Final Report

Screening Analysis of Potential BART-Eligible Sources in Texas

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GLOSSARY OF ACRONYMS

AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee Model
BAND	Bandelier
BART	Best Available Retrofit Technology
BIBE	Big Bend
bnatural	Clean Natural Conditions
BOAP	Bosque del Apache
BRET	Breton
bsource	Total light extinction due to a source
CAA	Clean Air Act
CACR	Caney Creek
CAIR	Clean Air Interstate Rule
CALPUFF	California Puff Model
CAMx	Comprehensive Air Quality Model with extensions
CCRS	Coarse Crustal particulate matter
CENRAP	Central Regional Air Planning Association
CMAQ	Community Multiscale Air Quality Modeling System
CPRM	Coarse other Primary particulate matter
del-dv	change in deciview (delta-deciview)
dv	deciviews
EC	Elemental Carbon
EGU	Electric Generating Units
EPA	Environmental Protection Agency
f(RH)	Relative Humidity adjustment factor
FCRS	Fine Crustal particulate matter
FLAG	Federal Land Managers Air Quality Related Values Workgroup
FLM	Federal Land Manager
FPRM	Fine other Primary particulate matter
FR	Federal Register
GREASD	Greatly Reduced and Simplified Dynamics
GRSA	Great Sand Dunes
GUMO	Guadalupe Mountains
HEGL	Hercules-Glade
Hg	Mercury
HI	Haze Index
IMPROVE	Interagency Monitoring of Protected Visual Environments
IRON	Incremental Reactions for Organics and Nitrogen Oxides
km	Kilometers
MEVE	Mesa Verde
MING	Mingo
Mm^{-1}	Inverse Megameters
MRPO	Midwest Regional Planning Organization
MW	Megawatt
NH_4	Ammonium
NO_3	Particulate Nitrate
non-EGU	Non-Electric Generating Units

NO_x	Nitrogen Oxides
NSR	New Source Review
OC	Organic Carbon
OMC	Organic Matter Carbon
OSAT	Ozone Source Apportionment Technology
PGM	Photochemical Grid Model
PiG	Plume-in-Grid
PLUVUE	Plume Visibility Model
PM	Particulate Matter
PM_{10}	Particulate Matter with aerodynamic diameters less than 10 microns
$PM_{2.5}$	Particulate Matter with aerodynamic diameters less than 2.5 microns
POA	Primary Organic Aerosol
PSAT	Particulate Matter Source Apportionment Technology
PSD	Prevention of Significant Deterioration
QAPP	Quality Assurance Program Plan
Q/D	Emissions of source / distance to nearest Class 1 area
RH	Relative Humidity
RHR	Regional Haze Rule
RPO	Regional Planning Organization
SACR	Salt Creek
SAPE	San Pedro Parks
SIP	State Implementation Plan
SMOKE	Sparse Matrix Operator Kernel Emissions
SO_2	Sulfur Dioxide
SO_4	Sulfate
SOA	Secondary Organic Aerosol
TCEQ	Texas Commission on Environmental Quality
TIP	Tribal Implementation Plan
tpy	tons per year
UARG	Utility Air Regulatory Group
UPBU	Upper Buffalo
VISTAS	Visibility Improvement State and Tribal Association of the Southeast
VOC	Volatile Organic Compounds
WEMI	Weminuche
WHIT	White Mountain
WHPE	Wheeler Peak
WHRI	White River monitor considered a surrogate for Flat Tops, Maroon Bells-Snowmass, West Elk, and Eagles Nest
WIMO	Wichita Mountains
WRAP	Western Regional Air Partnership

1.0 INTRODUCTION

OVERVIEW

The final version of EPA's Regional Haze Regulations was published in the *Federal Register* on July 6, 2005 (70 FR 39104, EPA, 2005). One of the provisions of the program is the requirement that certain existing stationary sources emitting visibility-impairing air pollutants install and operate the Best Available Retrofit Technology (BART). The regulations require case-by-case BART determination to define specific emissions limitations representing BART and schedules for compliance for each source subject to BART. This analysis will be part of the Regional Haze State Implementation Plan (SIP). The SIP must be submitted to EPA by December 17, 2007.

A BART eligible source or existing stationary facility means any stationary source of air pollutants, including any reconstructed source, which: (a) "was not in operation prior to August 7, 1962, and was in existence on August 7, 1977," (b) "has the potential to emit 250 tons per year or more of any air pollutant" and (c) falls within one or more of 26 specifically listed source categories (40 CFR Section 51.301). BART controls are required for any BART-eligible source that can be reasonably expected to cause or contribute to impairment of visibility in any of the 156 federal parks and wilderness (Class I) areas protected under the regional haze rule. Air quality modeling is an important tool available to the states in determining whether a source can be reasonably expected to contribute to visibility impairment at a Class I area.

Texas has over one hundred potential BART-eligible sources that need to be evaluated to determine whether they contribute significantly to visibility impairment of a Class I area. The individual modeling of each of these potential BART-eligible sources would be quite resource intensive. The Texas Commission on Environmental Quality (TCEQ) performed BART screening analysis to determine whether emissions from groups of potential BART-eligible sources contribute significantly to visibility impairment of Class I areas. If the visibility impacts from a group of potential BART-eligible sources does not contribute significantly to the visibility impairment of any Class I area, then it stands to reason that each BART source in the group would not contribute significantly to visibility impairment at any Class I area.

Purpose

The TCEQ compiled a list of potential BART-eligible sources against the three BART-eligible criteria and performed screening analyses to determine which source groups do not cause or contribute significantly to visibility impairment of Class I areas. The screening analyses then tested whether it is appropriate to exclude volatile organic compounds (VOC) and/or particulate matter (PM) emissions from potential BART-eligible sources in Texas from the BART process. The resulting screened potential BART-eligible sources list will be more manageable, allowing the TCEQ to focus their efforts on determining whether BART controls are needed for the remaining BART-eligible sources.

This document presents the results of the Texas BART screening analysis that was aimed at determining the following:

- Whether VOC and/or PM emissions from potential BART-eligible sources in Texas can be shown to contribute insignificantly to visibility impairment at Class I areas, and therefore, may not need perform any further BART analysis; and

- Whether there are groups of non-Electric Generating Utilities (non-EGU) potential BART-eligible sources whose total SO_2 and NO_x emissions can be shown to contribute insignificantly to visibility impairment at Class I areas, and therefore may not need perform any further BART analysis.

Texas BART Screening Analysis Modeling Protocol

Prior to performing the Texas BART screening analysis, a modeling protocol was prepared that provided details on the modeling approach to be used for the Texas group BART screening analysis (ENVIRON, 2005b). The modeling protocol was reviewed by TCEQ and EPA prior to performing the analysis. The Texas BART screening analysis modeling protocol contained a summary of the BART requirements taken from EPA's BART guidelines (EPA, 2005) and BART modeling protocols prepared by Visibility Improvement State and Tribal Association of the Southeast (VISTAS, 2006), Central Regional Air Planning Association (CENRAP), (Alpine and ENVIRON, 2005) and Western Regional Air Partnership (WRAP) (UCR and ENVIRON, 2006).

BART Modeling Guidance

To evaluate the visibility impacts of a potential BART-eligible source at Class I areas beyond 50 kilometers (km) from the source, EPA modeling guidance (EPA, 2003c) recommends the use of the California Puff Model (CALPUFF) model. For modeling the impact of sources closer than 50 km to a Class I area, EPA's BART guidance recommends that expert modeling judgment be used "giving consideration to both CALPUFF and other methods." The Plume Visibility Model-II (PLUVUE) model is mentioned as a possible model to consider in addition to CALPUFF within 50 km of a source. The EPA guidance notes that regional scale photochemical grid models may have merit, but such models are resource intensive relative to CALPUFF. Photochemical grid models are clearly more appropriate for cumulative modeling options such as in the determination of the aggregate contribution of all BART-eligible sources to visibility impairment, but such use should involve consultation with the appropriate EPA Regional Office.

CALPUFF is recommended for ascertaining whether a potential BART-eligible source may need to perform further BART analysis. If a source is determined to be subject to BART, CALPUFF or another appropriate model should be used to evaluate the improvement in visibility resulting from the application of BART controls. Emissions reflecting periods of start-up, shutdown, and malfunction are not to be considered in determining the appropriate emission rates. EPA recommends that states use the highest 24-hour average actual emission rate for the most recent five-year period (excluding periods with start-up, shutdown, and malfunctions). Visibility improvements may be evaluated on a pollutant-specific basis.

EPA's BART guidance allows states to "submit to EPA a demonstration, based on an analysis of overall visibility impacts, that emissions from BART-eligible sources in your state, considered together, are not reasonably anticipated to cause or contribute to any visibility impairment in a Class I area, and thus no source should be subject to BART" (EPA, 2005). This "Option 3"

approach that has been pursued in the Texas BART screening analysis discussed in this report. EPA guidance notes that "you may also use a photochemical grid model" and "if you wish to use a grid model, you should consult with the appropriate EPA Regional Office to develop an appropriate modeling protocol" (EPA, 2005). The TCEQ entered into discussions with EPA Region 6 and developed a group screening modeling approach that was agreed to as acceptable.

Overview of Approach

For the specific BART screening analysis undertaken in this study, a photochemical grid model is more appropriate than the single-source CALPUFF model for the following reasons:

- There are a large number of potential BART-eligible sources in Texas, and use of a photochemical grid model will allow the efficient screening of many sources in a scientifically defensible manner;
- For most potential BART-eligible sources in Texas, the Class I areas where visibility impacts will be estimated are far away from the source;
- TCEQ has identified which of the many potential BART-eligible sources satisfy the three criteria for being BART-eligible. If sources can be determined to make an insignificant contribution to visibility impairment at Class I areas as a group, resources can then be focused on those sources determined most likely to impact visibility in Class I areas;
- Use of a photochemical grid model allows the quantitative assessment of the visibility impacts due to potential BART-eligible sources' VOC and PM emissions;
- Use of a photochemical grid model with full chemistry alleviates concerns raised about the inadequacy of the CALPUFF sulfate and nitrate chemistry (Morris, Tana and Yarwood, 2003; Morris, Lau and Koo, 2005; Morris et al., 2006); and
- Use of a photochemical grid model provides an evaluation of the cumulative impact of BART-eligible sources on visibility in Class I areas.

The Texas BART screening analysis was built upon the regional photochemical modeling (Morris et al., 2005d) being conducted by CENRAP. In particular, the CENRAP 2002 36 km modeling database for the Comprehensive Air Quality Model with extensions (CAMx) (ENVIRON, 2005a) was enhanced to include a 12 km grid over Texas and nearby Class I areas. CAMx zero-out VOC and PM emissions from BART sources and inert primary PM BART sources emissions modeling was conducted to determine whether potential BART-eligible sources' VOC and PM emissions could be shown to contribute insignificantly to visibility impairment at any Class I area. The CAMx PM Source Apportionment Technology (PSAT) modeling was also conducted for groups of potential BART-eligible sources' SO_2 and NO_x emissions. A potential BART-eligible source in a group that is shown not to contribute significantly to visibility impairment at any Class I area may be excluded from further steps in the BART process. Several features and recent enhancements to the CAMx modeling system that make it more suitable for performing BART screening modeling include:

- **Flexi-nesting:** Finer grids can be specified (12 km in this case) without necessarily needing to provide finer grid meteorological and emission inputs. The flexi-nesting allows for better simulation of transport, dispersion, and chemistry of point sources.
- **PSAT:** PSAT allows tracking of the impacts of BART sources or groups of BART sources within a single run. A single run is more efficient than performing many separate zero-out modeling runs for each BART source or group of BART sources.

- **Implementation of PSAT and the full chemistry Plume-in-Grid (PiG):** The PSAT and full chemistry PiG provide more accurate treatment of the near-source transport, plume dispersion, and plume chemistry of the BART sources.

A new version of CAMx was used in this work that incorporates all of these features (CAMx V4.4). This version of CAMx is currently undergoing final testing and evaluation and will be posted on the CAMx website (www.camx.com) along with an updated user's guide and test problem in 2006. This version of the model is currently available on request from ENVIRON (contact camx@environ.org).

2.0 MODELING APPROACH

This section describes the modeling approach and databases that were used to perform the BART screening analysis of potential BART-eligible sources. The analyses consisted of two basic elements:

- **VOC and PM Modeling Analyses:** An analysis of the VOC and PM emissions from all potential BART-eligible sources was performed. Followed by analysis of VOC from all potential BART-eligible sources. Finally, analyses of the PM emissions from the BART-eligible sources was performed using grouped sources.

- **PSAT Modeling Analyses for SO_2 and NO_x emissions:** Screening analyses for groups of potential BART-eligible non-EGU sources' SO_2 and NO_x emissions were performed to determine whether the group's visibility impacts at Class I areas were insignificant.

Both elements of the BART screening analyses used the same 36/12 km 2002 annual database for CAMx (ENVIRON, 2005a) based on the database developed by CENRAP (www.cenrap.org). The VOC and PM emission screening analyses were performed using emissions zero-out modeling and, for primary PM only, inert simulations. The group of sources' SO_2 and NO_x emissions screening analyses were performed using an updated version of the CAMx PSAT.

2002 ANNUAL 36/12 KM MODELING DATABASE

The BART screening modeling was performed using the CAMx Version 4.4 model and the 2002 annual regional photochemical modeling database developed as part of the CENRAP (Morris, 2005d). CENRAP developed a 2002 annual modeling database for CAMx on the 36 km unified national Regional Planning Organization (RPO) grid that covers the continental United States. This database was developed following the procedures outlined in the CENRAP Modeling Protocol (Morris et al., 2004c) and CENRAP modeling Quality Assurance Program Plan (QAPP) (Morris and Tonnesen, 2004b). The CENRAP preliminary base case model performance evaluation results for the CAMx model on the national 36 km grid using the CENRAP base A emissions is given in Morris et al., (2005d). The CENRAP modeling protocol, QAPP, and preliminary base A evaluation reports provide details on the development of the CENRAP 2002 36 km annual modeling database. Provided below is a summary of the enhancements made to the CENRAP database for use in this BART screening analysis. Additional details can be found in the modeling protocol (ENVIRON, 2005b).

Enhancements to the CENRAP 2002 Modeling Database

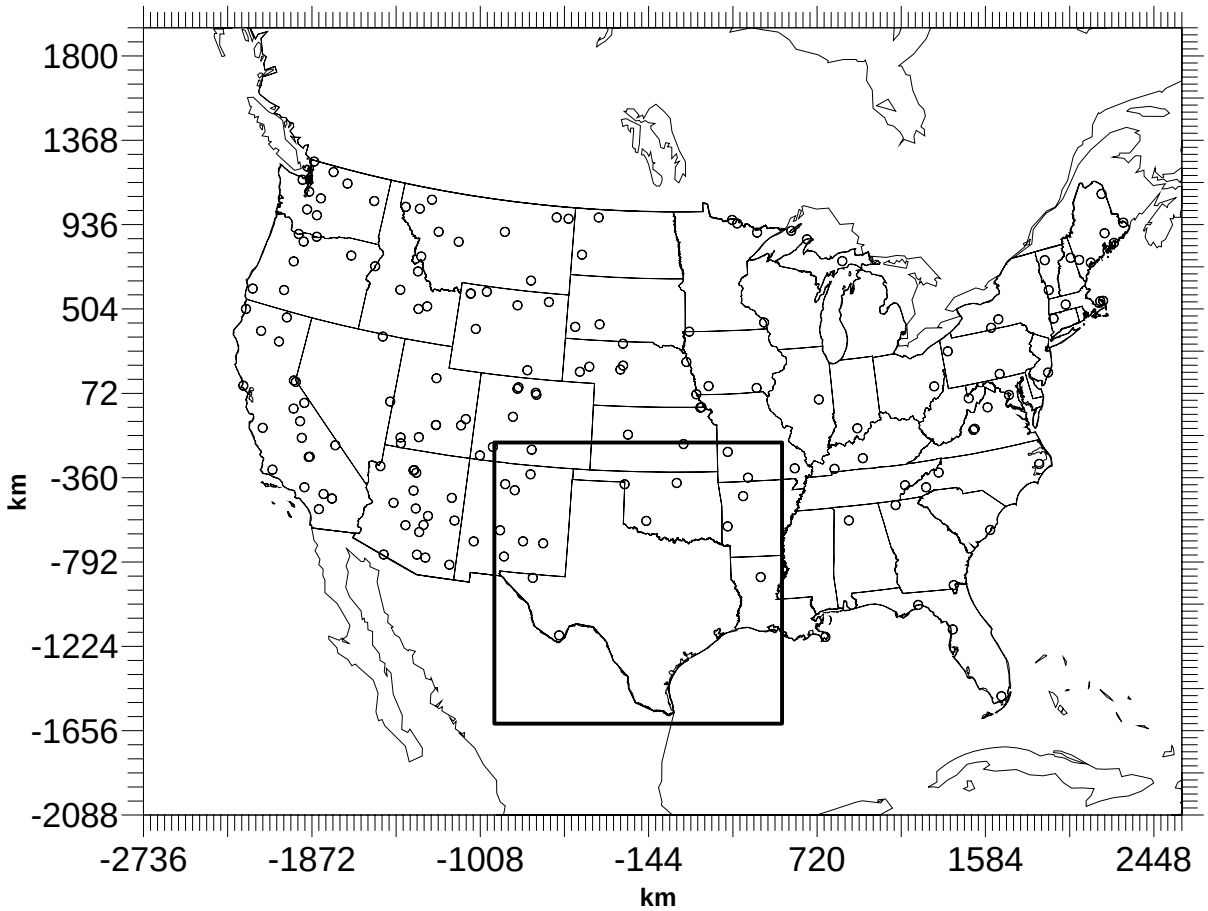
The CENRAP 2002 36 km annual CAMx evaluation using the base A emissions and CAMx Version 4.20 is reported in Morris and co-workers (2005d). Additional model performance evaluation displays for more recent base cases are available on the CENRAP modeling Website (http://pah.cert.ucr.edu/aqm/cenrap/cmaq.shtml#camx). CENRAP is currently updating the 2002 base case emissions and updated CMAQ and CAMx simulations are forthcoming. For the Texas

BART screening modeling, the base B base case database was used (the most current available at the time).

The CENRAP Base B 2002 36 km annual CAMx photochemical modeling database was updated to include a 12 km nested-grid that covers Texas and Class I areas in and near Texas including:

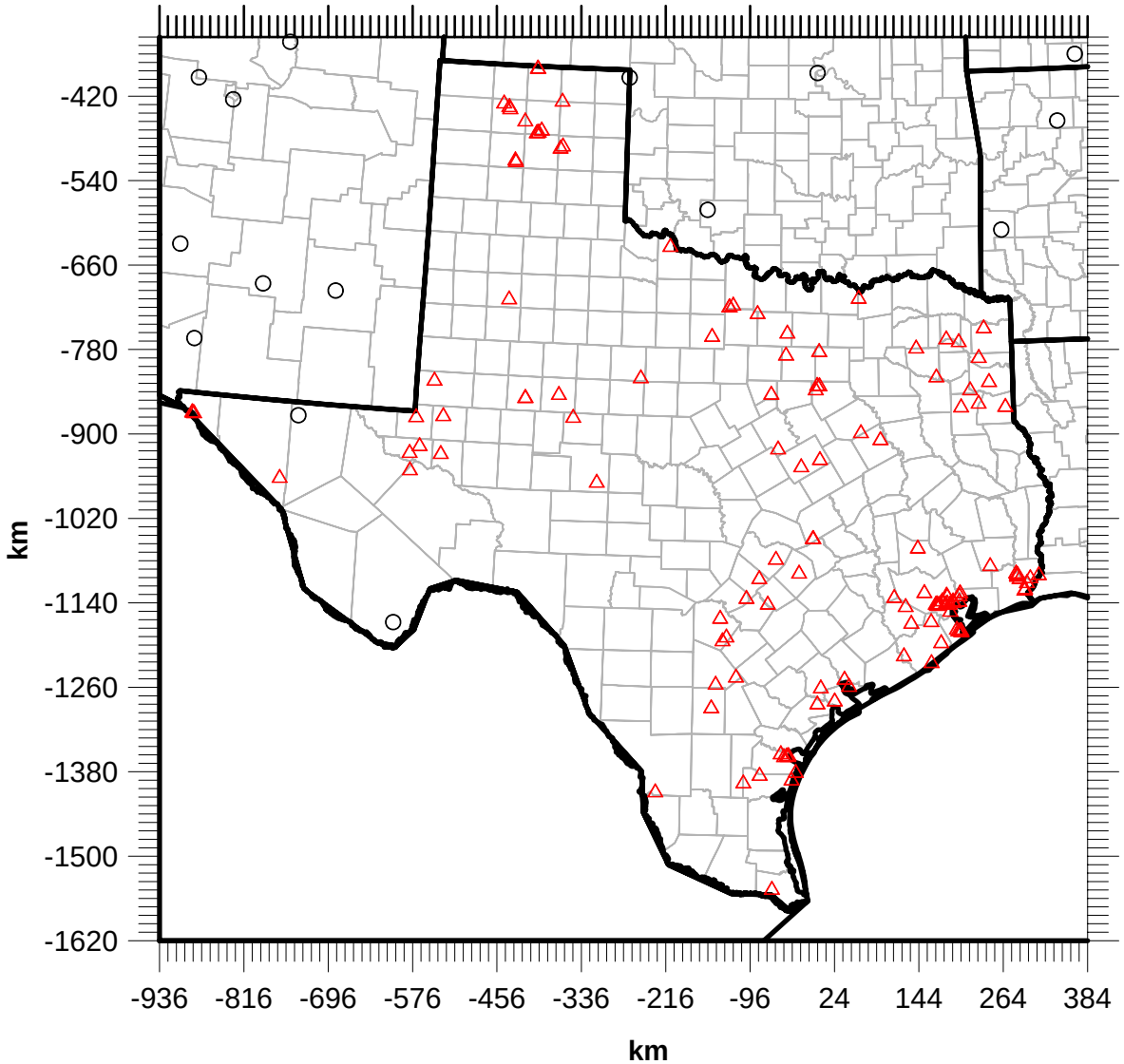
- National Parks: Big Bend (BIBE), Guadalupe Mountains (GUMO), and Carlsbad Caverns
- Wildlife Refuges: Salt Creek (SACR) and Wichita Mountains (WIMO)
- Wilderness Areas: White Mountain (WHIT), Caney Creek (CACR), Upper Buffalo (UPBU), and Hercules-Glade (HEGL).

Figure 2-1 displays the 36/12 km nested grid structure used for the CAMx BART screening modeling analysis. The locations of the potential BART-eligible sources and Interagency Monitoring of Protected Visual Environments (IMPROVE) sites that includes Class I areas within the 12 km modeling domain are shown in Figure 2-2. The CAMx flexi-nesting feature was used to specify a 12 km Texas fine grid within the CENRAP 36 km modeling domain. Full flexi-nesting was invoked in which CAMx internally interpolates meteorological data, emissions and other inputs from the 36 km grid to the 12 km grid.



36km Domain: South West Corner = (-2736 km, -2088 km) NX, NY = (148x112)
LCP Definition: (-97.0, 40.0, 45.0, 33.0)

Figure 2-1. Texas BART modeling 36/12 km modeling domain and the locations of the IMPROVE monitoring sites that include Class I areas, indicated by circles.



12km Domain: South West Corner = (-936 km, -1620 km) NX, NY = (111x108)
LCP Definition: (-97.0, 40.0, 45.0, 33.0)

Figure 2-2. Texas BART modeling 12 km modeling domain and the locations of the IMPROVE monitoring sites (circles) that include Class I areas and locations of potential BART-eligible sources in Texas (triangles).

ENHANCEMENTS TO THE PM SOURCE APPORTIONMENT TECHNOLOGY

PSAT was used to conduct the SO_2 and NO_x potential BART-eligible screening analysis. In Version 4.4 of CAMx, the PSAT was updated to be compatible with the CAMx full chemistry Plume-in-Grid (PiG) module. The next section briefly describes the PSAT technique and the enhancements that were made to the CAMx PiG and PSAT to make them compatible with each other. More details are provided in the modeling protocol (ENVIRON, 2005b).

PSAT Formulation

PSAT is designed to source apportion the following PM species modeled in CAMx:

- Sulfate (SO_4)
- Particulate nitrate (NO_3)
- Ammonium (NH_4)
- Particulate mercury (Hg(p))
- Secondary organic aerosol (SOA)
- Six categories of primary particulate matter (PM)
    - Elemental carbon (EC)
    - Primary organic aerosol (POA)
    - Fine crustal PM (FCRS)
    - Fine other primary PM (FPRM)
    - Coarse crustal PM (CCRS)
    - Coarse other primary PM (CPRM)

PSAT performs PM source apportionment for each user defined source group. A source group consists of a combination of a geographic regions and emissions source categories. Examples of source regions include: countries, states, nonattainment areas, or counties. Examples of source categories include: area sources, mobile sources, biogenic sources, elevated point sources or individual point sources. The user defines a map to specify the source regions. The user then defines each source category. For example, separate gridded low-level emissions and/or elevated point source emissions. The model then determines each source group by joining the source categories with the source region map.

The PSAT "reactive tracers" that are added for each source category/region combination (*i*) are described below. In general, a single tracer can track primary PM species, whereas secondary PM species require several tracers to track the relationship between gaseous precursors and the resulting PM. Particulate nitrate and secondary organics are the most complex species to apportion because the emitted precursor gases (NO_x and VOCs) are several steps removed from the resulting PM species (NO_3 and SOA). There is a PSAT convention that tracer names for particulate species begin with the letter "P."

<u>Sulfur (SO_4 Tracers)</u>

$SO2_i$ Primary SO_2 emissions
$PS4_i$ Particulate sulfate ion from primary emissions plus secondarily formed sulfate

<u>Nitrogen (NO_3 Tracers)</u>

RGN_i Reactive gaseous nitrogen including primary NO_x ($NO + NO_2$) emissions plus nitrate radical (NO_3), nitrous acid (HONO) and dinitrogen pentoxide (N_2O_5).
TPN_i Gaseous peroxyl acetyl nitrate (PAN) plus peroxy nitric acid (PNA)
NTR_i Organic nitrates (RNO_3)
$HN3_i$ Gaseous nitric acid (HNO_3)
$PN3_i$ Particulate nitrate ion from primary emissions plus secondarily formed nitrate
$NH3_i$ Gaseous ammonia (NH_3)
$PN4_i$ Particulate ammonium (NH_4)

Secondary Organic Aerosol (SOA Tracers)

- ALK_i Alkane/Paraffin secondary organic aerosol precursors
- ARO_i Aromatic (toluene and xylene) secondary organic aerosol precursors
- CRE_i Cresol secondary organic aerosol precursors
- TRP_i Biogenic olefin (terpene) secondary organic aerosol precursors
- $CG1_i$ Condensable gases from toluene and xylene reactions (low volatility)
- $CG2_i$ Condensable gases from toluene and xylene reactions (high volatility)
- $CG3_i$ Condensable gases from alkane reactions
- $CG4_i$ Condensable gases from terpene reactions
- $CG5_i$ Condensable gases from cresol reactions
- $PO1_i$ Particulate organic aerosol associated with CG1
- $PO2_i$ Particulate organic aerosol associated with CG2
- $PO3_i$ Particulate organic aerosol associated with CG3
- $PO4_i$ Particulate organic aerosol associated with CG4
- $PO5_i$ Particulate organic aerosol associated with CG5

Mercury (Hg Tracers)

- $HG0_i$ Elemental Mercury vapor
- $HG2_i$ Reactive gaseous Mercury vapor
- PHG_i Particulate Mercury

Primary Particulate Matter (PM Tracers)

- PEC_i Primary Elemental Carbon
- POA_i Primary Organic Aerosol
- PFC_i Fine Crustal PM
- PFN_i Other Fine Particulate
- PCC_i Coarse Crustal PM
- PCS_i Other Coarse Particulate

PSAT includes a total of 32 tracers for each source group (*i*) if source apportionment is applied to all types of PM. Since source apportionment may not always be needed for all species, the PSAT implementation is flexible and allows source apportionment for any or all of the chemical classes in each CAMx simulation (i.e. the SO_4, NO_3, SOA, Hg and primary PM classes listed above). For example, source apportionment for sulfate/nitrate/ammonium requires just nine tracers per source group.

One fundamental assumption in PSAT is that PM is apportioned back to the primary precursor for each type of PM. For example, SO_4 is apportioned to SO_x emissions, NO_3 is apportioned to NO_x emissions, NH_4 is apportioned to NH_3 emissions, etc.

Updates to the PSAT Formulation

The CAMx PSAT and PiG algorithms were updated to treat the near-source dispersion and chemistry of secondary PM formation in the PM source apportionment calculations. A new full-chemistry PiG module was developed that has been extended to PSAT and Ozone Source Apportionment Technology (OSAT). The full-chemistry PiG treats the gas-phase and aqueous-phase reactions associated with ozone, sulfate and nitrate formation.

PROCEDURES FOR VOC AND PM EMISSIONS BART SCREENING ANALYSIS

Two types of screening analyses were performed to assess the visibility impacts of VOC and PM emissions from potential BART-eligible sources:

(1) zero-out VOC and PM emissions modeling; and
(2) inert PM emissions modeling.

The results from the VOC and PM BART screening analyses are provided in Chapter 3.

Zero-Out VOC and PM Emissions Screening Analyses

The first BART screening analysis evaluated the cumulative visibility impacts at Class I areas of VOC and PM emissions from all potential BART-eligible sources in Texas using two 2002 annual CAMx 36/12 km simulations:

- 2002 BART base case emissions scenario (with estimated 24-hour maximum VOC and PM emissions for BART-eligible sources); and

- 2002 BART VOC and PM emissions zero-out scenario.

The 2002 BART base case emissions scenario was based on the CENRAP 2002 typical base B base case emissions scenario. The BART guidelines require that BART modeling use the maximum actual 24-hour emissions for each BART-eligible source (EPA, 2005). The CENRAP 2002 typical scenario includes average actual emissions for all sources. The maximum 24-hour actual emission rates are not readily available for most sources. To account for the differences between maximum 24-hour actual and average typical actual, the average typical actual emissions for potential BART-eligible sources in the CENRAP 2002 typical base B base case emissions scenario were doubled at the suggestion of EPA Region 6. EPA noted that this assumption provides a conservative (overstatement) estimate of maximum actual 24-hour emissions for most sources.

Visibility impacts were calculated at each Class I area using the differences in 24-hour PM concentrations between the 2002 BART base case and 2002 BART zero-out case following the procedures given in EPA's BART modeling guidance (EPA, 2005). The BART procedures were outlined in the Federal Land Managers Air Quality Related Values Workgroup report (FLAG, 2000) and EPA regional haze guidance documents (EPA, 2003a, b). The FLAG (2000) procedures were developed to estimate visibility impacts at Class I areas from proposed new sources as part of the Prevention of Significant Deterioration (PSD) and New Source Review (NSR) process and were adapted to BART. These procedures use the IMPROVE reconstructed mass extinction equation (Malm et al., 2000). Instead of using measured PM concentrations from an IMPROVE monitor, incremental PM concentrations from the differences in the CAMx 2002 BART base case and 2002 BART VOC/PM zero-out runs were used in the equation.

The IMPROVE reconstructed mass extinction equation is used to estimate visibility at Class I areas using IMPROVE monitoring data and has also been used for evaluating visibility impacts at Class I areas due to new sources using modeling output of a single source or group of sources.

The total light extinction due to a source (b_{source}), in units of inverse Megameters (Mm^{-1}), is assumed to be the sum of the light extinction due to the source's individual PM species concentration impacts times an extinction efficiency coefficient:

$$\mathbf{b_{source} = b_{SO4} + b_{NO3} + b_{OC} + b_{EC} + b_{soil} + b_{coarse}}$$

$$b_{SO4} = 3\,[(NH_4)_2SO_4]f(RH)$$
$$b_{NO3} = 3\,[NH_4NO_3]f(RH)$$
$$b_{OC} = 4\,[OMC]$$
$$b_{EC} = 10\,[EC]$$
$$b_{Soil} = 1\,[Soil]$$
$$b_{coarse} = 0.6\,[Coarse\ Mass]$$

Here f(RH) are relative humidity adjustment factors. As recommended by EPA BART modeling guidance, Class I area specific monthly average f(RH) values were used (EPA, 2005; 2003a). The concentrations in the square brackets are in $\mu g/m^3$ and are based on the differences in concentrations between the 2002 BART base case and 2002 BART VOC/PM zero-out case. Although CAMx explicitly models ammonia and ammonium, the IMPROVE extinction equation assumes that SO_4 and NO_3 are completely neutralized by ammonium. The OMC in the above equation is Organic Matter Carbon, and OC is Organic Carbon. When using IMPROVE measurements, the current IMPROVE extinction equation assumed an OMC/OC ratio of 1.4 (i.e., the IMPROVE OC measurement is multiplied by 1.4 to obtain OMC). Since CAMx directly models OMC, the 1.4 factor is not needed. The following species mappings were used to map the CAMx species to those used in the IMPROVE reconstructed mass extinction equation given above:

$$[(NH_4)_2SO_4] = 1.375 \times PSO4$$
$$[NH_4NO_3] = 1.290 \times PNO3$$
$$[OMC] = POA + SOA1 + SOA2 + SOA3 + SOA4 + SOA5$$
$$[EC] = PEC$$
$$[Soil] = FPRM + FCRS$$
$$[Coarse\ Mass] = CPRM + CCRS$$

Here PSO4 and PNO3 are the CAMx particulate sulfate and nitrate species. POA is the CAMx primary Particulate Organic Aerosol species, whereas SOA1 through 5 are the five Secondary Organic Aerosol species carried in CAMx. Primary Elemental Carbon is represented by PEC in CAMx. CAMx carries two species that represent the other $PM_{2.5}$ components (i.e., fine particles that are not SO_4, NO_3, EC or OC), one for the crustal (FCRS), and the other for the remainder of the primary emitted $PM_{2.5}$ species (FPRM). Similarly, CAMx carries two species to represent Coarse Mass ($PM_{10-2.5}$), one for crustal (CCRS), and one for other (CPRM).

The Haze Index (HI) for the source is calculated in deciviews from the source's extinction plus natural background using the following formula:

$$HI_{source} = 10 \ln[(b_{source} + b_{natural})/10]$$

Here, $b_{natural}$ is the Class I area specific clean natural visibility background (natural conditions); EPA's default values are used in this analysis (EPA, 2003b).

The source's HI is compared against natural conditions to assess the significance of the source's visibility impact. EPA guidance lists natural conditions ($b_{natural}$) by Class I areas in terms of Mm^{-1} (EPA, 2003b) and assumes clean conditions with no man-made or weather interference. The visibility significance metric for evaluating BART sources is the change in deciview (del-dv) from the source's and natural conditions Haze Indices:

$$\text{del-dv} = HI_{source} - HI_{natural} = 10 \ln[(b_{source} + b_{natural})/10] - 10 \ln[b_{natural}/10]$$
$$= 10 \ln[(b_{source} + b_{natural})/b_{natural}]$$

The visibility impacts from the CAMx BART VOC/PM zero-out run was first calculated using all PM species (i.e., those associated with both VOC and PM precursors). We then made separate visibility calculations using just those PM species associated with the elimination of the BART VOC emissions (i.e., SOA1, SOA2, SOA3, SOA4, and SOA5) and then just those species associated with the elimination of the primary PM emissions (i.e., PSO4, PNO3, POA, PEC, FCRS, FPRM, FCRS and CCRS).

VOC: $b_{source} = 4\,[SOA1+SOA2+SOA3+SOA4+SOA5]$

PM: $b_{source} = 3\,f(RH)([1.375PSO4]+[1.290PNO3]) + 4[POA] + 10[PEC] + 1[FPRM+FCRS] + 0.6[CPRM+CCRS])$

The del-dv impacts were calculated at each Class I area within the CENRAP southern BART modeling region that contains Texas, as specified in the CENRAP BART Modeling Protocol (Alpine and ENVIRON, 2005). Table 2-1 lists the Class I areas included in the BART screening analysis. Table 2-1 also includes the deciviews and the extinctions associated with the Annual Average Natural Conditions and Best 20% Natural Conditions of these Class I areas (EPA, 2003b). Since the PSAT runs are computationally resource intensive, not all of the Class I sites analyzed were included in the 12 km domain. Sites analyzed, which were in the 36 km domain, are noted is Table 2-1.

Table 2–1. Class I areas included in the analysis.

IMPROVE sites	Longitude	Latitude	Class I Area	Domain	Best 20%		Annual average	
					dv	$b_{natural}$ (Mm-1)	dv	$b_{natural}$ (Mm-1)
BAND1	-106.27	35.78	Bandelier	12km	1.90	12.1	4.46	15.6
BIBE1	-103.18	29.30	Big Bend	12km	1.81	12.0	4.37	15.5
BOAP1	-106.85	33.87	Bosque del Apache	12km	1.85	12.0	4.41	15.5
CACR1	-94.14	34.45	Caney Creek	12km	3.65	14.4	7.49	21.1
GUMO1	-104.81	31.83	Guadalupe Mountains, Carlsbad Caverns	12km	1.91	12.1	4.47	15.6
HEGL1	-92.92	36.61	Hercules-Glade	12km	3.59	14.3	7.43	21.0
SACR1	-104.40	33.46	Salt Creek	12km	1.87	12.1	4.43	15.6
SAPE1	-106.85	36.01	San Pedro Parks	12km	1.91	12.1	4.47	15.6
UPBU1	-93.20	35.83	Upper Buffalo	12km	3.60	14.3	7.44	21.0
WHIT1	-105.54	33.47	White Mountain	12km	1.86	12.0	4.42	15.6
WHPE1	-105.45	36.59	Wheeler Peak, Pecos	12km	1.95	12.2	4.51	15.7
WIMO1	-98.71	34.73	Wichita Mountains	12km	3.39	14.0	7.23	20.6
WHRI1	-106.82	39.15	Flat Tops, Maroon Bells-Snowmass, West Elk, Eagles Nest	36km	1.96	12.2	4.52	15.7
BRET1	-89.21	29.12	Breton	36km	3.85	14.7	7.69	21.6
GRSA1	-105.52	37.72	Great Sand Dunes	36km	1.98	12.2	4.54	15.7
WEMI1	-107.80	37.66	La Garita, Black Canyon of the Gunnison, Weminuche	36km	1.94	12.1	4.50	15.7
MEVE1	-108.49	37.20	Mesa Verde	36km	1.97	12.2	4.53	15.7
MING1	-90.14	36.97	Mingo	36km	3.59	14.3	7.43	21.0

EPA's BART guidance suggests that a significance threshold to determine whether a source contributes significantly to visibility impairment at a Class I area should be no greater than 0.5 dv. Thus, if the del-dv due to all potential BART-eligible sources VOC and/or PM emissions at every Class I area and for all days from 2002 are < 0.5 dv, then VOC and PM emissions from all potential BART-eligible sources may be determined to contribute insignificantly to visibility impairment. Therefore, the VOC and/or PM emissions from each potential BART source would not be significant. Under these conditions, VOC and/or PM emissions would no longer need to be considered.

Since there were days in 2002 for which the del-dv is > 0.5 dv in the BART VOC/PM zero-out screening analysis, the results were examined in more detail, including the analysis of the frequency, magnitude and duration of the visibility impacts. The BART guidance suggests comparing the 98th percentile del-dv at any Class I area with the 0.5 dv significant threshold to determine whether a significant visibility impact would reasonably be expected to occur. Using one year of modeling results (2002) the 98th percentile would correspond to the eighth highest 24-hour average visibility impact at each Class I area. PM and VOC were also analyzed separately to determine if one of these pollutants could be determined to impact insignificantly to visibility impairment at the Class I areas.

Inert Primary PM Screening Analysis

The preliminary zero-out modeling indicated that the visibility impacts at one or more Class I areas due to PM emissions from all potential BART-eligible sources in Texas exceeded the 0.5 del-dv threshold, therefore the group of all Texas BART PM sources were analyzed further. However, the visibility impacts due to all Texas BART sources' VOC emissions were not significant because they were < 0.5 del-dv threshold at all Class I areas. Therefore, each Texas BART source's VOC emissions are < 0.5 del-dv.

Further analyses of the BART PM emissions were made by grouping the sources for screening modeling. Since only primary PM emissions were being considered in these runs, chemistry was not needed. Primary PM emissions were analyzed using inert CAMx 2002 36/12 km simulations of the grouped BART sources. The procedures for evaluating the visibility impacts from the inert CAMx simulations are the same as described for the PM impacts from the zero-out runs. However, instead of using concentrations differences from the 2002 BART base case and 2002 zero-out case, the total concentrations due to all BART sources in each BART group from the CAMx inert simulation were used.

PROCEDURES FOR SCREENING MODELING OF BART SOURCES SO_2 AND NO_x EMISSIONS

The screening analysis for potential BART-eligible non-EGU SO_2 and NO_x emissions used the updated PSAT in CAMx V4.4 and the 2002 36/12 km modeling database described above. The non-EGU potential BART-eligible sources were initially divided up into 10 source groups for the PSAT screening analysis. CAMx/PSAT was run for the 2002 annual year on the 36/12 km grid with each potential BART-eligible source flagged to use the new PSAT PiG feature. As suggested by EPA Region 6, the CENRAP average non-EGU BART SO_2 and NO_x emissions were doubled to provide a conservative estimate of maximum 24-hour actual emissions.

As described for the zero-out run, if the del-dv due to all sources in a source group at every Class I area and for all days from 2002 is < 0.5 dv, then each potential BART-eligible source in the source group would be < 0.5 dv. Thus, each source would contribute insignificantly to visibility impairment.

PSAT Modeling for SO_2 and NO_x emissions was performed for non-EGUs. The $PM_{2.5}$ provisions of the Clean Air Interstate Rule (CAIR) apply to Texas. EPA BART guidance (EPA, 2005) states that CAIR satisfies the BART SO_2 and NO_x requirements for CAIR $PM_{2.5}$ States.

PSAT Visibility Impacts

The sulfate and nitrate families of PSAT tracers were invoked for the PSAT BART screening analysis. The visibility impacts at each Class I area were calculated in a similar manner as described above for the zero-out modeling, only the PSO4 and PNO3 concentrations from each PSAT BART source group were used in the extinction equation. The IMPROVE reconstructed mass extinction equation for each potential BART-eligible source group included the sulfate and nitrate components:

$$\mathbf{b_{group} = b_{SO4} + b_{NO3}}$$

$$b_{SO4} = 3\ [(NH_4)_2SO_4]f(RH)$$
$$b_{NO3} = 3\ [NH_4NO_3]f(RH)$$

The f(RH) are the monthly average relative humidity adjustment factors, as recommended by EPA's guidance (EPA, 2003a). The concentrations in the square brackets are in $\mu g/m^3$ and are the sulfate and nitrate from the PSAT output for each potential BART-eligible PSAT source group (i). Sulfate and nitrate are assumed to be fully neutralized by ammonium:

$$[(NH_4)_2SO_4] = 1.375 \times PS4_i$$
$$[NH_4NO_3] = 1.290 \times PN3_i$$

The Haze Index (HI) for the source group is calculated in deciview from the source group's extinction plus natural background using the following formula:

$$HI_{group} = 10\ \ln[(b_{group} + b_{natural})/10]$$

The source's HI is compared to natural conditions to assess the significance of the source's visibility impact. EPA guidance lists natural conditions ($b_{natural}$) by Class I area in terms of Mm^{-1} (EPA, 2003b) and assumes clean conditions with no anthropogenic or weather interference. The visibility significance metric for evaluating BART sources is the change in deciview (del-dv) from the source's and natural conditions haze indices:

$$\text{del-dv} = HI_{group} - HI_{natural} = 10\ \ln[(b_{group} + b_{natural})/10] - 10\ \ln[b_{natural}/10]$$

VISIBILITY SIGNIFICANCE THRESHOLDS

EPA's BART guidance lists a significance threshold for contributing to visibility impairment at a Class I area as a 0.5 change in deciview (del-dv) over natural conditions (EPA, 2005). The guidance also states that the 98th percentile (e.g., eighth highest in a year) change in deciview value should be compared against the 0.5 del-dv significance threshold. EPA's visibility natural conditions guidance document lists three default natural condition values corresponding to best 20% days, worst 20% days, and annual average (EPA, 2003b). The guidance recommends that natural conditions corresponding to the best 20% days be used when calculating the BART visibility significance metric. However, the use of the best 20% natural conditions in the BART significance test was challenged by the Utility Air Regulatory Group (UARG). As part of the settlement to this challenge, EPA now allows the use of annual average natural conditions in the calculation of the BART visibility significance metrics (Paise, 2006 a, b). This analysis presents the change in deciview (del-dv) due to each group of BART sources in Class I areas using both the maximum and 98th percentile values, and both the best 20% and annual average natural conditions. The final recommendation on the significance determination is based on the 98th percentile change in deciview over annual average natural conditions.

3. BART VOC AND PM SCREENING ANALYSIS

The first part of the BART screening analysis estimated the visibility impacts at Class I areas from VOC and PM emissions from all potential BART-eligible sources in Texas. The visibility impacts at Class I areas are expressed as the change in deciview (del-dv) compared to natural conditions. If the estimated 98th percentile del-dv compared to the annual average natural conditions due to VOC and PM emissions from all potential BART-eligible sources is < 0.5 at all Class I areas, then VOC and PM emissions from each BART source would be < 0.5 del-dv and therefore may require no further BART analyses. The BART VOC and PM emissions screening analysis was conducted using CAMx zero-out modeling as described in Section 2. Details of the screening VOC and PM screening analyses are given below.

BART-Eligible Sources' VOC and PM_{10} emissions

The zero-out modeling initially grouped all potential BART sources together. The initial screening analysis demonstrated that the visibility impacts of PM, and VOC emissions from all potential BART-eligible sources was > 0.5 del-dv as some Class I areas.

Because the VOC and PM impacts from all sources were shown to be > 0.5 del-dv, further screening modeling was conducted. The VOC emission impacts were shown to be < 0.5 del-dv (see Figure 3-1, below). The primary PM emissions impacts, however, were shown to be > 0.5 del-dv. Therefore, additional CAMx analyses of the BART PM emission were conducted.

BART EGU and non-EGU sources were separated and then further divided into subgroups. A list of BART-eligible EGU and non-EGU sources' VOC and PM_{10} emissions and their associated groups are shown in Tables 3-1 and 3-2, respectively.

The VOC and PM_{10} emissions in Tables 3-1 and 3-2 are the annual average emission estimates from the CENRAP 2002 database. To estimate the highest 24-hour actual emissions to be used in the BART analysis, the modeling used doubled annual average emissions. The VOC and PM_{10} emissions are processed by the Sparse Matrix Operator Kernel Emissions (SMOKE) emissions model that speciates the VOC and PM_{10} emissions into the individual VOC and PM species used in CAMx. The Carbon Bond IV (CB4) chemistry option was used in the CAMx runs.

Table 3-1. Potential BART-eligible EGU sources and their VOC/PM_{10} emissions.

ID	Account	Company	Plant	VOC (tpy)	PM_{10} (tpy)	VOC Zero-Out	PM Zero-Out group	Needs Further Analysis for PM
1	BC0015L	LOWER COLORADO RIVER AUTHORITY	LOWER COLORADO RIVE	32	52	pass	3A	
2	BG0057U	CITY PUBLIC SERVICE	SOMMERS DEELY SPRUC	147	1473	pass	1A	
3	BG0186I	CITY PUBLIC SERVICE	V.H. BRAUNIG PLANT	43	58	pass	3A	
4	CD0013K	AEP TEXAS CENTRAL COMPANY	LA PALMA POWER STAT	13	30	pass	2	
5	CI0012D	TEXAS GENCO LP	CEDAR BAYOU STATION	113	157	pass	pass	
6	DB0251U	TXU ELECTRIC COMPANY	NORTH LAKE STEAM EL	22	27	pass	2	
7	EE0029T	EL PASO ELECTRIC CO	NEWMAN STATION	31	54	pass	2	
8	FB0025U	TXU GENERATION COMPANY LP	VALLEY STEAM ELEC.	44	58	pass	3A	
9	FC0018G	LOWER COLORADO RIVER AUTHORITY	FAYETTE POWER PROJE	167	1255	pass	2	
10	FG0020V	TEXAS GENCO LP	W A PARISH STATION	89	281	pass	2	
11	FI0020W	TXU BIG BROWN COMPANY LP	BIG BROWN	134	933	pass	3A	
12	GB0037T	TEXAS GENCO LP	P H ROBINSON STATIO	43	62	pass	1A	
13	GJ0043K	SOUTHWESTERN ELECTRIC POWER		17	24	pass	2	
14	HQ0012T	TXU GENERATION COMPANY LP	DECORDOVA STEAM ELE	85	113	pass	2	
15	JI0030K	AEP TEXAS NORTH COMPANY	W.T.U.-FT. PHANTOM	26	36	pass	1A	
16	LN0081B	XCEL ENERGY	JONES STATION	43	85	pass	3A	
17	MB0116C	TXU GENERATION COMPANY LP	TRADINGHOUSE STM EL	89	116	pass	3A	
18	ME0006A	SOUTHWESTERN ELECTRIC POWER WILKES	WILKES POWER PLT	41	56	pass	2	
19	MM0023J	TXU GENERATION COMPANY LP	SANDOW STEAM ELECTR	67	735	pass	1A	
20	MO0014L	TXU GENERATION COMPANY LP	MORGAN CREEK STEAM	25	32	pass	1A	
21	MQ0009F	ENTERGY GULF STATES INC	LEWIS CREEK PLANT	65	89	pass	2	
22	NE0024E	AEP TEXAS CENTRAL COMPANY	BARNEY M DAVIS POWE	46	66	pass	2	
23	NE0025C	LON C HILL POWER	LON C HILL	7	10	pass	1A	
24	NE0026A	AEP TEXAS CENTRAL COMPANY	NUECES BAY POWER ST	28	39	pass	3A	
25	OC0013O	ENTERGY GULF STATES INC	SABINE PLANT	168	234	pass	3A	
26	PG0040T	SOUTHWESTERN PUBLIC SERVICE	NICHOLS STATION	10	19	pass	1A	
27	PG0041R	SOUTHWESTERN PUBLIC SERVICE	HARRINGTON STATION	97	1546	pass	2	
28	RL0020K	TXU GENERATION COMPANY LP	MARTIN LAKE ELECTRI	257	881	pass	1A	
29	TA0352I	TXU GENERATION COMPANY LP	EAGLE MOUNTAIN STAT	19	27	pass	1A	
30	TF0012D	SOUTHWESTERN ELECTRIC POWER	WELSH POWER PLANT	89	1755	pass	3B	X
31	TF0013B	TXU GENERATION COMPANY LP	MONTICELLO STM ELE	245	3297	pass	1B	X
32	TG0044C	AEP TEXAS		12	23	pass	3A	
33	TH0004D	ELECTRIC UTILITY DEPT	DECKER CREEK POWER	5	69	pass	1A	
34	VC0003D	VICTORIA POWER		5	8	pass	1A	
35	WC0028Q	TXU GENERATION COMPANY LP	PERMIAN BSN STM ELE	60	82	pass	3A	
36	WE0005G	LAREDO POWER		11	19	pass	2	
37	YB0017V	TXU GENERATION COMPANY LP	GRAHAM STEAM ELECTR	19	27	pass	2	

Table 3-2. Potential BART-eligible non-EGU sources and their VOC/PM_{10} emissions.

ID	Account	Company	Plant	VOC (tpy)	PM_{10} (tpy)	VOC Zero-Out	PM Zero-Out	Needs Further Analysis for PM	Note
1	AB0012W	DUKE ENERGY FIELD SERVICES	FULLERTON GAS PLANT	317	20	Pass	3		
2	AC0017B	ABITIBI CONSOLIDATED CORP		81	3	Pass	see note		Excluded (PM_{10}<10tpy)
3	AC0019U	EXAS FOUNDRIES		180	226	Pass	see note		No longer BART-eligible
4	AG0024G	PUEBLO MIDSTREAM GAS CORP	FASHING PLANT	39	1	Pass	see note		Excluded (PM_{10}<10tpy)
5	BG0045E	CAPITOL CEMENT DIV CAPITOL	PORTLAND CEMENT	95	40	Pass	2C		
6	BJ0001T	CHEMICAL LIME LTD	CHEMICAL LIME--CLIF	4	224	Pass	3		
7	BL0002S	AMOCO CHEMICAL CO	CHOCOLATE BAYOU PLN	417	130	Pass	1A		
8	BL0021O	BASF CORPORATION	FREEPORT SITE	38	4	Pass	see note		Excluded (PM_{10}<10tpy)
9	BL0038U	SOLUTIA INC		264	23	Pass	2AC		
10	BL0082R	THE DOW CHEMICAL CO	PLANT B	517	78	Pass	2C		
11	BL0113I	EQUISTAR		282	65	Pass	1A		
12	BL0268B	EQUISTAR CHEMICALS LP		397	13	Pass	3		
13	BL0758C	CHEVRON PHILLIPS CHEMICAL	SWEENY COMPLEX	109	103	Pass	1A		
14	CA0011B	J.L. DAVIS GAS PROCESSING	LULING GAS PLANT	9	1	Pass	see note		Excluded (PM_{10}<10tpy)
15	CB0003M	ALCOA ALUMINA & CHEMICALS	POINT COMFORT PLANT	176	296	Pass	1A		
16	CB0028T	UNION CARBIDE CORPORATION	SEADRIFT PLANT	492	60	Pass	1A		
17	CG0010G	INTERNATIONAL PAPER CO		1322	578	Pass	2AA	X	
18	CG0012C	ENBRIDGE PIPELINES	BRYANS MILL PLANT	2	1	Pass	see note		Excluded (PM_{10}<10tpy)
19	CI0022A	DYNEGY MIDSTREAM SERVICES		553	21	Pass	3		
20	CR0020C	COPANO PROCESSING LP		551	10	pass	1A		
21	CY0019H	DYNEGY MIDSTREAM SERVICES	WADDELL COMPRESSOR	35	1	pass	see note		Excluded (PM_{10}<10tpy)
22	EB0057B	HUNTSMAN POLYMERS		878	107	pass	1A		
23	EB0197H	DUKE ENERGY FIELD SERVICES		245	7	pass	see note		No longer BART-eligible
24	ED0011D	CHAPARRAL STEEL MIDLOTHIAN		340	157	pass	3		
25	ED0034O	NORTH TEXAS CEMENT COMPANY	NORTH TEXAS CEMENT	15	448	pass	1B		
26	ED0051O	OWENS CORNING		100	298	pass	3		
27	ED0066B	TXI OPERATIONS, L.P.	MIDLOTHIAN PLANT	18	85	pass	1A		
28	FG0036G	TXI OPERATION LP	CLODINE EXPANDED SH	5	77	pass	1A		
29	GB0001R	BP AMOCO CHEMICAL COMPANY	BP AMOCO CHEMICAL T	500	93	pass	3		
30	GB0004L	BP PRODUCTS NORTH AMERICA IN TEXAS	TEXAS CITY REFINERY	1180	737	pass	2B		
31	GB0055R	MARATHON ASHLAND PETROLEUM	TEXAS CITY REFINERY	478	272	pass	3		

ID	Account	Company	Plant	VOC (tpy)	PM_{10} (tpy)	VOC Zero-Out	PM Zero-Out	Needs Further Analysis for PM	Note
32	GB0073P	VALERO REFINING CO TEXAS	TEXAS CITY REFINERY	153	150	pass	3		
33	GB0076J	UNION CARBIDE CORP	VINYL ACETATE FACIL	154	0	pass	see note		Excluded (PM_{10}<10tpy)
34	GH0003Q	CABOT CORPORATION	PAMPA PLANT	1025	55	pass	3		
35	GH0004O	CELANESE CHEMICAL	CHEMICAL MANUFACTUR	644	194	pass	1A		
36	HD0029C	A.N.R. PIPELINE COMPANY	E.G. HILL COMPRESSO	82	33	pass	2B		
37	HG0033B	EQUISTAR CHEMICALS LP	CHANNELVIEW COMPLEX	29	0	pass	see note		Excluded (PM_{10}<10tpy)
38	HG0048L	LYONDELL CITGO REFINING L P	LYONDELL-CITGO REFI	888	284	pass	1A		
39	HG0126Q	HOECHST CELANESE CHEMICAL	CLEAR LAKE PLANT	334	601	pass	3		
40	HG0130C	VALERO REFINING TEXAS LP	HOUSTON REFINERY	252	188	pass	2C		
41	HG0175D	CROWN CENTRAL PETROLEUM	PASADENA PLANT	570	687	pass	1B		
42	HG0218K	EI DUPONT		306	35	pass	3		
43	HG0228H	EXXON CHEMICAL CO	BAYTOWN OLEFINS PLA	209	50	pass	2C		
44	HG0229F	EXXONMOBIL CHEMICAL CO	BAYTOWN CHEMICAL PL	746	75	pass	3		
45	HG0232Q	EXXONMOBIL CORP	EXXONMOBIL REF & SU	3983	761	pass	1B		
46	HG0310V	CHEVRON PHILLIPS CHEMICAL	CHEVRON CHEMICAL CO	364	211	pass	1A		
47	HG0558G	ATOFINA CHEMICALS INC	ATOFINA INC	11	1	pass	see note		Excluded (PM_{10}<10tpy)
48	HG0562P	TEXAS PETROCHEMICALS LP	TX PETROCHEMICALS L	48	51	pass	3		
49	HG0632T	ROHM & HAAS TEXAS	DEER PARK PLANT	578	234	pass	3		
50	HG0659W	SHELL OIL CO	DEER PARK PLANT	2219	359	pass	2AB		
51	HG0697O	RHODIA, INC.	HOUSTON PLANT	3	28	pass	1A		
52	HG1451S	OSYVINYLSLP		245	36	pass	2C		
53	HH0019H	NORIT AMERICAS INC	NORIT AMERICAS INC	163	168	pass	3		
54	HH0042M	EASTMAN CHEMICAL COMPANY	TEXAS OPERATIONS	4257	273	pass	1B		
55	HK0014M	TEXAS LEHIGH CEMENT CO	TEXAS LEHIGH CEMENT	153	272	pass	2AC		
56	HR0018T	VALENCE MIDSTREAM LTD	COMO PLT	7	6	pass	see note		Excluded (PM_{10}<10tpy)
57	HT0011Q	ALON USA LP	BIG SPRING REFINERY	517	91	pass	2B		
58	HT0027B	SID RICHARDSON CARBON CO	BIG SPRING CARBON B	17	19	pass	2C		
59	HW0008S	DEGUSSA ENGINEERED CARBONS BORGER	BORGER CARBON BLACK	100	71	pass	2AC		
60	HW0013C	CHEVRON PHILLIPS CHEMICAL CO		407	9	pass	see note		Excluded (PM_{10}<10tpy)
61	HW0017R	SID RICHARDSON CARBON	BORGER CARBON BLACK	2	111	pass	1A		
62	HW0018P	PHILLIPS 66 CO	BORGER REFINERY	145	21	pass	3		
63	HX2897U	BP AMOCO POLYMERS INC		249	8	pass	see note		No longer BART-eligible
64	JB0016M	VINTAGE PETROLEUM, INC.	W RANCH COMP STA VA	53	13	pass	2C		
65	JC0003K	WESTVACO		103	236	pass	2B		
66	JE0005H	ATOFINA PETROCHEMICALS INC	PORT ARTHUR REFINER	632	529	pass	2C		

ID	Account	Company	Plant	VOC (tpy)	PM_{10} (tpy)	VOC Zero-Out	PM Zero-Out	Needs Further Analysis for PM	Note
67	JE0039N	THE GOODYEAR TIRE AND RUBBER CO		1528	33	pass	1A		
68	JE0042B	PREMCOR REFINING GROUP	PORT ARTHUR REFINER	135	3	pass	see note		Excluded (PM_{10}<10tpy)
69	JE0052V	HUNTSMAN CORPORATION	PORT NECHES PLANT	304	58	pass	3		
70	JE0065M	EXXON MOBIL CHEMICAL CO		104	2	pass	see note		Excluded (PM_{10}<10tpy)
71	JE0067I	EXXONMOBIL OIL CORP	BEAUMONT REFINERY	462	574	pass	3		
72	JE0091L	SUN MARINE TERMINAL		40	0	pass	see note		Excluded (PM_{10}<10tpy)
73	JE0135Q	HUNTSMAN PETROCHEMICAL CORP		520	68	pass	2B		
74	JE0343H	BMC HOLDINGS INC	BMC HOLDINGS INC	24	63	pass	1A		
75	JH0025O	JOHNS MANVILLE INTERNATIONAL		75	141	pass	2AC		
76	MB0123F	LEHIGH CEMENT COMPANY	LEHIGH PORTLAND CEM	10	225	pass	2B		
77	MC0002H	ENBRIDGE PIPELINE	TILDEN GAS PLANT	36	0	pass	see note		Excluded (PM_{10}<10tpy)
78	MH0009H	CELANESE LIMITED		127	496	pass	1B		
79	MM0001T	ALCOA INC	ALCOA SANDOW PLANT	152	254	pass	1A		
80	MR0008T	DIAMOND SHAMROCK REFINING	MCKEE PLANTS	818	128	pass	2C		
81	NB0037F	TXI OPERATIONS, L.P.	STREETMAN PLANT	284	181	pass	3		
82	NE0022I	TICONA POLYMERS INC	BISHOP FACILITY	309	31	pass	3		
83	NE0027V	CITGO REFINING & CHEMICALS	CORPUS CHRISTI REFI	666	622	pass	1A		
84	NE0043A	VALERO REFINING COMPANY	COMPLEX 6B 7 8	823	175	pass	3		
85	NE0120H	KOCH PETROLEUM GROUP LP	CORPUS CHRISTI EAST	183	288	pass	3		
86	NE0122D	FLINT HILLS RESOURCES LP	WEST REFINERY	240	13	pass	1A		
87	OA0024I	NORTHERN NATURAL GAS CO	SPEARMAN PLANT	38	13	pass	see note		No longer BART-eligible
88	OC0007J	EI DUPONT DENEMOURS & CO	SABINE RIVER WORKS	1040	87	pass	2AC		
89	PE0024Q	DUKE ENERGY FIELD SERVICES	WAHA GAS PLANT	116	4	pass	see note		Excluded (PM_{10}<10tpy)
90	TH0010I	AUSTIN WHITE LIME CO		4	367	pass	see note		No longer BART-eligible
91	VC0008Q	EI DU PONT DE NEMOURS & CO	EI DU PONT DE NEMOU	230	187	pass	2B		
92	WH0014S	WICHITA FALLS PLANT		191	81	pass	2C		
93	WN0021G	DEVON GAS SERVICES, L.P.	BRIDGEPORT	226	28	pass	see note		No longer BART-eligible
94	WN0042V	DYNEGY MIDSTREAM SERVICES		3	0	pass	see note		Excluded (PM_{10}<10tpy)

BART VOC Zero-Out Results

Figure 3-1 displays the visibility impacts due to all Texas BART-eligible sources' VOC emissions. VOC produces secondary organic aerosol species (SOA) that degrade visibility (see Section 2). The results indicated that the del-dv for all of the metrics (the maximum and 98th percentile using both the best 20% and annual average natural conditions) were all below 0.2 del-dv and so did not exceed the 0.5 significance threshold at the Class I areas analyzed. Therefore, each Texas BART source's VOC emissions would also be below the 0.5 del-dv significance threshold and therefore does not require further BART analysis.

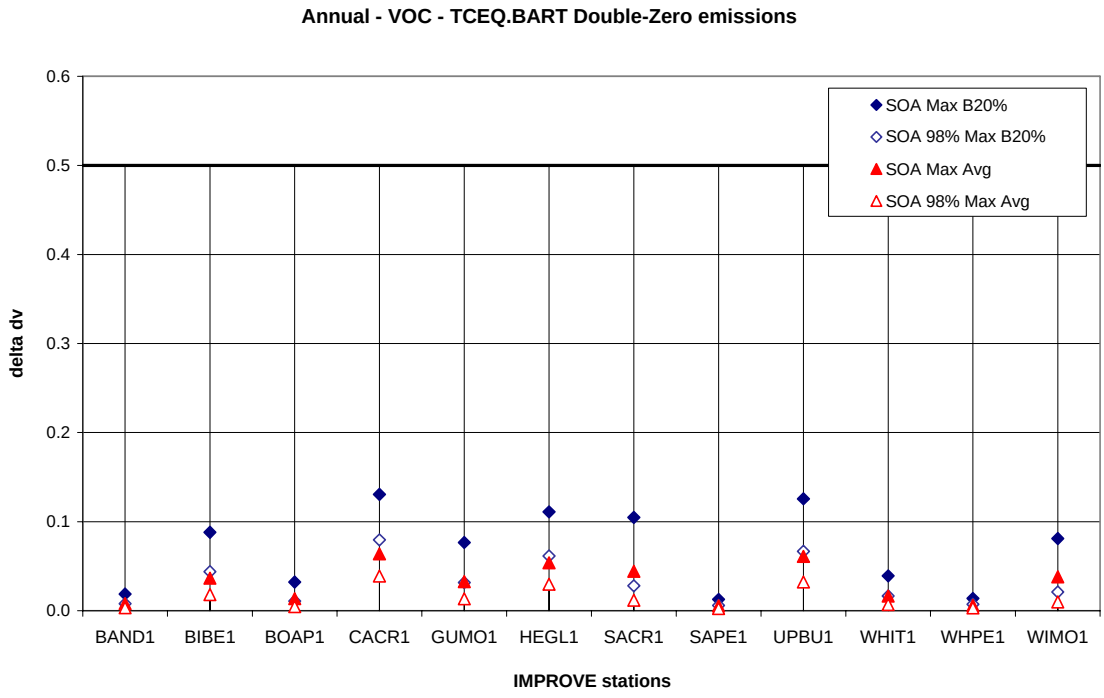


Figure 3-1. The visibility impacts (del-dv) at Class I areas from all eligible Texas BART sources' VOC emissions.

BART PM Zero-Out Results

The preliminary BART PM emissions zero-out modeling indicated that the visibility impacts due to PM emissions from all BART sources exceeded the 0.5 del-dv threshold at several Class I areas as shown in Figure 3-2 (unfilled triangle represents 98th percentile del-dv over annual average natural conditions. The larger visibility impacts occurred at the Class I areas near sources in northeast Texas (Caney Creek/CACR, Hercules-Glade/HEGL, and Upper Buffalo/UPBU), while smaller impacts appeared near sources in west Texas (Big Bend/BIBE and Guadalupe Mountains/GUMO) and north Texas (Wichita Mountains/WIMO). Given this information, further analyses were carried out by dividing the BART PM sources into subgroups, with consideration of their proximity to Class I areas and the magnitude of their PM emissions.

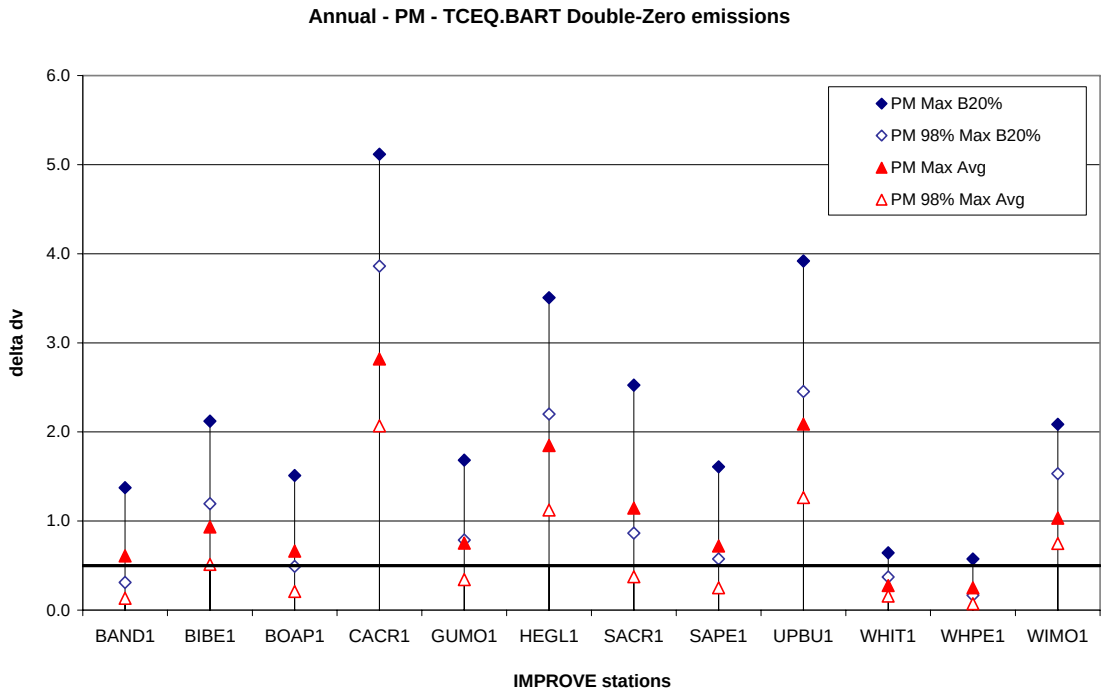


Figure 3-2. The visibility impacts (del-dv) at Class I areas from all Texas potentially BART-eligible sources' PM emissions.

Prior to conducting further PM modeling analyses, some BART sources were removed from the screening process. Six non-EGU accounts (WN0021G, EB0197H, OA0024I, TH0010I, HX2897U, and AC0019U) were dropped from the potential BART-eligible list based on information supplied by the sources to the TCEQ. Additionally, TCEQ eliminated 15 sources with PM emissions under 10 tons per year (tpy) based on the establishment of a de minimis threshold as suggested in EPA's BART Guidance (EPA, 2005). The remaining sources were divided into EGU and non-EGU categories. These source groups were then further divided into subgroups. Inert model runs were conducted with these groups, and if any source groups failed the 0.5 del-dv threshold, the sources in that group were broken down even further and re-analyzed.

The subgroup analyses for primary PM emissions were made for each of these BART source groups using CAMx inert simulations. The results for potential BART EGU sources are shown in Figures 3-3a-e. The potential BART-eligible EGU sources, except EGU source group #1B and 3B (account TF0013B and TF0012D, respectively), passed the BART PM group screening test. Accounts TF0013B and TF0012D impacted visibility impairment at CACR by approximately 0.61 del-dv and 0.72 del-dv, respectively. Further modeling analyses using better estimates of the highest actual 24-hour emissions may produce values < 0.5 del-dv for these two sources.

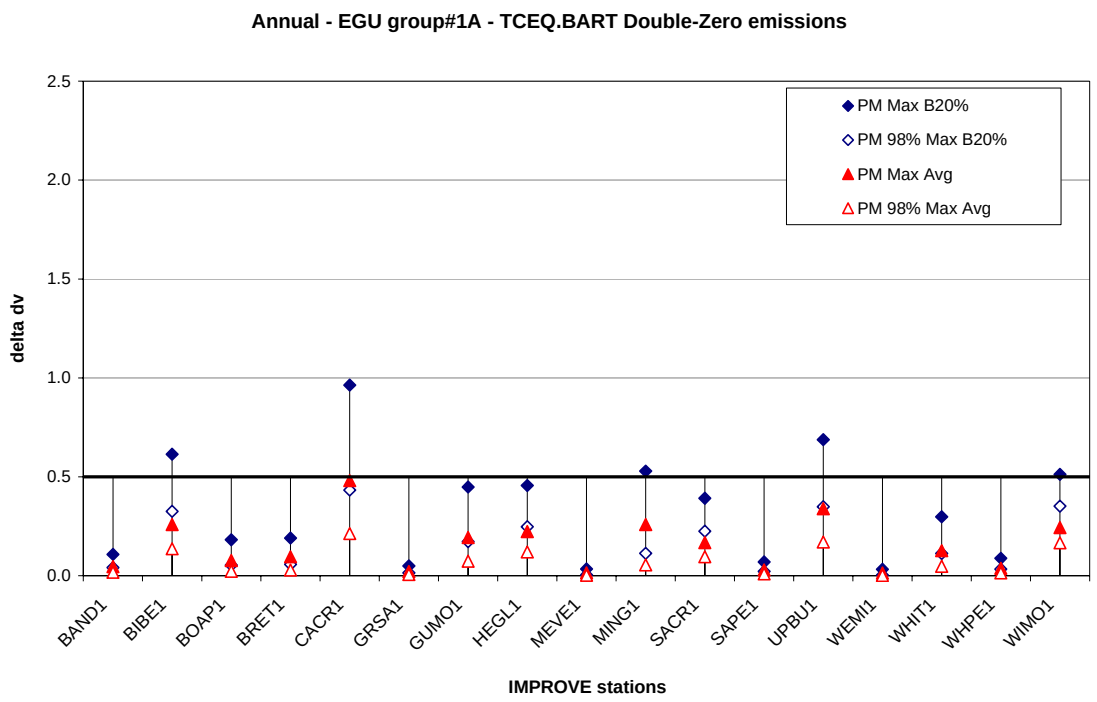


Figure 3-3a. Visibility impacts (del-dv) at Class I areas due to PM emissions from EGU Source Group 1A.

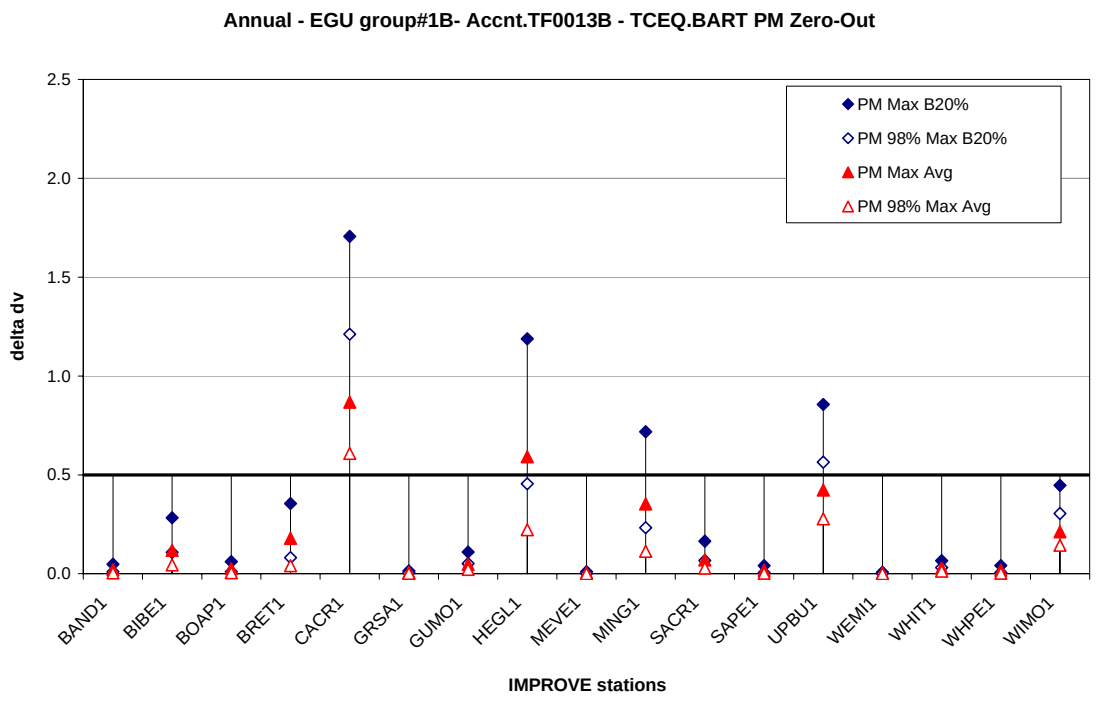


Figure 3-3b. Visibility impacts (del-dv) at Class I areas due to PM emissions from EGU Source Group 1B, account TF0013B. Del-dv > 0.5 at CACR for all metrics and HEGL/UPBU for 2 of 4 metrics.

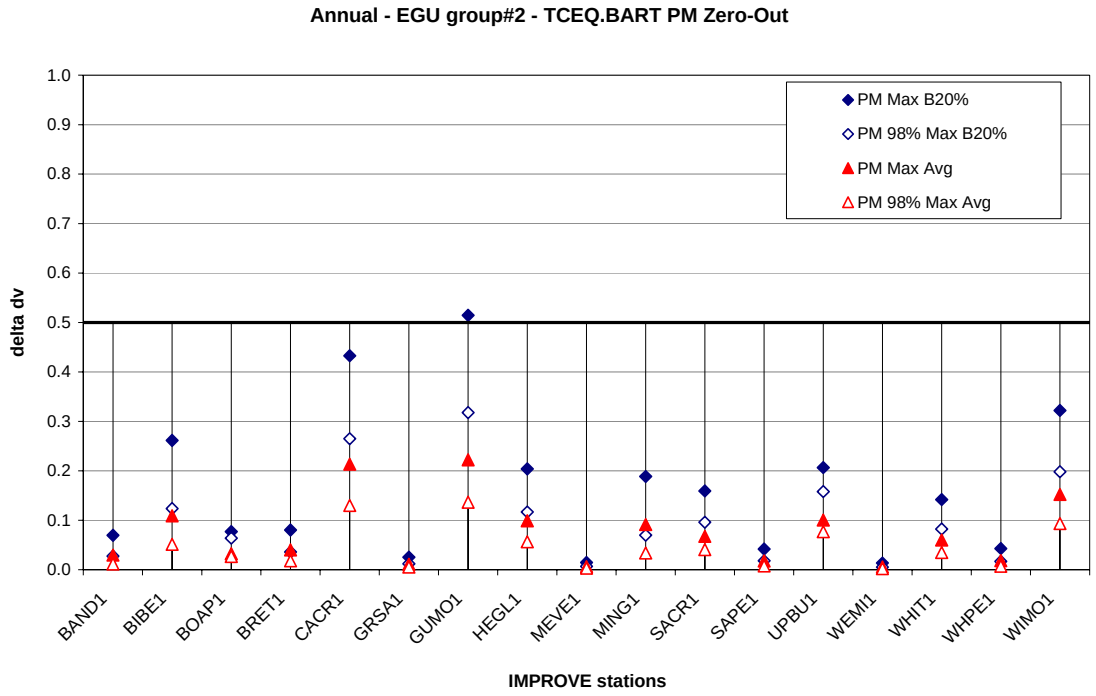


Figure 3-3c. Visibility impacts (del-dv) at Class I areas due to PM emissions from EGU Source Group 2.

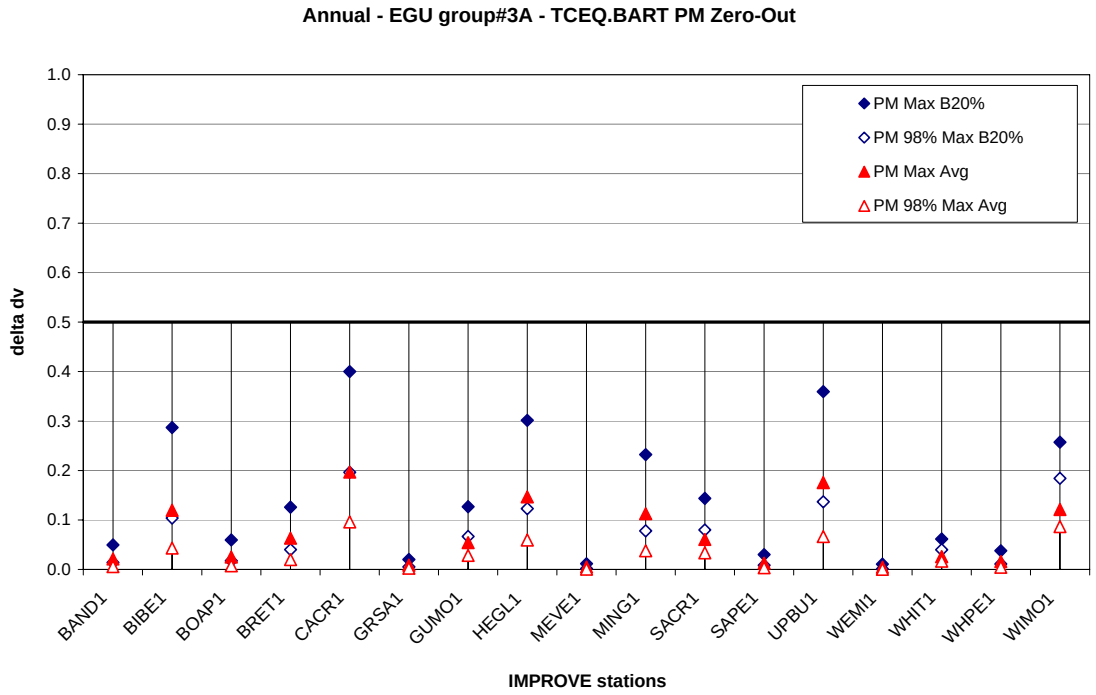


Figure 3-3d. Visibility impacts (del-dv) at Class I areas due to PM emissions from EGU Source Group 3A.

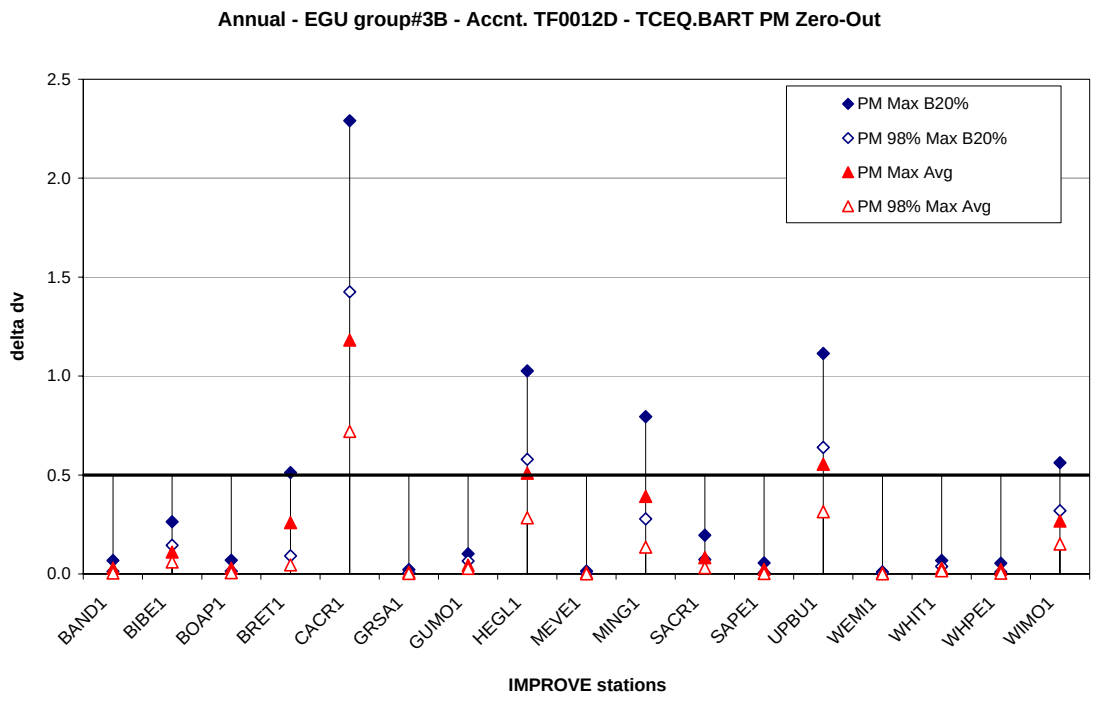


Figure 3-3e. Visibility impacts (del-dv) at Class I areas due to PM emissions from EGU Source Group 3B, account TF0012D. Del-dv > 0.5 at CACR for all metrics and HEGL/UPBU for 3 of 4 metrics.

The results for potential BART-eligible non-EGU sources are shown in Figure 3-4a-f. The potential BART non-EGU sources, except non-EGU group 2AA (account CG0010G), are under the 05. del-dv threshold and therefore may require no further BART analyses. Account CG0010G estimated 98th percentile visibility impairment at CACR was 0.92 del-dv and therefore must perform further analyses.

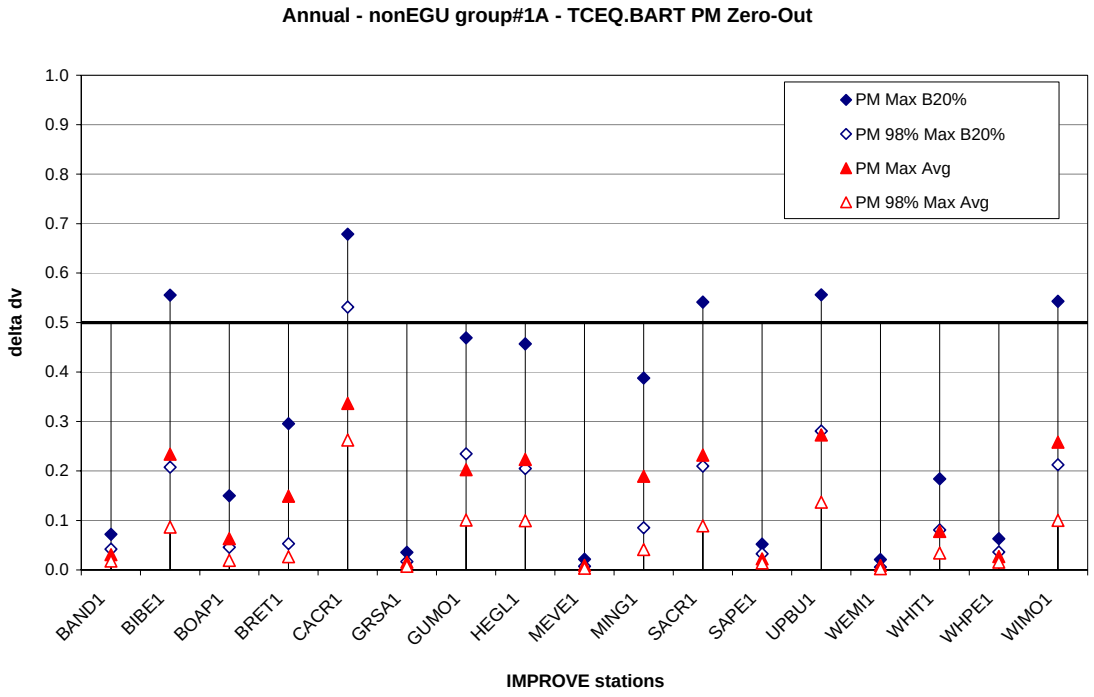


Figure 3-4a. Visibility impacts (del-dv) at Class I areas due to PM emissions from non-EGU Source Group 1A.

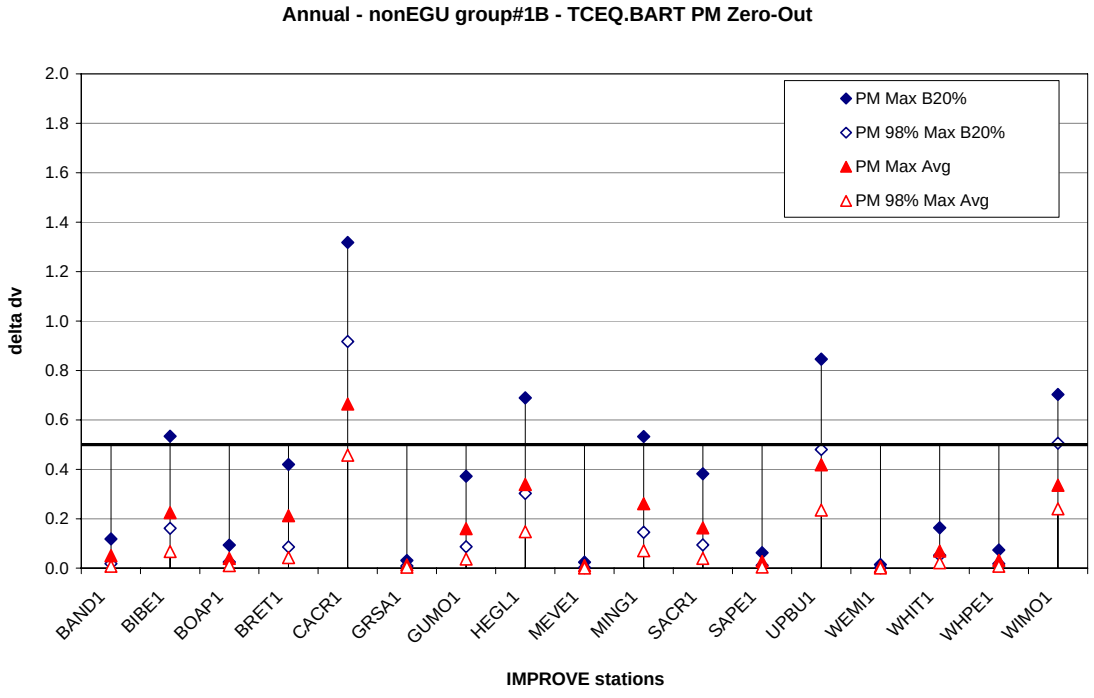


Figure 3-4b. Visibility impacts (del-dv) at Class I areas due to PM emissions from non-EGU Source Group 1B.

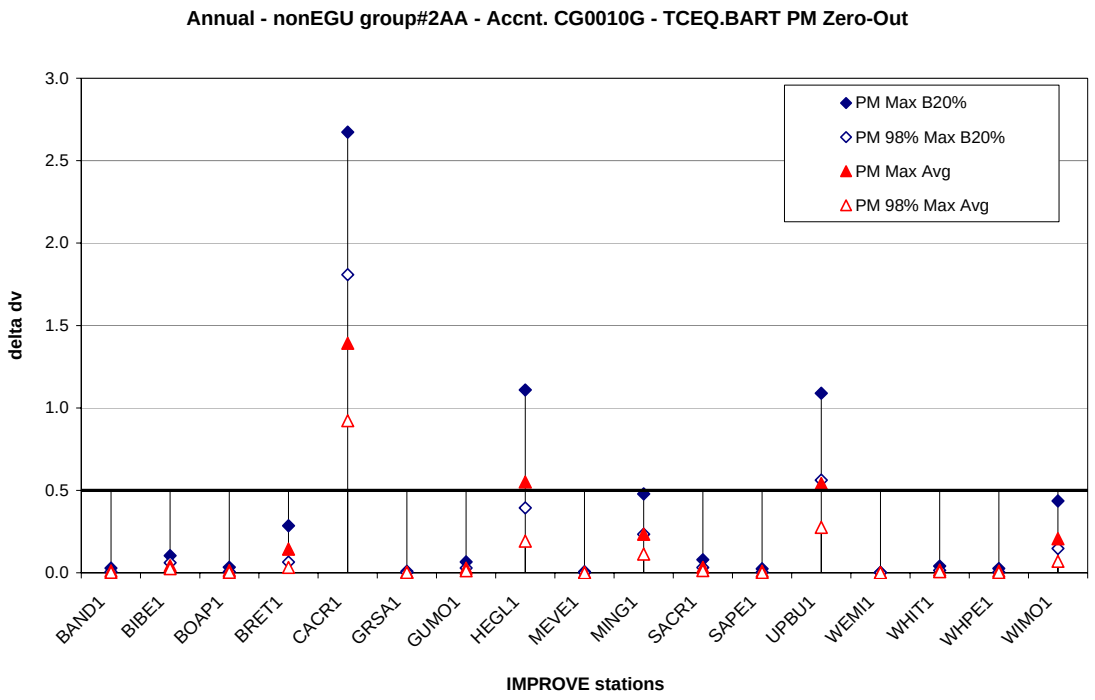


Figure 3-4c. Visibility impacts (del-dv) at Class I areas due to PM emissions from non-EGU Group Source 2AA, account CG0010G. Del-dv > 0.5 at CACR for all metrics and HEGL/UPBU for 2 and 3 of 4 metrics, respectively.

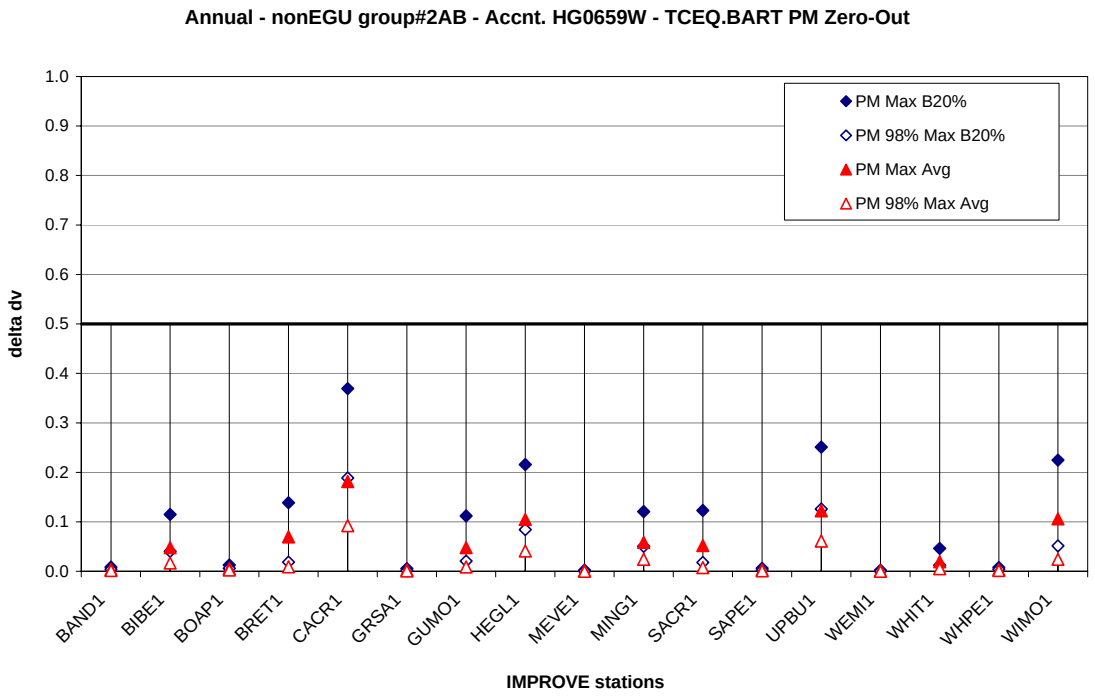


Figure 3-4d. Visibility impacts (del-dv) at Class I areas due to PM emissions from non-EGU Source Group 2AB.

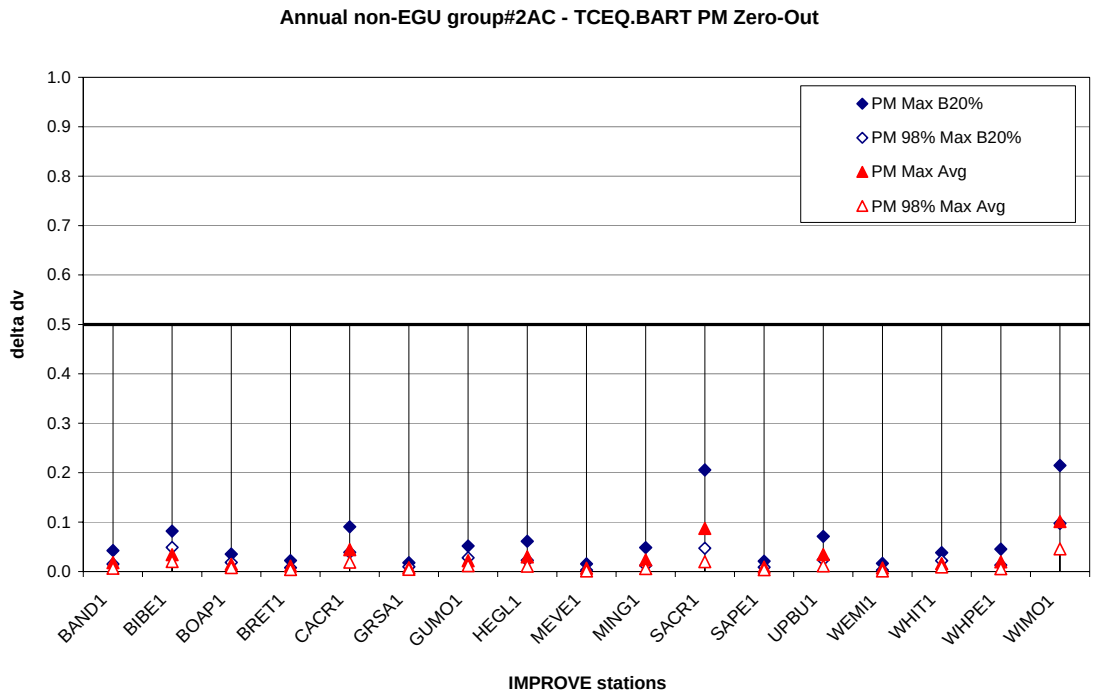


Figure 3-4e. Visibility impacts (del-dv) at Class I areas due to PM emissions from non-EGU Source Group 2AC.

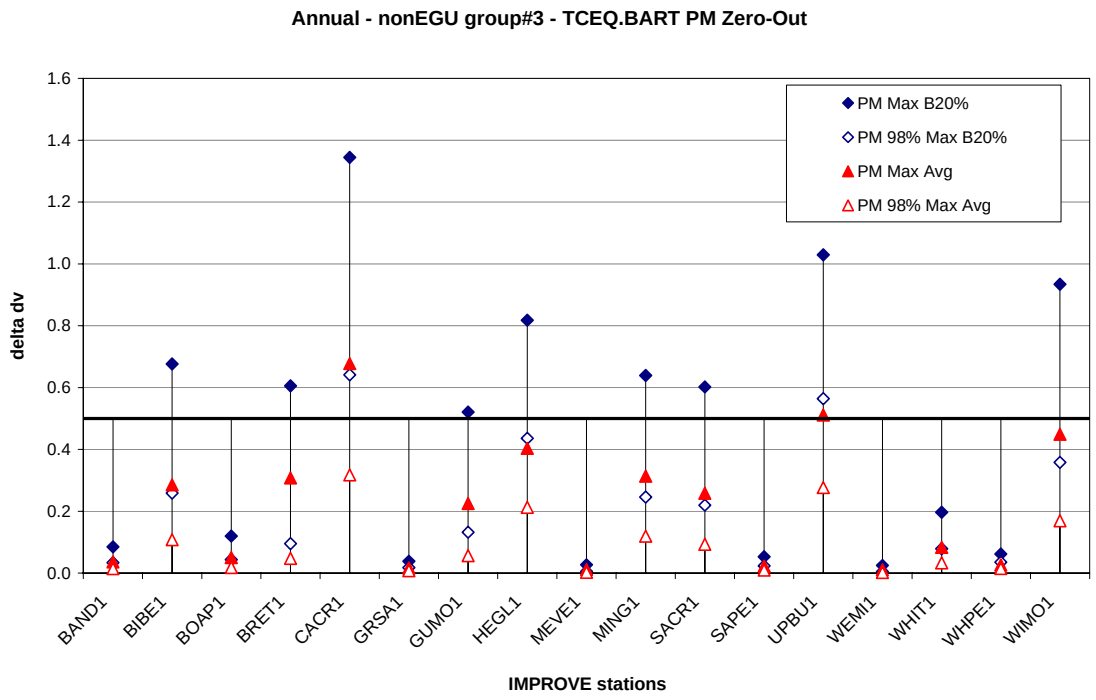


Figure 3-4f. Visibility impacts (del-dv) at Class I areas due to PM emissions from non-EGU Source Group 3.

One of the BART-eligible EGU sources, account CI0012D, was not included in the PM zero-out modeling runs. This account has a relatively small PM Q/D of 0.25 tpy/km and the nearest Class I area is BIBE. Other accounts in the same areas (shown in Figure 3-5), which have PM Q/D ranging from 0.02 - 4.7, were all screened out. Thus, account CI0012D can be reasonably assumed to pass the screening analysis as well.

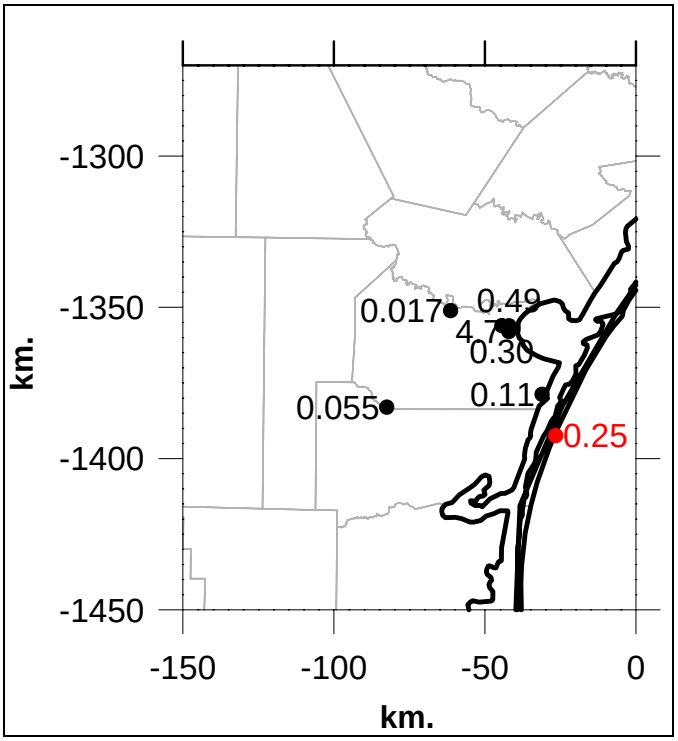


Figure 3-5. PM Q/D (tpy/km) of the facilities close to account CI0012D; account CI0012D shown in red.

Summary VOC and PM BART Analyses

The VOC zero-out analyses indicated that the visibility impacts at Class I areas, due to all Texas BART sources' VOC emissions, are well below the 0.5 del-dv significance threshold. However, the visibility impacts due to PM emissions from two EGU accounts (TF0013B, TF0012D) and one non-EGU account (CG0010G) exceeded the 0.5 del-dv threshold at Caney Creek (CACR). These three facilities' PM emissions will require further analysis under BART.

4. BART SO_2 AND NO_x SCREENING ANALYSES

The second part of the BART screening analysis estimated the visibility impacts at Class I areas due to SO_2 and NO_x emissions from non-EGU potential BART-eligible sources. Since Texas is part of the $PM_{2.5}$ provisions of the Clean Air Interstate Rule (CAIR), EPA guidance indicates that controls for potential BART-eligible EGU sources are covered under the CAIR program for $PM_{2.5}$, NO_x and SO_2. As described for the zero-out simulations, if a source group's 98th percentile del-dv over annual average natural conditions impact is < 0.5 at all Class I areas, each BART source in the group may be assumed to be insignificant and the source may require no further analysis under the BART rule.

Non-EGU Potential BART-Eligible Sources' SO_2 and NO_x Emissions

Table 4-1 lists potential BART-eligible non-EGU sources' SO_2 and NO_x emissions and their associated source groups that were used to perform screening modeling. Unlike the zero-out CAMx modeling for VOC and PM emissions and inert CAMx modeling for PM emissions, the group screening modeling for SO_2 and NO_x emissions used the CAMx PSAT to track the SO_4 and NO_3 contributions due to each BART source group. As described in Section 2, with more details in the modeling protocol (ENVIRON, 2005a), PSAT is an efficient method for looking at the contributions of many groups of sources to PM concentrations. With the implementation of PSAT within the full-chemistry PiG, as used in CAMx Version 4.4 in this study, this approach has all the advantages of a source-oriented plume model, like CALPUFF (near source plume dispersion), and a photochemical grid model (full-science chemistry, more accurate treatment of wind shear, transport, and dispersion at longer downwind distances). The PSAT screening analysis initially divided up the potential BART-eligible non-EGU sources into 10 source groups (referred to as the Round 1 groupings in Table 4-1). The assignment of potential BART-eligible non-EGU sources to the Round 1 source groups was made by ranking each source in terms of their total SO_2 and NO_x emissions divided by distance to the closest Class I area (i.e., Q/D). The top ten percent of the sources with the highest Q/D values were assigned to Group 1 and so on, so that the lower the source group number the more likely the group would have a potential visibility impact at a Class I areas due to higher emissions and/or closeness to a Class I area. Each BART source group in the preliminary run consisted of approximately 9 to 11 separate accounts (i.e., potential BART-eligible non-EGU sources).

Table 4-1. Classification of potential BART-eligible non-EGU sources into Source Groups for BART group screening modeling using CAMx/PSAT/PiG.

ID	Account	Company	Plant	NO_x* (tpy)	SO_2* (tpy)	Round 1 Group	Round 2 Group	Needs Further Analysis for SO_x and NO_x	Note
1	AB0012W	DUKE ENERGY FIELD SERVICES	FULLERTON GAS PLANT	1256	2374	1		X	
2	CG0010G	INTERNATIONAL PAPER CO		1619	374	1		X	
3	ED0034O	NORTH TEXAS CEMENT COMPANY	NORTH TEXAS CEMENT	2572	4434	1		X	
4	GB0004L	BP PRODUCTS NORTH AMERICA IN TEXAS	TEXAS CITY REFINERY	6320	4084	1		X	
5	GH0004O	CELANESE CHEMICAL	CHEMICAL MANUFACTUR	2609	4015	1		X	
6	HG0659W	SHELL OIL CO	DEER PARK PLANT	5811	6968	1		X	
7	HW0008S	DEGUSSA ENGINEERED CARBONS BORGER	BORGER CARBON BLACK	445	3604	1		X	
8	HW0017R	SID RICHARDSON CARBON	BORGER CARBON BLACK	638	3535	1		X	
9	JE0067I	EXXONMOBIL OIL CORP	BEAUMONT REFINERY	3871	9747	1		X	
10	HD0029C	A.N.R. PIPELINE COMPANY	E.G. HILL COMPRESSO	4028	0.4	2		X	
11	HG0232Q	EXXONMOBIL CORP	EXXONMOBIL REF & SU	4372	1301	2		X	
12	HH0042M	EASTMAN CHEMICAL COMPANY	TEXAS OPERATIONS	2612	105	2		X	
13	HR0018T	VALENCE MIDSTREAM LTD	COMO PLT	247	2743	2		X	
14	HT0011Q	ALON USA LP	BIG SPRING REFINERY	344	3311	2		X	
15	HT0027B	SID RICHARDSON CARBON CO	BIG SPRING CARBON B	185	3149	2		X	
16	MR0008T	DIAMOND SHAMROCK REFINING	MCKEE PLANTS	1549	2245	2		X	
17	NB0037F	TXI OPERATIONS, L.P.	STREETMAN PLANT	691	3468	2		X	
18	NE0027V	CITGO REFINING & CHEMICALS	CORPUS CHRISTI REFI	1201	5103	2		X	
19	ED0066B	TXI OPERATIONS, L.P.	MIDLOTHIAN PLANT	1388	893	3		X	
20	GB0055R	MARATHON ASHLAND PETROLEUM	TEXAS CITY REFINERY	1134	2329	3		X	
21	GH0003Q	CABOT CORPORATION	PAMPA PLANT	1335	342	3		X	

ID	Account	Company	Plant	NO_x* (tpy)	SO_2* (tpy)	Round 1 Group	Round 2 Group	Needs Further Analysis for SO_x and NO_x	Note
22	HG0048L	LYONDELL CITGO REFINING L P	LYONDELL-CITGO REFI	2288	789	3		X	
23	HG0697O	RHODIA, INC.	HOUSTON PLANT	6.8	5099	3		X	
24	HH0019H	NORIT AMERICAS INC	NORIT AMERICAS INC	489	784	3		X	
25	NE0043A	VALERO REFINING COMPANY	COMPLEX 6B 7 8	1318	3233	3		X	
26	OC0007J	EI DUPONT DENEMOURS & CO	SABINE RIVER WORKS	3125	7.3	3		X	
27	PE0024Q	DUKE ENERGY FIELD SERVICES	WAHA GAS PLANT	131	1571	3		X	
28	HG0126Q	HOECHST CELANESE CHEMICAL	CLEAR LAKE PLANT	946	1202	4		X	
29	HG0130C	VALERO REFINING TEXAS LP	HOUSTON REFINERY	461	2243	4		X	
30	HG0175D	CROWN CENTRAL PETROLEUM	PASADENA PLANT	566	1291	4		X	
31	HK0014M	TEXAS LEHIGH CEMENT CO	TEXAS LEHIGH CEMENT	1156	805	4		X	
32	JE0005H	ATOFINA PETROCHEMICALS INC	PORT ARTHUR REFINER	796	1007	4		X	
33	MC0002H	ENBRIDGE PIPELINE	TILDEN GAS PLANT	1.9	2276	4		X	
34	VC0008Q	EI DU PONT DE NEMOURS & CO	EI DU PONT DE NEMOU	2723	18	4		X	
35	EB0197H	DUKE ENERGY FIELD SERVICES		709	0	4		see note	No longer BART-eligible
36	WN0021G	DEVON GAS SERVICES, L.P.	BRIDGEPORT	936	0.8	4		see note	No longer BART-eligible
37	BG0045E	CAPITOL CEMENT DIV CAPITOL	PORTLAND CEMENT	718	850	5	2	X	
38	BJ0001T	CHEMICAL LIME LTD	CHEMICAL LIME--CLIF	700	509	5	1		
39	BL0002S	AMOCO CHEMICAL CO	CHOCOLATE BAYOU PLN	2006	12	5	1		
40	BL0082R	THE DOW CHEMICAL CO	PLANT B	1895	1.7	5	2	X	
41	HG0632T	ROHM & HAAS TEXAS	DEER PARK PLANT	748	1076	5	1		
42	JC0003K	WESTVACO		1489	72	5	2	X	
43	MB0123F	LEHIGH CEMENT COMPANY	LEHIGH PORTLAND CEM	531	576	5	3	X	

ID	Account	Company	Plant	NO_x* (tpy)	SO_2* (tpy)	Round 1 Group	Round 2 Group	Needs Further Analysis for SO_x and NO_x	Note
44	MM0001T	ALCOA INC	ALCOA SANDOW PLANT	36	1458	5	3	X	
45	OA0024I	NORTHERN NATURAL GAS CO	SPEARMAN PLANT	868	0	5	see note	see note	No longer BART-eligible
46	AG0024G	PUEBLO MIDSTREAM GAS CORP	FASHING PLANT	20	1005	6	4	X	
47	CA0011B	J.L. DAVIS GAS PROCESSING	LULING GAS PLANT	90	1021	6	4	X	
48	CY0019H	DYNEGY MIDSTREAM SERVICES	WADDELL COMPRESSOR	537	0.7	6	3	X	
49	ED0011D	CHAPARRAL STEEL MIDLOTHIAN		490	122	6	see note		Excluded (VOC modeled out)
50	HG0310V	CHEVRON PHILLIPS CHEMICAL	CHEVRON CHEMICAL CO	1013	44	6	5		
51	HW0018P	PHILLIPS 66 CO	BORGER REFINERY	590	59	6	4	X	
52	JE0039N	THE GOODYEAR TIRE AND RUBBER CO		1137	3.8	6	4	X	
53	JE0052V	HUNTSMAN CORPORATION	PORT NECHES PLANT	942	8.8	6	5		
54	JE0343H	BMC HOLDINGS INC	BMC HOLDINGS INC	1192	4.3	6	3	X	
55	EB0057B	HUNTSMAN POLYMERS		432	2.1	7	see note		Excluded (VOC modeled out)
56	GB0073P	VALERO REFINING CO TEXAS	TEXAS CITY REFINERY	637	264	7	6	X	
57	HG0228H	EXXON CHEMICAL CO	BAYTOWN OLEFINS PLA	1005	5.7	7	5		
58	HG0229F	EXXONMOBIL CHEMICAL CO	BAYTOWN CHEMICAL PL	701	104	7	7	X	
59	HG0558G	ATOFINA CHEMICALS INC	ATOFINA INC	18	920	7	6	X	
60	JB0016M	VINTAGE PETROLEUM, INC.	W RANCH COMP STA VA	1036	0.0	7	6	X	
61	JE0135Q	HUNTSMAN PETROCHEMICAL CORP		735	1.8	7	see note		Excluded (VOC modeled out)
62	NE0022I	TICONA POLYMERS INC	BISHOP FACILITY	1129	4.8	7	5		
63	NE0120H	KOCH PETROLEUM GROUP LP	CORPUS CHRISTI EAST	915	65	7	6	X	
64	BL0113I	EQUISTAR		636	1.4	8	see note		Excluded (VOC modeled out)

ID	Account	Company	Plant	NO_x* (tpy)	SO_2* (tpy)	Round 1 Group	Round 2 Group	Needs Further Analysis for SO_x and NO_x	Note
65	CB0003M	ALCOA ALUMINA & CHEMICALS	POINT COMFORT PLANT	951	20	8	7	X	
66	ED0051O	OWENS CORNING		329	26	8	8	X	
67	FG0036G	TXI OPERATION LP	CLODINE EXPANDED SH	194	635	8	7	X	
68	GB0001R	BP AMOCO CHEMICAL COMPANY	BP AMOCO CHEMICAL T	813	5	8	7	X	
69	HW0013C	CHEVRON PHILLIPS CHEMICAL CO		48	280	8	see note		Excluded (VOC modeled out)
70	MH0009H	CELANESE LIMITED		612	43	8	8	X	
71	WH0014S	WICHITA FALLS PLANT		107	28	8	8	X	
72	TH0010I	AUSTIN WHITE LIME CO		375	253	8	see note		No longer BART-eligible
73	BL0038U	SOLUTIA INC		502	10	9	see note		Excluded (VOC modeled out)
74	BL0758C	CHEVRON PHILLIPS CHEMICAL	SWEENY COMPLEX	356	15	9	9	X	
75	CB0028T	UNION CARBIDE CORPORATION	SEADRIFT PLANT	463	0.1	9	8	X	
76	CG0012C	ENBRIDGE PIPELINES	BRYANS MILL PLANT	84	0.3	9	9	X	
77	CI0022A	DYNEGY MIDSTREAM SERVICES		406	1.6	9	see note		Excluded (VOC modeled out)
78	CR0020C	COPANO PROCESSING LP		454	1.6	9	see note		Excluded (VOC modeled out)
79	HG0218K	EI DUPONT		160	175	9	see note		Excluded (VOC modeled out)
80	HG0562P	TEXAS PETROCHEMICALS LP	TX PETROCHEMICALS L	334	1.9	9	9	X	
81	NE0122D	FLINT HILLS RESOURCES LP	WEST REFINERY	284	27	9	9	X	
82	AC0017B	ABITIBI CONSOLIDATED CORP		28	0.3	10	10	X	
83	BL0021O	BASF CORPORATION	FREEPORT SITE	323	0.1	10	10	X	
84	BL0268B	EQUISTAR CHEMICALS LP		6.2	0.8	10	see note		Excluded (VOC modeled out)
85	HG0033B	EQUISTAR CHEMICALS LP	CHANNELVIEW COMPLEX	11	0.0	10	see note		Excluded (VOC modeled out)

ID	Account	Company	Plant	NO_x* (tpy)	SO_2* (tpy)	Round 1 Group	Round 2 Group	Needs Further Analysis for SO_x and NO_x	Note
86	HG1451S	OSYVINYLSLP		89	0.7	10	see note		Excluded (VOC modeled out)
87	JE0042B	PREMCOR REFINING GROUP	PORT ARTHUR REFINER	96	0.4	10	10	X	
88	JE0065M	EXXON MOBIL CHEMICAL CO		29	0.0	10	see note		Excluded (VOC modeled out)
89	JE0091L	SUN MARINE TERMINAL		0.9	0.1	10	see note		Excluded (VOC modeled out)
90	JH0025O	JOHNS MANVILLE INTERNATIONALJOHNS MANVILLE		97	19	10	10	X	
91	AC0019U	TEXAS FOUNDRIES		3	2	10	see note		No longer BART-eligible
92	HX2897U	BP AMOCO POLYMERS INC		31	0.3	10	see note		No longer BART-eligible
93	GB0076J	UNION CARBIDE CORP	VINYL ACETATE FACIL	0	0	see note	see note		Excluded (NO_x <20tpy and Sox<20tpy)
94	WN0042V	DYNEGY MIDSTREAM SERVICES		0	0	see note	see note		Excluded (NO_x <20tpy and SO_x<20tpy)

* SO_2 and NO_x average actual emissions from 2002 CENRAP database, modeling used doubled values as an estimate of 24-hour maximum emission rate.

SO_2 and NO_x Visibility Impacts from PSAT

The preliminary Round 1 PSAT results indicated that all 10 BART source groups exceeded the 0.5 del-dv threshold of the key significance metric (98th percentile change in deciview over annual average natural conditions) in at least one Class I area as shown. Therefore, the BART group failed the screening test. As shown in Figure 4-1, the first four BART source groups (i.e., ones with the highest Q/D values) contributed 2 to 3.5 del-dv at a Class I area using the key metric (98th percentile/annual average, unfilled triangle in Figure 4-1), whereas source groups 5 through 10 contributed < 2 del-dv. The largest estimated visibility impairments occurred at the Class I areas near northeast Texas, in Arkansas and southern Missouri (CACR, HEGL, and UPBU), while the next highest estimated visibility impacts occurred near western Texas (BIBE and GUMO) and northern Texas (WIMO in Oklahoma).

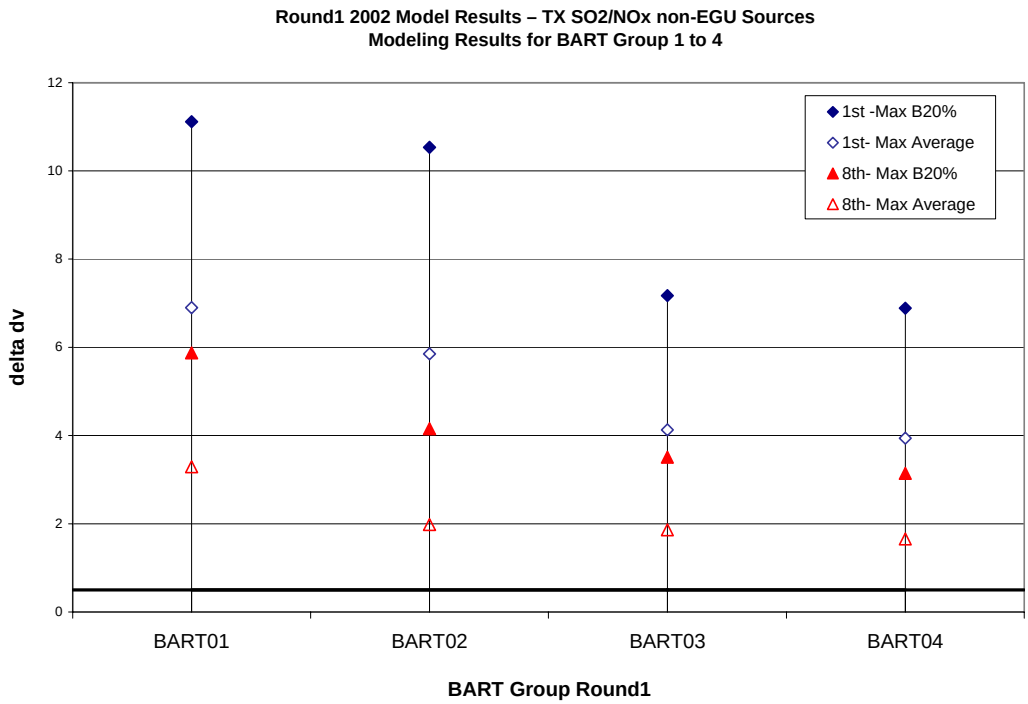


Figure 4-1. Preliminary Round 1 visibility impacts (del-dv) at Class I areas from potential BART- eligible non-EGU source groups 1 to 4 (highest Q/D).

TCEQ decided that SO_2 and NO_x emissions for sources in the first four groups from Round 1 would be unlikely to screen out. The SO_2/ NO_x BART screening modeling effort then concentrated on lower contributing BART source groups (source groups 5 to 10), which are composed of 56 accounts. Some of these accounts were removed from Round 2 PSAT analyses for two reasons: based on continuing analysis by the TCEQ on BART eligibility, some of the non-EGU accounts were found to not be BART-eligible as mentioned in the zero-out modeling in Section 3; and 13 sources that were classified as potential BART-eligible sources because their VOC emissions exceeded the emissions significance threshold (> 250 tpy). Since VOC emissions from all BART sources were shown to contribute insignificantly to visibility

impairment at any Class I area (see Section 3) and the SO_2 and/or NO_x emissions from these sources are typically under 20 tpy, the TCEQ determined that the emissions from these 13 sources were not significant so they were removed from the PSAT list. The remaining sources from the preliminary Round 1 modeling source groups 5 through 10 were then divided into 10 source groups for Round 2 screening modeling.

Round 2 of PSAT modeling indicated that only BART source Group 1 and Group 5 did not exceed the 0.5 dv threshold for the key visibility metric, as shown in Figure 4-2 (unfilled triangle); therefore, sources in these two groups may be determined to need no further BART analysis. The other Round 2 BART source groups estimated changes in deciview ranging from 0.7-1.2 del-dv, and therefore failed the group screening test. The largest visibility impairments occurred at the Class I areas near northeast Texas (CACR, HEGL, and UPBU), while second highest visibility impairments were estimated near north Texas (WIMO).

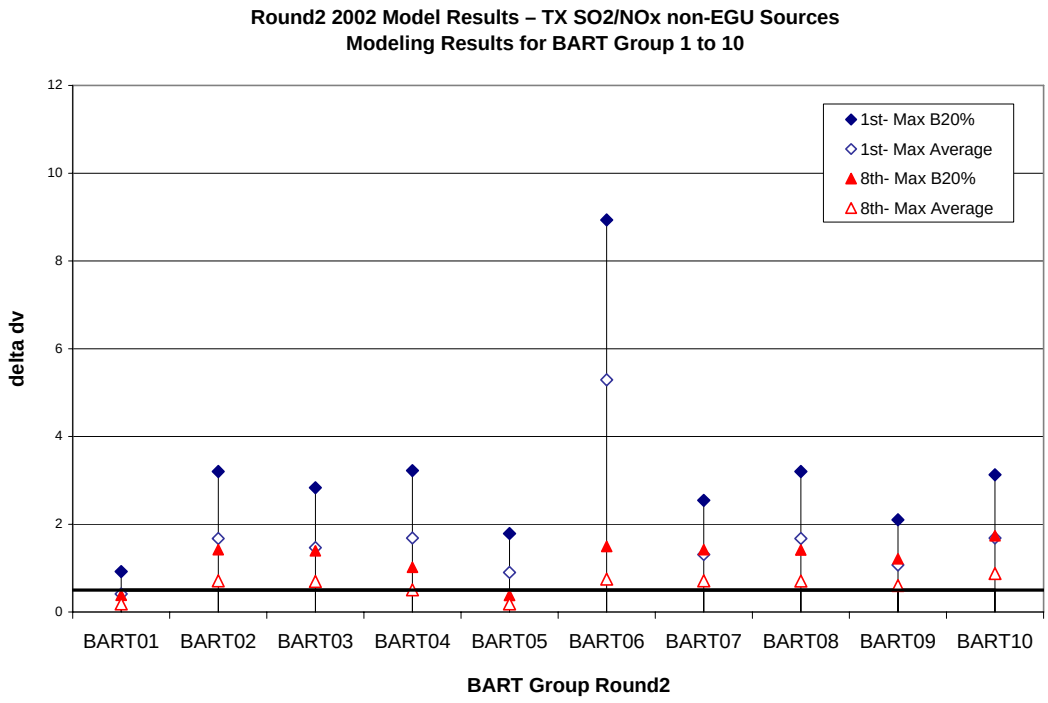


Figure 4-2. Round 2 visibility impacts (del-dv) at Class I areas from potential BART-eligible non-EGU Source Groups 1 to 10 SO_2 and NO_x emissions.

5. SUMMARY AND CONCLUSIONS

The TCEQ has evaluated a list of potential BART-eligible sources in Texas as part of the requirement in the EPA's Regional Haze Regulations. There are over one hundred such sources in Texas. The TCEQ performed group BART screening analyses to determine whether emissions from groups of potential BART-eligible sources contribute significantly to visibility impairment at Class I areas. This report presents a summary of the group BART screening analysis conducted for TCEQ. Two modeling approaches were used in the BART screening analysis: (1) BART VOC and PM emissions zero-out modeling; and (2) BART SO_2 and NO_x PSAT modeling. The visibility impacts at Class I areas are presented in terms of the percent change in deciview (del-dv) over natural conditions due to emissions from BART sources. The 0.5 del-dv significance threshold was used to assess whether a potential BART-eligible source group does not contribute significantly to visibility impairment. Both the estimated maximum and 98th percentile change in deciview over natural conditions at Class I areas were presented and two natural conditions were used: best 20% days and annual average. Based on EPA's BART Guidance (EPA, 2005) and recent updates (Paise, 2006a, b), the key visibility metric used to compare against the 0.5 del-dv significance threshold was the 98th percentile change in deciview over annual average natural conditions.

The following section summarizes which BART sources were in source groups that were below or above the 0.5 del-dv significance threshold. TCEQ will make the determination of whether a source is subject to BART or not.

Texas BART VOC Emissions Zero-Out Screening Analysis

The visibility impacts due to all Texas potential BART-eligible sources' VOC emissions did not exceed the 0.5 del-dv threshold at all Class I areas. Each Texas BART source's VOC emissions are below the 0.5 del-dv visibility significance threshold, therefore TCEQ is justified in stating that all VOC emissions from Texas BART sources require not further analysis under the BART rule.

Texas BART PM Emissions Zero-Out and Inert Screening Analysis

The visibility impacts due to all Texas potential BART-eligible sources' primary PM emissions from the CAMx zero-out modeling were > 0.5 del-dv at some Class I areas, so the sources failed the group BART. Further PM analyses were performed for potential BART-eligible source groups using CAMx inert PM simulations. Non-EGU and EGU sources were analyzed in separate source groups. Three accounts, TF0013B, TF0012D, and CG0010, exceeded the 0.5 threshold (see Table 5-1). These three accounts were located in northeast Texas and all three of these facilities exceeded the 0.5 del-dv visibility significance threshold by themselves at Caney Creek (CACR). The visibility impacts due to PM emissions from the remaining source groups of potential BART-eligible sources were below the 0.5 del-dv at all Class I areas so passed the group screening test for PM emissions.

Table 5–1. List of potential BART-eligible sources that failed the PM emissions screening analyses.

Account	Company	Plant	PM10 (tpy)	EGU/ NON-EGU	98 % del-dv
CG0010G	INTERNATIONAL PAPER CO		578	non-EGU	0.92
TF0012D	SOUTHWESTERN ELECTRIC POWER	WELSH POWER PLANT	1755	EGU	0.72
TF0013B	TXU GENERATION COMPANY LP	MONTICELLO STM ELE	3297	EGU	0.61

SO_2 and NO_x PSAT

The screening analysis for SO_2 and NO_x emissions was performed using the updated PSAT in CAMx. The analysis was only performed for potential BART-eligible non-EGU sources, as EPA has stated that the BART requirements for Texas EGU sources are covered under the CAIR $PM_{2.5}$ program. Due to the computational resource requirement, only two rounds of simulations were conducted, and thus, the results were reported as a group rather than an individual account. Source Groups with 65 accounts were estimated to exceed the 0.5 del-dv threshold so the group BART screening test was not passed. The highest visibility impairments occurred at the Class I areas near northeast Texas (CACR, HEGL, and UPBU), while some minor impairments that still exceeded the 0.5 del-dv threshold also were estimated near west Texas (BIBE and GUMO) and north Texas (WIMO). Table 5-2 lists the potential BART-eligible non-EGU sources that were in source groups that did not pass the group BART screening test for SO_2 and NO_x emissions.

Table 5–2. List of potential BART-eligible non-EGU sources that were in Source Groups whose SO_2 and NO_x emissions did not pass the group BART screening analysis test using the CAMx PSAT simulations.

Account	Company	Plant	NO_x (tpy)	SO_2 (tpy)
AB0012W	DUKE ENERGY FIELD SERVICES	FULLERTON GAS PLANT	1256	2374
AC0017B	ABITIBI CONSOLIDATED CORP		28	0.3
AG0024G	PUEBLO MIDSTREAM GAS CORP	FASHING PLANT	20	1005
BG0045E	CAPITOL CEMENT DIV CAPITOL	PORTLAND CEMENT	718	850
BL0021O	BASF CORPORATION	FREEPORT SITE	323	0.1
BL0082R	THE DOW CHEMICAL CO	PLANT B	1895	1.7
BL0758C	CHEVRON PHILLIPS CHEMICAL	SWEENY COMPLEX	356	15
CA0011B	J.L. DAVIS GAS PROCESSING	LULING GAS PLANT	90	1021
CB0003M	ALCOA ALUMINA & CHEMICALS	POINT COMFORT PLANT	951	20
CB0028T	UNION CARBIDE CORPORATION	SEADRIFT PLANT	463	0.1
CG0010G	INTERNATIONAL PAPER CO		1619	374
CG0012C	ENBRIDGE PIPELINES	BRYANS MILL PLANT	84	0.3
CY0019H	DYNEGY MIDSTREAM SERVICES	WADDELL COMPRESSOR	537	0.7
ED0034O	NORTH TEXAS CEMENT COMPANY	NORTH TEXAS CEMENT	2572	4434
ED0051O	OWENS CORNING		329	26
ED0066B	TXI OPERATIONS, L.P.	MIDLOTHIAN PLANT	1388	893
FG0036G	TXI OPERATION LP	CLODINE EXPANDED SH	194	635
GB0001R	BP AMOCO CHEMICAL COMPANY	BP AMOCO CHEMICAL T	813	5
GB0004L	BP PRODUCTS NORTH AMERICA IN TEXAS	TEXAS CITY REFINERY	6320	4084
GB0055R	MARATHON ASHLAND PETROLEUM	TEXAS CITY REFINERY	1134	2329
GB0073P	VALERO REFINING CO TEXAS	TEXAS CITY REFINERY	637	264

Account	Company	Plant	NO_x (tpy)	SO_2 (tpy)
GH0003Q	CABOT CORPORATION	PAMPA PLANT	1335	342
GH0004O	CELANESE CHEMICAL	CHEMICAL MANUFACTUR	2609	4015
HD0029C	A.N.R. PIPELINE COMPANY	E.G. HILL COMPRESSO	4028	0.4
HG0048L	LYONDELL CITGO REFINING L P	LYONDELL-CITGO REFI	2288	789
HG0126Q	HOECHST CELANESE CHEMICAL	CLEAR LAKE PLANT	946	1202
HG0130C	VALERO REFINING TEXAS LP	HOUSTON REFINERY	461	2243
HG0175D	CROWN CENTRAL PETROLEUM	PASADENA PLANT	566	1291
HG0229F	EXXONMOBIL CHEMICAL CO	BAYTOWN CHEMICAL PL	701	104
HG0232Q	EXXONMOBIL CORP	EXXONMOBIL REF & SU	4372	1301
HG0558G	ATOFINA CHEMICALS INC	ATOFINA INC	18	920
HG0562P	TEXAS PETROCHEMICALS LP	TX PETROCHEMICALS L	334	1.9
HG0659W	SHELL OIL CO	DEER PARK PLANT	5811	6968
HG0697O	RHODIA, INC.	HOUSTON PLANT	6.8	5099
HH0019H	NORIT AMERICAS INC	NORIT AMERICAS INC	489	784
HH0042M	EASTMAN CHEMICAL COMPANY	TEXAS OPERATIONS	2612	105
HK0014M	TEXAS LEHIGH CEMENT CO	TEXAS LEHIGH CEMENT	1156	805
HR0018T	VALENCE MIDSTREAM LTD	COMO PLT	247	2743
HT0011Q	ALON USA LP	BIG SPRING REFINERY	344	3311
HT0027B	SID RICHARDSON CARBON CO	BIG SPRING CARBON B	185	3149
HW0008S	DEGUSSA ENGINEERED CARBONS BORGER	BORGER CARBON BLACK	445	3604
HW0017R	SID RICHARDSON CARBON	BORGER CARBON BLACK	638	3535
HW0018P	PHILLIPS 66 CO	BORGER REFINERY	590	59
JB0016M	VINTAGE PETROLEUM, INC.	W RANCH COMP STA VA	1036	0.0
JC0003K	WESTVACO		1489	72
JE0005H	ATOFINA PETROCHEMICALS INC	PORT ARTHUR REFINER	796	1007
JE0039N	THE GOODYEAR TIRE AND RUBBER CO		1137	3.8
JE0042B	PREMCOR REFINING GROUP	PORT ARTHUR REFINER	96	0.4
JE0067I	EXXONMOBIL OIL CORP	BEAUMONT REFINERY	3871	9747
JE0343H	BMC HOLDINGS INC	BMC HOLDINGS INC	1192	4.3
JH0025O	JOHNS MANVILLE INTERNATIONAL	JOHNS MANVILLE	97	19
MB0123F	LEHIGH CEMENT COMPANY	LEHIGH PORTLAND CEM	531	576
MC0002H	ENBRIDGE PIPELINE	TILDEN GAS PLANT	1.9	2276
MH0009H	CELANESE LIMITED		612	43
MM0001T	ALCOA INC	ALCOA SANDOW PLANT	36	1458
MR0008T	DIAMOND SHAMROCK REFINING	MCKEE PLANTS	1549	2245
NB0037F	TXI OPERATIONS, L.P.	STREETMAN PLANT	691	3468
NE0027V	CITGO REFINING & CHEMICALS	CORPUS CHRISTI REFI	1201	5103
NE0043A	VALERO REFINING COMPANY	COMPLEX 6B 7 8	1318	3233
NE0120H	KOCH PETROLEUM GROUP LP	CORPUS CHRISTI EAST	915	65
NE0122D	FLINT HILLS RESOURCES LP	WEST REFINERY	284	27
OC0007J	EI DUPONT DENEMOURS & CO	SABINE RIVER WORKS	3125	7.3
PE0024Q	DUKE ENERGY FIELD SERVICES	WAHA GAS PLANT	131	1571
VC0008Q	EI DU PONT DE NEMOURS & CO	EI DU PONT DE NEMOU	2723	18
WH0014S	WICHITA FALLS PLANT		107	28

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