ENVIRON

Best Available Retrofit Technology Modeling Analysis

Huntsman Polymers Corporation
Odessa Plant
TCEQ Account EB0057B

Prepared for:

Huntsman Polymers Corporation
Odessa, Texas

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TEXAS PROFESSIONAL ENGINEER'S STATEMENT

30 TAC 116.1510(b) requires that modeling demonstrations used to show that a BART-eligible source does not contribute to visibility impairment at any Class I area must be submitted under seal of a Texas licensed professional engineer to the Texas Commission on Environmental Quality Air Permits Division. By this statement, I hereby certify that the dispersion modeling analysis described and documented within this report was performed by me or under my direct supervision and that the model inputs used and results presented are true and correct to the best of my knowledge. Any limitations with respect to sources or availability of information and assumptions used in the analysis are noted within the report.

_____ _____

Steven Hunter Ramsey, P.E. Date

Texas Licensed Professional Engineer
Number 69070

1. INTRODUCTION

1.1 Purpose

The Huntsman Polymers Corporation (Huntsman) retained ENVIRON International Corporation (ENVIRON) to perform a source-specific Best Available Retrofit Technology (BART) modeling analysis using the CALPUFF model for the Huntsman Odessa Plant located near Odessa, Texas. The source-specific BART screening modeling analysis presented within this report follows Texas Commission on Environmental Quality (TCEQ) and Central States Regional Air Planning Association (CENRAP) guidance.[1,2] TCEQ guidance is included as Attachment A to this report.

1.2 Background information

In 1999, the EPA promulgated rules to address visibility impairment – often referred to as "regional haze" – at designated federal Class I areas. These include areas such as national parks and wilderness areas where visibility is considered to be an important part of the visitor experience.[3] There are two Class I areas in Texas – Big Bend and Guadalupe National Parks – as well as a number in surrounding states in close proximity to Texas. Guidelines providing direction to the states for implementing the regional haze rules were issued by EPA in July 2005. Affected states, including Texas, are required to develop plans for addressing visibility impairment. This includes a requirement that certain existing sources be equipped with Best Available Retrofit Technology, or BART. Texas is required to submit a regional haze plan to EPA no later than December 17, 2007.

1.3 Potentially Affected Sources

The Texas Commission on Environmental Quality (TCEQ) regional haze rule adopted on January 10, 2007 (presented in Attachment B), identifies potentially affected sources as those:[4]

- Belonging to one of 26 industry source categories;[5]

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[1] *Best Available Retrofit Technology (BART) Modeling Protocol to Determine Sources Subject to BART in the State of Texas*, January 2007, prepared by the TCEQ.

[2] Alpine Geophysics, LLC.2005. *CENRAP BART Modeling Guidelines*.

[3] 40 CFR 51, Subpart P

[4] 30 TAC Chapter 116, Subchapter M, effective February 7, 2007.

[5] (1) fossil fuel-fired steam electric plants of more than 250 MMBtu/hour heat input; (2) coal-cleaning plants (thermal dryers); (3) Kraft pulp mills; (4) Portland cement plants; (5) primary zinc smelters; (6) iron and steel mill plants; (7) primary aluminum ore reduction plants; (8) primary copper smelters; (9) municipal incinerators capable of charging more than 250 tons of refuse per day; (10) hydrofluoric, sulfuric, and nitric acid plants; (11) petroleum refineries; (12) lime plants; (13) phosphate rock processing plants; (14) coke oven batteries; (15) sulfur recovery plants; (16) carbon black plants (furnace process); (17) primary lead smelters; (18) fuel conversion plants; (19) sintering plants; (20) secondary metal production facilities; (21) chemical process plants; (22) fossil fuel-fired boilers of more than 250 MMBtu/hour heat input; (23) petroleum storage and transfer facilities with capacity exceeding 300,000 barrels; (24) taconite ore processing facilities; (25) glass fiber processing plants; and (26) charcoal production facilities.

- Having the potential to emit (PTE) 250 tons per year or more of any visibility-impairing pollutant;[6] and
- Not in operation prior to August 7, 1962, and in existence on August 7, 1977.

Based on results of a survey completed by potential BART-eligible sources and submitted to the TCEQ in 2005, 126 accounts were identified as potentially BART-eligible. This includes the Huntsman Odessa Plant.

1.4 Exemptions

In 30 TAC 116.1510, the regulations identify four methods of exempting a BART-eligible source from the engineering analysis (described in 30 TAC 116.1520) and control requirements (described in 30 TAC 116.1530) of BART. These exemptions are as follows:

- Exempt by rule based on potential emissions and distance to the nearest Class I area.
- Electric Generating units (EGUs) participating in the Clean Air Interstate Rule (for nitrogen oxides and sulfur dioxide only).
- Screening exemption modeling conducted by the TCEQ.
- Source-specific exemption modeling.

Following is a brief discussion of each exemption.

1.4.1 Exempt by Rule

Following EPA guidance, the TCEQ has established exemptions based on potential emissions and distance to the nearest Class I area.

- Sources with the potential-to-emit (PTE) less than 500 tons per year of combined nitrogen oxides (NO_X) and sulfur dioxide (SO_2) and located more than 50 kilometers (km) from any Class I area are not subject to BART for NO_X and SO_2.
- Sources with the PTE less than 1,000 tons per year of combined NO_X and SO_2 and located more than 100 km from any Class I area are not subject to BART for NO_X and SO_2.
- Sources with the PTE of less than 40 tons per year of NO_X or SO_2 are not subject to BART for that pollutant, regardless of distance to a Class I area.
- Sources with the PTE less than 15 tons per year of particulate matter less than 10 microns in diameter (PM_{10}) are not subject to BART for PM_{10}, regardless of distance to a Class I area.

PTE is defined in 30 TAC 116.10 (27) as "The maximum capacity of a stationary source to emit a pollutant under its physical and operational design. Any physical or enforceable operational limitation on the capacity of the stationary source to emit a pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, may be treated as part of its

[6] *Visibility-impairing air pollutant* is defined in 30 TAC 116.1500(2) as "Any of the following: nitrogen oxides, sulfur dioxide, or particulate matter."

design only if the limitation or the effect it would have on emissions is federally enforceable." To take advantage of a model plant exemption, the PTE must be federally enforceable no later than April 30, 2007.

PTE for BART-eligible emission units at the Huntsman Odessa Plant is less than 1,000 tons per year and the distance to the closest Class I area is greater than 100 km. Therefore, the source is not subject to BART for NO_X and SO_2. Emissions of PM_{10}, however, are greater than the 15 ton per year threshold. Therefore, the Odessa Plant is not exempt by rule from BART for particulate matter.

1.4.2 EGU Exemption

BART-eligible EGUs that participate in the Clean Air Interstate Rule trading program for NO_X and SO_2 are not subject to the engineering analysis and control requirements of BART. The Huntsman Odessa Plant is not an EGU and does not qualify for this exemption.

1.4.3 TCEQ Screening Exemption Modeling

The TCEQ performed cumulative group BART screening exemption modeling using the Comprehensive Air Quality Model with extensions (CAMx). The 126 potentially BART-eligible sources were included in the screening exemption modeling.

Three types of BART screening exemption modeling were conducted:

- BART sources volatile organic compound (VOC) zero-out modeling to ascertain whether or not Texas BART VOC emissions cause or contribute to visibility impairment at any Class I area;
- BART sources primary particulate matter (PM) zero-out and chemically inert modeling to ascertain whether or not BART primary PM emissions cause or contribute to visibility impairment at any Class I area; and
- BART sources SO_2 and NO_X modeling using the PM Source Apportionment Technology (PSAT) and the Plume-in-Grid (PiG) subgrid-scale point source model.

Findings were as follows:

- The VOC zero-out modeling analysis indicated that visibility impacts at Class I areas due to VOC emissions from all Texas BART sources were well below the 0.5 deciview (dv) significance threshold.[7] As a result of this finding, the TCEQ decided to exclude VOC from the definition of visibility-impairing pollutant.
- Visibility impacts due to PM emissions were greater than the 0.5 dv significance threshold for two EGU and one non-EGU accounts. The EGUs are TXU's Monticello Steam Electric Station and AEP's Welsh Power Plant. The non-EGU is International Paper's Texarkana Mill.
- Visibility impacts due to SO_2 and NO_X emissions were greater than the 0.5 dv significance threshold for

[7] A *deciview* is a measure of visibility impairment.

source groupings that included 48 accounts.

For a more detailed description of the BART screening exemption modeling and the results of the modeling, the reader is referred to the following documents:

- *Final Report, Screening Analysis of Potential BART-Eligible Sources in Texas*, September 27, 2006, prepared by ENVIRON International Corporation;[8] and
- *ADDENDUM I, BART Exemption Screening Analysis, DRAFT*, December 6, 2006, prepared by ENVIRON International Corporation.[9]

30 TAC 116.1510(e) specifies that:

> "Any BART-eligible source that has been screened out by the Texas Commission on Environmental Quality-conducted screening modeling is not subject to the requirements of [BART] if the owner or operator has reviewed that modeling inputs for that source and the executive director receives written certification that the inputs are correct no later than February 28, 2007."

The Huntsman Odessa Plant passed the screening analysis for PM, NO_X and SO_2. However, certain PM emissions (specifically, emissions from a cooling tower) were not included in the TCEQ's screening analysis. As a result, Huntsman could not certify that the emissions used in the screening analysis were an accurate representation of worst-case actual 24-hour emissions. No model plant was developed by the TCEQ for the Class I Area closest to the Huntsman Odessa Plant: Carlsbad Caverns National Park in New Mexico. Therefore, the model plant approach is not available for demonstrating insignificant impacts and exemption from BART.

1.4.4 Source-Specific Exemption Modeling

TCEQ regulations state that:

> "The owner or operator of a BART-eligible source may demonstrate, using a model and modeling guidelines approved by the executive director, that the source does not contribute to visibility impairment at a Class I area. A BART-eligible source that does not contribute to visibility impairment at any Class I area is not subject to the requirements of [BART]. A source is considered to not contribute to visibility impairment if, as demonstrated by modeling performed by the executive director or performed in accordance with the guidelines approved by the executive director, it causes a visibility impairment of less than 0.5 deciviews at all Class I areas."

Exemption modeling is to be submitted to the TCEQ under the seal of a Texas professional engineer.

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[8] http://www.tceq.state.tx.us/assets/public/implementation/air/sip/bart/BART_FinalReport.pdf.

[9] http://www.tceq.state.tx.us/assets/public/implementation/air/sip/bart/addendum-screening.pdf.

TCEQ guidance identifies the following exemption modeling options for potentially BART-affected sources:

- CALPUFF for Class I areas located within 300 km of the source;
- CALPUFF for Class I areas located beyond 300 km of the source for a conservative screening analysis; and
- CAMx for Class I areas located beyond 300 km of the source in a refined analysis.

The Huntsman Odessa Plant is located approximately 190 km from the nearest Class I area: Carlsbad Caverns National Park in New Mexico.

2. CALPUFF MODELING APPROACH

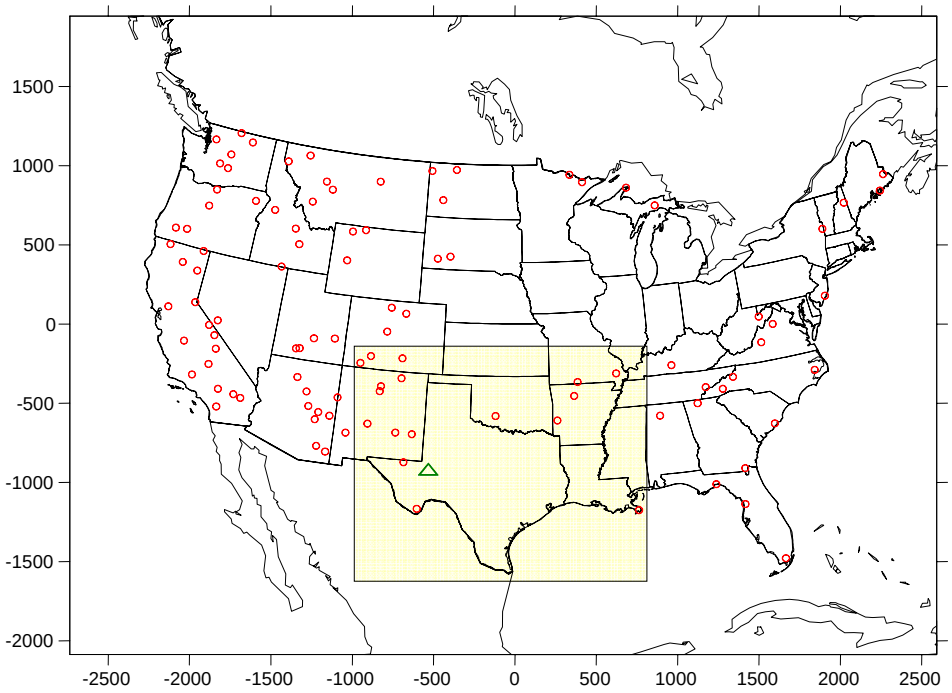
2.1 Overview

One of the air quality modeling approaches in EPA's BART guidance is an individual source attribution approach. Specifically, this entails modeling source-specific BART-eligible units and comparing modeled impacts to the deciview threshold. The modeling approach discussed here is specifically designed for conducting a source-specific BART screening modeling analysis.

2.2 Class I Areas to Assess

Figure 2-1 shows the location of the CENRAP South Domain (yellow box), Class I areas (red circles) and the Huntsman Odessa Plant (green triangle). Lambert Conformal Projection (LCP) coordinates are shown.

Figure 2-1. CENRAP South Domain



The Huntsman Odessa Plant is located approximately 190 km from Carlsbad Caverns National Park, the closest Class I Area. Other Class I areas within 300 km are Guadalupe Mountains National Park and Big Bend National Park, both in Texas. The CALPUFF screening analysis encompasses the entire CENRAP South Domain. Class I areas within the CENRAP South Domain are as follows:

- Bandelier National Monument, New Mexico

- Big Bend National Park, Texas
- Bosque del Apache National Wildlife Refuge, New Mexico
- Breton Wilderness Area, Louisiana
- Caney Creek Wilderness Area, Arkansas
- Carlsbad Caverns National Park, New Mexico
- Great Sand Dunes Wilderness Area, Colorado
- Guadalupe Mountains National Park, Texas
- Hercules-Glade Wilderness Area, Missouri
- La Garita Wilderness Area, Colorado
- Mesa Verde National Park, Colorado
- Mingo Wilderness Area, Missouri
- Pecos Wilderness Area, New Mexico
- Salt Creek Wilderness Area, New Mexico
- San Pedro Parks Wilderness Area, New Mexico
- Upper Buffalo Wilderness Area, Arkansas
- Weminuche Wilderness Area, Colorado
- Wheeler Peak Wilderness Area, New Mexico
- White Mountain Wilderness Area, New Mexico
- Wichita Mountains National Wildlife Refuge, Oklahoma

2.3 Air Quality Model and Inputs

2.3.1 Modeling Domains

The CALPUFF source-specific screening modeling for the Huntsman Odessa Plant is conducted with the CENRAP South Domain 6 km grid as shown in Figure 2-1. The domain extents are as follows.

- SW Corner (1,1): -1008.0 km, -1620.0 km
- NX, NY: 306, 246
- DX, DY: 6 km 6 km

2.3.2 CALPUFF System Implementation

There are three main components to the CALPUFF model:

- Meteorological Data Modeling (CALMET);

- Dispersion Modeling (CALPUFF); and
- Post-processing (POSTUTIL / CALPOST).

Versions of the modeling components used in the source-specific subject-to-BART screening modeling analysis for the Huntsman Odessa Plant are presented in Table 2-1. Note that the following processors are not used in this analysis because the Huntsman Odessa Plant analysis utilized the existing CENRAP-developed geophysical data file: TERREL, CTGCOMP, CTGPROC, and MAKEGEO. Since CALMET data provided by CENRAP is used in the analysis, CALMM5 is not used directly.

Table 2-1. CALPUFF Modeling Components

Processor	Version	Level
TERREL	3.311	030709
CTGCOMP	2.42	030709
CTGPROC	2.42	030709
MAKEGEO	2.22	030709
CALMM5	2.4	050413
CALMET	5.53a	040716
CALPUFF	5.711a	040716
POSTUTIL	1.3	030402
CALPOST	5.51	030709

2.3.3 Meteorological Data Modeling (CALMET)

The 2001-2003 CENRAP-developed CALMET dataset is used in the Huntsman Odessa Plant CALPUFF screening analysis as recommended by TCEQ guidance. TCEQ considers CALPUFF screening modeling to be conservative; therefore, they do not require use of observational data. Accordingly, observational data is not incorporated into the Huntsman Odessa Plant screening analysis.

2.3.4 Source Parameters

Source parameters required for modeling BART-eligible units are height of the stack opening from ground, inside stack diameter, exit gas flow rate, exit gas temperature, base elevation above sea level, and source location coordinates. Source parameters used in modeling the Huntsman Odessa Plant are presented in Table 2-2.

Table 2-2. Source Parameters Used in CALPUFF Modeling Analysis

Emission Point	LCP Coordinates		Height (m)	Base Elevation (m)	Diameter (m)	Velocity (m/s)	Temperature (°K)
	X (km)	Y (km)					
EY018ST	-505.0528	-891.9102	73.15	874.1	2.36	6.004	441.5
EY055ST	-505.0546	-891.9411	25.30	874.1	0.38	23.865	588.7
PP31465VN	-503.6725	-891.3401	25.91	874.1	0.28	6.157	422.0
PP31466VN	-503.6689	-891.2783	1.32	874.1	0.10	0.001	322.0
PP31470VN	-503.6707	-891.3092	11.89	874.1	0.15	12.923	333.2
PP31478VN	-503.7067	-891.0988	21.94	874.1	0.26	0.001	298.2
PP31842VN	-504.5859	-891.0662	3.05	874.1	0.20	0.001	322.0
PP31860VN	-503.6743	-891.3711	6.10	874.1	0.41	0.001	322.0
PP31865VN	-503.6743	-891.3711	10.67	874.1	0.41	0.001	322.0
PP31866VN	-503.7373	-891.1517	3.05	874.1	0.20	0.001	322.0
PP3RCDST	-503.6590	-891.4339	4.57	874.1	0.15	0.001	588.7
EY030CT	-505.1797	-891.5838	16.46	874.1	4.27	13.563	298.2

2.3.5 Emission Rates

TCEQ and CENRAP guidance identifies the following priority approach for determining maximum 24-hour actual emission rates to be used in a BART visibility impairment modeling analysis:

1. Continuous emission monitoring (CEM) data;
2. Facility emissions tests;
3. Emission factors;
4. Permit limits; or lastly,
5. Potential to emit.

Only emissions from BART-eligible emission units are included in the evaluation. Huntsman provided maximum 24-hour emission rate data to ENVIRON for use in the visibility modeling analysis. With the exception of cooling tower EY030CT, emission rates are derived from 1-hour permit allowable limits. Emissions for the cooling tower are estimated using the rated design circulation rate of 30,000 gallons per minute and the EPA *AP-42* emission factor of 0.019 lb PM_{10} per 1,000 gallons.[10]

Species included in the modeling analysis are listed in Table 2-3. For purposes of modeling the Huntsman Odessa Plant, it is conservatively assumed that all particulate matter is PM-fine ($PM_{2.5}$). Source Classification

[10] USEPA, *Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, AP 42, Fifth Edition*, Section 13.4, Wet Cooling Towers, Table 13.4-1.

Codes (SCC) and output from the Sparse Matrix Operator Kernel Emissions (SMOKE) program are used to further refine the estimate of PM species into sulfate (SO_4), nitrate (NO_3), elemental carbon (EC), organic carbon (OC) and unspeciated fine particulates (PMF). CALPUFF computes concentrations of HNO_3; it is not emitted directly.

Table 2-3. Species Included in BART Screening Modeling Analysis

Species	Modeled	Directly Emitted	Dry Deposited
SO_2	Yes	Yes	Computed-gas
SO_4	Yes	Yes	Computed-particle
NO_X	Yes	Yes	Computed-gas
HNO_3	Yes	No	Computed-gas
NO_3	Yes	Yes	Computed-particle
EC	Yes	Yes	Computed-particle
OC (SOA)	Yes	Yes	Computed-particle
PM-fine ($PM_{2.5}$)	Yes	Yes	Computed-particle
PM-coarse ($PM_{10-2.5}$)	Yes	Yes	Computed-particle

Huntsman Odessa Plant modeled emission rates are presented in Table 2-4.

Table 2-4. Emission Rates Used in CALPUFF Modeling Analysis

Emission Point	Emission Rate (g/s)[1]								
	SO_2	SO_4	NO_X	HNO_3	NO_3	EC	OC	PMC	PMF
EY018ST	0.0164	0.0079	3.9563	0.0000	0.0011	0.0040	0.0736	0.0000	0.1113
EY055ST	0.0000	0.0006	0.0000	0.0000	0.0001	0.0003	0.0052	0.0000	0.0078
PP31465VN	0.0000	0.0015	0.0000	0.0000	0.0002	0.0008	0.0141	0.0000	0.0213
PP31466VN	0.0000	0.0061	0.0000	0.0000	0.0008	0.0030	0.0562	0.0000	0.0850
PP31470VN	0.0000	0.0002	0.0000	0.0000	0.0000	0.0001	0.0019	0.0000	0.0028
PP31478VN	0.0000	0.0002	0.0000	0.0000	0.0000	0.0001	0.0014	0.0000	0.0021
PP31842VN	0.0000	0.0021	0.0000	0.0000	0.0003	0.0010	0.0195	0.0000	0.0294
PP31860VN	0.0000	0.0002	0.0000	0.0000	0.0000	0.0001	0.0014	0.0000	0.0021
PP31865VN	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000	0.0004
PP31866VN	0.0000	0.0021	0.0000	0.0000	0.0003	0.0010	0.0195	0.0000	0.0294
PP3RCDST	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0005	0.0000	0.0007
EY030CT	0.0000	0.4249	0.0000	0.0000	0.0129	0.0384	0.3805	0.0000	3.4525

[1]SO_2 = gaseous sulfur dioxide SO_4 = particulate sulfate NO_X = gaseous nitrogen oxides
HNO_3 = gaseous nitric acid NO_3 = particulate nitrate EC = particulate elemental carbon
OC = particulate organic carbon PMC = coarse particulate matter PMF = fine particulate matter

Particle size parameters are entered in the CALPUFF input file for dry and wet deposition of particles. For the Huntsman Odessa Plant modeling analysis, default values for "aerosol" species (e.g., SO_4, NO_3, and $PM_{2.5}$) of 0.48 µm geometric mass mean diameter and 2.0 µm geometric standard deviation are used.

2.3.6 Dispersion Model (CALPUFF)

CALMET output is used as input to the CALPUFF model. CALMET simulates the effects of meteorological conditions on the transport and dispersion of pollutants from an individual source. In general, the default options are used in the CALPUFF analysis. A listing of CALPUFF control file inputs is presented in Attachment C.

2.3.6.1 Building Downwash

CENRAP guidance recognizes that downwash is important only at short distances (within 20 km) and recommends use of building downwash algorithms for consistency purposes only if the data are available. For the Huntsman Odessa Plant, downwash data is not readily available and, given the distance to the nearest Class I area (90 km), there is no technical reason to include the effects of building downwash. Therefore, building downwash affects are not included in this analysis.

2.3.6.3 Background Ozone Concentrations

Ozone (O_3) background concentrations were obtained from the Texas Commission on Environmental Quality (TCEQ) in the form of OZONE.DAT files. Hourly concentration data for 2001 - 2003 from ambient monitors located within Texas are used in this modeling analysis. Only non-urban ozone stations are used in the OZONE.DAT files. A listing of the ozone monitors included in this analysis is presented in Table 2-5.

Table 2-5. Ozone Monitoring Stations

Station	LCP X-Coordinate (km)	LCP Y-Coordinate (km)
Longview	215.529	-840.002
Northwest Houston	128.701	-1102.158
Kaufman	64.039	-821.801

2.3.6.4 Background Ammonia Concentrations

As specified by TCEQ guidance, background ammonia (NH_3) concentrations are assumed to be temporally and spatially invariant and are fixed at 3 ppb across the entire domain for all months.

2.3.6.5 Receptors

Receptors are locations where model results are calculated and provided in the CALPUFF output

files. Receptor locations are derived from the National Park Service (NPS) Class I area receptor database.[11] The receptors are kept at the one (1) km spacing provided by the NPS.

2.3.6.6 Model Output

CALPUFF modeling results are displayed in units of micrograms per cubic meter ($\mu g/m^3$). CALPUFF output files are post-processed using CALPOST to determine visibility impacts in deciviews.

2.3.7 Post-Processing (CALPOST)

Hourly concentration outputs from CALPUFF are processed using POSTUTIL and CALPOST to determine impacts on visibility. POSTUTIL takes the concentration file output from CALPUFF and recalculates the nitric acid and nitrate partition based on total available sulfate and ammonia. CALPOST uses the concentration file processed through POSTUTIL, along with relative humidity data, to perform visibility calculations. POSTUTIL and CALPOST control file inputs are listed in Attachments D and E, respectively.

Light extinction must be determined in order to calculate visibility. CALPOST has seven methods for computing light extinction. The Huntsman Odessa Plant analysis uses Method 6, which computes extinction from speciated particulate matter with monthly Class I area-specific relative humidity adjustment factors. Relative humidity correction factors [*f*(RH)s] are applied to sulfate and nitrate concentration outputs from CALPUFF. Relative humidity correction factors are obtained from EPA's "Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule."[12] The $PM_{2.5}$ concentrations are considered part of the dry light extinction equation and do not have a humidity adjustment factor. The light extinction equation is the sum of the wet sulfate and nitrate and dry components ($PM_{2.5}$ plus Rayleigh scattering) which is 10 inverse megameters (Mm^{-1}).

Perceived visibility in deciviews is derived from the light extinction coefficient. The visibility change related to background is calculated using the modeled and established natural visibility conditions. For the Huntsman Odessa Plant evaluation, daily visibility is expressed as a change in deciviews compared to natural visibility conditions. Natural visibility conditions are based on the annual average natural levels of aerosol components at each Class I area taken from the EPA's "Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule."[13]

To determine whether or not a source may significantly contribute to visibility impairment at a Class I area, in a cooperative agreement with the FLMs and EPA Region VI and VII, CENRAP guidance deviates from use of 98th percentile impacts. The CALMET datasets, as described in the TCEQ protocol, were processed without use of surface and upper air observations in the CALMET wind field interpolation. In some applications, this may lead to potentially less conservatism in the CALPUFF visibility results compared with the use of CALMET with observations. As a result CENRAP agreed to EPA's recommendation that the

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[11] http://www2.nature.nps.gov/air/maps/receptors/index.cfm.

[12] U.S. EPA (September 2003). *Regional Haze: Estimating Natural Visibility Conditions Under the Regional Haze Rule*. EPA-454/B-03-005.

[13] Ibid.

maximum visibility impact rather than the 98th percentile value should be used for screening analyses performed using the CENRAP-developed CALMET datasets. This approach is used in performing the Huntsman Odessa Plant screening analysis.

2.3.8 Model Code Recompilation

To ensure compatibility with the CENRAP-developed CALMET files, CALPUFF, POSTUTIL and CALPOST model codes were recompiled using the Lahey-Fujitsu FORTRAN Express v7.1 compiler after making changes to the respective parameter files as follows (new parameter value provided).[14]

- *CALPUFF (modified params.puf):*
  - MXNX = 306
  - MXNXG = 306
  - MXSS = 375 (not applicable to this screening analysis)
  - MXPUFF = 100500 (not applicable to this screening analysis)
- *POSTUTIL (modified params.utl):*
  - MXGX = 306
  - MXGY = 246
  - MXSS = 375 (not applicable to this screening analysis)
  - MXPS = 375 (not applicable to this screening analysis)
- *CALPOST (modified params.pst):*
  - MXGX = 306
  - MXGY = 246
  - MXSS = 375 (not applicable to this screening analysis)

Updated executables for each program were created using the Lahey-Fujitsu FORTRAN Express v7.1 compiler following changes to the parameter files. These updated executables were used in this CALPUFF analysis. The updated parameter files are included in the electronic archive submitted with this modeling analysis.

[14] CALPUFF, POSTUTIL, and CALPOST have been modified for use in other BART modeling investigations, including those conducted in a refined mode. The same executables have been used for all facilities. As a result, some parameter changes are not applicable to a screening analysis and are noted accordingly.

3. CALPUFF MODELING RESULTS

Shown in Table 3-1 are the maximum impacts for each of the three years simulated in the CALPUFF screening analysis at each Class I area in the CENRAP South Domain. These results are presented graphically in Figures 3-1 and 3-2. As shown, the maximum impacts on visibility for the three years simulated are below 0.5 dv at all Class I areas considered in the analysis. Therefore, it is determined that emissions from BART-eligible emission units at the Huntsman Odessa Plant do not have the potential to significantly contribute to visibility impairment at any Class I area. Consequently, the Huntsman Odessa Plant is exempt from the requirement to perform a BART analysis or install BART controls.

Table 3-1. CALPUFF Modeling Results

Class I area	Maximum Visibility Impacts (dv)		
	2001	**2002**	**2003**
Bandelier National Monument	0.009	0.014	0.003
Big Bend National Park	0.032	0.058	0.038
Bosque del Apache National Wildlife Refuge	0.007	0.012	0.004
Breton Wilderness Area	0.002	0.003	0.004
Caney Creek Wilderness Area	0.008	0.007	0.009
Carlsbad Caverns National Park	0.047	0.052	0.051
Great Sand Dunes Wilderness Area	0.004	0.011	0.004
Guadalupe Mountains National Park	0.031	0.047	0.027
Hercules-Glade Wilderness Area	0.004	0.011	0.007
La Garita Wilderness Area	0.005	0.005	0.001
Mesa Verde National Park	0.006	0.002	<0.000
Mingo Wilderness Area	0.003	0.009	0.010
Pecos Wilderness Area	0.011	0.012	0.005
Salt Creek Wilderness Area	0.067	0.019	0.028
San Pedro Parks Wilderness Area	0.007	0.012	0.003
Upper Buffalo Wilderness Area	0.006	0.008	0.008
Weminuche Wilderness Area	0.007	0.006	0.001
Wheeler Peak Wilderness Area	0.007	0.011	0.006
White Mountain Wilderness Area	0.011	0.020	0.011
Wichita Mountains National Wildlife Refuge	0.020	0.026	0.026

Figure 3-1. CALPUFF Modeling Results:
Class I Areas Bandelier through La Garita

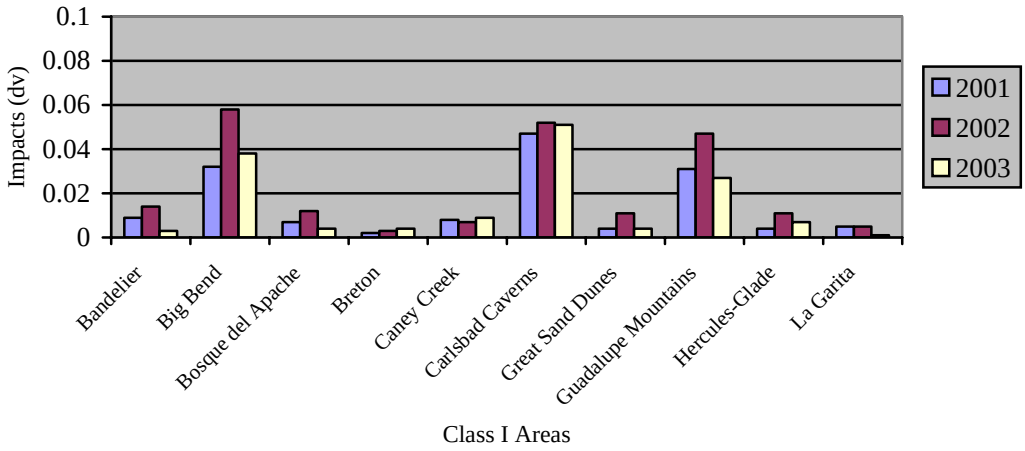
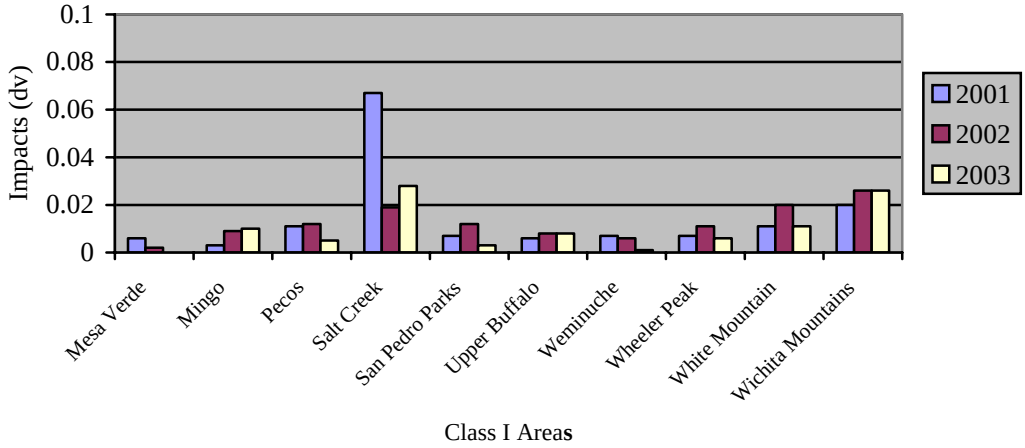


Figure 3-2. CALPUFF Modeling Results:
Class I Areas Mesa Verde through Wichita Mountains



An archive of modeling files is included as Attachment F. Within the attachment are disks with electronic copies of model input and output files used and created in the modeling analysis. Also included is a table explaining the file naming convention.

ATTACHMENT A

TCEQ BART Modeling Protocol

January 2007

Best Available Retrofit Technology (BART) Modeling Protocol to Determine Sources Subject to BART in the State of Texas

Air Permits Division
Texas Commission on Environmental Quality

Print on
Recycled paper

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Summary of Significant Changes

General - Removed "draft" wording and made other minor editorial changes throughout the document.

Section V.B - Changed the version of CALPUFF to the EPA approved version.

Section V.B - Changed the version of POSTUTIL to the EPA approved version.

Section V.B - Changed the version of CALPOST to the EPA approved version.

Section V.C - Added information about re-compiling the code when using the CENRAP-developed CALMET dataset.

Section V.E - Clarified that sources performing the source-specific subject-to-BART screening analysis should consider all visibility impairing species.

Section VIII - Added information for including files associated with re-compiling the code with the electronic archive.

I. Introduction

On July 6, 2005, the U.S. Environmental Protection Agency (EPA) published final amendments to its 1999 Regional Haze Rule in the Federal Register, including Appendix Y, the final guidance for Best Available Retrofit Technology (BART) determinations (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. Air quality modeling is a means for determining which sources cause or contribute to visibility impairment. Texas' proposed protocol for conducting this modeling for BART is provided herein.

The Texas Commission on Environmental Quality (TCEQ) foresees two purposes for this protocol. First, sources may use the protocol to determine if BART-eligible units are subject to BART and must perform a BART analysis. Second, sources that are subject to BART will have this protocol to use as a starting point to conduct modeling required when making a BART analysis.

New BART guidance, both formal and informal, continues to become available from EPA and the Federal Land Managers (FLMs) that oversee visibility in Class I areas. Texas has developed a schedule for completing BART analyses and implementing the BART strategy in order to meet State Implementation Plan (SIP) deadlines. If the state is to meet those deadlines, modeling to determine sources subject to BART and modeling to make BART analyses may need to be done before all final BART guidance from EPA and the FLMs becomes available.

II. Background

Generally, Class I areas are national parks and wilderness areas in which visibility is more stringently protected under the Clean Air Act than any other areas in the United States. The Class I areas are shown in Appendix A.

The BART requirements are a part of the SIP that will be submitted to EPA in late 2007. The SIP is a comprehensive plan of action to increase visibility in the Class I areas and includes reasonable progress goals in addition to the goals established by sources subject to BART.

The BART provisions are a part of the overall plan that focuses on reducing emissions from large sources that, due to age, were exempted from other control requirements in the Clean Air Act. An emissions source is considered eligible for BART if it:

- Falls into one of 26 listed categories;
- Has the potential to emit at least 250 tons per year of any visibility-impairing pollutant (primarily NO_x, SO_2, or PM); and
- Existed on August 7, 1977, yet was not in operation before August 7, 1962.

Thus, the BART provisions do not cover all sources that may cause or contribute to visibility impairment in any Class I area.

According to the BART guidance, an individual source is considered to cause visibility impairment if it has a least a 1.0 deciview (dv) impact on the visibility in a Class I area. A source is considered to contribute to visibility impairment if it has at least a 0.5 dv impact.

The BART guidance allows a state to exempt individual sources from the BART requirements if they do not cause or contribute to any impairment of visibility in a Class I area. Exemption is done through air quality modeling. Although the BART guidance does not dictate how such an analysis must be done, it provides direction, which was used to develop this modeling protocol.

The BART analysis process includes several other steps in addition to the modeling described in this protocol. These steps, none of which are addressed in this document, include detailed analysis of:

- Costs of compliance;
- Energy and non-air quality impacts;
- Existing pollution control technologies in use at the BART-eligible unit;
- Remaining useful life of the units and/or facility; and
- Improvements in visibility expected from the use of BART controls.

III. BART Air Quality Modeling Approach

One of the air quality modeling approaches suggested by 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 (described above).

The modeling approach discussed here is specifically designed for conducting a source-specific subject-to-BART screening analysis. There may be differences between modeling for conducting BART analyses and that for conducting a visibility analysis for a New Source Review permit, which may involve similar emission sources and the same air dispersion model used here.

In preparing this modeling protocol, the TCEQ consulted BART modeling protocols drafted by other organizations to maintain an appropriately consistent approach within the Central States Regional Air Planning Association (CENRAP). The three available BART modeling protocols consulted were:

1. "Best Available Retrofit Technology (BART) Modeling Protocol to Determine Sources Subject to BART in the State of Minnesota," final version March 2006;
2. "Best Available Retrofit Technology (BART) Modeling Protocol to Determine Sources Subject to BART in the State of Kansas," final version June 2006;
3. "Screening Analysis of Potentially BART-Eligible Sources in Texas," developed by ENVIRON International Corporation, December 2005.

This protocol is most similar to the Kansas and Minnesota final protocols. Texas is in EPA Region VI, and they will be reviewing Texas' Regional Haze SIP, of which BART will be a part.

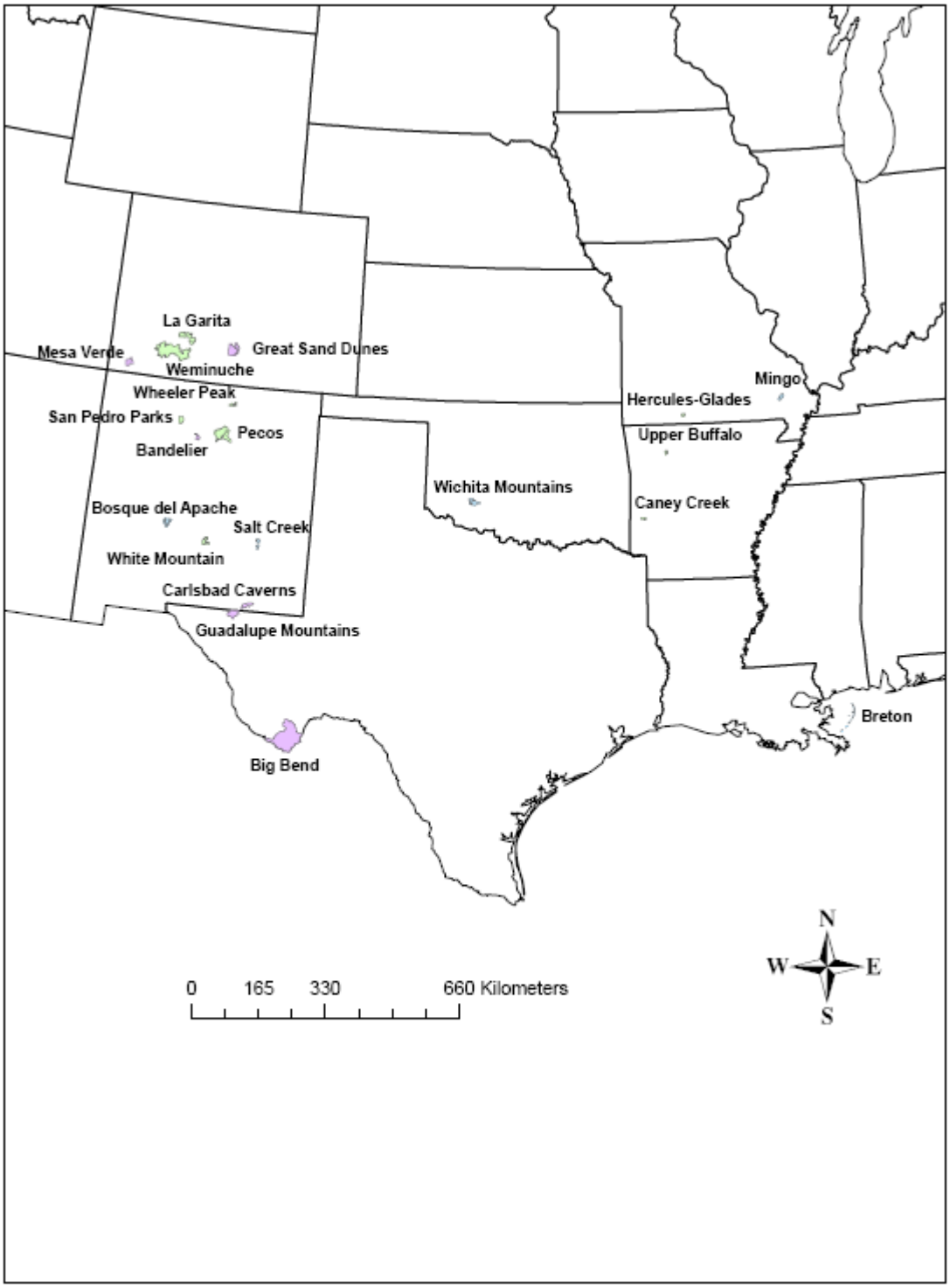
IV. Class I Areas to Assess

Table 1, *Class I Areas Evaluated for BART*, contains the list of Class I areas to be included in the modeling analysis. The list was developed for the subject-to-BART screening evaluation conducted by ENVIRON for the TCEQ. Figure 1, *Location of Class I Areas*, shows the location of each Class I area to be evaluated. Sources conducting the source-specific subject-to-BART screening analysis should include all Class I areas that the ENVIRON screening evaluation showed their source group to have impacts greater than 0.5 dv on visibility.

Table 1 - Class I Areas Evaluated for BART

Class I Area	State	Visibility Monitoring Site Name
Bandelier Wilderness Area	NM	BAND1
Big Bend National Park	TX	BIBE1
Bosque del Apache Wilderness Area	NM	BOAP1
Breton Wilderness Area	LA	BRET1
Caney Creek Wilderness Area	AR	CACR1
Carlsbad Caverns National Park	NM	GUMO1
Great Sand Dunes Wilderness Area	CO	GRSA1
Guadalupe Mountains National Park	TX	GUMO1
Hercules-Glades Wilderness Area	MO	HEGL1
La Garita Wilderness Area	CO	WEMI1
Mesa Verde National Park	CO	MEVE1
Mingo Wilderness Area	MO	MING1
Pecos Wilderness Area	NM	WHPE1
Salt Creek Wildlife Refuges	NM	SACR1
San Pedro Parks Wilderness Area	NM	SAPE1
Upper Buffalo Wilderness Area	AR	UPBU1
Weminuche Wilderness Area	CO	WEMI1
Wheeler Peak Wilderness Area	NM	WHPE1
White Mountain Wilderness Area	NM	WHIT1
Wichita Mountains Wildlife Refuges	OK	WIMO1

Figure 1 - Location of Class I Areas



V. Air Quality Model and Inputs

According to the final Regional Haze Rule's BART guidance, a source "can use CALPUFF or other appropriate model to predict the visibility impacts from a single source at a Class I area." For purposes of the source-specific subject-to-BART screening analysis, the TCEQ recommends the use of CALPUFF. The TCEQ recognizes that CALPUFF has limited ability to simulate the complex atmospheric chemistry involved in the estimation of secondary particulate formation. However, for purposes of this source-specific subject-to-BART screening analysis, the TCEQ recommends the use of CALPUFF for the following reasons:

1. The increased level of effort required for conducting particulate apportionment in the regional scale, full-chemistry Eulerian model (CAMx or CMAQ) to acquire individual source contributions to Class I areas, relative to the simplicity of the CALPUFF model;
2. The limited scope of what this modeling is to determine; and
3. The additional modeling of BART controls that will be conducted as part of the Regional Haze SIP with the CAMx or CMAQ models.

EPA's BART guidance recommends following the EPA's Interagency Workgroup on Air Quality Modeling (IWAQM) guidance, Phase 2 recommendations for long-range transport. The IWAQM guidance was developed to address air quality impacts as assessed through the Prevention of Significant Deterioration (PSD) program at Class I areas, where the source generally is located beyond 50 kilometer (km) of the Class I area. The IWAQM guidance does not specifically address the type of assessment that will occur with the BART analysis.

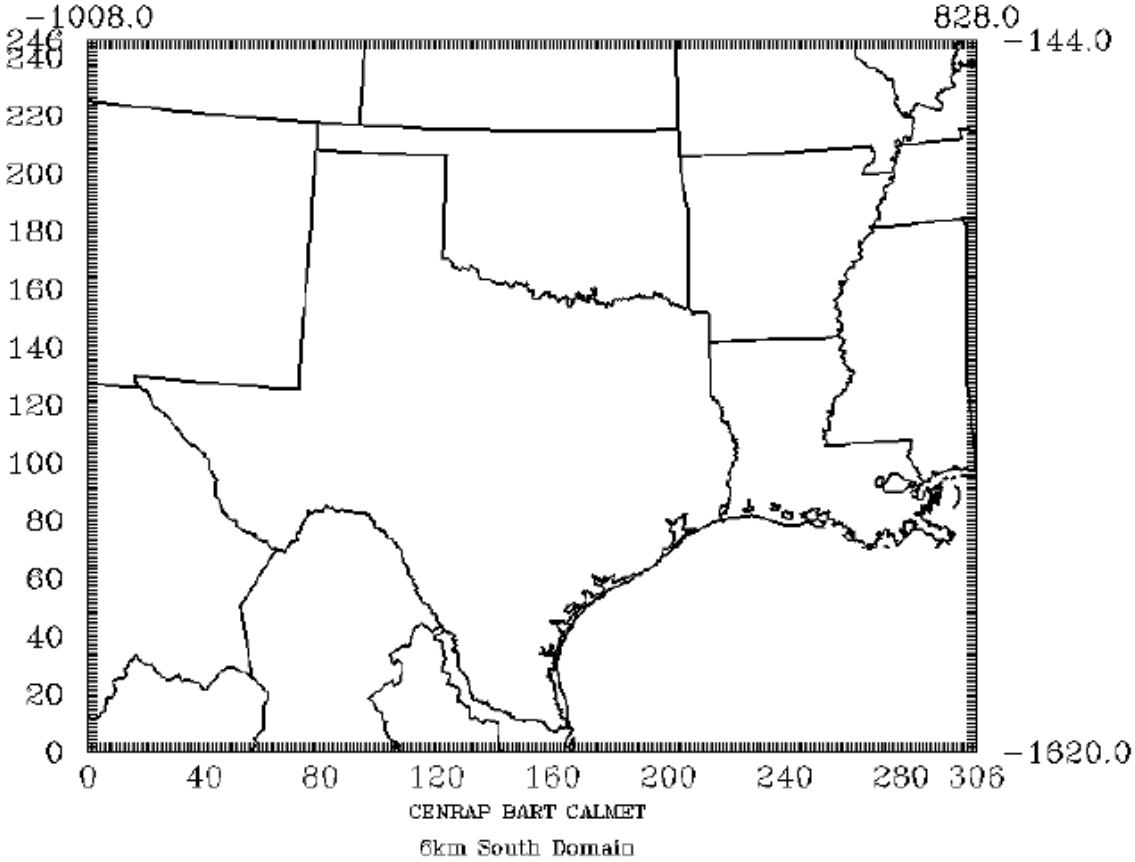
Given the uncertainties of transport and dispersion processes in CALPUFF for distances greater than 300 km, consideration may be given to the CAMx model for determining visibility impacts at Class I areas located 300 km beyond the source in a refined modeling analysis. Below is a list of options for selecting a model to use. The first two apply to the source-specific subject-to-BART screening analysis, and the third is an option for a refined modeling analysis:

1. CALPUFF for Class I areas located within 300 km of the source;
2. CALPUFF for Class I areas located beyond 300 km of the source for a conservative screening analysis; and
3. CAMx for Class I areas located beyond 300 km of the source in a refined analysis.

A. Modeling Domain

The CALPUFF source-specific subject-to-BART screening modeling should be conducted with the CENRAP south 6 km grid. The extent of the proposed CALPUFF domain is shown in Figure 2, *6 km CENRAP South CALPUFF Domain*.

Figure 2 - 6 km CENRAP South CALPUFF Domain



CALPUFF should be applied for three annual simulations spanning the years 2001 through 2003. The IWAQM guidance allows the use of fewer than five years of meteorological data if a meteorological model using four-dimensional data assimilation is used to supply data. See the section on meteorology for more information.

B. CALPUFF System Implementation

There are three main components to the CALPUFF model:

1. Meteorological Data Modeling (CALMET);
2. Dispersion Modeling (CALPUFF); and
3. Post processing (CALPOST).

Versions of the modeling components that may be used in the source-specific subject-to-BART screening analysis are shown in Table 2, *CALPUFF Modeling Components*.

Table 2 - CALPUFF Modeling Components

Processor	Version	Level
TERREL	3.311	030709
CTGCOMP	2.42	030709
CTGPROC	2.42	030709
MAKEGEO	2.22	030709
CALMM5	2.4	050413
CALMET	5.53a	040716
CALPUFF	5.711a	040716
POSTUTIL	1.3	030402
CALPOST	5.51	030709

C. Meteorological data modeling (CALMET)

The 2001-2003 CENRAP-developed CALMET dataset should be used in the source-specific subject-to-BART screening analysis. For additional information on the settings used to develop this dataset, refer to the CENRAP BART Modeling Guidelines document at www.cenrap.org/modeling_document.asp.

Since no observational data were used in the CALMET outputs developed by CENRAP, the prognostic meteorological dataset from MM5 is not supplemented with surface or upper air observations during the CALMET processing. The use of observations is thought to counterbalance smoothing that may occur when using the coarse grid scale of the MM5 data. Both the EPA and FLMs commented on the draft CENRAP guidelines that observations should be used in refined CALPUFF modeling. However, the TCEQ considers this screening modeling to be conservative. Therefore, the TCEQ will not require the use of observational data. Sources may use observational data if they wish to conduct a more refined modeling analysis.

In order to use the CENRAP-developed CALMET dataset, the parameter files for CALPUFF, POSTUTIL, and CALPOST may have to be edited to accommodate the size of the CENRAP-developed CALMET dataset modeling domain. Once the parameter files have been edited, the CALPUFF, POSTUTIL, and CALPOST model code will need to be re-compiled.

D. Stack parameters

Stack parameters required for modeling BART-eligible units are: height of the stack opening from ground, inside stack diameter, exit gas flow rate, exit gas temperature, base elevation above sea level, and location coordinates of the stack. Because the modeling conducted for BART is concerned with long-range transport, not localized impacts, including the effects of building downwash in the source-specific subject-to-BART screening analysis are not necessary. Sources may include the effects of building downwash if they wish to conduct a more refined modeling analysis.

E. Emissions

Emission rates for the BART analyses follow EPA's BART guidance. Specifically, the 24-hour average actual emission rate with normal operations from the highest emitting day of the year should be modeled. Identification of the maximum 24-hour actual emission rates should be made for the most recent four years (2002-2005), according to the following prioritization:

1. Continuous Emissions Monitoring (CEM) data;
2. Facility emissions tests;
3. Emissions factors;
4. Permit limits; or lastly,
5. Potential to emit.

The species that should be modeled and/or emitted in the source-specific subject-to-BART screening analysis are listed in Table 3, *Species Modeled in BART Screening Analysis*. Sources should include all species if the ENVIRON screening evaluation showed any of their source groups to have impacts greater than 0.5 dv on visibility.

Table 3 - Species Modeled in BART Screening Analysis

Species	Modeled	Emitted	Dry Deposited
SO_2	Yes	Yes	Computed-gas
SO_4	Yes	No	Computed-particle
NO_x	Yes	Yes	Computed-gas
HNO_3	Yes	No	Computed-gas
NO_3	Yes	No	Computed-particle
PM-fine	Yes	Yes	Computed-particle
PM-coarse	Yes	Yes	Computed-particle

Note: *In the case of a source where the PM profile for sulfate (SO_4), elemental carbon (EC), and secondary organic aerosols (SOA) are known, SO_4 should be modeled as a separate species in CALPUFF.*

Particle size parameters are entered in the CALPUFF input file for dry deposition of particles. There are default values for "aerosol" species (i.e., SO_4, NO_3, and $PM_{2.5}$). The default value for each of these species is 0.48 µm geometric mass mean diameter and 2.0 µm geometric standard deviation. Where the source is able to supply emissions of $PM_{2.5}$, the default values may be appropriate. However, many sources may not be able to supply $PM_{2.5}$ emissions and will supply what is available, PM_{10} emissions data. In this case, using the default values may underestimate deposition of particulates and overestimate the particulate contribution to visibility. For sources that are not able to supply $PM_{2.5}$ emissions, the source should speciate PM_{10} emissions to $PM_{2.5}$ and PM course by using $PM_{2.5}$/ PM_{10} emission factors, if they are available. If there are no emission factors available, either use the worst-case assumption that all particulate is $PM_{2.5}$ or the source could provide a suggested emissions factor with full scientific documentation.

F. Dispersion modeling (CALPUFF)

The CALMET output is used as input to the CALPUFF model, which simulates the effects of the meteorological conditions on the transport and dispersion of pollutants from an individual source. In general, the default options are used in the CALPUFF model. The CALPUFF model has a puff-splitting option that splits puffs that become large over greater transport distances. The TCEQ recommends that the puff-splitting option not be used in the source-specific subject-to-BART screening analysis.

Detailed information on all CALPUFF settings to be used in the source-specific subject-to-BART screening analysis can be found in Appendix B.

Ozone and ammonia concentrations: Ozone (O_3) and ammonia (NH_3) can be input to CALPUFF as hourly or monthly background values. Background ozone and ammonia concentrations are assumed to be temporally and spatially invariant and will be fixed at 40 and 3 ppb, respectively, across the entire domain for all months. NH_3 concentrations may be derived from regional modeling outputs that CENRAP is currently developing. However, at this time these NH_3 values are not available in a model ready form.

Receptors: Receptors are locations where model results are calculated and provided in the CALPUFF output files. Receptor locations should be derived from the National Park Service (NPS) Class I area receptor database at www2.nature.nps.gov/air/maps/receptors/index.cfm. The discrete receptors are necessary for calculating visibility impacts in the selected Class I areas. The NPS provides receptors in all the Class I areas on a 1 km basis. These receptors should be kept at the 1 km spacing for the BART modeling.

Outputs: The CALPUFF modeling results will be displayed in units of micrograms per cubic meter ($\mu g/m^3$). In order to determine visibility impacts, the CALPUFF outputs must be post-processed.

G. Post-processing (CALPOST)

Hourly concentration outputs from CALPUFF are processed through POSTUTIL and CALPOST to determine visibility conditions. Specifically, POSTUTIL takes the concentration file output from CALPUFF and recalculates the nitric acid and nitrate partition based on total available sulfate and ammonia. CALPOST uses the concentration file processed through POSTUTIL, along with relative humidity data, to perform visibility calculations. For the source-specific subject-to-BART screening analysis, the only modeling results out of the CALPUFF modeling system of interest are the visibility impacts. Please see Appendix C and D for detailed settings for POSTUTIL and CALPOST.

Light extinction: Light extinction must be computed in order to calculate visibility. CALPOST has seven methods for computing light extinction. The BART screening analysis should use Method 6, which computes extinction from speciated particulate matter with monthly Class I area-specific relative humidity adjustment factors. Relative humidity is an important factor in determining light extinction (and therefore visibility) because sulfate and nitrate aerosols, which absorb moisture from the air, have greater extinction efficiencies with greater relative humidity. The BART screening analysis should apply relative humidity correction factors (*f*(RH)s) to sulfate and nitrate concentration outputs from CALPUFF, which can be obtained from EPA's "Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule (EPA, 2003). The *f*(RH) values for the Class I areas that should be assessed are provided in Table 4, *Monthly Averaged f(RH) Based on Centroid of the Class I Area*.

Table 4 - Monthly Averaged *f*(RH) Based on Centroid of the Class I Area

Class I Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bandelier	2.2	2.1	1.8	1.6	1.6	1.4	1.7	2.1	1.9	1.7	2.0	2.2
Big Bend	2.0	1.9	1.6	1.5	1.6	1.6	1.7	2.0	2.1	1.9	1.8	1.9
Bosque del Apache	2.1	1.9	1.6	1.4	1.4	1.3	1.8	2.0	1.9	1.6	1.8	2.2
Breton	3.7	3.5	3.7	3.6	3.8	4.0	4.3	4.3	4.2	3.7	3.7	3.7
Caney Creek	3.4	3.1	2.9	3.0	3.6	3.6	3.4	3.4	3.6	3.5	3.4	3.5
Carlsbad Caverns	2.1	2.0	1.6	1.5	1.6	1.6	1.8	2.1	2.2	1.8	1.9	2.1
Great Sand Dunes	2.4	2.3	2.0	1.9	1.9	1.8	1.9	2.3	2.2	1.9	2.4	2.4
Guadalupe Mountains	2.0	2.0	1.6	1.5	1.6	1.5	1.9	2.2	2.2	1.8	1.9	2.2
Hercules-Glades	3.2	2.9	2.7	2.7	3.3	3.3	3.3	3.3	3.4	3.1	3.1	3.3
La Garita	2.3	2.2	1.9	1.8	1.8	1.6	1.7	2.1	2.0	1.8	2.2	2.3
Mesa Verde	2.5	2.3	1.9	1.5	1.5	1.3	1.6	2.0	1.9	1.7	2.1	2.3
Mingo	3.3	3.0	2.8	2.6	3.0	3.2	3.3	3.5	3.5	3.1	3.1	3.3
Pecos	2.3	2.1	1.8	1.7	1.7	1.5	1.8	2.1	2.0	1.7	2.0	2.2
Salt Creek	2.1	1.9	1.5	1.5	1.7	1.6	1.8	2.0	2.1	1.8	1.8	2.1
San Pedro Parks	2.3	2.1	1.8	1.6	1.6	1.4	1.7	2.0	1.9	1.7	2.1	2.2
Upper Buffalo	3.3	3.0	2.7	2.8	3.4	3.4	3.4	3.4	3.6	3.3	3.2	3.3
Weminuche	2.4	2.2	1.9	1.7	1.7	1.5	1.6	2.0	1.9	1.7	2.1	2.3
Wheeler Park	2.3	2.2	1.9	1.8	1.8	1.6	1.8	2.2	2.1	1.8	2.2	2.3
White Mountain	2.1	1.9	1.6	1.5	1.5	1.4	1.8	2.0	2.0	1.7	1.8	2.1
Wichita Mountains	2.7	2.6	2.4	2.4	3.0	2.7	2.3	2.5	2.9	2.6	2.7	2.8

The $PM_{2.5}$ concentrations are considered part of the dry light extinction equation and do not have a humidity adjustment factor. The light extinction equation is the sum of the wet sulfate and nitrate and dry components $PM_{2.5}$ plus Rayleigh scattering, which is 10 inverse megameters (Mm^{-1}).

VI. Visibility Impacts

Perceived visibility in deciviews is derived from the light extinction coefficient. The visibility change related to background is calculated using the modeled and established natural visibility conditions. For the BART screening analysis, daily visibility will be expressed as a change in deciviews compared to natural visibility conditions.

The annual average natural levels of aerosol components at each Class I area are shown in Table 5, *Average Annual Natural Levels of Aerosol Components ($\mu g/m^3$)*. Natural conditions

by component in this table are based on whether the Class I area is in the eastern or the western part of the United States. These data are in EPA's "Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule" (EPA, 2003).

Table 5 - Average Annual Natural Levels of Aerosol Components ($\mu g/m^3$)

Class I Area	Region	SO_4	NO_3	OC	EC	Soil	Coarse Mass
Bandelier	WEST	0.12	0.10	0.47	0.02	0.50	3.00
Big Bend	WEST	0.12	0.10	0.47	0.02	0.50	3.00
Bosque del Apache	WEST	0.12	0.10	0.47	0.02	0.50	3.00
Breton	EAST	0.23	0.10	1.40	0.02	0.50	3.00
Caney Creek	EAST	0.23	0.10	1.40	0.02	0.50	3.00
Carlsbad Caverns	WEST	0.12	0.10	0.47	0.02	0.50	3.00
Great Sand Dunes	WEST	0.12	0.10	0.47	0.02	0.50	3.00
Guadalupe Mountains	WEST	0.12	0.10	0.47	0.02	0.50	3.00
Hercules-Glades	EAST	0.23	0.10	1.40	0.02	0.50	3.00
La Garita	WEST	0.12	0.10	0.47	0.02	0.50	3.00
Mesa Verde	WEST	0.12	0.10	0.47	0.02	0.50	3.00
Mingo	EAST	0.23	0.10	1.40	0.02	0.50	3.00
Pecos	WEST	0.12	0.10	0.47	0.02	0.50	3.00
Salt Creek	WEST	0.12	0.10	0.47	0.02	0.50	3.00
San Pedro Parks	WEST	0.12	0.10	0.47	0.02	0.50	3.00
Upper Buffalo	EAST	0.23	0.10	1.40	0.02	0.50	3.00
Weminuche	WEST	0.12	0.10	0.47	0.02	0.50	3.00
Wheeler Peak	WEST	0.12	0.10	0.47	0.02	0.50	3.00
White Mountain	WEST	0.12	0.10	0.47	0.02	0.50	3.00
Wichita Mountains	WEST	0.12	0.10	0.47	0.02	0.50	3.00

In a cooperative agreement with EPA Regions VI and VII and FLMs, CENRAP guidance deviates from use of the 98th percentile impact. The CALMET datasets as described in this protocol were processed with the "No-Obs" options (i.e., surface and upper air observations were not used in the CALMET wind field interpolation). Aware that exercising CALMET with No-Obs may lead in some applications to potentially less conservatism in the CALPUFF visibility results compared with the use of CALMET with observations, CENRAP has agreed to EPA's recommendation that the maximum visibility impact, rather than the 98th percentile value, should be used for screening analyses using the CENRAP-developed CALMET datasets. This approach should be used in the source-specific subject-to-BART screening analysis.

Sources with modeled maximum impacts below the 0.5 dv threshold are exempt from the remainder of the BART process. Sources with impacts at or above 0.5 dv can either perform refined CALPUFF modeling to show their visibility impact is in fact below the 0.5 dv threshold or continue with the BART process and perform a BART analysis. This analysis will likely include more refined CALPUFF modeling, using observations coupled with the 98th percent impact, finer grid resolution, puff splitting, focused domain, etc.

VII. Change in Visibility Due to BART Controls

Once sources perform their BART analysis and BART emission limits are established, additional CALPUFF modeling should be conducted in order to establish visibility improvement at Class I areas with BART applied. The post-control CALPUFF simulation should be compared to the pre-control CALPUFF simulation by calculating the change in visibility over natural conditions between the pre-control and post-control simulations.

VIII. Reporting

Sources performing refined modeling will be required to submit a modeling protocol to the TCEQ for approval. Protocols must also be made available concurrently to EPA and FLMs for their review. Sources using TCEQ's source-specific subject-to-BART screening modeling protocol will not be required to provide a modeling protocol to the TCEQ. However, sources using the TCEQ's source-specific subject-to-BART screening modeling protocol must provide a modeling protocol to the EPA and FLMs for their review.

The report accompanying the source-specific subject-to-BART screening analysis should provide a clear description of the modeling procedures and the results of the analysis. An electronic archive that includes the full set of CALPUFF inputs and model output fields should also be included with the report. If the model code is re-compiled, the electronic archive should include all of the edited parameter files and a summary of the steps taken to re-compile the code, including the compiler used.

References

Minnesota Pollution Control Agency (March 2006). *Best Available Retrofit Technology (BART) Modeling Protocol to Determine Sources Subject to BART in the State of Minnesota*.

Kansas Department of Health and Environment (June 2006). *Best Available Retrofit Technology (BART) Modeling Protocol to Determine Sources Subject to BART in the State of Minnesota*.

Iowa Department of Natural Resources (May 2006). *Variegated Protocol in Support of Best Available Retrofit Technology Determinations*.

Scire, J.S., D.G. Strimaitis, and R.J. Yamartino. (January 2000). *A User's Guide for the CALPUFF Dispersion Model (Version 5).* Earth Tech, Inc., Concord, Massachusetts.

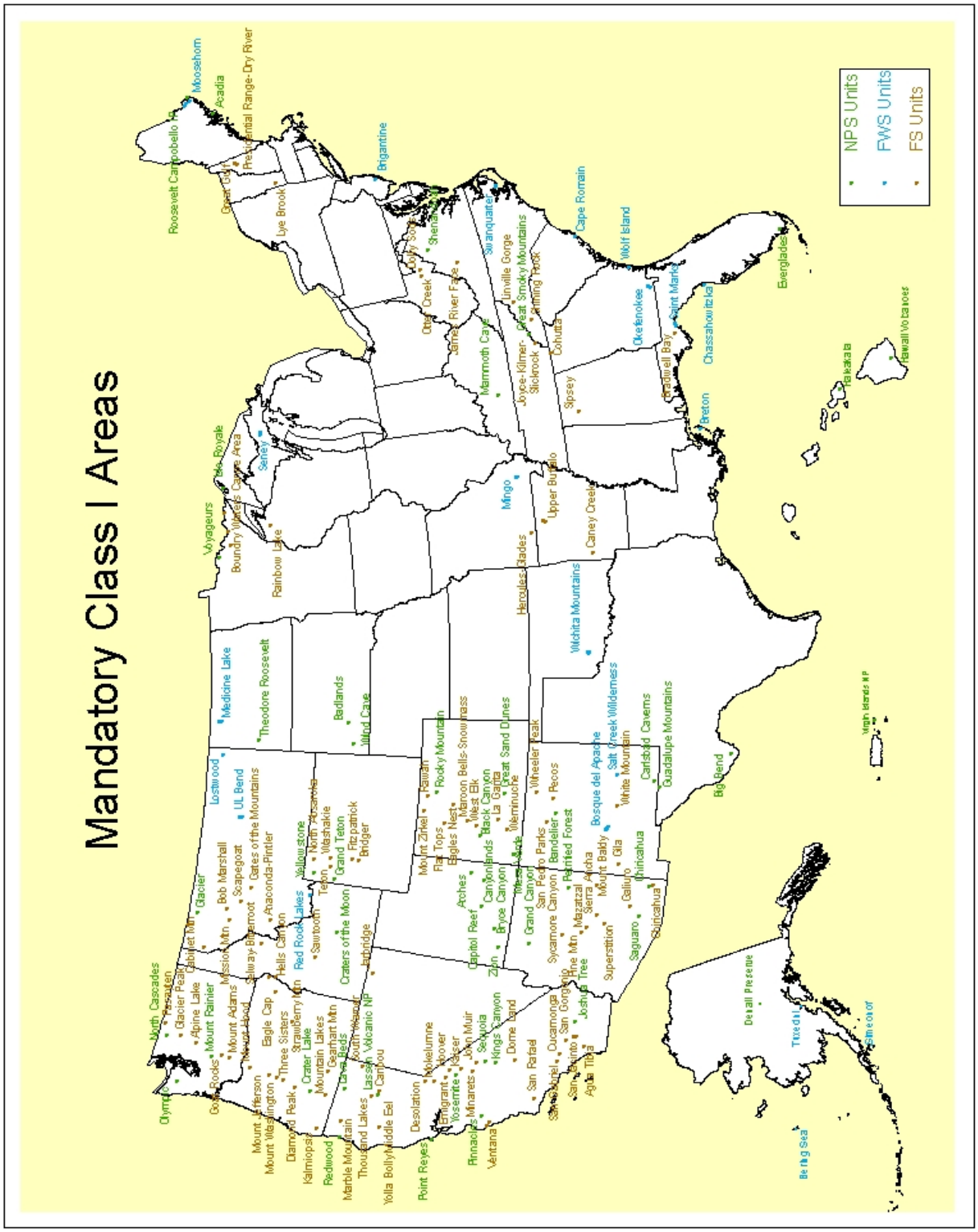
Scire, J.S., D.G. Strimaitis, and R.J. Yamartino. (January 2000). *A User's Guide for the CALMET Dispersion Model (Version 5).* Earth Tech, Inc., Concord, Massachusetts.

U.S. EPA. (December 1998). *Interagency Workgroup on Air Quality Modeling (IWAQM) Phase2—Summary Report and Recommendations for Modeling Long Range Transport Impacts.* EPA-454/R98-019.

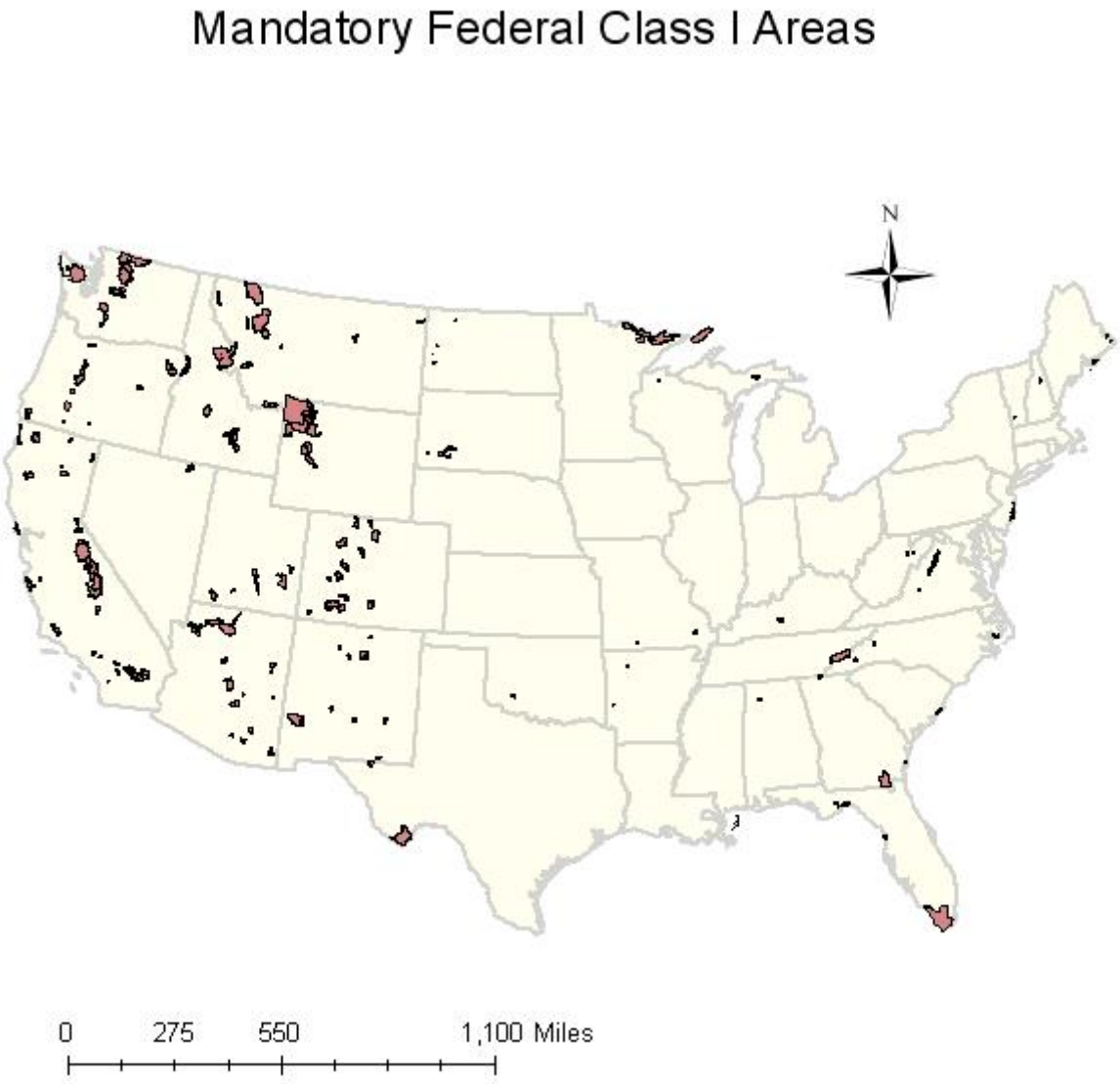
U.S. EPA (September 2003). *Regional Haze: Estimating Natural Visibility Conditions Under the Regional Haze Rule*. EPA-454/B-03-005.

U.S. EPA. (July 2005). *Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations.* Federal Register Vol. 70, No. 128.

Appendix A – Federal Class I Areas
Map showing locations and names of areas



Appendix A – Federal Class I Areas
Map showing extent of areas



Appendix B – CALPUFF Control File Inputs

Variable	Description	Value	Default	Comments
INPUT GROUP 1: General run control parameters				
METRUN	Control parameter for running all periods in met. File (0=no; 1=yes)	0	Y	
IBYR	Starting year of the CALPUFF run	2002	n/a	2001 and 2003 are the other years modeled
IBMO	Starting month	1	n/a	
IBDY	Starting day	1	n/a	
IBHR	Starting hour	1	n/a	
XBTZ	Base time zone	6.0	n/a	Central Standard Time
IRLG	Length of the run (hours)	8760	n/a	2001=8760hrs, 2003=8748hrs only 12 hrs on 12/31
NSPEC	Total number of species modeled	7	5	
NSE	Number of species emitted	4	3	
METFM	Meteorological data format	1	Y	CALMET unformatted file
AVET	Averaging time (minutes)	60.0	Y	
PGTIME	Averaging time (minutes) for PG - σ_y	60.0	Y	
INPUT GROUP 2: Technical options				
MGAUSS	Control variable determining the vertical distribution used in the near field	1	Y	Gaussian
MCTADJ	Terrain adjustment method	3	Y	Partial plume path adjustment
MCTSG	CALPUFF sub-grid scale complex terrain module (CTSG) flag	0	Y	CTSG not modeled
MSLUG	Near-field puffs are modeled as elongated “slugs”?	0	Y	No
MTRANS	Transitional plume rise modeled?	1	Y	Transitional plume rise computed
MTIP	Stack tip downwash modeled?	1	Y	Yes
MBDW	Method used to simulate building downwash?	1	Y	ISC method
MSHEAR	Vertical wind shear above stack top modeled in plume rise?	0	Y	No
MSPLIT	Puff splitting allowed?	0	Y	No
MCHEM	Chemical mechanism flag	1	Y	Transformation rates computed internally (MESOPUFF II scheme)
MAQCHEM	Aqueous phase transformation flag	0	Y	Aqueous phase not modeled
MWET	Wet removal modeled?	1	Y	Yes
MDRY	Dry deposition modeled?	1	Y	Yes
MDISP	Method used to compute dispersion coefficients	3	Y	PG dispersion coefficients in RURAL & MP coefficients in urban areas
MTURBVW	Sigma-v/sigma-theta, sigma-w measurements used?	3	Y	Use both sigma-(v/theta) and sigma-w from PROFILE.DAT Note: not provided

Variable	Description	Value	Default	Comments
MDISP2	Backup method used to compute dispersion when measured turbulence data are missing	3	Y	PG dispersion coefficients in RURAL & MP coefficients in urban areas
MROUGH	PG sigma-y,z adj. for roughness?	0	Y	No
MPARTL	Partial plume penetration of elevated inversion?	1	Y	Yes
MTINV	Strength of temperature inversion	0	Y	No
MPDF	PDF used for dispersion under convective conditions?	0	Y	No
MSGTIBL	Sub-Grid TIBL module used for shoreline?	0	Y	No
MBCON	Boundary conditions (concentration) modeled?	0	Y	No
MFOG	Configure for FOG model output	0	Y	No
MREG	TEST options specified to see if they conform to regulatory values?	1	Y	Checks made
INPUT GROUP 3: Species list				
CSPEC	Species modeled	SO2 SO4 NOX HNO3 NO3 PM25 PM10	n/a	Modeled: All Emitted: SO2, NOx, PM25, PM10 Dry deposited: SO2(gas), SO4(particle), NOx(gas), HNO3(gas), NO3(particle), PM25(particle), PM10(particle)
INPUT GROUP 4: Map projection and grid control parameters				
PMAP	Map projection	LCC	N	Lambert conformal conic
FEAST	False Easting	0.0	Y	
FNORT	False Northing	0.0	Y	
RLATO	Latitude	40N	n/a	
RLONG	Longitude	97W	n/a	
XLAT1 XLAT2	Matching parallel(s) of latitude for projection	33N 45N	n/a n/a	
DATUM	Datum region for the coordinates	WGS-G	N	WGS-84 GRS 80 spheroid, global coverage (WGS84)
NX NY NZ	<u>Meteorological grid</u>: No. X grid cells in meteorological grid No. Y grid cells in meteorological grid No. vertical layers in meteorological grid	306 246 10	n/a	
DGRIDKM	Grid spacing (km)	6	n/a	
ZFACE	Cell face heights (m)	0, 20, 40,80, 160, 320, 640, 1200,	n/a	

Variable	Description	Value	Default	Comments
		2000, 3000, 4000		
XORIGKM YORIGKM	Reference coordinates of SW corner of grid cell (1,1) (km)	-1008 -1620	n/a	
 IBCOMP JBCOMP IECOMP JECOMP	<u>Computational grid:</u> X index of LL corner Y index of LL corner X index of UR corner Y index of UR corner	 1 1 306 246	n/a	
LSAMP IBSAMP JBSAMP IESAMP JESAMP MESHDN	Logical flag indicating if gridded receptors are used X index of LL corner Y index of LL corner X index of UR corner Y index of UR corner Nesting factor of the sampling grid	F 1	- Y	Receptors are only in the Class I areas assessed
INPUT GROUP 5: Output options				
SPECIES	Species (or group) list for output options	1	n/a	Concentrations saved for SO2, SO4, NOx, HNO3, NO3, PM25, PM10
INPUT GROUP 6: Subgrid scale complex terrain (CTSG) inputs				
NHILL	Number of terrain features	0	Y	
NCTREC	Number of special complex terrain receptors	0	Y	
MHILL	Terrain and CTSG receptor data for CTSG hills input in CTDM format?	2	n/a	Hill data created by OPTHILL & input below in subgroup (6b); receptor data in subgroup (6c) note: no data provided
XHILL2M	Factor to convert horizontal dimensions to meters	1	Y	
ZHILL2M	Factor to convert vertical dimensions to meters	1	Y	
XCTDMKM	X-origin of CTDM system relative to CALPUFF coordinate system, in Km	0	n/a	
YCTDMKM	Y-origin of CTDM system relative to CALPUFF coordinate system, in Km	0	n/a	
INPUT GROUP 7: Chemical parameters for dry deposition of gases				
SPECIES DIFFUSVTY ALPHA STR REACTVTY MESO RES HENRYS C	Chemical parameters for dry deposition of gases	-	Y Y Y Y Y Y	SO2; NOx; HNO3 0.1509 0.1656 0.1628 1000 1 1 8 8 18 0 5 0 0.04 3.5 8.0*E-8
INPUT GROUP 8: Size parameters for dry deposition of particles				
SPECIES GEO. MASS MEAN DIA.	Single species: mean and standard deviation used to compute deposition velocity for	-	n/a	SO4 NO3 PM25 PM10 0.48 0.48 0.48 0.48

Variable	Description	Value	Default	Comments
GEO.STAND DEV.	NINT size-ranges; averaged to obtain mean deposition velocity. Grouped species: size distribution specified, standard deviation as "0". Model uses deposition velocity for stated mean diameter.			2 2 2 2
INPUT GROUP 9: Miscellaneous dry deposition parameters				
RCUTR	Reference cuticle resistance	30	Y	
RGR	Reference ground resistance	10	Y	
REACTR	Reference pollutant reactivity	8	Y	
NINT	Number of particle-size intervals to evaluate effective particle deposition velocity	9	Y	
IVEG	Vegetation state in unirrigated areas	1	Y	
INPUT GROUP 10: Wet deposition parameters				
POLL LIQ PRECIP FRZ PRECIP	Scavenging coefficients	-	Y Y Y	SO2 SO4 NOx HNO3 NO3 3E-5 1E-4 0 6E-5 1E-4 0 3E-5 0 0 3E-5
INPUT GROUP 11: Chemistry parameters				
MOZ	Ozone data input option	0	N	
BCKO3	Monthly ozone concentrations	-	N	12*40
BCKNH3	Monthly ammonia concentrations	-	N	12*3
RNITE1	Nighttime SO2 loss rate	0.2	Y	
RNITE2	Nighttime NOx loss rate	2.0	Y	
RNITE3	Nighttime HNO3 formation rate	2.0	Y	
MH2O2	H2O2 data input option	1	Y	
BCKH2O2	Monthly H2O2 concentrations	-	Y	MQACHEM = 0; not used
BCKPMF OFRAC VCNX	Secondary Organic Aerosol options	-	-	MCHEM = 1; thus, not used
INPUT GROUP 12: Misc. Dispersion and computational parameters				
SYTDEP	Horizontal size of puff beyond which time-dependent dispersion equations (Heffter) are used.	550	Y	
MHFTSZ	Switch for using Heffter equation for sigma z as above	0	Y	
JSUP	Stability class used to determine plume growth rates for puffs above boundary layer	5	Y	
CONK1	Vertical dispersion constant for stable conditions	0.01	Y	
CONK2	Vertical dispersion constant for neutral/unstable conditions	0.1	Y	
TBD	Factor determining transition-point from Schulman-Scire to Huber-Snyder building	0.5	Y	No building downwash used

Variable	Description	Value	Default	Comments
	downwash scheme			
IURB1 IURB2	Range of land use categories for which urban dispersion is assumed	10 19	Y Y	METFM=1; not used
ILANDUIN	Land use category for modeling domain	-	-	METFM=1; not used
ZOIN	Roughness length (m) for modeling domain	-	-	METFM=1; not used
XLAIIN	Leaf area index for modeling domain	-	-	METFM=1; not used
ELEVIN	Elevation above sea level	-	-	METFM=1; not used
XLATIN	Latitude (degrees) for met location	-	-	METFM=1; not used
XLONIN	Longitude (degrees) for met location	-	-	METFM=1; not used
ANEMHT	Anemometer height (m)	-	-	METFM=1; not used
ISIGMAV	Form of lateral turbulence data in PROFILE.DAT	1	Y	Read sigma-v
IMIXCTDM	Choice of mixing heights	-	-	METFM=1; not used
XMXLEN	Maximum length of a slug	1	Y	
XSAMLEN	Maximum travel distance of a puff/slug during one sampling step	1	Y	
MXNEW	Maximum number of slugs/puffs released from one source during one time step	99	Y	
MXSAM	Maximum number of sampling steps for one puff/slug during one time step	99	Y	
NCOUNT	Number of iterations used when computing the transport wind for a sampling step that includes gradual rise	2	Y	
SYMIN	Minimum sigma y for a new puff/slug	1	Y	
SZMIN	Minimum sigma z for a new puff/slug	1	Y	
SVMIN SWMIN	Default minimum turbulence velocities sigma-v and sigma-w for each stability class	-	Y	A B C D E F .5 .5 .5 .5 .5 .5 .2 .12 .08 .06 .03 .016
CDIV	Divergence criterion for dw/dz across puff used to initiate adjustment for horizontal convergence	0, 0	Y	
WSCALM	Minimum wind speed allowed for non-calm conditions. Used as minimum speed returned when using power-law extrapolation toward surface	0.5	Y	
XMAXZI	Maximum mixing height (m)	4000	N	Top interface in CALMET simulation
XMINZI	Minimum mixing height (m)	20	N	
WSCAT	Default wind speed classes	-	Y	1 2 3 4 5 1.54 3.09 5.14 8.23 10.80

Variable	Description	Value	Default	Comments
PLXO	Default wind speed profile power-law exponents for stabilities 1-6	-	Y ISC RURAL	A B C D E F .07 .07 .10 .15 .35 .55
PTGO	Default potential temperature gradient for stable classes E, F (deg K/m)	-	Y	0.020; 0.035
PPC	Default plume path coefficients for each stability class	-	Y	A B C D E F .5 .5 .5 .5 .35 .35
SL2PF	Slug-to-puff transitions criterion factor equal to sigma-y/length of slug	10	Y	
NSPLIT	Number of puffs that result every time a puff is split	3	Y	
IRESPLIT	Time of day when split puffs are eligible to be split once again; this is typically set once per day, around sunset before nocturnal shear develops	-	N	Hour 18 = 1
ZISPLIT	Split is allowed only if last hour's mixing height (m) exceeds a minimum value	100	Y	
ROLDMAX	Split is allowed only if ratio of last hour's mixing ht to the maximum mixing ht experienced by the puff is less than a maximum value	0.25	Y	
NSPLITH	Number of puffs that result every time a puff is split	5	Y	
SYSPLITH	Minimum sigma-y of puff before it may be split	1	Y	
SHSPLITH	Minimum puff elongation rate due to wind shear, before it may be split	2	Y	
CNSPLITH	Minimum concentration of each species in puff before it may be split	1E-7	Y	
EPSSLUG	Fractional convergence criterion for numerical SLUG sampling integration	1E-4	Y	
EPSAREA	Fractional convergence criterion for numerical AREA source integration	1E-6	Y	
DSRISE	Trajectory step-length (m) used for numerical rise integration	1	Y	
HTMINBC	Minimum height (m) to which BC puffs are mixed as they are emitted. Actual height is reset to the current mixing height at the release point if greater than this minimum	500	Y	
RSAMPBC	Search radius (in BC segment lengths) about a receptor for sampling nearest BC puff. BC puffs are emitted with a spacing	10	N	

Variable	Description	Value	Default	Comments
	of one segment length, so the search radius should be greater than 1			
MDEPBC	Near-surface depletion adjustment to concentration profile used when sampling BC puffs?	1	Y	Adjust concentration for depletion
INPUT GROUP 13: Point source parameters				
NPT1	Number of point sources with parameters	-	n/a	
IPTU	Units used for point source emissions	1	Y	
NSPT1	Number of source-species combinations with variable emissions scaling factors	0	Y	
NPT2	Number of point sources with variable emission parameters provided in external file	0	n/a	
INPUT GROUP 14: Area source parameters – Not used				
INPUT GROUP 15: Line source parameters – Not used				
INPUT GROUP 16: Volume source parameters – Not used				
INPUT GROUP 17: Non-gridded (discrete) receptor information				
NREC	Number of non-gridded receptors	0 3996	n/a	147 Bandelier 480 Big Bend 168 Bosque del Apache 40 Breton 80 Caney Creek 256 Carlsbad Caverns 195 Great Sand Dunes 127 Guadalupe Mountains 80 Hercules-Glades 187 La Garita 312 Mesa Verde 47 Mingo 321 Pecos 55 Salt Creek 247 San Pedro Parks 72 Upper Buffalo 744 Weminuche 109 Wheeler Peak 270 White Mountain 59 Wichita Mountains

Appendix C – POSTUTIL Control File Inputs

Variable	Description	Value	Default	Comments
INPUT GROUP 1: General run control parameters				
ISYR	Starting Year	2002	n/a	2001 and 2003 also modeled
ISMO	Starting month	1	n/a	
IDY	Starting day	1	n/a	
ISHR	Starting hour	1	n/a	
NPER	Number of periods to process	8760	n/a	2001=8760 hrs, 2003=8748hrs only 12 hrs on 12/31
NSPECINP	Number of species to process from CALPUFF runs	7	n/a	
NSPECOUT	Number of species to write to output file	7	n/a	
NSPECCMP	Number of species to compute from those modeled	0	n/a	
MDUPLCT	Stop run if duplicate species names found?	0	Y	
NSCALED	Number of CALPUFF data files that will be scaled	0	Y	
MNITRATE	Re-compute the HNO3/NO3 partition for concentrations?	1	N	Yes, for all sources combined
BCKNH3	Default ammonia concentrations used for HNO3/NO3 partition	-	N	12*3
INPUT GROUP 2: Species processing information				
ASPECI	NSPECINP species will be processed	-	n/a	SO2, SO4, NOx, HNO3, NO3, PM25, PM10
ASPECO	NSPECOUT species will be written	-	n/a	SO2, SO4, NOx, HNO3, NO3, PM25, PM10

Appendix D – CALPOST Control File Inputs

Variable	Description	Value	Default	Comments
INPUT GROUP 1: General run control parameters				
METRUN	Option to run all periods found in met files	0	Y	Run period explicitly defined
ISYR	Starting Year	2002	n/a	2001 and 2003 also modeled
ISMO	Starting month	1	n/a	
IDY	Starting day	1	n/a	
ISHR	Starting hour	1	n/a	
NHRS	Number of hours to process	8760	n/a	2001=8760hrs, 2003=8748hrs only 12 hrs on 12/31
NREP	Process every hour of data?	1	Y	Every hour processed
ASPEC	Species to process	VISIB	n/a	Visibility processing
ILAYER	Layer/deposition code	1	Y	CALPUFF concentrations
A, B	Scaling factors X(new) = X(old) *A + B	0, 0	Y	
LBACK	Add hourly background concentrations/fluxes?	F	Y	
MSOURCE	Option to process source contributions	0	Y	
LG LD	Gridded receptors processed? Discrete receptors processed?	F T	N/Y	Receptors located only in the Class I areas assessed
LCT	CTSG Complex terrain receptors processed?	F	Y	
LDRING	Report results by DISCRETE receptor RING?	F	Y	
NDRECP	Flag for all receptors after the last one assigned is set to "0"	-1	Y	
IBGRID JBGRID IEGRID JEGRID	Range of gridded receptors	-1 -1 -1 -1	Y	When LG = T Entire grid processed if all =-1
NGONOFF	Number of gridded receptor rows provided to identify specific gridded receptors to process	0	Y	
BTZONE	Base time zone for the CALPUFF simulation	6	n/a	
MFRH	Particle growth curve f(RH) for hygroscopic species	2	Y	FLAG (2000) f(RH) tabulation. Note: not used
RHMAX	Maximum relative humidity (%) used in particle growth curve	-	N	Not used
LVSO4 LVNO3 LVOC LVPMC LVPMF LVEC	Modeled species to be included in computing light extinction	T T F T T F	Y Y N Y Y N	
LVBK	Include BACKGROUND when ranking for TOP-N, TOP-50, and exceedence tables?	T	Y	
SPECPMC	Species name used for particulates in	PM10	N	

Variable	Description	Value	Default	Comments
SPECPMF	MODEL.DAT file	PM25	N	
EEPMC EEPMF	Modeled particulate species	0.6 1.0	Y Y	
EEPMCBK	Background particulate species	0.6	Y	
EESO4 EENO3 EEOC EESOIL EEEC	Other species	3.0 3.0 4.0 1.0 10	Y Y Y Y Y	
LAVER	Background extinction computation	F	Y	
MVISBK	Method used for background light extinction	6	N	Compute extinction from speciated PM measurements. FLAG RH adjustment factor applied to observed and modeled sulfate and nitrate
RHFAC	Extinction coefficients for hygroscopic species (modeled and background). Monthly RH adjustment factors	-	n/a	See Table 4 in main protocol document
BKSO4 BKNO3 BKPMC BKOC BKSOIL BKEC	Monthly concentrations of ammonium sulfate, ammonium nitrate, coarse particulates, organic carbon, soil and elemental carbon to compute background extinction coefficients	-	n/a	See Table 5 in main protocol document
BEXTRAY	Extinction due to Rayleigh scattering (1/Mm)	10	Y	
IPRTU	Units for all output	3	N	micrograms/cubic meter
L24HR	Averaging time reported	T	n/a	
LTOPN	Visibility: Top "N" table for each averaging time selected.	F	Y	
NTOP	Number of 'Top-N' values at each receptor selected (NTOP must be <=4)	4	Y	
MDVIS	Output file with visibility change at each receptor?	0	Y	Create file of DAILY (24 hour) delta-deciview. Grid model run.

ATTACHMENT B

30 TAC Chapter 116, Subchapter M: Best Available Retrofit Technology

SUBCHAPTER M: BEST AVAILABLE RETROFIT TECHNOLOGY (BART)
§§116.1500, 116.1510, 116.1520, 116.1530, 116.1540
Effective February 1, 2007

§116.1500. Definitions.

The following terms, when used in this subchapter, have the following meanings unless the context clearly indicates otherwise. For terms not defined in this section, the definitions contained in 40 Code of Federal Regulations (CFR) §51.301, as effective August 30, 1999, are incorporated by reference.

(1) **Best available retrofit technology (BART)-eligible source**--Any emissions units that comprise any of the following stationary sources of air pollutants, including any reconstructed source, that were not in operation prior to August 7, 1962, and were in existence on August 7, 1977, and collectively have the potential to emit 250 tons per year (including fugitive emissions, to the extent quantifiable) of any visibility-impairing air pollutant:

(A) fossil fuel-fired steam electric plants of more than 250 million British thermal units (BTU) per hour heat input;

(B) coal-cleaning plants (thermal dryers);

(C) kraft pulp mills;

(D) portland cement plants;

(E) primary zinc smelters;

(F) iron and steel mill plants;

(G) primary aluminum ore reduction plants;

(H) primary copper smelters;

(I) municipal incinerators capable of charging more than 250 tons of refuse per day;

(J) hydrofluoric, sulfuric, and nitric acid plants;

(K) petroleum refineries;

(L) lime plants;

(M) phosphate rock processing plants;

(N) coke oven batteries;

(O) sulfur recovery plants;

(P) carbon black plants (furnace process);

(Q) primary lead smelters;

(R) fuel conversion plants;

(S) sintering plants;

(T) secondary metal production facilities;

(U) chemical process plants;

(V) fossil fuel-fired boilers of more than 250 million BTUs per hour heat input;

(W) petroleum storage and transfer facilities with capacity exceeding 300,000 barrels;

(X) taconite ore processing facilities;

(Y) glass fiber processing plants; and

(Z) charcoal production facilities.

(2) **Visibility-impairing air pollutant**--Any of the following: nitrogen oxides, sulfur dioxide, or particulate matter.

Adopted January 10, 2007 Effective February 1, 2007

§116.1510. Applicability and Exemption Requirements.

(a) The requirements of this subchapter apply to best available retrofit technology (BART)-eligible sources as defined in §116.1500 of this title (relating to Definitions).

(b) The owner or operator of a BART-eligible source may demonstrate, using a model and modeling guidelines approved by the executive director, that the source does not contribute to visibility impairment at a Class I area. A BART-eligible source that does not contribute to visibility impairment at any Class I area is not subject to the requirements of §116.1520 or §116.1530 of this title (relating to Best Available Retrofit Technology (BART) Analysis and Best Available Retrofit Technology (BART) Control Implementation). A source is considered to not contribute to visibility impairment if, as

demonstrated by modeling performed by the executive director or performed in accordance with the guidelines approved by the executive director, it causes a visibility impairment of less than 0.5 deciviews at all Class I areas. The modeling demonstration must be submitted under seal of a Texas licensed professional engineer and must be received by the commission's Air Permits Division no later than April 30, 2007.

(c) The following BART-eligible sources are not subject to the requirements of §116.1520 or §116.1530 of this title for the indicated pollutant(s). Owners or operators claiming exemption under this subsection shall maintain records sufficient to demonstrate compliance with the exemption criteria, and shall make such records available upon request of personnel from the commission or any local air pollution control agency having jurisdiction.

(1) Any BART-eligible source that has the potential to emit less than 500 tons per year of combined nitrogen oxides (NO_x) and sulfur dioxide (SO_2) and that is located more than 50 kilometers from any Class I area is not subject to BART for NO_x and SO_2.

(2) Any BART-eligible source that has the potential to emit less than 1,000 tons per year of combined NO_x and SO_2 and that is located more than 100 kilometers from any Class I area is not subject to BART for NO_x and SO_2.

(3) Any BART-eligible source that has the potential to emit less than 40 tons per year of NO_x or 40 tons per year of SO_2 is not subject to BART for NO_x or SO_2, respectively. Any BART-eligible source that has the potential to emit less than 15 tons per year of particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}) is not subject to BART for PM_{10}.

(d) BART-eligible electric generating units participating in the Clean Air Interstate Rule Trading Program are not subject to the requirements of §116.1520 or §116.1530 of this title for NO_x and SO_2.

(e) Any BART-eligible source that has been screened out by the Texas Commission on Environmental Quality-conducted screening modeling is not subject to the requirements of §116.1520 or §116.1530 of this title, for the specified pollutant(s), if the owner or operator has reviewed the modeling inputs for that source and the executive director receives written certification that the inputs are correct no later than February 28, 2007.

Adopted January 10, 2007 Effective February 1, 2007

§116.1520. Best Available Retrofit Technology (BART) Analysis.

(a) Except as provided under §116.1510(b), (c), or (d) of this title (relating to Applicability and Exemption Requirements), each best available retrofit technology (BART)-eligible source shall conduct an analysis of emissions control alternatives for all visibility-impairing pollutants. This analysis must include the identification of all available, technically feasible retrofit technologies, and for

each technology identified, an analysis of the cost of compliance, the energy and non-air quality environmental impacts, the degree of visibility improvement in affected Class I areas resulting from the use of the control technology, the remaining useful life of the source, and any existing control technology present at the source. Based on this analysis, the owner or operator shall identify an emission control strategy as the prospective BART control strategy for the source. The determination of BART must be made according to 40 Code of Federal Regulations Part 51, Appendix Y, as effective September 6, 2005.

(b) As part of the BART analysis required in subsection (a) of this section, the owner or operator shall include detailed information documenting the projected hourly and annual emission limits for the selected BART control strategy.

(c) The owner or operator of each BART-eligible source shall submit a completed BART analysis to the commission's Air Permits Division under seal of a Texas licensed professional engineer. The completed BART analysis must be received by the commission's Air Permits Division no later than April 30, 2007.

Adopted January 10, 2007 Effective February 1, 2007

§116.1530. Best Available Retrofit Technology (BART) Control Implementation.

(a) Each owner or operator of a best available retrofit technology (BART)-eligible source shall install and operate BART-required control equipment no later than five years after the United States Environmental Protection Agency has approved a Regional Haze State Implementation Plan for the State of Texas. Each owner or operator shall maintain the BART-required control equipment and establish procedures to ensure such equipment is properly and continuously operated and maintained.

(b) Prior to any installation of BART-required control equipment, each owner or operator of a BART-eligible source shall comply with the requirements under Subchapter B of this chapter (relating to New Source Review Permits), Subchapter F of this chapter (relating to Standard Permits) or Subchapter H of this chapter (relating to Permits for Grandfathered Facilities) as applicable to authorize the construction or modification and to establish emission limitations of BART.

Adopted January 10, 2007 Effective February 1, 2007

§116.1540. Exemption from Best Available Retrofit Technology (BART) Control Implementation.

The owner or operator of any best available retrofit technology (BART)-eligible source may apply for an exemption from the requirement to install, operate, and maintain BART-required control equipment, pursuant to the provisions of 40 Code of Federal Regulations §51.303. Any exemption request under this section requires initial approval from the executive director and final approval from the administrator of the United States Environmental Protection Agency (EPA). Exemption requests submitted to the EPA must be accompanied by written concurrence from the executive director.

Adopted January 10, 2007 Effective February 1, 2007

ATTACHMENT C

CALPUFF Control File Inputs

Group	Paramater	Description	CALPUFF Input	Default	Comments
1	METRUN	Control parameter for running all periods in met. File (0=no; 1=yes)	0	0	
	IBYR	Starting year of the CALPUFF run	2002	N.A.	2001 and 2003 are the other years modeled
	IBMO	Starting month	1	N.A.	
	IBDY	Starting day	1	N.A.	
	IBHR	Starting hour	0	N.A.	
	XBTZ	Base time zone	0	N.A.	Greenwich Mean Time
	IRLG	Length of the run (hours)	8760	N.A.	2001=8760hrs, 2003=8748hrs only 12 hrs on 12/31
	NSPEC	Total number of species modeled	9	5	
	NSE	Number of species emitted	9	3	
	METFM	Meteorological data format	1	1	CALMET unformatted file
	AVET	Averaging time (minutes)	60	60	
	PGTIME	Averaging time (minutes) for PG - σ	60	60	
2	MGAUSS	Control variable determining the vertical distribution used in the near field	1	1	Gaussian
	MCTADJ	Terrain adjustment method	3	3	Partial plume path adjustment
	MCTSG	CALPUFF sub-grid scale complex terrain module (CTSG) flag	0	0	CTSG not modeled
	MSLUG	Near-field puffs are modeled as elongated "slugs"?	0	0	No
	MTRANS	Transitional plume rise modeled?	1	1	Transitional plume rise computed
	MTIP	Stack tip downwash modeled?	1	1	Yes
	MBDW	Method used to simulate building downwash?	1	1	ISC method
	MSHEAR	Vertical wind shear above stack top modeled in plume rise?	0	0	No
	MSPLIT	Puff splitting allowed?	0	0	0=No
	MCHEM	Chemical mechanism flag	1	1	Transformation rates computed internally (MESOPUFF II scheme)
	MAQCHEM	Aqueous phase transformation flag	0	0	Aqueous phase not modeled
	MWET	Wet removal modeled?	1	1	Yes
	MDRY	Dry deposition modeled?	1	1	Yes
	MDISP	Method used to compute dispersion coefficients	3	3	PG dispersion coefficients in RURAL & MP coefficients in urban areas
	MTURBVW	Sigma-v/sigma theta, sigma-w measurements used?	3	3	Use both sigma-(v/theta) and sigma-w from PROFILE.DAT Note: not provided
	MDISP2	Backup method used to compute dispersion when measured turbulence data are missing	3	3	PG dispersion coefficients in RURAL & MP coefficients in urban areas
	MROUGH	PG sigma-y,z adj. for roughness?	0	0	No
	MPARTL	Partial plume penetration of elevated inversion?	1	1	Yes
	MTINV	Strength of temperature inversion	0	0	No
	MPDF	PDF used for dispersion under convective conditions?	0	0	No
	MSGTIBL	Sub-Grid TIBL module used for shoreline?	0	0	No
	MBCON	Boundary conditions (concentration) modeled?	0	0	No
	MFOG	Configure for FOG model output	0	0	No
	MREG	TEST options specified to see if they conform to regulatory values?	1	1	Checks made
3	CSPEC	Species modeled	SO2, SO4, NOX, HNO3, NO3, EC, OC (SOA), PM25, PM10	N.A.	PM25=PMF PM10=PMC

Group	Paramater	Description	CALPUFF Input	Default	Comments
4	PMAP	Map projection	LCC	Lat Long	Lambert conformal conic
	FEAST	False Easting	0	0	
	FNORT	False Northing	0	0	
	RLATO	Latitude	40N	N.A.	
	RLONG	Longitude	97W	N.A.	
	XLAT1 XLAT2	Matching parallel(s) of latitude for projection	33N 45N	N.A.	
	DATUM	Datum region for the coordinates	WGS-G		WGS-84 GRS 80 spheroid, global coverage (WGS84)
	NX NY NZ	Meteorological grid: No. X grid cells in meteorological grid No. Y grid cells in meteorological grid No. vertical layers in meteorological grid	306 246 10	N.A.	
	DGRIDKM	Grid spacing (km)	6	N.A.	
	ZFACE	Cell face heights (m)	0, 20, 40, 80, 160, 320, 640, 1200, 2000, 3000, 4000	N.A.	
	XORIGKM YORIGKM	Reference coordinates of SW corner of grid cell (1,1) (km)	-1008 -1620	N.A.	
	IBCOMP JBCOMP IECOMP JECOMP	Computational grid: X index of LL corner Y index of LL corner X index of UR corner Y index of UR corner	1 1 306 246	N.A.	
	LSAMP IBSAMP JBSAMP IESAMP JESAMP MESHDN	- Logical flag indicating if gridded receptors are used - X index of LL corner - Y index of LL corner - X index of UR corner - Y index of UR corner - Nesting factor of the sampling grid	F 1	F	Receptors are only in the Class I areas assessed
5	SPECIES	Species (or group) list for output options	1	0	Concentrations saved for SO2, SO4, NOx, HNO3, NO3, EC, SOA, PM25, PM10
6	NHILL	Number of terrain features	0	0	
	NCTREC	Number of special complex terrain receptors	0	0	
	MHILL	Terrain and CTSG receptor data for CTSG hills input in CTDM format?	2	N.A.	Hill data created by OPTHILL & input below in subgroup (6b); receptor data in subgroup (6c) note: no data provided
	XHILL2M	Factor to convert horizontal dimensions to meters	1	1	
	ZHILL2M	Factor to convert vertical dimensions to meters	1	1	
	XCTDMKM	X-origin of CTDM system relative to CALPUFF coordinate system, in Km	0	N.A.	
	YCTDMKM	Y-origin of CTDM system relative to CALPUFF coordinate system, in Km	0	N.A.	
7	SPECIES DIFFUSVTY ALPHA STR REACTVTY MESO RES HENRYS C	Chemical parameters for dry deposition of gases	SO2 NOX HNO3 .1509 .1656 .1628 1000 1 1 8 8 18 0 5 0 .04 3.5 8.0*E-8	SO2 NOX HNO3 .1509 .1656 .1628 1000 1 1 8 8 18 0 5 0 .04 3.5 8.0*E-8	
8	SPECIES GEO. MASS DIA. GEO. SDEV.	Single species: mean and standard deviation used to compute deposition velocity for NINT size-ranges; averaged to obtain mean deposition velocity. Grouped species: size distribution specified, standard deviation as "0". Model uses deposition velocity for stated mean	SO4,NO3, EC, SOA, PM10, PM25 0.48 micron (all species) 2 microns (all species)	SO4,NO3, EC, SOA, PM10, PM25 0.48 micron (all species) 2 microns (all species)	
9	RCUTR	Reference cuticle resistance	30	30	
	RGR	Reference ground resistance	10	10	
	REACTR	Reference pollutant reactivity	8	8	
	NINT	Number of particle-size intervals to evaluate effective particle deposition velocity	9	9	
	IVEG	Vegetation state in unirrigated areas	1	1	
10	SPECIES LIQ. PRECIP. FROZ. PRECIP.	Scavenging coefficients	LIQ FROZ SO2: 3E-5 0 SO4: 1E-4 3E-5 NOX: 0 0 HNO3: 6E-5 0 NO3: 1E-4 3E-5 EC: 1E-4 3E-5 SOA: 1E-4 3E-5 PM10: 1E-4 3E-5 PM25: 1E-4 3E-5	LIQ FROZ SO2: 3E-5 0 SO4: 1E-4 3E-5 NOX: 0 0 HNO3: 6E-5 0 NO3: 1E-4 3E-5 EC: 1E-4 3E-5 SOA: 1E-4 3E-5 PM10: 1E-4 3E-5 PM25: 1E-4 3E-5	

Group	Paramater	Description	CALPUFF Input	Default	Comments
11	MOZ	Ozone data input option	1	0	1=Use hourly ozone data
	BCKO3	Monthly ozone concentrations	0 (12 months)		
	BCKNH3	Monthly ammonia concentrations	3 (12 months)		
	RNITE1	Nighttime SO2 loss rate	0.2	0.2	
	RNITE2	Nighttime Nox loss rate	2	2	
	RNITE3	Nighttime HNO3 formation rate	2	2	
	MH2O2	H2O2 data input option	1	1	
	BCKH2O2	Monthly H2O2 concentrations	-	-	MQACHEM = 0; not used
	BCKPMF OFRAC VCNX	Secondary Organic Aerosol options	-	-	MCHEM = 1; thus, not used
12	SYTDEP	Horizontal size of puff beyond which time-dependent dispersion equations (Heffter) are used	550	550	
	MHFTSZ	Switch for using Heffter equation for sigma z as above	0	0	
	JSUP	Stability class used to determine plume growth rates for puffs above boundary layer	5	5	
	CONK1	Vertical dispersion constant for stable conditions	0.01	0.01	
	CONK2	Vertical dispersion constant for neutral/unstable conditions	0.1	0.1	
	TBD	Factor determining transition-point from Schulman-Scire to Huber-Snyder building downwash scheme	0.5	-	No building downwash used
	IURB1 IURB2	Range of land use categories for which urban dispersion is assumed	10 19	-	METFM=1; not used
	ILANDUIN	Land use category for modeling domain	20	-	METFM=1; not used
	ZOIN	Roughness length (m) for modeling domain	0.25	-	METFM=1; not used
	XLAIIN	Leaf area index for modeling domain	3	-	METFM=1; not used
	ELEVIN	Elevation above sea level	0	-	METFM=1; not used
	XLATIN	Latitude (degrees) for met location	-	-	METFM=1; not used
	XLONIN	Longitude (degrees) for met location	-	-	METFM=1; not used
	ANEMHT	Anemometer height (m)	10	-	METFM=1; not used
	ISIGMAV	Form of lateral turbulence data in PROFILE.DAT	1	Y	Read sigma-v
	IMIXCTDM	Choice of mixing heights	-	-	METFM=1; not used
	XMXLEN	Maximum length of a slug	1	1	
	XSAMLEN	Maximum travel distance of a puff/slug during one sampling step	1	1	
	MXNEW	Maximum number of slugs/puffs released from one source during one time step	99	99	
	MXSAM	Maximum number of sampling steps for one puff/slug during one time step	99	99	
	NCOUNT	Number of iterations used when computing the transport wind for a sampling step that includes gradual rise	2	2	
	SYMIN	Minimum sigma y for a new puff/slug	1	1	
	SZMIN	Minimum sigma z for a new puff/slug	1	1	
	SVMIN SWMIN	Default minimum turbulence velocities sigma-v and sigma-w for each stability class	.5 .5 .5 .5 .5 .5 .2 .12.08 .06 .03 .016	.5 .5 .5 .5 .5 .5 .2 .12.08 .06 .03 .016	
	CDIV	Divergence criterion for dw/dz across puff used to initiate adjustment for horizontal convergence	0, 0	0, 0	
	WSCALM	Minimum wind speed allowed for non-calm conditions. Used as minimum speed returned when using power-law extrapolation toward surface	0.5	0.5	
	XMAXZI	Maximum mixing height (m)	4000		Top interface in CALMET simulation
	XMINZI	Minimum mixing height (m)	20		
	WSCAT	Default wind speed classes	1.54 3.09 5.14 8.23 10.80	1.54 3.09 5.14 8.23 10.80	
	PLXO	Default wind speed profile power-law exponents for stabilities 1-6	.07 .07 .10 .15 .35 .55	.07 .07 .10 .15 .35 .55	
	PTGO	Default potential temperature gradient for stable classes E, F (deg k/m)	.020 .035	.020 .035	
	PPC	Default plume path coefficients for each stability class	.5 .5 .5 .5 .35 .35	.5 .5 .5 .5 .35 .35	
	SL2PF	Slug-to-puff transitions criterion factor equal to sigma-v/length of slug	10	10	
	NSPLIT	Number of puffs that result every time a puff is split	3	3	

Group	Paramater	Description	CALPUFF Input	Default	Comments
	IRESPLIT	Time of day when split puffs are eligible to be split once again; this is typically set once per day, around sunset before nocturnal shear develops	Hour 18 = 1, All others = 0		
	ZISPLIT	Split is allowed only if last hour's mixing height (m) exceeds a minimum value	100	100	
	ROLDMAX	Split is allowed only if ratio of last hour's mixing ht to the maximum mixing ht experienced by the puff is less than a maximum value	0.25	0.25	
	NSPLITH	Number of puffs that result every time a puff is split	5	5	
	SYSPLITH	Minimum sigma-y of puff before it may be split	1	1	
	SHSPLITH	Minimum puff elongation rate due to wind shear, before it may be split	2	2	
	CNSPLITH	Minimum concentration of each species in puff before it may be split	1E-7	1E-7	
	EPSSLUG	Fractional convergence criterion for numerical SLUG sampling integration	1E-4	1E-4	
	EPSAREA	Fractional convergence criterion for numerical AREA source integration	1E-6	1E-6	
	DSRISE	Trajectory step-length (m) used for numerical rise integration	1	1	
	HTMINBC	Minimum height (m) to which BC puffs are mixed as they are emitted. Actual height is reset to the current mixing height at the release point if greater than this minimum	500	500	
	RSAMPBC	Search radius (in BC segment lengths) about a receptor for sampling nearest BC puff. BC puffs are emitted with a spacing of one segment length, so the search radius should be greater than 1	10		
	MDEPBC	Near-surface depletion adjustment to concentration profile used when sampling BC puffs?	1	1	Adjust concentration for depletion
13	NPT1	Number of point sources with parameters	4	N.A.	
	IPTU	Units used for point source emissions	1	1	
	NSPT1	Number of source-species combinations with variable emissions scaling factors	0	0	
	NPT2	Number of point sources with variable emission parameters provided in external file	0	N.A.	
17	NREC	Number of non-gridded receptors	3831	N.A.	147 Bandelier 480 Big Bend 168 Bosque del Apache 40 Breton 80 Caney Creek 256 Carlsbad Caverns 195 Great Sand Dunes 127 Guadalupe Mountains 80 Hercules-Glades 187 La Garita 147 Mesa Verde* 47 Mingo 321 Pecos 55 Salt Creek 247 San Pedro Parks 72 Upper Buffalo 744 Weminuche 109 Wheeler Peak 270 White Mountain

* Removed 165 receptors because they were located outside of the meteorological grid.

ATTACHMENT D

POSTUTIL Control File Inputs

Group	Paramater	Description	POSTUTIL Input	Default	Comments
1	ISYR	Starting year	2002	N.A.	2001 and 2003 also modeled
	ISMO	Starting month	1	N.A.	
	IDY	Starting day	1	N.A.	
	ISHR	Starting hour	0	N.A.	
	NPER	Number of periods to process	8760	N.A.	2001=8760 hrs, 2003=8748 hrs (only 12 hrs on 12/31)
	NSPECINP	Number of species to process from CALPUFF runs	9	N.A.	
	NSPECOUT	Number of species to write to output file	9	N.A.	
	NSPECCMP	Number of species to compute from those modeled	0	N.A.	
	MDUPLCT	Stop run if duplicate species names found?	0	Y	
	NSCALED	Number of CALPUFF data files that will be scaled	0	Y	
	MNITRATE	Re-compute the HNO3/NO3 for concentrations?	1	N	Yes, for all sources combined
	BCKNH3	Default ammonia concentrations used for HNO3/NO3 partition	-	N	12*3
2	ASPECI	NSPECINP species will be processed	-	N.A.	SO2, SO4, NOx, HNO3, NO3, EC, OC (SOA), PM25, PM10
	ASPECO	NSPECOUT species will be written	-	N.A.	SO2, SO4, NOx, HNO3, NO3, EC, OC (SOA), PM25, PM10

ATTACHMENT E

CALPOST Control File Inputs

Group	Paramater	Description	CALPOST Input	Default	Comments
1	METRUN	Option to run all periods found in met files	0	Y	Run period explicitly defined
	ISYR	Starting year	2002	N.A.	2001 and 2003 also modeled
	ISMO	Starting month	1	N.A.	
	IDY	Starting day	1	N.A.	
	ISHR	Starting hour	0	N.A.	
	NHRS	Number of hours to process	8760	N.A.	2001=8760 hrs, 2003=8748 hrs (only 12 hrs on 12/31)
	NREP	Process every hour of data?	1	Y	Every hour processed
	ASPEC	Species to process	VISIB	N.A.	Visibility processing
	ILAYER	Layer/deposition code	1	Y	CALPUFF concentration
	A,B	Scaling factors X(new)=X(old)*A+B	0,0	Y	
	LBACK	Add hourly background concentrations/fluxes?	F	Y	
	MSOURCE	Option to process source contributions	0	Y	
	LG LD	Gridded receptors processed? Discrete receptors processed?	F T	N/Y	Receptors located only in the Class I areas assessed
	LCT	CTSG Complex terrain receptors processed?	F	Y	
	LDRING	Report results by DISCRETE receptor RING?	F	Y	
	NDRECP	Flag for all receptors after the last one assigned is set to "0"	1	N	
	IBGRID JBGRID IEGRID JEGRID	Range of gridded receptors	-1 -1 -1 -1	Y	When LG=T entire grid processed if all = -1
	NGONOFF	Number of gridded receptor rows provided to identify specific gridded receptors to process	0	Y	
	BTZONE	Base time zone for the CALPUFF simulation	0	N.A.	Greenwich Mean Time
	MFRH	Particle growth curve f(RH) for hygroscopic species	2	Y	FLAG (2000) f(RH) tabulation. Note: not used
	RHMAX	Maximum relative humidity (%) used in particle growth curve	95	N	Not used
	LVSO4 LVNO3 LVOC LVPMC LVPMF LVEC	Modeled species to be included in computing light extinction	T T T T T T	Y Y Y Y Y Y	
	LVBK	Include BACKGROUND when ranking for TOP-N, TOP-50, and exceedance tables?	T	Y	
	SPECPMC SPECPMF	Species name used for particulates in MODEL.DAT file	PM10 PM25	N N	
	EEPMC EEPMF	Modeled particulate species	0.6 1.0	Y Y	
	EEPMCBK	Background particulate species	0.6	Y	
	EESO4 EENO3 EEOC EESOIL EEEC	Other species	3.0 3.0 4.0 1.0 10	Y Y Y Y Y	
	LAVER	Background extinction computation	F	Y	
	MVISBK	Method used for background light extinction	6	N	Compute extinction from speciated PM measurements. FLAG RH adjustment factor applied to observed and modeled sulfate and nitrate.
	RHFAC	Extinction coefficients for hygroscopic species (modeled and background). Monthly RH adjustment factors.	-	N.A.	See Table 4 in main protocol document
	BKSO4 BKNO3 BKPMC BKOC BKSOIL BKEC	Monthly concentrations of ammonium sulfate, ammonium nitrate, coarse particulates, organic carbon, soil and elemental carbon to compute background extinction coefficients	-	N.A.	See Table 5 in main protocol document
	BEXTRAY	Extinction due to Rayleigh scattering (1/Mm)	10	Y	
	IPRTU	Units for all output	3	N	micrograms/cubic meter
	L24HR	Averaging time reported	T	N.A.	
	LTOPN	Visibility: Top "N" table for each averaging time selected.	F	Y	
	NTOP	Number of "Top-N" values at each receptor selected (NTOP must be <=4)	4	Y	
	MDVIS	Output file with visibility change at each receptor?	0	Y	Create file of DAILY (24 hour) delta-deciview. Grid model run.

ATTACHMENT F

Modeling Archive

Attachment 6, Table 1: File Naming Convention

Model	File Type	File Name	Notes
CALPUFF	Input	2001a.cpi	2880 hrs – 1/1 – 4/30
		2001b.cpi	3024 hrs – 4/28 – 8/31
		2001c.cpi	2952 hrs – 8/29 – 12/31
		2002.cpi	8760 hrs
		2003.cpi	8748 hrs (only 12 hrs on 12/31)
POSTUTIL	Input	2001a_huntsman_postutil.inp	2880 hrs – 1/1 – 4/30
		2001b_huntsman_postutil.inp	3024 hrs – 4/28 – 8/31
		2001c_huntsman_postutil.inp	2952 hrs – 8/29 – 12/31
		2002_huntsman_postutil.inp	8760 hrs
		2003_huntsman_postutil.inp	8748 hrs (only 12 hrs on 12/31)
APPEND	Input	Append.inp	2001
CALPOST	Input	2001_huntsman_band_cpst.inp	Bandelier Wilderness Area
		2001_huntsman_bibe_cpst.inp	Big Bend National Park
		2001_huntsman_bosq_cpst.inp	Bosque del Apache Wilderness Area
		2001_huntsman_bret_cpst.inp	Breton Wilderness Area
		2001_huntsman_cacr_cpst.inp	Caney Creek Wilderness Area
		2001_huntsman_cave_cpst.inp	Carlsbad Caverns National Park
		2001_huntsman_grsa_cpst.inp	Great Sand Dunes Wilderness Area
		2001_huntsman_gumo_cpst.inp	Guadalupe Mountains National Park
		2001_huntsman_herc_cpst.inp	Hercules-Glades Wilderness Area
		2001_huntsman_laga_cpst.inp	La Garita Wilderness Area
		2001_huntsman_meve_cpst.inp	Mesa Verde National Park
		2001_huntsman_ming_cpst.inp	Mingo Wilderness Area
		2001_huntsman_peco_cpst.inp	Pecos Wilderness Area
		2001_huntsman_sacr_cpst.inp	Salt Creek Wildlife Refuges
		2001_huntsman_sape_cpst.inp	San Pedro Parks Wilderness Area
		2001_huntsman_upbu_cpst.inp	Upper Buffalo Wilderness Area
		2001_huntsman_wemi_cpst.inp	Weminuche Wilderness Area
		2001_huntsman_whpe_cpst.inp	Wheeler Peak Wilderness Area
		2001_huntsman_whmo_cpst.inp	White Mountain Wilderness Area
		2001_huntsman_wich_cpst.inp	Wichita Mountains Wildlife Refuges
		2002_huntsman_band_cpst.inp	Bandelier Wilderness Area
		2002_huntsman_bibe_cpst.inp	Big Bend National Park
		2002_huntsman_bosq_cpst.inp	Bosque del Apache Wilderness Area
		2002_huntsman_bret_cpst.inp	Breton Wilderness Area
		2002_huntsman_cacr_cpst.inp	Caney Creek Wilderness Area
		2002_huntsman_cave_cpst.inp	Carlsbad Caverns National Park
		2002_huntsman_grsa_cpst.inp	Great Sand Dunes Wilderness Area
		2002_huntsman_gumo_cpst.inp	Guadalupe Mountains National Park
		2002_huntsman_herc_cpst.inp	Hercules-Glades Wilderness Area
		2002_huntsman_laga_cpst.inp	La Garita Wilderness Area
		2002_huntsman_meve_cpst.inp	Mesa Verde National Park
		2002_huntsman_ming_cpst.inp	Mingo Wilderness Area

Attachment 6, Table 1: File Naming Convention

Model	File Type	File Name	Notes
CALPOST	Input	2002_huntsman_peco_cpst.inp	Pecos Wilderness Area
		2002_huntsman_sacr_cpst.inp	Salt Creek Wildlife Refuges
		2002_huntsman_sape_cpst.inp	San Pedro Parks Wilderness Area
		2002_huntsman_upbu_cpst.inp	Upper Buffalo Wilderness Area
		2002_huntsman_wemi_cpst.inp	Weminuche Wilderness Area
		2002_huntsman_whpe_cpst.inp	Wheeler Peak Wilderness Area
		2002_huntsman_whmo_cpst.inp	White Mountain Wilderness Area
		2002_huntsman_wich_cpst.inp	Wichita Mountains Wildlife Refuges
		2003_huntsman_band_cpst.inp	Bandelier Wilderness Area
		2003_huntsman_bibe_cpst.inp	Big Bend National Park
		2003_huntsman_bosq_cpst.inp	Bosque del Apache Wilderness Area
		2003_huntsman_bret_cpst.inp	Breton Wilderness Area
		2003_huntsman_cacr_cpst.inp	Caney Creek Wilderness Area
		2003_huntsman_cave_cpst.inp	Carlsbad Caverns National Park
		2003_huntsman_grsa_cpst.inp	Great Sand Dunes Wilderness Area
		2003_huntsman_gumo_cpst.inp	Guadalupe Mountains National Park
		2003_huntsman_herc_cpst.inp	Hercules-Glades Wilderness Area
		2003_huntsman_laga_cpst.inp	La Garita Wilderness Area
		2003_huntsman_meve_cpst.inp	Mesa Verde National Park
		2003_huntsman_ming_cpst.inp	Mingo Wilderness Area
		2003_huntsman_peco_cpst.inp	Pecos Wilderness Area
		2003_huntsman_sacr_cpst.inp	Salt Creek Wildlife Refuges
		2003_huntsman_sape_cpst.inp	San Pedro Parks Wilderness Area
		2003_huntsman_upbu_cpst.inp	Upper Buffalo Wilderness Area
		2003_huntsman_wemi_cpst.inp	Weminuche Wilderness Area
		2003_huntsman_whpe_cpst.inp	Wheeler Peak Wilderness Area
		2003_huntsman_whmo_cpst.inp	White Mountain Wilderness Area
		2003_huntsman_wich_cpst.inp	Wichita Mountains Wildlife Refuges
CALPUFF	Output	2001a.con	Concentration
		2001a.dry	Dry deposition
		2001a.wet	Wet deposition
		2001b.con	Concentration
		2001b.dry	Dry deposition
		2001b.wet	Wet deposition
		2001c.con	Concentration
		2001c.dry	Dry deposition
		2001c.wet	Wet deposition
		2002.con	Concentration
		2002.dry	Dry deposition
		2002.wet	Wet deposition
		2003.con	Concentration
		2003.dry	Dry deposition
		2003.wet	Wet deposition

Attachment 6, Table 1: File Naming Convention

Model	File Type	File Name	Notes
POSTUTIL	Output	2001a_huntsman_cpuf.dat	Concentration
		2001a_huntsman_postutil.lst	List file
		2001b_huntsman_cpuf.dat	Concentration
		2001b_huntsman_postutil.lst	List file
		2001c_huntsman_cpuf.dat	Concentration
POSTUTIL	Output	2001c_huntsman_postutil.lst	List file
		2002_huntsman_cpuf.dat	Concentration
		2002_huntsman_postutil.lst	List file
		2003_huntsman_cpuf.dat	Concentration
		2003_huntsman_postutil.lst	List file
APPEND	Output	2001_huntsman_cpuf.dat	Concentration - appended
		Append.lst	List file
CALPOST	Output	2001_huntsman_band_cpst.lst	Bandelier Wilderness Area
		2001_huntsman_bibe_cpst.lst	Big Bend National Park
		2001_huntsman_bosq_cpst.lst	Bosque del Apache Wilderness Area
		2001_huntsman_bret_cpst.lst	Breton Wilderness Area
CALPOST	Output	2001_huntsman_cacr_cpst.lst	Caney Creek Wilderness Area
		2001_huntsman_cave_cpst.lst	Carlsbad Caverns National Park
		2001_huntsman_grsa_cpst.lst	Great Sand Dunes Wilderness Area
		2001_huntsman_gumo_cpst.lst	Guadalupe Mountains National Park
		2001_huntsman_herc_cpst.lst	Hercules-Glades Wilderness Area
		2001_huntsman_laga_cpst.lst	La Garita Wilderness Area
		2001_huntsman_meve_cpst.lst	Mesa Verde National Park
		2001_huntsman_ming_cpst.lst	Mingo Wilderness Area
		2001_huntsman_peco_cpst.lst	Pecos Wilderness Area
		2001_huntsman_sacr_cpst.lst	Salt Creek Wildlife Refuges
		2001_huntsman_sape_cpst.lst	San Pedro Parks Wilderness Area
		2001_huntsman_upbu_cpst.lst	Upper Buffalo Wilderness Area
		2001_huntsman_wemi_cpst.lst	Weminuche Wilderness Area
		2001_huntsman_whpe_cpst.lst	Wheeler Peak Wilderness Area
		2001_huntsman_whmo_cpst.lst	White Mountain Wilderness Area
		2001_huntsman_wich_cpst.lst	Wichita Mountains Wildlife Refuges
		2002_huntsman_band_cpst.lst	Bandelier Wilderness Area
		2002_huntsman_bibe_cpst.lst	Big Bend National Park
		2002_huntsman_bosq_cpst.lst	Bosque del Apache Wilderness Area
		2002_huntsman_bret_cpst.lst	Breton Wilderness Area
		2002_huntsman_cacr_cpst.lst	Caney Creek Wilderness Area
		2002_huntsman_cave_cpst.lst	Carlsbad Caverns National Park
		2002_huntsman_grsa_cpst.lst	Great Sand Dunes Wilderness Area
		2002_huntsman_gumo_cpst.lst	Guadalupe Mountains National Park
		2002_huntsman_herc_cpst.lst	Hercules-Glades Wilderness Area
		2002_huntsman_laga_cpst.lst	La Garita Wilderness Area
		2002_huntsman_meve_cpst.lst	Mesa Verde National Park

Attachment 6, Table 1: File Naming Convention

Model	File Type	File Name	Notes
CALPOST	Output	2002_huntsman_ming_cpst.lst	Mingo Wilderness Area
		2002_huntsman_peco_cpst.lst	Pecos Wilderness Area
		2002_huntsman_sacr_cpst.lst	Salt Creek Wildlife Refuges
		2002_huntsman_sape_cpst.lst	San Pedro Parks Wilderness Area
		2002_huntsman_upbu_cpst.lst	Upper Buffalo Wilderness Area
		2002_huntsman_wemi_cpst.lst	Weminuche Wilderness Area
		2002_huntsman_whpe_cpst.lst	Wheeler Peak Wilderness Area
		2002_huntsman_whmo_cpst.lst	White Mountain Wilderness Area
		2002_huntsman_wich_cpst.lst	Wichita Mountains Wildlife Refuges
		2003_huntsman_band_cpst.lst	Bandelier Wilderness Area
		2003_huntsman_bibe_cpst.lst	Big Bend National Park
		2003_huntsman_bosq_cpst.lst	Bosque del Apache Wilderness Area
		2003_huntsman_bret_cpst.lst	Breton Wilderness Area
		2003_huntsman_cacr_cpst.lst	Caney Creek Wilderness Area
		2003_huntsman_cave_cpst.lst	Carlsbad Caverns National Park
		2003_huntsman_grsa_cpst.lst	Great Sand Dunes Wilderness Area
		2003_huntsman_gumo_cpst.lst	Guadalupe Mountains National Park
		2003_huntsman_herc_cpst.lst	Hercules-Glades Wilderness Area
		2003_huntsman_laga_cpst.lst	La Garita Wilderness Area
		2003_huntsman_meve_cpst.lst	Mesa Verde National Park
		2003_huntsman_ming_cpst.lst	Mingo Wilderness Area
		2003_huntsman_peco_cpst.lst	Pecos Wilderness Area
		2003_huntsman_sacr_cpst.lst	Salt Creek Wildlife Refuges
		2003_huntsman_sape_cpst.lst	San Pedro Parks Wilderness Area
		2003_huntsman_upbu_cpst.lst	Upper Buffalo Wilderness Area
CALPOST	Output	2003_huntsman_wemi_cpst.lst	Weminuche Wilderness Area
		2003_huntsman_whpe_cpst.lst	Wheeler Peak Wilderness Area
		2003_huntsman_whmo_cpst.lst	White Mountain Wilderness Area
		2003_huntsman_wich_cpst.lst	Wichita Mountains Wildlife Refuges

APPEND Discussion

Because of file size limitations, the CALPUFF simulation for 2001 was split into three separate CALPUFF runs (2001a, 2001b, and 2001c). When applying CALPUFF separately with meteorology that is split into multiple consecutive time periods, it is necessary to account for puffs that are remaining at the end of one time period in the next time period.[15] This is achieved by modeling overlapping time periods. Therefore, the 2001b and 2001c CALPUFF runs begin with 3 days of meteorology from the end of the previous month. For example, the 2001b CALPUFF run begins on April 28, 2001, instead of May 1, 2001. Similarly, the 2001c CALPUFF run begins on August 29, 2001, instead of September 1, 2001.

[15] http://www.src.com/calpuff/FAQ-answers.htm#4.2.1

The APPEND program can be used to append the sequential output data files into a single file for CALPOST processing. Output data files for 2001a, 2001b, and 2001c are appended to produce the 2001 output data file. Overlapping time periods are not a problem because the user can specify the number of hours to skip at the beginning and the total number of hours to read from each file. For this project, 72 hours (3 days) were skipped at the beginning of the 2001b and 2001c data files. The resulting output data file is 8760 hours in length.