y-axis.

**Table 11-14: Texas' Apportioned Contribution to the Measured 2002 and Projected 2018 Total Visibility Extinction at Breton Wilderness Area on Worst 20 Percent Days**

Particulate Matter Constituent	2002 Impacts at Breton Wilderness Area (inverse megameters)		2018 Impacts at Breton Wilderness Area (inverse megameters)	
	Texas Total	Total, All Source Areas	Texas Total	Total, All Source Areas
Sulfate	3.55	96.83	2.66	68.63
Nitrate	0.15	8.29	0.16	8.20
Primary Organic Aerosol	0.12	4.71	0.11	4.37
Elemental Carbon	0.14	5.40	0.06	3.92
Fine Soil	0.05	0.95	0.05	1.16
Coarse Mass	0.19	3.70	0.18	3.95
Secondary Organic Aerosol, Anthropogenic	not available <sup>1</sup>	1.63	not available <sup>1</sup>	1.38
Secondary Organic Aerosol, Biogenic	not available <sup>1</sup>	2.48	not available <sup>1</sup>	2.46
Total	4.20	123.99	3.23	94.06

### 11.3 REQUEST FOR FEDERAL EFFORTS TO REDUCE INTERNATIONAL TRANSPORT

Figures 11-2 and 11-4 show the CENRAP PSAT results apportioning the causes of 2000-2004 regional haze on the worst 20 percent visibility days at Big Bend and Guadalupe Mountains, based on the 2002 base period modeling. The figures show large contributions from anthropogenic sources categorized as from Mexico and from the boundary conditions outside the CENRAP modeling domain. The boundary conditions domain includes some of central Mexico, all of southern Mexico, most of the Mexican Yucatan, and all of Central America. Chapter 8: *Modeling Assessment* describes the modeling in more detail. These results are directionally consistent with federal studies that have previously found substantial international pollutant transport impacts on regional haze at Big Bend. These studies include the Big Bend Regional Aerosol and Visibility Observational (BRAVO) study of regional haze impacts at Big Bend and a number of National Park Service (NPS) studies in the 1990s that relied on back trajectory analysis to determine where air accumulated regional haze on its way to Big Bend (NPS et al. 2004). Figure 11-4 shows that the CENRAP PSAT modeling calculates that international transport contributes over 25 percent of the regional haze on the worst 20 percent of days during the base period at Guadalupe Mountains. Figures 11-9 and 11-15 show that international transport contributes over ten percent of the regional haze on the worst 20 percent of days at Salt Creek and Wichita Mountains. At Caney Creek, the international transport contribution to regional haze on the worst 20 percent of days is over five percent of the total (after discounting coarse mass, which the model does not represent reliably) (ENVIRON 2007).

CENRAP modeling estimates of the base period visibility impairment at Big Bend from the United States and foreign contributions indicate 52 percent of the light extinction at Big Bend on the worst 20 percent of regional haze days comes from international transport. The concentrations are adjusted to match the visibility extinction measured for the 2000 through 2005 base period.

Due to the large impact of international transport on anthropogenic regional haze in Texas, it will be impossible to reach natural conditions at the two Class I areas in Texas without reductions in international impacts to parallel the reductions in United States anthropogenic regional haze impacts on Texas' two Class I areas. Although the impact of international transport on Class I areas in the states bordering Texas is approximately ten percent or less of the total impairment, reductions in international transport of anthropogenic regional haze will also be needed for the Class I areas in these states to reach the natural conditions goal.

The TCEQ requests that the EPA initiate and pursue federal efforts to reduce international transport of visibility impairing pollutants into Texas.

#### **11.4 MINIMIZING VISIBILITY IMPAIRMENT FROM TEXAS EMISSIONS**

The TCEQ has implemented rules that limit and minimize emissions causing both local and regional visibility impairment. The Texas SIP includes numerous rules that minimize emissions that cause or contribute to local and regional visibility impairment. The TCEQ plans to continue to implement all these rules that protect visibility at Class I areas in Texas and other states (Appendices 11-2 and 11-3).

##### **11.4.1 Opacity Limitations**

Title 30 TAC Chapter 111, Control of Air Pollution from Visible Emissions and Particulate Matter, limits visible emissions and mass emissions from industrial and power plant stacks, motor vehicles, and incinerators. Together with opacity limits in many preconstruction permits, these rules limit the emissions of PM from a wide variety of sources. The TCEQ continues to enforce both the rule and permit limits on opacity and PM emissions from electric generating units (EGUs) and other sources.

##### **11.4.2 Sulfur Emission Limitations**

Title 30 TAC Chapter 112 Control of Air Pollution from Sulfur Compounds limits sulfur dioxide, hydrogen sulfide, total reduced sulfur compounds, and sulfuric acid from a variety of sources including EGUs, sulfuric acid plants, smelters, and sulfur recovery units. These rules, together with many lower limitations in permits for new and modified sources, limit the impacts of ammonium sulfate from Texas on the Class I areas in Texas and at the Class I areas in other states that Texas' emissions impact.

##### **11.4.3 Best Available Control Technology (BACT) Requirements**

BACT requirements have been in effect since 1972 for new and modified sources of air pollution for SO<sub>2</sub>, NO<sub>x</sub>, PM, and VOC. While federal new source review (NSR) rules requiring BACT apply only to major new sources or modifications, Texas law requires BACT for all emissions increases at new or modified units. The basic requirement is that each new and modified source of air pollution built in Texas use BACT to minimize or eliminate emissions of all pollutants subject to the national ambient air quality standards (NAAQS). This includes all the emissions from human activity that contribute to regional haze, including NO<sub>x</sub>, SO<sub>2</sub>, PM, and VOC. Title 30 TAC Chapter 116: Control of Air Pollution by Permits for New Construction or Modification contains these requirements.

Each applicable source must obtain a construction permit before beginning construction. Issuance of a construction permit can occur only after an engineering determination that the facility will use BACT. In some cases, the BACT requirements apply through permits by rule or standard permits rather than through case-by-case review of each new or modified source of air pollution.

##### **11.4.4 Programs to Manage Smoke Impacts on Class I Areas**

The Texas Forest Service (TFS) coordinates fire and smoke management issues in Texas. The 34th Texas Legislature created the TFS in 1915. The legal mandate of the TFS includes the

responsibility to "assume direction of all forest interests and all matters pertaining to forestry within the jurisdiction of the state." The TFS has developed a voluntary approach called the Texas Forest Service Smoke Management System, under which all land managers in Texas, including the NPS, inform the TFS before performing prescribed burns. The TFS dispatch office maintains communications with the TCEQ.

Examination of the data and modeling for the worst 20 percent visibility days at both Big Bend and Guadalupe Mountains indicates that smoke from agricultural burning and wildfires in Texas is not a large contributor to visibility impairment in Texas. There is no indication that agricultural burning and wildfires in Texas are significant contributors to regional haze on the worst 20 percent days at Class I areas that Texas impacts outside the state. For these reasons, the current rules, policies and plans listed below, along with the NPS smoke management plans, and the smoke management plans of other federal agencies responsible for Class I areas that Texas impacts, are adequate to meet the long-term strategy requirements. Appendix 11-1 contains documents in the following list. The TCEQ provides the documents as examples of the fire management plans that the responsible agencies maintain. This SIP revision does not incorporate the non-TCEQ documents. The outdoor burning rules are currently approved in to the Texas SIP.

- Texas Wildfire Protection Plan (TFS 2007)
- Texas Forest Service Smoke Management System (TFS 1995)
- 30 TAC Chapter 111, Subchapter B: Outdoor Burning (TCEQ 2006)
- Big Bend National Park Fire Management Plan (NPS 2005a)
- Guadalupe Mountains National Park Fire Management Plan (NPS 2005b)
- Big Thicket National Preserve Fire Management Plan (NPS 2004a)
- Lyndon B. Johnson National Historical Park Fire Management Plan (NPS 2005c)
- Padre Island National Seashore Fire Management Plan (NPS 2004b)
- San Antonio Missions National Historical Park Fire Management Plan (NPS 2004c).

A significant component of preventing wildfires is the authority that Texas counties have to prohibit open burning in times of drought. The counties get their authority from §352.081 and §352.082 of the Texas Local Government Code, relating to outdoor burning. Another component in reducing wildfire hazards is the red flag warnings that the National Weather Service issues in times of drought, low humidity, and windy conditions. The broadcast media routinely publicize these warnings, especially during times of drought and outdoor burning bans.

Because of the relatively low contribution of smoke from Texas to worst 20 percent day visibility impairment at Texas' Class I areas and the Class I areas Texas' emissions affect in other states, the TCEQ is not certifying a smoke management plan as part of this SIP revision.

#### **11.4.5 Program to Lower the Impact of Construction Activity on Air and Water Quality**

The main regulatory requirements that the TCEQ uses to minimize the air and water quality impacts of dust and soil from construction activity in Texas are under water pollution control requirements to prevent pollution from storm water runoff and mud and dirt tracked from construction sites. The reduction in silt-bearing runoff on paved roads and in mud and dirt tracked onto paved roads around construction sites reduces the amount of fine soil material suspended in the air from traffic in these areas.

The TCEQ's Texas Pollutant Discharge Emission System (TPDES) General Permit TXR150000 regulates activities at construction sites one acre or larger. The size threshold applies to single projects or multiple projects as part of a larger development plan. The TCEQ issued this permit March 5, 2003, pursuant to §26.040 of the Texas Water Code and §402 of the Clean Water Act.

State rule 30 TAC §111.145, Construction and Demolition, provides additional authority and states:

“For the purpose of this section, the following restrictions apply if the area of land affected by the listed activities is more than one acre in size, except for the City of El Paso, where restrictions shall apply regardless of the size of the area of land affected. No person may cause, suffer, allow, or permit a structure, road, street, alley, or parking area to be constructed, altered, repaired, or demolished, or land to be cleared without taking at least the following precautions to achieve control of dust emissions:

(1) Use of water or of suitable oil or chemicals for control of dust in the demolition of structures, in construction operations, in work performed on a road, street, alley, or parking area, or in the clearing of land.”

### **11.5 FEDERAL PROGRAMS THAT REDUCE EMISSIONS**

The Federal Motor Vehicle Control Program (FMVCP) has produced and is continuing to produce large reductions in motor vehicle emissions of NO<sub>x</sub>, PM, and VOCs. The increasingly lower federal limits on sulfur content for gasoline and diesel fuel are continuing to reduce the sulfur input to total sulfur emissions from internal combustion engines. They are enabling lower NO<sub>x</sub>, PM, and VOC emission limits for on-road motor vehicles, both diesel and gasoline, as well as for non-road engines. The lower sulfur fuel content is also enabling implementation of lower emission limits on new on-road and non-road engines.

The following lists several significant programs:

#### **Federal On-Road Measures**

- Federal Phase II reformulated gasoline (RFG) Dallas-Fort Worth (DFW) and Houston-Galveston-Brazoria (HGB)
- Tier 2 vehicle emission standards and federal low-sulfur gasoline
- National low emissions vehicle standards (NLEV)
- Heavy-duty diesel standards

#### **Federal Non-Road Measures**

- Lawn and garden equipment
- Tier 2 heavy-duty diesel equipment
- Locomotive engine standards
- Compression ignition standards for vehicles and equipment
- Recreational marine engine standards

Appendix 11-2: *Federal and Texas Programs Related to On-Road and Non-Road Mobile Sources* lists the federal and state rules and programs in considerable detail.

#### **11.5.1 Texas Vehicle Inspection and Maintenance Programs**

Motor vehicle inspection and maintenance programs are in place to maintain the effectiveness of the FMVCP in the HGB, DFW, Austin, and El Paso areas. The Department of Public Safety administers the programs and TCEQ maintains oversight of the programs including collecting and analyzing data directly from the equipment at the inspection stations.

#### **11.5.2 Air Check Texas Repair and Replacement Assistance Program**

In 2002, the TCEQ established a financial assistance program for qualified owners of vehicles that fail the emissions test. The Low Income Vehicle Repair Assistance, Retrofit, and Accelerated Vehicle Retirement Program (LIRAP) provisions of House Bill 2134, 77th Texas Legislature 2001, created the program. House Bill 1611 passed in the 79th Legislature 2005, modified the program. The LIRAP applies only to counties that implement a vehicle inspection and maintenance program and have elected to implement LIRAP provisions.

By enacting Senate Bill 12, the 80th Texas Legislature expanded the LIRAP program and appropriated \$45 million for LIRAP for fiscal year 2008 and an additional \$45 million for fiscal year 2009. The purpose of this voluntary program is to remove older, more polluting vehicles from Texas roadways in certain counties with high ozone. Under Senate Bill 12, residents of certain Texas counties who meet income criteria and whose vehicles meet certain registration criteria may be eligible to receive vouchers for up to \$3,500 toward the purchase of a new or no more than three-year-old qualifying vehicle from participating auto dealers. A motor vehicle scrappage facility must certify that the engine from a retired vehicle has been destroyed for the vehicle owner to be eligible for the voucher. Accelerated retirement of older, higher polluting vehicles will reduce NO<sub>x</sub>, fine PM, and VOC emissions.

## **11.6 EMISSION REDUCTIONS SINCE ISSUANCE OF THE REGIONAL HAZE RULE**

Since July 1, 1999, the TCEQ has implemented substantial programs that reduce Texas' regional haze impact at Class I areas in Texas and in surrounding states. Appendix 11-3: *Major Point Source NO<sub>x</sub> Rules and Reductions Promulgated in Texas Since 2000* provides a detailed list of the TCEQ rule provisions that regulate NO<sub>x</sub> and PM emissions .

### **11.6.1 NO<sub>x</sub> Emission Reduction Requirements in the Texas Ozone SIP Revisions**

Texas' SIP revisions from 2000 forward include required NO<sub>x</sub> emission reductions for the following regions: HGB, DFW, Beaumont-Port Arthur, Austin, and Northeast Texas as well as one for East Texas. In addition, the SIP includes the Texas low emission diesel requirements for East and Central Texas in 30 TAC Chapter 114. The rules for control of NO<sub>x</sub> emissions from stationary sources for the Texas ozone SIP are included in Chapter 117. Recent NO<sub>x</sub> control measures adopted in Chapter 117 address a wide range of point and area sources at major and minor sources of NO<sub>x</sub>. Some of these rules implemented the NO<sub>x</sub> reduction requirements of Senate Bill 7, for grandfathered EGUs, as discussed in more detail in Section 11.6.2 The TCEQ has submitted all of the Chapter 117 NO<sub>x</sub> limitations and requirements as well as the Chapter 114 low emission diesel fuel requirements to the EPA as revisions to the Texas SIP.

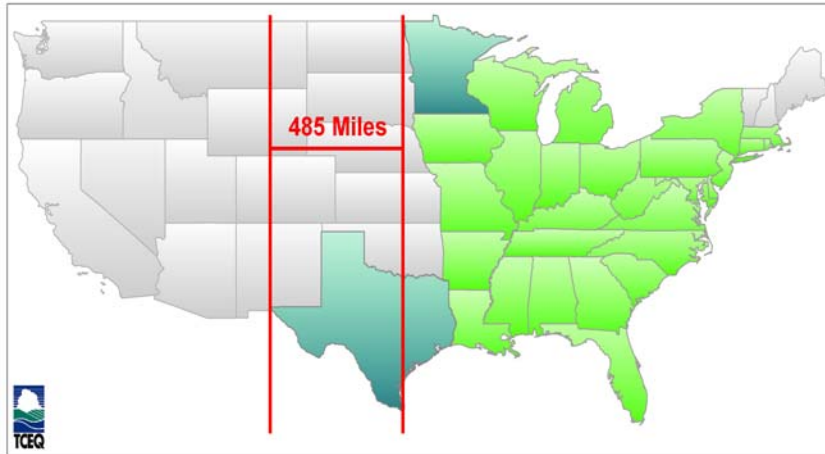
### **11.6.2 SO<sub>2</sub> and NO<sub>x</sub> Reduction Requirements under Senate Bill 7**

Senate Bill 7 required the following emission reductions from grandfathered EGUs: for NO<sub>x</sub>, a 50 percent reduction of the 1997 emission level by May 1, 2003, and for SO<sub>2</sub>, a 25 percent reduction of the 1997 emission level by May 1, 2003, accompanied by an in-state emissions cap and trade program. Grandfathered EGUs are the EGUs built before Texas' BACT emission control requirements for new and modified sources of air pollution went into effect in 1972. These requirements produced reductions approximately a decade before the BART emissions reductions will be effective in states without CAIR requirements. They were effective approximately six and seven years before the Phase I CAIR requirements will be effective in states that implement CAIR NO<sub>x</sub> and SO<sub>2</sub> emission reductions. Phase I of CAIR becomes effective in 2009 for NO<sub>x</sub> and in 2010 for SO<sub>2</sub>. Phase II of CAIR will become effective in 2015, at which time it will become the limiting requirement for SO<sub>2</sub> and NO<sub>x</sub> for most EGUs in Texas. This SIP revision presumes that either CAIR will be finally upheld by the courts or will be replaced with a federal program that achieves comparable reductions in emissions. On December 23, 2008, the U.S. Circuit Court of Appeals for the District of Columbia Circuit issued a decision remanding CAIR to EPA to initiate rulemaking consistent with its opinion, but the court did not vacate CAIR.

### **11.6.3 CAIR Reductions for NO<sub>x</sub> and SO<sub>2</sub>**

On March 10, 2005, the EPA issued the CAIR, requiring reductions in SO<sub>2</sub> and NO<sub>x</sub> emissions from EGUs in 28 states and the District of Columbia (70 FR 25162-25405). These include states in the Northeast, the South, and along the Mississippi River plus Texas, the only largely western state subject to the CAIR emissions reductions requirements. Figure 11-32 shows that the CAIR emissions reductions requirements in Texas apply more than 480 miles west of the areas where

CAIR requirements apply in other states. The map also shows that Texas is the only state where CAIR applies in the next tier of states west of the states that border the Mississippi River.



**Figure 11-32: CAIR Emission Reduction States**

Note: States shown in green have CAIR emission reductions requirements

Source: TCEQ 2007

CAIR applies to SO<sub>2</sub> in all CAIR areas except in Arkansas, Delaware, New Jersey, and New England. In states where CAIR applies to SO<sub>2</sub>, CAIR will reduce SO<sub>2</sub> emission allowances by over 60 percent from 2003 federal acid rain cap levels. In all CAIR states, the program will reduce NO<sub>x</sub> emission allowances by over 60 percent from 2003 federal acid rain cap levels. CAIR establishes an EPA-administered cap-and-trade program for EGUs in which states may participate as a means of meeting these requirements. The Texas Legislature directed the TCEQ to participate in this interstate cap-and-trade system. SO<sub>2</sub> and NO<sub>x</sub> reductions will occur in two phases under a cap-and-trade system established by the EPA. SO<sub>2</sub> emission caps will be lowered in 2010 and again in 2015. NO<sub>x</sub> emission allowables will decrease in 2009 and again in 2015. Table 11-15 shows the emission allowances for EGUs in Texas under the CAIR program.

**Table 11-15: EGU Emission Allowances in Texas under the CAIR Program**

Annual NO <sub>x</sub> Cap (tons)			
State	2003 Acid Rain Emissions Inventory	2009 CAIR Phase I Budget	2015 CAIR Phase II Budget
Texas	211,000	181,014	150,845
Annual SO <sub>2</sub> Cap (tons)			
State	2003 Acid Rain Emissions Inventory	2010 CAIR Phase I Budget	2015 CAIR Phase II Budget
Texas	578,000	320,946	224,662

Source: EPA



The TCEQ has submitted to the EPA as a revision to the Texas SIP its rules that implement the CAIR requirements. The following links provide further information on the CAIR SIP revisions and CAIR requirements for Texas.

The Texas CAIR SIP -

[http://www.tceq.state.tx.us/assets/public/implementation/air/sip/cair-camr/05048CAIRSIP\\_adoption\\_final.pdf](http://www.tceq.state.tx.us/assets/public/implementation/air/sip/cair-camr/05048CAIRSIP_adoption_final.pdf)

The Texas CAIR Rule -

[http://www.tceq.state.tx.us/assets/public/implementation/air/sip/cair-camr/05046101\\_ado\\_clean.pdf](http://www.tceq.state.tx.us/assets/public/implementation/air/sip/cair-camr/05046101_ado_clean.pdf)

The Texas CAIR/CAMR Web Page -

<http://www.tceq.state.tx.us/implementation/air/sip/caircamr.html>

#### **11.6.4 Best Available Retrofit Technology (BART) Requirements**

The commission adopted the final BART Rule (30 TAC Chapter 116, Subchapter M) January 10, 2007. It is available at:

[http://info.sos.state.tx.us/pls/pub/readtac\\$ext.ViewTAC?tac\\_view=5&ti=30&pt=1&ch=116&sc h=M&rl=Y](http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=5&ti=30&pt=1&ch=116&sc h=M&rl=Y).

Because most sources reviewed under the BART rule are a long distance from the nearest Class I federal area, a large percentage fell below the *de minimis* level for impacting all Class I areas, so they did not have to proceed to a BART engineering analysis. Chapter 9: *Best Available Retrofit Technology* details the implementation of the BART program in Texas in Table 9-7.

### 11.6.5 Comparison of the NO<sub>x</sub> Emission Limits for EGUs with CAIR Limits

The following table shows the relationship among the requirements.

**Table 11-16: Texas Electric Generating Utility NO<sub>x</sub> Control Strategies Compared to CAIR**

Facility Type	State Emission Rate Requirements	CAIR 2009	CAIR 2015
Utility Electric Generation in Ozone Nonattainment Areas Emission Specifications for Attainment Demonstrations			
<b>Houston-Galveston-Brazoria</b>	Pounds of NO <sub>x</sub> /MMBtu	Pounds of NO <sub>x</sub> /MMBtu	Pounds of NO <sub>x</sub> /MMBtu
Gas-Fired Utility Boilers	0.030 lb	0.15 lb	0.125 lb
Coal-Fired Utility Boilers	0.050 lb (wall-fired) 0.045 lb (tangential-fired)	0.15 lb	0.125 lb
Oil-Fired Utility Boilers	0.050 lb (wall-fired) 0.045 lb (tangential-fired)	0.15 lb	0.125 lb
Auxiliary Steam Utility Boilers	0.030 lb	0.15 lb	0.125 lb
Stationary Gas Turbines	0.032 lb	0.15 lb	0.125 lb
<b>Dallas-Fort Worth</b>			
Large Utility Boilers	0.033 lb	0.15 lb	0.125 lb
Small Utility Boilers	0.06 lb	0.15 lb	0.125 lb
<b>Beaumont-Port Arthur</b>			
All Utility Boilers	0.10 lb	0.15 lb	0.125 lb
<b>Utility Electric Generation in East and Central Texas</b>			
Gas-Fired Utility Boilers	0.14 lb	0.15 lb	0.125 lb
Coal-Fired Utility Boilers	0.165 lb	0.15 lb	0.125 lb
<b>Senate Bill 7</b>			
East Texas Region Grandfathered Facilities	0.14 lb	0.15 lb	0.125 lb
West Texas and El Paso Region Grandfathered Facilities	0.195 lb	0.15 lb	0.125 lb

Source: TCEQ, current as of February 23, 2007

#### 11.6.6 Sulfur Dioxide Reductions under the EPA Refinery Consent Decrees

The EPA refinery consent decrees cover both SO<sub>2</sub> and NO<sub>x</sub>. The NO<sub>x</sub> reductions are generally company-wide reduction requirements, and the details of which emission points will have reductions and the amount of the reductions are not yet available.

The EPA has provided specifics of the SO<sub>2</sub> reductions by emission point for refineries. In addition, information is available regarding SO<sub>2</sub> emission reductions at a large sulfuric acid plant at the western end of the Houston Ship Channel. The following table combines these SO<sub>2</sub> emission reduction data. The projected growth from 2002 to 2018 are estimates from CENRAP's emission inventory contractor (Pechan 2005). Since the TCEQ's new and modified source permitting requirements prohibit an increase in allowable emissions without a construction permit, which requires use of BACT, the projected emission increases between 2002 and 2018 may be substantially over estimated.

**Table 11-17: Annual SO<sub>2</sub> Emissions at Consent Decree Impacted Sources**

SO <sub>2</sub> Emissions	2002 (tpy)	2018 (tpy)
Pre-decree levels	48,868	62,229
Reduction estimate*	45,453	56,433
Difference (remaining emissions)	3,415	5,796

\*Reductions estimate applied to 2002 actual emissions to show theoretical impact.

Controls will be in place before 2018.

Source: EPA 1999

#### 11.6.7 Texas Low Emissions Diesel (TxLED) Program

The goal of the TxLED program is to lower emissions of NO<sub>x</sub> and other pollutants from diesel-powered motor vehicles and non-road equipment. It applies to diesel fuel producers, importers, common carriers, distributors, transporters, bulk terminal operators, and retailers. The rules cover 110 counties in eastern Texas, including the ozone nonattainment areas of Beaumont-Port Arthur, DFW, and HGB. The rules require that diesel fuel as defined under 30 TAC §114.6 produced for delivery and ultimate sale to the consumer for both on- and non-road use must contain less than 10 percent by volume of aromatic hydrocarbons and have a cetane number of 48 or greater. The rules, which took effect October 1, 2005, allow some compliance options (30 TAC 114, Subchapter A, §114.6 and Subchapter H, Division 2, §§114.312 - 114.319).

#### 11.6.8 The Texas Emission Reduction Plan (TERP)

TERP is a comprehensive set of incentive programs aimed at improving air quality in Texas. The TCEQ administers TERP grants and other TERP financial incentives. The Texas Legislature established the TERP in 2001 through enactment of Senate Bill 5. The TERP includes a number of voluntary financial incentive programs, as well as other assistance programs, to help improve the air quality in Texas. The goals of the TERP are to:

- assure that the air in this state is safe to breathe and meets minimum federal standards established under the FCAA (42 USC §7407);
- develop multi-pollutant approaches to solving the state's environmental problems; and
- adequately fund research and development that will make the state a leader in new technologies that can solve its environmental problems while creating new business and industry in the state.

The primary objective of the TERP has been to reduce NO<sub>x</sub> emissions to aid in attaining the NAAQS for ozone. By encouraging replacement of older on-road and non-road engines with newer engines, the TERP has also decreased fine PM emissions from the motor vehicles and equipment using these engines. As of January 2007, the TCEQ had approved over \$406 million in grants under the TERP since the program started in 2001.

The Texas Legislature approved over \$143 million for fiscal year 2008 and \$146 million for fiscal year 2009 to increase TERP grants aimed at NO<sub>x</sub> emission reductions in Texas. The program also reduces fine PM emissions by accelerating the replacement of older diesel engines with newer engines that have much lower PM emission rates.

## **CHAPTER 12. COMPREHENSIVE PERIODIC IMPLEMENTATION PLAN REVISIONS AND ADEQUACY OF THE EXISTING PLAN**

Title 40 CFR §51.308(f) requires states to revise and submit to the EPA a comprehensive regional haze implementation plan revision every 10 years until 2064. In addition, 40 CFR §51.308(g) requires periodic reports in the form of a SIP revision that evaluates progress towards the reasonable progress goals established for each Class I area. In accordance with the requirements, the TCEQ plans to submit a report to the EPA on reasonable progress every five years following the initial submittal of the Regional Haze SIP. The report will be in the form of a SIP revision and will evaluate the progress made towards the reasonable progress goal for each Class I area located within Texas, and in each Class I area located outside of Texas that may be affected by emissions from within Texas. The TCEQ will consult with the Federal Land Managers during the SIP revision development process. All requirements listed in 40 CFR §51.308(g) will be addressed in the SIP revision for demonstrating reasonable progress.

Depending on the findings of its five-year progress report, the TCEQ will examine the actions listed in 40 CFR §51.308(h). The findings of the five-year progress report may determine which action the state may choose as appropriate.

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Due to the public interest in Appendix 10, only this appendix will be directly attached to this Regional Haze SIP. Appendix 10-4 has a large spreadsheet that is not easily printed and will be available on line with all the other appendices.

All appendices are available on the web site  
<[http://www.tceq.state.tx.us/implementation/air/sip/bart/haze\\_appendices.html](http://www.tceq.state.tx.us/implementation/air/sip/bart/haze_appendices.html)>.  
If you have problems accessing, please contact:

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Texas Commission on Environmental Quality  
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Austin, TX 78752  
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**Appendix 10-1: Analysis of Control Strategies And  
Determination of Reasonable Progress Goals**

## APPENDIX 10-1: ANALYSIS OF CONTROL STRATEGIES AND DETERMINATION OF REASONABLE PROGRESS GOALS

### 10-1.1 IDENTIFICATION OF KEY POLLUTANTS

Chapter 11: *Long-Term Strategy to Reach Reasonable Progress Goals* demonstrates that NO<sub>x</sub> and SO<sub>2</sub> are the main anthropogenic pollutant emissions that affect visibility at Class I areas in Texas and in neighboring states. Table 1 summarizes the percentage contribution of various pollutants at the Texas Class I areas and those Class I areas in other states that PSAT modeling indicates receive more than 20 percent of their visibility impairing haze from Texas emissions in the 2002 base case modeling.

**Table 1: Pollutant Impacts on Visibility at the Class I Areas with a 20 Percent or Greater Impact from Texas Emissions**

Source	BIBE*	GUMO*	WIMO*	SACR*	WHIT*
SO <sub>4</sub>	49.7	57.7	54.7	43.2	52.9
NO <sub>3</sub>	4.4	10.2	22.5	26.1	14.7
POA	16.4	6.1	6.2	8.2	7.1
EC	9.1	6.6	5.3	7.4	7.4
Soil	6.7	6.8	4.6	6.0	6.8
CM	7.1	4.0	3.8	2.9	1.8
SOAA	1.9	2.7	1.4	2.2	3.4
SOAB	4.6	5.8	1.5	4.1	5.9

\* Big Bend, Guadalupe Mountains, Wichita Mountains, Salt Creek, and White Mountain areas

As the table indicates, sulfur dioxide (SO<sub>2</sub>) emissions, which form sulfate (SO<sub>4</sub>), are clearly the most important contributor to visibility impairment at these Texas-impacted Class I areas. In every case except for Big Bend, nitrate (NO<sub>3</sub>), which forms from NO<sub>x</sub> emissions is the second most important pollutant.

The situation at Big Bend is less clear, as shown in Table 2 shows.

**Table 2: Source Categories Contributing to Regional Haze at Big Bend National Park**

Source	Elevated Point	Low Level Point	Natural	On Road	Non Road	Area	IC	BC	SOAA	SOAB	total
SO <sub>4</sub>	32.0	1.3	0.0	0.5	0.8	3.4	0.0	11.5			49.7
NO <sub>3</sub>	1.1	0.1	0.7	0.8	0.5	0.6	0.0	0.6			4.4
POA	0.3	0.0	0.2	0.1	0.3	2.5	0.0	13.0			16.4
EC	0.0	0.0	0.1	0.4	1.4	1.9	0.0	5.2			9.1
SOIL	0.7	0.1	3.0	0.0	0.0	2.7	0.0	0.3			6.7
CM	0.0	0.0	5.6	0.0	0.1	1.2	0.0	0.2			7.1
SOAA									1.9		1.9
SOAB										4.6	4.6

After sulfur, Primary Organic Aerosols (POA) constitutes the next biggest source of impairment at Big Bend; however, the vast majority of POA is from the model's boundary conditions (BC), which include southern Mexico and Central and South America. Therefore, this source is not controllable by Texas. Elemental carbon (EC) is also dominated by the boundary conditions. The next two sources, soil and coarse mass (CM), are most likely from natural dust storm events. For these reasons, even at Big Bend, NO<sub>3</sub> becomes the second most important pollutant for Texas to consider in its regional haze SIP.

#### **10-1.2 IDENTIFICATION OF SOURCES FOR CONTROL**

Once the main types of pollutants affecting visibility in Texas-impacted Class I areas have been determined, the next step is to determine what kinds of sources emit these pollutants. That is, should the control strategy focus on point sources only or should area sources and mobile sources be considered as well? Table 3 shows the sources of these pollutants in the 2002 base case PSAT modeling for the two Class I areas in Texas. The numbers are in percentages. For example, 67.1 percent of the SO<sub>4</sub> impacting Big Bend can be attributed to point sources.

**Table 3: Source Category Contributions to SO<sub>4</sub> and NO<sub>3</sub> at the Five Class I Areas Texas Affects the Most (by percent)**

	Big Bend			Guadalupe Mountains		
	Point	Mobile	Area	Point	Mobile	Area
SO <sub>4</sub>	67.1	2.8	6.9	75.6	3.5	8.5
NO <sub>3</sub>	26.6	28.6	14.3	29.2	36.5	13.9

	Wichita Mountains			Salt Creek			White Mountain		
	Point	Mobile	Area	Point	Mobile	Area	Point	Mobile	Area
SO <sub>4</sub>	78.2	3.7	9.2	73.8	3.9	8.1	75.2	4.1	8.1
NO <sub>3</sub>	28.1	44.7	13.4	35.8	29.9	17.1	27.9	40.3	12.0

As Table 3 shows, sulfur emissions affecting visibility in the Class I areas are clearly dominated by point sources. The mobile source contribution will be reduced as much as feasible through federal fuel sulfur rules already on the books. As for area source sulfur, the TCEQ has significant concerns about the emissions inventory accuracy. For example, the CENRAP inventory for area source sulfur compound emissions is more than seven times higher than the TCEQ estimate for that category. For this reason, our control strategy analysis will focus on point sources of sulfur compounds.

Nitrogen oxide emissions are more evenly distributed among point, mobile, and area sources. As described in Chapters 10 and 11, Texas is already going well beyond the federal requirements to reduce both on-road and non-road mobile emissions. Furthermore, the states have very limited authority to reduce mobile source emissions. Control of mobile source NO<sub>x</sub> emissions is principally a federal responsibility. Area source NO<sub>x</sub> is of concern to Texas both for our ozone SIP and for the Regional Haze SIP. The biggest source of area source NO<sub>x</sub> is upstream oil and gas production. The TCEQ is taking all steps it has determined are reasonable at this time to control these sources in the Dallas-Fort Worth ozone SIP. In addition, the State of Texas is investing \$4,000,000 in a grant program to assist with the retrofitting of gas-fired, rich burn compressor engines<sup>1</sup>. The TCEQ will continue its research analysis of emissions from oil and gas production. We will re-examine these sources in the five-year update of the Regional Haze SIP. By that time, we expect to have much improved information on the inventory and the economic and technical feasibility of additional controls. Given these considerations, the TCEQ decided to focus on point sources of NO<sub>x</sub> when considering additional controls to improve visibility at Class I areas. It is important to note that Texas has already implemented substantial controls on point source NO<sub>x</sub> as part of its ozone SIPs. These are described in more detail in Chapter 11: Long Term Strategy.

### **10-1.3 SELECTION OF SOURCES FOR POSSIBLE ADDITIONAL CONTROLS**

Having narrowed the scope of the review to point sources of SO<sub>2</sub> and NO<sub>x</sub>, the next step is to develop a high-level estimate of the costs and reductions associated with a set of potentially reasonable additional controls to reduce regional haze. The TCEQ developed a set of possible controls focusing on sources that had the potential to affect visibility at Class I areas and that had the least costly available controls on a cost per ton basis. The CENRAP conducted a large-scale study of control options using the EPA's AirControlNet Model. This study served as the basis for the Texas analysis.

<sup>1</sup> <http://www.tceq.state.tx.us/implementation/air/sip/sb2003.html>

The CENRAP used the latest revised version of the U.S. EPA's AirControlNet model to analyze potential add-on control device strategies for appropriate emissions generating units (Alpine 2007). AirControlNet is a PC-based database tool for conducting pollutant emissions control strategy and cost analysis. The study overlaid a detailed EPA control measure database on CENRAP's emissions inventories to compute source- and pollutant-specific emission reductions and associated costs at various geographic levels. For Texas, the 2002 Texas point source emissions inventory was the basis for the analysis.

The potential strategies, estimated capital costs, and costs per ton reduced were summarized and distributed to each of the CENRAP states. In many cases more than one strategy was proposed for a type of unit. In these cases, the least costly control, on a dollar per ton cost basis, was assumed to be implemented first, with the incremental cost of adding the additional strategy included. In addition to the CENRAP proposed controls, TCEQ added flue gas desulfurization as a potential control for nine units at three carbon black plants.

The best candidate sources for proposed control strategies were identified with a two step process. First, sources with potential control strategy costs greater than \$2,700 per ton SO<sub>2</sub> for NO<sub>x</sub> were initially screened out to limit the population to potential sources with relatively cost effective control strategies. The group of sources was further reduced to eliminate sources that are so distant from any of the ten Class I areas that any reduction in emissions would be unlikely to have a perceptible impact on visibility. The list was restricted to those sources with a ratio of estimated projected 2018 base annual emissions (tons) to distance (kilometers) greater than five to any Class I area. Also, any source with predicted 2018 emissions less than 100 tons per year was excluded. The regulatory and logistical overhead associated with controlling these small sources would not be justified by the likely benefit.

The TCEQ also excluded additional NO<sub>x</sub> controls on cement kilns from consideration since the TCEQ has already required all the measures it has determined are reasonable to control NO<sub>x</sub> emissions from these sources in the latest Dallas-Fort Worth ozone SIP revision. A study performed for the SIP (July 2006, a report entitled "Assessment of NO<sub>x</sub> Emissions Reduction Strategies for Cement Kilns") evaluated the applicability, availability and cost effectiveness of potential NO<sub>x</sub> control technologies for the ten cement kilns located at three Ellis County sites. The report focused on selective catalytic reduction (SCR), selective non-catalytic reduction (SNCR), and low temperature oxidation (LoTOx). Based on the results of the study, the TCEQ conducted modeling sensitivity analyses at two levels of control to evaluate potential ozone reduction benefits from possible cement kiln control strategies. One modeling sensitivity assumed a range of 35 to 50 percent NO<sub>x</sub> control on cement kilns depending upon kiln type; the second assumed a range of 80 to 85 percent. After reviewing the report of the kiln study, the modeling sensitivity results, and all other available information, the TCEQ determined that the 35 to 50 percent control range was the most appropriate control level. The TCEQ develop a source cap that will require a reduction of approximately 9.69 tpd of NO<sub>x</sub> emissions from the cement kilns in Ellis County starting March 2009. The source cap approach does not require a specific technology, but provides flexibility for kiln operators to comply in the most effective, technically sound, and expeditious manner possible, while forcing sizeable NO<sub>x</sub> emission reductions from all cement kilns in the area. In most cases, the commission anticipates that the limitations will be attainable with SNCR and will not require costly and time consuming research and development of other technologies. Pilot testing of SNCR on wet and dry kilns in 2006 demonstrated that 30 to 40 percent reductions were achievable without hazardous by-product formation. Finally, before an increase in NO<sub>x</sub> emissions from a change in operation from one unit of the installation



of new kiln could occur, a corresponding and equivalent decrease in NO<sub>x</sub> emissions would be required from another existing unit.

This analysis relied on the CENRAP estimates of control costs and feasibility. The costs presented in this study are estimates based on categories of units. A site-specific analysis would be necessary to determine actual costs and whether a particular control device is not feasible at a particular unit due to physical or process constraints.

#### 10-1.4 PROPOSED CONTROLS

The types of industry and controls considered are listed below. These controls would go beyond what is already expected due to the Clean Air Interstate Rule (CAIR), BART controls planned for ozone SIPs.

- SO<sub>2</sub> control at 24 facilities from 15 sites
  - Natural Gas Transmission - flue gas desulfurization (FGD)
  - Crude Petroleum - Sulfur recovery and/or tail gas treatment
  - Inorganic chemical plants - coal washing and spray dryer absorber (SDA) on boilers, increase efficiency of sulfuric acid plants
  - Electric Generating Units (EGU) - coal washing and FGD wet scrubbing
  - Carbon black – FGD
- NO<sub>x</sub> control for 24 facilities at 15 sites
  - Natural Gas Transmission- Low NO<sub>x</sub> burners (LNB), SCR + LNB
  - EGU - LNB with close coupled over-fired air (LNC1), and with both close-coupled and separated over-fired air (LNC3)
  - Flat Glass - LNB, SCR
  - Paper Mills SNCR and oxygen trim (OT) with water injection
  - Chemical Plant Boiler - selective catalytic reduction (SCR)

Tables 6 through 10 provide details on the sources, costs, and control results expected from the set of point source controls considered to determine whether they are reasonable. Table 4 below summarizes the cost and emissions reductions expected from this analysis. Table 5 provides the estimated visibility improvement for each Class I. The basis for this estimate is provided in Appendix 10-2.

**Table 4: Summary of Additional Point Source Controls Considered for Reasonableness**

<b>Pollutant</b>	<b>Tons Per Year Reduced</b>	<b>Estimated Annualized Cost (\$2005)</b>
Sulfur Dioxide	155,873	\$270,800,000
Nitrogen Oxides	27,132	\$53,500,000
Total Costs		\$324,300,000

**Table 5: Estimated Haze Index Improvements for Affected Class I Areas From Additional Controls**

<b>Class 1</b>	<b>Big Bend</b>	<b>Breton Isle</b>	<b>Caney Creek</b>	<b>Carlsbad Caverns</b>	<b>Guadalupe Mountains</b>
HI Improvement (deciview)	0.16	0.05	0.33	0.22	0.22
<b>Class 1</b>	<b>Salt Creek</b>	<b>Upper Buffalo</b>	<b>Wheeler Peak</b>	<b>White Mountain</b>	<b>Wichita Mountains</b>
HI Improvement (dv)	0.18	0.16	0.04	0.24	0.36

As explained in Chapter 10, the TCEQ has determined that it is not reasonable to pursue additional controls at this time. The control set defined in this appendix yielded too little benefit for the cost.

#### **10-1.5 Area of Influence Determination**

To determine Texas' apportioned contribution to measured 2002 and predicted 2018 visibility extinction and impact of proposed controls, the area of influence (AOI) curves developed for CENRAP were used as a starting point. Working at CENRAP's direction, Alpine Geophysics (Alpine, 2006) used Residence Time Difference plots (DRI, 2005c), the Probability of Regional Source Contribution to Haze (PORSCH) plots (Raffuse *et al.*, 2005), the Tagged Species Source Apportionment (TSSA) results (Tonnesen and Wang, 2004; UCR, 2006), and engineering judgment to construct a consistent set of AOIs for each area.

The Residence Time Difference (RTD) plots are based on the Back Trajectory Residence Time (BTRT) plots. Back trajectory analyses use meteorological fields to estimate the geographical path an air mass traversed to end at a particular receptor. The Desert Research Institute (DRI) (2005b) developed the BTRT estimates used in this study by employing the NOAA HYSPLIT back trajectory model (Draxler and Hess, 1997; NOAA, 2006). BTRT plots give the fraction of total hours that an air parcel resided over each specific geographical area. The RTD plots for each pollutant come from by subtracting the map for all days at a site from the map for the 20 percent worst days for the respective pollutant. This process produced RTD plots for the twenty percentile worst sulfate, nitrate, organic carbon, elemental carbon, fine soil, and coarse mass days for each area CENRAP considered. The RTD maps show the areas that air was over more frequently (positive numbers) on worst case days compared to all days.

The PORSCH system is a suite of GIS tools that combines modeled backward wind trajectories, monitored concentrations, meteorological conditions, and emissions estimates to estimate probable regions of influence. PORSCH combines ensemble backward trajectories with chemically speciated emissions data to estimate the trajectory-emissions density-weighted area that is likely to affect a receptor site. PORSCH can do this for a single day or a suite of days. This study used only data relevant to the 20 percent worst haze days.

As the name implies Tagged Species Source Apportionment (TSSA) uses "Tagged Chemical Species," or tracers, to track chemical transformations and transport of each chemical species or

precursor species during an air quality model run. Key chemical species are identified. These tagged chemical species for specific emissions source regions and source categories are tracked during all phases of the air quality modeling run. The end results show the sources contributing to the final chemical species for any grid cell in model domain.

Because RTD plots were available for the entire suite of twenty-one areas, they served as the primary basis from which Alpine produced the AOIs. Alpine examined the RTD plots for each area and each pollutant to identify “break points” between the most significant and lower level areas of influence contributing to the high concentrations of each pollutant. Alpine examined the PORSCH and TSSA results to refine the area of influence contours. Alpine then compared the Level 1 areas of influence for the different pollutants for each area and for nearby areas to determine whether the Level 1 areas of influence could be combined for pollutants and for nearby areas. Alpine repeated the process for Level 2 and further level AOIs. This process produced the AOIs the TCEQ has used in developing the list of sources and four-factor analysis used to determine whether additional controls on Texas sources are reasonable to reduce the visibility impact of Texas’ emissions on each area they affect.

The TCEQ used the second order of influence for ten Class I areas within Texas and adjoining states to define the geographic area of concern for significant NO<sub>x</sub> and SO<sub>2</sub> emitting sources. The Class I areas considered were Caney Creek, Carlsbad Caverns, Big Bend, Guadalupe Mountains, Salt Creek, Upper Buffalo, Wheeler Peak, White Mountain, and Wichita Mountains. The population of sources determined from the entire state was apportioned to each Class I based on these curves. This list of sources for each Class I area was sent to appropriate state as part of the consultation process. This correspondence and lists of sources are in Appendix 4-3.

**Table 6: Proposed SO<sub>2</sub> Controls Based on CENRAP Modeling**

Acct No	FIN	Source Type for Control	Control Measure	2018 Base Case SO <sub>2</sub> -- Tons	Cntrl -- Tons Reduced	Cntrl -- CE (%)	Controls -- Annualized Cost (\$2005)	Controls - Cost Per Total Ton Reduced	Qbase /5d
BG0057U	BOILER1	Utility Boilers - Coal-Fired	Coal Washing	10,836	3,793	35	\$1,824,685	\$481	4.93
BG0057U	BOILER1	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	10,836	9724	90	\$25,000,104	\$2,564	4.93
BG0057U	BOILER2	Utility Boilers - Coal-Fired	Coal Washing	10,658	3,730	35	\$1,794,818	\$481	4.85
BG0057U	BOILER2	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	10,658	9,593	90	\$25,000,104	\$2,606	4.85
CG0012C	INCIN	Tail Gas Incinerator	FGD	1,328	1,195	90	\$1,703,960	\$1,425	2.00
FI0020W	B1	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	23,142	20,828	90	\$32,766,310	\$1,573	13.77
FI0020W	B2	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	23,641	21,277	90	\$32,766,310	\$1,540	14.07
GF0002R	B-1	Utility Boilers - Coal-Fired	Coal Washing	16,096	5,634	35	\$2,710,461	\$481	5.82
GF0002R	B-1	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	16,096	14,486	90	\$36,014,449	\$2,486	5.82
GH0004O	BLR0009A01	Bituminous/Sub-bituminous Coal (Industrial Boilers)	SDA	1,960	1,764	90	\$4,687,674	\$2,658	1.76
GH0004O	BLR0010A01	Utility Boilers - Coal-Fired	Coal Washing	1,160	406	35	\$195,408	\$481	1.04
HG0659W	H600	Cat Cracker Heater	FGD	5,491	4,942	90	\$8,474,217	\$1,715	2.09

Acct No	FIN	Source Type for Control	Control Measure	2018 Base Case SO2 -- Tons	Cntrl -- Tons Reduced	Cntrl -- CE (%)	Controls -- Annualized Cost (\$2005)	Controls - - Cost Per Total Ton Reduced	Qbase /5d
HG0697O	PIR-2	Sulfuric Acid Plants - Contact Absorber (98% Conversion)	Increase % Conversion to Meet NSPS (99.7)	4,101	3,486	85	\$670,008	\$192	1.55
HG0697O	U-8	Sulfuric Acid Plants - Contact Absorber (98% Conversion)	Increase % Conversion to Meet NSPS (99.7)	7,005	5,954	85	\$2,510,927	\$422	2.65
HR0018T	H-8*	Sulfur Plant Incinerator	FGD	3,590	3,231	90	\$6,865,014	\$2,124	3.60
RF0009N	INCIN-COMB	Incinerator	FGD	4,059	3,653	90	\$8,153,168	\$2,232	5.25
TF0013B	B1	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	19,144	17,230	90	\$32,196,462	\$1,869	23.06
TF0013B	B2	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	19,695	17,725	90	\$32,196,462	\$1,816	23.73

\*Unit Planned Shutdown March 2007

**Table 7: Location and Program Status Details For Emission Units With CENRAP Proposed SO<sub>2</sub> Controls**

County	Acct No	Company	Plant Name	FIN	BART	CAIR	Industrial Code Description	Nearest Area	Distance (km)
Bexar	BG0057U	CPS	SOMMERS DEELY SPRUCE PWR	BOILER1	No	Yes	Electric Services	Big Bend	440
Bexar	BG0057U	CPS	SOMMERS DEELY SPRUCE PWR	BOILER2	No	Yes	Electric Services	Big Bend	440
Cass	CG0012C	Enbridge	BRYANS MILL PLANT	INCIN	No	No	Nat'l Gas Liq	Caney Creek	133
Freestone	FI0020W	TXU	BIG BROWN	B1	No	Yes	Electric Services	Caney Creek	336
Freestone	FI0020W	TXU	BIG BROWN	B2	No	Yes	Electric Services	Caney Creek	336
Goliad	GF0002R	AEP	COLETO CREEK PLANT	B-1	No	Yes	Electric Services	Big Bend	553
Gray	GH0004O	Celanese	CHEMICAL MANUFACTURING	BLR0009A01	Yes	No	Industrial Organic Chemicals	Wichita Mtns	222
Gray	GH0004O	Celanese	CHEMICAL MANUFACTURING	BLR0010A01	Yes	No	Industrial Organic Chemicals	Wichita Mtns	222
Harris	HG0659W	Shell	DEER PARK PLANT	H600	Yes	No	Petroleum Refining	Caney Creek	526
Harris	HG0697O	Rhodia	HOUSTON PLANT	PIR-2	Yes	No	Industrial Inorganic Chemicals	Caney Creek	529
Harris	HG0697O	Rhodia	HOUSTON PLANT	U-8	Yes	No	Industrial Inorganic Chemicals	Caney Creek	529
Hopkins	HR0018T	Valence	COMO PLT	H-8	No*	No	Nat'l Gas Liq	Caney Creek	199
Reeves	RF0009N	El Paso Nat'l Gas	WAHA PLANT	INCIN-COMB	No	No	Natural Gas Transmission	Carlsbad	155
Titus	TF0013B	TXU	MONTICELLO STM ELE STN	B1	No	Yes	Electric Services	Caney Creek	166
Titus	TF0013B	TXU	MONTICELLO STM ELE STN	B2	No	Yes	Electric Services	Caney Creek	166

\* site was exempted for BART

**Table 8: Proposed SO<sub>2</sub> Control For Carbon Black Units**

County	Acct No.	Company	Site	FIN	BART	Description	2018 Base Case SO <sub>2</sub> (tons)	Control Measure	Cntrl CE (%)	Cntrl – Tons Reduced	dist. (km)	Nearest	Qbase/ 5d
Howard	HT0027B	Sid Richard- son	BIG SPRING	PR1002	No	MAIN PROCESS VENT,CO BOILER, and INCINERATION	3,890	FGD	80	3,112	295	Carlsbad	2.6
Howard	HT0027B	Sid Richard- son	BIG SPRING	DRYER22	No	PELLET DRYER	1,454	FGD	80	1,163	295	Carlsbad	1.0
Howard	HT0027B	Sid Richard- son	BIG SPRING	PR1004	No	MAIN PROCESS VENT,CO BOILER, INCINERATION	3,890	FGD	80	3,112	295	Carlsbad	2.6
Howard	HT0027B	Sid Richard- son	BIG SPRING	DRY1006	Yes	PELLET DRYER	1,790	FGD	80	1,432	295	Carlsbad	1.2
Howard	HT0027B	Sid Richard- son	BIG SPRING	DRYER24	No	PELLET DRYER	1,454	FGD	80	1,163	295	Carlsbad	1.0
Howard	HT0027B	Sid Richard- son	BIG SPRING	DRYER23	No	PELLET DRYER	1,454	FGD	80	1,163	295	Carlsbad	1.0
Howard	HT0027B	Sid Richard- son	BIG SPRING	PR1007	Yes	MAIN PROCESS VENT,CO BOILER, and INCINERATION	3,890	FGD	80	3,112	295	Carlsbad	2.6
Hutchin- son	HW0017R	Sid Richard- son	BORGER	B119N	No	INDUSTRIAL NATURAL GAS 10- 100MMBTU/HR	4,262	FGD	80	3,410	238	Wichita Mtns	3.6
Orange	OC0020R	Degussa	ECHO	I-1	No	MAIN PROCESS VENT,CO BOILER, and INCINERATION	3,354	FGD	80	2,683	430	Breton Isle	1.6
Total										20,350			

**Table 9: Proposed NO<sub>x</sub> Controls Based on CENRAP Modeling**

Account	Plant Name	FIN	Source Type for Control	Control Measure	2018 Base Case NO <sub>x</sub> (Tons)	Control -- Tons Reduced	Controls - - CE (%)	Controls -- Annualized Cost (\$2005)	Control -- Cost Per Ton Reduced	Qbase/ 5d
BG0057U	SOMMERS DEELY SPRUCE PWR	P-5	Utility Boiler - Coal/Tangential	LNC1	2,431	1,052	43.3	\$813,312	\$773	1.11
BG0057U	SOMMERS DEELY SPRUCE PWR	P-5	Utility Boiler - Coal/Tangential	LNC3	2,431	1,417	58.3	\$1,400,066	\$988	1.11
CG0010G	TEXARKANA MILL	PB02	ICI Boilers - Wood/Bark/Stoker - Large	SNCR - Urea Based	824	453	55	\$907,290	\$2,001	1.33
CG0010G	TEXARKANA MILL	RB02	Sulfate Pulping - Recovery Furnaces	OT + WI	822	535	65	\$368,011	\$689	1.32
C20005I	GUADALUPE COMPRESSOR STATION	C-1	Combustion Turbines - Natural Gas	Dry Low NO <sub>x</sub> Combustor	850	714	84	\$153,587	\$215	26.34
C20005I	GUADALUPE COMPRESSOR STATION	C-1	Combustion Turbines - Natural Gas	SCR + LNB	850	799	94	\$1,031,230	\$1,291	26.34
FC0018G	FAYETTE POWER PROJECT	3-1B	Utility Boiler - Coal/Tangential - POD10	LNC3	2,764	843	58.3	\$1,049,562	\$1,245	1.00
FI0020W	BIG BROWN	B1	Utility Boiler - Coal/Tangential	LNC3	3,574	593	58.3	\$1,518,941	\$2,560	2.13
FI0020W	BIG BROWN	B2	Utility Boiler - Coal/Tangential	LNC3	3,725	618	58.3	\$1,518,941	\$2,456	2.22
GH0003Q	PAMPA PLANT	P-1KATUINC	Indust. Incinerators	SNCR	1,230	553	45	\$1,345,248	\$2,431	1.11
GH0004O	CHEMICAL MANUFACTUR	BLR0009A01	ICI Boilers - Coal/Wall	SNCR	1,277	511	40	\$923,371	\$1,807	1.15
GH0004O	CHEMICAL MANUFACTUR	BLR0009A01	ICI Boilers - Coal/Wall	SCR	1,277	1,150	90	\$2,646,447	\$2,302	1.15



Account	Plant Name	FIN	Source Type for Control	Control Measure	2018 Base Case NOx (Tons)	Control -- Tons Reduced	Controls - - CE (%)	Controls -- Annualized Cost (\$2005)	Control -- Cost Per Ton Reduced	Qbase/ 5d
LB0047N	TOLK STATION	UNIT 1	Utility Boiler - Coal/Tangential	LNC3	2,698	823	58.3	\$1,426,484	\$1,733	3.03
LB0047N	TOLK STATION	UNIT 2	Utility Boiler - Coal/Tangential - POD10	LNC3	2,510	766	58.3	\$1,426,484	\$1,863	2.82
LI0027L	RELIANT ENERGY LIMESTONE	1	Utility Boiler - Coal/Tangential - POD10	LNC3	5,703	1,739	58.3	\$2,208,408	\$1,270	2.97
LI0027L	RELIANT ENERGY LIMESTONE	2	Utility Boiler - Coal/Tangential - POD10	LNC3	5,117	1,561	58.3	\$2,023,493	\$1,297	2.67
MM0023J	SANDOW STEAM ELECTRIC	S4MB	Utility Boiler - Coal/Tangential - POD10	LNC3	5,509	914	58.3	\$1,439,691	\$1,574	2.27
NB0014R	GUARDIAN INDUSTRIES	01002	Flat Glass Manufacturing	LNB	2,796	1,118	40	\$1,684,527	\$1,506	1.67
NB0014R	GUARDIAN INDUSTRIES	01002	Flat Glass Manufacturing	SCR	2,796	2,097	75	\$3,203,608	\$1,528	1.67
PG0041R	HARRINGTON STATION	UNIT 1	Utility Boiler - Coal/Tangential	LNC3	1,779	543	58.3	\$876,960	\$1,616	1.28
PG0041R	HARRINGTON STATION	UNIT 2	Utility Boiler - Coal/Tangential	LNC3	1,912	583	58.3	\$902,072	\$1,547	1.38
PG0041R	HARRINGTON STATION	UNIT 3	Utility Boiler - Coal/Tangential	LNC3	1,845	563	58.3	\$902,072	\$1,603	1.33
RL0020K	MARTIN LAKE	U1-B1	Utility Boiler - Coal/Tangential	LNC3	8,516	1,414	58.3	\$1,981,227	\$1,401	7.12
RL0020K	MARTIN LAKE	U2-B2	Utility Boiler - Coal/Tangential	LNC3	5,251	872	58.3	\$1,981,227	\$2,273	4.39
RL0020K	MARTIN LAKE	U3-B3	Utility Boiler - Coal/Tangential	LNC3	5,105	847	58.3	\$1,981,227	\$2,338	4.26

Account	Plant Name	FIN	Source Type for Control	Control Measure	2018 Base Case NOx (Tons)	Control -- Tons Reduced	Controls - - CE (%)	Controls -- Annualized Cost (\$2005)	Control -- Cost Per Ton Reduced	Qbase/ 5d
TF0013B	MONTICELLO	B2	Utility Boiler - Coal/Tangential	LNC3	4,553	756	58.3	\$1,492,524	\$1,975	5.48
WH0040R	WORKS NO 4	STA-22	Flat Glass Manufacturing	LNB	4,733	1,893	40	\$2,851,572	\$1,506	11.84
WH0040R	WORKS NO 4	STA-22	Flat Glass Manufacturing	SCR	4,733	3,550	75	\$5,423,079	\$1,528	11.84
WH0040R	WORKS NO 4	STA-23	Flat Glass Manufacturing	LNB	4,192	1,677	40	\$2,525,375	\$1,506	10.49
WH0040R	WORKS NO 4	STA-23	Flat Glass Manufacturing	SCR	4,192	3,144	75	\$4,802,723	\$1,528	10.49
				Totals				\$ 54,267,839		

**Table 10: Location and Program Status Details For Emission Units With Proposed NO<sub>x</sub> Controls**

County	Account	Company	Plant Name	FIN	BART	CAIR	Industrial Code Description	Nearest Area	Distance (km)
Bexar	BG0057U	CPS	SOMMERS DEELY SPRUCE PWR	P-5	No	Yes	Electric Services	Big Bend	440
Cass	CG0010G	IP	TEXARKANA MILL	PB02	Yes	No	Paper Mills	Caney Creek	124
Cass	CG0010G	IP	TEXARKANA MILL	RB02	Yes	No	Paper Mills	Caney Creek	124
Culberson	C20005I	EL PASO NATRL GAS	GUADALUPE COMPRESSOR STATION	C-1	No	No	Natural Gas Transmission	Guadalupe Mtns	6
Fayette	FC0018G	LCRA - Seymour	FAYETTE POWER PROJECT	3-1B	No	Yes	Electric Services	Caney Creek	554
Freestone	FI0020W	TXU	BIG BROWN	B1	No	Yes	Electric Services	Caney Creek	336
Freestone	FI0020W	TXU	BIG BROWN	B2	No	Yes	Electric Services	Caney Creek	336
Gray	GH0003Q	Cabot	PAMPA PLANT	P-1KATUINC	Yes	No	Carbon Black	Wichita Mtns	221
Gray	GH0004O	CELANESE	CHEMICAL MANUFACTURING	BLR0009A01	No	No	Industrial Organic Chemicals, NEC	Wichita Mtns	222
Lamb	LB0047N	XCEL	TOLK STATION	UNIT 1	No	Yes	Electric Services	Salt Creek	178
Lamb	LB0047N	XCEL	TOLK STATION	UNIT 2	No	Yes	Electric Services	Salt Creek	178
Limestone	LI0027L	Limestone	RELIANT ENERGY LIMESTONE	1	No	Yes	Electric Services	Caney Creek	384
Limestone	LI0027L	Limestone	RELIANT ENERGY LIMESTONE	2	No	Yes	Electric Services	Caney Creek	384

County	Account	Company	Plant Name	FIN	BART	CAIR	Industrial Code Description	Nearest Area	Distance (km)
Milam	MM0023J	TXU	SANDOW STEAM ELECTRIC	S4MB	No	Yes	Electric Services	Wichita Mtns	485
Navarro	NB0014R	GUARDIAN	GUARDIAN INDUSTRIES	01002	No	No	Flat Glass	Caney Creek	334
Potter	PG0041R	XCEL	HARRINGTON STATION	UNIT 1	No	Yes	Electric Services	Wichita Mtns	278
Potter	PG0041R	XCEL	HARRINGTON STATION	UNIT 2	No	Yes	Electric Services	Wichita Mountains	278
Potter	PG0041R	XCEL	HARRINGTON STATION	UNIT 3	No	Yes	Electric Services	Wichita Mountains	277
Rusk	RL0020K	TXU	MARTIN LAKE ELECTRICAL STATION	U1-B1	No	Yes	Electric Services	Caney Creek Wilderness	239
Rusk	RL0020K	TXU	MARTIN LAKE ELECTRICAL STATION	U2-B2	No	Yes	Electric Services	Caney Creek	239
Rusk	RL0020K	TXU	MARTIN LAKE ELECTRICAL STATION	U3-B3	No	Yes	Electric Services	Caney Creek	240
Titus	TF0013B	TXU	MONTICELLO STM ELE STN	B2	No	Yes	Electric Services	Caney Creek	166
Wichita	WH0040R	PPG	WORKS NO 4	STA-22	No	No	Flat Glass	Wichita Mtns	80
Wichita	WH0040R	PPG	WORKS NO 4	STA-23	No	No	Flat Glass	Wichita Mtns	80

## **Acronyms**

FGD – flue gas desulfurization  
LNB – low NO<sub>x</sub> burner  
LNC1 - LNB with close-coupled over-fired air (OFA)  
LNC2 – LNB with separated OFA  
LNC3 – LNB with both close-coupled and separated OFA.  
SDA – spray dryer absorber  
SCR – selective catalytic reduction  
SNCR – selective non-catalytic reduction  
OT + WI – oxygen trim plus water injection

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## **Appendix 10-2: Estimating Visibility Impacts From Additional Point Source Controls**

In order to determine reasonable progress goals for the state of Texas, the TCEQ needed to quantify the visibility benefit of the potentially reasonable set of point source controls that are described in Appendix 10-1. The TCEQ used CENRAP's modeling of additional point source controls as the basis of this estimate.

The CENRAP developed its set of potentially reasonable point source controls and used CMAQ to estimate the visibility benefit of those controls. The TCEQ and CENRAP used the same AirControlNet to develop their control sets. The CENRAP controls extended across all the CENRAP states, not just Texas. CENRAP also assumed a higher cost per ton as potentially reasonable. Table 1 compares the CENRAP control set to the Texas control set. Table 1 shows the annual cost per ton in constant 2005 dollars which define "potentially reasonable point source controls." The costs are annualized and standardized on 2005 dollars. (Note that under the Texas control scenario only additional controls in Texas are assumed.)

**Table 1: Comparison of CENRAP and Texas Control Sets**

	<b>CENRAP</b>	<b>Texas</b>
NO <sub>x</sub> (tpy) reduction	181,107	27,132
SO <sub>2</sub> (tpy) reduction	725,025	155,873
Total Cost	\$2,236,000,000	\$324,300,000

**Table 2: Projected Visibility Benefit from CENRAP Control Set**

<b>Class I Area</b>	<b>2018 (dv)</b>	<b>2018c (dv)</b>	<b>Improvement (dv)</b>
Big Bend	16.63	16.38	0.26
Breton Isle	22.67	17.80	0.46
Caney Creek	22.47	21.46	1.01
Carlsbad Caverns	16.30	16.04	0.26
Guadalupe Mtns	16.30	16.04	0.26
Salt Creek	17.04	16.88	0.15
Upper Buffalo	22.52	21.60	0.91
Wheeler Peak	10.23	10.18	0.05
White Mtn	12.96	12.70	0.26
Wichita Mtns	21.51	20.76	0.75

The projections in Table 2 (and subsequent tables) assume that there will be no change in the coarse mass and soil components of visibility between the base year and 2018.

Table 2 shows visibility impacts under two scenarios. One scenario assumed only "on-the-books" control strategies would be in place by 2018. These results are labeled simply 2018. The other scenario included on-the-books controls plus the CENRAP potentially reasonable control strategy. These results are labeled 2018c.



The Class I areas in Table 2 are of significant interest to Texas. The TCEQ staff used these model results as a framework for estimating the visibility benefits of the potentially reasonable control set developed by the TCEQ.

The CENRAP modeling derived relative response factors (RRF) specific to particular pollutants and Class I areas as per step 3 of section 6.4 of the EPA's "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM<sub>2.5</sub> and Regional Haze" (EPA 2007a). These RRF's were multiplied by the measured 2000 through 2004 concentrations at these Class I areas over the 20 percent worst visibility days to estimate concentrations projected for 2018 over said days, as per step 4 of EPA 2007a.

The TCEQ interpolated the RRFs for sulfate and nitrate calculated from the 2018 and 2018c scenarios for each Class I area to generate the expected RRF's that would be obtained if the Texas potentially reasonable control strategy (2018TXc) were selected. Since the emissions differences between the 2018 and 2018c scenarios involve differences over all of CENRAP while the changes in emissions between the 2018 and 2018TXc scenarios involve only changes within Texas, the TCEQ used the results of the PSAT modeling to obtain Class I area specific interpolation coefficients in order to better apportion the expected impacts. An outline of the procedure used is presented in Appendix 10-4, followed by a more general and rigorous mathematical derivation for those interested. A spreadsheet with all the computations is provided as Appendix 10-5. The resulting projected RRFs (shown in Table 3), and corresponding concentrations, of sulfate and nitrate are between those of the 2018 and 2018c scenarios, as would be expected.<sup>1</sup>

**Table 3: RRFs Using the Projected 2018 Impacts with the Texas Control Set on Select Class I Areas**

<b>Class I Area</b>	<b>Base g RRF for Sulfate</b>	<b>TXc RRF for Sulfate</b>	<b>Base gc RRF for Sulfate</b>	<b>Base g RRF for Nitrate</b>	<b>TXc RRF for Nitrate</b>	<b>Base gc RRF for Nitrate</b>
Big Bend (BIBE)	0.875	0.847	0.832	1.126	1.111	1.088
Guadalupe Mtns (GUMO)	0.764	0.706	0.699	1.003	0.997	0.987
Wichita Mts (WIMO)	0.709	0.658	0.616	0.814	0.798	0.758
Salt Creek (SACR)	0.800	0.741	0.744	0.917	0.923	0.931
White Mtn (WHIT)	0.809	0.732	0.729	0.987	0.983	0.975

These daily future year species concentrations are then used in steps 5 through 6 of section 6.4 of EPA 2007a to yield the projected visibility metrics, like mean concentrations, extinction, and haze index (in deciviews) for the most impaired days. A comparison of projected mean sulfate and nitrate concentrations over the most impaired days corresponding to the different RRF's at select Class I areas is presented in Table 4, including the projected impacts if the Texas control scenario (2018TXc) had been modeled.

<sup>1</sup> SACR saw a slight increase in modeled nitrate impact with the additional CENRAP potentially reasonable point source controls. This increase is likely due to the decrease of sulfate competing with the nitrate for the available ammonia.

**Table 4: Projected Mean Sulfate and Nitrate Concentrations on Select Class I Areas, for Most Impaired Days, Including Projected Concentrations if Texas Controls Had Been Modeled**

Class I Area	2018 Sulfate <sub>3</sub> (µg/m <sup>3</sup> )	2018TXc Sulfate <sub>3</sub> (µg/m <sup>3</sup> )	2018c Sulfate <sub>3</sub> (µg/m <sup>3</sup> )	2018 Nitrate <sub>3</sub> (µg/m <sup>3</sup> )	2018TXc Nitrate <sub>3</sub> (µg/m <sup>3</sup> )	2018c Nitrate <sub>3</sub> (µg/m <sup>3</sup> )
Big Bend (BIBE)	4.55	4.40	4.32	0.525	0.518	0.507
Guadalupe Mtns (GUMO)	2.28	2.11	2.09	0.657	0.653	0.646
Wichita Mts (WIMO)	4.32	4.01	3.75	2.212	2.170	2.060
Salt Creek (SACR)	2.59	2.39	2.40	1.686	1.698	1.713
White Mtn (WHIT)	1.79	1.62	1.62	0.588	0.586	0.581

The daily future year species concentrations are then used in steps 5 through 6 of section 6.4 of EPA 2007a, using the new IMPROVE Equation, to calculate the projected visibility impact. The use of the new IMPROVE Equation is described in Chapter 4 of the Modeling Technical Support Document contained in Appendix 8-1 of this Regional Haze SIP. A spreadsheet is presented in Appendix 10-6 that shows the calculations of the RRF interpolations all the way through application of the RRFs to obtain the visibility metrics (mean concentrations, extinctions, and haze indices over the most impaired days).

Table 5 shows the estimated impact of the Texas control strategy on the Class I areas of significant interest to Texas.

**Table 5: Modeled Visibility Benefit from the Texas Control Set**

Class I Area	2018 (dv)	2018 TXc (dv)	Improvement (dv)
Big Bend	16.63	16.47	0.16
Breton Isle	22.67	22.62	0.05
Caney Creek	22.47	22.14	0.33
Carlsbad Caverns	16.30	16.08	0.22
Guadalupe Mtns	16.30	16.08	0.22
Salt Creek	17.04	16.86	0.18
Upper Buffalo	22.52	22.35	0.16
Wheeler Peak	10.23	10.18	0.04
White Mtn	12.96	12.72	0.24
Wichita Mtns	21.51	21.15	0.36

Texas 2018 projections assume that there would be no change in the coarse mass and soil components of visibility between the base year and 2018. The TCEQ finds that this is a reasonable assumption for Big Bend and Guadalupe Mountains. The agency has not determined if it is a reasonable assumption for the other Class I areas shown. However, for consistency, TCEQ is presenting the Texas 2018 projections for those areas.

**Appendix 10-3: Uniform Rate of Progress Curves Using Default  
Natural Condition Estimates**

Chapter 10 presents the uniform rate of progress (URP) for the best 20 percent and the worst 20 percent days for the two Class I areas in Texas using the best site-specific natural conditions estimates available to the TCEQ. Appendix 10-3 shows the two different URPs for Big Bend National Park and the two for Guadalupe Mountains National Park based on the site-specific estimates and on the default natural conditions estimates the EPA recommends. These are the Natural Conditions II (NCII) estimates.

**Table 1: Uniform Rate of Progress for Class I Areas in Texas (Worst 20 Percent Days)**

Class I Area	Using Texas Site-specific Natural Condition Estimates			Using EPA-recommended NCII Default Natural Condition Estimates		
	Improve-ment Needed by 2018 assuming URP (dv)	Progress Annually to 2018 assuming URP (dv)	Improve-ment Needed by 2064 (dv)	Improve-ment Needed by 2018 assuming URP (dv)	Progress Annually to 2018 assuming URP (dv)	Improve-ment Needed by 2064 (dv)
Big Bend	1.7	0.12	7.2	2.3	0.17	10.1
Guadalupe Mountains	1.2	0.08	4.9	2.4	0.17	10.4

**Table 2: Reasonable Progress Goals for Class I Areas (Worst 20 Percent Days)**

Class I Area	Improve-ment Projected by 2018 using RPG (dv)	Using Texas Site-specific Natural Condition Estimates			Using EPA-recommended NCII Default Natural Condition Estimates		
		Improve-ment by 2018 at URP (dv)	Projected Improve-ment by 2064 at RPG Rate (dv)	Date Natural Visibility Attained at RPG Rate	Improve-ment by 2018 at URP (dv)	Projected Improve-ment by 2064 at RPG Rate (dv)	Date Natural Visibility Attained at RPG Rate
Big Bend	0.7	1.7	2.9	2155	2.3	2.9	2215
Guadalupe Mountains	0.9	1.2	3.8	2081	2.4	3.8	2167

These projections of the year in which visibility would improve to natural conditions for the worst 20 percent of days are a requirement of the Regional Haze Rule. The large contribution that international pollution transport makes to Big Bend and to Guadalupe Mountains means that U.S. emission reductions alone could never bring these two Class I areas to natural visibility conditions.

For the best 20 percent of days the requirement is to project the haze index in deciviews for the end of the planning period, which is 2018 for this first Regional Haze SIP submission, and to show that the projection does not show any degradation from the base period average haziness for the best 20 percent days. Table 10-3 in the body of Chapter 10 does show that the modeling

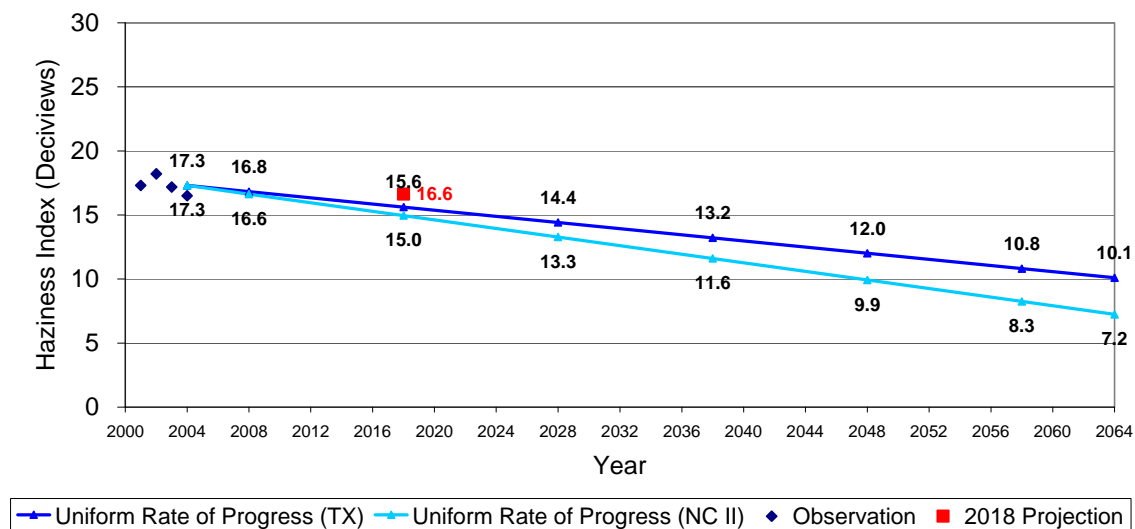
using Texas' long-term strategy does provide for 0.2 deciview improvement in haze for the best 20 percent of days at both Big Bend and Guadalupe Mountains. For quick reference a copy of Table 10-3 from the SIP text appears here:

**Table 3: Reasonable Progress Goals for Class I Areas (Best 20 Percent Days)**

Class I Area	Baseline Visibility (dv)	Projected 2018 Visibility (RPG) (dv)	Improvement by 2018 at RPG (dv)
Big Bend	5.8	5.6	0.2
Guadalupe Mountains	5.9	5.7	0.2

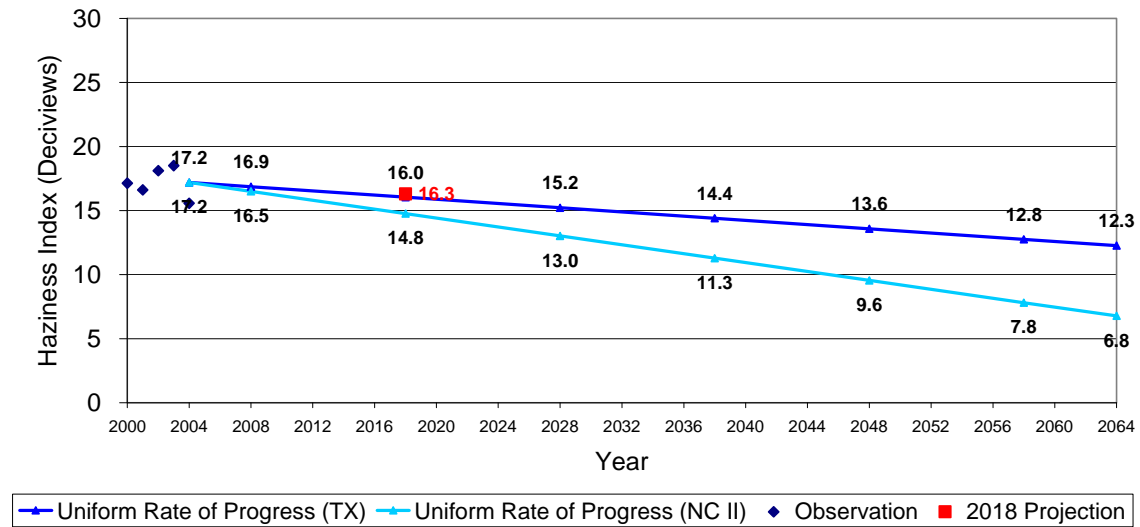
The following two figures show both the site-specific and the EPA default uniform rate of progress lines along with the 2018 projected RPG points for Big Bend and Guadalupe Mountains.

### Uniform Rate of Progress and 2018 Projected Progress Big Bend NP - W20% Data Days



**Figure 1: Glide Paths for Big Bend National Park Calculated Using Site-Specific 2064 Natural Conditions Estimates and Natural Conditions II Committee Estimates**

## Uniform Rate of Progress and 2018 Projected Progress Guadalupe Mountains NP - W20% Data Days



**Figure 2: Glide Paths for Guadalupe Mountains National Park Calculated Using Site-Specific 2064 Natural Conditions Estimates and Natural Conditions II Committee Estimates**

#### **Appendix 10-4: Detailed Calculations for Estimating Visibility Impacts**

## Estimating Control Impacts Based on Prior Modeling, Including Particulate Source Apportionment Technology (PSAT) Modeling

By Dr. David Halliday  
TCEQ

If results of two or more sets of modeling runs are available, but an estimate of the results of a different set of parameters is needed, such as a different set of controls, and it is not possible to obtain a new set of modeling runs (for instance due to time or budgetary constraints), then some other means of obtaining an estimate of these results is needed. Since Regional Haze modeling (like many other air quality modeling applications) is principally applied via calculation and application of Relative Response Factors (RRFs), it would be natural to interpolate RRFs from prior modeling to estimate RRFs that would be obtained by modeling a given set of controls that are similar to the control sets used in earlier runs.

Within this document we present a reasonable method for estimating impacts of controls that have not actually been modeled, based upon a linear interpolation over RRFs of two available modeling runs. This method is reasonable provided the two interpolated model runs have the same baseline conditions as the unmodeled run, and are sufficiently similar to each other and to the unmodeled run, to justify a linear approximation. The interpolation coefficient used in this method takes advantage of a Source Apportionment Technology (in this case, Particulate Source Apportionment Technology or PSAT) future case run to provide a receptor and/or monitor<sup>1</sup> specific interpolation, provided this run is sufficiently similar to the conditions of the future cases of the prior modeled runs.

Consider one of the two modeled runs to be a “base” control run. The difference in emissions between the “second” control run and this “base” control run are the emission reductions of the “second” control set. Further, the difference in emissions between the unmodeled, or, “target” control run and this “base” control run are the emission reductions of the “target” control set. Since this approach is a linear approximation, emission species such as sulfur dioxide and nitrogen oxides, will be associated with measured species that are most closely related, such as ammonium sulfate and ammonium nitrate, respectively.

The **emissions reduction ratio** associated with a given species will be the ratio of the emission reductions of the “target” control set associated with that species over the emissions reductions of the “second” control set associated with the same species. These ratios are computed on an emission apportionment category basis (such as source region and emitter category) using the same emission apportionment categories in the PSAT future case run. The **apportionment fraction**, for each species and receptor, is the fraction of the average PSAT modeled future case concentration apportioned to a given

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<sup>1</sup> Henceforth, the term *receptor* shall be used in place of receptor and/or monitor.



emission apportionment category, for that species and receptor, over all emission apportionment categories that differ between the “base” and “second” control runs. This ensures the sum of the apportionment fractions, over all the emission apportionment categories that differ between the “base” and “second” control runs, will yield one.

The interpolation coefficient, for each species and receptor, equals the sum, over all the emission apportionment categories that differ between the “base” and “second” control runs, of the product of the emissions reduction ratio associated with that species, and the apportionment fraction, for the category, species, and receptor.

This interpolation factor, for each species and receptor, is then multiplied by the difference in the RRFs of the “second” control run and the “base” control run (with the “base” being subtracted from the “second”). This product is added to the RRF of the “base” control run to obtain the estimate of the RRF of the “target” control run, for the given species and receptor.

What follows is a mathematical derivation of this method.

### ***Derivation of the Method***

Equation 10-4-1 below shows the method of linear interpolation to a new “target” RRF ( $RRF_T$ ) from RRFs obtained from “base” ( $RRF_B$ ) and “second” ( $RRF_S$ ) modeling runs, as above:

$$\begin{aligned} RRF_{T\,rs} &= (1 - f_{T\,rs}) RRF_{B\,rs} + f_{T\,rs} RRF_{S\,rs} \\ &= RRF_{B\,rs} + f_{T\,rs} (RRF_{S\,rs} - RRF_{B\,rs}) \end{aligned} \quad (\text{eq. 10-4-1})$$

where  $f_{T\,rs}$  is the interpolation coefficient,  $RRF_{x\,rs}$  is the RRF for modeling run  $x$ , (where  $x \in \{B, S, T\}$ ), with  $B$  and  $S$  representing the two modeled runs and  $T$  representing the interpolated “target” estimate desired, for each receptor ( $r$ ) and species ( $s$ ).

If the new control set is simply an interpolated set of emissions between those used in the “base” and “second” modeling, and emissions in these modeling runs are not too different (so a linear approximation is reasonable), then the interpolation coefficient is given by

$$f_{T\,rs} = f_{T\,s} = \frac{E_{T\,r} - E_{B\,s}}{E_{S\,s} - E_{B\,s}} = \frac{\Delta E_{T\,s}}{\Delta E_{S\,s}} \quad (\text{eq. 10-4-2})$$

where the  $E_{x\,s}$  are the emissions for modeling run  $x$  ( $x \in \{A, B, I\}$ ) associated with species  $s$ .

If emissions are not simply a scaled interpolation between “base” and “second” model runs, then determination of a proper interpolation coefficient becomes much less straight forward. In this case, the above interpolation is likely to misappropriate the impacts of

changes, since it applies the same interpolation for all receptors ( $r$ ), for a given species ( $s$ ).

However, if apportioned RRFs from "base" and "second" modeling runs were available, then interpolation of apportioned RRFs would be possible and a more representative set of emissions could be obtained. For instance, if the equivalent of RRFs for each run, species, receptor, and apportionment category (such as source region and emitter category, like electric generating units, etc.) were available, it would be possible to obtain RRFs apportioned by such categories.

Given  $RRF_{Brs} = \sum_t RRF_{Brs}^t$  and  $RRF_{Srs} = \sum_t RRF_{Srs}^t$ , where the "tag" ( $t$ ) runs over all apportionment categories (such as source region and emitter category) that differ between the runs, an interpolated "target"  $RRF_{Trs} = \sum_t RRF_{Trs}^t$  is obtained:

$$RRF_{Trs}^t = RRF_{Brs}^t + f_{Trs}^t \left( RRF_{Srs}^t - RRF_{Brs}^t \right) \quad (\text{eq. 10-4-3})$$

where

$$f_{Trs}^t = f_{Ts}^t = \frac{E_{Ts}^t - E_{Bs}^t}{E_{Ss}^t - E_{Bs}^t} = \frac{\Delta E_{Ts}^t}{\Delta E_{Ss}^t} \quad (\text{eq. 10-4-4})$$

If the baselines for the two "base" and "second" modeling runs and for the "target" modeling run are identical, then interpolation between RRFs is equivalent to interpolation between averaged modeled concentrations. Thus, if a Source Apportionment Technology (like PSAT) run for the future case is available that involves emissions that are not too different from the future "base", "second", and "target" cases, then an apportioned RRFs may be estimated as:

$$RRF_{xrs}^t \approx RRF_{xrs} \left( \frac{\langle C_{rs}^t \rangle}{\sum_t \langle C_{rs}^t \rangle} \right) = RRF_{xrs} \frac{\langle C_{rs}^t \rangle}{\langle C_{rs} \rangle} \quad (\text{eq. 10-4-5})$$

where  $\langle C_{rs}^t \rangle$  is the averaged modeled future case concentration apportioned to tag ( $t$ )

for receptor ( $r$ ), and species ( $s$ ).  $\langle C_{rs} \rangle$  is defined as  $\langle C_{rs} \rangle = \sum_t \langle C_{rs}^t \rangle$ .

Therefore, a better interpolation is thus obtained as:

$$\begin{aligned}
 RRF_{T_{rs}} &= \sum_t RRF_{T_{rs}}^t \\
 &= \sum_t RRF_{B_{rs}}^t + \sum_t f_{T_{rs}}^t \left( RRF_{S_{rs}}^t - RRF_{B_{rs}}^t \right) \\
 &\approx RRF_{B_{rs}} + \left( RRF_{S_{rs}} - RRF_{B_{rs}} \right) \sum_t f_{T_{rs}}^t \frac{\langle C_{rs}^t \rangle}{\langle C_{rs} \rangle} \\
 &= RRF_{B_{rs}} + f_{T_{rs}} \left( RRF_{S_{rs}} - RRF_{B_{rs}} \right)
 \end{aligned} \tag{eq. 10-4-6}$$

The interpolation coefficient,  $f_{T_{rs}}$ , now depends upon the receptor ( $r$ ), and is given by

$$f_{T_{rs}} = \sum_t f_{T_{rs}}^t \frac{\langle C_{rs}^t \rangle}{\langle C_{rs} \rangle} = \sum_t \frac{\Delta E_{T_{rs}}^t}{\Delta E_{S_{rs}}^t} \frac{\langle C_{rs}^t \rangle}{\langle C_{rs} \rangle} \tag{eq. 10-4-7}$$

The foregoing is a reasonable method for estimating impacts of controls that have not actually been modeled, based upon interpolation over two available modeling runs, provided, of course, the two runs over which we are interpolating have identical baseline conditions as would be used for the “target” run to be estimated, and are sufficiently similar to each other and to the “target” run. The interpolation coefficient, thereof, takes advantage of a Source Apportionment Technology (like PSAT) future case run to provide a receptor-specific interpolation, provided this run is sufficiently similar to the conditions of the future cases of the other available runs.

Appendix 10-4 has a large spreadsheet that is not easily printed and is available on line with all the other appendixes. All appendixes are available on the web site  
<[http://www.tceq.state.tx.us/implementation/air/sip/bart/haze\\_appendices.html](http://www.tceq.state.tx.us/implementation/air/sip/bart/haze_appendices.html)>.

If you have problems accessing any files, please contact me below or another SIP coordinator through the receptionist at 512-239-4900:

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## **Appendix 2-2: Response to Comments**

RESPONSE TO COMMENTS  
Regional Haze SIP, proposed 12-5-07

To assist readers with all the federal agencies that commented, a short acronym list is provided. A more complete list is located at the beginning of the Regional Haze SIP.

EPA	United States Environmental Protection Agency
FLM	Federal Land Managers (includes NPS, FWS, and FS for this document)
FS	United States Forest Service
FWS	United States Fish and Wildlife Service
NPS	National Park Service, United States Department of the Interior

**Chapter 1: Background and Overview of the Federal Regional Haze Regulation**

The Forest Service (FS) and one individual requested rewording of the sentence in paragraph one defining Class I areas as those “. . . that Congress has recognized at significant sites” to “Class I areas are national parks over 6,000 acres and wilderness areas over 5,000 acres that were in existence before August 7, 1977.” One individual commented that the Texas Commission on Environmental Quality (TCEQ) stated that Guadalupe Mountains contains the only congressionally designated wilderness in Texas; however, there are five congressionally designated wilderness areas in East Texas.

**The commission made the changes the FS suggested; this change also corrected the comment of the individual.**

The FS commented that Big Bend and Guadalupe Mountains are identified in Chapter 1: *Background and Overview of the Federal Regional Haze Regulation*, but out-of-state Class I areas are not. Including a summary of those other impacted Class I areas would provide balance to this chapter. The FS requested that the TCEQ include the out-of-state Class I areas that Texas impacts in Chapter 1. Additionally, the FS commented that Texas should quantitatively summarize its reasonable progress goals and associated rationale for each Class I area addressed in the Texas Regional Haze State Implementation Plan (SIP) revision.

**The commission added revisions in Chapter 1 that direct the reader to Chapter 11: *Long-Term Strategy to Reach Reasonable Progress Goals* for analysis of Texas' impacts on all impacted Class I areas. The commission disagrees with the suggestion that the Texas Regional Haze SIP revision should list the reasonable progress goals established by each state with a Class I area that Texas impacts. Instead, Chapter 11 details both the total and Texas' apportioned 2002 and projected 2018 extinction impacts on each Class I area impacted by Texas' emissions.**

One individual commented that Table 1-1: *Visibility-Impairing Pollutants* lists evergreen trees as emitting volatile organic compounds (VOC), but other trees, like oak, also emit VOC.

**Evergreen was removed from Table 1-1 in response to this comment.**

One individual commented that Table 1-1 does not document that many areas with bare soil or little vegetation are due to human impacts. Example: overgrazing occurred in the area that is now Big Bend before it became a park.

**Table 1-1 lists only major sources and not all possible sources. After discussions, the FLMs suggested that the commission could judiciously use 80 percent as the natural source of coarse and fine dust and 20 percent of coarse and fine dust due to human activity. The comparison plots in Chapter 5: *Assessment of Baseline and Current Conditions and Estimate of Natural Conditions in Class I Areas* show little difference in the final calculation whether natural dust sources are 80 or 100 percent. The commission made no changes in Chapter 1**

**in response to this comment, but changes were made in Chapter 5 and Appendix 5-2: *Estimate of Natural Visibility Conditions*. (Also see responses on grazing under Chapter 8: *Modeling Assessment*.)**

One individual would appreciate a definition of “maintaining adequate visibility.” One individual wants TCEQ to strive for better than adequate air quality in Big Bend and Guadalupe Mountains.

**The commission follows the requirements of the Federal Clean Air Act and EPA in regard to visibility. Since there is no health based standard for visibility, there is not an exact number to reach. The commission’s goal is to reduce haze-impairing pollutants in Texas and surrounding states to approximately natural conditions. Texas has calculated natural conditions to be about 11 deciviews at the state’s two Class I areas.**

#### **Chapter 2: General Planning Provisions**

The United States Environmental Protection Agency (EPA) commented that the TCEQ should ensure it followed the requirements of Part 51, Appendix V. The EPA also suggested that TCEQ edit the paragraph “Public Notice” in Chapter 2: *General Planning Provisions* to include a reference to Part 51, Appendix V. The EPA suggested additional documentation that the state complied with Part 51, Appendix V be included in Appendix 2-1: *Public Participation Process*.

**The commission has added the reference to Part 51, Appendix V. When the commission submits any SIP revision to the EPA for approval, it follows the administrative requirements of Appendix V, Section 2.0. This revision will be no exception. The commission’s order, referral letter, public hearing record book, and SIP narrative will address those relevant criteria.**

#### **Chapter 4: State, Tribe, and Federal Land Manager Consultation**

The EPA, National Park Service (NPS), Fish and Wildlife Service (FWS), Forest Service (FS), and one individual commented that the consultation process appeared incomplete. Circular questions about states that have not completed their BART or Regional Haze SIP process have arisen. All commenters requested: 1) more details on the technical information that was communicated and 2) signed documentation that adjacent states (Louisiana, Arkansas, Missouri, Oklahoma, Colorado, and New Mexico) were satisfied with Texas’ existing regulations for the next revision.

The EPA specifically requested that TCEQ should address the requirements of Section 51.308(d)(1)(iv).

- a) Do these states agree with the TCEQ on the level of their apportionments?
- b) What, if any, reductions in these states’ sources were negotiated through the consultation process as part of the TCEQ’s reasonable progress strategy?
- c) The TCEQ should demonstrate that it has included in its implementation plan all measures necessary to obtain its share of the emission reductions needed to meet the progress goal for those Class I areas for which it causes or contributes to visibility impairment.
- d) In Chapter 4, the TCEQ states that it attended Oklahoma’s three consultation calls held in August and September 2007. The TCEQ should discuss the results of those calls, including whether Oklahoma requested any additi

**The commission acknowledges some Regional Haze SIP and Best Available Retrofit Technology (BART) timing issues regarding consultation with neighboring states. To address this issue, the commission sent a formal consultation letter with attached Particulate Matter Source Apportionment Technology (PSAT) results, and where applicable, area of influence maps of Texas sources on Class I areas, and documents containing source-specific data on nitrogen oxides (NO<sub>x</sub>) and sulfur dioxide (SO<sub>2</sub>) contributions to neighboring states. The consultation letter discussed expected emissions**

reductions by 2018 that will improve visibility in the affected Class I areas. The commission also requested recipients of the letters to confirm they are not expecting any additional emission reductions from Texas sources. The letters and replies are in Appendix 4-3: *Additional Consultation Letters to Adjacent States*.

Oklahoma, Missouri, Arkansas and Colorado have replied with letters that those states concur with Texas' current level of controls; full replies are in Appendix 4-3. Colorado agrees that Texas' impact at Great Sand Dunes Wilderness Area was less than 5 percent and was not significant per Colorado's criteria. Louisiana has agreed via e-mail that Texas' existing regulations will suffice for now, and Louisiana does not expect more controls at this time. In the consultation calls with Oklahoma Department of Environmental Quality (ODEQ), Oklahoma did not request any additional emissions reductions from Texas. The commission requested written responses in 30 days so the comments could be added to Appendix 4-3. The commission has made changes to Chapter 4: *State, Tribe, and Federal Land Manager Consultation* and added a new appendix 4-3.

#### **Chapter 5: Estimate of Natural Conditions in Class I Areas**

The EPA commented that the TCEQ should provide more detail than is present in Appendix 5-2: *Estimate of Natural Visibility Conditions* on the calculation of the refined estimates of natural visibility for the two Texas Class I areas.

**Appendix 5-2b: *Estimating Natural Conditions Based on Revised IMPROVE Algorithm*** outlines the method used for the calculation of Texas' estimates of natural visibility at Big Bend and Guadalupe Mountains, including the scaling factors used, which are contained in the second part of Table 5-1: *Regional Annual Mean -Natural Concentrations (RAM-NC) of Trijonis and the EPA*. However, so others may more easily reproduce the calculations and see the details of both how the factors were calculated as well as the resultant calculations of natural visibility, the SAS Program code and input data files are bundled into a ZIP file named TXNC.zip and provided as Appendix 5-2c: *Texas Natural Conditions SAS Program File and Data*. The appendix was expanded to include more details as the EPA requested in their comments.

The NPS and FWS find the basic approach used by Texas in adjusting natural conditions for Big Bend and Guadalupe Mountains reasonable. However, Texas should provide a rationale for what fraction of coarse mass and fine soil is natural and what fraction is from human activity. Since human activity adds uncertainty to the estimate of what fraction of the coarse mass and fine soil is natural, Texas should present an alternative with a different fraction.

In response to this comment, the commission added information to Chapter 5 and Appendix 5-2 to show the comparisons between 80 and 100 percent of the coarse mass and fine soil due to a natural dust source. After discussions on the FLMs comments, the FLMs suggested that the commission could judiciously use 80 percent as the natural source of coarse and fine dust and 20 percent of coarse and fine dust due to human activity. The comparison plots in Chapter 5 and Appendix 5-2 show little difference in the final calculation whether natural dust sources are 80 or 100 percent. Additional supporting research from the Chihuahuan Desert (summarized and referenced in Appendix 5-2 Gill, T. et al. 2005; Kavouras, I. G. et al. 2006 and 2007) suggests that, at least for the estimation of natural visibility values for Texas Class I areas, major dust events are predominantly natural in origin.

The EPA suggested that the TCEQ explain why the baseline average for Big Bend, shown in Table 5-1: *Baseline Haze Indices*, does not include data from 2000.



**The fourth quarter data of 2000 for Big Bend was not sufficiently complete. The fourth quarter had only 10 complete days. This information is reflected in the Regional Haze Rule data that can be obtained through the Visibility Information Exchange Web System (VIEWS), such as the summary data through 2004 (at [vista.cira.colostate.edu/views/Web/IMPROVE/SummaryData.aspx](http://vista.cira.colostate.edu/views/Web/IMPROVE/SummaryData.aspx)). The commission made additional explanations in the SIP revision for clarification.**

The NPS, FWS, and FS acknowledged Texas' right to develop its own estimates of natural conditions, as established in 40 Code of Federal Regulations (CFR) 51.308; however, the FLMs requested that the EPA default estimates of natural conditions given equal weight in all tables, plots, and predictions that involve or depend upon an estimate of natural conditions.

**The comparisons with the EPA default, or more specifically, the Natural Conditions II (NC II) committee's estimates using the New/Revised IMPROVE Algorithm, are available in Appendix 5-2. The commission made some changes in response to this comment, however the NC II estimates will remain in the appendix.**

The NPS and FWS suggested that it would help the reader to summarize how the refinement affects the revised natural condition if the state included a chart showing the breakdown of each basic pollutant component. NPS and FWS also suggest that this would give a non-technical reader a simple reference about which components in the haze calculation were changed and by how much.

**In response to the comments, a paragraph has been added to Chapter 5, Section 5.3. In addition, a note to this effect has been added to Table 5-1 in Appendix 5-2 to illustrate that the fractions shown for all but coarse mass and fine soil are essentially the same as used by the Natural Conditions II.**

The EPA asked that the TCEQ provide documentation that supports the estimate that, at least for the estimation of natural visibility values for Texas Class I areas, major dust events can be assumed to be completely natural in origin.

**The commission has included additional supporting evidence in additional appendices (and references therein) to Chapter 5. Since there is uncertainty in this estimate, as there is in all the components of natural visibility conditions, the commission has provided plots showing the results for the 20 percent worst natural conditions haze index (in deciviews) if one were to treat only 80 percent of the coarse mass and fine soil to be natural. However, this 80 percent calculation is displayed only as an indication of how little sensitivity this natural visibility estimate has to approximating 100 percent of the coarse mass and fine soil as natural.**

The EPA noted that wind blown dust is a more important factor for Guadalupe Mountains than at Big Bend. The TCEQ acknowledges that the number of dust storms at Guadalupe Mountains and Big Bend do not correlate with each other in the SIP and appendixes. Because of these differences, the natural conditions for these two sites should be evaluated individually. The EPA requested that the TCEQ show how this information was considered in the assumptions and show calculations of the natural visibility values for each of Texas' Class I areas.

**The commission did calculate separate equations for Big Bend and Guadalupe Mountains; therefore, two different numbers were recommended for natural conditions (see Chapter 5 and Appendix 5-2). Regarding the difference in dust at Big Bend and Guadalupe Mountains, even using 80 percent versus 100 percent of the coarse mass and fine soil as natural made little difference in the final calculation (see Figures 5-1 and 5-3 in Chapter 5**

and Figures 5-1 and 5-2 in Appendix 5-2). In response to this comment, the commission added figures to Chapter 5 and Appendix 5-2 to show the comparisons.

The comment in the Stuart Dattner's paper in Appendix 5-2a: *Natural Events: Dust Storms in West Texas* about how the natural conditions for these two sites should be evaluated individually stems from the commission's long-standing assertion that Big Bend and Guadalupe Mountains cannot simply be treated as being essentially the same (Dattner, 2007 at <[www.tceq.state.tx.us/assets/public/implementation/air/sip/bart/haze\\_sip-dust\\_storms.pdf](http://www.tceq.state.tx.us/assets/public/implementation/air/sip/bart/haze_sip-dust_storms.pdf)>). There is ample evidence, in addition to that cited in the dust storm paper, that these parks are in many ways quite different. However, this paper does support the assertion of the Appendix 5-2b: *Estimating Natural Conditions Based on the Revised IMPROVE Algorithm*, (<[www.tceq.state.tx.us/assets/public/implementation/air/sip/bart/haze\\_sip-est.natural\\_conditions.pdf](http://www.tceq.state.tx.us/assets/public/implementation/air/sip/bart/haze_sip-est.natural_conditions.pdf)>), that the observed coarse mass and fine soil components of haze in the western United States, including Big Bend and Guadalupe Mountains, are consistent with Trijonis' estimates of natural conditions (see reference Trijonis 1990), which are used by the EPA and the Natural Conditions II committee in obtaining default estimates of natural conditions. In addition, though the estimate that the 20 percent worst natural visibility conditions can be best approximated by using 100 percent of the coarse mass and fine soil as stemming from natural sources is common to the calculation of natural conditions at both Texas Class I areas, the actual computations are carried out using each area's own data.

#### **Chapter 6: Monitoring Strategy**

The NPS, FWS, FS, and one individual commented that the TCEQ stated it will participate in the monitoring network as long as EPA or other states fund these programs. One individual considered the previous statement showed a lack of commitment by the TCEQ to protect Class I areas in and outside Texas. The NPS and FWS commented that the SIP stated the current funding for the Interagency Monitoring of Protected Visual Environments (IMPROVE) network to be primarily EPA with some funding from NPS. However, all the FLM agencies with Class I area management responsibilities (including FWS and FS) contribute to the establishment and operation of the IMPROVE monitoring network. The individual commented that the TCEQ has permitted air emissions in Texas to degrade visibility both inside and outside Texas, but considered it unfair that Texas was not willing to fund a Web site, monitoring, and collaboration with others whose Class I areas are diminished by Texas' air emissions. The commenters suggest Texas have a contingency plan for monitoring and reporting of data in case the IMPROVE program curtails operation of IMPROVE monitors or funding for Visibility Information Exchange Web System (VIEWS).

The commission agrees that the proposed SIP revision did not mention that the financial contributions from the FWS and FS to funding the IMPROVE monitoring at Class I areas. The SIP is revised to acknowledge these contributions. The commission agrees that it plans to consult with the FLM agencies for all the Class I areas that Texas impacts if the current federal funding of any of these IMPROVE monitoring network sites or the VIEWS services is threatened. The commission considers both continued IMPROVE monitoring at current Class I IMPROVE sites and continued VIEWS services to be centrally important to the effort to reduce anthropogenic haze impacts at these sites. The commission plans to work with the FLMs to attempt to find the funding to continue the current Class I IMPROVE monitoring and VIEWS services for these sites. The commission has added these commitments to the SIP in Chapter 6 Section 6.2. Concerning the availability of alternative data sites for the two Class I areas in Texas, the analysis by the IMPROVE Steering Committee has shown definitively that the two sites are each unique in the current IMPROVE Class I site network, so there is no acceptable, reasonably representative alternative that could substitute for either site.

In response to the question about the TCEQ's monitoring and monitoring plans at Big Bend and at Guadalupe Mountains, the commission notes that it currently operates a PM<sub>2.5</sub> TEOM, which is a Tapered Element Oscillating Microbalance that measures particulate matter with aerodynamic diameters less than 2.5 microns, an every-sixth-day PM<sub>2.5</sub> chemical speciation monitoring site, and a set of meteorological instruments at the Big Bend IMPROVE site. Additionally, the TCEQ hosts the NPS ozone data from Big Bend on the TCEQ Web site. In fact, the NPS ozone data appear on the TCEQ Web site.

The commission currently plans to continue this monitoring but is unable to make a binding commitment about future operation of these instruments. Operation is dependent on future funding of TCEQ monitoring and on potentially competing priorities for resources. As long as the TCEQ is able to continue its monitoring at Big Bend, it will make all the data available to the FLMS, the EPA, and the public.

#### **Chapter 7: Emissions Inventory**

The EPA requested an explanation of how the TCEQ resolved any significant differences between the actual locations of stationary sources in 2002 and the Integrated Planning Model (IPM)-generated 2018 locations.

As part of the review of the IPM Version 2.19 projections of emissions to the 2018 planning year for regional haze, the commission obtained from the EPA's Clean Air Markets Division an explanation of the procedure the IPM uses for predicting locations of new electric generating units (EGUs). As would be expected based on economic and logistic considerations, the procedure places a high priority on locating new units at existing plants. In consideration of current air quality, the model also projects locations of new units based on a hierarchy of county attainment status, such that the units are located in pollutant attainment counties, particulate matter nonattainment counties, and eight-hour ozone nonattainment counties, in that order. The commission acknowledges the uncertainties that any projection tool would have in predicting the location of new electric generating units, but considers the procedure used by the IPM is reasonable. Appendix 7-2: *Integrated Planning Model Projections of Electric Generating Unit Emissions for the Regional Haze State Implementation Plan* has been revised to discuss the EPA's procedure used by the IPM to locate projected EGUs.

The EPA asked how the TCEQ resolved any significant differences between the 2002 magnitudes of stationary sources and the IPM-generated 2018 magnitudes.

Central Regional Air Planning Association (CENRAP) used the IPM Version 2.19 to project emissions of EGUs from the base year of 2002 to the future planning year of 2018. CENRAP then used the projected EGU emissions in its photochemical modeling of visibility impacts in Class I areas. Inputs developed for IPM runs are based on assumptions applicable at the time the model is constructed, including fuel prices, fuel availability, regulatory policies, and a multitude of related factors. Emissions projected by the IPM for Texas EGUs are summarized in Appendix 7-2.

Table 2: *Texas Emissions of SO<sub>2</sub> and NO<sub>x</sub> from EGUs - IPM 2.19 Versus IPM 3.0* in Appendix 7-2 shows that for the period 2002 to 2018, the IPM Version 2.19 predicted an approximately 35 percent decrease in Texas EGU emissions of sulfur dioxide, the pollutant most important for regional haze formation in Class I areas of interest downwind from Texas. Based on regulatory programs intended to result in overall decreases of sulfur dioxide in Texas, this result appears to be reasonable. The commission acknowledges the uncertainty in the emissions projections, as the 2018 planning horizon for regional haze is particularly long and model assumptions are thus quite uncertain. However, the

commission still regards the IPM as a viable EGU emissions planning tool for Regional Haze SIP development and is not aware of a better tool. The commission has made no changes in this SIP revision.

The EPA asked whether the IPM-predicted total electrical generating capacity for 2018 appears to be reasonable when compared with that in 2002.

Appendix 7-2 focuses on electric generating capacity in Texas mainly for coal/lignite- and gas-fired electric generating capacity since emissions from the combustion of these fuels are of most concern relative to visibility impacts. The appendix provides a comparison of total capacity for these fuels for 2005 based on data from the National Electric Energy Database System, and for 2018 as projected by the IPM. As shown in Table 1: *Electric Generating Capacity in Texas - IPM 2.19 Versus IPM 3.0* of Appendix 7-2, the IPM Version 2.19 used by CENRAP projected an approximately 28 percent increase in total generating capacity in Texas for these fuels (combined) during the planning period. The commission believes this projected increase is reasonable based in part on population projections from the Office of the Texas Comptroller, which show about a 20 percent increase in population from 2005 to 2018. Also, generating capacity projections from the Electric Reliability Council of Texas (ERCOT) show continued growth of coal/lignite- and gas-fired capacity for the ERCOT region at least through 2013, the furthest projection year available from ERCOT. The commission acknowledges that the future growth of generating capacity for these fuel types will be related to more than population growth (e.g., fuel prices, fuel availability, environmental policies, growth in renewable energy resources, and other related factors), and that both the population projections and ERCOT-generating capacity projections are subject to uncertainties as are the projections. Appendix 7-2 has been revised to clarify the discussion of the IPM-projected total generating capacity.

The FS questioned why the 2018 modeling over-predicts point source emissions, considering point source emissions have declined in every year since 2001.

From 2002 to 2018, CENRAP projected emission increases in the organic compounds, carbon monoxide, and particulate categories. For non-EGU sources CENRAP predicted increases in all contaminant categories (ranging from slight in nitrogen oxide and sulfur dioxide categories to significant increases in carbon monoxide and organic compounds). The increases predicted by CENRAP's modeling are in contrast to actual decreases in these emissions in the actual annual inventory data collected between 2002 and 2005. Between 2002 and 2005, the historical data indicate actual industrial source emissions have decreased or held approximately constant for the point sources in all categories except carbon monoxide from electric generating units. Based on a historical decrease in emissions, CENRAP's predicted increase is considered conservative.

The EPA commented that Section 51.308(d)(4)(v) requires the TCEQ to submit an emissions inventory that includes emissions for a baseline year, emissions for the most recent year that data are available, and estimates of future projected emissions. The EPA requested that the TCEQ contrast its 2005 emission inventory with that from its baseline year of 2002, and 2018, in order to check the accuracy of the EI projection methodology.

A summary of the 2005 emissions inventory data was included in Appendix 7-1: *Texas Emissions Inventory Development: Base Year 2002 and Projected Year 2018*, Section 7.5 of this SIP revision. Summary data from 2002, 2005, and projected 2018 inventories are all included in the SIP revision. The commission made no changes in response to this comment.

The EPA, NPS, FWS, and FS commented that it was unclear which category the over reported tons per year (tpy) of sulfur dioxide were in and requested clarification on why Texas believes the CENRAP-generated sulfur dioxide inventory is incorrect.

**The 111,853 tpy of area source sulfur dioxide emissions modeled by the CENRAP are significantly higher than the 15,633 tpy of area source sulfur dioxide emissions reported by the TCEQ in 2002. The difference is attributed to industrial and residential coal combustion, which was erroneously included in the CENRAP modeling.** In other areas of the country, coal burning is used as fuel for small industrial sources and also to warm residential homes. Because of the abundance of natural gas, coal is not a preferred fuel type for these sources in Texas, therefore the use assumptions in the CENRAP model are not valid. The Texas area source 2002 annual inventory, developed with knowledge of fuel usage in Texas and submitted to EPA, is a more accurate reflection of the SO<sub>2</sub> emissions from these types of sources.

The EPA, NPS, and FWS questioned that CENRAP's modeled emissions estimate was not expected to significantly impact visibility estimates for 2018 because of the relatively small contribution from these Texas sources on Class I areas. The EPA, NPS and FWS commented that data presented in the SIP narrative suggested that Texas sources' emissions constitute the majority of visibility impact at the Wichita Mountains Salt Creek, and Caney Creek; and indicated that Texas sources' emissions have a great impact at White Mountain. The EPA, NPS and FWS asked that the TCEQ explain the specific difference between the reported TCEQ sulfur dioxide inventory and the CENRAP modeled inventory as well as the rationale for why TCEQ considers Texas' contribution to visibility impairment in neighboring states' Class I areas to not be significant.

**The SIP statement that “the SO<sub>2</sub> emissions modeled by the CENRAP are significantly higher than the 15,633 tpy reported by the TCEQ” was intended to refer specifically to the area sources of industrial and residential coal combustion that were over-represented in the CENRAP modeling inventory, not all SO<sub>2</sub> emissions. The commission did not intend to imply that emissions or emissions contributions to visibility from its sources were insignificant. The erroneously modeled industrial and residential coal combustion sources are typically individually smaller and distant from Class I areas. As a result, their representation in the model does not significantly detrimentally affect visibility estimates or model conclusions. In response to this comment, additions were made to Chapter 7: *Emissions Inventory* and Appendix 7-1 of the SIP revision for clarity.**

The NPS and FWS referenced the SIP Table 7-3: *CENRAP's 2018 Emissions Inventory Summary for Texas* showing that emission estimates of organics, primary particulates and ammonia are predicted to increase during the planning period (years 2002 to 2018). The NPS and FWS suggested that the TCEQ include a summary within the SIP revision of why estimates predict increases in organics, primary particulates, ammonia, and area source sulfur dioxide, together with a discussion of how much these increases are expected to affect visibility impairment at both Texas' and neighboring states' Class I areas rather than relying on the referenced CENRAP Technical Summary Document (TSD). This discussion should also consider the effects of emission decreases projected for sulfur and nitrogen products.

**Appendix 7-1 discusses the use of EPA's Economic Growth Analysis System Version 5.0 (EGAS5) methodology to predict 2018 emissions. The EGAS 5.0 factors were based on the most recently available (at the time of inventory projection) set of economic and demographic projections developed by Regional Economic Model, Incorporated (REMI) and the most current energy forecasts prepared by Department of Energy's Annual Energy Outlook (AEO). Data such as statistics from the Bureau of Labor, population growth, and projected energy use from the Department of Energy are input into the model. These**

anticipated increases in emissions are off-set in each category and region of the state by the appropriate on-the-books controls. The EGAS5 was used to predict future emissions for area sources except for wind blown dust from non-agricultural land use categories, emissions from wildfires, and emissions from Mexico. These categories were held constant.

The specific levels of area source emissions for the NO<sub>x</sub>, SO<sub>2</sub>, VOC, carbon monoxide (CO), ammonia, PM<sub>2.5</sub>, and particulate matter with aerodynamic diameters less than 10 microns (PM<sub>10</sub>) are listed in both Table 7-1: *CENRAP's 2002 Base Year Emissions Inventory Summary for Texas* and Table 7-3. The emissions inventory predictions made for the CENRAP modeling indicate, for the area source category, sulfur dioxide emissions increase by approximately 2 percent. Statewide emissions of organics are predicted to increase by 6 percent, the PM<sub>10</sub> by 2 percent and the PM<sub>2.5</sub> by approximately 7 percent.

Ammonia is predicted to increase by 33 percent. The largest portion of ammonia emissions are associated with the area source agricultural-based sources. The Carnegie Mellon University model was used to estimate these emissions. Ammonia is not a limiting pollutant for visibility for Texas' and neighboring Class 1 areas. The area source sulfur dioxide emissions were from industrial and residential fuel combustion categories, heavily influenced by population growth, which are erroneously included in the CENRAP inventory. These coal-burning industrial and residential sources are not applicable to Texas and were not part of Texas' area source 2002 annual emissions inventory submission to EPA. Changes were not made in response to comments because the chapter summarizes the modeled values.

The NPS, FWS, and FS agreed that Mexico emissions contained within the boundaries of the CENRAP modeling domain are important contributors to visibility impairment at Big Bend and Guadalupe. The NPS, FWS, and FS requested that Texas acknowledge the work contained in the final Big Bend Regional Aerosol and Visibility Observational (BRAVO) study. The BRAVO study indicated sources in Mexico, Texas, and the eastern United States all play a role in sulfate conditions at Big Bend. The NPS, FWS, and FS look forward to working with Texas to solicit EPA action with its sister agencies to address the Mexico portion of sulfate impairment at Big Bend. The NPS, FWS, and FS also requested that the SIP speak to the Texas contribution to sulfate found in the BRAVO field study in the long-term strategy and reasonable progress sections.

City League for Environmental Action Now (CLEAN) also agreed with the BRAVO study 2004, an interagency report, which CLEAN interpreted found sulfur emissions from coal-fired power plants contributed to a larger proportion of haze in Big Bend than previously suspected.

The commission used the emissions inventory for the modeling from the BRAVO study as updated by Mexico. The commission used the latest available acceptable data for modeling for long term strategy and reasonable progress modeling. The BRAVO study collected data in 1999, then analyzed and produced the BRAVO Report in 2004, indicating that approximately one-third of the sulfate at Big Bend comes from outside the United States, one-third from Texas, and one-third from areas of the United States upwind of Texas. The commission revised Chapter 11 Section 11.3 to include reference to the BRAVO report.

The modeling for the SIP revision uses the latest available emissions estimates, including BRAVO study emissions estimates. The commission agrees that sulfur emissions are the most significant contributor to haze in the Big Bend Class I area. The commission disagrees that the importance of sulfur dioxide emissions in contributing to visibility impairment at Big Bend is a new finding. The NPS monitoring at Big Bend was showing this fact in the 1990s. Coal fired power plants are the major source of sulfur dioxide emissions. In the 2002 base period for the Regional Haze SIP revision, sulfate pollution contributed 55

**percent of the visibility impairment from pollution. Texas' sulfur dioxide emissions contributed 21 percent of this 55 percent of the visibility impairment from pollution at Big Bend on the 20 percent worst visibility days in 2002.**

One individual was concerned that commission does not know the extent of emissions from upstream oil and gas production. This information should have been gathered by 1999 for the Houston-Galveston-Brazoria (HGB) Ozone One-Hour Nonattainment Area SIP revision. The individual commented that numerous small to medium size point sources should be controlled to reduce regional haze, hazardous air pollutants, and transported ozone and precursors. This individual suggested improving the emissions inventory and expanding its categories.

**The commission acknowledges the need to improve the upstream oil and gas production emissions inventory. Current effort is underway by the TCEQ and CENRAP to improve this estimate and any improved estimates will be included in the five year SIP review. No changes were made to the SIP.**

The EPA asked whether the mix of electrical generating capacity (gas versus coal plus renewables) as projected in 2018 by the IPM appears reasonable when compared to that in 2002.

**As shown in Table 1 of Appendix 7-2, the IPM Version 2.19, used by CENRAP, projected an approximately 14 percent increase in coal/lignite-fired generating capacity in Texas from 2005 to 2018, and about a 32 percent increase in gas-fired capacity. The ERCOT projections, which are available to 2013, show a greater percentage growth in coal/lignite-fired than natural gas-fired capacity based on utility planning that is publicly available. Both the IPM and ERCOT projections show a greater amount of gas-fired capacity in the latest available projection year than coal/lignite-fired capacity. Although IPM projections of generating capacity from renewable resources such as wind power are not summarized in Appendix 7-2 (since sources such as wind power do not create visibility impairing pollutants), other data obtained from the EPA indicate that IPM projections of generating capacity from such renewable sources are much lower than those from ERCOT. As is the case for total projected generating capacities, the commission acknowledges that the projected mix of fuels for generating capacity is subject to uncertainties. Appendix 7-2 has been revised to clarify the discussion of the IPM-projected generating capacities for coal/lignite and natural gas.**

The FS commented that the Midwest Regional Planning Organization used the IPM Version 3.0 rather than Version 2.19. The FS requested that the TCEQ justify the use of IPM Version 2.19 in light of the EPA's recent indication that IPM Version 3.0 provides a significantly more accurate prediction of future EGU operating scenarios and emissions.

**The commission is not aware of a specific indication from the EPA that the IPM Version 3.0 provides a significantly more accurate prediction of future EGU operating scenarios and emissions than IPM version 2.19. The commission acknowledges that Version 3.0 was based on more recent assumptions relating to fuel prices, fuel availability, regulatory policies, and a multitude of other factors. Thus, the commission conducted an analysis comparing the potential visibility impacts on Class I areas from Texas EGU emissions, based on projections of emissions from each version of the model. This analysis is documented in Appendix 7-2. The analysis provided evidence that visibility impacts of EGU emissions from each IPM version would be similar. Thus, the commission concluded that the IPM version 2.19 would be a viable planning tool for Texas to use for regional haze. Due to the particularly long planning horizon to 2018 for regional haze and the uncertainty in the assumptions upon which the IPM is based, the commission does not conclude that either version of IPM is necessarily better than the other. The commission is also not aware of a**

**better EGU emissions planning tool than the IPM for regional haze SIP development. The commission made no changes in response to this comment.**

The FS referred to a discussion in Appendix 7-1 regarding IPM 2.19 versus IPM 3.0. The FS commented that “since they state that IPM 2.1.9 was constructed when natural gas was prevalent, it is likely that projections for Texas under IPM 3.0 would have higher emissions due to more use of coal.” The FS also commented that Texas said that statewide the emissions projected in both versions were very similar.

**The discussion in the proposed SIP referred to by the FS is actually found in Section 7.3.2 of Appendix 7-1 instead of Section 7.2.2.4. As noted in Table 1 of Appendix 7-2, total sulfur dioxide emissions projected to 2018 for Texas EGUs by the IPM Version 3.0 were approximately the same as those projected by Version 2.19, even though the IPM Version 3.0 projected about a 14 percent greater coal-fired capacity in 2018 than did Version 2.19. The commission does not conclude that emissions of sulfur dioxide projected by the IPM Version 3.0 would necessarily be greater than those projected by Version 2.19. The projected emissions are a function not only of capacities for the fuel types but also of the assumptions upon which each IPM version is based, including the extent to which sources implement emission controls for projected units or purchase credits in response to the Clean Air Interstate Rule (CAIR) or successor cap and trade program. The IPM Version 3.0 projected about a 10 percent decrease in nitrogen oxides from Version 2.19. The commission believes that the projected decrease was primarily due to the fact that Version 3.0 retired a large number of nitrogen oxide-emitting gas-fired generating units. In response to this comment, the commission made revisions to Appendix 7-2 to clarify the discussion of IPM-projected emissions.**

The FS commented that it would be helpful for a more detailed discussion of the IPM results and the analysis of EGU impacts on visibility in the listed Class I areas. The FS said that a map showing the groupings of EGUs would add to the discussion.

**The commission notes that Section 7.3.2 of SIP Appendix 7-1, to which the commenter referred, contains only a brief summary of the IPM analysis. A detailed discussion comparing results from the analysis of the two IPM versions is provided in SIP Appendix 7-2. This appendix presents a map of Texas EGUs emitting sulfur dioxide, the pollutant of primary concern for downwind visibility impacts, and presents tables showing the upwind Texas EGU groupings upon which the analysis is based. The commission considers that the map and the tables of EGU groupings provide sufficient information for the discussion provided in the appendix. No change was made to the SIP.**

One individual questioned why the TCEQ did not state how accurately the emissions inventory was for regional haze and questioned if this emissions inventory was any better than past inventories. The individual referenced several reports discussing the inaccuracy of the emissions inventory in past ozone SIPs and other reports. One individual believed TCEQ was doing nothing in this SIP, other than to reflect emission reduction programs already in place and additional sulfur dioxide reductions from refineries as a result of EPA refinery consent decrees. The commenter considered these reductions inadequate and insufficient for ozone attainment since the emissions inventories were deficient.

**The commission acknowledges the uncertainties of emissions inventory estimation techniques. Significant effort was made to provide the CENRAP modeling with the best available emissions estimates. Additional effort was made in categories considered more critical to accurate modeling, such as mobile sources. The commission continues to be committed to improving the quality of emissions inventories. The reports referenced by the individual mostly addressed industrial source VOC emissions. The nitrogen oxide and**



sulfur dioxide emissions were determined by the TCEQ to have the most significant impact on visibility impairment. For example, at Big Bend National Park annual average sulfate and nitrate observed concentrations account for greater than 50 percent of the visibility impairment in 2002 as shown in Figure 8-2 of the Regional Haze SIP revision. The sulfur dioxide and nitrogen oxide inventories are not predisposed to the same level of uncertainty associated with parts of the volatile organic compounds inventory because emissions of these pollutants generally result from combustion sources that can be measured directly and often have continuous measuring or monitoring devices that record those emissions. In addition, ozone model understanding is more than a decade ahead of regional haze modeling, while this Regional Haze SIP is the first for most states. Predicting regional haze can be more complex than ozone photochemical modeling because while the same complex atmospheric chemistry is involved, there are also more pollutants to model. Haze does not have to meet a health based standard, but is measured in deciviews (dv) and meant to improve visibility. The Region Haze Rule requires using all existing rules and regulations, state and federal, to determine a uniform rate of progress to improve visibility. All nitrogen oxide reductions made in support of achieving the ozone standard throughout the state are beneficial also to reducing regional haze. The commission made no changes in response to these comments.

#### **Chapter 8: Modeling Assessment**

The NPS and FWS commented that both Figure 8-4: *Observed and Base Case Modeled Concentrations at Big Bend* and Figure 8-5: *Observed and Base Case Modeled Concentrations at Guadalupe Mountains* are intended to support the discussion of the model performance evaluation. The commenters asked that the commission explain why the figures are referencing the Typical 2002G base year inventory instead of the actual 2002 performance inventory.

The CENRAP modeling team evaluated the differences in model performance evaluation (MPE) results between a version of the 2002F base case and 2002F typical case and found the differences in the statistics to be negligible. A minor correction was made in the 2002F typical case inventory, and at that point, in an effort to conserve resources, the modeling team decided not to rerun the base case, but to rerun the typical case and perform an MPE on the 2002 typical case. The MPE results for the 2002F typical case are the most recent available. The commission made no change in response to this comment.

The FS commented that in Chapter 8 while high contributions from international transport and natural sources certainly affect progress for Class I areas such as Big Bend, these sources do not apply to the northern Class I areas. The FS stated that transport from Canada is often associated with the cleanest days at these northern Class I areas.

**The sentence referred to above was meant to apply to the Texas Class I areas. The commission made minor changes to clarify the text.**

One individual commented that the commission did not acknowledge Harris County source impacts in other states. The commenter questioned if the commission investigated the cumulative affect of sources along the Houston Ship Channel that can affect regional haze.

**The commission disagrees with the commenter. The commission specifically requested that the Particulate Matter Source Apportionment Technology (PSAT) modeling analyses examine the impact of three Texas source regions. The results of the PSAT analyses conducted by CENRAP and the commission are presented in Appendix 8-1: *Technical Support Document for CENRAP Emissions and Air Quality Modeling to Support Regional Haze SIP*, see Chapter 5: *Additional Supporting Analysis*. As shown in Figure 5-8: *30 Source Regions used in the CENRAP 2002 and 2018 CAMx PSAT PM Source Apportionment Modeling*, Texas is broken up into three regions, one of these being the Gulf Coast which**

includes Harris County and the Houston Ship Channel. The source impacts from this area can be found in the PSAT results. An example of the results for Caney Creek can be found in Figure 5-10: *PSAT Source Region by Source Category Contributions to the Average 2000-2004 Baseline and 2018 Projected Extinction for the Worst 20 Percent Visibility Days at Caney Creek, Arkansas of the TSD*. The commission made no changes in response to this comment.

One individual was concerned about the modeling results. The individual stated that the commission admitted that visibility falls 5 percent short at Breton and 40 percent short at Wichita Mountains. In addition, the commenter asserted that the high contributions of ... natural sources (e.g., windblown dust) are likely human caused because grazing and farming and can cause long-term changes to surface area exposure which creates more potential dust generating surfaces. The individual asked what the commission will do to reduce Texas's agricultural emissions so that Class I areas outside of Texas will reach acceptable visibility levels as soon as possible. The individual advocated for quantification of agricultural impacts and destruction of natural plant coverage. This individual recommended rules to require best management practices for grazing, farming, and agricultural practices that expose soil and an implementation plan with enforcement to ensure that the plan and goals are achieved.

The federal Regional Haze Rule suggests states should not try to attribute ancient human land disturbances as anthropogenic. Specifically, the *Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Program* (EPA 2003) states that “estimates of natural visibility conditions should reflect contemporary conditions and land use patterns,” rather than “historic conditions.”

While some dust (coarse mass and fine soil) at both of Texas' Class I areas must be from some human activity, analysis of the dust storms that dominate high dust events at Guadalupe Mountains, and significantly impact Big Bend suggests that the dust originates from dry desert and dry lake bed areas with little or no human activity, almost all of which are situated in the Chihuahuan Desert. For instance, in the 2005 report *Investigation of Dust Emission Hotspots in Chihuahuan Desert Playa Basins*, Gill et al. state the conclusion that “Field campaigns revealed that ... the vast majority of source points were natural desert landscapes” (Gill et al. 2005). In addition, the Gill et al. work found that:

Particle size analysis of surface sediment samples revealed that many of the dust source points have surface granulometries which create a “perfect storm” for aerosol emission. They include two or three distinct grain size populations: very fine clays in the PM<sub>2.5</sub> range (including particles as small as 0.2 micron in clay playa sites) and fine sands (50- 200 µm), and in some sites silts (10- 50 µm particle size). This is consistent with current state-of-the-science knowledge of the desert wind erosion process. Sand grains saltate (bounce) across the land surface in wind storms, breaking apart and “sandblasting” silt and clay aggregates and releasing their individual constituent grains into the atmosphere as dust.

The commission has included additional supporting evidence in Appendix 5 for the estimate that, at least for the estimation of natural visibility values for Texas Class I areas, that major dust events can be approximated to be completely natural in origin. Additionally, since there is uncertainty in this estimate, as there is in all the components of natural visibility conditions, the commission has provided plots showing the results for the 20 percent worst natural conditions Haze Index (in deciviews) if one were to treat only 80 percent of the coarse mass and fine soil to be natural. However, this 80 percent calculation is displayed only as an indication of how little sensitivity this natural visibility estimate has to approximating 100 percent of the coarse mass and fine soil as natural.

**At this time the commission has no plans to add additional control measures for grazing and farming dust emissions. This issue may be reviewed in future Regional Haze SIP revisions.**

One individual commented that the modeling may be inaccurate for the following reasons:

- the modeling area is larger than used for other nonattainment demonstrations;
- the poor quality of emissions inventory in Texas and other states; and
- the lack of credibility of the CAMx model being used since it has failed to model Houston and Dallas successfully towards ozone attainment using real monitoring data.

Due to these issues, the commenter suggested severe credibility problems for the Texas regional haze modeling. In Chapter 8, the commission did not provide any information about the accuracy of the modeling done by the TCEQ, CENRAP, or EPA. For previous ozone attainment SIP revisions, the commission stated that the modeling conducted was sufficient, adequate, and documented attainment; yet, the goals were not met.

**This modeling analysis is currently the most credible analysis available for regional haze. Texas and other states are continuing to improve their emission inventories and their modeling platforms. The regional haze modeling domain encompasses such a large area because pollutants that contribute to haze can travel great distances. The commission made no changes in response to this comment.**

The NPS and FWS commented that there is a considerable amount of discussion in the SIP revision that emissions used by CENRAP and others for modeling were greater than the inventory reported by the commission. However, Figures 8-4 and 8-5 use the CENRAP typical base year inventory of 2002 and consistently show significant under prediction of all visibility impact parameters when compared to observed values. Although the model is later used in a relative sense (employing relative reduction factors (RRFs)), Texas should address this apparent discontinuity between text describing a significant over estimate of SO<sub>2</sub> emissions and model performance metrics that indicate a significant under estimate. One individual advocated for more control measures since the modeling under estimates many haze-forming pollutants.

**The commission has analyzed the model performance and learned that the modeling under predicts the sulfate impacts from outside the United States, Texas, and states upwind of Texas. The commission has requested further analysis of the model performance. The initial results suggest that the model may be producing the correct sulfate concentrations but not transporting them all the way to these West Texas Class I areas. The first report of this work has been added as Appendix 8-2: *Big Bend Model Performance Analysis*. The commission has further model performance analysis work under way to support improved model performance in future Regional Haze SIP revisions. The commission is also working with its modeling contractor to correct the over estimation in the area source emissions inventories. No changes have been made in response to this comment. (For more details on controls, see the response under general comments with the current list of control measures, pages 44-45.)**

#### **Emission Categories Held Constant**

The NPS, FWS, and one individual commented that the Gulf of Mexico has significant contributions in 2018 for the worst 20 percent of visibility days. Offshore emissions should not be held constant through the planning period. The commenters suggested that a better estimate of the future case emissions should be made.

**The commission spoke with Minerals Management Service (MMS) personnel in spring 2008 who stated that MMS has no issues holding offshore emissions constant for the following reasons:**

- **MMS currently has no data to justify growth in emissions and agrees that a projection to the future with no change is a reasonable one.**
- **Current closer-in leases are being exhausted and shutdown; new leases are for deeper water offshore and further out into the gulf. Application of newer technology will reduce emissions per unit of production.**
- **MMS personnel indicate that these further out sources are likely to have less impact onshore.**

**MMS is currently preparing a 2008 emission inventory, which will be completed in 2010. Emission trends will be reviewed by the commission when that data is publicly available. No changes have been made based on these comments.**

One individual questioned why so many inventory categories between 2002 and 2018 were held constant.

- Global transport of air pollution from China would vary.
- Mexico and Central America emissions vary due to changes in economic activity.
- The Sam Houston National Forest and three other national forests in Texas are conducting more prescribed burning than in the past to provide better habitat for the federally endangered Red-cockaded Woodpecker. So within Texas, there may be more burning of vegetation.
- Emissions from wildfires between 2002 and 2018 can vary greatly depending on droughts, winds, and other factors.

**GEOS-Chem was used to model boundary conditions for the CENRAP modeling domain, including those for China. The commission cannot reasonably predict future emissions from China. Holding these inventories constant while growing Texas and the United States emissions puts more emphasis on the potential future impact from Texas and United States sources on Class I visibility impairment. Depending upon resources and quality of future global emission inventory data, the commission may consider future case model runs of GEOS-Chem or other global models to use for future case boundary conditions. In addition, regional haze from China appears not to be a significant factor in the worst 20 percent of days at Class I areas that Texas impacts, so the assumptions about this source of regional haze are likely to be insignificant in affecting future projections for these Class I areas.**

**For the Mexican and Central American emissions, the direction of emission changes is uncertain. Improving economic status often results in more investment in pollution controls. The improvement in pollution reduction may or may not offset the increasing economic activity and energy usage in these countries. The commission understands that Mexico is currently working on the development of a 2005 emissions inventory and future emissions projections and will review this information when it becomes publicly available.**

**In regards to prescribed burning and wildfires, the commission acknowledges that there can be great variability from year to year. However, in current analyses, smoke emissions from fires are not an important contributor to regional haze at Class I areas in Texas. No changes were made in response to these comments.**

One individual considered it a faulty assumption to use the same biogenic emission inventory between the base case and the future case for modeling. The commenter asserted that biogenic VOC was not constant due to urban deforestation caused by sprawl.

**Predicting future biogenic inventories is projected to cost approximately \$5 million and not necessarily more accurate than the base case inventory. Urban sprawl along with its vegetative changes is difficult to quantitatively estimate, so any predictions are also likely to be uncertain. If sufficient resources were available to project a future inventory, the commission could use the results for modeling; however, the new inventory would likely be consistent with the current biogenics assumption. No changes were made in response to this comment.**

#### **Chapter 9: Best Available Retrofit Technology (BART)**

The EPA and one individual noted concern that Texas had no BART sources that had to install control equipment of the approximately 250 potentially BART-eligible sources in the state. The EPA commented that Texas sources significantly contribute to visibility degradation to a number of Class I areas in other states, in some cases more than the host state. The EPA commented that it is unclear how this decision is “reasonable” under Section 51.308(e), which requires that, “The state must submit an implementation plan containing emission limitations representing BART and schedules for compliance with BART for each BART-eligible source that may reasonably be anticipated to cause or contribute to any impairment of visibility in any mandatory Class I Federal area.” The individual considered that Texas having no sources subject to BART showed that the commission has no desire to attain regional haze standards by the 2064 compliance date.

**BART applies to sources completed between August 7, 1962, and August 7, 1977. Many of these sources have already been subject to controls, which lowered the emissions to levels that screened potentially BART-eligible sources from visibility impairment in Class I areas. Some of these sources were constructed under Texas new source review (NSR) permitting requirements, which included best available control technology (BACT) requirements. These requirements were initially implemented between 1971 and 1972. Sources constructed under these rules were required to use effective engineering controls to minimize or eliminate emissions of all air pollutants. Additionally, Senate Bill 7, passed in the 76th session of the Texas Legislature in 1999, required all electric generating units (EGUs) to reduce sulfur dioxide and nitrogen oxide emissions under permits by no later than May 2005. Moreover, House Bill 2912, passed in the 77th session of the Texas Legislature in 2001, required all previously grandfathered sources (i.e. constructed prior to August 30, 1971) to obtain standard permits, permits by rule, or an individual permit. House Bill 2912 specified the performance required for upstream natural gas field compressors powered by internal combustion engines. For all other individual permits, the engineering standard required the sources to apply ten-year old BACT to obtain a permit. The compliance date required by these permits for sources in eastern Texas (except for small business owners) was March 1, 2007. The compliance date required by these permits for sources in western Texas and for small business owners was March 1, 2008.**

**BART was designed to bring major sources that had been grandfathered under federal new source review rules under effective control, but all Texas sources have already been brought under effective emission control requirements by Texas permitting requirements, and to some extent, recent EPA refinery consent decrees. Thus, since Texas has already addressed the control technology of its sources by requiring permits even when federal new source review was not in place or through its subsequent permit requirements under state law, it is not surprising that BART, designed to add controls to unregulated industry, did not require additional reductions.**

**Title 40 CFR 51.308(e)(4) says, "A state that chooses to meet the emission reduction requirements of the CAIR by participating in one or more of the EPA-administered CAIR trading programs for sulfur dioxide and nitrogen oxide need not require BART-eligible EGUs subject to such trading programs in the state to install, operate, and maintain BART for the pollutants covered by such trading programs in the state." Texas has adopted the CAIR rule as well as other SIP revisions that reduce emissions. These actions removed the large majority of the Texas sources from further BART consideration for sulfur dioxide and nitrogen oxide controls. The decision to treat CAIR as equivalent to BART will be revisited if CAIR is replaced with a trading program or rule that the EPA considers to be equivalent to BART, and that addresses the federal appellate court's ruling. The TCEQ will provide a SIP revision to address this issue, once the federal government has finalized its decision with respect to CAIR or a replacement trading program for sulfur dioxide and nitrogen oxide.**

**A large percentage of major non-EGU sulfur dioxide and nitrogen oxide sources in Texas are hundreds of kilometers from the nearest Class I area, so their contributions to visibility impairment at Class I areas are small. The emission reduction requirements under EPA's refinery consent decrees resulted in dramatic reductions in sulfur dioxide emissions from refinery and sulfuric acid plant emissions of sulfur dioxide. Without these consent decree reductions, BART requirements may have applied in some cases. Because emissions from these facilities have already been controlled by Texas' permitting requirements, these sources were not subject to additional controls as a result of the BART requirements, which have been incorporated into the TCEQ's BART rule adopted on January 10, 2007.**

**In accordance with the EPA guidance, the commission implemented the BART rule and followed procedures laid out in the rule. The commission modeled sources in a conservative manner to screen out sources that had less than a 0.5 deciview impact on Class I areas as provided in the EPA's BART rule. Some sources that did not screen out of the initial modeling chose to shut down facilities or to apply controls which reduced their impact on Class I areas. Other sources already had extensive controls in place due to other emission control programs for ozone SIP revisions, and the refinery consent decrees. The BART process is fully explained in Chapter 9: *Best Available Retrofit Technology* of the SIP revision. All BART-eligible sources are listed. In addition, there is a list of sources that reduced their potential to emit through permit amendments, and/or by shutting down units in order to avoid being subject to BART controls. At this time, all BART-eligible sources have modeled emission impacts below the BART determination threshold due to emission reductions required by existing regulations or consent decrees. No changes were made in response to these comments.**

The EPA, NPS, FWS, and FS commented that the federal Regional Haze Rule established BART criteria for exempting sources that are determined to be non-significant, and that the EPA offered an upper bound of that single source significance level at 0.5 deciview. The EPA and FS asked that Texas provide a discussion of how it arrived at its selected 0.5 deciview threshold value.

**The 0.5 deciview threshold was adopted by the commission on January 10, 2007, as part of the Texas BART rule. The response to comments in that rule adoption stated: "The commission will not lower the 0.5 deciview threshold. The commission has received no evidence that a lower threshold is appropriate in Texas. By using only a single threshold, the TCEQ does not intend to imply that the threshold for causing visibility impairment is the same as for contributing to. Since TCEQ expects all Class I areas have more than one source impacting visibility, any source that causes visibility-impairment (such as, using for example, based on the EPA's threshold of a humanly perceptible visibility impact of 1.0 deciview or greater) also contributes to the same. So 'the contributes to' threshold is the one relevant to this rule. ...The commission is following EPA guidance, Part 51, Appendix**

Y, Section III.A.1, and has made no changes in §116.1520 and §116.1530 in response to the comments.”

**Additionally, as discussed previously, almost all Texas sources that might have been subject to BART technical analysis requirements under the BART rule are hundreds of kilometers from the nearest Class I area and their emissions are already controlled under appropriate permitted emission limits. Since Texas has neither grandfathered sources nor a large number of sources near Class I areas and potentially subject to BART technical analysis and control requirements under BART, the commission does not consider it appropriate to use a threshold other than the 0.5 deciview threshold that EPA set. No changes were made in response to this comment.**

The EPA, NPS, and FWS commented that several tables in Chapter 9 were difficult to understand. The EPA asks for further documentation and building of a cross-walk to help demonstrate what modeling was used to screen-out each source. The NPS, FWS, and one individual questioned why Table 9-6: *Post-BART Emissions Reductions at Texas Sources* in Chapter 9 and Appendix 9-12: *BART-Eligible List* are not the same. The NPS, FWS, and one individual asked the commission to clarify the differences between the two tables and provide more definite information regarding the ExxonMobil facility.

**The commission acknowledges that the BART-eligible tables may be difficult to understand due to the complexity of the BART process.**

**The table in Appendix 9-12 is the BART-eligible list that has been on the Web site since April 2006 when the BART survey results were posted; this same source list has been updated with details of each exemption, modeling completion, usage of the model plant, and whether the source passed or failed the modeling threshold. To simplify this potentially six page BART-eligible list, this larger list was broken into smaller and simpler tables with an explanation of the differences. Therefore, combining all the tables in Chapter 9 are approximately equivalent to the larger, more detailed table in Appendix 9-12. The exception is the greater detail in Table 9-6 of Chapter 9, which documents the estimated post-BART reductions of approximately 9,000 tpy and that is found only in Chapter 9.**

**Not all of the sources shown in the table in Appendix 9-12 referred to in the comment will reduce NO<sub>x</sub>, SO<sub>2</sub>, or particulate matter emissions. Table 9-6 in Chapter 9 has been updated to clarify this, and to show the most current information available. The detailed documentation of the emission reductions shown in Appendix 9-10 has also been updated with the most current information available. Reduction estimates are conservative because they are from the 2002 actual emissions level to a potential to emit level. Should any of the reductions noted in the tables need to be further updated, they will be incorporated into the SIP revision at the next review in 2013. In response to these comments, the commission simplified the tables in Chapter 9 and updated the information on ExxonMobil.**

The EPA commented that in Chapter 9 of the SIP revision the TCEQ should address the following:

- a) The TCEQ should present additional detail on the methodology used to identify the initial list of potentially BART-eligible sources that received surveys. For instance, was a permit review part of this strategy? How did the TCEQ determine if particular sources were in one of the 26 BART categories; had a potential to emit of 250 tpy or more of any visibility-impairing pollutant; and were not operating prior to August 7, 1962, and were in existence on August 7, 1977? This should include a discussion of the sources discussed in Section 9.5, which were exempted from BART-eligibility through the TCEQ BART Rule.
- b) The TCEQ should present additional information that demonstrates this strategy effectively captured all potentially BART-eligible sources within the state.

**This Regional Haze SIP revision provides additional information on the survey methodology used by Texas. A copy of the survey is included as Appendix 9-3: *Texas Survey for BART Eligibility*. The updated information summarizes Texas' method to capture sources meeting the BART-eligibility requirements outlined in the EPA's Regional Haze Rule. Standard Industrial Codes and Source Classifications Codes were associated with the 26 source categories identified in the EPA BART Rule. The TCEQ surveyed all Texas sources with applicable codes and emissions thresholds, including fossil-fuel steam generating plants with potentially BART-eligible quantities of particulate, for additional information regarding build and reconstruct dates and potential to emit level for emissions. The information obtained in this survey helped identify the sources that were BART-eligible. Sources requested exemptions based on the 2007 Texas BART Rule, modeling for visibility impacts, or other updated information at the site. The exemption process is also discussed in Chapter 9 Section 9.2 through 9.5 of the Regional Haze SIP revision. The BART-eligible sources were adequately captured in this process. The companies surveyed represented over 97 percent of the sulfur dioxide and 77 percent of the nitrogen oxide emissions from 2002.**

The NPS and FWS commented that the two tables in Chapter 9 identify BART-eligible sources that were exempted after performing source-specific BART engineering determinations through either CALPUFF modeling (Table 9-3: *BART-Eligible Sources Exempted Based on CALPUFF Modeling Results*) or CAMx modeling (Table 9-4: *BART-Eligible Sources Exempted Using Single Source CAMx Modeling*). The commenters suggested that it would be helpful to list the modeled visibility impact results for each of these facilities in these tables (i.e., Class I area, deciview impact, and distance/direction information for each Class I area evaluated in the individual source modeling analyses). The commenters suggest that this information would provide the reader with a quick reference of the relative importance of each listed facility that was exempted through individual source attribution modeling.

**The commission provided the information requested in Chapter 9. Table 9-3 now presents the source, the Class I area modeled with the greatest impact, distance to the Class I areas, and the modeled visibility impact at each Class I area.**

One individual commented that the distances used for BART-eligible sources are too short (50 kilometers or 31 miles and 100 kilometers or 62 miles) since TCEQ and other agencies have shown that emissions can travel hundreds of miles away and affect Big Bend and Guadalupe Mountains. This individual suggests expanding distances up to 400 kilometers or 250 miles, since it has been documented by studies that ozone can be transported into the Dallas area from the Houston area. In the case referenced by the individual, ozone air pollution traveled over 400 kilometers or 250 miles.

**The commission did not limit the distance from a Class I area for potential BART-eligibility to 50 or 100 kilometers. All sources regardless of distance, with the appropriate category of sources as defined by the BART rule, within the state were considered. Based on analysis of visibility impacts, the EPA allowed the use of the model plant analysis by which a state could choose to exempt sources that emit smaller amounts of nitrogen oxide and or sulfur dioxide, as long as they were more distant from a Class I area, per Option 2: *Use of Model Plants to Exempt Individual Sources with Common Characteristics* under Appendix Y to Part 51-Guidelines for BART Determinations Under the Regional Haze Rule (page 39162). Texas concurred with this use for the lesser significant emitting sources for the purposes of BART analysis. All applicable sources within the 50 kilometer range were considered for BART. Additionally, all sources, regardless of their distance from the Class I areas or quantity of emissions, were included in regional haze modeling and consideration for additional potential controls, even if initially removed from BART consideration. The commission**



**looked at a range of distances from approximately 90 to 600 km (see Appendix 9-6, Table B-1). No changes were made in response to this comment.**

One individual suggested the TCEQ establish areas of influence (AOI) to capture sources farther away than 50 to 100 kilometers away from Class I areas. This individual suggest the TCEQ use these areas of influence subdivided geographic areas and emphasize sources that have the highest possibility of providing reductions that will benefit visibility and thus reduce regional haze impairment.

**As part of the area of influence analysis, the TCEQ identified any source within an area of influence with potential add-on controls and its costs were included. The analysis included sources greater than 50 to 100 kilometers from any of the ten Class I areas. Sources with potential controls were identified from the CENRAP list which was developed using EPA's AirControlNET. The visibility impact from these potential controls was evaluated and this SIP revision is updated to reflect this analysis in Chapter 9. Control strategies were limited to costs similar to those of other air control programs such as EPA's estimate of the Clean Air Interstate Rule's cost of \$2,700 per ton. Changes were made to Chapter 10 to more thoroughly explain the AOI-based analysis.**

#### **Chapter 10: Reasonable Progress Goals (RPGs)**

The FS commented that Texas correctly used the modeled value for the 20 percent best days as its reasonable progress goals (RPGs). As part of the consultation process, the FS has indicated to several other states their incorrect interpretation. The FS commends Texas for setting this reasonable progress goal correctly.

**The commission appreciates the comment and looks forward to a continued and collaborative relationship with the FS and other FLMs.**

The EPA requested that the TCEQ discuss the emissions reductions resulting from its BART rule. In Chapter 10, the TCEQ stated its reasonable progress goals, "These RPGs do not include additional emissions reductions from implementing the Texas BART rule ...."

**The reductions associated with the BART rule are discussed in the Chapter 9 and summarized in Table 9-5: *Post-BART Emissions Reductions at Texas Sources*. Although Chapter 9 estimates potential reductions, the commission chose not to include these reductions in the long term strategy in Chapter 10 at this time. Texas may examine these reductions again at the next revision, if needed. The commission made no changes in response to this comment.**

The EPA commented that there is no provision in the federal Regional Haze Rule for delaying potentially cost effective controls due to modeling uncertainty. The EPA noted that the TCEQ's proposed SIP stated a potential over prediction of electric generating units emissions on Class I areas by the IPM model analysis. Also, the EPA commented that the uncertainty in the impact of the CAIR program is one reason why the TCEQ has elected not to pursue additional controls at this time.

**Due to the uncertainty in the impact of CAIR or its eventual replacement (whether over predicting or under predicting emissions), the commission's approach at this time is to track CAIR or replacement program over the five-year and ten-year intervals, and determine if additional controls are needed in Texas.**

The EPA commented that under Section 51.308(d)(3)(ii), the TCEQ must demonstrate it has included all measures necessary to obtain its share of the emission reductions needed to meet the progress goal of Class I areas in other states as well. The EPA requested that the TCEQ

investigate reductions at Wichita Mountains in Oklahoma, Caney Creek in Arkansas, and Salt Creek in New Mexico, as well as other Class I areas Texas has shown to impact.

**The commission has updated Chapter 10 of the SIP revision and Appendix 10-1: *Analysis of Control Strategies RPG* with a summary of Texas' proposed control strategies for ten Class I areas. This includes the Big Bend and Guadalupe Mountains National Parks and eight others outside the state. The summary includes impacts of visibility impairment from proposed controls for those Class I areas.**

The EPA, FS, and one individual noted that the TCEQ took the position that even if over \$300 million dollars was spent on sulfur dioxide and nitrogen oxide controls at the 24 sources (Table 10-4: *The TCEQ's Point Source Control Strategy Summary*), only 0.05 deciview improvement would be seen at Big Bend and Guadalupe Mountains (Table 10-5: *Estimated Visibility Improvement*). The EPA and FS noted this assessment did not consider that the average cost of sulfur dioxide control was approximately \$1,850 per ton. Considering that sulfate (SO<sub>4</sub>) was the dominant controllable pollutant the TCEQ indicated causes or contributes to visibility impairment (Figures 8-4 and 8-5), the TCEQ should reconsider this assessment. One individual considered the value of people's lives and the pristine wilderness worth the cost of controls.

**The commission did consider source controls that were not already on the books. The on-the-books controls, including CAIR, were included in the CENRAP Base G modeling run. A CENRAP-directed effort used EPA's AirControlNet program to determine additional controls for various source categories beyond the Base G. These potential controls, associated costs, and benefits were considered in the four factor analysis which is revised in the SIP. The incremental cost was not reduced in this study. The commission's proposed control strategy for additional controls results in a negligible projected improvement in visibility. The commission's analysis concludes that additional controls for regional haze are not reasonable at this time. However, this will be reviewed in future SIP revisions.**

The FS referred to paragraph in Chapter 10 indicating that no electric generating unit was able to make an enforceable commitment to any particular pollution control strategy. The FS commented that Texas has no basis to state that the IPM projections were an over prediction. The FS commented that the IPM projections could also be an under prediction, which would not add to the justification for not pursuing any additional controls.

**The commission's wording in the proposed Regional Haze SIP referred to a potential over prediction of emissions by the IPM. However, the commission agrees with the commenter that the IPM could also be under predicting. The paragraph has been revised.**

The EPA commented that an evaluation on emissions over distance analysis (Q/5d) can be conducted but emissions over distance analysis are sensitive to the meteorology that impacts the transport and may not yield a conservative analysis. For example, if the source modeled is not upwind (and the source does not transport directly to the Class I area frequently), the analysis would not be conservative to evaluate another source that is upwind of the Class I area more frequently. The EPA requested an expanded discussion of this issue so the analysis for all sources is a conservative assessment.

**The commission agrees emissions over distance analyses can be sensitive to weather and transport and may not yield a conservative analysis so it used areas of influence for the top priority anthropogenic pollutant emissions from Texas for each Class I area affected by emissions from Texas. Development of these areas of influence integrated considerations of wind flow, frequency of pollutant impacts, residence time, and concentration of sources as well as distance from the individual sources to the Class I receptor and the emission rate of each source. Chapter 10 and its appendices provide further information on the use of areas**

**of influence and the four factor analysis in determining whether all reasonable controls have been applied in this round of emission reductions to proceed toward the national goal of natural conditions at all Class I areas. Changes were made in response to this comment.**

The NPS, FWS, and one individual commented that the text associated with Table 10-7: *Contributions to Visibility in the Texas Class I Areas* implies that the boundary conditions contribution to impairment is primarily from Central America. The CENRAP modeling assessment did not differentiate among five large-scale model boundaries when compiling data for sulfates and nitrates. The commenters requested Texas clarify whether Table 10-7 is referring to total contribution to extinction or contributions to sulfate and nitrate impairment based on the CENRAP tracking model. The TCEQ needs to acknowledge that a portion of boundary conditions may be a result of recirculation of Texas and other United States-generated emissions. The SIP revision should note that boundary conditions are highly uncertain and that contributions from within the model boundaries may be significantly higher.

**Because the CENRAP modeling does not identify the source area of pollutants transported into the CENRAP modeling domain from the boundary, the information about source areas beyond the CENRAP modeling domain comes in part from available information about the location, density, and nature of anthropogenic and natural sources. The information also comes from back trajectory analysis conducted by the NPS in the 1990s and back trajectory analysis for the 20 percent worst of days in 2002 at Big Bend.**

The commission interprets these data to be generally consistent with the CENRAP particulate matter source apportionment (PSAT) modeling, which shows in Figure 11-2: *Areas and Pollutants Causing Regional Haze at Big Bend* that the extinction contribution from Mexico and from the boundary conditions are roughly equal, but that nearly all the international transport of organic carbon and black carbon comes from the boundary condition area. This result is consistent with satellite imagery and other information pointing to southern Mexico plus the southern Yucatan as being the major source areas for the smoke at Big Bend. The large amount of oil and gas production activity in the Bay of Campeche plus the urban and industrial activity in Mexico from the southern part of Mexico, which includes Mexico City and all but the northern tip of the Yucatan, are in the boundary conditions domain. The commission concludes that these facts are generally consistent with the international sulfate impact at Big Bend, which the PSAT analysis attributes mainly to the northern portion of Mexico, which is in the CENRAP modeling domain.

The commission agrees that occasionally some United States continental haze does migrate far enough south into the Gulf of Mexico that the GEOS-Chem model used to produce the boundary condition estimates could have included it in the regional haze transported from the boundary conditions domain into the CENRAP modeling domain. The commission disagrees with the suggestion that a significant amount of regional haze attributed to the boundary conditions comes from the United States. When air masses penetrate that far south into the Gulf of Mexico, they are often following strong cool or cold fronts moving rapidly enough that they do not accumulate large amounts of regional haze. Slow moving summertime high pressure areas that accumulate large amounts of regional haze are much more often associated with recirculation into the United States from the central and northern Gulf of Mexico, where the CENRAP PSAT modeling analysis would identify the correct source area and attribute the pollution to that area.

The commission agrees that there is significant uncertainty about emissions in the boundary conditions area and from Mexico, but the commission concludes that the representations in the CENRAP PSAT analysis appear generally reasonable. The commission notes that the analysis in the BRAVO study concluded in the late 1990s and analyzed early in this decade

**indicates that approximately one-third of the sulfate at Big Bend comes from outside the United States, one-third from Texas, and one-third from areas of the United States upwind of Texas. The commission has revised its SIP revision to include these important perspectives. If this attribution of more of the sulfate to the midwestern and southeastern United States turns out to be more accurate than the CENRAP PSAT modeling, then the reductions from CAIR or its replacement program could be more effective in reducing regional haze at Big Bend and Guadalupe Mountains than the commission has projected using CENRAP PSAT modeling.**

The FS commented that the uniform rate of progress shown in Chapter 10 is not the EPA default rate and should be indicated as such.

**The commission disagrees that the EPA default should be in the SIP narrative as it might add to reader confusion; however, the text in Chapter 10 has been revised and refers the reader directly to the EPA default rate in Appendix 10-3: *Uniform Rate of Progress Curves Using Default Natural Conditions Estimates*. In addition, the appendices to Chapter 10 are located directly after Chapter 10 in the SIP submission so that the relevant information that the FS requested is more convenient for review.**

The NPS and FWS requested the additional references cited in the reasonable progress discussion, including the Alpine Geophysics, CENRAP, and EPA works, be included in the appendices.

**These documents were written by parties outside the agency and are cited as references in support of Texas' work. Except for the EPA documents, appropriate references have been added to the TCEQ's regional haze Web site in response to comments.**

One individual commented that it takes time to clean up present polluters. This individual proposed that Texas should not continue to grant exceptions to grandfathered emitters, and the TCEQ should not consider permitting additional uncontrolled sources.

**The commission does not agree that grandfathered sources are granted exceptions from permitting. There are no longer grandfathered facilities in Texas. The Texas Clean Air Act requires that all sources previously grandfathered submit a permit, qualify for an applicable permit-by-rule, or shut down by 2004. During the permit review process, the emissions from previously grandfathered sources are reviewed to ensure that the permit protects human health and the environment. The appropriate and feasible emission control requirements vary depending on the size and nature of the source are determined on a case-by-case basis. New and modified sources are required to meet current Best Available Control Technology (BACT), including these previously grandfathered sources. Any source that is modified must meet current technology requirements through additional permit review or by meeting the conditions of a permit-by-rule. Insignificant sources may be authorized under an applicable permit-by-rule, which may allow a lesser degree of control due to the small size of the source.**

#### **Four Factor Analysis**

The FS commented that given the uncertainty of the modeling and the implementation of CAIR, the SIP appeared to disregard Texas impacts to Class I areas in Arkansas and Missouri. PSAT results indicated that Texas sources were the largest contributor to visibility impacts at these wilderness areas, particularly at Caney Creek Wilderness in Arkansas. The FS requested that Texas analyze and fully disclose Texas impacts to these Class I areas. The long term strategy and four factor analysis for reasonable progress should address these Class I areas at Caney Creek and Upper Buffalo.

**The commission agrees that the SIP revision must show the full impact Texas has on each Class I area it impacts as well as the amount of reduction in that impact that modeling indicated the long-term strategy will produce by 2018. The commission has revised this SIP to show those full impacts and impact reductions for all Class I areas affected by Texas' emissions. The commission agrees that it is necessary to identify specific areas of influence for each Class I area impacted by Texas' emissions, including Arkansas and Missouri. Further, a four factor analysis is necessary for the set of sources in the respective areas of influence that impact each of the Class I areas that Texas' emissions impact. Chapter 10 presents these areas of influence, the sources within these areas that were considered for additional control, and the results of the four factor analysis for each set of sources. (The four factor analysis considers the cost of reducing air pollution emissions, the time necessary for compliance, the energy and non-air quality environmental impacts of reducing emissions, and the remaining useful life of existing sources that contribute to visibility impairment.) Changes were made to Chapter 10 Section 10.4 in response to this comment.**

One individual disagreed with TCEQ's approach of not adding more controls since 25 percent of regional haze emissions are due to international sources. The individual questioned if TCEQ had double counted emissions in Table 10-7 since boundary conditions and Mexico can have overlap. The individual questioned the accuracy of visibility impairment from international sources.

**The commission disagrees with these comments. The commission's decisions about the amount of control that is reasonable are independent of the impact of international transport. The boundary condition area and the areas of Mexico that are inside the CENRAP emission inventory and modeling domain are distinct. The modeling procedures were set up to separate the emission points into either the CENRAP modeling domain or the domain for GEOS-Chem, which was used to model the boundary condition domain. The dividing line is the southern boundary of the CENRAP modeling domain, shown in Figure 8-2: *National Inter-Regional Planning Organizations Modeling Domain*. The emission points in Mexico are in the CENRAP modeling domain if they are north of the CENRAP domain boundary. The Mexican emissions south of the CENRAP domain and the emissions from Central America are in the boundary conditions. The inventoried emissions from Mexico are assigned to only one of these two areas. Chapter 11 discusses the uncertainty in assignment of regional haze at Big Bend to international transport, to Texas, and to the rest of the United States. The commission's decisions about the amount of control that is reasonable in this Regional Haze SIP revision is based on the four factor analysis, as the EPA's Regional Haze Rule specifies. (The four factor analysis considers the cost of reducing air pollution emissions, the time necessary for compliance, the energy and non-air quality environmental impacts of reducing emissions, and the remaining useful life of existing sources that contribute to visibility impairment.)**

One individual was concerned that what makes emissions reductions from programs like CAIR unlikely is that many sources want to purchase emission credits and do not want to add on air pollution controls to reduce regional haze. These actions undermine TCEQ's statement that existing program reductions are sufficient so nothing more needs to be done for the next five years.

**The commission disagrees with these comments. The federal Regional Haze Rule requires that all reasonable reductions occur. Regarding CAIR or its eventual replacement, as a program that covers the entire Eastern United States, reductions occurring in surrounding states will positively impact visibility in Class I areas in Texas. The TCEQ has used the four factor analysis, as required, for the set of Texas sources impacting Class I areas, to determine whether all reasonable reductions have been required. The four factor analysis considers the cost of reducing air pollution emissions, the time necessary for compliance, the**

**energy and non-air quality environmental impacts of reducing emissions, and the remaining useful life of existing sources that contribute to visibility impairment.**

The NPS, FWS, and FS commented that in establishing the reasonable progress goals (RPG), the TCEQ failed to establish a sufficient relationship between the most attributable sources for visibility impacts and the affected Class I areas. The NPS and FWS found it difficult to ascertain what geographical source region and which sources contained within that region TCEQ considered when establishing the total costs for visibility improvement at the two Class I area within Texas. The NPS and FWS commented that the TCEQ provided insufficient information on the four factor analysis to show that controls at specific sources on a cost per ton basis were unreasonable. The NPS and FWS requested that the TCEQ identify specific geographic regions, based upon area of influence studies, that encompass the most important visibility-affecting emission sources for Big Bend and the Guadalupe Mountains and focus its reasonable progress analyses for these two Class I areas. The NPS and FWS asked that the TCEQ identify significant point sources in those areas of influence and conduct a thorough reasonable progress analysis with more specific four factor responses for that source region.

**In response to these comments, the commission revised the Regional Haze plan with a summary of the area of influence analysis for ten Class I areas, including eight outside the state. Impacts of emissions on those Class I areas are included. Texas has listed emissions from significant sources in a Class I's area of influence. A list of these sources is included in an adopted version of the SIP.**

**Costs of controls for sources that impact any of these ten Class I areas were considered in the four factor analysis. A more detailed four factor analysis is summarized in Chapter 10. The commission's analysis indicates that additional controls beyond those already existing on the books are not considered cost effective at this time. This issue will be readdressed in future Regional Haze SIP revisions. The federal Regional Haze rule requires states to submit five-year progress reports that include an assessment of whether the current plan strategies are sufficient for the state to meet the reasonable progress goals. If it is found that strategies are not sufficient, 40 CFR § 51.308(h)(4) requires that a revision to the SIP be submitted within one year, rather than waiting for the next 10-year comprehensive review. Changes were made in response to these comments.**

The NPS, FWS, and FS commented that in large geographic states such as Texas or Alaska, establishing these areas of influence are important for describing appropriate cost benefit arguments, since evaluations applied on a state-wide basis are often not relevant for any specific Class I area. The NPS, FWS, and FS asked that such areas be clearly identified by some geographic means, and to encompass sources that have the most visibility impairing significance for a given Class I area. In the case of Texas, CENRAP has already generated area of influence information. The commenters suggested including geographic extent and significant source information.

**The commission used the area of influence generated under CENRAP's direction to generate lists of major sources within the area of influence for ten Class I areas, including eight areas in adjoining states. Cost of controls for each of these Class I areas is addressed and is now included in an update of the SIP. The commission made changes to Chapter 10 and Appendix 10-1 in response to these comments.**

The NPS and FWS stated no narrative information was provided regarding cost benefit of controlling sources that may impair Class I areas outside Texas. The NPS and FWS asked that the TCEQ present information on how the controls were analyzed and provide tables specific to each Class I area. The NPS, FWS and FS asked that the TCEQ include analysis for all Class I areas to which Texas contributes.

**This SIP revision has been updated in Chapter 10 and Appendix 10-1, Table 6-10 to present a list of sources and potential controls for each Class I area of influence, including eight outside Texas. The commission reviewed all the proposed controls on all sources provided by the CENRAP cost control study. Only the controls with costs per ton within the price range of strategies currently promulgated by the state were reviewed. These are \$2,700 per ton (similar to levels for CAIR). These potential control strategies were further screened for potential effectiveness of the strategy by applying a cost over distance analysis for all units. Distance was defined as the closest Class I, regardless whether it was in- or out-of-state. Additionally, the units without a proposed strategy in the CENRAP study were reviewed to determine if any source categories were represented that the TCEQ believed a control strategy could be applied. For example, flue gas desulfurization for carbon black plants was added to the proposed list in this final step.**

The EPA, NPS, FWS, FS, and Sierra Club requested that the four factor analysis in Appendix 10-1, which is a required element in the federal Regional Haze Rule Section 51.308(d)(1)(i)(A), be included in the SIP narrative. The EPA, NPS, FWS, and FS commented that in Section 10.2 of the proposed SIP stated that Appendix 10-1 provided an analysis of the four factors identified by statute as required for setting reasonable progress goals and concluded that based upon these factors the goals are reasonable. The NPS, FWS, and FS recommend information in that appendix should be summarized in the SIP narrative and should clearly state the decision of the state on a Class I basis.

**This SIP has been revised with a more detailed four factor analysis in Chapter 10. Costs for controls for sources that impact any of these ten Class I areas were considered in the four factor analysis. The control list originally in Appendix 10 has been relocated to Chapter 10, not detached, to allow easier access by the public.**

The Sierra Club requested more evaluation of controls be located in the text of Chapter 10 instead of Appendix 10. The commenter does not have confidence in the existing TCEQ control strategies to meet the long time frames to address the proposed SIP revision.

**In response to this comment, the commission has updated the SIP narrative in Chapter 10 with more detail on the four factor analysis for controls. The list of specific list of controls, due to its length, remains in the appendix. In various parts of Texas, additional emission controls will be required due to the Dallas-Fort Worth and Houston-Galveston-Brazoria SIPs, other early action plans, and various near nonattainment agreements. The commission expects these adopted control strategies as part of SIPs for ozone nonattainment areas to also be pertinent for haze reduction as some of the precursor emissions are identical. The recent EPA refinery consent decrees are also subject to sulfur dioxide reduction as part of the EPA negotiated agreements. Reductions in both nitrogen oxide and sulfur dioxide emissions are planned. As a part of these ozone strategies and the Regional Haze SIP, periodic modeling and emissions inventories are required. The adequacy of Texas' control strategies and rules will be evaluated every five years as required by the federal Regional Haze Rule. The Regional Haze rule requires states to submit five-year progress reports that include an assessment of whether the current plan strategies are sufficient for the state to meet the reasonable progress goals. If it is found that strategies are not sufficient, 40 CFR § 51.308(h)(4) requires that a revision to the SIP be submitted within one year, rather than waiting for the next ten-year comprehensive review.**

### **Area of Influence (AOI)**

The NPS, FWS, FS, and one individual commented that the TCEQ has set a 20 percent cut off for emission impacts, which is an unacceptably high level of impact to allow. The commenters were concerned the data did not show Texas' visibility impacts on other states.

**The commission did not use a 20 percent impact level in its analysis in this SIP revision. However, in Appendix 10-1, the commission did include both Table 1: *Pollutant Impacts on Visibility at the Class I Areas from Texas Emissions* and Table 3: *Source Category Contributions to SO<sub>4</sub> and NO<sub>3</sub> at the Five Class I Areas Texas Affects the Most*, which showed Texas' impact on only the top five Class I areas in terms of the percentage of impact that came from Texas. This level was shown in the SIP for sake of summarizing results for the areas with the most impact from Texas. To prevent readers of the SIP from getting the incorrect impression that Texas used a 20 percent cut off, the SIP revision has been updated with a summary of impacts for ten Class I areas, including eight outside the state. Impacts of emissions from Texas sources on those Class I areas are included. Significant sources within each Class I area of influence (AOI) were identified, using an emissions over distance value (Q/d) of 5 to limit the list to those most likely to have a impact on a Class I area based on the magnitude of emissions and distance from the Class I area. The cost of potential controls on significant sources within an area of influence was analyzed. The commission revised Chapter 10 in response to these comments.**

The NPS, FWS, and FS requested that the TCEQ develop and adopt an area of influence approach to best define cost benefit information when concluding reasonable progress factors. Class I sites that should be included are: Big Bend (NPS managed in Texas), Guadalupe Mountains (NPS managed in Texas), Wichita Mountains (FWS managed in Oklahoma), Caney Creek (FS managed in Arkansas), Salt Creek (FWS managed in New Mexico), and White Mountains (FS managed in New Mexico). The NPS and FWS suggested that the reasonable progress analyses are missing specific information about Texas' contributions to visibility impairment at the Wichita Mountains in Oklahoma and other out-of-state Class I areas.

**The commission revised Chapters 4 and 10, and Appendices 4-3 and 10-1 in response to these comments as follows. The area of influence analysis for ten Class I areas were summarized. These areas include Big Bend, Breton Isle, Caney Creek, Carlsbad Caverns, Guadalupe Mountains, Salt Creek, Upper Buffalo, White Mountain, Wichita Mountains, and Wheeler Peak. The first two orders of magnitude (areas of influence) for each pollutant and each Class I area were identified. Then significant sources within this circle or area of influence were identified. The sources were screened using an emissions over distance value (Q/d) of five to limit the list to those sources most likely to have a impact on visibility at a Class I area based on the magnitude of emissions and distance from the Class I areas. Visibility impacts on those Class I areas are included.**

**Any source with identified potential add-on controls and its costs were included. These were identified from the CENRAP-directed list, which was developed using EPA's program, AirControlNET. The visibility impact from these potential controls was evaluated and the SIP is revised to reflect this analysis.**

The FS commented that if the averaged control costs in Chapter 10 are for the entire CENRAP region from Minnesota to Texas, this does not give an accurate description of costs sources would incur in Texas. The TCEQ should determine and use costs more representative of the southern tier of CENRAP states.

**The commission's use of the EPA's AirControlNET data to determine cost of controls for this SIP revision is consistent with other Texas SIPs. The commission typically relies on data supplied by EPA through resources such as AirControlNET. The commission takes**



into consideration any known differences in cost. The commission added an estimated cost for the flue gas desulfurization proposed set of controls for Texas carbon black sources. These controls were not proposed in the AirControlNET data used by CENRAP. In regards to Texas specific controls, the commission did consider some source controls beyond the EPA's AirControlNET in the proposed SIP revision. No changes were made to the SIP.

The NPS and FWS commented that the uncertainty of CAIR controls is clear in Texas with regard to purchased emission credits and source unwillingness to make control commitments. The NPS and FWS commented that this level of uncertainty can have a heavy influence on the ability of the state to predict or meet visibility goals into the future. The NPS and FWS commented that TCEQ should identify areas of influence for each Class I area and develop a list of the significant point sources within that area to form the primary basis to better evaluate the progress of those sources within the CAIR framework.

As part of the Regional Haze SIP development process, the commission considered control options beyond CAIR and BART, which are discussed in the four factor analysis summarized in Chapter 10. The commission's analysis indicates that additional controls beyond those already implemented are not considered cost effective at this time. The commission will address the need for addition requirements as part of the five-year review process, which starts in 2013. Due to the uncertainty of the impact of CAIR or its eventual replacement, whether over predicting or under predicting emissions, the commission's approach at this time is to track CAIR or its replacement over the five-year and ten-year intervals, and determine if additional controls are needed. The progress of impacted sources will be evaluated in future SIP revisions and review of annual emissions inventories, required by Federal Clean Air Act (FCAA) and the state.

#### **Appendix 10-1: Analysis of Control Strategies**

The FS stated it is also entirely possible that the control costs were over estimated.

The commission agrees there are variations and uncertainties associated with the control cost estimates that could result in lower estimates as well as higher ones. However, given the increase in costs of controls being installed in current systems, the commission considers higher costs are more likely. The United States Department of Energy stated in October 2007 that "the latest benchmarking study by the EUCG, formerly known as the Electric Utility Cost Group, examines the technology and cost of 49 flue gas desulfurization systems currently under design or construction by 12 of the United States' largest utilities. The base cost of a flue gas desulfurization system was \$243 per kilowatt hour. The survey found that flue gas desulfurization retrofit projects are increasing rapidly, even during the phased construction of similar units within a single utility. Overall cost increases were attributed to the rising costs of alloy steels and materials handling systems. Construction labor and concrete costs contributed least to these increases."

The EPA requested the TCEQ provide a detailed cost accounting for the numbers in Appendix 10-1 on Table 4: *Summary of Additional Point Source Controls Considered for Reasonableness*, which summarizes the estimated annualized costs for sulfur dioxide and NO<sub>x</sub> controls on 24 sources.

A detailed summary of the costs listed in Appendix 10-1 on Table 4 are in Table 6: *Proposed SO<sub>2</sub> Controls Based on CENRAP Modeling*; Table 8: *Proposed SO<sub>2</sub> Control for Carbon Black Units*; and Table 9: *Proposed NO<sub>x</sub> Controls Based on CENRAP Modeling*. Changes were made in Appendix 10-1 Section 1.5 in response to the comment.

The FS suggested that when looking at cost effectiveness of controls for sources, additional consideration should be given to those sources within the area of influence of more than one Class I area.

**The commission revised Appendix 10-1 with a summary of the area of influence analysis for ten Class I areas. The analysis for visibility impairment was based on each Class I area and costs of potential controls within that Class I area impact. Once a source was identified with a potential control, the cost of the control to the site remained the same, regardless of the number of areas of influence in which the source is located. A four factor analysis of source categories including cost effectiveness is included in Appendix 10-1.**

The FS commented that without analysis of sources in northeastern Texas and Class I areas affected by these sources, Appendix 10-1 is of limited value. Texas should show the four factor analysis by which it determined no further controls on cement kilns for NO<sub>x</sub> was reasonable.

**In July 2006, a report entitled *Assessment of Nitrogen Oxide Emissions Reduction Strategies for Cement Kilns - Ellis County: Final Report* was submitted to the TCEQ by ERG ([www.tceq.state.tx.us](http://www.tceq.state.tx.us)). This study evaluated the applicability, availability and cost effectiveness of potential nitrogen oxide control technologies for the ten cement kilns located at three Ellis County sites. The report focused on selective catalytic reduction (SCR), selective non-catalytic reduction (SNCR), and low temperature oxidation (LoTOx). Based on the results of the study, the TCEQ conducted modeling sensitivity analyses at two levels of control to evaluate potential ozone reduction benefits from possible cement kiln control strategies. A reduction in nitrogen oxide as part of the ozone control strategies has haze control co-benefits. One modeling sensitivity run assumed a range of 35 to 50 percent nitrogen oxide control on cement kilns depending upon kiln type; the second assumed a range of 80 to 85 percent. After reviewing the report of the kiln study, the modeling sensitivity results, and all other available information, the commission determined that the 35 to 50 percent control range was the most appropriate control level to address ozone in the Dallas Fort Worth area.**

**The commission developed a source cap that will require a reduction of approximately 9.69 tpd of nitrogen oxide emissions from the cement kilns in Ellis County starting March 2009. The source cap approach does not require a specific technology, but provides flexibility for kiln operators to comply in the most effective, technically sound, and expeditious manner possible, while forcing sizeable nitrogen oxide emission reductions from all cement kilns in the area. In most cases, the commission anticipates that the limitations will be attainable with selective non-catalytic reduction and will not require costly and time consuming research and development of other technologies. Pilot testing of selective non-catalytic reduction on wet and dry kilns in 2006 demonstrated that 30 to 40 percent reductions were achievable without hazardous by-product formation. In response to comments, two sections were revised: 1) Chapter 10 Section 10.4.2 and 2) Appendix 10-1 Section 10-1.3. The references were also updated to include the cement kiln report.**

The FS commented that the TCEQ provided no source-by-source determinations to identify sources that individually may have had a relatively high visibility impact on a particular Class I area(s). By eliminating consideration of additional point source controls for those Class I areas such as Breton, Wichita Mountains, and White Mountain that are not predicted to meet the uniform rate of progress, Texas does not justify how it contributed to its proportion of controls necessary to help these states work toward the uniform rate of progress.

**Impacts of emissions on those Class I areas are included in the SIP narrative, Section 10.3. Texas has updated this SIP and lists significant sources in each of ten Class I's area of influence, including those mentioned in the comment. Potential additional controls were**

evaluated for significant sources that may have an impact on a Class I area based on their emissions and distance to the Class I area. A four factor analysis was done for each source category. As part of the consultation process, this information was sent to other states with an impacted Class I area (see Appendix 10-1 and Appendix 4-3).

The commission performed category level reviews as allowed by the federal Regional Haze Rule. The non-air environmental impacts were considered on a source category basis. Most of these impacts, because they would be detrimental to any consideration of implementing a control, did not dissuade the original conclusion that the proposed control cost did not justify the limited benefit. The commission asserts the application of additional controls is unreasonable because the insufficient improvement of visibility of 0.05 deciview is achieved (see Tables 10-4 and 10-5). Based on the impact and cost of over \$300 million, the commission concluded that additional controls beyond those already on the books are not cost effective at this time (see Table 10-4).

The NPS and FWS stated that although the narrative portion of Appendix 10-1 presented an argument to conclude that additional controls are not reasonable, supporting information on how the controls were tested is neither provided nor described. Tables 6-10 of the Appendix 10-1 appear to include information that is not relevant to the narrative description. The NPS and FWS requested the tables include information on sources likely to impair visibility at Class I areas other than Guadalupe Mountains and Big Bend and present cost estimates that are in the range of those quoted in the narrative.

Appendix 10-1, Tables 6 through 10 are the detailed proposed controls for nitrogen oxide and sulfur dioxide sources that were discussed in Section 10-1.4 Proposed Controls. The summary of controls in Table 4 is a consolidation of those listed in Tables 6 through 10. The tables include the costs associated with those controls for all Class I areas impacted, not just Big Bend and Guadalupe Mountains. The commission evaluated all potential controls regardless of the Class I impacted, as required under the EPA haze regulations. In response to comments, Chapter 10 Section 10.4.2 and Appendix 10-1 Section 10-1.5 has been revised to clarify that visibility impairment for all Class I areas was assessed.

#### **Appendix 10-2: Estimating Visibility Impacts from Additional Point Source Controls**

The FS suggested Appendix 10-2: *Estimating Visibility Impacts from Additional Point Source Controls* should estimate impacts to the other Class I areas listed, both in and out of state.

The commission revised the SIP with a summary of the area of influence analysis for ten Class I areas, including eight out-of-state sites. Emissions and impacts from emissions on those Class I areas is included. Texas has listed emissions from significant sources in a Class I's area of influence. In response to this comment, two tables were expanded to include all 10 Class I areas that Texas impacts: Table 2: *Projected Visibility Benefit from CENRAP Control Set* and Table 5: *Modeled Visibility Benefit from the Texas Control Set*. In addition, several paragraphs were added to explain Texas impacts at these 10 sites.

The FS is uncertain if the additional point source controls were the same as those in the Base G modeling for the future year 2018c conducted by CENRAP.

The additional controls considered by the commission were beyond those listed in the CENRAP Base G modeling. They were developed with the assistance of the EPA's PC-based AirControlNet program and took into consideration the controls that were on the books or that would be in place by 2018. No changes were made to the SIP revision in response to this comment.

## **Chapter 11: Long-Term Strategy**

The FS commented that it would be very informative and helpful if Texas would show the PSAT results for the 20 percent best days as well as the 20 percent worst days.

**The commission agrees with this comment and has added graphs showing the PSAT results for the 20 percent best days for each Class I area analyzed in Chapter 11.**

An individual commented that the CAIR reductions projected for NO<sub>x</sub> are only 28.5 percent and for SO<sub>2</sub> are 61.1 percent. The commenter was concerned that Texas needs much greater reductions than these to increase visibility and reduce ozone precursors.

**Based on the four factor analysis, the commission has adopted all reasonable controls for the period to 2018. Sulfur dioxide reductions of more than 60 percent in the first of five ten-year planning periods are substantial. The reason the NO<sub>x</sub> control percentage is not as high is that NO<sub>x</sub> point sources have already been controlled in the last six years for ozone reduction purposes. (The four factor analysis considers the cost of reducing air pollution emissions, the time necessary for compliance, the energy and non-air quality environmental impacts of reducing emissions, and the remaining useful life of existing sources that contribute to visibility impairment.) No changes were made in response to this comment.**

One individual commented that TCEQ took credit for SO<sub>2</sub> reductions that the federal government required.

**Section 51.308(d)(3)(v) of the federal Regional Haze Rule requires each state to include all federal or state rules and legally enforceable requirements in its 2018 projections of the visibility improvements. The commission works with the federal EPA to improve the air across Texas. In the case of Big Bend and Guadalupe Mountains, SO<sub>2</sub> is a primary component of haze in western Texas. Approximately one-third of sulfate pollutants come from the Ohio Valley and other states according to the BRAVO study.**

One individual commented that the TCEQ says CAIR “is expected to reduce regional haze impact.” The individual commented that Texas' CAIR makes no improvements for particulate matter, ozone, or regional haze, and the TCEQ reduced NO<sub>x</sub> emissions due to the ozone non-attainment in Texas, especially Houston, and not because reductions were made for regional haze.

**The commission agrees that the HGB region NO<sub>x</sub> reductions were adopted to reduce ozone pollution. The commission notes that these reductions also reduce Texas' contribution to regional haze due to air chemistry and the formation of ozone and particulate matter. The commission disagrees that CAIR makes no improvements for particulate matter, ozone, or regional haze. The projected CAIR reductions in NO<sub>x</sub> and SO<sub>2</sub> emissions are substantial. Because NO<sub>x</sub> and SO<sub>2</sub> react in the atmosphere to form nitrate and sulfate, which are components of particulate matter and regional haze, the NO<sub>x</sub> and SO<sub>2</sub> reductions will lower concentrations of PM<sub>2.5</sub> and regional haze. The further NO<sub>x</sub> reductions will produce lower ozone concentrations.**

Several individuals were disappointed in this SIP revision that will not result in reasonable progress toward meeting the national goal of achieving natural visibility in our national parks by 2064. The inadequacy of Texas' Regional Haze SIP means that Guadalupe Mountains would not reach natural visibility until 2081, and Big Bend would not achieve natural visibility until 2155. Moreover, national parks and/or wilderness areas in nearby states will be affected by lack of adequate air pollution control on Texas sources.

**The commission disagrees with these comments. The commission notes that the federal Regional Haze Rule requirement to project dates for meeting the goal of natural conditions**

is unreasonable for Class I areas like Big Bend and Guadalupe Mountains National Parks that are heavily impacted by international transport of regional haze. This is particularly so given EPA's acknowledgement in the rule's preamble that international transport has not been sufficiently addressed by their rule. Because the anthropogenic portion of the international transport cannot be expected to approach zero, it is not realistic to project a date for zero anthropogenic haze impacts at such Class I areas. Since there are substantial international transport impacts at Texas' two Class I areas and there is not a reliable basis for projecting decreases in these impacts, Texas and other states would have to over control to compensate for the international impacts if the affected Class I areas were to have reasonable progress goals as low as the uniform rate of progress. The EPA's preamble to the federal Regional Haze Rule and EPA guidance clearly state that states are not expected to or required to impose such over control. No changes were made in response to this comment.

The FS and one individual commented that the second paragraph of Chapter 11 refuted the argument that Texas made later that assumed 100 percent of coarse mass was natural. Although the FS agreed that the majority of coarse mass likely is natural, some portion of it is likely anthropogenic. Therefore, Texas should consider treating some percentage determined in consultation with the FLMs and EPA as anthropogenic. The TCEQ must determine how much of the coarse mass and fine soil "comes primarily from natural dust storms and dust blowing from the Chihuahuan Desert" since much of this dust may be due to historical overgrazing or farming and therefore is human caused. Ecosystem restoration and reform of grazing and farming practices may be needed to reduce this human caused dust.

**The commission agrees that there is some anthropogenic contribution to coarse mass and fine soil at both Big Bend and Guadalupe Mountains National Parks. In response to recent discussions with the FLMs, Chapter 5 and Appendix 5-2 now compare the impact of an 80 percent and 100 percent natural approximation for coarse mass and fine soil. The commission is not currently aware of an adequate, workable methodology for developing a well-founded estimate of the proportion of coarse mass and fine soil that is anthropogenic at the two Texas Class I areas. The commission has chosen to use the approximation that 100 percent of the coarse mass and fine soil are natural for this first Regional Haze SIP revision. *The Assessment of the Principal Causes of Dust-Resultant Haze at IMPROVE Sites in the Western United States: Final Report*, prepared for WRAP in 2006 by the Desert Research Institute and Marc Pitchford of the National Oceanic and Atmospheric Administration includes a map that shows the areas of the Chihuahuan Desert in West Texas to be moderately-to-highly wind erodible shrub land and grassland areas. The map does not show erodible areas from human activity. The areas of the Chihuahuan Desert in northern Mexico are not categorized and are outside United States control.**

**The commission plans to consult with the FLMs and work to develop more refined scientifically supportable estimates of the actual percentages of natural and anthropogenic portions of coarse mass and fine soil at Big Bend and Guadalupe Mountains for the five-year assessment and future revisions.**

The FS requested the SIP address the reason the time of compliance was not considered and points to the need for a source by source analysis. No calculations are provided to justify the conclusion. The concept that instituting controls near the 2018 date would reduce the cost effectiveness in cost per ton is not convincing. The cost per ton is determined at a fixed rate at a fixed time, independent of any year except that used in the determination.

**The commission has revised the SIP with a summary of a four factor analysis. A four factor analysis of source categories has been added to Chapter 10. The cost of controls and improvements to visibility impairment are summarized for each Class 1 area. The**

**statement referencing timing of controls impacting the cost per ton has been removed from the SIP Appendix 10.1, Time for Compliance.**

The NPS and FWS were concerned the SIP revision proposal indicated that attribution from Texas emissions not only contribute to visibility impairment at Class I areas outside the Texas boundary, but these Texas emissions were clearly contributing at levels greater than the host state, like at Salt Creek, White Mountain, Wichita Mountains, and Caney Creek. The NPS and FWS requested that Texas demonstrate progress towards visibility goals in these out-of-state Class I areas (as part of the Texas plan's reasonable progress discussion), and also show more detailed consulting and planning with these neighboring states. Oklahoma, New Mexico, and Arkansas received even larger percent of total attribution to visibility impairment at their Class I areas from Texas sources than Texas' Class I areas receive from international sources. Texas should provide additional documentation on efforts to not only discuss impacts, but ways that the states planned to work together to make progress in Class I areas where Texas is the majority contributor. Because the state is not only a contributor, but the majority contributor, additional efforts should be shown to demonstrate multi-state controls. This should be further extended to demonstrate consistent control levels.

**The commission acknowledges that emissions from Texas do produce a significant minority of the visibility impairment at Salt Creek, White Mountain, Wichita Mountains, and Caney Creek Wilderness areas. In the 2002 base period year, the respective percentages of extinction contributed by Texas on the 20 percent worst days for these four areas are included in the following table:**

**2002 Contributions to Extinction on the 20 Percent Worst Days**

	<b>Salt Creek</b>	<b>White Mountain</b>	<b>Wichita Mountains</b>	<b>Caney Creek</b>
<b>Texas'</b>	<b>25.5%</b>	<b>22.5%</b>	<b>28.1%</b>	<b>11.1%</b>
<b>Host State's</b>	<b>28.3%</b>	<b>17.7%</b>	<b>14.7%</b>	<b>10.1%</b>

**The highest Texas contribution to extinction at one of these sites is 28.1 percent. The commission disagrees with the comment that Texas contributes a majority of the 20 percent worst days extinction to any Class I area in another state. Texas agrees that the PSAT modeling results show that Texas contributes more than the host state to extinction on the 20 percent worst days at White Mountain, Wichita Mountains, and Caney Creek.**

**The commission agrees with displaying the details of Texas' impact reductions at these Class I areas and other Class I areas impacted by Texas' emissions. The tables showing Texas' pollutant-by-pollutant impacts on extinction for both the 2002 base period and the 2018 planning year are now included in the consultation section of Chapter 11. These tables show the modeled impact of multi-state efforts to reduce visibility impairment at these sites. The commission disagrees with the suggestion to place this information in Chapter 11 on reasonable progress chapter. The Regional Haze rule requires Texas to develop RPGs for Class I areas in Texas.**

The EPA, NPS, FWS, FS, and one individual commented that just because Texas has not received a formal invitation for consultation from Colorado, Louisiana or New Mexico does not mean that these states accept Texas' long term strategy as adequate for producing Texas' share of emissions reductions to help meet reasonable progress goals at each state's respective Class I area(s). New Mexico has not completed their reasonable progress goal analysis and is further behind in the process. This lack of consultation should be noted in the SIP, and Texas should display its present and projected impacts to those state's Class I areas. The commenters would like better documentation in the SIP to explain the pertinent issues discussed and agreements reached through consultation activities to address all Class I areas where Texas' emissions are important contributors to visibility impairment.

**As the commenters acknowledge, each state may not have completed its reasonable progress goals. The consultation process in the federal Regional Haze rule is not proscriptive precisely because of the differences in each state's SIP development and regulatory programs. The proposed SIP revision indicated the state of consultations at the time it was published. The commission concurs that the adopted SIP revision include documentation that it meets the requirements of §51.308(d)(3)(i) – (iii). The commission has sent individual letters to Louisiana, Arkansas, Missouri, Oklahoma, Colorado, and New Mexico to ask each to confirm in writing that Texas' emissions reductions strategy is adequate to meet Texas' apportioned reductions in impact at the impacted Class I areas. The commission also requested that recipients of the letters confirm they are not expecting any additional emission reductions from Texas sources. Formal replies were requested of the adjoining states within 30 days for inclusion in this SIP revision. The states that responded have documented letters in Appendix 4-3.**

The NPS and FWS agreed that Mexican emissions contained within the boundaries of the CENRAP modeling domain are important contributors to visibility impairment at Big Bend and Guadalupe Mountains. The NPS and FWS requested that Texas acknowledge the work contained in the final Big Bend Regional Aerosol and Visibility Observational (BRAVO) study. This extensive BRAVO study indicated sources in Mexico, Texas, and the eastern United States all play a role in sulfate conditions at Big Bend. The NPS and FWS look forward to working with Texas to solicit EPA action with its sister agencies to address the Mexican portion of sulfate impairment at Big Bend. The NPS and FWS also requested that the SIP discuss the Texas contribution to sulfate found in the BRAVO field study in the long term strategy and reasonable progress sections.

**The commission agrees with this comment that the BRAVO results and their relationship to the CENRAP PSAT results warrant more discussion. The added discussion is included in Chapter 11.**

The EPA is concerned about the potential of the American Smelting and Refining Company (ASARCO) El Paso to affect visibility in Texas and New Mexico Class I areas. On February 13, 2008, the commission approved the renewal of Air Quality Permit No. 20345 for ASARCO Incorporated. The EPA stated that with the Regional Haze SIP revision, the commission should ensure that ASARCO's impact assessment will be included in Texas' BART, reasonable progress goals, and long term strategy.

On February 13, 2008, the TCEQ approved the renewal of Air Quality Permit Number 20345 for the American Smelting and Refining Company (ASARCO) El Paso smelter. As of the date this SIP revision was finalized, the TCEQ has not yet made a final determination regarding the BART status of ASARCO's facilities. Due to this and other permitting and operational readiness issues raised by ASARCO in their status report required by TCEQ order, there is uncertainty about the amount of allowable emissions the ASARCO El Paso facility would have should it begin operation. Because of this uncertainty in addition to time limitations, it is not possible for the TCEQ to account for possible future ASARCO El Paso emissions in this Regional Haze SIP revision. When the TCEQ has determined the allowable emissions from the ASARCO El Paso facility, the TCEQ will model the visibility impacts of these emissions at affected Class I areas. The TCEQ plans to consult with affected states and Federal Land Managers and include ASARCO's emissions and impacts in its next Regional Haze SIP revision.

The NPS and FWS commented on the uncertainty of CAIR implementation. The NPS and FWS requested that the commission be more proactive in response to the uncertainty associated with implementation of CAIR. Although Texas identifies clear conflicts with emission inventories developed by CENRAP, with the Integrated Planning Model predictions of large electric

generating unit growth results, and with the unwillingness of participating CAIR sources to commit to particular emission levels, it is concerning that Texas has elected to wait and see how the uncertainty unfolds as part of the required five-year review. The federal Regional Haze Rule mandates that each state develop a plan to make progress toward visibility impairment at Class I areas. Although the commission concludes that the already planned controls between now and 2018 are reasonable, it fails to address how multiple issues that prevent Texas from accurately determining future emissions to address Texas' substantial contribution to visibility improvement at Class I areas inside and outside of its territory. The NPS and FWS requested that Texas develop areas of influence and associated major source lists within these zones as a precursor to a focused five-year review. The NPS and FWS requested Texas establish in the SIP a process for ongoing discussions and consultations with neighboring states and FLMs on the progress of CAIR.

**The commission recognizes that the electric generating units are contributors to visibility for the Class I areas and that these electric generating units are covered by the provisions of CAIR as well as other state requirements. There are uncertainties associated with prediction because of the cap and trade provisions of the program. The predicted levels used in the model were from the EPA's Integrated Planning Model, a tool widely used in regional planning. The predictions are based on assumptions applicable at the time the model is constructed, including fuel prices, fuel availability, and regulatory policies. The commission acknowledges the uncertainty in the emissions projections. The commission is not aware of a better emissions prediction tool for electric generating units and believes the predictions provide a valid planning tool. The difference in inventories between CENRAP's and the TCEQ's was in industrial and residential boilers, not in electrical generating units addressed by CAIR or its replacement.**

**In response to comments, Texas has developed a list of significant industrial sources, including the electric generating units, based on the area of influence analysis developed by CENRAP for each Class I area, which progress can be evaluated during the CAIR time frame or equivalent time. The list of sources can be found in Appendix 10-1, Tables 6 to 10, and the area of influence maps are in Appendix 4-3. The commission will continue to consult with FLMs and states through the SIP consultation process on the implementation of CAIR.**

The NPS, FWS, FS, and one individual commented that the TCEQ needed to elaborate on how the New Source Review (NSR) and Prevention of Significant Deterioration (PSD) permitting programs will be used by TCEQ as part of its long term strategy for meeting reasonable progress goals. One individual commented that the Environmental Defense and the Sierra Club have requested that until these deficiencies in the PSD permitting program are resolved that EPA should prohibit construction of new sources in Texas and/or impose sanctions. As part of these written comments, the individual attached a copy of the Environmental Defense and Sierra Club petition that documents the inadequacy of the TCEQ's PSD permitting program. The NPS and FWS requested Texas establish in the SIP a process for ongoing discussions and consultations with neighboring states and FLMs on the progress of PSD/NSR efforts.

**The commission has a SIP-approved, PSD permitting program. The commission is committed to working with the FLMs to attempt to develop mutually acceptable procedures that allow adequate opportunity for FLM review of permit applications. In the five-year and ten-year reviews for the Regional Haze SIP revision, the commission plans to consider the cumulative impact of PSD permitting actions on the projected visibility impairment at the Class I areas that Texas' emissions affect. The commission will continue to consult with FLMs and states through the Regional Haze consultation process on the implementation of PSD/NSR permitting. Changes were made in Chapter 11, Section 11.6.3 in response to comments.**



The FS commented that Texas has been providing notification to the FLMs only for major-source actions within 100 km of Class I areas. In a letter dated August 21, 2007, the FS requested that Texas reconsider that policy and work with the FLMs to come up with a mutually acceptable policy of notification to the FLMs and surrounding states regarding NSR. Including resolution of this issue in the SIP would greatly strengthen the position that clean days are being maintained.

**The commission has commented on EPA rulemaking about PSD review that nationally uniform guidance is needed for review of particulate matter impacts. Also, the Executive Director in a letter to his counterpart in the Oklahoma Department of Environmental Quality has committed "to working with the FLMs on mutually acceptable criteria for determining when a proposed PSD source should conduct a Class I review" (see Appendix 4-3).**

### **Fire**

The NPS, FWS, and FS recommend that TCEQ reference fire and smoke plans in a way that does not require a SIP revision each time a fire or smoke plan is updated. The FS is concerned that linking the smoke management plans to the SIP will reduce the FS's ability to maintain flexibility in updating smoke management provisions and suggested these documents not be included in the SIP or its appendixes. The FS inquired if agricultural burning occurs in Texas and if it is regulated.

**According to discussion with EPA Region 6, the EPA prefers inclusion of the smoke management plans in the appendix. The smoke management plans contained in the Regional Haze SIP revision are for reference purposes. The commission considers the FS's flexibility to update the smoke management plans unhindered by inclusion in the Texas SIP. Agricultural burning does occur in Texas. Local and state ordinances regulate burning through fire permits. Texas has rules regulating outdoor burning in 30 Texas Administrative Code (TAC) §111, Subchapter B: Outdoor Burning. These rules cover a wide variety of burning, including prescribed burning. The Texas Forest Service tracks burning in Texas.**

The NPS and FWS commented that it is appropriate for the TCEQ to declare smoke plans as a contributing program for visibility protection, but neither the state or CENRAP evaluated performance resulting from this or any specific smoke management component. If the state wants to speak to not making a change to the smoke management plan, it should simply state that it is unreasonable to make modifications due to the low smoke apportionment or low priority of pollutant selection.

**The commission agrees with this comment. The commission has revised the Chapter 11 discussion of smoke management plans to state that it is unreasonable to make modifications to the smoke management plans due to the low smoke contribution from Texas to regional haze at the Class I areas that Texas' emissions impact.**

The NPS and FWS requested Texas indicate whether it intends to certify its Smoke Management System as provided for by the 1998 EPA *Interim Air Quality Policy on Wildland and Prescribed Fire*.

**The commission does not intend to certify its smoke management system.**

The NPS and FWS commented that the proposed SIP and the smoke management plans described in its Chapter 11 should identify appropriate nearby Class I areas (both the two within Texas as well as those located in neighboring states) as smoke sensitive areas. The commenters suggested

that prescribed burners should be required to apply the appropriate smoke management techniques to minimize smoke impacts.

**Such an additional designation of Class I areas as smoke sensitive areas is not required under the federal Regional Haze Rule or is a necessary part of this SIP revision because of the minimal impact of smoke from fires on regional haze in Texas. State rules under 30 TAC §111, Subchapter B: Outdoor Burning, already require all prescribed burning in Texas to apply appropriate smoke management techniques to minimize smoke impacts.**

The NPS and FWS commented that the proposed SIP stated that wildfire emissions are assumed to remain the same looking forward over the ten-year planning period. However, the SIP should identify if prescribed burning emissions are proposed to decline, stay the same, or increase.

**The commission does not determine how much prescribed burning occurs. The commission's role is to regulate prescribed burning to minimize smoke impacts. The manager or owner of land determines whether to conduct prescribed burning. Concerning the estimate of change in impact, the general increase in use of well controlled prescribed burning to prevent catastrophic wildfire may increase low concentration impacts and reduce high impact events. The commission does not have sufficient information to produce a more refined estimate than the no-change estimate used in the modeling to project conditions in 2018.**

One individual suggested that Chapter 11 should also list a smoke management plan for the national forests and grasslands in Texas (Davy Crockett, Sam Houston, Sabine, Angelina National Forests and Caddo and LBJ National Grasslands). The individual commented that more prescribed burning was being conducted than in the past due to increased emphasis on improving woodpecker habitat.

**The commission agrees that there are additional smoke management plans besides those listed as examples in Chapter 11. The plans referenced in the SIP include Class I areas in Texas and a number of larger jurisdictions. The commission does not consider an exhaustive listing of specific plans necessary as part of the Regional Haze SIP revision given the minimal impact fires are expected to have on visibility.**

One individual noted that the modeling indicated that primary organic carbon at Big Bend comes overwhelmingly from boundary conditions, which included the areas of the Yucatan and Central America with extensive agricultural burning and sometimes wildfire emissions each April and May. The individual wondered if TCEQ has correlated the actual burning and other sources with carbon concentrations and if the TCEQ knows where the problems exist. Since CENRAP modeling did not differentiate between boundaries, the commenter suggested that the TCEQ acknowledge that some of the air pollution coming from boundary conditions may be due to Texas' and other states' emissions that are re-circulated.

**For a decade, the commission has been watching satellite images of smoke from the spring agricultural burning and wild fires in Southern Mexico and Central America as winds transport it to Texas. The satellite fire channel data clearly show the locations of the fires. This is the only major source the TCEQ has observed for smoke being transported into Texas from areas outside the United States and affecting Class I areas in Texas and other states. Occasionally, smoke from marsh grass or crop stubble fires along the Texas and Louisiana coastal areas moves directly to impact nearby areas. Sometimes the trajectory takes the smoke a relatively short distance over the Gulf of Mexico. Marsh grass or crop stubble fires are not a significant source of smoke affecting Class I areas in Texas. While transport of continental haze from the United States can occasionally reach the boundary conditions domain, under such circumstances the air masses are usually associated with**

rapidly moving cool or cold fronts and are moving too quickly to accumulate much haze. Although re-circulation occurs, the commission notes it is a minor issue. No change was made in response to this comment.

#### **Chapter 12: Plan Revisions**

The FS requested that Chapter 12 should specifically mention that the SIP review and revision will involve consultation with the FLMs.

**The suggested change was made to the SIP. The commission looks forward to a continued and collaborative consultation process with the FLMs regarding haze reduction.**

#### **General Comments**

Several individuals commented that although half of the air pollution sources at Big Bend and Guadalupe Mountains are from other states and countries, Texans want to clean up the part that comes from Texas. Many individuals commented that no new air pollution control strategies were added to this SIP revision and requested controls be added specifically to reduce regional haze.

**The commission notes that the Texas BART rule, adopted in January 2007, was a TCEQ rule specifically adopted for the Regional Haze SIP revision (see 30 TAC §116, Subchapter M or Appendix 9-2). The commission agrees that Chapter 11 does cite rules and programs that have been in place that have reduced regional haze as well as other pollution impacts. The commission was reducing Texas' impact on visibility impairment long before issuance of the federal Regional Haze Rule. These long-standing rules and programs continue to be effective. The commission notes that the national goal established by Congress and the EPA is to achieve natural visibility conditions in the Class I areas by 2064, with a requirement for five ten-year planning periods that end in 2018, 2028, 2038, 2048, and 2058. Further, EPA guidance recognizes that states that have adopted CAIR requirements may already have sufficient reduction requirements on the books for the first ten-year planning period, which is to 2018. Based on the four factor analysis for each Class I area Texas impacts, Texas has adopted all reasonable controls for this first planning period. The four factor analysis considers the cost of reducing air pollution emissions, the time necessary for compliance, the energy and non-air quality environmental impacts of reducing emissions, and the remaining useful life of existing sources that contribute to visibility impairment.**

One individual commented that additional progress on cleaning up Texas' dirty air is possible if legislators from Texas use their clout in Congress to force Mexico to comply with its obligations to control emissions from coal-fired plants in Mexico.

**The commission considers that the request (see Chapter 11) for federal efforts to reduce international transport is the appropriate action for the TCEQ.**

The EPA, NPS, FWS, and FS requested the TCEQ combine the three sections of Texas, used for CENRAP modeling purposes, be added together to show the state's contribution as a whole and providing a better comparison with other states. The commenters requested this be done throughout the document.

**The commission has added tables showing Texas' total extinction contribution to each Class I area where Texas impacts visibility in other states. Several chapters and tables have been amended. Chapter 7 discusses the emissions inventory from Texas for each category. Only the figures break out the emissions by the three geographic areas in the tables in this section. Refer to Table 7-2: *Summary of 2002 Annual Emissions for the Nine-State CENRAP Region* and Table 7-5: *Nine-State CENRAP Total Emissions by Category* for a state level comparison of the emissions. For a discussion on impacts, the reader is referred**

**to Chapter 10. Impacts from emissions on the Class I areas are discussed in Chapter 10 and are discussed from the state as a whole, not by geographical region.**

One individual commented that this Regional Haze SIP revision should be withdrawn and revised to incorporate reductions in regional haze emissions over the next five years. If this is not done, the EPA should start the sanctions clock and in 18 months EPA should apply highway sanctions and require 2:1 offsets for regional haze emissions until an acceptable SIP is approved.

**The commission disagrees with these comments. The commission is submitting a Regional Haze SIP revision that meets the requirements of 40 CFR §51.308.**

One individual commented that with the uncertainty that the modeling provides it seems prudent that Texas make reductions now so that there will not be delayed regional haze attainment. There is no doubt that reductions must be made since on page 10-6, TCEQ implies that at least 48 percent for Big Bend and 75 to 80 percent for Guadalupe Mountains of the visibility impairment comes from Texas or other states, not foreign sources.

**The commission disagrees with the commenter's interpretation of Table 10-7 in Chapter 10 and associated text and the commenter's solution. Haze reduction is a national issue with a long-term goal of natural visibility conditions. At this time, the commission is working on the impact that Texas has on haze in Texas and other known states. The EPA and other federal agencies are working with other states and international governments to reduce haze causing pollutants. The commission acknowledges that the public can improve visibility in Class I areas by an individual commitment to pollution reduction and appreciates groups that actively encourage the public to reduce the human contribution.**

The Sierra Club commented that the commission was missing an opportunity to demonstrate a commitment to air quality cleanup in one of the most culturally, historically, and naturally important parts of our state. The failure to clear the air in Big Bend and Guadalupe Mountains translates into continued regional haze problems for state-owned lands such as Big Bend Ranch State Park, Davis Mountains State Park, and other such areas, which increasingly are of interest for outdoor recreation for Texas urban populations. The Sierra Club saw no real commitment on the part of the commission to address the deficiencies in the proposal.

**This SIP revision addresses significant controls and programs that Texas and EPA are undertaking that will reduce haze in Big Bend and Guadalupe Mountains as well as neighboring state public lands. As EPA anticipated when it developed the Regional Haze and BART rules, natural visibility conditions will take many years to achieve in any Class I area. The reduction of haze will require all states to reduce pollutants. Future revisions and possible additional controls are anticipated.**

The FS appreciated that Texas documented coordination with the FLMs and abandoned one approach based on FLM recommendations. The FS looks forward to continued consultation in the future.

**The commission appreciates the comment and looks forward to a continued and collaborative relationship with the FLMs in the future.**

The NPS and FWS appreciated the discussion of relative response factors and the two methods of applying relative response factors created by the CENRAP organization. The commenters welcomed the summary of these concepts in the main body of the SIP. It is very important to inform the non-technical reader how these complex models are applied in a relative sense.

**The commission appreciates the comment and looks forward to a continued and collaborative relationship with the NPS and FWS in the future.**

The FS commented that while Big Bend and Guadalupe Mountains, Class I areas within Texas, are identified in Chapter 1, other Class I areas identified elsewhere in the SIP as being impacted by Texas sources were not identified in this chapter. The commenter suggested including a summary of those other impacted Class I areas to provide balance to Chapter I.

**Chapter 1 is devoted to background information and an overview of regional haze and describes those Class I areas within Texas that are impacted. The commission addressed Class I areas located in other states within Chapters 4, 10, and 11. The commission made no changes to this SIP revision.**

The NPS and FWS commented that the Executive Summary says, "This SIP revision contains a list of BART-eligible sources and the determination of BART for each source that is reasonably anticipated to contribute to visibility impairment (BART-subject)." The NPS and FWS find this statement misleading, since the narrative stated that there were no sources subject to BART in Texas, and therefore no BART determinations were provided.

**The BART process is fully explained in Chapter 9 of the SIP. According to EPA Region 6 training and flow charts, Texas understands the BART rule to be at least a three tiered process. Texas went through at least 2 tiers of the process. The first step of BART is determining eligibility; all BART-eligible sources are listed in Chapter 9 and Appendix 9-13. In addition, there is a list of sources that reduced their potential to emit through permit amendments, or shut down units in order to avoid being subject to BART controls. At this time, all BART-eligible sources have modeled emissions impacts to be below the BART determination threshold in some extent due to past emission reductions required by state law not anticipated when the federal BART rule was developed.**

The FS commented that within the Executive Summary, the TCEQ should quantitatively summarize its reasonable progress goals and associated rationale for each Class I area addressed in the SIP revision.

**The commission added summaries of reasonable progress goals and associated rationale for each Class I area in Chapter 10. In response to this comment, no changes were made in the Executive Summary. However, more information was added to Chapter 10.**

The Sierra Club expressed disappointment that several generations of Texans will not be able to experience clear skies on a regular basis at these exceptional natural heritage parks. One individual commented that he hikes in Big Bend and Guadalupe Mountains and requested the commission take action to reduce haze for those who come after us. One individual commented that Big Bend has the honor of being a Biosphere Reserve under the United Nations Educational, Scientific and Cultural Organization (UNESCO) Man and Biosphere Program accentuating the need for the commission to do all it can to reduce haze at this special global site.

**This SIP revision addresses significant controls and programs that Texas and the EPA are undertaking that will reduce haze in Big Bend and Guadalupe Mountains as well as neighboring states' public lands. As the EPA anticipated when it developed the Regional Haze and BART rules, natural visibility conditions will take many years to accomplish in any Class I area. This goal will ultimately be achieved through the efforts spelled out in this revision, as well as future revisions that may include additional controls and programs not yet created. The commission acknowledges that Big Bend National Park has been designated an international Biosphere Reserve. The commission made no changes in response to these comments.**

The NPS and FWS commented that the Executive Summary stated that “TCEQ used a refined estimate of natural conditions for Class I areas in Texas and other states as permitted by EPA.” However, there is no evidence in the SIP that any other states have adopted Texas’ alternative natural conditions calculation approach. The commenters requested that this SIP revision specifically agree with the natural conditions adopted by Texas’ neighboring states for said states’ Class I areas.

**The commission has no substantive disagreement with the natural conditions estimates used by any other state at this time. Texas fully respects the right of all states to determine the natural conditions for their respective Class I areas. The phrase “and other states” has been removed from the referenced sentence in response to this comment.**

The NPS and FWS pointed out that the Cooperative Institute for Research in the Atmosphere, or CIRA ([www.cira.colostate.edu](http://www.cira.colostate.edu)) may have updated the baseline calculations found on the Visibility Information Exchange Web System (VIEWS) since the time of Texas’ SIP proposal.

**On January 2, 2008, the latest data was downloaded from the VIEWS Web site. The results have not changed for Big Bend or Guadalupe Mountains. The commission made no changes in response to this comment.**

One individual commented he was excluded from the consultation and stakeholder process since he submitted comments on BART and spoke with staff but was not contacted about regional haze.

**The commission issued public announcements on the BART and SIP list server, published numerous announcements in newspapers across the state, and regularly updated the commission’s regional haze Web site to reflect upcoming meetings and hearings open to the public. The commission does not automatically place an individual on its list server without their permission, but encourages the commenter to sign up with all the e-mail updates on SIP hot topics; over 30 topics are now available through the new GovDelivery service as of Fall 2007 ([www.tceq.state.tx.us](http://www.tceq.state.tx.us)).**

The EPA commented that the TCEQ should ensure that it has specifically addressed each requirement of Section 51.308. The EPA requested the checklist EPA developed be used.

**The commission has completed the EPA checklist that was provided to states giving references to specific chapters and appendices where each applicable requirements of Section 51.308 are addressed in the SIP revision. The commission will submit the checklist to the EPA with the adopted SIP package.**

The EPA requested that the TCEQ make sure all graphs and charts originally produced with color-coded lines and bars be reproduced in color, as black and white reproduction does not allow the identification of the individual items. This should be ensured in both printed and electronic versions of the SIP, including all appendices.

**The commission acknowledges that, where appropriate, graphs and charts produced in color should be reproduced in color. The print copies and files available electronically will be issued as originally produced.**

The EPA was not able to conduct a thorough review because of time, resource constraints, and because the TCEQ did not submit a paper copy of the SIP. The Sierra Club found it difficult to justify any significant expenditure of time or resources to do a thorough critique of the proposed Regional Haze SIP revisions because the commission did not address the deficiencies in the proposal.

**This SIP revision had a longer comment period than most as the 60 days for the FLMs was added to the 30-day public comment period, which made the comment period 90 days. As with other SIP revisions, Texas has provided EPA the ability to access and print revisions from the agency website. The commission was not made aware of the EPA's need for paper versions prior to the close of this comment period. Upon submission for review and approval, the EPA will receive paper copies of this SIP revision. The commission understands the time and resource constraints of both groups as the commission and its staff have similar limitations, however, no change was made in response to this comment.**

As required by Section 51.308(d)(4)(v), the EPA requested the commission include in the Regional Haze SIP revision a commitment to update the emissions inventory of pollutants that are reasonably anticipated to cause or contribute to visibility impairment in its Class I areas periodically.

**The commission remains committed to updating its emissions inventory. This commitment was included in Appendix 7-1, Section 7-5. "The Texas Commission on Environmental Quality (TCEQ), in compliance with the Clean Air Act Amendments and operating under the authority of the Texas Clean Air Act, Texas Health and Safety Code §382.014, and 30 TAC §101.10, conducts annual inventories of air emissions from point sources and periodic inventories of emissions from area, non-road mobile, and on-road mobile sources. The periodic inventory is updated statewide for all sectors every three years and submitted to EPA per the requirements of the Consolidated Emissions Reporting Rule, 40 CFR 51. The most recent, available inventory is for 2005 and is summarized in Table 7-4: *Non-EGU Point Source Controls*. The inventory will next be updated for 2008."**

The EPA Region 6 has submitted general comments on the Texas BART analysis with the intention of addressing the more significant issues that could be identified considering the review time available. The EPA was involved in review of much of the CAMx modeling done for screening out sources, but due to time and resource constraints, the EPA has not been possible to conduct a completely thorough review, particularly with regard to modeling. It is possible that additional concerns, not discovered during the review of this draft, will surface during the review of the final version of this SIP revision.

**The commission notes that the comment period was three times longer than usual. In addition to the standard 30-day public comment period, the FLMs were given 60 more days as required by the haze rule. Therefore, the comment period was 90 days. The commission understands time and resource constraints by government environmental agencies. The commission notes that EPA will have additional review after submittal.**

The NPS and FWS noted that appendices were available upon request. Since significant portions of the rationale for the commission's proposed Regional Haze SIP revision are contained within the appendices, these should be posted for public examination along with the SIP narrative document.

**The commission considers the SIP revision published for comment was complete and appropriate for public review and comment. As stated by the commenters, appendices were available upon request if needed. The appendices are currently available on the agency Web site.**

The FS asked Texas to explain what is meant by the terms, Elevated Point and Low Level Point in the modeling inventory.

**Pollutant emissions are treated in two basic ways within CAMx: low-level (gridded) emissions that are released into the lowest (surface) layer of the model; and elevated stack-specific (point) emissions with buoyant plume rise that can be emitted into any model layer. As shown in Table 8-2: *MM5 34 Vertical Layer Definitions* of the SIP, the surface layer is 36 meters and lower. The elevated layers are 36 meters and above. No changes were made in response to this comment.**

The Sierra Club commented that it is disappointed that natural visibility was not a high priority issue to the commission. Many of the same sources of pollution that affect the skies of the national parks in West Texas affect the air in cities elsewhere in the state. Aggressive cleanup of these sources will certainly benefit both, and the failure to take protective actions to clean up air quality from these sources will harm both.

**The commission is currently working to maintain health-effect standards as demonstrated by the state's current attainment for PM fine standards. Current nitrogen oxide and sulfur reductions obtained by programs such Senate Bill 7 benefit both the health-effect standards and visibility across the state. Any additional controls implemented for purposes of visibility only are not considered cost effective at this time.**

The Sierra Club, City League for Environmental Action Now (CLEAN) Houston, and over 300 individuals commented that the SIP is inadequate and want the commission to add control strategies. The Sierra Club acknowledged that significant air pollution affecting parks are coming from sources outside of Texas; however, the commission can do more to control those sources in Texas that are contributing to the problem. CLEAN agreed with the Sierra Club that the commission should reduce emissions from coal-fired power plants, which would make improvements in visibility within as little as five years; the commission should revise this SIP. One individual commented that the SIP revision explained several important reasons why controls were delayed but requested the commission do some controls. Another individual suggested that the commission was not making reasonable progress because it delays action for five years; five years is not reasonable.

**The commission is not delaying improvements in visibility impairment. Current control strategies are anticipated to decrease sulfur dioxide emissions by over 225,000 tpy and nitrogen oxides emissions by over 670,000 tpy by 2018. Chapter 10 has been updated with a more detailed discussion of the four factor analysis, including an updated cost-effectiveness analysis.**

In addition to Senate Bill 7 that the Texas Legislature implemented in 1997, emissions from coal-fired power plants are being controlled by the provisions of CAIR, which is to be implemented by 2015, with the first phase by 2009. Emissions reported from electric utilities have been decreasing annually with a decrease of over 80,000 tpy of nitrogen oxides and 27,000 tpy of sulfur dioxide between 2002 and 2005.

Significant cost-effective control strategies are already being implemented in Texas to control ozone. These strategies have been included in Texas' ozone SIP modeling. In addition to controlling ozone formation, the planned emissions reductions will also have a co-benefit of improving visibility impairment in Class I areas in Texas and nearby states by the reduction of sulfur dioxide and nitrogen oxides.

Because of the timing of various rule adoptions, not all of the following rules listed are in CENRAP's 2018 model. Those strategies included in CENRAP modeling are identified with an asterisk. Due to more recent adoption dates, other control strategies listed are not modeled by CENRAP but are expected to have emissions reductions by 2018. Control strategies that were effective after 2002 and prior to 2018 are listed as follows.



### **Point Source Controls - Electric Generating Utilities**

#### **Houston-Galveston-Brazoria**

- \*nitrogen oxide Mass Emission Cap and Trade (MECT)**

#### **Dallas-Fort Worth**

- \*30 TAC §117 nitrogen oxide unit specific limits**
- \*30 TAC §101 system-wide averaging caps**

#### **Beaumont-Port Arthur**

- \*30 TAC §117 nitrogen oxide unit specific limits**
- \*30 TAC §101 system-wide averaging caps**

#### **East and Central Texas**

##### **Clean Air Interstate Rule (CAIR)**

- \*30 TAC §117 nitrogen oxide unit specific limits**
- \*30 TAC §101 system-wide averaging caps**

#### **West Texas**

- \*30 TAC §101 SB7 nitrogen oxide caps with trading**

### **Point Source Controls - Non-Electric Generating Units**

#### **Statewide**

- \*Site specific Refinery Consent Decree sulfur dioxide levels**

#### **Houston-Galveston**

- \*nitrogen oxide Mass Emissions Cap and Trade (MECT)**
- \*Highly-Reactive VOC (HRVOC) Emission Cap and Trade (HECT)**

#### **Beaumont-Port Arthur**

- \*30 TAC §117 controls (process heaters, industrial boilers, engines)**

#### **Dallas-Fort Worth**

- \*30 TAC §117 controls for select**
  - Kilns (including cement, lime, brick and ceramic)**
  - Furnaces (reheat, smelting, blast, reverb, glass, fiberglass, and mineral wool)**
  - Heaters and ovens**
  - Industrial Boilers**
  - Engines**
- Increment of Progress (IOP) engine nitrogen oxide controls**
- Increment of Progress (IOP) surface coating VOC controls**

#### **East Texas**

- \*30 TAC §117 Cement Kiln nitrogen oxide limits**
- \*Agreed Orders/Consent decree sites specific reductions at Alcoa and Eastman**
- 30 TAC §117 engine nitrogen oxide controls in specified counties**

### **Area Source Controls**

#### **Statewide**

- \*30 TAC §117 nitrogen oxide emissions limits to water heaters, small boilers, and process heaters**

#### **Dallas-Fort Worth**

- IOP for Ellis, Johnson, Kaufman, Parker, Rockwall counties**
- VOC reductions from Stage I vapor recovery**
- VOC reductions from surface coating processes**

## **On-Road Mobile Source Controls**

### **Statewide**

- \*sulfur dioxide reductions from low sulfur diesel fuel**
- nitrogen oxide reductions from TxLED**

### **Nonattainment areas**

- \*Vehicle inspection and maintenance**
- TERP nitrogen oxide reductions**

## **Non-road Mobile Source Controls**

### **East Texas Counties (including nonattainment counties)**

- TxLED nitrogen oxide reductions**

### **Houston-Galveston and Dallas-Fort Worth**

- \*nitrogen oxide reductions from California Large Spark Ignition Engine Standards**
- TERP nitrogen oxide reductions**

**A proposed control strategy for regional haze with a limiting cost for controls, equivalent to the CAIR program of \$2,700 per ton, results in a negligible improvement projected in visibility with a cost over \$300 million (Table 10-4). The commission's analysis concludes that additional controls for regional haze are not reasonable at this time. This will be reconsidered in future SIP revisions.**

The Sierra Club and many individuals urged the commission to withdraw its proposed Regional Haze SIP and develop a new plan for addressing the regional haze problem to submit to the EPA. The Sierra Club found the proposed Regional Haze SIP revisions inadequate and insisted that the commission take responsibility to address the visibility issues at Big Bend and Guadalupe Mountains. Many individuals urged the commission to include specific air pollution control measures that go beyond existing rules so that Texas can move closer toward the national goal to clear the air in Texas and national parks in neighboring states.

**The commission does not plan to withdraw the proposed Regional Haze SIP revision. Significant cost-effective control strategies are already being implemented in Texas to control ozone. As part of these strategies, nitrogen oxides emissions will be reduced. State control measures required under Senate Bill 7 reduce both sulfur dioxide and nitrogen oxides at electric generating units. These control strategies will also reduce the emissions that contribute to visibility impairment in Class I areas. These strategies are anticipated to decrease these sulfur dioxide emissions by over 225,000 tons and nitrogen oxides emissions by over 670,000 tpy by 2018. The commission's analysis concludes that additional controls for regional haze are not reasonable at this time. This will be reconsidered in future SIP revisions.**

The Sierra Club requested the commission develop a new plan to reach the 2064 goal; cast the net wider for the active involvement of a much more diversified set of interests for input and collaboration on plan development, including especially bringing into the process much greater representation of interests that have a strong commitment to the protection of areas such as Big Bend and Guadalupe Mountains, rather than an over-reliance on industries with a interest in avoiding new air pollution control strategies.

**The commission made significant effort to contact interested parties during both the Texas BART Rule and Regional Haze SIP developments. Public notices were sent to update interested parties and solicit input in the regional haze process. Regional haze notices were sent to six newspapers: Austin American-Statesman, El Paso Times, Fort Worth Star-Telegram, Houston Chronicle, Midland Reporter-Telegram, and the Alpine Avalanche. Notices were also sent to twelve Councils of Government and Metropolitan Planning Organizations, and seven local programs throughout the state. Representatives from six**

adjacent state's environmental departments were also notified. A list server of over 200 participants was established for BART developments. After the BART rule was finalized, the SIP list server with over 500 participants was used for regional haze outreach. Among the notices were announcements for two informational meetings on the BART Rule and one meeting on the Regional Haze SIP. In addition, the Texas Regional Haze SIP was published in the Texas Register on December 21, 2007.

In addition to the health concerns in the areas of Dallas, Houston, San Antonio, and El Paso, one individual is concerned with the effects of air pollution on the investments in McDonald Observatory that will be seriously impacted by continued inaction.

**Although the Regional Haze SIP revision addresses haze impacts only at Class I areas in Texas and neighboring states, the commission anticipates that reduction in haze-causing emissions and activities will also benefit visibility in other parts of Texas, including the McDonald Observatory.**

The Sierra Club, CLEAN, and four individuals were concerned that the commission does not meet the goal of natural visibility by 2064. The Sierra Club was disappointed with the inadequacy of the Regional Haze SIP revisions being proposed by the commission at this time. One individual questioned if TCEQ is protecting and advocating for industry or the public.

**The commission remains committed to clean air and reducing haze in public wilderness areas, national parks, and throughout Texas. Texas has significant cost-effective control strategies to reduce nitrogen oxides and sulfur dioxide to control ozone. In addition to controlling ozone formation, the planned emission reductions will also have a co-benefit of improving visibility impairment in Class I areas in Texas and nearby states. The strategies in place are anticipated to decrease these sulfur dioxide emissions by over 225,000 tpy and nitrogen oxides emissions by over 670,000 tpy by 2018. The commission considers the strategies in place are a cost-effective, reasonable approach to reducing visibility impairment. The commission's analysis concludes that additional controls for regional haze are not reasonable at this time. This will be reconsidered in future SIP revisions.**

### **Corrections**

The EPA commented that Tables 8, 9, and 10 of Appendix 10-1 were truncated. The FS commented that in Chapter 8, Figures 4 and 5; the captions indicate that these figures used the 2002 Base F emission inventory, however, the headings for the graph say that they used the 2002G typical emission inventory. The FS asked the commission to correct this error. The NPS, FWS, and EPA commented that the folder for Appendix 11-1: *Fire Management Plans* was empty on the CD. The FS indicated park name corrections for Badlands, Bandelier, and Great Sand Dunes to national parks. The NPS and FWS noted that within Appendix 5-1 an ftp site was referenced for further information. The commenters noted that the ftp link was password protected and not publicly available.

**The commission thanks the EPA, FS, NPS, and FWS for identifying these errors. The corrections to Appendix 10-1 were made to the SIP revision and posted on the TCEQ regional haze Web site in February 2008. The Chapter 8 figure caption has been corrected to indicate that model results are from the Typical 2002G or Typ02G inventory. The commission corrected the error in the CD's missing Appendix 11-1 and e-mailed the materials as soon as staff was made aware of the omission. The park names were correct throughout the document. The ftp site is not a state Web site and the reference is not critical for the appendix, so the link has been deleted due to problematic access.**

**ORDER ADOPTING  
REVISION TO THE STATE IMPLEMENTATION PLAN**

Docket No. 2007-1539-SIP

On February 25, 2009, the Texas Commission on Environmental Quality (Commission), during a public meeting, considered adoption a revision of the State Implementation Plan (SIP) to address visibility impairment due to regional haze in Class I federal areas. The Commission adopts the SIP revision, which implements federal Clean Air Act requirements to make reasonable progress in reducing visibility impairment at Class I federal areas, including Big Bend and Guadalupe National Parks, resulting from anthropogenic pollution. Under Tex. Health & Safety Code Ann. §§ 382.011, 382.012, and 382.023 (Vernon 2001), the Commission has the authority to control the quality of the state's air and to issue orders consistent with the policies and purposes of the Texas Clean Air Act, Chapter 382 of the Tex. Health & Safety Code.

Pursuant to 40 Code of Federal Regulations § 51.102 and after proper notice, the Commission conducted a public hearing to consider the revision to the SIP. Proper notice included prominent advertisement in the areas affected at least 30 days prior to the date of the hearing. A public hearing was held in Austin, on February 19, 2008.

The Commission circulated hearing notices of its intended action to the public, including interested persons, the Regional Administrator of the EPA, and all applicable local air pollution control agencies. The public was invited to submit data, views, and recommendations on the proposed SIP revision, either orally or in writing, at the hearing or during the comment period. Prior to the scheduled hearing, copies of the proposed SIP revision were available for public inspection at the Commission's central office and on the Commission's Web site.

Data, views, and recommendations of interested persons regarding the proposed SIP revision were submitted to the Commission during the comment period, and were considered by the Commission as reflected in the analysis of testimony incorporated by reference to this Order. The Commission finds that the analysis of testimony includes the names of all interested groups or associations offering comment on the proposed SIP revision and their position concerning the same.

IT IS THEREFORE ORDERED BY THE COMMISSION that the revision to the SIP incorporated by reference to this Order is hereby adopted. The adopted SIP revision is incorporated by reference in this Order as if set forth at length verbatim in this Order.

IT IS FURTHER ORDERED BY THE COMMISSION that on behalf of the Commission, the Chairman should transmit a copy of this Order, together with the adopted SIP revision, to the Regional Administrator of EPA as a proposed revision to the Texas SIP pursuant to the Federal Clean Air Act, codified at 42 U.S. Code Ann. §§ 7401 - 7671q, as amended.

If any portion of this Order is for any reason held to be invalid by a court of competent jurisdiction, the invalidity of any portion shall not affect the validity of the remaining portions.

Date issued:

TEXAS COMMISSION ON  
ENVIRONMENTAL QUALITY

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Buddy Garcia, Chairman